No. 413PA21 TENTH DISTRICT

SUPREME COURT OF NORTH CAROLINA

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NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC., et al., Plaintiffs-Appellants,	)	
REBECCA HARPER, et al., Plaintiffs-Appellants, and	)	
COMMON CAUSE, Plaintiff-Intervenor-Appellant,	)	
v.	)	From Wake County 21 CVS 015426 21 CVS 500058
REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,	)	
Defendants-Appellees.	)	

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STATE OF NORTH CAROLINA COUNTY OF WAKE	IN THE GENERAL COURT OF JUSTICE SUPERIOR COURT DIVISION 21 CVS 015426
NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC., et al., REBECCA HARPER, et al., COMMON CAUSE, *Plaintiffs,* v. REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al. *Defendants.*	**EXPERT REPORT OF JAMES L. LELOUDIS II**

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Race and Voting Rights in North Carolina, 1860-2021

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I. Summary of Opinions

My name is James L. Leloudis II. I have taught history at the University of North Carolina at Chapel Hill for thirty-one years, with a focus on North Carolina and the American South. I have published extensively on the history of the state and region, and my scholarship has won awards from the nation's leading professional associations in my field.

I was retained by the Plaintiffs in this case to assess whether there is a history of racial discrimination in North Carolina, specifically with respect to the regulation of elections and legislative redistricting. Based on my forty years of researching, writing, and teaching in this field, and having reviewed published works by historians of race and politics in the American South, newspapers from the time period covered by this declaration, the public laws of North Carolina, archival sources for individuals and institutions, and reports from various federal and state agencies, it is my opinion that:

- North Carolina has a long and cyclical history of struggle over minority voting rights and political participation, from the time of Reconstruction to the present day.
- When minority rights have been constrained, North Carolina's state government has been decidedly unresponsive to minority concerns and interests related to social and economic policy. That lack of responsiveness to Blacks and, in recent years, a rapidly growing population of Hispanics, has perpetuated minority disadvantages in employment and education, further hindering the ability of minority populations to participate fully and freely in the political process.[1]
- Over the last century and a half, North Carolina lawmakers have employed a variety of measures to limit the rights of racial and ethnic minorities to register, to vote, and to participate in the democratic process. These measures have included vigilante violence, a literacy test and poll tax, and a host of other regulations regarding the preparation of ballots, procedures for challenging electors' right to register and to vote, and election monitoring by partisan poll watchers.
- During the late 1950s and 1960s, lawmakers acted to limit the political participation of newly enfranchised Black voters by switching from ward to at-large representation in county and municipal governments, increasing the number of multi-member districts in the state legislature, introducing numbered-seat plans for legislative elections, and outlawing single-shot voting. After the federal courts began to enforce the Voting Rights Act of 1965 and limited those practices, extreme partisan gerrymandering and racial vote dilution became the tactics of choice for limiting minority voting rights and political participation.
- Actions by the North Carolina legislature in the current redistricting cycle fit the pattern of conservative backlash to minority gains. With a rising minority electorate, lawmakers have created district maps that they claim are colorblind; but in fact, the maps reproduce

[1] The terms 'Hispanic' and 'Latino' are often used interchangeably to describe immigrants from Mexico, Cuba, and Central and South America. I will use 'Hispanic' throughout this report because that is the term most often employed by the U.S. Census Bureau, the North Carolina State Board of Elections, and other government agencies and researchers to characterize voters who have ties to those regions.

familiar forms of racial discrimination. The legislature is acting with no fear of repercussion in part because this is the first redistricting cycle without the preclearance protections of the Voting Rights Act of 1965.

- In the context of North Carolina's political history, race and politics overlap, to the extent that partisan gerrymandering many times acts as a cover for racial discrimination in redistricting.

Each of these opinions is explained and supported in detail below.

II. Background and Qualifications

I am employed as Professor of History at the University of North Carolina at Chapel Hill. I received a B.A., with highest honors, from the University of North Carolina at Chapel Hill (1977), an M.A. from Northwestern University (1979), and a Ph.D. from the University of North Carolina at Chapel Hill (1989). My primary training was in the history of the United States, with specialization in the history of race, politics, labor, and reform in the nineteenth- and twentieth-century American South. For the past thirty-one years I have taught undergraduate and graduate courses in my area of specialization. I have published four books, nine articles, and numerous book reviews. I have also made more than fifty presentations to academic and lay audiences.

My scholarship has won a number of prestigious awards, including the Louis Pelzer Prize for the best essay by a graduate student (1982, Organization for American Historians), the Philip Taft Labor History Award for the best book on the history of labor (1988, New York State School of Industrial and Labor Relations, Cornell University), the Merle Curti Award for the best book on American social history (1988, Organization of American Historians), the Albert J. Beveridge Award for the best book on the history of the United States, Latin America, or Canada (1988, American Historical Association), the Mayflower Cup for the best non-fiction work on North Carolina (1996, North Carolina Literary and Historical Association), and the North Caroliniana Society Award for the best work on North Carolina history (2010).

In 1982, as a graduate student in history at the University of North Carolina at Chapel Hill, I conducted research that became part of the expert testimony provided by Professor Harry Watson in *Gingles v. Edmisten*, 590 F. Supp. 345 (1984).[2] In 2014-2016, I provided expert testimony for the plaintiffs in *North Carolina State Conference of the NAACP v. McCrory*, 182 F. Supp. 3d 320 (M.D.N.C. 2016), and *North Carolina State Conference of the NAACP v. McCrory*, 831 F.3d 204 (4th Cir. 2016). In 2017, I was retained as an expert witness for the plaintiffs in *Hall v. Jones County Board of Commissioners*, 4:17-cv-00018 (E.D.N.C. July 5, 2017), but the case was settled before I submitted a report. I recently served as an expert witness for the plaintiffs in *Holmes v. Moore*, 270 N.C. App. 7 (Wake Cnty. Sup. Ct. 2019), and I am currently an expert witness for the plaintiffs in *North Carolina State Conference of the NCAAP v. Cooper*, 1:18-cv-01034 (M.D.N.C. Aug. 17, 2021).

I produced this report under contract with the Southern Coalition for Social Justice and Hogan Lovells, representing Common Cause. My billing rate is $300/hour, with total payment not

[2] *Gingles v. Edmisten*, 590 F. Supp. 345 (E.D.N.C. 1984).

to exceed $20,000, unless approved by counsel. Payment is not contingent on reaching specific conclusions as a result or my research, or on the outcome of my findings.

A detailed record of my professional qualifications and publications is set forth in the curriculum vitae appended to this report, which I prepared and know to be accurate.

III. Materials Reviewed

I have conducted qualitative research on the history of race, voting rights, voter suppression, and redistricting in North Carolina, from the end of the Civil War to the present. Sources that I have consulted include published works by historians of race and politics in the American South, newspapers from the time period covered by this declaration, the public laws of North Carolina, archival sources for individuals and institutions, court cases, and reports from various federal and state agencies. All of the sources relied upon for this report are footnoted and fully cited herein, and also listed in my bibliography.

IV. Scope

This report examines the historical context for recent attempts to limit minority citizens' voting rights and ability to elect candidates of their choice. It details more than a century and a half of fierce conflict between efforts to expand access to the ballot box for all citizens, especially Blacks, and campaigns to impose restrictions on the franchise and minority participation in democratic governance. The report begins with the Civil War and Reconstruction era and concludes with today's battles over the regulation of elections and both legislative and municipal redistricting.

V. Introduction – Democracy, Racial Equality, and the Rights of Citizenship

Today, Americans are sharply divided over questions of voting rights and minority political participation. To understand how we came to this impasse, we must look back to 1865 and the end of America's Civil War. The Union had been preserved and the Confederacy was in ashes, but the sacrifice of nearly three quarters of a million lives had not decided the republic's future. Would there be a "new birth of freedom," as Abraham Lincoln had imagined in his Gettysburg Address, or would the nation be reconstituted as a "white man's government," the outcome preferred by his successor, Andrew Johnson? Between 1865 and 1870, self-styled "radicals" in Lincoln's Republican Party answered that question with three constitutional amendments that historians have described as America's "Second Founding."[3]

The Thirteenth Amendment (1865) abolished slavery and guaranteed the liberty of four million Black men, women, and children who had been enslaved in the South. The Fourteenth (1868) granted them citizenship by birthright and established the principle of "equal protection of the laws." And the Fifteenth (1870) forbade the states from denying or abridging male citizens' right to vote "on account of race, color, or previous condition of servitude."

These constitutional guarantees tied the fate of American democracy to the citizenship rights of a newly emancipated Black minority and their descendants. For one hundred and fifty

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[3] Carmichael, *Lincoln's Gettysburg Address*, 72, and Foner, *Second Founding*. Johnson spoke often of a "white man's government"; for the example used here, see Speech on the Restoration of State Government, January 21, 1864, in Graf and Haskins, eds., *Papers of Andrew Johnson*, vol. 6, 577-78.

years, the exercise of those rights and the connection between racial justice and democratic governance have been the centermost issues in American politics. This has been particularly true for the right to vote.

In North Carolina, battles over the political rights of citizenship have played out through cycles of emancipatory politics and conservative retrenchment. In a pattern repeated multiple times, Blacks and their allies have formed political movements to end racial exploitation and claim their rights as equal citizens. They have done so not only to advance their own interests but to promote participatory democracy more generally and to make government responsive to the needs of all its people. Invariably, these efforts have met resistance from conservative lawmakers who erected safeguards – or what advocates of enfranchisement called barriers – around the ballot box. Conservatives have been remarkably creative in that work. When one restriction was struck down in the courts or through protest and political mobilization, they quickly invented another. Sometimes, they spoke in overtly racial terms and implemented reforms through violent means. At other times, they cast franchise restrictions in the more euphemistic language of fraud and corruption. Consistently, they presented strict regulation of the right to vote as a means of ensuring "good order" and "good government."

Some pundits have suggested that the fight over ballots and democratic governance represents little more than competition between Democrats and Republicans to reshape the electorate and gain partisan advantage. No doubt the contest has been intensely partisan, but the ideological realignment of the Democratic and Republican parties reminds us that something far more significant has been at stake. In the decades immediately after the Civil War, Conservatives called themselves Democrats, campaigned for limited social provision, and took the vote from Black men, while Republicans identified as social progressives, championed an expansive and generous state, and fought for equality at the ballot box and in the halls of government. Beginning in the mid twentieth century, these positions flipped. Grassroots activists and national leaders reshaped the Democratic Party to support the advancement of civil rights, while the Republican Party became overwhelmingly white, sought to limit federal involvement in state and local affairs, and adopted a restrictive stance toward citizenship and its attendant rights.

Through all these changes, one fact has remained constant. Discrimination on the basis of color has been white conservatives' primary means of securing both political advantage over minority citizens and their progressive white allies. That was glaringly obvious in 1900, when Democrats amended North Carolina's constitution in order to disenfranchise Black men. It is also evident today in Republicans' attempts to restrict minority citizens' voting rights and in their use of racially discriminatory redistricting practices and partisan gerrymandering to consolidate control over state government and public policy. This politics of race threatens the fundamental principles of our democracy. When racial equality has been denied, and when the consideration of race has been used for partisan gain and the exclusion of minority electors from the democratic polity, the result has been a society in which vast numbers of citizens – not only racial minorities – have had their right to fair and effective representation compromised.

Understood in this historical context, today's conflicts over minority political rights are reminders that we live in a time every bit as consequential as the flush of reform that followed the Civil War. Then, as now, democracy was imperiled by divisive racial appeals, violent expressions of white supremacy, and efforts to roll back newly won citizenship. In such a moment, history has clarifying power.

VI. War, Emancipation, and Reconstruction

A. Civil War to the Black Code

On the eve of the Civil War, North Carolina's government was an oligarchy, not a democracy. The state constitution gave political advantage to a slaveholding elite concentrated in the eastern counties of the coastal plain. Seats in the state Senate were apportioned among fifty districts defined by the value of the taxes that residents paid into state coffers; in the House of Representatives, apportionment was governed by the "federal ratio," which counted slaves as three-fifths of a person. These provisions, together with property requirements for election to high state office, effectively removed a large majority of middling and poor whites from governance of the state and their local communities. Free Black men with property had been entitled to vote under the state constitution of 1776, but that right was rescinded in 1835 by a constitutional amendment. This was the first time in the state's history that the franchise was restricted on the basis of race. Political leaders framed Black disenfranchisement as a necessary response to Nat Turner's rebellion in 1831 and the founding of the American Anti-Slavery Society in 1833. They saw it as protection against the threat of slave insurrections encouraged by white abolitionists and their perceived agents, free Black men exercising the rights of citizenship.[4]

By 1860 more than 85 percent of lawmakers in the North Carolina General Assembly were slaveholders, a higher percentage than in any other southern state. Wealth was closely held by this elite, who constituted roughly seven percent of the state's population of one million and resided primarily in the east. These men also maintained a firm grip on political power. Indeed, the principles of oligarchy were written into the state's constitution. At the local level, voters elected only two county officials: a sheriff and a clerk of court. The power to govern rested in the hands of justices of the peace who were nominated by members of the state House of Representatives and commissioned for life terms by the governor.[5]

North Carolina's antebellum oligarchs did not rule with unchallenged authority. In the 1850s, they faced political revolt by white yeoman farmers in the central Piedmont and the western mountain region who called for removal of property requirements for the right to vote for state senators and demanded an *ad valorem* tax on slaveholders' human property – more than three hundred and thirty thousand Black men, women, and children. Dissenters won the first contest by popular referendum on free suffrage in 1856, and they prevailed in the second when delegates to the state secession convention gave ground on taxation for fear that in war with the North, ordinary whites "would not lift a finger to protect rich men's negroes."[6]

Most of North Carolina remained behind Confederate lines until the final days of the Civil War, and for that reason the state bore a Herculean share of hardship and deprivation. By 1863, North Carolina troops were deserting by the thousands. Many did so with support from the Order of the Heroes of America, an underground network of Unionists and Quaker pacifists. Food riots broke out in the state's largest towns, and in the 1864 gubernatorial election, William Woods Holden, a self-made newspaper publisher, ran on a peace platform, arguing that a negotiated return

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[4] Escott, *Many Excellent People*, 3-31, and Morris, "Panic and Reprisal," 52.

[5] On antebellum North Carolina's economic and political structure, see Escott, *Many Excellent People*, chapt. 1. The figure on slaveholders in the state legislature is from p. 15.

[6] Ibid., 28-30, and 34.

to the Union offered North Carolina's only chance to "save human life" and "prevent the impoverishment and ruin of our people." Holden lost to incumbent governor Zebulon B. Vance by 58,070 to 14,491 votes, but his candidacy exposed a deep rift between the state's wealthy rulers and a significant minority of whites – twenty percent of the electorate – who had "tired of the rich man's war & poor man's fight."[7]

As defeat grew imminent, Calvin H. Wiley, a distinguished educator and publicist, warned of the insurrection that collapse of the Confederacy and the end of slavery would unleash. "The negroes [and] the meanest class of white people would constitute a majority," he warned, and those "who were once socially & politically degraded" would make common cause and rise up in rebellion. To forestall this political realignment, self-styled Conservatives took advantage of President Andrew Johnson's desire for a quick reconstruction of the South by acting decisively to retain political power and dominion over Black labor through legislative action.[8]

In the spring of 1866, Conservatives in the General Assembly passed an Act Concerning Negroes and Persons of Color, known informally as the Black Code. The act sought to keep Blacks subjugated and to "fix their status permanently" by attaching to them the same "burthen and disabilities" imposed on free persons of color by antebellum law.[9]

Under the Black Code, freedmen could not vote, carry weapons without a license, migrate into the state, return to the state after more than ninety days' absence, or give testimony against a white person in a court of law, except by consent of the white defendant. The law also gave sheriffs broad authority to prosecute freedmen for vagrancy, a crime punishable by hiring out to "service and labor."[10]

B. A New State Constitution and Expansion of the Franchise

The Republican majority in the U.S. Congress watched developments in North Carolina and elsewhere in the South with growing concern, particularly for the rights of freedmen. Thaddeus Stevens, congressman from Pennsylvania, warned North Carolina Conservatives that they would "have no peace until a negro is free as a white man . . . and is treated as a white man!" To that end, Congress approved the Fourteenth Amendment to the federal Constitution in June 1866 and tendered it for ratification by the states. The amendment gave citizenship to freedmen and struck directly at the Black Code by guaranteeing all citizens equal protection under the law and forbidding the states to deprive any citizen of life, liberty, or property without due process.[11]

In North Carolina, as in all other southern states except Tennessee, Conservative lawmakers stood firm. They refused to ratify an amendment that, in their view, turned "the slave, master, and the master, slave." Congress answered that defiance by asserting its authority once more, this time through passage of the Military Reconstruction Act of 1867. The act ordered the continued military occupation of the South, instructed army commanders to organize conventions that would

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[7] Escott, *Many Excellent People*, 44 and 49, and Raper, *William W. Holden*, 51. On internal dissent during the Civil War, see also Durrill, *Uncivil War*.

[8] Escott, *Many Excellent People*, 89-90.

[9] Ibid., 130, and *Public Laws of North Carolina, 1865-66*, chapt. 40. For North Carolina law governing slaves and free Blacks before the Civil War, see *Revised Code of North Carolina, 1854*, chapt. 107. See also Browning, "North Carolina Black Code."

[10] *Public Laws of North Carolina, 1865-66*, chapt. 40.

[11] Raper, *William W. Holden*, 91.

rewrite the southern states' constitutions, and granted all adult male citizens – "of whatever race, or color, or previous condition" – the right to vote for convention delegates.[12]

This extension of a limited franchise to Black men radically rearranged the political landscape in North Carolina. It was now possible that an alliance between freedmen and dissenting whites could constitute a political majority. With that end in view, opponents of Conservative rule gathered in Raleigh in March 1867 to establish a biracial state Republican Party. William Holden, the Confederate peace candidate who had served briefly as North Carolina's provisional governor after the South's surrender, stood at the party's head and directed efforts to build a statewide organization using networks established during wartime by the Heroes of America and by the Union League in its campaigns to mobilize freedmen.

When voters went to the polls to elect delegates to the constitutional convention, leaders of the old elite were stunned: Republicans won 107 of the convention's 120 seats. Of that majority, fifteen were Black, including religious and political leader James W. Hood, who had presided over the first political convention of Blacks in North Carolina in late 1865. At that gathering, 117 delegates, most of them former slaves, met in Raleigh to petition white leaders for "adequate compensation for our labor . . . education for our children . . . [and abolition of] all the oppressive laws which make unjust discriminations on account of race or color."[13]

During the winter of 1867-68, delegates to the constitutional convention crafted a document that defined a thoroughly democratic polity. The proposed constitution guaranteed universal manhood suffrage, removed all property qualifications for election to high state office, and at the county level put local government in the hands of elected commissioners rather than appointed justices of the peace. North Carolina would no longer be "a republic erected on race and property." The constitution of 1868 also expanded the role of the state in advancing the welfare of its citizens by levying a capitation tax to fund education and "support of the poor," mandating for the first time in North Carolina history a state system of free public schools, and establishing a state board of public charities to make "beneficent provision for the poor, the unfortunate and orphan."[14]

Black delegates to the convention knew that the success of these reforms would depend on safeguarding broad access to the franchise and appealed for the forceful defense of voting rights. The convention passed an ordinance to criminalize efforts to intimidate "any qualified elector of this State . . . by violence or bribery, or by threats of violence or injury to his person or property."[15]

In May 1868, voters ratified the constitution, elected William Holden governor, and gave the biracial Republican Party six of North Carolina's seven Congressional seats and control of more than two-thirds of the seats in the state legislature. The scale of the Republicans' victory reflected the fact that in North Carolina the percentage of whites who crossed the color line and made common cause with former bondsmen was larger than in any other southern state.[16]

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[12] Escott, *Many Excellent People*, 135, and *Statutes at Large, Treaties, and Proclamations*, 429. Tennessee had been readmitted to the Union in 1866.

[13] Escott, *Many Excellent People*, 125 and 142; Bernstein, "Participation of Negro Delegates in the Constitutional Convention of 1868," 391; and Hamilton, *Reconstruction in North Carolina*, 240-46.

[14] *Constitution of the State of North Carolina, 1868*, Article V, sec. 2; Article VI, Sec. 1; Article VII, Sec. 1; and Article XI, sec. 7; and Orth, "North Carolina Constitutional History," 1779.

[15] *Constitution of North Carolina, 1868*, Ordinances, chapt. XXXVI.

[16] Raper, *William W. Holden*, 101, and Foner, *Reconstruction*, 332.

That alliance and the democratic society it envisioned were startling, even by today's standards. In 1869, twenty Black political leaders from North Carolina traveled to Washington, D.C. to attend the Colored National Labor Convention, where they joined nearly two hundred other delegates from points across the South and throughout the nation. James H. Harris, a Black lawmaker and one of the founders of the North Carolina Republican Party, was elected president of the convention. Over the next five days, the delegates drafted a manifesto for a future built upon racial cooperation, labor solidarity, and respect for the rights of women and immigrants. The document called for unions organized "without regard to color"; extended a "welcome hand to the free immigration of labor of all nationalities"; and implored the states to fund "free school system[s] that know no distinction . . . on account of race, color, sex, creed or previous condition." These things, the manifesto proclaimed, would make the "whole people of this land the wealthiest and happiest on the face of the globe."[17]

C. Klan Violence and "Redemption"

Historian Paul Escott writes that North Carolina's Republican Party "offered a new and vibrant democracy. It seemed inspired with a mission: to open up North Carolina's . . . politics and social system." But as he observes, the party's Conservative rivals were determined to make race, not democracy, the "central question." They described Republicans as a "mongrel mob" spawned by "negro suffrage and social disorder," and they warned non-elite whites of the loss of racial privilege. "IT IS IN THE POOR MAN'S HOUSE," the editor of the *Wilmington Journal* railed, "THAT THE NEGRO WILL ENFORCE HIS EQUALITY."[18]

Such provocations struck deep chords of sentiment in a society that had been organized around racial division for more than two hundred years. But in the new order, words alone could not loosen the Republicans' hold on power. To strike the crippling blow, Conservatives turned to the Ku Klux Klan and vigilante violence. The Klan was first organized in Tennessee in 1868 and subsequently spread across the South. In North Carolina, its leader was one of the Conservatives' own: William L. Saunders, a former Confederate colonel and later a trustee of the state university and secretary of state.

The Klan's masked nightriders committed "every degree of atrocity; burning houses, whipping men and women, beating with clubs, shooting, cutting, and other methods of injuring and insult." In Graham, the seat of Alamance County, they murdered Wyatt Outlaw, a Black town commissioner and constable, and hung his body from a tree in the public square; and in Caswell County, Klansmen lured state senator John W. Stephens, a white Republican, into the basement of the county courthouse, where they beat and stabbed him to death.[19]

Violence occurred in all parts of the state, but as the murders of Outlaw and Stephens attest, backlash against Black political power was especially fierce in the central Piedmont, where the Klan aimed to intimidate not only Black voters, but also the large number of dissenting whites who had crossed the race line. As one Klan leader explained, he and his compatriots aimed not to

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[17] *Proceedings of the Colored National Labor Convention*, 4 and 11-12.
[18] Escott, *Many Excellent People*, 145-48 and 151.
[19] Raper, *William W. Holden*, 160.

restore "a white man's government only, but – mark the phrase – an *intelligent* white man's government."[20]

On July 8, 1870, Governor Holden declared Alamance and Caswell Counties to be in open insurrection and ordered the state militia to suppress the Klan and arrest its leaders. That move quelled the worst violence but gave Holden's Conservative opponents the issue they needed to win back control of the General Assembly in the fall election. In 1871, Conservatives successfully impeached and removed Holden from office on charges of unlawfully suspending the prisoners' right of habeas corpus.[21]

From there, the democratic experiment of Reconstruction rapidly unwound. White northerners, weary of a decade of struggle with the South, had little will to continue a states' rights battle with their neighbors. Slavery had been abolished and secession, punished. That was enough for most whites, who found it perfectly consistent to hate the institution of slavery and to despise the slave with equal passion. For a majority, racial equality had never been a part of the Civil War's purpose. The last federal troops left North Carolina in 1877, a year after Conservatives – now calling themselves Democrats – elected Zebulon B. Vance Governor, a post that he had held for two terms during the Civil War. Across the state, Democrats celebrated "redemption" from what they had long described as the "unwise . . . doctrine of universal equality."[22]

In an effort to secure their victory, white Democrats abolished elected county government, returned authority to appointed justices of the peace, and limited appointed offices to whites only. But continued Black political participation at the state level sustained a competitive two-party system. White Democrats never polled more than 54 percent of the gubernatorial vote, and between 1877 and 1900, forty-three Black lawmakers served in the state House of Representatives, eleven served in the state Senate, and four served in the U.S. House of Representatives.[23]

D. New Forms of Economic Subjugation

Economic change swept through rural North Carolina in the decades after Reconstruction as an emerging merchant class pressed freedmen and white yeoman farmers into commercial production. The result was the notorious system of sharecropping that turned once-independent whites into debtors and locked Blacks in virtual peonage. Each spring, sharecroppers took out loans in the form of the seeds, tools, and supplies they needed in order to plant the year's crop. To ensure repayment – often at interest rates as high as 50 percent – merchants demanded that their clients grow cotton or tobacco, which could be sold readily for cash. As farmers produced more of these cash crops, prices fell and rural families spiraled downward into debt. Whites who owned their land sometimes managed to escape this trap, but Blacks – the vast majority of whom were landless and had to pay rent to landlords as well as interest to merchants – had no recourse. Black sharecroppers often ended the agricultural year with no profit and were unable to accumulate wealth. This process of immiseration repeated itself from generation to generation and produced enduring poverty. In eastern North Carolina, where sharecropping had dominated the agricultural economy,

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[20] Hamilton, ed., *Papers of Randolph Abbott Shotwell*, vol. 2, 376.

[21] Ibid., chapts. 8-9.

[22] Escott, *Many Excellent People*, 147.

[23] Crow, "Cracking the Solid South," 335, and Escott, *Many Excellent People*, 181. On North Carolina's Black congressmen, see E. Anderson, *Race and Politics in North Carolina, 1872-1901.*

the effects could still be seen a century later, when Blacks' per capita income in the region was as low as 22 percent of that of whites.[24]

Desperation and resentment over a new economic order that rewarded manipulators of credit more than cultivators of the land led farmers into revolt. Whites joined the Southern Farmers Alliance, first organized in Texas and then spread throughout the South by means of local chapters, and Blacks affiliated with a parallel organization, the Colored Farmers Alliance. In 1892, these groups sought redress through the political process. Blacks remained true to the Republican Party, while whites, calling themselves Populists, bolted from the Democratic Party – controlled by the state's economic elite – to the new national People's Party. The results were disastrous for the Populists. In the governor's race, the Democratic candidate won 48.3 percent of the vote, while the Republican candidate received 33.8 percent and the Populist candidate trailed with 17.04 percent. These numbers contained a lesson that was obvious to voters who were less than a generation removed from the biracial politics of Reconstruction. Divided, the dissidents were all but certain to lose; united, they could challenge Democratic power.[25]

VII. Fusion Politics and a New Campaign for White Supremacy

A. Biracial Alliance, Electoral Reform, and Investment in Social Provision

In 1894, white Populists and Black Republicans in North Carolina forged a political partnership under the banner of "Fusion" and ran a historic joint slate of candidates. The logic of that move was clear and compelling. As one Populist explained, "We can join with others who agree with us and win a great victory." This sentiment also appealed to skilled artisans and factory laborers, Black and white, who during the 1880s had rallied to the Knights of Labor and embraced the organization's call for interracial cooperation and class solidarity. On Election Day, Fusion candidates won 116 of the 170 seats in the North Carolina legislature. On the local level, in 1894 and 1896, they also elected more than one thousand Black officials, including county commissioners, deputy sheriffs, school committeemen, and magistrates.[26]

A commitment to fair play and democracy animated the Fusion legislature. Lawmakers capped interest rates at 6 percent, a godsend for cash-strapped farmers who relied on credit to survive; shifted the weight of taxation from individuals to corporations; and restored elected local government, a postwar reform that Democrats had reversed after their return to power in the 1870s. In addition, the legislature made new investments in public services that Democrats had starved for resources, including the state penitentiary, state schools for deaf and blind children, a state-supported home for Black orphans, and state mental asylums.[27]

Most important, Fusion legislators also revised state election law with the aim of guaranteeing full and fair access to the franchise:

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[24] Petty, *Standing Their Ground*, and Goldfield, *Still Fighting the Civil War*, 277-78.

[25] Beckel, *Radical Reform*, 135-77, and North Carolina Governor, 1896, <http://bit.ly/32oHPk>, September 5, 2019.

[26] On local elections, see Escott, *Many Excellent People*, 247, and Gershenhorn, "Rise and Fall of Fusion Politics in North Carolina," 4.

[27] Kousser, *Shaping of Southern Politics, 186*, and *Public Laws and Resolutions of the State of North Carolina, Session of 1895*, chaps. 69, 73, 116, 135, 174, 183, 219, 275, 348.

- The revised law required that the clerk of the superior court in every county lay out compact precincts "so as to provide, as near as may be, one separate place of voting for every three hundred and fifty electors." The clerks were also instructed to publish the details of precinct boundaries and polling places in local newspapers and to post that information in public places. In a rural state in which population was widely dispersed, these provisions ensured that neither travel nor lack of public notice would be an impediment to voting. Legislators revisited the law in 1897 to provide additional protection for the opportunity as well as the right to cast a ballot. They stipulated that every elector was "entitled," without penalty, "to absent himself from service or employment" for sufficient time to register and to vote.[28]
- To safeguard impartiality in voter registration and the supervision of elections, the law gave clerks of court – who were elected officials, and therefore accountable to voters – the authority to appoint in every precinct one registrar and one election judge from "each political party of the state." Prior to this time, that responsibility had belonged to county officers who owed their appointment and their loyalty to the majority party in the legislature.[29]
- The law also criminalized various forms of physical and economic intimidation. It specified that "no regimental, battalion or company muster shall be called or directed on election day, nor shall armed men assemble on the day of election." In addition, any person who attempted "by force and violence" to "break up or stay any election" was guilty of a misdemeanor, punishable by imprisonment and a fine of up to one hundred dollars. Similar penalties applied to "any person who shall discharge from employment, withdraw patronage from, or otherwise injure, threaten, oppress, or attempt to intimidate, any qualified voter."[30]
- The law sought to limit frivolous and obstructive challenges to voter eligibility and the legality of ballots cast by presuming the truthfulness of citizens' declarations. Challenges were allowed only on a specified day prior to an election, at which time registration books were opened for public review, and challengers were required to present proof that an elector had withheld or provided false information at the time of registration. Otherwise, the law treated "entry of the name, age, residence, and date of registration of any person by the registrar, upon the registration book of a precinct, [as] presumptive evidence of the regularity of such registration, the truth of the facts stated, and the right of such person to register and to vote at such precinct."[31]
- The law accommodated illiterate voters – 23 percent of whites and 60 percent of Blacks – by authorizing political parties to print ballots on colored paper and to mark them with party insignia, an old practice that Democrats had abolished. In this period, before the introduction of official, non-partisan ballots and secret voting, electors received ballots from the party, or parties, they favored, marked through the names of any candidates they did not support, and handed their ballots to an election judge for deposit in boxes labeled with the office or group of offices for which they were voting. The use of color coding and party

[28] *Public Laws and Resolutions, Session of 1895*, chapt. 159, sec. 5, and *Public Laws and Resolutions, Session of 1897*, chapt. 185, sec. 72.

[29] *Public Laws and Resolutions, Session of 1895*, chapt. 159, sec. 7.

[30] Ibid., chapt. 159, secs. 38, 39, and 41.

[31] Ibid., chapt. 159, secs. 10-12 and 14.

insignia helped illiterate voters correctly identify and cast the ballot of the party they favored. To protect voters from fraudulent handling of their ballots, the law also specified that "any ballot found in the wrong box shall be presumed to have been deposited there by mistake of the officers of election, and unless such presumption shall be rebutted, the ballot shall be counted." This was important, because there could be as many as six boxes at each polling place, and apart from their labels, they all looked alike.[32]

- Finally, the law required public disclosure of campaign financing. Every candidate had to provide, within ten days after an election, "an itemized statement, showing in detail all the moneys contributed or expended by him, directly or indirectly, by himself or through any other person in aid of his election." Those reports also were to "give the names of the various persons who received the moneys, the specific nature of each item, and the purpose for which it was expended or contributed."[33]

These changes produced momentous results in the 1896 election. Republican registration overall increased by 25 percent, and turnout among registered Black voters rose from 60 to nearly 90 percent. Fusionists won more than three-fourths of the seats in the legislature and elected a white Republican, Daniel L. Russell Jr., as governor. Fusion insurgencies arose in other southern states, but only in North Carolina did a biracial alliance take control of both the legislative and executive branches of government.[34]

Fusion lawmakers used their political strength to redress two decades of Democrats' underinvestment in education. This was a particularly important issue for Black Republicans, whose predecessors had led the campaign to include a mandate for public schools in the 1868 state constitution and whose constituents were profoundly disadvantaged in their day-to-day interactions with landlords, merchants, and employers by an inability to read and do basic arithmetic. In an Act to Encourage Local Taxation for Public Schools, lawmakers instructed county commissioners to hold elections in every school district under their supervision on the question of "levying a special district tax" for public education. Districts that voted in favor of taxation were entitled to apply for matching funds from the state. To pressure those that refused, legislators ordered an election every two years until a special tax was approved.[35]

In separate legislation, Black lawmakers used their influence in the Fusion alliance to ensure equitable provision for students in their communities. A revised school law abolished separate white and Black committees appointed at the township level to manage schools for each race and replaced them with consolidated committees made up of five appointees, no more than three of whom could come from the same political party. The law charged the new committees with managing the schools in their districts as a single enterprise. They were to appropriate funds on a strict per capita basis and to apportion "school money . . . so as to give each school in their district, white

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[32] *Public Laws and Resolutions, Session of 1895*, chapt. 159, secs. 19 and 20; Trelease, "Fusion Legislatures of 1895 and 1897," 282; and Beeby, *Revolt of the Tar Heels*, 40. On illiteracy, see *Report of Population of the United States at the Eleventh Census: 1890*, part 2, xxxv.

[33] *Public Laws and Resolutions, Session of 1895*, chapt. 159, sec. 72.

[34] Escott, *Many Excellent People*, 245-47; Beckel, *Radical Reform*, 179-80; and Kousser, *Shaping of Southern Politics*, 182 and 187.

[35] *Public Laws and Resolutions, Session of 1897*, chapt. 421.

and colored, the same length of school term." Districts were also required to limit enrollments to no more than 65 students per school, so as to ensure a rough measure of equity in school facilities.[36]

The election and education reforms enacted in 1895 and 1897 affirmed the values that Black and white reformers had written into the state constitution in 1868. That document, the core of which remains in force today, opened by invoking the Declaration of Independence and connecting the ideals of the American republic to the economic and political struggles set in motion by Confederate defeat and the abolition of slavery. Italics highlight language added by the framers of 1868: "We do declare . . . that all men are created equal; that they are endowed by their Creator with certain unalienable rights; that among these are life, liberty, *the enjoyment of the fruits of their own labor*, and the pursuit of happiness. . . . That all political power is vested in, and derived from the people; all government of right originates from the people, is founded upon their will only, and is instituted *solely for the good of the whole*."[37] Fusion lawmakers in North Carolina, historian Morgan Kousser has observed, created "the most democratic" political system "in the late nineteenth-century South."[38]

B. Resurgent White Supremacy and the Wilmington Coup

As they approached the election of 1898, Democrats once again made white supremacy their rallying cry and vigilante violence their most potent political weapon. Responsibility for orchestrating the party's return to power fell to former congressman Furnifold M. Simmons. Simmons lived in eastern North Carolina, in the Second Congressional District, which was known as the "Black Second" because of its large and politically active Black population. Counties in the district sent more than fifty Black representatives to the General Assembly in Raleigh and elected all four of the state's 19th-century Black congressmen, including Henry P. Cheatham, who had deprived Simmons of his seat in the 1888 election. Simmons and other Democratic leaders dodged the economic and class issues that held the Fusion coalition together and appealed instead to the specter of "negro domination."[39]

Democratic newspapers took the lead in whipping up race hatred. None was more influential than the Raleigh *News and Observer*, published by Josephus Daniels. Day after day, in the weeks leading up to the election, Daniels ran political cartoons on the front page of the paper to illustrate the evils unleashed by Black political participation. The cartoons depicted Black men as overlords and sexual predators who were intent on emasculating white men, turning them into supplicants and ravaging their wives and daughters. Across scores of images, the *News and Observer*'s message was clear: in an inversion of the racial order, Blacks had lifted themselves by pressing white men down.

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[36] Ibid., chapt. 108.
[37] *Constitution of the State of North Carolina, 1868*, Article I, secs. 1-2.
[38] Kousser, *Shaping of Southern Politics*, 183.
[39] Escott, *Many Excellent People*, 253-58, and Korstad and Leloudis, *To Right These Wrongs*, 206. On the Black Second, see E. Anderson, *Race and Politics in North Carolina, 1872-190*, and Justesen, *George Henry White.*

The New Slavery.

"The New Slavery,"
Raleigh *News and Observer*, October 15, 1898.

The News and Observer.

VOL. XLV. NO. 17. RALEIGH, N. C., TUESDAY MORNING, SEPTEMBER 27, 1898. PRICE FIVE CENTS.

LEADS ALL NORTH CAROLINA DAILIES IN NEWS AND CIRCULATION.

GETS DOWN TO WORK

The Commission to Investigate the War Department.

FIRST FORMAL SESSION

PROCEEDINGS LIMITED TO OUTLINING A GENERAL POLICY.

THE MEETING WAS STRICTLY SECRET

Letters of Inquiry will be Addressed to War Department Officials, Army Officers and all who Know Anything of Facts Complained of.

Washington, Sept. 26.—The commission selected by the President to investigate the conduct of the War Department held its first formal session to-day with all the members present.

To-day's meeting was strictly secret, and was confined to a session of two hours duration in the forenoon. The proceedings were limited to the outlining of a general policy and the formation of letters of inquiry which will be made public to-morrow.

The letters which have been decided upon are to be addressed to the Secretary of War, the Quartermaster General, the Commissary General, the Surgeon General and the Chief of the Ordnance Department of the Army. They will consist in the main of inquiries intended to bring out all the facts that

employed as mail messenger, to carry the mail from the postoffice to the mail train, from which it is caught by the postal clerk.

On the day the robbery occurred, Alexander Smith, Jr., carried the mail from the postoffice, he opened the pouch, took therefrom a registered letter containing $30, tore it open sufficiently to extract $5, after which he replaced it in the pouch and hung the pouch on the mail crane, from which it was caught by the postal clerk, D. L. Gray, who noticed the condition of the pouch and registered letter.

After procuring the money, Alexander evidently began preparing for war, with the Spaniards, Americans, or other parties, as he purchased three pistols. . .He soon encountered war, in which his pistols were of no avail, for his father having obtained some information as to his having money, whipped him thoroughly, until he admitted how he obtained the money and in doing so implicated Charlie Douglas, a neighbor of his.

Alexander's father performed his duty nobly, and instead of endeavoring to hide, or excuse his son's crime, he carried him before the United States Commissioner and surrendered him to the law.

On the examination it was developed that Charlie Douglas was not implicated and had only shared in the profits to the extent of a nickel and some candy, hence he was discharged, while Alexander Smith was held for trial at Wilmington and gave bond for his appearane.

MAY SEIZE INSURGENT FLEET.

The Filipinos Flying an Unrecognized Flag, Liable to Seizure as Pirates.

Manila, Sept. 26.—When the United States auxiliary cruiser McCulloch captured the insurgent steamer Abbey, formerly the Pasig, sixty miles south of Manila, the Abbey, it is believed, having landed seven thousand rifles, the insurgent gunboats followed the American vessel into Cavite and now the Americans contemplate taking posses-

The Vampire That Hovers Over North Carolina.

OUR SICK SOLDIERS

ly applauded and his speech was telling in its effect.

Mr. W. A. Dun next addressed the assembly. He spoke briefly of what fusion and Republicanism have done for North

REVISION DECIDED ON

PRISONER OF DEVIL'S ISLAND MAY YET

TELEGRAPHIC FLASHES.

Manzanillo will be evacuated by October 7.

"The Vampire that Hovers Over North Carolina,"
Raleigh *News and Observer*, September 27, 1898.

Democrats wielded racial appeals as a wrecking ball, much as they had done during Reconstruction. Some white Populists buckled. They gave in to the deeply entrenched ways that race shaped political and social perception and began arguing that they, not Democrats, were the most ardent defenders of white supremacy. Even so, the political battle would not be won by words alone.

In the closing days of the 1898 campaign, leaders of the Democratic Party turned once more to violence. They organized local White Government Unions and encouraged the party faithful to don the paramilitary uniform known as the "red shirt," a symbol of the blood sacrifice of the Confederacy and the late-nineteenth-century equivalent of the hooded robes worn by Klansmen in an earlier era. Democrats engaged in open intimidation of voters at registration and polling places across the state. Former congressman Alfred M. Waddell called white men to war. "You are Anglo-Saxons," he exclaimed. "You are armed and prepared, and you will do your duty. Be ready at a moment's notice. Go to the polls tomorrow, and if you find the negro out voting, tell him to leave the polls, and if he refuses, kill him. Shoot him down in his tracks." The effect was terrifying. In Winston, a Republican newspaper reported that "there were crowds of men who gathered around the polls in each ward and . . . boldly drove a large percent of the colored Republican voters and a good many white voters away from the polls."[40]


Armed Red Shirts in Laurinburg and their uniform.
Courtesy of the North Carolina State Archives and
the North Carolina Museum of History.

Democrats' determination to defeat their challengers at any cost was revealed most starkly in the majority-Black coastal city of Wilmington. Revisions to the city charter made by the Fusion legislatures of 1895 and 1897 had undone Democratic gerrymandering and produced a Republican majority – including three Blacks – on the board of aldermen. Democrats were enraged by that

[40] "The North Carolina Race Conflict," *Outlook* 60 (November 19, 1898), 708, and Korstad, *Civil Rights Unionism*, 53.

development and the fact that they would not be able to challenge local Republican rule at the polls until the next municipal election in 1899.[41]

On November 9, the day after the 1898 election, Democratic leaders drew up a declaration of independence that called for the restoration of white rule in Wilmington. They acted on belief "that the Constitution of the United States contemplated a government to be carried on by an enlightened people; [belief] that its framers did not anticipate the enfranchisement of an ignorant population of African origin, and [belief] that those men of the State of North Carolina, who joined in forming the Union, did not contemplate for their descendants a subjection to an inferior race." "The negro [has] antagonized our interest in every way, and especially by his ballot," the Wilmington *Morning Star* exclaimed. "We will no longer be ruled, and will never again be ruled, by men of African origin."[42]

The next day, armed white men under the command of Alfred Waddell staged the only municipal coup d'état in the nation's history. They marauded through Wilmington's Black district, set ablaze the print shop of the city's only Black newspaper, murdered as many as thirty Black citizens in the streets, and drove the sitting board of alderman from office in order to make room for a new, self-appointed city government with Waddell at its head.

A souvenir postcard produced by a local photographer documented destruction of Love and Charity Hall, which housed the *Daily Record*, Wilmington's Black newspaper. Courtesy of the New Hanover County Public Library, Robert M. Fales Collection.

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[41] For a detailed account of events in Wilmington, see *1898 Wilmington Race Riot Report*, 1898 Wilmington Race Riot Commission, May 31, 2006, <http://bit.ly/2HOWsgJ>, September 5, 2019. The report was commissioned by the state legislature in 2000. In 2007, lawmakers expressed "'profound regret that violence, intimidation and force' were used to overthrow an elected government, force people from their homes and ruin lives." See "Senate Apologizes for Wilmington Race Riot," Raleigh *News and Observer*, August 2, 2007.

[42] Raleigh *News and Observer,* November 10, 1898; *Wilmington Morning Star*, November 10, 1898; and *Wilmington Messenger*, November 10, 1898.

Democrats won the 1898 election statewide by a narrow margin. They claimed only 52.8 percent of the vote, but that was enough to oust most Fusionists from the legislature. The victors moved immediately to "rid themselves . . . of the rule of Negroes and the lower classes of whites."[43]

C. The 1899 Act to Regulate Elections and Black Disenfranchisement

In the 1899 legislative session, Democrats drafted an amendment to the state constitution that aimed to end biracial politics once and for all by stripping Black men of the most fundamental privilege of citizenship: the right to vote. The Fifteenth Amendment to the federal Constitution, adopted during Reconstruction, forbade the states from denying the ballot to citizens on the basis of race. North Carolina Democrats, like their counterparts elsewhere in the South, circumvented that prohibition by adopting a literacy test.

In order to vote, citizens first had to demonstrate to local election officials that they could "read and write any section of the Constitution in the English language." That gave Democratic registrars wide latitude to exclude Black men from the polls. Democrats also included a grandfather clause in the amendment that exempted from the literacy test adult males who had been eligible to vote or were lineal descendants of men who had been eligible to vote on or before January 1, 1867. That was a magic date, because it preceded the limited right to vote given to Black men under the Military Reconstruction Act, passed in March of that year. The literacy test was thus designed to achieve the very thing the federal Fifteenth Amendment expressly outlawed – voter exclusion based on race.[44]

Male citizens could also be denied access to the franchise if they failed to pay the capitation tax (poll tax) levied in accordance with Article V, Section 1, of the 1868 State Constitution.[45] This link between payment of the capitation tax and the right to vote was a new impediment put in place by the disenfranchisement amendment. The amendment required that electors pay the tax before the first day of May, prior to the election in which they intended to vote. At that time of year, before the fall harvest, Black sharecroppers were unlikely to have cash on hand for such a payment.

Democrats rewrote state election law to boost the odds that the amendment would win approval. In the 1899 Act to Regulate Elections, they repealed reforms made by the Fusion legislatures of 1895 and 1897, and they put in place new provisions that were crafted to deliver "a good Democratic majority."[46]

- With the aim of purging as many Fusion voters as possible, lawmakers ordered an "entirely new registration" in advance of the next election. In that process, registrars could, at their discretion, require an applicant to "prove his identity or age and residence by the testimony of at least two electors under oath." The law also gave "any by stander" the right to challenge a registrant's truthfulness and force a lengthy examination.[47]
- In a reversal of provisions made in the 1895 election law, information recorded in a registration book no longer stood as presumptive evidence of an individual's right to

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[43] Kousser, *Shaping of Southern Politics*, 191, and Escott, *Many Excellent People*, 258.
[44] *Laws and Resolutions, 1900,* chapt. 2.
[45] Ibid.
[46] Kousser, *Shaping of Southern Politics*, 190, and *Public Laws and Resolutions, Session of 1899*, chapt. 16.
[47] *Public Laws and Resolutions, Session of 1899*, chapt. 507, secs. 11 and 18.

vote. On polling day, "any elector [could] challenge the vote of any person" on suspicion of fraud. In such cases, election officials were to question the suspect voter and compel him to swear an oath of truthfulness. But even that might not be proof enough. The law stipulated that after an oath was sworn, "the registrar and judges may, nevertheless, refuse to permit such a person to vote."[48]

- The law loosened safeguards against partisanship in the management of elections. Lawmakers took the authority to appoint local election officials from the county clerks of superior court, who were directly accountable to voters, and gave it to a seven-member state board of elections that was appointed by the Democratic majority in the legislature. That board's power was expansive. For instance, it had the authority to remove county election officials from office "for any satisfactory cause."[49]
- The law also put an end to practices that accommodated illiterate voters. All ballots were now to be "printed upon white paper, without ornament, symbol, or device." And if a voter or election official placed a ballot in the wrong box (there were six), it was declared void and was discarded.[50]

White supremacy souvenir badge, 1898.
Courtesy of the North Carolina Gallery, Wilson Library, University of North Carolina at Chapel Hill.

[48] Ibid., chapt. 507, secs. 11, 21, and 22.
[49] Ibid., chapt. 507, secs. 4-5 and 8-9.
[50] Ibid., chapt. 507, secs. 27 and 29.

With these new rules in place, Democrats approached the 1900 election confident of victory. Democratic gubernatorial candidate Charles B. Aycock made disenfranchisement the centerpiece of his campaign. On the stump, he offered the white electorate a new "era of good feeling" in exchange for racial loyalty. Aycock argued that the presence of Blacks in politics was the source of bitterness among whites, and that only their removal would heal the white body politic. "We must disenfranchise the negro," he explained to white voters. "Then we shall have . . . peace everywhere. . . . We shall forget the asperities of past years and . . . go forward into the twentieth century a united people."[51]

To whites who were unconvinced and Blacks who were determined to resist, Aycock issued veiled threats. "There are three ways in which we may rule," he told a white audience in eastern North Carolina. "We have ruled by force, we can rule by fraud, but we want to rule by law." To reinforce the point, bands of armed Red Shirts again paraded through towns and cities in the Piedmont and the east, cheered Aycock at campaign rallies, and loitered around polling places on Election Day. The beleaguered Populist and Republican opposition could not withstand that Democratic onslaught. With a turnout of 75 percent of the electors allowed to register under the revised election law of 1899, Aycock and disenfranchisement won by a 59 to 41 percent margin.[52]

Democrats cast that result as a victory of white over Black, but in truth what they feared most and worked hardest to defeat was the interracial coalition that emerged from the calamity of the Civil War and reappeared in the form of Fusion. In a moment of candor, the *Charlotte Daily Observer* admitted as much. It characterized the 1900 campaign as "the struggle of the white people to rid themselves of the danger of the rule of Negroes and the lower classes of whites." The fight in 1900 was not only to establish white supremacy but also to settle the question of which white men would rule supreme.[53]

When the legislature convened in 1901, Democrats secured their victory by passing a law to implement the white-supremacy amendment to the state constitution. The legislation stipulated that in order to register to vote, male citizens would be required to demonstrate their ability to read and write "*to the satisfaction*" (emphasis added) of a county registrar. In effect, that provision gave local election officials limitless authority to decide who would pass a literacy test and be granted – or denied – the right to vote.[54]

VIII. Jim Crow

A. Racial Segregation and Economic Exploitation

The Democrats' triumph in 1900 cleared the way for a new order characterized by one-party government, segregation, and cheap labor. With the removal of Black men from politics, North Carolina's Republican Party became little more than an expression of regional differences among whites that set the western mountain region, the party's surviving stronghold, against the central Piedmont and eastern Coastal Plain.

[51] Connor and Poe, eds., *Life and Speeches of Charles Brantley Aycock*, 82 and 218-19.
[52] "Aycock at Snow Hill," Raleigh *Morning Post*, March 1, 1900; Prather, "Red Shirt Movement," 181–83; and Kousser, *Shaping of Southern Politics*, 193.
[53] Untitled item, *Charlotte Daily Observer*, June 6, 1900, and Woodward, *Origins of the New South*, 328.
[54] *Public Laws, Session of 1901*, chapt. 89.

Leaders of the Democratic Party controlled the selection of candidates through a tightly managed state convention. That arrangement, combined with the fact that no Republican had a realistic chance of winning election to a statewide office, convinced most electors that there was little reason to cast a ballot. Only 50 percent of the newly constrained pool of eligible voters turned out for the 1904 gubernatorial election, and by 1912 the number had declined to less than 30 percent.[55]

Having regained control of the machinery of government, Democrats began implementing public policies that secured what one scholar has termed their "reactionary revolution." Black subjugation was at the head of their agenda. Over time, they developed an elaborate regime of law and custom that they called Jim Crow, a name taken from the Blackface characters in nineteenth-century minstrel shows. Most Americans – certainly most white Americans – think of Jim Crow as an expression of prejudice and discrimination. But it was much more than that: Jim Crow was a system of power and plunder that concentrated wealth and opportunity in the hands of the few and mobilized racial animosity in defense of that accumulation.[56]

Lawmakers passed North Carolina's first Jim Crow law in 1899, during the same session in which they crafted the disenfranchisement amendment to the state constitution. The law required separate seating for Blacks and whites on trains and steamboats. The aim of that and other such regulations – including the segregation of streetcars in 1907, legislation in 1921 that made miscegenation a felony, and a host of local ordinances that segregated drinking fountains, toilets, and cemeteries – was to mark Blacks as a people apart and make it psychologically difficult for whites to imagine interracial cooperation. Segregation also divided most forms of civic space – courthouses, neighborhoods, and public squares – that might otherwise have been sites for interaction across the color line.[57]

In Charlotte, soon to be North Carolina's largest city and the hub of its new textile economy, neighborhoods in 1870 had been surprisingly undifferentiated. As historian Thomas Hanchett has noted, on any given street "business owners and hired hands, manual laborers and white-collared clerks . . . Black people and white people all lived side by side." By 1910, that heterogeneity had been thoroughly "sorted" along lines of race and class. In communities large and small across the state, this process played out a thousand times over. White supremacy denied Blacks access to economic and political power and erected a nearly insurmountable wall between Blacks and poor whites who had risen in the mid 1890s to challenge Democrats' rule by asserting their shared grievances and claim to the franchise.[58]

Hardening racial segregation relegated the majority of Black North Carolinians to the countryside and created, in effect, a bound agricultural labor force. In the 1910s, Clarence Poe, editor of the *Progressive Farmer*, led a movement to perfect that arrangement by proposing "territorial segregation" in rural areas and an amendment to the state constitution that would have allowed white communities to prohibit the sale of land to Blacks. He modeled the idea on policies implemented in the new Union of South Africa that laid the foundation for the system of apartheid established in 1948.

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[55] Escott, *Many Excellent People*, 261, and Kousser, *Shaping of Southern Politics*, 195.

[56] Kousser, *Shaping of Southern Politics*, 261. The account that follows is adapted from Korstad and Leloudis, *To Right These Wrongs*, 16-18, and Korstad, *Civil Rights Unionism*, 54-57.

[57] *Public Laws and Resolutions, Session of 1899*, chapt. 384, and Paschal, *Jim Crow in North Carolina*.

[58] Hanchett, *Sorting Out the New South City*, 187.

Poe believed that his reforms would lock Blacks into permanent status as tenants and sharecroppers and would make way for a "great rural civilization" to flourish among whites. He understood that the scheme might run afoul of the Fourteenth Amendment but brushed that concern aside. "If our people make up their minds that segregation is a good and necessary thing," Poe argued, "they will find a way to put it into effect – just as they did in the case of Negro disenfranchisement despite an iron-bound Amendment specifically designed to prevent it." Poe's proposal ultimately failed in the state legislature, but it had broad backing among small-scale white farmers. It also revealed how tightly Poe and North Carolina were connected to a global movement to assert white dominion over peoples of color.[59]

Blacks who lived in cities and small towns had opportunities that were only modestly better than those available in rural areas. Most Black women worked in white households as maids, cooks, and laundresses. In Durham and Winston, both tobacco manufacturing centers, and in tobacco market towns in the eastern part of the state, Black women and men labored in stemmeries where they processed the leaf before it was made into cigarettes and chewing plugs. The work was dirty and undesirable – the kind of labor that whites expected Blacks to perform.[60]

Jim Crow held most Black North Carolinians' earnings to near-subsistence levels. That, in turn, depressed the market value of all labor and dragged white wages downward. In textiles – North Carolina's leading industry – men, women, and children worked for some of the lowest wages in the country. Prior to the implementation of a national minimum wage in the 1930s, they earned on average 40 percent less than workers in comparable jobs in the North. Even so, textile manufacturers often boasted that they had built their mills to save poor whites from destitution. That, they said, was also their reason for restricting textile employment, with few exceptions, to whites only. The message to white laborers was clear: mill owners would make up for slim pay envelopes by safeguarding what W. E. B. Du Bois called the "psychological wages" of whiteness.[61]

Such insistence on maintaining the color line denied Black North Carolinians something they had prized since the time of Emancipation: quality education for their children. In the 1880s, the state spent roughly equal amounts per capita on white and Black students in the public schools, but by 1920 spending on white students outpaced that for Blacks by a margin of three-to-one. The state spent ten times as much on white school buildings as it did on Black schools, and Black teachers made only half of the $252 a year paid to whites. The results were predictable: in 1920, 24.5 percent of Blacks over the age of ten were illiterate, as compared to 8.2 percent of whites. Racial disadvantage was also persistent.[62]

Added to all of this, Black North Carolinians were plagued by "sickness, misery, and death." In 1940, the annual mortality rate for Blacks was 11.6 per thousand, compared to 7.6 per

[59] Herbin-Triant, "Southern Segregation South African-Style," 171 and 186.

[60] See Sharpless, *Cooking in Other Women's Kitchens*, and Korstad, *Civil Rights Unionism*.

[61] Hall, Leloudis, Korstad, Murphy, Jones, and Daly, *Like a Family*, 80; Williamson, *Crucible of Race*, 430-32; and Du Bois, *Black Reconstruction*, 700.

[62] Thuesen, *Greater Than Equal*, 31, 86, and 268 n. 48.

thousand for whites. Blacks were one-and-a-half times more likely than whites to die from tuberculosis and malaria, and Black infant mortality exceeded that for whites by the same margin.[63]

B. World War I and the Great Migration

A casual observer of the Jim Crow South could have been forgiven for concluding that white supremacy's victory was complete, its hold of the region unassailable. Josephus Daniels, one of the regime's architects, suggested as much shortly after the 1900 election. "When Governor Aycock was elected," Daniels explained to a friend, "I said to him that I was very glad that we had settled the Negro question for all times." Aycock replied, "Joe, you are badly mistaken. . . . Every generation will have the problem on their hands, and they will have to settle it for themselves." The governor was more prescient than he might have imagined. Even at the height of Jim Crow's power, Black Americans refused to surrender their claim on equal citizenship and a fair share of social resources and economic opportunities. Over half a century – through two world wars and a global economic crisis – they clawed their way back into politics. Progress was slow and small gains often met fierce white resistance, but by the late 1950s Blacks had built a new freedom movement and prepared the way for a second Reconstruction.[64]

World War I put the first chinks in Jim Crow's armor. When fighting broke out in Europe in 1914, it cut off the supply of European immigrant laborers on which the factories of the Midwest and Northeast relied. Industrial recruiters ventured southward to entice sharecroppers off the land. By 1919, nearly 440,000 Blacks had left the South in what came to be called the Great Migration. They made new homes in Baltimore, Philadelphia, New York, Pittsburgh, Chicago, and Detroit. Another 708,000 migrants followed during the 1920s. In the absence of poll taxes and literacy tests, these refugees gained access to the ballot box and influence in city politics. They also created large enclaves from which a vibrant urban Black culture emerged. Literature, art, and music gave voice to the "New Negro" – a figure dignified and defiant, determined to hold the nation accountable to its democratic promise.[65]

C. The Great Depression, a New Deal, and Good-Bye to the Party of Lincoln

During the 1930s, newly enfranchised Black voters reshaped national politics by abandoning the party of Lincoln in favor of Franklin D. Roosevelt and his New Deal. Many were at first wary of Roosevelt, a Democrat whose party stood for white supremacy in the South. But Blacks were especially hard hit by the Great Depression, and Roosevelt's New Deal delivered much-needed relief. The largest federal jobs programs employed Blacks in proportion to their representation in the general population and, with mixed results, attempted to prohibit discrimination in job placement and wages. Black appointees in New Deal agencies also served President Roosevelt as a shadow cabinet, and First Lady Eleanor Roosevelt publicly supported the NAACP's civil rights agenda. America remained a Jim Crow nation, but at no time since Reconstruction had the federal

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[63] Carlton and Coclanis, *Confronting Southern Poverty*, 33, 42, 54-55, and 59; Larkins, *Negro Population of North Carolina*, 29; and Shin, "Black-White Differentials in Infant Mortality in the South, 1940-1970," 17. The infant mortality rate for Blacks was 76.6 per 1,000 live births, compared to 50.3 per 1,000 live births for whites.

[64] Josephus Daniels to John T. Graves, December 21, 1942, cited in Ward, *Defending White Democracy*, 2.

[65] Estimates of the scale of the Great Migration vary. The figures cited here are from Gregory, "Second Great Migration," 21. On the New Negro, see Whalan, *The Great War and the Culture of the New Negro*.

government held out such hope for redressing racial injustice. In his 1936 bid for re-election, Roosevelt won 71 percent of the Black vote in a landslide victory over Republican challenger Alf Landon.[66]

The effects were felt in North Carolina. In 1932, newspaperman Louis E. Austin helped to organize a political conference in Durham that attracted more than five hundred Black business, civic, and religious leaders from across the state. Austin was editor of the city's *Carolina Times*, a paper widely regarded as an exemplar of "new Negro journalism." Like others at the conference, he believed that southern Blacks needed a new strategy for advancing civil rights. Since Emancipation, Blacks had cast their lot with the Republican Party, but Republican leaders largely abandoned them in the early twentieth century. In North Carolina, the party was controlled by men who rejected its biracial heritage, and at the national level, Republican president Herbert Hoover showed little concern for Blacks' disproportionate suffering in the Great Depression. The times seemed to call for a radical change of direction, one that would challenge white supremacy at its root by mounting a political assault from within the Democratic Party.[67]

That is what participants in the Durham conference had in mind when they made plans for a statewide voter registration drive. Their aim was "to become a factor in the party that has the power" by adding Black voters to the registration rolls as Democrats, not Republicans. Success came slowly, but by the mid-1930s upwards of forty thousand Black men and women had managed to pass the state's literacy test and affiliate themselves with the Democratic Party. In Durham, these new voters elected Louis Austin and Black theater owner Frederick K. Watkins as justices of the peace on the Democratic ticket. The *Pittsburgh Courier*, one of the nation's leading Black newspapers, pronounced that win "the beginning of the 'New Deal' in the South."[68]

Incremental Black gains and the temerity of men like Austin angered the keepers of white rule. When Blacks registered as Democrats in Raleigh, Josephus Daniels used the *News and Observer* to warn that they were part of a plot "to destroy the great victory" won in 1900 under his leadership and that of Charles Aycock. "The Democratic Party in North Carolina is a white man's party," he exclaimed. "It came through blood and fire in allegiance to that principle." At his urging, election officials in Raleigh attempted to disqualify every Black registrant – Democrat and Republican alike – but Black citizens sued and won a court order to have the names of two hundred and ten restored to the voter rolls. They also taunted white Democrats. "Why," they wondered, "is it a crime for the Negro to seek to vote the triumphant ticket of the major party of the section in which he lives?"[69]

Josiah Bailey, U.S. Senator from North Carolina, shared Daniels' fear of Black claims on the rights of citizenship. In 1937, shortly after President Roosevelt's election to a second term, he threatened a Congressional revolt against the New Deal. Bailey recruited southern Democrats and a number of Republicans to endorse a Conservative Manifesto, which, had it been implemented, would have given local officials control over federal jobs programs for the unemployed. That was

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[66] Election data are from Ladd Jr., with Hadley, *Transformations of the American Party System*, 59.

[67] "North Carolinians Hold State-wide Political Confab," *Pittsburgh Courier*, April 12, 1932, and "Durham, Thriving Southern Metropolis of 17,000 Negro Inhabitants," *Norfolk Journal and Guide*, April 16, 1932.

[68] "Carolina Whites Horrified as Negro Democrats Vote," *Atlanta Daily World*, June 6, 1932, and "Elect Magistrates on Democratic Ticket in North Carolina," *Pittsburgh Courier*, November 24, 1934.

[69] "Dagger at the Heart," Raleigh *News and Observer*, May 25, 1932; "More Talk About Negro Situation," Raleigh *News and Observer*, June 1, 1932; and Gershenhorn, *Louis Austin*, 49.

key to maintaining the Black-white wage differential and Jim Crow's promise to ordinary whites that Blacks would always be beneath them. The manifesto affirmed the value of small government; called for reduced taxation of private and corporate wealth; and insisted on the primacy of "states' rights, home rule, [and] local self-government." On the Senate floor and in private exchanges, Bailey criticized President Roosevelt for pandering to the "Negro vote," caricatured the New Deal as "a gift enterprise [conducted] at the expense of those who work and earn and save," and warned that he and his allies were prepared to defend white supremacy, whatever the cost. "Keep your nose out of the South's business," he advised Roosevelt, or "be assured that a [new] white man's party [will] arise" to claim the region's loyalty.[70]

That threat was more than empty bluster. From the outset, southern Democrats had worked to blunt the New Deal. In North Carolina, Democratic officials backed tobacco manufacturers who resisted the National Recovery Administration's efforts to raise wages for Black workers. They also managed the Agricultural Adjustment Administration's price support programs in ways that allowed white landlords to dismiss thousands of Black tenants and keep government crop subsidies for themselves. At the national level, southern Democrats led the effort to exclude agricultural and domestic workers – the vast majority of whom were Black – from the old-age pensions established by the Social Security Act of 1935 and the minimum-wage protection afforded by the Fair Labor Standards Act of 1938.[71]

University of North Carolina sociologist Guy Johnson recognized in all of this "a tendency to perpetuate . . . existing inequalities." Blacks had made important gains, but they still lacked the means "to command" an adequate wage and a "decent share of the services and benefits of government." The consequences were tragic – for Blacks, most obviously, and for poor whites in ways that Jim Crow obscured. Johnson urged politicians to confront these truths, surrender white rule, and substitute "fairness and justice" for a "policy of repression." Doing so would make possible "better homes, better health, better living, cultural development, and human adequacy for both races." White southerners had "all to gain and nothing to lose," Johnson declared." "Self-interest, simple justice, and common-sense demand that [they] give the Negro a new deal." That was not going to happen in North Carolina, at least not without a fight.[72]

D. World War II and Civil Rights Unionism

World War II lifted the nation out of economic depression and further eroded white southerners' capacity to hold the line on civil rights. Millions more Blacks left the land. Some moved along familiar paths to work in northern war industries; others found employment in southern cities or on the sprawling military bases that were scattered across the region. They expanded their influence in Democratic Party politics, swelled the national ranks of the NAACP from fifty thousand to four hundred and fifty thousand members, and through the militant unions of the Congress of Industrial Organizations (CIO) gained new bargaining power on the factory floor. The federal

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[70] Moore, "Senator Josiah W. Bailey and the 'Conservative Manifesto' of 1937"; Patterson, "Failure of Party Realignment in the South," 603; Bailey to Peter Gerry, October 19, 1937, Senatorial Series, General Correspondence, Bailey Papers; "Roosevelt 'Purge' Rapped by Bailey," *Atlanta Constitution*, September 11, 1938; and Dunn, *Roosevelt's Purge*, 237.

[71] Katznelson, *Fear Itself*, chapt. 5.

[72] Johnson, "Does the South Owe the Negro a New Deal?"

government, concerned that racial tensions not impede the war effort, acted to limit employment discrimination and to restrain white violence.[73]

All of this played into what civil rights activists came to call a Double V strategy that encouraged Black mobilization – in the military and on the home front – to defeat the twin evils of fascism and white supremacy. The potential for making change at home was apparent even before a formal declaration of war. In early 1941, A. Philip Randolph, president of the Brotherhood of Sleeping Car Porters, proposed a march on Washington to pressure President Roosevelt to desegregate the military and guarantee equal employment opportunities in war industries. Noting the strength of grassroots support for the march, some observers predicted that more than one hundred thousand people would participate. In June, months before the Japanese attack on Pearl Harbor, Roosevelt handed the organizers a partial victory. He issued Executive Order 8802, which prohibited racial discrimination in federal job training programs and defense industry employment. With that, Randolph canceled the march.[74]

This positioning of the federal government as a civil rights ally gave courage to the nearly eight thousand Black women and men who labored in the R.J. Reynolds tobacco factories in Winston-Salem. In 1943, they began organizing with assistance from the CIO's Food, Tobacco, and Allied Workers union (FTA). Under ordinary circumstances, Reynolds would have easily crushed the effort, but the war years were anything but ordinary.

When workers staged a sit-down strike, the federal Mediation and Conciliation Service intervened to negotiate a temporary settlement. Months later, the National Labor Relations Board – a New Deal agency established in 1935 by the Wagner Act – set the ground rules for a fair election in which Black workers and a significant minority of whites voted to establish a union local. Despite that result, Reynolds managers refused to sign a contract until forced by the National War Labor Board to pay higher wages and improve working conditions. Stemmery worker Ruby Jones said of that victory, "It was just like being reconstructed."[75]

Jones and others understood that winning in the workplace was but one step toward equal citizenship. Dethroning Jim Crow required that they also organize politically. "If you are going to defeat these people," union leader Robert Black explained, "not only do you do it across the negotiating table in the R.J. Reynolds Building, but you go to city hall, you elect people down there that's going to be favorable and sympathetic and represent the best interest of the working class." To that end, the union sponsored citizenship and literacy classes and launched a city-wide voter registration drive. Those efforts paid off in 1947, when Black voters elected Reverend Kenneth R. Williams to the Winston-Salem board of aldermen. He was the first Black politician in the South to defeat a white opponent at the state or local level since the Fusion era of the 1890s.[76]

The unionists in Winston-Salem and ten thousand members of a sister FTA local in eastern North Carolina's tobacco warehouses and stemmeries were in the vanguard of a statewide campaign for more inclusive politics. They provided local support for the Progressive Party, formed in 1947 by breakaway Democrats to back the presidential candidacy of Henry A. Wallace.

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[73] On the growth of the NAACP and the CIO, see Dalfiume, "'Forgotten Years' of the Negro Revolution," 99-100, and Zieger, *The CIO*.

[74] Jones, *March on Washington*, chapt. 1.

[75] Korstad, *Civil Rights Unionism*, 202.

[76] Ibid., 251-52.

Wallace had served in Franklin Roosevelt's New Deal administration as vice president, secretary of agriculture, and secretary of commerce. He established a reputation as a full-throated critic of Jim Crow and, during the early years of the Cold War, opposed hardline anticommunism as a threat to democratic values at home and abroad. In 1948, Wallace challenged Roosevelt's successor, Harry S. Truman, with demands for peaceful cooperation with the Soviet Union and an immediate end to racial segregation.[77]

In North Carolina, the Progressive Party nominated a slate of candidates that represented an extraordinary commitment to equal citizenship. Of the nineteen nominees, five were white women, including journalist and civil rights activist Mary Watkins Price, who was the first woman to run for governor in the state. Black candidates included Reverend William T. Brown from Maxton, who opposed former governor J. Melville Broughton for a seat in the U.S. Senate; Robert E. Brown, also from Maxton, who sought election in the Eighth Congressional District; Robert Latham, an FTA organizer in Rocky Mount, who ran in the Second Congressional District; Durham civil rights lawyer Conrad O. Pearson, who stood for state attorney general; Gertrude Green, a tobacco worker from Kinston, and Randolph Blackwell, a student at the Agricultural and Technical College of North Carolina in Greensboro (now North Carolina Agricultural and Technical State University), who sought election to the state house of representatives; and Leila B. Michael, a teacher and NAACP leader from Buncombe County, who vied for a place on her local board of education. These men and women ran on a platform that demanded repeal of North Carolina's anti-union labor laws and regressive sales tax, "civil rights for all people, improved schools, higher teacher pay, [and] increased aid to needy people." These priorities were not so different from those of Reconstruction-era Republicans and the Fusion politicians of the 1890s.[78]

When Wallace stumped the state for the Progressive ticket in August 1948, bands of white hecklers, sometimes numbering in the thousands and waving Confederate flags, followed his entourage from town to town and pelted them with eggs and tomatoes. Shouts of "nigger lover" filled the air and were echoed in more genteel terms by the state's newspapers. The editors of the *Charlotte Observer* suggested that Wallace and his compatriots had brought the trouble upon themselves by announcing in advance that the candidate "would speak to none but unsegregated audiences."[79]

Wallace gave his detractors no quarter. In a 1947 speech, he had declared that "Jim Crow in America has simply got to go." His reasoning echoed a long tradition of dissent within the South: "The cancerous disease of race hate, which bears so heavily upon Negro citizens . . . at the same time drags the masses of southern white citizens into the common quagmire of poverty and ignorance and political servitude . . . Jim Crow divides white and Negro for the profit of the few. It is a very profitable system indeed."

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[77] On Wallace's life and career, see Culver and Hyde, *American Dreamer*.

[78] "Wallace Party Names Picks for N.C. Posts," *Norfolk Journal and Guide*, September 4, 1948, and Report of the Nominating Committee, Progressive Party of North Carolina, box 2, folder 13, Scales Papers. On Blackwell, see Chafe, *Civilities and Civil Rights*, 27-28. For more on the Progressive Party and the Wallace campaign in North Carolina, see Uesugi, "Gender, Race, and the Cold War."

[79] Devine, *Henry Wallace's 1948 Presidential Campaign*, p. 245, and "Deplorable Disorders," *Charlotte Observer*, September 1, 1948.

Henry A. Wallace campaign poster. Courtesy of Georgia State University Library Digital Collections, M. H. Ross Papers.

The price exacted by Jim Crow was measured not just in dollars, but in lives as well. Wallace made that point with a "single grim fact": "a Negro child born this day has a life expectancy ten years less than that of a white child born a few miles away." "Those ten years," he explained, "are what we are fighting for. I say that those who stand in the way of the health, education, housing, and social security programs which would erase that gap commit murder. I say that those who perpetuate Jim Crow are criminals. I pledge you that I shall fight them with everything I have." Wallace understood the fury his words would provoke. "Every uttered truth," he observed, "produces a tremor in those who live by lies."[80]

Wallace's prospects, and those of the Progressive Party in North Carolina, were hamstrung from the start. He faced the problem that has plagued every third-party candidate in American politics: a concern among potential supporters that to cast a ballot for him was to waste a vote. His strong stand against racism and opposition to Cold War anticommunism also meant that he drew most of his support from the Left, including the Communist Party USA, which endorsed his candidacy. On Election Day, Wallace and his North Carolina running mates garnered only a fraction of the vote. But the issues they raised were far from settled. That became evident two years later in the Democratic primary election for the U.S. Senate.

[80] Wallace, "Ten Extra Years," <http://bit.ly/31hRDVR>, November 29, 2020.

E. The Senate Campaign of 1950 and Reassertion of White Rule

The story of the 1950 election began a year before, when Senator J. Melville Broughton died in office. Governor W. Kerr Scott appointed University of North Carolina president Frank Porter Graham to fill the post until the next general election. Graham's liberal views were well known. He was an outspoken supporter of labor unions; he had served as a member of the White House advisory council that helped establish Social Security in 1935; he chaired Roosevelt's Advisory Committee on Economic Conditions in the South, which documented widespread poverty in the region; and in 1938 he was founding president of the Southern Conference for Human Welfare, an interracial organization devoted "equal and exact justice to all" (a phrase borrowed from President Thomas Jefferson's 1801 inaugural address).[81]

In the 1950 Democratic primary, Graham faced a field of challengers that included Willis Smith, a respected Raleigh attorney and former president of the American Bar Association. On the first ballot, Graham defeated Smith and the other candidates by winning a plurality, but not a majority, of votes. As runner-up, Smith was entitled to call for a runoff, but he hesitated. He was unsure that he could raise the necessary money or that he had the stamina for another contest. Then, on June 5, just days before the deadline for Smith's decision, the U.S. Supreme Court handed down rulings that affirmed Black students' right to equal access to publicly funded graduate education and banned segregation on railroads. The court's actions galvanized Smith's supporters. On the afternoon of June 6, Jesse Helms, a young news director for WRAL Radio in Raleigh, made arrangements to air at fifteen-minute intervals a plea for Smith backers to rally at his home and urge him to demand a runoff. The crowd that gathered on Smith's lawn was persuasive. The next morning, Smith called for a second primary.[82]

The political battle that followed was the rawest since the white supremacy campaigns of 1898 and 1900. Smith's backers brought race front and center. They focused particularly on Frank Graham's service in 1946-47 on President Harry Truman's Committee on Civil Rights, which issued the first federal report on race relations and laid the groundwork for Truman's desegregation of the military a year later. The report, titled *To Secure These Rights*, a phrase taken from the Declaration of Independence, called unequivocally for "the elimination of segregation, based on race, color, creed, or national origin, from American life."[83]

The Smith campaign directed its harshest criticism at the committee's recommendation that Truman establish a permanent Fair Employment Practices Committee to monitor and eliminate racial discrimination in the workplace. Frank Graham – who preferred moral suasion over government intervention as an instrument of social change – had dissented from that part of the committee report, but Smith and his lieutenants paid no mind. In campaign press releases, they warned that Graham supported reforms that would allow Blacks to steal white jobs. Handbills distributed in rural communities and white working-class neighborhoods raised the alarm even more shrilly. "White People Wake Up Before It's Too Late," one exclaimed. "Frank Graham Favors Mingling of the Races."[84]

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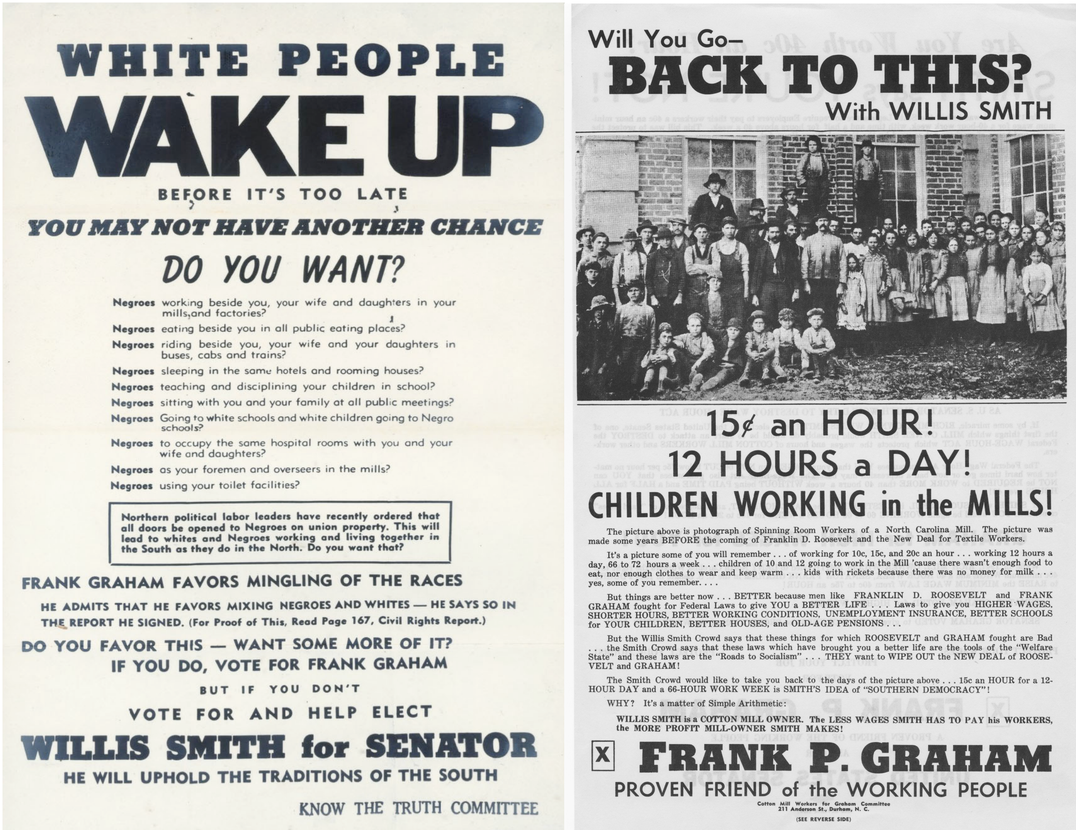
[81] Pleasants and Burns, *Frank Porter Graham and the 1950 Senate Race*, 5–30, and Ashby, *Frank Porter Graham*, 77, 144–45, 151–59.

[82] Pleasants and Burns, *Frank Porter Graham and the 1950 Senate Race*, 196–201.

[83] President's Committee on Civil Rights, *To Secure These Rights*, 166.

[84] Pleasants and Burns, *Frank Porter Graham*, 140 and 223.



Smith and Graham campaign handbills. Courtesy of the Southern Historical Collection, Wilson Library, University of North Carolina at Chapel Hill, Daniel Augustus Powell Papers.

These attacks were powerful in the simplicity of their message: Graham posed a threat to white privilege and the racial division of labor from which it was derived. Graham's campaign countered by warning white working people that Smith would roll back the hard-won economic gains of the New Deal, but on Election Day race trumped class. Smith won the second primary by more than nineteen thousand votes. He traveled to Washington to take his Senate seat in 1951 and carried Jesse Helms with him as a member of his staff. Twenty-two years later, Helms returned as a Republican Senator and leader of the conservative movement that came to be known as the New Right.

IX. Black Advance and White Reaction in the Forgotten 1950s

A. Challenging Jim Crow at the Ballot Box

In the aftermath of the election, Graham's supporters were distraught. "I weep for the people of North Carolina," one woman wrote, "because they [were] swayed by prejudices [and] lies." But Black newspaper editor Louis Austin found cause for hope, even as he mourned Graham's defeat. He reminded readers of the *Carolina Times* that more than two hundred and sixty thousand voters – the vast majority of them white – had cast their ballots for Graham, and in doing so had refused to bow to "race hatred." Despite obvious similarities, Graham's loss was not a calamity on the same scale as the defeat of Fusion half a century before. Appeals to justice and decency had loosened Jim Crow's grasp and created new room for Blacks to maneuver. Austin urged his readers to seize that opportunity, to light a "torch of freedom" that would "send bright rays into the dark corners of [a] benighted State."[85]

Leaders and ordinary folk in Black communities across North Carolina took up that challenge. In 1951, a "rush" of thirteen Black candidates stood for election in eleven cities, from Rocky Mount in the east to Winston-Salem in the central Piedmont. Three of them won seats on their municipal councils.[86] Two years later, twenty-four Black candidates ran in nineteen cities, and six bested their white opponents.[87]

The victories in 1953 were, in many respects, predictable. With one exception, they occurred in Piedmont cities with substantial Black populations and active Black civic organizations. In Winston-Salem, unionized tobacco workers had spurred voter registration and created a political movement that continued to elect a Black candidate to the city's board of aldermen. Black business leaders in Durham had similar success. Under the auspices of their Committee on Negro Affairs, they had been registering voters and sponsoring candidates for the better part of two decades. In 1953, they broke through with the election of Rencher N. Harris, a real estate appraiser, to the city council. Harris also had the backing of a short-lived interracial alliance of progressive whites and unionized textile and tobacco workers.[88]

More surprising, and ultimately more threatening to white rule, was the fact that seven Black candidates had the courage to seek office in eastern North Carolina, where Jim Crow was most deeply entrenched, and that in Wilson, a small tobacco market town located in that section of the state, George K. Butterfield Sr. won election to the board of commissioners. Through the end of the decade, this spread of civil rights activism beyond the cities of the Piedmont tested white politicians' ability to deflect Black claims on equal citizenship.

The story of George Butterfield's political career in Wilson epitomized the contest between white men in power and their Black challengers in the east. Butterfield was a dentist and a veteran of World War I, born in Bermuda and educated at Meharry Dental College in Nashville, Tennessee. He moved to Wilson in 1928 and quickly established himself as a leader in the city's Black community. George K. Butterfield Jr., who currently represents North Carolina's First Congressional District, remembers that his father "was always a thorn in the side of the white establishment." In the 1940s, the elder Butterfield and his brother-in-law, Fred Davis Jr., directed a number of voter registration drives. They recruited brave volunteers and "sat up the night with them" to

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85 Ibid., 247-48, and "Victorious in Defeat," *Carolina Times*, July 1, 1950.

86 Dr. William Hampton won a seat on the Greensboro city council, Reverend William R. Crawford won a runoff and replaced Kenneth Williams on the Winston-Salem board of aldermen, and Dr. W. P. Devane was re-elected to the Fayetteville city council. Later in 1951, Hampton and Crawford were the first Black city officials to attend meetings of the North Carolina League of Municipalities. See "Rush of Negro Candidates for City Posts in N. Carolina," *Atlanta Daily World*, May 8, 1951; "Two Win City Council Seats in No. Carolina," *Atlanta Daily World*, May 17, 1951; and "First Negro to N.C. League of Municipalities," *Atlanta Daily World*, November 10, 1951.

87 "Negro Candidates Seek Offices in Twenty North Carolina Cities," *Chicago Defender*, May 2, 1953. Despite the title, only nineteen cities are listed in this article. For clarification of the number of city council candidates in Concord, see "Candidates Win Three North Carolina Races," *Atlanta Daily World*, May 7, 1953, and "Primary Vote at Concord Slated Tuesday," *Charlotte Observer*, April 13, 1953. For the successful candidates, see "They Scored," *Chicago Defender*, May 23, 1953. William Crawford and William Hampton won re-election in Winston-Salem and Greensboro, respectively; Rencher N. Harris claimed a seat on the Durham city council; Hubert J. Robinson was elected to the Chapel Hill town council; Nathaniel Barber took a seat on the city council in Gastonia; and Dr. George K. Butterfield Sr. was elected to the city council in Wilson.

88 Gershenhorn, *Louis Austin*, 114, and "They Scored," *Chicago Defender*, May 23, 1953.

memorize and "rehearse the Constitution." When those aspiring voters took the literacy test, "some would pass and some would not," because the outcome was "just the whim of the registrar." Progress was slow, but over time, the effort paid off. By 1953, more than five hundred of Wilson's Black citizens had qualified to vote.[89]

That figure was large enough to convince Butterfield to stand for election as a town commissioner representing Wilson's third ward. Although Blacks constituted a majority in the ward, whites outnumbered them among registered voters. Butterfield's supporters overcame that disadvantage by turning out at a much higher rate than their white neighbors. When ballots were counted, Butterfield and his opponent each received three hundred and eighty-two votes. As stipulated in Wilson's town charter, election officials decided the winner by drawing lots. A blindfolded child pulled Butterfield's name from a hat.[90]

Butterfield used his political office to press for improved municipal services in Wilson's Black neighborhoods, additional funds for Black schools, and the desegregation of recreational facilities, including the town's minor-league baseball stadium. After he won re-election in 1955, Wilson's white commissioners moved to be rid of him. Shortly before the 1957 election, they approved a surprise resolution to change from a ward system to an at-large form of municipal government in which a full slate of commissioners would be elected in a single, multi-candidate contest. Under that arrangement, a Black candidate would face not one but many white opponents.[91]

The state legislature quickly approved the change and added a provision to Wilson's charter that prohibited single-shot, or as it was sometimes called, bullet voting. That was the practice of marking a ballot for only one candidate in at-large, multi-candidate contests in which the top vote getters won election to a set number of open seats. In simple mathematical terms, single-shot voting offered Black voters – always a minority – their best chance at electing representatives from their communities. The new prohibition undercut that prospect by requiring that election officials discard single-shot ballots.[92]

These changes in Wilson's town government denied Butterfield a third term. In the 1957 election, he placed eighth in a field of sixteen candidates who vied for six seats on the town commission. Four years later, Reverend Talmadge A. Watkins, Butterfield's pastor and political ally, ran for a place on the town commission and, after losing, challenged the anti-single-shot rule in a lawsuit. North Carolina's Supreme Court ultimately decided the case, *Watkins v. City of Wilson*, in favor of the defendants. The justices wrote: "It is an established principle that to entitle a private individual to invoke the judicial power to determine the validity of executive or legislative action he must show that he has sustained, or is immediately in danger of sustaining, a direct injury as the result of that action and it is not sufficient that he has merely a general interest common to all members of the public." Watkins did not meet that standard, because "even if credited with all

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[89] McKinney, *Greater Freedom*, 21-22 and 54, and Butterfield interview, <http://bit.ly/2RMrziw>, November 29, 2020.

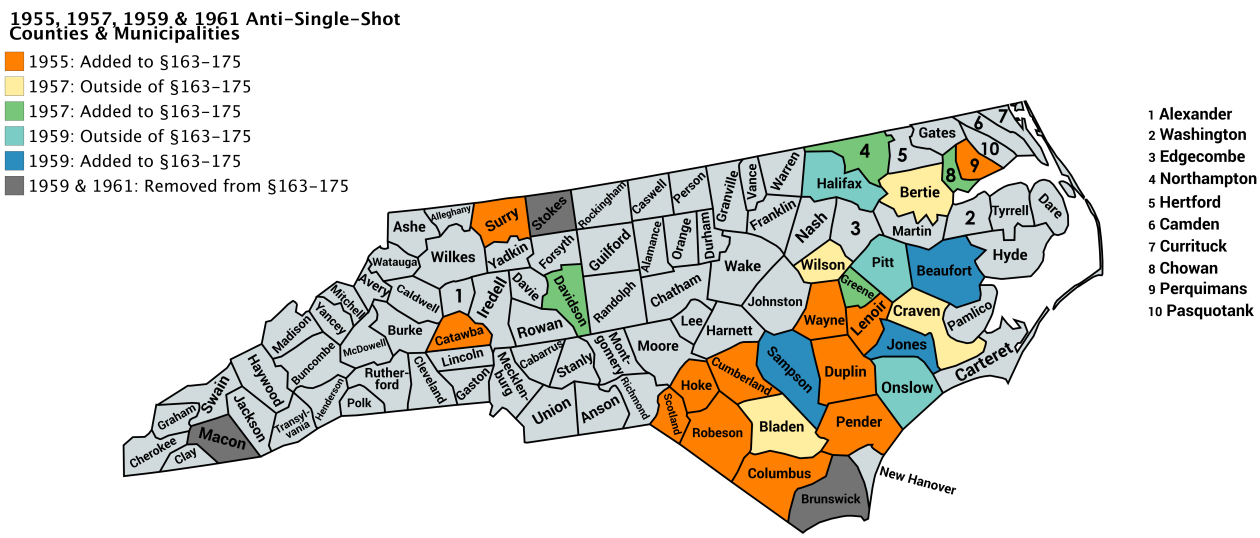
[90] McKinney, *Greater Freedom*, 58-59, and Butterfield interview, < http://bit.ly/2RMrziw>, November 29, 2020.

[91] McKinney, *Greater Freedom*, 91-96, and Butterfield interview, < http://bit.ly/2RMrziw>, November 29, 2020.

[92] *Session Laws and Resolutions, State of North Carolina, Extra Session of 1956, and Regular Session, 1957*, chapt. 13.

rejected ballots, he would not have enough votes to change the [election] result." In 1962, the U.S. Supreme Court declined to review the case on appeal.[93]

Watkin's defeat in court validated the work of white politicians who had been busy restructuring local governments across eastern North Carolina. Between 1955 and 1961, the state legislature approved a flurry of new laws that mandated at-large voting in a shifting mix of elections for county boards of commissioners and town councils in twenty-three eastern counties. In each of those places, lawmakers also prohibited single-shot voting. As a reporter for the *News and Observer* later noted, the purpose of these measures was "to slow the growth of Black political power.[94]



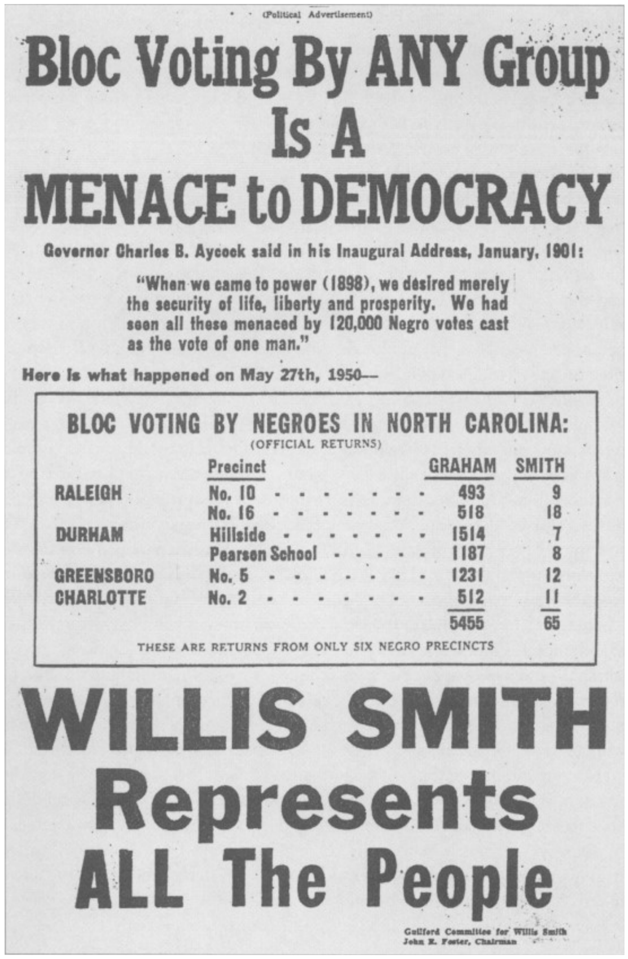
Anti-single shot counties and municipalities, 1955-1961. The western counties were places where Republicans exerted some influence in local government.

With no sense of irony, white politicians defended these measures as protection against the corrupting influence of "bloc" interests, particularly those defined by race. That was a well-worn rationale. For instance, a group of Willis Smith's supporters had charged in 1950 that "bloc voting by any group is a menace to democracy." In an advertisement published in the *News and Observer*, they turned to Charles Aycock – one of the original architects of white supremacy – as their authority on the matter. Looking back on his election as governor in 1900, Aycock had justified his party's use of political violence by pointing to heavily Black counties in the east, where, he claimed, "120,000 Negro votes cast as the vote of one man" threatened the "security of life, liberty, and property."[95]

[93] McKinney, *Greater Freedom*, 96 and 139-44; Butterfield interview, < http://bit.ly/2RMrziw>, November 29, 2020; *Watkins v. City of Wilson*, 121 S.E.2d 861 (N.C. 1961); and *Watkins v. Wilson*, 370 U.S. 46 (1962).

[94] "Failure of Singleshot Ban May Strengthen Black Vote," Raleigh *News and Observer*, January 17, 1972.

[95] Raleigh *News and Observer*, June 20, 1950.


(Political Advertisement)

Bloc Voting By ANY Group Is A MENACE to DEMOCRACY

Governor Charles B. Aycock said in his Inaugural Address, January, 1901:

"When we came to power (1898), we desired merely the security of life, liberty and prosperity. We had seen all these menaced by 120,000 Negro votes cast as the vote of one man."

Here is what happened on May 27th, 1950—

BLOC VOTING BY NEGROES IN NORTH CAROLINA:
(OFFICIAL RETURNS)

	Precinct	GRAHAM	SMITH
RALEIGH	No. 10	493	9
	No. 16	518	18
DURHAM	Hillside	1514	7
	Pearson School	1187	8
GREENSBORO	No. 5	1231	12
CHARLOTTE	No. 2	512	11
		5455	65

THESE ARE RETURNS FROM ONLY SIX NEGRO PRECINCTS

WILLIS SMITH Represents ALL The People

Guilford Committee for Willis Smith
John R. Foster, Chairman

Willis Smith campaign advertisement, Raleigh
News and Observer, June 20, 1950.

The hypocrisy of such historical claims infuriated *Carolina Times* editor Louis Austin. He noted that since the end of slavery, Blacks had found the "biggest 'bloc' of . . . all . . . arrayed against them." It included "leaders of the Ku Klux Klan," politicians who "continuously fanned the flames of race hatred," and the "mass of white voters" who elected them. Together, these enemies of democracy barred Blacks from political office and denied them both "equal education [and] equal employment opportunities." Such actions left Blacks no alternative but to vote their group interests, or as Austin put it, to "look principally to [their] own tents for whatever advancements" might be made.[96]

B. Challenging Jim Crow in Court

The guardians of white rule were shrewd adversaries who displayed their resourcefulness not only at polling places but also in courts of law. That was perhaps nowhere more apparent than in the adjudication of a series of lawsuits brought by James R. Walker Jr., a young Black attorney from eastern North Carolina. Walker grew up in Hertford County, located in the historic Second Congressional District, where Black political strength had been concentrated in the decades after

[96] "The 'Negro Bloc' and the 'Single Shot,'" *Carolina Times*, May 22, 1965.

Emancipation. His parents, James and Ethel, were teachers who instilled in their son a determination to "fight social injustice." After serving in the U.S. Army during World War II, the younger Walker set out to become a civil rights lawyer.[97]

In 1949, Walker applied for admission to the school of law at the University of North Carolina in Chapel Hill but was rejected on account of his race. With no other option, he enrolled at the North Carolina College for Negroes (now North Carolina Central University), where state lawmakers had established a separate and decidedly unequal law school to protect the white university from desegregation. But within a year, the U.S. Supreme Court changed the game. The court ruled in a Texas case, *Sweatt v. Painter*, that racially segregated programs of graduate and professional education were acceptable only if they exhibited "substantive equality." On the basis of that judgment, Walker and four other Black plaintiffs – Harvey Beech, James Lassiter, J. Kenneth Lee, and Floyd McKissick – sued in federal court and won admission to the law school in Chapel Hill. They began their studies during the summer of 1951. Lee and Walker took their degrees a year later and became the University of North Carolina's first Black graduates.[98]

In 1955, Black community leaders in Halifax County persuaded Walker to return to eastern North Carolina and join their struggle for political rights. When he opened his law office in Weldon, he was the only Black attorney in a six-county area where sharecropping still bound Black families to the land and racial violence was a fearsome fact of life. Walker was unafraid. "I was an Army man," he remembered. "Had been to the front. . . . I wasn't scared of nothing."[99]

Walker drew financial and professional support from a small community of Black lawyers in North Carolina's Piedmont cities. He also built a loose network of Black preachers, teachers, businessmen, and club women from twenty-five eastern counties. He called the group the Eastern Council on Community Affairs. Its members gathered news of voter infringement, mobilized to confront hostile white election officials, and helped Walker identify plaintiffs who were prepared to challenge Jim Crow in court.[100]

Walker began filing lawsuits in 1956. In one of his first cases, he sued on his own behalf to challenge the prohibition of single-shot voting in an at-large election for seats on the Halifax County Board of Education. Officials had discarded his ballot because he cast a single vote for the one Black candidate rather than comply with instructions to choose seven of eight contenders.

The case eventually made its way to the North Carolina Supreme Court, where Walker ran afoul of state lawmakers' efforts to stall school desegregation. In 1955, quick on the heels of the U.S. Supreme Court's *Brown* decision, they extended their influence over policy at the local level by making seats on county school boards appointed rather than elected positions. Under the new arrangement, political parties continued to hold primary elections, but the results were no longer binding. County boards of elections reported the winners to the State Superintendent of Public Instruction, who in turn sent their names to the legislature in the form of nominations. Lawmakers then appointed school board members as they saw fit. By time the high court heard Walker's appeal, lawmakers had already exercised their authority to appoint members of the Halifax County

[97] Wertheimer, *Law and Society in the South*, 131-32.
[98] Ibid., chapt. 7, and Nixon, "Integration of UNC-Chapel Hill – Law School First." The following account of Walker's career and legal challenges to Jim Crow election law draws broadly on Wertheimer (above) and Barksdale, "Indigenous Civil Rights Movement."
[99] Wertheimer, *Law and Society in the South*, 142 and 150.
[100] Ibid., 146 and 148.

Board of Education. In light of that fact, the court ruled that "questions raised by plaintiff are now moot" and dismissed Walker's case.[101]

While litigating his personal complaint in Halifax County, Walker filed another lawsuit on behalf of Louise Lassiter, a resident of nearby Northampton County who had been denied the right to register after failing to prove that she was literate. At the time, registrars enjoyed broad authority to administer literacy tests in whatever form they imagined. They often framed the tests as civics exams that reached well beyond a simple assessment of an applicant's ability to read and write. Observers documented a "bewildering variety" of questions. Can you "name the signers of the Declaration of Independence?" a registrar might ask. "What is habeas corpus?" "If the NAACP attacked the U.S. government, on which side would you fight?" "Explain how a person [can] be imprisoned for debt in North Carolina, who created the world, and what 'create' mean[s]." Louise Lassiter failed her test because she mispronounced words from the state constitution, including the term 'indictment.'[102]

Lassiter's case set off alarm bells in Raleigh, where state officials worried that she might prevail in federal court. Her complaint coincided with passage of the Civil Rights Act of 1957, the first national legislation of its kind since Reconstruction. That law established the U.S. Civil Rights Commission to investigate allegations of voter suppression and authorized the Department of Justice to institute civil action against any person who interfered with the right of another "to vote or to vote as he may choose."[103]

Just days before Lassiter's case was scheduled to be heard in U.S. district court, legislators revised state election law to make the literacy test less arbitrary. They struck the requirement that literacy be proven "to the satisfaction" of registrars and created an appeal process for citizens who failed the test – though complaints would be heard only if filed "by 5:00 p.m. on the day following denial." These changes were enough to satisfy the federal court, which declined to proceed with Lassiter's case until she had petitioned for a local remedy.[104]

Soon after the court's decision, Lassiter made another attempt to register. But this time, at Walker's instruction, she refused examination on grounds that the literacy test violated her right to vote. That focused Lassiter's legal complaint on the constitutionality of the test itself rather than the method of its administration. When the case reached the North Carolina Supreme Court, lawyers for the Northampton County Board of Elections argued in circles. They denied that the literacy test was discriminatory on account of race and then defended it as a political necessity adopted to correct the "outrages perpetrated upon the people of this State during the Tragic Era of Reconstruction," when the ballot was "placed in the hands of illiterate people" – that is, former slaves – "supported by the armed might of the Federal Government." Convinced by such reasoning, the

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[101] Eure, *Public School Laws of North Carolina*, 13-14; *Session Laws and Resolutions, State of North Carolina, Extra Session of 1956, and Regular Session, 1957,* chapt. 137; and *Walker v. Moss*, 97 S. E.2d 836 (N.C. 1957).

[102] North Carolina Advisory Committee to the United States Commission on Civil Rights, *Equal Protection of the Laws in North Carolina*, 28 and 33, and Wertheimer, *Law and Society*, 141 and 151.

[103] Public Law 85-315: An Act to Provide Means of Further Securing and Protecting the Civil Rights of Persons Within the Jurisdiction of the United States, 637, <http://bit.ly/2UGEvGA>, September 5, 2019, and Winquist, "Civil Rights: Legislation: The Civil Rights Act of 1957."

[104] *Session Laws and Resolutions, State of North Carolina, Extra Session of 1956, and Regular Session, 1957,* chapt. 287, and *Lassiter v. Taylor*, 152 F. Supp. 295 (E.D.N.C. 1957).

court rejected Lassiter's constitutional claims. It found no evidence of "discrimination in favor, or against any [person] by reason of race, creed, or color."[105]

On appeal in 1959, the U.S. Supreme Court unanimously affirmed that ruling. Writing for the court, Justice William O. Douglas acknowledged that when arbitrary authority was vested in registrars, a literacy requirement could "make racial discrimination easy." But he found no evidence of that intent in North Carolina's election law as amended in 1957. He instead read literacy tests as an expression of the state's desire "to raise the standards for people of all races who cast the ballot." Ignoring the effects of a century of school discrimination in the South and the core reasoning of the 1954 *Brown* decision, Douglas insisted that "literacy and illiteracy are neutral on race, creed, color, and sex, as reports around the world show."[106]

Black certainly had no natural inclination to illiteracy, but the connection between illiteracy and race as a social category and lived experience was undeniable. Had Justice Douglas examined conditions in Northampton County, that harsh reality would have been readily apparent. In 1950, Black adults in the county had completed, on average, 5 years of schooling. That compared to 5.6 years for Black adults and 8.6 years for white adults statewide. These figures meant that a considerable portion of voting-age Blacks, in Northampton County and across the state, had completed fewer than the three years of education that demographers assumed was required to develop basic literacy skills. Jim Crow's shadow remained long and deep.[107]

In 1960, Walker returned to court with a new client. Having failed to win a judgment that the literacy test was unconstitutional per se, he revisited the question of how it was administered. His client, Bertie County resident Nancy Bazemore, had been denied by a registrar who required that she write down passages from the state constitution as he read them aloud. Bazemore failed because of spelling errors. When the case reached the State Supreme Court, the justices ruled in Bazemore's favor and issued guidelines that sharply limited registrars' discretion in determining the form and content of the literacy test. They instructed those officials to evaluate "nothing more" than applicants' ability to "utter aloud" a section of the state constitution and to write it out "in a reasonably legible hand." Furthermore, the test was to be based on a printed copy of the constitution – not dictation – and there were to be no penalties for "the occasional misspelling and mispronouncing of more difficult words."[108]

The *Bazemore* decision represented what many observers came to view as the North Carolina way in managing Black demands for equal rights. It rejected naked discrimination and insisted on "fair and impartial" enforcement of the law, but also left room for sorting citizens into racial categories. Across North Carolina, most whites registered and voted without a literacy test. They "took it for granted" that they were entitled to do so because of the color of their skin. In Nancy Bazemore's home county, one registrar was forthright. When asked if any whites had failed the literacy test, he replied, "No. I mean I didn't have any to try it." Though the State Supreme

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[105] "Defendant Appellee's Brief," *Lassiter v. Northampton Board of Elections*, Supreme Court of North Carolina, fall term 1957, no. 172, Sixth District, quoted in Wertheimer, *Law and Society in the South*, 155, and *Lassiter v. Northampton County Board of Elections*, 102 S.E.2d 853 (N.C. 1958).

[106] *Lassiter v. Northampton County Board of Elections*, 360 U.S. 45 (1959).

[107] North Carolina Advisory Committee to the United States Commission on Civil Rights, *Equal Protection of the Laws in North Carolina*, 144, and Collins and Margo, "Historical Perspectives on Racial Differences in Schooling," <http://bit.ly/2UMbN7e>, September 5, 2019, 4.

[108] *Bazemore v. Bertie County Board of Elections*, 119 S.E.2d 637 (N.C. 1961).

Court did not address this issue directly, it validated the underlying assumption by ruling that there was no legal requirement that every registrant be examined. "It would be unrealistic to say that the test *must* be administered to all applicants," the justices wrote. "The statute only requires that the applicant *have* the ability" to read and write (emphasis in original). "If the registrar in good faith knows that [the] applicant has the requisite ability, no test is necessary."[109]

This reading of state election law suggested that registrars still possessed the authority to group citizens into two classes: whites who were assumed to be literate and Blacks who had to prove it. The law did not require that the literacy test be administered to all citizens on an equal basis, but only that it "be administered, where uncertainty of ability exists, to all alike." That was a notably pernicious doctrine in a white man's society long habituated to the idea that Blacks, by their very nature, lacked the intellectual and moral capacity to function as citizens.[110]

North Carolina's response to Black demands for political rights was adaptive, not reactionary. It stood apart from what became known as "massive resistance" elsewhere in the South. As one contemporary observed, it was a "subtle strategy" for preventing "the Black vote from being effective." White political leaders were willing to tolerate the registration of a limited number of Black voters and even the occasional election of a Black officeholder, but they conceded nothing on the foundational principles of Jim Crow: Black inferiority and second-class citizenship. This was their way of maintaining what Charles Aycock had called "good order" and of warding off federal intervention, an existential threat since the days of slavery.[111]

C. Challenging Jim Crow at School

A willingness to concede change at the margins shaped not only the battle over the ballot box but also the racial contest at the schoolhouse door. In the early 1930s, Black educators, organized through the North Carolina Teachers Association (NCTA), collaborated with the NAACP in a campaign to equalize Black and white teachers' pay. They were emboldened by the New Deal's support for organized labor and the minimum wage standards set by the National Recovery Administration. In October 1933, more than 2500 teachers filled the streets in Raleigh to press their demands. Weeks later, their representatives issued a bold indictment of Jim Crow:

> We are disenfranchised and told to acquire learning and fitness for citizenship. We undertake the preparation in our inadequate, wretchedly equipped schools. Our children drag through the mud while others ride in busses, we pass the courses required by the state and in most places when we present ourselves for registration, we are denied that right and lose our votes. Our teachers, disadvantaged by disenfranchisement, by lack of the means to prepare themselves, nevertheless do meet the high and exacting standards of the best white institutions of the country, and then armed with the state's highest certificate go into the employment of a commonwealth which reduces their wages to the level of janitors and hod carriers.

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109 Ibid.; Wertheimer, *Law and Society*, 161; and North Carolina Advisory Committee to the U.S. Commission on Civil Rights, "Voting and Voter Registration in North Carolina, 1960," 22.

110 *Bazemore v. Bertie County Board of Elections*, 119 S.E.2d 637 (N.C. 1961).

111 Towe, "Barriers to Black Political Participation in North Carolina," 11-12.

The NCTA urged its members to register to vote and to "unite their forces at the polls." "We are informed that it is best for us if we stay out of politics," the Black educators declared, but "we have stayed out and this is what we have."[112]

That effort at political mobilization produced one of the South's earliest lawsuits to challenge the constitutionality of the literacy test. In 1934, two Iredell County teachers, T. E. Allison and Robert W. Dockery, appeared before a white registrar who instructed them to read and write passages from the state constitution. When they were done, he declared his judgment: "You do not satisfy me." Allison and Dockery subsequently sued the registrar and the county and state boards of election.[113]

The North Carolina Supreme Court heard their case on appeal in 1936 and ruled for the defendants. Associate Justice R. Heriot Clarkson – a Confederate veteran and leader of the white supremacy campaigns of 1898 and 1900 – wrote for the court. He affirmed the constitutionality of the literacy test and said of the plaintiffs, they "just do not like the law of their State." Clarkson closed with a history lesson: "It would not be amiss to say that [the] constitutional amendment providing for an educational test . . . brought light out of darkness as to education for all the people of the State. Religious, educational, and material uplift went forward by leaps and bounds. . . . The rich and poor, the white and colored, alike have an equal opportunity for an elementary and high school education."[114]

Given the difficulties of voter registration, the NCTA had limited ability to bring direct pressure to bear on state and local politicians, but its continued agitation of the salary equalization issue, the ongoing involvement of the NAACP, and a growing number of lawsuits filed elsewhere across the South convinced the state legislature in 1939 to allocate $250,000 to raise Black teachers' pay. Still, the average Black teacher earned only three-quarters of what the average white teacher was paid.[115]

The U.S. Court of Appeals for the Fourth Circuit put southern lawmakers on notice in 1940, when it ruled in a Norfolk, Virginia case that racial disparities in teacher pay violated the equal protection clause of the Fourteenth Amendment. A three-judge panel affirmed Black teachers' "civil right . . . to pursue their profession without being subjected to discriminatory legislation on account of race or color." America's entry into World War II then provided the final impetus to close the gap. In 1942, James W. Seabrook, president of both the NCTA and Fayetteville State Teachers College, appealed to white politicians' sense of fair play and their not-so-secret fears for Black loyalty in the war effort. He urged them to "give the Negro confidence that the principles of democracy for which he is being called upon to fight in the four corners of the earth will be applied to him here at home." Two years later, the General Assembly appropriated funds to equalize Black and white teachers' salaries.[116]

[112] Thuesen, *Greater Than Equal*, 142-48.

[113] Ibid., 147.

[114] *Allison v. Sharp*, 184 S.E. 27 (N.C. 1936). On Justice Clarkson, see *Prominent People of North Carolina*, 16-17. In 1896, Clarkson organized one of the state's first "White Supremacy" clubs. Governor Charles Aycock rewarded his political loyalty with an appointment as solicitor of the state's Twelfth Judicial District.

[115] Thuesen, *Greater Than Equal*, 152.

[116] *Alston v. School Board of City of Norfolk*, 112 F.2d 992 (4th Cir. 1940); Douglas, *Reading, Writing, and Race*, 20; and Thuesen, *Greater Than Equal*, 153-55.

During the war years, Black educators' demand for equal pay expanded into a call for equal facilities. Children led the way. In October 1946, more than four hundred students, organized in a local NAACP Youth Council, filled the streets in Lumberton, a small town in southeastern North Carolina. They carried placards that cheered the triumph of democracy in World War II and set that achievement against the wretched condition of Black schools: "inadequate and unhealthy . . . overcrowded . . . and dilapidated." "D-Day," and "V for Victory," the signs exclaimed. "How Can I Learn When I'm Cold?" "It Rains on Me." "Down with Our Schools."[117]

Protests spread across eastern and central North Carolina, accompanied by lawsuits that challenged the constitutionality of unequal school funding. In 1950, plaintiffs in Durham won a breakthrough case in the U.S. District Court for the Middle District of North Carolina. Judge Johnson Jay Hayes ruled that city school officials had a legal obligation to provide "negro school children substantially equal facilities to those furnished white children." He found no "excuse or justification" for failing to meet that standard and ordered an end to discriminatory school spending.[118]

Anyone who read Judge Hayes's ruling closely would have spotted a single sentence that was even more prescient in its implications. "The burdens inherent in segregation," he wrote, "must be met by the state which maintains them." Had Hayes pronounced a death sentence for Jim Crow? In 1951, a group of fifty-five Black parents filed suit in Pamlico County to test that question. They demanded that their children be assigned to white schools unless adequate Black facilities were provided. As historian Sarah Thuesen noted, this was "the first lawsuit filed in the federal courts from North Carolina – and only the second in the South – to raise the possibility of integration." The plaintiffs dropped their complaint when county officials agreed to build a new Black high school, but they had made their point. As the editor of the *Kinston Free Press* noted, "If we want to keep segregation, we must bend over backward to see that facilities are equal."[119]

To that end, state leaders put a $50 million school bond on the ballot in late 1953, as the U.S. Supreme Court prepared to hear final arguments in *Brown v. Board*. One observer noted that many white voters supported the measure in hope that it "might tend to influence" a judgment favorable to the white South. They could not have been more mistaken. On May 17, 1954, the Court ruled that "in the field of public education, the doctrine of 'separate but equal' has no place. Separate educational facilities are inherently unequal. Therefore, we hold that . . . segregation is a denial of the equal protection of the laws." In the aftermath of that decision, state and local officials scrambled once more to invent means of defending the substance, if not the letter, of Jim Crow statutes.[120]

D. *Brown v. Board* and the Pearsall Committees

Two gubernatorial advisory committees, popularly known by the name of their chairman, wealthy eastern landowner and Democratic power-broker Thomas J. Pearsall, set the course for opposition to *Brown*. They worked from the principle "that members of each race prefer to associate with other members of their race *and that they will do so naturally unless they are prodded and inflamed and controlled by outside pressure*."(emphasis in the original).[121] To that end, the

[117] Thuesen, *Greater Than Equal*, 169-70.
[118] *Blue v. Durham Public School District*, 95 F. Supp. 441 (M.D.N.C. 1951).
[119] Thuesen, *Greater Than Equal*, 191.
[120] Ibid., 200, and *Brown v. Board of Education of Topeka*, 347 U.S. 483 (1954).
[121] Leloudis and Korstad, *Fragile Democracy*, 63.

committees proposed "the building of a new school system on a new foundation – a foundation of no racial segregation by law, but assignment according to natural racial preferences and the administrative determination of what is best for the child."[122]

The first Pearsall committee recommended that the state cede authority over school assignments to local districts. That proposal informed the Pupil Assignment Act of 1955, passed in the same legislative session as the prohibition of single-shot voting. Lawmakers removed references to race from state school assignment policy and gave parents "freedom of choice" in selecting the schools their children would attend. But there was a catch. The law required that Black parents petition individually to have their children assigned to white schools. Doing so demanded great courage. Parents faced the prospect of retribution by angry employers and landlords, and they had to accept the risk that their children might stand alone to face white resistance. The law also gave local school boards broad discretionary authority in ruling on parents' requests. They could reject an application if they believed that it did not serve a child's "best interests," or that it would compromise "proper administration," "proper instruction," or "health and safety" in a target school.[123]

A year later, the second Pearsall committee proposed an amendment to the state constitution that would authorize the legislature to provide private school vouchers for "any child assigned against the wishes of his parents to a school in which the races are mixed." Local school boards would also be permitted to call for public referenda to close schools in case of "enforced mixing of the races." The committee presented the amendment as a balm for racial conflict stirred up by outsiders, most notably the NAACP and the federal courts. They looked forward to a day "when sanity returns," and to re-establishment of "the harmonious relations which the races have enjoyed in North Carolina for more than fifty years" – that is, from the time of white redemption and Black disenfranchisement. In September 1956, voters approved the amendment by a margin of more than four to one. Though no schools were ever closed and only one private school voucher was issued, the amendment effectively undermined any notion that desegregation might be achieved more quickly.[124]

These policies won North Carolina praise as a "moderate" southern state but produced one of the lowest desegregation rates in the region. At the beginning of the 1958-59 school year, only ten of the state's roughly 322,000 Black students were enrolled in formerly white schools. That result impressed officials in Little Rock, Arkansas, where in 1957 white resistance to desegregation had prompted President Dwight Eisenhower to use federal troops to restore order. They complimented their North Carolina colleagues: "You . . . have devised one of the cleverest techniques of perpetuating segregation that we have seen. . . . If we could be half as successful as you have been, we could keep this thing to a minimum for the next fifty years."[125]

The Little Rock admirer put his finger on a lesson that is as true today as it was in the 1950s. White supremacy, often violent and inflexible, can also be subtle and adaptive. A tobacco

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[122] *Report of the North Carolina Advisory Committee on Education, April 5, 1956,* 7 and 9, <http://bit.ly/2LTNQXw>, September 5, 2019.

[123] *Session Laws and Resolutions, 1955*, chapt. 366, 310.

[124] *Report of the North Carolina Advisory Committee on Education, April 6, 1956,* 8-10; Wettach, "North Carolina School Legislation, 1956," 7; and Batchelor, *Race and Education in North Carolina*, 108-9. The U.S. District Court for the Western District of North Carolina struck down the voucher plan in 1966. See Batchelor, 110.

[125] Batchelor, *Race and Education in North Carolina*, 73, and Chafe, *Civilities and Civil Rights*, 97 and 106.

worker from eastern North Carolina said it best: "My experience . . . is that if you beat the white man at one trick, he will try another."[126]

E. Stalled Revolution

When most Americans think about the history of civil rights, they tend to view the past through a rearview mirror. They see a series of struggles that led inevitably to the demise of Jim Crow in the mid-1960s. But for an observer on the ground at the beginning of that decade, the future seemed far less certain. The U.S. Supreme Court had effectively embraced the North Carolina way. In *Lassiter v. Northampton County Board of Elections*, the court affirmed the constitutionality of the literacy test, and in *Brown II*, its ruling on the enforcement of school desegregation, the court embraced the go-slow approach proposed in an amicus curiae brief filed by North Carolina's attorney general.

North Carolina State Assistant Attorney General I. Beverly Lake Sr. drafted the brief and presented it along with oral arguments in April 1955. He urged the court to "allow the greatest possible latitude to . . . District Judges in drafting final [desegregation] decrees." It stood to reason, he explained, that "only a court conversant with local conditions and granted wide discretion [could] tailor [a] decree to fit the local variations." Lake also offered a dire warning against any "attempt to compel the intermixture of the races." Such action would result in "violent opposition" and place the public schools in "grave danger of destruction." In its ruling in *Brown II*, the high Court heeded Lake's advice. The Justices left it to lower courts to determine the pace and process of desegregation, guided by "their proximity to local conditions" and understanding of the need for "practical flexibility in shaping remedies." That was the essence of *Brown II*'s vague directive that desegregation proceed "with all deliberate speed."[127]

Congress was even less inclined to effect sweeping change, thanks in significant measure to the outsized influence wielded by southern lawmakers. In the decades after Black disenfranchisement, national leaders ignored Section 2 of the Fourteenth Amendment, which requires a reduction in representation for states that deny voting rights on the basis of race. Political scientist Richard Valelly estimates that had Section 2 been enforced, the Jim Crow South would have lost as many as twenty-five seats in the U.S. House of Representatives between 1903 and 1953. But the disenfranchisers never paid that penalty; instead, they expanded their influence in national politics. "That itself," Valelly writes, "was a major if silent constitutional change, a tacit, extraconstitutional [revision] of the Fourteenth Amendment."[128]

The denial of Black voting rights and the systematic suppression of two-party politics in the South also limited dissent and ensured that Democratic incumbents in Congress would be reelected term after term. Over time, southern politicians accrued seniority and gained control of key committees in both the House of Representatives and the Senate. Their power was obvious in contests over civil rights issues, but much of it was otherwise out of view. As the chairmen of committees charged with administrative oversight, they permitted unchecked racial discrimination by government agencies, from the Federal Housing Administration's use of red lining to enforce

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[126] Korstad, *Civil Rights Unionism*, 384.
[127] Brief of Harry McMullen, Attorney General of North Carolina, Amicus Curiae, 3 and 6, <http://bit.ly/36PHJfd>, November 29, 2020, and *Brown v. Board of Education of Topeka*, 347 U.S. 483 (1954).
[128] Valelly, *Two Reconstructions*, 146-47.

racial segregation in America's cities and suburbs to the Veterans Administration's biased allocation of resources under the G.I. Bill and the U.S. Department of Agriculture's denial of subsidized loans and other resources to Black farmers. Examples abound. In every instance, willful neglect helped to entrench Jim Crow not only in the life of the South, but in that of the nation as well.[129]

X. Civil Rights at Last

A. Sit-Ins and Direct Action

By the late 1950s, most white southerners understood that the world they had built over the last half century would not last forever, but they were determined to preserve it as long as they could. They had reason to be confident and optimistic. The *Brown* decision had not integrated public schools, Martin Luther King Jr.'s Montgomery movement had accomplished little more than the desegregation of city buses, and despite increases in voter registration, Black political power was still negligible. On top of that, most whites outside the South were content with the racial status quo.

Then a civil insurrection broke out. The uprising drew strength from Black moral anger and frustration with white recalcitrance, and it was given form and direction by years of preparation and social learning in Black communities across the South. Clear in hindsight, but less so at the time, the signal event took place on February 1, 1960, when four students at the Agricultural and Technical College of North Carolina – Ezell Blair Jr., David Richmond, Franklin McCain, and Joseph McNeil – demanded service at a Woolworth's lunch counter in Greensboro. Sit-ins quickly spread across the state and throughout the South. Two months later, college students, Black and white, gathered at Shaw University in Raleigh – North Carolina's oldest Black institution of higher learning – to organize the Student Nonviolent Coordinating Committee (SNCC).[130]

Inspired by North Carolina native and Shaw graduate Ella Baker, SNCC embraced a grassroots strategy for mobilizing ordinary citizens as leaders in the struggle for civil rights. Volunteers from every corner of the nation fanned out across the South to register voters, to build alternative schools for Black children, and to press for the desegregation of public facilities. Other civil rights organizations – including King's Southern Christian Leadership Conference, the Congress on Racial Equality (CORE), and the NAACP – adopted similar strategies of direct action. What these groups set in motion was a second Reconstruction in which Black people reached up not to receive but to seize their freedom.[131]

In the years between 1960 and 1965, Black protests forced issues of race and democracy to the center of national attention. As in the first Reconstruction, whites responded with state-sanctioned and extra-legal violence, which were not always distinguishable. The stories that filled columns of newsprint and the images that flooded television screens have become iconic: the firebombing and brutal beating of Freedom Riders; the assassination of Medgar Evers; the death of four little girls in the Klan bombing of the Sixteenth Street Baptist Church in Birmingham; the exhumation of the bodies of James Chaney, Andrew Goodman, and Michael Schwerner, CORE organizers murdered by Klansmen and law offers in Neshoba County, Mississippi; and the police attack on protestors attempting to cross Selma's Edmund Pettis Bridge. These and other outrages

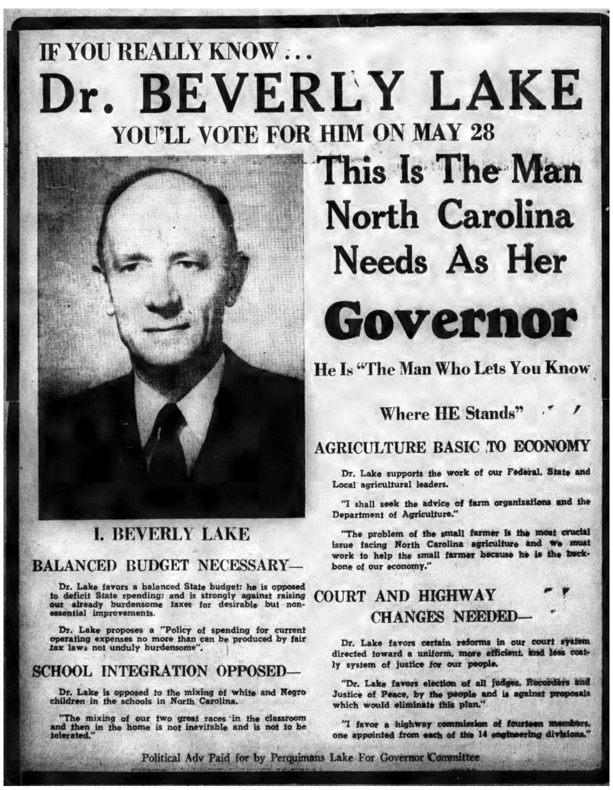
[129] Ibid. See also Katznelson, *When Affirmative Action Was White*, and Daniel, *Dispossession.*
[130] Chafe, *Civilities and Civil Rights*, 98-141.
[131] Hogan, *Many Minds One Heart*.

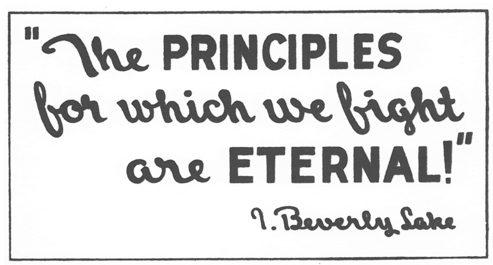
ultimately swayed public opinion and shamed majorities in Congress to pass the landmark Civil Rights Act of 1964 and the Voting Rights Act of 1965.

B. A Second Emancipation

Each state has its own history of dealing with the moral and civic crisis brought on by the mass mobilization for democratic rights and equal citizenship. Though it had the largest Klan organization in the South, North Carolina did not experience the widespread violence that beset the Deep South. In large part, that was because of a critical gubernatorial election in 1960, won by moderate Democrat Terry Sanford. Throughout his administration, Sanford, a protégé of Frank Graham, preached a message of opportunity for all and used the police power of the state to surveil and restrain the Klan.[132]

Sanford won the Democratic gubernatorial nomination in a bitter primary contest with former Assistant Attorney General I. Beverly Lake Sr., a respected jurist who had taught law at Wake Forest College and was widely admired for his defense of Jim Crow. After his appearance before the U.S. Supreme Court in *Brown II*, Lake had proposed an amendment to the state constitution that would have made desegregation a moot issue by removing the Reconstruction-era mandate for publicly funded schools. In his campaign for governor, Lake assured supporters that "The PRINCIPLES for which we fight are ETERNAL!"[133]





"The mixing of our two great races in the classroom and then in the home is not inevitable and is not to be tolerated."

I. Beverly Lake campaign ad, *Perquimans Weekly*, May 27, 1960, and campaign card. Courtesy of the North Carolina Collection, Wilson Library, University of North Carolina at Chapel Hill.

[132] Covington, *Terry Sanford*, 342-43. Klan membership in North Carolina exceeded that of Alabama and Mississippi combined. See Cunningham, *Klansville, U.S.A.*

[133] "N.C. Bar Association Award Carries Legacy of Explicit Racism," Raleigh *News and Observer*, June 28, 2016.

Sanford was a different breed of politician. He belonged to the generation who had fought in World War II and had seen horrifying reflections of American racism in German concentration camps and in the concepts of common blood and ethnic nationalism that shaped Japan's imperial project in Asia. Veterans like Sanford came home full of confidence in their ability to make the world a better place, and they were convinced that the South had to change – as a matter of what was just and right, and as an economic imperative if the region was to lift itself out of the misery that had long defined it as the most impoverished section of the nation.[134]

When Lake challenged his allegiance to Jim Crow, Sanford refused to be race baited. He pivoted to the "bright look of the future" and invited voters to join him in building for a "New Day" in North Carolina. That required improving public schools, not excising them from the state constitution. "We are going to continue to go forward," Sanford declared, "to give our children a better chance, to build a better state through better schools." That appeal was persuasive and reassuring. Sanford bested Lake and went on to win the general election.[135]

Soon after taking office, Sanford embarked on a tour of schools across the state. When he visited students – particularly at Black schools – he began to question his faith in education as a corrective for the damage wrought by Jim Crow. "I had a sickening feeling," he later recalled, "that I was talking about opportunities that I knew, and I feared [the children] knew, didn't exist, no matter how hard they might work in school." The "improvement of schools wasn't enough," he concluded. "Not nearly enough."[136]

By his own account, the governor was learning hard lessons – from school-aged children and from their older siblings who filled the streets with urgent demands for equal rights. He began to comprehend the connections between poverty and racial injustice that tobacco workers in Winston-Salem had exposed in the 1940s, that the biracial Fusion alliance had grasped during the 1890s, and that Black and white Republicans had identified as a central concern of Reconstruction. "We must move forward as one people or we will not move forward at all," Sanford told Black college students in Greensboro. "We cannot move forward as whites or Negroes . . . We can only move forward as North Carolinians."[137]

Sanford's words were a direct refutation of the foundational principle of Jim Crow, which Charles Aycock had explained in 1901 to an audience at the Negro State Fair in Raleigh. "It is absolutely necessary that each race should remain distinct," he said, "and have a society of its own. . . . The law which separates you from the white people of the State . . . always has been and always will be inexorable."[138]

In the winter of 1962-63, as the nation marked the centenary of Abraham Lincoln's Emancipation Proclamation, Sanford shared a "bold dream for the future." He startled white educators at a meeting in Dallas, Texas when he declared, "We need our own . . . emancipation proclamation which will set us free to grow and build, set us free . . . from hate, from demagoguery." Back home, he urged members of the North Carolina Press Association to join him in a campaign to make good on the unfulfilled promise of freedom and equality. "We can do this," Sanford declared.

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[134] See Covington, *Terry Sanford*, chapt. 5.
[135] Drescher, *Triumph of Good Will*, 67, 171, and 175.
[136] Manuscript containing notes for an abandoned book on Terry Sanford's term as governor, subseries 3.1, box 174, Records and Papers of Terry Sanford.
[137] "Fraternity's Award Goes to Sanford," *Greensboro Daily News*, April 28, 1963.
[138] "A Message to the Negro," in Connor and Poe, eds., *Life and Speeches of Charles Brantley Aycock*, 249-50.

"We should do this. We will do it because we are concerned with the problems and the welfare of our neighbors. We will do it because our economy cannot afford to have so many people fully and partially unproductive. We will do it because it is honest and fair for us to give all men and women their best chance in life."[139]

As he spoke to the journalists, and through them the citizens of North Carolina, Sanford must have been mindful of another southern governor who had been in the headlines just days before. In his inaugural address, delivered from the steps of the state capitol in Montgomery, Alabama, George C. Wallace exclaimed, "Segregation now, segregation tomorrow, segregation forever."[140]

C. Lifting the Economic Burden of Jim Crow

Six months later, Sanford called on his friends in the press once again, this time to publicize the launch the North Carolina Fund, a non-governmental organization that would use private resources – from the Ford Foundation and North Carolina's own Z. Smith Reynolds and Mary Reynolds Babcock Foundations – to attack the state's "poverty-segregation complex." That plan was audacious. Nearly 40 percent of North Carolinians lived below the poverty line, and in eastern counties where slavery and later sharecropping dominated the economy, Black poverty was so deep and pervasive that outsiders referred to the region as "North Carolina's 'little Mississippi.'" As the Fund took on this challenge, it became a model for the national war on poverty, which President Lyndon Johnson and Congress launched with the Economic Opportunity Act of 1964, the establishment of Medicare and Medicaid in 1965, and the expansion of multiple programs that sought to educate, feed, clothe, and house the poor. In subsequent years, the Fund was an important conduit for millions of dollars in federal aid that flowed into North Carolina.[141]

From the beginning, the Fund modeled a future built on equal citizenship. Its staff and board of directors were remarkable for the number of women and Blacks who served in leadership roles, and its headquarters was located in Durham's Black business district, an intentional sign of the organization's guiding principles. The Fund also adopted the direct-action techniques of the civil rights movement. Its community partners led boycotts of businesses that refused to hire Black workers, staged rent strikes to demand that landlords repair sub-standard housing, registered voters, and taught poor people how to pressure politicians and government officials for a fair share of social provision: more and better public housing; job training; paved streets, clean water, and sewer lines for neighborhoods that had been denied those services on account of race; and low-interest mortgages and community development grants from the U.S. Department of Agriculture and other federal agencies.[142]

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[139] Address to the Commission on Secondary Schools of the Southern Association of Colleges and Schools, Dallas, Texas, November 28, 1962, in Mitchell, ed., *Messages, Addresses, and Public Papers of Terry Sanford*, 302; "Observations for a Second Century," subseries 3.1, box 174, Records and Papers of Terry Sanford; and film of Sanford's address to the North Carolina Press Association, series 6.2, VT3531/1a, Terry Sanford Papers.

[140] On Wallace's gubernatorial inauguration, see Carter, *Politics of Rage*, 104-9.

[141] Untitled document on the Choanoke Area Development Association, series 4.11, folder 4825, North Carolina Fund Papers, and John Salter to Jim Dombrowski, April 28, 1964, folder 22, Gray (Salter) Papers. On conditions of poverty in North Carolina and the North Carolina Fund's relationship to the national war on poverty, see Korstad and Leloudis, *To Right These Wrongs*, 57-59, and 115-19.

[142] For a detailed account of the North Carolina Fund's antipoverty work, see Korstad and Leloudis, *To Right These Wrongs*, chapts. 3-5.

Through these efforts, the Fund attempted to create an interracial movement of the poor, but it had only limited success. By time the organization closed its doors in 1968, national politics had begun to take a sharp conservative turn. For many whites, civil rights victories amplified Jim Crow dogma, which insisted that Blacks could advance only at white expense.

Fund staff often pointed to the resurgence of the Ku Klux Klan in North Carolina as evidence of that tragic worldview. For more than half a century, Jim Crow had all but quashed the possibility of interracial cooperation and one-party government had denied poor and working-class whites a say in politics. Similarly, fierce antiunionism, defended by lawmakers and employers as a means of protecting white jobs, left working-class whites without a collective voice. Throughout the 20th century, North Carolina was one of the least unionized states in the nation and ranked near the bottom for manufacturing wages. These circumstances, in ways that echoed the past, made it easy for firebrands to channel economic grievances into racial animosity.[143]

D. Rise of a New Republican Party

The North Carolina Fund – and more particularly, the challenge it posed to the economic and political structures of Jim Crow – became the social irritant around which a new conservative movement took shape. Republican Congressman James C. Gardner, who represented eastern North Carolina's Fourth District, pointed the way. His election in 1966 marked the beginning of a party realignment that over the next two decades profoundly altered the state's political landscape.

In the summer of 1967, Gardner launched a public assault on the North Carolina Fund. He charged that it had become "a political action machine" and called for an investigation of its "meddling in the affairs of local communities." Gardner also played on racial fears that dated back to the era of Reconstruction and the white supremacy politics of the late 1890s. In a press release, he shared reports from eastern North Carolina that Fund staff were promoting "'revolutionary . . . attitudes'" by speaking openly of the need for a "coalition . . . between poor whites and Negroes to give political power to the disadvantaged."[144]

A subsequent audit by federal authorities cleared the Fund of any wrongdoing, but Gardner had achieved his purpose. He positioned himself on the national stage as a leading critic of social welfare programs, and he made the war on poverty and its connections to Black political participation a wedge issue that could draw disaffected white Democrats into an insurgent Republican movement.

Republican Party elders in North Carolina recognized the promise of Gardner's leadership and the shrewdness of his strategy. They had named him party chairman a year before his congressional bid. Sim A. DeLapp, the party's general counsel and himself a former chairman, wrote to encourage Gardner. "From the standpoint of voter sentiment," he advised, "we are in the best shape that we have ever been [in] during my lifetime. People are permanently angry at the so-called Democratic Party. . . . They are mad because [Lyndon] Johnson has become the President of the negro race and of all the left wingers." I. Beverly Lake Sr., who was now a Justice on the North Carolina Supreme Court, expressed the depth of white anger. "The apostles of appeasement . . .

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143 See Salter, "The Economically Deprived Southern White," box 2, folder 7, Gray (Salter) Papers. David Cunningham makes a similar argument in *Klansville, U.S.A*.

144 Gardner press release, July 25, 1967, series 1.2.2, folder 318, North Carolina Fund Records. For more on Gardner's criticisms of the Fund, see Korstad and Leloudis, *To Right These Wrongs*, 290-306.

must be removed from positions of public trust," he advised Gardner. "We must clean up the whole foul mess and fumigate the premises."[145]

In 1968, Republican presidential candidate Richard Nixon tapped this racial animosity to flip the once solidly Democratic South. He secured an endorsement from Strom Thurmond, U.S. Senator from South Carolina, who had led the 1948 Dixiecrat revolt in defense of states' rights and had left the Democratic Party in 1964 to become a Republican. Nixon also cast his campaign in racially coded language. He offered himself as a spokesman for the "great majority of Americans, the forgotten Americans, the non-shouters, the non-demonstrators" who played by the rules, worked hard, saved, and paid their taxes. This strategy won Nixon the keys to the White House and marked the beginning of the Republican Party's new reliance on the white South as a base of support.[146]

Four years later, Nixon made a clean sweep of the region by winning the states that third-party segregationist candidate George Wallace carried in 1968: Alabama, Arkansas, Georgia, Louisiana, and Mississippi. This was the "white uprising" predicted by one of Congressman Gardner's constituents. Like her, most of the white voters who turned out for Nixon in North Carolina were still registered as Democrats, but they elected James E. Holshouser Jr. governor – the first Republican to win the office since Fusion candidate Daniel Russell in 1896 – and sent Jesse Helms to the U.S. Senate. Helms, who served for six terms, quickly rose to prominence as a national leader of what came to be called the New Right.[147]

E. Conservative Democrats Hold the Line on Black Voting Rights

Conservatives in the state Democratic Party held on through the 1970s and fought a rear-guard battle against civil rights advocates who used the courts to challenge suppression of the Black vote. In late 1965, the U.S. District Court for the Middle District of North Carolina ruled that the system for apportioning seats in both houses of the state legislature on the basis of geography rather than population violated the principle of "one man, one vote." That standard, derived from the Fourteenth Amendment's equal protection clause, holds that all votes cast in an election should carry roughly equal weight.[148]

The state constitution guaranteed each of North Carolina's one hundred counties a seat in the state House of Representatives. That privileged small rural counties, where whites were most firmly in control, and diluted Black votes in urban areas. The largest legislative district had nearly twenty times more residents than the smallest. That meant that a majority in the House "could be assembled from members who represented only 27.09 percent of the state's population." The state Senate was apportioned more evenly. The constitution required that Senate districts contain equal populations, though a separate provision that no county was to be divided created some imbalance. The largest Senate districts had nearly three times more residents than the smallest. The court

[145] DeLapp to James Gardner, September 1, 1965, box 9, DeLapp Papers, and Lake to Gardner, August 5, 1967, box 23, Gardner Papers.

[146] Perlstein, *Nixonland*, 283-85, and Nixon, Nomination Acceptance Address, August 8, 1968, <http://bit.ly/2HPCoel>, September 5, 2019.

[147] Quotation from Doris Overman to Gardner, undated, box 14, Gardner Papers.

[148] *Drum v. Seawell*, 249 F. Supp. 877 (M.D.N.C. 1965).

ordered that both chambers be redistricted immediately, and that the populations of the largest new districts not exceed those of the smallest by more than a factor of 1.3.[149]

Lawmakers convened in special session in 1966 to draw new district maps. They reduced population ratios as directed by the court but did so by creating a large number of multimember districts – fifteen of thirty-three in the Senate, which previously had thirty-six districts, eleven of which were multimember; and forty-one of forty-nine in the House, which previously had one hundred districts, twelve of which were multimember. Initially, seats in all of the multimember districts were to be filled through at-large elections. This was a familiar means of disadvantaging Black candidates. Lawmakers had used it effectively in the 1950s when they changed county and municipal governments from ward to at-large systems of representation.[150]

In 1967, lawmakers did two things that further walled off the General Assembly. First, they approved a constitutional amendment, ratified by voters in the next election, that required that counties be kept whole in the creation of state House as well as Senate districts. This effectively made multimember districts a permanent feature of legislative apportionment, since it was mathematically difficult to base house and senate seats on equal measures of population without resorting to such a solution.[151]

Second, lawmakers added a numbered-seat plan in twenty of the forty-one multimember House districts and three of the fifteen multimember districts in the Senate. Taken together, these districts covered nearly all of the heavily Black counties in the eastern section of the state. The apportionment law directed that in multimember districts each seat would be treated as a separate office. When citizens went to the polls, they would no longer vote for a set number of candidates out of a larger field of contenders – for instance, three out of five. Instead, their ballots would list separate races within the district, and they would vote for only one candidate in each race.[152] This enabled election officials to place individual minority candidates in direct, one-to-one competition with the strongest white candidates.

Proponents explained that the numbered-seat scheme was designed to "cure the problem of 'single-shot' voting," which was still legal in legislative elections. With conservative Democrats' critique of Black bloc voting clearly in mind, one lawmaker explained that in a numbered-seat election, "you are running against a man and not a group." Another added that numbered seats all but guaranteed "that no Negro could be elected to the General Assembly." The numbered-seat plan was, indeed, so effective that in 1971 the General Assembly had only two Black members: Henry E. Frye, a lawyer from Guilford County, who was elected to his first term in 1968 through a single-shot campaign, and Joy J. Johnson, a minister from Robeson County, who ran in one of the few eastern districts without numbered seats. Frye was the first Black lawmaker to serve in the General Assembly since 1898.[153]

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[149] Ibid., and O'Connor, "Reapportionment and Redistricting," 32-33.

[150] *Session Laws and Resolutions, State of North Carolina, Extra Session, 1966*, chaps. 1 and 5, and *Session Laws of the State of North Carolina, Regular Session, 1965*, 9–11.

[151] *Session Laws and Resolutions, State of North Carolina, Regular Session, 1967*, chap. 640.

[152] Ibid., chap. 106.

[153] "Seat Numbering Bill Produced Hot Debate," Raleigh *News and Observer*, July 8, 1967; "Senate Endorses 'Numbered Seats,'" Raleigh *News and Observer*, July 30, 1967; "Numbered Seat Bill Advances," Raleigh *News and Observer*, June 22, 1967; "Numbered Seats Measure Given House Approval," Raleigh *News and Observer*, June 13,

Conservative Democrats attempted to expand the scope of the numbered-seat plan in 1971. They reapportioned the state House to have forty-five districts. Thirty-five were multimember, and of those, twenty-three had numbered seats. In the Senate, there were twenty-seven districts. Eighteen were multimember, and within that group, eleven districts had numbered seats. Had these changes been implemented, the numbered-seat plan would have covered all North Carolina counties with populations that were 30 percent or more Black. But the U.S. Department of Justice blocked the move. It did so under authority of section 5 of the Voting Rights Act, which stipulated that in affected jurisdictions, changes to voting and representation had to be precleared by either the U.S. Attorney General or the U.S. District Court for the District of Columbia to ensure that they would not discriminate against protected minorities. In 1972, the U.S. District Court for the Middle District of North Carolina affirmed the Justice Department's decision. Ruling in *Dunston v. Scott*, the court struck down both the numbered-seat plan and the anti-single-shot laws that regulated elections in certain counties and municipalities. A three-judge panel concluded that "selective and arbitrary application" of both provisions "in some districts and not in others, denies to the voters of North Carolina the equal protection of the laws and is unconstitutional."[154]

Though not a basis for their decision, the judges also suggested that the single-shot prohibition violated the U.S. Constitution by constraining voters' choice in use of the ballot. They wrote, "We are inclined to believe that the right to vote includes the right of the voter to refuse to vote for someone he does not know, may not agree with, or may believe to be a fool, and under the Fourteenth and Fifteenth Amendments, we doubt that the state may constitutionally compel a voter to vote for a candidate of another race or political philosophy in order to get his vote counted."[155]

In subsequent elections, Black representation in the General Assembly grew from two members in 1970 to a high of six in both 1974 and 1976. The number then fell back to five in 1978 and to four in 1980. Numbered seats or not, Black candidates were still hard-pressed to win in multimember districts.[156]

XI. Judicial Intervention and Battles Over a More Inclusive Democracy

A. *Gingles* v. *Edmisten* and Black Electoral Gains

In 1981, four Black voters filed suit in *Gingles* v. *Edmisten* to challenge the legislative redistricting plan that the General Assembly had crafted after the 1980 Census and the 1968 constitutional provision that counties not be divided when apportioning state House and Senate seats. Lawmakers had not submitted the plan or the amendment for preclearance by the U.S. Department of Justice; when they did so after the plaintiffs' filing, both were denied approval.[157]

1967; Towe, *Barriers to Black Political Participation*, 28; *National Roster of Black Elected Officials*; "The Negro Vote," *Greensboro Daily News*, November 11, 1968; and "Failure of Singleshot Ban May Strengthen Black Vote," Raleigh *News and Observer*, January 17, 1972.

[154] *Session Laws and Resolutions, State of North Carolina, Regular Session, 1971*, chaps. 483, 1177, 1234, and 1237; Towe, *Barriers to Black Political Participation*, 61–62; Manderson, "Review of the Patterns and Practices of Racial Discrimination," 31; Watson, "North Carolina Redistricting Process, 1965–1966," 8; and *Dunston v. Scott*, 336 F. Supp. 206 (E.D.N.C. 1972).

[155] *Dunston v. Scott*, 336 F. Supp. 206 (E.D.N.C. 1972).

[156] "North Carolina African-American Legislators, 1969–2019," < http://bit.ly/38KWF0u>, November 29, 2020.

[157] Keech and Sistrom, "Implementation of the Voting Rights Act in North Carolina," 14.

Lawmakers reacted quickly by drafting a new plan that included five majority-Black House districts and one majority-Black Senate district. The creation of those districts aided the election of eight new Black members of the House, raising the total from three to eleven. As the court later noted, however, the legislature's change of heart was in some measure cynical. "The pendency of this very legislation," the court observed, "worked a one-time advantage for Black candidates in the form of unusual organized political support by white leaders concerned to forestall single-member districting." The U.S. District Court for the Eastern District of North Carolina ruled for the plaintiffs in April 1984. Acting in an extra session, the General Assembly subsequently divided a number of multimember districts into new single-member districts that improved the prospects of Black candidates. In November balloting, two additional Black lawmakers were elected to the General Assembly, bringing the total to thirteen.[158]

By 1989, nineteen Black lawmakers served in the General Assembly, more than were elected during either Reconstruction or the Fusion era. Two years later, members elected state Representative Dan Blue Speaker of the House, at that time the highest state office held by a Black politician in North Carolina. Blacks also made substantial gains at the local level, largely as a result of legal challenges to at-large elections and multimember districts that followed the *Gingles* decision. At the end of the decade, more than four hundred Black elected officials served in county and municipal governments across the state.[159]

Growing Black political influence was also evident in 1991, when the General Assembly redrew North Carolina's congressional districts on the basis of the 1990 census. Under pressure from the U.S. Department of Justice and Black leaders in the Democratic Party, legislators created two districts with slim Black majorities. They explained that had they not done so, the state would have been vulnerable to legal challenge for violating the Voting Rights Act of 1965. The issue was dilution of the Black vote. In most parts of the state, the geographical scope of congressional districts submerged Black voters in sizable white majorities. Statewide, whites also had a long, well-documented history of refusing to support Black candidates. As a result, it was difficult for Black voters to make their voices heard in federal elections. To remedy this marginalization, lawmakers created a new First Congressional District in the heavily Black northeastern corner of the state and a new Twelfth District that snaked along a narrow, 160-mile path from Durham to Charlotte. In 1992, voters in these districts elected Eva Clayton and Mel Watt, the first Black North Carolinians to serve in the U.S. House of Representatives since George Henry White, who ended his second term in 1901.[160]

B. Jesse Helms and Racial Polarization

By the mid-1980s, North Carolina once again had a tightly contested two-party political system. A visitor from a similar time a century before would have been confounded by the way that party labels had flipped. Democrats now resembled the party of Lincoln, and Republicans looked like Democrats of old. But the visitor would easily have recognized the competing social visions the parties offered voters. One party stressed the importance of balancing individual rights

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[158] Ibid., 13-14, and *Gingles v. Edmisten*, 590 F. Supp. 345 (1984).

[159] Earls, Wynes, and Quatrucci, "Voting Rights in North Carolina," 581; "Two Blacks Join N.C.'s U.S. House Delegation," Raleigh *News and Observer*, November 4, 1992; and Keech and Sistrom, "Implementation of the Voting Rights Act in North Carolina," 14–17.

[160] Kousser, *Colorblind Injustice*, 243–76.

against social responsibility, contended that government had an indispensable role to play in promoting the general welfare, and viewed the prerogatives of citizenship as the birthright of every American. The other party was wary of government infringement on personal choice and thought of equal citizenship as a privilege to be earned rather than an entitlement. In a society that for most of its history had stood on a foundation of slavery and Jim Crow, contests over these competing ideals were centered, more often than not, on the question of racial equality. Conservatives – whatever their party label – took a narrow view on that issue, partly out of racial animus but also because they understood that Black enfranchisement led to progressive social policies.

This was at no time more obvious than in 1984 and 1990, when U.S. Senator Jesse Helms faced two Democratic challengers: Governor James B. (Jim) Hunt Jr. in the first contest, and, in the second, former Charlotte mayor Harvey B. Gantt.

After his first-term election in 1972, Helms had quickly established himself as a leading spokesman of the new Republican Party that was ascendant in North Carolina and across the nation. He did so by holding true to what I. Beverly Lake Sr. had described as the "eternal principles" of white southern conservatism. Helms championed individualism and free enterprise; he opposed labor unions and attributed inequality to the values and behaviors of people who lived on society's margins; and he characterized social welfare programs as instruments of theft that rewarded the takers rather than the makers of wealth. "A lot of human beings have been born bums," Helms famously declared at the height of the civil rights movement and war on poverty. "Most of them – until fairly recently – were kept from behaving like bums because work was necessary for all who wished to eat. The more we remove penalties for being a bum, the more bumism is going to blossom."[161]

Helms had a talent for capturing the anger of white Americans who felt aggrieved by their fellow citizens' demands for rights and respect. He was also an innovative campaigner. His North Carolina Congressional Club, founded in 1978, was a fund-raising juggernaut that pioneered targeted political advertising of the sort that began with mass mailing in Helms's era and today is conducted via the internet and social media. Added to all of that, Helms was unwavering in his convictions. Supporters and adversaries alike knew him as "Senator No." He was, in the words of one sympathetic biographer, "an uncompromising ideologue."[162]

Jim Hunt, Helms's opponent in 1984, was cut from different cloth. Born in 1937, he belonged to a new generation of Democrats whose politics had been shaped by the progressive currents of the post–World War II era. Hunt followed in the footsteps of his parents, who had been devout New Dealers and supporters of Frank Graham. In 1960, while studying at North Carolina State University, he managed Terry Sanford's gubernatorial campaign on campuses statewide. As Sanford's protégé, he also learned to appreciate the ways that Jim Crow blighted North Carolina with illiteracy, hunger, sickness, and want. During two terms as governor – from 1977 to 1985 – Hunt put those lessons to work. He established a reputation as one of the South's most progressive leaders by persuading lawmakers to appropriate $281 million in new spending on public education. He also recruited high-wage industries to shift North Carolina away from its traditional cheap-

[161] Viewpoint, December 5, 1966, Jesse Helms Viewpoint editorial transcripts.
[162] Link, *Righteous Warrior*, 9 and 144–46.

labor economy, appointed former Chapel Hill mayor Howard Lee as the first Black cabinet secretary in state history, and named pioneering Black lawmaker Henry Frye to the North Carolina Supreme Court.[163]

As Hunt began his campaign to unseat Senator Helms in the 1984 election, he had reason to expect victory. Polls conducted in early 1983 showed him leading Helms by more than twenty percentage points. Hunt enjoyed particularly enthusiastic support among low-income whites earning less than $15,000 a year. They preferred him over Helms by a margin of 64 to 21 percent. That was a testament to the popularity of Hunt's policies on education and economic development.[164]

Events later in the year warned how quickly that lead could be undone. In early October, Helms led a four-day filibuster against legislation that eventually created a national Martin Luther King Jr. holiday. He revived a line of attack on King that he had honed during the 1960s as a nightly editorialist on Raleigh's WRAL-TV. King, he charged, was a communist revolutionary, not a peacemaker, and his actions and ideals were "not compatible with the concepts of this country." When President Ronald Reagan signed the King holiday bill into law a month later, many in the press reported a humiliating defeat for Helms. But the senator knew his audience back home. Even negative headlines helped him solidify his image as an uncompromising defender of conservative values. The effectiveness of that ploy showed in the polls. At the beginning of the race, Hunt had led Helms by 30 percentage points in counties where Blacks made up less than 10 percent of the population and whites were inclined to worry more about economic opportunities than civil rights. In the months after the filibuster, that deficit turned into a ten-point lead for Helms.[165]

As one senior adviser acknowledged, the Helms campaign knew that they "couldn't beat Jim Hunt on issues," so they came out guns blazing on race. The campaign ran thousands of newspaper and radio ads that linked Hunt to the threat of a "bloc vote" being organized by Black Democratic presidential candidate Jesse Jackson and other civil rights leaders. One print ad showed Hunt and Jackson sitting together in the governor's residence and warned, "Gov. James B. Hunt Jr. wants the State Board of Elections to boost minority voter registration in North Carolina. . . . Ask yourself: Is this a proper use of taxpayer funds?"[166]

As a means of courting evangelical Christian voters, Helms and his allies focused similar attacks on the emerging gay rights movement. The *Landmark*, a right-wing paper supported largely by advertising income from the Helms campaign, charged that Hunt was a closeted homosexual and had accepted contributions from "faggots, perverts, [and] sexual deviates." In a move reminiscent of the 1950 contest between Frank Graham and Willis Smith, Helms distanced himself from the specifics of those charges but reminded voters at every turn that his enemies were "the atheists, the homosexuals, the militant women's groups, the union bosses, the bloc voters, and so on." This enemies list endeared Helms to enough North Carolinians to best Hunt with 52 percent of the vote.[167]

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163 Pearce, *Jim Hunt*, 11–41, 145-46.

164 Link, *Righteous Warrior*, 268, and Kellam, "Helms, Hunt, and Whiteness," 53.

165 Kellam, "Helms, Hunt, and Whiteness," 53, and Link, *Righteous Warrior*, 262–69.

166 Link, *Righteous Warrior*, 274 and 284, and Goldsmith, "Thomas Farr, Jesse Helms, and the Return of the Segregationists.," <http://bit.ly/36QLq4c>, November 29, 2020.

167 Link, *Righteous Warrior*, 290–91 and 304; "Pro-Helms Newspaper Publishes Rumor That Hunt Had a Gay Lover," Raleigh *News and Observer*, July 6, 1984; and "Article Stirs New Charges in Carolina Senate Race," *New York Times*, July 7, 1984.

Six years later, race became an issue by default when Harvey Gantt won the Democratic senatorial nomination. His very presence on the ticket testified to the gains that Blacks had made in access to the ballot box and political influence. Gantt was born in 1943 in the South Carolina Lowcountry, where cotton and rice barons had built their fortunes from the labor of his enslaved forebears. His parents moved the family to Charleston when he was still an infant. There his father found a job in the city's shipyard, thanks to Roosevelt's executive order opening war industries to Black workers. Gantt grew up in public housing and was educated in the city's segregated public schools. He traced his fascination with politics to his father's membership in the NAACP and to dinner table conversations about civil rights. As a high school student, Gantt joined his local NAACP Youth Council, and in April 1960, shortly after sit-in demonstrations began in North Carolina, he led similar protests in downtown Charleston.[168]

When Gantt thought about college, an obvious option was to attend a historically Black institution, such as Howard University or the Tuskegee Institute. But he believed that America's future was going to be "all about" integration, so he headed off to Iowa State University, where he expected to get "an integrated education." Iowa State turned out to be as white as Howard was Black. Disappointed, Gantt returned home to create the future he longed for. He tried three times to gain admission to Clemson Agricultural College (now Clemson University) but was denied. With support from the NAACP Legal Defense Fund, Gantt sued, and in 1963 he won a federal court order that he be admitted as the school's first Black student. He graduated with a degree in architecture and then earned an M.A. in city planning from the Massachusetts Institute of Technology. Gantt made his way to Charlotte in 1971, opened an architectural firm, and quickly became involved in politics. He served on the city council from 1974 to 1983 and won election as mayor for two terms, from 1983 to 1987. When he challenged Helms in 1990, Gantt was the first Black Democrat in the nation's history to run for the U.S. Senate.[169]

Helms's campaign against Gantt echoed his attacks on Hunt. When Gantt raised issues of education, health, and the environment, Helms pointed to Gantt's financial ties to "militant homosexuals." One newspaper ad asked, why are "homosexuals buying this election?" The answer: "Because Harvey Gantt will support their demands for mandatory gay rights." At a campaign rally, Helms echoed the "White People Wake Up" warning from Willis Smith's campaign against Frank Graham. "Think about it," he said. "Homosexuals and lesbians, disgusting people marching in our streets demanding all sorts of things, including the right to marry each other. How do you like them apples?"[170]

Still, that only got Helms so far. In mid-October, some polls had him trailing Gantt by as many as 8 percentage points. It was time to play what one of Helms's advisers called "the race card." In the run-up to Election Day, the Helms campaign aired a television ad that played on white anxiety over Black access to desegregated workplaces. The ad showed a white man's hands crumpling a rejection letter. He wore a wedding band and presumably had a family to support. And he was dressed in a flannel shirt, not a button-down and tie. He obviously worked with those hands. The voice-over lamented, "You needed that job and you were the best qualified. But they had to give it to a minority because of a racial quota. Is that really fair? Harvey Gantt says it is. Harvey Gantt supports . . . [a] racial quota law that makes the color of your skin more important than your

[168] Gantt interview, <https://unc.live/31hWV3N>, November 29, 2020.
[169] Ibid., and *Gantt v. Clemson Agricultural College of South Carolina*, 320 F.2d 611 (4th Cir. 1963).
[170] Link, *Righteous Warrior*, 375.

qualifications. You'll vote on this issue next Tuesday. For racial quotas, Harvey Gantt. Against racial quotas, Jesse Helms." The reference to quotas arose from debate over the proposed Civil Rights Act of 1990. Conservatives charged that it included such strict antidiscrimination rules that employers would feel compelled to adopt minority hiring goals in order to preempt potential law-suits. President George H. W. Bush vetoed the law on October 22, days before the Helms ad ran on television. There was in all of this striking irony for anyone who cared to notice it. The ad attacked the very thing that Helms and his supporters sought to protect – economic privilege based on skin color.[171]

At the same time, the state Republican Party attempted to suppress Black voter turnout by mailing postcards to one hundred and twenty-five thousand voters in heavily Black precincts, warning recipients incorrectly that they would not be allowed to cast a ballot if they had moved within thirty days, and that if they attempted to vote, they would be subject to prosecution and imprisonment. Helms subsequently won the election with 65 percent of the white vote and 53 percent of the vote overall. When Gantt challenged him again in 1996, the results were the same.[172]

These battles over Helms's seat in the U.S. Senate made it clear that the political realign-ment that had begun in the mid-1960s was all but complete. White conservatives now identified as Republicans, and a coalition of minority voters and liberal whites constituted the Democratic Party's base. Contests between the two camps were often decided by slim margins. That was evi-dence of how closely divided North Carolinians were in the ways that they imagined the state's future. It also revealed the profound difference that racially prejudicial appeals could make in the outcome of elections and the character of governance.

C. Progressive Democrats and Expansion of the Franchise

Despite his loss to Jesse Helms in 1984, Jim Hunt remained popular with North Carolina voters. They knew him as a reformer and modernizer who had improved the public schools and recruited new jobs that offset the loss of employment in the state's traditional manufacturing sector – textiles, tobacco, and furniture. In 1992, Hunt presented himself for an encore in the governor's office. On the campaign trail, Hunt spoke in optimistic terms. He told voters that he wanted "to change North Carolina," to "build a state that would be America's model." Hunt bested his Repub-lican opponent, Lieutenant Governor Jim Gardner, by 10 percentage points. In 1996, he went on to win a fourth term by an even larger margin.[173]

Over the course of eight years, Hunt and fellow Democrats in the General Assembly built on the accomplishments of his first administration. They established Smart Start, a program that pumped $240 million into local communities to provide preschool education and improved health care to young children; raised teacher salaries by a third and increased state spending on public education from 76 to 86 percent of the national average; launched Health Choice, a state program for uninsured children who were ineligible for Medicaid or other forms of federal assistance; and created a new Department of Juvenile Justice to address the underlying causes of youth crime.

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[171] Goldsmith, "Thomas Farr, Jesse Helms, and the Return of the Segregationists"; Helms, Hands ad, <http://bit.ly/2Q5zJnr >, September 5, 2019; and "President Vetoes Bill on Job Rights, Showdown Is Set," *New York Times*, October 23, 1990.

[172] Link, *Righteous Warrior*, 380; Earls, Wynes, and Quatrucci, "Voting Rights in North Carolina," 589; and Christensen, *Paradox of Tar Heel Politics*, 278.

[173] Pearce, *Jim Hunt*, 210, quotations at 217 and 220.

Hunt also continued to champion inclusive governance. When he left office in 2001, 22 percent of his appointees to state agencies and commissions were minorities, a figure that matched the state's demography.[174]

Between 1992 and 2009, Democratic lawmakers worked to sustain these achievements by expanding minority citizens' access to the franchise. Many of their reforms echoed the Fusion election law of 1895. Key legislation created an option for early voting; allowed voters who went to the wrong precinct on Election Day to cast a provisional ballot; permitted same-day registration during early voting; and created a system for preregistering sixteen- and seventeen-year-olds, so that their names would be placed on the voter rolls automatically when they turned eighteen. The net effect of these reforms was a steady increase in voter participation. In 1996, North Carolina ranked forty-third among the states for voter turnout; it rose to thirty-seventh place by 2000 and to eleventh place in 2012.[175]

Most of the increase was driven by higher rates of Black political participation. Between 2000 and 2012, Black voter registration surged by 51.1 percent, as compared to 15.8 percent among whites. Black turnout followed apace. Between 2000 and 2008, it jumped from 41.9 to 71.5 percent. In the 2008 and 2012 elections, Blacks registered and voted at higher rates than whites for the first time in North Carolina's history. That level of participation was critically important in the 2008 presidential contest, when Barack Obama won North Carolina with a slim margin of 14,171 votes out of 4,271,125 ballots cast. He was the first Democrat running for President to carry the state since Jimmy Carter in 1976.[176]

D. Emergence of a New Multiracial Majority

The history of North Carolina and the South has been marked so profoundly by race that it is tempting to read the politics of the early twenty-first century solely in terms of Black and white. But there is, in fact, a new multiracial majority emerging. It bears resemblance to the biracial alliances of the Reconstruction and Fusion eras but has been shaped by the arrival of a new, rapidly expanding population of Hispanic citizens and immigrants.

Close observers of North Carolina politics noted that Hispanic voters were also "indispensable" to Obama's victory. The state's Hispanic population grew more than tenfold, from just over 75,000 to roughly 800,000, between 1990 and 2010. By 2018, that number exceeded 996,000, just shy of 10 percent of the state's total population. That expansion was driven by the economic boom of the 1990s and early 2000s, when immigrants poured into North Carolina to work jobs in pork and poultry processing, construction, building maintenance, and hospitality. By 2010, Hispanics represented 8.5 percent of the state's total population and 1.3 percent of registered voters. In a tight election, even that small number could change the outcome. North Carolina's Hispanic voters,

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[174] Ibid., 145-46 and 263-66. In 1977, Hunt appointed Howard Lee, former mayor of Chapel Hill, to serve as Secretary of the Department of Natural Resources and Community Development. Seven years later, he named Henry E. Frye to the State Supreme Court, and in 1999 elevated Frye to chief justice.

[175] Berman, *Give Us the Ballot*, 290–91.

[176] For increases in Black voter registration and turnout, see *North Carolina State Conference v. McCrory*, No. 16-1468 (4th Cir. 2016), 13, and Berman, *Give Us the Ballot*, 291.

most of whom favored Democrats, cast 20,468 ballots in 2008, a figure larger than Obama's winning margin.[177]

Hispanic voters' influence in state politics is likely to increase dramatically in the coming decade. Today the population stands at 997,000, roughly 10 percent of the state total, and the annual growth rate, at 24.6 percent, is a third higher than in the United States overall. Moreover, nearly 40 percent of North Carolina's current Hispanic residents are children or young teenagers who – unlike many of their parents' generation – were born in this country. Under the terms of the Fourteenth and Fifteenth Amendments, ratified during Reconstruction, and the Twenty-Sixth, ratified in 1971, they will be entitled to vote when they reach the age of eighteen. Taken together, these figures point to the potential for a new multiracial alliance of Hispanic, Black, and progressive white voters.[178]

XII. Retrenchment

A. Polarized Politics of Race and Ethnicity

By the early 2000s, North Carolina voters had become as racially polarized as they were at the end of the nineteenth century. Whites, by a wide margin, associated with the party that favored a restricted franchise, limited government, tax cuts, and reduced spending on education and social services. For their part, the majority of Blacks and Hispanics gave their allegiance to the party that advocated for enlarged access to the franchise, education, and healthcare; equal job opportunities; and a broad social safety net that offers protection from poverty and misfortune. National polling data on registered voters' party affiliation, collected by Gallup in 2012, tell the story:

	White	**Black**	**Hispanic**	**Asian**	**Other**	**Undesignated**
Republicans	89%	2%	6%	1%	1%	1%
Democrats	60%	22%	13%	2%	1%	2%

Republican and Democratic Party demographics. Newport, "Democrats Racially Diverse; Republicans Mostly White." Gallup, 2012.

In tight elections, this polarization heightened the importance of two related factors: newly enfranchised voters' access to the ballot box and the effectiveness of racial strategies for limiting turnout.[179]

How had this happened? As historian Carol Anderson argues, the 2008 election was the tipping point. At the national level, Barack Obama attracted a larger share of the white vote than Democrat John Kerry in 2004. He also won substantial majorities among Hispanic, Asian, youth, and women voters, along with 95 percent of Blacks. This loose coalition had gone to the polls to

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[177] Ross, "Number of Latino Registered Voters Doubles in North Carolina," <http://bit.ly/2I3lGID>, September 5, 2019; "North Carolina's Hispanic Community: 2019 Snapshot," <http://bit.ly/2SY8Rpd>, November 29, 2020; and "Latinos in the 2016 Election: North Carolina," <https://pewrsr.ch/2HOyFNV>, September 5, 2019.

[178] "North Carolina's Hispanic Community: 2019 Snapshot," <http://bit.ly/2SY8Rpd>, November 29, 2020, and Tippett, "Potential Voters Are Fastest-Growing Segment of N.C. Hispanic Population," <http://bit.ly/2QRRpQh>, November 29, 2020.

[179] Newport, "Democrats Racially Diverse; Republicans Mostly White," <http://bit.ly/2HOkDvH>, September 5, 2019.

voice support for an expansive vision of government that Republicans had opposed since the days of the New Deal. They rallied to Obama's hopeful slogan, "Yes We Can," and his belief that Washington could improve people's lives with achievable reforms, such as raising the minimum wage, expanding the Earned Income Tax Credit, protecting the rights of labor, investing in public education, and guaranteeing universal access to affordable health care. Looking back on the election, Republican U.S. Senator Lindsey Graham identified the problem: his party was "not generating enough angry white guys to stay in business for the long term."[180]

An economy in crisis offered the makings of a solution. When Obama took the oath of office in January 2009, a near collapse of the banking system was threatening to plunge America and the rest of the world into a second Great Depression. North Carolina was one of the states hit hardest. Within a year, the unemployment rate soared to 10.9 percent. That caused pain in every corner of the labor market, but the situation in manufacturing and construction became particularly grim. Between 2007 and 2012, those sectors experienced job losses of 18 and 32 percent, respectively. The banking crisis had begun with the implosion of the market for subprime mortgages. As more people lost their jobs, they fell behind on payments that under the best of circumstances had strained their budgets. Between 2006 and 2014, nine million American families lost their homes; in 2008 alone, the number in North Carolina was 53,995.[181]

Voters grew angry, particularly at politicians they felt had let the crisis happen and now sought to fix it with bailouts for financial institutions and corporations that were ostensibly "too big to fail." That fury fueled the Tea Party revolt that erupted in 2009. The movement was overwhelmingly white, and its supporters' grievances echoed principles that had defined a century of conservative thought and politics. Tea Partiers rallied against big government; denounced the 2010 Affordable Care Act as a socialist violation of individual liberty; criticized social welfare programs as a waste of taxpayers' money; and launched a xenophobic attack on immigrants who they claimed were stealing American jobs, dealing in illicit drugs, and perpetrating violent crime. The Tea Party sprang from the grassroots, but soon many of its rallies were financed and orchestrated by Americans for Prosperity, a conservative political action group backed by billionaire brothers Charles G. and David A. Koch and a national network of wealthy donors and like-minded organizations.[182]

Tea Partiers channeled much of their anger through racial invective. They hailed President Obama as "primate in chief"; they donned T-shirts that demanded, "Put the White Back in White House"; and at rallies in Washington, D.C., they carried placards that exclaimed, "We came unarmed [this time]." In North Carolina, a member of the Charlotte-Mecklenburg Board of Education argued against increases in school spending on grounds that costs had been inflated by what he called "Obama Bucks" – a pejorative term initially applied to food stamps but soon attached to a wide variety of federal social welfare programs. Three years later, when Charlotte hosted the Democratic National Convention, V. R. Phipps, a self-styled "patriot" from eastern North Carolina, captured headlines when he parked his truck and a trailer near delegates' downtown hotels. The trailer contained effigies of the president and state political figures, each strung up lynching-style

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[180] C. Anderson, *White Rage*, 138–39; 2008 Democratic Party Platform, <http://bit.ly/2ti7IhI>, November 29, 2020; and "As Republican Convention Emphasizes Diversity, Racial Incidents Intrude," *Washington Post*, August 29, 2012.

[181] Gitterman, Coclanis, and Quinterno, "Recession and Recovery in North Carolina," 7, <https://unc.live/2HSb8vw>, September 5, 2019; Samuels, "Never-Ending Foreclosures," <http://bit.ly/35X96mZ>, November 29, 2020; and "N.C. Foreclosures Jumped 9% in 2008," *Triad Business Journal*, January 5, 2009.

[182] Mayer, "Covert Operations," <http://bit.ly/30m6w8Z>, November 29, 2020.

in a hangman's noose. Phipps later took his display on tour in the Midwest and up and down the East Coast.[183]

Republican leaders embraced white voters' anger and presented themselves as the party that would defy the Black president and his supporters. Shortly before the 2010 midterm elections, in which Republicans won control of the U.S. House of Representatives, Mitch McConnell, the Republican majority leader in the Senate, pledged to voters, "The single most important thing we want to achieve is for President Obama to be a one-term president. . . . You need to go out and help us finish the job." Writing a year later, Ron Unz, publisher of the *American Conservative*, an influential online political forum, described that racial logic in approving terms: "As whites become a smaller and smaller portion of the local population in more and more regions, they will naturally become ripe for political polarization based on appeals to their interests as whites. And if Republicans focus their campaigning on racially charged issues such as immigration and affirmative action, they will promote this polarization, gradually transforming the two national political parties into crude proxies for direct racial interests, effectively becoming the 'white party' and the 'non-white party.'" Unz predicted that since white voters constituted a majority of the national electorate, "the 'white party' – the Republicans – will end up controlling almost all political power and could enact whatever policies they desired, on both racial and non-racial issues."[184]

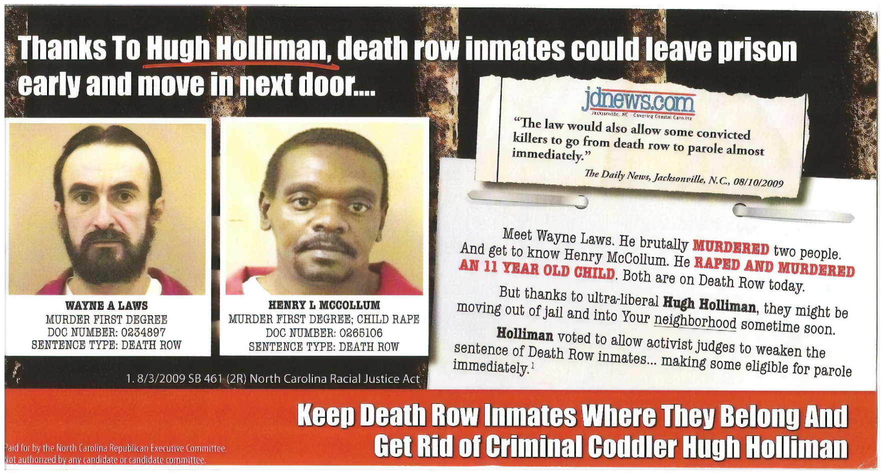
Unz's assessment read like a script for the future of North Carolina politics. Voter discontent offered Republicans an opportunity to extend their success in presidential and senatorial elections downward into campaigns for seats in the state legislature.

Racial appeals figured prominently in the 2010 election. Take, for example, the effort to unseat John J. Snow Jr., a state senator from western North Carolina, and L. Hugh Holliman, Democratic majority leader in the state House of Representatives. Both had voted for the 2009 Racial Justice Act, which Democrats passed after decades of effort to reform or abolish capital punishment. The law gave inmates the right to challenge imposition of the death penalty by using statistical evidence to prove that race was a factor in their sentencing. In the closing weeks of the campaign, the executive committee of the state Republican Party produced a mass mailing that attacked the law and its backers. An oversized postcard featured a photograph of Henry L. McCollum, who had been convicted of raping and killing an eleven-year-old girl. It played to the same ugly stereotypes of Black men's bestial sexuality that had been front-and-center in the white supremacy campaigns of 1898 and 1900, warning that "thanks to ultra-liberal lawmakers" like Holliman and Snow, McCollum might "be moving out of jail and into Your *neighborhood* (emphasis in the original) sometime soon." The not-so-subtle message was that recipients who cared

[183] Blake, "What Black America Won't Miss about Obama," <https://cnn.it/2tXfX2E>, November 29, 2020; "Racial Resentment Adds to GOP Enthusiasm," <https://on.msnbc.com/378OX1r>, November 29, 2020; Okun, *Emperor Has No Clothes*, 151; Charlotte-Mecklenburg Board of Education, meeting minutes, September 8, 2009, <http://bit.ly/2LQCjYX>, September 5, 2019; "GOP Mailing Depicts Obama on Food Stamps, Not Dollar Bill," <https://n.pr/34GHrHT>, September 5, 2019; and "'Hanging Obama' Truck Makes Way into Charlotte," <http://bit.ly/32sZJu4>, September 5, 2019.

[184] "GOP's No-Compromise Pledge," <https://politi.co/2IyrixL>, November 29, 2020, and Unz, "Immigration, the Republicans, and the End of White America," <http://bit.ly/32sEyYY>, September 5, 2019.

for their families' safety would vote to "get rid of criminal coddler[s]" and keep predators like McCollum "where they belong."[185]



Republicans used this postcard and a similar mailing to target Democrats Hugh Holliman and John Snow for their support of the 2009 Racial Justice Act. Courtesy of WRAL.com.

There was a double layer of tragedy in this racial appeal. Holliman, a staunch defender of the death penalty, had lost a sixteen-year-old daughter to murder decades earlier. He and many of the public found the postcard so offensive that they demanded an apology from Tom Fetzer, state chairman of the Republican Party. Fetzer obliged but also took the opportunity to criticize Holliman's vote for the racial justice law. Then, in 2014, McCollum was exonerated and released from prison. The *New York Times* reported that the case against him, "always weak, fell apart after DNA evidence implicated another man" who "lived only a block from where the victim's body was found" and "had admitted to committing a similar rape and murder around the same time."[186]

Conservative activists disparaged North Carolina's growing Hispanic population in comparable ways. In 2009, Jeff Mixon, legislative director in the Raleigh office of Americans for Prosperity, attacked Hispanic immigrants as deadbeats and thugs. He described North Carolina as a "magnet for illegals" who came to America to "take advantage [of a] vast array of benefits . . . from food stamps and free medical care to in-state tuition at our community colleges." He also played on historically familiar prejudices that associate dark skin with criminality. "Poor illegal aliens" deserved no sympathy, he argued, because they provided cover for "wolves among the sheep" – members of Mexican "narco gangs" who threatened to "ruin our communities."[187]

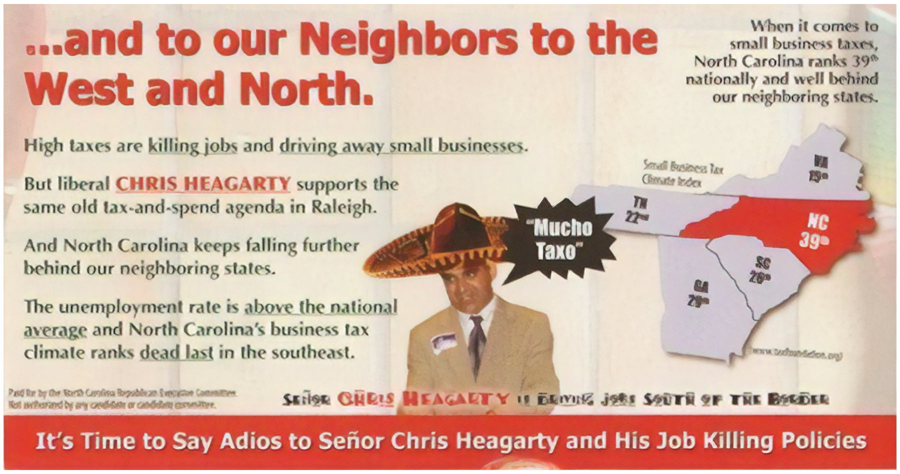
A year later, the executive committee of the North Carolina Republican Party played on such anti-immigrant sentiments in a mailer it distributed to support candidate Thomas O. Murray, who was running against sitting Democrat John Christopher Heagarty for the District 41

[185] Roth, *Great Suppression*, 96–98, and "GOP Featured McCollum in 2010 Attack Ad," <http://bit.ly/37SalWG>, September 5, 2019.

[186] "GOP Featured McCollum in 2010 Attack Ad," <http://bit.ly/37SalWG>, September 5, 2019; Mayer, "State for Sale," <http://bit.ly/37VMm96>, November 29, 2020; "Flier Opens an Old Wound," *Winston-Salem Journal*, October 21, 2010; and "DNA Evidence Clears Two Men in 1983 Murder," *New York Times*, September 2, 2014.

[187] Mixon, "Just Look at the Results," <http://bit.ly/32tZmj1>, September 5, 2019; "Narco Gangs in North Carolina," <http://bit.ly/2HNmPnq>, September 5, 2019; and "Who Benefits from Illegal Immigration?" <http://bit.ly/2I3fLTV>, September 5, 2019.

House seat in the General Assembly. With a sombrero atop his head and his skin darkened by clever photo editing, "Señor" Heagarty exclaims, "Mucho taxo" – a reference to policies that Republicans charged were driving away jobs.[188]



Republicans produced this postcard to insinuate that Democrat Chris Heagerty's stance on tax issues was connected to the interests of Hispanic immigrants. Courtesy of *IndyWeek*.

On Election Day, Snow, Holliman, Heagarty, and fifteen of the other Democrats lost their seats, giving Republicans a majority in both houses of the state legislature. Republican lawmakers subsequently consolidated their hold on power. The timing of Republican gains in North Carolina was fortuitous. The nation's decennial census was complete, and lawmakers would now take up the job of redistricting the state.

B. 2011 Redistricting

In 2011, Republican lawmakers redrew state legislative districts in a way that exposed the centrality of race in their strategy for extending and securing their partisan advantage. Managers of the process claimed – falsely – that in order to comply with the Voting Rights Act of 1965, the General Assembly was required to create majority-minority legislative districts in equal proportion to North Carolina's Black population. They instructed an outside consultant, Republican Party strategist Thomas Hofeller, to create such districts wherever geographically possible, and to complete that task before drawing other district lines. The plan that Hofeller designed, and the General Assembly ultimately approved, included thirty-six districts – twenty-four in the House and twelve in the Senate – in which Blacks constituted more than fifty percent of the voting age adults. These districts accounted for twenty-one percent of seats in the General Assembly, a figure that matched the percentage of Blacks in the state's population.[189]

Republican leaders presented the redistricting plan as evidence of their commitment to civil rights, but that was a sleight of hand. The new majority-minority districts were bizarrely shaped; they sprawled across county lines, divided municipalities, and split precincts – all for the purpose

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188 "Anti-Heagerty Ads", <http://bit.ly/2tmNfZ3>, November 29, 2020.

189 *Covington v. the State of North Carolina*, 316 F.R.D. 117 (M.D.N.C. 2016), 2, 4-6; *Covington v. North Carolina* (M.D.N.C.) 1:15-cv-00399, 3.

of packing Black voters together as tightly as possible. These configurations dismissed "traditional race-neutral districting principles" established by the U.S. Supreme Court, including "compactness contiguity, and respect for . . . communities defined by actual shared interests." The effect was to separate many Black voters from the interracial alliances that the Democratic Party had been building since the mid 1980s. In the 2012 election, Black candidates gained seven seats in the General Assembly, but nineteen of their white allies suffered defeat.[190] This gave Republicans a super majority in both chambers of the legislature, which, along with the election of Republican governor Patrick L. (Pat) McCrory, sharply diminished Black North Carolinians' ability to influence public policies that mattered to their communities.[191]

B. *Shelby County v. Holder* and House Bill 589

The severity of that setback quickly became apparent when the new Republican-controlled legislature convened. For more than a year, party leaders had been gathering information that might help them roll back Democratic reforms that had expanded access to the ballot box. As early as January 2012, a member of the Republican legislative staff had asked the State Board of Elections, "Is there any way to get a breakdown of the 2008 voter turnout, by race (white and Black) and type of vote (early and Election Day)?" A year later, a Republican lawmaker wondered, "Is there no category for 'Hispanic' voter?" Another questioned University of North Carolina officials "about the number of Student ID cards that [were] created and the percentage of those who [were] African American," and in April 2013, an aide to the Speaker of the House requested "a breakdown, by race, of those registered voters [who] do not have a driver's license number."[192]

Two months later, the U.S. Supreme Court gave white conservatives an opening to make wholesale changes to state elections law. In *Shelby County v. Holder*, a 5-4 majority of justices struck down Section 5 of the Voting Rights Act, which had required that the U.S. Department of Justice preclear changes in voting procedures in portions of North Carolina and other affected jurisdictions to ensure that they would not disadvantage protected minorities. Within hours of the ruling, Republican leaders in North Carolina announced that they planned to introduce an omnibus bill that would dramatically modify the ways that citizens registered to vote and cast their ballots.[193]

What eventually emerged was House Bill 589, legislation that targeted the electoral clout of the alliance of Black, Hispanic, and progressive white voters within the Democratic Party. Like

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[190] *North Carolina General Assembly, 149th Session 2011-2012: House of Representatives*, https://www.ncleg.gov/DocumentSites/HouseDocuments/2011-2012%20Session/2011%20Demographics.pdf; *North Carolina General Assembly, 150th Session 2013-2014: House of Representatives*, https://www.ncleg.gov/DocumentSites/HouseDocuments/2013-2014%20Session/2013%20Demographics.pdf. *North Carolina General Assembly 2011 Senate Demographics*, https://www.ncleg.gov/DocumentSites/SenateDocuments/2011-2012%20Session/2011%20Demographics.pdf; *North Carolina General Assembly 2013 Senate Demographics*, https://www.ncleg.gov/DocumentSites/SenateDocuments/2013-2014%20Session/2013%20Senate%20Demographics.pdf.

[191] "North Carolina Election Results 2012: McCrory Wins Governor's Race; Hudson Tops Kissell for House Seat; Romney Gets Narrow Victory," *Washington Post*, November 7, 2012, https://www.washingtonpost.com/politics/decision2012/north-carolina-election-results-2012-mccrory-wins-governors-race-hudson-tops-kissell-for-house-seat-romney-gets-narrow-victory/2012/11/07/201e8c1c-23a8-11e2-ac85-e669876c6a24_story.html.

[192] "Inside the Republican Creation of the Norther Carolina Voting Bill Dubbed the 'Monster' Law," *Washington Post*, September 2, 2016.

[193] Ibid.

the Act to Regulate Elections that opponents of Fusion crafted in 1899, House Bill 589 made no explicit reference to race or ethnicity; nevertheless, it threatened to limit political participation by non-white minorities. The law included a number of provisions that would have made voting harder for Black and Hispanic electors.

- House Bill 589 required that in-person voters provide one of eight approved forms of photo identification in order to cast a ballot. Blacks constituted 22 percent of North Carolina's population, but according to an analysis of State Board of Elections data by political science and election scholars Michael Herron and Daniel Smith, they represented more than a third of the registered voters who at the time did not possess the two most common forms of photo identification: a valid driver's license or a state-issued nonoperator's ID card.[194]
- The law also eliminated the first week of early voting, same-day registration, and straight-ticket voting. Statistics from the 2008 election in North Carolina suggested that these changes would have a disproportionately negative effect on Black voter participation. In the run-up to Election Day, 71 percent of Black voters cast their ballots early, including 23 percent who did so within the first week of the early voting period. That compared, respectively, to 51 and 14 percent of whites. Thirty-five percent of same-day voter registrants were Black, a figure 50 percent higher than what might have been predicted on the basis of population statistics, and Democrats voted straight-ticket by a two-to-one ratio over Republicans.[195]
- House Bill 589 targeted young future voters in similar fashion. It ended a program that permitted sixteen and seventeen-year-olds to pre-register at their high schools and other public sites. That opportunity had been particularly popular among Black teenagers. Blacks constituted 27 percent of the pool of pre-registered youth, once again a figure that was significantly higher than Black representation in the general population.[196]

  Many observers at the time noted this potentially disproportionate effect on Black electors, but most missed something equally important. The elimination of pre-registration for sixteen and seventeen-year-olds was remarkably forward looking: it stood to diminish the impact of rapid growth in the number of Hispanic voters – growth that observers identified as the "future of Progressive strength in America."[197]

  A report from the University of North Carolina's Population Center explained the details. In 2012, as illustrated in the graph below, most of the state's Hispanic residents were non-citizens and only one if four was eligible to vote, but just over the horizon, Republicans faced a large population of young Hispanics who had been born in the United States, who would soon cast a ballot, and data showed were inclined to support Democrats. Of the

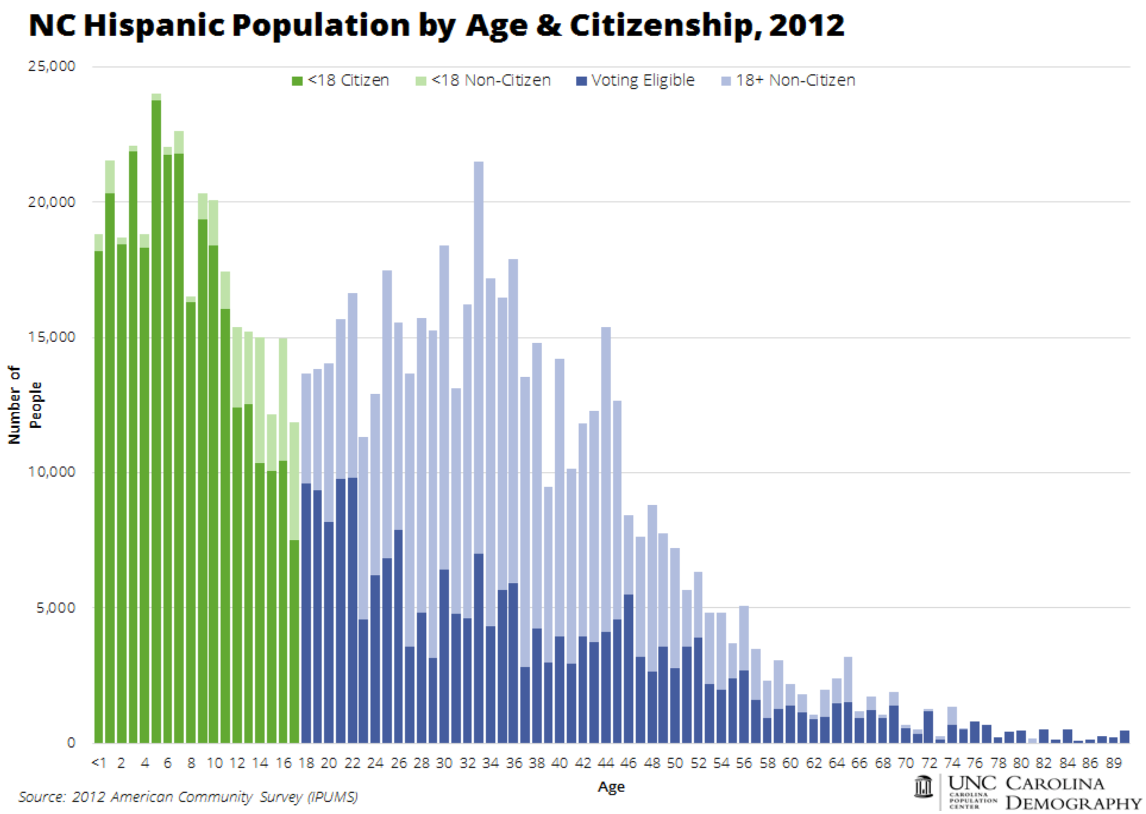
[194] Herron and Smith, "Race, *Shelby County*, and the Voter Information Verification Act in North Carolina," 497.

[195] and Heberling and Greene, "Conditional Party Teams," 117.

[196] Herron and Smith, "Race, *Shelby County*, and the Voter Information Verification Act in North Carolina," 505.

[197] Broockman and Roeder, "Hispanics Are the Future of Progressive Strength in America, New Organizing Institute, <http://bit.ly/2HPJ3Fn>, September 5, 2019; "Republicans Have a Major Demographic Problem, and It's Only Going to Get Worse," *Washington Post*, April 22, 2014; "The South is Solidly Republican Right Now; It Might Not Be that Way in 10 Years," *Washington Post*, April 29, 2014; and "Immigration is Changing the Political Landscape in Key States.," <https://ampr.gs/32wwPsW>, September 5, 2019.

Hispanics who had or would turn eighteen between 2012 and 2015, 72 percent were citizens. That figure rose to 84 percent of those who would turn eighteen between 2015 and 2010, and to 98 percent of those who would do so between 2020 and 2030. For Republicans politically, there was little to be gained and much to be risked by pre-registering these future voters.[198]



Blue bars represent voting-age Hispanics, with dark shading for citizens and light shading for non-citizens. Green bars represent Hispanics under age eighteen, again with dark shading for citizens and light shading for non-citizens. Courtesy of Carolina Demography, University of North Carolina at Chapel Hill.

- Finally, House Bill 589 changed the rules for challenging voters' eligibility to cast a ballot and, by doing so, heightened the potential for intimidation. Three revisions were important in this regard. First, residents throughout the state were now allowed to inspect and challenge registration records in any of North Carolina's one hundred counties. In the past, challengers were permitted to act only in the counties in which they resided. Second, residents of a county were permitted to challenge voters' eligibility to cast a ballot at polling sites countywide, not just in the precincts where they themselves were registered. Third, the chair of each political party in a county were permitted to appoint ten at-large observers to monitor voting at any polling place they believed warranted close supervision. These poll watchers would be appointed in addition to the election judges assigned to specific voting sites.

[198] Tippett, "North Carolina Hispanics and the Electorate," <http://bit.ly/2UDvIVC>, September 5, 2019.

> Worry that these provisions would encourage frivolous challenges and voter intimidation was based on more than speculation. During the 2012 election, a loose confederation of conservative activists mobilized by True the Vote, state-level Voter Integrity Projects, and the Madison Project launched a campaign they called Code Red USA. Their aim was to marshal a "cavalry" of volunteer poll watchers to police alleged voter fraud in battleground states, including North Carolina. In one incident, self-appointed watchdogs in Wake County petitioned to have more than five hundred voters, most of them people of color, removed from the registration rolls.
>
> Though the attempt failed, it echoed in disturbing ways a similar episode during Reconstruction, when a group of whites in the same county challenged one hundred and fifty Black voters on grounds that they had registered fraudulently. As a researcher from the Brennan Center for Justice at the New York University School of Law observed, the 1872 challenge was "one of the first organized attempts by private citizens . . . to systematically undermine Black political participation in North Carolina – a practice that would continue throughout the Jim Crow era." The mechanism to allow and facilitate this practice was reintroduced by the enactment of House Bill 589.[199]

When pressed on these issues, Republican lawmakers insisted that their intent was not to infringe on voting rights. Thom Tillis, Speaker of the House, encouraged the public to think of House Bill 589 instead as a means of "restoring confidence in government."[200]

C. Rolling Back Reform, Restricting Social Provision

The new Republican-led North Carolina Legislature wanted to roll back reforms that previous Democratic-led legislatures had fought so hard for, reforms that brought equity back into electoral politics. *Shelby County* and the nullification of the Federal Government's preclearance regime gave the new legislature the impetus to put forth discriminatory laws such as HB 589 and its successor SB 824, but also set up a decade of fights over the suppression of Black voters in various ways and has ultimately led to this lawsuit over the new 2021 district maps.

The Republicans' sweeping revision of state election law was a key element in a broader legislative agenda designed to roll back decades of reform that had made state government more responsive to the economic and social needs of minority populations who had been politically and economically marginalized throughout much of the state's history.

One of Republicans' top priorities was to repeal the 2009 Racial Justice Act. Democrats defended the law by pointing to a simple set of numbers: between 1977 and 2010, North Carolina courts had sent three hundred and ninety-two people to death row, 49 percent of whom were Black – a figure more than double Blacks' representation in the general population. Opponents were not impressed. Thomas Goolsby, a Republican in the state Senate, insisted that the Racial Justice Act was unnecessary because inmates on death row already had "multiple avenues of appeal." Governor Pat McCrory seconded that claim, arguing that the law did nothing more than create a new "judicial loophole to avoid the death penalty and not a path to justice." Timothy K.

[199] "Looking, Very Closely, for Voter Fraud," *New York Times*, September 17, 2012; "The Madison Project Launches the Code Red USA Project"; and Riley, "Lesson from North Carolina on Challengers," <http://bit.ly/32uhGbN>, September 5, 2019.

[200] Berman, *Give Us the Ballot*, 290.

(Tim) Moore, who later became the state's Speaker of the House, heaped ridicule atop McCrory's scorn. "The Racial Justice Act tries to put a carte blanche solution on the problem," he said. "A white supremacist who murdered an African American could argue he was a victim of racism if Blacks were on the jury." There was, of course, no evidence that Blacks had systematically persecuted white supremacists in the past, or that prosecutors were eager to empanel Black jurors. In fact, district attorneys in North Carolina struck eligible Black jurors at roughly 2.5 times the rate they excluded

all others. In early June 2013, lawmakers voted largely along party lines to rescind the Racial Justice Act, and Governor McCrory quickly signed the repeal into law.[201]

North Carolina's minority schoolchildren also ran afoul of Republican lawmakers, who mounted a stepwise campaign to weaken public education and expand private alternatives. The starting point was an issue that had been front and center in the 2012 election: a projected $3 billion shortfall in the state budget. There were obvious ways to address that problem – raise taxes, cut spending, or do some of both. The Republican majority in the General Assembly chose austerity, and because expenditures on education accounted for nearly 40 percent of North Carolina's annual budget, public schools were in the bullseye. For fiscal year 2014, the total appropriation for K-12 education, when adjusted for inflation, fell $563 million short of school spending in fiscal year 2008. Included in that figure were deep cuts in funding for pre-K programs, transportation, textbooks, and construction. The reductions hit teachers particularly hard. Their pay effectively stagnated as compensation in North Carolina fell from twenty-second to forty-seventh place in the nation. Soon teachers were fleeing the state's public schools; some dropped out of the profession, and others were lured away by better pay in neighboring states.[202]

Spending cuts and teacher attrition created a public perception of crisis, which was amplified by changes in the way that state officials had begun to report school performance. In 2012, the General Assembly created a simplified system that distilled a variety of measurements into letter grades that ranged from A to F. A year later, seven hundred and seven public schools received a grade of D or F. Parents and educators were shocked, in part because officials failed to tell them that nearly all of the underperforming schools were also high-poverty, majority-minority schools, where children needed more, not less, funding for supplemental instruction, pre-K and after-school programs, lower student-teacher ratios, and reduced class size.[203]

Republican lawmakers ignored those needs and instead used the low grades to argue for increased public support for charter schools and implementation of a new freedom-of-choice

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[201] Kotch and Mosteller, "Racial Justice Act," 2035 and 2088; "North Carolina Repeals Law Allowing Racial Bias Claim in Death Penalty Challenges," *New York Times*, June 5, 2013; Grosso and O'Brien, "Stubborn Legacy," 1533; Florsheim, "Four Inmates Might Return to Death Row," <http://bit.ly/37qiEss>, September 5, 2019; and "McCrory Signs Repeal of Racial Justice Act," *Winston-Salem Journal*, June 20, 2013.

[202] "North Carolina's Step-by-Step War on Public Education," *Washington Post*, August 7, 2015; Johnson and Ellinwood, *Smart Money*, < http://bit.ly/37tcCqO>, November 29, 2020; 2013–2015 North Carolina Budget Short-Changes Students, Teachers, and Public Education, <http://bit.ly/2RTBUrA>, November 29, 2020; Gerhardt, "Pay Our Teachers or Lose Your Job," <http://bit.ly/2ROO19t>, November 29, 2020; Wagner, "North Carolina Once Again Toward the Bottom in National Rankings on Teacher Pay," <http://bit.ly/2TZHA67>, November 29, 2020; and Brenneman, "Teacher Attrition Continues to Plague North Carolina," <http://bit.ly/2uuLBVu>, November 29, 2020.

[203] 2013–14 School Performance Grades (A–F) for North Carolina Public Schools. On the grading scheme, see *Unraveling*, <http://bit.ly/2TYTpcG>, November 29, 2020.

voucher program for private and religious academies. These policy decisions threatened to accelerate school re-segregation, which had been gathering speed since 2000, when the U.S. Supreme Court overturned its earlier decision in *Swann v. Charlotte-Mecklenburg Board of Education*. The Swann ruling, issued in 1971, had made busing a preferred means of desegregation and, in Charlotte, led to the creation of one of the nation's most integrated school systems. But behind that success lay deep racial anxiety, which led a group of white parents to initiate the court challenge to *Swann* in 1997 and, more broadly, informed the creation of North Carolina's charter school program a year later. A Duke University study of charter schools in the period between 1998 and 2012 offered insight into these developments and their role in re-segregation. The Duke researchers found that white parents preferred schools that were no more than 20 percent Black. Beyond that tipping point, they began to look for alternatives. The results showed in the demography of North Carolina schools. In 2012, only about 30 percent of students in the traditional public education system attended highly segregated schools that were more than 80 percent or less than 20 percent Black. In charter schools, the figures were reversed; more than two-thirds of students were enrolled in schools that were overwhelmingly white or Black. The Duke team concluded from these numbers that "North Carolina's charter schools have become a way for white parents to secede from the public school system, as they once did to escape racial integration orders."[204]

North Carolina's voucher program also undermined confidence in public schools and encouraged re-segregation. The program used public school funds to offer Opportunity Scholarships to low-income families that earned less than 133 percent of the federal poverty line. The State Department of Public Instruction marketed the vouchers, valued at up to $4,200 a year, as assistance for parents who wished to remove their students from high-poverty, under resourced schools – that is, underperforming schools created by state policies. Today, 93 percent of voucher recipients attend religious schools, which, on average, do not serve them particularly well. North Carolina accountability standards for voucher-eligible schools are among the most lenient in the nation. Those schools are not required to seek accreditation, employ licensed teachers, comply with state curriculum standards, or administer end-of-year evaluations of student learning. Given that lax oversight, it is not surprising that in the small number of voucher-eligible schools that do report results from standardized reading and math tests, 54 percent of students score below national averages. Enrollment data for voucher-eligible schools is not readily available, but information from disparate sources suggests that they are an increasingly attractive choice for white families who are looking for an alternative to integrated public schools. Between the 2014-15 and 2016-17 academic years, the share of vouchers claimed by Black students fell from 49 to 35 percent, while the share used by whites increased from 27 to 41 percent. One fact provides at least a partial explanation of that shift: in large religious schools with more than eighty voucher students, average enrollment was 89 percent white.[205]

Restoring "blindfolded" justice that dismissed four centuries of racial inequity in American jurisprudence and defaulting on North Carolina's constitutional obligation to provide all children equal opportunities in school – this was the agenda that Republicans enacted after their sweep of

[204] Ladd, Clotfelter, and Holbein, "Growing Segmentation," 11, 35, <https://ampr.gs/32wwPsW>, September 5, 2019, and "White Parents in North Carolina Are Using Charter Schools to Secede from the Education System," *Washington Post*, April 15, 2015.

[205] *School Vouchers*, 1–2, 7, 11–13, and 21n2, <http://bit.ly/2Sbg03j>, November 29, 2020; Opportunity Scholarship Program, 2019–20 School Year, <http://bit.ly/2GoFFzZ>, November 29, 2020; and Private School Minority Statistics in North Carolina, <http://bit.ly/3aJN8I4>, November 29, 2020.

the General Assembly and governor's office in 2012. On election night in 2016, as he celebrated Donald J. Trump's presidential victory, Tim Moore, the state Speaker of the House, looked back on his party's handiwork and declared, "We've had a great four years since we took the majority." But even in that moment, Moore and other party leaders surely knew that candidates with different priorities might prevail in future elections and sweep away Republicans' accomplishments. How, then, to make the conservative revolution permanent? One answer – the answer that Charles Aycock and white-rule Democrats had imposed in 1900 – was to disenfranchise dissenting voters. That was the threat posed by House Bill 589, which a federal court would later describe as "the most restrictive voting law North Carolina has seen since the era of Jim Crow."[206]

D. House Bill 589 in the Federal Courts

In 2016, the North Carolina NAACP, League of Women Voters, and U.S. Department of Justice lost their challenge to House Bill 589 in the U.S. District Court for the Middle District of North Carolina. But on appeal, the Fourth Circuit ruled for the plaintiffs and reversed the district court's decision. A three-judge panel found compelling evidence of discriminatory intent in the Republican election law. Among other considerations, the court pointed to "the inextricable link between race and politics in North Carolina," Republican lawmakers' consideration and use of race-specific data on voting practices, and the bill's timing. In addition to following closely on the heels of the *Shelby County* decision, House Bill 589 was also situated at a critical juncture in North Carolina politics. The appellate court judges noted that "after years of preclearance and expansion of voting access, by 2013 African American registration and turnout rates had finally reached near-parity with white registration and turnout rates. African Americans were poised to act as a major electoral force." Republican lawmakers "took away that opportunity because [Blacks] were about to exercise it," and they did so, the judges added, "with almost surgical precision."[207]

From this and other evidence, the Fourth Circuit panel concluded "that, because of race, the legislature enacted one of the largest restrictions of the franchise in modern North Carolina." They did not directly cite North Carolina's 1900 disenfranchisement amendment to the state constitution, but that was the obvious historical reference point. No other change to election law had been so sweeping in its effect. The judges remanded the House Bill 589 case to the district court, with instructions to enjoin the voter ID requirement and changes made to early voting, same-day registration, out-of-precinct voting, and teen preregistration.[208]

Republican leaders quickly regrouped after the Fourth Circuit ruling. They began to prepare an appeal to the Supreme Court and, in the interim, attempted to salvage some of the advantage that House Bill 589 would have given them in the upcoming 2016 general election. In mid-August, Republican governor Pat McCrory petitioned Chief Justice John G. Roberts Jr. to reinstate the law's photo ID requirement, which had been implemented months earlier in the spring primaries. Roberts declined. At the same time, Dallas Woodhouse, executive director of the state

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[206] "North Carolina's 'Racial Justice Act,'" Civitas Institute, November 16, 2010, <http://bit.ly/38K467o>, November 29, 2029; "Berger and Moore Celebrate Majority Victory in State Legislature," Raleigh *News and Observer*, (updated online, <http://bit.ly/2tIJPjJ>, November 29, 2020); *North Carolina State Conference of the NAACP v. McCrory*, 831 F.3d 204, 229 (4th Cir. 2016).

[207] *North Carolina State Conference of the NAACP v. McCrory*, 831 F.3d 204, 214, 215 (4th Cir. 2016); *see also North Carolina State Conference of the NAACP v. McCrory*, 182 F. Supp. 3d 320 (M.D.N.C. 2016); *North Carolina State Conference of the NAACP v. McCrory*, 997 F. Supp. 2d 322 (M.D.N.C 2014).

[208] *North Carolina State Conference of the NAACP v. McCrory*, 831 F.3d 204, 239–241 (4th Cir. 2016).

Republican Party, encouraged county election boards to press ahead with what he called "party line changes" to early voting. The boards no longer had legal authority to shorten the early-voting period, but they could achieve much the same effect by reducing the number of early-voting sites and cutting the hours they would be open.[209]

Seventeen county boards, mostly in the east, did just that. Had Section 5 of the Voting Rights Act still been in place, the changes would have required preclearance from the U.S. Department of Justice, but that was no longer a hurdle. In the affected counties, Black voter turnout sagged significantly through much of the early voting period and caught up to 2012 levels only after a Herculean get-out-the-vote effort. Tellingly, state Republican Party officials reported that news in explicitly racial terms. The "North Carolina Obama coalition" was "crumbling," they reported in a news release. "As a share of Early Voters, African Americans are down 6.0%, (2012: 28.9%, 2016: 22.9%) and Caucasians are up 4.2%, (2012: 65.8%, 2016: 70.0%)."[210]

On appeal in 2017, the U.S. Supreme Court declined to review the Fourth Circuit's ruling on House Bill 589.[211]

E. Redistricting in Federal and State Courts

As House Bill 589 wound its way through the federal courts, plaintiffs raised related objections to the redistricting plan enacted by Republican lawmakers in 2011. In *Covington v. North Carolina*, twenty-eight plaintiffs contested the configuration of the same number of new, majority-minority districts in the General Assembly. They charged that those districts had been created "through the predominant and unjustified use of race." State defendants answered the complaint by insisting that "race was not the primary factor used in the redistricting, and that even if it was, their use of race was necessary to serve a compelling state interest – namely, compliance with Section 2 and Section 5 of the Voting Rights Act."[212]

In August 2016, the U.S. District Court for the Middle District of North Carolina rejected that defense. The court ruled against the Section 2 claim, noting that Republican lawmakers presented no evidence that they had created majority-minority districts to remedy situations in which "vote dilution" – as in at-large elections, or as a consequence of white bloc voting – restricted minority citizens' "opportunity . . . to participate in the political process and to elect representatives of their choice." In fact, the court observed, Black legislators had a strong record of electoral success in "non-majority-Black" districts. It noted that "in three election cycles preceding the 2011 redistricting, African-American candidates for the North Carolina House won thirty-nine general elections in districts without a majority [Black voting age population] . . . and African-American candidates for the North Carolina Senate won twenty-four such elections." The court took a similarly jaundiced view of Republican lawmakers' Section 5 claim. It pointed out that "eleven of the

[209] "McCrory Asks Supreme Court to Restore Voter ID Law," Raleigh *News and Observer*, August 16, 2016, and "N.C. Republican Party Seeks 'Party Line Changes' to Limit Early Voting Hours," Raleigh *News and Observer*, August 18, 2016.

[210] Newkirk, "What Early Voting in North Carolina Actually Reveals," <http://bit.ly/2ULBchm>, September 5, 2019, and North Carolina Republican Party, "NCGOP Sees Encouraging Early Voting," <http://bit.ly/2HS9B8J>, September 5, 2019.

[211] *North Carolina v. North Carolina State Conference of the NAACP*, 137 S. Ct. 1399 (2017).

[212] *Covington v. North Carolina*, 316 F.R.D. 117, 124, 126, 174 (M.D.N.C. 2016).

[twenty-eight] challenged districts [did] not include any county, in whole or in part, that was covered by Section 5 in 2011, and therefore those districts could not have been drawn to remedy a Section 5 violation."[213]

The court concluded that Republican lawmakers could point to "no strong basis in evidence" that they had acted to correct voting practices or procedures that limited racial minorities' "effective exercise of the electoral franchise."[214] In fact, the 2011 redistricting plan appeared to have been designed to do just the opposite. In Guilford County, for example, the Republican map split forty-six precincts in order to cram 88.39 percent of Greensboro's Black voting-age residents into three majority-minority state House districts. Similarly, Senate district 28 split Greensboro and neighboring High Point along racial lines, and by doing so captured 82.45 percent of the Black voting age population in Greensboro, along with 60 percent of that population in High Point.[215]

Based on these observations, the court ruled that the 2011 redistricting plan "constitute[d] racial gerrymandering in violation of the [Fourteenth Amendment's] Equal Protection Clause." North Carolina "citizens have the right to vote in districts that accord with the Constitution," the court declared. "We therefore order that new maps be drawn that comply with the Constitution and the Voting Rights Act."[216] In 2017, the General Assembly adopted a new redistricting plan that included 116 revised districts. *Covington* plaintiffs objected that twelve of the new districts failed to remedy original instances of racial gerrymandering, or were otherwise unconstitutional. The district court found that nine of those complaints had merit and appointed a Special Master to make additional revisions. On appeal in 2018, the U.S. Supreme Court upheld four of the Special Master's revised maps.[217]

As the *Covington* case came to closure in the federal courts, Common Cause and twenty-three individual plaintiffs sued in state court to block the 2017 redistricting plan. They charged that despite revisions intended to correct racial gerrymandering, redrawn legislative districts still advantaged Republicans over the Democratic challengers that most Black and progressive white voters preferred. In their court filing, the plaintiffs explained how this was done:

> To maximize the number of Republican seats in the General Assembly, the 2017 Plan meticulously 'pack[ed] and crack[ed]' Democratic voters. Packing and cracking are the two primary means by which mapmakers carry out a partisan gerrymander. 'Packing' involves concentrating one party's backers in a few districts that they will win by overwhelming margins to minimize the party's votes elsewhere. 'Cracking' involves dividing a party's supporters among multiple districts so that they fall comfortably short of a majority in each district.[218]

The configuration of legislative districts in Charlotte and Mecklenburg County offered a striking example of these practices in action. The 2017 plan broke Mecklenburg County into twelve House

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[213] Ibid., 125.
[214] Ibid., 174.
[215] Ibid., 47–48 and 164.
[216] Ibid., 178.
[217] Order, *Covington v. North Carolina*, 316 F.R.D. 117 (M.D.N.C. 2016) (No. 1:15-cv-399); Memo. Op. and Order, *Covington v. North Carolina*, 316 F.R.D. 117 (M.D.N.C.) (No. 1:15-cv-399); *North Carolina v. Covington*, 137 S. Ct. 1624 (2017); *North Carolina v. Covington*, 138 S. Ct. 2548, 2550, 2555 (2018).
[218] Amended Compl., 33, *Common Cause v. Lewis*, 2019 N.C. Super. LEXIS 56, 18 CVS 014001 (N.C. Super. Ct. Sept. 3, 2019).

districts. Democratic voters were packed into eight of the districts, seven of which included no Republican-leaning precincts. Conversely, Charlotte's Republican voters were packed into three districts in southern Mecklenburg County, and the last remaining district, in north Mecklenburg, was drawn to give Republicans an advantage by dodging adjacent Democratic-leaning precincts. Senate districts followed a similar pattern. All of Charlotte's Republican-leaning precincts were packed into two districts that overlapped the southern House districts, and Democrat-leaning precincts were concentrated in three districts that included heavily minority, inner city neighborhoods.[219] Given the sharp racial polarization in political party membership, this configuration worked to disadvantage minority citizens, the overwhelming majority of whom affiliate as Democrats.

The effectiveness of packing and cracking was apparent in the 2018 statewide election results. In contests for "both the state House and state Senate . . . Democratic candidates won a majority of the statewide vote." Even so, Republicans secured "a substantial majority of seats in each chamber": 29 of 50 in the Senate and 65 of 120 in the House.[220] "The [electoral] maps," Common Cause and its allies complained, "are impervious to the will of the voters." So was policy making. "In today's state legislatures—and particularly in North Carolina," the Common Cause plaintiffs observed, "Republican representatives are simply not responsive to the views and interests of Democratic voters. Regardless of whether gerrymandering has caused this increased partisanship, such extreme partisanship magnifies the effects of partisan gerrymandering. When Democratic voters lose the ability to elect representatives of their party as a result of partisan gerrymandering, those voters lose not only electoral power, but also the ability to influence legislative outcomes – because Republican representatives pay no heed to these voters' views and interests once in office."[221]

In September 2019, a three-judge panel of the Wake County Superior Court affirmed these claims. They ruled that the 2017 redistricting plan violated the North Carolina state constitution on three counts. "First, the court wrote that partisan gerrymandering 'strikes at the heart' of the Free Elections Clause, a provision of the North Carolina Constitution stating that 'all elections shall be free.' Second, the court held that partisan gerrymandering violated the North Carolina Equal Protection Clause, which [state] courts have interpreted to include the fundamental 'right to vote on equal terms.' . . . Finally, the court declared that under the North Carolina Constitution, partisan gerrymandering unconstitutionally burdens the free speech and assembly rights of those who vote for the disfavored party by diluting their votes and their ability to effectively organize."[222] Based

[219] *Common Cause v. Lewis*, N. C. General Court of Justice, Superior Court Division, 18 CVS 014001, Complaint, November 13, 2018, 1, 28, 109-17, 186-91.

[220] Amended Compl. 1, *Common Cause v. Lewis*, N. 2019 N.C. Super. LEXIS 56, 18 CVS 014001 (N.C. Super. Ct. Sept. 3, 2019); Millhiser, "Cracks in the GOP's Gerrymandering Firewall," <http://bit.ly/35Tq1qL>, November 29, 2020. *See also* North Carolina General Assembly 2019 Senate Demographics, <https://cutt.ly/IUsQoPw>.

[221] Amended Compl. 64, *Common Cause v. Lewis*, 2019 N.C. Super. LEXIS 56, 18 CVS 014001 (N.C. Super. Ct. Sept. 3, 2019); *Common Cause v. Lewis*, Common Cause North Carolina blog, December 17, 2019, <https://cutt.ly/qUenOvR>.

[222] Recent Case: Common *Cause v. Lewis*, Harvard Law Review Blog, October 15, 2019, <https://cutt.ly/cUem59X>.

on these findings, the court ordered that legislative maps be redrawn once more. The General Assembly complied, without legal objection, in October 2019.[223]

Taken together, these judicial rulings underscore the fact that in North Carolina politics, extreme partisan gerrymandering is a highly effective means of discriminating against racial minorities. It works to restrict minority voting power, and, by doing so, weakens the influence of interracial and multiethnic coalitions, particularly within the Democratic Party. The ultimate effect is to entrench white conservatives' control of the General Assembly and public policy.

F. Constitutional Amendment – A New Old Strategy

Republican leaders – including party chairman Robin Hayes, Senate President Pro Tempore Phil Berger, and Speaker of the House Tim Moore – answered these defeats with public declarations that they would "continue to fight." Having failed to secure a comprehensive revision of election law with House Bill 589, they narrowed their focus to voter ID and shifted the battle to the state constitution, where similar struggles over voting rights, race, and democracy had been waged in 1868 and again in 1900. In 2018, Republican lawmakers drafted a constitutional amendment that would require photographic identification of all electors "offering to vote in person." They placed it on the ballot for ratification in the upcoming November election.[224]

That was a shrewd tactical move. As Gerry Cohen, retired special counsel to the General Assembly, observed, Republicans viewed the amendment as a means of "immuniz[ing] voter ID, specifically photo voter ID, from [court challenges on] state constitutional grounds." A future legislature dominated by Democrats would also find it far more difficult to reverse a constitutional amendment than to repeal an election law like House Bill 589. These were live concerns for Republicans who faced a Democratic majority on the North Carolina Supreme Court and, if opinion polls in advance of Election Day had any predictive power, were at risk of losing their supermajority in the state House of Representatives.[225]

Over the course of the campaign, Republicans argued for the voter ID amendment as a reasonable, necessary, and common-sense reform. It was reasonable, they said, because the state had made adequate provision for its citizens to acquire a photo ID. The amendment was necessary,

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[223] *Common Cause v. Lewis*, N. C. General Court of Justice, Superior Court Division, 18 CVS 014001, Judgment, September 3, 2019; *Common Cause v. Lewis*, Common Cause North Carolina blog, December 17, 2019, < https://cutt.ly/qUenOvR>.

[224] "Supreme Court Won't Rescue N.C. Voter ID Law; GOP Leaders Say They Will Try Again with New Law," Raleigh *News and Observer*, May 15, 2017; Act to Amend the North Carolina Constitution to Require Photo Identification to Vote in Person, S.L. 2018-128, H.B. 1092, <http://bit.ly/2LRAE5p>, September 5, 2019; and "Voter ID to Go on N.C. Ballots," <http://bit.ly/2LVTh8c>, September 5, 2019.

[225] Cohen interview, <http://bit.ly/34VsjXc>, September 5, 2019; Act to Amend the North Carolina Constitution to Require Photo Identification to Vote in Person, S.L. 2018-128, House Bill 1092, <http://bit.ly/2LRAE5p>, September 5, 2019; and "Voter ID to Go on N.C. Ballots," <http://bit.ly/2LVTh8c>, September 5, 2019. In June 2018, National Research Inc. conducted a poll for the conservative Civitas Institute, headquartered in Raleigh. When asked which party they would support if the "election for [the] North Carolina State Legislature were held today," 42 percent of respondents favored Democrats and only 34 percent supported Republicans. That was a dramatic change from February and May, when Democrats and Republicans were locked in a tie. The poll, labeled Generic Ballot, General Assembly, was made public on the Longleaf Politics web site, <http://bit.ly/34Gp8CB>, September 5, 2019. The online link is no longer active.

proponents claimed, because widespread voter fraud threatened the integrity of elections. And requiring a photo ID to vote made sense because similar proof of identity was required to "board an airplane, see an R-rated movie, cash a check, or use a credit card."[226]

Voter ID campaign card, Republican John Bell,
Raleigh *News and Observer*, November 1, 2018.

These arguments for the amendment did not stand up to close scrutiny. On the point of reasonableness, the fact remained that Blacks made up 23 percent of registered voters but accounted for 34 percent of voters without photo ID. And widespread voter fraud was simply a myth. In April 2017, the State Board of Elections released an audit of the previous year's general election in which it reported that questionable ballots accounted for just over 0.01 percent of the 4.8 million total votes cast. Of the five hundred and eight cases of fraudulent voting that the board identified, only one involved the kind of in-person deception that a photo ID requirement was designed to expose and prevent. In that instance, a voter impersonated her recently deceased mother, whom she described to election officials as "a tremendous Donald Trump fan." Of the remaining ineligible ballots, four hundred and forty-one were cast by people with felony records whose right to vote had not been restored; forty-one were cast by non-citizens; twenty-four were cast by people who double voted; and one was cast by mail.[227]

The notion of common sense was equally misleading. Theaters have no legal obligation to check moviegoers' photo IDs; the Transportation Safety Administration routinely allows passengers to board planes without a photo ID, so long as they can present other forms of identification; the American Express merchant guide imposes no photo ID requirement on authorized credit card

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[226] "Voter ID: A Form of Suppression or Necessary Protection?" <http://bit.ly/2IR8wOL>, November 29, 2020; "Support Voter ID Today," <http://bit.ly/33mJf8x>, November 29, 2020; "Voter ID Is Back in North Carolina, and the Justifications Are as Lame as Ever," *Charlotte Observer*, June 7, 2018; and "North Carolina Voter ID Amendment Debate Features Misleading Claims," <http://bit.ly/32A2tpJ>, September 5, 2019.

[227] "County-by-County Data Reveal Dramatic Impact of Proposed Election Changes on Voters," <https://bit.ly/3nj4fpK>, November 29, 2020; and *Postelection Audit Report: General Election 2016*, 2, appendix 4.2, and appendix 5, <http://bit.ly/2LQ3TFP>, November 29, 2020. See also Citizens Without Proof, 3, <http://bit.ly/34QpHtJ>, September 5, 2019; Atkeson et. al., "New Barriers to Participation," <http://bit.ly/2LSocT6>, September 5, 2019.

customers; and Visa and Mastercard require a photo ID only for face-to-face cash disbursements, not purchases.[228]

These points of fact notwithstanding, voters approved the constitutional amendment in November 2018 by a margin of 55.49 to 44.51 percent. Republicans carried the day, in part because they had effectively undermined faith in the electoral process by convincing voters that fraud was widespread but remained invisible because there were no laws to expose it. Dallas Woodhouse put it this way: "Millions of North Carolinians believe that there is voter fraud. Now, somebody can disagree with them, but they believe it. So, adding confidence into the system is a very important thing."[229]

Republican leaders had also broken with the General Assembly's well-established practice of appointing study commissions to evaluate the impact of constitutional changes and of drafting legislation to make the details of implementation public and transparent. The bill that authorized the photo ID amendment stipulated that it would be presented as a single declarative sentence on which voters were to decide 'yes' or 'no.' Under pressure from critics, the North Carolina Constitutional Amendments Publication Commission, provided a lengthier explanation:

> This amendment requires you to show photographic identification to a poll-worker before you can vote in person. It does not apply to absentee voting.
>
> The Legislature would make laws providing the details of acceptable and unacceptable forms of photographic identification after passage of the proposed amendment. The Legislature would be authorized to establish exceptions to the requirement to present photographic identification before voting. However, it is not required to make any exceptions.
>
> There are no further details at this time on how voters could acquire valid photographic identification for the purposes of voting. There is no official estimate of how much this proposal would cost if it is approved.

Even though it still lacked specifics, and did not change what voters saw on the ballot itself, this description weakened voter support for photo ID. Shortly before the election, an Elon University poll found that "based upon that language," voter approval dropped from 63 to 59 percent. Had the General Assembly followed past practice and offered a draft of enabling legislation, support might have eroded further.[230]

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[228] "Voter ID Is Back in North Carolina, and the Justifications Are as Lame as Ever," *Charlotte Observer*, June 7, 2018; "North Carolina Voter ID Amendment Debate Features Misleading Claims," <http://bit.ly/32A2tpJ>, September 5, 2019; American Express Merchant Reference Guide – U.S., <https://amex.co/2HKPqtq>, September 5, 2019; Visa Core Rules and Visa Product and Services Rules, <https://vi.sa/2HKJGzJ 336>, September 5, 2019; and Mastercard Transaction Processing Rules, 75, <http://bit.ly/32w1iaI>, September 5, 2019.

[229] "North Carolina Voter ID Amendment (2018)," <http://bit.ly/32tAI1Z>, September 5, 2019. Woodhouse's comments are transcribed from a video recording of a press conference he held on July 29, 2016. See "N.C. Voter ID Law Overturned," Raleigh *News and Observer*, February 9, 2018, (updated online, <http://bit.ly/32oS3cm>), September 5, 2019.

[230] Schofield, "Former Legislative Counsel Gerry Cohen on N.C.'s Six Proposed Constitutional Amendments," <http://bit.ly/34NR8Ea>, September 5, 2019; North Carolina Constitutional Amendments Publication Commission, Official Explanation of the Proposed Constitutional Amendment to Require Photographic Identification to Vote, S.L. 2018-128, <http://bit.ly/34PG5KX>, September 5, 2019; and "N.C. Voters Know Little About Proposed Constitutional Amendments," <http://bit.ly/34VCcnM>, September 5, 2019.

Shortly after Thanksgiving, Republican leaders convened a special session of the General Assembly to pass Senate Bill 824, legislation crafted to implement the photo ID amendment. They were in a hurry, because in the 2018 general election they had lost their super-majority in the state House of Representatives and would soon be unable to counter Democratic Governor Roy Cooper's opposition. When Cooper vetoed the bill, the lame duck legislature quickly overrode him and made it into law.[231]

In December 2018, plaintiffs in *Holmes v. Moore* challenged Senate Bill 824 in state Superior Court. They noted that the new law had been shepherded through the legislature by the same Republican leaders who crafted House Bill 589 five years earlier. Thus, there was no surprise that Senate Bill 824 "retain[ed] many of the harmful provisions" from the voter photo ID section of the prior legislation, and, by doing so, "reproduced the . . . racially discriminatory intent" identified by the Fourth Circuit Court of Appeals. More specifically, the plaintiffs contended that Senate Bill 824 violated the North Carolina Constitution's equal protection and free elections clauses, its property qualification clause, and its protection of free speech and the right of assembly and petition.[232]

A three-judge panel ruled, two to one, for the plaintiffs in September 2021. Senate Bill 824, they wrote, "was enacted in part for a discriminatory purpose and would not have been enacted in its current form but for its tendency to discriminate against African American voters." The legislation therefore violated Article 1, section 19, of the North Carolina State Constitution, which affords all citizens "equal protection of the laws" and specifies that no person "shall . . . be subjected to discrimination by the State because of race, color, religion, or national origin." In reaching this conclusion, authors of the majority opinion pointed to a "totality of circumstances" that included North Carolina's "history of voting and election laws." That history, they observed, "shows a recurring pattern in which the expansion of voting rights and ballot access to African Americans is followed by periods of backlash and retrenchment that roll back those gains for African American voters." In the judges' view, this "historical context" supported plaintiffs' claims the Republican legislature "intended to discriminate against African American voters."[233]

G. Redistricting Redux

Over the course of a decade, Republican legislators have largely failed in their efforts to use the power of the law to restrict minority political participation and influence in shaping public policy. But the fight is hardly over. As noted above, *Shelby v. Holder* gave conservatives new freedom to rewrite election law, and by nullifying the federal preclearance regime, has significantly disadvantaged voting rights advocates, who must now contest discriminatory practices after the fact and on a case-by-case basis. In that respect, the voting rights landscape in North Carolina today bears a troubling resemblance to that of the 1950s.

Republicans retained control of the General Assembly in the 2020 election, and in the subsequent legislative session used the decennial redistricting process to make another run at partisan gerrymandering. In early November of this year, they released maps of new Congressional and

[231] "House Enacts Voter ID with Veto Override," <http://bit.ly/2HNXXf0>, November 29, 2020, and Civitas Statement on Overriding Governor Cooper's Voter ID Veto, <https://bit.ly/33Fc5RH>, November 20, 2020.

[232] *Holmes v. Moore,* N. C. General Court of Justice, Superior Court Division, 18 CVS 15292, Verified Complaint, December 19, 2018, 3, 20- 15292, Verified Complaint, December 19, 2018, 3-5.

[233] *Holmes v. Moore,* N. C. General Court of Justice, Superior Court Division, 18 CVS 15292, Judgment and Order, September 17, 2021, 76, 78; *Constitution of the State of North Carolina, 1868.*

legislative districts that, in the view of critics and partisans alike, will give Republicans a wide advantage over Democratic challengers. Pundits predict that in the 2022 election, Republicans are likely to win ten or eleven of North Carolina's congressional seats and may re-establish a veto-proof super majority in the state legislature.[234]

In court challenges to the new district maps, plaintiffs charge that Republican lawmakers have once again manipulated the redistricting process in order suppress minority political participation and deny political influence to Black and Hispanic voters, who constitute fifty percent of the Democratic electorate. Republican leaders answer that charge by insisting that they "did not look at race" while drawing new district maps.[235]

That claim to colorblindness is cynical and pernicious. It asks us to believe that history has ended; that in a society deeply scarred by slavery and Jim Crow, race no longer matters; and that politicians vying for public office in the racially polarized America of the twenty-first century lack an intimate knowledge of where people live and how they vote.

As historian Morgan Kousser has observed, redistricting will always be informed by race – "formally or informally, precisely or approximately" – because racial divisions "are the single most salient social and political facts in contemporary America, as they have been in much of the nation's past. Redistricting cannot be race-unconscious until the country ceases to be, and pretending that society or politics has become colorblind can only allow discrimination to go unchecked." That is particularly true in North Carolina, where conservatives have long relied on racial discrimination to secure partisan advantage. As the state Superior Court judges noted in *Holmes v. Moore*, "this history of restricting African American voting rights . . . is not ancient; it is a twenty-first-century phenomenon."[236]

XIII. Conclusion

Today's contests over access to the ballot box and representation in government are the latest chapters in North Carolina's long and cyclical history of suppressing minority political participation. Over the last century and a half, white conservatives have employed a variety of measures to limit the rights of racial and ethnic minorities. In the process, they have imposed a heavy burden of injustice. Historically, when minority rights have been constrained, North Carolina's government has been decidedly unresponsive to minority concerns and interests related to social and economic policy. This lack of accountability has perpetuated stark racial disparities in education, employment, health, and general well-being. These circumstances undermine the principles enshrined in North Carolina's constitution by newly emancipated slaves and their white al-

[234] "North Carolina Passes New Maps Giving GOP and Edge in Congress, State Legislature," *News and Observer* (Raleigh, N.C.), November 4, 2021.

[235] "N.C. Redistricting Suits Challenges Lack of Race Data for Maps," WFAE 90.7, October 30, 2021, < https://cutt.ly/YUyjoDF>; "Map by Map, GOP Chips Away at Black Democrats' Power," *New York Times*, December 18, 2021.

[236] J. Morgan Kousser, *Colorblind Injustice: Minority Voting Rights and the Undoing of the Second Reconstruction* (Chapel Hill: University of North Carolina Press, 1999), 270; *Holmes v. Moore,* N. C. General Court of Justice, Superior Court Division, 18 CVS 15292, Judgment and Order, September 17, 2021, 77.

lies of good conscience. "All political power is vested in, and derived from the people," that document still proclaims, and "all government of right originates from the people, is founded upon their will only, and is instituted solely for the good of the whole."[237]

I declare under penalty of perjury under the laws of North Carolina that the foregoing is true and correct.

James L. Leloudis II

December 23, 2021

[237] Constitution of North Carolina, Article I, Section 2.

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Widestrom, Amy M. "Impoverished Democracy." American Political Science Association, August 31- September 4, 2006. <http://bit.ly/2HODy9J>, September 5, 2019.

Appendix

Curriculum Vitae

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ADDRESSES

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EDUCATION

Ph.D., University of North Carolina at Chapel Hill, May 15, 1989

M.A., Northwestern University, June 16, 1979

B.A., with highest honors, University of North Carolina at Chapel Hill, May 14, 1977

ACADEMIC APPOINTMENT

Professor, Department of History, University of North Carolina at Chapel Hill

ADMINISTRATIVE APPOINTMENTS (in reverse chronological order)

Co-Chair, University Commission on History, Race, and a Way Forward, University of North Carolina at Chapel Hill, January 2020 to present.

Peter T. Grauer Associate Dean for Honors Carolina and founding Director, The James M. Johnston Center for Undergraduate Excellence, College of Arts and Sciences, University of North Carolina at Chapel Hill. Appointed July 1, 1999-June 30, 2004; reappointed July 1, 2004-June 30, 2009, appointment revised and extended July 1, 2007-June 30, 2012; reappointed July 1, 2012-June 30, 2017; appointment revised and extended July 1, 2014-June 30, 2019; reappointed July 1, 2019-June 30, 2024.

Interim Director, Center for the Study of the American South, University of North Carolina at Chapel Hill, July 1, 1998-June 30, 1999.

Associate Chair, Department of History, University of North Carolina at Chapel Hill, July 1, 1996-June 30, 1998.

SCHOLARSHIP

Books

Co-author, *Fragile Democracy: The Struggle Over Race and Voting Rights in North Carolina* (Chapel Hill: University of North Carolina Press, 2020).

Co-author, *To Right These Wrongs: The North Carolina Fund and the Battle to End Poverty and Inequality in 1960s America* (Chapel Hill: University of North Carolina Press, 2010).

Schooling the New South: Pedagogy, Self, and Society in North Carolina, 1880-1920 (Chapel Hill: University of North Carolina Press, 1996).

Co-author, *Like a Family: The Making of a Southern Cotton Mill World* (Chapel Hill: University of North Carolina Press, 1987 and 2000; New York: W.W. Norton, 1989).

Historical Exhibits

"Fragile Democracy: The Struggle Over Race and Voting Rights in North Carolina," https://adobe.ly/3c8WJsL.

"Silent Sam: The Confederate Monument at the University of North Carolina," https://silent-sam.online and https://adobe.ly/3dT3XRe.

"The Carolina Hall Story," a permanent exhibit on race, politics, and historical memory at the University of North Carolina at Chapel Hill, installed in Carolina Hall, November, 2016.

"Like a Family: The Making of a Southern Cotton Mill World," Teaching and Learning in the Digital Age, American Historical Association, 2001 (no longer available online).

Articles

Co-author, "Citizen Soldiers: The North Carolina Volunteers and the South's War on Poverty," in Elna C. Green, ed., *The New Deal and Beyond: Social Welfare in the South since 1930* (Athens: University of Georgia Press, 2003), pp. 138-62.

"A Classroom Revolution: Graded School Pedagogy and the Making of the New South," in Czeslaw Majorek and Erwin V. Johanningmeier, eds., *Educational Reform in International Perspective: Past, Present, and Future* (Krakow: Polish Academy of Sciences, 2000), pp. 245-60.

Co-author, "Citizen Soldiers: The North Carolina Volunteers and the War On Poverty," *Law and Contemporary Problems* 62 (No. 4, Autumn 1999): 178-96.

"Schooling the New South: Pedagogy, Self, and Society in North Carolina, 1880-1920," *Historical Studies in Education/Revue d'histoire de l'éducation* 5 (Fall 1993): 203-229.

"Oral History and Piedmont Mill Villages, 1880-1940," *International Journal of Oral History* 7 (November 1986): 163-80.

"Cotton Mill People: Work, Community, and Protest in the Textile South, 1880-1940," (with Jacquelyn Hall and Robert Korstad) *American Historical Review* 91 (April 1986): 245-86.

"School Reform in the New South: The Woman's Association for the Betterment of Public School Houses in North Carolina, 1902-1919," *Journal of American History* 69 (March 1983): 886-909.

"Subversion of the Feminine Ideal: The *Southern Lady's Companion* and White Male Morality in the Antebellum South, 1847-1854," in Rosemary S. Keller, Louise L. Queen, and Hilah F. Thomas, eds., *Women in New Worlds: Historical Perspectives on the Wesleyan Tradition*, vol. 2 (Nashville: Abingdon Press, 1982), pp. 60-75.

Legal Consulting

Plaintiffs' expert witness, *Holmes v. Moore*. Paul, Weiss, Rifkind, Wharton, and Garrison LLP, New York, N.Y., and Southern Coalition for Social Justice, representing Jabari Holmes, Fred Culp, Daniel E. Smith, Brendon Jayden Peay, and Paul Kearney Sr. 2020 and ongoing.

Plaintiff's expert witness. *North Carolina State Conference of the NCAAP v. Cooper*, 1:18-cv-01034, U.S. District Court, Middle District of North Carolina. Arnold and Porter LLP, Washington, D.C., and Forward Justice. 2019 and ongoing.

Plaintiffs' expert witness, *Hall v. Jones County Board of Commissioners*, 4:17-cv-00018, U.S. District Court, Eastern District of North Carolina. Cleary Gottlieb Steen and Hamilton LLP, New York, N.Y., representing John Hall, Elaine Robinson-Strayhorn, Lindora Toudle, and Thomas Jerkins. 2018.

Plaintiff's expert witness. *North Carolina State Conference of the NAACP v. McCrory*, 182 F. Supp. 3d 320 (M.D.N.C. 2016), and *North Carolina State Conference of the NAACP v. McCrory*, No. 16-1468 (4th Cir. 2016). Kirkland and Ellis LLP, Washington, D.C., and North Carolina State Chapter of the NAACP.

TEACHING

Courses

U.S. Since 1865   North Carolina Since 1865   The New South (1865-present)

History of Poverty   Slavery and the University   Oral History Methodology

Recent Doctoral Advisees

R. Joshua Sipe, "Evolving Jim Crow: An Analysis of the Consolidation Movement on the Virginia Peninsula, 1940-1958," M.A. thesis, 2019.

Elizabeth Lundeen, "Brick and Mortar: Historically Black Colleges and the Struggle for Equality, 1930-1960," Ph.D. dissertation, 2018.

Evan Faulkenbury, "Poll Power: The Voter Education Project and the Financing of the Civil Rights Movement, 1961-1992," Ph.D. dissertation, 2016. Published as *Poll Power: The Voter Education Project and the Movement for the Ballot in the American South* (University of North Carolina Press, 2019).

Willie J. Griffin, "Courier of Crisis, Messenger of Hope: Trezzvant W. Anderson and the Black Freedom Struggle for Economic Justice," Ph.D. dissertation, 2016. Forthcoming, Vanderbilt University Press, 2021.

Brandon K. Winford, "'The Battle for Freedom Begins Every Morning': John Hervey Wheeler, Civil Rights, and New South Prosperity," Ph.D. dissertation, 2014. Published as *John Hervey Wheeler: Black Banking and the Economic Struggle for Civil*

Rights (University Press of Kentucky, 2020). Winner of the Lillian Smith Award, 2020.

PROFESSIONAL AWARDS AND FELLOWSHIPS

Faculty Service Award, General Alumni Association, University of North Carolina at Chapel Hill, 2019.

Engaged Scholarship Award, Office of the Provost, University of North Carolina at Chapel Hill, 2011.

Senior Fellow, Kenan Institute for Ethics, Duke University, "Moral Challenges of Poverty and Inequality," 2010-2011.

North Caroliniana Society Book Award, 2010. Awarded for *To Right These Wrongs*.

Academic Leadership Fellow, Institute for the Arts and Humanities, University of North Carolina at Chapel Hill, 2003. Included participation in the Leadership Development Program, Center for Creative Leadership, San Diego, California.

Commencement Speaker, University of North Carolina at Chapel Hill, December 2003 (selected by Senior Class officers and marshals).

Chapman Family Fellowship, Institute for the Arts and Humanities, University of North Carolina at Chapel Hill, 1997.

Fellow of the Academy of Distinguished Teaching Scholars, University of North Carolina at Chapel Hill, inducted in 1996.

Mayflower Cup, awarded by the North Carolina Literary and Historical Association for the year's best work in non-fiction, 1996. Awarded for *Schooling the New South*.

Ruth and Phillip Hettleman Award for Outstanding Scholarly or Artistic Accomplishment by Young Faculty, University of North Carolina at Chapel Hill, 1995.

Fellow of the Institute for the Arts and Humanities, University of North Carolina at Chapel Hill, 1992.

Students' Undergraduate Teaching Award, University of North Carolina at Chapel Hill, 1991.

Claude A. Eggertsen History of Education Dissertation Award, 1989, presented by the Rackham School of Graduate Studies, University of Michigan, for the best dissertation on the history of education.

Albert J. Beveridge Award, 1988, presented by the American Historical Association for *Like a Family*.

Merle Curti Social History Award, 1988, presented by the Organization of American Historians for *Like a Family*.

Philip Taft Labor History Award, 1988, presented by the New York State School of Industrial and Labor Relations, Cornell University for *Like a Family*.

Honorable mention, John Hope Franklin Award, 1988, presented by the American Studies Association for *Like a Family*.

Honorable mention, Research on Women in Education Award, 1984, presented by Women Educators, American Educational Research Association, for "School Reform in the New South."

Louis Pelzer Memorial Award, 1982, presented by the Organization of American Historians for "School Reform in the New South."

IN THE UNITED STATES DISTRICT COURT
FOR THE MIDDLE DISTRICT OF NORTH CAROLINA

NORTH CAROLINA STATE CONFERENCE OF THE NAACP, et al., Plaintiffs, vs. PATRICK LLOYD MCCRORY, in his official capacity as the Governor of North Carolina, et al., Defendants.	Case No: 1:13-CV-658
LEAGUE OF WOMEN VOTERS OF NORTH CAROLINA, et al., Plaintiffs, vs. THE STATE OF NORTH CAROLINA, et al., Defendants.	Case No: 1:13-CV-660
UNITED STATES OF AMERICA, Plaintiff, vs. THE STATE OF NORTH CAROLINA, et al., Defendants.	Case No: 1:13-CV-861

VIDEOTAPED DEPOSITION
OF
JAMES L. LELOUDIS II, Ph.D.

NCLCV v. Hall
21 CVS 15426
LDTX127

Exhibit #
Leloudis 2
12/29/2021 - JNC
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VIDEOTAPED DEPOSITION

OF

JAMES L. LELOUDIS II, Ph.D.

9:59 A.M.

FRIDAY, APRIL 3, 2015

MARRIOTT COURTYARD
100 MARRIOTT WAY
CHAPEL HILL, NORTH CAROLINA

By: Denise Myers Byrd, CSR 8340, RPR, CLR 102409-02

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INDEX OF EXAMINATION

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Leloudis 2	Surrebuttal Expert Report - May 2, 2014	9
Leloudis 3	Expert Report - February 12, 2015	9

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THE VIDEOGRAPHER: We are now on the record. The time is 9:59. Today's date is April 3, 2015.

This is the deposition of James Leloudis in the matter of North Carolina State Conference of the NAACP, et al., plaintiff, versus Patrick Lloyd McCrory in his official capacity as Governor of North Carolina, et al., and related actions, defendants.

Would counsel please now introduce themselves.

MR. STRACH: Phil Strach, counsel for the defendants.

MS. WU: Jodi Wu from Kirkland & Ellis on behalf of the NAACP plaintiffs and the witness.

MS. SWAIN: Caitlin Swain with Advancement Project on behalf of the NAACP and the witness.

MR. STEIN: Adam Stein on behalf of the NAACP, plaintiffs.

MR. BROOK: Christopher Brook --

MS. GREENE: Judybeth Greene from the Department of Justice on behalf of the United States.

MR. BROOK: Christopher Brook on behalf of the League of Women Voter plaintiffs from the ACLU of North Carolina.

MR. SEAWELL: Emily Seawell, Southern Coalition for Social Justice, on behalf of League of Women Voters, North Carolina, plaintiffs.

JAMES LELOUDIS,

having been first duly sworn or affirmed by the Certified Shorthand Reporter and Notary Public to tell the truth, the whole truth and nothing but the truth, testified as follows:

EXAMINATION

BY MR. STRACH:

Q. Good morning.

A. Good morning.

Q. Would you tell me again how to pronounce your last name.

A. Leloudis.

Q. Dr. Leloudis, my name is Phil Strach, proud Carolina law grad so got some connection. I'm going to be taking your deposition today.

You understand, of course, that you're under oath as if you were in court, correct?

A. Yes.
Q. And have you had your deposition taken before?
A. I have not.
Q. Okay. Then let me just give you a few of the ground rules.
When you answer questions, if you will be careful to say yes, no or some other audible response so that the court reporter can take it down. That would be great. Is that okay?
A. That's fine. Okay.
Q. If you need a break at any time, let me know. And I will take occasional breaks also.
If I ask a question that is not clear or you need -- it needs to be clarified in some way, don't hesitate to let me know.
Is that okay?
A. Okay, that's fine.
Q. Primarily what we will be looking at this morning are the expert reports that you have submitted in this case, and by my account, I see one that was submitted last year, then a short surrebuttal --
A. Yes.
Q. -- and then another one this year; is that correct?

A. Yes, that's correct.
Q. And can you tell me what hourly rate you're being paid.
A. 300 an hour.
Q. 300 an hour?
A. Yeah.
Q. And do you know how much total to date you've been paid?
A. Not the exact figure. Something on the order of 48-, 49,000.
Q. Okay. And have you -- who's your -- who's your client, the NAACP?
A. Yes, the NAACP.
Q. And have you submitted invoices to them?
A. For the initial work. Not for the latest report.
Q. Okay. So what I will do here, initially I am just going to mark these as Leloudis 1, 2 and 3. One will be your April 2014 report, 2 will be your May surrebuttal report and 3 will be the 2015 report.
(WHEREUPON, Defendants' Exhibits 1, 2 and 3 were marked for identification.)
BY MR. STRACH:
Q. Dr. Leloudis, I am going to focus on certain

aspects of the report. Obviously feel free to read whatever you think you need to read to answer the question fairly, and if I ask you something in a paragraph somewhere and you need to read around it, just let me know.
A. Okay. Thank you.
MS. WU: Which one are we going to start with?
MR. STRACH: We will start with the April 2014 report, Exhibit 1.
BY MR. STRACH:
Q. Let me start, Dr. Leloudis, on Page 30 of your April 2014 report.
A. All right.
Q. And in particular, I'm looking at the paragraph in the middle of the page where you're talking about the Helms-Gantt contest and a political realignment in the making.
A. Uh-huh.
Q. And you state that this new political realignment involved conservative whites, particularly white men, were moving in ever-greater numbers into the Republican Party, and in the Democratic Party a new biracial alliance was coalescing around a progressive

social vision.
What did you mean by "progressive social vision" there?
A. What that phrase refers to is a vision of state and federal government that is proactive in the expansion of access to the franchise, the guarantee of economic opportunity, access to quality education.
Q. Okay. Is it fair to say that some might describe that as a liberal ideology?
A. That's fair.
Q. So the new biracial alliance that you describe there involve black voters and I guess, for lack of a better term, white liberals?
A. Yes.
Q. And then in the next paragraph you talk about some of the policy issues that Governor Jim Hunt supported during his terms in office.
Do you see that?
A. Yes.
Q. And I guess I just want to understand what point, if any, you're making about his support for those particular -- those particular policies. Is there a reason why you picked those particular policies to focus on?

A. I picked those particular policies because they are -- they offer very concrete description of the kinds of policies that would be embraced in that progressive social vision.
Q. Okay. So here you're using Governor Hunt as sort of an example of implementation of this new biracial alliance that you described earlier?
A. Of its political and economic agenda or vision, yes.
Q. Okay. And for whites in particular who oppose or did not agree with these particular programs that you describe in this paragraph, how would you categorize those folks?
A. I would categorize them as conservatives who embrace a very different conception of the role of government.
Q. Okay. And is it your opinion that conservatives who embrace the different -- a different role of government are necessarily a product of, say, Jim Crow laws from the early part of the century?
MS. WU: Object to form.
THE WITNESS: What I would say is that it is well documented in the scholarly

literature and elsewhere that as the Democratic Party more firmly embraced this liberal progressive agenda in the years after World War II, the conservative whites moved increasingly out of that party into the Republican Party.

BY MR. STRACH:

Q. Okay. And have you concluded that the conservative whites moved out of that party primarily as a reaction to blacks or primarily as a reaction to liberal policies that they didn't agree with?

MS. WU: Object to form.

THE WITNESS: I don't think they would have made the distinction between the two.

BY MR. STRACH:

Q. You don't think that the conservative whites who left --

A. Right.

Q. -- would have made that --

A. Would have made that distinction.

MS. WU: Make sure you let him finish his question. It's easier for the court reporter.

MR. STRACH: And I'll try to do good on that too.

BY MR. STRACH:
Q. Now, in particular, the conservative whites we were talking about, is there a particular timeframe that you're thinking about those folks that wouldn't make that distinction?
A. I think that change began as early as the 1930s as Roosevelt's New Deal began to open the door ever so slightly, particularly to economic opportunity for blacks in the South and elsewhere in the nation and accelerated in the years after that, particularly after World War II as the Democratic Party more firmly and officially endorsed the Civil Rights agenda.
Q. Do you think that there are modern conservative whites who disagree with, say, a Governor Hunt's progressive social vision -- who disagree with that vision for reasons completely unrelated to race?
MS. WU: Object to form.
THE WITNESS: I don't think one can make that distinction. The policies we're talking about here by very definition involve a differential impact on minority Americans, and if that's the case, then race is an issue.
BY MR. STRACH:

Q. And that's your view based simply on your review of the historical record, correct?
A. It is.
Q. You've not done -- have you done any surveys of voter attitudes on race versus ideology?
A. No, I have not.
Q. On Page 31 of the report you talk about, in Section 2, electoral reform from 2000 to 2012, and in the first paragraph there you remark that the reforms open the way for black turnout to soar to historic highs in the 2008 and 2012 elections.
Do you see that?
A. Yes.
Q. What evidence do you have that the turnout by blacks in 2008 and 2012 was due to the election reforms as opposed to the candidacy of Barack Obama?
MS. WU: Object to form.
Just for the record, the entire sentence says "when voters rallied behind the candidacy of Barack Obama, who would become the first African American president of the United States."
MR. STRACH: Thank you, Jodi. We can

all read that.
BY MR. STRACH:
Q. Do you remember the question?
A. Let me -- restate it, please, if you would.
Q. What evidence do you have that the increase in black turnout in 2008 and 2012 was due to the election reforms and not the candidacy of Barack Obama?
A. I'd point to two things: One, that those election reforms addressed and mitigated barriers to participation that are well documented in the scholarly literature, including the fact that minority voters suffer a higher rate of poverty, higher rates of unemployment, are more likely than whites to be sick or disabled, are more likely to work in jobs that don't provide time off to vote during regular hours on a weekday, workday.
So those reforms mitigated those -- those barriers and barriers that are themselves a legacy of a long history of racial discrimination under Jim Crow.
And the second thing I'd point to is that the increase in participation begins before 2008. If it were attributable solely to

the candidacy of Barack Obama, I think we would have expected a much sharper spike in 2008, but the numbers actually crest 50 percent for the first time in 2004.

Q. Right. I don't see where you mentioned that in this report.

A. I'm sorry. It's not in this report. It's illustrated in the most recent report.

Q. All right. Have you done any quantitative studies of the turnout in 2008 and 2012 to attempt to determine the source of that turnout?

A. I have not. I have relied on the scholarly literature.

Q. And what scholarly literature have you reviewed that concluded that the turnout by blacks in 2008 in North Carolina were due to the election reforms?

MS. WU: Object to form.

THE WITNESS: Those sources are documented in footnotes on this page, particularly Footnote 85, and I'd refer you to the subsequent report where additional literature is cited.

BY MR. STRACH:

Q. Okay. Footnote 85 here, we have an article by McLaughlin, "Improving Voter Participation."
Do you recall what publication that was in?
A. I don't. I'd need to look at the bibliography.
Q. And the other article that you cite is by Crowell, which I believe is Michael Crowell.
A. Who is at the Institute of Government, yes.
Q. And it looks like the other article that you cited is the Atlantic Wire; is that correct?
A. Yes.
Q. If you would turn to Page 33. In the first full paragraph that starts "The policies at the Civitas Institute opposes," et cetera, you talk about several policy issues starting with the lawmakers cut benefits for North Carolinians who are chronically unemployed, et cetera.
Do you see that?
A. Yes.
Q. In your opinion with respect to these particular issues that you outline in this paragraph, are there any legitimate reasons for opposing these programs that are not related to race?
MS. WU: Object to form.

THE WITNESS: I'm sure the reasons are not -- not unilateral, but, again, it is very clear and well documented that these policies have a differential impact on minority voters. They address sort of turning back of policies that had been designed to mitigate the long-term consequences of Jim Crow and racial discrimination.

So again, to the degree that these reforms disproportionately affect minority voters, it seems to me they are by virtue of that fact a matter of race.

BY MR. STRACH:

Q. Okay. So the disproportionate impact is what you're focused on there?

A. Yes.

Q. Do you have any evidence that the provision of unemployment benefits when it was first created was enacted specifically to help blacks?

A. I do not.

MS. WU: Object to form.

BY MR. STRACH:

Q. Do you have any evidence that Medicaid was created specifically to help blacks?

A. I have not undertaken exhaustive research on that topic, but I think it's well accepted in the scholarly literature that, yes, Medicare established in the mid 1960s in the context of the Voting Rights Act and Civil Rights Act was meant in significant measure to address these racial disparities.

Q. Excuse me. Can you -- sitting here today, can you direct me to any scholarly literature that concludes that?

A. I can't sitting here today.

Q. Further down the page there's several bullet points. In the second one is a paragraph discussing difficulty in acquiring identification, and there's a sentence that says, "The U.S. Department of Justice reports that in 10 North Carolina counties the DMV operates only a single office that opens once per month," and you provide other such statements in that paragraph, and I just want to understand the source.

I see the Footnote 91 which cites the case number in this particular legal action.

Do you recall what specifically was the basis for the information in that bullet point?

A. One of the plaintiffs' expert's reports.

Q. Okay. Do you recall which one?
A. I do not.
Q. With regard to this issue of disproportionate impact on blacks that we've talked about, is it your opinion that if blacks utilize a particular election procedure at a higher rate than other voters that it's inappropriate to repeal that practice?
MS. WU: Object to form; calls for a legal conclusion.
THE WITNESS: I don't think I have the expertise to render a judgment.
BY MR. STRACH:
Q. Is the -- in your mind, if blacks utilize a particular election procedure at a higher rate than other voters, can there be any legitimate reason to repeal it that does not have a basis in race?
MS. WU: Object to form; calls for speculation.
THE WITNESS: I'm not willing to speculate on that -- on that point.
BY MR. STRACH:
Q. Why do you think that it's asking you to speculate?

A. Because it's asking me to speak to the motives of people whose -- whose motives I've not inquired into.
Q. Okay. That's fair.
Let's take a look at the surrebuttal report.
MS. WU: Is this Exhibit 2?
MR. STRACH: This is Exhibit 2, yes.
BY MR. STRACH:
Q. Let me ask you a more general question about the -- what we just looked at.
From a pure history professor perspective, does your study, as reflected in Exhibit 1, reflect any -- reflect any particular genre of historical study?
A. I don't believe --
MS. WU: Object to form.
THE WITNESS: I don't believe so.
BY MR. STRACH:
Q. In Paragraph 1 of the surrebuttal report, you address the reports by Dr. Donald Schroeder and Sean Trende in which they attempt to put the North Carolina election law in context of other states.
A. Uh-huh.

Q. Do you see that? Do you think it's important in assessing the impact of an election law in one state to put it in the context of other states?

MS. WU: Object to form.

THE WITNESS: In this instance, no.

BY MR. STRACH:

Q. And why is that?

A. I think it's -- it's false argument that doesn't stand up to scrutiny. It reminds me of an argument that basically says I used to beat my wife a little. Other states do it more, let me do it more to move to the middle. And it in that sense ignores and dodges the history that is detailed -- that is laid out in detail in each of these reports.

Q. So in your mind, historical context in the state matters but other types of context do not?

MS. WU: Object to form.

THE WITNESS: Forms of context that don't speak to the fundamental issue, they do not help us in understanding.

BY MR. STRACH:

Q. Okay. And in your mind, what is the

fundamental issue?

MS. WU: Object to form.

THE WITNESS: The issue I believe is a fundamental right of access to the ballot and to exercise the franchise.

BY MR. STRACH:

Q. And so in your mind, in terms of access to the ballot, it's irrelevant what other states do?

A. If other states also deny that access, yes, I think it is irrelevant.

Q. In the second paragraph of this Exhibit 2 you note that in 2001, lawmakers gave nearly unanimous approval to a bill that extended early voting to party primaries.

With regard to that bill specifically, do you have any evidence that that bill was passed specifically to remedy black-voting issues?

A. Yes, to the degree that it was spearheaded by lawmakers who were accountable to that constituency.

Q. Right. But do you have any evidence that it was passed in order to remedy black-voting issues?

MS. WU: Object to form.

THE WITNESS: I'm not sure I understand the question.
BY MR. STRACH:
Q. Can you point me to any -- other than speculation about representation of constituents, can you point to any evidence in any record anywhere that indicates this bill was passed to remedy black-voting issues?
MS. WU: Object to the characterization of the witness' testimony, and he's already answered the question.
BY MR. STRACH:
Q. You can answer.
A. I do believe I've answered the question. And I would just say that I think drawing a link between lawmakers' actions and the interest of their constituencies is not speculation.
Q. Is that the only evidence that you have?
A. Yes.
Q. And then the sentence goes on to discuss in 2003 they supported legislation that allowed for ballots cast out of precinct to be counted on a provisional basis.
What evidence do you have that that particular legislation was passed to remedy

black-voting issues?
A. The same evidence that I've just cited.
Q. Okay. In the next paragraph you make -- you ask the rhetorical question "What changed after 2007," and you go on to talk about the voter participation in 2008.
Are you aware of when a photo ID requirement was first sought in the North Carolina General Assembly?
A. I'm not.
Q. Do you know if a photo ID requirement was sought before 2007?
A. I do not.
Q. Have you made -- ever made any attempt to research that issue?
A. I have not researched that issue in part because the legislation here spans well beyond simple requirement of voter ID.
Q. Okay. Do you -- are you aware of any opposition to out-of-precinct voting that occurred in the legislature prior to 2007?
MS. WU: Object to form.
THE WITNESS: I have not. It's not something I've researched.
BY MR. STRACH:

Q. Are you aware of a bill that passed in 2005 that clarified that out-of-precinct votes would be counted?
A. I'd have to look in more detail in the subsequent report to answer that.
Q. In the next paragraph you make a statement that the 2010 redistricting process diminished the voting power of African Americans.
In what way?
A. The gerrymandering of districts that isolated pools of African American voters and their white allies and gerrymandering that was calculated.
Q. Are you aware of the number of seats held by African Americans in the North Carolina legislature prior to 2010?
A. I can't cite that precise number here today.
Q. Are you aware that the number of seats significantly increased after the 2010 redistricting process?
MS. WU: Object to form.
THE WITNESS: I'm not, but I'm not sure that that's wholly relevant. There could be an increase in the number of seats but still those lawmakers isolated in a small minority.

BY MR. STRACH:
Q. Because they're Democrats?
A. Because of the gerrymandering that produced a majority Republican legislature.
Q. Okay. So you're saying they lost voting power because they're Democrats and Democrats are in the minority?
MS. WU: Object to form.
THE WITNESS: No. I'm saying that they lost voting power because they were black Democrats and that race has been a fundamental constitutive force in this process at every step.
BY MR. STRACH:
Q. Now, if the number of blacks holding seats in the legislature increased, though, logically that means they increase their voting power, correct?
MS. WU: Object to form.
THE WITNESS: Their voting power on the legislative floor itself, they might have increased numbers, but they lost effectiveness.
BY MR. STRACH:
Q. And they lost effectiveness because they're Democrats?

A. They lost effectiveness because they're black Democrats.
Q. Why does it matter if they're black Democrats or white Democrats if the Democrats are in a minority?
A. Well, that would require a long accounting of this history, but I would repeat the fact that the history of partisan politics in this state that race has at every step along the way been a powerful constitutive force in party alignment.
Q. Okay. I understand your opinion on that, but I don't understand how their voting power, if their numbers are increased in the legislature, are decreased -- is decreased unless it's simply because they're in the minority party.
MS. WU: Do you need him to rephrase the question?
THE WITNESS: Yes. Rephrase the question for me, please.
BY MR. STRACH:
Q. How -- if African American numbers in the state legislature have increased, how is their voting power diminished through anything other than the fact that they are in the minority party?

MS. WU: Object to form.
THE WITNESS: Those lawmakers' effectiveness on the floor of the legislature is diminished because they and the alliance in which they are situated is shaped in fundamental ways by issues of race, have been effectively ring-fenced and contained in gerrymandered districting.
BY MR. STRACH:
Q. So does that mean that since those black members of the General Assembly are Democrats, that Democrats are therefore entitled to be in the majority so that their voting power is not diminished?
MS. WU: Object to form.
THE WITNESS: I'm not sure I understand the question.
BY MR. STRACH:
Q. If their voting power has been diminished because they are black Democrats, are you saying that they are entitled -- are you saying that their voting power would only not be diminished if they were in the majority --
MS. WU: Same objection.
BY MR. STRACH:

Q. -- party in the legislature?
MS. WU: Same objection.
THE WITNESS: I'm not sure I understand that question.
BY MR. STRACH:
Q. I take it you do not purport to be a redistricting expert, correct?
A. I am not.
Q. Okay. Let's take a look at Exhibit 3, the most recent report. And one thing I wanted to confirm just for the sake of efficiency and time is I read it -- as I read it, the sections that were added or significantly changed were Subsections F and G under the discussion.
A. That's correct.
Q. Okay. And the Subsections A through E at least appear to me to be virtually the same as the last report, correct?
A. Yes. Minor changes, but...
Q. If you'll turn to Page 30, you list -- you have several bullet points and you list several pieces of legislation. The first one is 1992, a particular statute required the State Board of Elections to initiate a statewide voter registration drive and adopt rules under which

county boards of elections were to conduct the drive.

Are you saying that this House Bill 1776 was adopted in 1992?

A. Yes.

Q. And what evidence do you have that it was adopted to remedy black-voting issues?

MS. WU: Object to form.

THE WITNESS: Again, I'd repeat a point I made before and that it was proposed, advocated for by the lawmakers who were responsive to their constituency.

BY MR. STRACH:

Q. And do you recall which lawmaker proposed this bill?

A. I do not.

Q. Do you recall which lawmakers voted for it?

A. I did not investigate roll call vote.

Q. And Senate Bill 568, as referenced in the next paragraph but there's no bullet point, was that something to your knowledge that was also passed in 1992?

A. Yes.

Q. And other than the evidence that you've referred to several times, do you have any other evidence that this was passed to remedy black-voting issues?

MS. WU: Object to form.

THE WITNESS: I believe I've already stated the evidence which I've drawn that conclusion.

BY MR. STRACH:

Q. Okay. And in 2002, you reference 163-227.2 allowed voting not earlier than the third Thursday before an election.

Were you aware of the fact that that law actually shortened the early voting period previously in effect?

A. No.

Q. The next statute is 163-166.11 allowing voters who went to the wrong precinct on election day to vote a provisional ballot.

I think we talked about that already.

A. Yes.

Q. 2005 is -- you have a reference to Senate Bill 133. This is the bill I think we talked about earlier which the General Assembly clarified its intent regarding out-of-precinct provisional ballots, correct?

A. Yes.

Q. And you refer here to a reference by the General Assembly regarding African American disproportionate use of out-of-precinct voting.
Do you see that?
A. Yes.
Q. Are you aware of what data the General Assembly relied upon to make that statement?
A. I am not.
Q. Okay. Have you done any independent investigation of that statement?
A. None other than the legislation, no.
Q. All right. Regarding the vote on Senate Bill 133, are you aware of what the partisan breakdown was on the final vote?
A. I did not investigate roll call.
Q. 2007, you reference House Bill 91 allowing for same-day registration, correct?
A. Yes.
Q. Are you aware of what the partisan breakdown on the vote on that was?
A. No.
Q. And do you have -- other than the evidence you've discussed already, do you have any evidence that same-day registration was enacted to remedy black-voting issues?

MS. WU: Object to form.

THE WITNESS: I believe I've already stated the evidence.

BY MR. STRACH:

Q. Okay. And then similarly with the 2009 pre-registration, are you aware of the vote breakdown on that bill?

A. I am not.

Q. And other than evidence you've discussed, do you have any evidence that pre-registration was enacted to remedy black-voting issues?

MS. WU: Object to form.

THE WITNESS: Other than the evidence I've already stated, no.

BY MR. STRACH:

Q. Are you aware of what the black turnout was in the 2014 election following the repeal of same-day registration and out-of-precinct voting?

A. I don't have that number at hand.

Q. All right. Have you done any independent study or review of the number of voters who may lack an identification that's required under House Bill 589?

A. I've not taken an independent investigation,

no.
Q. Are you aware of any -- are you aware of the scholarly literature on the effect of early voting on turnout?
MS. WU: Object to form.
THE WITNESS: Other than the sources cited in this report, no.
BY MR. STRACH:
Q. Are you aware of the literature that concludes that early voting does not increase turnout?
MS. WU: Object to form.
THE WITNESS: I am not.
BY MR. STRACH:
Q. Are you aware of any literature that discusses the impact of same-day registration on turnout?
A. Other than the literature cited in this report, no.
Q. Have you ever studied educational disparities between whites and blacks in states other than North Carolina?
A. I have not.
Q. Are you aware of whether there are states that have educational disparities that are higher than the educational disparities in North Carolina?

A. Yes.
Q. Are you aware that some of those states are states without the history of official discrimination that North Carolina has?
MS. WU: Object to form.
THE WITNESS: I'm not sure I understand the term "official discrimination."
BY MR. STRACH:
Q. What does that mean to you?
A. Law.
Q. De jure like --
A. Yes.
Q. -- say, de jure segregation?
A. Yes.
Q. Do you know if Wisconsin has a history of de jure segregation?
A. No.
Q. Do you know whether or not the educational disparities between whites and blacks in Wisconsin is higher or lower than those disparities in North Carolina?
A. I don't have that information at hand.
MR. STRACH: Take a break.
THE VIDEOGRAPHER: Off record, the time is 10:50.

(Brief Recess.)

THE VIDEOGRAPHER: Now back on the record, 10:57.

MR. STRACH: Thank you, Dr. Leloudis, I don't have any further questions for you right now.

THE WITNESS: Thank you.

MS. WU: No questions.

THE VIDEOGRAPHER: Then this concludes the deposition at 10:57.

MS. GREENE: No questions.

[SIGNATURE RESERVED]

[DEPOSITION CONCLUDED AT 10:57 A.M.]

A C K N O W L E D G E M E N T O F D E P O N E N T

I, JAMES L. LELOUDIS II, Ph.D., declare under the penalties of perjury under the State of North Carolina that I have read the foregoing 38 pages, which contain a correct transcription of answers made by me to the questions therein recorded, with the exception(s) and/or addition(s) reflected on the correction sheet attached hereto, if any.

Signed this the day of , 2015.

JAMES L. LELOUDIS II, Ph.D.

E R R A T A S H E E T

Case Name: NAACP vs. Patrick Lloyd McCrory, et al.

Witness Name: JAMES L. LELOUDIS II, Ph.D.

Deposition Date: Friday, April 3, 2015

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Signature Date

STATE OF NORTH CAROLINA)
) C E R T I F I C A T E
COUNTY OF WAKE)

I, DENISE MYERS BYRD, Court Reporter and Notary Public, the officer before whom the foregoing proceeding was conducted, do hereby certify that the witness whose testimony appears in the foregoing proceeding were duly sworn by me; that the testimony of said witness was taken by me to the best of my ability and thereafter transcribed under my supervision; and that the foregoing pages, inclusive, constitute a true and accurate transcription of the testimony of the witness(es).

Before completion of the deposition, review of the transcript [X] was [ ] was not requested. If requested, any changes made by the deponent (and provided to the reporter) during the period allowed are appended hereto.

I further certify that I am neither counsel for, related to, nor employed by any of the parties to this action, and further, that I am not a relative or employee of any attorney or counsel employed by the parties thereof, nor financially or otherwise interested in the outcome of said action.

This the 27th day of April 2015.

Denise Myers Byrd
CSR 8340, RPR, CLR 102409-02

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V

IDEAS

We Drew Congressional Maps for Partisan Advantage. That Was the Point.

Politics is a legal consideration, while race sometimes is not.

By Ralph Hise and David Lewis

Representative David Lewis addresses the House during a special session at the general assembly in Raleigh, North Carolina. (Gerry [illegible]ome / AP)

NCLCV v. Hall
21 CVS 15426
LDTX130

MARCH 25, 2019

SHARE

Exhibit#:
Hise 04
12/30/21

Representative David Lewis addresses the House during a special session at the general assembly in Raleigh, North Carolina. (Gerry Broome / AP)

MARCH 25, 2019 SHARE

About the authors: *Senator Ralph Hise chairs the N.C. Senate Committee on Redistricting. Representative David Lewis is a Republican member of the North Carolina general assembly representing the state's 53rd House district since 2002. He chaired the N.C. House of Representatives Redistricting Committee from 2011 to 2018, and he is a named defendant in* Rucho v. Common Cause, *which the U.S. Supreme Court will hear on March 26, 2019.*

"I propose that we draw the maps to give a partisan advantage to 10 Republicans and three Democrats, because I do not believe it's possible to draw a map with 11 Republicans and two Democrats," one of us said in 2016, as the North Carolina legislature drew new congressional maps.

It's a made-for-headlines statement, an apparent gaffe that reveals what everybody knows but nobody says. And on Tuesday, as the U.S. Supreme Court hears arguments in the landmark partisan gerrymandering case *Rucho v. Common Cause,* it will likely take center stage again.

EXHIBIT 5

Joint Meeting of Committees

August 18, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

Offered by:
Representative Harrison

Pass: ______

Fail: ______

Proposed Redistricting Process

1. **Start the Redistricting Process Immediately Upon Legacy Data Release.** The Committees should begin the redistricting process by utilizing the Legacy Format Summary File of P.L. 94-171 data. General Assembly central staff should start processing the legacy format data immediately upon release of that data by the U.S. Census Bureau.

2. **Provide Redistricting Information on the NCGA Website.** To facilitate public comment and participation, the General Assembly should maintain the existing redistricting webpage, clearly bookmarked from the home page of the NCGA website, containing all redistricting information in one location, including the following: meeting notices, livestream links, draft maps and any related data and information, and a public comment portal. This webpage should also include an up-to-date posting of the public comments received via the public comment portal.

3. **Permit Written and Oral Public Comment.** The Committees should ensure all North Carolinians have an opportunity to provide public comment to the members of the Committees regarding redistricting. The Committees should receive public comment in accordance with the following:
   a. Through a public comment portal, email, and the U.S. Postal Service. Information about how North Carolinians can submit public input should be provided contemporaneously with any Redistricting committee meeting notices.
   b. Before any draft maps are drawn and before final proposed maps are voted on by the Committees.

4. **Ensure Quality Video and Audio Broadcast in Public Meetings.** The Committees should strive to ensure that video and audio of Committee meetings related to map drawing are timestamped and of a quality such that the public can view relevant details of the proposed maps and hear relevant discussion. Committee notices should include a contact phone number for those observing the process to report technical issues. The Committees should halt map drawing until any technical issues that prevent public observation are resolved.

5. **Hold Accessible Public Hearings Throughout the State.** The Committees should provide live in-person hearings in areas throughout the State for community members to provide live testimony. In scheduling the public hearings, the Committees should comply with the following:
   a. The Committees should conduct at least thirteen hearings, accounting for one from each of the 2019 Congressional districts. Consideration should be given to locations and facilities that are accessible by public transport and to those with disabilities.
   b. The Committees should provide remote options for viewing public hearings and for providing public comment where it is technologically feasible to do so.
   c. The Committees should endeavor to post a full schedule of public hearings at the beginning of the redistricting process, and in any event provide at least two weeks' notice of any public hearing on redistricting. Public hearings should not be scheduled during or near public holidays, such as Labor Day.

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21 CVS 15426
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Joint Meeting of Committees

August 18, 2021

House Committee on Redistricting

Senate Committee on Redistricting and Elections

6. **Disclose All Third Parties Involved in Redistricting.** The Committees should immediately disclose all consultants and counsel to members and committees of either house of the General Assembly who are paid by State funds who will be participating in the redistricting process. Such disclosure should occur within 24 hours of adoption of this criteria or engagement, whichever occurs first.

7. **Committee Consideration of Maps.** The Committees should consider only maps that comply with all of the following:
    a. Any criteria, systems, or data used in developing the map was disclosed to the public in advance of its use in a manner that allows the public to have a reasonable and adequate opportunity to view the information.
    b. The map was released online for public comment, and the public had adequate time to review the map and to submit public comment on the map before it is considered by the Committee or revised by the Committee.
    c. The map was drawn in the public view, including a live-stream of the drawing.
    d. Written documentation justifying the districts chosen was released online with the map for public viewing.

8. **Disclose Initial Draft Maps.** After receiving and incorporating public comment, draft maps should be released online for additional public comment within 30 days of when the Committees begin drawing maps.

9. **Submit Final Proposed Maps to the General Assembly.** The final proposed maps should be publicly released online no later than 21 days after the draft maps are released. The Committees should deliver the final proposed bill containing the map to the appropriate Chamber within 10 days of the release of the final proposed maps.

Offered By: Representative Harrison

Signature: ____________________

EXHIBIT 8

Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

Criteria Adopted by the Committees

- **Equal Population.** The Committees will use the 2020 federal decennial census data as the sole basis of population for the establishment of districts in the 2021 Congressional, House, and Senate plans. The number of persons in each legislative district shall be within plus or minus 5% of the ideal district population, as determined under the most recent federal decennial census. The number of persons in each congressional district shall be as nearly as equal as practicable, as determined under the most recent federal decennial census.

- **Contiguity.** No point contiguity shall be permitted in any 2021 Congressional, House, and Senate plan. Congressional, House, and Senate districts shall be compromised of contiguous territory. Contiguity by water is sufficient.

- **Counties, Groupings, and Traversals.** The Committees shall draw legislative districts within county groupings as required by *Stephenson v. Bartlett*, 355 N.C. 354, 562 S.E.2d 377 (2002) (*Stephenson I*), *Stephenson v. Bartlett*, 357 N.C. 301, 582 S.E.2d 247 (2003) (*Stephenson II*), *Dickson v. Rucho*, 367 N.C. 542, 766 S.E.2d 238 (2014) (*Dickson I*) and *Dickson v. Rucho*, 368 N.C. 481, 781 S.E. 2d 460 (2015) (*Dickson II*). Within county groupings, county lines shall not be traversed except as authorized by *Stephenson I*, *Stephenson II*, *Dickson I*, and *Dickson II*.

  Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking. If a county is of sufficient population size to contain an entire congressional district within the county's boundaries, the Committees shall construct a district entirely within that county.

- **Racial Data.** Data identifying the race of individuals or voters *shall not* be used in the construction or consideration of districts in the 2021 Congressional, House, and Senate plans. The Committees will draw districts that comply with the Voting Rights Act.

- **VTDs.** Voting districts ("VTDs") should be split only when necessary.

- **Compactness.** The Committees shall make reasonable efforts to draw legislative districts in the 2021 Congressional, House and Senate plans that are compact. In doing so, the Committee may use as a guide the minimum Reock ("dispersion") and Polsby-Popper ("permiter") scores identified by Richard H. Pildes and Richard G. Neimi in *Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances After Shaw v. Reno*, 92 Mich. L. Rev. 483 (1993).

- **Municipal Boundaries.** The Committees may consider municipal boundaries when drawing districts in the 2021 Congressional, House, and Senate plans.

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Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

- **Election Data.** Partisan considerations and election results data *shall not* be used in the drawing of districts in the 2021 Congressional, House, and Senate plans.

- **Member Residence.** Member residence may be considered in the formation of legislative and congressional districts.

- **Community Consideration.** So long as a plan complies with the foregoing criteria, local knowledge of the character of communities and connections between communities may be considered in the formation of legislative and congressional districts.

Map 15. VTD CCSC for NC-11

EXHIBIT 11

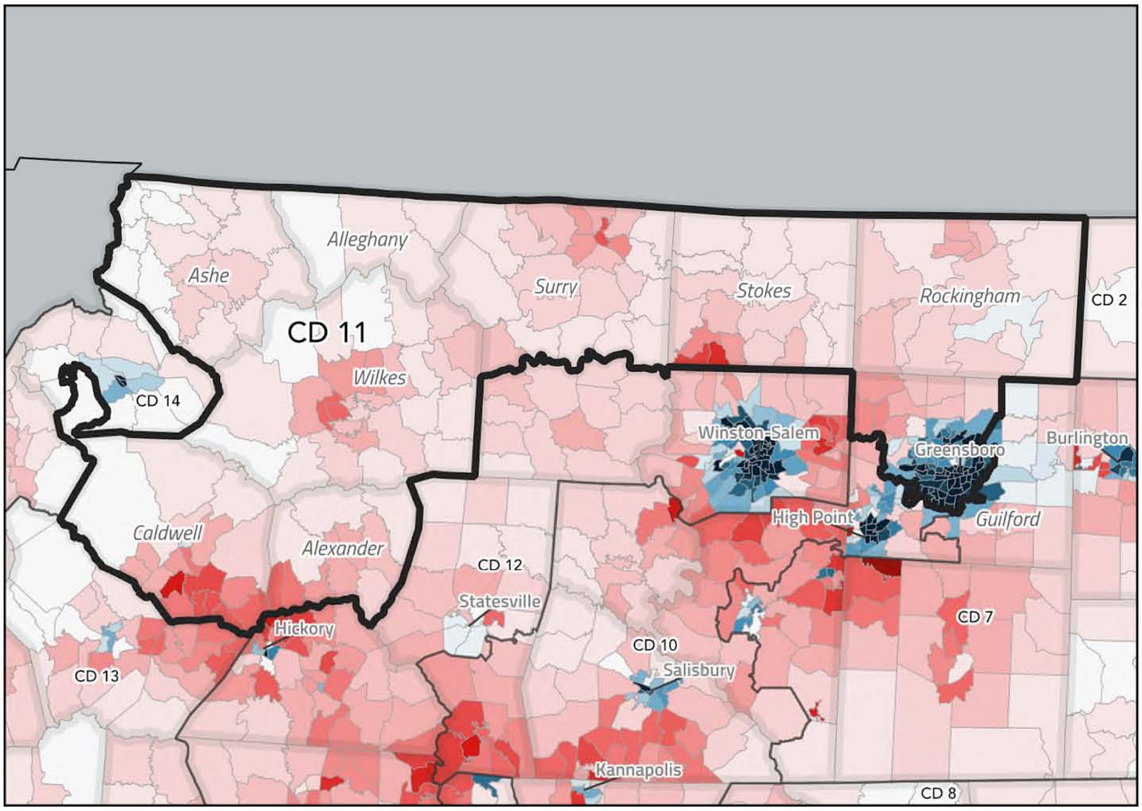

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Exhibit 13

Map 19. VTD CCSC for the Granville and Wake County Cluster

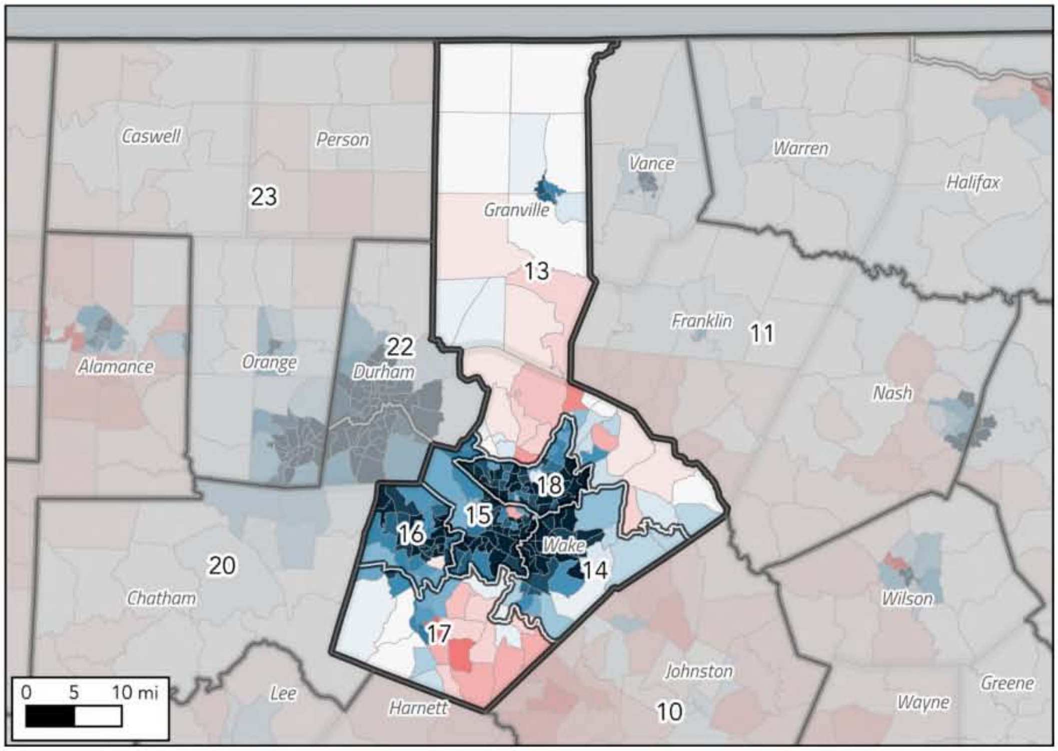

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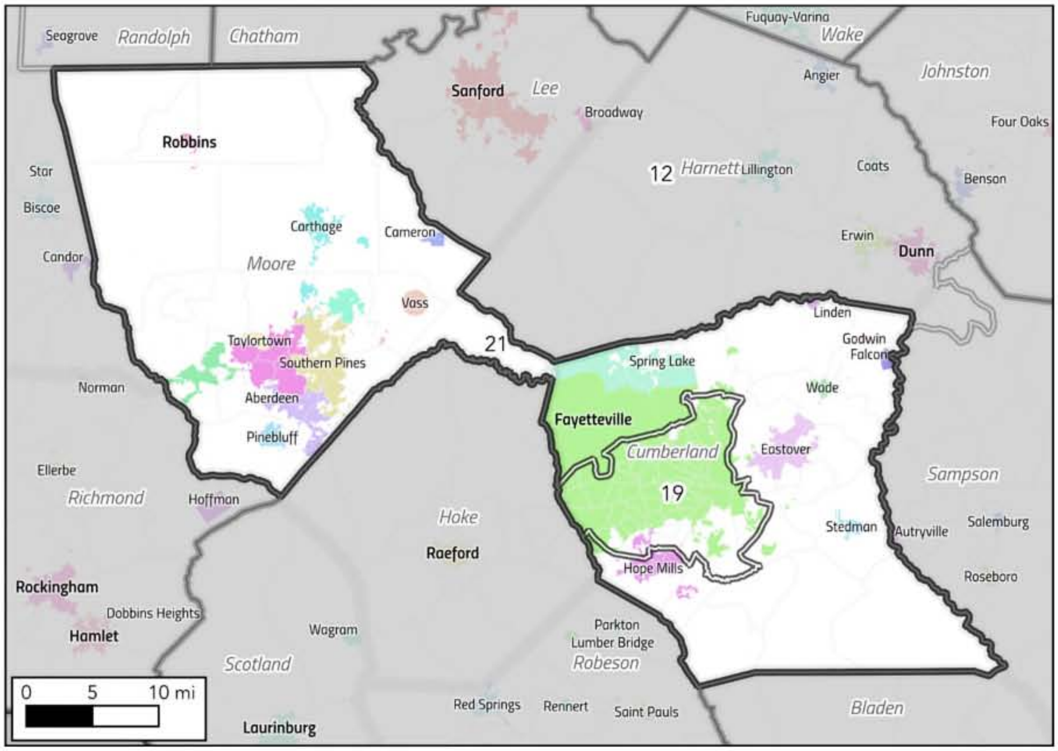
EXHIBIT 14

Map 25. Municipal Splits for the Cumberland and Moore County Cluster



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Map 24. VTD CCSC for the Cumberland and Moore County Cluster

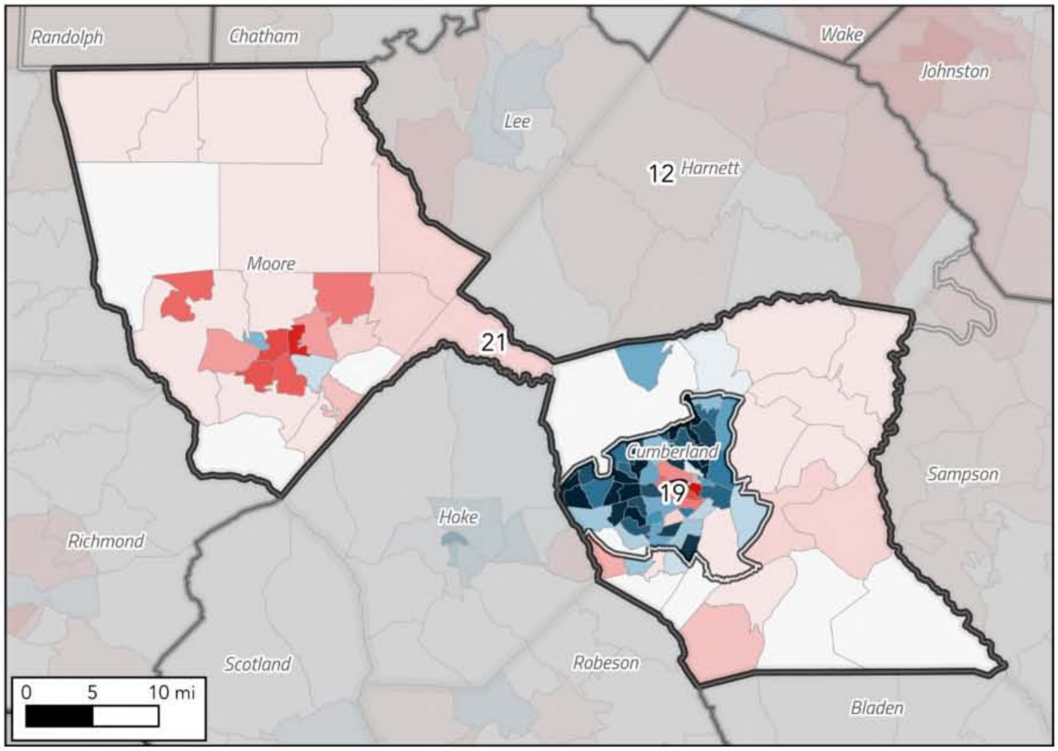


EXHIBIT 16

Map 26. VTD CCSC for the Forsyth and Stokes County Cluster

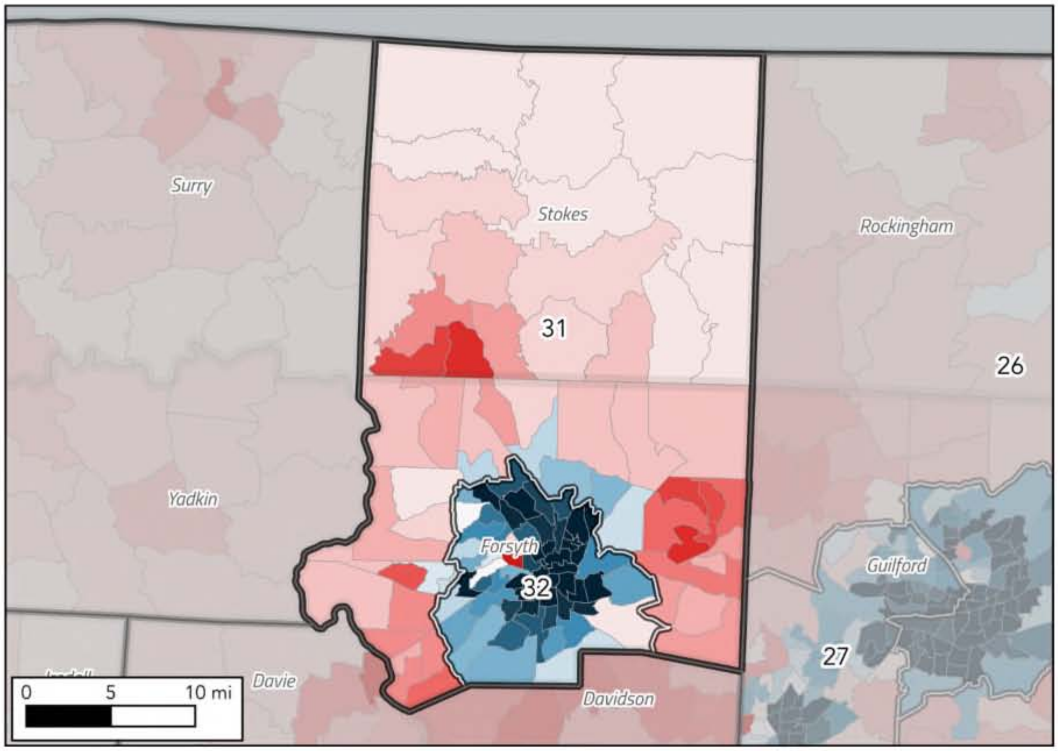
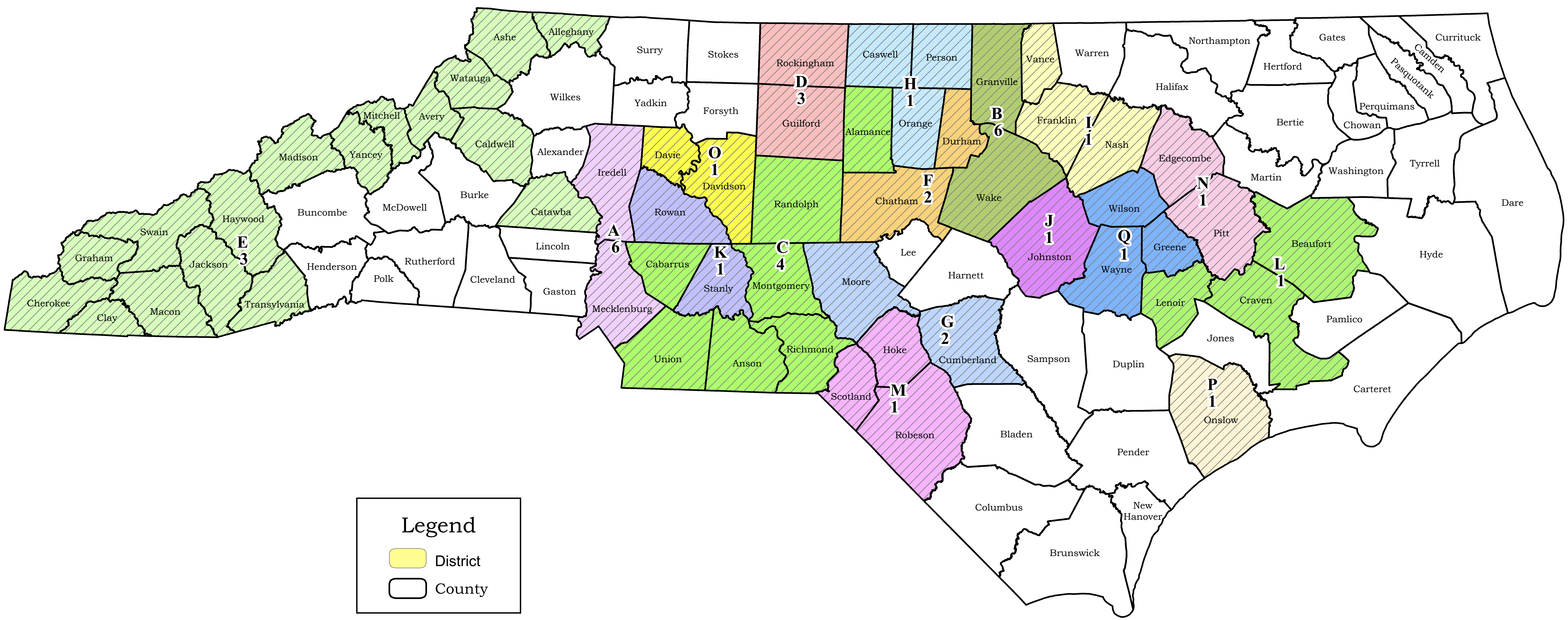
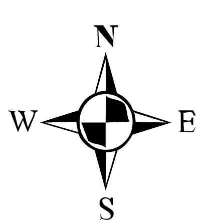
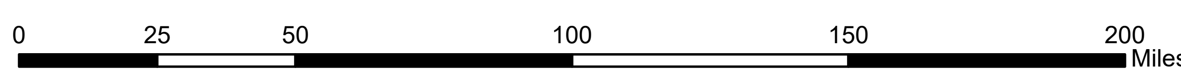


EXHIBIT 69

Duke_Senate_Fixed







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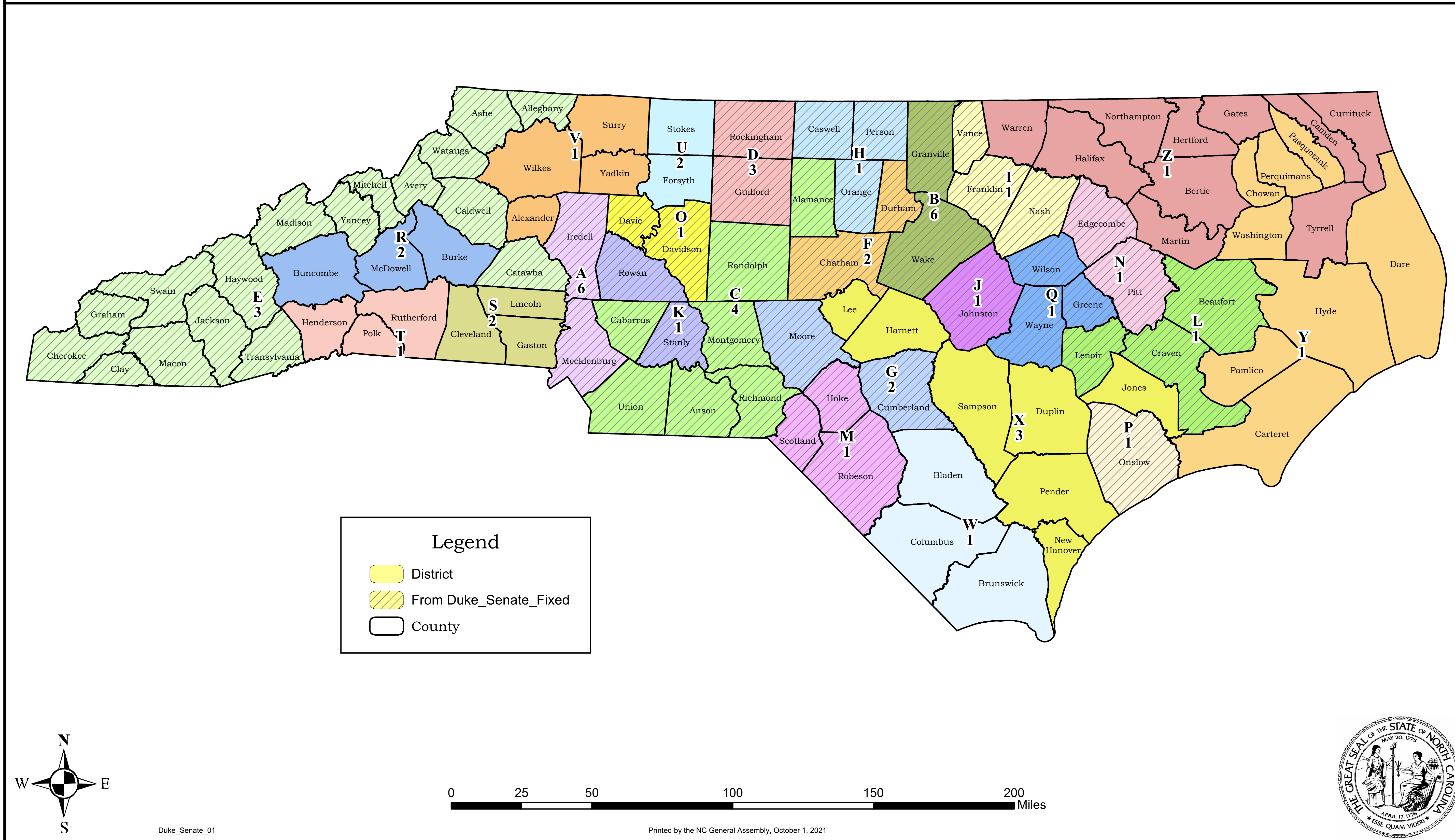
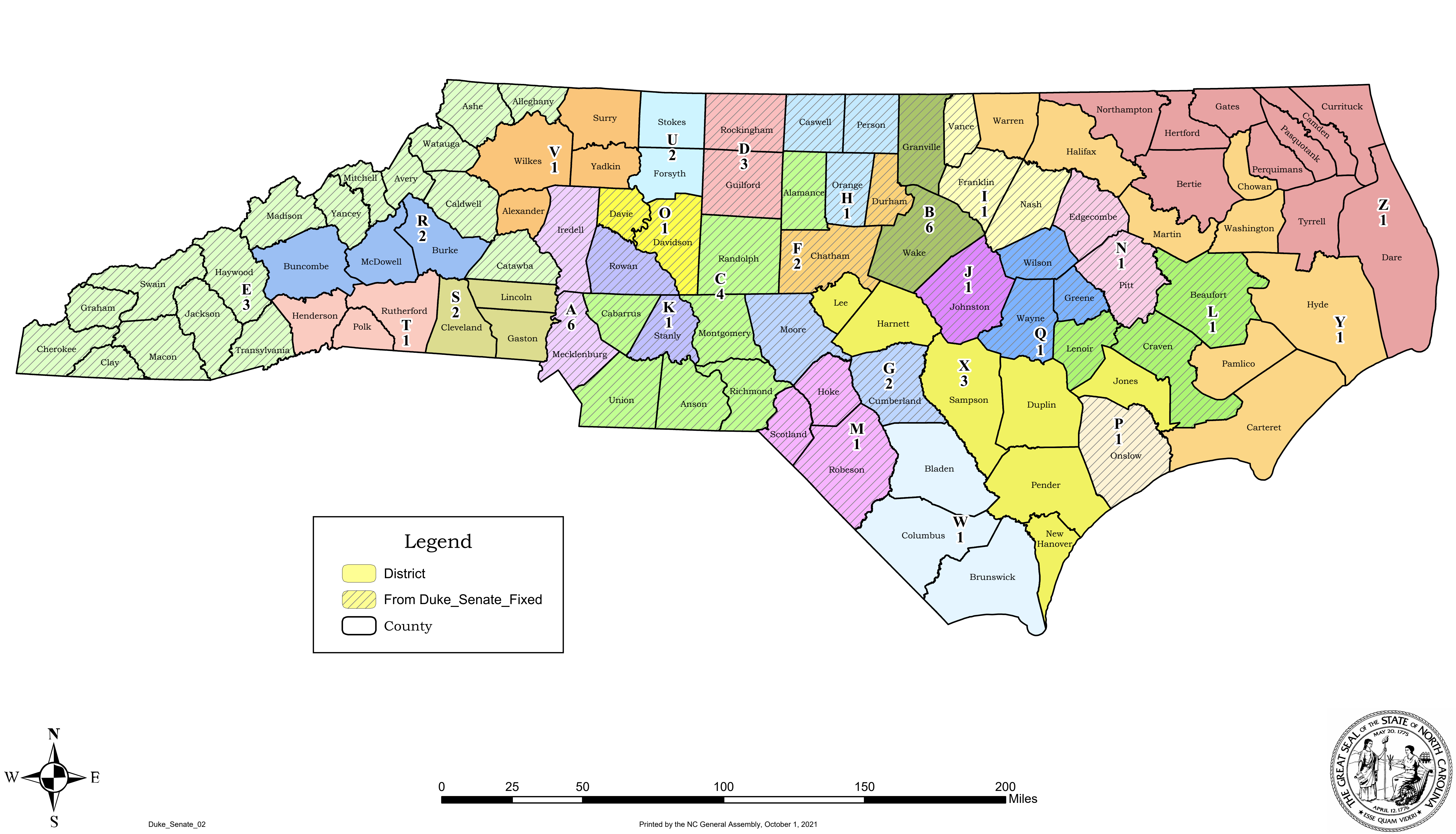
DUKE SENATE GROUPINGS

Plan Name	A	B	C	D
Duke_Senate 01	A1	B1	C1	D1
Duke_Senate 02	A1	B1	C1	D2
Duke_Senate 03	A1	B1	C2	D1
Duke_Senate 04	A1	B1	C2	D2
Duke_Senate 05	A1	B2	C1	D1
Duke_Senate 06	A1	B2	C1	D2
Duke_Senate 07	A1	B2	C2	D1
Duke_Senate 08	A1	B2	C2	D2
Duke_Senate 09	A2	B1	C1	D1
Duke_Senate 10	A2	B1	C1	D2
Duke_Senate 11	A2	B1	C2	D1
Duke_Senate 12	A2	B1	C2	D2
Duke_Senate 13	A2	B2	C1	D1
Duke_Senate 14	A2	B2	C1	D2
Duke_Senate 15	A2	B2	C2	D1
Duke_Senate 16	A2	B2	C2	D2

Duke_Senate 01



Duke_Senate 02



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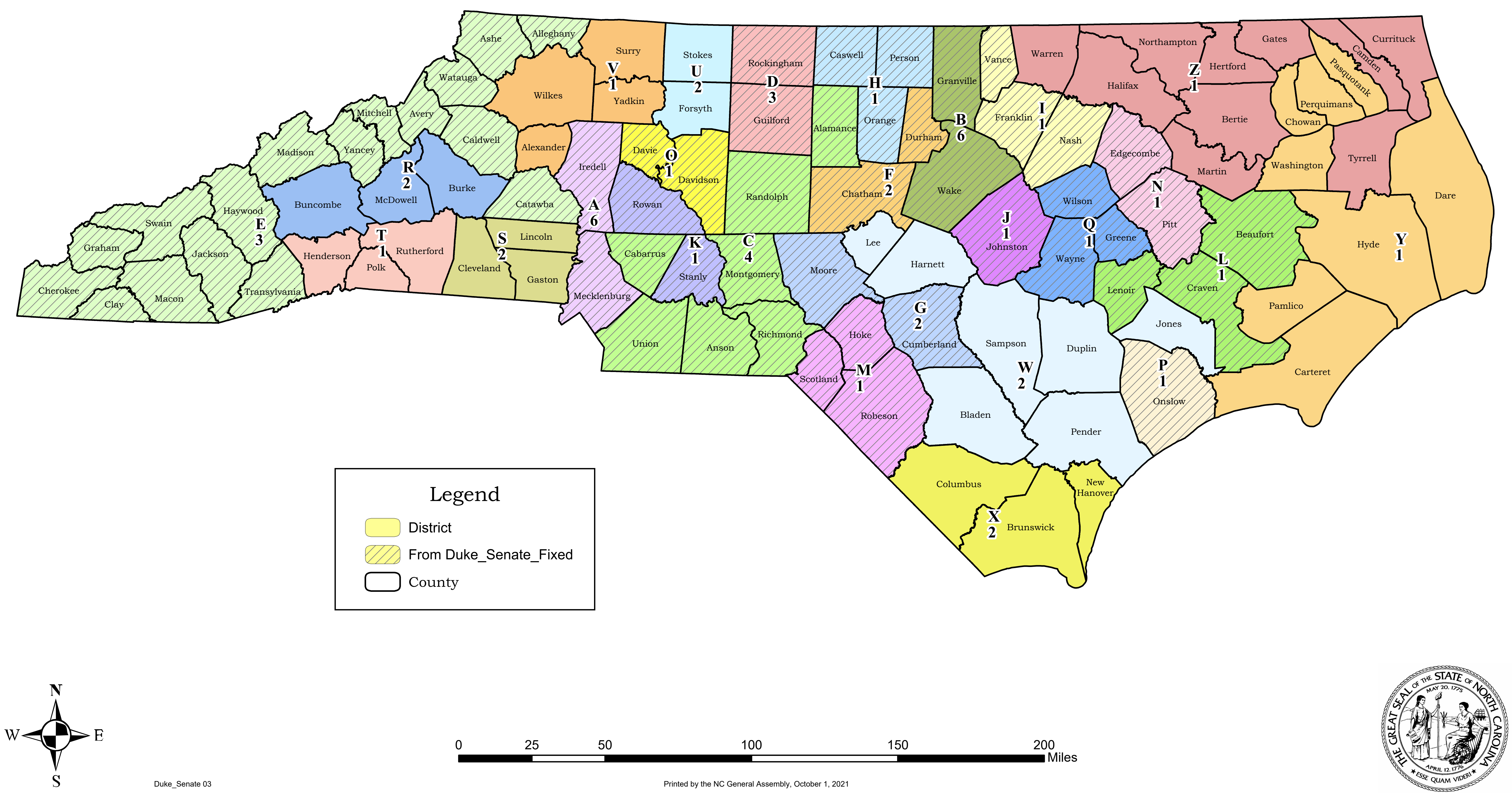

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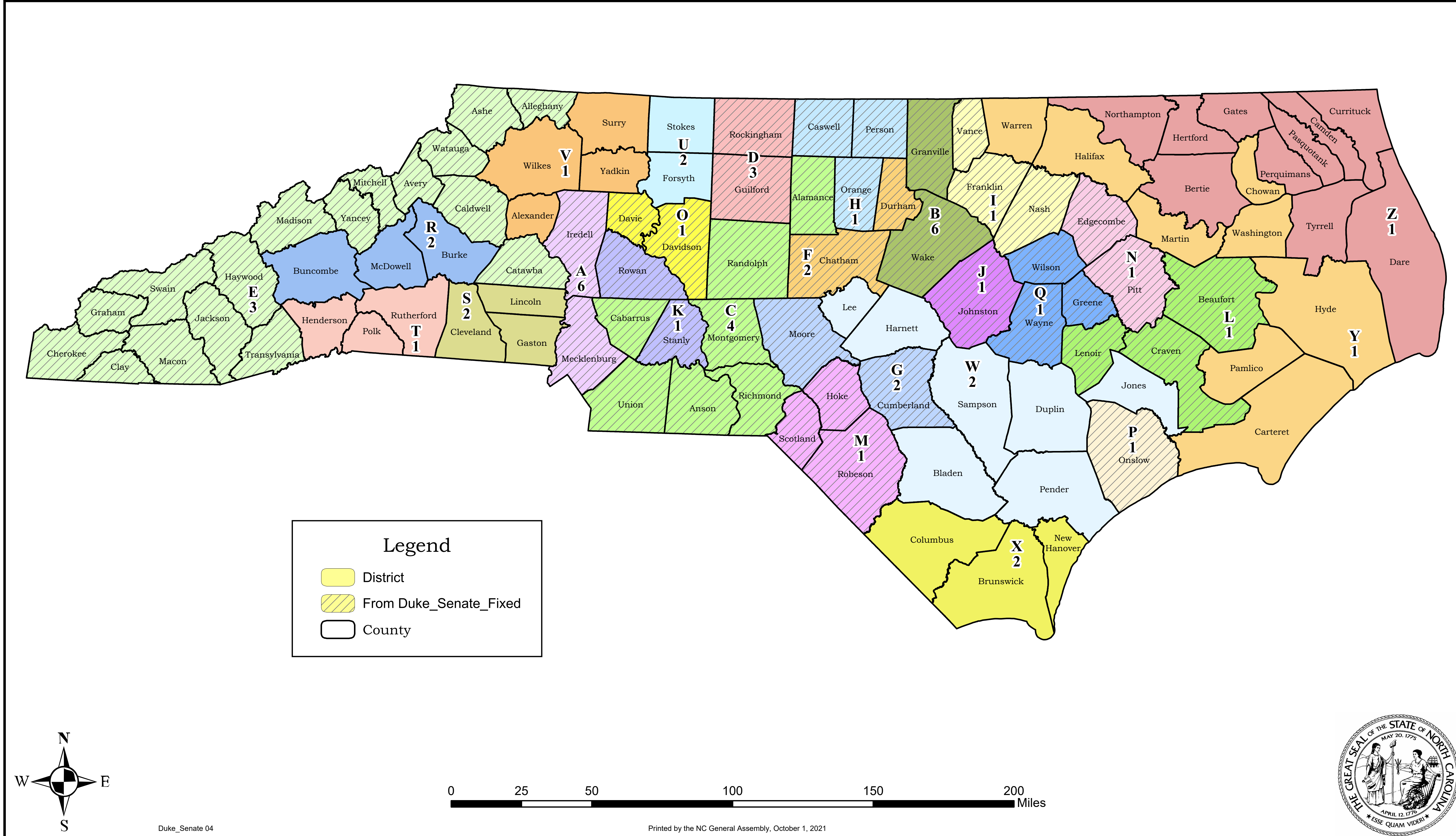
Duke_Senate 04



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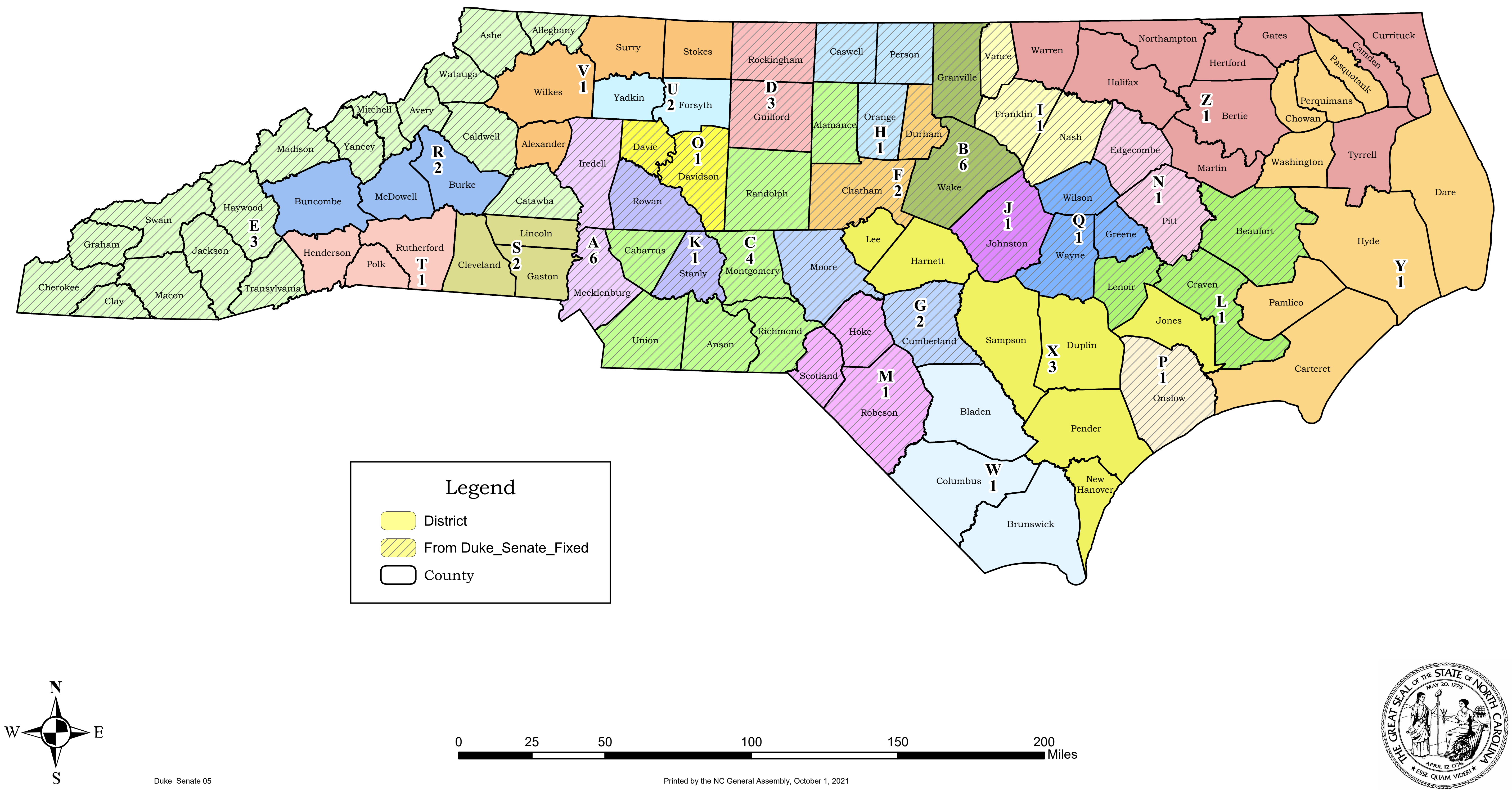

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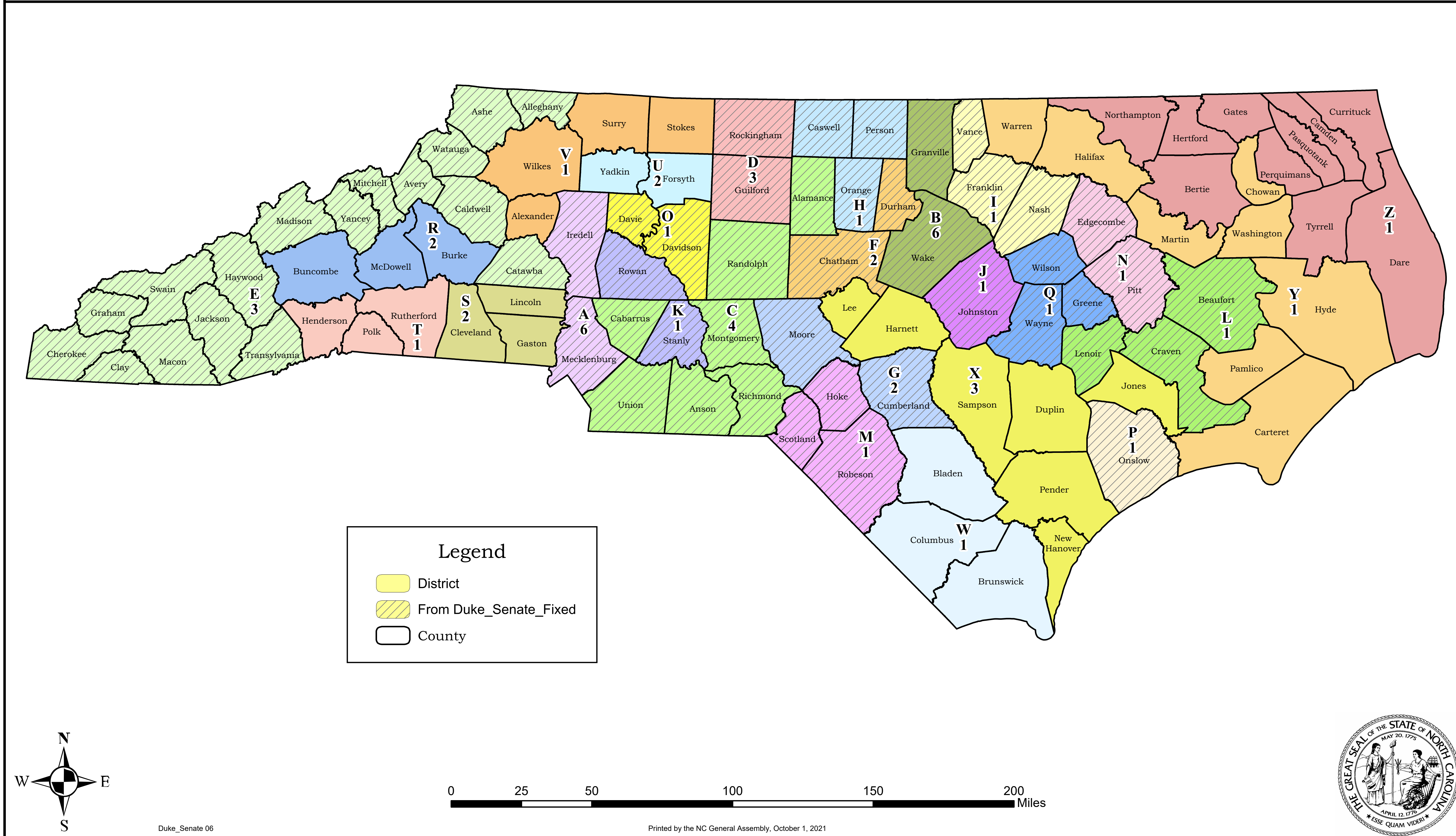

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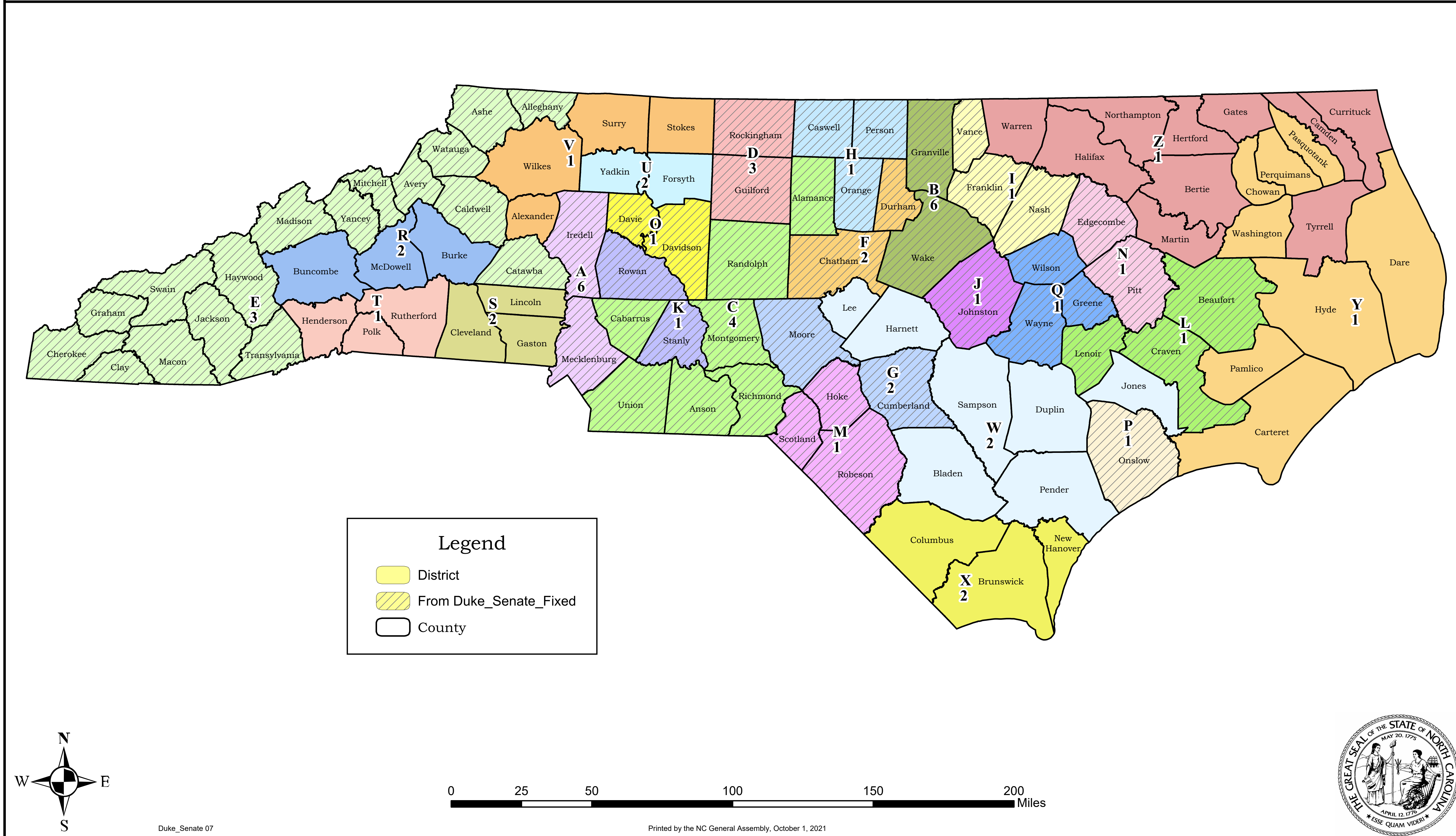

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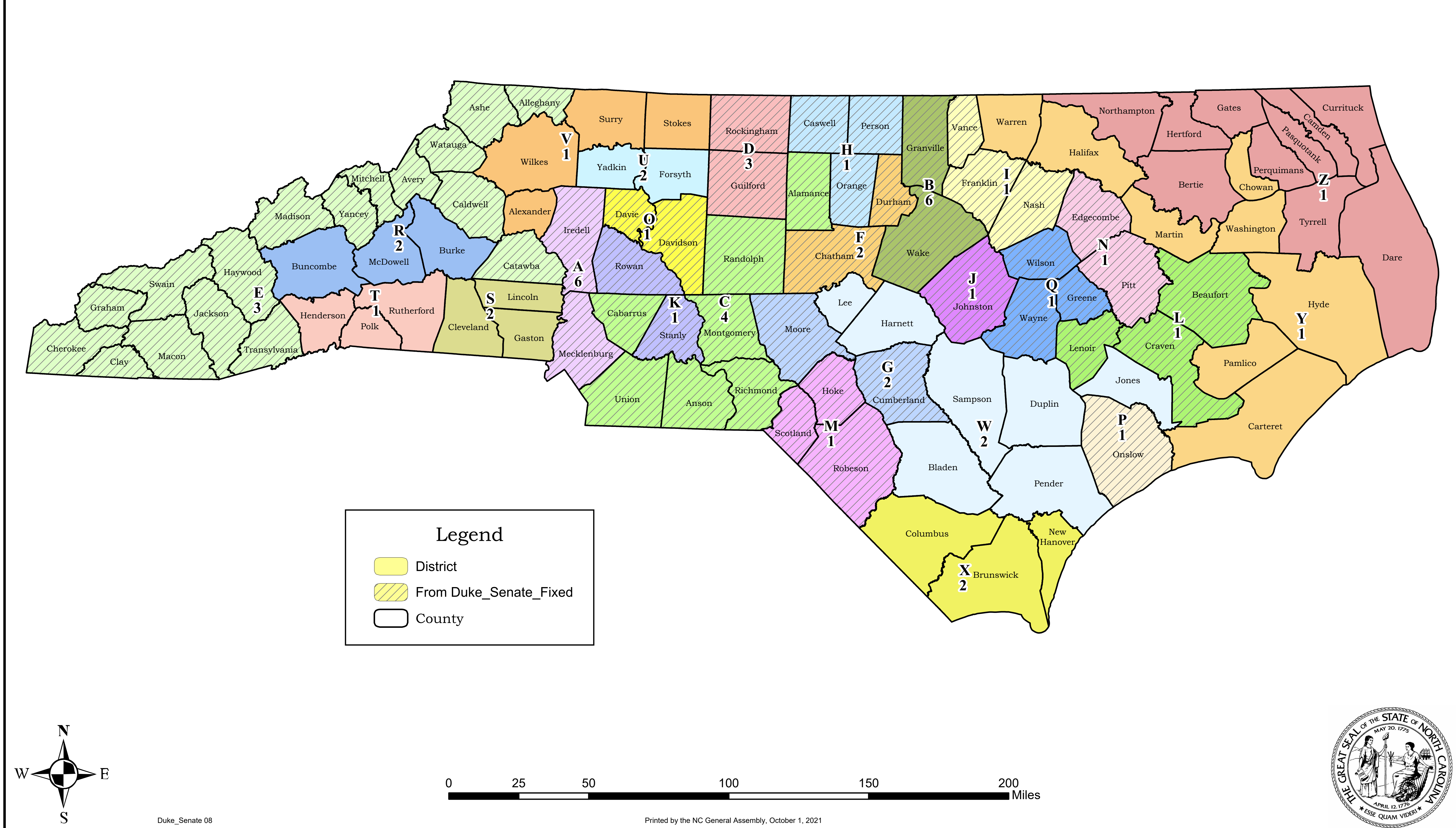

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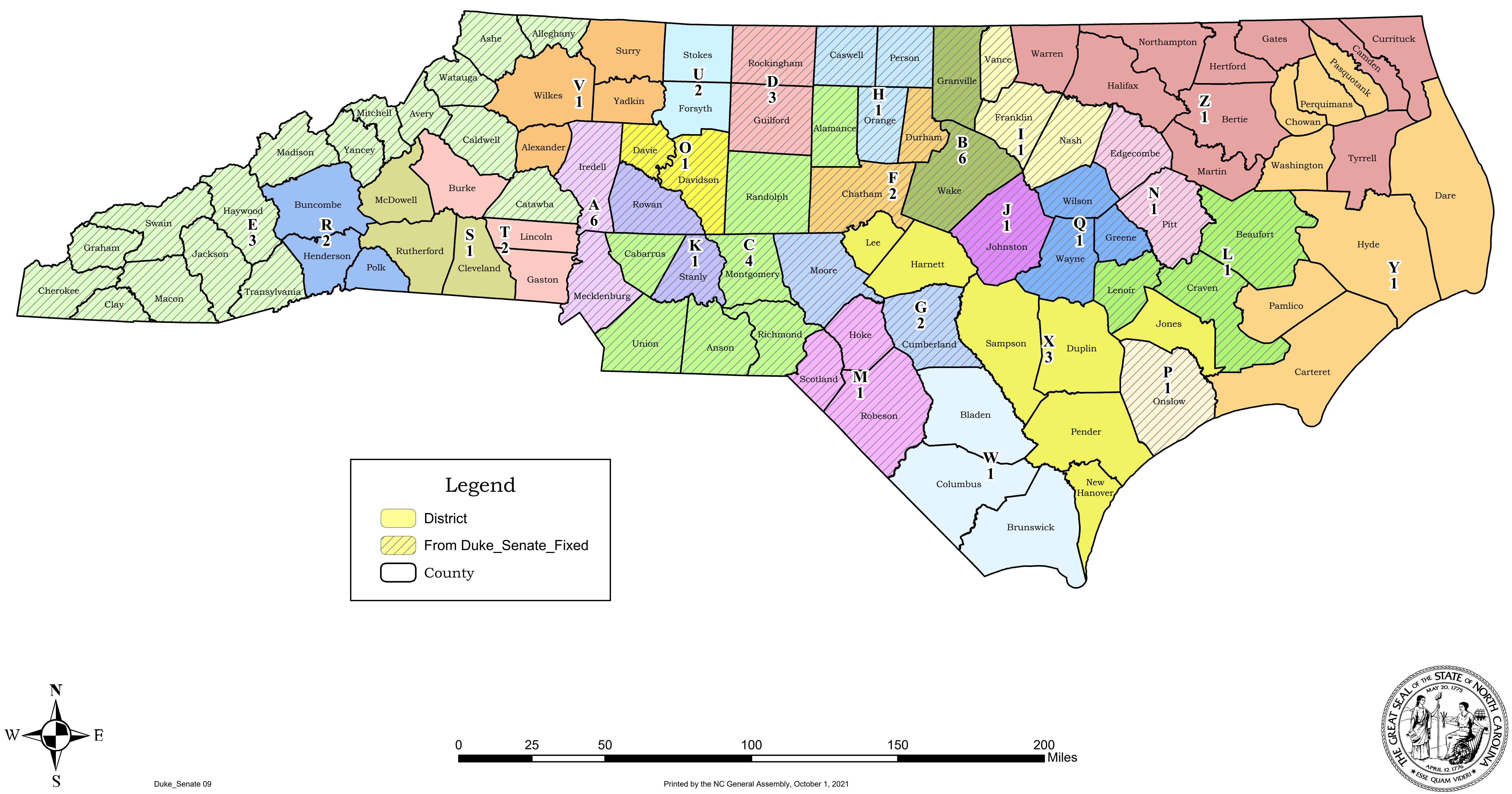

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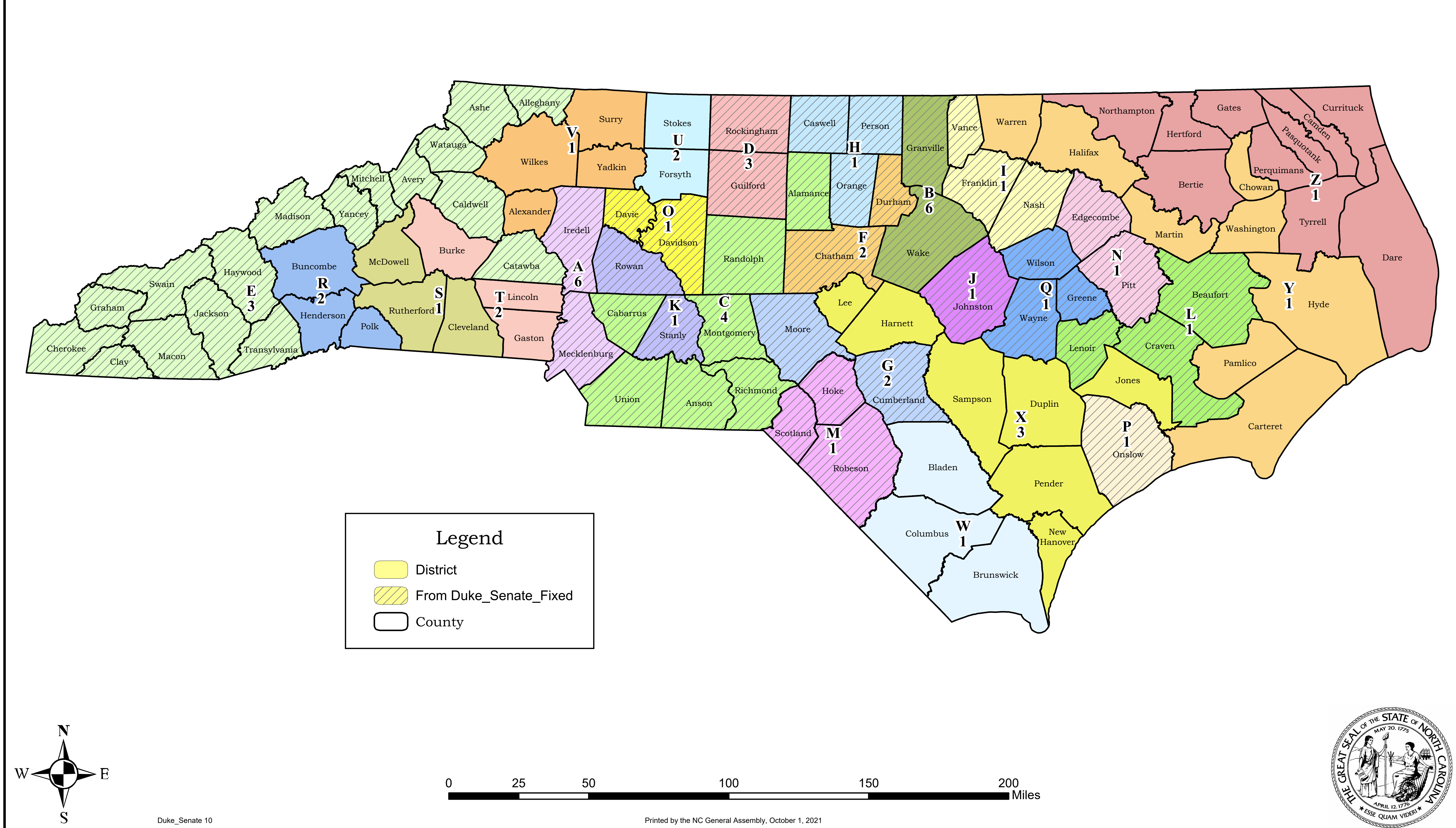

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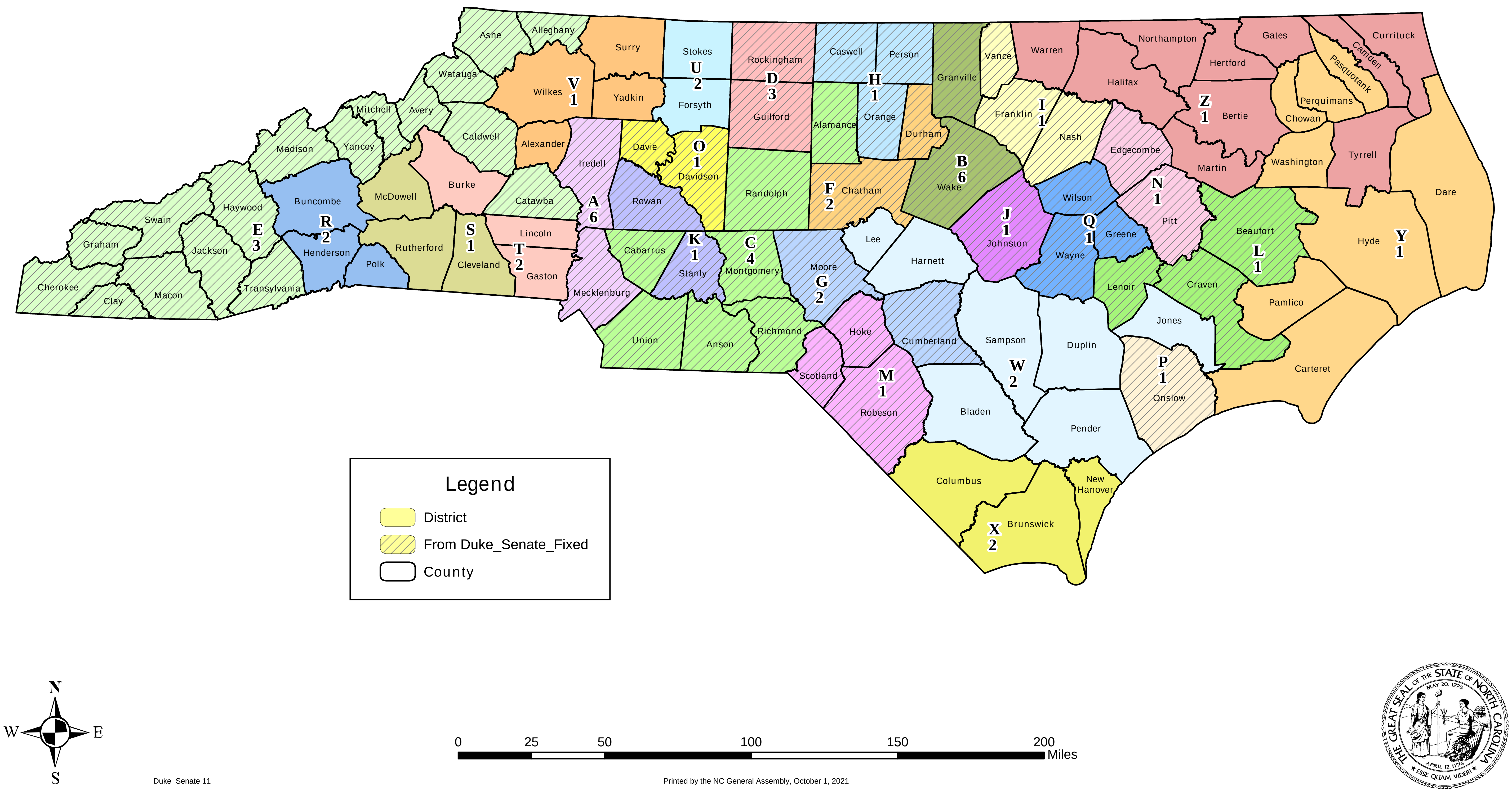

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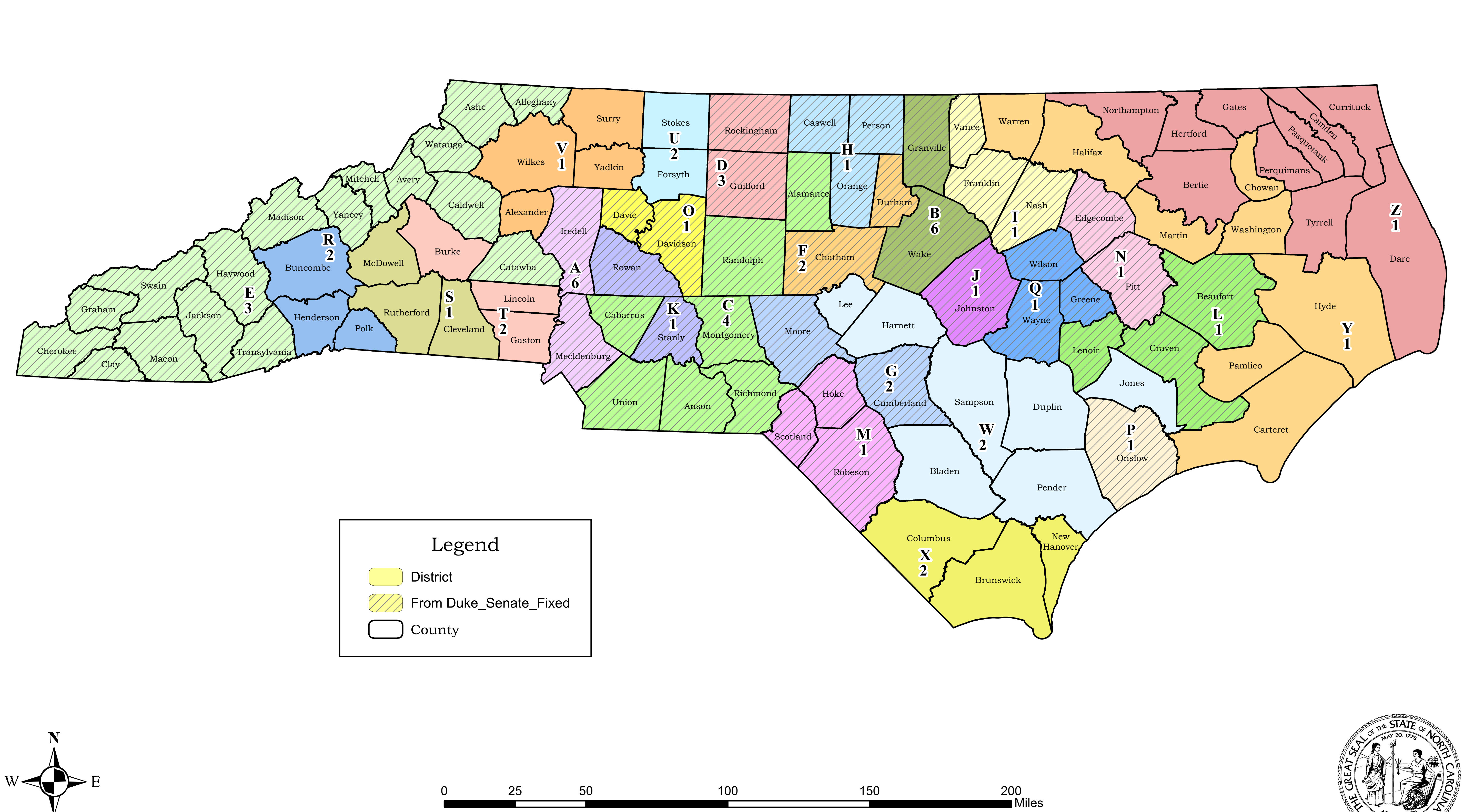
Duke_Senate 12



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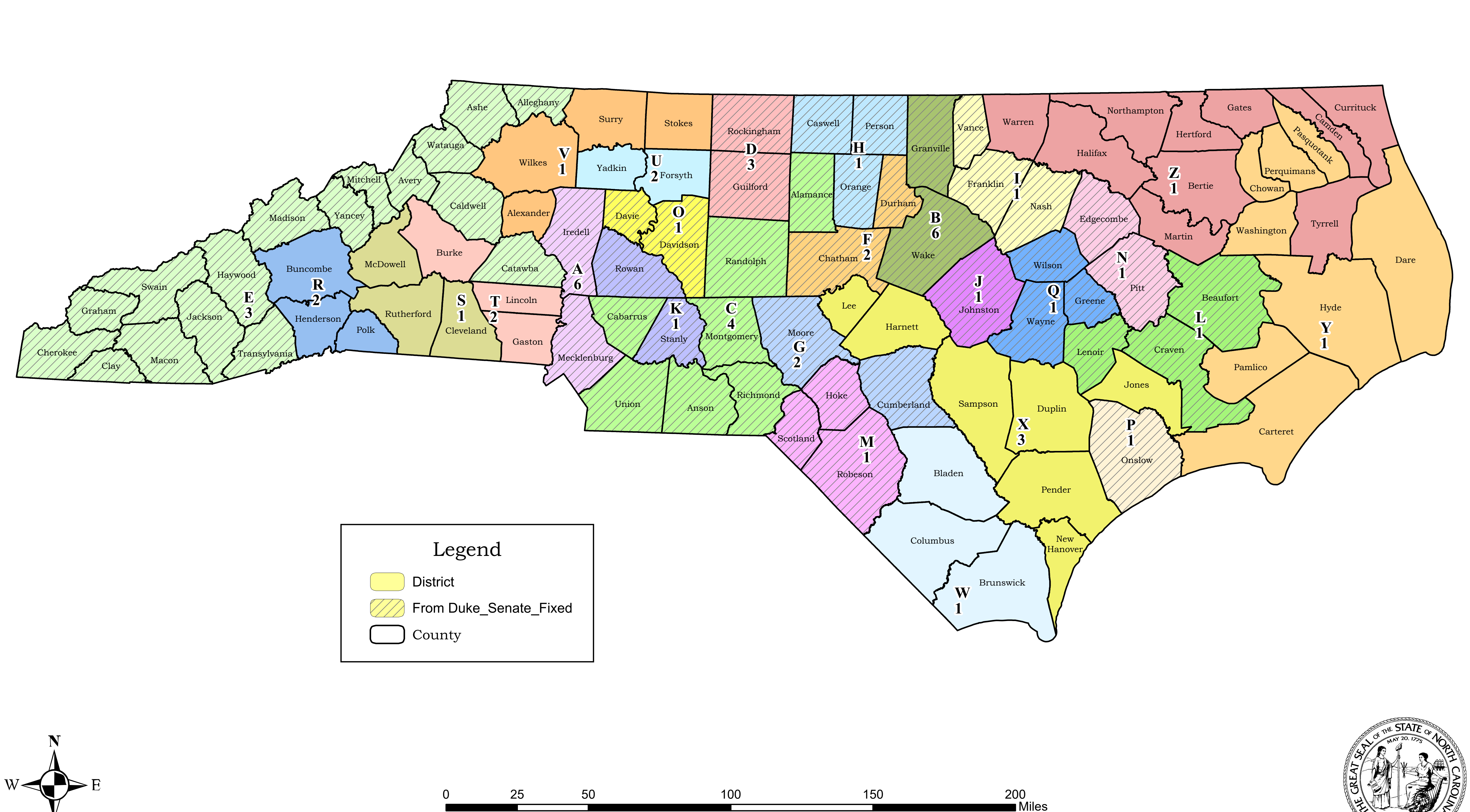
Duke_Senate 13



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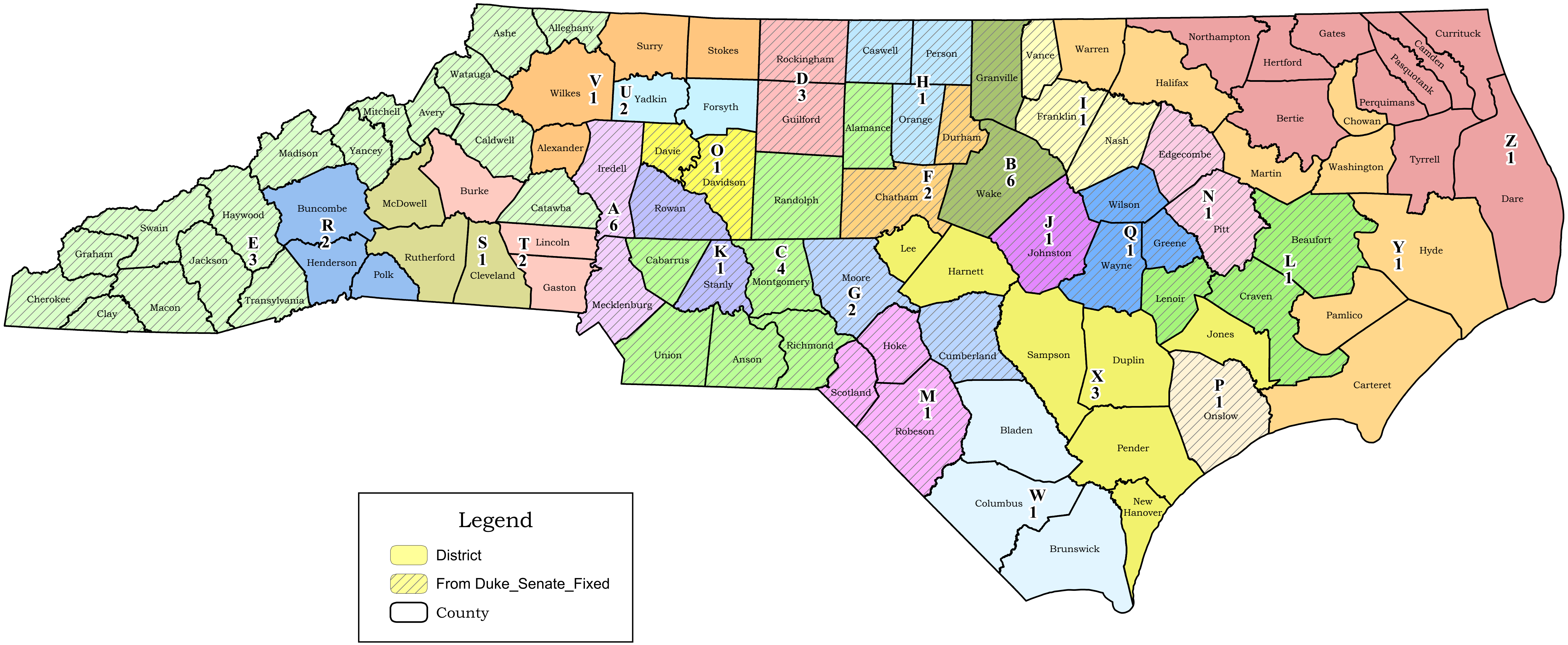
Duke_Senate 14



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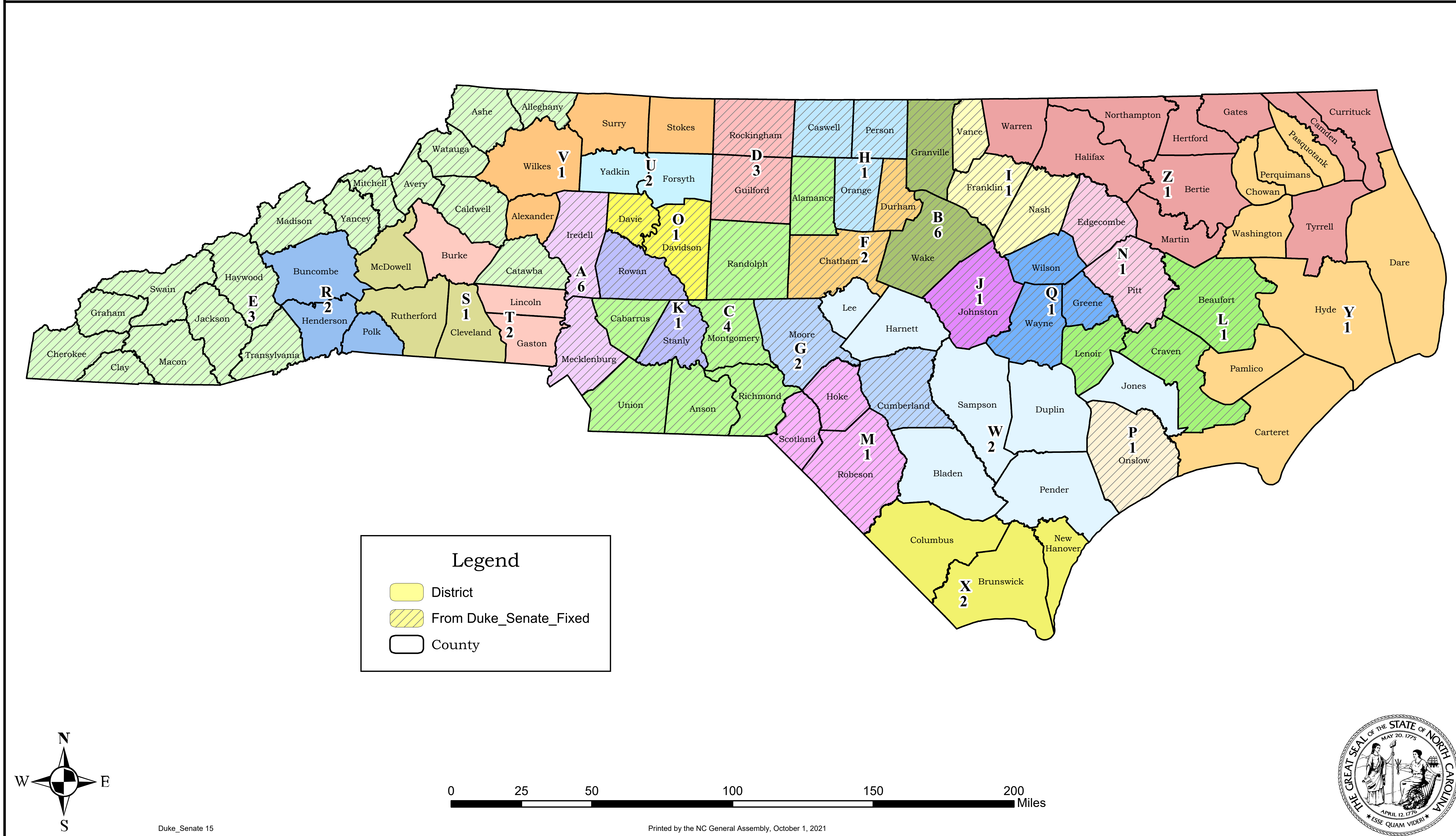
Duke_Senate 15



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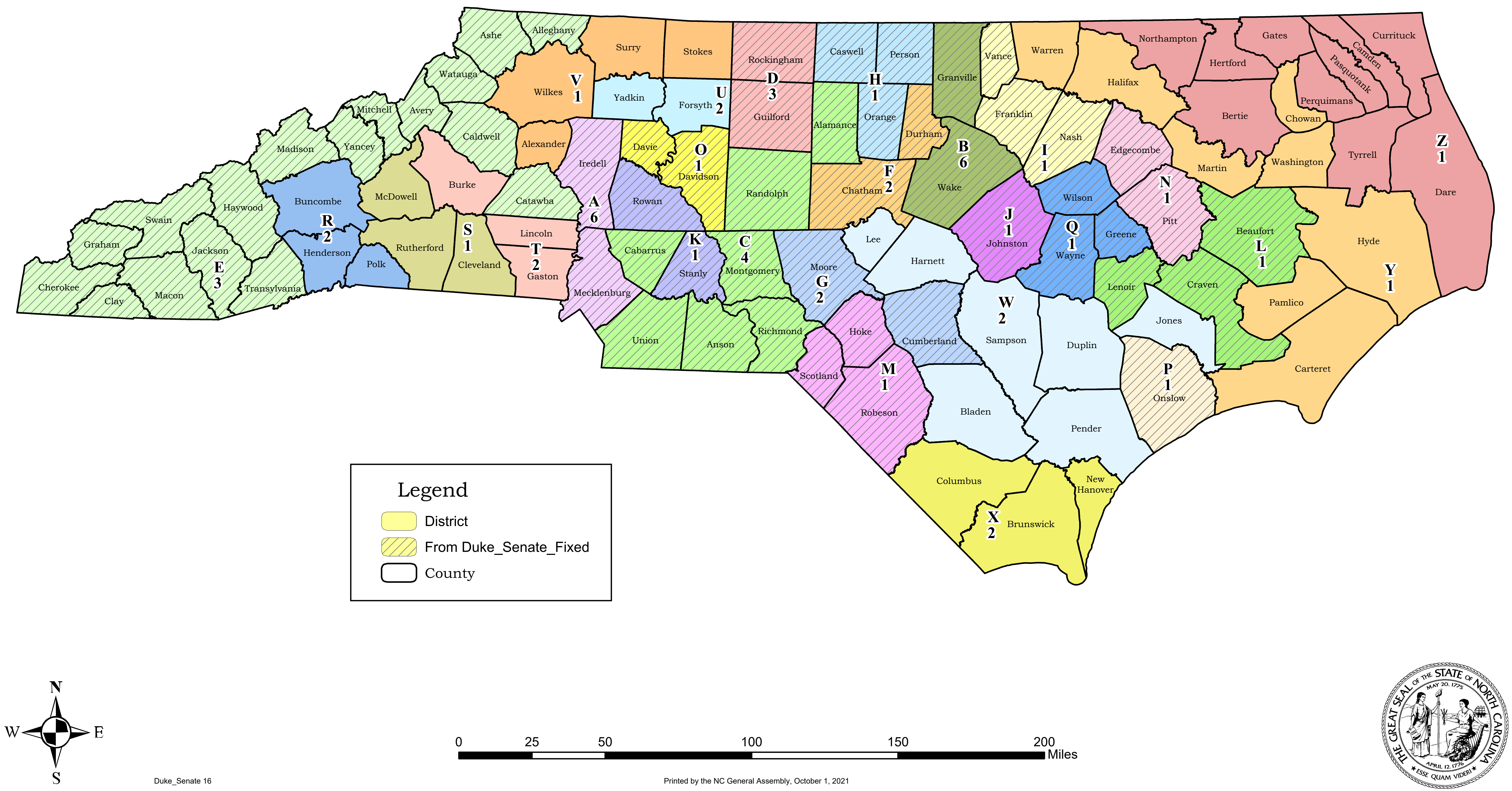

Printed by the NC General Assembly, October 1, 2021

EXHIBIT 60

From: Allison Riggs
To: Phil.Berger@ncleg.gov; Robin.Braswell@ncleg.gov; Tim.Moore@ncleg.gov; Grace.Irvin@ncleg.gov; Warren.Daniel@ncleg.gov; Andy.Perrigo@ncleg.gov; Ralph.Hise@ncleg.gov; Susan.Fanning@ncleg.gov; Paul.Newton@ncleg.gov; Andrew.Stiffel@ncleg.gov; Destin.Hall@ncleg.gov; Lucy.Harrill@ncleg.gov; Dan.Blue@ncleg.gov; Bonnie.McNeil@ncleg.gov; Robert.Reives@ncleg.gov; Veronica.Green@ncleg.gov; Dan.Blue@ncleg.gov; Bonnie.McNeil@ncleg.gov; Ben.Clark@ncleg.gov; Michael.Johnson@ncleg.gov; Don.Davis@ncleg.gov; Edwin.Woodard@ncleg.gov; Chuck.Edwards@ncleg.gov; Heather.Millett@ncleg.gov; Carl.Ford@ncleg.gov; Angela.Ford@ncleg.gov; Kathy.Harrington@ncleg.gov; Lorie.Byrd@ncleg.gov; Brent.Jackson@ncleg.gov; William.Kirkley@ncleg.gov; Joyce.Krawiec@ncleg.gov; Debbie.Lown@ncleg.gov; Paul.Lowe@ncleg.gov; Corneisha.Mitchell@ncleg.gov; Natasha.Marcus@ncleg.gov; Jessica.Bolin@ncleg.gov; Wiley.Nickel@ncleg.gov; Michael.Cullen@ncleg.gov; Jim.Perry@ncleg.gov; LeighAnn.Biddix@ncleg.gov; Bill.Rabon@ncleg.gov; Paula.Fields@ncleg.gov; William.Richardson@ncleg.gov; Leigh.Lawrence@ncleg.gov; Jason.Saine@ncleg.gov; MaryStuart.Sloan@ncleg.gov; John.Torbett@ncleg.gov; Viddia.Torbett@ncleg.gov; Cecil.Brockman@ncleg.gov; Matthew.Barley@ncleg.gov; Becky.Carney@ncleg.gov; Beth.LeGrande@ncleg.gov; Linda.Cooper-Suggs@ncleg.gov; Caroline.Enloe@ncleg.gov; Jimmy.Dixon@ncleg.gov; Michael.Wiggins@ncleg.gov; Jon.Hardister@ncleg.gov; Jayne.Nelson@ncleg.gov; Pricey.Harrison@ncleg.gov; Mary.Lee@ncleg.gov; Kelly.Hastings@ncleg.gov; Sophia.Hastings@ncleg.gov; Zack.Hawkins@ncleg.gov; Anita.Wilder@ncleg.gov; Brenden.Jones@ncleg.gov; Jeff.Hauser@ncleg.gov; Grey.Mills@ncleg.gov; Mason.Barefoot@ncleg.gov; Robert.Reives@ncleg.gov; Veronica.Green@ncleg.gov; David.Rogers@ncleg.gov; Misty.Rogers@ncleg.gov; John.Szoka@ncleg.gov; Beverly.Slagle@ncleg.gov; Harry.Warren@ncleg.gov; Cristy.Yates@ncleg.gov; Lee.Zachary@ncleg.gov; Martha.Jenkins@ncleg.gov
Cc: Hilary Harris Klein; Mitchell D. Brown; Katelin Kaiser
Subject: 2021 North Carolina redistricting - SCSJ correspondence re: process and cluster maps
Date: Friday, October 8, 2021 4:19:23 PM
Attachments: SCSJ correspondence_NCGA redistricting_2021.10.08.pdf
Importance: High

Senators and Representatives and NCGA staff,

Please find attached correspondence from the Southern Coalition for Social Justice regarding the redistricting process and the cluster maps released on Tuesday. Please don't hesitate to reach out to me if you have any questions.

Sincerely,

Allison Riggs
Co-Executive Director, Programs
Chief Counsel for Voting Rights
Southern Coalition for Social Justice
1415 West Highway 54, Ste. 101
Durham, NC 27707
919-323-3380 ext. 117
919-323-3942 (fax)
allison@southerncoalition.org

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SOUTHERN COALITION for SOCIAL JUSTICE

1415 W. Hwy 54, Suite 101
Durham, NC 27707
919-323-3380
southerncoalition.org

October 8, 2021

VIA EMAIL

To: Sen. Phil Berger
President Pro Tempore, North Carolina Senate
Rep. Tim Moore
Speaker, North Carolina House of Representatives
Sen. Daniel, Sen. Hise, and Sen. Newton
Co-Chairs, Senate Standing Committee on Redistricting and Elections
Rep. D. Hall, Chair
House Standing Committee on Redistricting

CC: Sen. Dan Blue, Senate Democratic Leader
Rep. Robert T. Reives, II, House Democratic Leader
Members, Senate Standing Committee on Redistricting and Elections
Members, House Standing Committee on Redistricting

Senators and Representatives,

The undersigned respectfully submit this letter to bring to the attention of the legislative leadership, Members of the Senate Standing Committee on Redistricting and Elections, Members of the House Standing Committee on Redistricting, and, indeed, the entire legislative body, certain areas of concern within the county clustering option maps you introduced on Tuesday, October 5, 2021. The Committee Chairs stated that these maps represent the only legally compliant county clustering options in which ultimate district lines will be drawn. We disagree.

In *Stephenson v. Bartlett*, the North Carolina Supreme Court developed a methodology for how counties should be grouped together to form county clusters.[1] Under *Stephenson*, first, districts must be drawn to satisfy Section 2 of the Voting Rights Act ("VRA") to ensure voters of color have an equal opportunity to participate in the political process and elect their candidates of choice. Only after that analysis is performed and those districts are drawn may any work be done to harmonize and maximize compliance with North Carolina's Whole County Provision ("WCP").[2]

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[1] *Stephenson v. Bartlett*, 355 N.C. 354 (2002); *Stephenson v. Bartlett*, 357 N.C. 301 (2003).

[2] We do not concede that your interpretation of the *Stephenson* criteria after the first step—drawing VRA-required districts—is correct.

Although the *Stephenson* criteria outlines a process for how counties are grouped together to create districts, there is still discretion regarding the choices about how and where to group counties. Consequently, these individual choices can result in different county grouping options that directly affect political opportunities and voting power for voters of color. We will be monitoring your choices with respect to county clusters closely, as well as the impact of those choices. But even now, we can identify serious problems with your judgment being used in this redistricting process, including but not limited to gross mischaracterizations of applicable law.

I. The North Carolina General Assembly Continues to Flout Well-Established Redistricting Law

At this point, we have only seen draft district lines for the aforementioned clusters presented by your Committees, which create some (but not all) districts and thus do not constitute full maps. As a result, this letter does not and cannot address all potential violations of the North Carolina Constitution, the federal Voting Rights Act, or the North Carolina Supreme Court's instructions in the *Stephenson* cases. Our intent here is to bring to your attention the potential problems in the county clustering maps from which you have indicated you intend to choose. We also seek to highlight, once again, the erroneous legal interpretation under which you appear to be operating, just as in last decade's redistricting cycle. Absent a material change in direction, we may have further critiques or concerns. However, it is not too late to remedy these issues and embark on a redistricting process that will comply with applicable law.

1. <u>The North Carolina Legislature Is Already Violating the *Stephenson* Instructions</u>

Because this body is erroneously avoiding the use of all racial data, you per se cannot comply with *Stephenson.* Without that data, you cannot assess what districts are required under the VRA and draw those districts first as required. The failure to consider racial data is deeply problematic for other legal and policy grounds, but in this letter, we focus on the potential county clusters where it is unlikely that a district that will provide voters of color an equal opportunity to elect their preferred candidates can be produced by the county cluster.

The North Carolina Supreme Court has been unequivocal: *Stephenson* mandates that "districts required by the VRA be drawn first."[3] Indeed, the Supremacy Clause of the United States Constitution requires federal law compliance be prioritized. In order to determine whether it is necessary to draw VRA districts, the Legislature must determine the level of racially polarized voting in the relevant geographical area.[4] Without any analysis of racial voting data, you are making it impossible to assess whether VRA districts are required and violating the plain rule in *Stephenson*. Thus, to comply with *Stephenson* and the VRA, we believe the Legislature must conduct a regionally-focused racially polarized voting ("RPV") study to determine if there is legally significant racially polarized voting. If there is that level of racially polarized voting,

[3] *Stephenson v. Bartlett*, 355 N.C. 354, 383 (2002).
[4] *Thornburg v. Gingles*, 478 U.S. 30, 55 (1986).

and if any cluster which you claim is required under strict compliance with *Stephenson* produces a district in which voters of color would not be able to elect their preferred candidate, then you must draw a VRA district first and only then engage in developing clusters around that district.[5] As discussed below, your claims that RPV studies done in 2011 and the *Covington* court's ruling in 2016[6] somehow negate the possibility that any VRA districts may be necessary today, in 2021, is plainly wrong.

2. The North Carolina General Assembly Is Grossly Misinterpreting *Covington v. North Carolina* and Other Precedent from Last Cycle

Sen. Hise and Rep. Hall are factually incorrect in representing that courts last decade ruled that racially polarized voting in North Carolina does not exist. In the most relevant case, *Covington v. North Carolina*, the federal court that invalidated 28 North Carolina legislative districts as unconstitutional racial gerrymanders in fact stated the opposite.[7] The court acknowledged that there were two reports before the Legislature indicating there was statistically significant racially polarized voting in the state[8], but the bipartisan panel of federal judges excoriated the Legislature for "failing to evaluate whether there was a strong basis of evidence for the third *Gingles* factor in any potential VRA district."[9] That is, the court acknowledged the "general finding regarding the existence of [] racially polarized voting," but said the Legislature had to do a deeper inquiry, which "is exactly what Defendants did not do."[10] This body seems bound and determined to make the same legal mistake again this redistricting cycle by once again abdicating its responsibility to do the analysis it is required by law to do. If this Legislature declines to meet its obligations under *Stephenson* to determine and draw districts required by the VRA first, it should be prepared for a court to ultimately draw the maps needed for elections next year.

Second, no case from the last redistricting cycle overturns or otherwise renders null *Stephenson*'s requirement that the Legislature draw VRA districts first. In a meeting of the Joint Redistricting and Elections Committee on August 12, 2021, the Committee Chairs, in response to Senator Clark's question about complying with the VRA, stated that RPV analysis was not necessary due to "the 2019 decisions."[11] The 2019 Superior Court decision *Common Cause v. Lewis* found that compliance with the VRA was not a plausible excuse to a charge of partisan

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[5] *Stephenson v. Bartlett*, 355 N.C. 354 (2002) (holding legislative districts required by the VRA be formed prior to the creation of non-VRA districts to ensure redistricting plans "ha[ve] no retrogressive effect upon minority voters.").
[6] *Covington v. North Carolina*, 316 F.R.D. 117 (M.D.N.C. 2016).
[7] *Id.* at 169-170 (finding that Defendants' "reports conclude that there is evidence of racially polarized voting in North Carolina [.]").
[8] *Id.*
[9] *Id.* at 167.
[10] *Id.* at 167-68.
[11] NCGA Redistricting, *2021-08-12 Committee (Joint)*, YOUTUBE (Aug. 13, 201), https://www.youtube.com/watch?v=gSm2OhE7Slk&t=718s.

gerrymandering.[12] It did *not* hold that the General Assembly may completely ignore racial voting data when drawing districts following the release of U.S. Census data. As a result, *Lewis* in no way alters *Stephenson*'s mandate that the Legislature first draw VRA districts with the assistance of racial voting data analysis.

Lastly, no other federal law or Supreme Court decision compels or even allows this body to ignore racial data in drawing district lines. The Supreme Court decision *Cooper v. Harris* explains that states *can* use racial data in redistricting to comply with the VRA.[13] In 2017, the Supreme Court found that the creation of two North Carolina congressional districts violated the federal Constitution because map drawers had used racial data in ways *not required* by the VRA.[14] *Cooper* found that map drawers were using the VRA as an excuse to pack far more Black voters into a district than was necessary for VRA compliance; it did not state that the use of racial data is unconstitutional in every circumstance.[15] In fact, *Cooper* demonstrates the very necessity of using racial voting data. It is impossible to determine what demographic configuration is sufficient for VRA compliance without analyzing racial voting data.

With these legal deficiencies in your approach explained, we now turn to areas of concern in the county cluster maps introduced on Tuesday. We note at the outset that the authors of the paper presenting possible county clusters explicitly did not look at the first step in *Stephenson* – drawing VRA districts.[16] Thus, while this paper and methodology may be informative, they cannot substitute for the legislative analysis required by North Carolina and federal law. Indeed, it would not be algorithmically possible to do the kind of "intensely local appraisal"[17] necessary to determine whether a district was required under Section 2 of the VRA.

II. Certain Areas in the North Carolina Senate Cluster Maps Require Examination for VRA Compliance

a. Cluster in Greene/Wayne/Wilson

One of the Senate county clusters that you designate as required under an "optimal" county grouping map for the Senate districts appears to violate the VRA. Cluster "Q1" is a district comprised of three counties that would likely deprive voters of color of the opportunity to elect their candidate of choice. In the current Senate map, Senate District 4 is comprised of Halifax, Edgecombe and Wilson Counties, and the Black voting age population ("BVAP") in

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[12] *Common Cause v. Lewis*, No. 18 CVS 014001, at *345 (N.C. Sup. Ct. Sept. 3, 2019).
[13] *Cooper v. Harris*, 137 S. Ct. 1455, 1464 (2017).
[14] *Id.* at 1472.
[15] *Id.* at 1470-71.
[16] Christopher Cooper, et al., *NC General Assembly County Clusterings from the 2020 Census*, QUANTIFYING GERRYMANDERING (Aug. 17, 2021), https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf. (last visited Oct. 7, 2021).
[17] *Thornburg v. Gingles*, 478 U.S. 30, 79 (1986).

that district is 47.46% using benchmark data. Black voters have the ability to elect their candidate of choice in this district.

In a county group analysis where race is not considered at all, we are concerned that you will propose that Senate District 4 be comprised going forward of Green, Wayne, and Wilson Counties. A district comprised of those 3 counties would be only 35.02% BVAP. If Section 5 were still in place, we are certain that such a change to that district would constitute impermissible retrogression and not be approved. We have done some initial analysis of racially polarized voting in those 3 new counties that would comprise Senate District 4. Examining racially contested statewide elections[18] in these counties shows two things: using a number of different analytic approaches, the Black candidate is overwhelmingly supported by Black voters and white voters offer very little support for Black candidates. That is, voting is racially polarized. And most importantly, in those counties, were the electoral outcomes to be determined just by voting there, the Black candidates would have been defeated. Thus, the racially polarized voting is legally significant. We urge you to perform a formal RPV analysis in these counties before dictating that the Senate district must be comprised of these 3 counties.

Moreover, knowing as you do (or certainly do now) that there is a concentration of Black voters who, in concert with a small number of non-Black voters in the original configuration of the district (Wilson, Edgecombe and Halifax) are able to elect their candidate of choice, "if there were a showing that a State intentionally drew district lines in order to destroy otherwise effective crossover district[]," you would likely be subjecting the State to liability under the Fourteenth and Fifteenth Amendments.[19]

b. Cluster in Hoke/Robeson/Scotland

We are also concerned that in the absence of racial data analysis, the proposed Senate district comprised of Hoke, Robeson, and Scotland Counties may not be in compliance with the Voting Rights Act. This county cluster would create a new District 21 out of what were previously sections of Senate Districts 13, 21, and 25. In North Carolina's current map, District 21 is 42.15% BVAP using benchmark data, and Black voters in that district have the ability to elect their candidate of choice.

A district composed of Hoke, Robeson, and Scotland counties would be only 29.63% BVAP. Our initial review of recent racially-contested elections suggests that voting in these counties is highly racially polarized. Drawing a district with such a low BVAP might deprive

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[18] We examined the 2020 race for Chief Justice of the North Carolina Supreme Court involving a Black candidate, Cheri Beasley, and a white candidate, Paul Newby. We examined the 2020 race for Commissioner of Labor involving a Black candidate, Jessica Holmes, and a white candidate, Joshua Dobson. We examined the 2016 race for Treasurer involving a Black candidate, Dan Blue III, and a white candidate, Dale Folwell. And we examined the 2016 race for Lieutenant Governor, involving a Black candidate, Linda Coleman, and two white candidates, Dan Forest and Jacki Cole.

[19] *Bartlett v. Strickland*, 556 U.S. 1, 24 (2009).

Black voters the opportunity to elect a candidate of their choice. We urge you to perform a formal RPV analysis for these three counties to determine if a VRA-compliant district is required for the new district in this area.

III. Certain Areas in the North Carolina House Cluster Maps Require Examination for VRA Compliance

a. Cluster in Sampson/Wayne

Our preliminary data analysis shows that a new House District 21 may be created out of a cluster composed of either Sampson and Wayne counties ("LL2") or Duplin and Wayne counties ("KK2"). Our initial analysis indicates that the LL2 configuration is particularly problematic. Neither Sampson nor Wayne Counties individually have a high enough population to compose a single district under one person, one vote jurisprudence. However, the North Carolina General Assembly could create two House districts from a Wayne and Sampson County cluster.

Current House District 21 is composed of only portions of both Wayne and Sampson Counties. It is 39.00% BVAP using benchmark data and provides Black voters the opportunity to elect their candidate of choice. Our preliminary analysis was fairly conclusive – based on the statewide elections examined, voting in Sampson and Wayne Counties, together, is highly racially polarized and the Black candidates in statewide elections would not have won had the elections been determined in those counties alone. Thus, we believe this presents substantial evidence that there is legally significant racially polarized voting, and there may be a VRA district required to be drawn in this cluster; or if that is not possible under one-person, one-vote principles, this cluster cannot be used – it would not be compliant with Section 2 of the Voting Rights Act or *Stephenson*.

b. Cluster in Camden/Gates/Hertford/Pasquotank

One of the proposed multi-county single House districts in your proposed clusters is composed of Camden, Gates, Hertford, and Pasquotank Counties (Cluster "NN1" in "Duke_House_01," "Duke_House_03," "Duke_House_05" and "Duke_House_07"). The current district for this area, House District 5, is 44.32% BVAP using benchmark data, and Black voters have the opportunity to elect a candidate of their choice. A House district composed of Camden, Gates, Hertford, and Pasquotank Counties would be only 38.59% BVAP. Our analysis indicates that white voters are voting in bloc there and may be doing so in a way that would prevent a Black-preferred candidate from winning (and, thus, legally significant). More analysis must be done on this cluster to determine whether there is legally significant racially polarized voting, and, if so, a district composed of this county cluster might eliminate the ability of Black voters to elect a candidate of their choice and thus violate federal and state law.

IV. Conclusion

To be clear, in this letter, we are raising issues with the clusters you released on Tuesday, October 5, 2021. We can identify potential VRA issues where districts are dictated by groupings of whole counties or where, in a small 2-district cluster, we can observe voting patterns with sufficient certainty to identify a potential problem. However, we do not yet know how district lines will be drawn within counties or within multi-county, multi-district clusters. For example, we suspect that the way district lines are drawn in a Nash/Wilson House county grouping or Granville/Vance/Franklin House county grouping could be problematic. In short, this is a non-exhaustive list of concerns, particularly given the lack of draft maps at this moment. But this body should consider itself on notice for the need to perform RPV analysis in certain regions of the state and the need to examine racial data to ensure VRA compliance.

Importantly, we are not saying conclusively that VRA districts are required in the above county groupings; however, it cannot be ascertained without conducting an intensely local appraisal of voting conditions and a targeted RPV analysis, which you are required by law to undertake.[20] Without conducting any RPV analysis prior to grouping counties, the Legislature is departing from the requirements of the *Stephenson* criteria and may ultimately deny voters of color an equal opportunity to participate in North Carolina's elections. Therefore, by allegedly engaging in race-blind drawing, you violate not only the VRA but also *Stephenson* and our State's case precedent. It is neither appropriate nor required to draw districts race-blind. Rather, your current path ensures redistricting will once again be a tool used to harm voters of color, and we implore you to reconsider this path immediately.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Allison J. Riggs
Co-Executive Director for Programs and Chief Counsel for Voting Rights
Hilary Harris Klein
Senior Counsel, Voting Rights
Mitchell Brown
Counsel, Voting Rights
Katelin Kaiser
Counsel, Voting Rights

[20] *Id.*

EXHIBIT 61

From: Allison Riggs
To: "Phil.Berger@ncleg.gov"; "Robin.Braswell@ncleg.gov"; "Tim.Moore@ncleg.gov"; "Grace.Irvin@ncleg.gov"; "Warren.Daniel@ncleg.gov"; "Andy.Perrigo@ncleg.gov"; "Ralph.Hise@ncleg.gov"; "Susan.Fanning@ncleg.gov"; "Paul.Newton@ncleg.gov"; "Andrew.Stiffel@ncleg.gov"; "Destin.Hall@ncleg.gov"; "Lucy.Harrill@ncleg.gov"; "Dan.Blue@ncleg.gov"; "Bonnie.McNeil@ncleg.gov"; "Robert.Reives@ncleg.gov"; "Veronica.Green@ncleg.gov"; "Dan.Blue@ncleg.gov"; "Bonnie.McNeil@ncleg.gov"; "Ben.Clark@ncleg.gov"; "Michael.Johnson@ncleg.gov"; "Don.Davis@ncleg.gov"; "Edwin.Woodard@ncleg.gov"; "Chuck.Edwards@ncleg.gov"; "Heather.Millett@ncleg.gov"; "Carl.Ford@ncleg.gov"; "Angela.Ford@ncleg.gov"; "Kathy.Harrington@ncleg.gov"; "Lorie.Byrd@ncleg.gov"; "Brent.Jackson@ncleg.gov"; "William.Kirkley@ncleg.gov"; "Joyce.Krawiec@ncleg.gov"; "Debbie.Lown@ncleg.gov"; "Paul.Lowe@ncleg.gov"; "Corneisha.Mitchell@ncleg.gov"; "Natasha.Marcus@ncleg.gov"; "Jessica.Bolin@ncleg.gov"; "Wiley.Nickel@ncleg.gov"; "Michael.Cullen@ncleg.gov"; "Jim.Perry@ncleg.gov"; "LeighAnn.Biddix@ncleg.gov"; "Bill.Rabon@ncleg.gov"; "Paula.Fields@ncleg.gov"; "William.Richardson@ncleg.gov"; "Leigh.Lawrence@ncleg.gov"; "Jason.Saine@ncleg.gov"; "MaryStuart.Sloan@ncleg.gov"; "John.Torbett@ncleg.gov"; "Viddia.Torbett@ncleg.gov"; "Cecil.Brockman@ncleg.gov"; "Matthew.Barley@ncleg.gov"; "Becky.Carney@ncleg.gov"; "Beth.LeGrande@ncleg.gov"; "Linda.Cooper-Suggs@ncleg.gov"; "Caroline.Enloe@ncleg.gov"; "Jimmy.Dixon@ncleg.gov"; "Michael.Wiggins@ncleg.gov"; "Jon.Hardister@ncleg.gov"; "Jayne.Nelson@ncleg.gov"; "Pricey.Harrison@ncleg.gov"; "Mary.Lee@ncleg.gov"; "Kelly.Hastings@ncleg.gov"; "Sophia.Hastings@ncleg.gov"; "Zack.Hawkins@ncleg.gov"; "Anita.Wilder@ncleg.gov"; "Brenden.Jones@ncleg.gov"; "Jeff.Hauser@ncleg.gov"; "Grey.Mills@ncleg.gov"; "Mason.Barefoot@ncleg.gov"; "Robert.Reives@ncleg.gov"; "Veronica.Green@ncleg.gov"; "David.Rogers@ncleg.gov"; "Misty.Rogers@ncleg.gov"; "John.Szoka@ncleg.gov"; "Beverly.Slagle@ncleg.gov"; "Harry.Warren@ncleg.gov"; "Cristy.Yates@ncleg.gov"; "Lee.Zachary@ncleg.gov"; "Martha.Jenkins@ncleg.gov"
Cc: Hilary Harris Klein; Mitchell D. Brown; Katelin Kaiser
Subject: 2021 North Carolina redistricting - SCSJ correspondence re: proposed Senate map
Date: Monday, October 25, 2021 8:14:02 PM
Attachments: SCSJ Letter Senate Map 10 25 21 FINAL.pdf

Senators and Representatives and NCGA staff,

Please find attached correspondence from the Southern Coalition for Social Justice regarding the proposed Senate map that we understand will be the subject of public comment tomorrow. Please don’t hesitate to reach out to me if you have any questions.

Sincerely,

Allison Riggs
Co-Executive Director, Programs
Chief Counsel for Voting Rights
Southern Coalition for Social Justice
1415 West Highway 54, Ste. 101
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919-323-3380 ext. 117
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allison@southerncoalition.org

NCLCV v. Hall
21 CVS 15426
LDTX140

Exhibit#:
Hise 61
12/30/21
exhibitsticker.com

SOUTHERN COALITION for SOCIAL JUSTICE

1415 W. Hwy 54, Suite 101
Durham, NC 27707
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October 25, 2021

VIA EMAIL

To: Sen. Phil Berger
President Pro Tempore, North Carolina Senate
Rep. Tim Moore
Speaker, North Carolina House of Representatives
Sen. Daniel, Sen. Hise, and Sen. Newton
Co-Chairs, Senate Standing Committee on Redistricting and Elections
Rep. D. Hall, Chair
House Standing Committee on Redistricting

CC: Sen. Dan Blue, Senate Democratic Leader
Rep. Robert T. Reives, II, House Democratic Leader
Members, Senate Standing Committee on Redistricting and Elections
Members, House Standing Committee on Redistricting

Senators and Representatives,

It is disappointing that the State Senate map, "SST-4," that has been drafted, and apparently will be offered to the committees, has completely ignored important racial considerations. As we raised in our October 8, 2021 letter, the rejection of all racial data in drafting these maps raises serious legal concerns that are illustrated by SST-4.

The selections from clusters that you offered on October 5, 2021 as legal options for county clustering appear to raise further concerns. There were two cluster options for the Senate district in northeastern North Carolina, both of which you asserted were legal clusters. This body appears to be poised to select the map within SST-4 that is obviously worse for Black voters, the "Z1" cluster "Duke_Senate 02."

Even without considering racial data, it would have been painfully obvious to anyone with a passing familiarity with North Carolina's political geography that excluding Warren, Halifax, and Martin from a cluster where the incumbent is the candidate of choice of Black voters – and herself Black – will be fatal to the ability of Black voters to continue electing their candidate of choice. We will provide you the data to confirm that.

The cluster that obviously does not interfere with the ability of Black voters to elect their candidate of choice is comprised of Warren, Halifax, Martin, Bertie, Northampton, Hertford, Gates, Camden, Currituck, and Tyrell. The Black Voting Age Population ("BVAP") in that district is 42.33%. It is a district where the Democratic candidate, in the last two presidential elections and last two gubernatorial elections, would have won. While there is racially polarized voting in these counties, collectively, using reconstituted election results, this one-district cluster would have elected the Black-preferred candidate in each of the statewide, racially contested elections we mentioned in our October 5 letter. That is, racially polarized voting is not legally significant in this cluster, and therefore, it is the obvious choice unless one wanted to undermine Black voting strength.

The cluster that the committee chair and presumably legislative leadership selected in SST-4 is comprised of Northampton, Hertford, Bertie, Gates, Perquimans, Pasquotank. Camden, Currituck, Tyrell, and Dare, and most certainly destroys the ability of Black voters to elect their candidate of choice. While Senate District 3 is not majority-Black in its current form, it is an effective crossover district that is electing the candidate of choice of Black Voters. The BVAP in District 1 (the analog to SD 3 in the current map) with the cluster you have chosen is only 29.49%. It is a district where the Republican candidate won in the last two presidential elections, the last two gubernatorial elections, and the 2020 state supreme court election. Not only is there racially polarized voting in the counties comprising this district, collectively, using reconstituted election results, this one-district cluster would not have elected the Black-preferred candidate in any of the statewide, racially contested elections we mentioned in our October 5 letter. That is, racially polarized voting is legally significant. The selection of this cluster, therefore, is inexplicable absent discriminatory intent.

This letter is being submitted as an addendum to our October 5 letter. To our understanding, none of the concerns raised in our October 5 letter have been addressed in any capacity. If the North Carolina General Assembly proceeds with the SST-4 proposed map, this body will ensure that two of the three representatives of choice of Black voters in northeastern North Carolina will not be re-elected, nor any candidate of choice of Black voters within those two districts. This extremely discriminatory result—especially in the face of the information being provided to this body—strongly suggests that such a result is intentional. Once again, we urge you to reconsider your actions and to enact a redistricting plan that is legal and fair to all voters of North Carolina.

If you have any questions, please do not hesitate to contact us.

Sincerely,

Allison J. Riggs
Co-Executive Director for Programs and Chief Counsel for Voting Rights
Hilary Harris Klein
Senior Counsel, Voting Rights
Mitchell Brown
Counsel, Voting Rights
Katelin Kaiser
Counsel, Voting Rights

EXHIBIT 62

From: Bob Phillips <bphillips@commoncause.org>
Subject: RPV Analysis for proposed SD9 and SD1 in member submitted map "SST-4"
Date: October 26, 2021 at 11:54:06 AM EDT
To: "Tim.Moore@ncleg.gov" <Tim.Moore@ncleg.gov>, "Grace.Irvin@ncleg.gov" <Grace.Irvin@ncleg.gov>, "Phil.Berger@ncleg.gov'" <Phil.Berger@ncleg.gov>, "Robin.Braswell@ncleg.gov" <Robin.Braswell@ncleg.gov>, "Warren.Daniel@ncleg.gov" <Warren.Daniel@ncleg.gov>, "Andy.Perrigo@ncleg.gov" <Andy.Perrigo@ncleg.gov>, "Ralph.Hise@ncleg.gov" <Ralph.Hise@ncleg.gov>, "Susan.Fanning@ncleg.gov" <Susan.Fanning@ncleg.gov>, "Paul.Newton@ncleg.gov" <Paul.Newton@ncleg.gov>, "Andrew.Stiffel@ncleg.gov" <Andrew.Stiffel@ncleg.gov>, "Destin.Hall@ncleg.gov" <Destin.Hall@ncleg.gov>, "Lucy.Harrill@ncleg.gov" <Lucy.Harrill@ncleg.gov>, "Dan.Blue@ncleg.gov" <Dan.Blue@ncleg.gov>, "Bonnie.McNeil@ncleg.gov" <Bonnie.McNeil@ncleg.gov>, "Robert.Reives@ncleg.gov" <Robert.Reives@ncleg.gov>, "Veronica.Green@ncleg.gov" <Veronica.Green@ncleg.gov>, "Ben.Clark@ncleg.gov" <Ben.Clark@ncleg.gov>, "Michael.Johnson@ncleg.gov" <Michael.Johnson@ncleg.gov>, "Don.Davis@ncleg.gov" <Don.Davis@ncleg.gov>, "Edwin.Woodard@ncleg.gov" <Edwin.Woodard@ncleg.gov>, "Chuck.Edwards@ncleg.gov" <Chuck.Edwards@ncleg.gov>, "Heather.Millett@ncleg.gov" <Heather.Millett@ncleg.gov>, "Carl.Ford@ncleg.gov" <Carl.Ford@ncleg.gov>, "Angela.Ford@ncleg.gov" <Angela.Ford@ncleg.gov>, "Kathy.Harrington@ncleg.gov" <Kathy.Harrington@ncleg.gov>, "Lorie.Byrd@ncleg.gov" <Lorie.Byrd@ncleg.gov>, "Brent.Jackson@ncleg.gov" <Brent.Jackson@ncleg.gov>, "William.Kirkley@ncleg.gov" <William.Kirkley@ncleg.gov>, "Joyce.Krawiec@ncleg.gov" <Joyce.Krawiec@ncleg.gov>, "Debbie.Lown@ncleg.gov" <Debbie.Lown@ncleg.gov>, "Paul.Lowe@ncleg.gov" <Paul.Lowe@ncleg.gov>, "Corneisha.Mitchell@ncleg.gov" <Corneisha.Mitchell@ncleg.gov>, "Natasha.Marcus@ncleg.gov" <Natasha.Marcus@ncleg.gov>, "Jessica.Bolin@ncleg.gov" <Jessica.Bolin@ncleg.gov>, "Wiley.Nickel@ncleg.gov" <Wiley.Nickel@ncleg.gov>, "Michael.Cullen@ncleg.gov" <Michael.Cullen@ncleg.gov>, "Jim.Perry@ncleg.gov" <Jim.Perry@ncleg.gov>, "LeighAnn.Biddix@ncleg.gov" <LeighAnn.Biddix@ncleg.gov>, "Bill.Rabon@ncleg.gov" <Bill.Rabon@ncleg.gov>, "Paula.Fields@ncleg.gov" <Paula.Fields@ncleg.gov>, "William.Richardson@ncleg.gov" <William.Richardson@ncleg.gov>, "Leigh.Lawrence@ncleg.gov" <Leigh.Lawrence@ncleg.gov>, "Jason.Saine@ncleg.gov" <Jason.Saine@ncleg.gov>, "MaryStuart.Sloan@ncleg.gov" <MaryStuart.Sloan@ncleg.gov>, "John.Torbett@ncleg.gov" <John.Torbett@ncleg.gov>, "Viddia.Torbett@ncleg.gov" <Viddia.Torbett@ncleg.gov>, "Cecil.Brockman@ncleg.gov" <Cecil.Brockman@ncleg.gov>, "Matthew.Barley@ncleg.gov" <Matthew.Barley@ncleg.gov>, "Becky.Carney@ncleg.gov" <Becky.Carney@ncleg.gov>, "Beth.LeGrande@ncleg.gov" <Beth.LeGrande@ncleg.gov>, "Linda.Cooper-Suggs@ncleg.gov" <Linda.Cooper-Suggs@ncleg.gov>, "Caroline.Enloe@ncleg.gov" <Caroline.Enloe@ncleg.gov>, "Jimmy.Dixon@ncleg.gov" <Jimmy.Dixon@ncleg.gov>, "Michael.Wiggins@ncleg.gov" <Michael.Wiggins@ncleg.gov>, "Jon.Hardister@ncleg.gov" <Jon.Hardister@ncleg.gov>, "Jayne.Nelson@ncleg.gov" <Jayne.Nelson@ncleg.gov>, "Pricey.Harrison@ncleg.gov" <Pricey.Harrison@ncleg.gov>, "Mary.Lee@ncleg.gov" <Mary.Lee@ncleg.gov>, "Kelly.Hastings@ncleg.gov" <Kelly.Hastings@ncleg.gov>, "Sophia.Hastings@ncleg.gov" <Sophia.Hastings@ncleg.gov>, "Zack.Hawkins@ncleg.gov" <Zack.Hawkins@ncleg.gov>, "Anita.Wilder@ncleg.gov" <Anita.Wilder@ncleg.gov>, "Brenden.Jones@ncleg.gov" <Brenden.Jones@ncleg.gov>, "Jeff.Hauser@ncleg.gov" <Jeff.Hauser@ncleg.gov>, "Grey.Mills@ncleg.gov" <Grey.Mills@ncleg.gov>, "Mason.Barefoot@ncleg.gov" <Mason.Barefoot@ncleg.gov>, "David.Rogers@ncleg.gov" <David.Rogers@ncleg.gov>, "Misty.Rogers@ncleg.gov" <Misty.Rogers@ncleg.gov>, "John.Szoka@ncleg.gov" <John.Szoka@ncleg.gov>, "Beverly.Slagle@ncleg.gov" <Beverly.Slagle@ncleg.gov>, "Harry.Warren@ncleg.gov" <Harry.Warren@ncleg.gov>, "Cristy.Yates@ncleg.gov" <Cristy.Yates@ncleg.gov>, "Lee.Zachary@ncleg.gov" <Lee.Zachary@ncleg.gov>, "Martha.Jenkins@ncleg.gov" <Martha.Jenkins@ncleg.gov>

Subject: RPV Analysis for proposed SD9 and SD1 in member submitted map "SST-4"

Dear Senators and Representatives,

Attached are analyses of recent state-wide election results in the proposed SD9 and SD1 as drawn in the member submitted map "SST-4" that we believe are indicative of racially polarized voting in these jurisdictions. We strongly urge the House and Senate Redistricting Committees to consider this information, and to take care this redistricting cycle to ensure that House and Senate maps do not dilute the voting power of voters of color, particularly for voters in Northeast North Carolina.

NCLCV v. Hall
21 CVS 15426
LDTX141

Exhibit#:
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RPV in SD1 in SST4 Bertie-Camden-Currituck-Dare-Gates-Hertford-Northampton-Pasquotank-Perquimans-Tyrrell (Ernestine Bazemore)

Beasley vs. Newby - NC Supreme Court 2020GEN

	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (0)	≥ 90% White Precincts (18)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Beasley		34.58%	90.74%	27.00%	98.71%	21.02%	95.80%	23.69%	46.55%
Newby		65.42%	9.26%	73.00%	1.86%	78.94%	4.20%	76.31%	53.45%

Holmes vs. Dobson - NC Commissioner of Labor 2020GEN

	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (0)	≥ 90% White Precincts (18)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Holmes		33.59%	91.96%	26.15%	98.61%	20.31%	96.41%	22.50%	46.40%
Dobson		66.41%	8.04%	73.85%	0.98%	79.73%	3.59%	77.50%	53.60%

Blue vs. Folwell - NC Treasurer 2016GEN

	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (25)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Blue	93.86%	34.11%	93.41%	26.70%	98.79%	24.05%	97.19%	25.73%	48.07%
Folwell	6.14%	65.89%	6.59%	73.31%	0.79%	75.90%	2.81%	74.27%	51.93%

Coleman vs. Forest vs. Cole - Lt. Governor 2016GEN

	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (25)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Coleman	93.69%	33.83%	91.15%	25.49%	98.16%	22.79%	90.05%	27.98%	46.58%
Forest	5.74%	62.71%	8.85%	74.51%	1.16%	74.73%	9.13%	70.36%	50.98%
Cole	0.56%	3.47%			0.57%	3.42%	0.82%	1.66%	2.44%

RPV in SD9 in SST-4 Greene-Wayne-Wilson (Milton "Toby" Fitch Jr.)

	Beasley vs. Newby - NC Supreme Court 2020GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (0)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Beasley	94.90%		99.31%	18.74%	98.69%	8.57%	97.28%	10.60%	48.28%
Newby	5.10%		0.69%	81.26%	1.13%	91.40%	2.72%	89.40%	51.72%

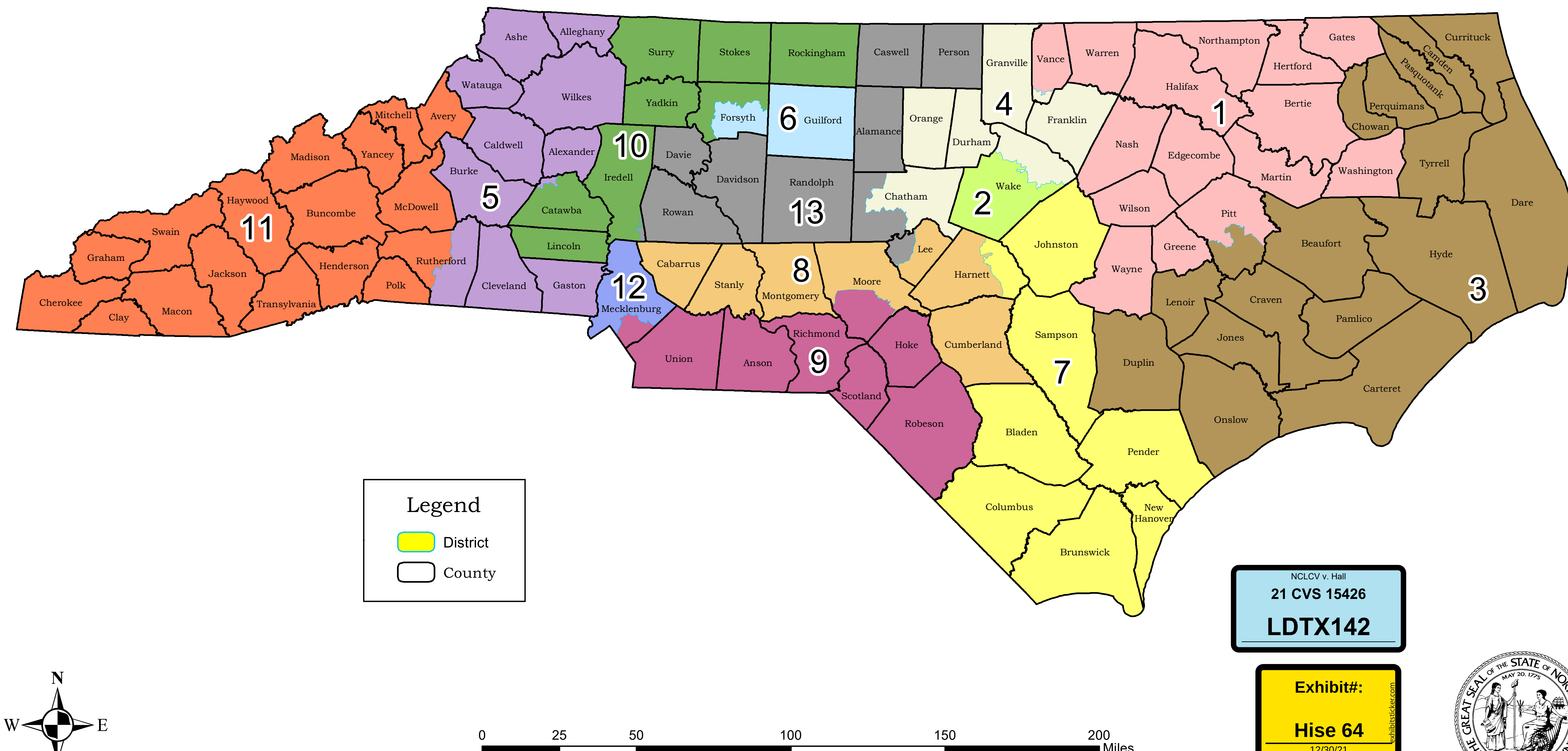
	Holmes vs. Dobson - NC Commissioner of Labor 2020GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (0)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Holmes	95.87%		100.00%	16.96%	99.11%	7.29%	97.89%	8.67%	47.68%
Dobson	4.13%		0.00%	83.04%	0.02%	92.70%	2.11%	91.33%	52.32%

	Blue vs. Folwell - NC Treasurer 2016GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (2)	≥ 90% White Precincts (1)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Blue	96.55%	15.82%	100.00%	17.62%	99.02%	13.55%	97.40%	15.83%	48.71%
Folwell	3.45%	84.18%	0.00%	82.38%	0.84%	86.28%	2.60%	84.17%	51.29%

	Coleman vs. Forest vs. Cole - Lt. Governor 2016GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (2)	≥ 90% White Precincts (1)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Coleman	96.76%	13.79%	99.86%	14.28%	99.19%	9.91%	83.13%	22.97%	46.32%
Forest	2.19%	84.90%	0.14%	85.72%	0.90%	87.47%	16.19%	76.55%	51.96%
Cole	1.05%	1.31%			1.68%	1.80%	0.67%	0.48%	1.72%

EXHIBIT 64

HB1029 3rd Edition



NCLCV v. Hall

21 CVS 15426

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Exhibit#:

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12/30/21

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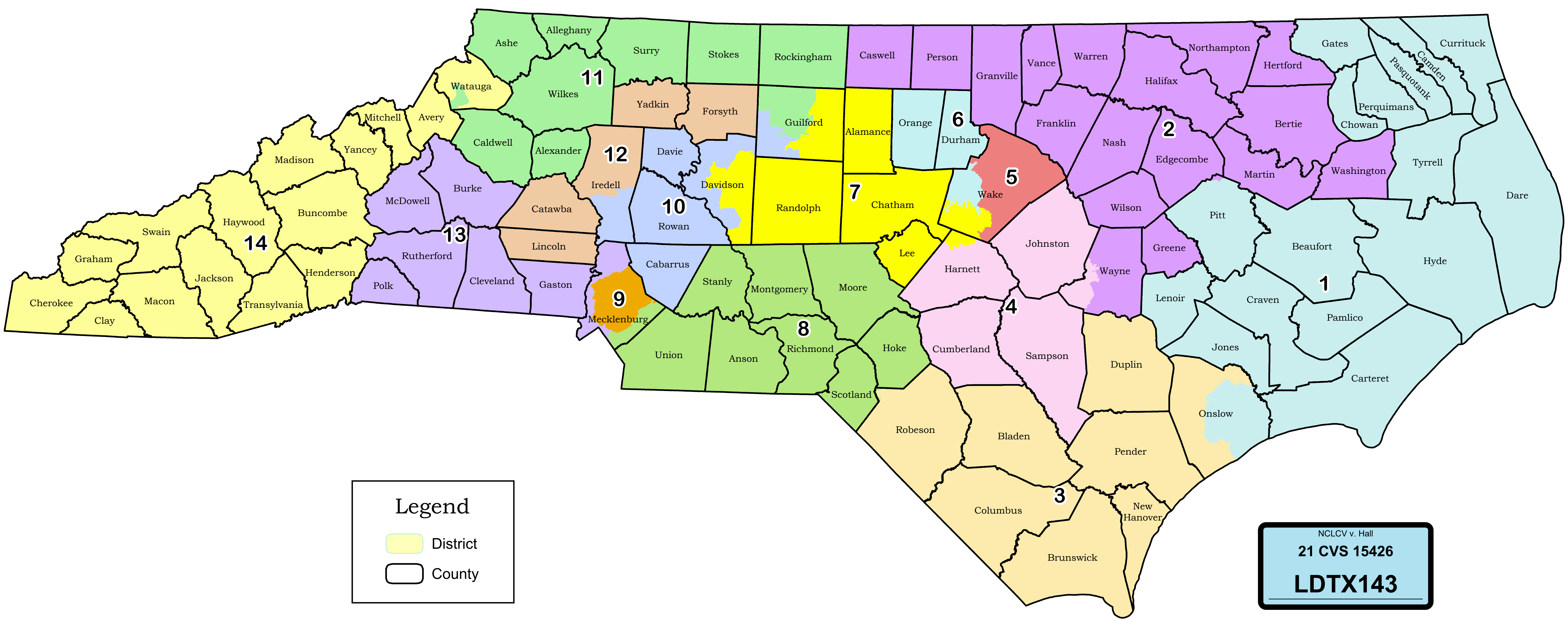
THE GREAT SEAL OF THE STATE OF NORTH CAROLINA MAY 20, 1775 APRIL 12, 1776 ESSE QUAM VIDERI

C-Goodwin-A-1-TC

Printed by the NC General Assembly, November 14, 2019

EXHIBIT 66

S.L. 2021-174 Congress



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NCLCV v. Hall
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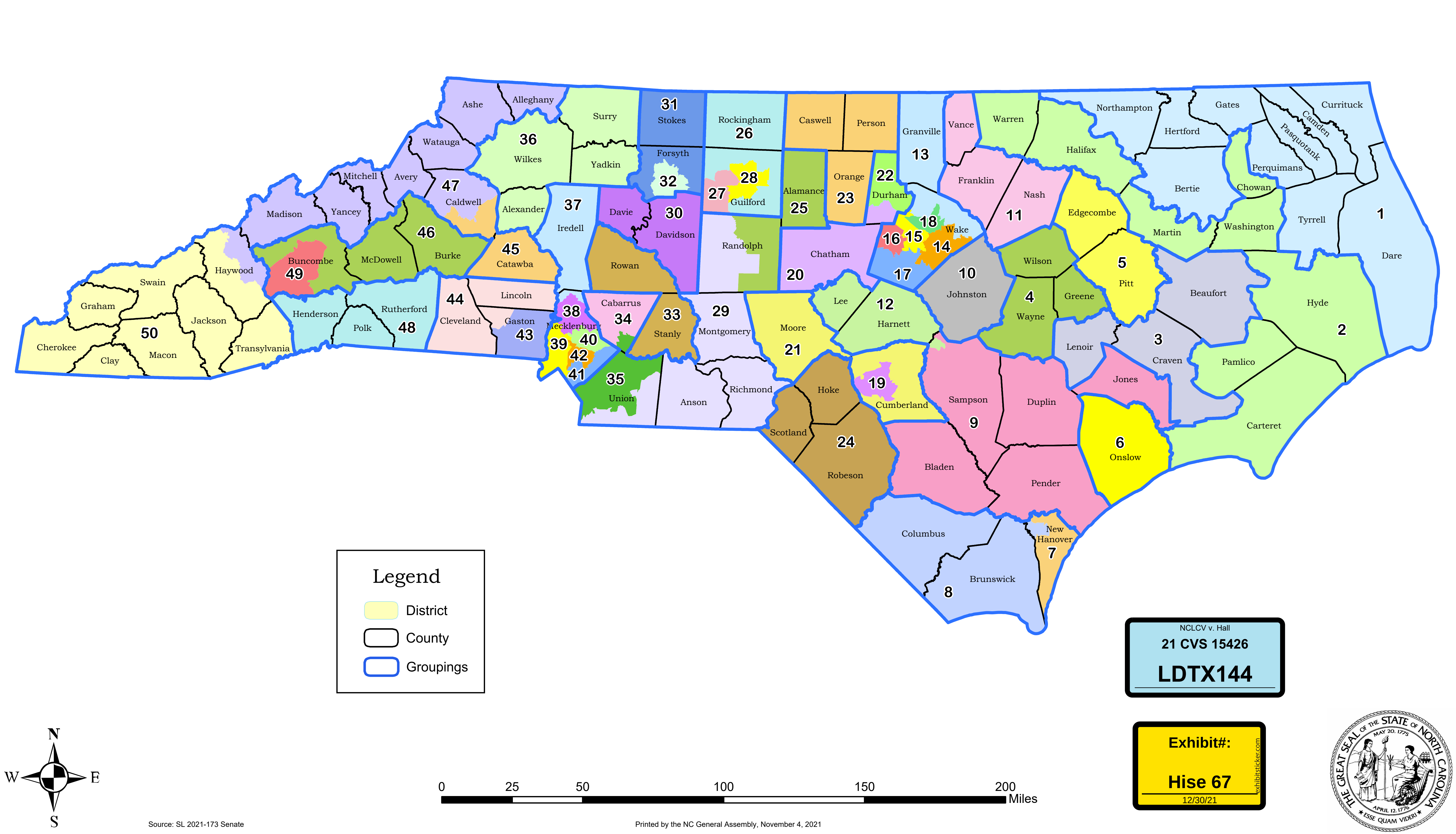
THE GREAT SEAL OF THE STATE OF NORTH CAROLINA
MAY 20, 1775
APRIL 12, 1776
ESSE QUAM VIDERI

SL 2021-174 Congress

Printed by the NC General Assembly, November 4, 2021

EXHIBIT 67

S.L. 2021-173 Senate



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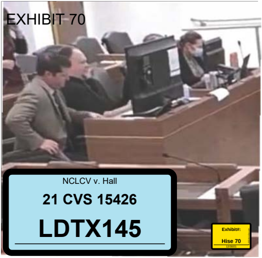
EXHIBIT 70
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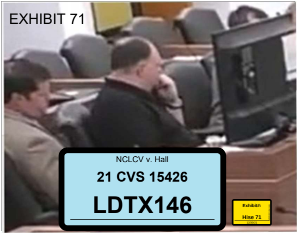
EXHIBIT 71
NCLCV v. Hall
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EXHIBIT 72
NCLCV v. Hall
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– Ex. 10025 –


EXHIBIT 73
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LDTX148
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EXHIBIT 74
NCLCV v. Hall
21 CVS 15426
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Exhibit#:
Hise 74
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An Evaluation of North Carolina's Congressional, State Senate, and State House District Maps

Daniel B. Magleby, Ph.D

Contents

1 Introduction

I am an Associate Professor in the Department of Political Science at Binghamton University, SUNY where I also hold a courtesy appointment in the Department of Economics. At Binghamton, I am also the director of the Center for the Analysis of Voting and Elections at Binghamton University. In 2007, I received an M.S. in Mathematical Methods in the Social Sciences from Northwestern University. I hold an M.A. in political science from the University of Michigan, Ann Arbor where I also received a Ph.D in political science in 2011. I have published academic papers on legislative districting and political geography in several political science journals, including *Political Analysis*, the *Election Law Journal*, *American Politics Research*, and *Social Science Quarterly*. My academic areas of expertise include legislative elections, geographic information systems (GIS) data, redistricting, voting rights, legislatures, and political geography. I have expertise in analyzing political geography, elections, and redistricting using computer simulations and other techniques. I have been retained by plaintiff Common Cause to perform the analysis described below at a rate of $250 an hour. My compensation is not predicated on arriving at any particular opinion.

1.1 Data

My opinions follow from analysis of the following data:

- VTD boundaries provided as ESRI Shapefiles by the US Census Bureau available on at the following URL `https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html`

- Census block boundaries and population data provided by the US Census Bureau. These are collected as part of the constitutionally mandated decennial census that most recently concluded in 2020.

- County boundaries as reported by the US Census Bureau.

- County clusterings provided by Christopher Cooper, Blake Esselstyn, Gregory Herschlag, Jonathan Mattingly, and Rebecca Tippett in a report that may be accessed at the following URL. `https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf`

- Election returns as reported by the Voting and Election Science Team[1] group and aggregated to Census-provided VTD boundaries and provided on the Redistricting Data Hub[2] website. I aggregate statewide elections returns from 2016 and 2020 to the set of legislature drawn districts and to the districts in each of the hypothetical alternative maps. In my analysis , I set aside election returns from 2018 because the only statewide races held that year were judicial elections which follow very different patterns compared to elections for other offices.

- 1,000 alternative, hypothetical maps of North Carolina's congressional, Senate, and House districts generated by a neutral, partisan-blind computer algorithm. The redistricting algorithm I use in my analysis was developed by me and a collaborator, Daniel Mosesson (consultant in private practice), in a paper that is forthcoming in *Political Analysis*. In our published work, we show that the algorithm produces a large number of unique maps of legislative districts without any indication of bias.

- Legislature-drawn boundaries of districts intended to elect representatives to Congress, the North Carolina Senate, and the North Carolina House of Representatives. These data are available on the North Carolina General Assembly website and may be accessed at the following URLs. `https://www.ncleg.gov/Redistricting`

[1] `https://dataverse.harvard.edu/dataverse/electionscience`
[2] `https://redistrictingdatahub.org`

2 Methods and Data

In this section I inform my analysis of North Carolina's map using computer-simulated redistricting methods. I discuss the data I use to analyze the maps, and describe the methods for measuring partisan bias in electoral maps. The purpose of these methods is to assess and describe potential biases that arise from the legislature-drawn electoral maps. In particular, I will describe how computer simulations may be used to evaluate alternative, hypothetical scenarios that are free of bias that human mapmakers may incorporate into a system of electoral districts. For the purposes of this report, I will define bias to mean a party receiving more representation that it should given underlying patterns of partisan support. Critically, I will not measure bias as an absolute deviation from proportionality, but rather as a deviation from patterns of representation we would expect if an electoral map were drawn in a neutral manner.

2.1 Computer-Drawn Maps

The purpose of my analysis is to determine if the legislature intended to discriminate against a particular group in North Carolina, or if the dilution of one group's influence arises for other more benign reasons. For example, political scientists have observed that even in systems that award representation in an unbiased manner, political parties receive a representational "bonus" for votes they receive over the majoritarian threshold of 50%. That is, a 1% increase in votes produces an increase of more than 1% in representation. As a result, parties that receive a little more than a majority of the votes may receive much more than a majority of seats in a legislature (see Edgeworth 1898; Butler 1952, 1951; Niemi and Deegan 1978). Likewise, electoral advantages may arise out of the geographic distribution of voters. For example, one group of voters may be evenly distributed across a jurisdiction that must be divided into multiple districts. If the distribution is even enough, it may be that it is impossible for a neutral process to draw a single-member district in which that group constitutes a majority. Alternatively, it may be that voters of one particular type are concentrated in an area or region. If that is the case, even a neutral process may collect those voters into a district in which they form a large majority leaving likeminded voters in neighboring districts in which they form a modest minority. My academic work focuses on developing tools to account for natural sources of bias through dilution and over-concentration of voters as a result of residential geography (Magleby and Mosesson 2018).

One way to evaluate a districting plan's bias is to compare a set of districts to an alternative set that we know to be unbiased. If the enacted plan is similar to the unbiased alternative, we may conclude that the enacted plan is also unbiased. Alternatively, if the enacted plan differs significantly from the alternative we know to be unbiased, we may conclude that the enacted plan is biased.

For this report, I used a computer algorithm I developed as part of my academic research to generate a large set of fair, hypothetical alternatives against which we may compare the North Carolina's legislature-drawn maps. The algorithm has been subject to peer review (see Magleby and Mosesson 2018) and has formed an important part of the analysis for several other peer reviewed articles (see e.g. Best et al. 2017; Krasno et al. 2018). The algorithm simulates a redistricting process constrained to draw districts that are contiguous and contain roughly equal population.[3] For the purposes of this report, I have constrained the algorithm to prioritize maintaining VTDs, roughly voting precincts, in North Carolina whole. The algorithm builds districts using data provided by the US Census Bureau. Census data include information about the number of people who reside within a geographic units and the geographies to which blocks are adjacent. Critically, the algorithm is blind to partisanship and race, so it does not consider the political preferences or race of residents as it constructs various hypothetical districts.

I use the algorithm to generate large sets (between 20,000 and 100,000) of maps from which I take a random sample of 1,000 maps that meet the set of redistricting criteria

[3]For a more technical discussion of the algorithm please see Appendix A

announced by the North Carolina legislature in advance of the last round of redistricting there. Each iteration of the computer algorithm combines geographies in different ways, so the result is 1,000 maps that contain unique combinations of contiguous districts that meet the legislature's announced criteria. This large set of maps constitutes a sample of the larger set of possible maps that mapmakers could have drawn. Each map represents a distinct, hypothetical example of a map of North Carolina's congressional, Senate, or House districts that was produced by a neutral process.

The maps generated by the computer are examples of outcomes we would expect if mapmakers were not motivated by partisan goals. Since each map is slightly different, the set of maps represents a range of possible outcomes from a neutral redistricting process. If the partisan characteristics of the enacted plan of congressional, Senate, and House districts in North Carolina falls outside the normal range of neutral outcomes generated by the algorithm, we can conclude that the map represents a significant deviation from a fair outcome.

This approach to evaluating districting plans is common in academic settings. Advances in computers made it possible for scholars to implement methods for developing a neutral, unbiased counterfactual of a jurisdiction's legislative districts (see Chen and Cottrell 2014; Chen and Rodden 2013; Tam Cho and Liu 2016; Cirincione, Darling and O'Rourke 2000; Engstrom and Wildgen 1977; Fifield et al. 2015; McCarty, Poole and Rosenthal 2009; O'Loughlin and Taylor 1982). Recently, courts have also relied upon maps generated by computer algorithms to determine the presence of dilution in enacted plans of legislative districts.

2.2 Measuring Gerrymanders

Measuring Partisanship in the Simulated Districts

To assess the partisanship of the maps produced by the computer algorithm, I use election returns from the 2016 and 2020 general election in North Carolina aggregated to the VTD-level. For each hypothetical map, I determine which simulated district a precinct would fall into, and assign the votes cast in that precinct to that district. If a precinct falls in more than one simulated district, I assign the the votes in that precinct to a simulated district according to the proportion of the precinct's population that falls inside that district.

I use statewide races (as opposed to congressional races) because scholars have shown those data to be reliable predictors of future behavior (Meier 1975). Moreover, a focus on statewide races serves to avoid problems of endogeneity that could be a problem with data from congressional elections. That is, differences in partisan performance in congressional elections can arise for many reasons besides the location of district boundaries. For example, incumbency, quality of challengers, campaign contributions, and campaign organization have all been shown to influence election outcomes, and those can vary widely across districts. By contrast, all those factors are held constant in statewide elections.

Statewide races have an additional advantage: the candidates on the ballot in statewide races appear in every precinct across the state. For this reason, returns from statewide contests are imperative when analyzing the computer generated, hypothetical maps. The computer frequently assigns precincts that fall in different districts in North Carolina's legislature-drawn map to the same district in a hypothetical map. In such a scenario, voters considered different candidates for Congress, and comparing a vote for Democratic candidate for Congress in one district to a Democrat running for Congress in another district requires that we assume away possible differences between contests and candidates. On the other hand, these factors are held constant when if we consider statewide contests.

For robustness, I use returns from multiple statewide contests. For each district in the legislature-drawn map and algorithm drawn maps I calculate a composite partisan score based the election results from the 2016 and 2020 election cycles. In those elections North Carolina held statewide contests for President, US Senate, Governor, Lieutenant Governor, Attorney General, Treasurer, Secretary of State, Auditor, Agriculture Commissioner, Insurance Commissioner, Labor Commissioner, and Superintendent of Public Instruction. To calculate the composite score, I take the sum the votes cast for Republican candidates for statewide office in 2016. I likewise sum the votes cast for Democratic candidates for statewide office. Then I determine the proportion of votes cast for the Democratic candidates by dividing the total votes cast for the Democratic candidates by the sum of the total votes cast for Republicans and total votes cast for Democrats. The result, the Democratic proportion of total votes cast in that district, is a composite measure of underlying support of for Democrats for voters living that district.

Using precinct-level returns for statewide races, I can determine the partisanship of the hypothetical districts drawn by the computer algorithm. The vast majority of VTDs are wholly contained within one district; however, I allow the computer algorithm to "break" VTDs into census blocks. It is therefore possible for the districts drawn by the algorithm to split existing VTDs. When that happens, I presume that the votes are distributed across blocks according to the proportion of a VTD's voting age population (VAP) that resides within a block. For example, suppose a precinct has a VAP of 100, and that voters cast 20 votes for a Republican candidate and 30 votes for a Democratic candidate. If a block within that precinct has a VAP of 10 people, I calculate that 2 votes for the Republican and 3 votes for the Democrat came from that block.

Districts Carried

I use the composite partisanship to calculate the number of districts carried in each map. I presume that districts in which the Democratic proportion of the composite votes exceeds 0.5 is a district that is more likely to elect a Democrat than a Republican. Conversely, if the Democratic proportion of the composite vote falls below 0.5, I presume that Republicans carried the district. For example, suppose Democrats received proportions of the composite vote equaling 0.47, 0.58, and 0.52 in a three-district jurisdiction. In such a scenario, I say that Democrats "carried" the second and third district and failed to carry the first. In this analysis I consider three jurisdictions, a 14-district congressional map, a 50-district Senate map, and a 120-district House map.

Median-Mean Difference

I also use the proportion of the composite partisan vote to calculate the median-mean difference metric. Consider the same example districts in which Democrats received proportions of the voted equaling 0.47, 0.58, and 0.52. To find the mean, we divide the sum of the Democratic proportions by the number of districts. In this case, (0.47+0.58+0.52)/3 = 1.57/3 = 0.52. To find the median we sort the Democratic proportions so that they are ordered from smallest to largest. The median is the proportion for which number of proportions that are larger is equal to the number of proportions that are smaller. In this example, we would order 0.47, 0.52, 0.58. Here, the median is 0.52 because there is one proportion that is larger and one that is smaller. Of course, in my analysis in this report, I take the number of districts in the map as the denominator in each map I analyze.

3 Findings: Partisan Bias

In this section, I describe the results of 1000 simulations of the redistricting process for North Carolina's congressional districts, Senate districts, and House districts. I show that the legislature drawn map of electoral districts for Congress, the Senate, and the House show significant bias against Democratic voters and that bias goes beyond anything we would expect based on the patterns of electoral geography in North Carolina. I begin by discussing the results of my simulations of the House map and comparing those results to the characteristics of the map drawn by the legislature. Next, I present the results of computer simulated redistricting for the North Carolina Senate electoral map and show that the legislature-drawn map exhibits more bias than we would expect based on chance alone. Finally, I repeat the analysis focused on the electoral map used to elected North Carolina's congressional delegation. I show that, as with the other maps, the legislature-drawn map shows bias above and beyond what we would expect had the legislature used a neutral process, free from an intent to produce a partisan bias, to determine district boundaries.

3.1 State House Districts

To draw a set neutral and partisan-blind maps of North Carolina's House districts, I take the following steps.

1. Build a map consisting of VTDs that are appropriate to the electoral map.
2. Divide that map into House-specific clusters as described by Cooper et. al.
3. Determine which VTDs are adjacent to each other in the cluster by cluster maps.
4. Run simulations for up to 40,000 maps per cluster.
5. For each cluster, I aggregate the characteristics of each VTD to the district to which it is assigned in each hypothetical map.
6. Aggregate the characteristics of each hypothetical map to ascertain its demographic and partisan characteristics. At this point, I subset the resulting maps to remove any maps in which the population of each district does not fall within 1.5% of constitutional requirements that districts contain equal population.[4] For the purposes of exposition, I randomly sample remaining maps and focus my analysis on 1000 of those randomly sampled.
7. Finally, I combine the data from each of the clusters and describe the partisan characteristics of the full set of maps.

The result of this process is a set of maps that approximate the legislatures announced districting criteria. Each systemwide map is a unique combination of North Carolina's geography. At no point in developing the sample of 1000 maps upon which I base my analysis do I consider any factors besides population and the geographic characteristics of

[4]Because of the compressed time available, a few counties posed coding problems because the average population deviation within clusters abutted the constitutional limit. Thus I allowed the algorithm slightly more flexibility. The algorithm draws maps randomly, there is no reason to believe this slight deviation from exact population parity should create an advantage for either Democrats or Republicans.

units of geography upon which the maps are based. Thus, taken together, the maps represent the distribution of outcomes we might expect from a neutral redistricting process.

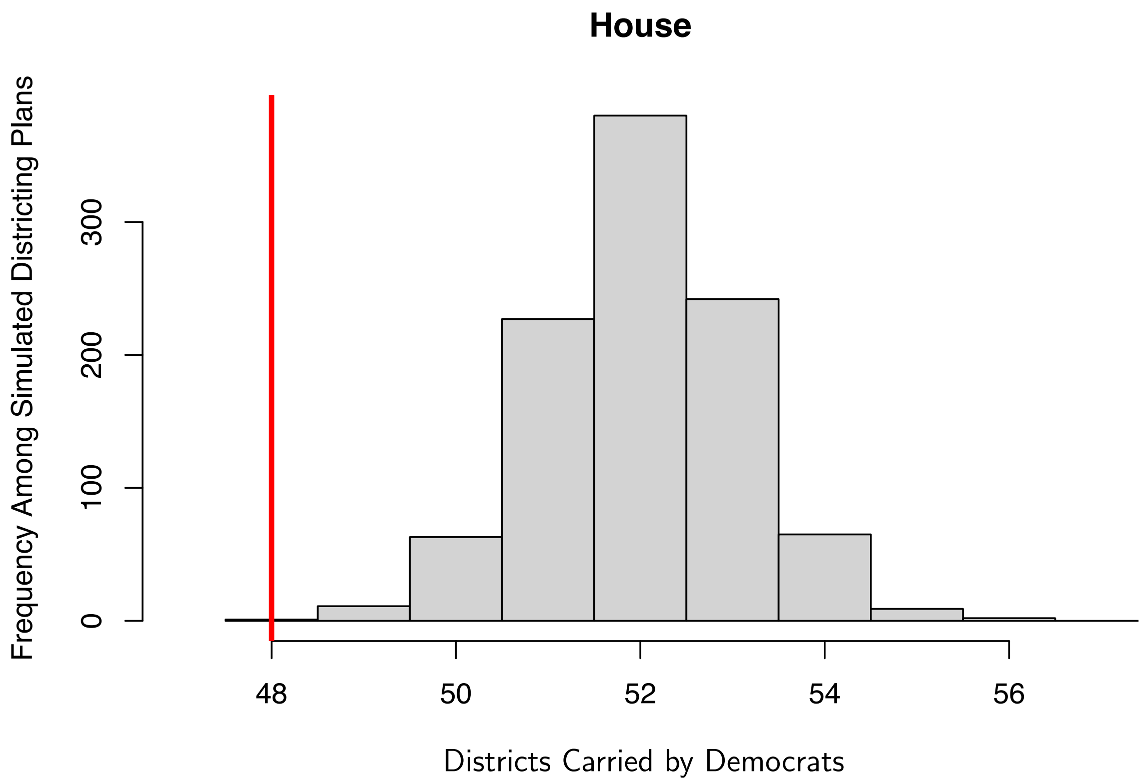

Figure 1: Distribution of outcomes from 1000 simulations of the redistricting process used to draw North Carolina's House districts. The x-axis represents the number of districts carried (out of 120) by Democrats using the partisan composite score. The vertical red line corresponds to the number of districts carried by Democrats in the legislature-drawn map. Democrats carried in 48/120 districts in the legislature-drawn map. Democrats carried just one of the 1000 sampled algorithm-drawn maps ($p = 0.001$).

Figure 1 summarizes the partisan characteristics of the set of algorithm-drawn maps and compares the distribution of those characteristics to the characteristics of the Legislature-drawn map of House districts. Here, I summarize the number of districts carried by Democrats. Recall that I say a Democrats carry a district if Democrats received more votes in that district in statewide contests during the 2016 and 2020 elections. Along the x-axis, numbers correspond to the number of districts favoring Democrats in a particular map. The y-axis describes the frequency with which I observe maps that exhibit a particular set of partisan characteristics. Thus, the relative height of the bars corresponds to the relative frequency with which I observe maps with particular characteristics in the set of Algorithm-drawn maps I analyzed.

In the sample of maps represented here, Democrats carried as few as 48 (out of 120) and as many as 56. In the sample, the most common outcome was one in which Democrats carried in 52/120 districts. By contrast, Democrats carried just 48 of the legislature-drawn districts. The algorithm drew just one map in which Democrats carried so few districts. Thus, based on this sample of maps, I may say that there is about a 1 in 1000 chance of drawing a map in which Democrats carried as few or fewer districts. In short, it is highly unlikely that the legislature-drawn map was developed though a process that treated partisanship of voters neutrally.

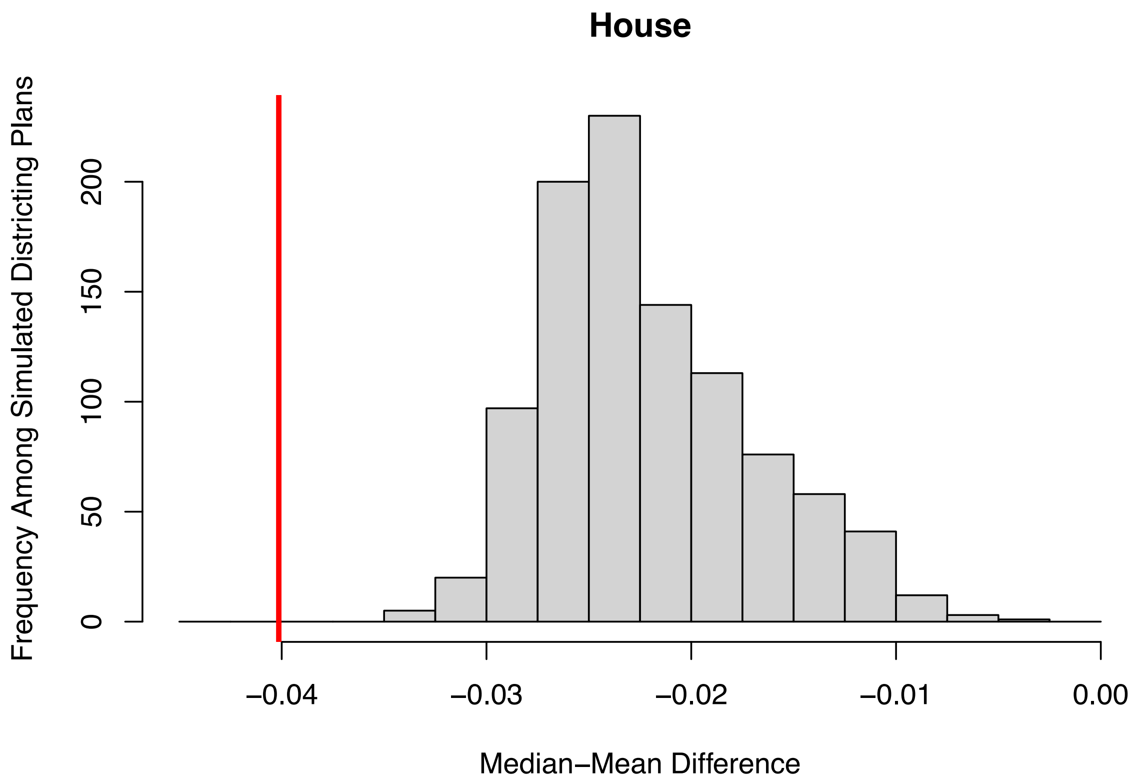

Figure 2: Distribution of outcomes from 1000 simulations of the redistricting process used to draw North Carolina's House districts. The x-axis represents the difference in the median Democratic vote share and the mean Democratic vote share calculated using the partisan composite score. The vertical red line corresponds to the difference in the median Democratic vote share and mean of Democratic vote share in the legislature-drawn map. The legislature drawn map has a median-mean difference of −0.04. None of the algorithm-drawn maps had a median-mean difference that extreme ($p = 0.0$).

The degree to which Democrats are disadvantaged by the legislature drawn map is even more stark when I consider the median-mean difference. Figure 4 summarizes the partisan characteristics of the set of algorithm-drawn maps and compares the distribution of those characteristics to the characteristics of the Legislature-drawn map. Here, I summarize the median-mean difference in the algorithm-drawn map and the legislature-drawn map. Recall that the median-mean difference is found by taking the map-level median and the map-level mean of Democratic share of the two-party vote. If the difference takes a negative number, the map is biased against Democrats. If the difference takes a positive value, the map is biased in favor of Democrats. If the difference equals 0, then the map is neither biased in favor nor biased against Democrats. Along the x-axis, numbers correspond to the number of districts carried by Democrats in a particular map. Maps are sorted into bins depending on whether the median-mean difference exhibited in the map falls into the interval the bar covers on the x-axis. The y-axis describes the frequency with which I observe maps that exhibit a particular set of partisan characteristics. Thus, the relative size of the bars corresponds to the relative frequency with which I observe maps with particular characteristics in the set of algorithm-drawn maps I analyzed.

In the sample of maps represented in my analysis, the most common median-mean difference in Democratic vote share fell between -0.0225 and -0.025. The lowest median-mean difference in the sample of maps I analyze here was -0.034, and the highest median-mean difference was -0.005. By contrast, the legislature-drawn map has a median-mean difference of -0.04. No map in the sample of algorithm drawn maps showed a degree of bias as extreme as the bias I observe in the legislature-drawn map. The data indicate that there is less than a 1 in 1000 chance that we would observe a map as extreme as the map drawn by the legislature if the legislature was following a neutral, party-blind process.

3.2 State Senate Districts

To draw a set neutral and partisan-blind maps of North Carolina's House districts, I take follow the same steps I took to develop maps for the House.

1. Build a map consisting of VTDs that are appropriate to the electoral map.
2. Divide that map into Senate-specific clusters as described by Cooper et. al.
3. Determine which VTDs are adjacent to each other in the cluster by cluster maps
4. Run simulations for up to 40,000 maps per cluster
5. For each cluster, I aggregate the characteristics of each VTD to the district to which it is assigned in each hypothetical map.

6. Aggregate the characteristics of each hypothetical map to ascertain its demographic and partisan characteristics. At this point, I subset the resulting maps to remove any maps in which the population of each district does not fall within 1.5% of constitutional requirements that districts contain equal population.[5] For the purposes of exposition, I randomly sample remaining maps and focus my analysis on the 1000 randomly sampled maps.

7. Finally, I combine the data from each of the clusters and describe the partisan characteristics of the full set of maps.

The result of this process is a set of maps that approximate the legislatures announced districting criteria. Each systemwide map is a unique combination of North Carolinas geography. At no point in developing the sample of 1000 maps upon which I base my analysis do I consider any factors besides population and the geographic characteristics of units of geography upon which the maps are based. Thus, taken together, the maps represent the distribution of outcomes we might expect from a neutral redistricting process.

[5]As described in an earlier footnote, we allow the algorithm more leeway to account for highly constrained average population deviations in some clusters.

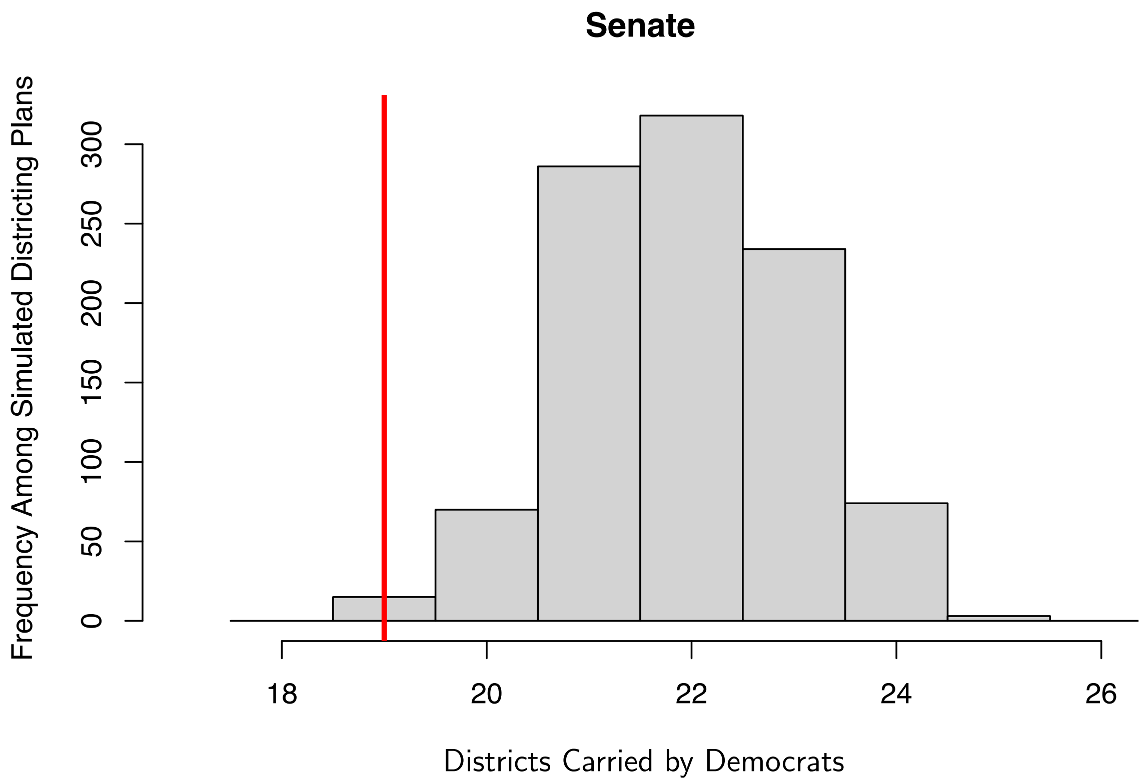

Figure 3: Distribution of outcomes from 1000 simulations of the redistricting process used to draw North Carolina's Senate districts. The x-axis represents the number of districts carried (out of 50) by Democrats using the partisan composite score. The vertical red line corresponds to the number of districts carried by Democrats in the legislature-drawn map. Democrats carried 19/50 districts in the legislature-drawn map. Just 15 out of 1000 of the algorithm-drawn maps had so few districts carried by Democrats ($p = 0.015$).

Figure 3 summarizes the partisan characteristics of the set of algorithm-drawn maps and compares the distribution of those characteristics to the characteristics of the Legislature-drawn map of Senate districts. Here, I summarize the number of districts carried by Democrats. Recall that I say Democrats carry a district if Democrats received more votes in that district in statewide contests during the 2016 and 2020 elections. Along the x-axis, numbers correspond to the number of districts carried by Democrats in a particular map. The y-axis describes the frequency with which I observe maps that exhibit a particular set of partisan characteristics. Thus, the relative size of the bars corresponds to the relative frequency with which I observe maps with particular characteristics in the set of algorithm-drawn maps I analyzed.

In the sample of maps represented here, Democrats carried as few as 19 (out of 50) and as many as 25. In the sample, the most common outcome was one in which Democrats carried 22/50 districts. By contrast, Democrats carried just 18 of the legislature-drawn districts. The algorithm drew 15 maps in which Democrats carried so few districts. Thus, based on this sample of maps, I may say that there is about a 1.5 in 100 chance of drawing a map in which Democrats carried as few or fewer districts. In short, it is highly improbable that the legislature-drawn map was developed though a process that treated partisanship of voters neutrally.

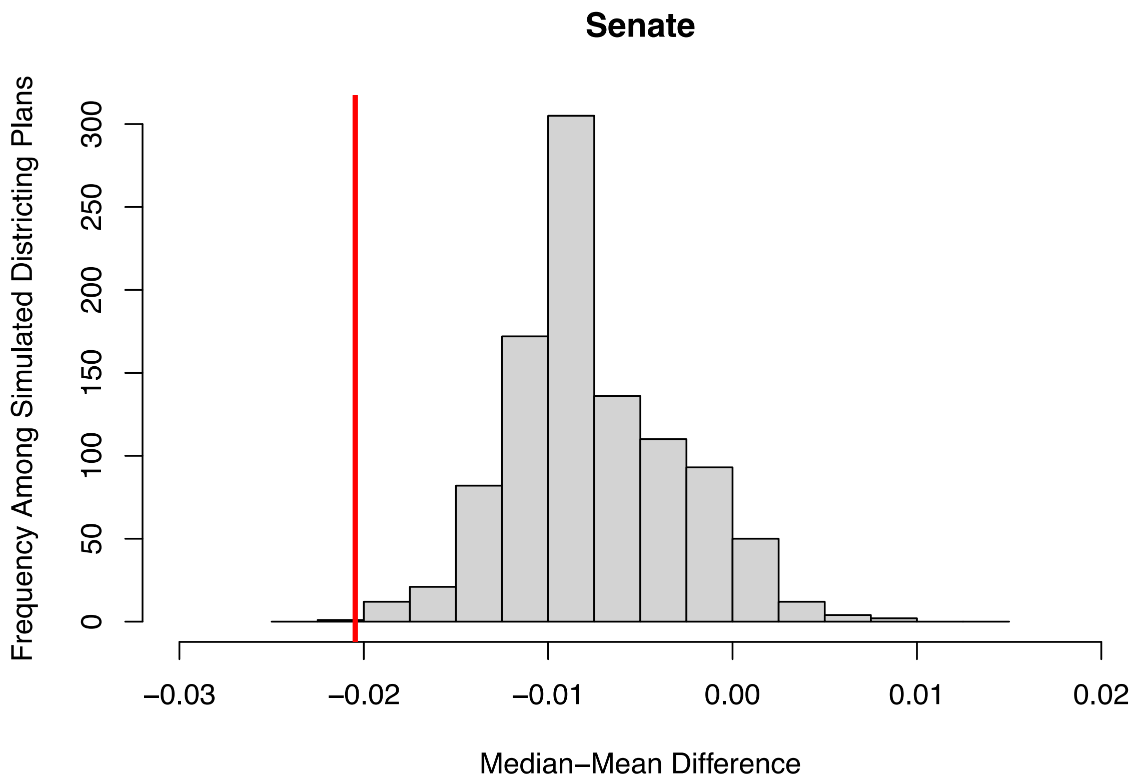

Figure 4: Distribution of outcomes from 1000 simulations of the redistricting process used to draw North Carolina's Senate districts. The x-axis represents the difference in the median Democratic vote share and the mean Democratic vote share calculated using the partisan composite score. The vertical red line corresponds to the difference in the median Democratic vote share and mean of Democratic vote share in the legislature-drawn map. The legislature drawn map has a median-mean difference of -0.0204. None of the algorithm-drawn maps had a median-mean difference that extreme ($p = 0.0$).

The degree to which Democrats are disadvantaged by the legislature drawn map is even more stark when I consider the median-mean difference. Figure 4 summarizes the partisan characteristics of set of algorithm-drawn maps of Senate districts and compares the distribution of those characteristics to the characteristics of the Legislature-drawn map in terms of median-mean difference. Recall that the median-mean difference is found by taking the map-level median and the map-level mean of Democratic share of the two-party vote. If the difference takes a negative number, the map is biased against Democrats. If the difference takes a positive value, the map is biased in favor of Democrats. If the difference equals 0, then the map is neither biased in favor nor biased against Democrats. Along the x-axis, numbers correspond to the number of districts carried by Democrats in a particular map. Maps are sorted into bins depending on whether the median-mean difference exhibited in the map falls into the interval the bar covers on the x-axis. The y-axis describes the frequency with which I observe maps that exhibit a particular set of partisan characteristics. Thus, the relative size of the bars corresponds to the relative frequency with which I observe maps with particular characteristics in the set of algorithm-drawn maps I analyzed.

In the sample of maps represented in my analysis, the most common median-mean difference in Democratic vote share fell between -0.0075 and -0.01. The lowest median-mean difference in the sample of maps I analyze here was -0.0201, and the highest median-mean difference was -0.005. By contrast, the legislature-drawn map has a median-mean difference of -0.009. No map in the sample of algorithm-drawn maps showed a degree of bias as extreme as the bias I observe in the legislature-drawn map. The data indicate that there is less than a 1 in 1000 chance that the legislature would arrive a map as biased as their map of Senate districts if they followed a neutral, party-blind process.

3.3 Congressional Districts

To draw a set neutral and partisan-blind maps of North Carolina's House districts, I follow the same steps I took to develop maps for the House.

1. Build a map consisting of VTDs that are appropriate to the electoral map. In the case of the congressional map, I maintained whole all counties that the legislature did not break in their map.

2. Divide that map into Senate-specific clusters as described by Cooper et. al.

3. Determine which VTDs are adjacent to each other in the cluster by cluster maps.

4. Run simulations for 100,000 maps.

5. For each cluster, I aggregate the characteristics of each VTD to the district to which it is assigned in each hypothetical map.

6. Aggregate the characteristics of each hypothetical map to ascertain its demographic and partisan characteristics. At this point, I subset the resulting maps to remove any maps in which the population of each district does not fall within 0.01 of constitutional requirements that districts contain equal population. For the purposes of exposition, I randomly sample remaining maps and focus my analysis on 1000.

7. Finally, I combine the data from each of the clusters and describe the partisan characteristics of the full set of maps.

The result of this process is a set of maps that approximate the legislature's announced districting criteria. Each systemwide map is a unique combination of North Carolinas geography. At no point in developing the sample of 1000 maps upon which I base my analysis do I consider any factors besides population and the geographic characteristics of units of geography upon which the maps are based. Thus, taken together, the maps represent the distribution of outcomes we might expect from a neutral redistricting process.

Figure 5 presents a histogram summarizing findings from 1000 simulations of the redistricting process in North Carolina. The x-axis corresponds the possible number of districts that Democrats could carry by the composite partisan vote. The y-axis corresponds to the

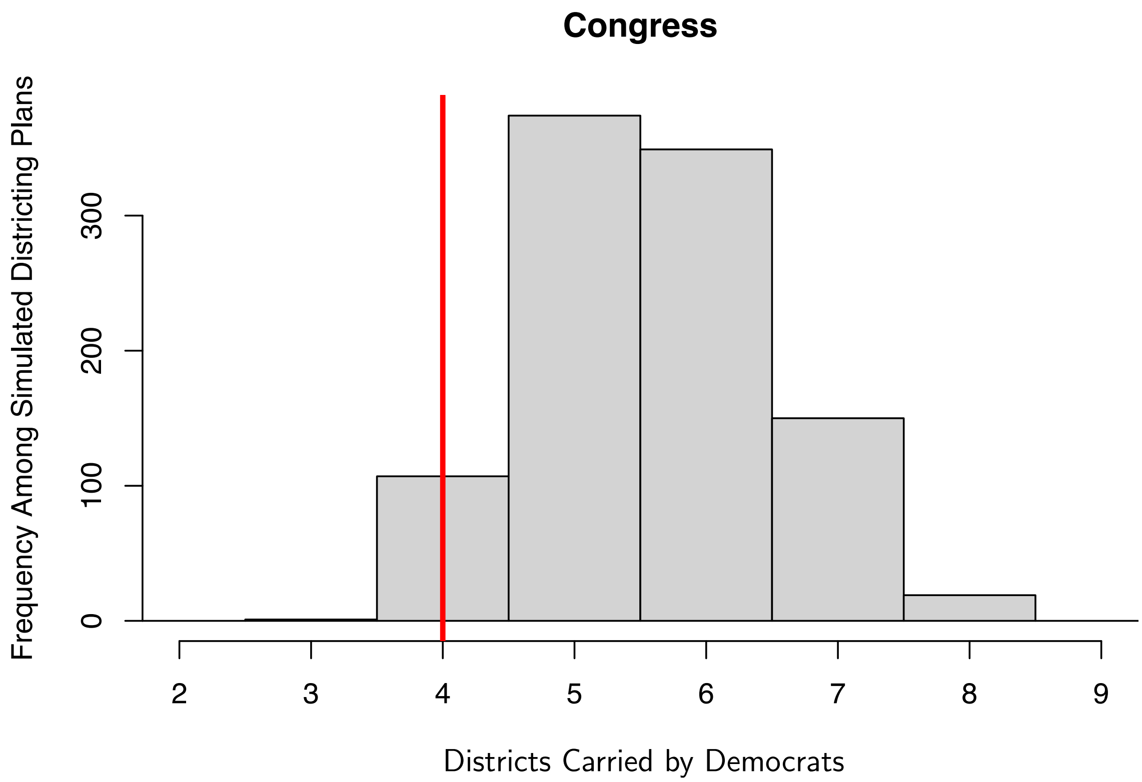

Figure 5: Distribution of outcomes from 1000 simulations of the redistricting process used to draw North Carolina's congressional districts. The x-axis represents the number of districts carried (out of 14) by Democrats using the partisan composite score. The vertical red line corresponds to the number of districts carried by Democrats in the legislature-drawn map.

frequency with which maps with a particular count of districts carried appear in the set of simulated maps. Higher bars correspond to outcomes that occurred more often in the set of simulated maps. The simulations produced maps with as few as 3 and as many as 8 districts that would favor a Democratic candidate. The most common outcome, occurring in 374/1000 simulations, in the simulation was Democrats carrying 5/14 districts based on the composite partisan score. Democrats carried 6/14 districts in nearly as many districts (349/1000 simulations). Democrats carried 7/10 and 8/10 districts in 150/1000 and 19/1000 maps respectively. In the enacted map, we would expect Democrats to carry 4 districts by the composite partisan index. In 108/1000, Democrats carried 4 or fewer districts. Thus the legislature drawn map shares characteristics with roughly 1/10 of the maps drawn by the algorithm.

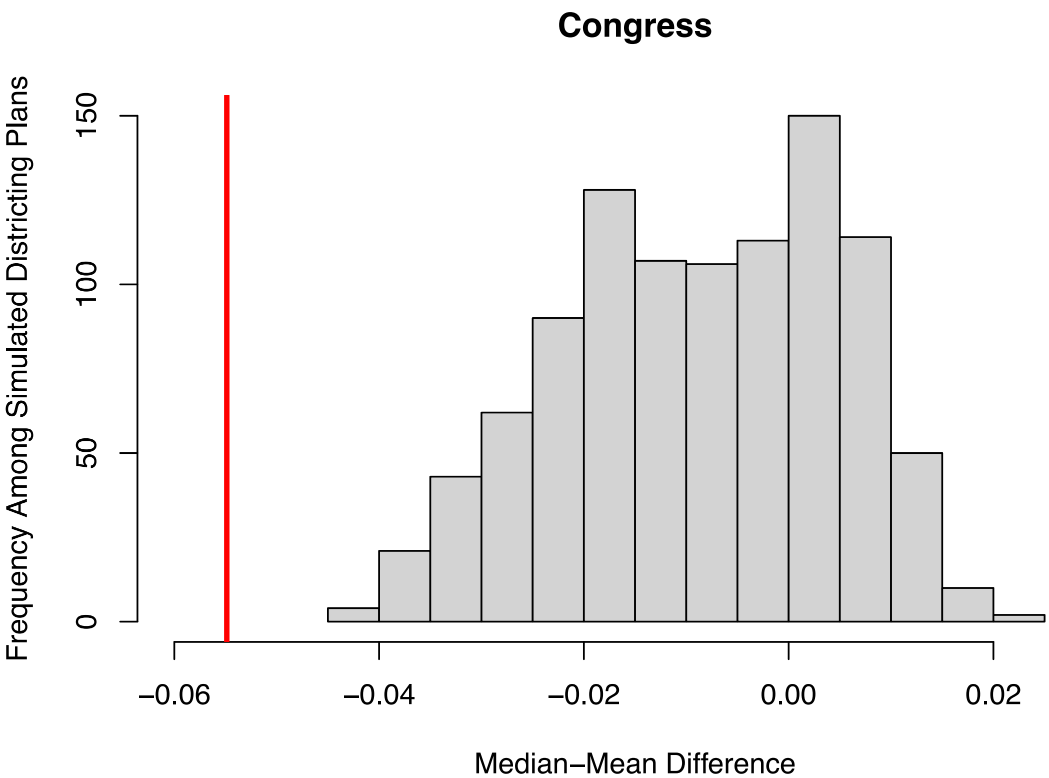

Figure 6: Distribution of outcomes from 1000 simulations of the redistricting process used to draw North Carolina's congressional districts. The x-axis represents the difference in the median Democratic vote share and the mean Democratic vote share calculated using the partisan composite score. The vertical red line corresponds to the difference in the median Democratic vote share and mean of Democratic vote share in the legislature-drawn map.

Figure 6 presents a histogram that summarizes the difference in median composite partisan vote share and mean composite partisan vote share for 1000 simulated maps of North Carolina's Congressional districts. Here the x-axis corresponds to possible values that the median-mean difference may take. The y-axis corresponds to frequency with which particular values appear in the algorithm-drawn map. As before, the vertical red line corresponds to the median-mean difference in the legislature-drawn map.

In the simulated maps, the median-mean difference ranged from -0.042 to 0.025. the distribution is bimodal with two peaks at just greater than -0.02 and another peak at a little above 0.0. The fact that simulations regularly show median-mean differences of greater than 0.0 which corresponds to no votes being weighted roughly equally in the system of districts.

In fact, 326/1000, just shy of a third of the simulations, corresponds to maps that were not skewed against Democrats. The legislature drawn map showed a median-mean score of -0.055. Not a single algorithm-drawn map was more extreme than the map drawn by the legislature. By contrast, the minimum median-mean difference observed in the simulated maps was just -0.041.

4 Conclusion

Each legislature-drawn map represents a significant deviation from unbiased alternatives produced by the computer algorithm I describe here. Based on the simulations, there is less than a 1 in 1000 chance that a neutral process produced the House map. There is less than a 2 in 100 chance that a neutral process led to the Senate map. The odds of arriving at a congressional map as biased as the legislature-drawn map are similarly long.

As independent events, the emergence of these three maps would be cause for concern that partisan biased actions were taken in the construction. Taken together, concern compounds. The computer simulations that I described in this report suggest that the legislature drew three maps that represent gerrymanders in favor of Republicans.

A A Description of the Magleby-Mosesson Algorithm

The process we use to develop a large set of neutral counterfactuals draws maps in a four-step process. For a more technical representation along with evaluations of the authors' claims of neutrality (see Magleby and Mosesson 2018).

Step 1: Convert map into a graph

We reduce the map to a connected graph where each geographic unit, a VTD in this setting, is a vertex of the graph. Two vertices are connected by edges if the units of geography share more than a single point of their boundary (thus, the resulting districts will be "rook" contiguous).

Step 2: Divide the graph randomly

The algorithm randomly collects connected vertices into groups and joins them into a new vertex that aggregates the demography of each of its constituent vertices and preserves the connectedness with any vertex with which a constituent vertex was adjacent. It continues to randomly join groups of vertices until the number of groups is equal to the number of districts in the state.

Step 3: Refine the divided graph

In order to achieve balance (population parity between districts), Magleby and Mosesson use an algorithm proposed by Kernigan and Lin to switch constituent vertices between groups of vertices. If it is not possible to achieve balance with a moderate number of switches, then we discard the map and start over. If balance is possible after a fixed number of switches, then we record the map for future analysis.

Step 4: Repeat

Repeat steps 1, 2, and 3 until we find a large sample maps that contain roughly equal district populations.

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I declare under penalty of perjury under the laws of NC that the foregoing is true and correct

Daniel B. Magleby, Ph.D.

Date: 12/29/21

A Rebuttal to Michael J. Barber, Ph.D.'s Expert Report

Daniel B. Magleby, Ph.D.

Contents

1 Introduction

I am an Associate Professor in the Department of Political Science at Binghamton University, SUNY where I also hold a courtesy appointment in the Department of Economics. At Binghamton, I am also the director of the Center for the Analysis of Voting and Elections at Binghamton University. In 2007, I received an M.S. in Mathematical Methods in the Social Sciences from Northwestern University. I hold an M.A. in political science from the University of Michigan, Ann Arbor where I also received a Ph.D in political science in 2011. I have published academic papers on legislative districting and political geography in several political science journals, including *Political Analysis*, the *Election Law Journal*, *American Politics Research*, and *Social Science Quarterly*. My academic areas of expertise include legislative elections, geographic information systems (GIS) data, redistricting, voting rights, legislatures, and political geography. I have expertise in analyzing political geography, elections, and redistricting using computer simulations and other techniques. I have been retained by plaintiff Common Cause to perform the analysis described below at a rate of $250 an hour. My compensation is not predicated on arriving at any particular opinion.

2 Research Question and Summary of Findings

In Dr. Barber's report, he engages in a cluster-by-cluster analysis of the legislature-drawn plan. He compares the legislature's plan to a large set of simulations he conducted using a computer-based redistricting algorithm. He concludes that the deviations he observes are not sufficient to deem the legislature-drawn maps "an extreme partisan gerrymander." In this report, I will explain how Dr. Barber's solely cluster-based analysis and his exclusive focus on seats carried does not provide a sufficient basis to reach the conclusion he makes in his report.

The legislature-drawn maps are partisan gerrymanders because they exhibit significant partisan bias, and the bias is likely to persist when Democrats increase their vote share in

North Carolina. Bias is present in cluster-by-cluster analysis; however, the consequences of the cluster-level bias are more pronounced when we consider the aggregate effect of cluster-level bias statewide. Finally, because Democrats are capable of carrying a majority of the vote statewide, the legislature drawn map will likely entrench Republicans in power even if only a minority of North Carolina voters support them.

2.1 Data

My opinions follow from analysis of the following data:

- Results of computer simulations reported by Michael J. Barber, Ph.D. in his Expert Report dated December 22, 2021.
- VTD boundaries provided as ESRI Shapefiles by the US Census Bureau available on at the following URL. `https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html`
- Census block boundaries and population data provided by the US Census Bureau. These are collected as part of the constitutionally mandated decennial census that most recently concluded in 2020.
- County boundaries as reported by the US Census Bureau.
- County clusterings provided by Christopher Cooper, Blake Esselstyn, Gregory Herschlag, Jonathan Mattingly, and Rebecca Tippett in a report that may be accessed at the following URL. `https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf`
- Election returns as reported by the Voting and Election Science Team[1] group and aggregated to Census-provided VTD boundaries and provided on the Redistricting

[1] `https://dataverse.harvard.edu/dataverse/electionscience`

Data Hub[2] website. I aggregate statewide elections returns from 2016 and 2020 to the set of legislature drawn districts and to the districts in each of the hypothetical alternative maps. In my analysis, I set aside election returns from 2018 because the only statewide races held that year were judicial elections which follow very different patterns compared to elections for other offices. I prefer to use all statewide elections because it ensures that my analysis captures lower-profile elections in which voters will rely on their partisan preferences rather than the personal appeal of candidates. Thus in all of my analyses, the Democratic two-party vote share is 48.8% in my composite partisan score. This makes my analysis a more conservative evaluation of the legislature-drawn maps, and adds confidence that when I observe a gerrymander it is in fact a gerrymander.

- 1,000 alternative, hypothetical maps of North Carolina's congressional, Senate, and House districts generated by a neutral, partisan-blind computer algorithm. The redistricting algorithm I use in my analysis was developed by me and a collaborator, Daniel Mosesson (consultant in private practice), and published in *Political Analysis* in 2018. In our published work, we show that the algorithm produces a large number of unique maps of legislative districts without any indication of bias.

- Legislature-drawn boundaries of districts intended to elect representatives to Congress, the North Carolina Senate, and the North Carolina House of Representatives. These data are available on the North Carolina General Assembly website and may be accessed at the following URLs. `https://www.ncleg.gov/Redistricting`

3 Mechanics of Gerrymandering

Professor Barber evaluates his simulations relying solely on estimates of the number of seats carried under a composite partisan score that makes the unusual choice to include an election

[2] `https://redistrictingdatahub.org`

from 2014. A deviation from the number of seats carried compared to a neutral counterfactual can be indicative of a gerrymander. It is just one indicator of a gerrymander and by only examining the expected seats carried, Professor Barber misses the dynamics by which the maps drawn by the state legislature effectuate their cumulative and durable gerrymander.

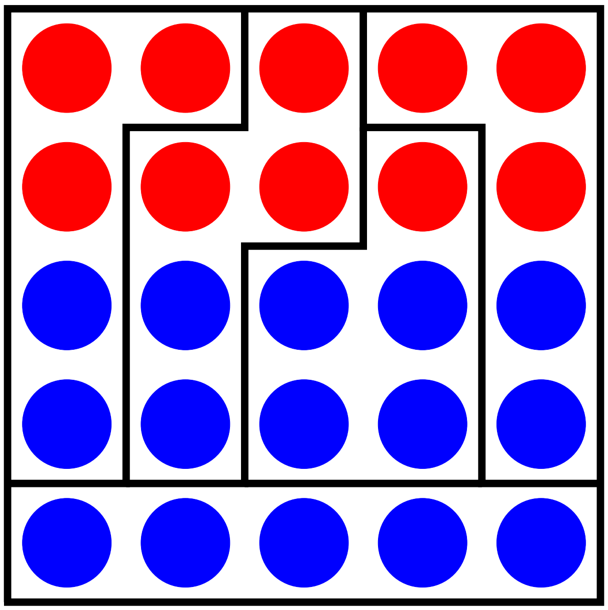


Figure 1: An example of a packing gerrymander in a hypothetical jurisdiction with 25 voters divided into 5 districts.

To understand why it can be problematic to focus exclusively on seats carried, it is helpful to review how gerrymanders work. Consider the example included in Figure 1. For simplicity, suppose each dot corresponds to one voter and that these voters are distributed in "geographic space" as represented in the figure. The voters have preferences that correspond to their voting preference. As I have drawn it, blues constitute a majority and reds are a minority. If a mapmaker was required to divide this space into five districts each with five voters he could do it in a number of ways. Suppose that the mapmaker's goal was to maximize the number of districts carried by red voters. In this instance, a mapmaker might draw a map with district boundaries that look like those in Figure 1 in which there are three districts carried by reds and two blues. We call this a packing gerrymander.

Packing gerrymanders distort representation. In packed systems, one party receives more representation than they should as in the example of the packing gerrymander in Figure 1. In addition, packing gerrymanders can potentially entrench a group in power even when they receive a minority of votes. In the example I provide in Figure 1, the reds are a minority, yet they carry a majority of seats.

The mechanics by which a packing gerrymander accomplishes distortion in representation reveals the shortcomings of relying solely on seats carried as the metric. Observe that in addition to denying representation, packing gerrymanders serve to underweight the votes of one group of voters. In the example I provide here, blues cast more than 50% of the voters, but they carry fewer than 50% of the seats. The reverse is true for reds in the example I provide in Figure 1. This contrast in outcomes is significant because it indicates a significant difference in the ways that blue and red votes are weighted, with each red vote effectively counting for more than each blue vote. In practical terms, a packing gerrymander accomplishes this differential vote weighting by over-concentrating one group of voters, the blues in the example I provide in Figure 1. Thus, it is not enough to only consider the seats carried in a plan of legislative districts, but it is necessary to consider the margins by which districts are carried (as I did in my median-mean difference analysis).

One way to conceive of the effect of a packing gerrymander is that it treats parties asymmetrically. That is, for a given proportion of the vote, two parties receive different shares of representation. For example, suppose Republicans receive 52% of the vote and receive 54% of the seats. A map treats Democrats symmetrically if Democrats receive 54% of the seats with 52% of the vote. Note that symmetry does not require proportionality. Parties can receive more (or less) than x% of the seats when they receive x% of the vote so long as the opposing party receives the same number of seats at that voter percentage.

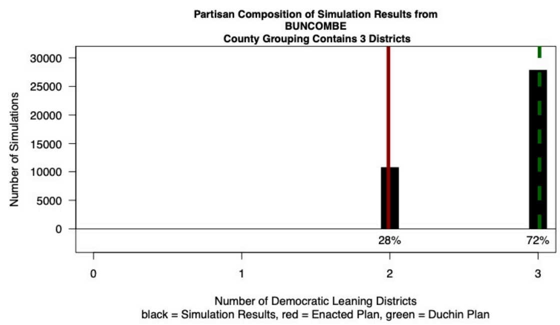
One of the simplest measures of symmetry we can apply to redistricting scenarios is the median-mean difference (see Katz, King and Rosenblatt 2020; McDonald and Best 2015; Best et al. 2017). The median-mean difference is a way of evaluating whether the distribution of districts in a map is symmetrical. We find it by taking the mean (average) of the district-level vote share and comparing it to the median district-level vote-share, the district-level vote share for which there are an equal number of districts with higher vote shares as there are districts with lower vote shares. When the median and mean are equal, the distribution of districts is symmetrical and the map will treat the parties with symmetry. If the median-mean difference is not zero, it means that map will not treat votes cast for the parties equally.

4 County-Based Clusters

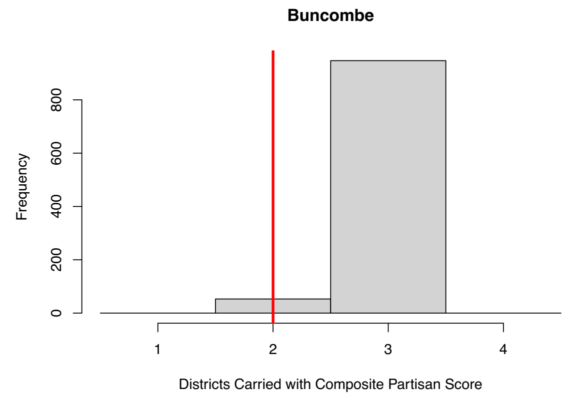
In order "to minimize the overall number of county splits while maintaining population balance in the redistricting process" the legislature adopted a set of county clusterings described Cooper et al (2021). One effect of the clustering is that each cluster represents a separate redistricting scenario. In effect, it turned North Carolina into a series of smaller "states" that all needed to be redistricted separately. Barber considers each of these clusters separately. He finds the legislature frequently deviates from most common outcomes of the simulations he conducted, but that the deviations most often fall "often within the range of the non-partisan simulated maps" (Barber, 269).

Barber is not always clear in what he means by "range." In many places, he seems to mean that the legislature-drawn map is consistent with at least one of the simulations he produced; however, that is an unusual standard to use in statistical analysis. At one point, in evaluating the Cumberland map, he seems to adopt a new standard arguing that the optimal map "falls outside of the 50% range of simulation results and is thus classified as a partisan outlier result" (110).

An example from Professor Barber's analysis is illustrative of why the legislature-drawn plan is problematic. For clarity, I provide a copy of a histogram of Professor Barber's results in Figure 2. In Buncombe, 72% of Dr. Barber's simulations have 3 Democratic leaning



Barber Simulations



Magleby Simulations

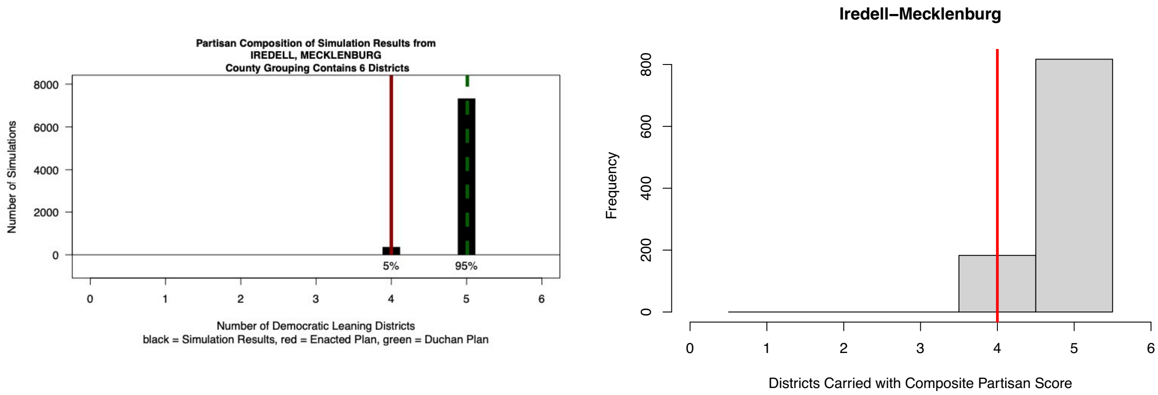
Figure 2: A copy of Dr. Barber's summary of simulations of Buncombe copied from his report dated December 22, 2021 and a summary of 1000 simulations using the algorithm proposed by Magleby and Mosesson (2018).

districts, but the legislature only drew 2. Here, the outcome is consistent with some of the simulations produced by Dr. Barber, but most of his simulations suggest that Democrats should carry 3 of Buncombe County's districts. In 72% of the simulated maps, Democrats made up a majority in all 3 of the districts. In contrast to the large majority of Dr. Barber's simulations, the legislature managed to draw a single district carried by Republicans. In order to draw a Republican-majority district, they had to concentrate Democrats in fewer districts than Democrats would naturally carry. As a result, the district carried by Republicans is insulated against any wave in which Democrats might receive more votes than expected based on Dr. Barber's partisan vote index.

Figure 2 also provides a summary of the 1000 cluster-level redistricting simulations I conducted in Buncombe County as part of my analysis of the House map. The patterns are broadly consistent with what Barber found; however, in the set of simulations I conducted it was more likely that Democrats carry 3 as opposed to 2 districts. Where Dr. Barber finds that there is a 28% chance that Democrats carry just two districts, I find that Democrats carry 2 districts in 5.3% of the simulations. A shortage of time does not allow me to explore exactly what drives the difference in Barber's estimates and my estimates, but it is noteworthy that the simulations are broadly similar and show the same outcome is most likely when following a neutral process.

The legislature-drawn map repeats this pattern in several clusters analyzed by Dr. Barber. He finds that in the Forsyth, Stokes cluster, 67% of his simulated maps have 3 or more Democratic districts. In the Forsyth, Stokes cluster, the legislature drew 2 districts carried by Democrats in Barber's partisan composite. In Guilford County, 99% of Barber's maps had 5 or more Democratic districts. In Guilford, Democrats carried 4 using Barber's partisan index. In each of those instances, Democrats carry fewer seats, than Dr. Barber's simulations indicate they should. Moreover, the legislature drew extra districts carried by Republicans by packing Democrats into relatively fewer districts than they should have carried based on the analysis presented by Dr. Barber. The consequence of the packing present in each of these clusters is a systematic under-weighting of Democratic votes.

In the Senate map, Barber's analysis again shows that Republicans opted to pack Democratic voters in certain clusters. Consider the distribution represented in Figure 3. On the left side, I provide a copy of the results summarized in Dr. Barber's analysis. Here he finds that 95% of his simulations yield a map in which Democrats carry more seats than they carry in the legislature drawn map. While that outcome is in the range of outcomes yielded by his simulations, it is not particularly likely and it is far from the most likely outcome. In Figure 3, I also summarize the analysis of Iredell and Mecklenburg County that arises from 1000 simulations using the Magleby-Mosesson Algorithm (2018). As before the patterns are broadly similar. The most likely outcome in Iredell and Mecklenburg counties is that Democrats carry 5 of 6 districts. I find that the algorithm generates maps in which Democrats receive as few as 4 seats, but that only occurs in a minority of simulations



Barber Simulations

Magleby Simulations

Figure 3: A copy of Dr. Barber's summary of simulations of the Iredell-Mecklenburg cluster copied from his report dated December 22, 2021 and a summary of 1000 simulations using the algorithm proposed by Magleby and Mosesson (2018).

(18.3%). It is noteworthy again that the simulations yield broadly similar findings and that both Dr. Barber's simulations and those that formed part of my analysis of the Senate map indicate that Democrats should carry more seats than they do in the legislature-drawn map.

The result of this pattern is the same in the Senate as it was in the House. By opting to pack democrats into fewer districts, the legislature underweights Democratic votes in Iredell and Mecklenburg Counties. By considering one cluster at a time, Barber describes the impact as relatively minor – Democrats receive one fewer seat than we would expect if the legislature engaged in a neutral district-drawing process. However, in reality, because this is repeated in other clusters, the resulting difference in vote-weights state-wide makes it extremely unlikely that Democrats will be able to achieve legislative majorities should they secure a majority of votes for legislative office.

5 Conclusion

The data presented in Dr. Barber's report are inconsistent with his claim that the legislature-drawn maps are not a gerrymanders. One issue with Dr. Barber's report is that he relies on a metric, seats carried, that does not allow us to directly consider the way the legislature's maps systematically underweight Democratic votes. Yet in cluster after cluster, he shows that Republicans packed Democrats in ways that would underweight Democratic votes. In my analysis, I calculated the median-mean difference for the legislature-drawn Senate and House maps. I find that both legislature-drawn maps show patterns of treating Democratic and Republican voters asymmetrically with Democratic votes being systematically underweighted. Moreover, the median-mean difference is more extreme in the legislature-drawn maps than what I observe in any of the 1000 simulations of the House and Senate that I analyzed in my report.

The legislature-drawn maps are partisan gerrymanders because they exhibit significant partisan bias, and the bias is likely to persist when Democrats increase their vote share in North Carolina. The consequences of the cluster-level bias are pronounced when we consider the aggregate effect of cluster-level bias statewide.

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McDonald, Michael D. and Robin E. Best. 2015. "Unfair partisan gerrymanders in politics and law: A diagnostic applied to six cases." *Election Law Journal* 14(4):312–330.

I declare under penalty of perjury under the laws of NC that the foregoing is true and correct

Daniel B. Magleby

____

Daniel B. Magleby, Ph.D.

Date: 12/28/21

EXHIBIT H

STATE OF NORTH CAROLINA **IN THE GENERAL COURT OF JUSTICE**

COUNTY OF WAKE **SUPERIOR COURT DIVISION**

No.21 CVS 500085

REBECCA HARPER; AMY CLARE OSEROFF; DONALD RUMPH; JOHN ANTHONY BALLA; RICHARD R. CREWS; LILY NICOLE QUICK; GETTYS COHEN JR.; SHAWN RUSH; JACKSON THOMAS DUNN, JR.; MARK S. PETERS; KATHLEEN BARNES; VIRGINIA WALTERS BRIEN; DAVID DWIGHT BROWN,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING; SENATOR WARREN DANIEL, IN HIS OFFICIAL CAPACITY AS CO-CHAIR OF THE SENATE STANDING COMMITTEE ON REDISTRICTING AND ELECTIONS; SENATOR RALPH HISE, IN HIS OFFICIAL CAPACITY AS CO-CHAIR OF THE SENATE STANDING COMMITTEE ON REDISTRICTING AND ELECTIONS; SENATOR PAUL NEWTON, IN HIS OFFICIAL CAPACITY AS CO-CHAIR OF THE SENATE STANDING COMMITTEE ON REDISTRICTING AND ELECTIONS; SPEAKER OF THE NORTH CAROLINA HOUSE OF REPRESENTATIVES TIMOTHY K. MOORE; PRESIDENT PRO TEMPORE OF THE NORTH CAROLINA SENATE PHILIP E. BERGER; THE NORTH CAROLINA STATE BOARD OF ELECTIONS; DAMON CIRCOSTA, IN HIS OFFICIAL CAPACITY AS CHAIRMAN OF THE NORTH

EXPERT REPORT OF DR. JOWEI CHEN

Exhibit #
CHEN 1
12/29/2021 - JNC
exhibitsticker.com

CAROLINA STATE BOARD OF ELECTIONS; STELLA ANDERSON, IN HER OFFICIAL CAPACITY AS SECRETARY OF THE NORTH CAROLINA STATE BOARD OF ELECTIONS; JEFF CARMON III, IN HIS OFFICIAL CAPACITY AS MEMBER OF THE NORTH CAROLINA STATE BOARD OF ELECTIONS; STACY EGGERS IV, IN HIS OFFICIAL CAPACITY AS MEMBER OF THE NORTH CAROLINA STATE BOARD OF ELECTIONS; TOMMY TUCKER, IN HIS OFFICIAL CAPACITY AS MEMBER OF THE NORTH CAROLINA STATE BOARD OF ELECTIONS,

Defendants.

I, Dr. Jowei Chen, upon my oath, declare and say as follows:

1. I am over the age of eighteen (18) and competent to testify as to the matters set forth herein.

2. I am an Associate Professor in the Department of Political Science at the University of Michigan, Ann Arbor. I am also a Research Associate Professor at the Center for Political Studies of the Institute for Social Research at the University of Michigan and a Research Associate at the Spatial Social Science Laboratory at Stanford University. In 2007, I received a M.S. in Statistics from Stanford University, and in 2009, I received a Ph.D. in Political Science from Stanford University.

3. I have published academic papers on legislative districting and political geography in several political science journals, including The American Journal of Political Science and The American Political Science Review, and Election Law Journal. My academic areas of expertise include legislative elections, spatial statistics, geographic information systems

(GIS) data, redistricting, racial politics, legislatures, and political geography. I have expertise in the use of computer simulations of legislative districting and in analyzing political geography, elections, and redistricting.

4. I have authored expert reports in the following redistricting court cases: *The League of Women Voters of Florida v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2012); *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); Brown v. Detzner (N.D. Fla. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Harper v. Lewis* (N.C. Super. 2019); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021). I have testified either at deposition or at trial in the following cases: *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013*); Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C. 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP* v. *The State of Georgia* (N.D. Ga. 2017); *The*

League of Women Voters of Michigan v. Johnson (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020).

5. I have been retained by Plaintiffs in the above-captioned matter. I am being compensated $550 per hour for my work in this case.

6. Plaintiffs' counsel asked me to analyze the SB 740 districting plan for North Carolina's congressional districts (the "Enacted Plan"), as passed on November 4, 2021. Plaintiffs' counsel asked me to produce a set of computer-simulated plans for North Carolina's congressional districts by following the criteria adopted by the North Carolina General Assembly's Joint Redistricting Committee on August 12, 2021 (the "Adopted Criteria"). Plaintiffs' counsel asked me to compare the district-level partisan attributes of the Enacted Plan to those of the computer-simulated plans and to identify any districts in the Enacted Plan that are partisan outliers. Plaintiffs' counsel also asked me to compare the partisan composition of the individual Plaintiffs' congressional districts under the Enacted Plan to the partisan composition of Plaintiffs' districts under the computer-simulated plans and to identify any Plaintiffs whose Enacted Plan districts are partisan outliers.

7. ***The Use of Computer-Simulated Districting Plans:*** In conducting my academic research on legislative districting, partisan and racial gerrymandering, and electoral bias, I have developed various computer simulation programming techniques that allow me to produce a large number of nonpartisan districting plans that adhere to traditional districting criteria using US Census geographies as building blocks. This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to draw districting plans following various traditional districting goals, such as equalizing

population, avoiding county and Voting Tabulation District (VTD) splits, and pursuing geographic compactness. By randomly generating a large number of districting plans that closely adhere to these traditional districting criteria, I am able to assess an enacted plan drawn by a state legislature and determine whether partisan goals motivated the legislature to deviate from these traditional districting criteria. More specifically, by holding constant the application of nonpartisan, traditional districting criteria through the simulations, I am able to determine whether the enacted plan could have been the product of something other than partisan considerations. With respect to North Carolina's 2021 Congressional Enacted Plan, I determined that it could not.

8. I produced a set of 1,000 valid computer-simulated plans for North Carolina's congressional districts using a computer algorithm programmed to strictly follow the required districting criteria enumerated in the August 12, 2021 Adopted Criteria of the General Assembly's Joint Redistricting Committee. In following these Adopted Criteria, the computer algorithm uses the same general approach that I employed in creating the simulated state House and state Senate plans that I analyzed in *Common Cause v. Lewis* (2019) and the simulated congressional plans that I used in *Harper v. Lewis* (2019).

9. By randomly drawing districting plans with a process designed to strictly follow nonpartisan districting criteria, the computer simulation process gives us an indication of the range of districting plans that plausibly and likely emerge when map-drawers are not motivated primarily by partisan goals. By comparing the Enacted Plan against the distribution of simulated plans with respect to partisan measurements, I am able to determine the extent to which a map-drawer's subordination of nonpartisan districting criteria, such as geographic compactness and preserving precinct boundaries, was motivated by partisan goals.

10. These computer simulation methods are widely used by academic scholars to analyze districting maps. For over a decade, political scientists have used such computer-simulated districting techniques to analyze the racial and partisan intent of legislative map-drawers.[1] In recent years, several courts have also relied upon computer simulations to assess partisan bias in enacted districting plans.[2]

11. ***Redistricting Criteria:*** I programmed the computer algorithm to create 1,000 independent simulated plans adhering to the following the seven districting criteria, as specified in the Adopted Criteria:

a) Population Equality: Because North Carolina's 2020 Census population was 10,439,388, districts in every 14-member congressional plan have an ideal population of 745,670.6. Accordingly, the computer simulation algorithm populated each districting plan such that precisely six districts have a population of 745,670, while the remaining eight districts have a population of 745,671.

b) Contiguity: The simulation algorithm required districts to be geographically contiguous. Water contiguity is permissible. I also programmed the simulation algorithm to avoid double-traversals within a single county. In other words, for every simulated district, the portion of that district within any given county will be geographically contiguous.

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[1] E.g., Carmen Cirincione, Thomas A. Darling, Timothy G. O'Rourke. "Assessing South Carolina's 1990s Congressional Districting," Political Geography 19 (2000) 189–211; Jowei Chen, "The Impact of Political Geography on Wisconsin Redistricting: An Analysis of Wisconsin's Act 43 Assembly Districting Plan." Election Law Journal

[2] *See, e.g.*, *League of Women Voters of Pa. v. Commonwealth*, 178 A. 3d 737, 818-21 (Pa. 2018); *Raleigh Wake Citizens Association v. Wake County Board of Elections*, 827 F.3d 333, 344-45 (4th Cir. 2016); *City of Greensboro v. Guilford County Board of Elections*, No. 1:15-CV-599, 2017 WL 1229736 (M.D.N.C. Apr 3, 2017); *Common Cause v. Rucho*, No. 1:16-CV-1164 (M.D.N.C. Jan 11, 2018*); The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Common Cause v. David Lewis* (N.C. Super. 2018).

c) Minimizing County Splits: The simulation algorithm avoided splitting any of North Carolina's 100 counties, except when doing so is necessary to avoid violating one of the aforementioned criteria. When a county is divided into two districts, the county is considered to have one split. A county divided into three districts is considered to have two splits. A county divided into four districts is considered to have three splits, and so on. For the purpose of creating equally populated districts, each newly drawn congressional district requires only one county split. But the fourteenth and final district drawn in North Carolina does need not create an additional county split, since this final district should simply be the remaining area unassigned to the first thirteen districts. Therefore, an entire plan of 14 congressional districts requires only 13 county splits. Accordingly, I require that every simulated plan contain only 13 county splits. The 2021 Adopted Criteria do not prohibit splitting a county more than once, so I allow some of these 13 county splits to occur within the same county. As a result, the total number of counties containing one or more splits may be fewer than 13.

d) Minimizing VTD Splits: North Carolina is divided into 2,666 VTDs. The computer simulation algorithm attempted to keep these VTDs intact and not split them into multiple districts, except when doing so is necessary for creating equally populated districts. For the purpose of creating equally populated districts, each newly drawn congressional district requires one VTD split. But the fourteenth and final district drawn in North Carolina does need not create an additional VTD split, since this final district should simply be the remaining area unassigned to the first thirteen districts. Therefore, an entire plan of 14 congressional districts requires only 13 VTD splits. I therefore require that every simulated plan split only 13 VTDs in total.

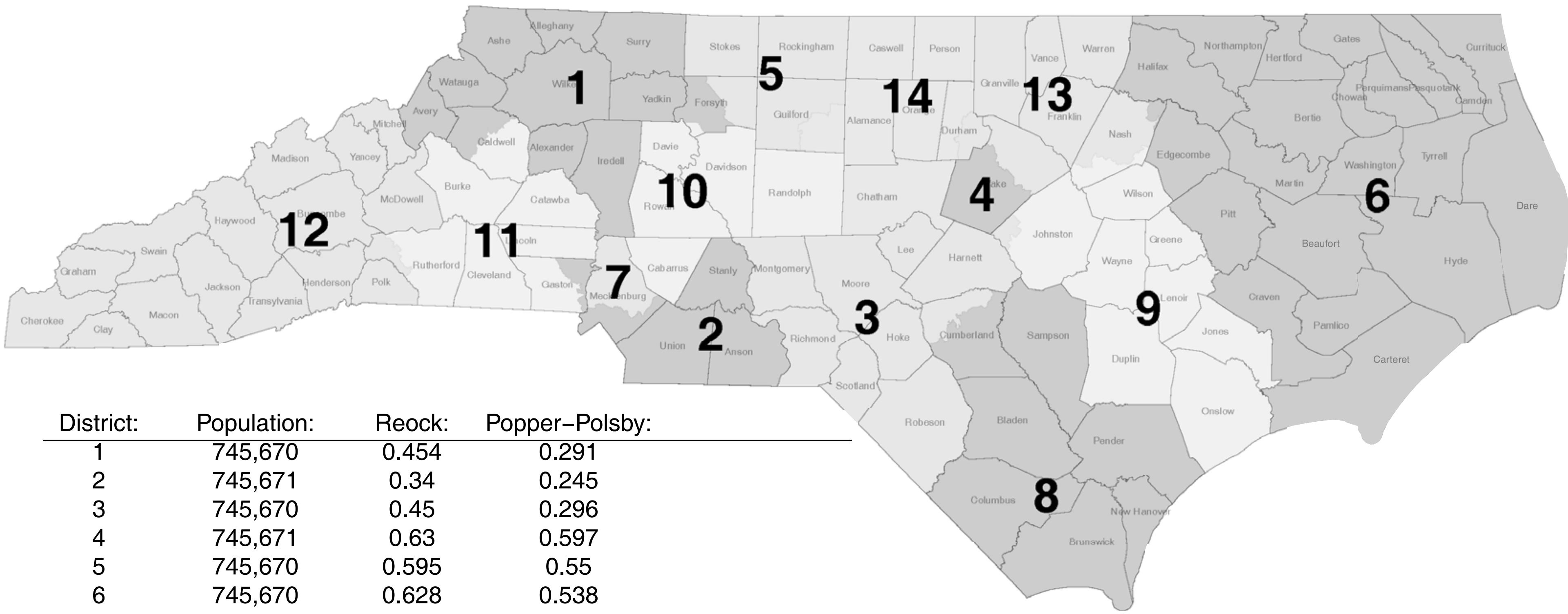
e) Geographic Compactness: The simulation algorithm prioritized the drawing of geographically compact districts whenever doing so does not violate any of the aforementioned criteria.

f) Avoiding Incumbent Pairings: North Carolina's current congressional delegation includes two incumbents, Representatives Ted Budd and David Price, who announced before the Enacted Plan was adopted that they will not run for reelection in 2022. For the remaining eleven congressional incumbents, the simulation algorithm intentionally avoids pairing multiple incumbents in the same district. Hence, in every computer-simulated plan, each district contains no more than one incumbent's residence.

g) Municipal Boundaries: The simulation algorithm generally favors not splitting municipalities, but this consideration is given lower priority than all of the aforementioned criteria. For example, the algorithm would not intentionally split a VTD in order to preserve a municipality, as the Adopted Criteria clearly prioritizes VTD preservation over municipal boundaries.

12. On the following page of this report, Map 1 displays an example of one of the computer-simulated plans produced by the computer algorithm. The lower half of this Map also reports the population of each district, the compactness scores for each district, and the county splits and VTD splits created by the plan. As with every simulated plan, this plan contains exactly 13 VTD splits and 13 county splits, with 11 counties split into two or more districts.

Map 1:
Example of a Computer–Simulated Congressional Plan Protecting all 11 Incumbents



District:	Population:	Reock:	Popper–Polsby:
1	745,670	0.454	0.291
2	745,671	0.34	0.245
3	745,670	0.45	0.296
4	745,671	0.63	0.597
5	745,670	0.595	0.55
6	745,670	0.628	0.538
7	745,671	0.555	0.44
8	745,671	0.555	0.402
9	745,671	0.494	0.345
10	745,671	0.527	0.535
11	745,670	0.592	0.295
12	745,671	0.354	0.313
13	745,671	0.629	0.396
14	745,670	0.513	0.439
Plan Average:	745,670.6	0.523	0.406

11 Split Counties:
Caldwell (Districts 1, 11)
Cumberland (Districts 3, 8)
Durham (Districts 13, 14)
Forsyth (Districts 1, 10, 5)
Gaston (Districts 11, 2)
Guilford (Districts 14, 5)
Johnston (Districts 3, 9)
Mecklenburg (Districts 2, 7)
Nash (Districts 13, 6, 9)
Rutherford (Districts 11, 12)
Wake (Districts 13, 4)

13 Split VTD's:
VTD 00PR32 in Caldwell County (Districts 1 and 11)
VTD 00CC17 in Cumberland County (Districts 3 and 8)
VTD 055–11 in Durham County (Districts 13 and 14)
VTD 000051 in Forsyth County (Districts 1 and 10)
VTD 000301 in Forsyth County (Districts 1 and 5)
VTD 000025 in Gaston County (Districts 11 and 2)
VTD 000PG1 in Guilford County (Districts 14 and 5)
VTD 00PR33 in Johnston County (Districts 3 and 9)
VTD 000216 in Mecklenburg County (Districts 2 and 7)
VTD 00P16A in Nash County (Districts 13 and 6)
VTD 00P22A in Nash County (Districts 13 and 9)
VTD 000018 in Rutherford County (Districts 11 and 12)
VTD 001–36 in Wake County (Districts 13 and 4)

The Enacted Plan's Compliance with the Adopted Criteria:

13. Although all seven of the criteria listed above are part of the General Assembly's Adopted Criteria, five of these criteria are ones that the Joint Redistricting Committee "shall" or "should" follow in the process of drawing its Congressional districting plan. These five mandated criteria are: equal population; contiguity, minimizing county splits, minimizing VTD splits, and geographic compactness.[3]

14. I assessed whether the 2021 Enacted Plan complies with these five mandated criteria, and I describe my findings in this section. I found that the Enacted Plan does not violate the equal population requirement, nor do any of its districts violate contiguity.

15. However, by comparing the Enacted Plan to the 1,000 computer-simulated plans, I found that the Enacted Plan fails to minimize county splits, fails to minimize VTD splits, and is significantly less geographically compact than is reasonably possible. I describe these findings below in detail.

16. ***Minimizing County Splits:*** In comparing the total number of county splits in the Enacted Plan and in the computer-simulated plans, I counted the total number of times a county is split into more than one district. Specifically, a county fully contained within a single district counts as zero splits. A county split into two full or partial districts counts as one split. And a county split into three full or partial districts counts as two splits. And so on.

17. Using this standard method of accounting for total county splits, I found that the Enacted Plan contains 14 total county splits, which are detailed in Table 1. These 14 total county splits are spread across 11 counties. Eight of these 11 counties are split only once, but Guilford,

[3] In listing these five mandated criteria, I am not including the Adopted Criteria's prohibitions on the use of racial data, partisan considerations, and election results data. I did not assess whether the Enacted Plan complies with the prohibition on racial considerations.

Mecklenburg, and Wake Counties are each split into three districts, thus accounting for two splits each. Thus, the Enacted Plan has 14 total county splits, as listed in Table 1.

Table 1: Total Number of County Splits in the 2021 Enacted Plan

	County:	Congressional Districts:	Total County Splits:
1	Davidson	7 and 10	1
2	Guilford	7, 10, and 11	2
3	Harnett	4 and 7	1
4	Iredell	10 and 12	1
5	Mecklenburg	8, 9, and 13	2
6	Onslow	1 and 3	1
7	Pitt	1 and 2	1
8	Robeson	3 and 8	1
9	Wake	5, 6, and 7	2
10	Watauga	11 and 14	1
11	Wayne	2 and 4	1
Total County Splits:			14

18. As explained in the previous section, a congressional plan in North Carolina needs to contain only 13 county splits if the map-drawer is attempting to minimize the splitting of counties. The Enacted Plan's 14 county splits is therefore one more split than is necessary. This "extra" split is specifically found at the border between District 7 and District 10. In general, the border between any two congressional districts in North Carolina needs to split only one county, at most. But in the Enacted Plan, the border between Districts 7 and 10 creates two county splits: One split of Davidson County and one split of Guilford County. Creating two county splits of Davidson and Guilford Counties was not necessary for equalizing district populations. Nor was it necessary for protecting incumbents, as no incumbents reside in the

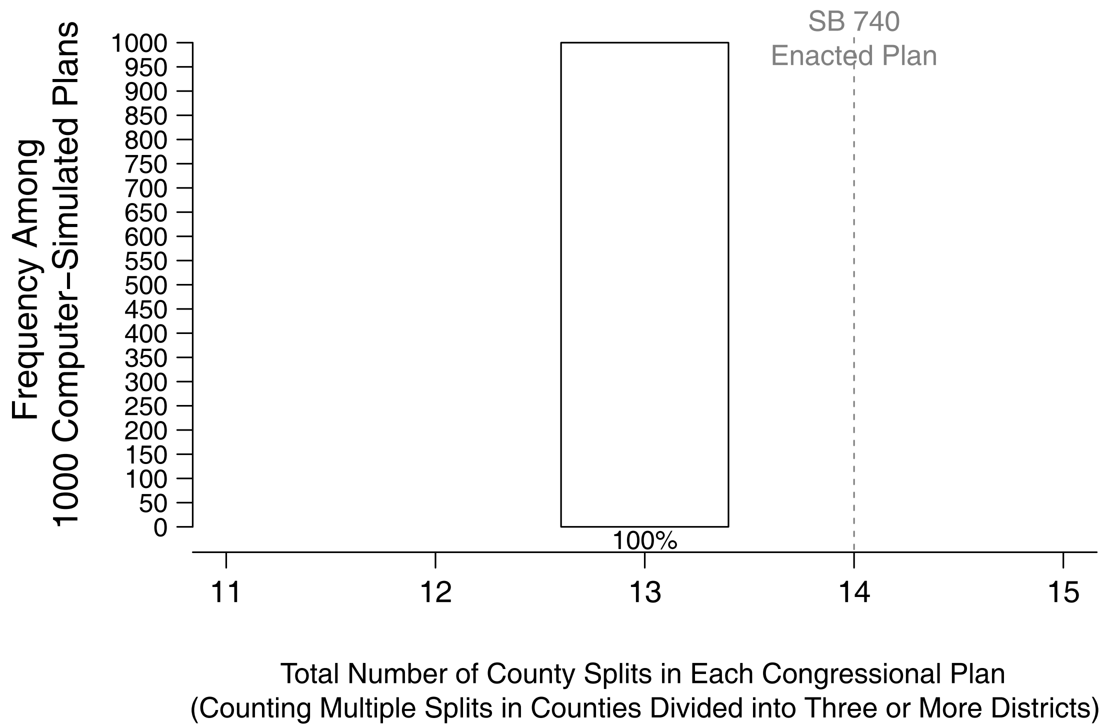
portions of Davidson and Guilford Counties within District 7 and District 10. Hence, the "extra" county split in Davidson and Guilford Counties does not appear to be consistent with the 2021 Adopted Criteria, which mandate that "Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking."

19. Indeed, I found that the computer simulation algorithm was always able to draw districts complying with the Adopted Criteria without using an "extra" 14th county split. As the upper half of Figure 1 illustrates, all 1,000 computer-simulated plans contain exactly 13 county splits. The Enacted Plan clearly contains more county splits than one would expect from a map-drawing process complying with the Adopted Criteria. Therefore, I conclude that the Enacted Plan does not comply with the Adopted Criteria's rule against unnecessary division of counties.

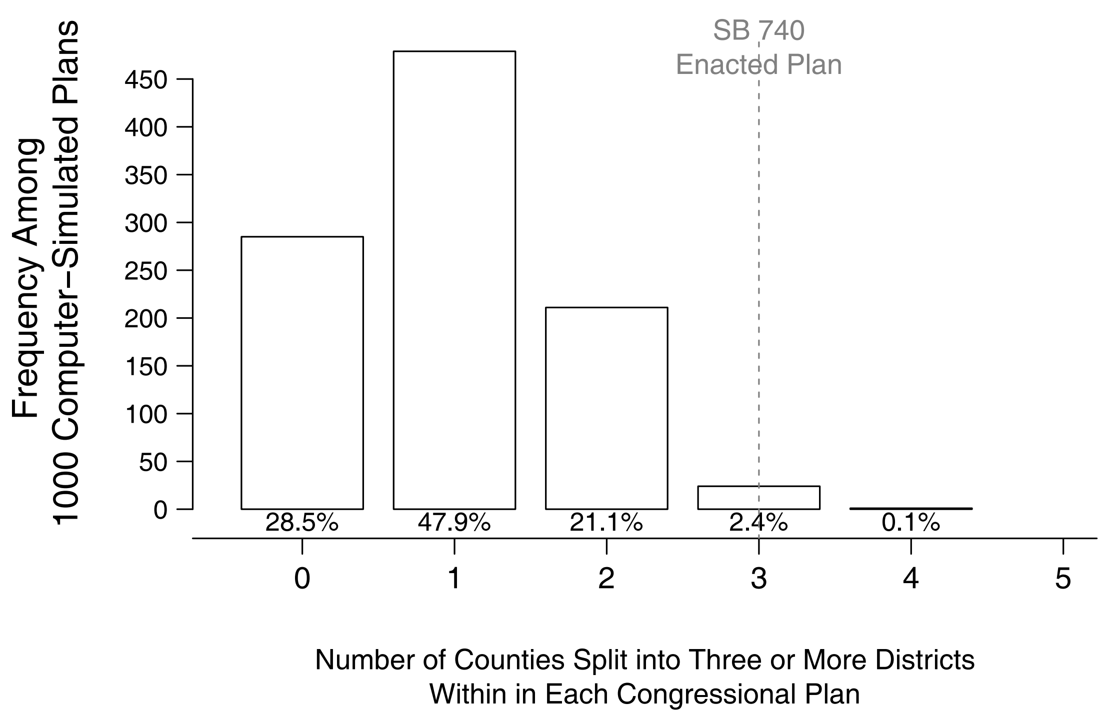
20. The Adopted Criteria do not explicitly limit the number of county splits within any single county. Nevertheless, it is notable that under the Enacted Plan, three different counties (Guilford, Mecklenburg, and Wake) are split multiple times. These three counties are each split into three districts under the Enacted Plan. This is an outcome that rarely occurs under the computer-simulated plans. As the lower half of Figure 1 illustrates, only 2.5% of the computer-simulated plans similarly split three or more counties multiple times. Thus, it is clear that the Enacted Plan's level of concentrating multiple county splits within a single county is an outcome that generally does not occur in a vast majority of the simulated plans drawn according to the Adopted Criteria.

Figure 1:

Comparison of Total County Splits in Enacted SB 740 Plan and 1,000 Computer–Simulated Plans



Number of Counties Split Multiple Times in Enacted SB 740 Plan and 1,000 Computer–Simulated Plans



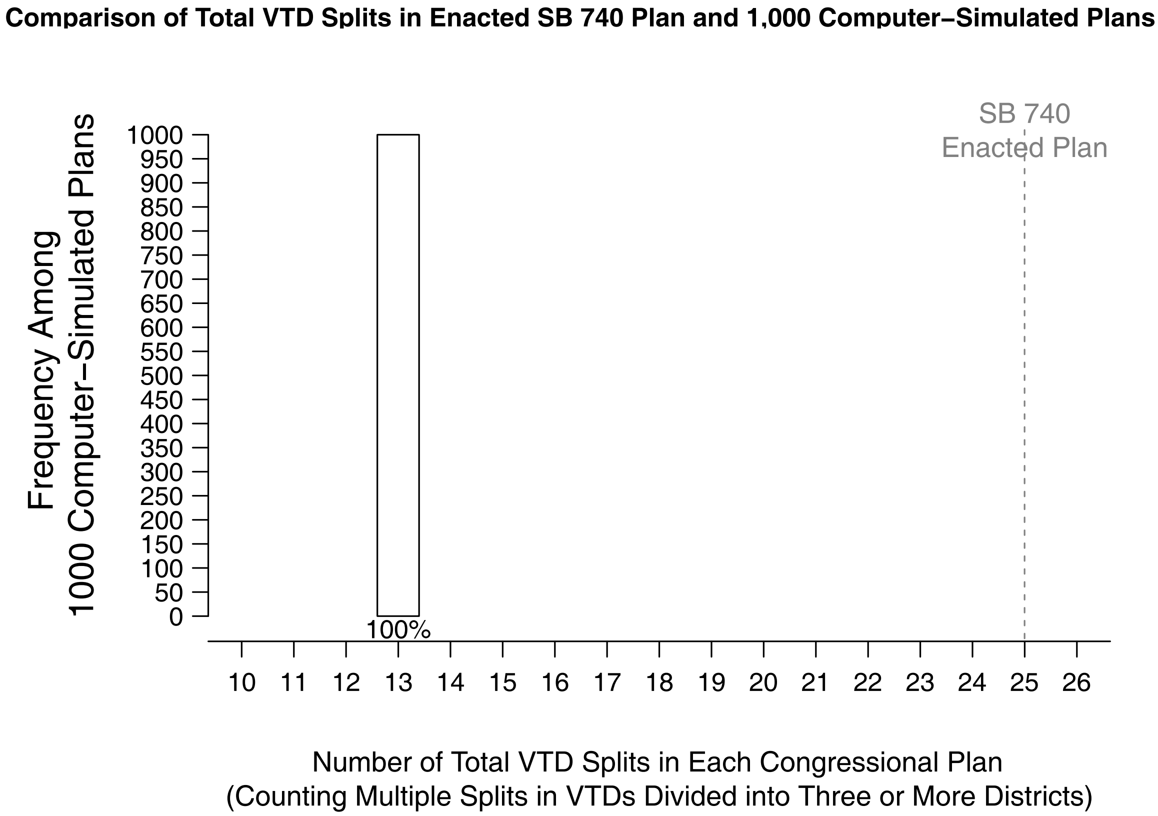
21. Minimizing VTD Splits: The Adopted Criteria mandates that "Voting districts ("VTDs") should be split only when necessary." As explained earlier in this report, each newly drawn congressional district needs to create only one VTD split for the purpose of equalizing the district's population. But the fourteenth and final district drawn in North Carolina does need not create an additional VTD split, since this final district should simply be the remaining area unassigned to the first thirteen districts. Therefore, an entire plan of 14 congressional districts needs to create only 13 VTD splits.

22. However, the Enacted Plan creates far more VTD splits than is necessary. As the General Assembly's "StatPack" Report[4] for the Enacted SB 740 Plan details, the Enacted plan splits 24 VTDs into multiple districts. Among these 24 split VTDs, 23 VTDs are split into two districts, while one VTD (Wake County VTD 18-02) is split into three districts. Thus, using the same method of accounting for splits described earlier, the Enacted Plan contains 25 total VTD splits, and 24 VTDs are split into two or more districts.

23. The Enacted Plan's 25 total VTD splits is far more than is necessary to comply with the Adopted Criteria' equal population requirement. As explained earlier, only 13 VTD splits are necessary in order to produce an equally-populated congressional plan in North Carolina. Thus, as Figure 2 illustrates, every one of the 1,000 computer-simulated plans contains exactly 13 VTD splits, and the Enacted Plan's 25 total VTD splits is clearly not consistent with the Adopted Criteria's requirement that "Voting districts ('VTDs') should be split only when necessary."

[4] Available at: https://webservices.ncleg.gov/ViewBillDocument/2021/53447/0/SL%202021-174%20-%20StatPack%20Report.

Figure 2:



24. ***Measuring Geographic Compactness***: The August 12, 2021 Adopted Criteria mandates that the Joint Redistricting Committee "shall" attempt to draw geographically compact congressional districts. The Adopted Criteria also specify two commonly used measures of district compactness: the Reock score and the Polsby-Popper score.

25. In evaluating whether the Enacted Plan follows the compactness requirement of the Adopted Criteria, it is useful to compare the compactness of the Enacted Plan and the 1,000 computer-simulated plans. The computer-simulated plans were produced by a computer algorithm adhering strictly to the traditional districting criteria mandated by the Adopted Criteria and ignoring any partisan or racial considerations. Thus, the compactness scores of these computer-simulated plans illustrate the statistical range of compactness scores that could be

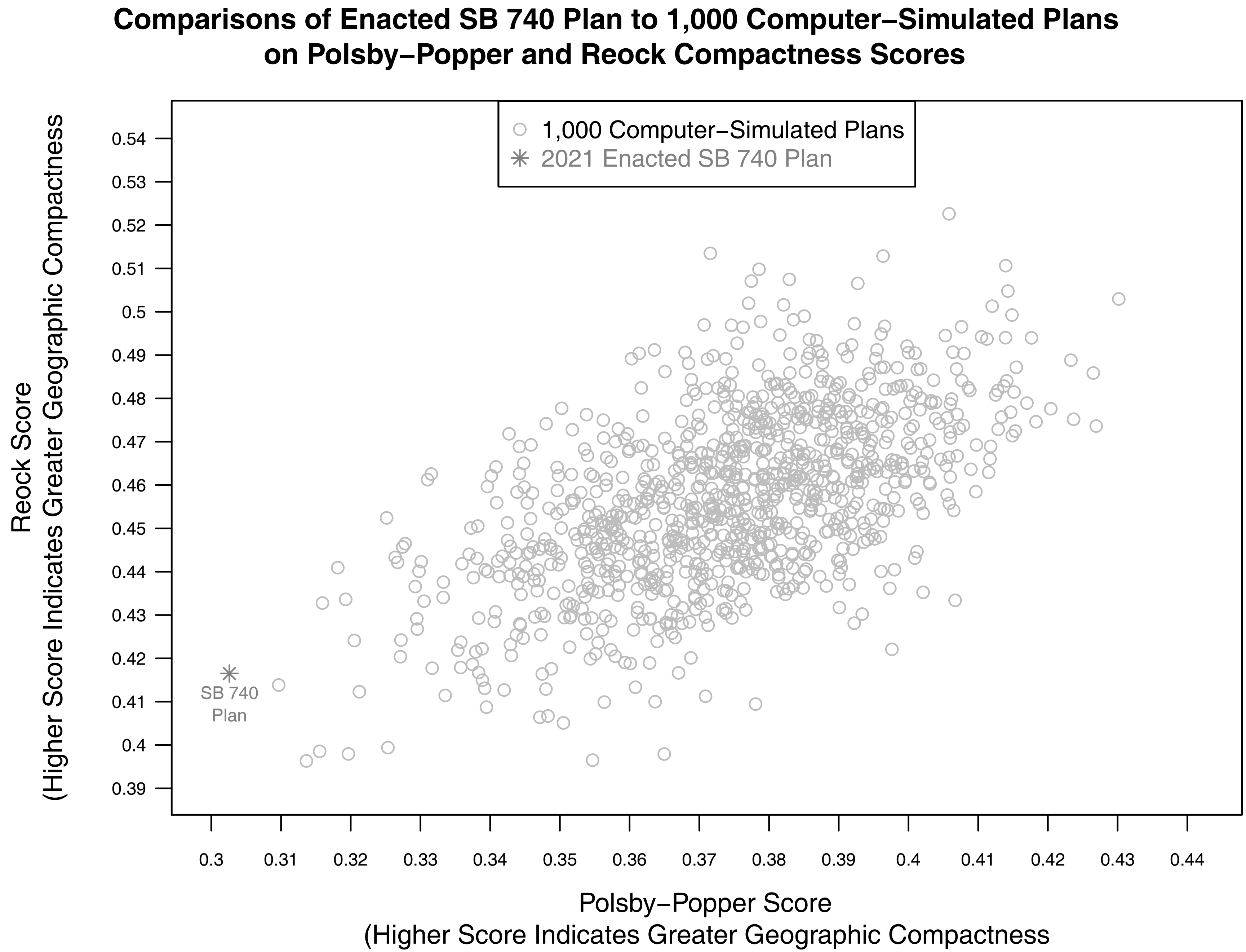
reasonably expected to emerge from a districting process that solely seeks to follow the Adopted Criteria while ignoring partisan and racial considerations. I therefore compare the compactness of the simulated plans and the Enacted Plan using the two measures of compactness specified by the 2021 Adopted Criteria.

26. First, I calculate the average Polsby-Popper score of each plan's districts. The Polsby-Popper score for each individual district is calculated as the ratio of the district's area to the area of a hypothetical circle whose circumference is identical to the length of the district's perimeter; thus, higher Polsby-Popper scores indicate greater district compactness. The 2021 Enacted Plan has an average Polsby-Popper score of 0.3026 across its 14 congressional districts. As illustrated in Figure 3, every single one of the 1,000 computer-simulated House plans in this report exhibits a higher Polsby-Popper score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Polsby-Popper score ranging from 0.36 to 0.39, and the most compact computer-simulated plan has a Polsby-Popper score of 0.43. Hence, it is clear that the Enacted Plan is significantly less compact, as measured by its Polsby-Popper score, than what could reasonably have been expected from a districting process adhering to the Adopted Criteria.

27. Second, I calculate the average Reock score of the districts within each plan. The Reock score for each individual district is calculated as the ratio of the district's area to the area of the smallest bounding circle that can be drawn to completely contain the district; thus, higher Reock score indicate more geographically compact districts. The 2021 Enacted Plan has an average Reock score of 0.4165 across its 14 congressional districts. As illustrated in Figure 3, 97.7% of the 1,000 computer-simulated plans exhibit a higher Reock score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Reock

score ranging from 0.44 to 0.47, and the most compact computer-simulated plan has an average Reock score of 0.52. Hence, it is clear that the Enacted Plan is significantly less compact, as measured by its Reock score, than what could reasonably have been expected from a districting process adhering to the Adopted Criteria.

Figure 3:



– Ex. 10089 –

Measuring the Partisanship of Districting Plans

28. In general, I use actual election results from recent, statewide election races in North Carolina to assess the partisan performance of the Enacted Plan and the computer-simulated plans analyzed in this report. Overlaying these past election results onto a districting plan enables me to calculate the Republican (or Democratic) share of the votes cast from within each district in the Enacted Plan and in each simulated plan. I am also able to count the total number of Republican and Democratic-leaning districts within each simulated plan and within the Enacted Plan. All of these calculations thus allow me to directly compare the partisanship of the Enacted Plan and the simulated plans. These partisan comparisons allow me to determine whether or not the partisanship of individual districts and the partisan distribution of seats in the Enacted Plan could reasonably have arisen from a districting process adhering to the Adopted Criteria and its explicit prohibition on partisan considerations. Past voting history in federal and statewide elections is a strong predictor of future voting history. Mapmakers thus can and do use past voting history to identify the class of voters, at a precinct-by-precinct level, who are likely to vote for Republican or Democratic congressional candidates.

29. In the 2011, 2016, and 2017 rounds of state legislative and congressional redistricting last decade, the North Carolina General Assembly publicly disclosed that it was relying solely on recent statewide elections in measuring the partisanship of the districting plans being created. I therefore follow the General Assembly's past practice from last decade by using results from a similar set of recent statewide elections in order to measure the partisanship of districts in the Enacted Plan and in the computer-simulated plans.

30. ***The 2016-2020 Statewide Election Composite:*** During the General Assembly's 2017 legislative redistricting process, Representative David Lewis announced at the Joint

Redistricting Committee's August 10, 2017 meeting that the General Assembly would measure the partisanship of legislative districts using the results from some of the most recent elections held in North Carolina for the following five offices: US President, US Senator, Governor, Lieutenant Governor, and Attorney General.

31. To measure the partisanship of all districts in the computer-simulated plans and the 2021 Enacted Plan, I used the two most-recent election contests held in North Carolina for these same five offices during 2016-2020. In other words, I used the results of the following ten elections: 2016 US President, 2016 US Senator, 2016 Governor, 2016 Lieutenant Governor, 2016 Attorney General, 2020 US President, 2020 US Senator, 2020 Governor, 2020 Lieutenant Governor, and 2020 Attorney General. I use these election results because these are the same state and federal offices whose election results were used by the General Assembly during its 2017 legislative redistricting process, and the 2017 redistricting process was the most recent one in which the leadership of the General Assembly's redistricting committees publicly announced how the General Assembly would evaluate the partisanship of its own districting plans.

32. I obtained precinct-level results for these ten elections, and I disaggregated these election results down to the census block level. I then aggregated these block-level election results to the district level within each computer-simulated plan and the Enacted Plan, and I calculated the number of districts within each plan that cast more votes for Republican than Democratic candidates. I use these calculations to measure the partisan performance of each simulated plan analyzed in this report and of the Enacted Plan. In other words, I look at the census blocks that would comprise a particular district in a given simulation and, using the actual election results from those census blocks, I calculate whether voters in that simulated district collectively cast more votes for Republican or Democratic candidates in the 2016-2020 statewide

election contests. I performed such calculations for each district under each simulated plan to measure the number of districts Democrats or Republicans would win under that particular simulated districting map.

33. I refer to the aggregated election results from these ten statewide elections as the "2016-2020 Statewide Election Composite." For the Enacted Plan districts and for all districts in each of the 1,000 computer-simulated plans, I calculate the percentage of total two-party votes across these ten elections that were cast in favor of Republican candidates in order to measure the average Republican vote share of the district. In the following section, I present district-level comparisons of the Enacted Plan and simulated plan districts in order to identify whether any individual districts in the Enacted Plan are partisan outliers. I also present plan-wide comparisons of the Enacted Plan and the simulated plans in order to identify the extent to which the Enacted Plan is a statistical outlier in terms of common measures of districting plan partisanship.

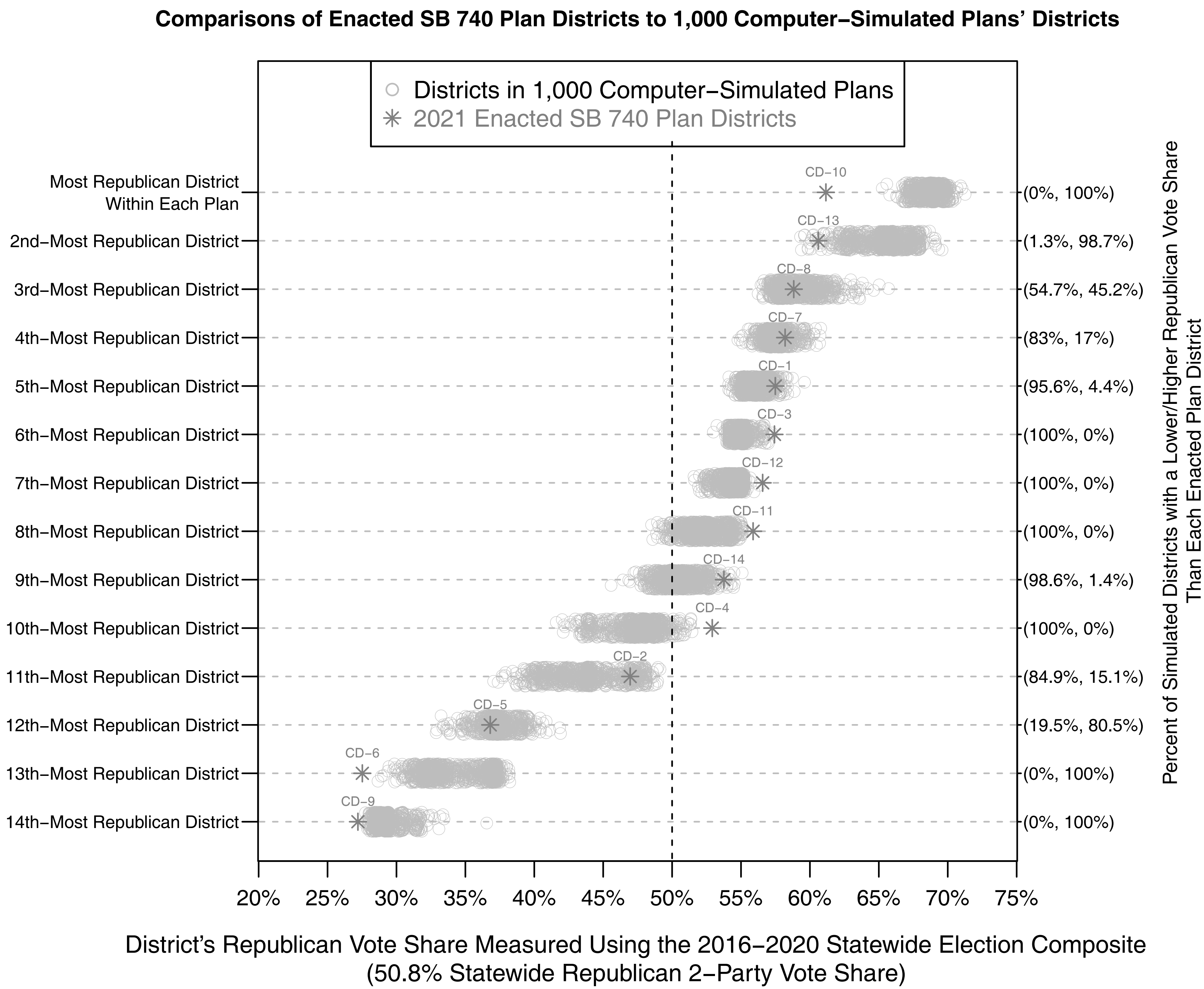
District-Level and Plan-Wide Partisan Comparisons of the Enacted Plan and Simulated Plans

34. In this section, I present partisan comparisons of the Enacted Plan to the computer-simulated plans at both a district-by-district level as well as a plan-wide level using several common measures of districting plan partisanship. First, I compare the district-level Republican vote share of the Enacted Plan's districts and the districts in the computer-simulated plans. Next, I compare the number of Republican-favoring districts in the Enacted Plan and in the computer-simulated plans. Finally, I use several common measures of partisan bias to compare the Enacted Plan to the computer-simulated plans. Overall, I find that the several individual districts in the Enacted Plan are statistical outliers, exhibiting extreme partisan characteristics that are rarely or never observed in the computer-simulated plan districts drawn with strict adherence to the Adopted Criteria. Moreover, I find that at the plan-wide level, the Enacted Plan creates a degree of partisan bias favoring Republicans that is more extreme than the vast majority of the computer-simulated plans. I describe these findings in detail below:

35. ***Partisan Outlier Districts in the Enacted Plan***: In Figure 4, I directly compare the partisan distribution of districts in the Enacted Plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the Enacted Plan's districts from the most to the least-Republican district, as measured by Republican vote share using the 2016-2020 Statewide Election Composite. The most-Republican district appears on the top row, and the least-Republican district appears on the bottom row of Figure 4. Next, I analyze each of the 1,000 computer-simulated plans and similarly order each simulated plan's districts from the most- to the least-Republican district. I then directly compare the most-Republican Enacted Plan district (CD-10) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In other words, I compare one district from the Enacted Plan to 1,000 computer-simulated

districts, and I compare these districts based on their Republican vote share. I then directly compare the second-most-Republican district in the Enacted Plan to the second-most-Republican district from each of the 1,000 simulated plans. I conduct the same comparison for each district in the Enacted Plan, comparing the Enacted Plan district to its computer-simulated counterparts from each of the 1,000 simulated plans.

Figure 4:



Comparisons of Enacted SB 740 Plan Districts to 1,000 Computer−Simulated Plans' Districts
Districts in 1,000 Computer−Simulated Plans
2021 Enacted SB 740 Plan Districts
Most Republican District Within Each Plan
2nd−Most Republican District
3rd−Most Republican District
4th−Most Republican District
5th−Most Republican District
6th−Most Republican District
7th−Most Republican District
8th−Most Republican District
9th−Most Republican District
10th−Most Republican District
11th−Most Republican District
12th−Most Republican District
13th−Most Republican District
14th−Most Republican District
CD−10
CD−13
CD−8
CD−7
CD−1
CD−3
CD−12
CD−11
CD−14
CD−4
CD−2
CD−5
CD−6
CD−9
(0%, 100%)
(1.3%, 98.7%)
(54.7%, 45.2%)
(83%, 17%)
(95.6%, 4.4%)
(100%, 0%)
(100%, 0%)
(100%, 0%)
(98.6%, 1.4%)
(100%, 0%)
(84.9%, 15.1%)
(19.5%, 80.5%)
(0%, 100%)
(0%, 100%)
20%
25%
30%
35%
40%
45%
50%
55%
60%
65%
70%
75%
District's Republican Vote Share Measured Using the 2016−2020 Statewide Election Composite
(50.8% Statewide Republican 2−Party Vote Share)
Percent of Simulated Districts with a Lower/Higher Republican Vote Share
Than Each Enacted Plan District

36. Thus, the top row of Figure 4 directly compares the partisanship of the most-Republican Enacted Plan district (CD-10) to the partisanship of the most-Republican district from each of the 1,000 simulated plans. The two percentages (in parentheses) in the right margin of this Figure report the percentage of these 1,000 simulated districts that are less Republican than, and more Republican than, the Enacted plan district. Similarly, the second row of this Figure compares the second-most-Republican district from each plan, the third row compares the third-most-Republican district from each plan, and so on. In each row of this Figure, the Enacted Plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row.

37. As the bottom row of Figure 4 illustrates, the most-Democratic district in the Enacted Plan (CD-9) is more heavily Democratic than 100% of the most-Democratic districts in each of the 1,000 computer-simulated plans. This calculation is numerically reported in the right margin of the Figure. Every single one of the computer-simulated counterpart districts would have been more politically moderate than CD-9 in terms of partisanship: CD-9 exhibits a Republican vote share of 27.2%, while all 1,000 of the most-Democratic districts in the computer-simulated plans would have exhibited a higher Republican vote share and would therefore have been more politically moderate. It is thus clear that CD-9 packs together Democratic voters to a more extreme extent than the most-Democratic district in 100% of the computer-simulated plans. I therefore identify CD-9 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

38. The next-to-bottom row of Figure 4 reveals a similar finding regarding CD-6 in the Enacted Plan. This row illustrates that the second-most-Democratic district in the Enacted

Plan (CD-6) is more heavily Democratic than 100% of the second-most-Democratic districts in each of the 1,000 computer-simulated plans. Every single one of its computer-simulated counterpart districts would have been more politically moderate than CD-6 in terms of partisanship: CD-6 exhibits a Republican vote share of 27.5%, while 100% of the second-most-Democratic districts in the computer-simulated plans would have exhibited a higher Republican vote share and would therefore have been more politically moderate. In other words, CD-6 packs together Democratic voters to a more extreme extent than the second-most-Democratic district in 100% of the computer-simulated plans. I therefore identify CD-6 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

39. Meanwhile, the top two rows of Figure 4 reveal a similar finding: As the top row illustrates, the most-Republican district in the Enacted Plan (CD-10) is less heavily Republican than 100% of the most-Republican districts in each of the 1,000 computer-simulated plans. A similar pattern appears in the second-to-top row of Figure 4, which illustrates that the second-most-Republican district in the Enacted Plan (CD-13) is less heavily Republican than 98.7% of the second-most-Republican districts in each of the 1,000 computer-simulated plans.

40. It is especially notable that these four aforementioned Enacted Plan districts – the two most Republican districts (CD-10 and CD-13) and the two most Democratic districts (CD-9 and CD-6) in the Enacted Plan – were drawn to include more Democratic voters than virtually all of their counterpart districts in the 1,000 computer-simulated plans. These “extra” Democratic voters in the four most partisan-extreme districts in the Enacted Plan had to come from the remaining ten more moderate districts in the Enacted Plan. Having fewer Democratic voters in these more moderate districts enhances Republican candidate performance in these districts.

41. Indeed, the middle six rows in Figure 4 (i.e., rows 5 through 10) confirm this precise effect. The middle six rows in Figure 4 compare the partisanship of districts in the fifth, sixth, seventh, eighth, ninth, and tenth-most Republican districts within the Enacted Plan and the 1,000 computer-simulated plans. In all six of these rows, the Enacted Plan district is a partisan outlier. In each of these six rows, the Enacted Plan's district is more heavily Republican than over 95% of its counterpart districts in the 1,000 computer-simulated plans. Four of these six rows illustrate Enacted Plan districts that are more heavily Republican than 100% of their counterpart districts in the computer-simulated plans. The six Enacted Plan districts in these six middle rows (CD-1, 3, 4, 11, 12, and 14) are more heavily Republican than nearly all of their counterpart computer-simulated plan districts because the four most partisan-extreme districts in the Enacted Plan (CD-6, 9, 10, and 13) are more heavily Democratic than nearly all of their counterpart districts in the computer-simulated plans.

42. I therefore identify the six Enacted Plan districts in the six middle rows (CD-1, 3, 4, 11, 12, and 14) of Figure 4 as partisan statistical outliers. Each of these six districts has a Republican vote share that is higher than over 95% of the computer-simulated districts in its respective row in Figure 4. I also identify the four Enacted Plan districts in the top rows and the bottom two rows (CD-6, 9, 10, and 13) of Figure 4 as partisan statistical outliers. Each of these four districts has a Republican vote share that is lower than over 98% of the computer-simulated districts in its respective row in Figure 4.

43. In summary, Figure 4 illustrates that 10 of the 14 districts in the Enacted Plan are partisan outliers: Six districts (CD-1, 3, 4, 11, 12, and 14) in the Enacted Plan are more heavily Republican than over 95% of their counterpart computer-simulated plan districts, while four

districts (CD-6, 9, 10, and 13) are more heavily Democratic than over 98% of their counterpart districts in the computer-simulated plans.

44. The Appendix of this report contains ten additional Figures (Figures A1 through A10) that each contain a similar analysis of the Enacted Plan districts and the computer-simulated plan districts. Each of these ten Figures in the Appendix measures the partisanship of districts using one of the individual ten elections included in the 2016-2020 Statewide Election Composite. These ten Figures generally demonstrate that the same extreme partisan outlier patterns observed in Figure 4 are also present when district partisanship is measured using any one of the ten statewide elections held in North Carolina during 2016-2020.

45. ***"Mid-Range" Republican Districts:*** Collectively, the upper ten rows in Figure 4 illustrate that the Enacted Plan's ten most-Republican districts exhibit a significantly narrower range of partisanship than is exhibited by the ten most-Republican districts in each of the computer-simulated plans. Specifically, the Enacted Plan's ten most-Republican districts all have Republican vote shares within the narrow range of 52.9% to 61.2%. As explained earlier, this narrow range is the product of two distinct dynamics: In the top two rows of Figure 4, the Enacted Plan's districts are significantly less Republican than nearly all of the simulated plans' districts in these rows. But in the fifth to tenth rows of Figure 4, the Enacted Plan's districts are more safely Republican-leaning than over 95% of the computer-simulated districts within each of these six rows. The overall result of these two distinct dynamics is that the Enacted Plan contains ten districts that all have Republican vote shares within the narrow range of 52.9% to 61.2%. I label any districts within this narrow range of partisanship as "mid-range" Republican-leaning districts, reflecting the fact that these districts have generally favored Republican candidates, but not by overwhelmingly large margins.

46. Is the Enacted Plan's creation of ten such "mid-range" Republican-leaning districts an outcome that ever occurs in the 1,000 computer-simulated plans? I analyzed the simulated plans and counted the number of districts within each plan that are similarly "mid-range" with a Republican vote share between 52.9% and 61.2%. As Figure 5 illustrates, the Enacted Plan's creation of ten "mid-range" Republican districts is an extreme statistical outlier. None of the 1,000 simulated plans comes close to creating ten such districts. Virtually all of the simulated plans contain from two to six "mid-range" Republican districts, and the most common outcome among the simulations is four such districts. Hence, the Enacted Plan is clearly an extreme partisan outlier in terms of its peculiar focus on maximizing the number of "mid-range" Republican districts, and the Enacted Plan did so to an extreme degree far beyond any of the 1,000 simulated plans created using a partisan-blind computer algorithm that follows the Adopted Criteria.

47. ***Competitive Districts:*** The Enacted Plan's maximization of "mid-range" Republican districts necessarily comes at the expense of creating more competitive districts. As Figure 4 illustrates, the Enacted Plan contains zero districts whose Republican vote share is higher than 47.0% and lower than 52.9%, as measured using the 2016-2020 Statewide Election Composite. In other words, there are zero districts in which the Republican vote share is within 5% of the Democratic vote share.

48. I label districts with a Republican vote share from 47.5% to 52.5% as "competitive" districts to reflect the fact that such districts have a nearly even share of Republican and Democratic voters, and election outcomes in the district could therefore swing in favor of either party. The Enacted Plan contains zero "competitive" districts, as measured using the 2016-2020 Statewide Election Composite.

Figure 5:

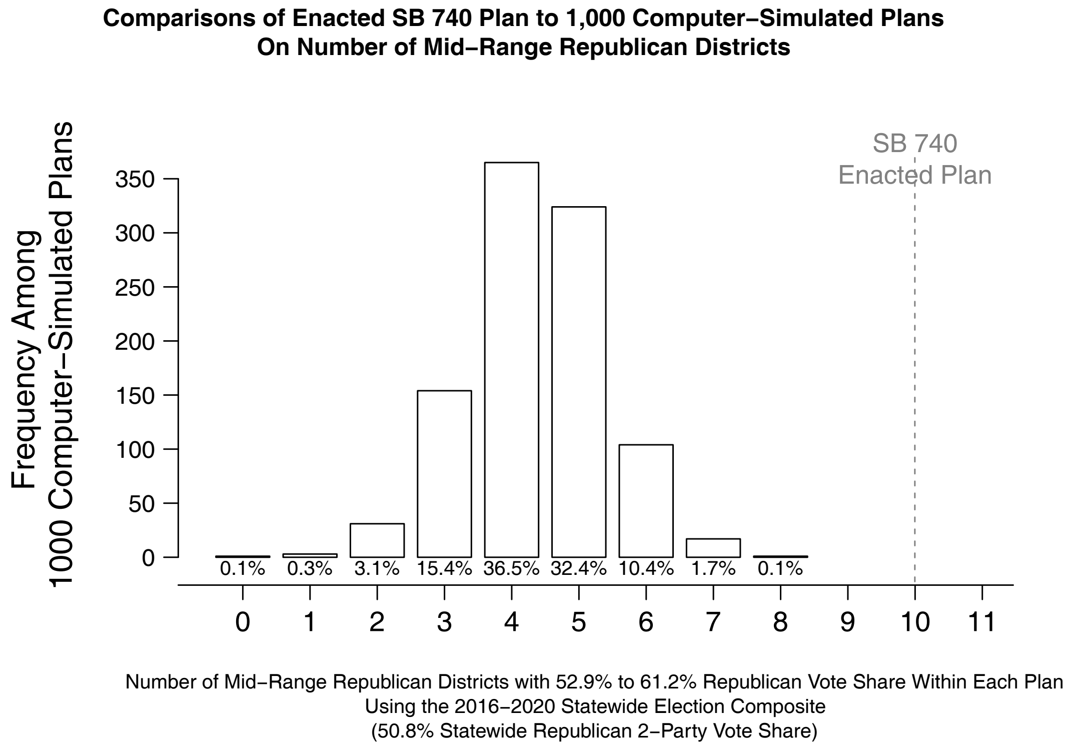
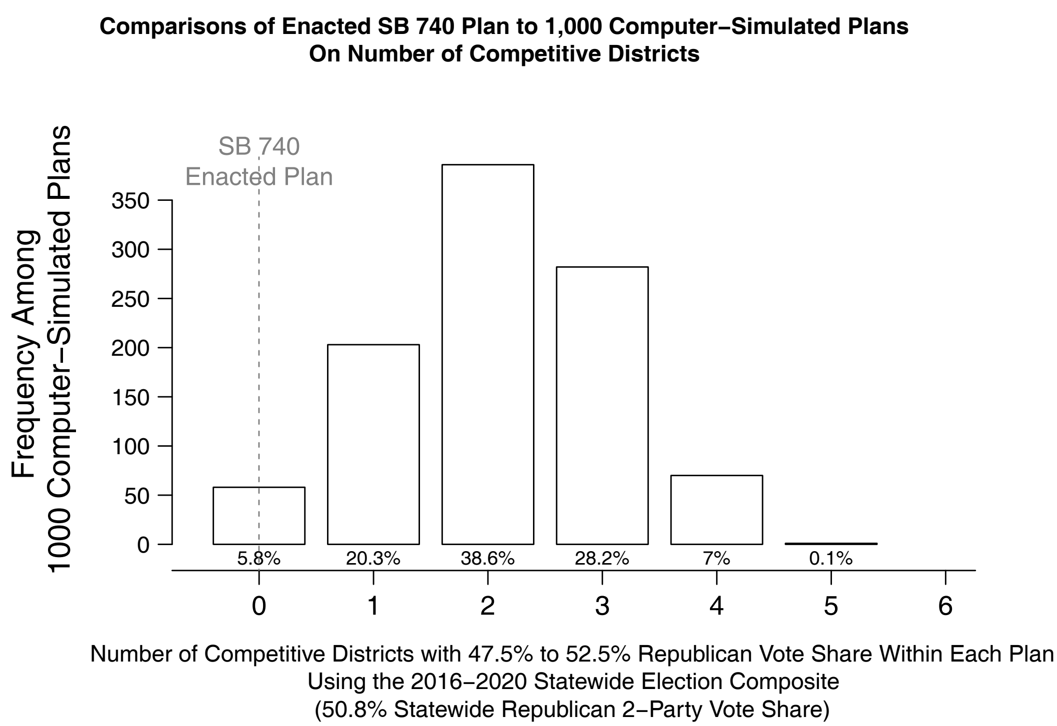


Figure 6:



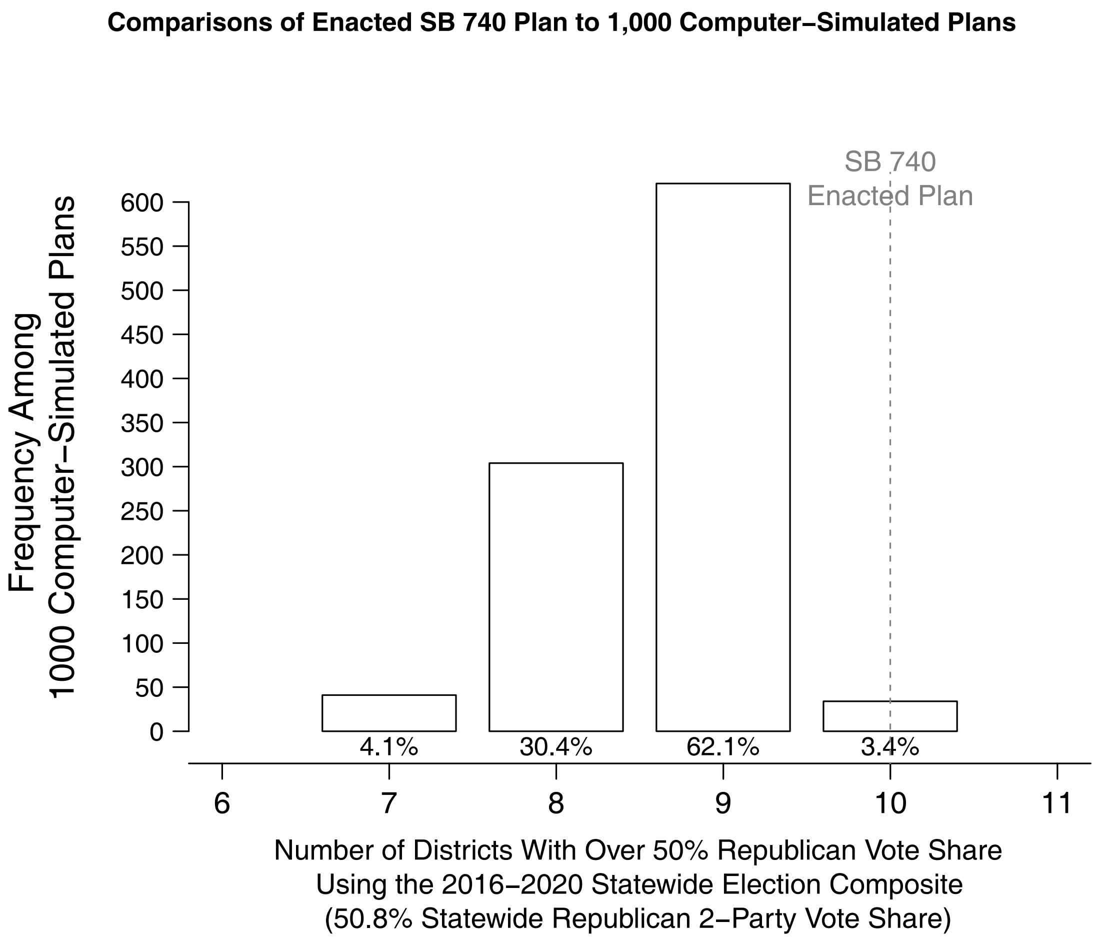
49. Is the Enacted Plan's failure to create any "competitive" districts an outcome that ever occurs in the 1,000 computer-simulated plans? I analyzed the simulated plans and counted the number of districts within each plan that are "competitive" districts with a Republican vote share between 47.5% and 52.5%. As Figure 6 illustrates, the Enacted Plan's creation of zero "competitive" districts is almost a statistical outlier: Only 5.8% of the 1,000 simulated plans similarly fail to have a single "competitive" district. The vast majority of the computer-simulated plans contain two or more "competitive" districts. Over 94% of the computer-simulated plans create more "competitive" districts than the Enacted Plan does.

50. ***Number of Democratic and Republican Districts:*** Figure 7 compares the partisan breakdown of the computer-simulated plans to the partisanship of the Enacted Plan. Specifically, Figure 7 uses the 2016-2020 Statewide Election Composite to measure the number of Republican-favoring districts created in each of the 1,000 simulated plans. Across the entire state, Republican candidates collectively won a 50.8% share of the votes in the ten elections in the 2016-2020 Statewide Election Composite. But within the 14 districts in the Enacted Plan, Republicans have over a 50% vote share in 10 out of 14 districts. In other words, the Enacted Plan created 10 Republican-favoring districts, as measured using the 2016-2020 Statewide Election Composite.. By contrast, only 3.4% of the computer-simulated plans create 10 Republican-favoring districts, and no computer-simulated plan ever creates more than 10 Republican districts.

51. Hence, in terms of the total number of Republican-favoring districts created by the plan, the 2021 Enacted Plan is a statistical outlier when compared to the 1,000 computer-simulated plans. The Enacted Plan creates the maximum number of Republican districts that ever occurs in any computer-simulated plan, and the Enacted Plan creates more Republican districts

than 96.6% of the computer-simulated plans, which were drawn using a non-partisan districting process adhering to the General Assembly's 2021 Adopted Criteria. I characterize the Enacted Plan's creation of 10 Republican districts as a statistical outlier among the computer-simulated plans because the Enacted Plan exhibits an outcome that is more favorable to Republicans than over 95% of the simulated plans.

Figure 7:



52. Notably, the ten elections included in the Statewide Election Composite all occurred in two election years and in electoral environments that were relatively favorable to Republicans across the country (November 2016 and November 2020). North Carolina did not hold any statewide elections for non-judicial offices in November 2018, which was an electoral environment more favorable to Democrats across the country.

53. Hence, the projected number of Republican seats would be even lower in the computer-simulated plans if one measured district partisanship using a statewide election whose outcome was more partisan-balanced or even favorable to Democrats. In the Appendix, I present ten histograms (labeled as Figures B1 to B10), each presenting the projected number of Republican seats across all of the simulated plans and the Enacted Plan using only one of the ten elections in the Statewide Election Composite.

54. The ten histograms in Figures B1 to B10 illustrate how the partisanship of the Enacted Plan compares to the partisanship of the 1,000 computer-simulated plans under a range of different electoral environments, as reflected by the ten elections in the Statewide Election Composite. Most notably, under all ten of these elections, the Enacted Plan always contains exactly 10 Republican-favoring districts and 4 Democrat-favoring districts. Hence, it is clear that the Enacted Plan creates a 10-to-4 distribution of seats in favor of Republican candidates that is durable across a range of different electoral conditions.

55. Moreover, the histograms in Figures B1 to B10 demonstrate that the Enacted Plan becomes a more extreme partisan outlier relative to the computer-simulated plans under electoral conditions that are slightly to moderately favorable to the Democratic candidate. For example, Figure B1 compares the Enacted Plan to the computer-simulated plan using the results of the 2016 Attorney General election, which was a near-tied statewide contest in which Democrat Josh

Stein defeated Republican Buck Newton by a very slim margin. Using the 2016 Attorney General election to measure district partisanship, the 2021 Enacted Plan contains 10 Republican-favoring districts out of 14. The Enacted Plan's creation of 10 districts favoring Republican Buck Newton over Democrat Josh Stein is an outcome that occurs in only 0.2% of the 1,000 computer-simulated plans, indicating that the Enacted Plan is a partisan statistical outlier under electoral conditions that are more favorable for Democrats (and thus relatively more unfavorable for Republicans) than is normal in North Carolina.

56. An even more favorable election for the Democratic candidate was the 2020 gubernatorial contest, in which Democrat Roy Cooper defeated Republican Dan Forest by a 4.5% margin. Figure B7 compares the Enacted Plan to the computer-simulated using the results of this 2020 gubernatorial election. Using the results from this election, the 2021 Enacted Plan contains 10 Republican-favoring districts out of 14. None of the 1,000 simulated plans ever contain 10 districts favoring the Republican candidate. The Enacted Plan's creation of 10 Republican-favoring districts is therefore an extreme partisan outlier that is durable even in Democratic-favorable electoral conditions. In fact, the 10-to-4 Republican partisan advantage under the Enacted Plan appears to become even more of an extreme partisan outlier under Democratic-favorable elections.

57. ***The Mean-Median Difference:*** I also calculate each districting plan's mean-median difference, which is another accepted method that redistricting scholars commonly use to compare the relative partisan bias of different districting plans. The mean-median difference for any given plan is calculated as the mean district-level Republican vote share, minus the median district-level Republican vote share. For any congressional districting plan, the mean is calculated as the average of the Republican vote shares in each of the 14 districts. The median, in

turn, is the Republican vote share in the district where Republican performed the middle-best, which is the district that Republican would need to win to secure a majority of the congressional delegation. For a congressional plan containing 14 districts, the median district is calculated as the average of the Republican vote share in the districts where Republican performed the 7th and 8th-best across the state.

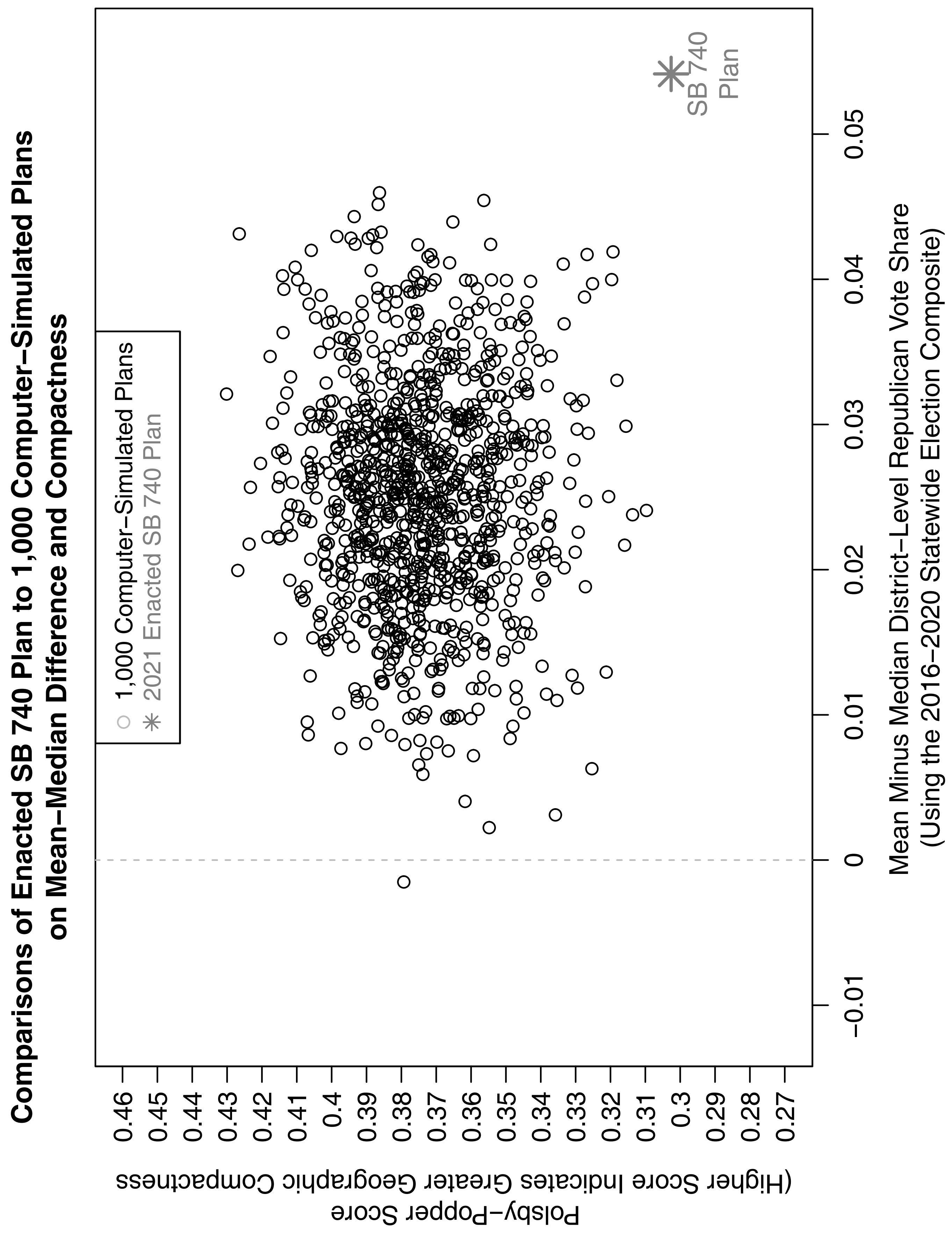
58. Using the 2016-2020 Statewide Election Composite to measure partisanship, the districts in the 2021 Enacted Plan have a mean Republican vote share of 50.8%, while the median district has a Republican vote share of 56.2%. Thus, the Enacted Plan has a mean-median difference of +5.4%, indicating that the median district is skewed significantly more Republican than the plan's average district. The mean-median difference thus indicates that the Enacted Plan distributes voters across districts in such a way that most districts are significantly more Republican-leaning than the average North Carolina congressional district, while Democratic voters are more heavily concentrated in a minority of the Enacted Plan's districts.

59. I perform this same mean-median difference calculation on all computer-simulated plans in order to determine whether this partisan skew in the median congressional districts could have resulted naturally from North Carolina's political geography and the application of the Adopted Criteria. Figure 8 compares the mean-median difference of the Enacted Plan to the mean-median difference for each the 1,000 computer-simulated plans.

60. Figure 8 contains 1,000 gray circles, representing the 1,000 computer-simulated plans, as well as a red star, representing the 2021 Enacted Plan. The horizontal axis in this Figure measures the mean-median difference of the 2021 Enacted Plan and each simulated plan using the 2016-2020 Statewide Election Composite, while the vertical axis measures the average Polsby-Popper compactness score of the districts within each plan, with higher Polsby-Popper

scores indicating more compact districts. Figure 8 illustrates that the Enacted Plan’s mean-median difference is +5.4%, indicating that the median district is skewed significantly more Republican than the plan’s average district. Figure 8 further indicates that this difference is an extreme statistical outlier compared to the 1,000 computer-simulated plans. Indeed, the Enacted Plan's +5.4% mean-median difference is an outcome never observed across these 1,000 simulated plans. The 1,000 simulated plans all exhibit mean-median differences that range from -0.2% to +4.6%. In fact, the middle 50% of these computer-simulated plans have mean-median differences ranging from +2.0% to +3.0%, indicating a much smaller degree of skew in the median district than occurs under the 2021 Enacted Plan. These results confirm that the Enacted Plan creates an extreme partisan outcome that cannot be explained by North Carolina’s voter geography or by strict adherence to the required districting criteria set forth in the General Assembly’s Adopted Criteria.

Figure 8:


Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
on Mean–Median Difference and Compactness
1,000 Computer–Simulated Plans
2021 Enacted SB 740 Plan
SB 740
Plan
Polsby–Popper Score
(Higher Score Indicates Greater Geographic Compactness)
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0.39
0.38
0.37
0.36
0.35
0.34
0.33
0.32
0.31
0.3
0.29
0.28
0.27
−0.01
0
0.01
0.02
0.03
0.04
0.05
Mean Minus Median District–Level Republican Vote Share
(Using the 2016–2020 Statewide Election Composite)

61. Figure 8 illustrates that the Enacted Plan is less geographically compact than every single one of the computer-simulated plans, as measured by each plan's average Polsby-Popper score. The simulated plans have Polsby-Popper scores ranging from 0.31 to 0.43. In fact, the middle 50% of these computer-simulated plans have Polsby-Popper scores ranging from 0.36 to 0.39. Meanwhile, the Enacted Plan exhibits a Polsby-Popper score of only 0.30, which is lower than all 1,000 of the computer-simulated plans. Hence, it is clear that the Enacted Plan did not seek to draw districts that were as geographically compact as reasonably possible. Instead, the Enacted Plan subordinated geographic compactness, which enabled the Enacted Plan to create a partisan skew in North Carolina's congressional districts favoring Republican candidates.

62. ***The Efficiency Gap:*** Another commonly used measure of a districting plan's partisan bias is the efficiency gap.[5] To calculate the efficiency gap of the Enacted Plan and every computer-simulated plan, I first measure the number of Republican and Democratic votes within each Enacted Plan district and each computer-simulated district, as measured using the 2016-2020 Statewide Election Composite. Using this measure of district-level partisanship, I then calculate each districting plan's efficiency gap using the method outlined in *Partisan Gerrymandering and the Efficiency Gap.*[6] Districts are classified as Democratic victories if, using the 2016-2020 Statewide Election Composite, the sum total of Democratic votes in the district during these elections exceeds the sum total of Republican votes; otherwise, the district is classified as Republican. For each party, I then calculate the total sum of surplus votes in districts

[5] Eric McGhee, "Measuring Partisan Bias in Single-Member District Electoral Systems." Legislative Studies Quarterly Vol. 39, No. 1: 55–85 (2014).

[6] Nicholas O. Stephanopoulos & Eric M. McGhee, *Partisan Gerrymandering and the Efficiency Gap,* 82 University of Chicago Law Review 831 (2015).

the party won and lost votes in districts where the party lost. Specifically, in a district lost by a given party, all of the party's votes are considered lost votes; in a district won by a party, only the party's votes exceeding the 50% threshold necessary for victory are considered surplus votes. A party's total wasted votes for an entire districting plan is the sum of its surplus votes in districts won by the party and its lost votes in districts lost by the party. The efficiency gap is then calculated as total wasted Republican votes minus total wasted Democratic votes, divided by the total number of two-party votes cast statewide across all seven elections.

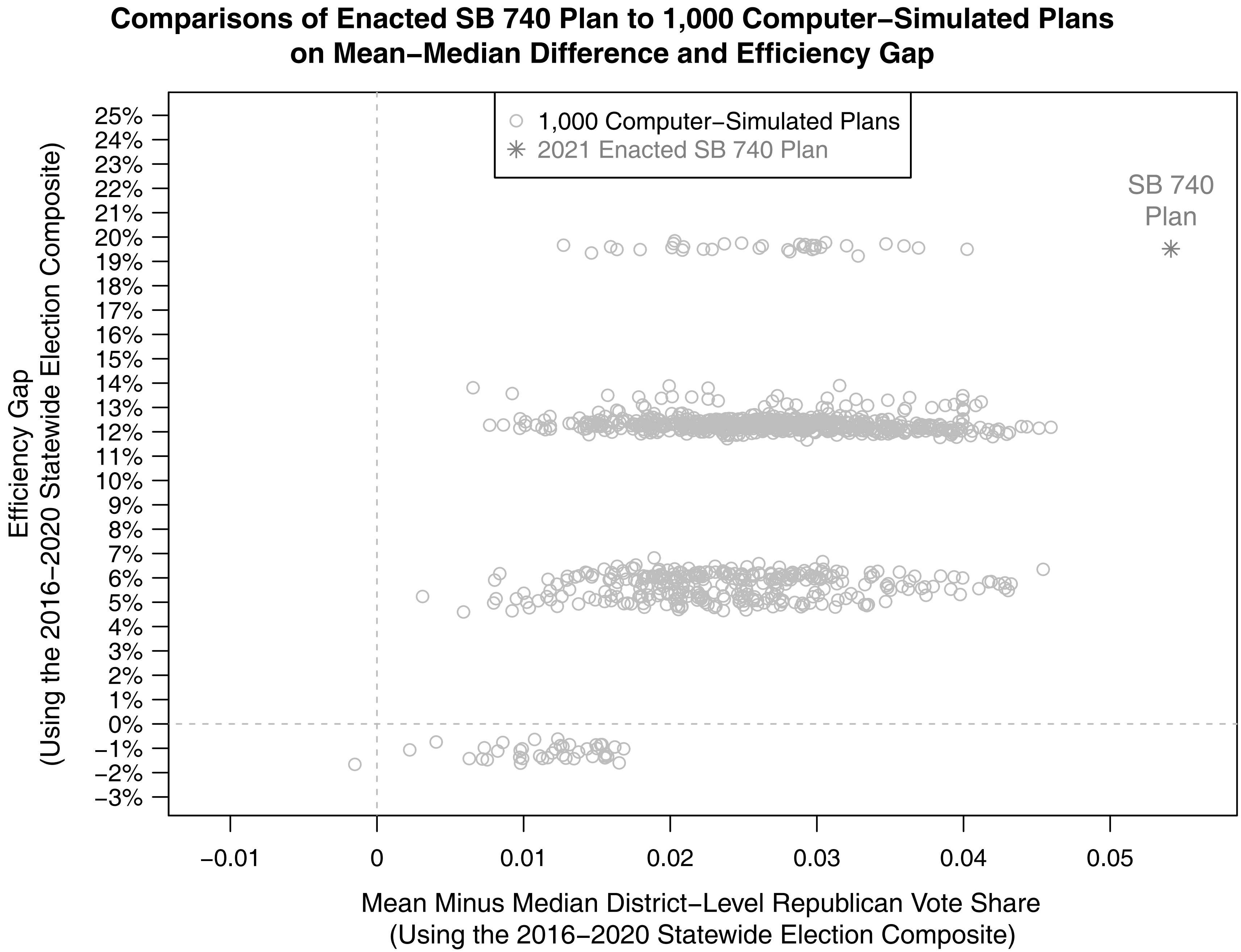
63. Thus, the theoretical importance of the efficiency gap is that it tells us the degree to which more Democratic or Republican votes are wasted across an entire districting plan. A significantly positive efficiency gap indicates far more Republican wasted votes, while a significantly negative efficiency gap indicates far more Democratic wasted votes.

64. I analyze whether the Enacted Plan's efficiency gap arises naturally from a map-drawing process strictly adhering to the mandated criteria in the General Assembly's Adopted Criteria, or rather, whether the skew in the Enacted Plan's efficiency gap is explainable only as the product of a map-drawing process that intentionally favored one party over the other. By comparing the efficiency gap of the Enacted Plan to that of the computer-simulated plans, I am able to evaluate whether or not such the Enacted Plan's efficiency gap could have realistically resulted from adherence to the Adopted Criteria.

65. Figure 9 compares the efficiency paps of the Enacted Plan and of the 1,000 computer-simulated plans. As before, the 1,000 circles in this Figure represent the 1,000 computer-simulated plans, while the red star in the lower right corner represents the Enacted Plan. Each plan is plotted along the vertical axis according to its efficiency gap, while each plan is plotted along the horizontal axis according to its mean-median difference.

66. The results in Figure 9 illustrate that the Enacted Plan exhibits an efficiency gap of +19.5%, indicating that the plan results in far more wasted Democratic votes than wasted Republican votes. Specifically, the difference between the total number of wasted Democratic votes and wasted Republican votes amounts to 19.5% of the total number of votes statewide. The Enacted Plan's efficiency gap is larger than the efficiency gaps exhibited by 97.7% of the computer-simulated plans. This comparison reveals that the significant level of Republican bias exhibited by the Enacted Plan cannot be explained by North Carolina's political geography or the Adopted Criteria alone.

Figure 9:


Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
on Mean–Median Difference and Efficiency Gap
1,000 Computer–Simulated Plans
2021 Enacted SB 740 Plan
SB 740
Plan
Efficiency Gap
(Using the 2016–2020 Statewide Election Composite)
25%
24%
23%
22%
21%
20%
19%
18%
17%
16%
15%
14%
13%
12%
11%
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
–1%
–2%
–3%
–0.01
0
0.01
0.02
0.03
0.04
0.05
Mean Minus Median District–Level Republican Vote Share
(Using the 2016–2020 Statewide Election Composite)

67. ***The Lopsided Margins Measure:*** Another measure of partisan bias in districting plans is the "lopsided margins” test. The basic premise captured by this measure is that a partisan-motivated map-drawer may attempt to pack the opposing party’s voters into a small number of extreme districts that are won by a lopsided margin. Thus, for example, a map-drawer attempting to favor Party A may pack Party B’s voters into a small number of districts that very heavily favor Party B. This packing would then allow Party A to win all the remaining districts with relatively smaller margins. This sort of partisan manipulation in districting would result in Party B winning its districts by extremely large margins, while Party A would win its districts by relatively small margins.

68. Hence, the lopsided margins test is performed by calculating the difference between the average margin of victory in Republican-favoring districts and the average margin of victory in Democratic-favoring districts. The 2021 Enacted Plan contains four Democratic-favoring districts (CD-2, 5, 6, and 9), and these four districts have an average Democratic vote share of 65.4%, as measured using the 2016-2020 Statewide Election Composite. By contrast, the Enacted Plan contains ten Republican-favoring districts (CD-1, 3, 4, 7, 8, 10, 11, 12, 13, and 14), and these ten districts have an average Republican vote share of 57.3%. Hence, the difference between the average Democratic margin of victory in Democratic-favoring districts and the average Republican margin of victory in Republican-favoring districts is +8.1%, which is calculated as 65.4% - 57.3%. I refer to this calculation of +8.1% as the Enacted Plan’s lopsided margins measure.

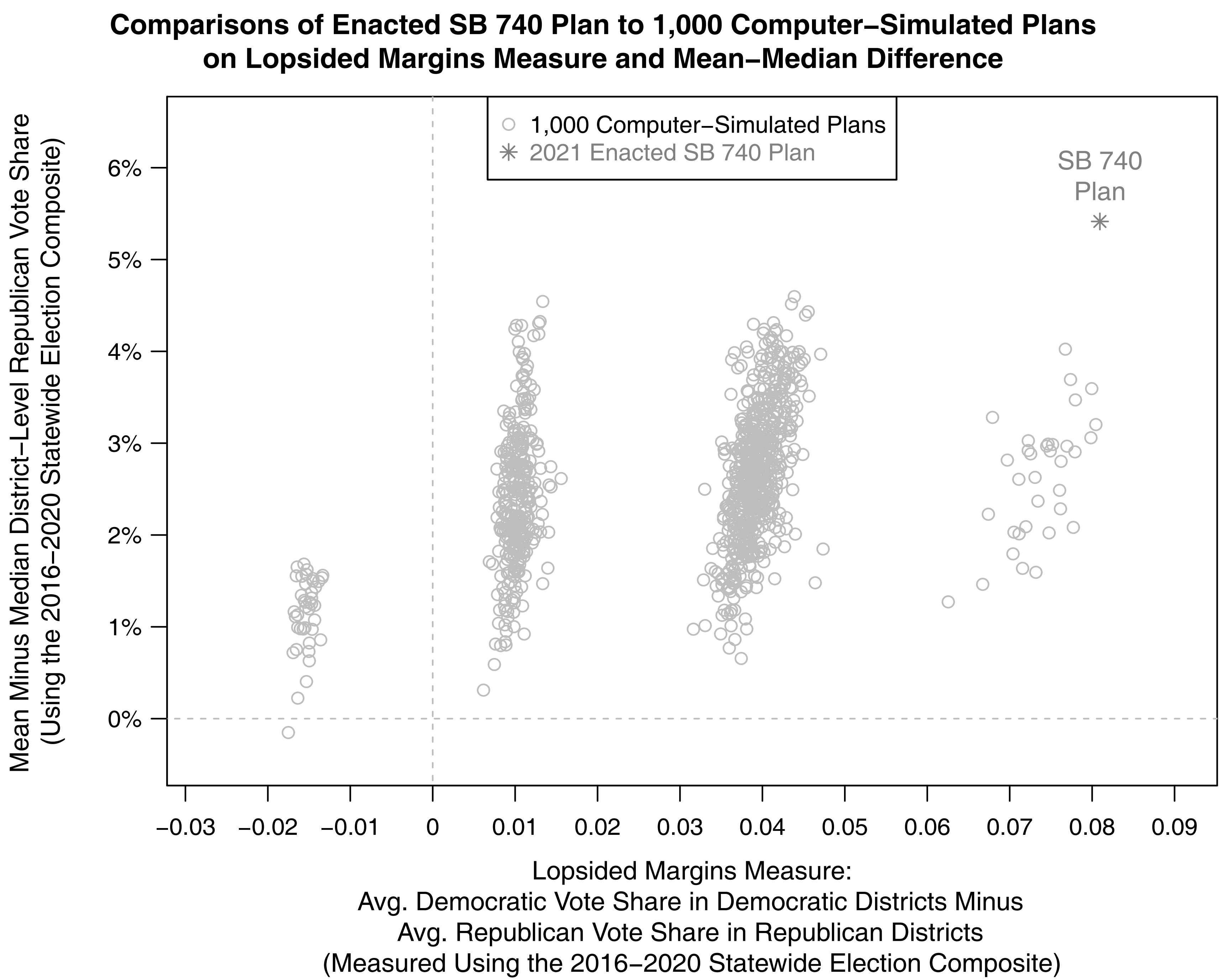
69. How does the 8.1% lopsided margins measure of the Enacted Plan compare to the same calculation for the 1,000 computer-simulated plans? Figure 10 reports the lopsided margins calculations for the Enacted Plan and for the simulated plans. In Figure 10, each plan is plotted

along the horizontal axis according to its lopsided margins measure and along the vertical axis according to its mean-median difference.

70. Figure 10 reveals that the Enacted Plan's +8.1% lopsided margins measure is an extreme outlier compared to the lopsided margins measures of the 1,000 computer-simulated plans. All 1,000 of the simulated plans have a smaller lopsided margins measure than the Enacted Plan. In fact, a significant minority (34.5%) of the 1,000 simulated plans have a lopsided margins measure of between -2% to +2%, indicating a plan in which Democrats and Republicans win their respective districts by similar average margins.

71. By contrast, the Enacted Plan's lopsided margins measure of +8.1% indicates that the Enacted Plan creates districts in which Democrats are extremely packed into their districts, while the margin of victory in Republican districts is significantly smaller. The "lopsidedness" of the two parties' average margin of victory is extreme when compared to the computer-simulated plans. The finding that all 1,000 simulated plans have a smaller lopsided margins measure indicates that the Enacted Plan's extreme packing of Democrats into Democratic-favoring districts was not simply the result of North Carolina's political geography, combined with adherence to the Adopted Criteria.

Figure 10:


Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
on Lopsided Margins Measure and Mean−Median Difference
1,000 Computer−Simulated Plans
2021 Enacted SB 740 Plan
SB 740
Plan
Mean Minus Median District−Level Republican Vote Share
(Using the 2016−2020 Statewide Election Composite)
6%
5%
4%
3%
2%
1%
0%
−0.03
−0.02
−0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Lopsided Margins Measure:
Avg. Democratic Vote Share in Democratic Districts Minus
Avg. Republican Vote Share in Republican Districts
(Measured Using the 2016−2020 Statewide Election Composite)

Conclusions Regarding Partisanship and Traditional Districting Criteria:

72. The analysis described thus far in this report lead me to reach two main findings: First, among the five traditional districting criteria mandated by the General Assembly's 2021 Adopted Criteria, the Enacted Plan fails to minimize county splits, fails to minimize VTD splits, and is significantly less geographically compact than is reasonably possible under a districting process that follows the Adopted Criteria. Second, I found that the Enacted Plan is an extreme partisan outlier when compared to computer-simulated plans produced by a process following the Adopted Criteria. The Enacted Plan contains 10 districts that are partisan outliers when compared to the simulated plans' districts, and using several different common measures of partisan bias, the Enacted Plan creates a level of pro-Republican bias more extreme than in over 95% of the computer-simulated plans. In particular, the Enacted Plan creates more "mid-range" Republican districts than is created in 100% of the computer-simulated plans (Paragraphs 45-46).

73. Based on these two main findings, I conclude that partisanship predominated in the drawing of the 2021 Enacted Plan and subordinated the traditional districting principles of avoiding county splits, avoiding VTD splits, and geographic compactness. Because the Enacted Plan fails to follow three of the Adopted Criteria's mandated districting principles while simultaneously creating an extreme level of partisan bias, I therefore conclude that the partisan bias of the Enacted Plan did not naturally arise by chance from a districting process adhering to the Adopted Criteria. Instead, I conclude that partisan goals predominated in the drawing of the Enacted Plan. By subordinating traditional districting criteria, the General Assembly's Enacted Plan was able to achieve partisan goals that could not otherwise have been achieved under a partisan-neutral districting process that follows the Adopted Criteria.

The Effect of the Enacted Plan Districts on Plaintiffs

74. I evaluated the congressional districts in which each Plaintiff would reside under the 1,000 computer-simulated using a list of geocoded residential addresses for the Plaintiffs that counsel for the Plaintiffs provided me. I used these geocoded addresses to identify the specific district in which each Plaintiff would be located under each computer-simulated plan, as well as under the Enacted Plan. I then compared the partisanship of each individual Plaintiff's Enacted Plan district to the partisanship of the Plaintiff's 1,000 districts from the 1,000 computer-simulated plans. Using this approach, I identify whether each Plaintiff's district is a partisan outlier when compared to the Plaintiff's 1,000 computer-simulated districts.

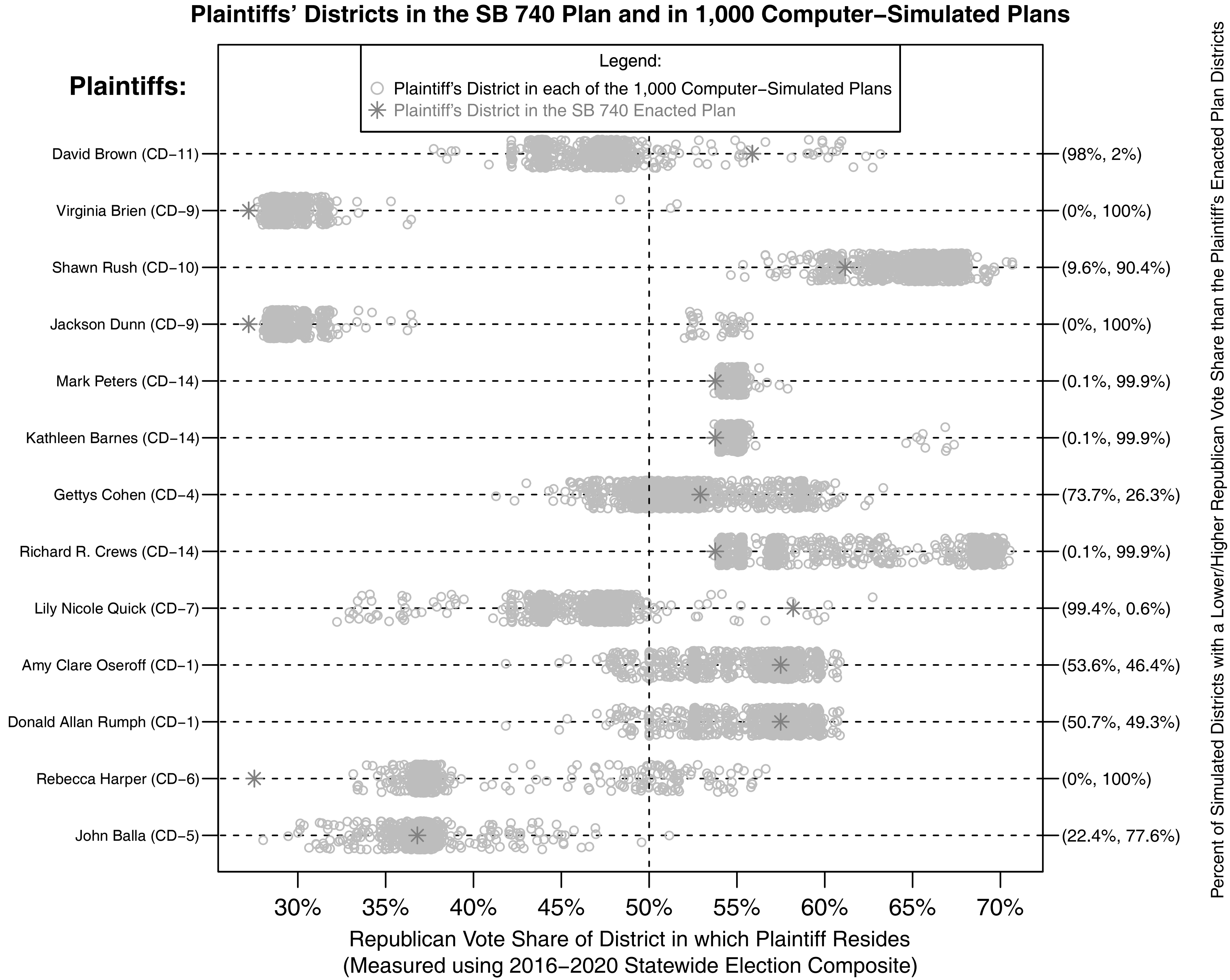
75. Figure 11 present the results of this analysis. This Figure lists the individual Plaintiffs and describes the partisanship of each Plaintiff's district of residence in the Enacted Plan, as well as the partisanship of the district the Plaintiff would have resided in under each of the 1,000 simulated congressional plans.

76. To explain these analyses with an example each row in Figure 11 corresponds to a particular individual Plaintiff. In the first row, describing Plaintiff David Brown, the red star depicts the partisanship of the Plaintiff's Enacted Plan district (CD-11), as measured by Republican vote share using the 2016-2020 Statewide Election Composite. The 1,000 gray circles on this row depict the Republican vote share of each of the 1,000 simulated districts in which the Plaintiff would reside in each of the 1,000 computer-simulated plans, based on that Plaintiff's residential address. In the margin to the right of each row, I list in parentheses how many of the 1,000 simulated plans would place the plaintiff in a more Democratic-leaning district (on the left) and how many of the 1,000 simulations would place the plaintiff in a more Republican-leaning district (on the right) than the Plaintiff's Enacted Plan district. Thus, for

example, the first row of Figure 11 reports that 98% of the 1,000 computer-simulated plans would place Plaintiff David Brown in a more Democratic-leaning district than his actual Enacted Plan district (CD-11). Therefore, I can conclude that Plaintiff David Brown's Enacted Plan district is a partisan statistical outlier when compared to his district under the 1,000 simulated plans.

77. Figure 11 shows that two Plaintiffs residing in Republican-leaning districts under the Enacted Plan would be placed in a more Democratic-leaning district in over 95% of the computer-simulated plans: David Brown (CD-11) and Lily Nicole Quick (CD-7).

Figure 11:


Plaintiffs' Districts in the SB 740 Plan and in 1,000 Computer–Simulated Plans
Plaintiffs:
Legend:
Plaintiff's District in each of the 1,000 Computer–Simulated Plans
Plaintiff's District in the SB 740 Enacted Plan
David Brown (CD–11)
Virginia Brien (CD–9)
Shawn Rush (CD–10)
Jackson Dunn (CD–9)
Mark Peters (CD–14)
Kathleen Barnes (CD–14)
Gettys Cohen (CD–4)
Richard R. Crews (CD–14)
Lily Nicole Quick (CD–7)
Amy Clare Oseroff (CD–1)
Donald Allan Rumph (CD–1)
Rebecca Harper (CD–6)
John Balla (CD–5)
(98%, 2%)
(0%, 100%)
(9.6%, 90.4%)
(0%, 100%)
(0.1%, 99.9%)
(0.1%, 99.9%)
(73.7%, 26.3%)
(0.1%, 99.9%)
(99.4%, 0.6%)
(53.6%, 46.4%)
(50.7%, 49.3%)
(0%, 100%)
(22.4%, 77.6%)
30%
35%
40%
45%
50%
55%
60%
65%
70%
Republican Vote Share of District in which Plaintiff Resides
(Measured using 2016–2020 Statewide Election Composite)
Percent of Simulated Districts with a Lower/Higher Republican Vote Share than the Plaintiff's Enacted Plan Districts

78. Additionally, Figure 11 shows that six Plaintiffs would be placed in a more Republican district in 99.9% or more of the simulated plans relative to their districts under the Enacted Plan: Virginia Brien (CD-9), Jackson Dunn (CD-9), Mark Peters (CD-14), Kathleen Barnes (CD-14), Richard R. Crews (CD-14), and Rebecca Harper (CD-6).

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

This 30th day of November, 2021.

____

Dr. Jowei Chen

Jowei Chen
Curriculum Vitae

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Website: http://www.umich.edu/~jowei

Academic Positions:

Associate Professor (2015-present), Assistant Professor (2009-2015), Department of Political Science, University of Michigan.
Research Associate Professor (2016-present), Faculty Associate (2009-2015), Center for Political Studies, University of Michigan.
W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, 2013.
Principal Investigator and Senior Research Fellow, Center for Governance and Public Policy Research, Willamette University, 2013 – Present.

Education:

Ph.D., Political Science, Stanford University (June 2009)
M.S., Statistics, Stanford University (January 2007)
B.A., Ethics, Politics, and Economics, Yale University (May 2004)

Publications:

Chen, Jowei and Neil Malhotra. 2007. "The Law of k/n: The Effect of Chamber Size on Government Spending in Bicameral Legislatures."
__American Political Science Review__. 101(4): 657-676.

Chen, Jowei, 2010. "The Effect of Electoral Geography on Pork Barreling in Bicameral Legislatures."
American Journal of Political Science. 54(2): 301-322.

Chen, Jowei, 2013. "Voter Partisanship and the Effect of Distributive Spending on Political Participation."
American Journal of Political Science. 57(1): 200-217.

Chen, Jowei and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures"
Quarterly Journal of Political Science, 8(3): 239-269.

Bradley, Katharine and Jowei Chen, 2014. "Participation Without Representation? Senior Opinion, Legislative Behavior, and Federal Health Reform."
Journal of Health Politics, Policy and Law. 39(2), 263-293.

Chen, Jowei and Tim Johnson, 2015. "Federal Employee Unionization and Presidential Control of the Bureaucracy: Estimating and Explaining Ideological Change in Executive Agencies."
Journal of Theoretical Politics, Volume 27, No. 1: 151-174.

Bonica, Adam, Jowei Chen, and Tim Johnson, 2015. "Senate Gate-Keeping, Presidential Staffing of 'Inferior Offices' and the Ideological Composition of Appointments to the Public Bureaucracy."
Quarterly Journal of Political Science. Volume 10, No. 1: 5-40.

Chen, Jowei and Jonathan Rodden, 2015. "Cutting Through the Thicket: Redistricting Simulations and the Detection of Partisan Gerrymanders."
Election Law Journal. Volume 14, Number 4: 331-345.

Chen, Jowei and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House."
Electoral Studies. Volume 44 (December 2016): 329-340.

Chen, Jowei, 2017. "Analysis of Computer-Simulated Districting Maps for the Wisconsin State Assembly."
Election Law Journal. Volume 16, Number 4 (December 2017): 417-442.

Chen, Jowei and Nicholas Stephanopoulos, 2020. "The Race-Blind Future of Voting Rights."
Yale Law Journal, Forthcoming. Volume 130, Number 4: 778-1049.

Kim, Yunsieg and Jowei Chen, 2021. "Gerrymandered by Definition: The Distortion of 'Traditional' Districting Principles and a Proposal for an Empirical Redefinition."
Wisconsin Law Review, Forthcoming, Volume 2021, Number 1.

Chen, Jowei and Nicholas Stephanopoulos, 2021. "Democracy's Denominator."
California Law Review, Accepted for Publication, Volume 109.

Non-Peer-Reviewed Publication:

Chen, Jowei and Tim Johnson. 2017. "Political Ideology in the Bureaucracy."
Global Encyclopedia of Public Administration, Public Policy, and Governance.

Research Grants:

"How Citizenship-Based Redistricting Systemically Disadvantages Voters of Color". 2020 ($18,225). Combating and Confronting Racism Grant. University of Michigan Center for Social Solutions and Poverty Solutions.

Principal Investigator. National Science Foundation Grant SES-1459459, September 2015 – August 2018 ($165,008). “The Political Control of U.S. Federal Agencies and Bureaucratic Political Behavior.”

“Economic Disparity and Federal Investments in Detroit,” (with Brian Min) 2011. Graham Institute, University of Michigan ($30,000).

“The Partisan Effect of OSHA Enforcement on Workplace Injuries,” (with Connor Raso) 2009. John M. Olin Law and Economics Research Grant ($4,410).

Invited Talks:

September, 2011. University of Virginia, American Politics Workshop.
October 2011. Massachusetts Institute of Technology, American Politics Conference.
January 2012. University of Chicago, Political Economy/American Politics Seminar.
February 2012. Harvard University, Positive Political Economy Seminar.
September 2012. Emory University, Political Institutions and Methodology Colloquium.
November 2012. University of Wisconsin, Madison, American Politics Workshop.
September 2013. Stanford University, Graduate School of Business, Political Economy Workshop.
February 2014. Princeton University, Center for the Study of Democratic Politics Workshop.
November 2014. Yale University, American Politics and Public Policy Workshop.
December 2014. American Constitution Society for Law & Policy Conference: Building the Evidence to Win Voting Rights Cases.
February 2015. University of Rochester, American Politics Working Group.
March 2015. Harvard University, Voting Rights Act Workshop.
May 2015. Harvard University, Conference on Political Geography.
Octoer 2015. George Washington University School of Law, Conference on Redistricting Reform.
September 2016. Harvard University Center for Governmental and International Studies, Voting Rights Institute Conference.
March 2017. Duke University, Sanford School of Public Policy, Redistricting Reform Conference.
October 2017. Willamette University, Center for Governance and Public Policy Research
October 2017, University of Wisconsin, Madison. Geometry of Redistricting Conference.
February 2018: University of Georgia Law School
September 2018. Willamette University.
November 2018. Yale University, Redistricting Workshop.

November 2018. University of Washington, Severyns Ravenholt Seminar in Comparative Politics.
January 2019. Duke University, Reason, Reform & Redistricting Conference.
February 2019. Ohio State University, Department of Political Science. Departmental speaker series.
March 2019. Wayne State University Law School, Gerrymandering Symposium.
November 2019. Big Data Ignite Conference.
November 2019. Calvin College, Department of Mathematics and Statistics.
September 2020 (Virtual). Yale University, Yale Law Journal Scholarship Workshop

Conference Service:

Section Chair, 2017 APSA (San Francisco, CA), Political Methodology Section
Discussant, 2014 Political Methodology Conference (University of Georgia)
Section Chair, 2012 MPSA (Chicago, IL), Political Geography Section.
Discussant, 2011 MPSA (Chicago, IL) "Presidential-Congressional Interaction."
Discussant, 2008 APSA (Boston, MA) "Congressional Appropriations."
Chair and Discussant, 2008 MPSA (Chicago, IL) "Distributive Politics: Parties and Pork."

Conference Presentations and Working Papers:

"Ideological Representation of Geographic Constituencies in the U.S. Bureaucracy," (with Tim Johnson). 2017 APSA.

"Incentives for Political versus Technical Expertise in the Public Bureaucracy," (with Tim Johnson). 2016 APSA.

"Black Electoral Geography and Congressional Districting: The Effect of Racial Redistricting on Partisan Gerrymandering". 2016 Annual Meeting of the Society for Political Methodology (Rice University)

"Racial Gerrymandering and Electoral Geography." Working Paper, 2016.

"Does Deserved Spending Win More Votes? Evidence from Individual-Level Disaster Assistance," (with Andrew Healy). 2014 APSA.

"The Geographic Link Between Votes and Seats: How the Geographic Distribution of Partisans Determines the Electoral Responsiveness and Bias of Legislative Elections," (with David Cottrell). 2014 APSA.

"Gerrymandering for Money: Drawing districts with respect to donors rather than voters." 2014 MPSA.

"Constituent Age and Legislator Responsiveness: The Effect of Constituent Opinion on the Vote for Federal Health Reform." (with Katharine Bradley) 2012 MPSA.

"Voter Partisanship and the Mobilizing Effect of Presidential Advertising." (with Kyle Dropp) 2012 MPSA.

"Recency Bias in Retrospective Voting: The Effect of Distributive Benefits on Voting Behavior." (with Andrew Feher) 2012 MPSA.

"Estimating the Political Ideologies of Appointed Public Bureaucrats," (with Adam Bonica and Tim Johnson) 2012 Annual Meeting of the Society for Political Methodology (University of North Carolina)

"Tobler's Law, Urbanization, and Electoral Bias in Florida." (with Jonathan Rodden) 2010 Annual Meeting of the Society for Political Methodology (University of Iowa)

"Unionization and Presidential Control of the Bureaucracy" (with Tim Johnson) 2011 MPSA.

"Estimating Bureaucratic Ideal Points with Federal Campaign Contributions" 2010 APSA. (Washington, DC).

"The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures," Vanderbilt University Conference on Bicameralism, 2009.

"When Do Government Benefits Influence Voters' Behavior? The Effect of FEMA Disaster Awards on US Presidential Votes," 2009 APSA (Toronto, Canada).

"Are Poor Voters Easier to Buy Off?" 2009 APSA (Toronto, Canada).

"Credit Sharing Among Legislators: Electoral Geography's Effect on Pork Barreling in Legislatures," 2008 APSA (Boston, MA).

"Buying Votes with Public Funds in the US Presidential Election," Poster Presentation at the 2008 Annual Meeting of the Society for Political Methodology (University of Michigan).

"The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures," 2008 MPSA.

"Legislative Free-Riding and Spending on Pure Public Goods," 2007 MPSA (Chicago, IL).

"Free Riding in Multi-Member Legislatures," (with Neil Malhotra) 2007 MPSA (Chicago, IL).

"The Effect of Legislature Size, Bicameralism, and Geography on Government Spending: Evidence from the American States," (with Neil Malhotra) 2006 APSA (Philadelphia, PA).

Figure A1: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Attorney General Election Results

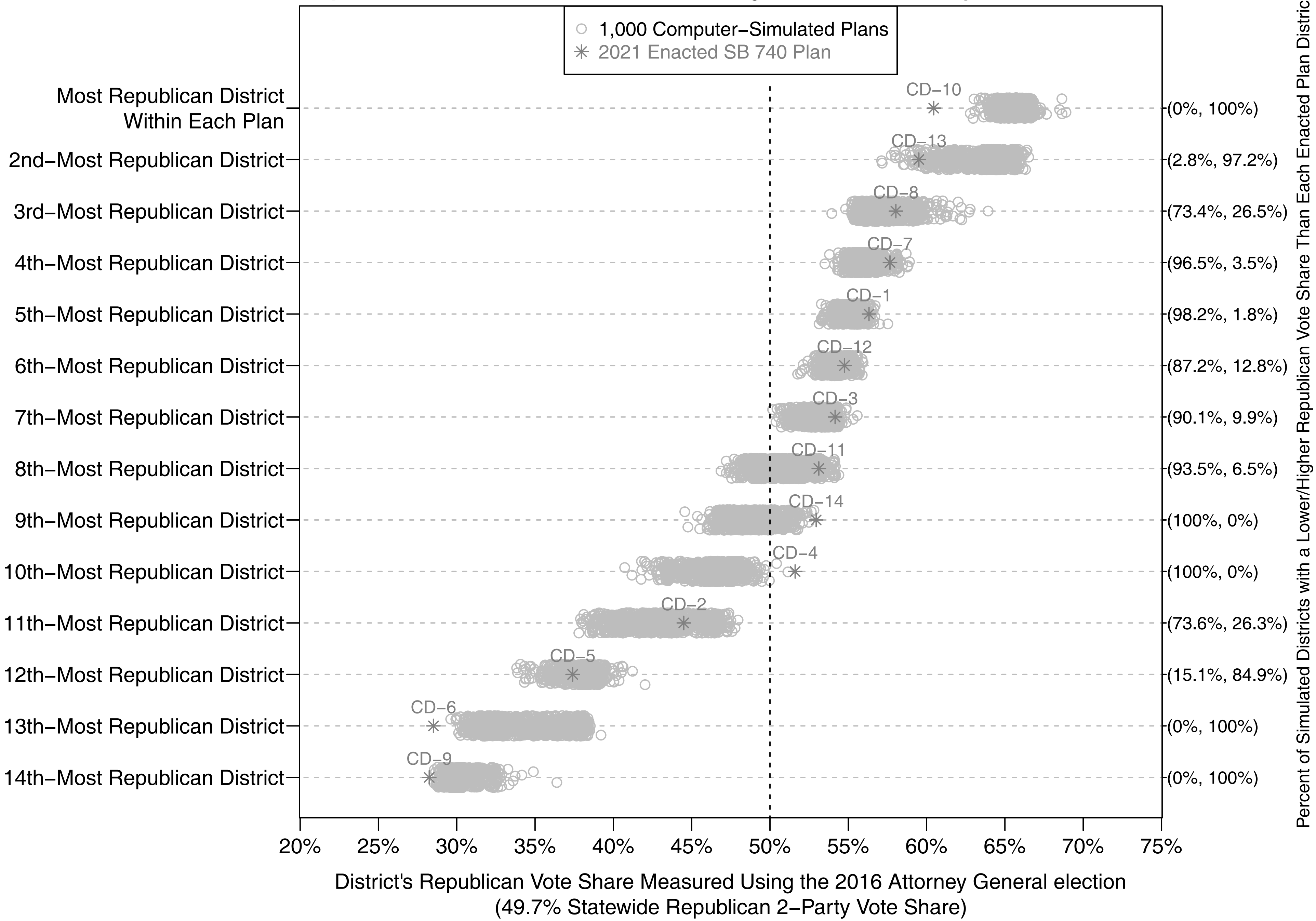
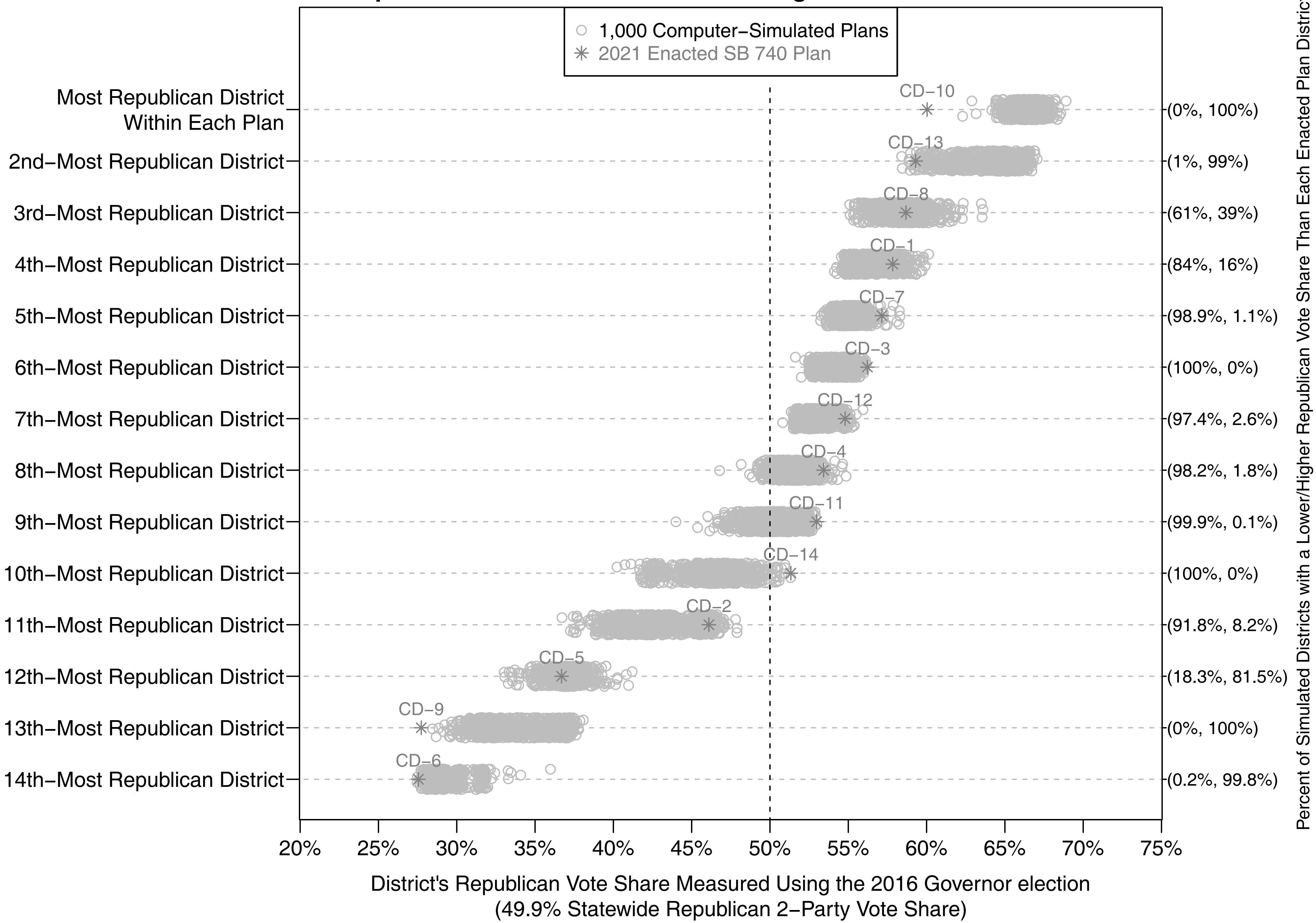


Figure A2: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Governor Election Results



– Ex. 10128 –

Figure A3: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Lieutenant Governor Election Results

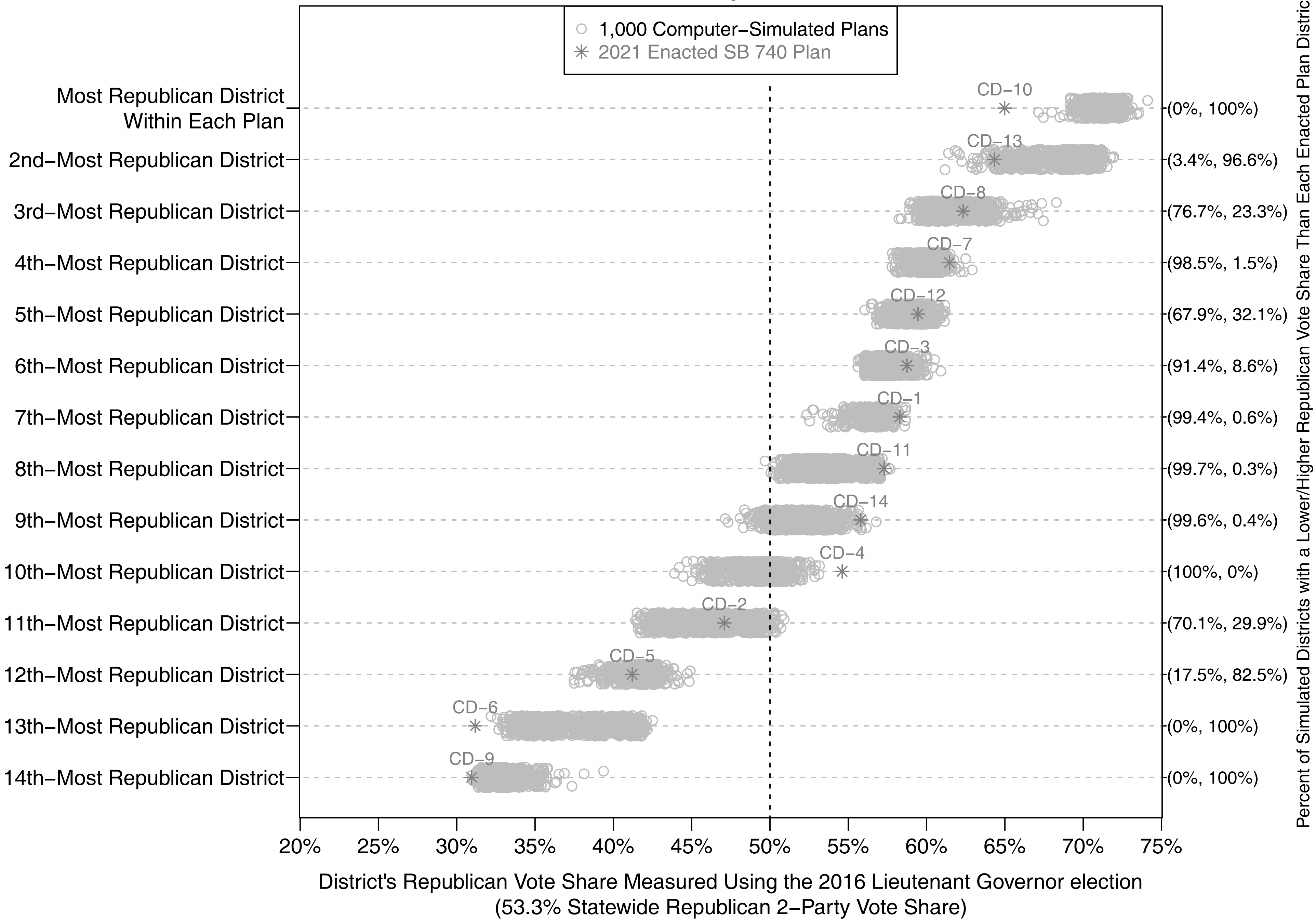


Figure A4: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US President Election Results

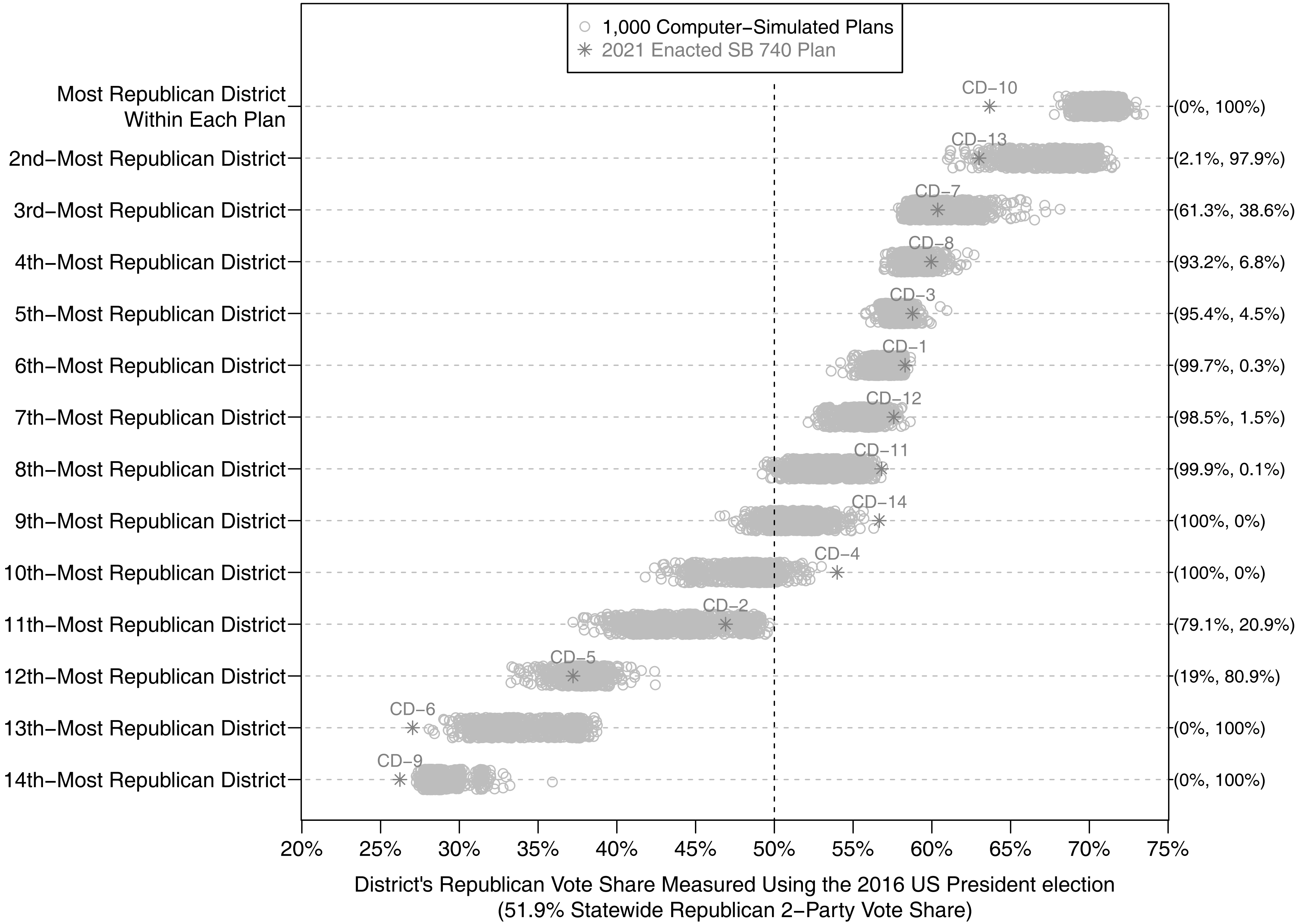
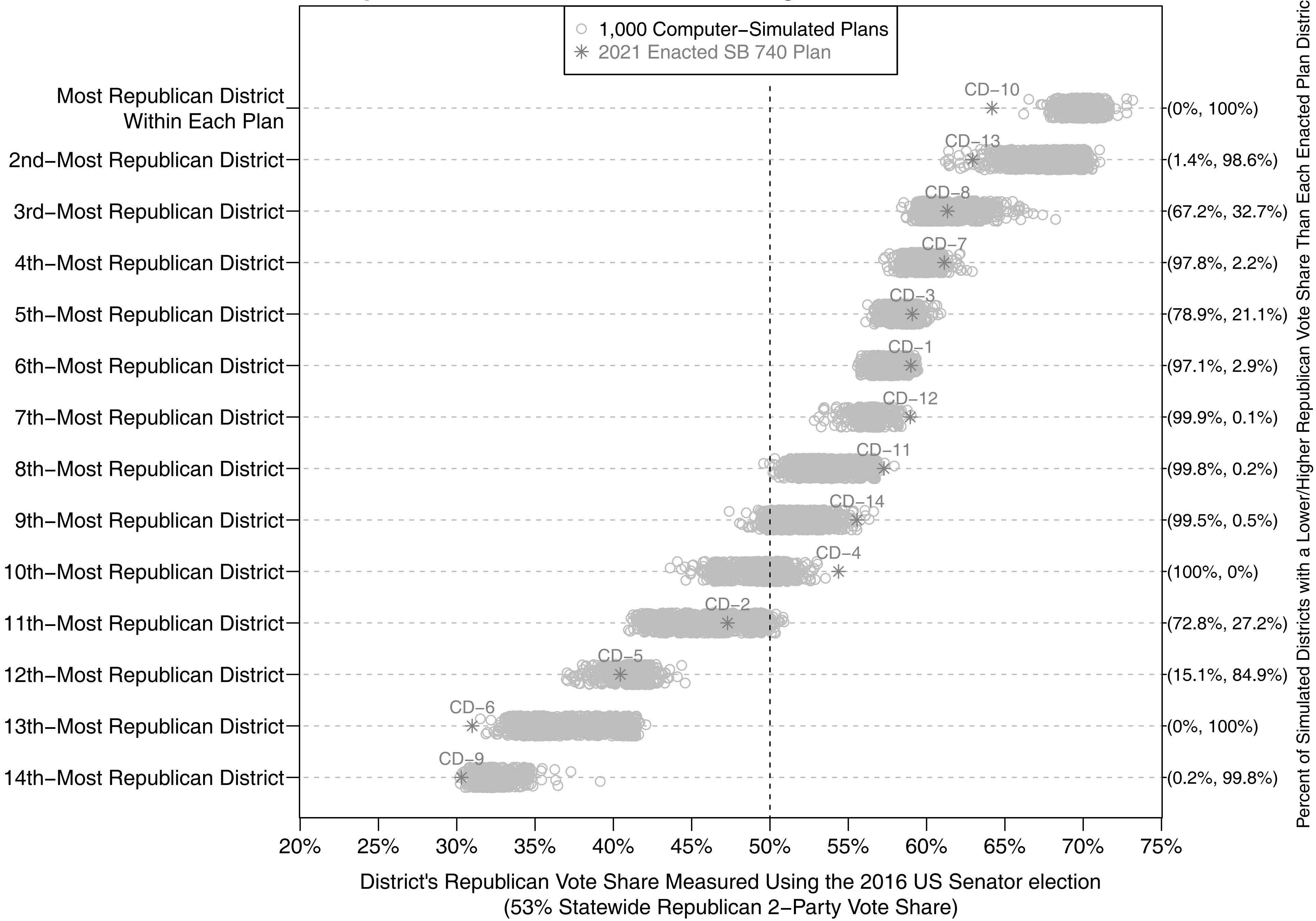


Figure A5: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US Senator Election Results



– Ex. 10131 –

Figure A6: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Attorney General Election Results

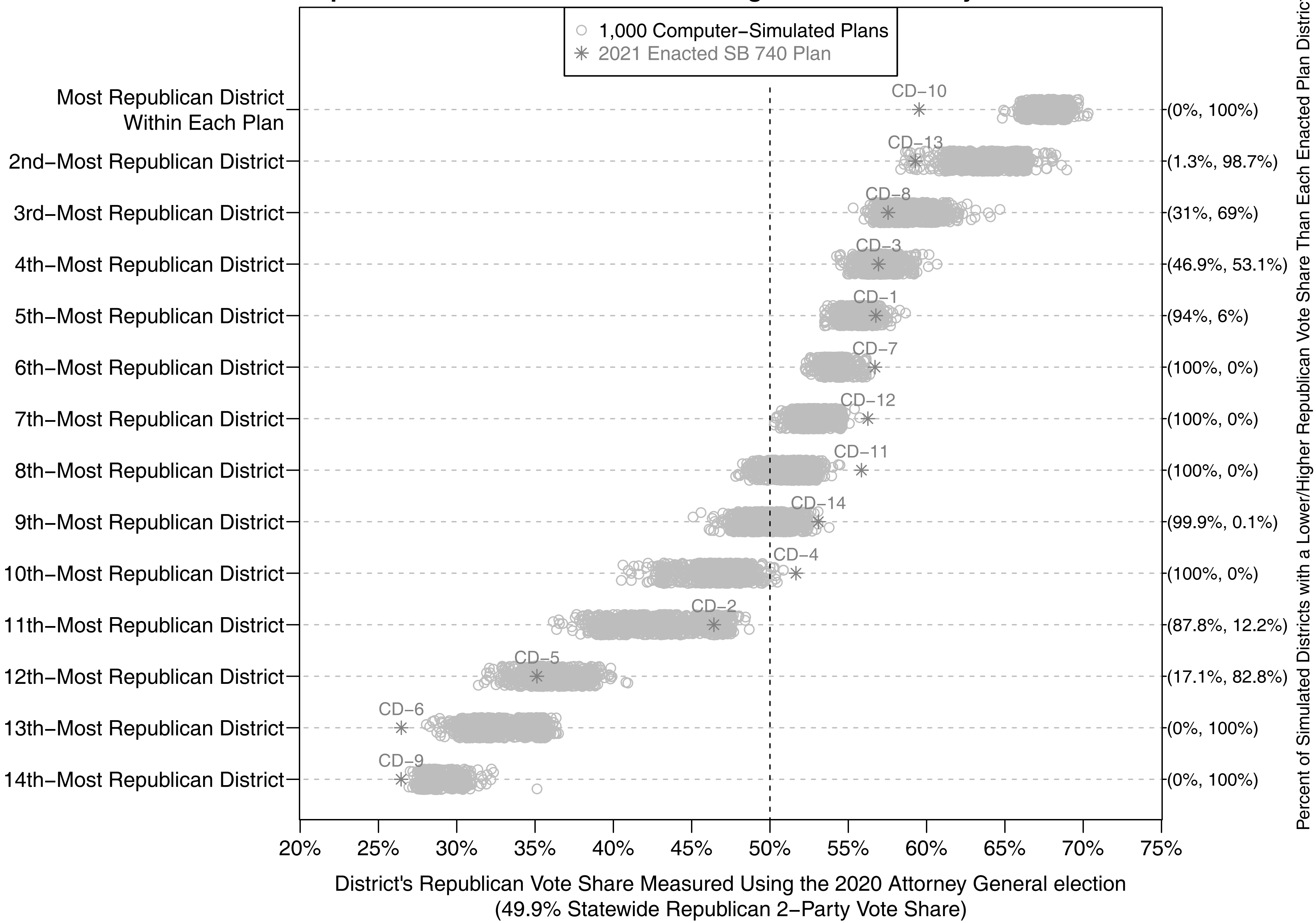


Figure A7: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Governor Election Results

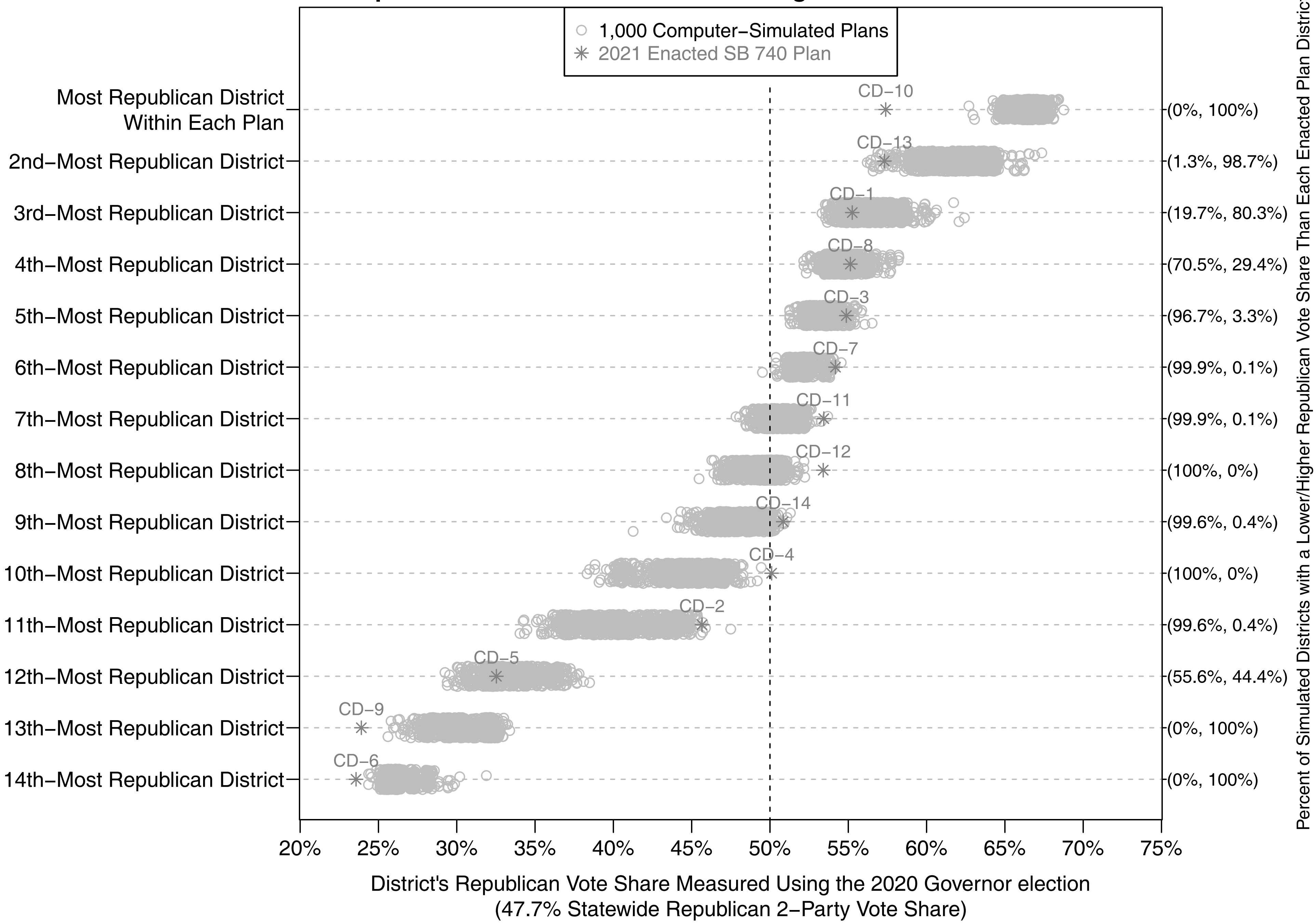


Figure A8: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Lieutenant Governor Election Results

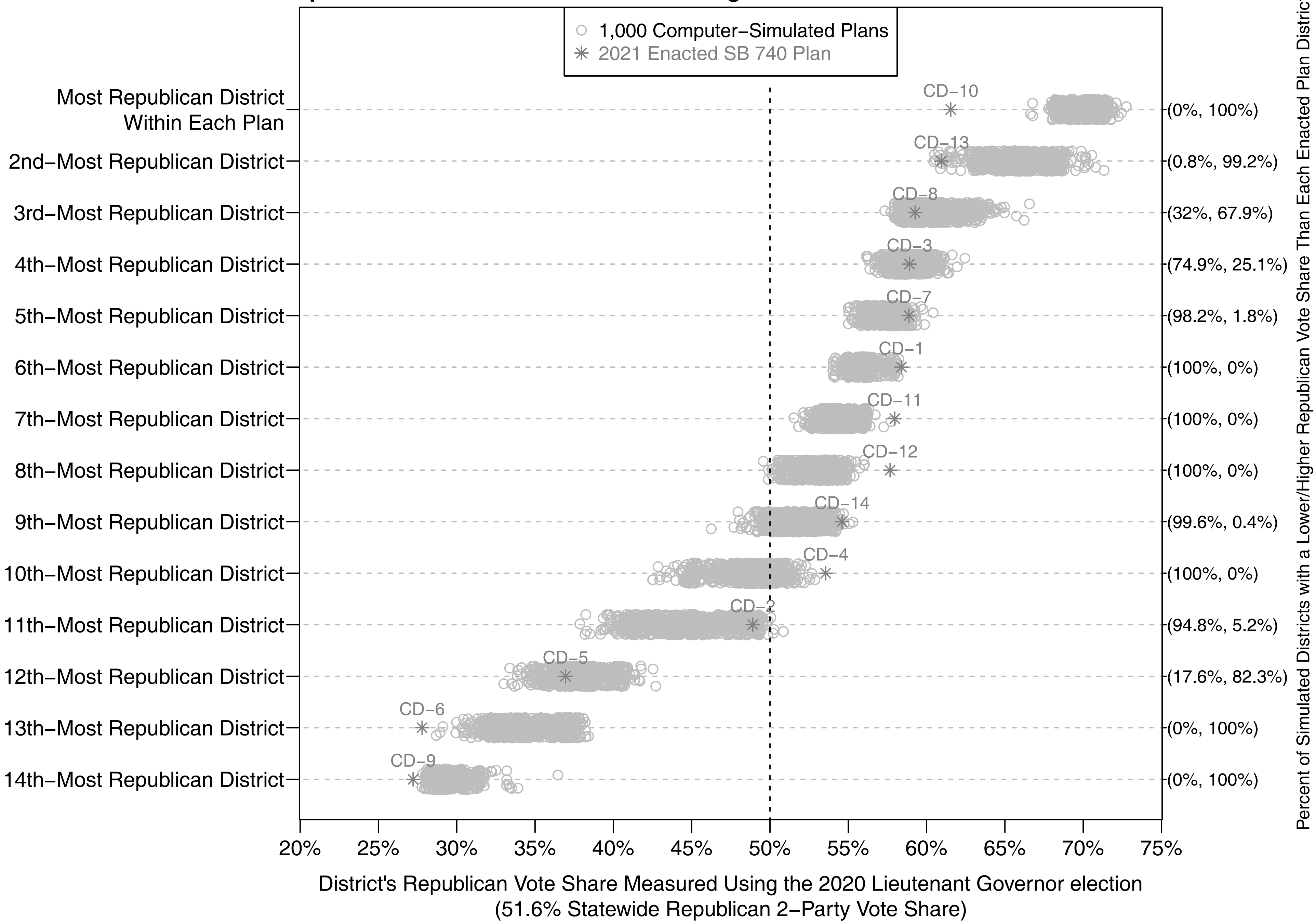


Figure A9: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US President Election Results

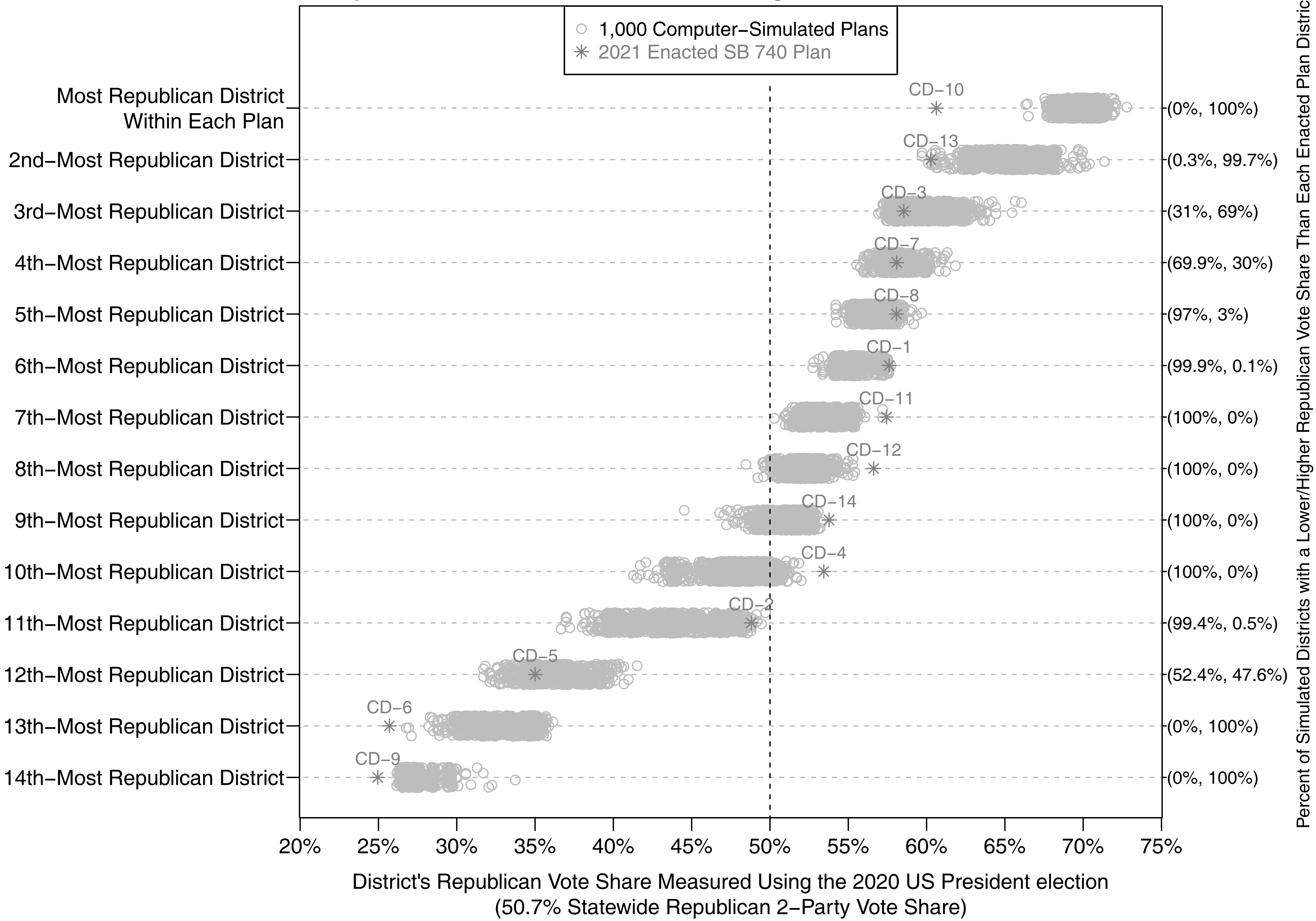


Figure A10: Comparison of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US Senator Election Results

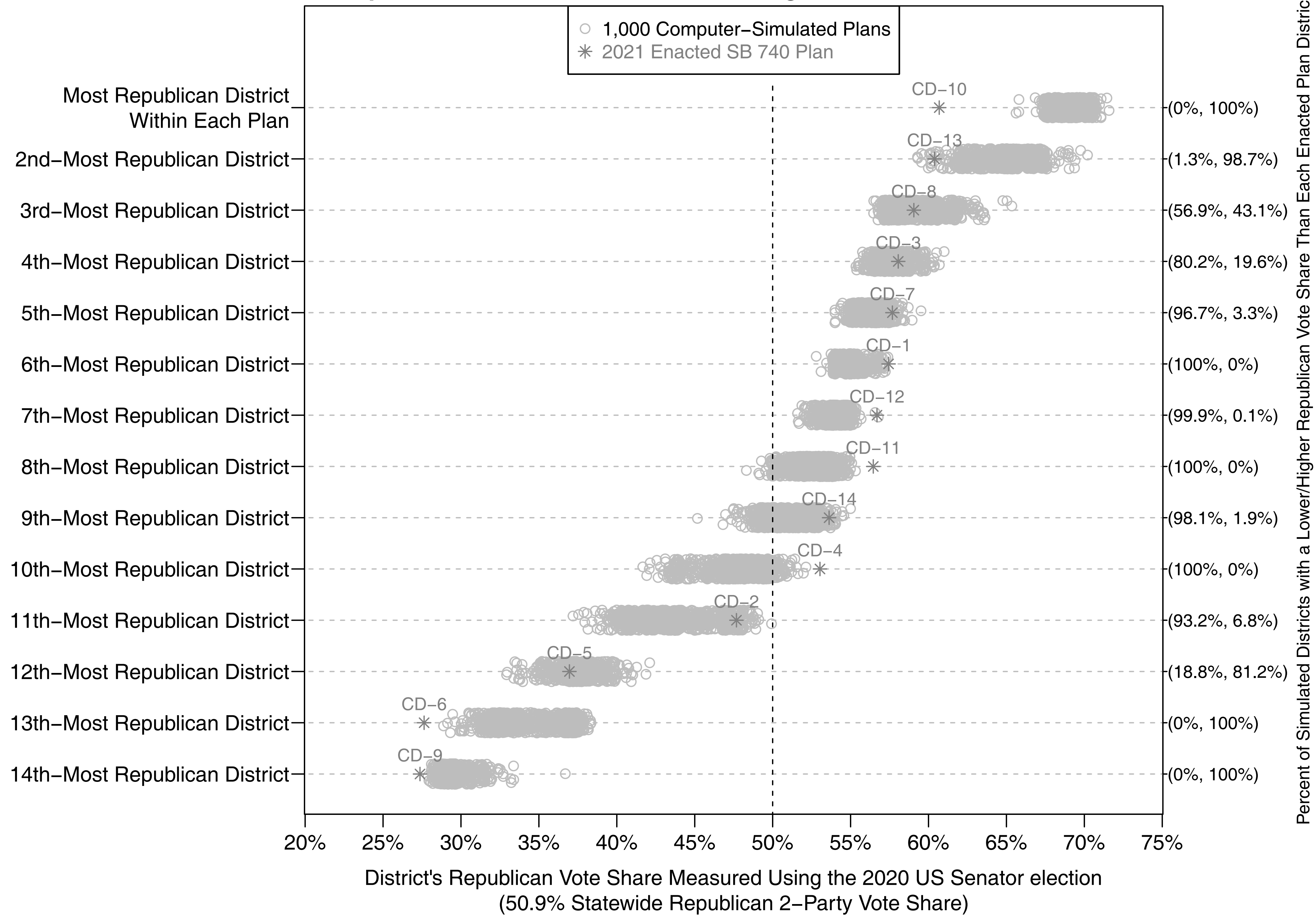


Figure B1: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 Attorney General election
(49.7% Statewide Republican 2−Party Vote Share)

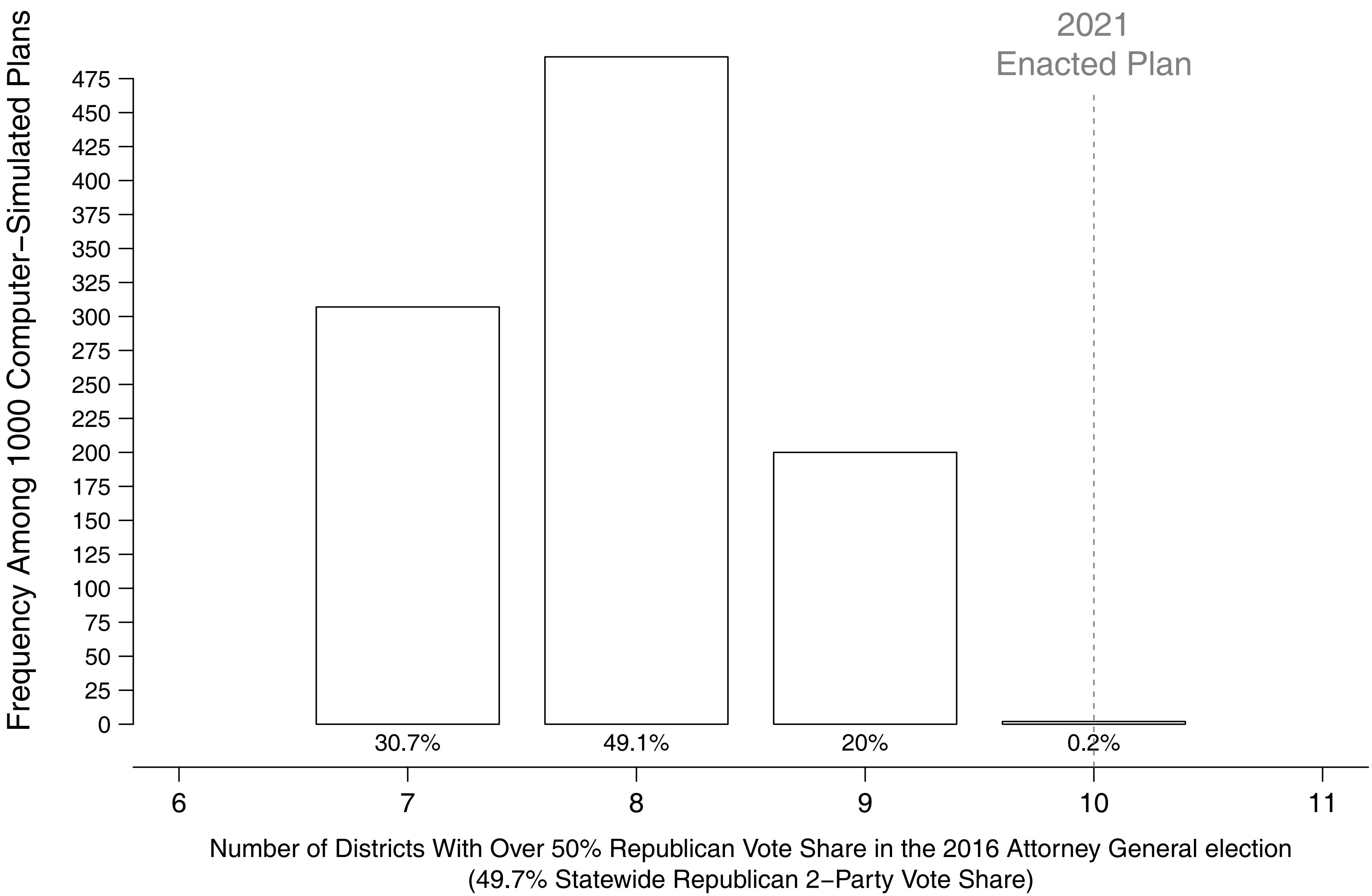


Figure B2: Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 Governor election
(49.9% Statewide Republican 2–Party Vote Share)

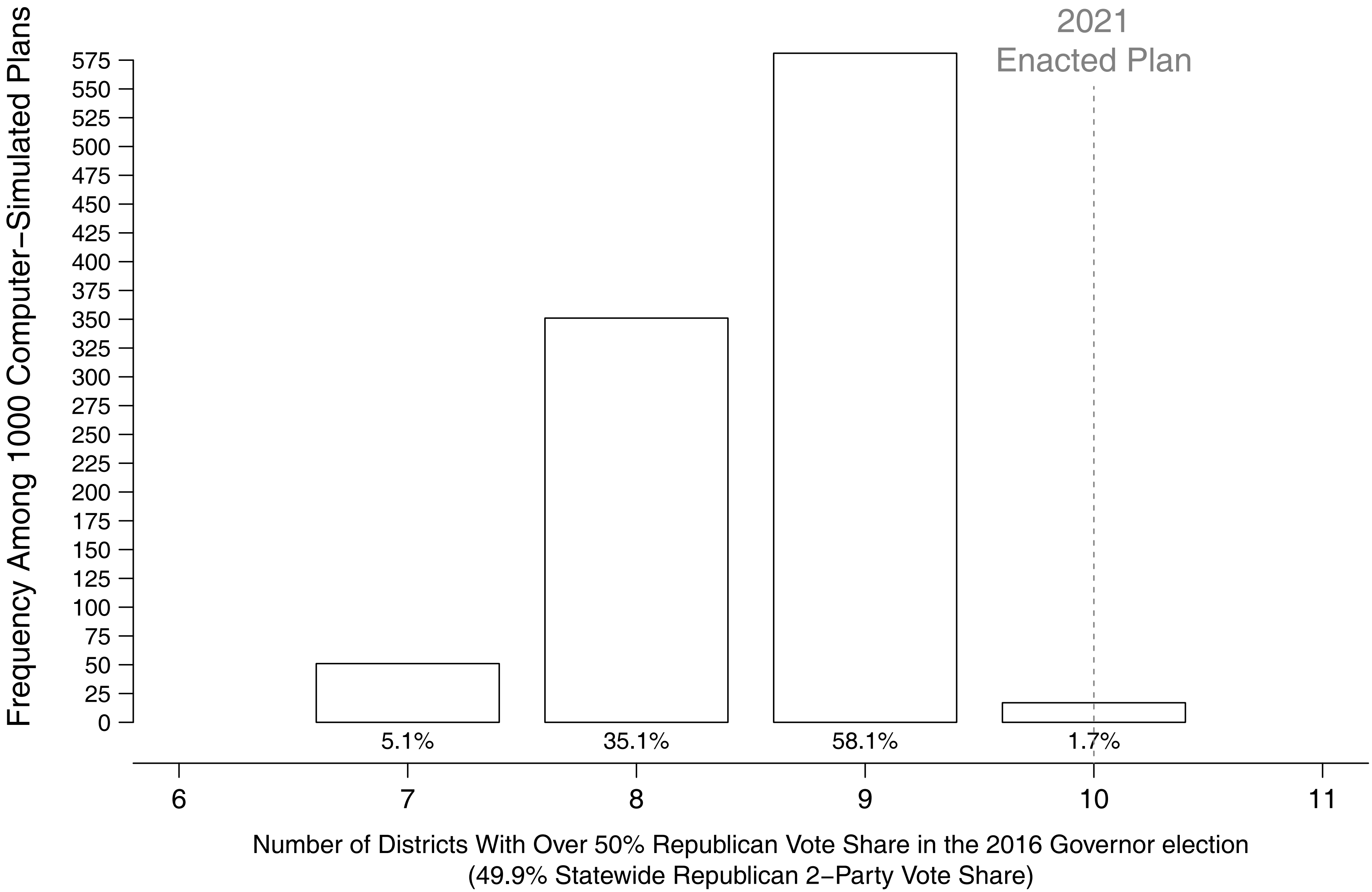


Figure B3: Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 Lieutenant Governor election
(53.3% Statewide Republican 2–Party Vote Share)

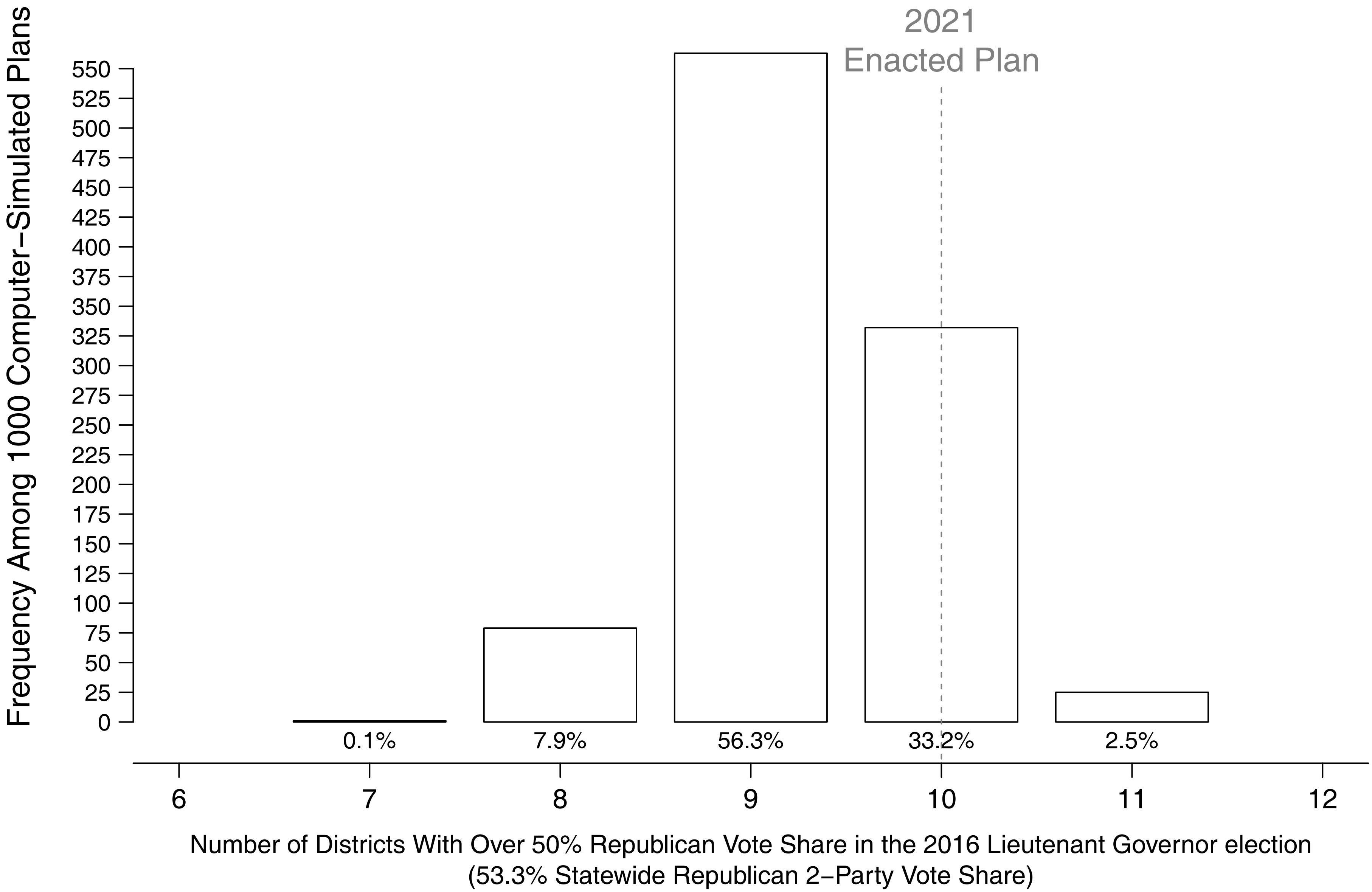


Figure B4: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 US President election
(51.9% Statewide Republican 2−Party Vote Share)

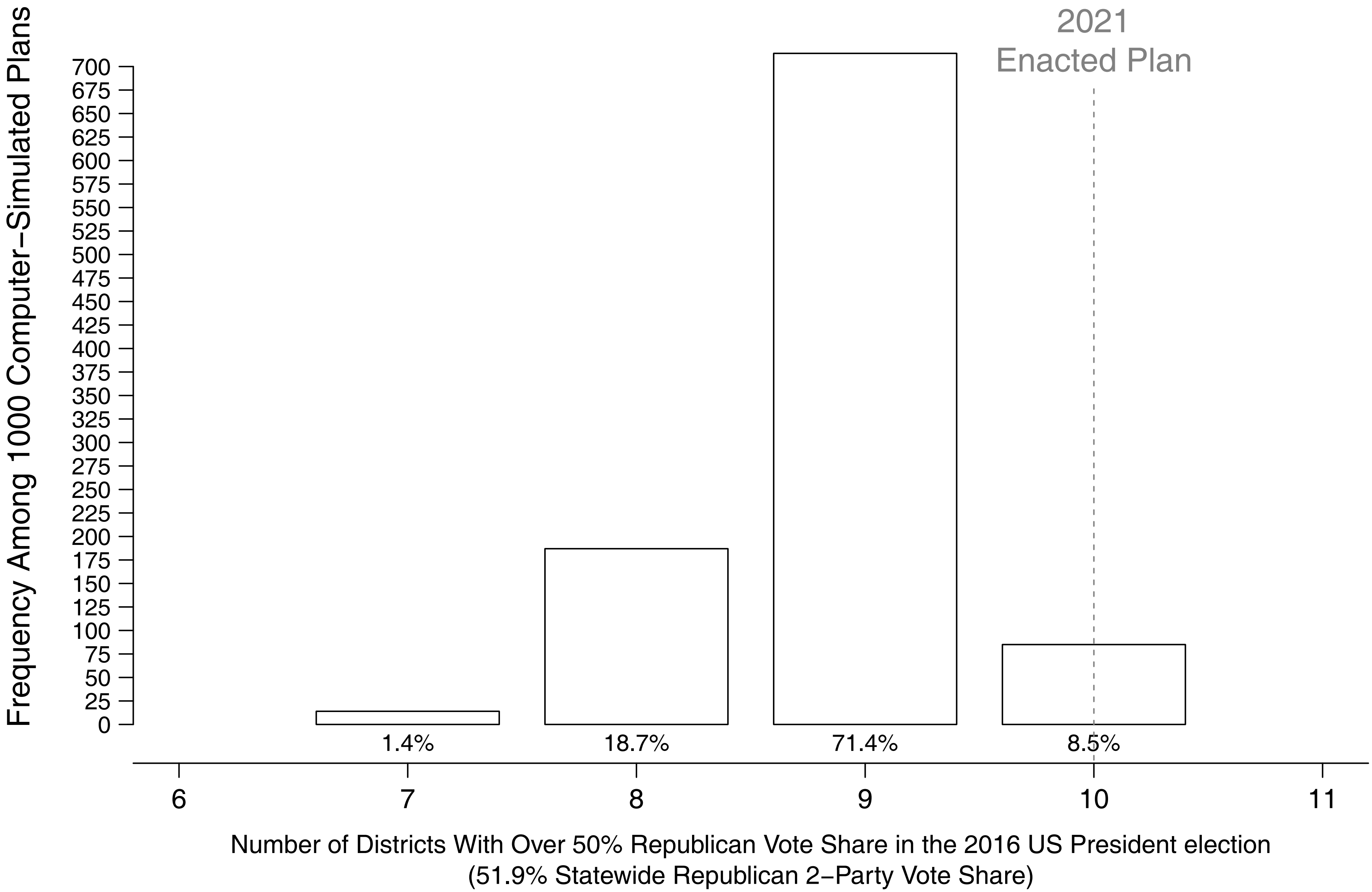


Figure B5: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 US Senator election
(53% Statewide Republican 2−Party Vote Share)

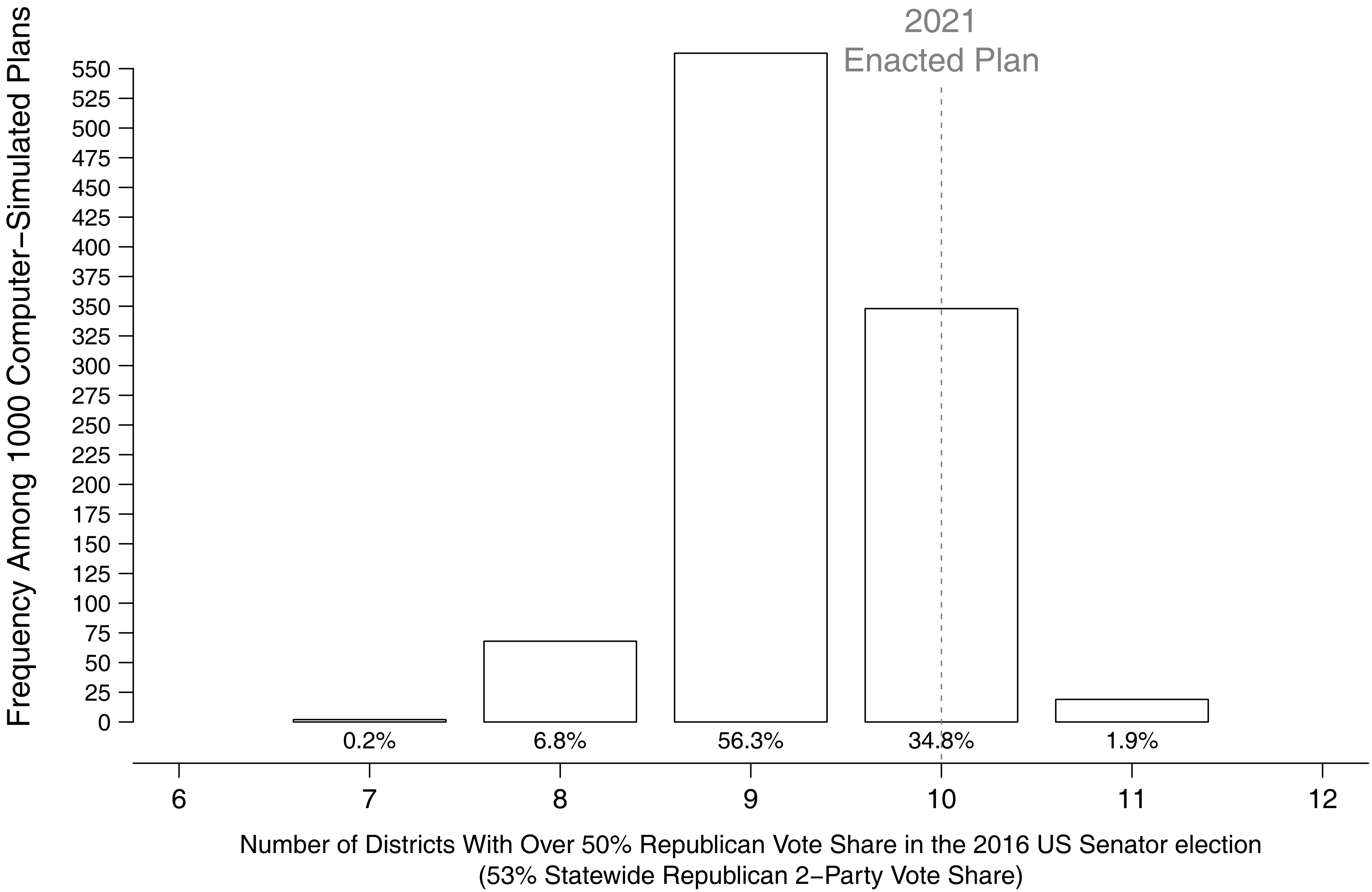


Figure B6: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 Attorney General election
(49.9% Statewide Republican 2−Party Vote Share)

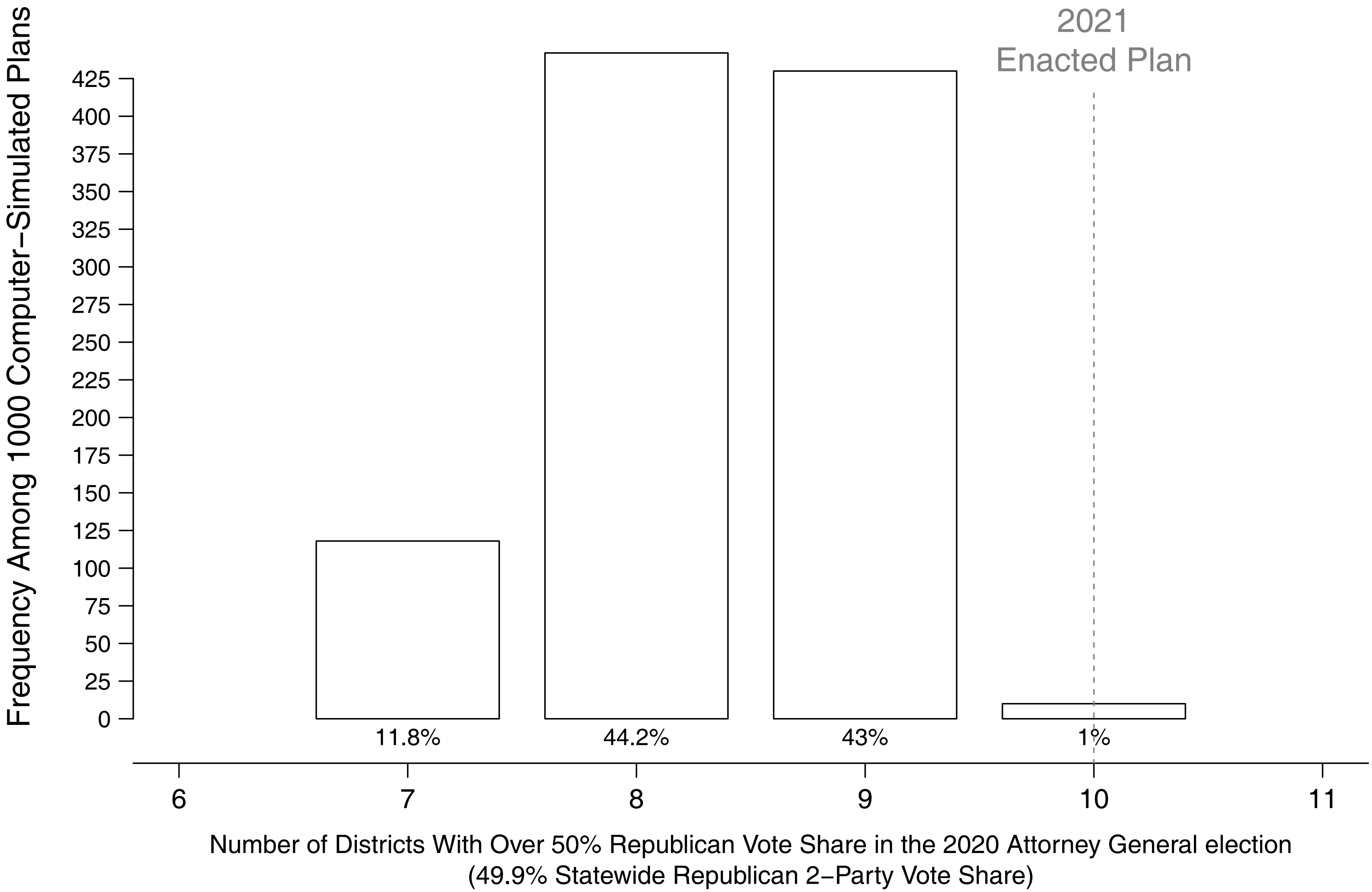


Figure B7: Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 Governor election
(47.7% Statewide Republican 2–Party Vote Share)

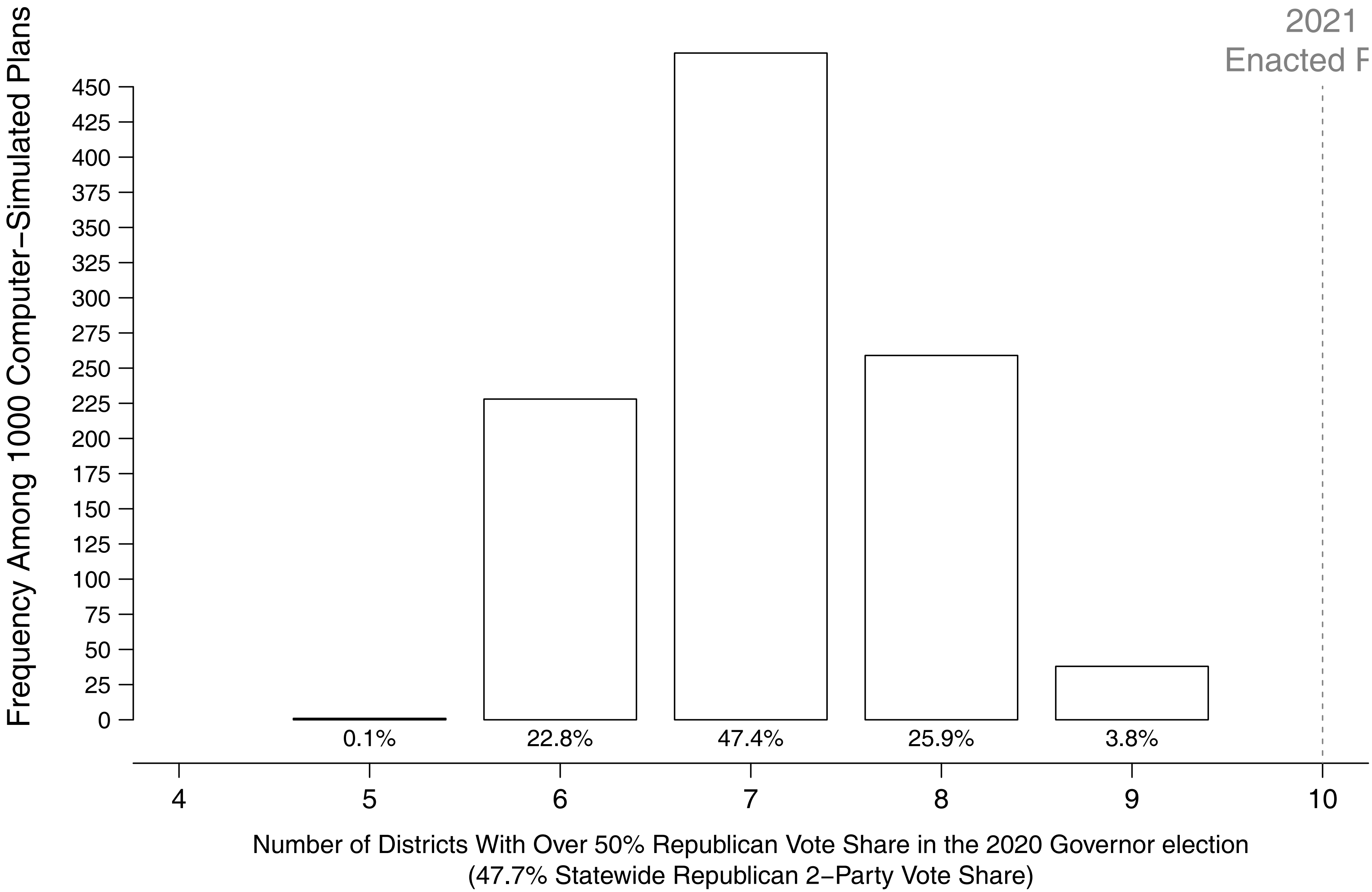


Figure B8: Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 Lieutenant Governor election
(51.6% Statewide Republican 2–Party Vote Share)

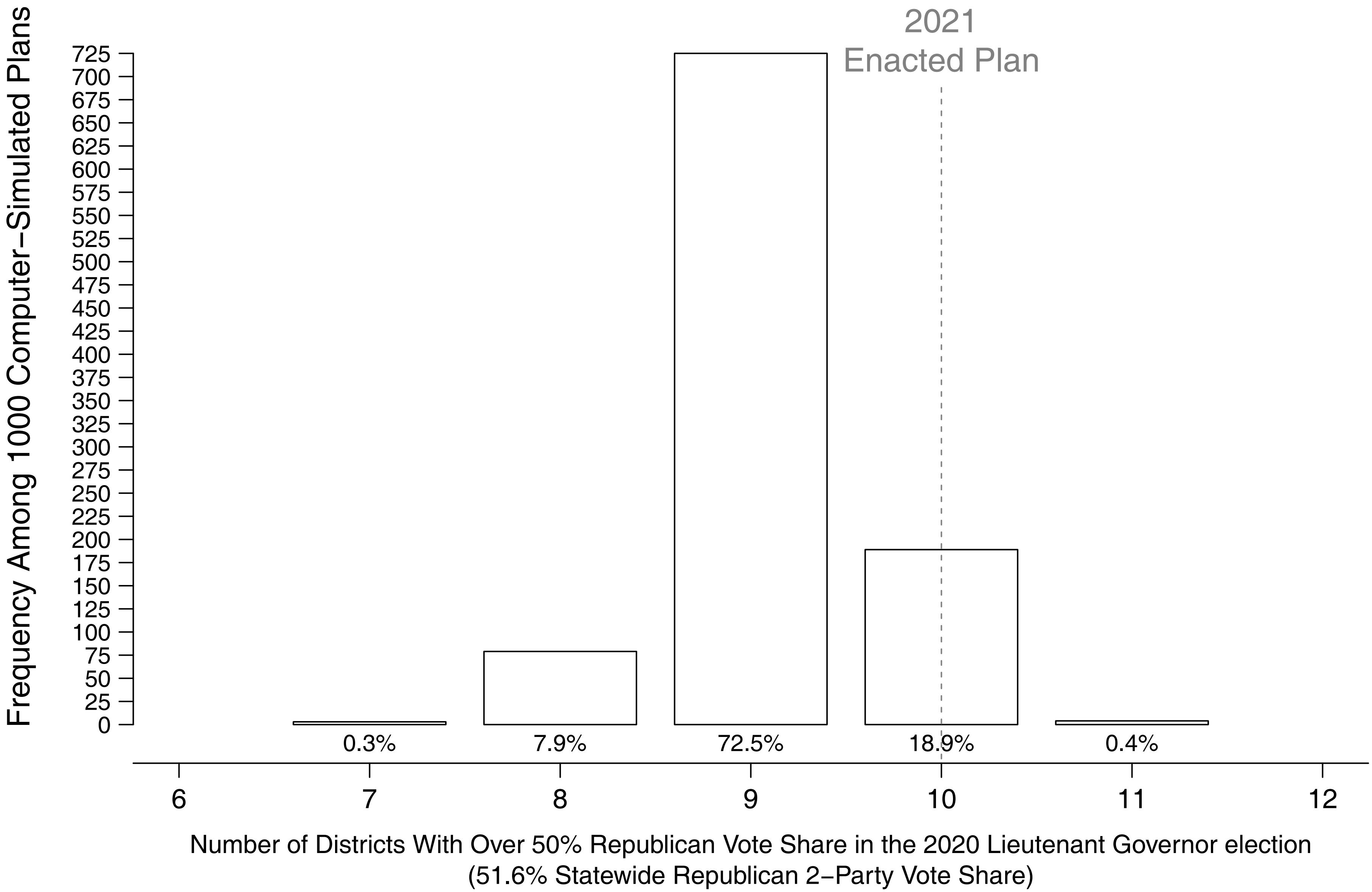


Figure B9: Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans Number of Districts With Over 50% Republican Vote Share in the 2020 US President election (50.7% Statewide Republican 2–Party Vote Share)

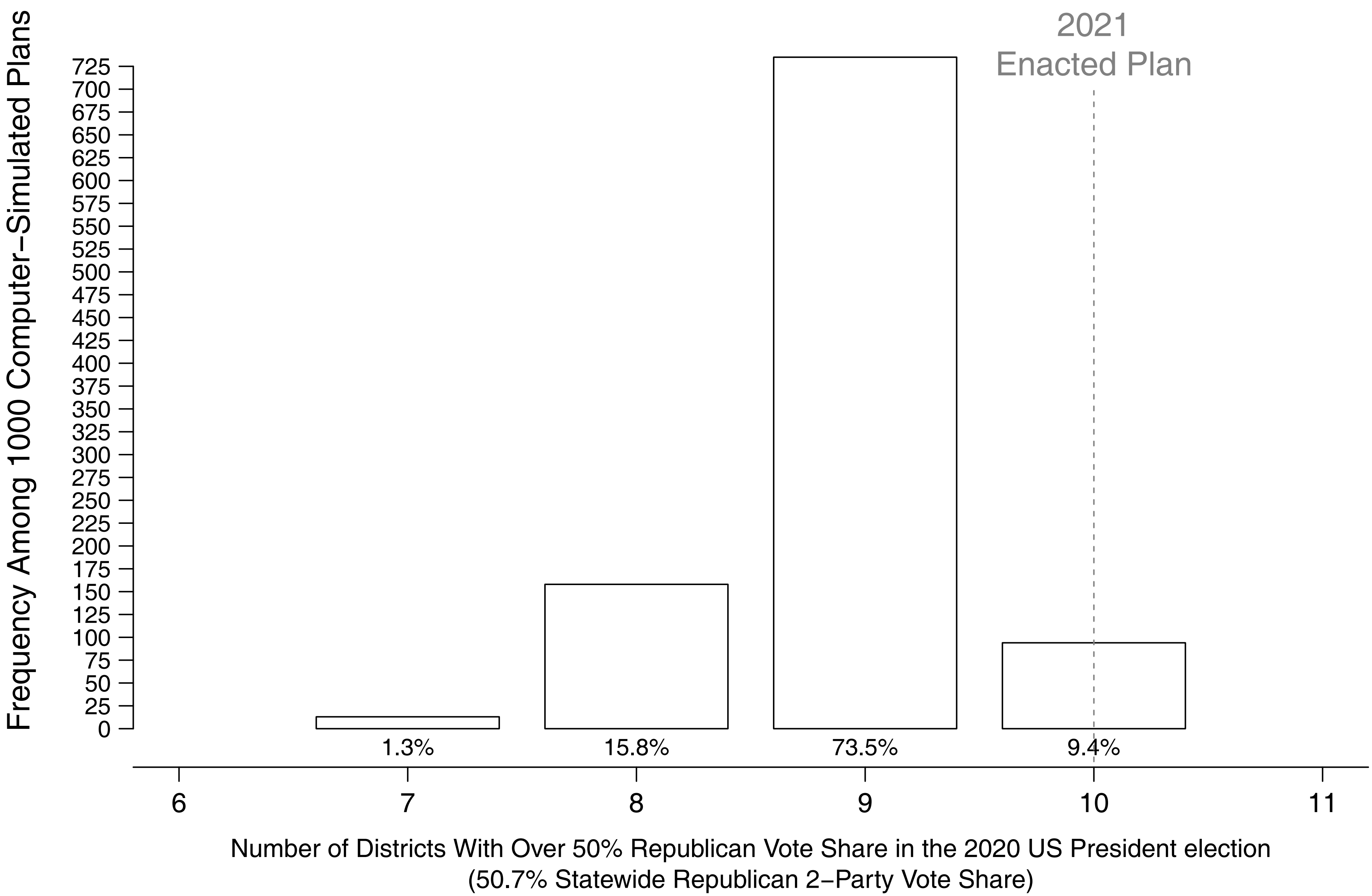
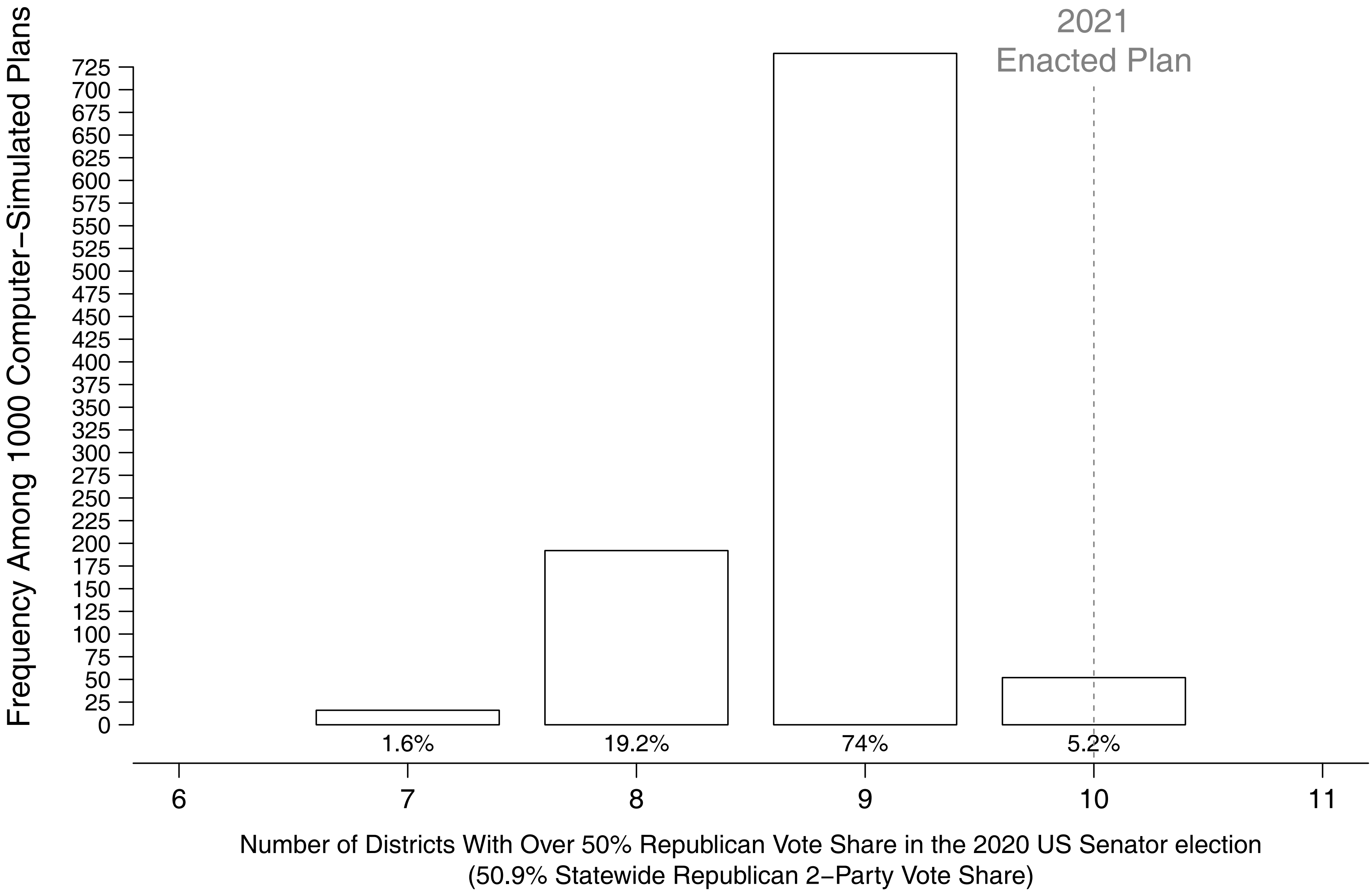


Figure B10: Comparisons of Enacted SB 740 Plan to 1,000 Computer–Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 US Senator election
(50.9% Statewide Republican 2–Party Vote Share)



– Ex. 10146 –

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
No. 21 CVS 015426
No. 21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC., *et al.*,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS SENIOR CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING, *et al.*,

Defendants.

REBECCA HARPER, *et al.*,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS SENIOR CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING, *et al.*,

Defendants.

COMMON CAUSE,

Plaintiff,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS SENIOR CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING, *et al.*,

Defendants.

EXPERT REPORT OF DR. JOWEI CHEN

NCLCV v. Hall
21 CVS 15426
LDTX153

Exhibit #
CHEN 2
12/29/2021 - JNC

I, Dr. Jowei Chen, upon my oath, declare and say as follows:

1. I am over the age of eighteen (18) and competent to testify as to the matters set forth herein.

2. I am an Associate Professor in the Department of Political Science at the University of Michigan, Ann Arbor. I am also a Research Associate Professor at the Center for Political Studies of the Institute for Social Research at the University of Michigan and a Research Associate at the Spatial Social Science Laboratory at Stanford University. In 2007, I received a M.S. in Statistics from Stanford University, and in 2009, I received a Ph.D. in Political Science from Stanford University.

3. I have published academic papers on legislative districting and political geography in several political science journals, including The American Journal of Political Science and The American Political Science Review, and Election Law Journal. My academic areas of expertise include legislative elections, spatial statistics, geographic information systems (GIS) data, redistricting, racial politics, legislatures, and political geography. I have expertise in the use of computer simulations of legislative districting and in analyzing political geography, elections, and redistricting.

4. I have authored expert reports in the following redistricting court cases: *The League of Women Voters of Florida v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2012); *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *Brown v. Detzner* (N.D. Fla. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho*

(M.D.N.C 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Harper v. Lewis* (N.C. Super. 2019); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020*); McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021). I have testified either at deposition or at trial in the following cases: *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C. 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021).

5. I have been retained by Plaintiffs in the above-captioned matter. I am being compensated $550 per hour for my work in this case.

6. Plaintiffs' counsel asked me to analyze the SB 740 districting plan for North Carolina's congressional districts (the "Enacted Plan"), as passed on November 4, 2021. Plaintiffs' counsel asked me to produce a set of computer-simulated plans for North Carolina's congressional districts by following the criteria adopted by the North Carolina General Assembly's Joint Redistricting Committee on August 12, 2021 (the "Adopted Criteria").

Plaintiffs' counsel asked me to compare the district-level partisan attributes of the Enacted Plan to those of the computer-simulated plans and to identify any districts in the Enacted Plan that are partisan outliers. Plaintiffs' counsel also asked me to compare the partisan composition of the individual Plaintiffs' congressional districts under the Enacted Plan to the partisan composition of Plaintiffs' districts under the computer-simulated plans and to identify any Plaintiffs whose Enacted Plan districts are partisan outliers.

7. The Use of Computer-Simulated Districting Plans: In conducting my academic research on legislative districting, partisan and racial gerrymandering, and electoral bias, I have developed various computer simulation programming techniques that allow me to produce a large number of nonpartisan districting plans that adhere to traditional districting criteria using US Census geographies as building blocks. This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to draw districting plans following various traditional districting goals, such as equalizing population, avoiding county and Voting Tabulation District (VTD) splits, and pursuing geographic compactness. By randomly generating a large number of districting plans that closely adhere to these traditional districting criteria, I am able to assess an enacted plan drawn by a state legislature and determine whether partisan goals motivated the legislature to deviate from these traditional districting criteria. More specifically, by holding constant the application of nonpartisan, traditional districting criteria through the simulations, I am able to determine whether the enacted plan could have been the product of something other than partisan considerations. With respect to North Carolina's 2021 Congressional Enacted Plan, I determined that it could not.

8. I produced a set of 1,000 valid computer-simulated plans for North Carolina's congressional districts using a computer algorithm programmed to strictly follow the required districting criteria enumerated in the August 12, 2021 Adopted Criteria of the General Assembly's Joint Redistricting Committee. In following these Adopted Criteria, the computer algorithm uses the same general approach that I employed in creating the simulated state House and state Senate plans that I analyzed in *Common Cause v. Lewis* (2019) and the simulated congressional plans that I used in *Harper v. Lewis* (2019).

9. By randomly drawing districting plans with a process designed to strictly follow nonpartisan districting criteria, the computer simulation process gives us an indication of the range of districting plans that plausibly and likely emerge when map-drawers are not motivated primarily by partisan goals. By comparing the Enacted Plan against the distribution of simulated plans with respect to partisan measurements, I am able to determine the extent to which a map-drawer's subordination of nonpartisan districting criteria, such as geographic compactness and preserving precinct boundaries, was motivated by partisan goals.

10. These computer simulation methods are widely used by academic scholars to analyze districting maps. For over a decade, political scientists have used such computer-simulated districting techniques to analyze the racial and partisan intent of legislative map-drawers.[1] In recent years, several courts have also relied upon computer simulations to assess partisan bias in enacted districting plans.[2]

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[1] *E.g.*, Carmen Cirincione, Thomas A. Darling, Timothy G. O'Rourke. "Assessing South Carolina's 1990s Congressional Districting," Political Geography 19 (2000) 189–211; Jowei Chen, "The Impact of Political Geography on Wisconsin Redistricting: An Analysis of Wisconsin's Act 43 Assembly Districting Plan." Election Law Journal.

[2] *See, e.g.*, *League of Women Voters of Pa. v. Commonwealth*, 178 A. 3d 737, 818-21 (Pa. 2018); *Raleigh Wake Citizens Association v. Wake County Board of Elections*, 827 F.3d 333, 344-45 (4th Cir. 2016); *City of Greensboro v. Guilford County Board of Elections*, No. 1:15-CV-599, 2017 WL 1229736 (M.D.N.C. Apr 3, 2017); *Common Cause v. Rucho*, No. 1:16-CV-1164 (M.D.N.C. Jan 11, 2018); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Common Cause v. David Lewis* (N.C. Super. 2018).

11. Redistricting Criteria: I programmed the computer algorithm to create 1,000 independent simulated plans adhering to the following seven districting criteria, as specified in the Adopted Criteria[3]:

a) Population Equality[4]: Because North Carolina's 2020 Census population was 10,439,388, districts in every 14-member congressional plan have an ideal population of 745,670.6. Accordingly, the computer simulation algorithm populated each districting plan such that precisely six districts have a population of 745,670, while the remaining eight districts have a population of 745,671.

b) Contiguity[5]: The simulation algorithm required districts to be geographically contiguous. Water contiguity is permissible. I also programmed the simulation algorithm to avoid double-traversals within a single county. In other words, for every simulated district, the portion of that district within any given county will be geographically contiguous.

c) Minimizing County Splits[6]: The simulation algorithm avoided splitting any of North Carolina's 100 counties, except when doing so is necessary to avoid violating one of the aforementioned criteria. When a county is divided into two districts, the county is considered to have one split. A county divided into three districts is considered to have two splits. A county divided into four districts is considered to have

[3] Since my November 30 report, I made the following changes to the computer simulation algorithm. First, I added additional code at the conclusion of the algorithm that checks for the occurrence of double traversals. The computer is instructed to automatically reject any simulated plan that contains a double traversal. Second, the algorithm now contains several steps that further increase the preservation of municipal boundaries, discussed further below.
[4] The Adopted Criteria state: "The number of persons in each congressional district shall be as nearly as equal as practicable, as determined under the most recent federal decennial census."
[5] The Adopted Criteria state: "No point contiguity shall be permitted in any 2021 Congressional, House, and Senate plan. Congressional, House, and Senate districts shall be compromised of contiguous territory. Contiguity by water is sufficient."
[6] The Adopted Criteria state: "Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking."

three splits, and so on. For the purpose of creating equally populated districts, each newly drawn congressional district requires only one county split. But the fourteenth and final district drawn in North Carolina does need not create an additional county split, since this final district should simply be the remaining area unassigned to the first thirteen districts. Therefore, an entire plan of 14 congressional districts requires only 13 county splits. Accordingly, I require that every simulated plan contain only 13 county splits. The 2021 Adopted Criteria do not prohibit splitting a county more than once, so I allow some of these 13 county splits to occur within the same county. As a result, the total number of counties containing one or more splits may be fewer than 13. The algorithm also follows the Adopted Criteria in that it draws a congressional district wholly within Mecklenburg and Wake counties, which each have sufficient population size to contain an entire congressional district within their boundaries.

d) Minimizing VTD Splits[7]: North Carolina is divided into 2,666 VTDs. The computer simulation algorithm attempted to keep these VTDs intact and not split them into multiple districts, except when doing so is necessary for creating equally populated districts. For the purpose of creating equally populated districts, each newly drawn congressional district requires one VTD split. But the fourteenth and final district drawn in North Carolina does need not create an additional VTD split, since this final district should simply be the remaining area unassigned to the first thirteen districts. Therefore, an entire plan of 14 congressional districts requires only 13 VTD splits. I therefore require that every simulated plan split only 13 VTDs in total.

[7] The Adopted Criteria state: "Voting districts ('VTDs') should be split only when necessary."

e) Geographic Compactness[8]: The simulation algorithm prioritized the drawing of geographically compact districts whenever doing so does not violate any of the aforementioned criteria.

f) Avoiding Incumbent Pairings: North Carolina's current congressional delegation includes two incumbents, Representatives Ted Budd and David Price, who announced before the Enacted Plan was adopted that they will not run for reelection in 2022. For the remaining eleven congressional incumbents, the simulation algorithm intentionally avoids pairing multiple incumbents in the same district. Hence, in every computer-simulated plan, each district contains no more than one incumbent's residence.

g) Municipal Boundaries[9]: The simulation algorithm generally favors not splitting municipalities. The algorithm contains several steps that favor the preservation of municipal boundaries, so long as other considerations required by the Adopted Criteria are not subordinated. To the extent that the algorithm avoids unnecessary splitting of counties, the municipalities within non-split counties are of course preserved. When the algorithm splits up a county by assigning the county's various VTDs to two different districts, the algorithm only allows one municipality to be split in this process of assigning the county's VTDs to different districts. Finally, as explained earlier, VTDs are only split when doing so is necessary for equalizing district populations. When a single VTD is split for this population equalization purpose, the algorithm attempts to split the VTD in such a way that minimizes the number of municipalities split within the VTD. In

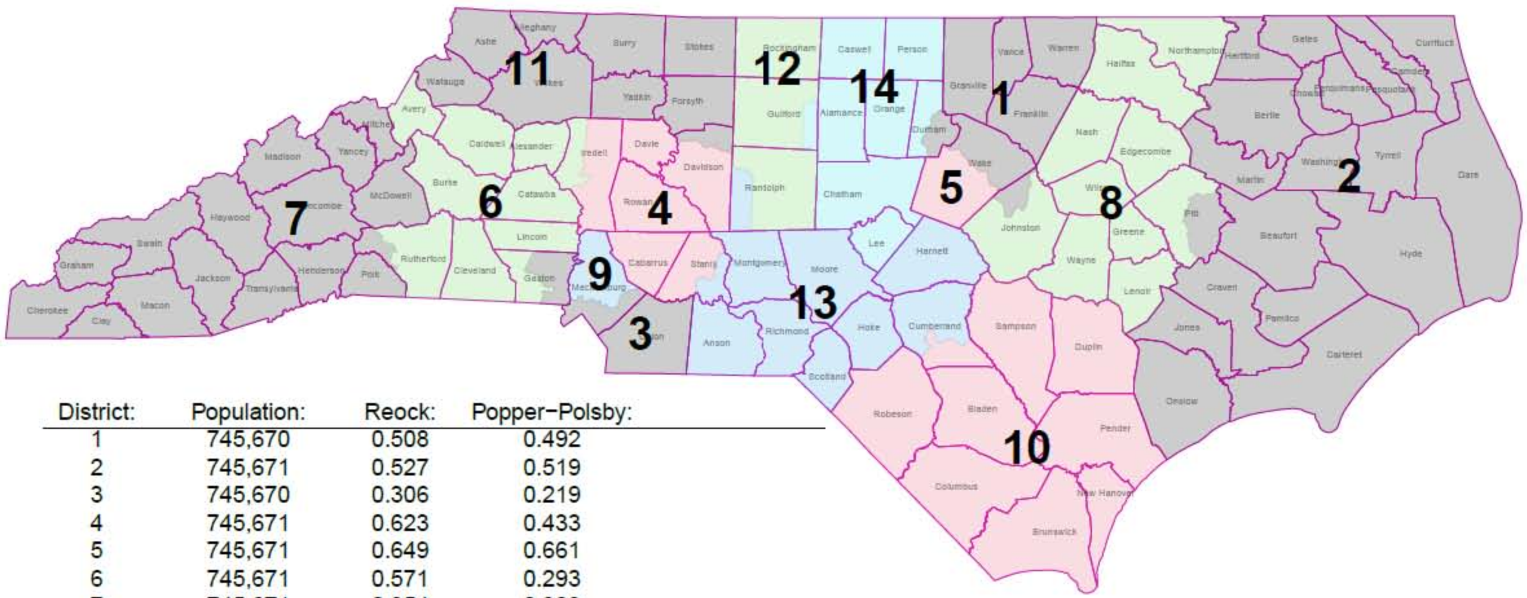
[8] The Adopted Criteria state: "The Committees shall make reasonable efforts to draw legislative districts in the 2021 Congressional, House and Senate plans that are compact."

[9] The Adopted Criteria state: "The Committees may consider municipal boundaries when drawing districts in the 2021 Congressional, House, and Senate plans."

other words, the algorithm attempts to draw the district border within the VTD without crossing municipal boundaries.

12. On the following page of this report, Map 1 displays an example of one of the computer-simulated plans produced by the computer algorithm. The lower half of this Map also reports the population of each district, the compactness scores for each district, and the county splits and VTD splits created by the plan. As with every simulated plan, this plan contains exactly 13 VTD splits and 13 county splits, with 11 counties split into two or more districts.

Map 1:
Example of a Computer−Simulated Congressional Plan Protecting all 11 Incumbents



District:	Population:	Reock:	Popper−Polsby:
1	745,670	0.508	0.492
2	745,671	0.527	0.519
3	745,670	0.306	0.219
4	745,671	0.623	0.433
5	745,671	0.649	0.661
6	745,671	0.571	0.293
7	745,671	0.354	0.303
8	745,670	0.468	0.352
9	745,670	0.576	0.405
10	745,671	0.649	0.534
11	745,670	0.377	0.424
12	745,671	0.4	0.48
13	745,671	0.46	0.301
14	745,670	0.457	0.519
Plan Average:	745,670.6	0.495	0.424

13 Split Counties:
Alamance (Districts 12, 13)
Burke (Districts 10, 3)
Davie (Districts 2, 8)
Granville (Districts 1, 14)
Hoke (Districts 13, 6)
Mecklenburg (Districts 5, 9)
Nash (Districts 1, 11)
Orange (Districts 1, 13)
Pitt (Districts 11, 7)
Rockingham (Districts 12, 2)
Rowan (Districts 10, 8)
Rutherford (Districts 3, 9)
Wake (Districts 14, 4)

13 Split VTD's:
VTD 00008N in Alamance County (Districts 12 and 13)
VTD 000053 in Burke County (Districts 10 and 3)
VTD 000011 in Davie County (Districts 2 and 8)
VTD 00TYHO in Granville County (Districts 1 and 14)
VTD 000063 in Hoke County (Districts 13 and 6)
VTD 000018 in Mecklenburg County (Districts 5 and 9)
VTD 00P09A in Nash County (Districts 1 and 11)
VTD 0000CX in Orange County (Districts 1 and 13)
VTD 001301 in Pitt County (Districts 11 and 7)
VTD 0000LI in Rockingham County (Districts 12 and 2)
VTD 000033 in Rowan County (Districts 10 and 8)
VTD 000018 in Rutherford County (Districts 3 and 9)
VTD 008−03 in Wake County (Districts 14 and 4)

The Enacted Plan's Compliance with the Adopted Criteria

13. Although all seven of the criteria listed above are part of the General Assembly's Adopted Criteria, five of these criteria are ones that the Joint Redistricting Committee "shall" or "should" follow in the process of drawing its Congressional districting plan. These five mandated criteria are equal population, contiguity, minimizing county splits, minimizing VTD splits, and geographic compactness.[10]

14. I assessed whether the 2021 Enacted Plan complies with these five mandated criteria, and I describe my findings in this section. I found that the Enacted Plan does not violate the equal population requirement, nor do any of its districts violate contiguity.

15. However, by comparing the Enacted Plan to the 1,000 computer-simulated plans, I found that the Enacted Plan fails to minimize county splits, fails to minimize VTD splits, and is significantly less geographically compact than is reasonably possible. I describe these findings below in detail.

16. ***Minimizing County Splits:*** In comparing the total number of county splits in the Enacted Plan and in the computer-simulated plans, I counted the total number of times a county is split into more than one district. Specifically, a county fully contained within a single district counts as zero splits. A county split into two full or partial districts counts as one split. And a county split into three full or partial districts counts as two splits. And so on.

17. Using this standard method of accounting for total county splits, I found that the Enacted Plan contains 14 total county splits, which are detailed in Table 1. These 14 total county splits are spread across 11 counties. Eight of these 11 counties are split only once, but Guilford,

[10] In listing these five mandated criteria, I am not including the Adopted Criteria's prohibitions on the use of racial data, partisan considerations, and election results data. I did not assess whether the Enacted Plan complies with theprohibition on racial considerations.

Mecklenburg, and Wake Counties are each split into three districts, thus accounting for two splits each. Thus, the Enacted Plan has 14 total county splits, as listed in Table 1.

Table 1: Total Number of County Splits in the 2021 Enacted Plan

	County:	Congressional Districts:	Total County Splits:
1	Davidson	7 and 10	1
2	Guilford	7, 10, and 11	2
3	Harnett	4 and 7	1
4	Iredell	10 and 12	1
5	Mecklenburg	8, 9, and 13	2
6	Onslow	1 and 3	1
7	Pitt	1 and 2	1
8	Robeson	3 and 8	1
9	Wake	5, 6, and 7	2
10	Watauga	11 and 14	1
11	Wayne	2 and 4	1
Total County Splits:			**14**

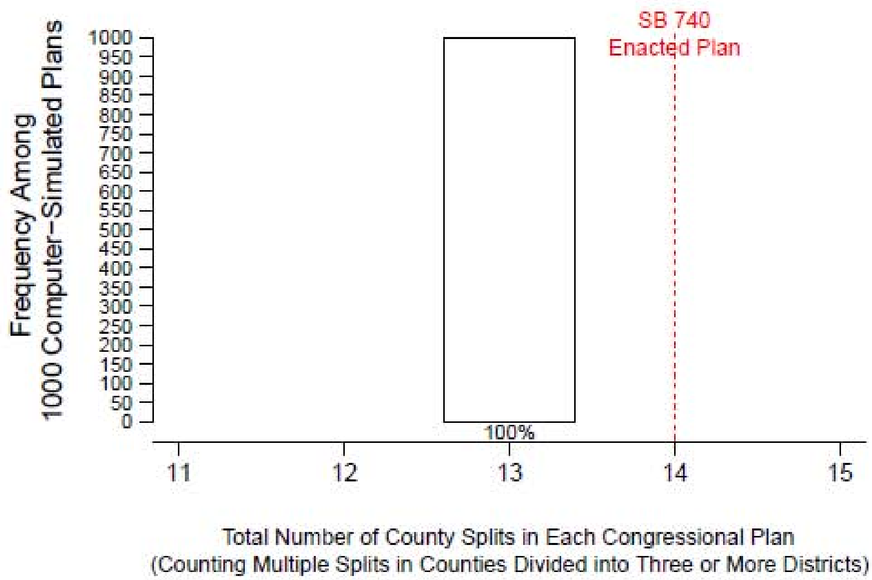
As explained in the previous section, a congressional plan in North Carolina needs to contain only 13 county splits if the map-drawer is attempting to minimize the splitting of counties. The Enacted Plan's 14 county splits is therefore one more split than is necessary. This "extra" split is specifically found at the border between District 7 and District 10. In general, the border between any two congressional districts in North Carolina needs to split only one county, at most. But in the Enacted Plan, the border between Districts 7 and 10 creates two county splits: One split of Davidson County and one split of Guilford County. Creating two county splits of Davidson and Guilford Counties was not necessary for equalizing district populations. Nor was it necessary for protecting incumbents, as no incumbents reside in the portions of Davidson and Guilford Counties within District 7 and District 10. Hence, the "extra" county split in Davidson and Guilford Counties does not appear to be consistent with the 2021 Adopted Criteria, which mandate that "Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking."

18. Indeed, I found that the computer simulation algorithm was always able to draw districts complying with the Adopted Criteria without using an "extra" 14th county split. As the upper half of Figure 1 illustrates, all 1,000 computer-simulated plans contain exactly 13 county splits. The Enacted Plan clearly contains more county splits than one would expect from a map-drawing process complying with the Adopted Criteria. Therefore, I conclude that the Enacted Plan does not comply with the Adopted Criteria's rule against unnecessary division of counties.

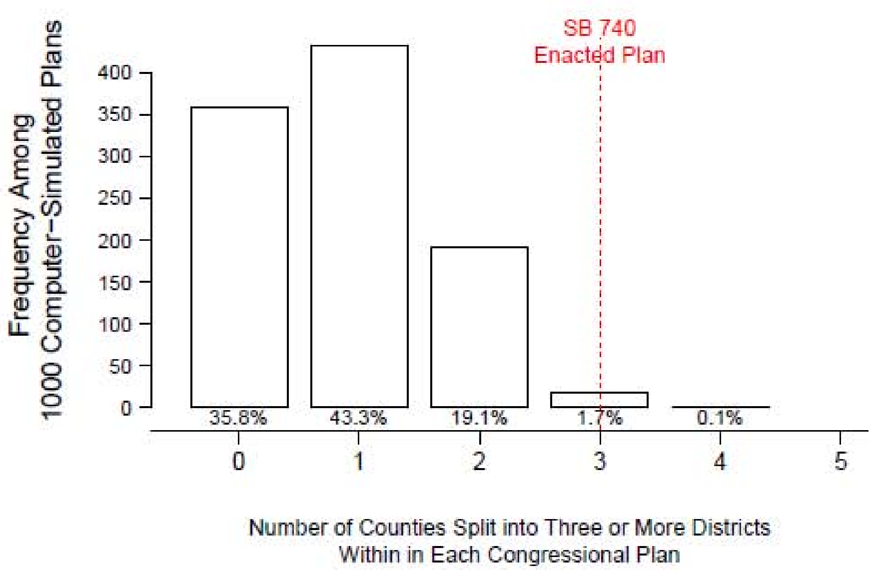
19. The Adopted Criteria do not explicitly limit the number of county splits within any single county. Nevertheless, it is notable that under the Enacted Plan, three different counties (Guilford, Mecklenburg, and Wake) are split multiple times. These three counties are each split into three districts under the Enacted Plan. This is an outcome that rarely occurs under the computer-simulated plans. As the lower half of Figure 1 illustrates, only 1.8% of the computer-simulated plans similarly split three or more counties multiple times. Thus, it is clear that the Enacted Plan's level of concentrating multiple county splits within a single county is an outcome that generally does not occur in a vast majority of the simulated plans drawn according to the Adopted Criteria. Additionally, not once in the small number of simulated plans that split at least three counties three ways are Guilford, Mecklenburg, and Wake Counties all split multiple times.

Figure 1:

Comparison of Total County Splits in Enacted SB 740 Plan and 1,000 Computer–Simulated Plans



Number of Counties Split Multiple Times in Enacted SB 740 Plan and 1,000 Computer–Simulated Plans



21. **Minimizing VTD Splits:** The Adopted Criteria mandates that "Voting districts ('VTDs') should be split only when necessary." As explained earlier in this report, each newly drawn congressional district needs to create only one VTD split for the purpose of equalizing the district's population. But the fourteenth and final district drawn in North Carolina does need not create an additional VTD split, since this final district should simply be the remaining area unassigned to the first 13 districts. Therefore, an entire plan of 14 congressional districts needs to create only 13 VTD splits.

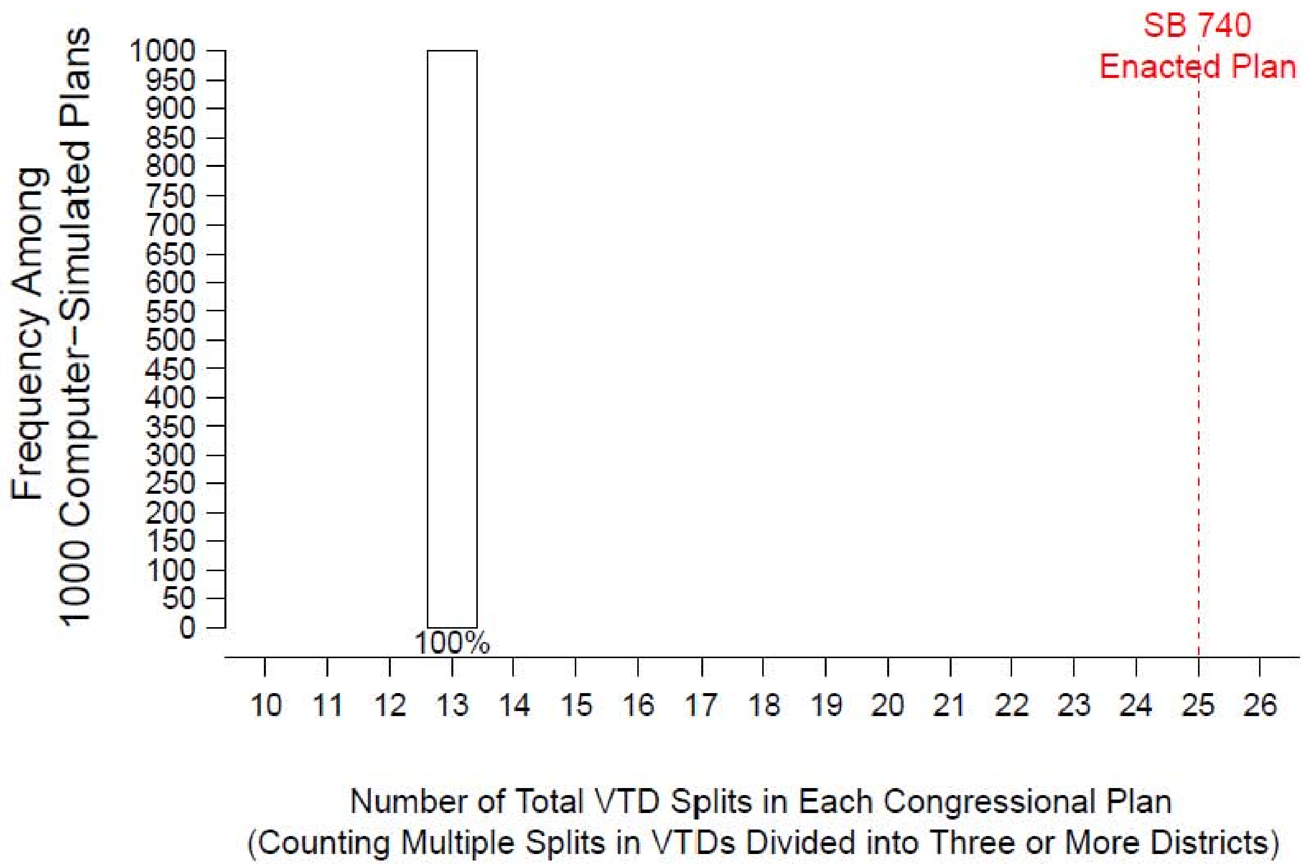
22. However, the Enacted Plan creates far more VTD splits than is necessary. As the General Assembly's "StatPack" Report[11] for the Enacted SB 740 Plan details, the Enacted Plan splits 24 VTDs into multiple districts. Among these 24 split VTDs, 23 VTDs are split into two districts, while one VTD (Wake County VTD 18-02) is split into three districts. Thus, using the same method of accounting for splits described earlier, the Enacted Plan contains 25 total VTD splits, and 24 VTDs are split into two or more districts.

23. The Enacted Plan's 25 total VTD splits is far more than is necessary to comply with the Adopted Criteria' equal population requirement. As explained earlier, only 13 VTD splits are necessary in order to produce an equally populated congressional plan in North Carolina. Thus, as Figure 2 illustrates, every one of the 1,000 computer-simulated plans contains exactly 13 VTD splits, and the Enacted Plan's 25 total VTD splits is clearly not consistent with the Adopted Criteria's requirement that "Voting districts ('VTDs') should be split only when necessary."

[11] Available at: https://webservices.ncleg.gov/ViewBillDocument/2021/53447/0/SL%202021-174%20-%20StatPack%20Report.

Figure 2:

Comparison of Total VTD Splits in Enacted SB 740 Plan and 1,000 Computer−Simulated Plans



24. ***Measuring Geographic Compactness***: The August 12, 2021 Adopted Criteria mandates that the Joint Redistricting Committee "shall" attempt to draw geographically compact congressional districts. The Adopted Criteria also specify two commonly used measures of district compactness: the Reock score and the Polsby-Popper score.

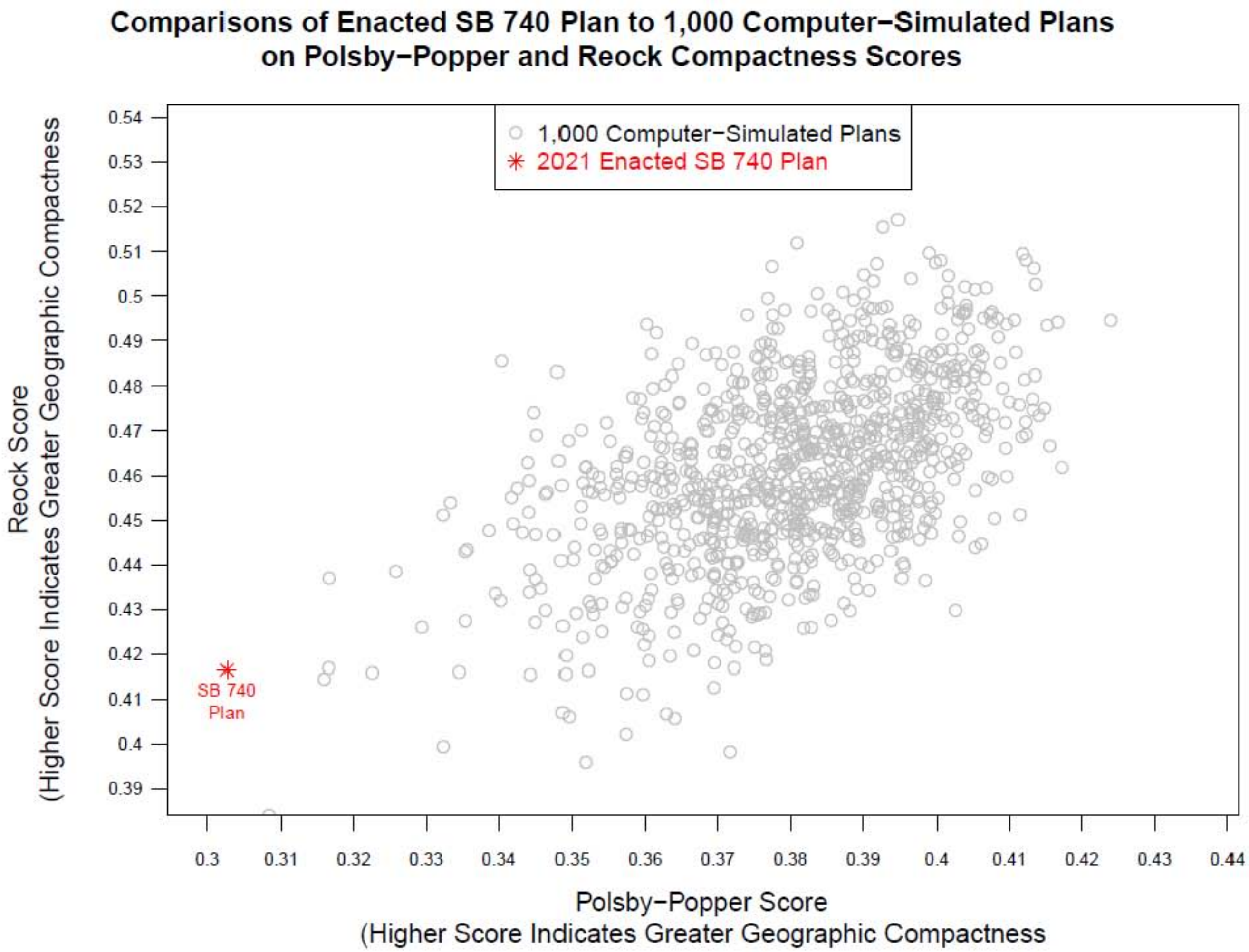
25. In evaluating whether the Enacted Plan follows the compactness requirement of the Adopted Criteria, it is useful to compare the compactness of the Enacted Plan and the 1,000 computer-simulated plans. The computer-simulated plans were produced by a computer algorithm adhering strictly to the traditional districting criteria mandated by the Adopted Criteria and ignoring any partisan or racial considerations. Thus, the compactness scores of these computer-simulated plans illustrate the statistical range of compactness scores that could be reasonably expected to emerge from a districting process that solely seeks to follow the Adopted Criteria while ignoring partisan and racial considerations. I therefore compare the compactness of the simulated plans and the Enacted Plan using the two measures of compactness specified by the 2021 Adopted Criteria.

26. First, I calculate the average Polsby-Popper score of each plan's districts. The Polsby-Popper score for each individual district is calculated as the ratio of the district's area to the area of a hypothetical circle whose circumference is identical to the length of the district's perimeter; thus, higher Polsby-Popper scores indicate greater district compactness. The 2021 Enacted Plan has an average Polsby-Popper score of 0.3026 across its 14 congressional districts. As illustrated in Figure 3, every single one of the 1,000 computer-simulated House plans in this report exhibits a higher Polsby-Popper score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Polsby-Popper score ranging from 0.37 to 0.39, and the most compact computer-simulated plan has a Polsby-Popper score of 0.42. Hence,

it is clear that the Enacted Plan is significantly less compact, as measured by its Polsby-Popper score, than what could reasonably have been expected from a districting process adhering to the Adopted Criteria.

27. Second, I calculate the average Reock score of the districts within each plan. The Reock score for each individual district is calculated as the ratio of the district's area to the area of the smallest bounding circle that can be drawn to completely contain the district; thus, higher Reock scores indicate more geographically compact districts. The 2021 Enacted Plan has an average Reock score of 0.4165 across its 14 congressional districts. As illustrated in Figure 3, 98.2% of the 1,000 computer-simulated plans exhibit a higher Reock score than the Enacted Plan. In fact, the middle 50% of these 1,000 computer-simulated plans have an average Reock score ranging from 0.45 to 0.46, and the most compact computer-simulated plan has an average Reock score of 0.52. Hence, it is clear that the Enacted Plan is significantly less compact, as measured by its Reock score, than what could reasonably have been expected from a districting process adhering to the Adopted Criteria.

Figure 3:


Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
on Polsby−Popper and Reock Compactness Scores
1,000 Computer−Simulated Plans
2021 Enacted SB 740 Plan
SB 740
Plan
Reock Score
(Higher Score Indicates Greater Geographic Compactness
0.54
0.53
0.52
0.51
0.5
0.49
0.48
0.47
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0.39
0.3
0.31
0.32
0.33
0.34
0.35
0.36
0.37
0.38
0.39
0.4
0.41
0.42
0.43
0.44
Polsby−Popper Score
(Higher Score Indicates Greater Geographic Compactness

Measuring the Partisanship of Districting Plans

28. In general, I use actual election results from recent, statewide election races in North Carolina to assess the partisan performance of the Enacted Plan and the computer-simulated plans analyzed in this report. Overlaying these past election results onto a districting plan enables me to calculate the Republican (or Democratic) share of the votes cast from within each district in the Enacted Plan and in each simulated plan. I am also able to count the total number of Republican and Democratic-leaning districts within each simulated plan and within the Enacted Plan. All of these calculations thus allow me to directly compare the partisanship of the Enacted Plan and the simulated plans. These partisan comparisons allow me to determine whether or not the partisanship of individual districts and the partisan distribution of seats in the Enacted Plan could reasonably have arisen from a districting process adhering to the Adopted Criteria and its explicit prohibition on partisan considerations. Past voting history in federal and statewide elections is a strong predictor of future voting history. Mapmakers thus can and do use past voting history to identify the class of voters, at a precinct-by-precinct level, who are likely to vote for Republican or Democratic congressional candidates.

29. In the 2011, 2016, and 2017 rounds of state legislative and congressional redistricting last decade, the North Carolina General Assembly publicly disclosed that it was relying solely on recent statewide elections in measuring the partisanship of the districting plans being created. I therefore follow the General Assembly's past practice from last decade by using results from a similar set of recent statewide elections in order to measure the partisanship of districts in the Enacted Plan and in the computer-simulated plans.

30. ***The 2016-2020 Statewide Election Composite:*** During the General Assembly's 2017 legislative redistricting process, Representative David Lewis announced at the Joint Redistricting Committee's August 10, 2017 meeting that the General Assembly would measure

the partisanship of legislative districts using the results from some of the most recent elections held in North Carolina for the following five offices: US President, US Senator, Governor, Lieutenant Governor, and Attorney General.

31. To measure the partisanship of all districts in the computer-simulated plans and the 2021 Enacted Plan, I used the two most-recent election contests held in North Carolina for these same five offices during 2016-2020. In other words, I used the results of the following ten elections: 2016 US President, 2016 US Senator, 2016 Governor, 2016 Lieutenant Governor, 2016 Attorney General, 2020 US President, 2020 US Senator, 2020 Governor, 2020 Lieutenant Governor, and 2020 Attorney General. I use these election results because these are the same state and federal offices whose election results were used by the General Assembly during its 2017 legislative redistricting process, and the 2017 redistricting process was the most recent one in which the leadership of the General Assembly's redistricting committees publicly announced how the General Assembly would evaluate the partisanship of its own districting plans.

32. I obtained precinct-level results for these ten elections, and I disaggregated these election results down to the census block level. I then aggregated these block-level election results to the district level within each computer-simulated plan and the Enacted Plan, and I calculated the number of districts within each plan that cast more votes for Republican than Democratic candidates. I use these calculations to measure the partisan performance of each simulated plan analyzed in this report and of the Enacted Plan. In other words, I look at the census blocks that would comprise a particular district in a given simulation and, using the actual election results from those census blocks, I calculate whether voters in that simulated district collectively cast more votes for Republican or Democratic candidates in the 2016-2020 statewide election contests. I performed such calculations for each district under each simulated plan to

measure the number of districts Democrats or Republicans would win under that particular simulated districting map.

33. I refer to the aggregated election results from these ten statewide elections as the "2016-2020 Statewide Election Composite." For the Enacted Plan districts and for all districts in each of the 1,000 computer-simulated plans, I calculate the percentage of total two-party votes across these ten elections that were cast in favor of Republican candidates in order to measure the average Republican vote share of the district. In the following section, I present district-level comparisons of the Enacted Plan and simulated plan districts in order to identify whether any individual districts in the Enacted Plan are partisan outliers. I also present plan-wide comparisons of the Enacted Plan and the simulated plans in order to identify the extent to which the Enacted Plan is a statistical outlier in terms of common measures of districting plan partisanship.

District-Level and Plan-Wide Partisan Comparisons of the Enacted Plan and Simulated Plans

34. In this section, I present partisan comparisons of the Enacted Plan to the computer-simulated plans at both a district-by-district level as well as a plan-wide level using several common measures of districting plan partisanship. First, I compare the district-level Republican vote share of the Enacted Plan's districts and the districts in the computer-simulatedplans. Next, I compare the number of Republican-favoring districts in the Enacted Plan and in the computer-simulated plans. Finally, I use several common measures of partisan bias to compare the Enacted Plan to the computer-simulated plans. Overall, I find that the several individual districts in the Enacted Plan are statistical outliers, exhibiting extreme partisan characteristics that are rarely or never observed in the computer-simulated plan districts drawn with strict adherence to the Adopted Criteria. Moreover, I find that at the plan-wide level, the

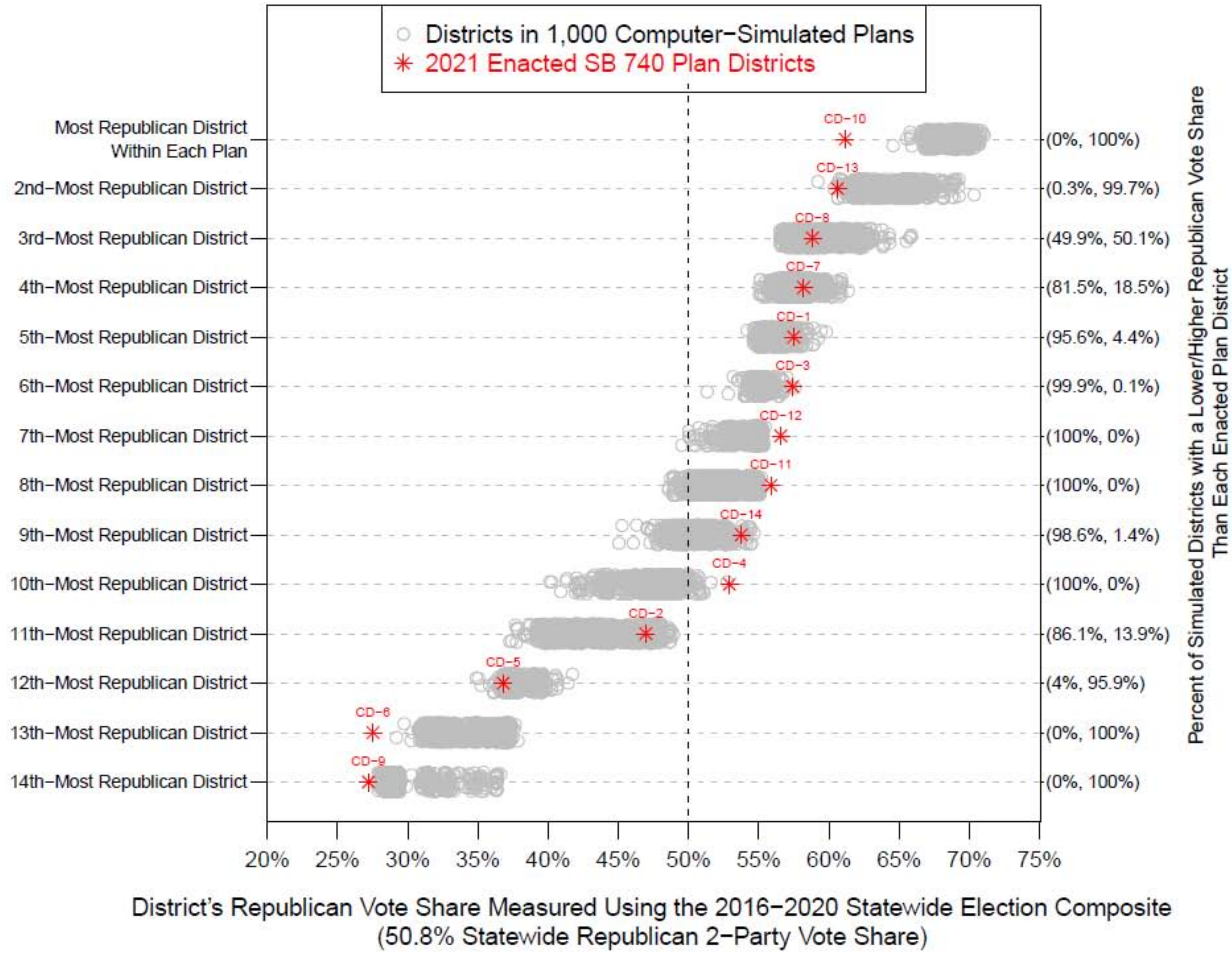
Enacted Plan creates a degree of partisan bias favoring Republicans that is more extreme than the vast majority of the computer-simulated plans. I describe these findings in detail below:

35. ***Partisan Outlier Districts in the Enacted Plan***: In Figure 4, I directly compare the partisan distribution of districts in the Enacted Plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the Enacted Plan's districts from the most to theleast-Republican district, as measured by Republican vote share using the 2016-2020 Statewide Election Composite. The most-Republican district appears on the top row, and the least- Republican district appears on the bottom row of Figure 4. Next, I analyze each of the 1,000 computer-simulated plans and similarly order each simulated plan's districts from the most- to the least-Republican district. I then directly compare the most-Republican Enacted Plan district (CD-10) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In other words, I compare one district from the Enacted Plan to 1,000 computer-simulated

districts, and I compare these districts based on their Republican vote share. I then directly compare the second-most-Republican district in the Enacted Plan to the second-most-Republican district from each of the 1,000 simulated plans. I conduct the same comparison for each district in the Enacted Plan, comparing the Enacted Plan district to its computer-simulated counterparts from each of the 1,000 simulated plans.

Figure 4:

Comparisons of Enacted SB 740 Plan Districts to 1,000 Computer−Simulated Plans' Districts



36. Thus, the top row of Figure 4 directly compares the partisanship of the most-Republican Enacted Plan district (CD-10) to the partisanship of the most-Republican district from each of the 1,000 simulated plans. The two percentages (in parentheses) in the right margin of this Figure report the percentage of these 1,000 simulated districts that are less Republican than, and more Republican than, the Enacted Plan district. Similarly, the second row of this Figure compares the second-most-Republican district from each plan, the third row compares the third-most-Republican district from each plan, and so on. In each row of this Figure, the Enacted Plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row.

37. As the bottom row of Figure 4 illustrates, the most-Democratic district in the Enacted Plan (CD-9) is more heavily Democratic than 100% of the most-Democratic districts in each of the 1,000 computer-simulated plans. This calculation is numerically reported in the right margin of the Figure. Every single one of the computer-simulated counterpart districts would have been more politically moderate than CD-9 in terms of partisanship: CD-9 exhibits a Republican vote share of 27.2%, while all 1,000 of the most-Democratic districts in the computer-simulated plans would have exhibited a higher Republican vote share and would therefore have been more politically moderate. It is thus clear that CD-9 packs together Democratic voters to a more extreme extent than the most-Democratic district in 100% of the computer-simulated plans. I therefore identify CD-9 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

38. The next-to-bottom row of Figure 4 reveals a similar finding regarding CD-6 in the Enacted Plan. This row illustrates that the second-most-Democratic district in the Enacted

Plan (CD-6) is more heavily Democratic than 100% of the second-most-Democratic districts in each of the 1,000 computer-simulated plans. Every single one of its computer-simulated counterpart districts would have been more politically moderate than CD-6 in terms of partisanship: CD-6 exhibits a Republican vote share of 27.5%, while 100% of the second-most-Democratic districts in the computer-simulated plans would have exhibited a higher Republican vote share and would therefore have been more politically moderate. In other words, CD-6 packs together Democratic voters to a more extreme extent than the second-most-Democratic district in 100% of the computer-simulated plans. I therefore identify CD-6 as an extreme partisan outlier when compared to its 1,000 computer-simulated counterparts, using a standard threshold test of 95% for statistical significance.

39. Meanwhile, the top two rows of Figure 4 reveal a similar finding: As the top row illustrates, the most-Republican district in the Enacted Plan (CD-10) is less heavily Republican than 100% of the most-Republican districts in each of the 1,000 computer-simulated plans. A similar pattern appears in the second-to-top row of Figure 4, which illustrates that the second-most-Republican district in the Enacted Plan (CD-13) is less heavily Republican than 99.7% of the second-most-Republican districts in each of the 1,000 computer-simulated plans.

40. It is especially notable that these four aforementioned Enacted Plan districts – the two most Republican districts (CD-10 and CD-13) and the two most Democratic districts (CD-9 and CD-6) in the Enacted Plan – were drawn to include more Democratic voters than virtually allof their counterpart districts in the 1,000 computer-simulated plans. These "extra" Democratic voters in the four most partisan-extreme districts in the Enacted Plan had to come from the remaining ten more moderate districts in the Enacted Plan. Having fewer Democratic voters in these more moderate districts enhances Republican candidate performance in these districts.

41. Indeed, the middle six rows in Figure 4 (i.e., rows 5 through 10) confirm this precise effect. The middle six rows in Figure 4 compare the partisanship of districts in the fifth, sixth, seventh, eighth, ninth, and tenth-most Republican districts within the Enacted Plan and the 1,000 computer-simulated plans. In all six of these rows, the Enacted Plan district is a partisan outlier. In each of these six rows, the Enacted Plan's district is more heavily Republican than over 95% of its counterpart districts in the 1,000 computer-simulated plans. Three of these six rows illustrate Enacted Plan districts that are more heavily Republican than 100% of their counterpart districts in the computer-simulated plans. The six Enacted Plan districts in these six middle rows (CD-1, 3, 4, 11, 12, and 14) are more heavily Republican than nearly all of their counterpart computer-simulated plan districts because the four most partisan-extreme districts inthe Enacted Plan (CD-6, 9, 10, and 13) are more heavily Democratic than nearly all of their counterpart districts in the computer-simulated plans.

42. I therefore identify the six Enacted Plan districts in the six middle rows (CD-1, 3,4, 11, 12, and 14) of Figure 4 as partisan statistical outliers. Each of these six districts has a Republican vote share that is higher than over 95% of the computer-simulated districts in its respective row in Figure 4. I also identify the four Enacted Plan districts in the top rows and the bottom two rows (CD-6, 9, 10, and 13) of Figure 4 as partisan statistical outliers. Each of these four districts has a Republican vote share that is lower than at least 99.7% of the computer-simulated districts in its respective row in Figure 4.

43. In summary, Figure 4 illustrates that 10 of the 14 districts in the Enacted Plan are partisan outliers: Six districts (CD-1, 3, 4, 11, 12, and 14) in the Enacted Plan are more heavily Republican than over 95% of their counterpart computer-simulated plan districts, while four

districts (CD-6, 9, 10, and 13) are more heavily Democratic than at least 99.7% of their counterpart districts in the computer-simulated plans.

44. The Appendix of this report contains ten additional Figures (Figures A1 through A10) that each contain a similar analysis of the Enacted Plan districts and the computer- simulated plan districts. Each of these ten Figures in the Appendix measures the partisanship ofdistricts using one of the individual ten elections included in the 2016-2020 Statewide ElectionComposite. These ten Figures generally demonstrate that the same extreme partisan outlier patterns observed in Figure 4 are also present when district partisanship is measured using any one of the ten statewide elections held in North Carolina during 2016-2020.

45. ***"Mid-Range" Republican Districts:*** Collectively, the upper ten rows in Figure 4 illustrate that the Enacted Plan's ten most-Republican districts exhibit a significantly narrower range of partisanship than is exhibited by the ten most-Republican districts in each of the computer-simulated plans. Specifically, the Enacted Plan's ten most-Republican districts all have Republican vote shares within the narrow range of 52.9% to 61.2%. As explained earlier, this narrow range is the product of two distinct dynamics: In the top two rows of Figure 4, the Enacted Plan's districts are significantly less Republican than nearly all of the simulated plans' districts in these rows. But in the fifth to tenth rows of Figure 4, the Enacted Plan's districts are more safely Republican-leaning than over 95% of the computer-simulated districts within each of these six rows. The overall result of these two distinct dynamics is that the Enacted Plan contains ten districts that all have Republican vote shares within the narrow range of 52.9% to 61.2%. I label any districts within this narrow range of partisanship as "mid-range" Republican-leaning districts, reflecting the fact that these districts have generally favored Republican candidates, but not by overwhelmingly large margins.

46. Is the Enacted Plan's creation of ten such "mid-range" Republican-leaning districts an outcome that ever occurs in the 1,000 computer-simulated plans? I analyzed the simulated plans and counted the number of districts within each plan that are similarly "mid- range" with a Republican vote share between 52.9% and 61.2%. As Figure 5 illustrates, the Enacted Plan's creation of ten "mid-range" Republican districts is an extreme statistical outlier. None of the 1,000 simulated plans comes close to creating ten such districts. Virtually all of the simulated plans contain from two to six "mid-range" Republican districts, and the most commonoutcome among the simulations is four such districts. Hence, the Enacted Plan is clearly an extreme partisan outlier in terms of its peculiar focus on maximizing the number of "mid-range"Republican districts, and the Enacted Plan did so to an extreme degree far beyond any of the 1,000 simulated plans created using a partisan-blind computer algorithm that follows the Adopted Criteria.

47. ***Competitive Districts:*** The Enacted Plan's maximization of "mid-range" Republican districts necessarily comes at the expense of creating more competitive districts. As Figure 4 illustrates, the Enacted Plan contains zero districts whose Republican vote share is higher than 47.0% and lower than 52.9%, as measured using the 2016-2020 Statewide ElectionComposite. In other words, there are zero districts in which the Republican vote share is within5% of the Democratic vote share.

48. I label districts with a Republican vote share from 47.5% to 52.5% as "competitive" districts to reflect the fact that such districts have a nearly even share of Republican and Democratic voters, and election outcomes in the district could therefore swing in favor of either party. The Enacted Plan contains zero "competitive" districts, as measured using the 2016-2020 Statewide Election Composite.

Figure 5:
Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans On Number of Mid−Range Republican Districts

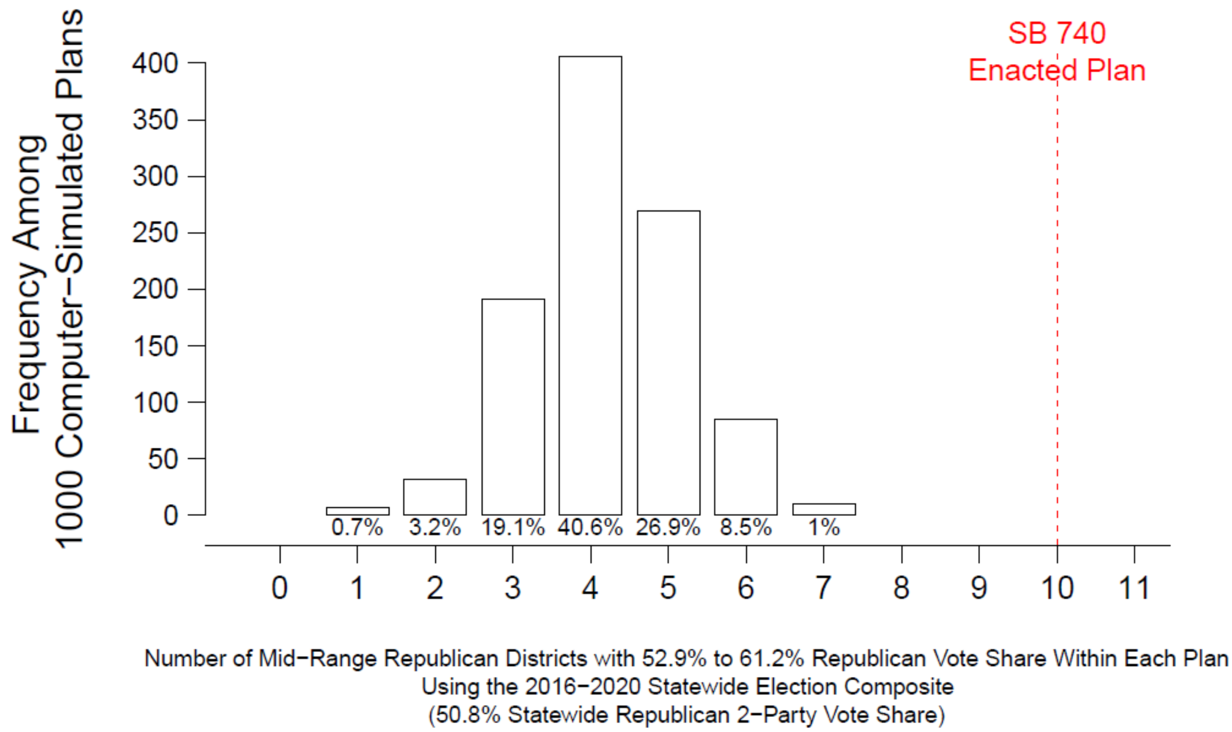
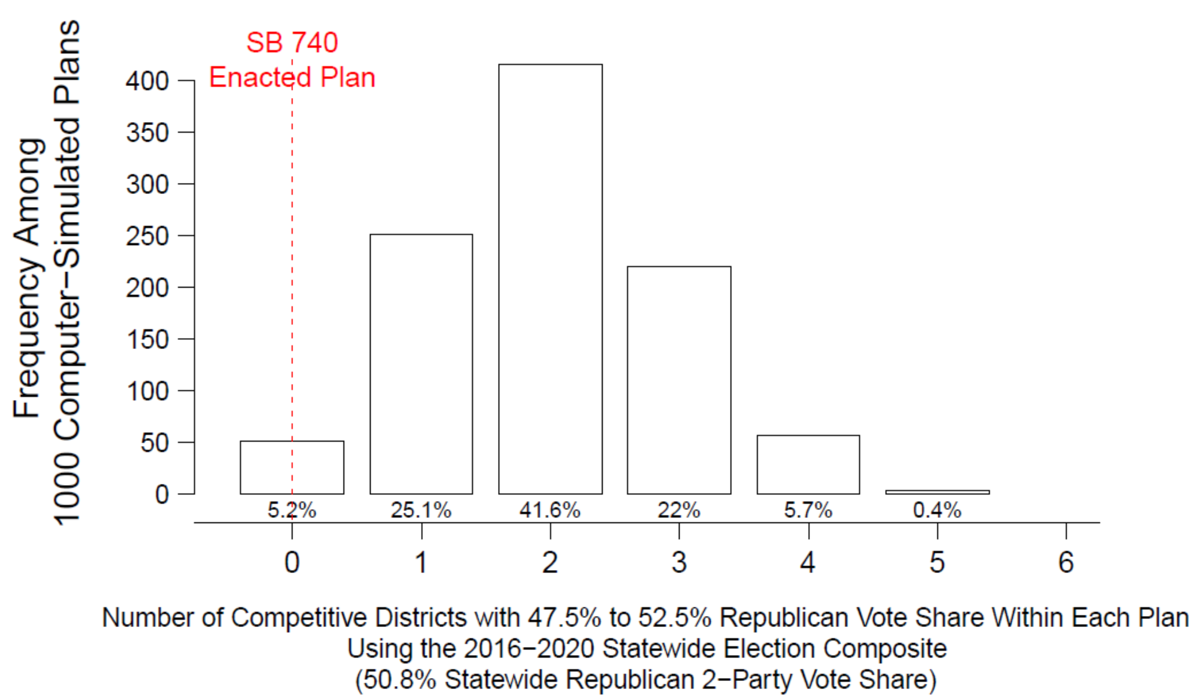


Figure 6:
Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans On Number of Competitive Districts



49. Is the Enacted Plan's failure to create any "competitive" districts an outcome that ever occurs in the 1,000 computer-simulated plans? I analyzed the simulated plans and counted the number of districts within each plan that are "competitive" districts with a Republican vote share between 47.5% and 52.5%. As Figure 6 illustrates, the Enacted Plan's creation of zero "competitive" districts is almost a statistical outlier: Only 5.2% of the 1,000 simulated plans similarly fail to have a single "competitive" district. The vast majority of the computer-simulated plans contain two or more "competitive" districts. Almost 95% of the computer-simulated plans create more "competitive" districts than the Enacted Plan does.

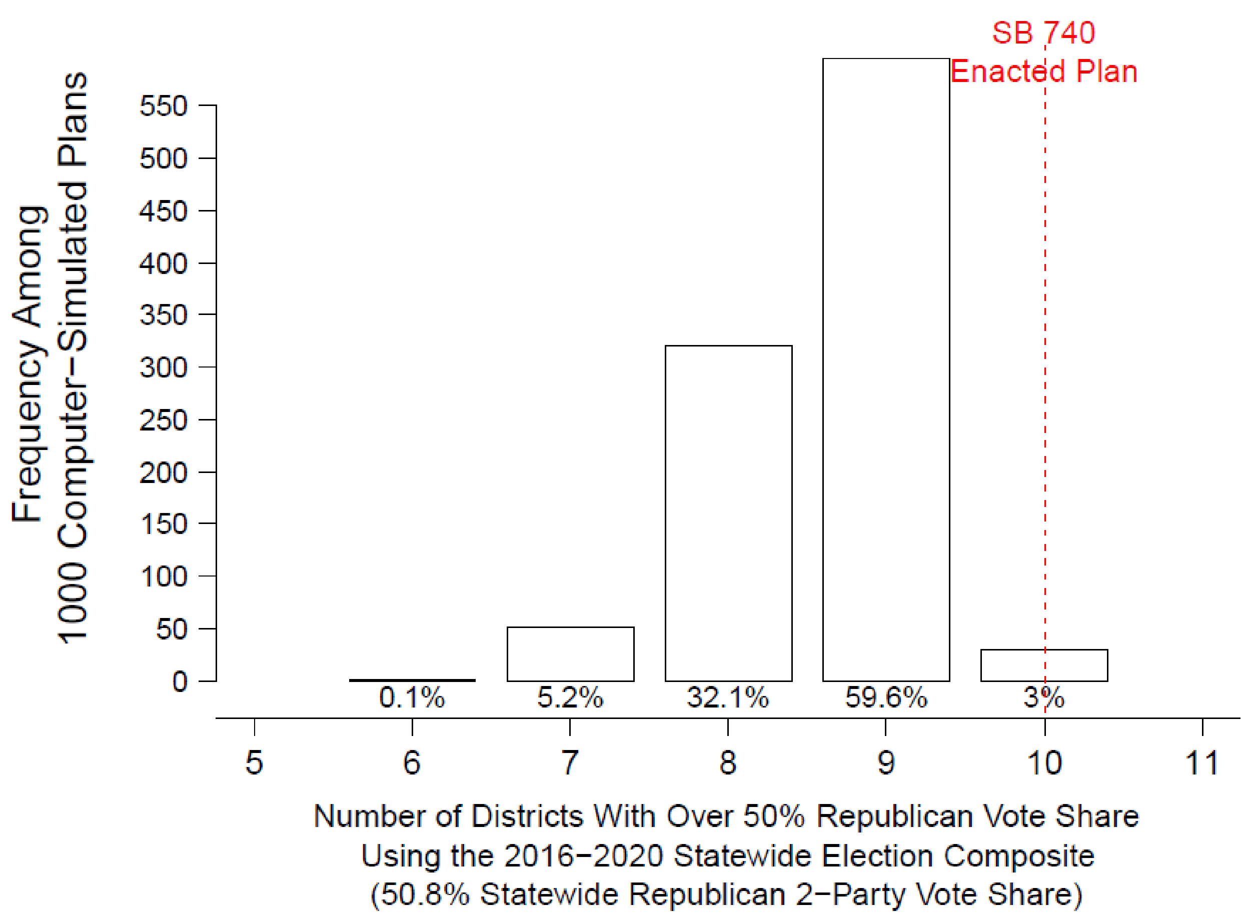
50. ***Number of Democratic and Republican Districts:*** Figure 7 compares the partisan breakdown of the computer-simulated plans to the partisanship of the Enacted Plan. Specifically, Figure 7 uses the 2016-2020 Statewide Election Composite to measure the number of Republican-favoring districts created in each of the 1,000 simulated plans. Across the entire state, Republican candidates collectively won a 50.8% share of the votes in the ten elections in the 2016-2020 Statewide Election Composite. But within the 14 districts in the Enacted Plan, Republicans have over a 50% vote share in 10 out of 14 districts. In other words, the Enacted Plan created 10 Republican-favoring districts, as measured using the 2016-2020 Statewide Election Composite. By contrast, only 3% of the computer-simulated plans create 10 Republican-favoring districts, and no computer-simulated plan ever creates more than 10 Republican districts.

51. Hence, in terms of the total number of Republican-favoring districts created by the plan, the 2021 Enacted Plan is a statistical outlier when compared to the 1,000 computer- simulated plans. The Enacted Plan creates the maximum number of Republican districts that everoccurs in any computer-simulated plan, and the Enacted Plan creates more Republican districts

than 97% of the computer-simulated plans, which were drawn using a non-partisan districting process adhering to the General Assembly's 2021 Adopted Criteria. I characterize the Enacted Plan's creation of 10 Republican districts as a statistical outlier among the computer-simulated plans because the Enacted Plan exhibits an outcome that is more favorable to Republicans than over 95% of the simulated plans.

Figure 7:

Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans



52. Notably, the ten elections included in the Statewide Election Composite all occurred in two election years and in electoral environments that were relatively favorable to Republicans across the country (November 2016 and November 2020). North Carolina did not hold any statewide elections for non-judicial offices in November 2018, which was an electoral environment more favorable to Democrats across the country.

53. Hence, the projected number of Republican seats would be even lower in the computer-simulated plans if one measured district partisanship using a statewide election whose outcome was more partisan-balanced or even favorable to Democrats. In the Appendix, I presentten histograms (labeled as Figures B1 to B10), each presenting the projected number of Republican seats across all of the simulated plans and the Enacted Plan using only one of the tenelections in the Statewide Election Composite.

54. The ten histograms in Figures B1 to B10 illustrate how the partisanship of the Enacted Plan compares to the partisanship of the 1,000 computer-simulated plans under a range of different electoral environments, as reflected by the ten elections in the Statewide Election Composite. Most notably, under all ten of these elections, the Enacted Plan always contains exactly 10 Republican-favoring districts and 4 Democrat-favoring districts. Hence, it is clear thatthe Enacted Plan creates a 10-to-4 distribution of seats in favor of Republican candidates that is durable across a range of different electoral conditions.

55. Moreover, the histograms in Figures B1 to B10 demonstrate that the Enacted Plan becomes a more extreme partisan outlier relative to the computer-simulated plans under electoral conditions that are slightly to moderately favorable to the Democratic candidate. For example, Figure B1 compares the Enacted Plan to the computer-simulated plan using the results of the 2016 Attorney General election, which was a near-tied statewide contest in which Democrat Josh

Stein defeated Republican Buck Newton by a very slim margin. Using the 2016 Attorney General election to measure district partisanship, the 2021 Enacted Plan contains 10 Republican-favoring districts out of 14. The Enacted Plan's creation of 10 districts favoring Republican BuckNewton over Democrat Josh Stein is an outcome that never occurs in the 1,000 computer-simulated plans, indicating that the Enacted Plan is a partisan statistical outlier under electoral conditions that are more favorable for Democrats (and thus relatively more unfavorable for Republicans) than is normal in North Carolina.

56. An even more favorable election for the Democratic candidate was the 2020 gubernatorial contest, in which Democrat Roy Cooper defeated Republican Dan Forest by a 4.5% margin. Figure B7 compares the Enacted Plan to the computer-simulated plans using the resultsof this 2020 gubernatorial election. Using the results from this election, the 2021 Enacted Plan contains 10 Republican-favoring districts out of 14. None of the 1,000 simulated plans ever contain 10 districts favoring the Republican candidate. The Enacted Plan's creation of 10 Republican-favoring districts is therefore an extreme partisan outlier that is durable even in Democratic-favorable electoral conditions. In fact, the 10-to-4 Republican partisan advantage under the Enacted Plan appears to become even more of an extreme partisan outlier under Democratic-favorable elections.

57. ***The Mean-Median Difference:*** I also calculate each districting plan's mean-median difference, which is another accepted method that redistricting scholars commonly use to compare the relative partisan bias of different districting plans. The mean-median difference for any given plan is calculated as the mean district-level Republican vote share, minus the median district-level Republican vote share. For any congressional districting plan, the mean is calculated as the average of the Republican vote shares in each of the 14 districts. The median, in

turn, is the Republican vote share in the district where Republican performed the middle-best, which is the district that Republican would need to win to secure a majority of the congressional delegation. For a congressional plan containing 14 districts, the median district is calculated as the average of the Republican vote share in the districts where Republican performed the 7th and8th-best across the state.

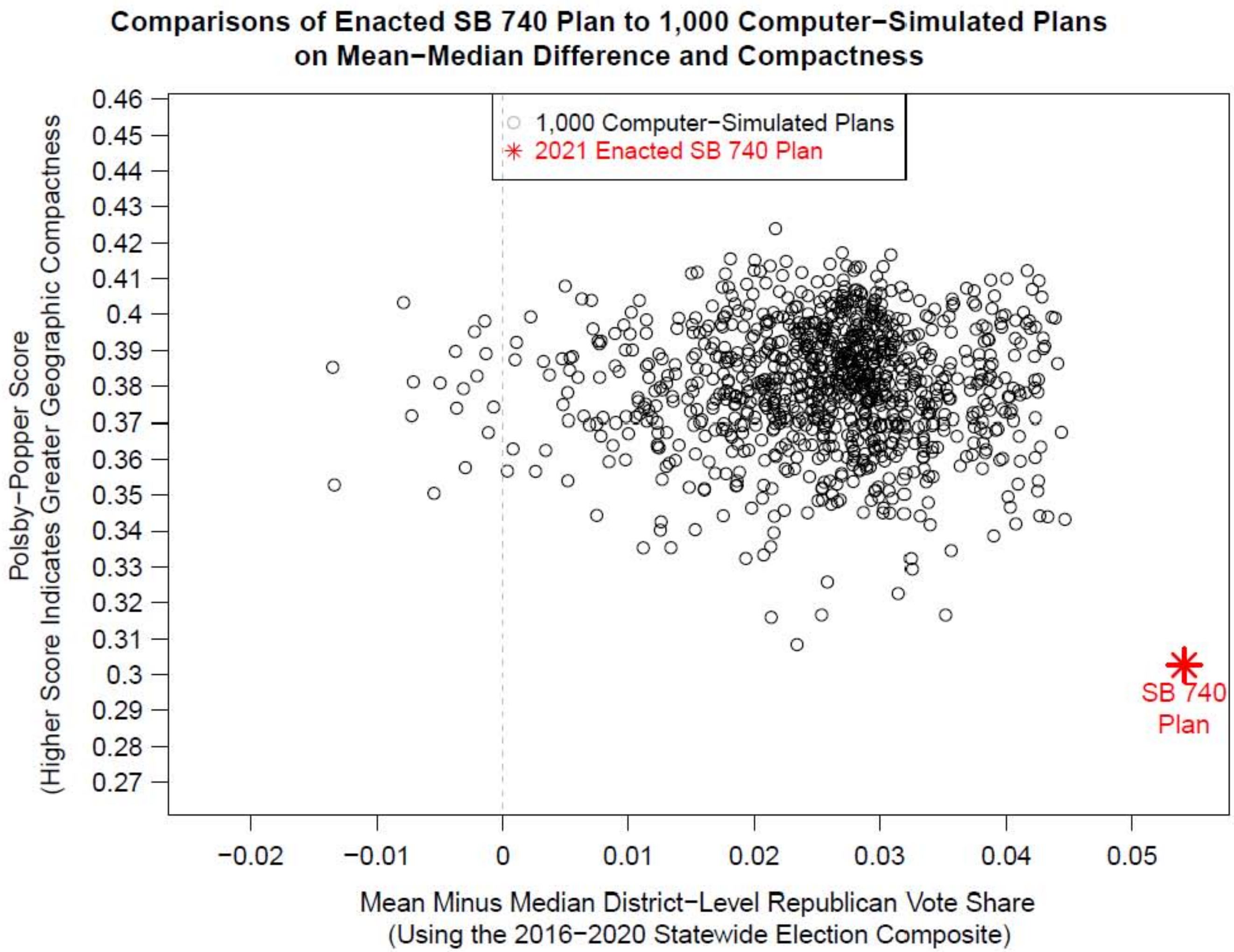
58. Using the 2016-2020 Statewide Election Composite to measure partisanship, the districts in the 2021 Enacted Plan have a mean Republican vote share of 50.8%, while the median district has a Republican vote share of 56.2%. Thus, the Enacted Plan has a mean-mediandifference of +5.4%, indicating that the median district is skewed significantly more Republican than the plan's average district. The mean-median difference thus indicates that the Enacted Plandistributes voters across districts in such a way that most districts are significantly more Republican-leaning than the average North Carolina congressional district, while Democratic voters are more heavily concentrated in a minority of the Enacted Plan's districts.

59. I perform this same mean-median difference calculation on all computer-simulated plans in order to determine whether this partisan skew in the median congressional districts could have resulted naturally from North Carolina's political geography and the application of the Adopted Criteria. Figure 8 compares the mean-median difference of the Enacted Plan to the mean-median difference for each the 1,000 computer-simulated plans.

60. Figure 8 contains 1,000 gray circles, representing the 1,000 computer-simulated plans, as well as a red star, representing the 2021 Enacted Plan. The horizontal axis in this Figure measures the mean-median difference of the 2021 Enacted Plan and each simulated plan using the 2016-2020 Statewide Election Composite, while the vertical axis measures the average Polsby-Popper compactness score of the districts within each plan, with higher Polsby-Popper

scores indicating more compact districts. Figure 8 illustrates that the Enacted Plan's mean-median difference is +5.4%, indicating that the median district is skewed significantly more Republican than the plan's average district. Figure 8 further indicates that this difference is an extreme statistical outlier compared to the 1,000 computer-simulated plans. Indeed, the Enacted Plan's +5.4% mean-median difference is an outcome never observed across these 1,000 simulated plans. The 1,000 simulated plans all exhibit mean-median differences that range from -0.1% to +4.6%. In fact, the middle 50% of these computer-simulated plans have mean-median differences ranging from +2.1% to +3.1%, indicating a much smaller degree of skew in the median district than occurs under the 2021 Enacted Plan. These results confirm that the Enacted Plan creates an extreme partisan outcome that cannot be explained by North Carolina's voter geography or by strict adherence to the required districting criteria set forth in the General Assembly's Adopted Criteria.

Figure 8:


Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
on Mean−Median Difference and Compactness
1,000 Computer−Simulated Plans
2021 Enacted SB 740 Plan
Polsby−Popper Score
(Higher Score Indicates Greater Geographic Compactness
0.46
0.45
0.44
0.43
0.42
0.41
0.4
0.39
0.38
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0.35
0.34
0.33
0.32
0.31
0.3
0.29
0.28
0.27
SB 740
Plan
−0.02
−0.01
0
0.01
0.02
0.03
0.04
0.05
Mean Minus Median District−Level Republican Vote Share
(Using the 2016−2020 Statewide Election Composite)

61. Figure 8 illustrates that the Enacted Plan is less geographically compact than every single one of the computer-simulated plans, as measured by each plan's average Polsby-Popper score. The simulated plans have Polsby-Popper scores ranging from 0.31 to 0.42. In fact, the middle 50% of these computer-simulated plans have Polsby-Popper scores ranging from 0.37 to 0.39. Meanwhile, the Enacted Plan exhibits a Polsby-Popper score of only 0.30, which is lower than all 1,000 of the computer-simulated plans. Hence, it is clear that the Enacted Plan did not seek to draw districts that were as geographically compact as reasonably possible. Instead, the Enacted Plan subordinated geographic compactness, which enabled the Enacted Plan to create a partisan skew in North Carolina's congressional districts favoring Republican candidates.

62. ***The Efficiency Gap:*** Another commonly used measure of a districting plan's partisan bias is the efficiency gap.[12] To calculate the efficiency gap of the Enacted Plan and every computer-simulated plan, I first measure the number of Republican and Democratic votes within each Enacted Plan district and each computer-simulated district, as measured using the 2016- 2020 Statewide Election Composite. Using this measure of district-level partisanship, I then calculate each districting plan's efficiency gap using the method outlined in *Partisan Gerrymandering and the Efficiency Gap.*[13] Districts are classified as Democratic victories if, using the 2016-2020 Statewide Election Composite, the sum total of Democratic votes in the district during these elections exceeds the sum total of Republican votes; otherwise, the district is classified as Republican. For each party, I then calculate the total sum of surplus votes in districts the party won and lost votes in districts where the party lost. Specifically, in a district lost by a

[12] Eric McGhee, "Measuring Partisan Bias in Single-Member District Electoral Systems." Legislative Studies Quarterly Vol. 39, No. 1: 55–85 (2014).
[13] Nicholas O. Stephanopoulos & Eric M. McGhee, *Partisan Gerrymandering and the Efficiency Gap*, 82 University of Chicago Law Review 831 (2015).

given party, all of the party's votes are considered lost votes; in a district won by a party, only the party's votes exceeding the 50% threshold necessary for victory are considered surplus votes. A party's total wasted votes for an entire districting plan is the sum of its surplus votes in districts won by the party and its lost votes in districts lost by the party. The efficiency gap is then calculated as total wasted Democratic votes minus total wasted Republican votes, divided by the total number of two-party votes cast statewide across all seven elections.

63. Thus, the theoretical importance of the efficiency gap is that it tells us the degree to which more Democratic or Republican votes are wasted across an entire districting plan. A significantly positive efficiency gap indicates far more Democratic wasted votes, while a significantly negative efficiency gap indicates far more Republican wasted votes.

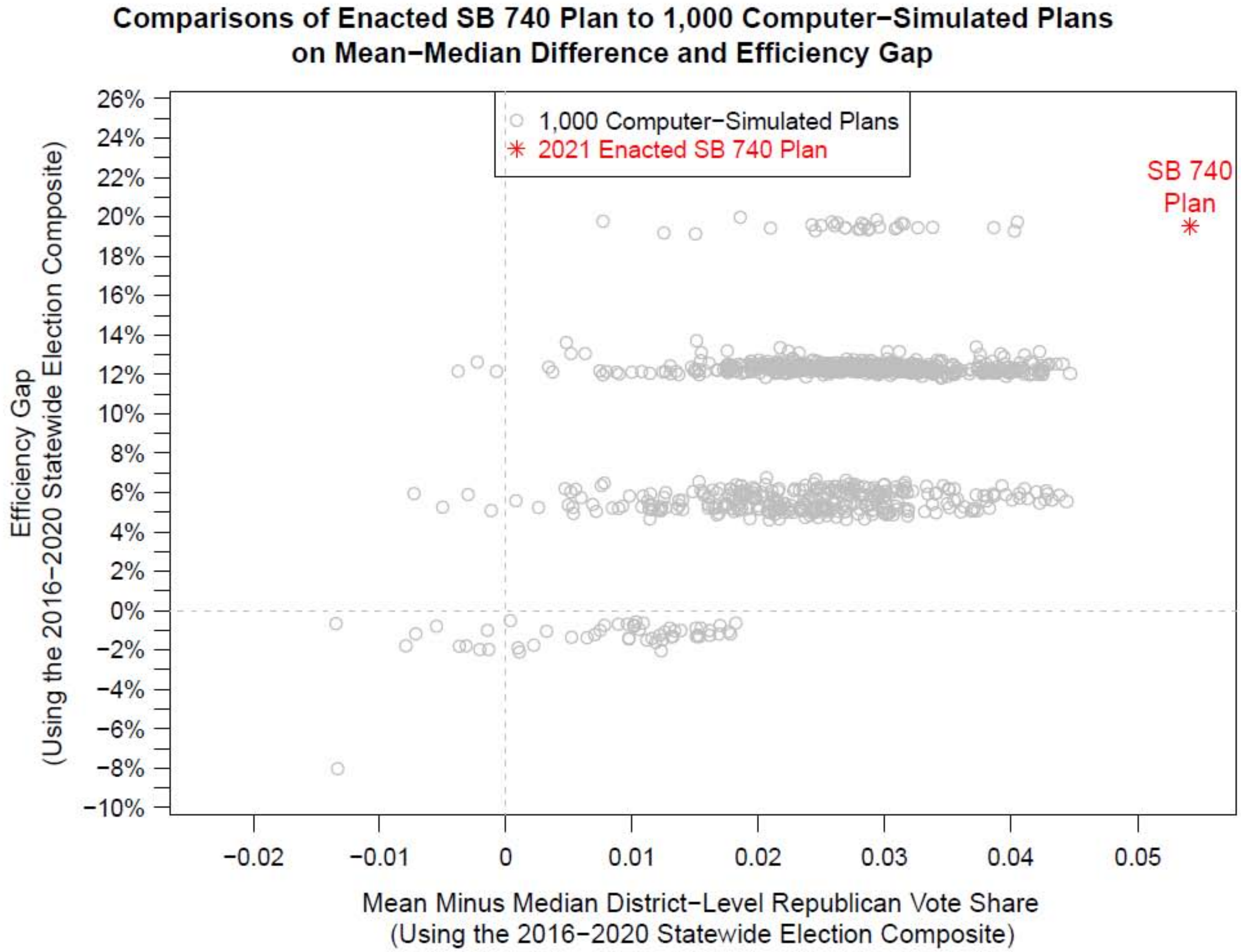
64. I analyze whether the Enacted Plan's efficiency gap arises naturally from a map-drawing process strictly adhering to the mandated criteria in the General Assembly's Adopted Criteria, or rather, whether the skew in the Enacted Plan's efficiency gap is explainable only as the product of a map-drawing process that intentionally favored one party over the other. By comparing the efficiency gap of the Enacted Plan to that of the computer-simulated plans, I am able to evaluate whether or not such the Enacted Plan's efficiency gap could have realistically resulted from adherence to the Adopted Criteria.

65. Figure 9 compares the efficiency gaps of the Enacted Plan and of the 1,000 computer-simulated plans. As before, the 1,000 circles in this Figure represent the 1,000 computer-simulated plans, while the red star in the upper right corner represents the Enacted Plan. Each plan is plotted along the vertical axis according to its efficiency gap, while each plan is plotted along the horizontal axis according to its mean-median difference.

66. The results in Figure 9 illustrate that the Enacted Plan exhibits an efficiency gap

of +19.5%, indicating that the plan results in far more wasted Democratic votes than wasted Republican votes. Specifically, the difference between the total number of wasted Democratic votes and wasted Republican votes amounts to 19.5% of the total number of votes statewide. The Enacted Plan's efficiency gap is larger than the efficiency gaps exhibited by 98.7% of the computer-simulated plans. This comparison reveals that the significant level of Republican bias exhibited by the Enacted Plan cannot be explained by North Carolina's political geography or the Adopted Criteria alone.

Figure 9:



Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
on Mean−Median Difference and Efficiency Gap
1,000 Computer−Simulated Plans
2021 Enacted SB 740 Plan
SB 740
Plan
Efficiency Gap
(Using the 2016−2020 Statewide Election Composite)
26%
24%
22%
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
−2%
−4%
−6%
−8%
−10%
−0.02
−0.01
0
0.01
0.02
0.03
0.04
0.05
Mean Minus Median District−Level Republican Vote Share
(Using the 2016−2020 Statewide Election Composite)

67. ***The Lopsided Margins Measure:*** Another measure of partisan bias in districting plans is the "lopsided margins" test. The basic premise captured by this measure is that a partisan-motivated map-drawer may attempt to pack the opposing party's voters into a small number of extreme districts that are won by a lopsided margin. Thus, for example, a map-drawer attempting to favor Party A may pack Party B's voters into a small number of districts that very heavily favor Party B. This packing would then allow Party A to win all the remaining districts with relatively smaller margins. This sort of partisan manipulation in districting would result in Party B winning its districts by extremely large margins, while Party A would win its districts by relatively small margins.

68. Hence, the lopsided margins test is performed by calculating the difference between the average margin of victory in Republican-favoring districts and the average margin of victory in Democratic-favoring districts. The 2021 Enacted Plan contains four Democratic-favoring districts (CD-2, 5, 6, and 9), and these four districts have an average Democratic vote share of 65.4%, as measured using the 2016-2020 Statewide Election Composite. By contrast, the Enacted Plan contains ten Republican-favoring districts (CD-1, 3, 4, 7, 8, 10, 11, 12, 13, and 14), and these ten districts have an average Republican vote share of 57.3%. Hence, the difference between the average Democratic margin of victory in Democratic-favoring districts and the average Republican margin of victory in Republican-favoring districts is +8.1%, which is calculated as 65.4% - 57.3%. I refer to this calculation of +8.1% as the Enacted Plan's lopsided margins measure.

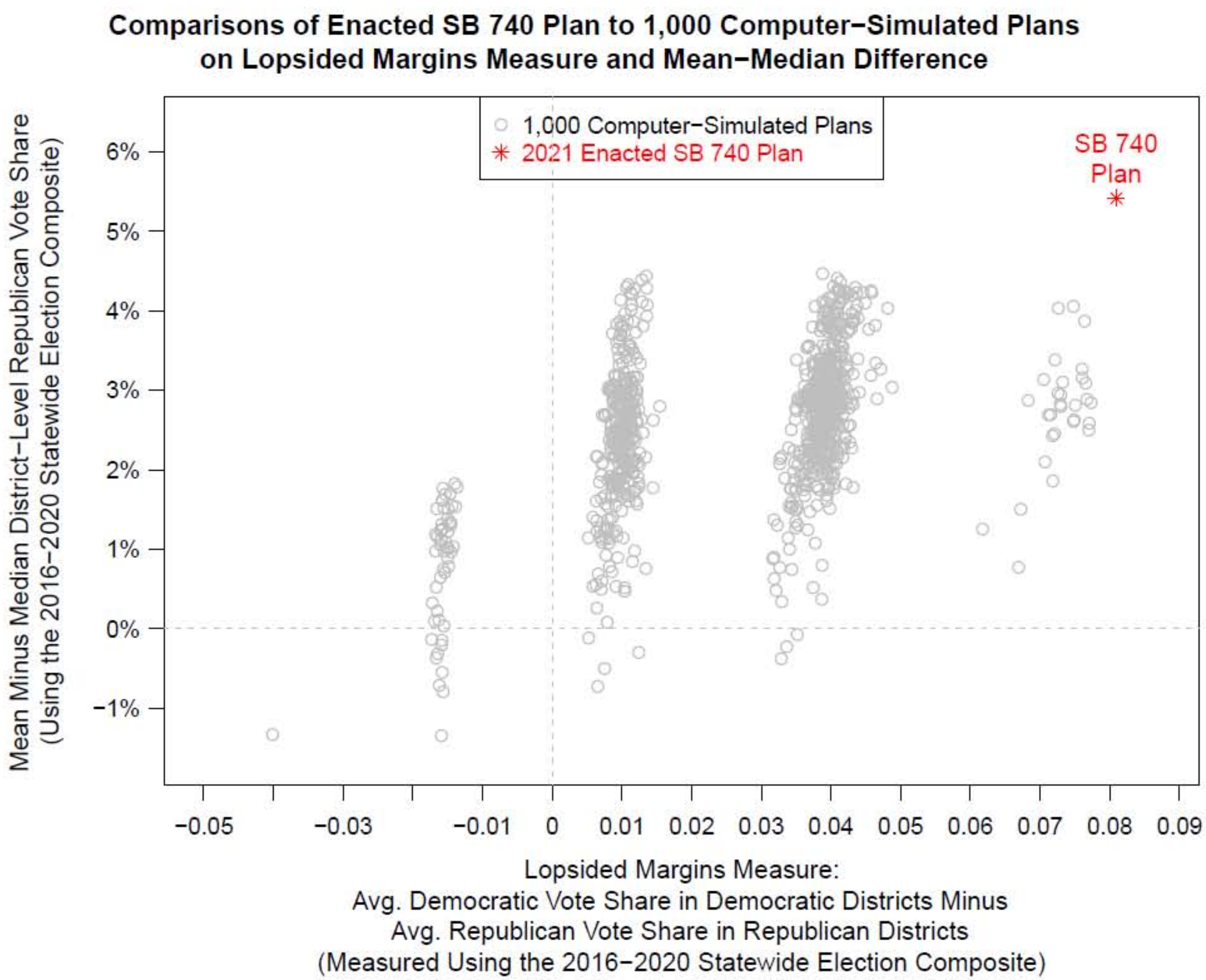
69. How does the 8.1% lopsided margins measure of the Enacted Plan compare to the same calculation for the 1,000 computer-simulated plans? Figure 10 reports the lopsided margins calculations for the Enacted Plan and for the simulated plans. In Figure 10, each plan is plotted

along the horizontal axis according to its lopsided margins measure and along the vertical axis according to its mean-median difference.

70. Figure 10 reveals that the Enacted Plan's +8.1% lopsided margins measure is an extreme outlier compared to the lopsided margins measures of the 1,000 computer-simulated plans. All 1,000 of the simulated plans have a smaller lopsided margins measure than the Enacted Plan. In fact, a significant minority (37.3%) of the 1,000 simulated plans have a lopsided margins measure of between -2% to +2%, indicating a plan in which Democrats and Republicans win their respective districts by similar average margins.

71. By contrast, the Enacted Plan's lopsided margins measure of +8.1% indicates that the Enacted Plan creates districts in which Democrats are extremely packed into their districts, while the margin of victory in Republican districts is significantly smaller. The "lopsidedness" of the two parties' average margin of victory is extreme when compared to the computer-simulated plans. The finding that all 1,000 simulated plans have a smaller lopsided margins measure indicates that the Enacted Plan's extreme packing of Democrats into Democratic-favoring districts was not simply the result of North Carolina's political geography, combined with adherence to the Adopted Criteria.

Figure 10:


Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
on Lopsided Margins Measure and Mean−Median Difference
1,000 Computer−Simulated Plans
2021 Enacted SB 740 Plan
SB 740
Plan
6%
5%
4%
3%
2%
1%
0%
−1%
Mean Minus Median District−Level Republican Vote Share
(Using the 2016−2020 Statewide Election Composite)
−0.05
−0.03
−0.01
0
0.01
0.02
0.03
0.04
0.05
0.06
0.07
0.08
0.09
Lopsided Margins Measure:
Avg. Democratic Vote Share in Democratic Districts Minus
Avg. Republican Vote Share in Republican Districts
(Measured Using the 2016−2020 Statewide Election Composite)

72. ***Partisan Symmetry Based on Uniform Swing:*** Another common measure of partisan bias is based on the concept of partisan symmetry and asks the following question: Under a given districting plan and given a particular election-based measure of district partisanship, what share of seats would each party win in a hypothetical tied election (i.e., 50% vote share for each of two parties). To approximate the district-level outcomes in a hypothetical tied election, one normally uses a uniform swing in order to simulate a tied statewide election. We then calculate whether each party would receive more than or less than 50% of the seats under this hypothetical tied election in a given districting plan. This particular measure is often referred to in the academic literature as "partisan bias." In order to avoid confusion with other measures of partisan bias described in this report, I will refer to this measure as "Partisan Symmetry Based on Uniform Swing."

73. Specifically, I use the 2016-2020 Statewide Election Composite to calculate the Partisan Symmetry measure for both the Enacted Plan and for the computer-simulated plans. The 2016-2020 Statewide Election Composite produces a statewide Republican vote share of 50.8%. Therefore, I use a uniform swing of -0.8% in order to estimate the partisanship of districts under a hypothetical tied election in which each party wins exactly 50% of the statewide vote. In other words, this uniform swing subtracts 0.8% from the Republican vote share in every district, both in the Enacted Plan and in all simulated plans.

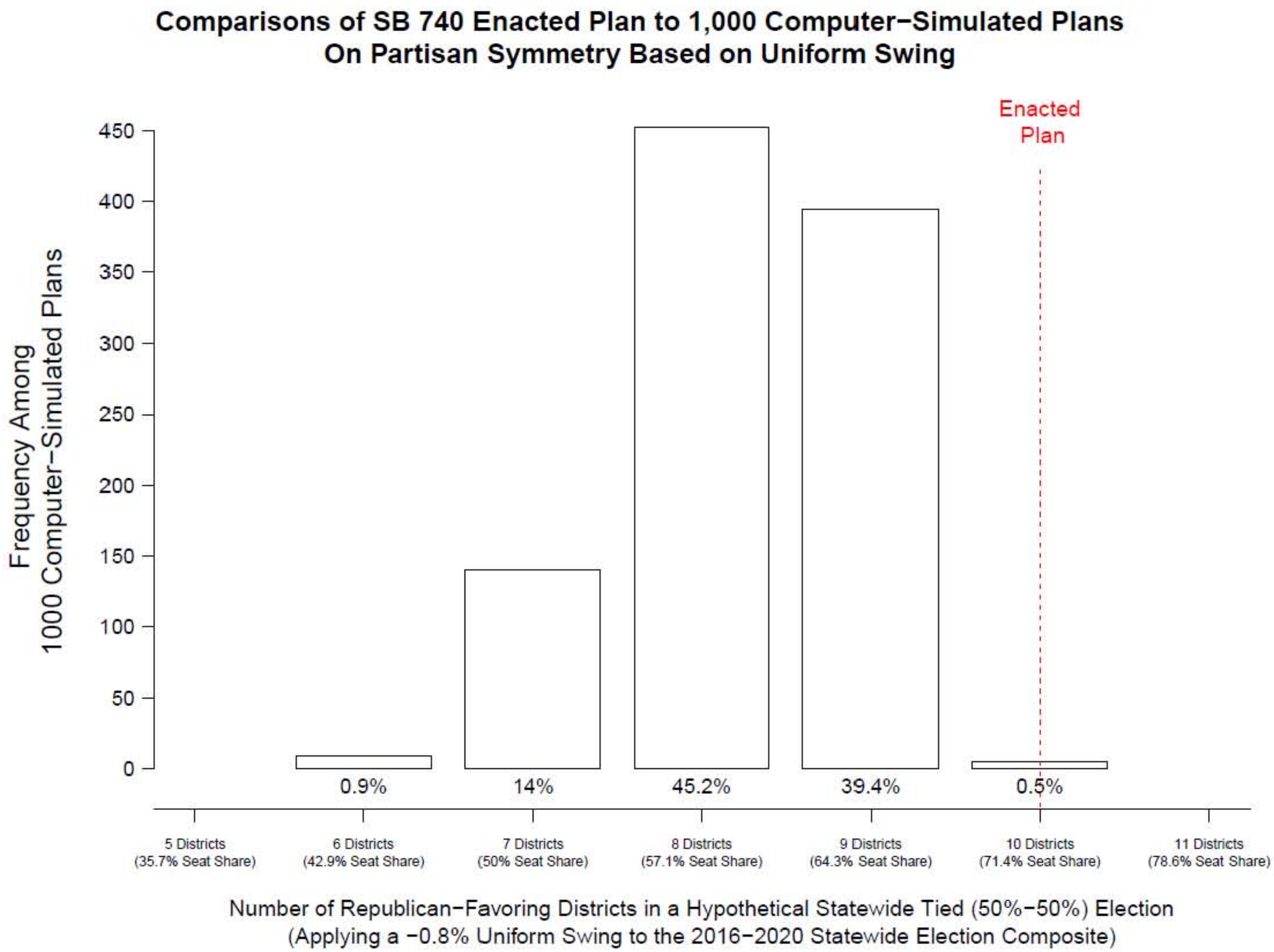
74. After applying this -0.8% uniform swing, I compare the number of Republican-favoring districts in the Enacted Plan and the simulated plans. In the Enacted Plan, 71.4% of the districts (10 out of 14) are Republican-favoring after applying the uniform swing. I then report the Republicans' seat share (71.4%) under this hypothetical tied election in Figure 11 as the "Partisan

Symmetry Based on Uniform Swing" measure for the Enacted Plan. Figure 11 also reports the calculations for all 1,000 simulated plans using this identical method.

75. Figure 11 reveals 99.5% of the 1,000 simulated plans have a "Partisan Symmetry Based on Uniform Swing" measure that is closer to 50% than the Enacted Plan's measure. In fact, 14% of the simulated plans have a measure that is exactly 50% (7 out of 14 districts), while over 60% of the simulated plans are between 40% and 60%.

76. By contrast, the Enacted Plan's measure of 71.4% in Figure 11 would be a statistical outlier and is more favorable to Republicans than in 99.5% of the simulated plans. Substantively, this 71.4% measure reflects the Enacted Plan's creation of a durable Republican majority for North Carolina's congressional delegation, such that even when Democrats win 50% of the statewide vote, Republicans will still be favored in 10 out of 14 (71.4%) of the congressional districts, while Democrats will only be favored in only 4 out of the 14 (28.6%) districts.

Figure 11:



Comparisons of SB 740 Enacted Plan to 1,000 Computer−Simulated Plans
On Partisan Symmetry Based on Uniform Swing
Enacted Plan
Frequency Among
1000 Computer−Simulated Plans
450
400
350
300
250
200
150
100
50
0
0.9%
14%
45.2%
39.4%
0.5%
5 Districts (35.7% Seat Share)
6 Districts (42.9% Seat Share)
7 Districts (50% Seat Share)
8 Districts (57.1% Seat Share)
9 Districts (64.3% Seat Share)
10 Districts (71.4% Seat Share)
11 Districts (78.6% Seat Share)
Number of Republican−Favoring Districts in a Hypothetical Statewide Tied (50%−50%) Election
(Applying a −0.8% Uniform Swing to the 2016−2020 Statewide Election Composite)

Conclusions Regarding Partisanship and Traditional Districting Criteria

77. The analysis described thus far in this report lead me to reach two main findings: First, among the five traditional districting criteria mandated by the General Assembly's 2021 Adopted Criteria, the Enacted Plan fails to minimize county splits, fails to minimize VTD splits, and is significantly less geographically compact than is reasonably possible under a districting process that follows the Adopted Criteria. Second, I found that the Enacted Plan is an extreme partisan outlier when compared to computer-simulated plans produced by a process following the Adopted Criteria. The Enacted Plan contains 10 districts that are partisan outliers when compared to the simulated plans' districts, and using several different common measures of partisan bias, the Enacted Plan creates a level of pro-Republican bias more extreme than in over 95% of the computer-simulated plans. In particular, the Enacted Plan creates more "mid-range" Republican districts than is created in 100% of the computer-simulated plans (Paragraphs 45-46).

78. Based on these two main findings, I conclude that partisanship predominated in the drawing of the 2021 Enacted Plan and subordinated the traditional districting principles of avoiding county splits, avoiding VTD splits, and geographic compactness. Because the Enacted Plan fails to follow three of the Adopted Criteria's mandated districting principles while simultaneously creating an extreme level of partisan bias, I therefore conclude that the partisan bias of the Enacted Plan did not naturally arise by chance from a districting process adhering to the Adopted Criteria. Instead, I conclude that partisan goals predominated in the drawing of the Enacted Plan. By subordinating traditional districting criteria, the General Assembly's Enacted Plan was able to achieve partisan goals that could not otherwise have been achieved under a partisan-neutral districting process that follows the Adopted Criteria.

Regional Comparisons of Enacted Plan and Simulated Plan Districts

79. I have thus far compared the Enacted Plan to the simulated plans at a statewide level using several common measures of partisan bias and by identifying individual districts that are partisan outliers. However, I also analyzed the extent to which partisan bias affected the map-drawing process within specific cities and geographic regions of North Carolina. I found that the Enacted Plan's individual districts in certain regions exhibit extreme political bias when compared to the computer-simulated districts in the same regions. Below, I describe my findings regarding the partisan bias caused by the Enacted Plan's district boundaries in the Piedmont Triad area, in the Research Triangle, and in Mecklenburg County.

80. ***The Piedmont Triad Area:*** The Enacted Plan splits Guilford County into three different districts: CD-7, 10, and 11. These three fragments of Guilford County, which has voted solidly Democratic in recent statewide elections, are each combined with more Republican areas in surrounding counties across the Piedmont Triad area. This three-way splitting of Guilford County results in CD-7, 10, and 11 being safely Republican, each with a Republican vote share between 55.9% and 61.2%, as measured using the 2016-2020 Statewide Election Composite.

81. Is this three-way splitting of Guilford County, and the resulting creation of three safe Republican districts, a districting outcome that could have resulted naturally from the region's political geography, combined with the districting principles required by the Adopted Criteria? A comparison of the Enacted Plan's districts to the simulated districts in the Piedmont Triad area reveals that the Enacted Plan managed to crack Democratic voters in the region to a more extreme extent than in virtually all of the computer-simulated plans. Moreover, the Enacted Plan achieved this extreme cracking of Democrats by creating districts that are significantly less compact than virtually all of the Guilford County districts in the computer-simulated plans.

82. Figure 12 directly compares the partisanship of the Enacted Plan's districts to the simulated plans' districts in the Piedmont Triad area at a local level. Specifically, the top row of Figure 12 describes the district within each plan that contains the most amount of Greensboro's population. In the Enacted Plan, this district is CD-11, and Figure 12 directly compares the Republican vote share of CD-11 to the Republican vote shares of all simulated districts that contain the largest portion of Greensboro residents among all districts in their respective simulated plans. The Figure reveals that the Enacted Plan's CD-11 is more safely Republican than 99.6% of the computer-simulated Greensboro districts. In fact, although CD-11 exhibits a 55.9% Republican vote share, 96.1% of the simulated districts containing Greensboro are Democratic-favoring districts. Hence, it is clear that the Enacted Plan created a safe Republican district for Greensboro, even though a partisan-neutral districting process following the Adopted Criteria would almost always have placed Greensboro in a Democratic-favoring district.

83. The second row of Figure 12 illustrates a similar finding regarding the city of High Point in Guilford County. The Enacted Plan places High Point into CD-10, which has a Republican vote share of 61.2%. CD-10 is more heavily Republican than 99.6% of the High Point-based district in the 1,000 computer-simulated plans. Once again, nearly all of the simulated plans place High Point into a Democratic-favoring district, but the Enacted Plan managed to place High Point into an anomalously Republican district.

84. The third row of Figure 12 reveals a similar finding regarding CD-7, the third district containing a fragment of Guilford County. The city of Burlington (Alamance and Guilford Counties) is assigned to the Enacted Plan's CD-7, which exhibits a 58.2% Republican vote share. CD-7 is more heavily Republican than 99.7% of the Burlington-based districts in the 1,000 computer-simulated plans. In fact, 95.5% of the Burlington districts in the simulated plans

favor the Democrats, often by an extremely wide margin. Thus, it is clear that the Enacted Plan created a far more Republican-favorable district for Burlington than could be reasonably expected from a partisan-blind districting process.

85. Of course, the creation of three safe Republican districts (CD-7, 10, and 11) in the Guilford County area required bringing in Republican voters from other, surrounding districts. One such district was CD-12, a safely Republican district covering areas in the Piedmont Triad region to the west of Guilford County. The fourth row of Figure 12 compares the partisanship of the Enacted Plan's district containing Winston-Salem (CD-12) to the simulated plans' districts containing Winston-Salem. The simulated plan results on this row illustrate that under a partisan-blind districting process, Winston-Salem would normally be placed into an even more heavily Republican district than the Enacted Plan's CD-12. The Enacted Plan's CD-12 is a safe Republican seat with a Republican vote share of 56.6%, but it is less heavily Republican than 91.4% of the computer-simulated districts containing the most of Winston-Salem's population. This finding suggests that CD-12 was drawn to be less extremely Republican than should be expected, given the political geography of the Piedmont Triad area. As a result, more Republican voters could be placed in the surrounding districts, particularly CD-10 and CD-11, that split up Guilford County.

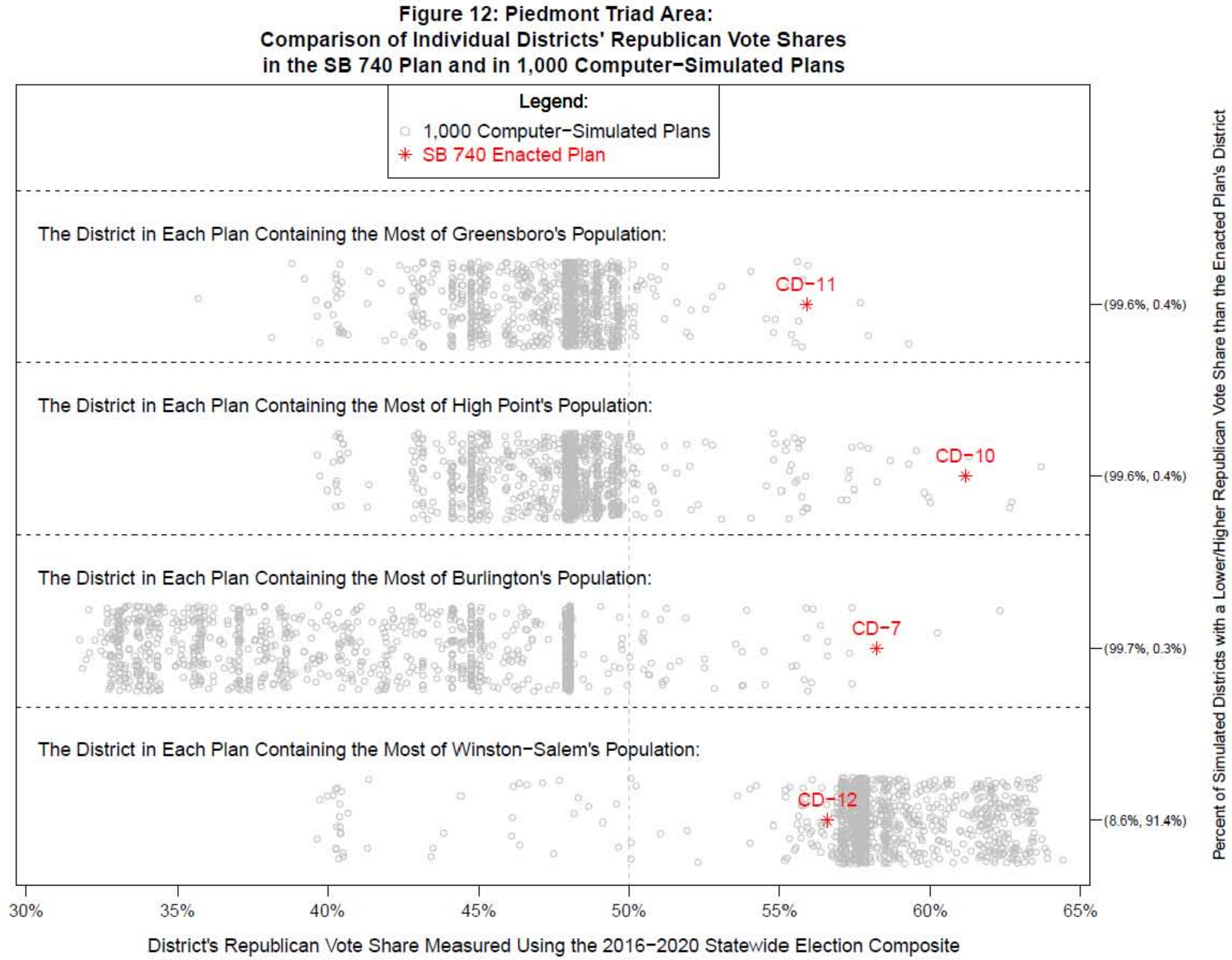
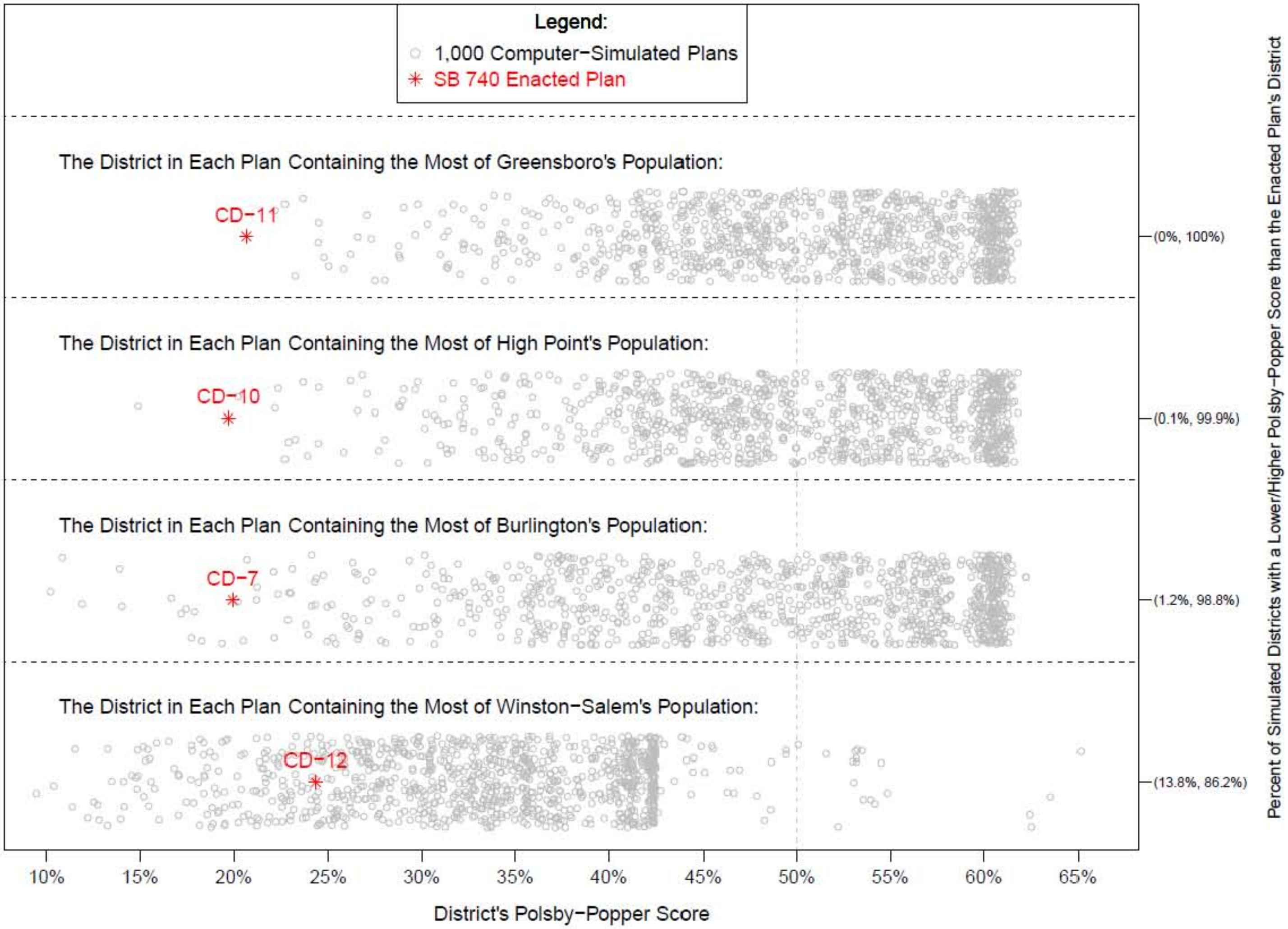


Figure 12: Piedmont Triad Area:
Comparison of Individual Districts' Republican Vote Shares
in the SB 740 Plan and in 1,000 Computer−Simulated Plans
Legend:
1,000 Computer−Simulated Plans
SB 740 Enacted Plan
The District in Each Plan Containing the Most of Greensboro's Population:
CD−11
(99.6%, 0.4%)
The District in Each Plan Containing the Most of High Point's Population:
CD−10
(99.6%, 0.4%)
The District in Each Plan Containing the Most of Burlington's Population:
CD−7
(99.7%, 0.3%)
The District in Each Plan Containing the Most of Winston−Salem's Population:
CD−12
(8.6%, 91.4%)
30%
35%
40%
45%
50%
55%
60%
65%
District's Republican Vote Share Measured Using the 2016−2020 Statewide Election Composite
Percent of Simulated Districts with a Lower/Higher Republican Vote Share than the Enacted Plan's District

86. Could the Enacted Plan's cracking of Guilford County Democrats into three districts (CD-7, 10, and 11) have resulted from a mapdrawing process attempting to follow the Adopted Criteria? The geographic characteristics of these three districts illustrate the opposite conclusion: The General Assembly managed to split Guilford County into three safe Republican districts by subordinating the districting principles required by the Adopted Criteria. Although the Adopted Criteria do not explicitly prohibit dividing Guilford County into three districts, doing so was not necessary to comply with the Adopted Criteria. Guilford County's population is well under that of an equally populated congressional district. In fact, the vast majority (75.6%) of the computer-simulated plans do not split Guilford County a single time. When Guilford County is split, the simulated plans usually split it only once.

87. Moreover, the compactness scores of the Enacted Plan's CD-7, 10, and 11 reveal that the General Assembly subordinated geographic compactness considerations in the process of cracking Democrats in Guilford County. The first row of Figure 13 illustrates that the Enacted Plan's CD-11 has a lower Polsby-Popper score than all 1,000 of the Greensboro-based districts in the computer-simulated plans. The second and third rows of Figure 13 reveal a nearly identical conclusion regarding the other two districts covering Guilford County (CD-7 and CD-10). In fact, there is a vast disparity between the compactness of the Enacted Plan's Guilford County districts and the simulated plans' districts in Guilford County. CD-7, 10, and 11 have Polsby-Popper scores of 0.197, 0.199, and 0.207. Meanwhile, over half of the simulated districts displayed in these upper three rows of Figure 13 have a Polsby-Popper score over 0.5. It is therefore clear that the Enacted Plan subordinated geographic compactness in the pursuit of Republican partisan advantage in the drawing of district boundaries in the Piedmont Triad area.

Figure 13: Piedmont Triad Area: Comparison of Individual Districts' Compactness Scores in the SB 740 Plan and in 1,000 Computer−Simulated Plans



88. ***The Research Triangle:*** Figures 14 and 15 present a similar analysis of the districts in the Research Triangle. The top row of Figure 14 compares the Republican vote shares of the Enacted Plan's and each computer-simulated plan's district containing the most of Raleigh's population. The second row of Figure 14 is a similar comparison of the Enacted Plan's and each simulated plan's district containing the most of Durham's population. Overall, these two rows illustrate that the Enacted Plan's Raleigh-based district (CD-5) and Durham-based district (CD-6) are more heavily packed with Democrats than almost 100% of the computer-simulated districts containing Raleigh and Durham.

89. The top two rows of Figure 15 illustrate that extreme degree of Democratic voter packing in CD-5 and CD-6 is not the result of the Research Triangle's political geography or the Adopted Criteria. Instead, Figure 15 reveals that CD-5 and CD-6 are less geographically compact than nearly 100% of the computer-simulated districts containing Raleigh and Durham. Thus, the General Assembly managed to unnaturally pack Democrats in its Raleigh-based and Durham-based districts by subordinating geographic compactness in the drawing of these districts.

90. As a result of this packing of Democratic voters in CD-5 and CD-6, the surrounding districts in the Enacted Plan are more safely Republican than they would have been in the absence of such packing of Democrats. One example of these surrounding Republican districts in the Enacted Plan is CD-7, which combines Southern Wake County with various counties west of the Research Triangle. Southern Wake County is more politically moderate than the heavily Democratic cores of Raleigh and Durham. The third row of Figure 14 compares the partisanship of the Enacted Plan's district and each simulated plan's district containing the most of Holly Springs's and Fuquay-Varina's populations in Southern Wake County. The results on

this row illustrate that in the computer-simulated plans drawn according to the Adopted Criteria, Southern Wake County is generally placed into a heavily-Democratic district because it is generally placed into the same district with part of Raleigh. But the Enacted Plan packed Democrats into CD-5 (Raleigh) and CD-6 (Durham), so the General Assembly was able to create a safe Republican district by combining Southern Wake County with other Republican-favoring counties to the west of the Research Triangle. As the third row of Figure 14 illustrates, this outcome is an extreme statistical outlier compared to the computer-simulated districts in Southern Wake County. 99.2% of the simulated plans place Southern Wake County into a Democratic-favoring district, and 100% of the simulated districts containing Southern Wake County are less extremely Republican than CD-7. Hence, it is clear that CD-7 is a partisan outlier that was enabled by the packing of Democratic voters in CD-5 (Raleigh) and CD-6 (Durham).

Figure 14: Research Triangle Area: Comparison of Individual Districts' Republican Vote Shares in the SB 740 Plan and in 1,000 Computer−Simulated Plans

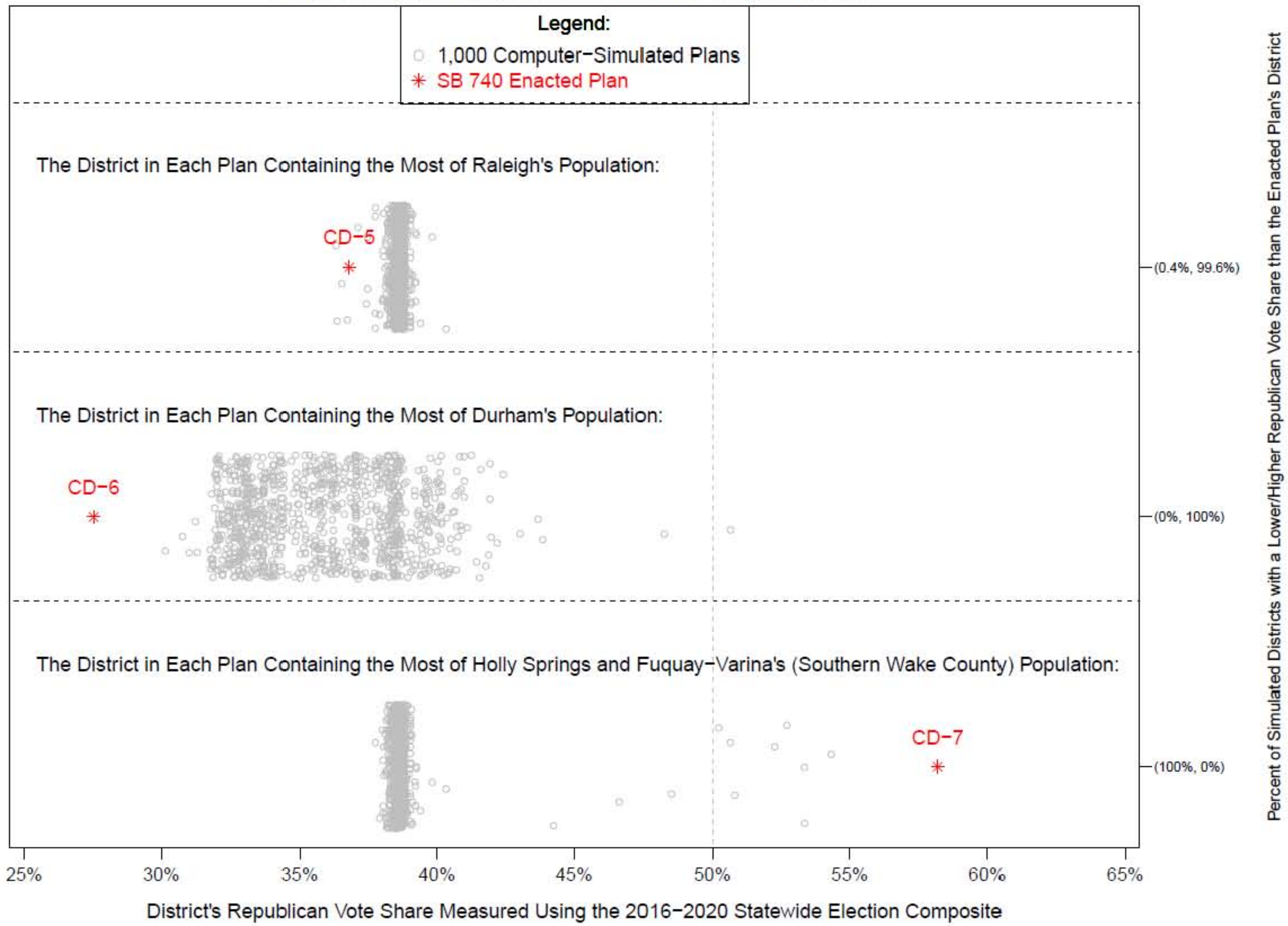
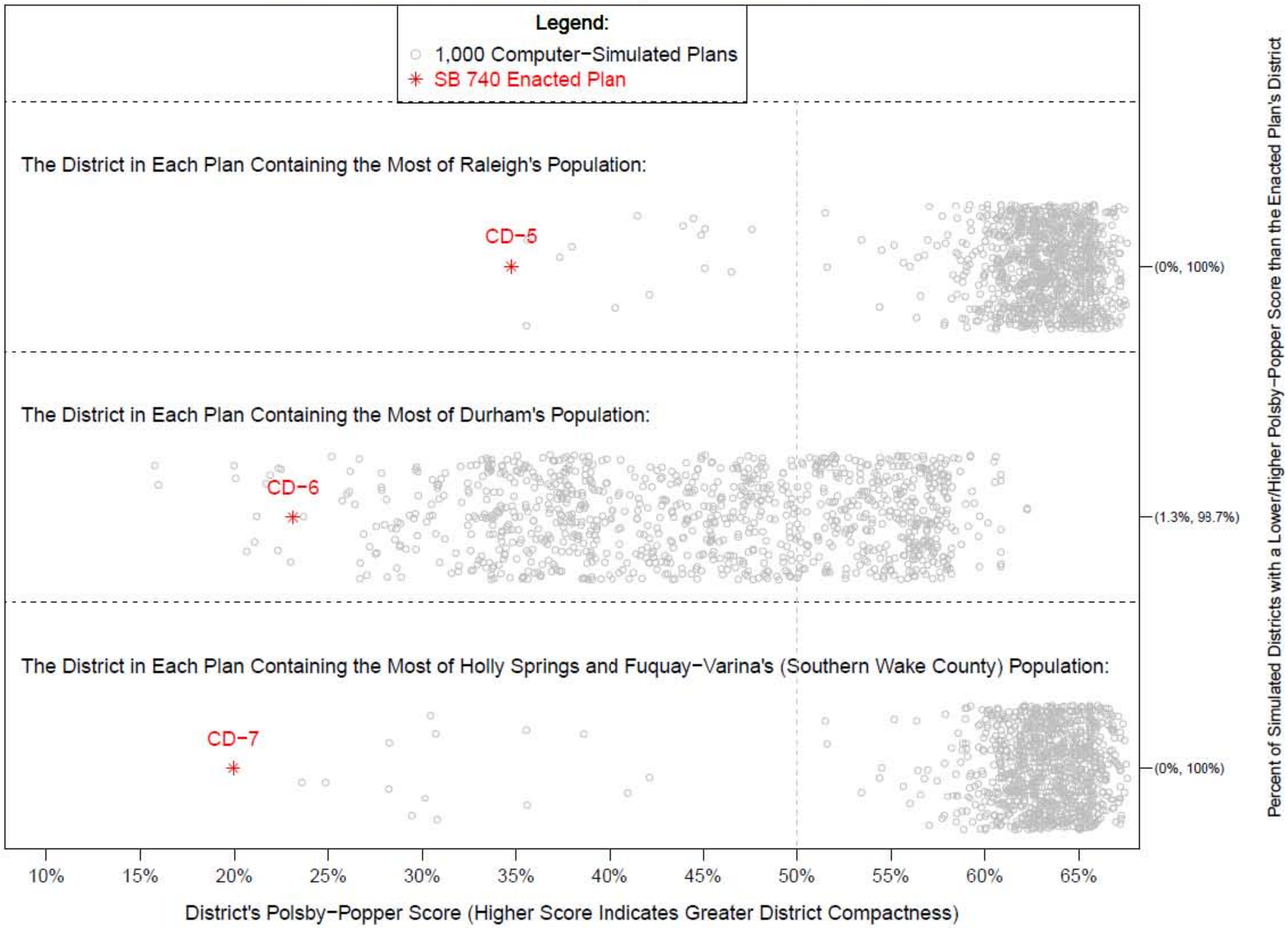


Figure 15: Research Triangle Area: Comparison of Individual Districts' Compactness Scores in the SB 740 Plan and in 1,000 Computer−Simulated Plans



91. ***Mecklenburg County Districts:*** Figure 16 illustrates a similar finding regarding Mecklenburg County. The top row of Figure 16 compares the partisanship of the Enacted Plan's district and each simulated plan's district containing the most of Charlotte's population. The results in this row illustrate that the Enacted Plan's CD-9 is more heavily Democratic than 100% of the simulated plans' primary Charlotte districts.

92. As a result, the second and third rows of Figure 16 reveal that the surrounding suburban districts in the Enacted Plan are more safely Republican than their geographic counterparts in all of the computer-simulated plans. Specifically, the second row of Figure 16 compares the partisanship of the Enacted Plan's district and each simulated plan's district containing the most of Huntersville's (Northern Mecklenburg County) population. In the simulated plans, Huntersville is either placed into the same district as most of Charlotte, resulting in a heavily Democratic district, or it is grouped with other counties outside of Mecklenburg, thus forming a politically competitive district with a Republican vote share close to 50%. But the Enacted Plan places Huntersville into a district (CD-13) that is much more strongly Republican than all 100% of the simulated districts containing Huntersville.

93. The third row of Figure 16 reveals a similar finding regarding Eastern Mecklenburg County. Specifically, this row compares the partisanship of the Enacted Plan's district and each simulated plan's district containing the most of Mint Hill's and Matthews' (Eastern Mecklenburg County) population. Once again, the results reveal that the Enacted Plan places Eastern Mecklenburg County into a district (CD-8) that is more strongly Republican than all 100% of the computer-simulated districts containing Mint Hill and Matthews.

94. Thus, it is clear that the Enacted Plan packed Democrats in Mecklenburg County to an extent greater than what naturally occurs as a result of the area's political geography.

Democratic voters are residentially concentrated in Charlotte, and this political geography tends to cause a clustering of Democratic voters in Mecklenburg County districts, as reflected in the simulation results in Figure 16. But the Enacted Plan's packing of Democratic voters in Mecklenburg goes beyond what is caused by political geography, resulting in a Charlotte district that is even more heavily Democratic than what could be expected from a partisan-blind map-drawing process.

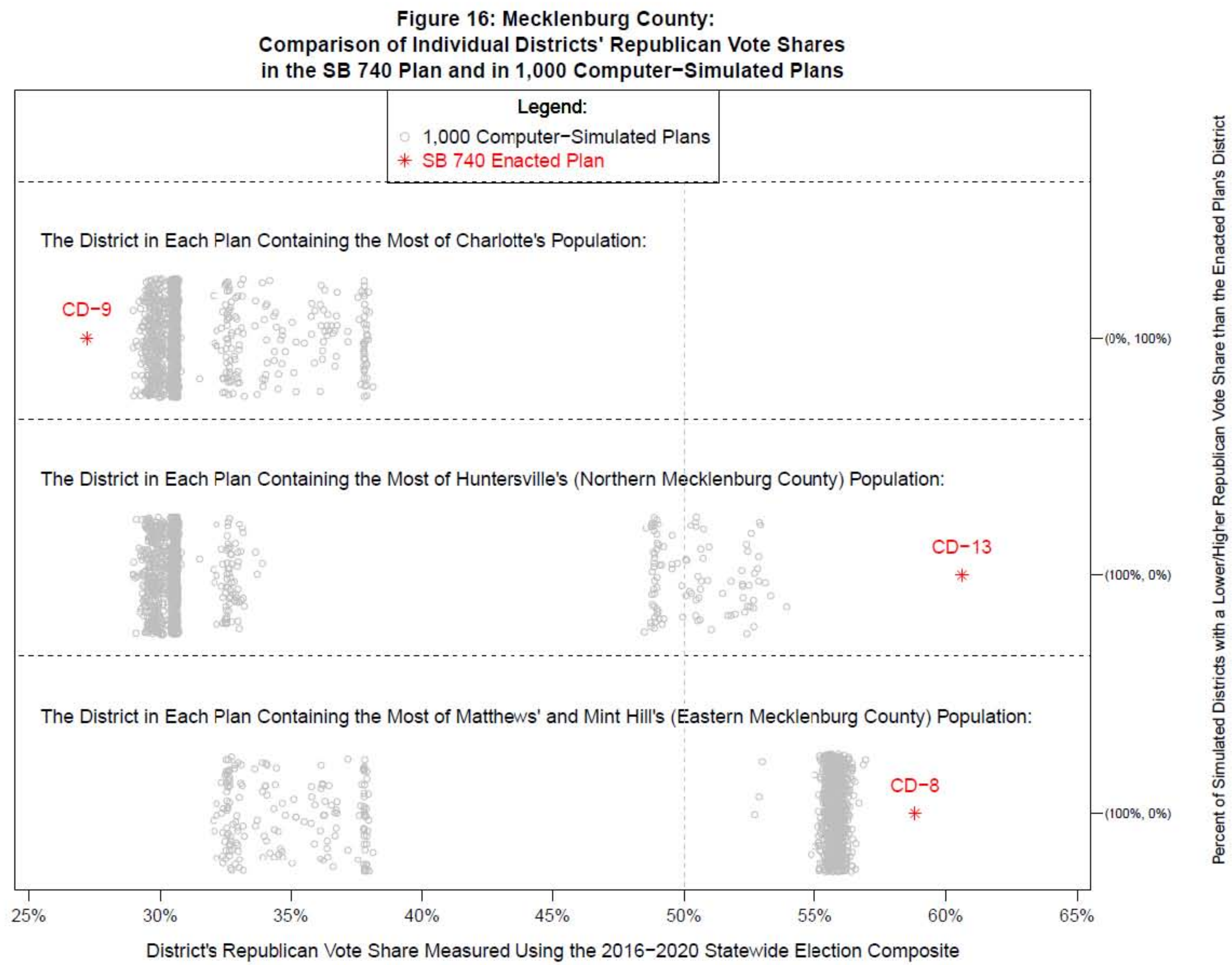


Figure 16: Mecklenburg County:
Comparison of Individual Districts' Republican Vote Shares
in the SB 740 Plan and in 1,000 Computer−Simulated Plans
Legend:
1,000 Computer−Simulated Plans
SB 740 Enacted Plan
The District in Each Plan Containing the Most of Charlotte's Population:
CD−9
(0%, 100%)
The District in Each Plan Containing the Most of Huntersville's (Northern Mecklenburg County) Population:
CD−13
(100%, 0%)
The District in Each Plan Containing the Most of Matthews' and Mint Hill's (Eastern Mecklenburg County) Population:
CD−8
(100%, 0%)
25%
30%
35%
40%
45%
50%
55%
60%
65%
District's Republican Vote Share Measured Using the 2016−2020 Statewide Election Composite
Percent of Simulated Districts with a Lower/Higher Republican Vote Share than the Enacted Plan's District

North Carolina's Political Geography Did Not Cause the Enacted Plan's Extreme Partisan Bias

95. How does North Carolina's political geography affect the partisan characteristics of the 2021 Enacted Plan? Democratic voters tend to be geographically concentrated in the urban cores of several of the state's largest cities, including Charlotte, Raleigh, and Greensboro. As I have explained in my prior academic research,[14] these large urban clusters of Democratic voters, combined with the common districting principle of drawing geographically compact districts, can sometimes result in urban districts that "naturally" pack together Democratic voters, thus boosting the Republican vote share of other surrounding suburban and rural districts.

96. More importantly, my prior academic research explained how I can estimate the precise level of electoral bias in districting caused by a state's unique political geography: I programmed a computer algorithm that draws districting plans using North Carolina's unique political geography, including the state's census population data and political subdivision boundaries. In this report, I have also programmed the algorithm to follow North Carolina's Adopted Criteria. I then analyzed the partisan characteristics of the simulated districting plans using North Carolina's precinct-level voting data from past elections (past elections that were themselves skewed towards Republicans). Hence, the entire premise of conducting districting simulations is to fully account for North Carolina's unique political geography, its political subdivision boundaries, and its districting criteria, as mandated by the General Assembly's Adopted Criteria.

97. This districting simulation analysis allowed me to identify how much of the

[14] Jowei Chen and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures" Quarterly Journal of Political Science, 8(3): 239-269; Jowei Chen and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House." Electoral Studies, Vol. 44, No. 4: 329-430.

electoral bias in the 2021 Enacted Plan is caused by North Carolina's political geography and how much is caused by the map-drawer's intentional efforts to favor one political party over the other. North Carolina's natural political geography, combined with the Adopted Criteria, almost never resulted in simulated congressional plans containing 10 Republican-favoring districts out of 14 total districts.

98. The 2021 Enacted Plan's creation of 10 electorally safe Republican districts, which persists across a range of electoral outcomes, goes beyond any "natural" level of electoral bias caused by North Carolina's political geography or the political composition of the state's voters. The Enacted Plan is a statistical outlier in terms of its partisan characteristics when compared to the 1,000 computer-simulated plans and cannot be explained by North Carolina's natural political geography.

99. The two most Republican districts (CD-10 and CD-13) and the two most Democratic districts (CD-9 and CD-6) in the Enacted Plan were drawn to include more Democratic voters than virtually all of their counterpart districts in the 1,000 computer-simulated plans. Six other districts (CD-1, 3, 4, 11, 12, and 14) were drawn to be more heavily Republican than over 95% of their counterpart computer-simulated plan districts. Ten districts were drawn precisely to have Republican vote shares within the narrow range of 52.9% to 61.2%—an outcome that never arises in the computer-simulated plans.

100. This extreme, additional level of partisan bias in the 2021 Enacted Plan can be directly attributed to the map-drawer's clear efforts to favor the Republican Party. This level of partisan bias was not caused by North Carolina's political geography.

The Effect of the Enacted Plan Districts on Plaintiffs

101. I evaluated the congressional districts in which each Plaintiff would reside under the 1,000 computer-simulated maps using a list of geocoded residential addresses for the Plaintiffs that counsel for the Plaintiffs provided me. I used these geocoded addresses to identify the specific district in which each Plaintiff would be located under each computer-simulated plan, as well as under the Enacted Plan. I then compared the partisanship of each individual Plaintiff's Enacted Plan district to the partisanship of the Plaintiff's 1,000 districts from the 1,000 computer-simulated plans. Using this approach, I identify whether each Plaintiff's district is a partisan outlier when compared to the Plaintiff's 1,000 computer-simulated districts.

102. Figures 17a and 17b present the results of this analysis. These Figures list the individual Plaintiffs and describes the partisanship of each Plaintiff's district of residence in the Enacted Plan, as well as the partisanship of the district the Plaintiff would have resided in under each of the 1,000 simulated congressional plans. The first half of the plaintiffs are analyzed in Figure 17a, while the second half of the plaintiffs appear in Figure 17b.

103. To explain these analyses with an example, each row in Figure 17a corresponds to a particular individual Plaintiff. In the first row, describing Plaintiff Bobby Jones, the red star depicts the partisanship of the Plaintiff's Enacted Plan district (CD-2), as measured by its Republican vote share using the 2016-2020 Statewide Election Composite. The 1,000 gray circles on this row depict the Republican vote share of each of the 1,000 simulated districts in which the Plaintiff would reside in each of the 1,000 computer-simulated plans, based on that Plaintiff's residential address. In the margin to the right of each row, I list in parentheses how many of the 1,000 simulated plans would place the plaintiff in a more Democratic-leaning district (on the left) and how many of the 1,000 simulations would place the plaintiff in a more

Republican-leaning district (on the right) than the Plaintiff's Enacted Plan district. Thus, for example, the first row of Figure 17a reports that 99% of the 1,000 computer-simulated plans would place Plaintiff Bobby Jones in a more Republican-leaning district than his actual Enacted Plan district (CD-2). Therefore, I can conclude that Plaintiff Bobby Jones' Enacted Plan district is a partisan statistical outlier when compared to his district under the 1,000 simulated plans.

Figure 17a:
Plaintiffs' Districts in the SB 740 Plan and in 1,000 Computer−Simulated Plans

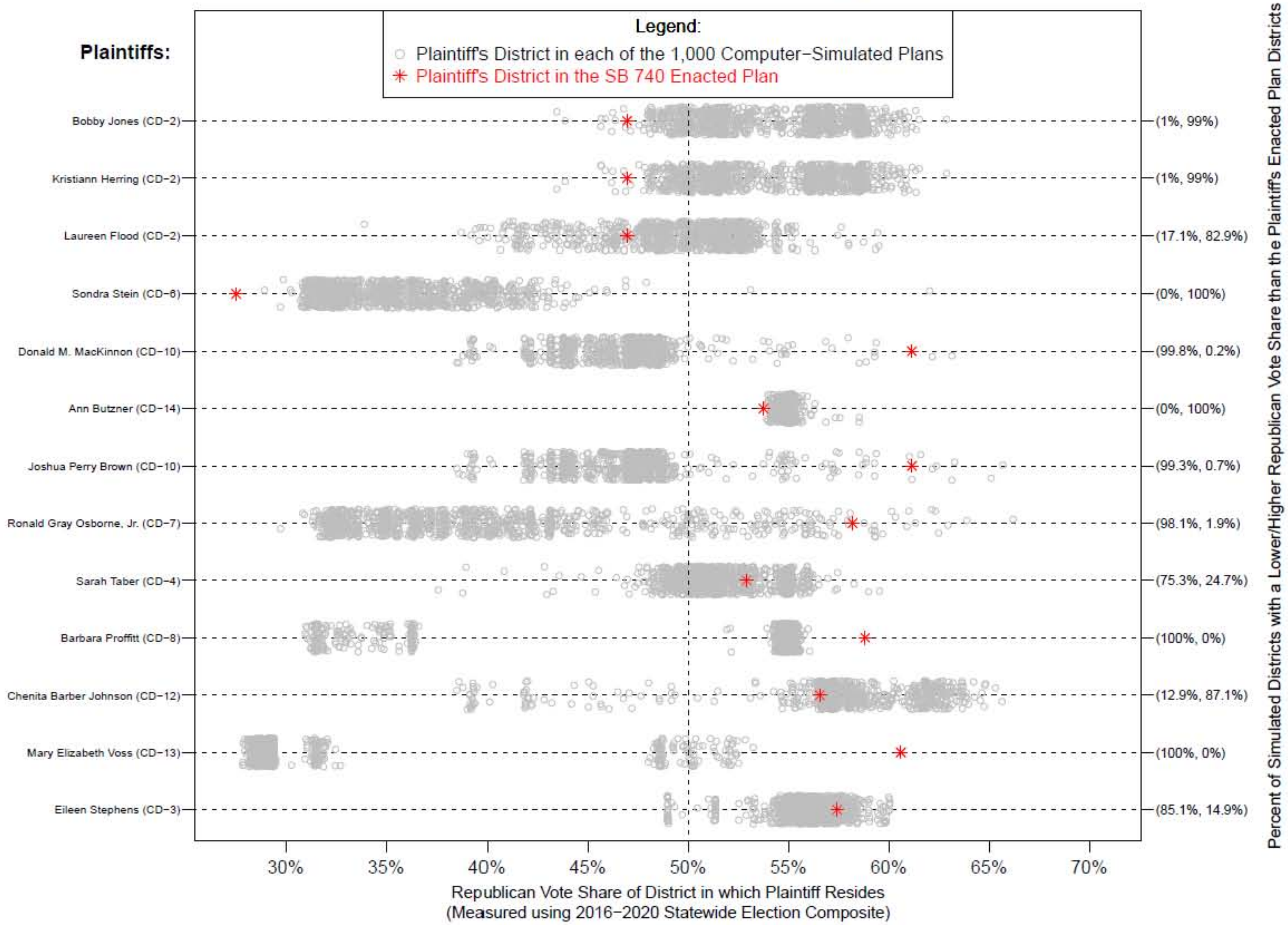
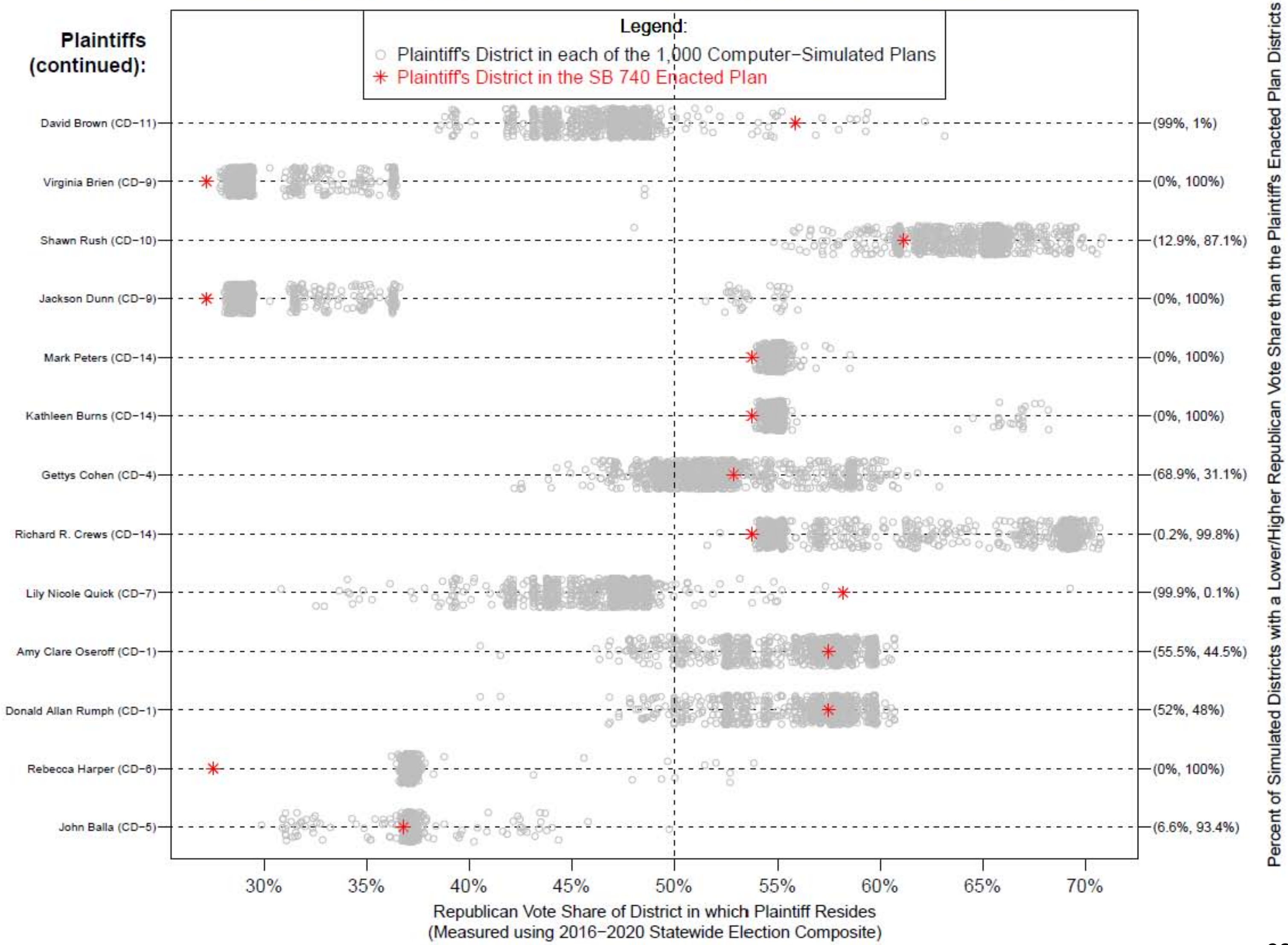


Figure 17b:
Plaintiffs' Districts in the SB 740 Plan and in 1,000 Computer−Simulated Plans



104. Figures 17a and 17b show that seven Plaintiffs residing in Republican-leaning districts under the Enacted Plan would be placed in a more Democratic-leaning district in over 95% of the computer-simulated plans: Donald M. MacKinnon (CD-10), Joshua Perry Brown (CD-10), Ronald Gray Osborne, Jr. (CD-7), Barbara Proffitt (CD-8), Mary Elizabeth Voss (CD-13); David Brown (CD-11) and Lily Nicole Quick (CD-7). Additionally, six Plaintiffs residing in Democratic-leaning districts under the Enacted Plan would be placed in a more Republican-leaning district in over 95% of the computer-simulated plans: Bobby Jones (CD-2), Kristiann Herring (CD-2), Sondra Stein (CD-6), Virginia Brien (CD-9), Jackson Dunn (CD-9), and Rebecca Harper (CD-6). Additionally, six Plaintiffs would be placed in a more Republican district in 99.9% or more of the simulated plans relative to their districts under the Enacted Plan: Ann Butzner (CD-14), Virginia Brien (CD-9), Jackson Dunn (CD-9), Mark Peters (CD-14), Kathleen Barnes (CD-14), Richard R. Crews (CD-14), and Rebecca Harper (CD-6).

I declare under penalty of perjury that the foregoing is true and correct to the best of my knowledge.

This 23rd day of December, 2021.

Dr. Jowei Chen

Jowei Chen
Curriculum Vitae

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Website: http://www.umich.edu/~jowei

Academic Positions:
Associate Professor (2015-present), Assistant Professor (2009-2015), Department of Political Science, University of Michigan.
Research Associate Professor (2016-present), Faculty Associate (2009-2015), Center for Political Studies, University of Michigan.
W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, 2013.
Principal Investigator and Senior Research Fellow, Center for Governance and Public Policy Research, Willamette University, 2013 – Present.

Education:
Ph.D., Political Science, Stanford University (June 2009)
M.S., Statistics, Stanford University (January 2007)
B.A., Ethics, Politics, and Economics, Yale University (May 2004)

Publications:

Chen, Jowei and Neil Malhotra. 2007. "The Law of k/n: The Effect of Chamber Size on Government Spending in Bicameral Legislatures."
American Political Science Review. **101(4): 657-676.**

Chen, Jowei, 2010. "The Effect of Electoral Geography on Pork Barreling in Bicameral Legislatures."
American Journal of Political Science. **54(2): 301-322.**

Chen, Jowei, 2013. "Voter Partisanship and the Effect of Distributive Spending on Political Participation."
American Journal of Political Science. **57(1): 200-217.**

Chen, Jowei and Jonathan Rodden, 2013. "Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures"
Quarterly Journal of Political Science, **8(3): 239-269.**

Bradley, Katharine and Jowei Chen, 2014. "Participation Without Representation? Senior Opinion, Legislative Behavior, and Federal Health Reform."
***Journal of Health Politics, Policy and Law*. 39(2), 263-293.**

Chen, Jowei and Tim Johnson, 2015. "Federal Employee Unionization and Presidential Control of the Bureaucracy: Estimating and Explaining Ideological Change in Executive Agencies."
***Journal of Theoretical Politics*, Volume 27, No. 1: 151-174.**

Bonica, Adam, Jowei Chen, and Tim Johnson, 2015. "Senate Gate-Keeping, Presidential Staffing of 'Inferior Offices' and the Ideological Composition of Appointments to the Public Bureaucracy."
***Quarterly Journal of Political Science*. Volume 10, No. 1: 5-40.**

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***Election Law Journal.* Volume 14, Number 4: 331-345.**

Chen, Jowei and David Cottrell, 2016. "Evaluating Partisan Gains from Congressional Gerrymandering: Using Computer Simulations to Estimate the Effect of Gerrymandering in the U.S. House."
***Electoral Studies.* Volume 44 (December 2016): 329-340.**

Chen, Jowei, 2017. "Analysis of Computer-Simulated Districting Maps for the Wisconsin State Assembly."
***Election Law Journal.* Volume 16, Number 4 (December 2017): 417-442.**

Chen, Jowei and Nicholas Stephanopoulos, 2020. "The Race-Blind Future of Voting Rights."
Yale Law Journal, Forthcoming. Volume 130, Number 4: 778-1049.

Kim, Yunsieg and Jowei Chen, 2021. "Gerrymandered by Definition: The Distortion of 'Traditional' Districting Principles and a Proposal for an Empirical Redefinition."
Wisconsin Law Review, Forthcoming, Volume 2021, Number 1.

Chen, Jowei and Nicholas Stephanopoulos, 2021. "Democracy's Denominator."
California Law Review, Accepted for Publication, Volume 109.

Non-Peer-Reviewed Publication:

Chen, Jowei and Tim Johnson. 2017. "Political Ideology in the Bureaucracy."
***Global Encyclopedia of Public Administration, Public Policy, and Governance*.**

Research Grants:

"How Citizenship-Based Redistricting Systemically Disadvantages Voters of Color". 2020 ($18,225). Combating and Confronting Racism Grant. University of Michigan Center for Social Solutions and Poverty Solutions.

Principal Investigator. National Science Foundation Grant SES-1459459, September 2015 – August 2018 ($165,008). "The Political Control of U.S. Federal Agencies and Bureaucratic Political Behavior."

"Economic Disparity and Federal Investments in Detroit," (with Brian Min) 2011. Graham Institute, University of Michigan ($30,000).

"The Partisan Effect of OSHA Enforcement on Workplace Injuries," (with Connor Raso) 2009. John M. Olin Law and Economics Research Grant ($4,410).

Invited Talks:

September, 2011. University of Virginia, American Politics Workshop.
October 2011. Massachusetts Institute of Technology, American Politics Conference.
January 2012. University of Chicago, Political Economy/American Politics Seminar.
February 2012. Harvard University, Positive Political Economy Seminar.
September 2012. Emory University, Political Institutions and Methodology Colloquium.
November 2012. University of Wisconsin, Madison, American Politics Workshop.
September 2013. Stanford University, Graduate School of Business, Political Economy Workshop.
February 2014. Princeton University, Center for the Study of Democratic Politics Workshop.
November 2014. Yale University, American Politics and Public Policy Workshop.
December 2014. American Constitution Society for Law & Policy Conference: Building the Evidence to Win Voting Rights Cases.
February 2015. University of Rochester, American Politics Working Group.
March 2015. Harvard University, Voting Rights Act Workshop.
May 2015. Harvard University, Conference on Political Geography.
Octoer 2015. George Washington University School of Law, Conference on Redistricting Reform.
September 2016. Harvard University Center for Governmental and International Studies, Voting Rights Institute Conference.
March 2017. Duke University, Sanford School of Public Policy, Redistricting Reform Conference.
October 2017. Willamette University, Center for Governance and Public Policy Research
October 2017, University of Wisconsin, Madison. Geometry of Redistricting Conference.
February 2018: University of Georgia Law School
September 2018. Willamette University.
November 2018. Yale University, Redistricting Workshop.

November 2018. University of Washington, Severyns Ravenholt Seminar in Comparative Politics.
January 2019. Duke University, Reason, Reform & Redistricting Conference.
February 2019. Ohio State University, Department of Political Science. Departmental speaker series.
March 2019. Wayne State University Law School, Gerrymandering Symposium.
November 2019. Big Data Ignite Conference.
November 2019. Calvin College, Department of Mathematics and Statistics.
September 2020 (Virtual). Yale University, Yale Law Journal Scholarship Workshop

Conference Service:

Section Chair, 2017 APSA (San Francisco, CA), Political Methodology Section
Discussant, 2014 Political Methodology Conference (University of Georgia)
Section Chair, 2012 MPSA (Chicago, IL), Political Geography Section.
Discussant, 2011 MPSA (Chicago, IL) "Presidential-Congressional Interaction."
Discussant, 2008 APSA (Boston, MA) "Congressional Appropriations."
Chair and Discussant, 2008 MPSA (Chicago, IL) "Distributive Politics: Parties and Pork."

Conference Presentations and Working Papers:

"Ideological Representation of Geographic Constituencies in the U.S. Bureaucracy," (with Tim Johnson). 2017 APSA.

"Incentives for Political versus Technical Expertise in the Public Bureaucracy," (with Tim Johnson). 2016 APSA.

"Black Electoral Geography and Congressional Districting: The Effect of Racial Redistricting on Partisan Gerrymandering". 2016 Annual Meeting of the Society for Political Methodology (Rice University)

"Racial Gerrymandering and Electoral Geography." Working Paper, 2016.

"Does Deserved Spending Win More Votes? Evidence from Individual-Level Disaster Assistance," (with Andrew Healy). 2014 APSA.

"The Geographic Link Between Votes and Seats: How the Geographic Distribution of Partisans Determines the Electoral Responsiveness and Bias of Legislative Elections," (with David Cottrell). 2014 APSA.

"Gerrymandering for Money: Drawing districts with respect to donors rather than voters." 2014 MPSA.

“Constituent Age and Legislator Responsiveness: The Effect of Constituent Opinion on the Vote for Federal Health Reform.” (with Katharine Bradley) 2012 MPSA.

“Voter Partisanship and the Mobilizing Effect of Presidential Advertising.” (with Kyle Dropp) 2012 MPSA.

“Recency Bias in Retrospective Voting: The Effect of Distributive Benefits on Voting Behavior.” (with Andrew Feher) 2012 MPSA.

“Estimating the Political Ideologies of Appointed Public Bureaucrats,” (with Adam Bonica and Tim Johnson) 2012 Annual Meeting of the Society for Political Methodology (University of North Carolina)

“Tobler’s Law, Urbanization, and Electoral Bias in Florida.” (with Jonathan Rodden) 2010 Annual Meeting of the Society for Political Methodology (University of Iowa)

“Unionization and Presidential Control of the Bureaucracy” (with Tim Johnson) 2011 MPSA.

“Estimating Bureaucratic Ideal Points with Federal Campaign Contributions” 2010 APSA. (Washington, DC).

“The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures,” Vanderbilt University Conference on Bicameralism, 2009.

“When Do Government Benefits Influence Voters’ Behavior? The Effect of FEMA Disaster Awards on US Presidential Votes,” 2009 APSA (Toronto, Canada).

“Are Poor Voters Easier to Buy Off?” 2009 APSA (Toronto, Canada).

“Credit Sharing Among Legislators: Electoral Geography’s Effect on Pork Barreling in Legislatures,” 2008 APSA (Boston, MA).

“Buying Votes with Public Funds in the US Presidential Election,” Poster Presentation at the 2008 Annual Meeting of the Society for Political Methodology (University of Michigan).

“The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures,” 2008 MPSA.

“Legislative Free-Riding and Spending on Pure Public Goods,” 2007 MPSA (Chicago, IL).

“Free Riding in Multi-Member Legislatures,” (with Neil Malhotra) 2007 MPSA (Chicago, IL).

“The Effect of Legislature Size, Bicameralism, and Geography on Government Spending: Evidence from the American States,” (with Neil Malhotra) 2006 APSA (Philadelphia, PA).

**Figure A1: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans:
Districts' Republican Vote Share Measured Using the 2016 Attorney General Election Results**

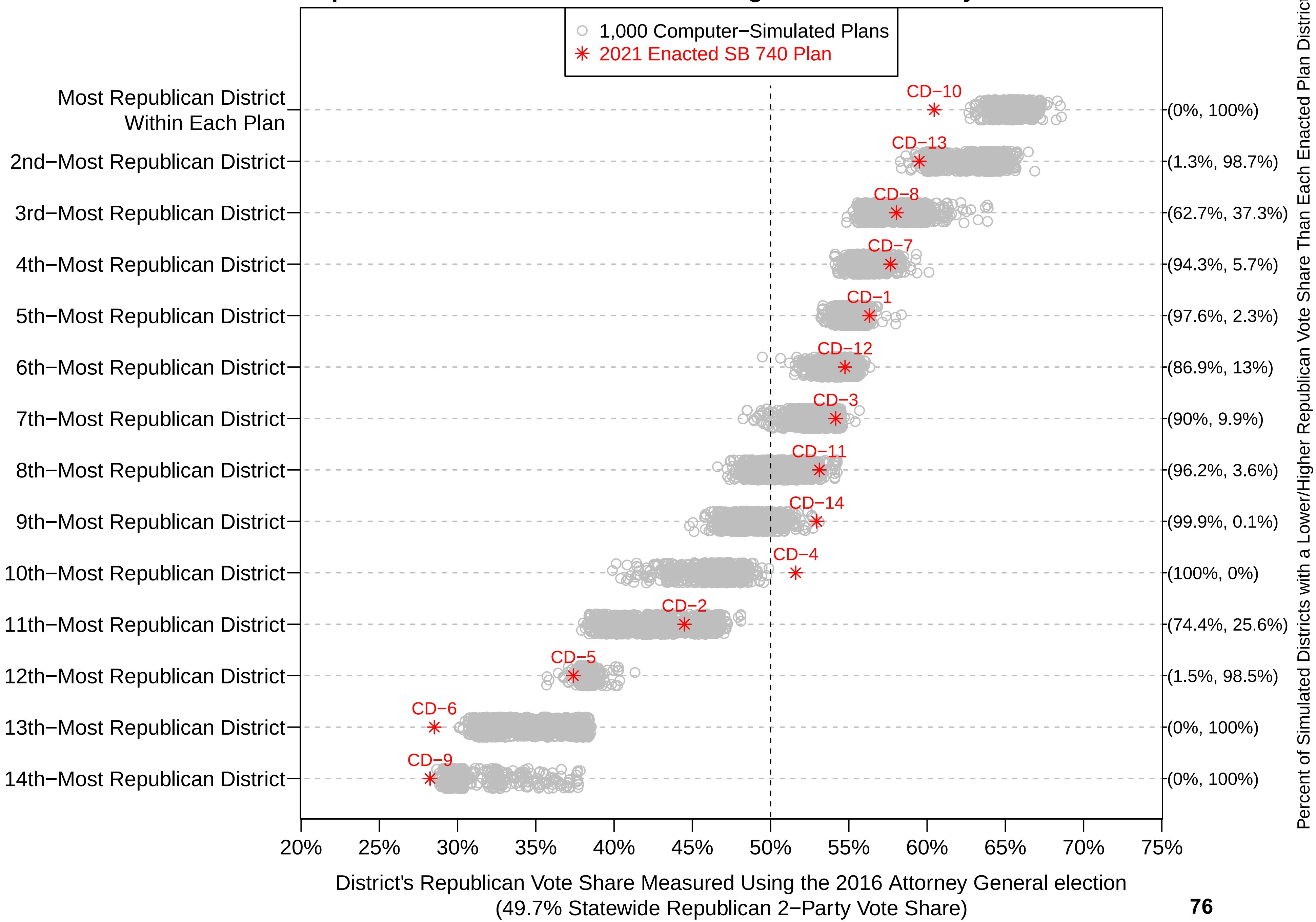


Figure A2: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Governor Election Results

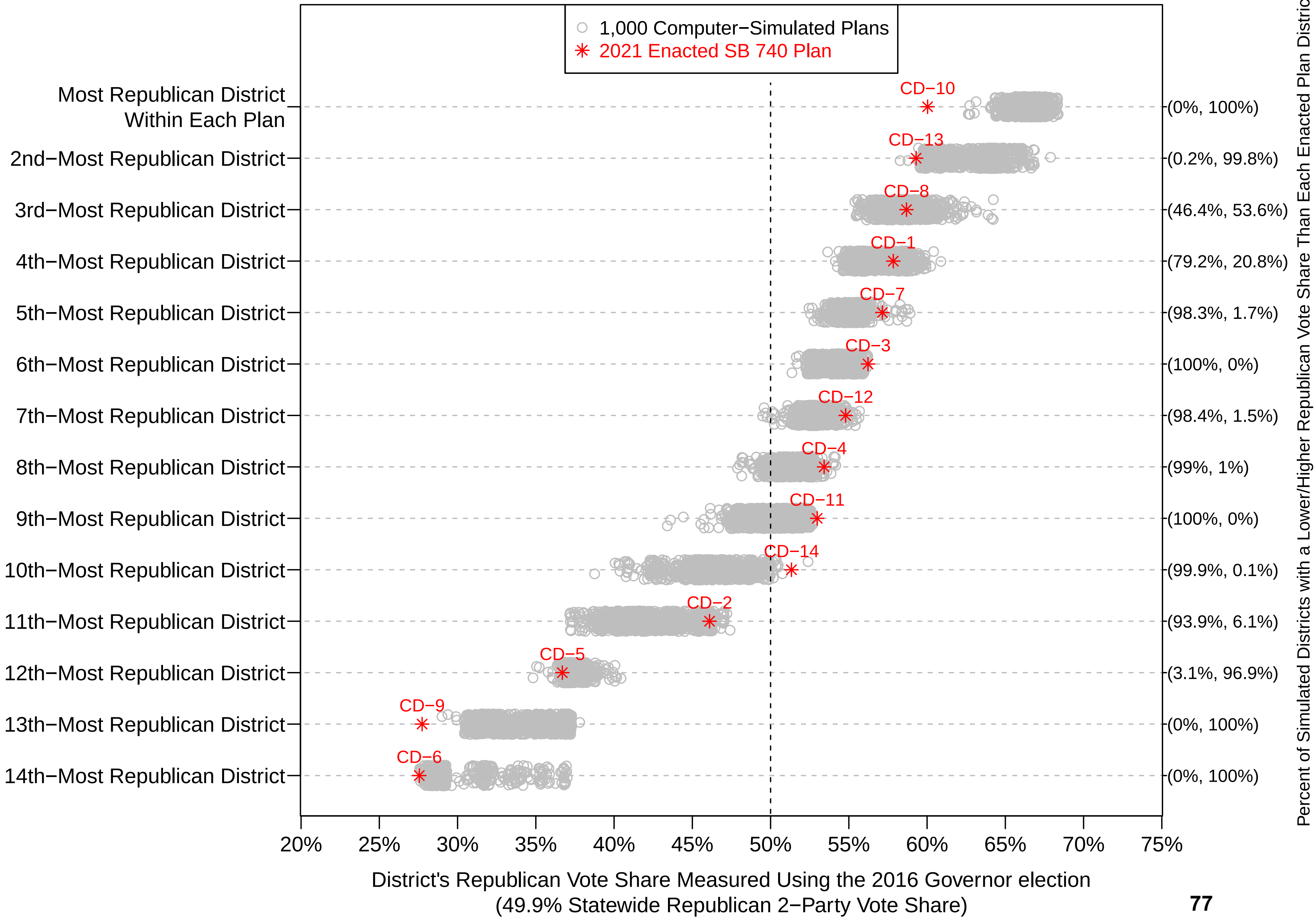


Figure A3: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 Lieutenant Governor Election Results

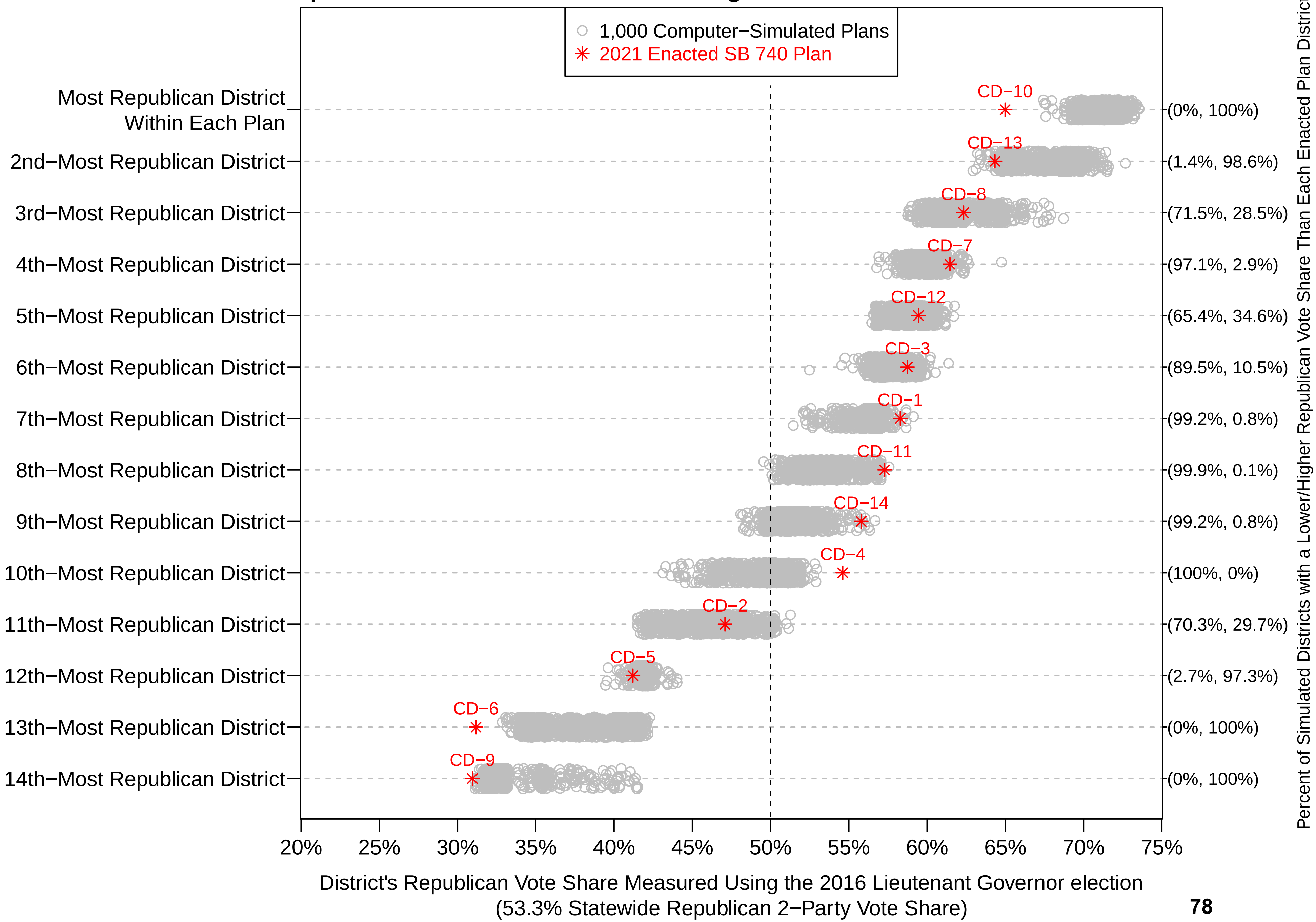


Figure A4: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US President Election Results

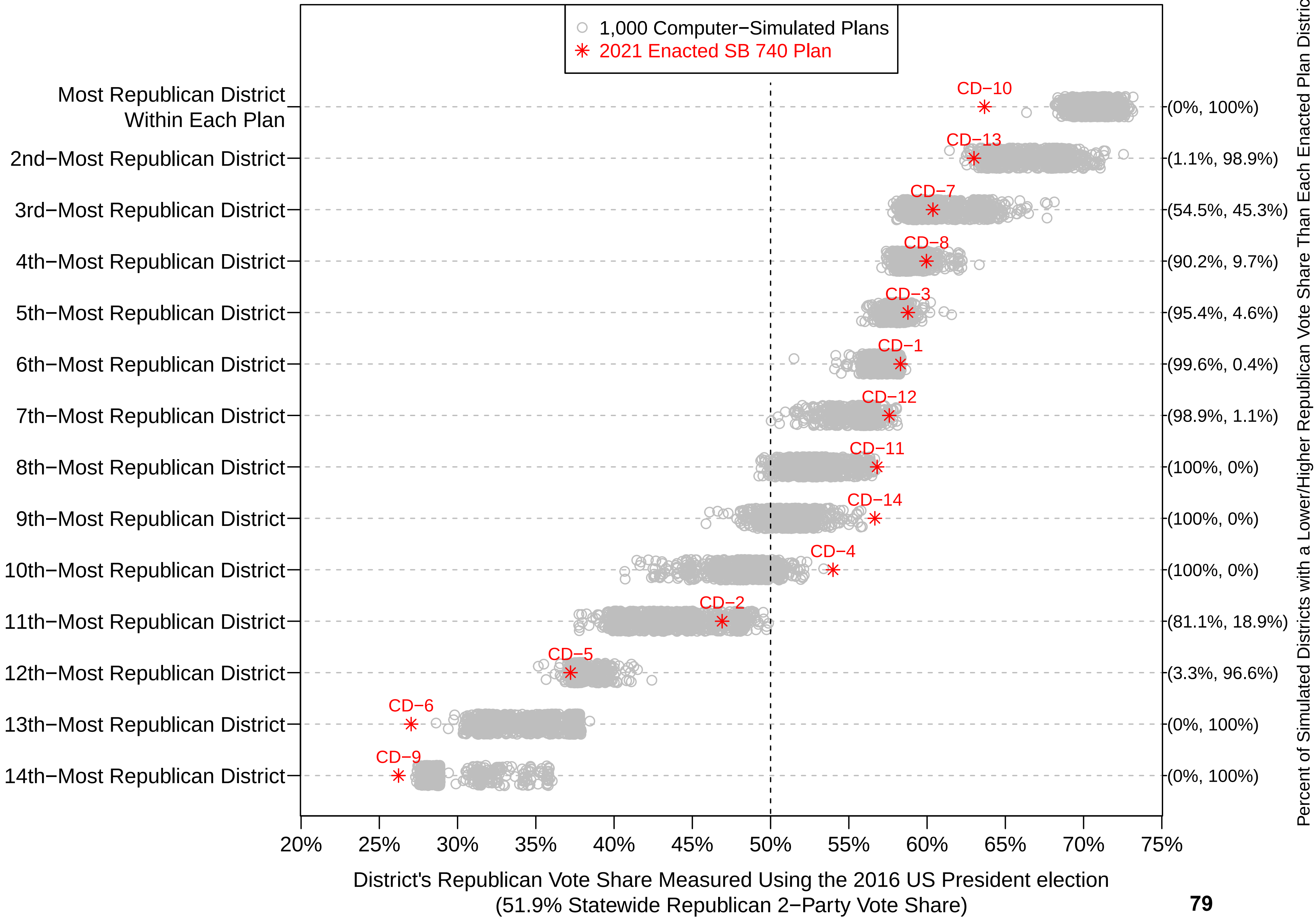


Figure A5: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2016 US Senator Election Results

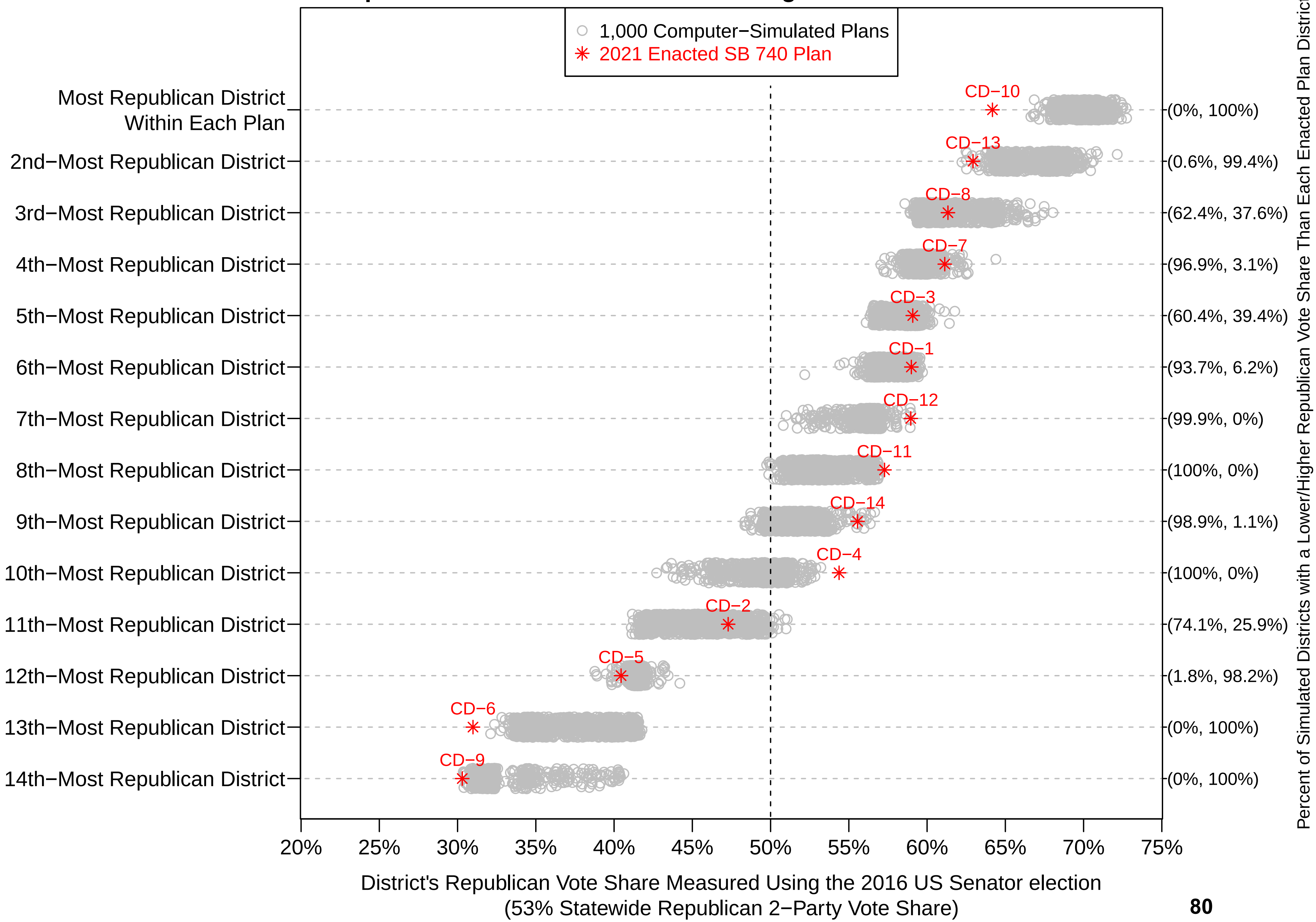


Figure A6: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Attorney General Election Results

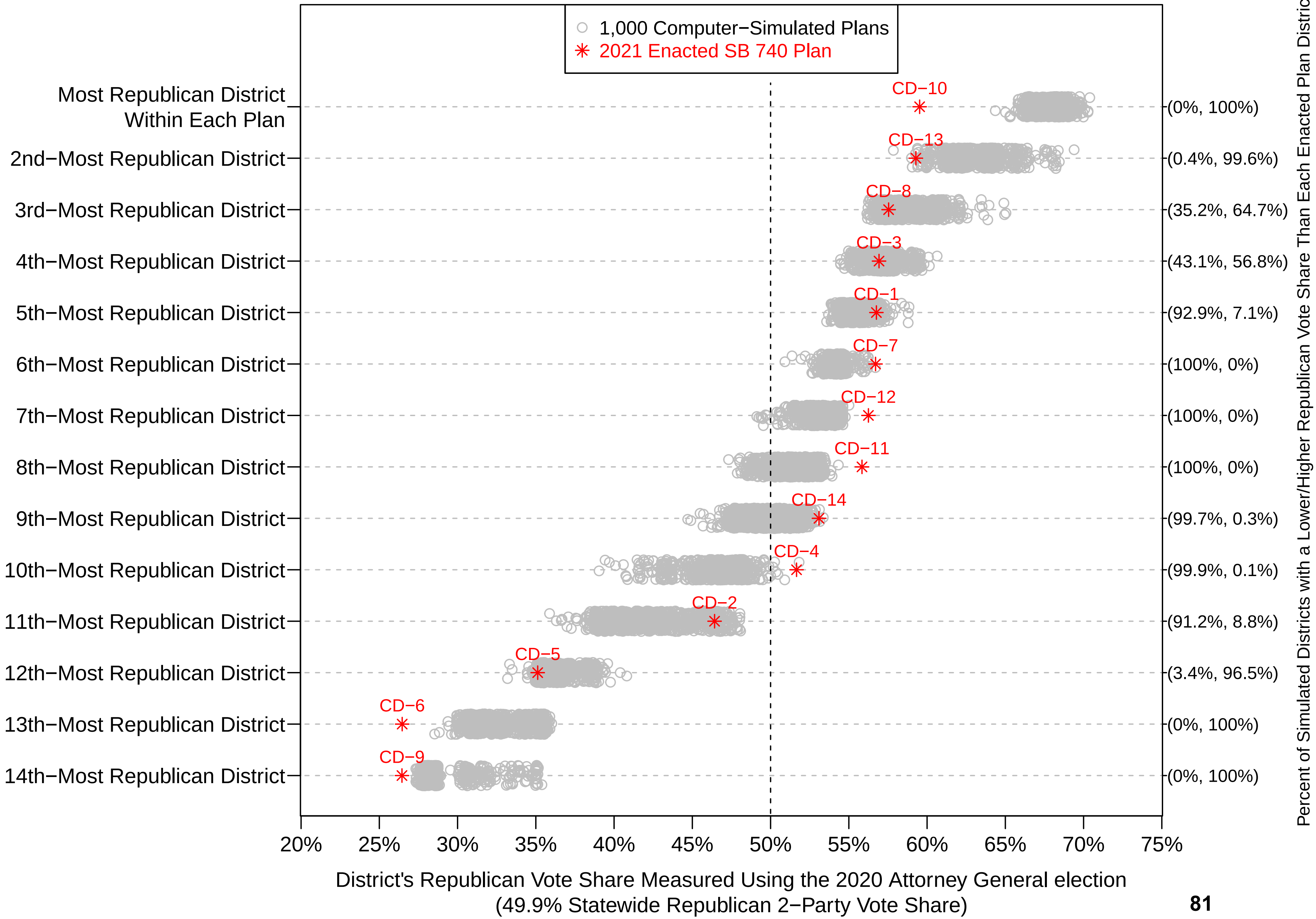


Figure A7: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Governor Election Results

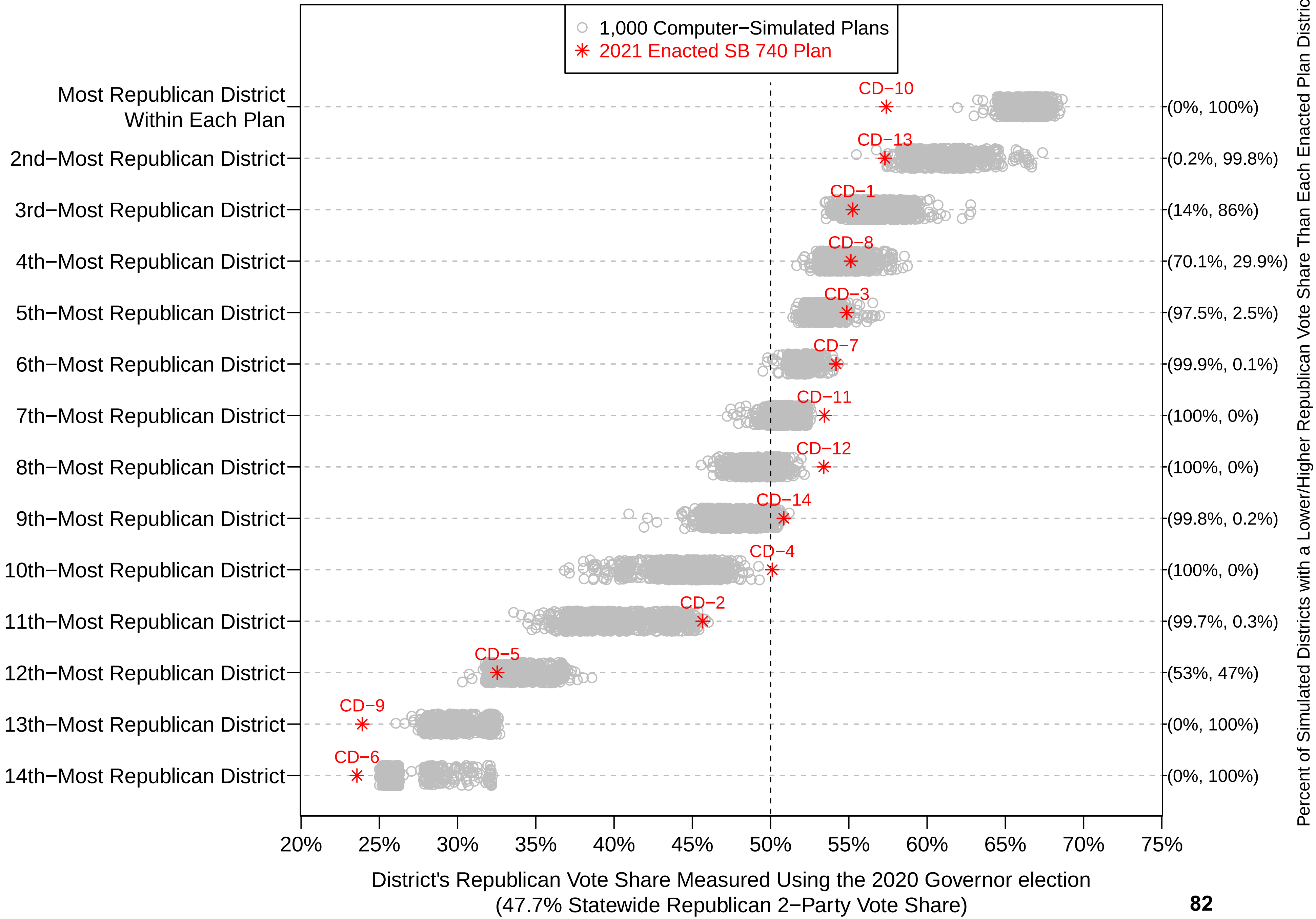


Figure A8: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 Lieutenant Governor Election Results

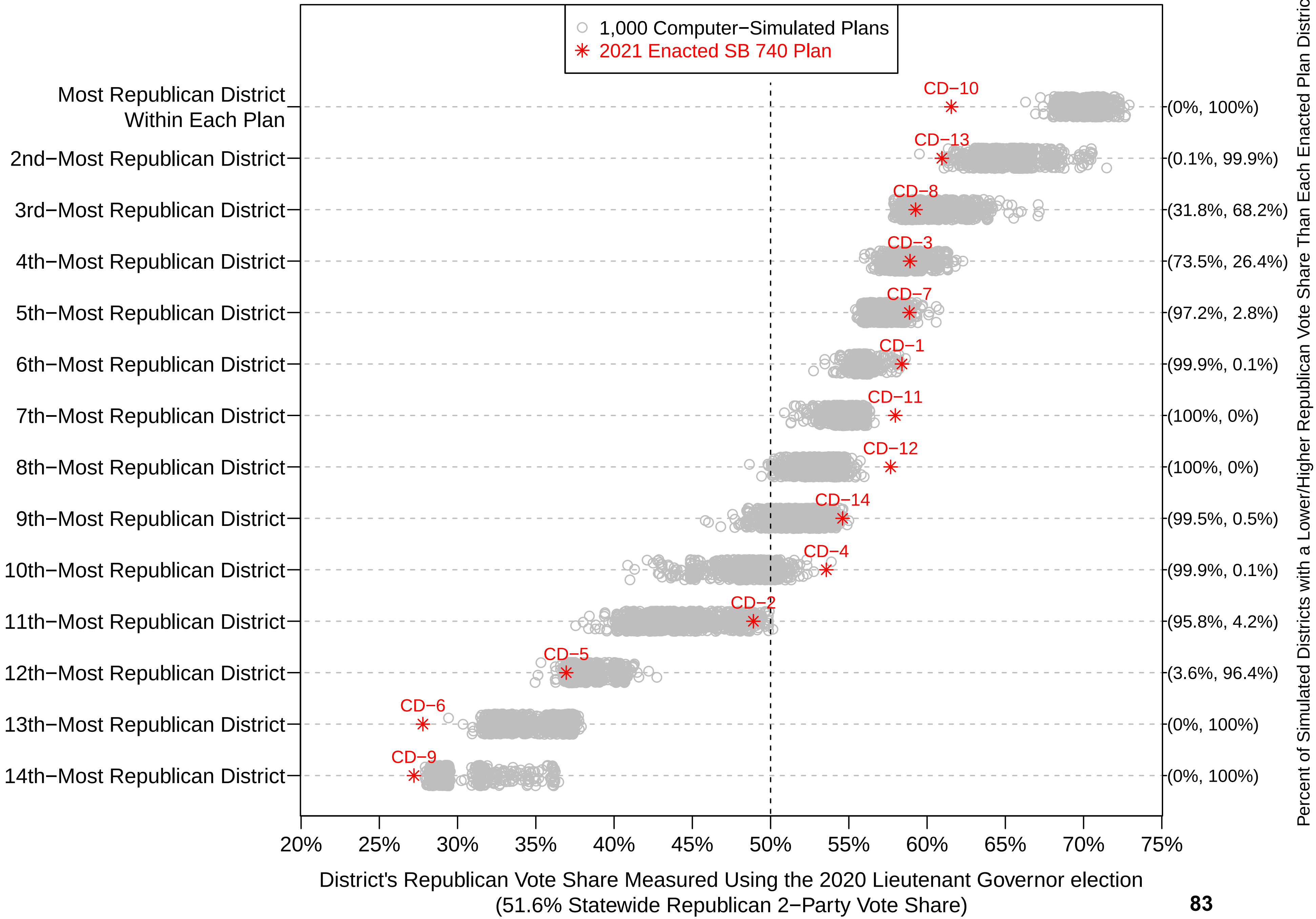


Figure A9: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US President Election Results

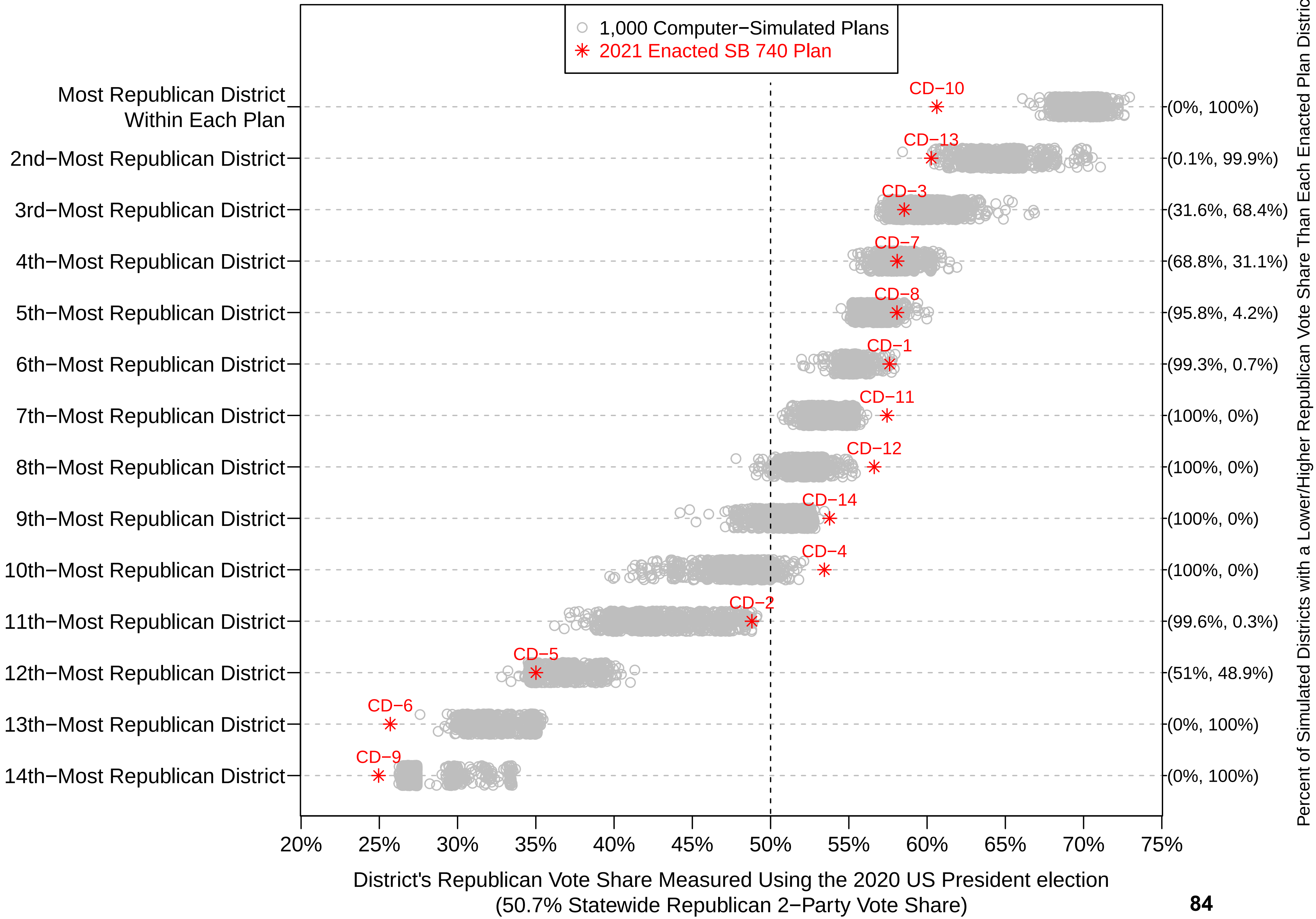


Figure A10: Comparison of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans: Districts' Republican Vote Share Measured Using the 2020 US Senator Election Results

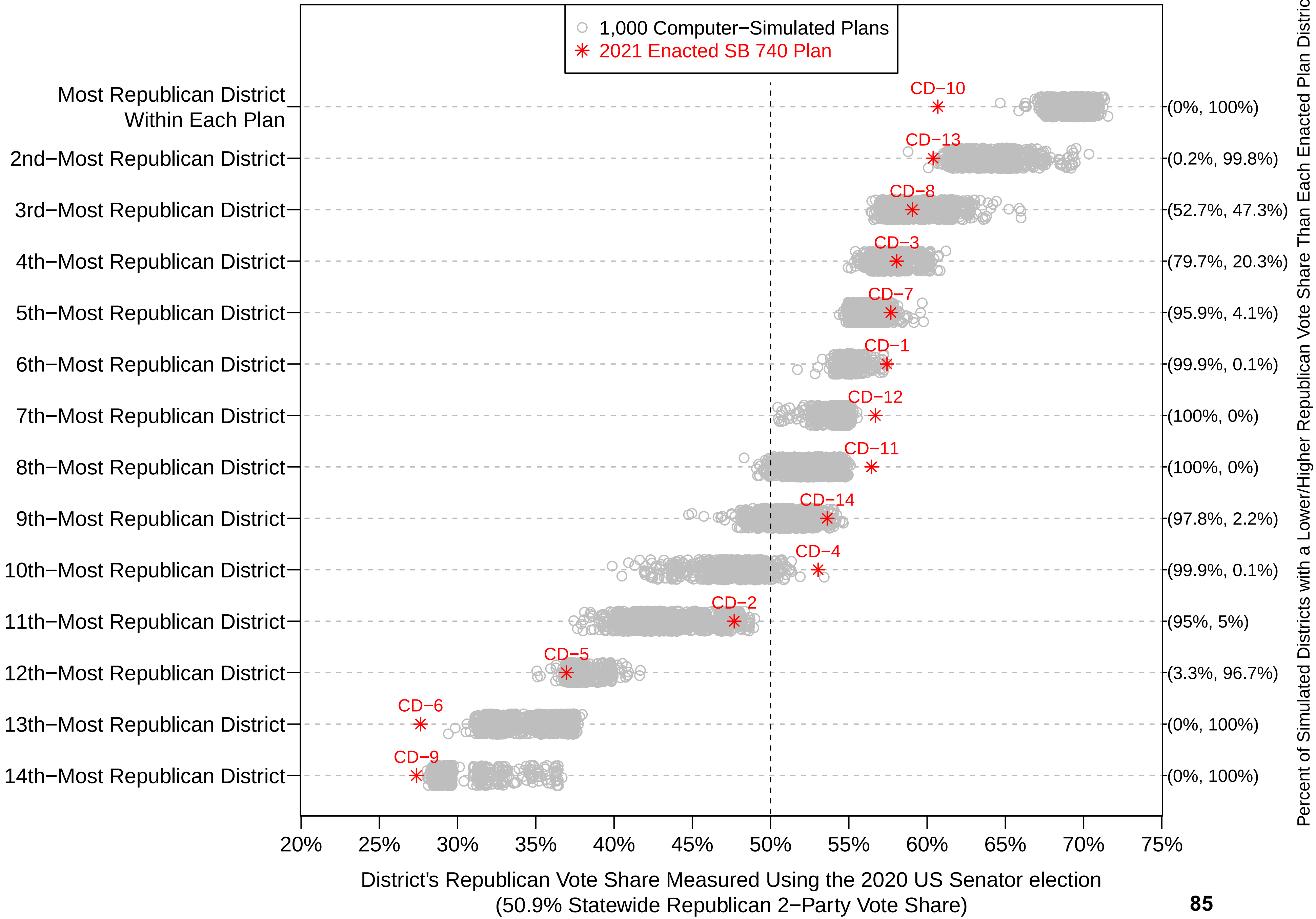


Figure B1: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 Attorney General election
(49.7% Statewide Republican 2−Party Vote Share)

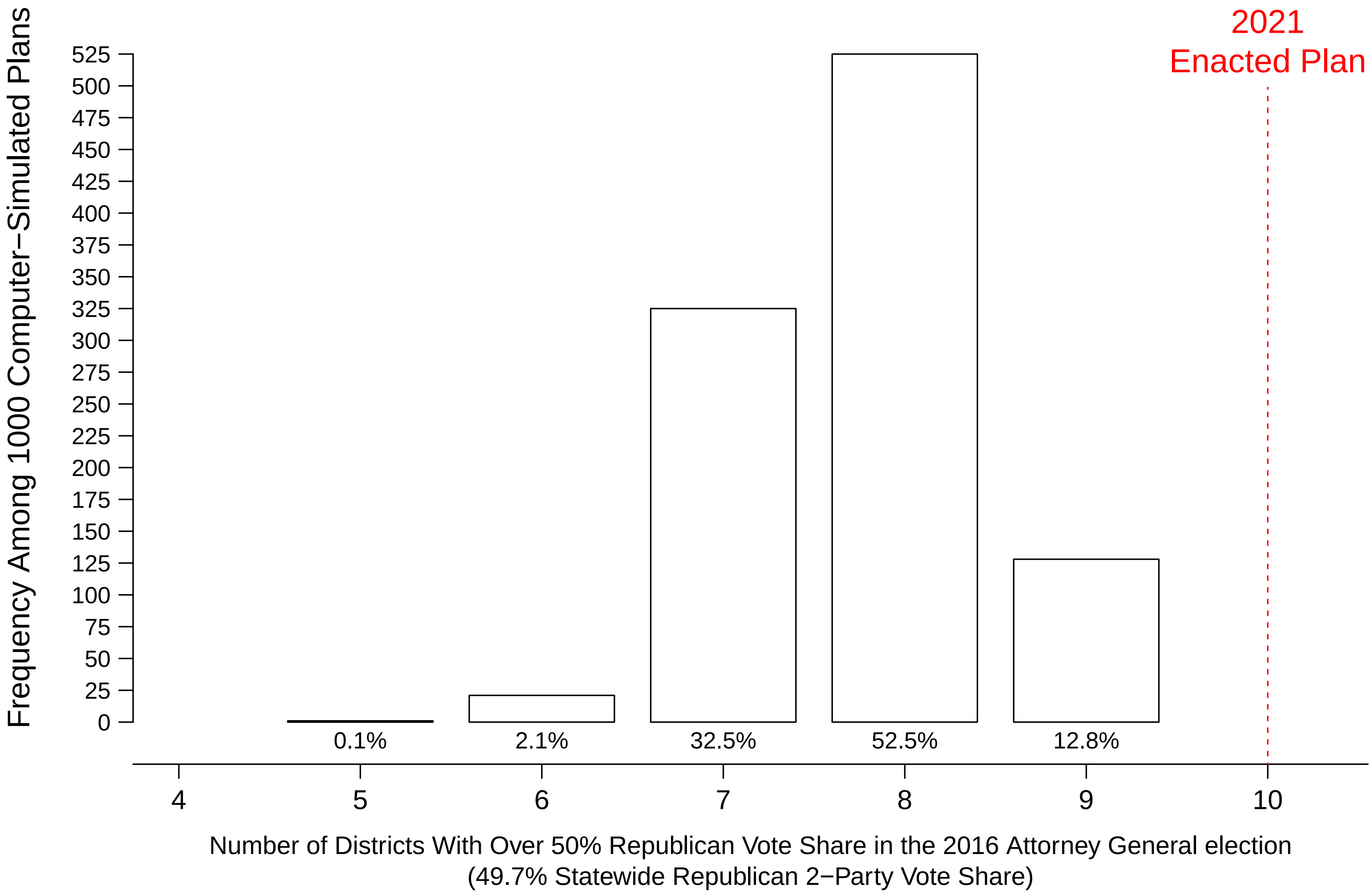


Figure B2: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 Governor election
(49.9% Statewide Republican 2−Party Vote Share)

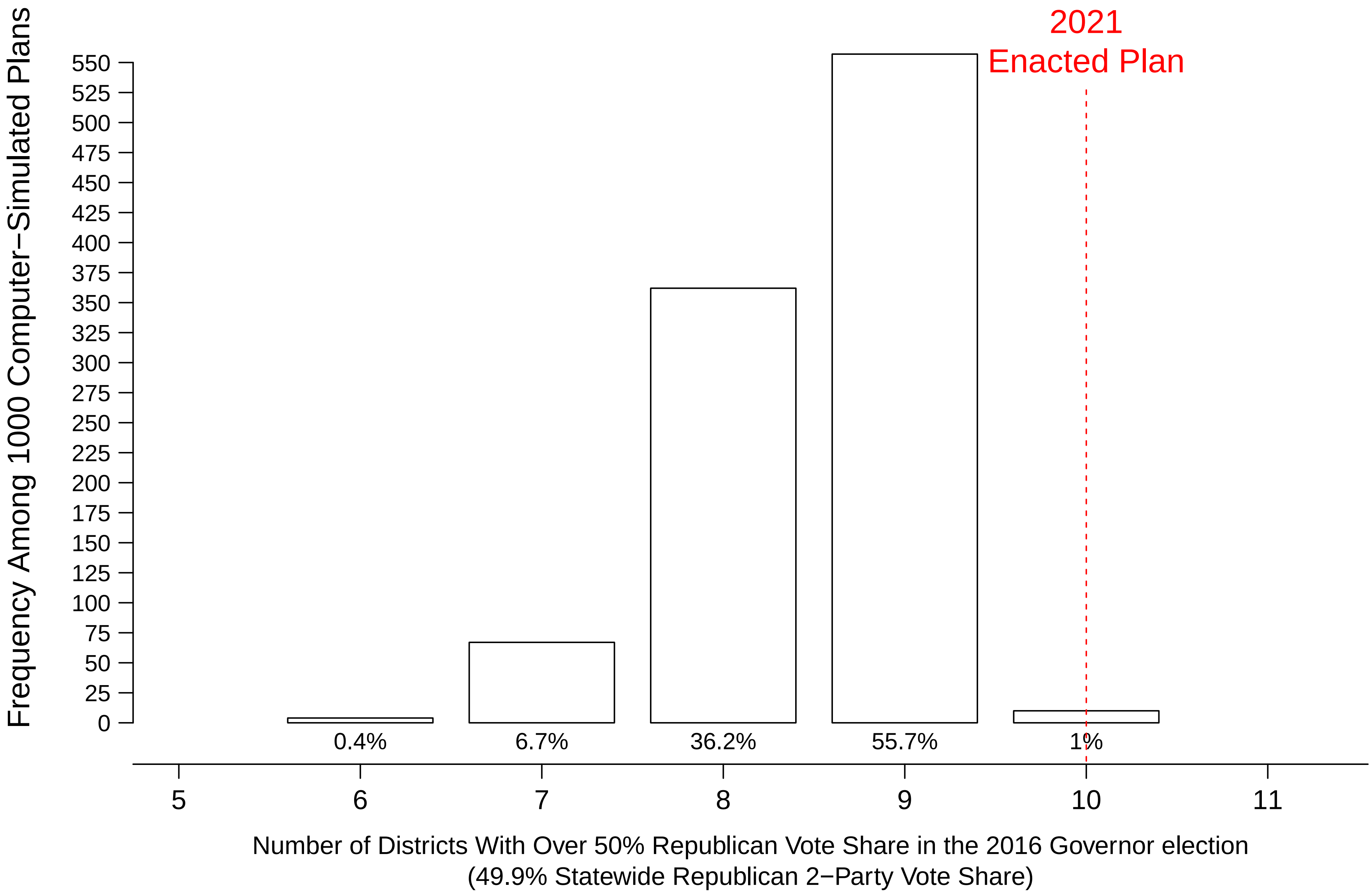


Figure B3: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 Lieutenant Governor election
(53.3% Statewide Republican 2−Party Vote Share)

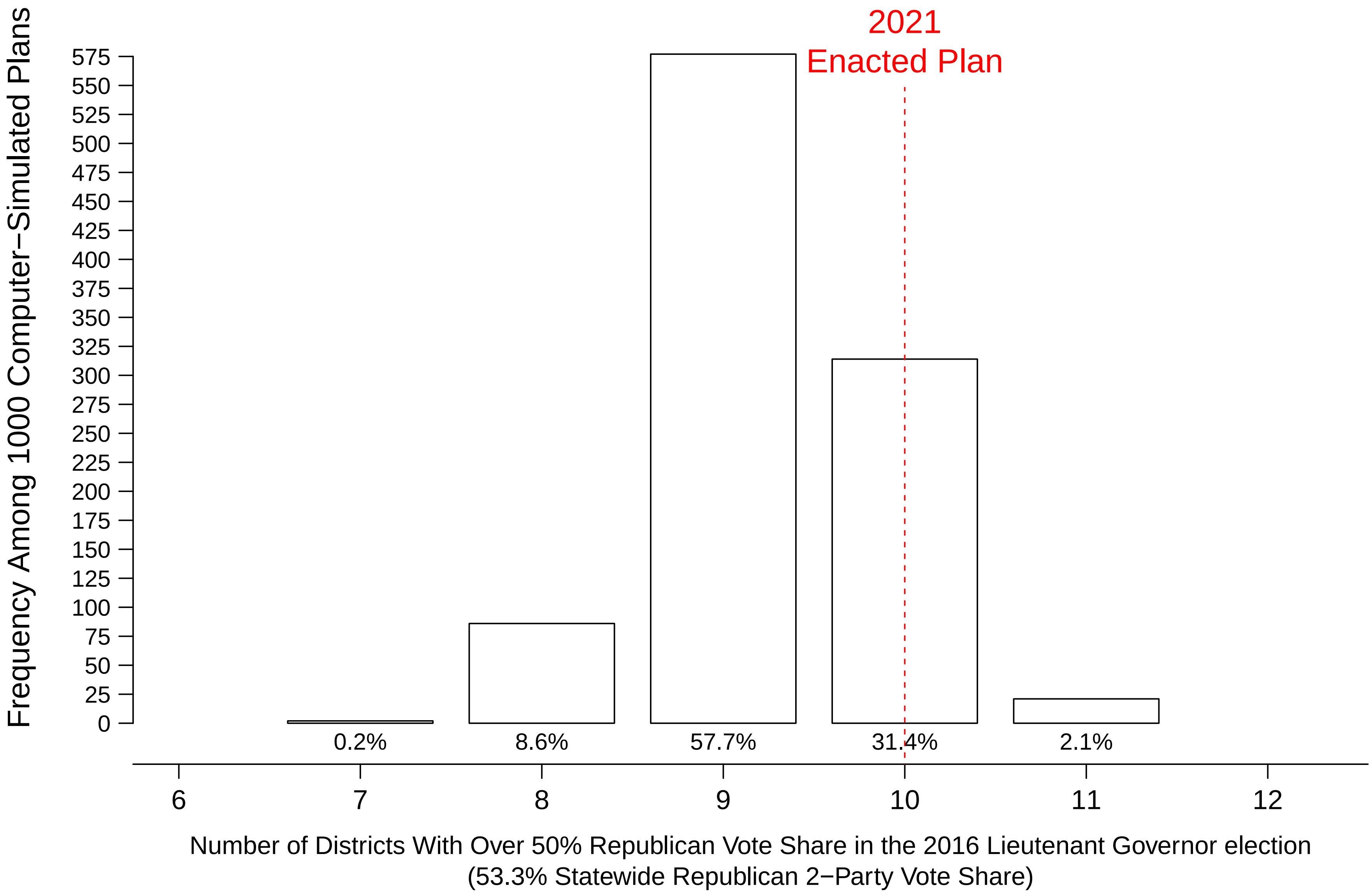


Figure B4: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 US President election
(51.9% Statewide Republican 2−Party Vote Share)

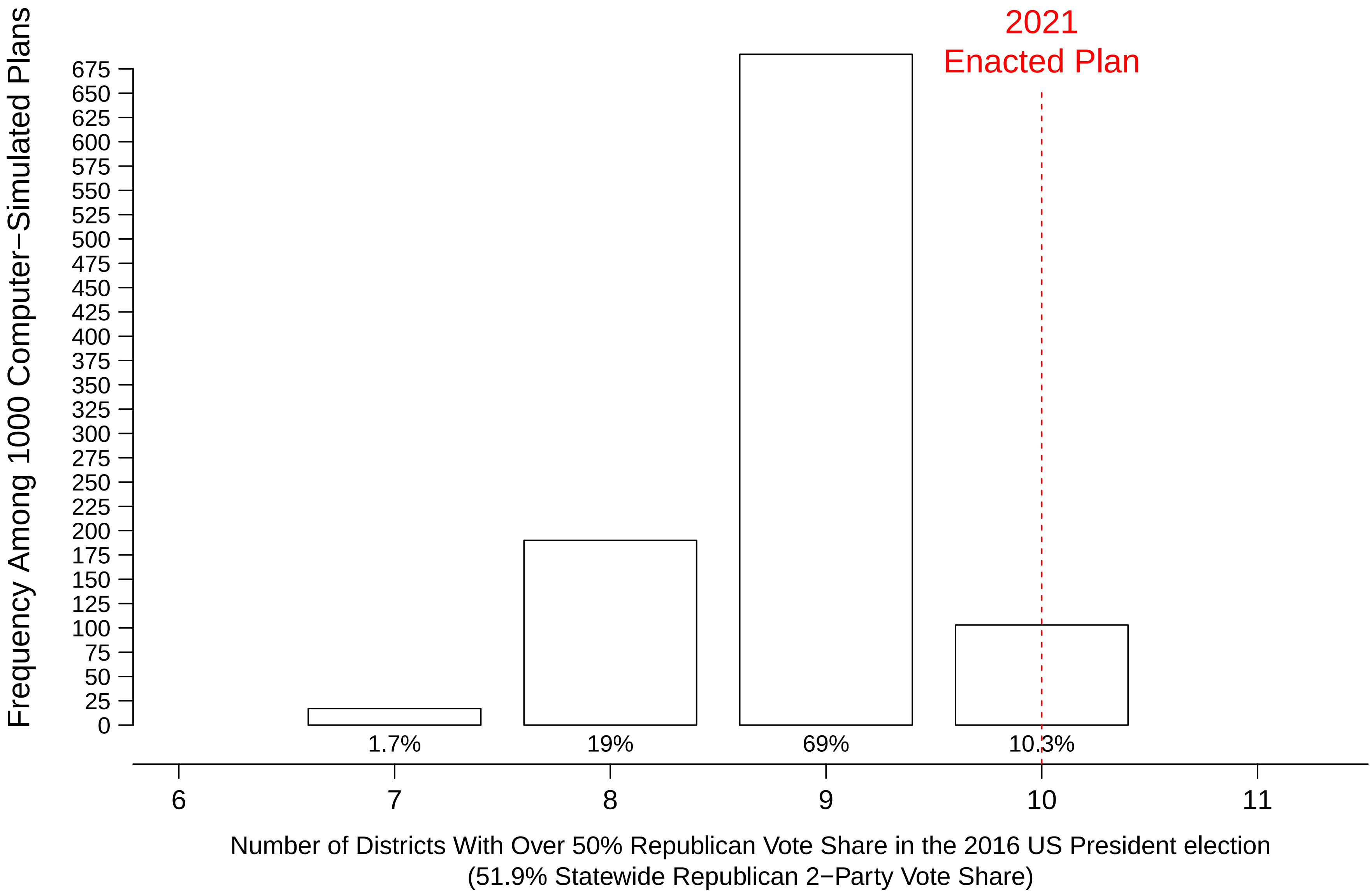


Figure B5: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2016 US Senator election
(53% Statewide Republican 2−Party Vote Share)

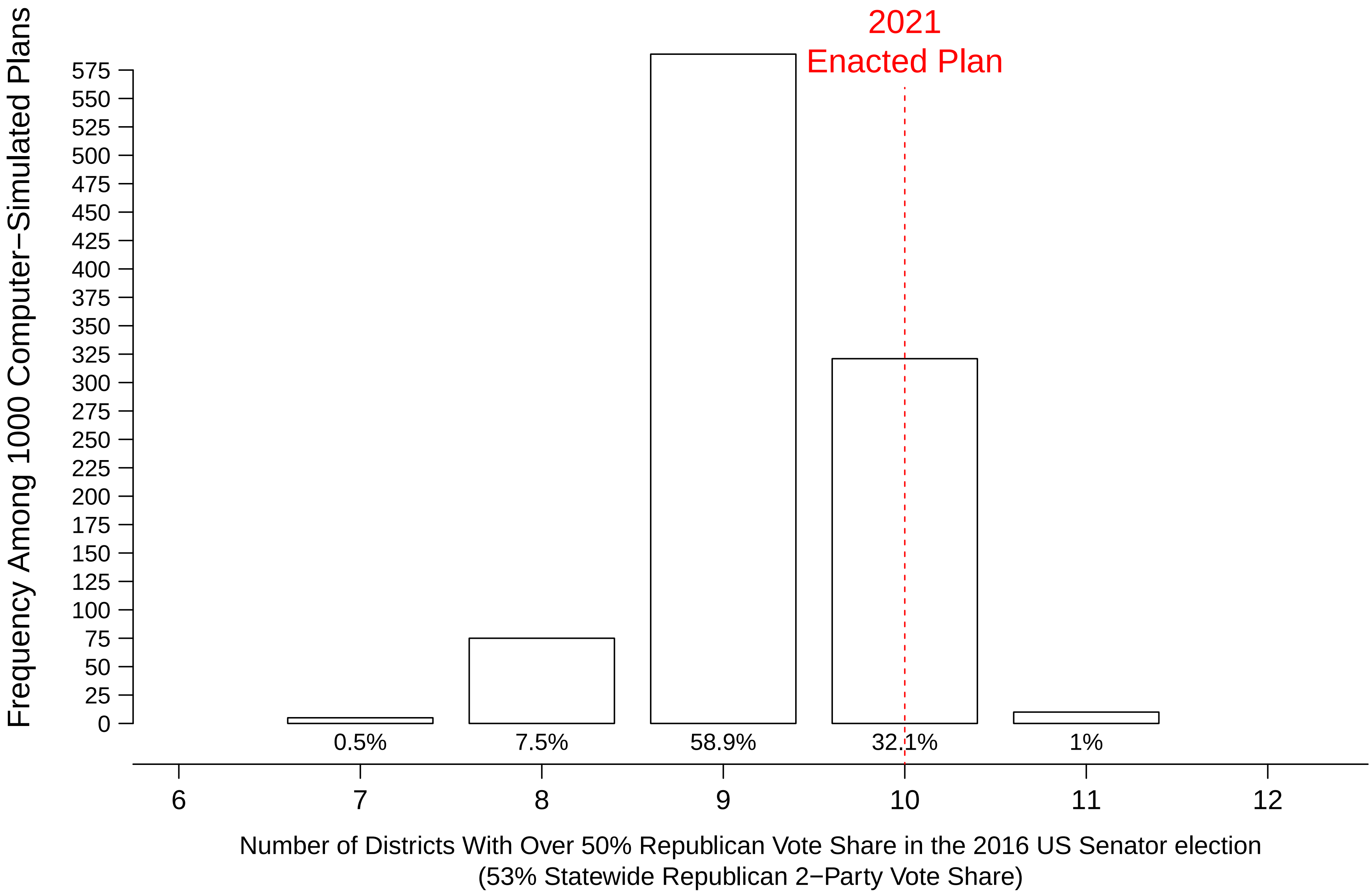


Figure B6: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 Attorney General election
(49.9% Statewide Republican 2−Party Vote Share)

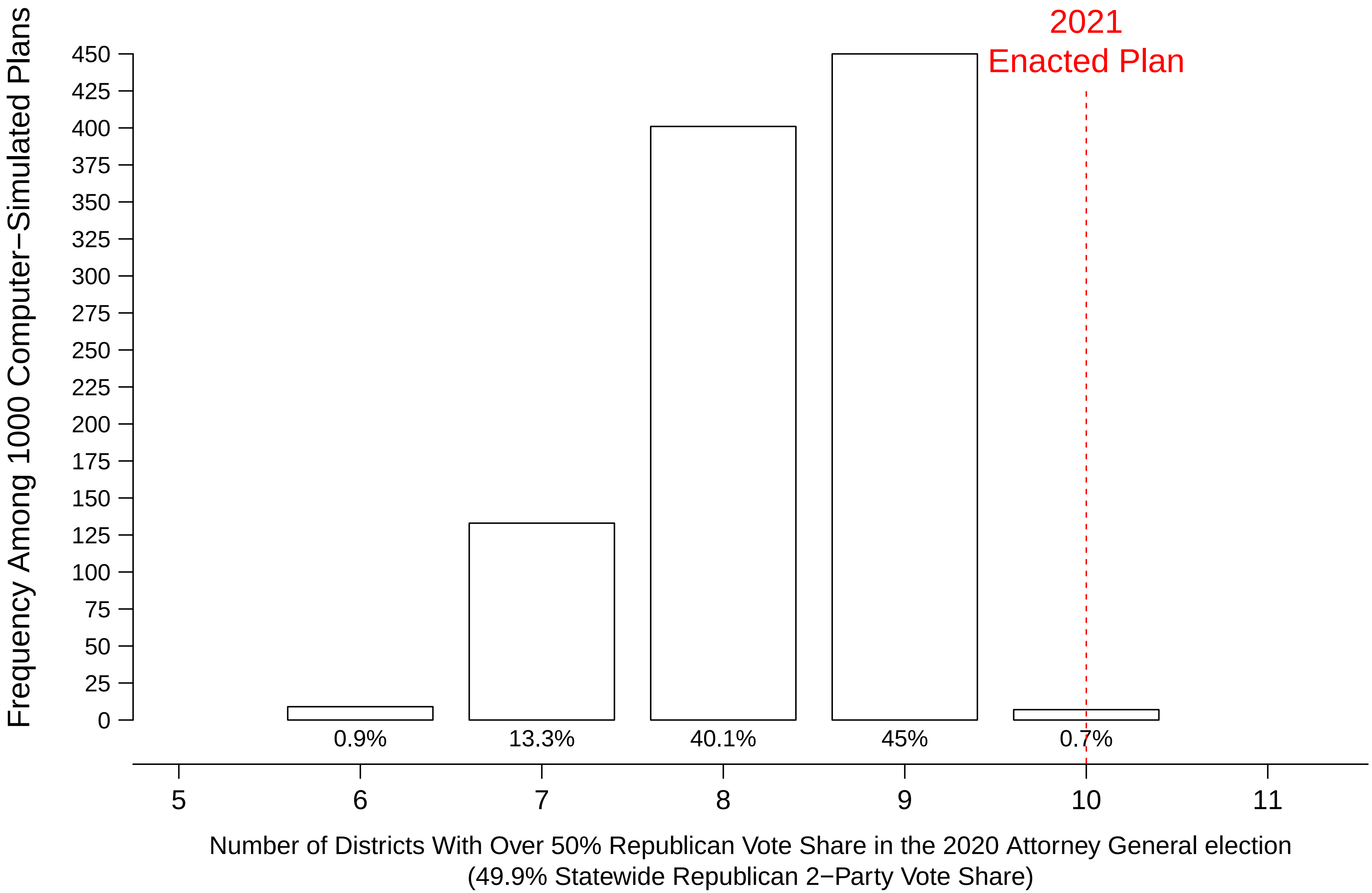


Figure B7: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 Governor election
(47.7% Statewide Republican 2−Party Vote Share)

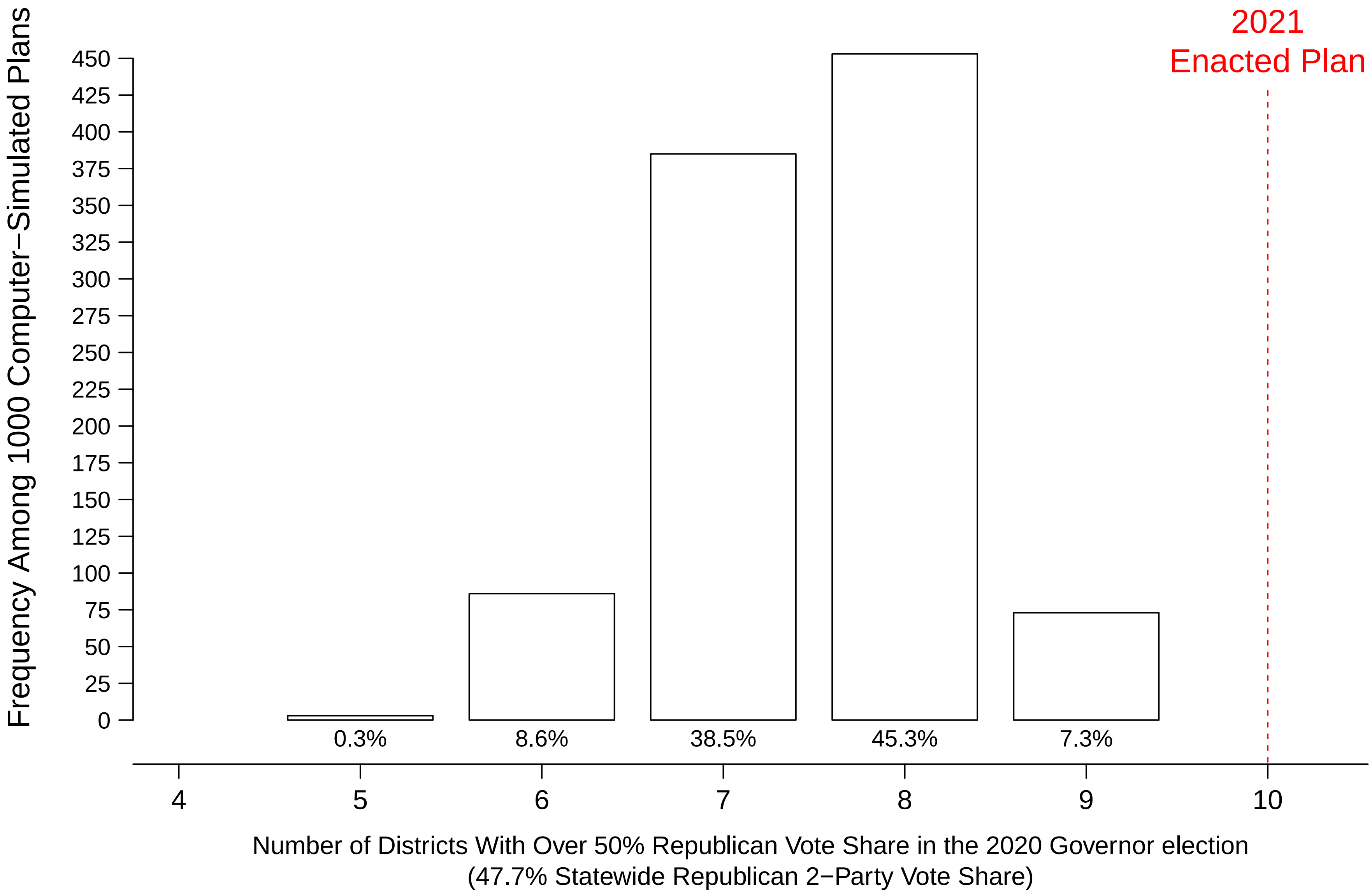


Figure B8: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 Lieutenant Governor election
(51.6% Statewide Republican 2−Party Vote Share)

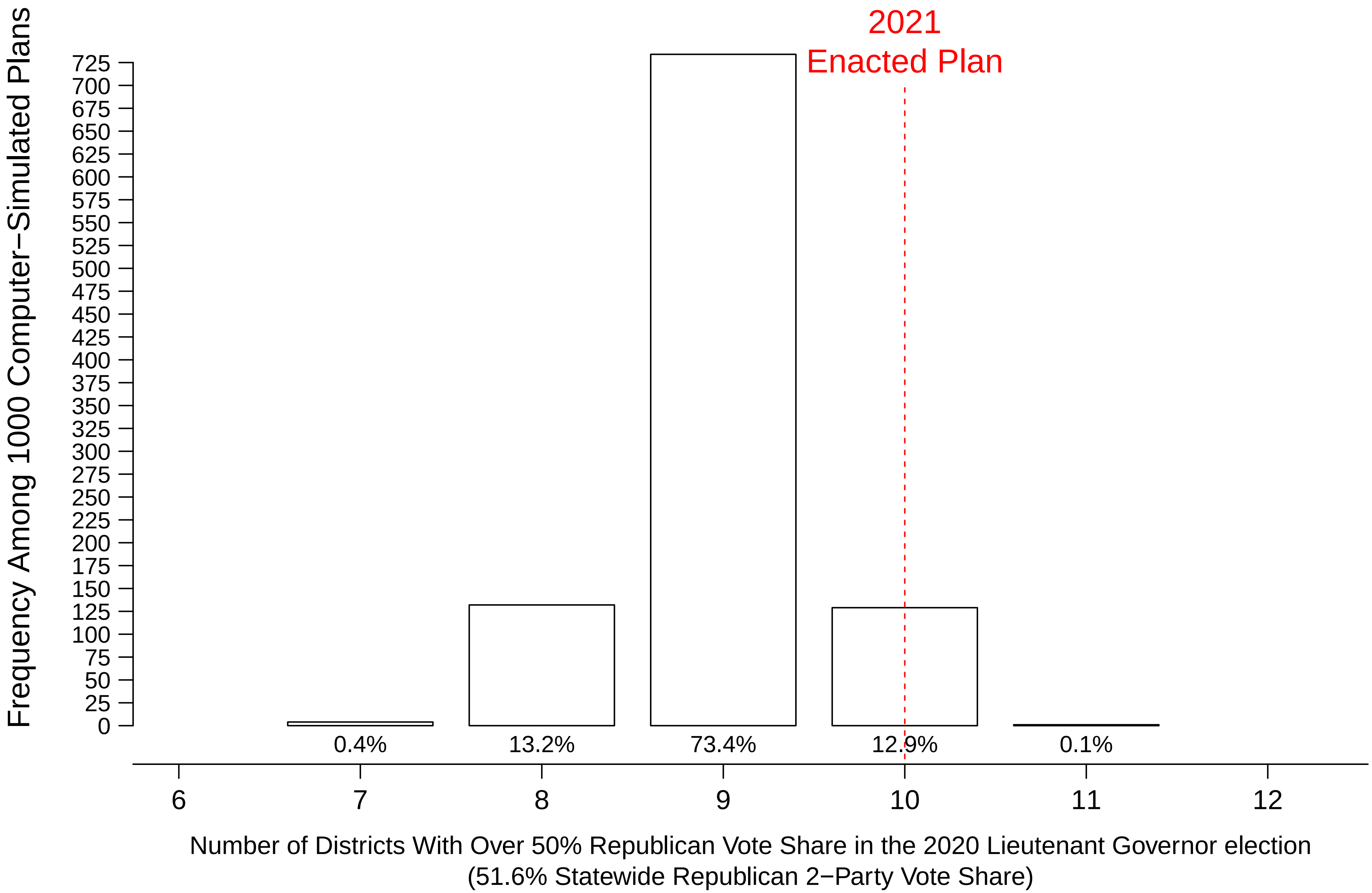


Figure B9: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 US President election
(50.7% Statewide Republican 2−Party Vote Share)

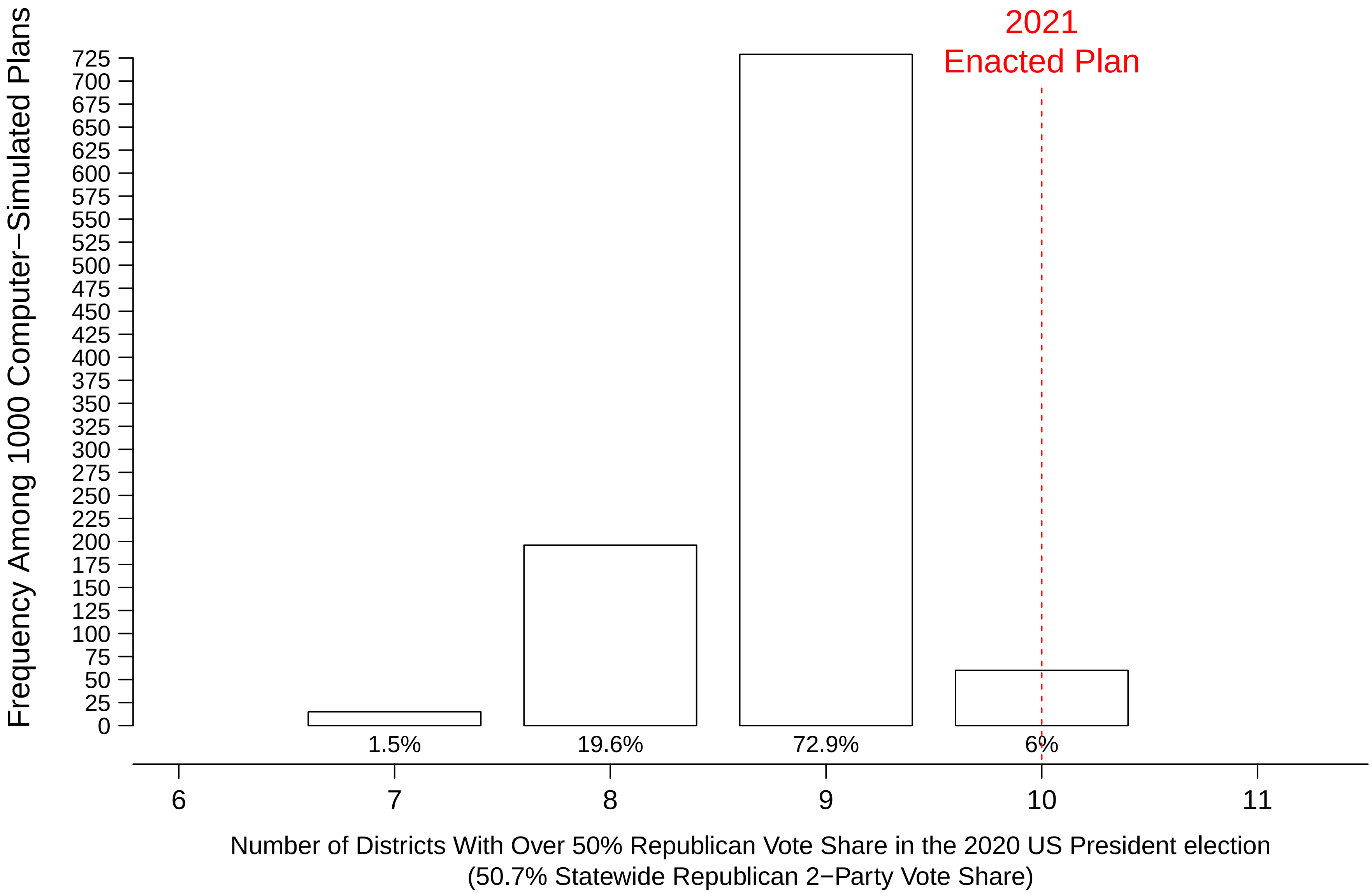
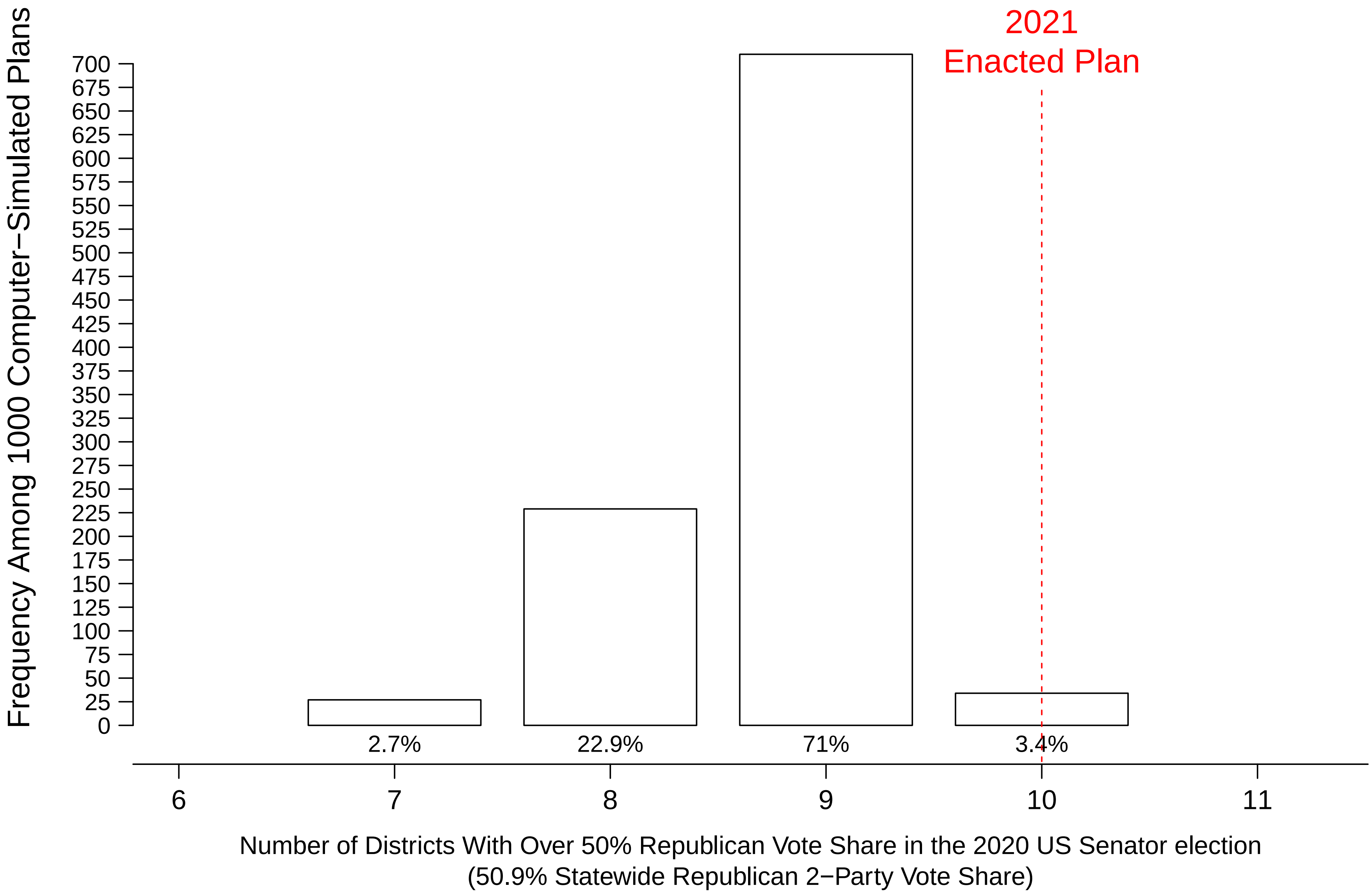


Figure B10: Comparisons of Enacted SB 740 Plan to 1,000 Computer−Simulated Plans
Number of Districts With Over 50% Republican Vote Share in the 2020 US Senator election
(50.9% Statewide Republican 2−Party Vote Share)



Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting

Senate Committee on Redistricting and Elections

Criteria Adopted by the Committees

- **Equal Population.** The Committees will use the 2020 federal decennial census data as the sole basis of population for the establishment of districts in the 2021 Congressional, House, and Senate plans. The number of persons in each legislative district shall be within plus or minus 5% of the ideal district population, as determined under the most recent federal decennial census. The number of persons in each congressional district shall be as nearly as equal as practicable, as determined under the most recent federal decennial census.

- **Contiguity.** No point contiguity shall be permitted in any 2021 Congressional, House, and Senate plan. Congressional, House, and Senate districts shall be compromised of contiguous territory. Contiguity by water is sufficient.

- **Counties, Groupings, and Traversals.** The Committees shall draw legislative districts within county groupings as required by *Stephenson v. Bartlett*, 355 N.C. 354, 562 S.E.2d 377 (2002) (*Stephenson I*), *Stephenson v. Bartlett*, 357 N.C. 301, 582 S.E.2d 247 (2003) (*Stephenson II*), *Dickson v. Rucho*, 367 N.C. 542, 766 S.E.2d 238 (2014) (*Dickson I*) and *Dickson v. Rucho*, 368 N.C. 481, 781 S.E. 2d 460 (2015) (*Dickson II*). Within county groupings, county lines shall not be traversed except as authorized by *Stephenson I*, *Stephenson II*, *Dickson I*, and *Dickson II*.

  Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking. If a county is of sufficient population size to contain an entire congressional district within the county's boundaries, the Committees shall construct a district entirely within that county.

- **Racial Data.** Data identifying the race of individuals or voters *shall not* be used in the construction or consideration of districts in the 2021 Congressional, House, and Senate plans. The Committees will draw districts that comply with the Voting Rights Act.

- **VTDs.** Voting districts ("VTDs") should be split only when necessary.

- **Compactness.** The Committees shall make reasonable efforts to draw legislative districts in the 2021 Congressional, House and Senate plans that are compact. In doing so, the Committee may use as a guide the minimum Reock ("dispersion") and Polsby-Popper ("permiter") scores identified by Richard H. Pildes and Richard G. Neimi in *Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances After Shaw v. Reno*, 92 Mich. L. Rev. 483 (1993).

- **Municipal Boundaries.** The Committees may consider municipal boundaries when drawing districts in the 2021 Congressional, House, and Senate plans.

Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

- **Election Data.** Partisan considerations and election results data *shall not* be used in the drawing of districts in the 2021 Congressional, House, and Senate plans.

- **Member Residence.** Member residence may be considered in the formation of legislative and congressional districts.

- **Community Consideration.** So long as a plan complies with the foregoing criteria, local knowledge of the character of communities and connections between communities may be considered in the formation of legislative and congressional districts.

– Ex. 10244 –

UNDERLYING DATA MARKED CONFIDENTIAL PURSUANT TO PROTECTIVE ORDER

plan	minpop	maxpop	vtdfiles	spctys	MultSpCtys	spmcds	spmcds.pop	ctyfrags	reockt	polsbyt	EG	UniformRS	RepAvgRshare	DemAvgRshare
1	745670	745671	13	11	2	16	9	113	0.451598	0.368981	0.123858	9	0.576322912	0.385205
2	745670	745671	13	12	1	13	6	113	0.473078	0.369956	0.123206	8	0.573767106	0.389411
3	745670	745671	13	13	0	15	8	113	0.466139	0.40947	0.123595	9	0.576855434	0.383602
4	745670	745671	13	11	2	14	8	113	0.444955	0.356721	-0.00508	7	0.585423012	0.430114
5	745670	745671	13	12	1	19	12	113	0.455168	0.36863	0.12505	9	0.579788901	0.378505
6	745670	745671	13	13	0	17	10	113	0.42915	0.375784	0.052713	8	0.578997141	0.412833
7	745670	745671	13	11	2	15	10	113	0.434711	0.345747	0.120592	9	0.572096291	0.393221
8	745670	745671	13	13	0	14	7	113	0.448675	0.380979	0.051565	8	0.584649886	0.404882
9	745670	745671	13	12	1	17	8	113	0.450791	0.387667	0.061978	7	0.587527791	0.402069
10	745670	745671	13	13	0	20	10	113	0.458141	0.382791	0.124854	9	0.576709477	0.383416
11	745670	745671	13	13	0	18	11	113	0.490733	0.394943	0.122432	9	0.578779984	0.382426
12	745670	745671	13	12	1	15	10	113	0.448991	0.373575	0.123017	9	0.57476168	0.387811
13	745670	745671	13	13	0	19	12	113	0.458365	0.356362	0.058234	7	0.589603032	0.400915
14	745670	745671	13	11	2	18	10	113	0.4503	0.369854	0.124428	9	0.577650996	0.382124
15	745670	745671	13	11	2	14	8	113	0.446939	0.386295	0.124272	8	0.574909271	0.386239
16	745670	745671	13	13	0	12	9	113	0.398264	0.371668	-0.01375	7	0.591666384	0.42437
17	745670	745671	13	12	1	21	11	113	0.444344	0.370409	0.054485	8	0.586838752	0.401075
18	745670	745671	13	12	1	14	9	113	0.467452	0.386806	0.124472	8	0.572034295	0.391641
19	745670	745671	13	11	2	16	9	113	0.471702	0.3817	0.120926	9	0.585903562	0.370406
20	745670	745671	13	12	1	20	10	113	0.465981	0.384393	0.122871	9	0.579341574	0.380626
21	745670	745671	13	12	1	17	7	113	0.449144	0.341959	0.125851	8	0.579878614	0.379971
22	745670	745671	13	13	0	16	10	113	0.432873	0.37709	0.051776	8	0.582871824	0.408624
23	745670	745671	13	12	1	18	10	113	0.472299	0.40113	0.198437	9	0.565878849	0.361159
24	745670	745671	13	11	2	15	7	113	0.451495	0.388321	0.123597	9	0.579298288	0.380828
25	745670	745671	13	12	1	12	8	113	0.479381	0.375814	0.061189	8	0.587468173	0.401943
26	745670	745671	13	13	0	16	10	113	0.457356	0.39312	0.125028	8	0.577114607	0.382849
27	745670	745671	13	11	2	14	10	113	0.463381	0.389102	0.122611	8	0.573586236	0.390718
28	745670	745671	13	12	1	14	10	113	0.485343	0.381439	0.121112	9	0.58074861	0.379848
29	745670	745671	13	13	0	12	9	113	0.452769	0.392097	0.052862	8	0.584169737	0.405136
30	745670	745671	13	12	1	18	11	113	0.429639	0.388181	0.050512	8	0.589462863	0.40304
31	745670	745671	13	13	0	13	9	113	0.452633	0.38089	0.052568	6	0.579059453	0.413415
32	745670	745671	13	10	2	14	9	113	0.470985	0.361236	0.06191	8	0.577716243	0.415797
33	745670	745671	13	13	0	18	9	113	0.437634	0.371785	0.059451	6	0.57584438	0.417614
34	745670	745671	13	11	2	13	10	113	0.460115	0.390439	0.059271	8	0.590751212	0.398589
35	745670	745671	13	11	2	21	11	113	0.498416	0.401525	0.121171	9	0.580742211	0.378724
36	745670	745671	13	11	1	15	9	113	0.47408	0.344794	0.051621	8	0.588467787	0.401933
37	745670	745671	13	11	2	17	9	113	0.48169	0.406629	0.123041	9	0.579349047	0.380269
38	745670	745671	13	12	1	12	6	113	0.461164	0.3856	0.050487	8	0.596226461	0.390969
39	745670	745671	13	12	1	16	8	113	0.479616	0.381897	0.120506	9	0.582169834	0.376489
40	745670	745671	13	12	1	17	10	113	0.456482	0.388028	0.125507	8	0.575338856	0.385815
41	745670	745671	13	11	2	13	8	113	0.494513	0.39027	0.124892	9	0.576184131	0.385383
42	745670	745671	13	11	2	20	11	113	0.450422	0.378294	0.12349	8	0.576496776	0.384103
43	745670	745671	13	11	2	19	11	113	0.486411	0.399242	0.120752	9	0.580141527	0.379823
44	745670	745671	13	11	2	14	8	113	0.455092	0.389074	0.062488	8	0.585804741	0.403019
45	745670	745671	13	12	1	17	9	113	0.460302	0.355968	0.123827	8	0.58094118	0.375879
46	745670	745671	13	13	0	16	11	113	0.475082	0.414792	0.122771	8	0.575715854	0.386091
47	745670	745671	13	12	1	20	10	113	0.465288	0.37099	0.123198	9	0.578563784	0.381008
48	745670	745671	13	11	1	16	10	113	0.448176	0.377506	0.053257	8	0.584671851	0.405165
49	745670	745671	13	13	0	17	8	113	0.449124	0.380929	0.12319	8	0.575065581	0.385724
50	745670	745671	13	11	1	15	8	113	0.439466	0.390797	0.054909	8	0.589565872	0.401074
51	745670	745671	13	12	1	13	9	113	0.467009	0.388952	-0.0132	7	0.607080708	0.406783
52	745670	745671	13	11	2	18	7	113	0.446946	0.39588	0.130049	9	0.583037442	0.374383
53	745670	745671	13	11	2	17	9	113	0.447747	0.382293	0.121676	9	0.581095366	0.378245
54	745670	745671	13	13	0	21	12	113	0.470365	0.381818	0.05006	8	0.584583319	0.405117
55	745670	745671	13	12	1	16	10	113	0.412638	0.369436	0.053962	8	0.577821051	0.415573
56	745670	745671	13	11	2	17	9	113	0.465053	0.378856	0.127811	9	0.573859437	0.387534
57	745670	745671	13	13	0	15	9	113	0.437101	0.377419	0.048809	8	0.588911595	0.39916
58	745670	745671	13	12	1	18	11	113	0.464748	0.388411	0.123261	9	0.57686807	0.384642
59	745670	745671	13	13	0	16	8	113	0.460024	0.394053	0.053289	8	0.58679219	0.403236
60	745670	745671	13	13	0	15	11	113	0.432395	0.360416	0.123617	9	0.576499352	0.385665
61	745670	745671	13	13	0	22	14	113	0.487971	0.400658	0.122297	8	0.5761864	0.384076
62	745670	745671	13	10	3	18	10	113	0.45624	0.383595	0.050392	8	0.583850869	0.406109
63	745670	745671	13	11	2	16	7	113	0.461436	0.389992	0.124117	9	0.579674854	0.38075
64	745670	745671	13	12	1	19	10	113	0.452561	0.368514	0.051995	8	0.583657594	0.407489
65	745670	745671	13	11	2	14	7	113	0.424129	0.369994	0.051578	8	0.580598166	0.412968
66	745670	745671	13	11	2	17	10	113	0.442097	0.385935	0.121727	9	0.576449679	0.386761
67	745670	745671	13	13	0	15	10	113	0.495022	0.40831	0.060699	8	0.585141159	0.404219
68	745670	745671	13	12	1	23	13	113	0.456271	0.3699	0.127249	9	0.578054623	0.380428
69	745670	745671	13	11	2	18	11	113	0.503898	0.39642	0.123296	9	0.580073814	0.378938
70	745670	745671	13	13	0	13	9	113	0.455826	0.388966	-0.0148	7	0.599802916	0.416186
71	745670	745671	13	13	0	19	12	113	0.463677	0.379981	0.060345	8	0.591434118	0.396472
72	745670	745671	13	11	1	17	12	113	0.420705	0.376546	0.123615	8	0.573746675	0.389299
73	745670	745671	13	13	0	17	11	113	0.495735	0.37753	0.123905	8	0.57718091	0.382987
74	745670	745671	13	13	0	16	9	113	0.49013	0.391282	0.060533	8	0.585728015	0.403886
75	745670	745671	13	12	1	16	10	113	0.497628	0.393222	0.122087	9	0.57849926	0.383558
76	745670	745671	13	13	0	20	10	113	0.465352	0.387211	0.199775	7	0.563447219	0.36473
77	745670	745671	13	12	1	14	7	113	0.448912	0.380523	0.064054	7	0.590506962	0.397017
78	745670	745671	13	12	1	16	14	113	0.487288	0.38772	0.121373	8	0.58148434	0.377209
79	745670	745671	13	12	1	20	10	113	0.480785	0.373321	0.194505	9	0.572134438	0.351485
80	745670	745671	13	13	0	14	11	113	0.507466	0.399775	0.121374	8	0.577361472	0.384885
81	745670	745671	13	12	1	13	10	113	0.475872	0.41134	0.058595	8	0.594455513	0.39108
82	745670	745671	13	13	0	17	10	113	0.449896	0.369507	0.125394	9	0.576541334	0.38363
83	745670	745671	13	13	0	14	9	113	0.466033	0.364632	0.123551	8	0.579277793	0.380011
84	745670	745671	13	12	1	15	8	113	0.46442	0.381868	0.122507	8	0.577539225	0.381514
85	745670	745671	13	12	1	12	7	113	0.460785	0.372957	0.121531	7	0.573777236	0.389839
86	745670	745671	13	13	0	18	11	113	0.457358	0.398851	0.122241	9	0.5791577	0.379961
87	745670	745671	13	12	1	17	9	113	0.459274	0.389985	0.124133	7	0.574369117	0.386134
88	745670	745671	13	12	1	12	7	113	0.4551	0.38472	0.123812	9	0.575741591	0.386465
89	745670	745671	13	10	3	13	7	113	0.441896	0.36982	0.124725	9	0.576543291	0.383412
90	745670	745671	13	12	1	18	10	113	0.444239	0.380978	0.051721	8	0.583545644	0.407754
91	745670	745671	13	12	1	16	11	113	0.477051	0.376497	0.196779	9	0.567432581	0.359663
92	745670	745671	13	13	0	17	12	113	0.44311	0.39376	0.057612	8	0.590939615	0.397142
93	745670	745671	13	12	1	19	10	113	0.471822	0.354637	0.120583	9	0.578037664	0.383274

NCLCV v. Hall
21 CVS 15426
LDTX156

Exhibit #
CHEN 5
12/29/2021 - JNC

UNDERLYING DATA MARKED CONFIDENTIAL PURSUANT TO PROTECTIVE ORDER

94	745670	745671	13	12	1	18	12	113	0.429327	0.36355	0.121962	8	0.575930239	0.385378
95	745670	745671	13	13	0	20	13	113	0.499463	0.376849	0.121643	9	0.577277312	0.384725
96	745670	745671	13	12	1	18	11	113	0.480896	0.373453	0.123801	8	0.575886998	0.388047
97	745670	745671	13	12	1	18	10	113	0.45747	0.397251	0.194283	10	0.566320682	0.362957
98	745670	745671	13	13	0	18	11	113	0.429722	0.402545	0.05768	8	0.590288198	0.398202
99	745670	745671	13	13	0	14	8	113	0.45132	0.371385	0.127227	7	0.57392208	0.386843
100	745670	745671	13	13	0	17	7	113	0.428701	0.375525	0.12368	9	0.57126668	0.394086
101	745670	745671	13	13	0	16	10	113	0.460368	0.384228	0.062475	7	0.587686011	0.400636
102	745670	745671	13	12	1	15	10	113	0.429454	0.359261	0.052244	8	0.58076674	0.412177
103	745670	745671	13	11	2	18	10	113	0.465424	0.38744	0.120407	8	0.581409143	0.377644
104	745670	745671	13	11	1	13	8	113	0.460876	0.399031	0.058633	8	0.594361513	0.392792
105	745670	745671	13	12	1	20	11	113	0.456133	0.386603	0.124497	8	0.575232029	0.384864
106	745670	745671	13	13	0	13	9	113	0.466484	0.362037	0.124756	9	0.576821371	0.383198
107	745670	745671	13	12	1	20	9	113	0.482322	0.397196	-0.00878	7	0.598324444	0.416614
108	745670	745671	13	11	2	15	10	113	0.456283	0.346618	0.192783	10	0.567845441	0.359532
109	745670	745671	13	13	0	16	10	113	0.487426	0.40014	0.121229	9	0.576797	0.385112
110	745670	745671	13	13	0	17	12	113	0.483376	0.402657	0.122294	9	0.578672629	0.382429
111	745670	745671	13	11	2	20	8	113	0.463703	0.3854	0.120711	9	0.585055068	0.371752
112	745670	745671	13	13	0	14	8	113	0.460863	0.375648	0.123588	9	0.576412998	0.38608
113	745670	745671	13	11	2	16	10	113	0.49101	0.389311	0.063401	8	0.578647942	0.413389
114	745670	745671	13	13	0	19	9	113	0.440912	0.391895	0.123776	9	0.574896798	0.386903
115	745670	745671	13	11	2	13	7	113	0.517116	0.394697	-0.00689	7	0.591775284	0.42323
116	745670	745671	13	12	1	18	9	113	0.496485	0.403019	0.05647	8	0.59042485	0.398597
117	745670	745671	13	12	1	11	7	113	0.496856	0.379188	0.123099	9	0.580407431	0.379296
118	745670	745671	13	12	1	18	8	113	0.475209	0.382935	0.121784	9	0.577314586	0.385171
119	745670	745671	13	13	0	14	9	113	0.500623	0.390103	0.122329	8	0.577836186	0.382305
120	745670	745671	13	13	0	16	12	113	0.473505	0.414056	0.123557	9	0.575855784	0.38523
121	745670	745671	13	11	2	14	9	113	0.49473	0.402864	0.125152	9	0.580257974	0.37751
122	745670	745671	13	12	1	13	9	113	0.450011	0.361801	0.052014	8	0.585857783	0.404869
123	745670	745671	13	12	1	17	7	113	0.457113	0.377069	0.121184	8	0.579655596	0.380908
124	745670	745671	13	12	1	16	8	113	0.443977	0.362548	0.124525	7	0.576647089	0.383396
125	745670	745671	13	13	0	17	9	113	0.477246	0.395172	0.122359	8	0.574639352	0.388006
126	745670	745671	13	12	1	14	9	113	0.456446	0.389391	0.123734	8	0.572328914	0.390328
127	745670	745671	13	13	0	19	10	113	0.463465	0.399441	0.121668	8	0.579543589	0.380083
128	745670	745671	13	12	1	13	5	113	0.447754	0.374131	0.123316	9	0.574036558	0.391672
129	745670	745671	13	11	1	15	9	113	0.443413	0.335629	0.122607	8	0.572154486	0.391621
130	745670	745671	13	12	1	20	9	113	0.467043	0.375882	0.124149	8	0.579405649	0.379922
131	745670	745671	13	11	1	11	8	113	0.406771	0.362881	0.055846	7	0.577728764	0.414375
132	745670	745671	13	10	2	15	8	113	0.451747	0.363921	0.051411	8	0.579428853	0.414714
133	745670	745671	13	12	1	17	9	113	0.457424	0.366433	0.125617	7	0.575272636	0.385319
134	745670	745671	13	10	2	21	12	113	0.496007	0.38978	0.120302	9	0.581789313	0.377463
135	745670	745671	13	10	3	18	9	113	0.476087	0.396879	0.125381	9	0.579789969	0.379025
136	745670	745671	13	12	1	17	8	113	0.442216	0.376041	0.052649	8	0.585068158	0.40574
137	745670	745671	13	12	1	18	10	113	0.441531	0.369221	0.051845	8	0.586355021	0.402343
138	745670	745671	13	12	1	13	8	113	0.450363	0.40792	0.053589	8	0.577948148	0.415028
139	745670	745671	13	13	0	16	8	113	0.477612	0.386891	0.124089	9	0.575247109	0.385165
140	745670	745671	13	12	1	15	6	113	0.465123	0.365589	0.12362	8	0.576387496	0.384168
141	745670	745671	13	12	1	18	10	113	0.509499	0.411811	-0.00889	7	0.606703198	0.407656
142	745670	745671	13	11	2	18	11	113	0.469719	0.383465	0.131953	7	0.579668564	0.380803
143	745670	745671	13	12	1	16	10	113	0.445599	0.389075	-0.0197	7	0.58817504	0.42911
144	745670	745671	13	12	1	21	10	113	0.433327	0.382582	0.194453	9	0.569612074	0.354355
145	745670	745671	13	13	0	15	9	113	0.45142	0.370612	0.053439	8	0.585625268	0.403329
146	745670	745671	13	12	1	13	7	113	0.447816	0.381807	0.046127	8	0.588289904	0.402229
147	745670	745671	13	12	1	16	8	113	0.425005	0.353999	0.130542	8	0.576935263	0.385621
148	745670	745671	13	13	0	18	8	113	0.461832	0.4006	0.123662	8	0.576713553	0.384002
149	745670	745671	13	13	0	18	11	113	0.446233	0.394048	0.125548	8	0.574754797	0.385502
150	745670	745671	13	12	1	14	9	113	0.485445	0.340365	0.065487	8	0.577508187	0.414457
151	745670	745671	13	12	1	17	9	113	0.486459	0.375238	0.126172	8	0.576850796	0.383364
152	745670	745671	13	13	0	16	9	113	0.476657	0.399369	0.124536	8	0.576034639	0.384034
153	745670	745671	13	12	1	14	9	113	0.455908	0.36875	0.120848	9	0.577424578	0.384063
154	745670	745671	13	13	0	20	14	113	0.496023	0.40362	0.122436	8	0.579314773	0.38056
155	745670	745671	13	12	1	18	12	113	0.447193	0.356616	0.052369	7	0.576910605	0.416676
156	745670	745671	13	12	1	15	12	113	0.479827	0.40232	0.053411	7	0.585420107	0.403634
157	745670	745671	13	11	1	14	10	113	0.46971	0.386364	0.05765	8	0.582599631	0.407619
158	745670	745671	13	12	1	18	10	113	0.458861	0.359678	0.123087	8	0.575844143	0.385961
159	745670	745671	13	12	1	13	8	113	0.461676	0.393425	0.050286	8	0.586711464	0.403019
160	745670	745671	13	12	1	15	11	113	0.447101	0.380566	0.118779	9	0.578312917	0.382771
161	745670	745671	13	13	0	20	9	113	0.449932	0.398501	0.120484	9	0.571823654	0.394315
162	745670	745671	13	13	0	16	11	113	0.480767	0.38725	0.122408	9	0.574154485	0.388519
163	745670	745671	13	12	1	15	11	113	0.457775	0.348565	0.123418	9	0.576947125	0.383642
164	745670	745671	13	13	0	14	9	113	0.462684	0.393664	0.049128	8	0.585833556	0.40476
165	745670	745671	13	12	1	16	9	113	0.453114	0.392241	-0.02096	7	0.584674401	0.431574
166	745670	745671	13	11	2	18	9	113	0.45962	0.366986	0.12317	9	0.577637423	0.38292
167	745670	745671	13	12	1	16	12	113	0.466672	0.394697	0.056075	8	0.585113544	0.40506
168	745670	745671	13	12	1	15	10	113	0.448164	0.382639	0.050686	8	0.582046333	0.40905
169	745670	745671	13	12	1	22	9	113	0.472335	0.389705	0.04899	8	0.587064551	0.40302
170	745670	745671	13	12	1	17	8	113	0.484626	0.376604	0.061105	8	0.585777175	0.404015
171	745670	745671	13	11	2	15	7	113	0.429264	0.376531	0.121237	8	0.571421968	0.395194
172	745670	745671	13	13	0	15	9	113	0.470513	0.386243	0.122313	9	0.580704133	0.378494
173	745670	745671	13	13	0	17	10	113	0.452391	0.38817	0.052275	7	0.587881071	0.400337
174	745670	745671	13	13	0	20	11	113	0.483504	0.400684	0.123238	9	0.577207218	0.384037
175	745670	745671	13	13	0	23	11	113	0.466759	0.398246	0.1254	9	0.579723808	0.378592
176	745670	745671	13	11	2	22	14	113	0.495872	0.407318	0.1227	9	0.580609492	0.377852
177	745670	745671	13	13	0	21	9	113	0.453131	0.394132	0.123547	9	0.576127318	0.384536
178	745670	745671	13	13	0	21	11	113	0.470041	0.398052	0.054617	7	0.587688187	0.399995
179	745670	745671	13	12	1	16	8	113	0.470081	0.368327	0.059557	8	0.585730241	0.404405
180	745670	745671	13	11	2	14	9	113	0.457218	0.363544	0.05854	8	0.584335875	0.404487
181	745670	745671	13	13	0	15	10	113	0.500535	0.383706	0.123203	9	0.580208723	0.379209
182	745670	745671	13	13	0	22	16	113	0.444896	0.36946	0.048377	8	0.58897615	0.400891
183	745670	745671	13	12	1	16	10	113	0.418725	0.376654	0.058633	7	0.588835297	0.398887
184	745670	745671	13	12	1	13	8	113	0.453556	0.363803	0.123135	8	0.574507549	0.388761
185	745670	745671	13	12	1	18	10	113	0.4579	0.367358	0.059627	7	0.582597569	0.407022
186	745670	745671	13	11	1	12	6	113	0.440087	0.378193	0.119644	9	0.580175074	0.379729
187	745670	745671	13	13	0	19	8	113	0.49353	0.393621	0.062222	8	0.585364693	0.402474

UNDERLYING DATA MARKED CONFIDENTIAL PURSUANT TO PROTECTIVE ORDER

188	745670	745671	13	9	3	16	7	113	0.474838	0.377578	0.120092	9	0.578762155	0.381938
189	745670	745671	13	13	0	22	9	113	0.461771	0.379695	0.051525	8	0.586582616	0.402097
190	745670	745671	13	12	1	16	9	113	0.457208	0.375199	0.058281	8	0.583281742	0.405876
191	745670	745671	13	12	1	17	10	113	0.489578	0.376494	0.124306	9	0.578170605	0.380349
192	745670	745671	13	12	1	19	11	113	0.452996	0.388669	0.120946	8	0.575994418	0.386064
193	745670	745671	13	13	0	12	7	113	0.495751	0.37404	0.059472	8	0.591534745	0.396323
194	745670	745671	13	13	0	16	11	113	0.442522	0.370136	0.055647	8	0.596555064	0.390414
195	745670	745671	13	12	1	15	9	113	0.447635	0.360723	0.122067	8	0.578503074	0.380839
196	745670	745671	13	12	1	15	8	113	0.453605	0.382489	0.057403	7	0.57925817	0.413618
197	745670	745671	13	11	1	13	6	113	0.411086	0.359691	0.056077	8	0.579840898	0.412204
198	745670	745671	13	13	0	14	7	113	0.454379	0.384495	0.052389	7	0.584797359	0.406045
199	745670	745671	13	13	0	16	8	113	0.464668	0.364558	0.123489	8	0.577875502	0.381884
200	745670	745671	13	11	2	17	8	113	0.451737	0.344105	0.052059	8	0.581171698	0.412486
201	745670	745671	13	13	0	22	8	113	0.455591	0.371318	0.054527	8	0.588047319	0.399376
202	745670	745671	13	13	0	18	11	113	0.465558	0.374637	0.122291	9	0.578707644	0.382238
203	745670	745671	13	11	2	20	8	113	0.456012	0.373566	0.131758	8	0.577170377	0.383666
204	745670	745671	13	12	1	14	7	113	0.440324	0.37132	0.121468	7	0.578824569	0.382447
205	745670	745671	13	11	2	16	11	113	0.473599	0.362705	0.121445	8	0.577880424	0.382331
206	745670	745671	13	13	0	17	7	113	0.440639	0.355322	0.046325	8	0.58296056	0.408934
207	745670	745671	13	10	2	19	10	113	0.46326	0.378725	0.121437	8	0.586830534	0.368248
208	745670	745671	13	12	1	16	10	113	0.464398	0.390526	0.05212	7	0.585560255	0.404226
209	745670	745671	13	12	1	13	7	113	0.442132	0.369008	0.054452	8	0.584305106	0.405104
210	745670	745671	13	11	1	15	8	113	0.47438	0.39985	0.120581	9	0.580531964	0.379808
211	745670	745671	13	13	0	18	9	113	0.430079	0.373899	0.122064	9	0.574659289	0.389086
212	745670	745671	13	11	2	22	10	113	0.489728	0.387863	0.192943	9	0.569156383	0.358763
213	745670	745671	13	13	0	16	10	113	0.483069	0.382653	0.06155	8	0.584923057	0.403578
214	745670	745671	13	13	0	17	9	113	0.448077	0.356649	0.121162	9	0.579257784	0.378937
215	745670	745671	13	12	1	19	10	113	0.472141	0.391722	0.124816	8	0.573139662	0.38999
216	745670	745671	13	12	1	17	8	113	0.479117	0.397358	0.063019	8	0.585210398	0.403269
217	745670	745671	13	13	0	18	10	113	0.418029	0.369511	0.12356	9	0.575783691	0.385087
218	745670	745671	13	12	1	15	10	113	0.487995	0.395712	0.125266	9	0.577973454	0.38282
219	745670	745671	13	13	0	18	10	113	0.487498	0.377105	0.122515	8	0.578706447	0.380344
220	745670	745671	13	12	1	17	8	113	0.461798	0.395722	0.122727	9	0.580010293	0.380195
221	745670	745671	13	13	0	13	8	113	0.481082	0.402591	0.126573	8	0.576533755	0.382666
222	745670	745671	13	12	1	10	7	113	0.454144	0.372924	0.052976	8	0.583700896	0.406112
223	745670	745671	13	12	1	14	8	113	0.468419	0.378431	0.122902	7	0.57462307	0.387965
224	745670	745671	13	11	2	14	9	113	0.451182	0.411429	0.122752	9	0.572767102	0.392306
225	745670	745671	13	11	1	13	5	113	0.427086	0.345012	0.124506	8	0.575641725	0.383867
226	745670	745671	13	13	0	18	12	113	0.465228	0.401375	0.062128	8	0.585812724	0.402347
227	745670	745671	13	12	1	16	9	113	0.457133	0.342532	-0.01077	7	0.597731239	0.417959
228	745670	745671	13	11	1	11	5	113	0.464374	0.39289	0.059192	8	0.594560712	0.393704
229	745670	745671	13	11	2	23	11	113	0.487296	0.388698	0.19558	9	0.571628074	0.351378
230	745670	745671	13	12	1	14	9	113	0.41558	0.349066	0.194647	10	0.567962103	0.358782
231	745670	745671	13	11	2	18	11	113	0.425734	0.381815	0.120944	9	0.582653457	0.376952
232	745670	745671	13	11	2	14	9	113	0.4675	0.381935	0.121343	9	0.580214685	0.379019
233	745670	745671	13	13	0	23	11	113	0.45957	0.358165	0.052787	8	0.585073096	0.405233
234	745670	745671	13	12	1	16	11	113	0.4573	0.353788	0.063365	8	0.583192903	0.405879
235	745670	745671	13	13	0	17	8	113	0.463588	0.38065	0.05449	8	0.590578153	0.399351
236	745670	745671	13	12	1	13	9	113	0.484794	0.364531	0.124043	9	0.580663474	0.377553
237	745670	745671	13	12	1	17	9	113	0.468087	0.386521	0.123086	8	0.577282193	0.38474
238	745670	745671	13	11	2	13	9	113	0.44679	0.374934	0.05345	8	0.580851196	0.412348
239	745670	745671	13	13	0	14	7	113	0.458875	0.362453	0.123693	7	0.568850556	0.398186
240	745670	745671	13	12	1	15	8	113	0.440217	0.36673	0.05582	7	0.587084451	0.402683
241	745670	745671	13	12	1	18	12	113	0.477568	0.37623	0.124694	9	0.576770015	0.385749
242	745670	745671	13	11	2	14	9	113	0.482807	0.376506	0.055924	8	0.587370034	0.401531
243	745670	745671	13	11	1	14	10	113	0.407071	0.348678	0.050233	8	0.58298695	0.409797
244	745670	745671	13	11	2	17	10	113	0.468817	0.391736	0.056631	7	0.58272019	0.407217
245	745670	745671	13	13	0	14	6	113	0.468745	0.389364	0.123911	9	0.579872384	0.378045
246	745670	745671	13	12	1	16	9	113	0.45964	0.407021	0.060319	8	0.586773156	0.401799
247	745670	745671	13	12	1	16	10	113	0.454376	0.380865	0.125732	7	0.573150938	0.389372
248	745670	745671	13	12	1	17	10	113	0.494578	0.410669	0.125118	8	0.576178707	0.384769
249	745670	745671	13	11	2	16	9	113	0.473172	0.379943	0.063431	8	0.588858516	0.399409
250	745670	745671	13	11	2	18	10	113	0.448125	0.369329	0.058899	8	0.581601519	0.409484
251	745670	745671	13	13	0	18	9	113	0.456259	0.352712	0.063454	8	0.580538586	0.409762
252	745670	745671	13	13	0	15	11	113	0.497428	0.390683	0.122845	9	0.577249372	0.384001
253	745670	745671	13	13	0	15	11	113	0.455883	0.381216	-0.01179	6	0.591297565	0.424883
254	745670	745671	13	11	2	14	7	113	0.455047	0.341718	0.123182	9	0.581422066	0.374719
255	745670	745671	13	12	1	20	11	113	0.490526	0.393956	0.123609	8	0.574300474	0.389207
256	745670	745671	13	12	1	13	6	113	0.443559	0.376399	0.061948	7	0.584334984	0.405301
257	745670	745671	13	13	0	19	10	113	0.487024	0.360844	0.1212	9	0.582818139	0.375873
258	745670	745671	13	12	1	17	10	113	0.449105	0.374512	-0.01246	7	0.596027858	0.418921
259	745670	745671	13	12	1	17	10	113	0.463682	0.402591	0.063149	8	0.582669464	0.406155
260	745670	745671	13	12	1	20	10	113	0.457865	0.378153	0.052136	8	0.584208686	0.406485
261	745670	745671	13	13	0	17	8	113	0.469688	0.381823	0.060421	8	0.585102801	0.403874
262	745670	745671	13	13	0	10	8	113	0.42486	0.363984	0.051725	8	0.583620604	0.406609
263	745670	745671	13	12	1	21	10	113	0.432486	0.382044	0.048669	8	0.58371107	0.407064
264	745670	745671	13	13	0	17	12	113	0.446756	0.345066	0.195948	8	0.565650514	0.362578
265	745670	745671	13	13	0	16	9	113	0.47565	0.39714	0.054892	8	0.587047782	0.401516
266	745670	745671	13	12	1	14	8	113	0.442095	0.356017	0.066189	8	0.581501363	0.408546
267	745670	745671	13	13	0	14	9	113	0.464161	0.35732	0.124963	9	0.577582606	0.381784
268	745670	745671	13	12	1	13	9	113	0.476177	0.378542	0.12299	9	0.577728496	0.38365
269	745670	745671	13	13	0	19	9	113	0.470142	0.351176	0.122117	9	0.578206394	0.382853
270	745670	745671	13	13	0	22	11	113	0.464444	0.396331	0.125669	9	0.577673206	0.381316
271	745670	745671	13	11	2	18	9	113	0.443326	0.353042	0.12312	9	0.578290933	0.380479
272	745670	745671	13	10	2	24	11	113	0.482099	0.382711	0.12221	9	0.57767697	0.383016
273	745670	745671	13	11	2	20	11	113	0.481007	0.388666	0.121623	9	0.58452299	0.372479
274	745670	745671	13	11	1	17	8	113	0.473568	0.40058	0.056902	8	0.586637779	0.403547
275	745670	745671	13	12	1	23	12	113	0.481983	0.375819	0.066657	8	0.582156747	0.407391
276	745670	745671	13	11	2	14	8	113	0.457986	0.368343	0.063425	8	0.587668781	0.398784
277	745670	745671	13	13	0	19	9	113	0.474416	0.388277	0.06163	7	0.576214569	0.417483
278	745670	745671	13	10	2	16	11	113	0.481623	0.388317	0.119836	8	0.583750849	0.374145
279	745670	745671	13	10	3	17	9	113	0.454212	0.397468	0.12346	9	0.579824892	0.38119
280	745670	745671	13	12	1	16	9	113	0.472901	0.391796	0.057966	8	0.591546433	0.396459
281	745670	745671	13	12	1	17	9	113	0.484642	0.396541	0.054591	8	0.590537407	0.398208

282	745670	745671	13	11	1	19	8	113	0.460514	0.375199	0.058731	7	0.58083105	0.410504
283	745670	745671	13	12	1	15	9	113	0.452631	0.362379	0.121505	9	0.577948643	0.382399
284	745670	745671	13	12	1	16	11	113	0.471267	0.385592	0.046501	8	0.576616693	0.418204
285	745670	745671	13	13	0	17	7	113	0.416402	0.352164	0.060479	7	0.581201618	0.408839
286	745670	745671	13	13	0	17	10	113	0.444673	0.406103	0.122942	9	0.583727118	0.372199
287	745670	745671	13	13	0	19	8	113	0.451586	0.371352	0.058803	8	0.591151207	0.396852
288	745670	745671	13	13	0	22	8	113	0.454645	0.3681	0.055576	8	0.586891326	0.403061
289	745670	745671	13	11	2	18	12	113	0.486367	0.406274	0.123192	8	0.581755437	0.37537
290	745670	745671	13	13	0	20	12	113	0.452305	0.361564	0.193886	10	0.569610552	0.35382
291	745670	745671	13	13	0	15	9	113	0.457962	0.383922	0.124551	8	0.575985037	0.383486
292	745670	745671	13	11	2	14	8	113	0.439331	0.380434	0.126473	8	0.572108763	0.389213
293	745670	745671	13	12	1	13	9	113	0.44742	0.370644	0.059275	8	0.579553903	0.412775
294	745670	745671	13	13	0	21	11	113	0.474089	0.396318	0.124853	9	0.577289373	0.382468
295	745670	745671	13	12	1	18	10	113	0.46003	0.363432	0.056413	8	0.591978458	0.396245
296	745670	745671	13	13	0	18	11	113	0.452438	0.386696	0.125116	7	0.576160416	0.384169
297	745670	745671	13	12	1	15	9	113	0.462422	0.391808	0.11976	9	0.571170046	0.396166
298	745670	745671	13	11	2	15	9	113	0.474744	0.396682	0.126081	9	0.580600351	0.377539
299	745670	745671	13	11	2	22	11	113	0.467618	0.383071	0.048883	8	0.585185724	0.406078
300	745670	745671	13	11	2	15	11	113	0.459216	0.363804	0.121132	8	0.570838784	0.397496
301	745670	745671	13	12	1	18	10	113	0.511891	0.380887	0.12151	9	0.584593014	0.372822
302	745670	745671	13	13	0	16	11	113	0.487353	0.410873	0.051937	8	0.585581033	0.404603
303	745670	745671	13	11	1	20	10	113	0.438828	0.36327	0.118071	9	0.581209026	0.37894
304	745670	745671	13	13	0	18	9	113	0.467227	0.398588	0.050452	8	0.584014734	0.407016
305	745670	745671	13	13	0	21	11	113	0.482332	0.413522	0.122537	9	0.57590587	0.386579
306	745670	745671	13	12	1	18	12	113	0.469082	0.395996	0.050399	7	0.581547392	0.409904
307	745670	745671	13	12	1	20	8	113	0.491782	0.361514	0.194168	9	0.571302381	0.351978
308	745670	745671	13	10	3	17	9	113	0.478214	0.398344	0.123789	9	0.579827509	0.380712
309	745670	745671	13	13	0	16	8	113	0.48659	0.394327	0.122834	8	0.575763407	0.385704
310	745670	745671	13	12	1	16	11	113	0.482547	0.377372	0.123455	9	0.581071206	0.375748
311	745670	745671	13	13	0	14	9	113	0.4468	0.389049	0.048715	8	0.585341784	0.405958
312	745670	745671	13	13	0	17	10	113	0.471382	0.394204	0.122832	8	0.576132866	0.385248
313	745670	745671	13	13	0	21	10	113	0.456685	0.405286	0.124368	9	0.575198024	0.385739
314	745670	745671	13	11	2	22	13	113	0.471042	0.384972	0.124932	8	0.575881924	0.387375
315	745670	745671	13	12	1	17	11	113	0.481026	0.392242	0.122657	9	0.575964582	0.385752
316	745670	745671	13	13	0	21	9	113	0.46937	0.39013	0.122611	9	0.575382872	0.386318
317	745670	745671	13	12	1	20	12	113	0.491752	0.396275	0.121043	9	0.58231243	0.37611
318	745670	745671	13	11	2	14	8	113	0.44714	0.384693	0.119811	9	0.577614203	0.385625
319	745670	745671	13	12	1	15	9	113	0.456248	0.381713	0.122665	9	0.575306807	0.388181
320	745670	745671	13	12	1	13	11	113	0.434274	0.375094	0.059899	7	0.578963699	0.413449
321	745670	745671	13	12	1	15	8	113	0.479195	0.379057	0.064251	8	0.585290774	0.402315
322	745670	745671	13	13	0	14	10	113	0.443965	0.350239	0.123473	8	0.573633899	0.389955
323	745670	745671	13	13	0	18	12	113	0.465942	0.399331	-0.01754	7	0.590487896	0.42601
324	745670	745671	13	12	1	17	9	113	0.468994	0.397095	0.12292	8	0.576129044	0.385278
325	745670	745671	13	11	2	14	11	113	0.446625	0.383306	0.120937	8	0.575135945	0.387486
326	745670	745671	13	13	0	15	8	113	0.4601	0.388068	0.12537	9	0.57446026	0.38751
327	745670	745671	13	11	2	20	8	113	0.464329	0.35716	0.195667	9	0.57185553	0.35082
328	745670	745671	13	12	1	18	11	113	0.444117	0.376704	0.12348	8	0.576100539	0.385355
329	745670	745671	13	13	0	15	10	113	0.44014	0.387003	0.125135	8	0.586903509	0.364311
330	745670	745671	13	13	0	16	9	113	0.472809	0.359525	0.123218	9	0.577759654	0.382559
331	745670	745671	13	13	0	17	7	113	0.450171	0.380447	0.123413	9	0.576114424	0.383774
332	745670	745671	13	13	0	21	11	113	0.467173	0.38438	0.121854	8	0.577395103	0.38295
333	745670	745671	13	13	0	17	11	113	0.454308	0.377136	0.121475	7	0.572193359	0.392853
334	745670	745671	13	11	2	13	9	113	0.453198	0.394703	0.052476	8	0.585506282	0.403617
335	745670	745671	13	12	1	11	8	113	0.431688	0.352236	0.057246	8	0.583548794	0.407152
336	745670	745671	13	11	2	17	8	113	0.478693	0.392961	0.059091	8	0.584173848	0.406052
337	745670	745671	13	12	1	17	10	113	0.476866	0.390097	0.123997	8	0.576066457	0.384236
338	745670	745671	13	12	1	16	10	113	0.453904	0.373044	0.121686	9	0.572176024	0.39277
339	745670	745671	13	12	1	21	9	113	0.487988	0.402054	0.123576	9	0.578289842	0.383224
340	745670	745671	13	13	0	16	7	113	0.493682	0.360177	0.051145	8	0.588214404	0.401314
341	745670	745671	13	12	1	19	10	113	0.48517	0.386195	0.058391	8	0.588007302	0.401857
342	745670	745671	13	12	1	18	10	113	0.496423	0.407542	0.051858	7	0.583403172	0.407154
343	745670	745671	13	10	3	19	9	113	0.470462	0.377295	0.123434	9	0.579311688	0.382802
344	745670	745671	13	12	1	16	9	113	0.472367	0.368393	0.121402	9	0.579762061	0.381361
345	745670	745671	13	12	1	16	12	113	0.433459	0.371186	0.122777	8	0.573898732	0.389523
346	745670	745671	13	11	2	12	7	113	0.473951	0.379862	0.059361	8	0.583886094	0.405377
347	745670	745671	13	12	1	16	8	113	0.440625	0.372776	0.123641	9	0.576874961	0.384179
348	745670	745671	13	11	2	15	8	113	0.484661	0.382522	0.12283	9	0.580267414	0.380243
349	745670	745671	13	11	2	12	8	113	0.450669	0.394039	0.125199	9	0.577752962	0.381321
350	745670	745671	13	13	0	15	9	113	0.464391	0.39772	0.061401	8	0.585571236	0.403641
351	745670	745671	13	13	0	16	11	113	0.461943	0.390427	0.122496	9	0.57694979	0.383636
352	745670	745671	13	12	1	20	7	113	0.469074	0.385085	0.126684	9	0.573404132	0.388109
353	745670	745671	13	10	2	13	8	113	0.440138	0.372555	0.122274	8	0.589409666	0.362449
354	745670	745671	13	13	0	17	8	113	0.445956	0.367973	0.061824	8	0.577710382	0.413711
355	745670	745671	13	11	1	12	6	113	0.456477	0.352078	0.120911	8	0.574894926	0.387576
356	745670	745671	13	13	0	19	11	113	0.443141	0.363956	0.056772	8	0.5864365	0.401884
357	745670	745671	13	13	0	19	11	113	0.4811	0.392391	0.122373	9	0.576736481	0.385035
358	745670	745671	13	11	2	16	10	113	0.451123	0.386667	0.125568	9	0.577578689	0.382652
359	745670	745671	13	13	0	17	6	113	0.485754	0.403327	-0.01788	6	0.596092268	0.419549
360	745670	745671	13	11	2	10	5	113	0.486353	0.382504	0.122948	8	0.580149002	0.378624
361	745670	745671	13	13	0	17	11	113	0.4707	0.362857	0.123526	9	0.57546924	0.38647
362	745670	745671	13	13	0	17	13	113	0.430468	0.356811	0.046567	8	0.58490526	0.406241
363	745670	745671	13	11	2	17	8	113	0.42161	0.372442	0.120024	9	0.580154538	0.381592
364	745670	745671	13	12	1	17	10	113	0.471236	0.390924	0.125762	9	0.575629248	0.385625
365	745670	745671	13	13	0	13	9	113	0.506625	0.377443	0.12245	9	0.578441562	0.382682
366	745670	745671	13	13	0	15	9	113	0.466403	0.382218	0.123572	9	0.578594023	0.380673
367	745670	745671	13	12	1	15	11	113	0.470505	0.387432	0.059056	8	0.585071703	0.405463
368	745670	745671	13	12	1	16	9	113	0.469929	0.402701	0.121722	9	0.578169259	0.383878
369	745670	745671	13	12	1	13	7	113	0.435885	0.373237	0.0535	7	0.576299272	0.416788
370	745670	745671	13	13	0	13	9	113	0.473432	0.404846	0.124181	9	0.575801188	0.384886
371	745670	745671	13	12	1	13	7	113	0.419611	0.349144	0.067504	7	0.58118483	0.4075
372	745670	745671	13	11	2	16	11	113	0.453042	0.369931	0.120191	8	0.569525935	0.398664
373	745670	745671	13	13	0	12	8	113	0.436661	0.371521	0.123269	9	0.575378908	0.386677
374	745670	745671	13	13	0	15	8	113	0.453587	0.391836	0.124815	8	0.577435637	0.383368
375	745670	745671	13	11	2	13	10	113	0.465632	0.392471	0.125056	9	0.574624077	0.388509

376	745670	745671	13	13	0	14	10	113	0.454529	0.367349	0.052767	7	0.578451812	0.414044
377	745670	745671	13	13	0	16	12	113	0.493512	0.386468	0.061811	8	0.585172679	0.40356
378	745670	745671	13	13	0	19	12	113	0.481508	0.412063	0.124336	8	0.575677358	0.384534
379	745670	745671	13	12	1	16	7	113	0.447703	0.384854	0.123717	9	0.579546959	0.381143
380	745670	745671	13	11	1	18	10	113	0.446358	0.373715	0.118968	9	0.580702765	0.379622
381	745670	745671	13	12	1	20	12	113	0.466494	0.397877	0.061737	8	0.584953597	0.403624
382	745670	745671	13	11	2	21	12	113	0.469248	0.381011	0.050791	8	0.585953193	0.404241
383	745670	745671	13	13	0	16	9	113	0.489364	0.366442	0.123378	9	0.576287772	0.385701
384	745670	745671	13	10	3	12	6	113	0.476614	0.388756	0.125319	9	0.580383139	0.3791
385	745670	745671	13	13	0	18	7	113	0.454307	0.364968	0.124116	8	0.57932217	0.379306
386	745670	745671	13	12	1	14	7	113	0.425993	0.329378	0.120946	9	0.580635576	0.379583
387	745670	745671	13	11	2	18	12	113	0.476253	0.403393	0.050693	8	0.585687985	0.40392
388	745670	745671	13	12	1	18	11	113	0.472178	0.381358	0.121833	9	0.580245022	0.379694
389	745670	745671	13	11	2	13	8	113	0.485462	0.388705	0.124664	9	0.57932406	0.381412
390	745670	745671	13	12	1	18	7	113	0.477223	0.392929	0.124385	9	0.578674903	0.382849
391	745670	745671	13	13	0	13	8	113	0.478533	0.378686	0.05106	7	0.581407607	0.409909
392	745670	745671	13	13	0	16	9	113	0.464334	0.393146	0.126642	8	0.576145724	0.382686
393	745670	745671	13	12	1	17	10	113	0.443125	0.355123	0.064443	8	0.581456005	0.408053
394	745670	745671	13	13	0	17	11	113	0.503308	0.391423	0.121431	8	0.576473899	0.385601
395	745670	745671	13	11	2	16	9	113	0.483524	0.372611	0.122617	9	0.578946207	0.381504
396	745670	745671	13	12	1	17	9	113	0.420794	0.366661	0.12254	9	0.578803764	0.38185
397	745670	745671	13	13	0	19	10	113	0.463369	0.385367	0.123633	9	0.575445786	0.385867
398	745670	745671	13	12	1	19	12	113	0.472569	0.380162	0.127436	8	0.577629845	0.379933
399	745670	745671	13	13	0	16	11	113	0.435949	0.380788	0.057932	8	0.589520884	0.398362
400	745670	745671	13	12	1	15	8	113	0.434187	0.369691	0.12174	7	0.572617588	0.393011
401	745670	745671	13	12	1	18	9	113	0.458435	0.388209	0.124871	8	0.573230299	0.389797
402	745670	745671	13	12	1	19	9	113	0.438475	0.325785	0.197435	9	0.570371994	0.352567
403	745670	745671	13	12	1	14	9	113	0.4529	0.378954	0.052325	8	0.582044918	0.410176
404	745670	745671	13	12	1	19	12	113	0.453889	0.37706	0.047348	8	0.58376355	0.408026
405	745670	745671	13	12	1	18	8	113	0.450805	0.360522	0.051455	8	0.58382446	0.407032
406	745670	745671	13	12	1	15	8	113	0.472733	0.39334	0.059566	8	0.597640544	0.388732
407	745670	745671	13	11	1	14	8	113	0.402236	0.357333	0.051692	8	0.587639156	0.403071
408	745670	745671	13	12	1	15	7	113	0.45388	0.333317	0.050609	8	0.583731648	0.40913
409	745670	745671	13	12	1	13	8	113	0.492731	0.378257	0.060277	7	0.588789052	0.400802
410	745670	745671	13	13	0	16	8	113	0.470655	0.396647	0.051613	8	0.58187192	0.409794
411	745670	745671	13	11	1	19	7	113	0.434945	0.372267	0.120848	8	0.57842694	0.381583
412	745670	745671	13	10	2	16	7	113	0.47495	0.398674	0.124528	9	0.579134386	0.381941
413	745670	745671	13	12	1	13	10	113	0.424028	0.360496	0.125801	8	0.572079796	0.39289
414	745670	745671	13	13	0	19	10	113	0.469809	0.395965	0.061352	8	0.584615305	0.404789
415	745670	745671	13	13	0	20	12	113	0.448887	0.370632	0.121228	8	0.575500962	0.387715
416	745670	745671	13	12	1	19	9	113	0.447328	0.373764	0.060751	8	0.582773311	0.408115
417	745670	745671	13	12	1	17	12	113	0.45347	0.382932	-0.01328	7	0.597269801	0.418589
418	745670	745671	13	12	1	13	10	113	0.507222	0.391888	0.131592	9	0.575497135	0.385892
419	745670	745671	13	12	1	17	11	113	0.454416	0.3739	-0.01804	7	0.58868185	0.427947
420	745670	745671	13	12	1	13	9	113	0.471321	0.394121	0.120253	9	0.577985824	0.382964
421	745670	745671	13	10	2	17	10	113	0.467709	0.355124	0.059825	8	0.587954973	0.401386
422	745670	745671	13	11	1	14	5	113	0.44304	0.365363	0.118472	9	0.575515113	0.389238
423	745670	745671	13	13	0	18	11	113	0.485019	0.408727	0.053766	7	0.585367463	0.40321
424	745670	745671	13	13	0	21	12	113	0.448221	0.398176	-0.00999	7	0.584453271	0.431353
425	745670	745671	13	12	1	14	8	113	0.477163	0.359313	0.052145	7	0.589078889	0.399406
426	745670	745671	13	12	1	16	9	113	0.476875	0.387584	0.124283	9	0.576258718	0.384554
427	745670	745671	13	11	2	14	9	113	0.452278	0.395588	-0.01258	7	0.598662274	0.417049
428	745670	745671	13	11	1	16	8	113	0.455473	0.393448	0.056766	7	0.581994813	0.407786
429	745670	745671	13	12	1	16	8	113	0.492272	0.391194	0.053061	8	0.585769556	0.40355
430	745670	745671	13	12	1	17	9	113	0.493457	0.396919	0.058279	8	0.591453553	0.398607
431	745670	745671	13	11	2	17	9	113	0.477646	0.371261	0.122256	9	0.585573338	0.369808
432	745670	745671	13	12	1	19	9	113	0.461081	0.371048	0.121647	8	0.575707161	0.385939
433	745670	745671	13	11	2	13	9	113	0.472539	0.392661	0.123549	9	0.57402996	0.391051
434	745670	745671	13	11	2	19	10	113	0.439321	0.354376	0.059973	8	0.57717052	0.415935
435	745670	745671	13	12	1	20	9	113	0.47758	0.396127	0.122262	9	0.584202164	0.372831
436	745670	745671	13	13	0	14	9	113	0.469595	0.378466	0.058312	8	0.588412323	0.401828
437	745670	745671	13	12	1	13	7	113	0.451478	0.371227	-0.01619	7	0.598643224	0.418075
438	745670	745671	13	13	0	18	12	113	0.418504	0.360487	0.131595	8	0.583439702	0.370687
439	745670	745671	13	13	0	13	7	113	0.46397	0.397081	0.060889	8	0.585012874	0.404584
440	745670	745671	13	12	1	21	11	113	0.436908	0.388809	0.121663	8	0.578459801	0.382625
441	745670	745671	13	12	1	19	10	113	0.476732	0.382082	0.12186	9	0.583863082	0.374915
442	745670	745671	13	13	0	17	8	113	0.44696	0.380753	0.122255	9	0.579436322	0.379455
443	745670	745671	13	13	0	20	10	113	0.440268	0.395335	0.05377	8	0.587747748	0.402612
444	745670	745671	13	13	0	15	9	113	0.454624	0.366838	0.124004	9	0.57449	0.387663
445	745670	745671	13	12	1	16	9	113	0.489365	0.392547	0.125267	9	0.571995493	0.392421
446	745670	745671	13	12	1	18	11	113	0.487863	0.405697	0.051546	7	0.588026618	0.401076
447	745670	745671	13	13	0	19	13	113	0.497165	0.391404	0.121335	9	0.576971855	0.385031
448	745670	745671	13	9	4	16	7	113	0.44903	0.379465	0.053885	8	0.585523521	0.406803
449	745670	745671	13	12	1	18	9	113	0.465355	0.386009	0.119902	9	0.56955729	0.398628
450	745670	745671	13	13	0	18	8	113	0.449163	0.351115	0.194732	9	0.567642582	0.359791
451	745670	745671	13	13	0	16	12	113	0.433539	0.339506	0.052343	8	0.585535591	0.405433
452	745670	745671	13	12	1	19	10	113	0.453432	0.381477	0.049941	8	0.584933306	0.406207
453	745670	745671	13	12	1	14	10	113	0.430665	0.352592	0.060378	7	0.584031008	0.407097
454	745670	745671	13	12	1	18	10	113	0.461792	0.362175	0.063984	7	0.588265194	0.399281
455	745670	745671	13	13	0	20	11	113	0.434525	0.389096	0.122951	9	0.575641879	0.385576
456	745670	745671	13	13	0	20	11	113	0.455593	0.379183	0.126432	9	0.577441083	0.381664
457	745670	745671	13	13	0	15	10	113	0.457759	0.384421	0.125681	9	0.576828559	0.382345
458	745670	745671	13	13	0	19	9	113	0.456546	0.371196	0.122334	9	0.577750244	0.383237
459	745670	745671	13	13	0	14	9	113	0.452369	0.380005	0.05819	7	0.582591374	0.407024
460	745670	745671	13	13	0	18	10	113	0.477736	0.391442	0.121652	9	0.578967763	0.38105
461	745670	745671	13	13	0	18	10	113	0.47042	0.387949	0.122585	9	0.575500695	0.387104
462	745670	745671	13	12	1	16	10	113	0.474819	0.369203	0.048064	8	0.587750472	0.403158
463	745670	745671	13	12	1	12	5	113	0.446981	0.378918	0.05194	8	0.585199746	0.406157
464	745670	745671	13	11	2	18	11	113	0.4844	0.402409	0.121722	9	0.580203046	0.37952
465	745670	745671	13	13	0	24	10	113	0.453402	0.365383	0.123308	8	0.577121051	0.384282
466	745670	745671	13	11	2	14	11	113	0.474447	0.369133	0.122465	9	0.579862748	0.380136
467	745670	745671	13	11	2	18	11	113	0.460568	0.377412	0.120717	9	0.576589788	0.386882
468	745670	745671	13	13	0	19	10	113	0.456391	0.385036	0.061086	7	0.585528031	0.405369
469	745670	745671	13	11	2	18	13	113	0.497938	0.404028	0.121493	8	0.576877956	0.385136

470	745670	745671	13	12	1	14	8	113	0.469831	0.386151	0.124705	8	0.575822457	0.38419
471	745670	745671	13	13	0	15	10	113	0.449628	0.403191	0.047558	8	0.583969084	0.406903
472	745670	745671	13	13	0	14	9	113	0.490744	0.408453	0.126659	7	0.574895819	0.384725
473	745670	745671	13	12	1	17	9	113	0.477453	0.358258	0.124959	9	0.581688551	0.376919
474	745670	745671	13	11	2	15	9	113	0.495024	0.406413	0.124844	9	0.58005448	0.379914
475	745670	745671	13	13	0	22	12	113	0.446734	0.365271	0.122579	9	0.576250823	0.386333
476	745670	745671	13	12	1	15	7	113	0.445016	0.371811	0.0552	8	0.583738764	0.406573
477	745670	745671	13	13	0	15	10	113	0.506221	0.413351	0.122404	9	0.578623798	0.382728
478	745670	745671	13	13	0	13	8	113	0.474131	0.359749	0.125067	9	0.577926668	0.381474
479	745670	745671	13	11	2	16	9	113	0.448177	0.376345	0.123526	9	0.575261201	0.387808
480	745670	745671	13	12	1	16	12	113	0.472162	0.389085	0.060065	7	0.582862247	0.407714
481	745670	745671	13	12	1	18	11	113	0.476376	0.369778	0.121753	9	0.577862481	0.383948
482	745670	745671	13	13	0	19	7	113	0.423716	0.351373	0.124487	9	0.575870847	0.385286
483	745670	745671	13	13	0	18	12	113	0.395937	0.351802	0.053895	7	0.583157379	0.405837
484	745670	745671	13	13	0	17	12	113	0.434201	0.390824	0.122338	8	0.575060529	0.386217
485	745670	745671	13	12	1	15	9	113	0.497259	0.400585	-0.0078	7	0.591546261	0.423597
486	745670	745671	13	13	0	19	14	113	0.432367	0.368731	0.123255	8	0.574501279	0.388169
487	745670	745671	13	11	2	15	8	113	0.454106	0.381003	0.13102	7	0.577845165	0.384165
488	745670	745671	13	11	2	12	7	113	0.468335	0.390913	0.121897	9	0.579172982	0.380697
489	745670	745671	13	12	1	16	6	113	0.457709	0.387923	0.049328	7	0.578239306	0.415891
490	745670	745671	13	13	0	19	10	113	0.470516	0.395906	0.058042	8	0.588529454	0.400373
491	745670	745671	13	13	0	19	7	113	0.434339	0.36085	0.048672	8	0.584477363	0.407037
492	745670	745671	13	11	2	14	6	113	0.445591	0.385584	0.122732	9	0.574731095	0.387572
493	745670	745671	13	13	0	20	9	113	0.494541	0.423932	0.052581	8	0.586014843	0.40374
494	745670	745671	13	13	0	13	9	113	0.463397	0.36631	0.122439	9	0.577540675	0.383984
495	745670	745671	13	10	2	16	9	113	0.463133	0.372951	0.120699	9	0.581142548	0.37746
496	745670	745671	13	11	2	15	9	113	0.437943	0.369472	0.120279	9	0.577477153	0.384728
497	745670	745671	13	11	2	18	11	113	0.467694	0.387113	0.05057	8	0.584644779	0.405571
498	745670	745671	13	13	0	17	12	113	0.384046	0.308329	0.052108	8	0.583071082	0.408364
499	745670	745671	13	12	1	18	9	113	0.457211	0.376533	0.122898	9	0.576405429	0.384794
500	745670	745671	13	12	1	14	11	113	0.452082	0.368084	0.049444	7	0.582251902	0.409242
501	745670	745671	13	13	0	18	12	113	0.480719	0.372886	0.122469	9	0.582088604	0.37522
502	745670	745671	13	13	0	13	6	113	0.476025	0.400084	0.126541	9	0.569309079	0.398056
503	745670	745671	13	12	1	16	13	113	0.496591	0.382802	0.059007	8	0.587105774	0.40319
504	745670	745671	13	12	1	19	9	113	0.440183	0.371406	0.122628	8	0.574296103	0.388672
505	745670	745671	13	13	0	17	10	113	0.411346	0.357402	0.125118	9	0.576304755	0.384848
506	745670	745671	13	11	2	20	11	113	0.473713	0.395102	0.120849	8	0.576812926	0.386322
507	745670	745671	13	12	1	15	6	113	0.456478	0.375534	0.051271	8	0.585053268	0.404247
508	745670	745671	13	12	1	19	9	113	0.441008	0.387985	0.121604	9	0.581001331	0.37686
509	745670	745671	13	11	2	14	12	113	0.474536	0.379471	0.197359	9	0.568404804	0.356823
510	745670	745671	13	11	2	14	8	113	0.436554	0.377856	0.122325	9	0.572468631	0.392626
511	745670	745671	13	13	0	20	10	113	0.474814	0.36882	0.122376	9	0.579913021	0.380145
512	745670	745671	13	11	1	14	8	113	0.456742	0.361461	0.119769	9	0.573791424	0.392172
513	745670	745671	13	12	1	14	9	113	0.415855	0.322555	0.061284	8	0.584838674	0.40469
514	745670	745671	13	12	1	19	8	113	0.445869	0.359213	0.053328	8	0.589746341	0.401524
515	745670	745671	13	13	0	15	11	113	0.455464	0.372445	0.121434	8	0.577421536	0.38513
516	745670	745671	13	10	3	12	8	113	0.471948	0.377376	0.051511	8	0.584687503	0.405653
517	745670	745671	13	12	1	13	8	113	0.458612	0.379393	0.124612	9	0.571846214	0.395221
518	745670	745671	13	12	1	15	8	113	0.496883	0.404045	0.124652	9	0.575528073	0.387544
519	745670	745671	13	13	0	12	8	113	0.445686	0.397596	0.127272	8	0.575417682	0.38402
520	745670	745671	13	11	2	17	11	113	0.446254	0.375676	0.050828	8	0.585308644	0.405402
521	745670	745671	13	11	2	15	10	113	0.454958	0.37933	-0.0179	7	0.590049389	0.426377
522	745670	745671	13	12	1	17	9	113	0.448695	0.392643	0.121332	9	0.578448286	0.382377
523	745670	745671	13	13	0	13	9	113	0.476498	0.364699	0.121496	9	0.578054306	0.382945
524	745670	745671	13	13	0	14	9	113	0.436861	0.353065	0.121	9	0.578945693	0.382497
525	745670	745671	13	12	1	14	8	113	0.469048	0.345163	0.193375	9	0.565913682	0.365795
526	745670	745671	13	12	1	15	9	113	0.470844	0.397257	0.053689	8	0.584522446	0.405792
527	745670	745671	13	12	1	15	11	113	0.489109	0.386781	0.121751	9	0.576892944	0.385489
528	745670	745671	13	13	0	19	10	113	0.475436	0.385309	0.123522	8	0.577092884	0.38371
529	745670	745671	13	13	0	18	10	113	0.460484	0.381923	0.121754	9	0.577843142	0.383692
530	745670	745671	13	12	1	19	9	113	0.459184	0.407568	0.122174	9	0.577014625	0.384726
531	745670	745671	13	12	1	19	11	113	0.475134	0.379632	0.122962	9	0.577340235	0.383745
532	745670	745671	13	12	1	16	11	113	0.469468	0.394172	0.06375	8	0.585536371	0.402296
533	745670	745671	13	12	1	17	10	113	0.447721	0.35797	-0.00889	7	0.604507406	0.410069
534	745670	745671	13	12	1	16	7	113	0.446401	0.360245	0.121282	9	0.584125048	0.372863
535	745670	745671	13	12	1	20	9	113	0.473057	0.397456	0.126483	9	0.579752649	0.378319
536	745670	745671	13	13	0	19	11	113	0.484299	0.405829	0.122315	9	0.578346985	0.382874
537	745670	745671	13	12	1	18	10	113	0.462967	0.362213	0.058098	8	0.595664	0.388896
538	745670	745671	13	13	0	18	9	113	0.450791	0.395925	0.125058	9	0.574399273	0.386889
539	745670	745671	13	11	1	12	7	113	0.440693	0.382851	0.058362	8	0.593361958	0.395848
540	745670	745671	13	13	0	16	10	113	0.454435	0.375148	0.126013	9	0.576963823	0.382462
541	745670	745671	13	13	0	14	12	113	0.450877	0.378729	0.12163	9	0.576488834	0.386423
542	745670	745671	13	13	0	17	10	113	0.465262	0.36949	0.121611	9	0.57631828	0.385708
543	745670	745671	13	12	1	23	13	113	0.459817	0.380692	0.121573	9	0.586353557	0.368228
544	745670	745671	13	12	1	21	9	113	0.465424	0.382445	0.124318	7	0.575273334	0.384492
545	745670	745671	13	13	0	16	10	113	0.494398	0.396192	0.12171	8	0.577505966	0.384393
546	745670	745671	13	11	1	20	10	113	0.462969	0.359762	0.128778	9	0.579854339	0.379815
547	745670	745671	13	13	0	19	10	113	0.468388	0.390795	-0.01059	7	0.597919092	0.417761
548	745670	745671	13	13	0	13	3	113	0.439077	0.363154	0.121212	8	0.57588139	0.387444
549	745670	745671	13	12	1	19	12	113	0.455283	0.389463	0.053045	8	0.587978474	0.401451
550	745670	745671	13	13	0	13	9	113	0.465966	0.382858	0.060772	8	0.585324747	0.404261
551	745670	745671	13	12	1	15	9	113	0.486083	0.375616	0.126724	8	0.573089814	0.388275
552	745670	745671	13	12	1	17	10	113	0.495595	0.385997	0.125321	8	0.575478856	0.383956
553	745670	745671	13	11	2	15	5	113	0.461074	0.365604	0.12197	9	0.576947585	0.385075
554	745670	745671	13	12	1	13	10	113	0.502644	0.413602	0.122781	9	0.580182671	0.379881
555	745670	745671	13	12	1	24	11	113	0.469641	0.371861	0.122687	9	0.575149637	0.387385
556	745670	745671	13	12	1	21	9	113	0.46776	0.379729	0.054399	8	0.58526315	0.402802
557	745670	745671	13	11	2	18	11	113	0.454788	0.377126	0.051875	8	0.595682583	0.392076
558	745670	745671	13	12	1	20	12	113	0.460341	0.378602	0.137094	7	0.573925186	0.386248
559	745670	745671	13	13	0	15	9	113	0.481231	0.39052	0.063143	8	0.585554468	0.40178
560	745670	745671	13	13	0	14	8	113	0.480833	0.401307	0.126464	8	0.57625279	0.383321
561	745670	745671	13	12	1	16	8	113	0.447169	0.373177	0.124147	9	0.577479704	0.383223
562	745670	745671	13	13	0	17	11	113	0.481204	0.403839	0.053186	8	0.588101783	0.400986
563	745670	745671	13	12	1	10	8	113	0.445553	0.367432	0.050866	7	0.575960763	0.418796

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UNDERLYING DATA MARKED CONFIDENTIAL PURSUANT TO PROTECTIVE ORDER

564	745670	745671	13	11	2	17	12	113	0.445528	0.373523	0.062319	8	0.580818141	0.410801
565	745670	745671	13	12	1	15	10	113	0.476745	0.376398	0.046545	8	0.591085712	0.398007
566	745670	745671	13	12	1	17	11	113	0.469832	0.386075	0.05569	8	0.590974082	0.398751
567	745670	745671	13	12	1	17	7	113	0.447644	0.379592	0.121119	9	0.57952403	0.381646
568	745670	745671	13	12	1	14	8	113	0.452301	0.363232	0.124804	8	0.575696289	0.385224
569	745670	745671	13	10	2	8	6	113	0.42205	0.35984	-0.01388	7	0.596114555	0.420611
570	745670	745671	13	13	0	18	9	113	0.482603	0.37558	0.124287	7	0.575925161	0.384206
571	745670	745671	13	13	0	18	10	113	0.468356	0.395198	0.124163	7	0.575316724	0.385853
572	745670	745671	13	13	0	17	10	113	0.465537	0.370592	0.125095	8	0.57684015	0.382916
573	745670	745671	13	10	3	15	10	113	0.459666	0.353596	0.121804	8	0.580717224	0.37651
574	745670	745671	13	13	0	15	7	113	0.425153	0.371576	0.058214	8	0.592647787	0.395521
575	745670	745671	13	12	1	17	12	113	0.474543	0.372814	0.121439	9	0.577493397	0.385849
576	745670	745671	13	12	1	17	9	113	0.426966	0.370622	0.122187	9	0.576229359	0.386036
577	745670	745671	13	13	0	14	6	113	0.474152	0.362316	0.059212	8	0.589012984	0.400876
578	745670	745671	13	12	1	19	11	113	0.451112	0.332311	0.122985	9	0.578337197	0.381928
579	745670	745671	13	12	1	14	7	113	0.469453	0.378515	0.050294	8	0.585731242	0.40467
580	745670	745671	13	12	1	14	8	113	0.452119	0.387651	0.121448	8	0.571528152	0.393562
581	745670	745671	13	13	0	16	9	113	0.480268	0.362691	0.060139	8	0.588812734	0.400839
582	745670	745671	13	12	1	15	7	113	0.446291	0.376125	0.12103	9	0.57750147	0.383879
583	745670	745671	13	12	1	21	10	113	0.483957	0.397864	0.123143	9	0.575891485	0.385418
584	745670	745671	13	12	1	15	10	113	0.447654	0.338642	0.123998	9	0.579303805	0.378615
585	745670	745671	13	11	2	11	6	113	0.440273	0.362843	0.124868	9	0.575216438	0.38553
586	745670	745671	13	13	0	16	6	113	0.442322	0.358408	0.122361	8	0.573258789	0.390301
587	745670	745671	13	13	0	16	10	113	0.446292	0.374289	0.125047	9	0.576420291	0.383645
588	745670	745671	13	10	3	12	8	113	0.457949	0.386085	0.121864	8	0.5718364	0.391468
589	745670	745671	13	12	1	13	9	113	0.467228	0.379026	0.051035	8	0.588056172	0.400608
590	745670	745671	13	12	1	15	9	113	0.463536	0.3791	0.124542	9	0.575763952	0.384859
591	745670	745671	13	12	1	17	10	113	0.459852	0.375871	0.050306	8	0.590358915	0.399779
592	745670	745671	13	12	1	17	13	113	0.399443	0.332339	0.046727	8	0.582094756	0.410854
593	745670	745671	13	11	2	13	9	113	0.491467	0.39344	0.124553	9	0.581336035	0.375155
594	745670	745671	13	11	1	17	9	113	0.456194	0.394521	0.118999	9	0.578550317	0.382803
595	745670	745671	13	11	2	12	6	113	0.47858	0.37943	0.124604	9	0.576871978	0.38232
596	745670	745671	13	12	1	19	11	113	0.483034	0.39251	0.121478	9	0.581003138	0.377768
597	745670	745671	13	13	0	22	10	113	0.431334	0.364501	0.123017	9	0.586676222	0.366965
598	745670	745671	13	12	1	17	10	113	0.489071	0.375884	0.065151	8	0.584569405	0.403272
599	745670	745671	13	13	0	14	10	113	0.419542	0.363398	-0.02041	7	0.600162144	0.415849
600	745670	745671	13	11	2	15	9	113	0.50456	0.401566	0.122902	9	0.576974213	0.385183
601	745670	745671	13	11	2	13	7	113	0.455754	0.34641	0.057578	8	0.585656161	0.402745
602	745670	745671	13	13	0	13	9	113	0.460908	0.366219	0.123012	8	0.579899441	0.377633
603	745670	745671	13	12	1	19	10	113	0.4846	0.370497	0.122695	9	0.581150467	0.37755
604	745670	745671	13	13	0	14	9	113	0.494124	0.407529	0.062262	8	0.585390279	0.402871
605	745670	745671	13	12	1	17	10	113	0.445822	0.368941	0.196695	9	0.564993626	0.364485
606	745670	745671	13	11	2	17	9	113	0.447201	0.343236	0.120367	9	0.576794805	0.384415
607	745670	745671	13	12	1	17	10	113	0.47429	0.394975	0.121371	9	0.571656759	0.394042
608	745670	745671	13	12	1	19	9	113	0.468569	0.380239	0.124701	9	0.575706227	0.387345
609	745670	745671	13	12	1	20	11	113	0.487468	0.394538	-0.00741	7	0.592703044	0.422161
610	745670	745671	13	11	2	13	10	113	0.490131	0.388641	0.120149	9	0.574810308	0.388313
611	745670	745671	13	13	0	16	10	113	0.502078	0.403834	0.124234	9	0.579082468	0.380227
612	745670	745671	13	13	0	18	7	113	0.472851	0.402142	0.123517	9	0.577110766	0.383565
613	745670	745671	13	12	1	17	12	113	0.483333	0.381127	0.121568	9	0.576334251	0.385101
614	745670	745671	13	12	1	14	6	113	0.415439	0.344327	-0.01005	7	0.591799044	0.423797
615	745670	745671	13	12	1	18	10	113	0.465852	0.383392	0.124336	9	0.57611328	0.384225
616	745670	745671	13	13	0	15	9	113	0.473867	0.397491	0.122529	8	0.575546323	0.386362
617	745670	745671	13	13	0	18	10	113	0.450538	0.367338	0.122788	9	0.578430469	0.382021
618	745670	745671	13	11	2	13	6	113	0.483263	0.405229	0.12203	9	0.580425978	0.378788
619	745670	745671	13	12	1	19	10	113	0.457775	0.375018	0.12244	8	0.574661946	0.390276
620	745670	745671	13	11	2	14	8	113	0.484614	0.397057	-0.00678	7	0.594653599	0.41985
621	745670	745671	13	11	2	13	8	113	0.482154	0.363664	0.122097	9	0.580353259	0.380197
622	745670	745671	13	12	1	16	10	113	0.474845	0.406266	0.053769	8	0.586022675	0.402561
623	745670	745671	13	13	0	13	9	113	0.46202	0.356085	-0.01183	7	0.600035171	0.415318
624	745670	745671	13	11	1	21	11	113	0.41606	0.334526	0.120056	8	0.575926743	0.385236
625	745670	745671	13	13	0	20	12	113	0.461225	0.374193	0.195492	8	0.567831491	0.357376
626	745670	745671	13	12	1	16	11	113	0.441629	0.382405	0.120525	8	0.577706315	0.38307
627	745670	745671	13	13	0	16	11	113	0.487486	0.405213	0.123372	8	0.575485271	0.386031
628	745670	745671	13	11	1	14	8	113	0.427469	0.385585	0.054804	8	0.582301041	0.40768
629	745670	745671	13	11	2	16	7	113	0.445325	0.382408	0.051228	7	0.583013172	0.407713
630	745670	745671	13	12	1	15	8	113	0.493659	0.409601	0.121265	9	0.580258502	0.38023
631	745670	745671	13	12	1	17	13	113	0.465854	0.382469	0.19776	9	0.562273845	0.370805
632	745670	745671	13	13	0	22	10	113	0.459183	0.402363	0.124894	9	0.574977171	0.385632
633	745670	745671	13	12	1	13	7	113	0.457887	0.369214	0.121632	9	0.577122604	0.385157
634	745670	745671	13	13	0	17	10	113	0.486818	0.368364	0.122134	8	0.578364259	0.381653
635	745670	745671	13	12	1	14	9	113	0.499024	0.388737	0.121528	9	0.576836934	0.384708
636	745670	745671	13	12	1	16	9	113	0.464804	0.370943	0.122435	9	0.58680189	0.366591
637	745670	745671	13	13	0	13	8	113	0.454876	0.400173	0.049699	8	0.58411414	0.407257
638	745670	745671	13	13	0	14	9	113	0.46609	0.362489	0.060064	8	0.58806749	0.402083
639	745670	745671	13	12	1	17	13	113	0.484999	0.379348	0.064374	8	0.584001025	0.404589
640	745670	745671	13	13	0	20	10	113	0.468225	0.40056	0.051665	8	0.594580154	0.392
641	745670	745671	13	11	1	15	8	113	0.455223	0.379364	0.121924	9	0.577001116	0.384214
642	745670	745671	13	12	1	9	6	113	0.475329	0.387832	0.060675	8	0.587412672	0.402318
643	745670	745671	13	13	0	20	9	113	0.468052	0.39898	0.125684	9	0.574767881	0.386638
644	745670	745671	13	11	2	13	8	113	0.452436	0.381866	0.049687	8	0.582521367	0.409321
645	745670	745671	13	12	1	14	8	113	0.461442	0.363286	0.124363	8	0.579891352	0.378116
646	745670	745671	13	12	1	14	10	113	0.477121	0.413182	0.051317	8	0.589231397	0.399515
647	745670	745671	13	10	2	17	10	113	0.469318	0.381866	0.120198	9	0.58234227	0.376363
648	745670	745671	13	13	0	17	11	113	0.475229	0.404367	0.130575	8	0.567569673	0.400577
649	745670	745671	13	13	0	12	8	113	0.46377	0.375805	0.051738	8	0.581535801	0.412068
650	745670	745671	13	13	0	15	8	113	0.459514	0.383456	0.053469	8	0.579622656	0.412025
651	745670	745671	13	13	0	20	11	113	0.447122	0.385835	0.127376	9	0.576343613	0.382736
652	745670	745671	13	13	0	11	6	113	0.43685	0.363666	0.121101	9	0.573896723	0.391225
653	745670	745671	13	13	0	22	13	113	0.491869	0.393587	0.123703	8	0.579346486	0.379506
654	745670	745671	13	12	1	16	7	113	0.432133	0.364389	0.124815	8	0.573727648	0.389932
655	745670	745671	13	12	1	17	8	113	0.4825	0.394308	0.123351	9	0.575347333	0.388953
656	745670	745671	13	11	2	15	7	113	0.483073	0.34793	0.120406	9	0.578274208	0.382563
657	745670	745671	13	13	0	19	8	113	0.442515	0.377549	0.063667	8	0.582809768	0.406373

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UNDERLYING DATA MARKED CONFIDENTIAL PURSUANT TO PROTECTIVE ORDER

658	745670	745671	13	12	1	18	12	113	0.445293	0.380595	0.052396	8	0.584893564	0.403596
659	745670	745671	13	13	0	13	9	113	0.47116	0.391026	0.063721	8	0.584873093	0.403969
660	745670	745671	13	13	0	18	11	113	0.480698	0.382011	0.124331	9	0.57518768	0.38617
661	745670	745671	13	12	1	12	8	113	0.500952	0.401486	0.123348	8	0.577349128	0.383363
662	745670	745671	13	12	1	21	11	113	0.457652	0.359453	0.061942	8	0.593289696	0.393833
663	745670	745671	13	13	0	17	10	113	0.469216	0.412297	0.122895	8	0.575640882	0.386124
664	745670	745671	13	12	1	15	7	113	0.454565	0.385666	0.05192	7	0.583260943	0.407339
665	745670	745671	13	12	1	17	8	113	0.416955	0.372235	-0.00631	7	0.593778987	0.421499
666	745670	745671	13	11	2	15	7	113	0.473391	0.370754	0.121541	9	0.578852904	0.383446
667	745670	745671	13	12	1	16	6	113	0.430144	0.368229	0.124474	9	0.572855262	0.391008
668	745670	745671	13	10	2	13	8	113	0.448148	0.388854	0.124825	8	0.57510519	0.384872
669	745670	745671	13	12	1	15	12	113	0.504764	0.390105	-0.0057	7	0.5922972	0.421891
670	745670	745671	13	12	1	17	9	113	0.459915	0.360722	0.124626	8	0.574417766	0.388234
671	745670	745671	13	13	0	17	8	113	0.458959	0.390247	0.060876	8	0.585192351	0.404518
672	745670	745671	13	12	1	20	13	113	0.497259	0.392559	-0.00745	7	0.592038938	0.422817
673	745670	745671	13	11	2	13	7	113	0.44927	0.364178	0.120487	9	0.573606955	0.391666
674	745670	745671	13	11	2	16	7	113	0.47474	0.382589	0.123742	9	0.580369582	0.380026
675	745670	745671	13	13	0	19	10	113	0.438831	0.344257	0.123257	7	0.570259504	0.39542
676	745670	745671	13	12	1	13	9	113	0.482479	0.402147	0.051873	8	0.584874071	0.405651
677	745670	745671	13	11	1	13	8	113	0.471805	0.406438	0.054317	8	0.58284134	0.408824
678	745670	745671	13	12	1	16	11	113	0.464191	0.393996	0.062877	8	0.582783199	0.406448
679	745670	745671	13	13	0	13	10	113	0.489151	0.377213	0.122947	9	0.578546221	0.381734
680	745670	745671	13	13	0	15	8	113	0.456725	0.373816	0.122153	9	0.57612836	0.384627
681	745670	745671	13	10	2	16	8	113	0.487246	0.369652	0.118837	9	0.578306341	0.384008
682	745670	745671	13	13	0	15	7	113	0.477715	0.39944	0.123729	9	0.575900585	0.385912
683	745670	745671	13	13	0	16	11	113	0.437459	0.369355	0.049706	8	0.585353083	0.405069
684	745670	745671	13	11	1	15	8	113	0.432142	0.379709	0.057462	8	0.579383829	0.412648
685	745670	745671	13	13	0	22	12	113	0.477993	0.405286	0.052392	8	0.586011101	0.403911
686	745670	745671	13	13	0	15	7	113	0.447896	0.377282	0.051916	8	0.583000446	0.407164
687	745670	745671	13	13	0	15	8	113	0.471513	0.368043	0.123111	9	0.57729317	0.383302
688	745670	745671	13	12	1	20	10	113	0.44989	0.37237	0.124756	8	0.57470304	0.38942
689	745670	745671	13	13	0	19	9	113	0.476714	0.372683	0.121188	9	0.581122125	0.378264
690	745670	745671	13	11	2	10	6	113	0.450562	0.374219	0.121501	7	0.572617781	0.392204
691	745670	745671	13	12	1	16	11	113	0.462044	0.395205	0.126206	7	0.568587456	0.397758
692	745670	745671	13	13	0	16	10	113	0.462906	0.379495	0.122879	8	0.575519603	0.386493
693	745670	745671	13	12	1	15	10	113	0.483155	0.397606	0.122734	9	0.575730269	0.38717
694	745670	745671	13	13	0	18	12	113	0.479579	0.404712	0.122588	9	0.575783199	0.38681
695	745670	745671	13	13	0	21	10	113	0.437563	0.366366	0.050082	8	0.586376298	0.404344
696	745670	745671	13	12	1	22	11	113	0.467107	0.386211	-0.01412	7	0.597672231	0.418823
697	745670	745671	13	12	1	18	13	113	0.437162	0.369479	0.051619	8	0.588823697	0.401124
698	745670	745671	13	11	2	20	10	113	0.46585	0.399289	0.123786	9	0.580078661	0.381097
699	745670	745671	13	13	0	14	10	113	0.479533	0.40906	0.122987	9	0.575585367	0.386347
700	745670	745671	13	12	1	14	7	113	0.453499	0.387299	0.123426	9	0.576929913	0.384496
701	745670	745671	13	12	1	18	10	113	0.474913	0.37337	0.121395	9	0.581667484	0.377586
702	745670	745671	13	12	1	12	6	113	0.464806	0.381481	0.12451	9	0.575206415	0.386321
703	745670	745671	13	13	0	19	12	113	0.448588	0.394913	0.059929	8	0.588982065	0.398834
704	745670	745671	13	13	0	12	6	113	0.466879	0.366387	0.121827	9	0.583398468	0.375364
705	745670	745671	13	11	2	15	9	113	0.468849	0.360763	0.122232	9	0.579998647	0.379429
706	745670	745671	13	12	1	15	10	113	0.453561	0.371435	-0.00951	7	0.589382218	0.426672
707	745670	745671	13	13	0	18	11	113	0.45701	0.388381	0.125313	7	0.576068149	0.383796
708	745670	745671	13	12	1	13	7	113	0.455316	0.366695	0.123291	9	0.573925666	0.38983
709	745670	745671	13	13	0	18	10	113	0.462463	0.37954	0.122322	8	0.581182231	0.376318
710	745670	745671	13	11	2	10	7	113	0.477512	0.386911	-0.01046	7	0.591502081	0.425677
711	745670	745671	13	11	2	14	7	113	0.479722	0.381557	0.122121	8	0.580512551	0.379922
712	745670	745671	13	11	1	21	11	113	0.451277	0.377501	0.118906	9	0.579890092	0.380312
713	745670	745671	13	12	1	19	9	113	0.429719	0.346403	0.049398	8	0.590421768	0.400815
714	745670	745671	13	13	0	17	9	113	0.46179	0.417207	0.127709	8	0.575082162	0.383201
715	745670	745671	13	11	2	14	9	113	0.473696	0.407776	0.125233	9	0.579844501	0.379759
716	745670	745671	13	12	1	12	7	113	0.446905	0.353968	0.119887	9	0.58447635	0.374241
717	745670	745671	13	13	0	17	12	113	0.465693	0.397515	0.12519	8	0.57894935	0.380699
718	745670	745671	13	11	2	11	7	113	0.462881	0.34397	0.056172	8	0.590658208	0.39842
719	745670	745671	13	12	1	17	8	113	0.453964	0.399262	0.125202	9	0.580046115	0.378601
720	745670	745671	13	11	2	16	9	113	0.457283	0.38103	0.130409	8	0.575854091	0.385236
721	745670	745671	13	12	1	8	5	113	0.471325	0.398982	0.12313	9	0.579695713	0.379884
722	745670	745671	13	12	1	18	11	113	0.433618	0.375636	0.126611	8	0.577893821	0.38229
723	745670	745671	13	13	0	16	10	113	0.453665	0.387407	0.123228	9	0.575169621	0.386678
724	745670	745671	13	11	2	17	11	113	0.449143	0.395769	0.124395	9	0.584196803	0.372589
725	745670	745671	13	12	1	14	11	113	0.490891	0.390196	0.122719	8	0.577334823	0.384939
726	745670	745671	13	11	2	16	10	113	0.50145	0.40526	0.193914	9	0.571338704	0.353618
727	745670	745671	13	13	0	17	10	113	0.465187	0.387697	0.123866	8	0.575875335	0.384373
728	745670	745671	13	13	0	14	11	113	0.428816	0.352838	-0.08023	6	0.605424988	0.434698
729	745670	745671	13	11	2	14	6	113	0.449485	0.369362	0.121197	9	0.573769663	0.390638
730	745670	745671	13	13	0	17	10	113	0.461176	0.370112	0.058673	8	0.577088177	0.415213
731	745670	745671	13	12	1	19	11	113	0.492715	0.377539	0.122987	8	0.57766268	0.384784
732	745670	745671	13	12	1	15	10	113	0.4832	0.387759	0.121906	8	0.57743851	0.384338
733	745670	745671	13	12	1	20	9	113	0.49259	0.404337	0.12154	9	0.580035449	0.380416
734	745670	745671	13	13	0	21	11	113	0.45175	0.392575	0.063543	7	0.592051135	0.394505
735	745670	745671	13	10	3	19	8	113	0.472339	0.376111	0.123325	9	0.573030281	0.392193
736	745670	745671	13	11	2	18	10	113	0.433825	0.344208	0.123247	9	0.578974163	0.379906
737	745670	745671	13	13	0	19	10	113	0.462262	0.377867	0.050319	8	0.583252727	0.407328
738	745670	745671	13	13	0	15	11	113	0.486642	0.399318	0.122308	9	0.578596655	0.382837
739	745670	745671	13	13	0	22	12	113	0.440827	0.355297	0.053973	8	0.585855768	0.402998
740	745670	745671	13	11	2	17	12	113	0.449651	0.387834	0.12316	9	0.579383865	0.382701
741	745670	745671	13	13	0	24	11	113	0.45292	0.361035	0.122701	9	0.578533943	0.382796
742	745670	745671	13	13	0	22	11	113	0.425516	0.359662	0.121219	8	0.574833665	0.387595
743	745670	745671	13	12	1	17	10	113	0.472433	0.376507	0.060176	8	0.585655581	0.403597
744	745670	745671	13	12	1	19	11	113	0.440261	0.389704	0.124876	8	0.576770675	0.383667
745	745670	745671	13	13	0	18	11	113	0.473965	0.397493	0.063073	8	0.58464198	0.404022
746	745670	745671	13	13	0	21	13	113	0.425957	0.358884	-0.01314	7	0.593961697	0.42054
747	745670	745671	13	12	1	14	9	113	0.445085	0.369317	0.120137	9	0.577981172	0.381457
748	745670	745671	13	13	0	19	13	113	0.472589	0.372902	0.125904	9	0.576526921	0.38382
749	745670	745671	13	12	1	18	11	113	0.458047	0.38457	0.124849	8	0.574749882	0.386893
750	745670	745671	13	12	1	19	9	113	0.405794	0.364048	0.050764	8	0.584013134	0.406838
751	745670	745671	13	13	0	15	7	113	0.463913	0.391806	0.061598	8	0.584796473	0.404645

752	745670	745671	13	12	1	16	11	113	0.461559	0.387428	0.123455	9	0.577147582	0.38451
753	745670	745671	13	11	1	18	11	113	0.477979	0.381463	0.12032	9	0.585578416	0.371518
754	745670	745671	13	12	1	16	11	113	0.451431	0.38114	0.124388	7	0.572663212	0.389352
755	745670	745671	13	13	0	15	6	113	0.486323	0.377848	0.122452	8	0.579314216	0.379831
756	745670	745671	13	12	1	11	7	113	0.462073	0.387857	-0.01318	7	0.599305448	0.417251
757	745670	745671	13	13	0	16	7	113	0.47373	0.372669	0.123497	9	0.576168419	0.385636
758	745670	745671	13	13	0	17	9	113	0.423184	0.371182	0.050983	8	0.581995243	0.408732
759	745670	745671	13	12	1	15	11	113	0.447147	0.395391	0.060743	8	0.585403911	0.404133
760	745670	745671	13	11	1	17	8	113	0.454499	0.377072	0.055241	7	0.580657846	0.410508
761	745670	745671	13	11	2	16	10	113	0.467035	0.371058	0.060661	8	0.587007057	0.404148
762	745670	745671	13	13	0	17	11	113	0.451528	0.399717	0.123729	9	0.576945901	0.383308
763	745670	745671	13	13	0	23	11	113	0.447027	0.399213	0.051561	8	0.584921833	0.405444
764	745670	745671	13	13	0	23	15	113	0.468512	0.363657	0.121261	8	0.576737555	0.384534
765	745670	745671	13	12	1	18	11	113	0.463043	0.401852	0.123325	9	0.575465349	0.385953
766	745670	745671	13	12	1	17	12	113	0.470255	0.391021	0.12232	8	0.579078536	0.381197
767	745670	745671	13	13	0	18	11	113	0.483519	0.39991	0.123988	9	0.579337002	0.379271
768	745670	745671	13	11	2	14	9	113	0.4818	0.399139	0.053519	8	0.585341716	0.404258
769	745670	745671	13	13	0	19	9	113	0.467798	0.349423	0.121368	9	0.577524194	0.383456
770	745670	745671	13	12	1	22	10	113	0.451958	0.392056	0.129836	8	0.577322708	0.383847
771	745670	745671	13	12	1	10	6	113	0.428982	0.374823	0.122129	8	0.586912338	0.366659
772	745670	745671	13	13	0	18	9	113	0.465026	0.366296	0.12487	8	0.574938936	0.386781
773	745670	745671	13	13	0	16	8	113	0.455055	0.356461	0.124985	8	0.575390912	0.384637
774	745670	745671	13	13	0	18	12	113	0.472105	0.38443	0.123392	9	0.579280106	0.380487
775	745670	745671	13	11	2	14	7	113	0.460537	0.352729	0.122462	9	0.579492624	0.382555
776	745670	745671	13	12	1	15	11	113	0.436932	0.395186	0.124713	9	0.576145557	0.384494
777	745670	745671	13	12	1	15	11	113	0.472938	0.396712	0.1253	9	0.577200819	0.382789
778	745670	745671	13	13	0	17	9	113	0.4732	0.374758	0.122785	9	0.575919113	0.386032
779	745670	745671	13	13	0	17	10	113	0.431301	0.387377	-0.0189	7	0.587520388	0.429365
780	745670	745671	13	12	1	19	12	113	0.484062	0.397818	0.05067	8	0.586089495	0.403612
781	745670	745671	13	12	1	13	8	113	0.460595	0.366436	0.06481	7	0.580508773	0.411267
782	745670	745671	13	13	0	13	8	113	0.496174	0.403579	0.121504	9	0.577105023	0.385032
783	745670	745671	13	12	1	13	8	113	0.457082	0.356045	0.121256	9	0.577633112	0.384825
784	745670	745671	13	13	0	15	10	113	0.469627	0.38528	0.124385	8	0.575538851	0.385385
785	745670	745671	13	11	1	14	11	113	0.455406	0.382199	0.049873	8	0.583209799	0.40839
786	745670	745671	13	12	1	20	11	113	0.481192	0.372056	0.125097	9	0.578768861	0.382167
787	745670	745671	13	11	2	14	9	113	0.444976	0.377296	0.119469	9	0.575508584	0.38832
788	745670	745671	13	13	0	19	9	113	0.474394	0.378855	0.127103	8	0.577949182	0.3799
789	745670	745671	13	12	1	18	12	113	0.475894	0.404847	0.060854	8	0.597214441	0.389244
790	745670	745671	13	12	1	18	6	113	0.465177	0.357439	0.12413	9	0.578414916	0.382417
791	745670	745671	13	13	0	15	8	113	0.442644	0.38562	0.196257	9	0.569999251	0.353939
792	745670	745671	13	12	1	18	11	113	0.454254	0.395685	0.123236	8	0.577082927	0.38333
793	745670	745671	13	11	1	17	12	113	0.459748	0.409612	0.122754	9	0.574707782	0.386786
794	745670	745671	13	11	2	17	9	113	0.444447	0.366112	-0.00631	7	0.592134453	0.421847
795	745670	745671	13	12	1	13	9	113	0.479417	0.368043	0.120564	9	0.576789812	0.384099
796	745670	745671	13	11	2	13	9	113	0.451988	0.380792	0.124675	9	0.577375407	0.383621
797	745670	745671	13	11	2	17	9	113	0.487391	0.398364	0.124966	9	0.580584405	0.378889
798	745670	745671	13	13	0	20	13	113	0.479516	0.361046	0.059115	8	0.587801704	0.401496
799	745670	745671	13	11	2	21	9	113	0.465762	0.375192	0.125663	8	0.572088739	0.390428
800	745670	745671	13	12	1	19	13	113	0.446323	0.376303	0.049846	8	0.583591066	0.408091
801	745670	745671	13	13	0	16	10	113	0.480499	0.390294	0.126802	8	0.576986281	0.380989
802	745670	745671	13	12	1	16	9	113	0.467402	0.38955	0.124827	9	0.577725602	0.381771
803	745670	745671	13	13	0	12	6	113	0.457591	0.357824	0.123249	8	0.575420978	0.386446
804	745670	745671	13	13	0	16	9	113	0.441129	0.350089	0.06118	8	0.595048177	0.390439
805	745670	745671	13	13	0	20	10	113	0.458818	0.344174	0.122846	9	0.581718712	0.376031
806	745670	745671	13	12	1	20	11	113	0.468798	0.40662	0.06287	8	0.585103172	0.403506
807	745670	745671	13	12	1	20	11	113	0.470072	0.39312	0.060999	8	0.584487145	0.404747
808	745670	745671	13	12	1	13	9	113	0.449447	0.38084	0.123499	9	0.586747104	0.366115
809	745670	745671	13	12	1	16	9	113	0.466625	0.415513	0.0608	8	0.579860159	0.411468
810	745670	745671	13	13	0	17	12	113	0.478343	0.372056	0.125056	8	0.576209716	0.383956
811	745670	745671	13	11	1	16	9	113	0.458384	0.370476	0.05058	8	0.583450501	0.407801
812	745670	745671	13	12	1	11	7	113	0.462806	0.380309	0.123854	9	0.577745755	0.383309
813	745670	745671	13	12	1	13	7	113	0.491621	0.38717	0.122097	9	0.580424344	0.378777
814	745670	745671	13	11	2	15	8	113	0.442189	0.374963	0.121093	9	0.584232111	0.372785
815	745670	745671	13	12	1	14	10	113	0.487227	0.393929	0.124005	9	0.578697585	0.380869
816	745670	745671	13	12	1	13	8	113	0.491437	0.400672	0.123991	9	0.578699215	0.380644
817	745670	745671	13	13	0	17	9	113	0.425892	0.382841	-0.01975	7	0.592061199	0.423817
818	745670	745671	13	11	2	16	9	113	0.470352	0.406873	0.126886	9	0.580855983	0.375959
819	745670	745671	13	13	0	17	12	113	0.493428	0.41516	0.124595	7	0.57543475	0.385
820	745670	745671	13	11	2	13	10	113	0.500869	0.387236	0.122486	9	0.577234287	0.384435
821	745670	745671	13	12	1	20	13	113	0.47199	0.412221	0.120408	8	0.580387274	0.379887
822	745670	745671	13	12	1	18	9	113	0.458278	0.376831	0.121405	7	0.577073335	0.385186
823	745670	745671	13	13	0	18	7	113	0.452542	0.364172	0.12212	8	0.572183719	0.391607
824	745670	745671	13	12	1	16	8	113	0.509647	0.398942	0.055986	8	0.586202134	0.405162
825	745670	745671	13	13	0	21	11	113	0.475537	0.384553	-0.01008	7	0.598287884	0.417421
826	745670	745671	13	11	2	15	8	113	0.475702	0.386664	0.122731	9	0.577770696	0.385271
827	745670	745671	13	13	0	15	10	113	0.468936	0.381594	0.057285	7	0.582961362	0.408278
828	745670	745671	13	12	1	20	12	113	0.453694	0.372437	0.194634	8	0.568689786	0.359148
829	745670	745671	13	11	2	18	10	113	0.476099	0.364574	0.121751	9	0.57820298	0.383485
830	745670	745671	13	12	1	16	10	113	0.474721	0.413238	0.124544	9	0.576742682	0.383948
831	745670	745671	13	11	1	15	10	113	0.477372	0.401045	0.060996	7	0.581705824	0.409156
832	745670	745671	13	11	2	18	10	113	0.467778	0.391618	0.123414	9	0.579178232	0.382024
833	745670	745671	13	12	1	19	12	113	0.473988	0.381337	0.12536	8	0.576637411	0.38515
834	745670	745671	13	12	1	15	8	113	0.458643	0.396033	0.123984	9	0.575878934	0.385737
835	745670	745671	13	13	0	18	12	113	0.474231	0.392752	0.12335	9	0.580080528	0.377965
836	745670	745671	13	11	2	15	10	113	0.456872	0.365883	0.064131	8	0.584284625	0.404202
837	745670	745671	13	13	0	18	11	113	0.462115	0.402899	0.125224	8	0.574871743	0.386293
838	745670	745671	13	11	2	14	10	113	0.458331	0.351398	0.052111	7	0.576423832	0.417236
839	745670	745671	13	12	1	13	9	113	0.484362	0.381079	0.124385	9	0.577752011	0.382214
840	745670	745671	13	12	1	20	11	113	0.48402	0.401677	0.120461	9	0.585514798	0.371161
841	745670	745671	13	11	2	18	10	113	0.446391	0.388001	0.12281	7	0.574197033	0.387952
842	745670	745671	13	11	2	18	7	113	0.443395	0.385281	-0.00656	6	0.595522847	0.420366
843	745670	745671	13	10	2	13	7	113	0.430802	0.360012	0.119759	8	0.57373815	0.389933
844	745670	745671	13	13	0	20	10	113	0.46489	0.403948	-0.01219	7	0.588164975	0.427242
845	745670	745671	13	13	0	18	10	113	0.496867	0.385122	0.059912	8	0.587257882	0.403311

846	745670	745671	13	12	1	19	10	113	0.45305	0.35115	0.124422	9	0.580772738	0.377317
847	745670	745671	13	13	0	19	11	113	0.463134	0.39203	0.122196	7	0.577828718	0.382771
848	745670	745671	13	11	2	16	7	113	0.464966	0.366362	0.131556	9	0.580551722	0.378115
849	745670	745671	13	11	2	14	8	113	0.459281	0.382139	0.122997	8	0.576120808	0.387644
850	745670	745671	13	12	1	15	9	113	0.461762	0.351752	0.052035	8	0.586070589	0.403818
851	745670	745671	13	13	0	15	8	113	0.446412	0.394786	0.053825	8	0.587379612	0.40244
852	745670	745671	13	12	1	16	11	113	0.456216	0.384427	0.127206	9	0.572961491	0.389028
853	745670	745671	13	13	0	19	9	113	0.474604	0.384174	0.127075	9	0.577562736	0.380967
854	745670	745671	13	13	0	14	8	113	0.469946	0.368679	0.121428	9	0.583398289	0.374286
855	745670	745671	13	12	1	18	13	113	0.450524	0.369596	0.12085	8	0.574714682	0.390317
856	745670	745671	13	12	1	13	4	113	0.434294	0.37071	0.121638	8	0.569728499	0.396021
857	745670	745671	13	13	0	16	12	113	0.461965	0.386322	0.125314	9	0.579142473	0.379952
858	745670	745671	13	12	1	15	9	113	0.451347	0.387216	0.06213	8	0.58395247	0.404316
859	745670	745671	13	13	0	19	8	113	0.465689	0.383042	0.062614	8	0.586032521	0.4026
860	745670	745671	13	13	0	17	9	113	0.477437	0.400126	0.12502	7	0.576272578	0.384448
861	745670	745671	13	12	1	14	8	113	0.456502	0.378349	0.121858	9	0.587752014	0.366515
862	745670	745671	13	12	1	14	6	113	0.440698	0.372521	0.049598	8	0.582666043	0.408392
863	745670	745671	13	12	1	13	8	113	0.471579	0.378934	0.124751	9	0.577790855	0.381638
864	745670	745671	13	11	2	13	9	113	0.456089	0.386934	0.120732	7	0.574861007	0.38849
865	745670	745671	13	11	2	15	8	113	0.452373	0.389033	0.124859	9	0.579895355	0.380109
866	745670	745671	13	13	0	16	11	113	0.494131	0.416635	0.123369	9	0.578675768	0.381525
867	745670	745671	13	13	0	19	12	113	0.476389	0.390525	0.123673	8	0.578441576	0.381073
868	745670	745671	13	13	0	18	11	113	0.44668	0.347471	0.062841	8	0.58486728	0.402958
869	745670	745671	13	10	2	16	10	113	0.479028	0.398369	0.057177	8	0.593599858	0.394996
870	745670	745671	13	12	1	22	12	113	0.436714	0.34507	0.121481	9	0.574715375	0.388224
871	745670	745671	13	11	2	15	8	113	0.45804	0.374697	0.058783	8	0.583548977	0.408435
872	745670	745671	13	13	0	17	9	113	0.448578	0.38682	0.125115	8	0.577286393	0.381261
873	745670	745671	13	12	1	14	9	113	0.449985	0.381543	0.123082	8	0.578171327	0.38213
874	745670	745671	13	13	0	18	10	113	0.462004	0.351833	0.12477	8	0.573423553	0.388263
875	745670	745671	13	12	1	16	9	113	0.416963	0.316546	0.052298	8	0.586025226	0.40455
876	745670	745671	13	12	1	21	10	113	0.449746	0.381345	0.119721	9	0.576652848	0.385526
877	745670	745671	13	13	0	18	9	113	0.482919	0.400804	0.124896	9	0.575553815	0.38503
878	745670	745671	13	13	0	20	10	113	0.473027	0.377209	0.121359	9	0.576975552	0.384135
879	745670	745671	13	12	1	16	10	113	0.466611	0.399437	0.123449	9	0.578091498	0.382248
880	745670	745671	13	10	2	16	10	113	0.477534	0.399656	0.1969	10	0.568011041	0.357099
881	745670	745671	13	12	1	18	12	113	0.475941	0.387772	0.123617	9	0.573278994	0.389953
882	745670	745671	13	13	0	15	9	113	0.428273	0.374669	0.122739	7	0.572784486	0.390693
883	745670	745671	13	12	1	15	10	113	0.457962	0.396762	0.061225	7	0.584116181	0.407423
884	745670	745671	13	12	1	20	10	113	0.468742	0.380285	0.191329	9	0.567182518	0.365578
885	745670	745671	13	11	2	14	6	113	0.43124	0.353971	0.124352	9	0.572231923	0.391601
886	745670	745671	13	11	2	12	9	113	0.491023	0.385315	0.121521	9	0.577320992	0.386044
887	745670	745671	13	13	0	15	9	113	0.467123	0.373688	0.123595	9	0.576343358	0.38504
888	745670	745671	13	11	2	17	11	113	0.47642	0.380359	0.123549	9	0.575015359	0.389719
889	745670	745671	13	13	0	17	9	113	0.453316	0.386752	0.124422	9	0.57672142	0.383535
890	745670	745671	13	10	2	15	8	113	0.464958	0.383701	0.058325	8	0.582829482	0.40686
891	745670	745671	13	13	0	16	11	113	0.427364	0.335358	-0.01027	7	0.598331807	0.416366
892	745670	745671	13	11	2	15	10	113	0.446358	0.402997	0.125192	7	0.572864151	0.390521
893	745670	745671	13	13	0	15	8	113	0.473261	0.398147	0.054366	8	0.587403085	0.402109
894	745670	745671	13	10	3	14	7	113	0.469746	0.397223	0.121764	9	0.576211417	0.387645
895	745670	745671	13	13	0	19	10	113	0.462105	0.377899	0.123117	9	0.578337048	0.38231
896	745670	745671	13	12	1	17	10	113	0.475342	0.383397	0.058506	8	0.586071366	0.403621
897	745670	745671	13	12	1	9	5	113	0.456013	0.37788	0.125094	7	0.571283581	0.39453
898	745670	745671	13	12	1	16	9	113	0.442876	0.335321	-0.01493	7	0.599462315	0.416469
899	745670	745671	13	11	2	10	6	113	0.476004	0.376243	0.061905	8	0.585787701	0.403478
900	745670	745671	13	11	2	13	8	113	0.476516	0.409964	0.121954	9	0.585211076	0.371259
901	745670	745671	13	11	2	15	11	113	0.459743	0.369426	-0.01249	7	0.600601491	0.414947
902	745670	745671	13	13	0	17	9	113	0.468684	0.411711	0.123265	8	0.57518743	0.38667
903	745670	745671	13	11	2	16	8	113	0.443433	0.374772	0.049769	8	0.586844717	0.405912
904	745670	745671	13	11	2	14	9	113	0.473215	0.378752	-0.01184	7	0.607083436	0.406546
905	745670	745671	13	13	0	18	10	113	0.451684	0.390104	-0.01438	7	0.600935417	0.414569
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911	745670	745671	13	13	0	20	9	113	0.48351	0.396117	-0.01006	7	0.597929123	0.41709
912	745670	745671	13	13	0	19	11	113	0.439323	0.381722	0.12095	9	0.576966767	0.38478
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922	745670	745671	13	13	0	14	9	113	0.457958	0.38929	0.121833	8	0.573068032	0.391609
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925	745670	745671	13	12	1	11	4	113	0.45064	0.367101	0.121075	8	0.573580566	0.392361
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937	745670	745671	13	12	1	18	9	113	0.484253	0.403966	0.124025	9	0.580349425	0.380143
938	745670	745671	13	11	2	17	11	113	0.432492	0.357306	0.130856	8	0.579043845	0.379108
939	745670	745671	13	11	2	13	5	113	0.445252	0.389417	0.12374	9	0.579531857	0.381445

UNDERLYING DATA MARKED CONFIDENTIAL PURSUANT TO PROTECTIVE ORDER

940	745670	745671	13	13	0	17	9	113	0.465146	0.39573	0.124166	8	0.575587048	0.384942
941	745670	745671	13	13	0	16	8	113	0.456993	0.389705	0.121639	6	0.569369839	0.39777
942	745670	745671	13	12	1	15	10	113	0.426231	0.348708	0.048197	8	0.583627758	0.407951
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999	745670	745671	13	12	1	18	10	113	0.456268	0.362425	0.128195	8	0.567496349	0.39858
1000	745670	745671	13	13	0	12	9	113	0.464761	0.3909	0.061243	8	0.582543184	0.408063

21 CV 015426

FILED

STATE OF NORTH CAROLINA

COUNTY OF WAKE

2021 NOV 16 P 4:22

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
__ CVS ____

WAKE CO. C.S.C.

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC.; HENRY M. MICHAUX, JR.; DANDRIELLE LEWIS; TIMOTHY CHARTIER; TALIA FERNÓS; KATHERINE NEWHALL; JASON PARSLEY; EDNA SCOTT; ROBERTA SCOTT; YVETTE ROBERTS; JEREANN KING JOHNSON; REVEREND REGINALD WELLS; YARBROUGH WILLIAMS, JR.; REVEREND DELORIS L. JERMAN; VIOLA RYALS FIGUEROA; and COSMOS GEORGE,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting; SENATOR WARREN DANIEL, in his official capacity as Co-Chair of the Senate Standing Committee on Redistricting and Elections; SENATOR RALPH E. HISE, JR., in his official capacity as Co-Chair of the Senate Standing Committee on Redistricting and Elections; SENATOR PAUL NEWTON, in his official capacity as Co-Chair of the Senate Standing Committee on Redistricting and Elections; REPRESENTATIVE TIMOTHY K. MOORE, in his official capacity as Speaker of the North Carolina House of Representatives; SENATOR PHILIP E. BERGER, in his official capacity as President Pro Tempore of the North Carolina Senate; THE STATE OF NORTH CAROLINA; THE NORTH CAROLINA STATE BOARD OF ELECTIONS; DAMON CIRCOSTA, in his official capacity as Chairman of the North Carolina State Board of Elections; STELLA ANDERSON, in her official capacity as Secretary of the North Carolina State Board of Elections; JEFF CARMON III, in his official capacity as Member of the North Carolina State Board of Elections; STACY EGGERS IV, in his official capacity as Member of the North Carolina State Board of Elections; TOMMY TUCKER, in his official capacity as Member of the North Carolina State Board of Elections; and KAREN BRINSON BELL, in her official capacity as Executive Director of the North Carolina State Board of Elections,

Defendants.

AFFIDAVIT OF DR. MOON DUCHIN

NCLCV v. Hall
21 CVS 15426
LDTX157

Exhibit #
Duchin 1
12/30/21 - SL
exhibitsticker.com

I, Dr. Moon, Duchin, having been duly sworn by an officer authorized to administer oaths, depose and state as follows:

1. I am over 18 years of age, legally competent to give this Affidavit, and have personal knowledge of the facts set forth in this Affidavit.
2. All of the quantitative work described in this Affidavit was performed by myself with the support of research assistants working under my direct supervision.

Background and qualifications

3. I hold a Ph.D. and an M.S in Mathematics from the University of Chicago as well as an A.B. in Mathematics and Women's Studies from Harvard University.
4. I am a Professor of Mathematics and a Senior Fellow in the Jonathan M. Tisch College of Civic Life at Tufts University.
5. My general research areas are geometry, topology, dynamics, and applications of mathematics and computing to the study of elections and voting. My redistricting-related work has been published in venues such as the Election Law Journal, Political Analysis, Foundations of Data Science, the Notices of the American Mathematical Society, Statistics and Public Policy, the Virginia Policy Review, the Harvard Data Science Review, Foundations of Responsible Computing, and the Yale Law Journal Forum.
6. My research has had continuous grant support from the National Science Foundation since 2009, including a CAREER grant from 2013–2018. I am currently on the editorial board of the journals Advances in Mathematics and the Harvard Data Science Review. I was elected a Fellow of the American Mathematical Society in 2017 and was named a Radcliffe Fellow and a Guggenheim Fellow in 2018.
7. A current copy of my full CV is attached to this report.
8. I am compensated at the rate of $400 per hour.

Analysis of 2021 enacted redistricting plans in North Carolina

Moon Duchin
Professor of Mathematics, Tufts University
Senior Fellow, Tisch College of Civic Life

November 16, 2021

1 Introduction

On November 4, 2021, the North Carolina General Assembly enacted three districting plans: maps of 14 U.S. Congressional districts, 50 state Senate districts, and 120 state House districts. This affidavit contains a brief summary of my evaluation of the properties of these plans. My focus will be on the egregious partisan imbalance in the enacted plans, following a brief review of the traditional districting principles.

Because redistricting inevitably involves complex interactions of rules, which can create intricate tradeoffs, it will be useful to employ a direct comparison to an alternative set of plans. These demonstrative plans illustrate that it is possible to *simultaneously maintain or improve* metrics for all of the most important redistricting principles that are operative in North Carolina's constitution and state and federal law. Crucially, this shows that nothing about the state's political geography compels us to draw a plan with a massive and entrenched partisan skew.

To this end, I will be comparing the following plans: the enacted plans SL-174, SL-173, and SL-175 and a corresponding set of alternative plans labeled NCLCV-Cong, NCLCV-Sen, and NCLCV-House (proposed by plaintiffs who include the North Carolina League of Conservation Voters).

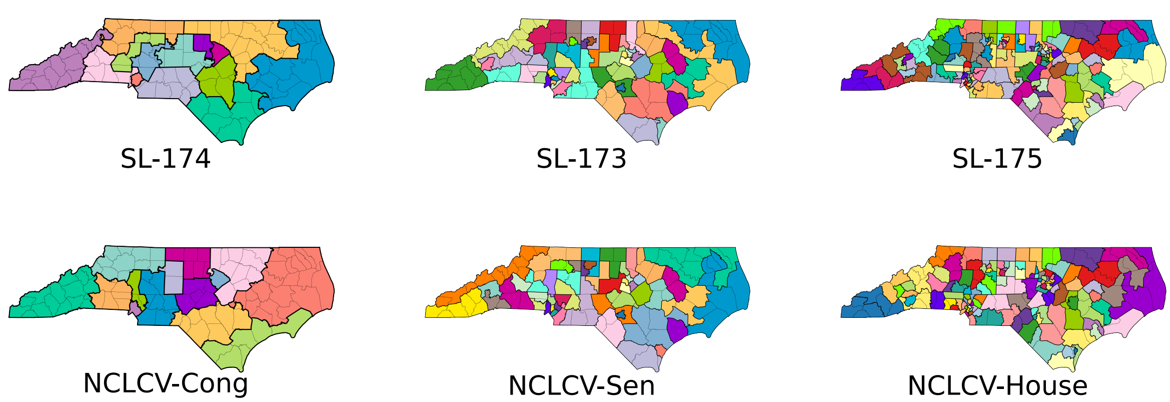

Figure 1: The six plans under discussion in this affidavit.

2 Traditional districting principles

Principles that are relevant to North Carolina redistricting include the following.

- **Population balance.** The standard interpretation of *One Person, One Vote* for Congressional districts is that districts should be fine-tuned so that their total Census population deviates by no more than one person from any district to any other.

  There is more latitude with legislative districts; they typically vary top-to-bottom by no more than 10% of ideal district size. In North Carolina, the Whole County Provisions make it very explicit that 5% deviation must be tolerated if it means preserving more counties intact.

  All six plans have acceptable population balance.

Population deviation

	Max Positive Deviation	District	Max Negative Deviation	District
SL-174	0	(eight districts)	−1	(six districts)
NCLCV-Cong	0	(eight districts)	−1	(six districts)
SL-173	10,355 (4.960%)	5	−10,434 (4.997%)	13,18
NCLCV-Sen	10,355 (4.960%)	5	−10,427 (4.994%)	15
SL-175	4250 (4.885%)	18	−4189 (4.815%)	112
NCLCV-House	4341 (4.990%)	82	−4323 (4.969%)	87

Table 1: Deviations are calculated with respect to the rounded ideal district populations of 745,671 for Congress, 208,788 for Senate, and 86,995 for House.

- **Minority electoral opportunity.** Minority groups' opportunity to elect candidates of choice is protected by both state and federal law. A detailed assessment of opportunity must hinge not on the demographics of the districts but on electoral history and an assessment of polarization patterns. That is not the focus of the current affidavit. Instead we make the brief note that it is important to avoid the conflation of *majority-minority districts* with *effective districts* for a minority group. An involved analysis of voting patterns—necessarily incorporating both primary and general elections to ensure that candidates of choice can be successfully nominated and elected—will frequently reveal that districts can be effective at demographic levels well below 50% of voting-age population or citizen voting-age population (VAP and CVAP, respectively). For instance, in [3], my co-authors and I drew an illustrative plan for Texas congressional districting in which some parts of the state had districts that were shown to reliably elect Black candidates of choice with BCVAP as low as 28.6%; by contrast, there are other parts of Texas where a 40% BCVAP district is less consistently effective. In a Louisiana case study, we found somewhat different patterns of human and political geography, producing numerous examples of Congressional-sized districts with 55% BCVAP in some parts of the state that are nonetheless marginal in terms of opportunity for Black voters to elect candidates of choice.

  In North Carolina, taking the crossover voting patterns of White, Latino, and Asian voters into account, I note that a district with BCVAP in the low to mid 30s can often be effective for Black voters—but there is no demographic shortcut to a full examination of primary and general election history.

- **Contiguity.** All six plans are contiguous; for each district, it is possible to transit from any part of the district to any other part through a sequence of census blocks that share boundary segments of positive length. As is traditional in North Carolina, contiguity through water is accepted.

- **Compactness.** The two compactness metrics most commonly appearing in litigation are the *Polsby-Popper score* and the *Reock score*. Polsby-Popper is the name given in redistricting to a metric from ancient mathematics: the isoperimetric ratio comparing a region's area to its perimeter via the formula $4\pi A/P^2$. Higher scores are considered more compact, with circles uniquely achieving the optimum score of 1. Reock is a different measurement of how much a shape differs from a circle: it is computed as the ratio of a region's area to that of its circumcircle, defined as the smallest circle in which the region can be circumscribed. From this definition, it is clear that it too is optimized at a value of 1, which is achieved only by circles.

  These scores depend on the contours of a district and have been criticized as being too dependent on map projections or on cartographic resolution [1, 2]. Recently, some mathematicians have argued for using discrete compactness scores, taking into account the units of Census geography from which the district is built. The most commonly cited discrete score for districts is the *cut edges score*, which counts how many adjacent pairs of geographical units receive different district assignments. In other words, cut edges measures the "scissors complexity" of the districting plan: how much work would have to be done to separate the districts from each other? Plans with a very intricate boundary would require many separations. This score improves on the contour-based scores by better controlling for factors like coastline and other natural boundaries, and by focusing on the units actually available to redistricters rather than treating districts like free-form Rorschach blots.

  The alternative plans are significantly more compact than the enacted plans in all three compactness metrics.

Compactness

	block cut edges (lower is better)	average Polsby-Popper (higher is better)	average Reock (higher is better)
SL-174	5194	0.303	0.381
NCLCV-Cong	4124	0.383	0.444
SL-173	9702	0.342	0.402
NCLCV-Sen	9249	0.369	0.423
SL-175	16,182	0.351	0.419
NCLCV-House	13,963	0.414	0.456

Table 2: Comparing compactness scores via one discrete and two contour-based metrics.

- **Respect for political subdivisions.** For legislative redistricting, North Carolina has one of the strongest requirements for county consideration of any state in the nation. In my understanding, courts have interpreted the Whole County Provisions as follows.

  - First, if any county is divisible into a whole number of districts that will be within ±5% of ideal population, then it must be subdivided accordingly without districts crossing into other counties.
  - Next, seek any contiguous grouping of two counties that is similarly divisible into a whole number of districts.
  - Repeat for groupings of three, and so on, until all counties are accounted for.

  A complete set of solutions is described in detail in the white paper of Mattingly et al.—though with the important caveat that the work "does not reflect... compliance with the Voting Rights Act" [4]. Absent a VRA conflict, the 2020 Decennial Census population data dictates that the North Carolina Senate plan must be decomposed into ten single-district fixed clusters and seven multi-district fixed clusters (comprising 2, 2, 3, 3, 4, 6, and 6 districts, respectively). It has four more areas in which there is a choice of groupings. In all, there are sixteen different possible clusterings for Senate, each comprising 26 county clusters. The House likewise has 11 single-district fixed clusters and 22 multi-district fixed clusters (with two to thirteen districts per cluster), together with three more areas with a choice of groupings. In all, the House has only eight acceptable clusterings, each comprising 40 county clusters. Again, it is important to note that VRA compliance may present a compelling reason to select some clusterings and reject others.

Once clusters have been formed, there are more rules about respecting county lines within clusters. The legal language is again explicit: "[T]he resulting interior county lines created by any such groupings may be crossed or traversed in the creation of districts within said multi-county grouping but only to the extent necessary" to meet the ±5% population standard for districts. To address this, I have counted the *county traversals* in each plan, i.e., the number of times a district crosses between adjacent counties within a grouping.

Table 3 reflects the county integrity metric that is most relevant at each level: the enacted congressional plan splits 11 counties into 25 pieces while the alternative plan splits 13, but splits no county three ways. (The enacted plans unnecessarily split three counties into three pieces.) In the legislative plans, the law specifies traversals as the fundamental integrity statistic.

The alternative plans are comparable to the enacted plans, or sometimes far superior, in each of these key metrics regarding preservation of political boundaries.

County and municipality preservation

	# county pieces
SL-174	25
NCLCV-Cong	26

	# traversals
SL-173	97
NCLCV-Sen	89
SL-175	69
NCLCV-House	66

	# municipal pieces
SL-174	90
NCLCV-Cong	58
SL-173	152
NCLCV-Sen	125
SL-175	292
NCLCV-House	201

Table 3: Comparing the plans’ conformance to political boundaries.

I will briefly mention several additional redistricting principles.

- **Communities of interest.** In North Carolina, there was no sustained effort by the state or by community groups to formally collect community of interest (COI) maps, to my knowledge. Without this, it is difficult to produce a suitable metric.
- **Cores of prior districts.** In some states, there is statutory guidance to seek districting plans that preserve the cores of prior districts. In North Carolina, this is not a factor in the constitution, in statute, or in case law. In addition, attention to core preservation would be prohibitively difficult in the Senate and House because of the primacy of the Whole County Provisions, which forces major changes to the districts simply as a consequence of fresh population numbers.

- **Incumbent pairing.** In 2017, the North Carolina legislative redistricting committee listed "incumbency protection" as a goal in their itemization of principles. In 2021, this was softened to the statement that "Member residence may be considered" in the drawing of districts. I have counted the districts in each plan that contain more than one incumbent address; these are sometimes colorfully called "double-bunked" districts. For this statistic, it is not entirely clear whether a high or low number is preferable. When a plan remediates a gerrymandered predecessor, we should not be surprised if it ends up pairing numerous incumbents.

Double-bunking

	# districts pairing incumbents
SL-174	3
NCLCV-Cong	1
SL-173	6
NCLCV-Sen	9
SL-175	7
NCLCV-House	15

Table 4: For Congress and Senate, the enacted and alternative plans are comparable; at the House level, the alternative plan has more double-bunking. *Note: These numbers were calculated using the most accurate incumbent addresses that have been provided to me.*

3 Partisan fairness

3.1 Abstract partisan fairness

There are many notions of partisan fairness that can be found in the scholarly literature and in redistricting practitioner guides and software. Most of them are numerical, in the sense that they address *how a certain share of the vote should be translated to a share of the seats* in a state legislature or Congressional delegation.

The numerical notions of partisan fairness all tend to agree on one central point: an electoral climate with a 50-50 split in partisan preference should produce a roughly 50-50 representational split. North Carolina voting has displayed a partisan split staying consistently close to even between the two major parties over the last ten years, but the plans released by the General Assembly after the 2010 census were very far from realizing the ideal of converting even voting to even representation. This time, with a 14th seat added to North Carolina's apportionment, an exactly even seat outcome is possible. But the new enacted plans, like the plans from ten years ago, are not conducive to even representation.

3.2 Geography and fairness

However, some scholars have argued that this ideal (that even vote preferences should translate to even representation) ignores the crucial *political geography*—the location of votes for each party, and not just the aggregate preferences, has a major impact on redistricting outcomes. In [5], my co-authors and I gave a vivid demonstration of the impacts of political geography in Massachusetts: we showed that for a ten-year span of observed voting patterns, even though Republicans tended to get over one-third of the statewide vote, it was impossible to draw a single Congressional district with a Republican majority. That is, the geography of Massachusetts Republicans locked them out of Congressional representation. It is therefore not reasonable to charge the Massachusetts legislature with gerrymandering for having produced maps which yielded all-Democratic delegations; they could not have done otherwise.

In North Carolina, this is not the case. The alternative plans demonstrate that it is possible to produce maps that give the two major parties a roughly equal opportunity to elect their candidates. These plans are just examples among many thousands of plausible maps that convert voter preferences to far more even representation by party. In Congressional redistricting, the geography is easily conducive to a seat share squarely in line with the vote share. In Senate and House plans, even following the strict detail of the Whole County Provisions, there are likewise many alternatives giving a seat share for each party that falls, in aggregate, within a few percentage points of the vote share across a large set of elections.

The clear conclusion is that the political geography of North Carolina today does not obstruct the selection of a map that treats the parties equally and fairly.

3.3 Translating votes to seats

The enacted plans behave as though they are built to resiliently safeguard electoral advantage for Republican candidates. We can examine this effect without invoking assumptions like "uniform partisan swing" that impose counterfactual voting conditions; instead, we will use the rich observed dataset of 52 statewide party-ID general elections in North Carolina in the last ten years. 29 of these are elections for Council of State (ten offices elected three times, with the Attorney General race uncontested in 2012), three presidential races, three for U.S. Senate, and 17 judicial races since mid-decade, when those became partisan contests. See Table 6 for more detail on the election dataset.

I will sometimes focus on the smaller set of better-known "up-ballot" races: in order, the first five to appear on the ballot are the contests for President, U.S. Senator, Governor, Lieutenant Governor, and Attorney General. Together these occurred 14 times in the last Census cycle.

	Up-ballot generals (14)		**All generals (52)**	
	D vote share	D seat share	D vote share	D seat share
SL-174	.4883	.2908	.4911	.3118
NCLCV-Cong		.4796		.4931
SL-173	.4883	.3957	.4911	.4065
NCLCV-Sen		.4557		.4592
SL-175	.4883	.3994	.4911	.4080
NCLCV-House		.4649		.4684

Table 5: Comparing overall fidelity of representation to the voting preferences of the electorate. Vote shares are reported with respect to the major-party vote total.

To understand how the enacted plans create major shortfalls for Democratic representation, we will overlay the plans with voting patterns from individual elections in the past Census cycle. As we will see, the enacted Congressional plan (SL-174) shows a remarkable lack of responsiveness, giving 10–4 partisan outcomes across a wide range of recent electoral conditions, meaning that 10 Republicans and only 4 Democrats would represent North Carolina in Congress. The alternative plan (NCLCV-Cong) is far more faithful to the vote share, far more responsive, and tends to award more seats to the party with more votes.

The top of Figure 2 shows this dynamic in the three Presidential contests in the last Census cycle, with a Democratic vote share (pink box) between 48% and 50% of the major-party total each time. For a contest that is so evenly divided, we would expect a fair map to have 6, 7, or 8 out of 14 districts favoring each party. The alternative Congressional map NCLCV-Cong does just that, while the enacted plan SL-174 has just 4 out of 14 Democratic-majority districts each time (green and maroon circles). The alternative plan is far more successful at reflecting the even split of voter preferences. Below the initial explainer, simplified versions of the same type of graphic are presented for all five up-ballot races. Figure 3 compares legislative maps in the same fashion. Next, Figure 4 returns to the full 52-election dataset to give the big picture of entrenched partisan advantage in the enacted plans.

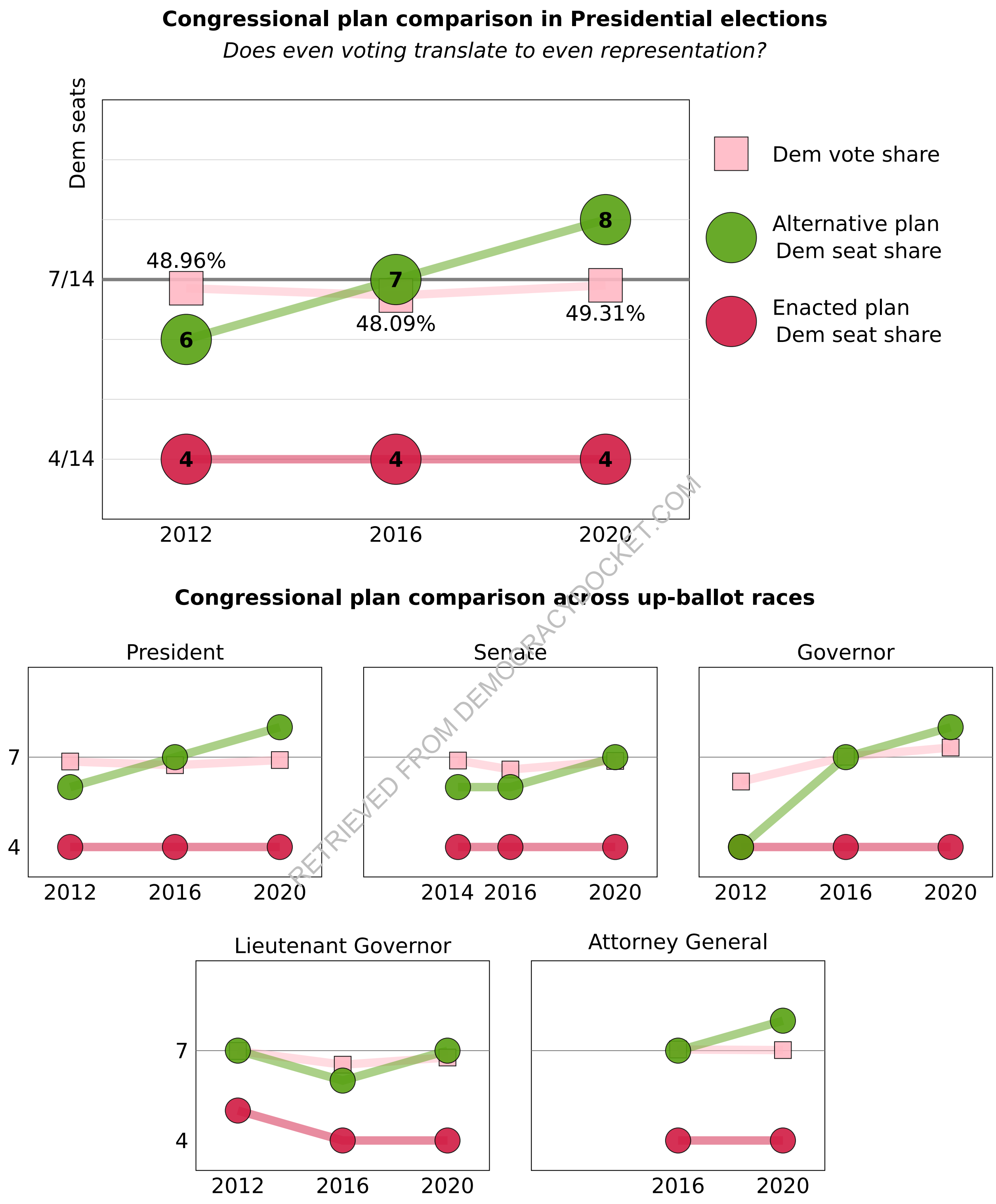

Figure 2: For up-ballot general election contests across the previous Census cycle, we can compare the seat share under the enacted Congressional plan SL-174 (maroon) and the seat share under the alternative Congressional plan NCLCV-Cong (green) to the vote share (pink) for Democratic candidates. At top is a detailed look at the presidential contests; this is repeated below, alongside the other four up-ballot offices. The 50% line is marked each time.

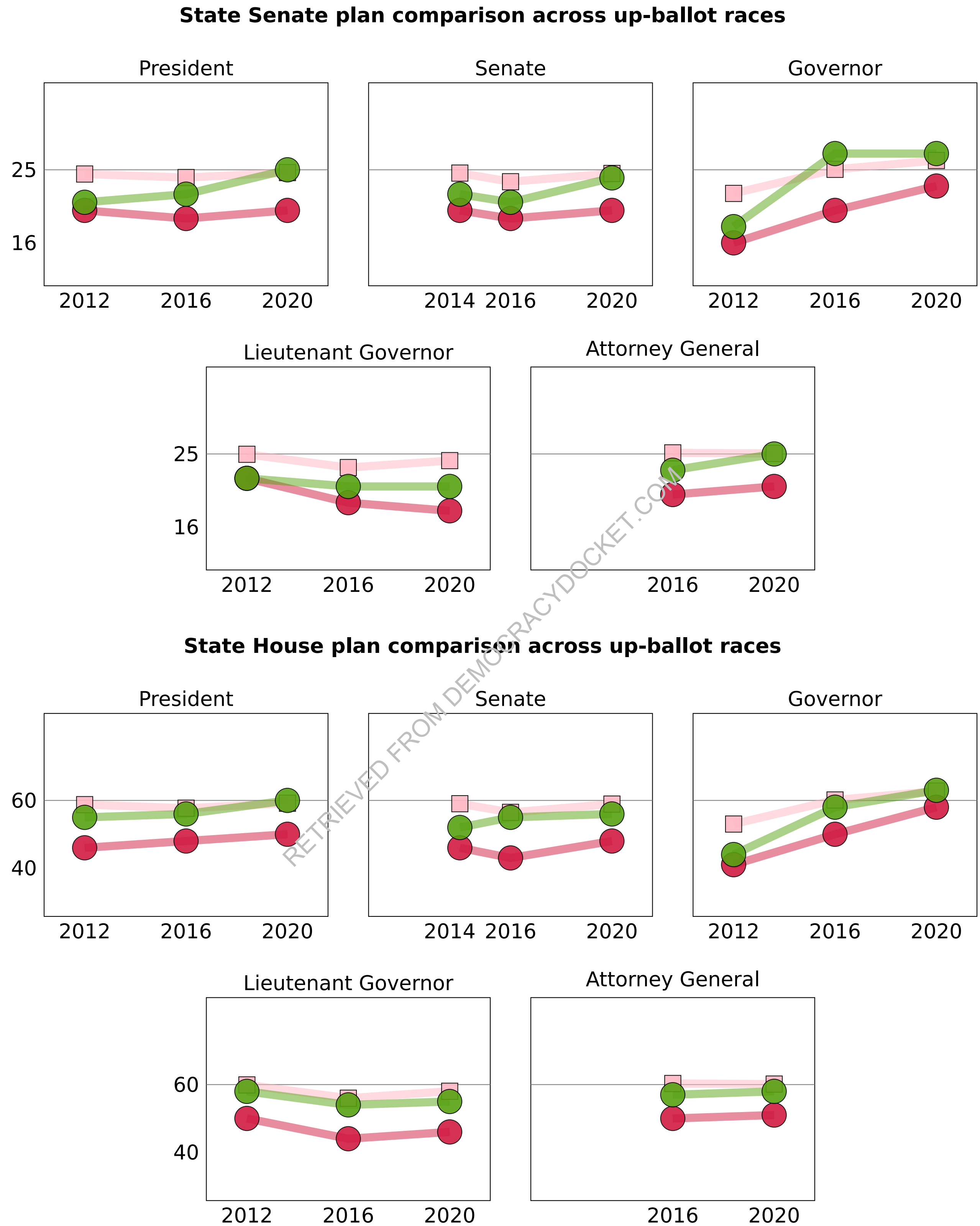

Figure 3: Legislative plans tested against voting patterns from up-ballot elections. The enacted plans SL-173 and SL-175 are shown in maroon. The alternative plans NCLCV-Sen and NCLCV-House, in green, have seat shares tracking much closer to the nearly even voting preferences.

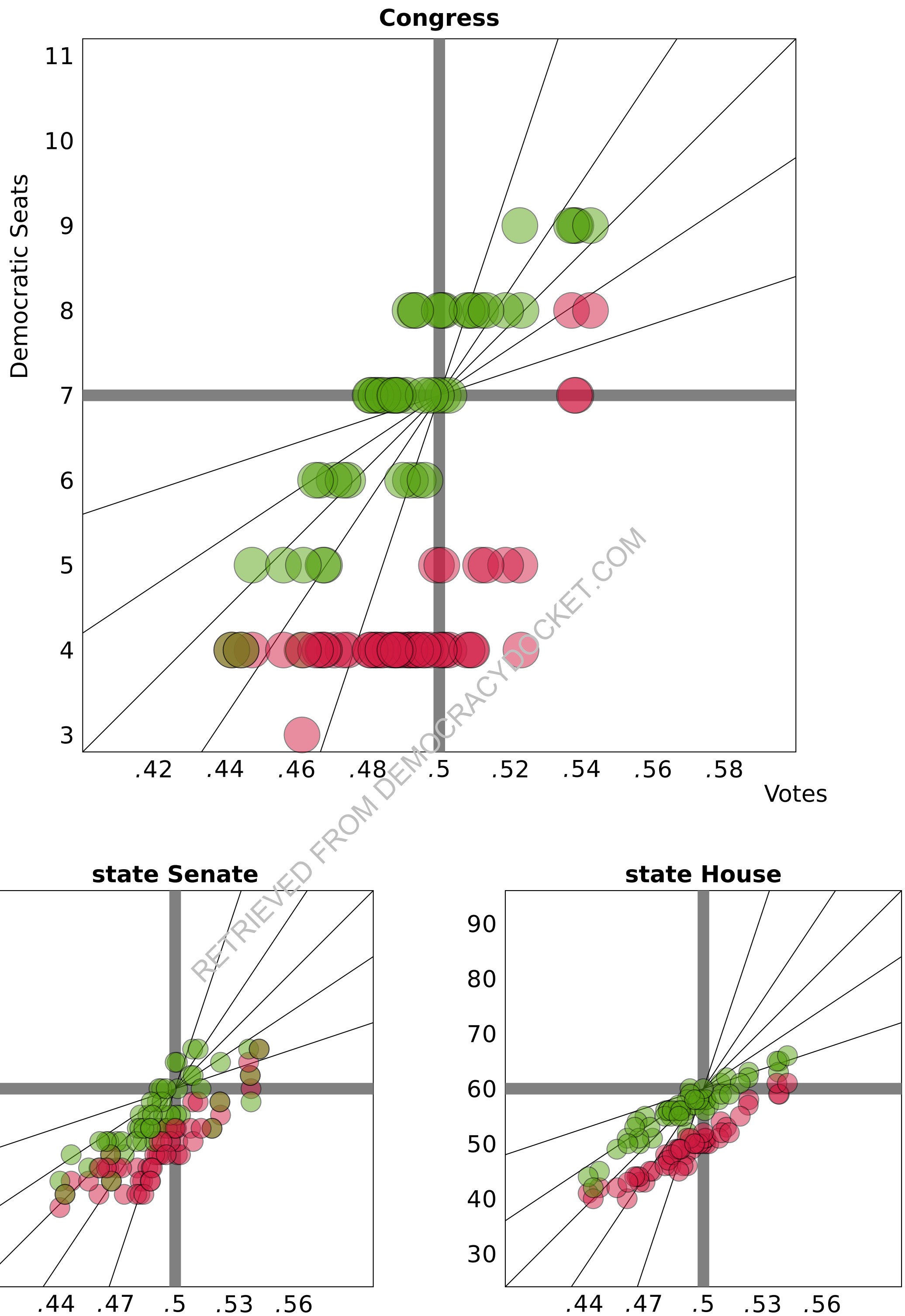

Figure 4: On a seats-vs.-votes plot, the election results for the six maps are shown for 52 general election contests in the last decade; each colored dot is plotted as the coordinate pair (vote share, seat share). The diagonals show various lines of *responsiveness* that pivot around the central point of fairness: half of the votes securing half of the seats. The Congressional comparison is at top, followed by Senate and House. The enacted plans are shown in maroon and the alternative plans in green.

3.4 Swing districts and competitive contests

Another way to understand the electoral properties of districting plans is to investigate how many districts always give the same partisan result over a suite of observed electoral conditions, and how many districts can "swing" between the parties. Figure 5 compares the six plans across the up-ballot elections. The enacted plans lock in large numbers of always-Republican seats. In the Senate and House, nearly half the seats are locked down for Republicans. In the Congressional plan, it's well *over* half. This provides another view from which the NCLCV plans provide attractive alternatives.

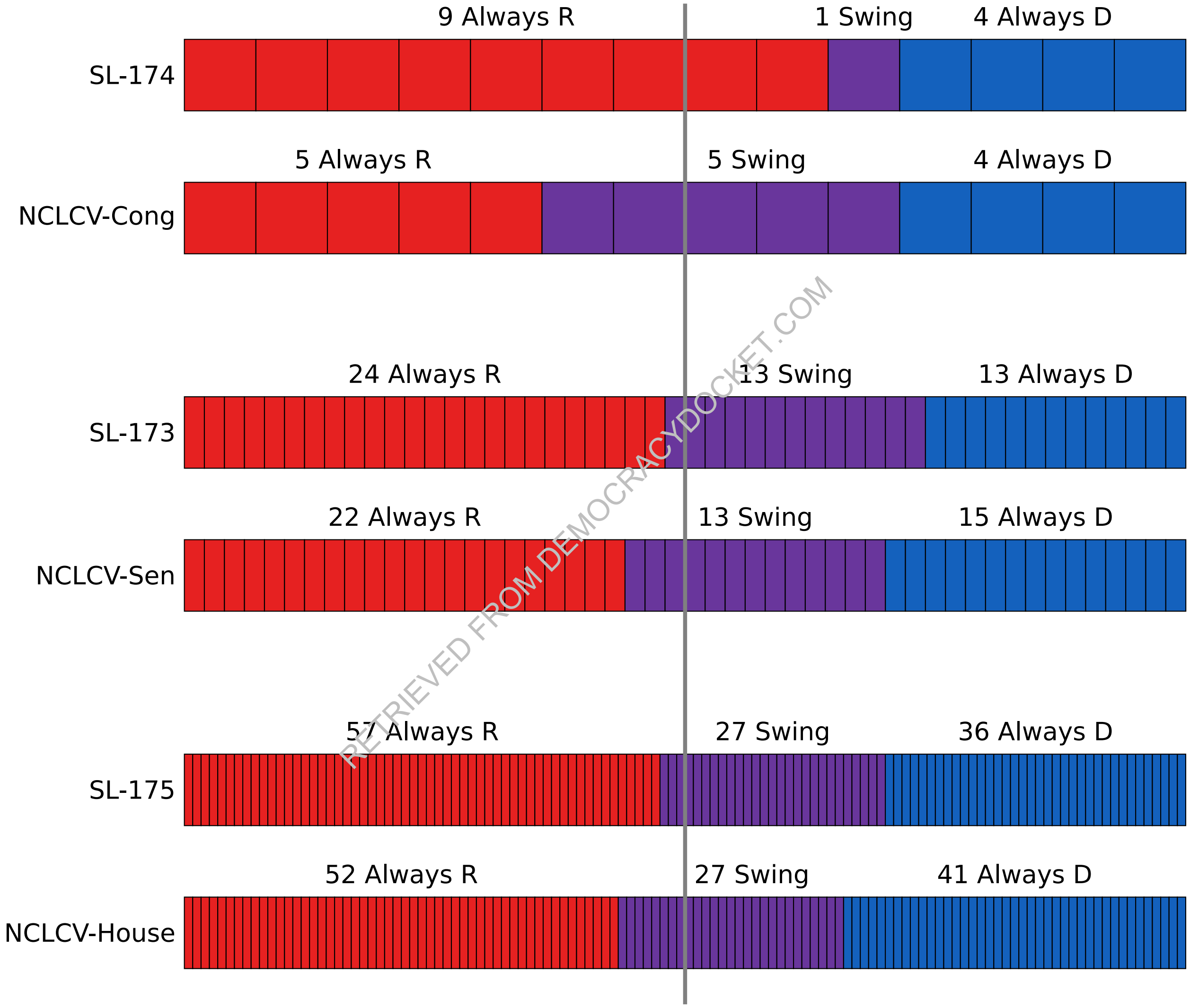

Figure 5: These visuals show the breakdown of seats that always have a Republican winner, always have a Democratic winner, or are sometimes led by each party across the 14 up-ballot elections over the previous Census cycle. The 50-50 split is marked.

One more measure of partisan fairness, frequently referenced in the public discourse, is the tendency of a districting plan to promote close or competitive contests. We close with a comparison of the enacted and alternative plans that displays the number of times across the full dataset of 52 elections that a contest had a partisan margin of closer than 10 points, 6 points, or 2 points, respectively. This can occur up to $14 \cdot 52 = 728$ times in Congressional maps, $50 \cdot 52 = 2600$ times in state Senate maps, and $120 \cdot 52 = 6240$ times in state House maps. The figures below show horizontal rules at every 10% interval of the total number of possible competitive contests; we can see, for instance, that the alternative Congressional plan has contests within a 10-point margin more than 40% of the time.

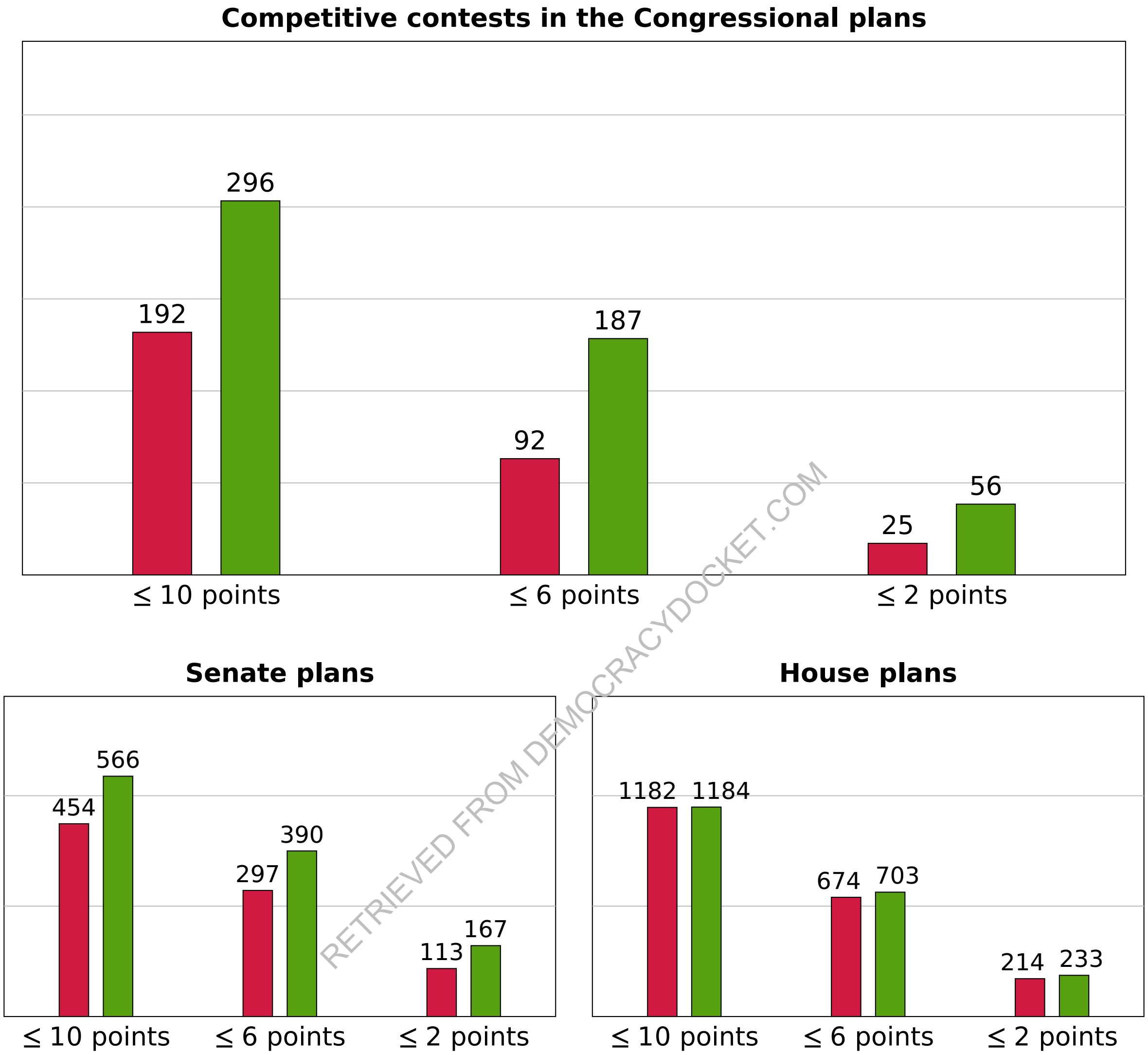

Figure 6: These bar graphs show the number of competitive contests for the enacted plans (maroon) and the alternative plans (green). In each plot, we consider increasingly restrictive definitions of "competitive" from left to right, counting districts in which the major-party vote split is closer than 45-55, 47-53, and 49-51, respectively.

4 Conclusion

North Carolina is a very "purple" state. In 38 out of the 52 contests in our dataset, the statewide partisan outcome is within a 6-point margin: 47-53 or closer. We can make a striking observation by laying our six plans over the vote patterns.

	D Vote Share	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
GOV12	0.4418	4	4	16	18	41	44
AGC16	0.4444	4	4	17	17	40	42
LAC16	0.4475	4	5	18	20	42	45
JHU16	0.4563	4	5	18	19	42	49
AGC20	0.4615	3	4	17	19	40	51
JZA16	0.4619	4	5	19	21	43	50
JDI16	0.4653	4	6	19	21	44	53
LTG16	0.4665	4	6	19	21	44	54
LAC12	0.4674	4	5	20	20	44	51
AGC12	0.4678	4	5	18	18	43	50
SEN16	0.4705	4	6	19	21	43	55
TRS16	0.4730	4	6	19	21	45	53
TRS20	0.4743	4	6	17	20	45	51
JA620	0.4806	4	7	17	21	46	55
PRS16	0.4809	4	7	19	22	48	56
JA420	0.4822	4	7	17	22	47	56
INC20	0.4823	4	7	18	23	47	56
LTG20	0.4836	4	7	18	21	46	55
JA720	0.4842	4	7	17	22	48	56
SUP20	0.4862	4	7	19	23	49	56
JA520	0.4874	4	7	18	22	49	57
JA218	0.4876	4	7	18	22	45	55
JS420	0.4879	4	7	19	24	49	56
J1320	0.4885	4	7	19	23	49	56
PRS12	0.4897	4	6	20	21	46	55
SEN20	0.4910	4	7	20	24	48	56
LAC20	0.4918	4	8	21	25	51	58
SEN14	0.4919	4	6	20	22	46	52
PRS20	0.4932	4	8	20	25	50	60
JS220	0.4934	4	8	21	24	51	59
SUP16	0.4941	4	6	22	23	49	57
JS118	0.4955	4	7	20	25	50	58
INC16	0.4960	4	6	22	22	50	57
JST16	0.4976	4	7	21	23	50	58
LTG12	0.4992	5	7	22	22	50	58
JS120	0.5000	4	8	22	27	52	60
AUD16	0.5007	5	8	22	23	51	56
GOV16	0.5011	4	7	20	27	50	58
ATG20	0.5013	4	8	21	25	51	58
ATG16	0.5027	4	7	20	23	50	57
JA118	0.5078	4	8	22	26	51	58
AUD20	0.5088	4	8	24	28	54	61
JA318	0.5091	4	8	21	26	52	59
SOS20	0.5116	5	8	24	28	53	62
JGE16	0.5131	5	8	22	25	52	59
INC12	0.5186	5	8	22	22	55	61
SOS16	0.5226	5	9	24	24	57	62
GOV20	0.5229	4	8	23	27	58	63
AUD12	0.5371	8	9	27	28	61	65
SOS12	0.5379	7	9	26	26	59	63
TRS12	0.5383	7	9	25	24	59	65
SUP12	0.5424	8	9	28	28	61	66

Table 6: 52 general elections, sorted from lowest to highest Democratic share. Election codes have a three-character prefix and a two-digit suffix designating the office and the election year, respectively. AGC = Agriculture Commissioner; ATG = Attorney General; AUD = Auditor; GOV = Governor; INC = Insurance Commissioner; LAC = Labor Commissioner; PRS = President; SEN = Senator; SOS = Secretary of State; SUP = Superintendent of Schools; TRS -=Treasurer. The prefix JA* refers to judicial elections to the Court of Appeals (so that, for instance, JA118 is the election to the Seat 1 on the Court of Appeals in 2018), those beginning with JS* refer to elections to the state Supreme Court. All other J* prefixes refer to an election to replace a specific judge on the Court of Appeals.

The three enacted plans combine with those 38 relatively even vote patterns to produce 114 outcomes. Every single pairing of an enacted plan with a close statewide contest—a complete sweep of 114 opportunities—gives an *outright Republican majority* of seats. All three enacted plans will lock in an extreme, resilient, and unnecessary advantage for one party.

By every measure considered above that corresponds to a clear legal or good-government redistricting goal or value, the alternative plans meet or exceed the performance of the enacted plans. It is therefore demonstrated to be possible, without any cost to the redistricting principles in play, to select maps that are far fairer to the voters of North Carolina.

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I declare under penalty of perjury that the foregoing is true and correct.

Executed this 16th day of November, 2021.

Moon Duchin

Sworn and subscribed before me

this the 16 of November, 2021.

Notary Public

Name:

My Commission Expires:

GREGORY J. AGNEW
Notary Public
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My Commission Expires
June 28, 2024

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Education

University of Chicago MS 1999, PhD 2005
Mathematics
Advisor: Alex Eskin Dissertation: *Geodesics track random walks in Teichmüller space*

Harvard University BA 1998
Mathematics and Women's Studies

Appointments

Tufts University
Professor of Mathematics 2021—
Assistant Professor, Associate Professor 2011–2021

Director | Program in Science, Technology, & Society 2015–2021
(on leave 2018–2019)

Principal Investigator | MGGG Redistricting Lab 2017—

Senior Fellow | Tisch College of Civic Life 2017—

University of Michigan
Assistant Professor (postdoctoral) 2008–2011

University of California, Davis
NSF VIGRE Postdoctoral Fellow 2005–2008

Research Interests

Data science for civil rights, computation and governance, elections, geometry and redistricting.
Science, technology, and society, science policy, technology and law.
Random walks and Markov chains, random groups, random constructions in geometry.
Large-scale geometry, metric geometry, isoperimetric inequalities.
Geometric group theory, growth of groups, nilpotent groups, dynamics of group actions.
Geometric topology, hyperbolicity, Teichmüller theory.

Awards & Distinctions

Research Professor - MSRI Program in Analysis and Geometry of Random Spaces Spring 2022
Guggenheim Fellow 2018
Radcliffe Fellow - Evelyn Green Davis Fellowship 2018–2019
Fellow of the American Mathematical Society elected 2017
NSF C-ACCEL (PI) - Harnessing the Data Revolution: Network science of Census data 2019–2020
NSF grants (PI) - CAREER grant and three standard Topology grants 2009–2022
Professor of the Year, Tufts Math Society 2012–2013
AAUW Dissertation Fellowship 2004–2005
NSF Graduate Fellowship 1998–2002
Lawrence and Josephine Graves Prize for Excellence in Teaching (U Chicago) 2002
Robert Fletcher Rogers Prize (Harvard Mathematics) 1995–1996

Mathematics Publications & Preprints

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Foundations of Data Science, online first. (with Thomas Needham and Thomas Weighill)

You can hear the shape of a billiard table: Symbolic dynamics and rigidity for flat surfaces
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(with Viveka Erlandsson, Christopher Leininger, and Chandrika Sadanand)

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International mobility and U.S. mathematics
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Graduate Advising in Mathematics

Nate Fisher (PhD 2021), Sunrose Shrestha (PhD 2020), Ayla Sánchez (PhD 2017), Kevin Buckles (PhD 2015), Mai Mansouri (MS 2014)

Outside committee member for Chris Coscia (PhD 2020), Dartmouth College

Postdoctoral Advising in Mathematics

Principal supervisor Thomas Weighill (2019–2020)

Co-supervisor Daryl DeFord (MIT 2018–2020), Rob Kropholler (2017–2020), Hao Liang (2013–2016)

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Geometric Literacy
Module-based graduate topics course. Modules have included: p-adic numbers, hyperbolic geometry, nilpotent geometry, Lie groups, convex geometry and analysis, the complex of curves, ergodic theory, the Gauss circle problem.

Markov Chains (graduate topics course)
Teichmüller Theory (graduate topics course)
Fuchsian Groups (graduate topics course)
Continued Fractions and Geometric Coding (undergraduate topics course)
Mathematics for Elementary School Teachers

Standard Courses

Discrete Mathematics, Calculus I-II-III, Intro to Proofs, Linear Algebra, Complex Analysis, Differential Geometry, Abstract Algebra, Graduate Real Analysis, Mathematical Modeling and Computation

Weekly Seminars Organized

- Geometric Group Theory and Topology
- Science, Technology, and Society Lunch Seminar

Selected Talks and Lectures

Distinguished Plenary Lecture		June 2021
75th Anniversary Meeting of Canadian Mathematical Society, Ottawa, Ontario		*online (COVID)*
BMC/BAMC Public Lecture		April 2021
Joint British Mathematics/Applied Mathematics Colloquium, Glasgow, Scotland		*online (COVID)*
AMS Einstein Public Lecture in Mathematics		[March 2020]
Southeastern Sectional Meeting of the AMS, Charlottesville, VA		*postponed*
Gerald and Judith Porter Public Lecture		
AMS-MAA-SIAM, Joint Mathematics Meetings, San Diego, CA		January 2018
Mathematical Association of America Distinguished Lecture		
MAA Carriage House, Washington, DC		October 2016
American Mathematical Society Invited Address		
AMS Eastern Sectional Meeting, Brunswick, ME		September 2016

Named University Lectures

- Parsons Lecture | UNC Asheville	October 2020
- Loeb Lectures in Mathematics | Washington University in St. Louis	[March 2020]
- Math, Stats, CS, and Society | Macalester College	October 2019
- MRC Public Lecture | Stanford University	May 2019
- Freedman Memorial Colloquium | Boston University	March 2019
- Julian Clancy Frazier Colloquium Lecture | U.S. Naval Academy	January 2019
- Barnett Lecture | University of Cincinnati	October 2018
- School of Science Colloquium Series | The College of New Jersey	March 2018
- Kieval Lecture | Cornell University	February 2018
- G. Milton Wing Lectures | University of Rochester	October 2017
- Norman Johnson Lecture | Wheaton College	September 2017
- Dan E. Christie Lecture | Bowdoin College	September 2017

Math/Computer Science Department Colloquia

- Reed College	Dec 2020
- Georgetown (CS)	Sept 2020
- Santa Fe Institute	July 2020
- UC Berkeley	Sept 2018
- Brandeis-Harvard-MIT-NEU	Mar 2018
- Northwestern University	Oct 2017
- University of Illinois	Sept 2017
- University of Utah	Aug 2017
- Wesleyan	Dec 2016
- Worcester Polytechnic Inst.	Dec 2016
- Université de Neuchâtel	Jun 2016
- Brandeis University	Mar 2016
- Swarthmore College	Oct 2015
- Bowling Green	May 2015
- City College of New York	Feb 2015
- Indiana University	Nov 2014
- the Technion	Oct 2014
- Wisconsin–Madison	Sept 2014
- Stony Brook	March 2013

Minicourses

- Integer programming and combinatorial optimization (two talks) | Georgia Tech — May 2021
- Workshop in geometric topology (main speaker, three talks) | Provo, UT — June 2017
- Growth in groups (two talks) | MSRI, Berkeley, CA — August 2016
- Hyperbolicity in Teichmüller space (three talks) | Université de Grenoble — May 2016
- Counting and growth (four talks) | IAS Women's Program, Princeton — May 2016
- Nilpotent groups (three talks) | Seoul National University — October 2014
- Sub-Finsler geometry of nilpotent groups (five talks) | Galatasaray Univ., Istanbul — April 2014

Science, Technology, and Society

- The Mathematics of Accountability | Sawyer Seminar, Anthropology, Johns Hopkins — February 2020
- STS Circle | Harvard Kennedy School of Government — September 2019
- Data, Classification, and Everyday Life Symposium | Rutgers Center for Cultural Analysis — January 2019
- Science Studies Colloquium | UC San Diego — January 2019
- Arthur Miller Lecture on Science and Ethics | MIT Program in Science, Tech, and Society — November 2018

Data Science, Computer Science, Quantitative Social Science

- Data Science for Social Good Workshop (DS4SG) | Georgia Tech (virtual) — November 2020
- Privacy Tools Project Retreat | Harvard (virtual) — May 2020
- Women in Data Science Conference | Microsoft Research New England — March 2020
- Quantitative Research Methods Workshop | Yale Center for the Study of American Politics — February 2020
- Societal Concerns in Algorithms and Data Analysis | Weizmann Institute — December 2018
- Quantitative Collaborative | University of Virginia — March 2018
- Quantitative Social Science | Dartmouth College — September 2017
- Data for Black Lives Conference | MIT — November 2017

Political Science, Geography, Law, Democracy, Fairness

- The Long 19th Amendment: Women, Voting, and American Democracy | Radcliffe Institute — Nov–Dec 2020
- "The New Math" for Civil Rights | Social Justice Speaker Series, Davidson College — November 2020
- Math, Law, and Racial Fairness | Justice Speaker Series, University of South Carolina — November 2020
- Voting Rights Conference | Northeastern Public Interest Law Program — September 2020
- Political Analysis Workshop | Indiana University — November 2019
- Program in Public Law Panel | Duke Law School — October 2019
- Redistricting 2021 Seminar | University of Chicago Institute of Politics — May 2019
- Geography of Redistricting Conference Keynote | Harvard Center for Geographic Analysis — May 2019
- Political Analytics Conference | Harvard University — November 2018
- Cyber Security, Law, and Society Alliance | Boston University — September 2018
- Clough Center for the Study of Constitutional Democracy | Boston College — November 2017
- Tech/Law Colloquium Series | Cornell Tech — November 2017
- Constitution Day Lecture | Rockefeller Center for Public Policy, Dartmouth College — September 2017

Editorial Boards

Harvard Data Science Review
Associate Editor — since 2019

Advances in Mathematics
Member, Editorial Board — since 2018

Selected Professional and Public Service

Amicus Brief of Mathematicians, Law Professors, and Students 2019
principal co-authors: Guy-Uriel Charles and Moon Duchin
Supreme Court of the United States, in Rucho v. Common Cause - cited in dissent

Committee on Science Policy 2020–2023
American Mathematical Society

Program Committee 2020–2021
Symposium on Foundations of Responsible Computing

Presenter on Public Mapping, Statistical Modeling 2019, 2020
National Conference of State Legislatures

Committee on the Human Rights of Mathematicians 2016–2019
American Mathematical Society

Committee on The Future of Voting: Accessible, Reliable, Verifiable Technology 2017–2018
National Academies of Science, Engineering, and Medicine

Visiting Positions and Residential Fellowships

Visiting Professor Department of Mathematics — Fall 2021
Boston College | Chestnut Hill, MA

Fellow Radcliffe Institute for Advanced Study — 2018–19
Harvard University | Cambridge, MA

Member Center of Mathematical Sciences and Applications — 2018–19
Harvard University | Cambridge, MA

Visitor Microsoft Research Lab — 2018–19
MSR New England | Cambridge, MA

Research Member Geometric Group Theory program — Fall 2016
Mathematical Sciences Research Institute | Berkeley, CA

Research Member Random Walks and Asymptotic Geometry of Groups program — Spring 2014
Institut Henri Poincaré | Paris, France

Research Member Low-dimensional Topology, Geometry, and Dynamics program — Fall 2013
Institute for Computational and Experimental Research in Mathematics | Providence, RI

Research Member Geometric and Analytic Aspects of Group Theory program — May 2012
Institut Mittag-Leffler | Stockholm, Sweden

Research Member Quantitative Geometry program — Fall 2011
Mathematical Sciences Research Institute | Berkeley, CA

Postdoctoral Fellow Teichmüller "project blanc" — Spring 2009
Agence Nationale de la Recherche (Collège de France) | Paris, France

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426, 21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC.; HENRY M. MICHAUX, JR., et al.,

Plaintiffs,

REBECCA HARPER, et al.,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

AFFIDAVIT OF PROFESSOR MOON DUCHIN

NCLCV v. Hall
21 CVS 15426
LDTX158

Exhibit #
Duchin 2
12/30/21 - SL
exhibitsticker.com

I, Dr. Moon, Duchin, having been duly sworn by an officer authorized to administer oaths, depose and state as follows:

1. I am over 18 years of age, legally competent to give this Affidavit, and have personal knowledge of the facts set forth in this Affidavit.
2. All of the quantitative work described in this Affidavit was performed by myself with the support of research assistants working under my direct supervision.

Background and qualifications

3. I hold a Ph.D. and an M.S in Mathematics from the University of Chicago as well as an A.B. in Mathematics and Women's Studies from Harvard University.
4. I am a Professor of Mathematics and a Senior Fellow in the Jonathan M. Tisch College of Civic Life at Tufts University.
5. My general research areas are geometry, topology, dynamics, and applications of mathematics and computing to the study of elections and voting. My redistricting-related work has been published in venues such as the Election Law Journal, Political Analysis, Foundations of Data Science, the Notices of the American Mathematical Society, Statistics and Public Policy, the Virginia Policy Review, the Harvard Data Science Review, Foundations of Responsible Computing, and the Yale Law Journal Forum.
6. My research has had continuous grant support from the National Science Foundation since 2009, including a CAREER grant from 2013–2018. I am currently on the editorial board of the journals Advances in Mathematics and the Harvard Data Science Review. I was elected a Fellow of the American Mathematical Society in 2017 and was named a Radcliffe Fellow and a Guggenheim Fellow in 2018.
7. A current copy of my full CV is attached to this report.
8. I am compensated at the rate of $400 per hour.

Analysis of 2021 enacted redistricting plans in North Carolina

Moon Duchin
Professor of Mathematics, Tufts University
Senior Fellow, Tisch College of Civic Life

December 23, 2021

1 Introduction

On November 4, 2021, the North Carolina General Assembly enacted three districting plans: maps of 14 U.S. Congressional districts, 50 state Senate districts, and 120 state House districts. This affidavit contains a brief summary of my evaluation of the properties of these plans. My focus will be on the egregious partisan imbalance and racial vote dilution in the enacted plans, following a brief review of the traditional districting principles.

Because redistricting inevitably involves complex interactions of rules, which can create intricate tradeoffs, it will be useful to employ a direct comparison to an alternative set of plans. These demonstrative plans illustrate that it is possible to *simultaneously maintain or improve* metrics for all of the most important redistricting principles that are operative in North Carolina's constitution and state and federal law. Crucially, this shows that nothing about the state's political geography compels us to draw a plan with a massive and entrenched partisan skew or a significant dilutive effect on Black voters.

To this end, I will be comparing the following plans: the enacted plans SL-174, SL-173, and SL-175 and a corresponding set of alternative plans labeled NCLCV-Cong, NCLCV-Sen, and NCLCV-House (proposed by plaintiffs who include the North Carolina League of Conservation Voters). The accompanying block assignment files are Appendices A1, A2, A3 to this affidavit, and I understand that they will be provided to the court in native format.

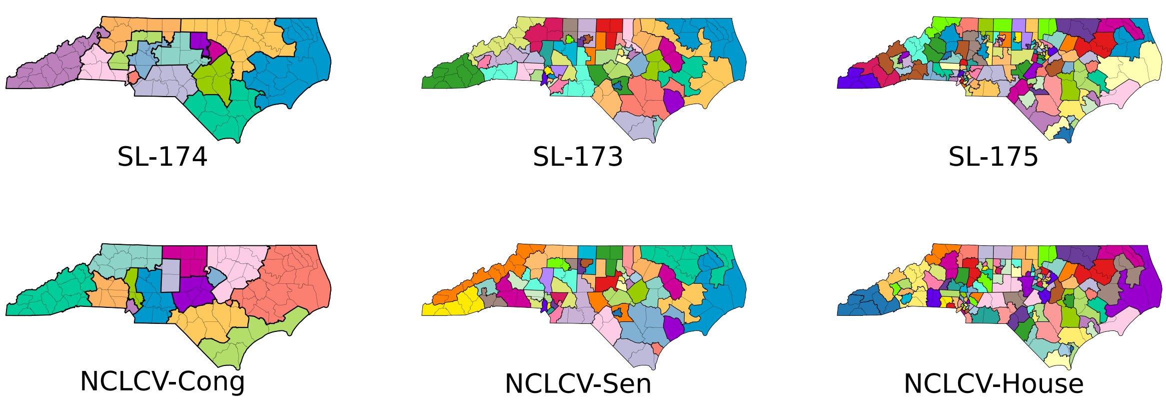

Figure 1: The six plans under discussion in this affidavit.

2 Partisan gerrymandering

2.1 Abstract partisan fairness

There are many notions of partisan fairness that can be found in the scholarly literature and in redistricting practitioner guides and software. Most of them are numerical, in the sense that they address *how a certain quantitative share of the vote should be translated to a quantitative share of the seats* in a state legislature or Congressional delegation.

The numerical notions of partisan fairness all tend to agree on one central point: an electoral climate with a roughly 50-50 split in partisan preference should produce a roughly 50-50 representational split. I will call this the *Close-Votes-Close-Seats* principle. North Carolina voting has displayed a partisan split staying consistently close to even between the two major parties over the last ten years, but the plans released by the General Assembly after the 2010 census were very far from realizing the ideal of converting even voting to even representation. This time, with a 14th seat added to North Carolina's apportionment, an exactly even seat outcome is possible. But the new enacted plans, like the plans from ten years ago, are decidedly not conducive to even representation.

Importantly, Close-Votes-Close-Seats is not tantamount to a requirement for proportionality. Rather, it is closely related to the principle of *Majority Rule*: a party or group with more than half of the votes should be able to secure more than half of the seats. In fact, Close-Votes-Close-Seats is essentially a corollary (or byproduct) of Majority Rule. It is not practicable to design a map that *always* attains these properties, but by contrast a map that *consistently thwarts* them should be closely scrutinized and usually rejected.

Unlike proportionality, neither Close-Votes-Close-Seats nor Majority Rule has any bearing on the preferred representational outcome when one party has a significant voting advantage: these principles are silent about whether 70% vote share should secure 70% of the seats, as proportionality would dictate, or 90% of the seats, as supporters of the efficiency gap would prefer. The size of the "winner's bonus" is not at all prescribed by a Close-Votes-Close-Seats norm.

2.2 Geography and fairness

Some scholars have argued that all numerical ideals, including Close-Votes-Close-Seats, ignore the crucial *political geography*—this school of thought reminds us that the location of votes for each party, and not just the aggregate preferences, has a major impact on redistricting outcomes. In [5], my co-authors and I gave a vivid demonstration of the impacts of political geography in Massachusetts: we showed that for a ten-year span of observed voting patterns, even though Republicans tended to get over one-third of the statewide vote, it was impossible to draw a single Congressional district with a Republican majority. That is, the geography of Massachusetts Republicans locked them out of Congressional representation. It is therefore not reasonable to charge the Massachusetts legislature with gerrymandering for having produced maps which yielded all-Democratic delegations; they could not have done otherwise.

In North Carolina, this is not the case. The alternative plans demonstrate that it is possible to produce maps that give the two major parties a roughly equal opportunity to elect their candidates. These plans are just examples among many thousands of plausible maps that convert voter preferences to far more even representation by party. In Congressional redistricting, present-day North Carolina geography is easily conducive to a seat share squarely in line with the vote share. In Senate and House plans, even following the strict detail of the Whole County Provisions, there are likewise many alternatives converting nearly even voting patterns to nearly even representation, across a large set of recent elections.

The clear conclusion is that the political geography of North Carolina today does not obstruct the selection of a map that treats Democratic and Republican voters fairly and even-handedly.

2.3 Overlaying elections and plans

The enacted plans behave as though they are built to resiliently safeguard electoral advantage for Republican candidates. We can examine this effect without invoking any predictions or assumptions about future voting behavior by using a standard technique in election analysis: pairing proposed plans with actual recent elections. This method works by overlaying (or superimposing) the districting plans on a series of observed voting patterns from the recent past; this lets us take advantage of the rich dataset of real electoral outcomes in North Carolina in the last ten years to avoid speculative or predictive modeling about voting trends in the future.[1]

The overlay method works best when there is a large set of statewide elections to apply, which is certainly true in North Carolina. Of the 52 statewide party-ID general elections from the last cycle, 29 are elections for Council of State (ten offices elected three times, with the Attorney General race uncontested in 2012), three are presidential races, three are for U.S. Senate, and 17 are judicial races since mid-decade, when those became partisan contests. See Table 1 for more detail on the election dataset.

2.4 Partisanship outcomes

North Carolina is a very "purple" state. In 38 out of the 52 contests in our dataset, the statewide partisan outcome is within a 6-point margin: 47-53 or closer.

To understand how the enacted plans create major shortfalls for Democratic representation, we will overlay the plans with voting patterns from individual elections in the past Census cycle. We can make a striking observation by laying our six plans over the vote patterns, shown in Table 1. This reveals that the enacted Congressional plan (SL-174) shows a remarkable lack of responsiveness, giving 10–4 partisan outcomes across a wide range of recent electoral conditions, meaning that 10 Republicans and only 4 Democrats would represent North Carolina in Congress. The alternative plan (NCLCV-Cong) is far more faithful to the vote share, far more responsive, and tends to award more seats to the party with more votes—usually upholding both basic small-d-democratic principles of Majority Rules and Close-Votes-Close-Seats, which are violated by the enacted plan.

The same patterns are visible at the Senate and House level. Overall, the three enacted plans combine with those 38 relatively even vote patterns to produce 114 outcomes. Every single pairing of an enacted plan with a close statewide contest—a complete sweep of 114 opportunities—gives an *outright Republican majority* of seats. All three enacted plans will lock in an extreme, resilient, and unnecessary advantage for one party.

By every measure considered above that corresponds to a clear legal or good-government redistricting goal or value, the alternative plans meet or exceed the performance of the enacted plans. This demonstrates that it is possible, without any cost to the redistricting principles in play, to select maps that are far fairer to the voters of North Carolina.

Below, the outcomes of overlaying the plans on the elections will be presented in a series of tables and figures. First, Table 1 overviews the overlays with numbers.[2] Then, Figure 2 offers a visualization to depict the same big picture of entrenched partisan advantage in the enacted plans with the full 52-election dataset. The diagonals show various lines of *responsiveness* that pivot around the central point of fairness: half of the votes securing half of the seats.

Finally, we will restrict to a smaller set of the 14 "up-ballot" races and consider the comparison for one office at a time in Figures 3-5.

[1] Many authors have used this technique of overlaying "exogenous" statewide elections rather than using statistical regressions and other modeling to manipulate "endogenous" districted elections. For instance this can be found in peer-reviewed work and expert reports of scholar-practitioners such as Bernard Grofman and Steven Ansolabehere.

[2] The backup data supporting Table 1 is attached to this report as Appendix C and I understand that it will be provided to the court in native format.

Do close votes translate to close seats?

The table records the number of districts in each plan with a Democratic win. This shows that the enacted maps systematically violate the principles of Close-Votes-Close-Seats and Majority Rule.

	D Vote Share	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
GOV12	0.4418	4	4	16	18	41	44
AGC16	0.4444	4	4	17	17	40	42
LAC16	0.4475	4	5	18	20	42	45
JHU16	0.4563	4	5	18	19	42	49
AGC20	0.4615	3	4	17	19	40	51
JZA16	0.4619	4	5	19	21	43	50
JDI16	0.4653	4	6	19	21	44	53
LTG16	0.4665	4	6	19	21	44	54
LAC12	0.4674	4	5	20	20	44	51
AGC12	0.4678	4	5	18	18	43	50
SEN16	0.4705	4	6	19	21	43	55
TRS16	0.4730	4	6	19	21	45	53
TRS20	0.4743	4	6	17	20	45	51
JA620	0.4806	4	7	17	21	46	55
PRS16	0.4809	4	7	19	22	48	56
JA420	0.4822	4	7	17	22	47	56
INC20	0.4823	4	7	18	23	47	56
LTG20	0.4836	4	7	18	21	46	55
JA720	0.4842	4	7	17	22	48	56
SUP20	0.4862	4	7	19	23	49	56
JA520	0.4874	4	7	18	22	49	57
JA218	0.4876	4	7	18	22	45	55
JS420	0.4879	4	7	19	24	49	56
J1320	0.4885	4	7	19	23	49	56
PRS12	0.4897	4	6	20	21	46	55
SEN20	0.4910	4	7	20	24	48	56
LAC20	0.4918	4	8	21	25	51	58
SEN14	0.4919	4	6	20	22	46	52
PRS20	0.4932	4	8	20	25	50	60
JS220	0.4934	4	8	21	24	51	59
SUP16	0.4941	4	6	22	23	49	57
JS118	0.4955	4	7	20	25	50	58
INC16	0.4960	4	6	22	22	50	57
JST16	0.4976	4	7	21	23	50	58
LTG12	0.4992	5	7	22	22	50	58
JS120	0.5000	4	8	22	27	52	60
AUD16	0.5007	5	8	22	23	51	56
GOV16	0.5011	4	7	20	27	50	58
ATG20	0.5013	4	8	21	25	51	58
ATG16	0.5027	4	7	20	23	50	57
JA118	0.5078	4	8	22	26	51	58
AUD20	0.5088	4	8	24	28	54	61
JA318	0.5091	4	8	21	26	52	59
SOS20	0.5116	5	8	24	28	53	62
JGE16	0.5131	5	8	22	25	52	59
INC12	0.5186	5	8	22	22	55	61
SOS16	0.5226	5	9	24	24	57	62
GOV20	0.5229	4	8	23	27	58	63
AUD12	0.5371	8	9	27	28	61	65
SOS12	0.5379	7	9	26	26	59	63
TRS12	0.5383	7	9	25	24	59	65
SUP12	0.5424	8	9	28	28	61	66

53 – 47 or closer (rows SEN16 through GOV20)

AGC = Agriculture Commissioner; ATG = Attorney General; AUD = Auditor; GOV = Governor; INC = Insurance Commissioner; LAC = Labor Commissioner; LTG = Lieutenant Governor; PRS = President; SEN = Senator; SOS = Secretary of State; SUP = Superintendent of Public Instruction; TRS = Treasurer. The prefix JA* refers to judicial elections to the Court of Appeals (so that, for instance, JA118 is the election to the Seat 1 on the Court of Appeals in 2018), JS* are elections to the state Supreme Court. All other J* prefixes refer to an election to replace a specific judge on the Court of Appeals. Where there was more than one judicial candidate from a given party on the ballot, they were combined for this analysis. The two-digit suffix designates the election year.

Table 1: 52 general elections, sorted from lowest to highest Democratic share.

Seats vs. Votes

Majority Rule says that outcomes should tend to fall in the Northeast and Southwest quadrants, avoiding the Southeast and Northwest. Close-Votes-Close-Seats says that points should not miss the bulls-eye near the center by systematically deviating to the North or the South. These principles are clearly upheld by the alternative plans (**green**) and violated by the enacted plans (**maroon**).

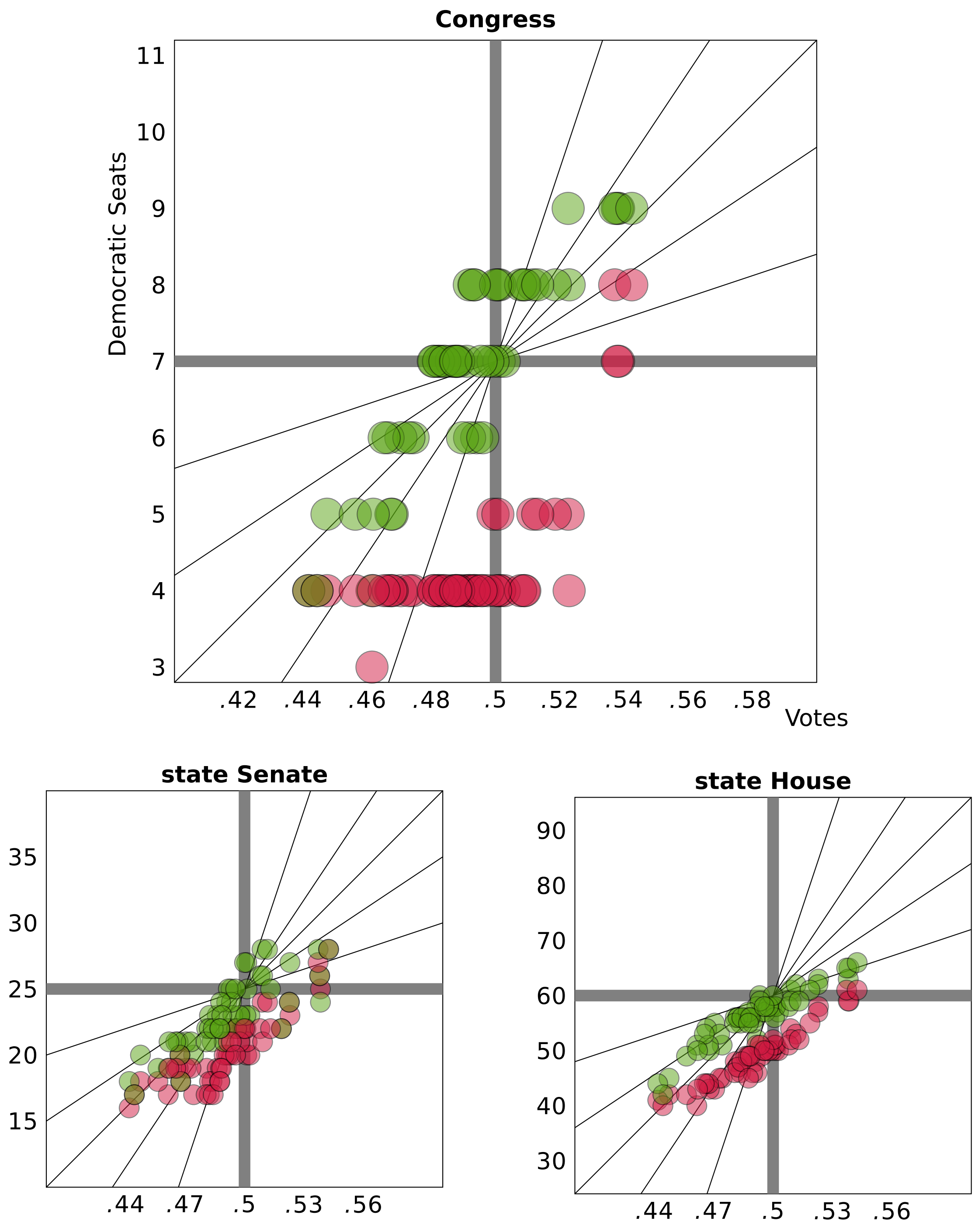

Figure 2: On these seats-vs.-votes plots, we see the election results when overlaying the six maps on the 52 general election contests in the last decade; each colored dot is plotted as the coordinate pair (vote share, seat share).

2.5 Up-ballot races

The same patterns are apparent if we narrow our focus to the smaller set of better-known "up-ballot" races: in order, the first five to appear on the ballot are the contests for President, U.S. Senator, Governor, Lieutenant Governor, and Attorney General. Together these occurred 14 times in the last Census cycle.

	Up-ballot generals (14)		**All generals (52)**	
	D vote share	D seat share	D vote share	D seat share
SL-174	.4883	.2908	.4911	.3118
NCLCV-Cong		.4796		.4931
SL-173	.4883	.3957	.4911	.4065
NCLCV-Sen		.4557		.4592
SL-175	.4883	.3994	.4911	.4080
NCLCV-House		.4649		.4684

Table 2: Comparing overall fidelity of representation to the voting preferences of the electorate. Vote shares are computed with respect to the major-party vote total.

Figure 3 shows the performance of the Congressional maps in the three Presidential contests in the last Census cycle, where the Democratic vote share (pink box) was between 48% and 50% of the major-party total each time. For a contest that is so evenly divided, we would expect a fair map to have 6, 7, or 8 out of 14 districts favoring each party. The alternative Congressional map NCLCV-Cong does just that, while the enacted plan SL-174 has just 4 out of 14 Democratic-majority districts each time (green and maroon circles). The alternative plan is far more successful at reflecting the even split of voter preferences.

Congressional plan comparison in Presidential elections

Do close votes translate to close seats?

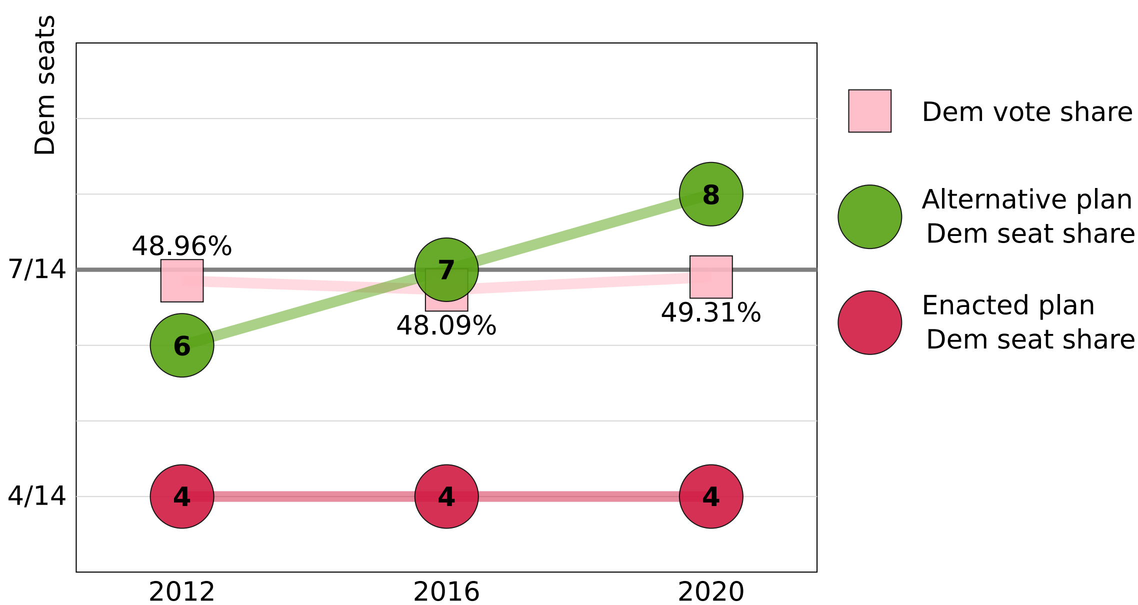

Figure 3: When Presidential voting is overlaid on the plans, we can compare the Democratic seat share in the enacted Congressional plan SL-174 (**maroon**) and the alternative Congressional plan NCLCV-Cong (**green**) to the vote share (**pink**) for Democratic candidates. The 50% line is marked.

Next, simplified versions of the same type of graphic are presented for all five up-ballot offices. Figure 4 compares Congressional maps, and Figure 5 compares legislative maps in the same fashion.

In these figures, we can view whether the plans display a tendency to uphold the Close-Votes-Close-Seats norm, for one office at a time. The pink squares are the vote share. If they are close to the 50-50 mark, then a fair map would also produce seat shares that are close to that mark. This is consistently true for the alternative plans and consistently false for the enacted plans.

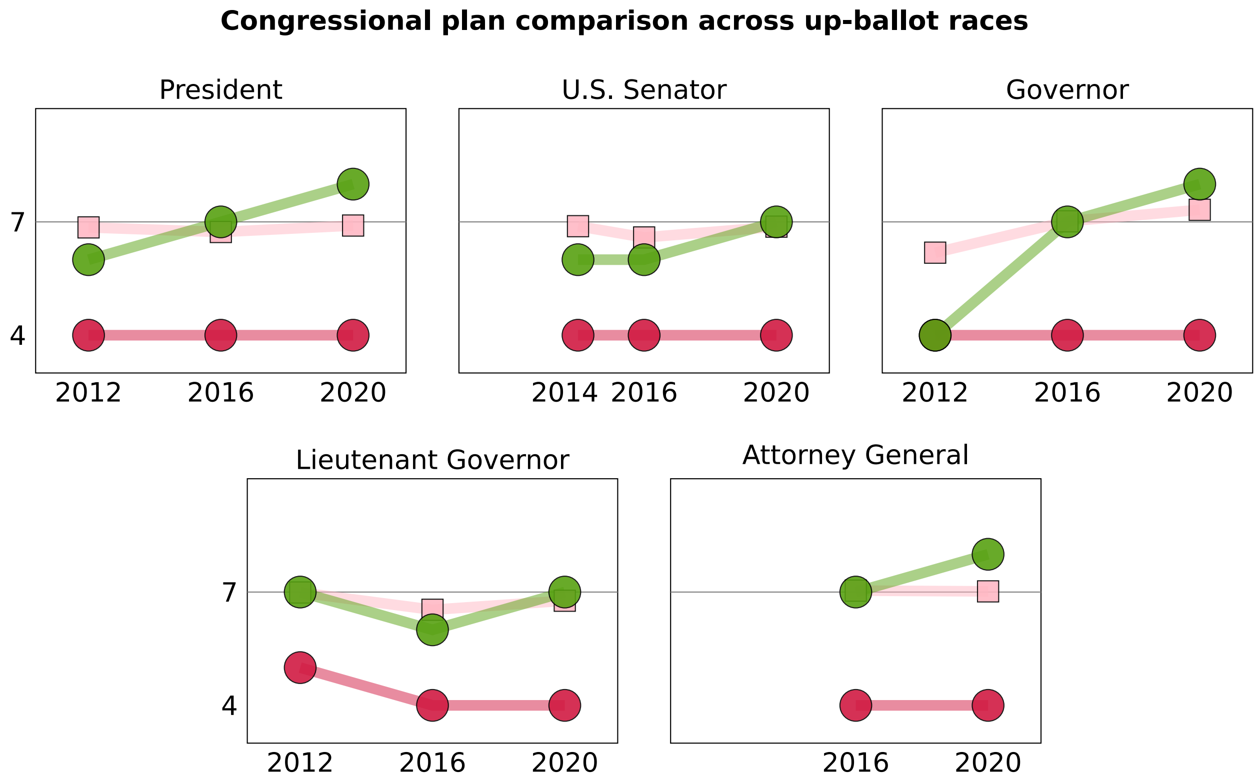

Figure 4: For up-ballot general election contests across the previous Census cycle, we can compare the seat share under the enacted Congressional plan SL-174 (**maroon**) and the seat share under the alternative Congressional plan NCLCV-Cong (**green**) to the vote share (**pink**) for Democratic candidates. The presidential comparison from the previous figure is repeated here, alongside the other four up-ballot offices. The 50% line is marked each time.

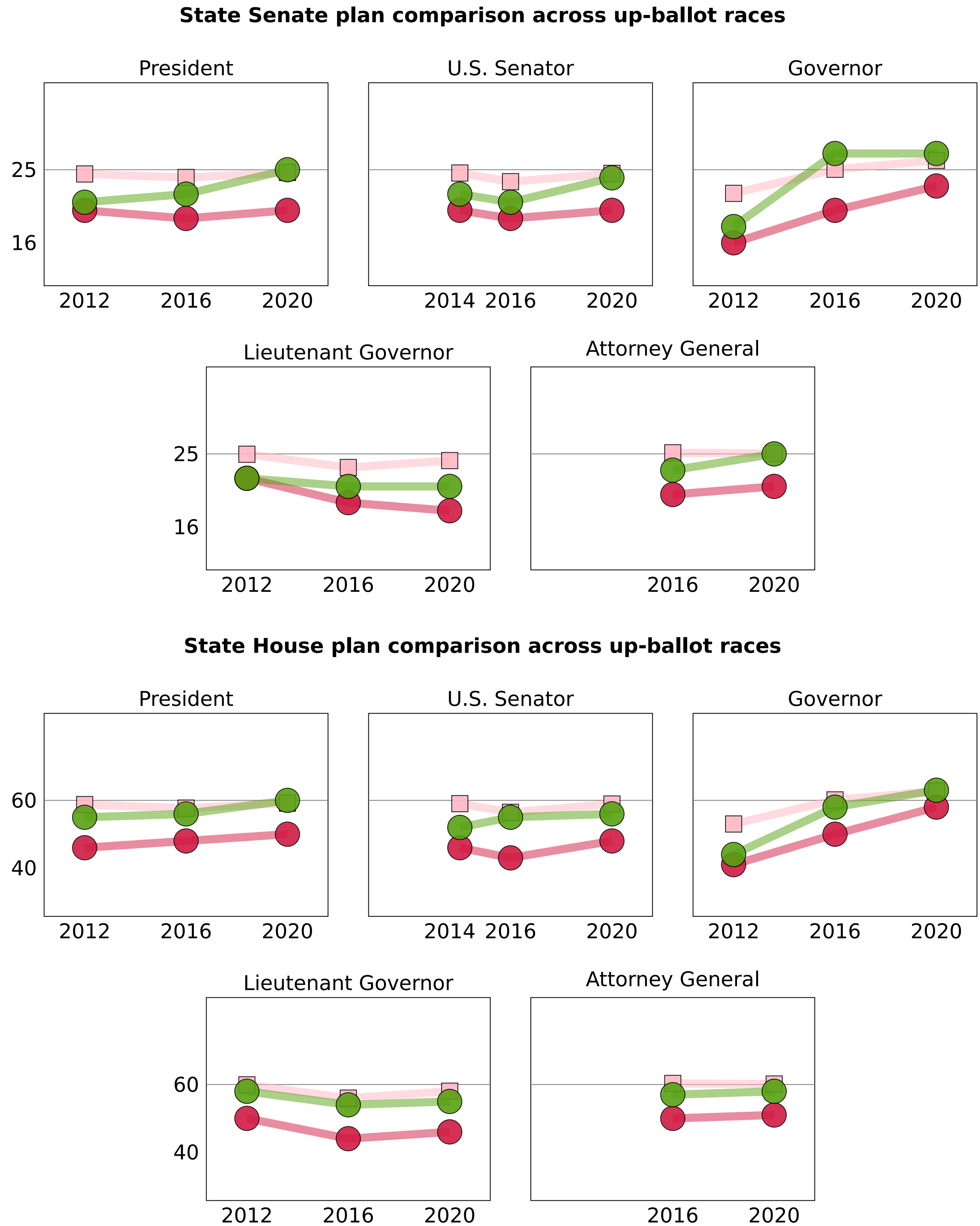

Figure 5: Legislative plans overlaid with voting patterns from up-ballot elections. The enacted plans SL-173 and SL-175 are shown in **maroon**. The alternative plans NCLCV-Sen and NCLCV-House, in **green**, have seat shares tracking much closer to the nearly even voting preferences.

3 Racial vote dilution

North Carolina has a large minority of Black-identified residents. Over two million North Carolinians—2,107,526 out of 10,439,388 to be precise, or about 20.2%—were identified as non-Hispanic Black-alone on the Census. Within the voting-age population, the numbers shift to 1,620,569 out of 8,155,099, or about 19.9%. Increasing numbers of Americans identify as Black in combination with other races and/or Hispanic ethnicity. Passing to this more expansive definition of Black voting age population raises the numbers to 1,743,052 out of 8,155,099, or 21.4%.

Minority groups' opportunity to elect candidates of choice is protected by both state and federal law. A detailed assessment of opportunity must not primarily hinge on the demographics of the districts, but must also rely on electoral history and an assessment of polarization patterns.[3]

I have used industry-leading techniques to study the racial polarization patterns in North Carolina general and primary elections from the last decade. They indicate a consistent pattern of polarization in statewide general elections, such that White voters are estimated to support the Republican candidate at a rate of over 61% in every general election, and Black voters are estimated to support the Democratic candidate at a rate of over 94% each time. Polarization is present in many Democratic primary elections as well, particularly in elections in which there is a Black Democratic candidate. I have designated a selection of eight elections—four generals and four primaries—chosen to be particularly informative in determining whether Black voters have an opportunity to elect their candidates of choice.

Democratic Primaries

- Sutton preferred over Mangrum in the 2020 Superintendent primary;
- Smith preferred over Wadsworth in the 2020 Ag. Commissioner primary;
- Williams preferred over Stein in the 2016 Attorney General primary;
- Coleman preferred over the field in the 2016 Lieutenant Governor primary.

General Elections

- Holley preferred over Robinson in the 2020 Lieutenant Governor election;
- Cunningham preferred over Tillis in the 2020 U.S. Senate election;
- Coleman preferred over Forest in the 2016 Lieutenant Governor election;
- Blue preferred over Folwell in the 2016 Treasurer election.

These eight contests were chosen by a combination of factors that combine to make an election particularly informative with respect to the preferences of Black voters. Namely: I prioritized elections that are more recent, that have a Black candidate on the ballot, that are clearly polarized, and that are close enough to produce variation at the district level.[4]

The electoral alignment score derived from these elections is a value from 0 to 8. I consider a district in which the Black candidate of choice prevails in at least 6 of these 8 contests to be aligned with Black voting preferences in the state.[5] If, in addition, at least 25% of the voting age population is Black, then I label the district to be effective for Black voters.

I note that the use of electoral history is not just cosmetic: there are House-sized districts with 35-39% BVAP that are nonetheless not labeled effective in these lists because they fall short of the standard of inclining to the Black candidate of choice in at least six out of the eight chosen elections.

[3] A detailed discussion of the inadequacy of using demographics alone as a proxy can be found in [3].

[4] Of the candidates above, Sutton, Williams, Coleman, Colley, and Blue are themselves Black-identified.

[5] I have used statewide ecological inference ("EI") runs to determine the candidate of choice for Black voters. I note that it is also possible to run EI on smaller geographies (such as counties or county clusters) to detect regional candidates of choice rather than statewide candidates of choice; in most cases, these will be the same, but in some cases, regional effects may be meaningful and could affect these results at the margin.

At all three levels, the NCLCV alternative maps provide more effective opportunity-to-elect districts for Black voters than the corresponding enacted plans.

Effective districts for Black voters
Out of 14 Congressional districts, SL-174 has 2 effective districts, while NCLCV-Cong has 4.
Out of 50 Senate districts, SL-173 has 8 effective districts, while NCLCV-Sen has 12.
Out of 120 House districts, SL-175 has 24 effective districts, while NCLCV-House has 36.

effective districts in state plan	effective districts in alternative plan
CD2, 9	CD2, 4, 9, 11
SD5, 11, 14, 19, 28, 38, 39, 40	SD1, 5, 11, 14, 18, 19, 26, 27, 32, 38, 39, 40
HD8, 23, 24, 25, 27, 32, 38, 39, 42, 44, 48, 57, 58, 60, 66, 71, 92, 99, 100, 101, 102, 106, 107, 112	HD2, 8, 9, 10, 23, 24, 25, 27, 31, 32, 33, 38, 39, 40, 42, 43, 44, 45, 48, 57, 58, 59, 60, 61, 63, 66, 71, 88, 92, 99, 100, 101, 102, 106, 107, 112

4 Detailed plan comparison

Detailed maps showing how the district lines cut through the patterns of Democratic and Republican support, and how they cut through the demographic location of Black voting age population, can be found in Appendix B.

4.1 Traditional districting principles

Principles that are relevant to North Carolina redistricting include the following.

- **Population balance.** The standard interpretation of *One Person, One Vote* for Congressional districts is that districts should be fine-tuned so that their total Census population deviates by no more than one person from any district to any other.

  There is more latitude with legislative districts; they typically vary top-to-bottom by no more than 10% of ideal district size. In North Carolina, the Whole County Provisions make it very explicit that 5% deviation must be tolerated if it means preserving more counties intact.

  All six plans have acceptable population balance.

Population deviation

	Max Positive Deviation	District	Max Negative Deviation	District
SL-174	0	(eight districts)	−1	(six districts)
NCLCV-Cong	0	(eight districts)	−1	(six districts)
SL-173	10,355 (4.960%)	5	−10,434 (4.997%)	13,18
NCLCV-Sen	10,355 (4.960%)	5	−10,427 (4.994%)	15
SL-175	4250 (4.885%)	18	−4189 (4.815%)	112
NCLCV-House	4341 (4.990%)	82	−4323 (4.969%)	87

Table 3: Deviations are calculated with respect to the rounded ideal district populations of 745,671 for Congress, 208,788 for Senate, and 86,995 for House.

- **Contiguity.** All six plans are contiguous; for each district, it is possible to transit from any part of the district to any other part through a sequence of census blocks that share boundary segments of positive length. As is traditional in North Carolina, contiguity through water is accepted.

- **Compactness.** The two compactness metrics most commonly appearing in litigation are the *Polsby-Popper score* and the *Reock score*. Polsby-Popper is the name given in redistricting to a metric from ancient mathematics: the isoperimetric ratio comparing a region's area to its perimeter via the formula $4\pi A/P^2$. Higher scores are considered more compact, with circles uniquely achieving the optimum score of 1. Reock is a different measurement of how much a shape differs from a circle: it is computed as the ratio of a region's area to that of its circumcircle, defined as the smallest circle in which the region can be circumscribed. From this definition, it is clear that it too is optimized at a value of 1, which is achieved only by circles.

  These scores depend on the contours of a district and have been criticized as being too dependent on map projections or on cartographic resolution [1, 2]. Recently, some mathematicians have argued for using discrete compactness scores, taking into account the units of Census geography from which the district is built. The most commonly cited discrete score for districts is the *cut edges score*, which counts how many adjacent pairs of geographical units receive different district assignments. In other words, cut edges measures the "scissors complexity" of the districting plan: how much work would have to be done to separate the districts from each other? Plans with a very intricate boundary would require many separations. This score improves on the contour-based scores by better controlling for factors like coastline and other natural boundaries, and by focusing on the units actually available to redistricters rather than treating districts like free-form Rorschach blots.

  The alternative plans are significantly more compact than the enacted plans in all three compactness metrics.

Compactness

	block cut edges (lower is better)	average Polsby-Popper (higher is better)	average Reock (higher is better)
SL-174	5194	0.303	0.417
NCLCV-Cong	4124	0.383	0.470
SL-173	9702	0.342	0.416
NCLCV-Sen	9249	0.369	0.428
SL-175	16,182	0.351	0.437
NCLCV-House	13,963	0.414	0.465

Table 4: Comparing compactness scores via one discrete and two contour-based metrics. These scores were computed using dissolved districts based on the census blocks that were assigned in the plans under discussion.

District-by-district compactness scores for the contour-based metrics are shown in Tables 5-7.

	Reock		Polsby-Popper	
CD	SL-174	NCLCV-Cong	SL-174	NCLCV-Cong
1	0.517	0.534	0.324	0.403
2	0.303	0.47	0.278	0.323
3	0.484	0.212	0.331	0.228
4	0.487	0.412	0.39	0.304
5	0.468	0.582	0.347	0.514
6	0.418	0.472	0.231	0.483
7	0.424	0.664	0.199	0.434
8	0.472	0.523	0.532	0.398
9	0.678	0.579	0.469	0.43
10	0.41	0.285	0.197	0.254
11	0.282	0.553	0.207	0.532
12	0.247	0.388	0.243	0.368
13	0.41	0.558	0.266	0.379
14	0.232	0.354	0.221	0.313

Table 5: Compactness scores by district for the Congressional plans.

	Reock		Polsby-Popper	
SD	SL-173	NCLCV-Sen	SL-173	NCLCV-Sen
1	0.263	0.297	0.213	0.174
2	0.231	0.397	0.105	0.178
3	0.409	0.409	0.179	0.179
4	0.564	0.564	0.406	0.406
5	0.403	0.403	0.335	0.335
6	0.616	0.616	0.595	0.595
7	0.213	0.553	0.219	0.411
8	0.446	0.457	0.439	0.478
9	0.443	0.441	0.217	0.226
10	0.618	0.618	0.614	0.614
11	0.464	0.464	0.376	0.376
12	0.42	0.388	0.395	0.404
13	0.284	0.357	0.257	0.4
14	0.399	0.523	0.247	0.45
15	0.397	0.52	0.231	0.398
16	0.619	0.51	0.473	0.388
17	0.488	0.54	0.361	0.505
18	0.376	0.644	0.309	0.514
19	0.53	0.53	0.34	0.34
20	0.384	0.387	0.363	0.344
21	0.218	0.218	0.137	0.137
22	0.473	0.459	0.471	0.517
23	0.498	0.498	0.529	0.529
24	0.52	0.52	0.452	0.452
25	0.283	0.325	0.271	0.276
26	0.451	0.397	0.301	0.331
27	0.541	0.364	0.437	0.321
28	0.444	0.544	0.248	0.457
29	0.317	0.378	0.202	0.252
30	0.4	0.4	0.456	0.456
31	0.482	0.429	0.344	0.355
32	0.62	0.455	0.422	0.354
33	0.322	0.322	0.294	0.294
34	0.49	0.477	0.523	0.489
35	0.375	0.342	0.225	0.348
36	0.463	0.314	0.411	0.294
37	0.401	0.397	0.421	0.437
38	0.523	0.566	0.334	0.444
39	0.356	0.391	0.295	0.368
40	0.381	0.453	0.382	0.538
41	0.287	0.519	0.294	0.531
42	0.429	0.397	0.273	0.469
43	0.533	0.341	0.522	0.274
44	0.386	0.425	0.46	0.357
45	0.343	0.391	0.25	0.3
46	0.229	0.249	0.184	0.213
47	0.186	0.116	0.127	0.113
48	0.404	0.373	0.38	0.264
49	0.479	0.424	0.358	0.22
50	0.422	0.312	0.441	0.335

Table 6: Compactness scores by district for the Senate plans.

	Reock		Polsby-Popper	
HD	SL-175	NCLCV-House	SL-175	NCLCV-House
1	0.413	0.393	0.213	0.168
2	0.316	0.404	0.326	0.468
3	0.377	0.448	0.298	0.329
4	0.482	0.337	0.448	0.237
5	0.28	0.28	0.3	0.3
6	0.389	0.539	0.479	0.549
7	0.476	0.442	0.44	0.403
8	0.394	0.437	0.327	0.314
9	0.587	0.698	0.411	0.425
10	0.589	0.606	0.567	0.398
11	0.359	0.654	0.246	0.473
12	0.312	0.312	0.291	0.291
13	0.379	0.367	0.425	0.488
14	0.384	0.305	0.291	0.204
15	0.546	0.468	0.371	0.395
16	0.404	0.483	0.242	0.388
17	0.416	0.668	0.227	0.473
18	0.589	0.336	0.37	0.374
19	0.462	0.482	0.285	0.359
20	0.463	0.172	0.557	0.173
21	0.45	0.591	0.206	0.469
22	0.528	0.528	0.361	0.361
23	0.453	0.453	0.359	0.359
24	0.463	0.554	0.538	0.638
25	0.463	0.402	0.511	0.455
26	0.45	0.474	0.4	0.412
27	0.433	0.433	0.353	0.353
28	0.573	0.411	0.498	0.43
29	0.36	0.519	0.333	0.645
30	0.381	0.306	0.356	0.389
31	0.415	0.476	0.323	0.533
32	0.534	0.528	0.587	0.543
33	0.491	0.254	0.289	0.252
34	0.414	0.383	0.289	0.349
35	0.28	0.528	0.292	0.464
36	0.586	0.396	0.532	0.443
37	0.417	0.372	0.369	0.379
38	0.377	0.522	0.247	0.383
39	0.649	0.399	0.519	0.245
40	0.413	0.342	0.336	0.242
41	0.521	0.581	0.423	0.498
42	0.537	0.402	0.395	0.258
43	0.52	0.415	0.281	0.372
44	0.587	0.564	0.419	0.564
45	0.248	0.555	0.274	0.495
46	0.316	0.432	0.239	0.275
47	0.604	0.535	0.498	0.453
48	0.479	0.479	0.442	0.442
49	0.447	0.555	0.358	0.604
50	0.375	0.384	0.343	0.388
51	0.48	0.427	0.283	0.262
52	0.352	0.468	0.214	0.28
53	0.322	0.597	0.256	0.449
54	0.459	0.486	0.376	0.442
55	0.458	0.534	0.312	0.399
56	0.502	0.652	0.37	0.691
57	0.436	0.589	0.368	0.475
58	0.397	0.521	0.257	0.432
59	0.455	0.463	0.334	0.56
60	0.383	0.361	0.261	0.407
61	0.388	0.356	0.294	0.346
62	0.318	0.651	0.312	0.589
63	0.56	0.596	0.353	0.533
64	0.329	0.48	0.257	0.459
65	0.594	0.594	0.764	0.764
66	0.457	0.46	0.264	0.293
67	0.444	0.444	0.486	0.486
68	0.45	0.577	0.305	0.502
69	0.539	0.49	0.346	0.364
70	0.542	0.638	0.535	0.65
71	0.267	0.488	0.275	0.509
72	0.521	0.495	0.27	0.398
73	0.487	0.46	0.421	0.612
74	0.367	0.548	0.299	0.425
75	0.388	0.468	0.266	0.53
76	0.43	0.43	0.497	0.497
77	0.408	0.408	0.297	0.297
78	0.341	0.479	0.204	0.447
79	0.523	0.353	0.36	0.2
80	0.285	0.413	0.319	0.359
81	0.481	0.434	0.312	0.359
82	0.311	0.444	0.32	0.477
83	0.474	0.473	0.328	0.342
84	0.498	0.57	0.515	0.645
85	0.501	0.493	0.315	0.299
86	0.49	0.49	0.437	0.437
87	0.538	0.512	0.437	0.526
88	0.233	0.367	0.211	0.364
89	0.304	0.462	0.291	0.338
90	0.508	0.431	0.349	0.381
91	0.541	0.563	0.522	0.583
92	0.28	0.399	0.244	0.455
93	0.317	0.33	0.288	0.319
94	0.507	0.496	0.348	0.371
95	0.616	0.49	0.596	0.516
96	0.358	0.316	0.351	0.33
97	0.321	0.321	0.515	0.515
98	0.593	0.574	0.576	0.589
99	0.469	0.471	0.322	0.443
100	0.537	0.359	0.333	0.312
101	0.488	0.518	0.31	0.515
102	0.392	0.621	0.23	0.36
103	0.278	0.546	0.349	0.479
104	0.573	0.432	0.32	0.313
105	0.395	0.437	0.419	0.391
106	0.599	0.485	0.419	0.503
107	0.304	0.529	0.183	0.556
108	0.374	0.402	0.24	0.288
109	0.466	0.485	0.421	0.522
110	0.355	0.514	0.277	0.39
111	0.348	0.641	0.24	0.436
112	0.58	0.266	0.397	0.229
113	0.392	0.368	0.224	0.186
114	0.307	0.549	0.182	0.46
115	0.559	0.308	0.349	0.289
116	0.401	0.532	0.159	0.332
117	0.422	0.581	0.271	0.393
118	0.412	0.412	0.247	0.247
119	0.276	0.276	0.22	0.22
120	0.4	0.4	0.367	0.367

Table 7: Compactness scores by district for the House plans.

- **Respect for political subdivisions.** For legislative redistricting, North Carolina has one of the strongest requirements for county consideration of any state in the nation. In my understanding, courts have interpreted the Whole County Provisions as follows.[6]

  - First, if any county is divisible into a whole number of districts that will be within ±5% of ideal population, then it must be subdivided accordingly without districts crossing into other counties.
  - Next, seek any contiguous grouping of two counties that is similarly divisible into a whole number of districts.
  - Repeat for groupings of three, and so on, until all counties are accounted for.

  Once clusters have been formed, there are more rules about respecting county lines within clusters. The legal language is again explicit: "[T]he resulting interior county lines created by any such groupings may be crossed or traversed in the creation of districts within said multi-county grouping but only to the extent necessary" to meet the ±5% population standard for districts. To address this, I have counted the *county traversals* in each plan, i.e., the number of times a district crosses between adjacent counties within a grouping.

  Table 8 reflects the county integrity metric that is most relevant at each level: the enacted congressional plan splits 11 counties into 25 pieces while the alternative plan splits 13, but splits no county three ways. (The enacted plans unnecessarily split three counties into three pieces.) In the legislative plans, the law specifies traversals as the fundamental integrity statistic.

County and municipality preservation

	# county pieces
SL-174	25
NCLCV-Cong	26

	# traversals
SL-173	97
NCLCV-Sen	89
SL-175	69
NCLCV-House	66

	# municipal pieces (considering all blocks)	# municipal pieces (considering populated blocks)
SL-174	90	50
NCLCV-Cong	58	41
SL-173	152	91
NCLCV-Sen	125	100
SL-175	292	222
NCLCV-House	201	173

Table 8: Comparing the plans' conformance to political boundaries.

[6]A complete set of solutions is described in detail in the white paper of Mattingly et al.—though with the important caveat that the work "does not reflect... compliance with the Voting Rights Act" [4]. Absent a VRA conflict, the 2020 Decennial Census population data dictates that the North Carolina Senate plan must be decomposed into ten single-district fixed clusters and seven multi-district fixed clusters (comprising 2, 2, 3, 3, 4, 6, and 6 districts, respectively). It has four more areas in which there is a choice of groupings. In all, there are sixteen different possible clusterings for Senate, each comprising 26 county clusters. The House likewise has 11 single-district fixed clusters and 22 multi-district fixed clusters (with two to thirteen districts per cluster), together with three more areas with a choice of groupings. In all, the House has only eight acceptable clusterings, each comprising 40 county clusters. Again, it is important to note that VRA compliance may present a compelling reason to select some clusterings and reject others.

The alternative plans are comparable to the enacted plans, and often superior, in each of these key metrics regarding preservation of political boundaries. This remains true whether splits of municipalities are counted by the division of any of their census blocks, or only by the division of populated census blocks.

I will briefly mention several additional redistricting principles.

- **Communities of interest.** In North Carolina, there was no sustained effort by the state or by community groups to formally collect community of interest (COI) maps, to my knowledge. Without this, it is difficult to produce a suitable metric.
- **Cores of prior districts.** In some states, there is statutory guidance to seek districting plans that preserve the cores of prior districts. In North Carolina, this is not a factor in the constitution, in statute, or in case law. In addition, attention to core preservation would be prohibitively difficult in the Senate and House because of the primacy of the Whole County Provisions, which forces major changes to the districts simply as a consequence of fresh population numbers.
- **Incumbent pairing.** In 2017, the North Carolina legislative redistricting committee listed "incumbency protection" as a goal in their itemization of principles. In 2021, this was softened to the statement that "Member residence may be considered" in the drawing of districts. I have counted the districts in each plan that contain more than one incumbent address; these are sometimes colorfully called "double-bunked" districts. For this statistic, it is not entirely clear whether a high or low number is preferable. When a plan remediates a gerrymandered predecessor, we should not be surprised if it ends up pairing numerous incumbents.

Double-bunking

	# districts pairing incumbents
SL-174	3
NCLCV-Cong	1
SL-173	5
NCLCV-Sen	9
SL-175	6
NCLCV-House	16

Table 9: For Congress and Senate, the enacted and alternative plans are comparable; at the House level, the alternative plan has more double-bunking. *Note: These numbers were calculated using incumbent addresses that I understand were provided by the Legislative Defendants.*

4.2 Swing districts and competitive contests

Another way to understand the electoral properties of districting plans is to investigate how many districts always give the same partisan result over a suite of observed electoral conditions, and how many districts can "swing" between the parties. Figure 6 compares the six plans across the up-ballot elections. The enacted plans lock in large numbers of always-Republican seats. In the Senate and House, nearly half the seats are locked down for Republicans. In the Congressional plan, it's well *over* half. This provides another view from which the NCLCV plans provide attractive alternatives.

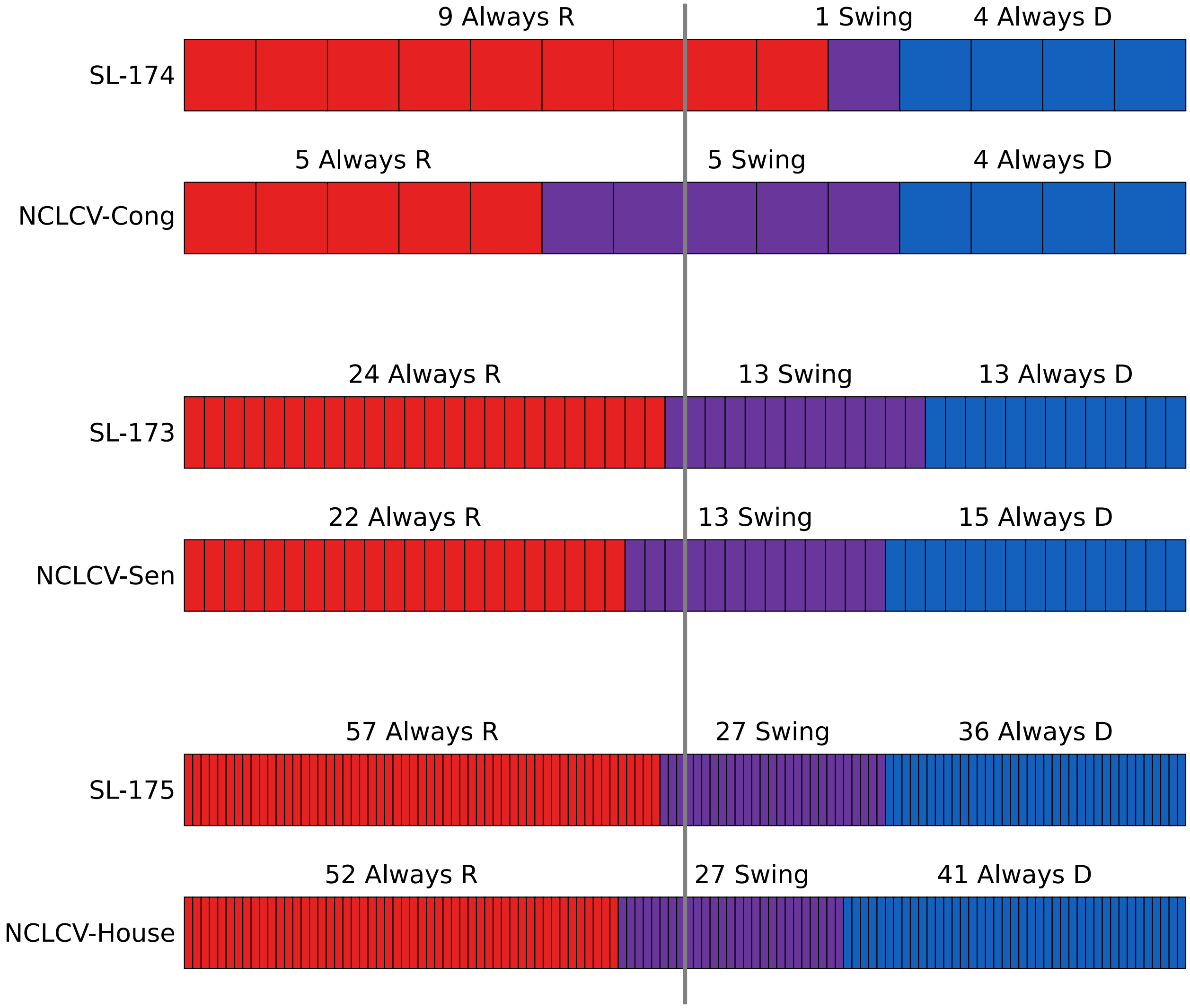

Figure 6: These visuals show the breakdown of seats that always have a Republican winner, always have a Democratic winner, or are sometimes led by each party across the 14 up-ballot elections over the previous Census cycle. The 50-50 split is marked.

In interpreting this visualization, note that this is consistent with the discussion elsewhere of entrenched Republican majorities in the enacted maps. These Always-Republican districts provide a *floor* for Republican performance from the viewpoint of these up-ballot contests.

One more measure of partisan fairness, frequently referenced in the public discourse, is the tendency of a districting plan to promote close or competitive contests. We close with a comparison of the enacted and alternative plans that displays the number of times across the full dataset of 52 elections that a contest had a partisan margin of closer than 10 points, 6 points, or 2 points, respectively. This can occur up to $14 \cdot 52 = 728$ times in Congressional maps, $50 \cdot 52 = 2600$ times in state Senate maps, and $120 \cdot 52 = 6240$ times in state House maps. The figures below show horizontal rules at every 10% interval of the total number of possible competitive contests; we can see, for instance, that the alternative Congressional plan has contests within a 10-point margin more than 40% of the time.

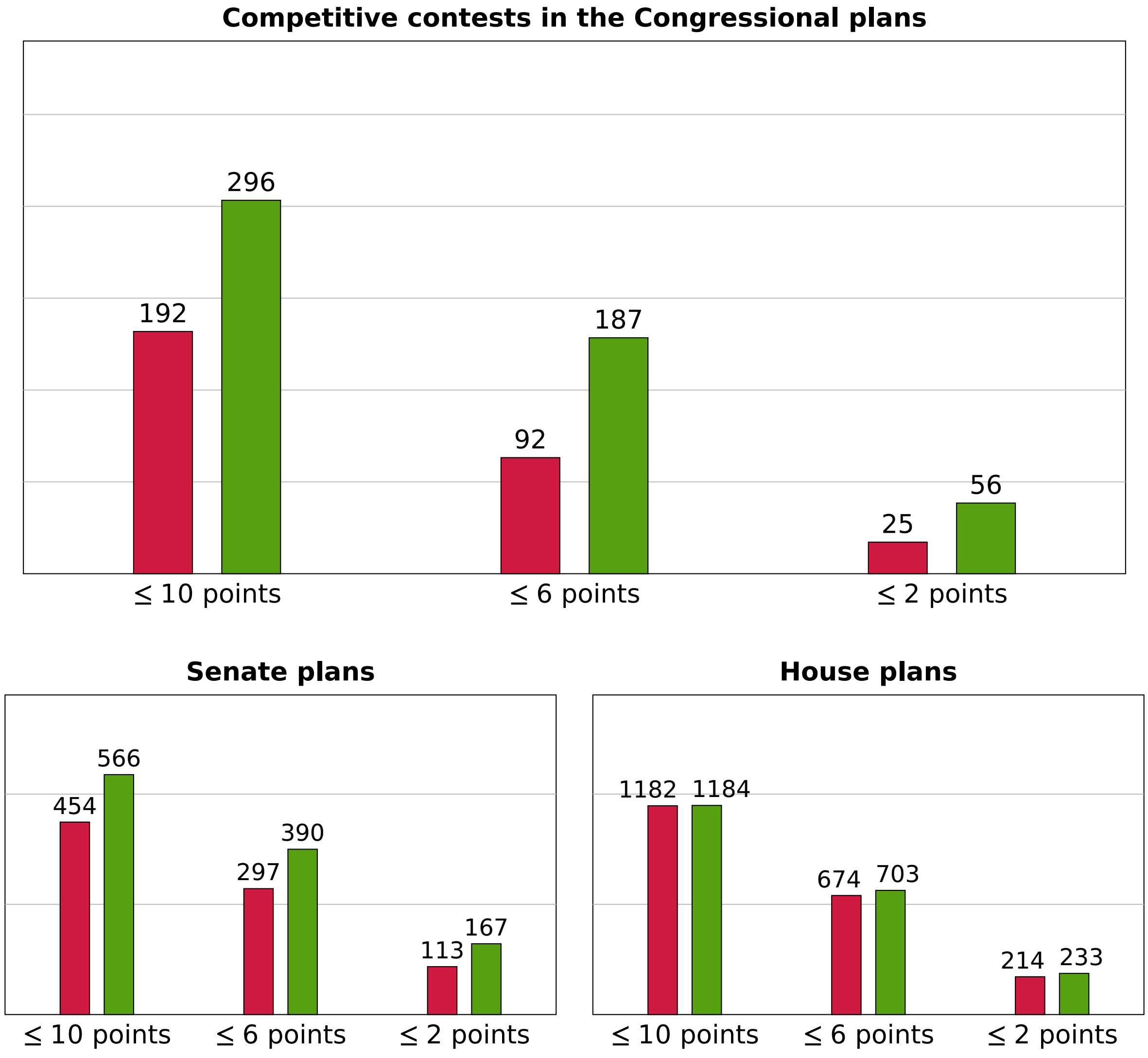

Figure 7: These bar graphs show the number of competitive contests for the enacted plans (**maroon**) and the alternative plans (**green**). In each plot, we consider increasingly restrictive definitions of "competitive" from left to right, counting districts in which the major-party vote split is closer than 45-55, 47-53, and 49-51, respectively.

5 Location-specific comparison of electoral opportunity

I received information reflecting the residential locations of 147 individuals, who come from either of two groups:

- plaintiffs in the NCLCV v. Hall case; or
- registered voters belonging to the NCLCV membership who are Black and/or are registered as Democrats.

In Table 10 below, I summarize the impact on the identified individuals in terms of electoral opportunity if the enacted maps are compared to the alternative maps.

Subsequently, Figures 8 and 9 provide a visualization that pinpoints the geographical sites where the alternative plans improve electoral opportunities for plaintiffs and NCLCV members—that is, places where the identified individuals (as Democrats and/or Black voters) have measurably greater ability to elect their candidates of choice under the alternative plans than under the existing plans.

This is backed up by the data in Tables 11-13 below, which identify the district numbers in the six enacted and alternative plans for each of these identified individuals. The district numbers were computed using census block information to specify the locations, but the table reports the locations by larger units (VTDs) in order to protect privacy.

Lost opportunity for Democratic and Black voters

	greater Democratic opportunity in alternative plan than enacted plan
Congress	51 individuals
Senate	37 individuals
House	39 individuals

	resides in effective district in alternative plan but not enacted plan
Congress	28 Black voters
Senate	21 Black voters
House	21 Black voters

Table 10: Of the 147 identified individuals, how many saw a change in their opportunity for Democratic representation? How many Black voters saw a change in their opportunity to elect Black candidates of choice?

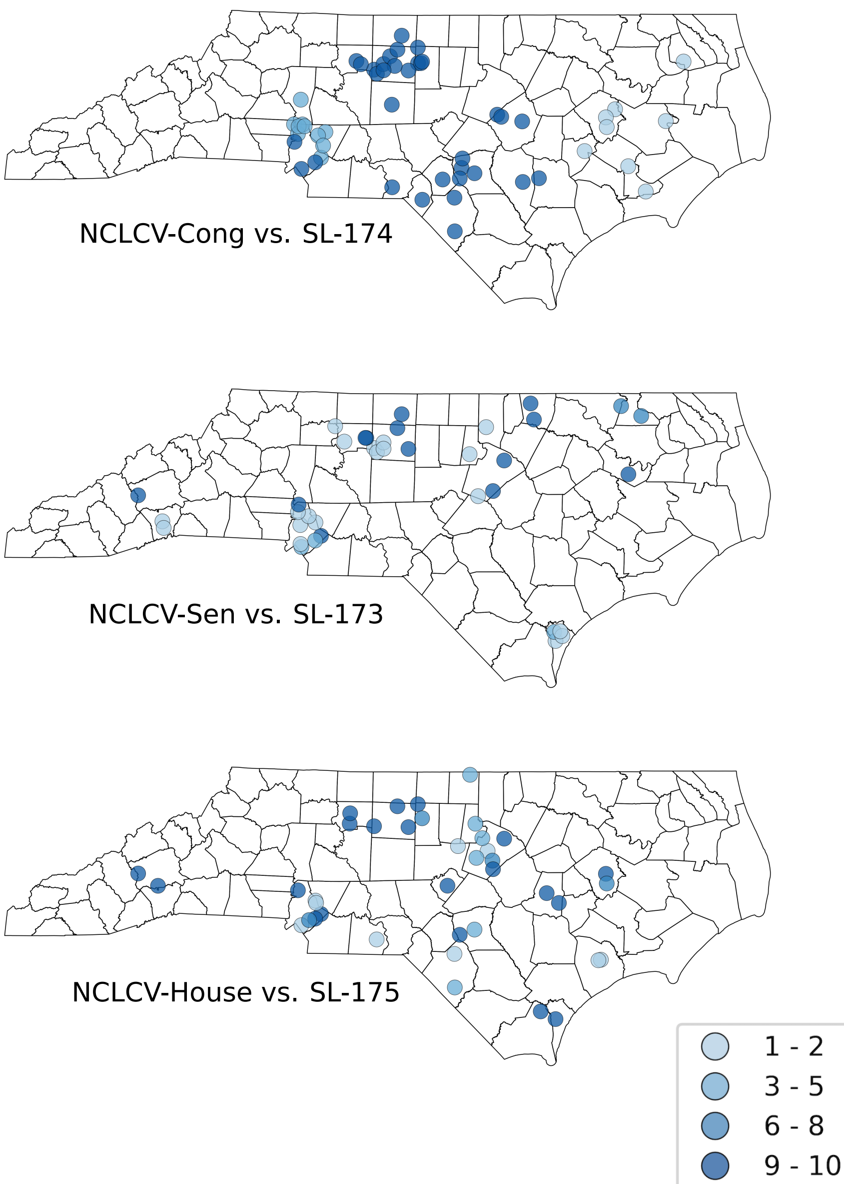

Figure 8: Locations where identified individuals have less opportunity to be represented by a Democrat in Congress, state Senate, and state House under the enacted plans. The shading indicates the drop in Democratic wins across the 14 up-ballot races in the enacted map relative to the alternative map. There are 51 such individuals in the Congressional maps, 37 in the Senate maps, and 31 in the House maps.

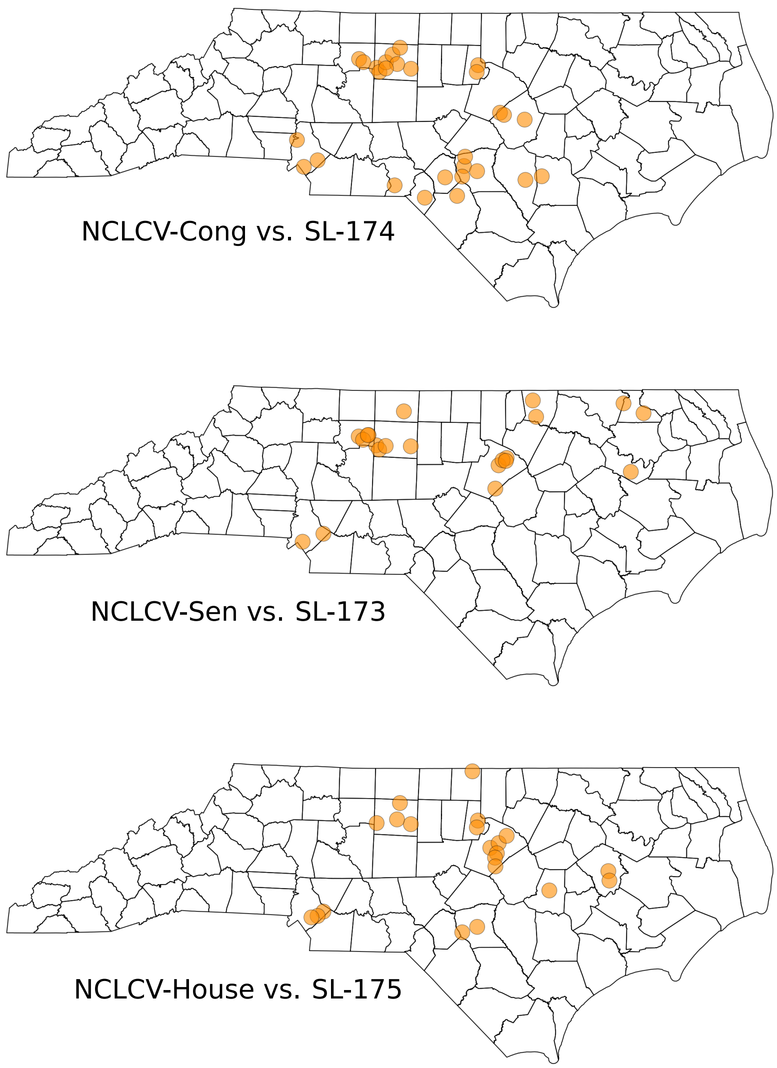

Figure 9: Locations where Black voters from the identified individuals list would be in a district that provides effective electoral opportunity under the alternative plan, but not under the enacted plan. There are 28 such voters at the Congressional level and 21 at each of the Senate and House level.

VTD Census ID	VTD/Precinct Name	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
37025001-07	01-07	10	10	34	34	73	73
37025012-03	12-03	10	10	34	34	82	82
37025002-07	02-07	10	10	34	34	83	73
37009000002	CLIFTON	11	12	47	47	93	93
37063000029	GLENN ELEMENTARY	6	2	22	22	2	2
37063000043	FOREST VIEW ELEMENTARY	6	6	22	20	30	30
37063000052	EVANGEL ASSEMBLY OF GOD	6	2	22	22	31	31
37063055-11	055-11	6	6	20	22	29	29
37071000012	FLINT GROVES	13	13	43	43	108	108
37071000004	FOREST HEIGHTS	13	13	43	43	109	109
37057000076	THOMASVILLE 10 76	7	8	30	30	80	80
371350000EF	EFLAND	6	6	23	23	50	50
371050000A2	A2	7	7	12	12	51	54
37131NEWTOW	NEWTOWN	2	2	1	1	27	27
371350000CF	CEDAR FALLS	6	6	23	23	56	56
37081000H25	H25	10	11	27	27	62	60
37093000061	RAEFORD 1	8	4	24	24	48	48
37081000RC2	RC2	7	11	26	26	59	59
3712700P15A	OAK LEVEL	2	2	11	11	25	25
3707700TYHO	00TYHO	2	2	13	13	32	32
370910000CO	COFIELD	2	1	1	1	5	5
37057000038	EASTSIDE 38	7	8	30	30	81	81
370210021.1	HAW CREEK ELEMENTARY SCHOOL	14	14	49	49	115	114
37019000015	GRISSETTOWN	3	3	8	8	17	19
37047000P15	TATUM	3	3	8	8	46	46
37019000002	LELAND	3	3	8	8	17	17
370450CASAR	CASAR	13	13	44	44	110	111
370210007.1	KENILWORTH PRESBYTERIAN CHURCH	14	14	49	49	114	115
370210053.1	LEICESTER 2 - COMMUNITY CENTER	14	14	46	49	116	116
370210054.2	LUTHERAN CHURCH OF THE NATIVITY	14	14	49	49	116	115
37193000108	FAIRPLAINS	11	12	36	36	94	94
37173000BC2	BC2	14	14	50	47	119	119
37119000054	54	9	9	40	42	102	112
37119000108	108	9	9	40	40	100	100
37119000208	208	13	10	37	38	98	98
371190204.1	204.1	9	10	40	40	99	106
37119000097	97	9	9	42	39	112	105
37119000222	222	9	9	38	39	101	101
37097000ST6	STATESVILLE 6	12	10	37	37	84	84
370970DV1-B	DAVIDSON 1-B	10	10	37	37	95	95
37119000048	48	9	9	42	42	88	104
37119000216	216	8	9	41	41	103	99
37081000G27	G27	11	11	28	28	57	57
37081000G43	G43	11	11	27	28	58	62
37153000006	WOLF PIT 3	8	4	29	29	52	52
371570000MS	MOSS STREET	11	6	26	26	65	65
3716300ROWA	ROWAN	4	4	9	9	22	22
3719500PRWI	WILSON I	2	2	4	4	24	24
37119000206	206	13	10	37	37	98	98
37119000236	236	8	10	41	40	103	99

Table 11: Locations of identified individuals, Part 1 of 3. For each location, the district numbers are given for the six plans discussed here. VTDs are listed rather than the more precise census block in order to protect privacy. Rows highlighted **blue** indicate individuals who lose Democratic opportunity in at least one of the enacted plans, relative to the alternative plans. Rows highlighted **orange** indicate Black voters who lose the opportunity to be in an effective district for Black candidates of choice in at least one level. (As it turns out, every instance of lost opportunity for Black voters is also an instance of lost Democratic opportunity.)

VTD Census ID	VTD/Precinct Name	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
37119000142	142	13	10	38	38	98	112
37081000G65	G65	11	11	27	27	58	58
37081000G70	G70	11	11	28	26	61	61
3708100H19A	H19A	10	11	27	27	60	60
3708100MON3	MON3	11	11	26	28	59	57
37183015-01	15-01	5	7	17	14	37	38
37183019-17	19-17	5	5	18	18	39	66
37183001-31	01-31	5	5	15	15	11	33
37183012-02	12-02	7	7	17	17	37	37
37119000087	87	8	9	41	41	105	105
37119000068	68	9	9	42	41	104	100
371190223.1	223.1	13	9	39	39	101	101
37119000081	81	9	9	39	39	92	101
37119000237	237	9	10	38	40	106	106
37119000127	127	13	10	37	37	98	98
37191000014	14	2	1	4	4	4	10
37183005-01	05-01	6	7	16	16	41	41
37183020-09	20-09	6	7	16	17	36	36
37183004-18	04-18	6	7	16	16	49	11
37191000010	10	2	1	4	4	10	10
37183019-21	19-21	5	5	13	18	35	66
37183001-46	01-46	5	5	18	18	34	40
37183001-50	01-50	5	5	14	14	33	38
37183016-05	16-05	5	5	14	14	21	38
37119000145	145	9	10	38	38	107	107
37183008-03	08-03	5	5	15	15	40	49
37183017-05	17-05	5	5	14	18	38	40
37183013-09	13-09	5	5	18	18	66	66
370490000N2	FORT TOTTEN	1	1	3	3	3	3
37049000002	HAVELOCK	1	1	3	3	13	13
37001000004	MORTON	7	6	25	25	64	63
37001000126	BURLINGTON 6	7	6	25	25	63	64
3700100003N	NORTH BOONE	7	6	25	25	64	64
37001000124	BURLINGTON 4	7	6	25	25	63	63
37165001-16	01-16/01	8	4	24	24	48	48
37067000063	CASH ELEMENTARY SCHOOL	12	12	31	32	75	75
37067000074	MEADOWLARK MIDDLE SCHOOL	12	12	31	31	74	74
37067000709	WARD ELEMENTARY SCHOOL	12	12	32	31	74	71
37067000065	KERNERSVILLE 7TH DAY ADVENTIST CHURCH	12	12	31	32	75	75
37067000507	SEDGE GARDEN REC CTR	12	11	32	32	71	75
371510000AE	ASHEBORO EAST	7	11	29	29	70	70
37067000905	BETHABARA MORAVIAN CH	12	12	32	31	91	72
37067000402	FOURTEENTH STREET REC	12	11	32	32	72	72
370890000FR	FLAT ROCK	14	14	48	48	113	117
3708900HV-1	HENDERSONVILLE-1	14	14	48	48	117	117
37023000039	MORGANTON 09	13	13	46	46	86	86
3710900LB34	LABORATORY	12	13	44	46	97	97
3706100WARS	WARSAW	3	4	9	9	4	4
3712900CF01	CF01	3	3	8	7	18	17
370130BELHV	BELHAVEN	1	1	3	3	79	1

Table 12: Locations of identified individuals, Part 2 of 3. For each location, the district numbers are given for the six plans discussed here. VTDs are listed rather than the more precise census block in order to protect privacy. Rows highlighted **blue** indicate individuals who lose Democratic opportunity in at least one of the enacted plans, relative to the alternative plans. Rows highlighted **orange** indicate Black voters who lose the opportunity to be in an effective district for Black candidates of choice in at least one level. (As it turns out, every instance of lost opportunity for Black voters is also an instance of lost Democratic opportunity.)

VTD Census ID	VTD/Precinct Name	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
37037NWM117	NORTH WILLIAMS	7	7	20	20	54	54
3714100CL05	COLUMBIA	3	3	9	9	16	16
3713300BM08	BRYNN MARR	1	3	6	6	14	15
3713300NR02	NEW RIVER	1	3	6	6	15	15
37051SL78-3	Spring Lake 3	4	4	21	21	42	44
3705100G10A	STONEY POINT 2-G10	4	4	19	19	45	45
37051000G1A	CROSS CREEK 02-G1	4	4	19	19	43	42
37035000035	SWEETWATER	12	13	45	45	96	96
37035000032	SOUTH NEWTON	12	13	45	45	89	89
3705100CC32	CROSS CREEK 32	4	4	19	19	44	44
37059000007	JERUSALEM	10	8	30	30	77	77
3708500PR01	ANDERSON CREEK	4	7	12	12	6	6
3708500PR07	BARBECUE	4	7	12	12	6	6
371070000K8	KINSTON-8	1	1	3	3	12	12
37189000009	ELK	14	12	47	47	87	93
371170000BG	BEAR GRASS	2	1	2	1	23	23
371010PR12B	NORTH CLEVELAND 2	4	2	10	10	26	26
371010PR31B	SOUTHWEST CLEVELAND	4	2	10	10	53	53
3710100PR24	EAST SELMA	4	2	10	10	28	28
3714701102A	SIMPSON A	1	1	5	5	9	8
37167000003	ALBEMARLE NUMBER 3	8	8	33	33	67	67
3700700LILE	LILESVILLE	8	8	29	29	55	55
3704500KM-N	KM N	13	13	44	44	111	110
37143BETHEL	BETHEL	1	1	1	2	1	1
37147000601	CHICOD	1	1	5	5	9	9
37147001201	PACTOLUS	1	1	5	5	8	8
37159000040	NORTH WARD	10	8	33	33	76	76
3712900FP04	FP04	3	3	7	8	19	20
37129000W16	W16	3	3	7	7	20	18
37129000H11	H11	3	3	7	7	18	20
37129000H02	H02	3	3	7	7	20	20
37159000036	SOUTH WARD	10	8	33	33	76	76
37125000DHR	DEEP RIVER/HIGH FALLS/RITTER	8	7	21	21	78	51
37069000015	EAST FRANKLINTON	2	2	11	11	7	7
3719908-CRA	CRABTREE	14	14	47	47	85	85
3719700EBND	EAST BEND	12	12	36	31	77	77
37171000018	MT AIRY 8	11	12	36	36	90	90
3708700WS-2	WAYNESVILLE SOUTH 2	14	14	50	50	118	118
3715500005A	FAIRMONT	3	4	24	24	46	47
37155000028	RENNERT	3	4	24	24	47	47
37113000011	SMITHBRIDGE	14	14	50	50	120	120
3714500WDSD	WOODSDALE	2	6	23	23	2	2
3717900029A	SHILOH ELEMENTARY SCHOOL	8	8	35	35	68	69
3717900037A	NEXT LEVEL CHURCH	8	8	35	35	69	69
37169000017	WEST WALNUT COVE	11	12	31	36	91	91
37185000007	SHOCCO	2	2	2	1	27	27
37185000013	NORLINA	2	2	2	1	27	27

Table 13: Locations of identified individuals, Part 3 of 3. For each location, the district numbers are given for the six plans discussed here. VTDs are listed rather than the more precise census block in order to protect privacy. Rows highlighted **blue** indicate individuals who lose Democratic opportunity in at least one of the enacted plans, relative to the alternative plans. Rows highlighted **orange** indicate Black voters who lose the opportunity to be in an effective district for Black candidates of choice in at least one level. (As it turns out, every instance of lost opportunity for Black voters is also an instance of lost Democratic opportunity.)

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[1] Assaf Bar-Natan, Lorenzo Najt, and Zachary Schutzmann, *The gerrymandering jumble: map projections permute districts' compactness scores*. Cartography and Geographic Information Science, Volume 47, Issue 4, 2020, 321–335.

[2] Richard Barnes and Justin Solomon, *Gerrymandering and Compactness: Implementation Flexibility and Abuse.* Political Analysis, Volume 29, Issue 4, October 2021, 448–466.

[3] Amariah Becker, Moon Duchin, Dara Gold, and Sam Hirsch, *Computational redistricting and the Voting Rights Act.* Election Law Journal.
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[4] Christopher Cooper, Blake Esselstyn, Gregory Herschlag, Jonathan Mattingly, and Rebecca Tippett, *NC General Assembly County Clusterings from the 2020 Census.*
https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf

[5] Moon Duchin, Taissa Gladkova, Eugene Henninger-Voss, Heather Newman, and Hannah Wheelen, *Locating the Representational Baseline: Republicans in Massachusetts.* Election Law Journal, Volume 18, Number 4, 2019, 388–401.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 23 day of December, 2021.

Professor Moon Duchin

Sworn and subscribed before me
this the 23rd of December, 2021

SHANNON C PETERSON
Notary Public
State of Colorado
Notary ID # 20214018369
My Commission Expires 05-10-2025

Notary Public

Name: Shannon C Peterson

My commission expires: 05/10/2025

Moon Duchin

moon.duchin@tufts.edu - mduchin.math.tufts.edu
Mathematics · STS · Tisch College of Civic Life | Tufts University

Education

University of Chicago MS 1999, PhD 2005
Mathematics
Advisor: Alex Eskin Dissertation: *Geodesics track random walks in Teichmüller space*

Harvard University BA 1998
Mathematics and Women's Studies

Appointments

Tufts University
Professor of Mathematics 2021—
Assistant Professor, Associate Professor 2011–2021

Director | Program in Science, Technology, & Society 2015–2021
(on leave 2018–2019)

Principal Investigator | MGGG Redistricting Lab 2017—

Senior Fellow | Tisch College of Civic Life 2017—

University of Michigan
Assistant Professor (postdoctoral) 2008–2011

University of California, Davis
NSF VIGRE Postdoctoral Fellow 2005–2008

Research Interests

Data science for civil rights, computation and governance, elections, geometry and redistricting.
Science, technology, and society, science policy, technology and law.
Random walks and Markov chains, random groups, random constructions in geometry.
Large-scale geometry, metric geometry, isoperimetric inequalities.
Geometric group theory, growth of groups, nilpotent groups, dynamics of group actions.
Geometric topology, hyperbolicity, Teichmüller theory.

Awards & Distinctions

Research Professor - MSRI Program in Analysis and Geometry of Random Spaces Spring 2022
Guggenheim Fellow 2018
Radcliffe Fellow - Evelyn Green Davis Fellowship 2018–2019
Fellow of the American Mathematical Society elected 2017
NSF C-ACCEL (PI) - Harnessing the Data Revolution: Network science of Census data 2019–2020
NSF grants (PI) - CAREER grant and three standard Topology grants 2009–2022
Professor of the Year, Tufts Math Society 2012–2013
AAUW Dissertation Fellowship 2004–2005
NSF Graduate Fellowship 1998–2002
Lawrence and Josephine Graves Prize for Excellence in Teaching (U Chicago) 2002
Robert Fletcher Rogers Prize (Harvard Mathematics) 1995–1996

Mathematics Publications & Preprints

The (homological) persistence of gerrymandering
Foundations of Data Science, online first. (with Thomas Needham and Thomas Weighill)

You can hear the shape of a billiard table: Symbolic dynamics and rigidity for flat surfaces
Commentarii Mathematici Helvetici, to appear. arXiv:1804.05690
(with Viveka Erlandsson, Christopher Leininger, and Chandrika Sadanand)

Conjugation curvature for Cayley graphs
Journal of Topology and Analysis, online first. (with Assaf Bar-Natan and Robert Kropholler)

A reversible recombination chain for graph partitions
Preprint. (with Sarah Cannon, Dana Randall, and Parker Rule)

Recombination: A family of Markov chains for redistricting
Harvard Data Science Review. Issue 3.1, Winter 2021. online. (with Daryl DeFord and Justin Solomon)

Census TopDown: The impact of differential privacy on redistricting
2nd Symposium on Foundations of Responsible Computing (FORC 2021), 5:1–5:22. online.
(with Aloni Cohen, JN Matthews, and Bhushan Suwal)

Stars at infinity in Teichmüller space
Geometriae Dedicata, Volume 213, 531–545 (2021). (with Nate Fisher) arXiv:2004.04321

Random walks and redistricting: New applications of Markov chain Monte Carlo
(with Daryl DeFord) For edited volume, Political Geometry. Under contract with Birkhäuser.

Mathematics of nested districts: The case of Alaska
Statistics and Public Policy. Vol 7, No 1 (2020), 39–51. (w/ Sophia Caldera, Daryl DeFord, Sam Gutekunst, & Cara Nix)

A computational approach to measuring vote elasticity and competitiveness
Statistics and Public Policy. Vol 7, No 1 (2020), 69–86. (with Daryl DeFord and Justin Solomon)

The Heisenberg group is pan-rational
Advances in Mathematics **346** (2019), 219–263. (with Michael Shapiro)

Random nilpotent groups I
IMRN, Vol 2018, Issue 7 (2018), 1921–1953. (with Matthew Cordes, Yen Duong, Meng-Che Ho, and Ayla Sánchez)

Hyperbolic groups
chapter in *Office Hours with a Geometric Group Theorist*, eds. M.Clay,D.Margalit, Princeton U Press (2017), 177–203.

Counting in groups: Fine asymptotic geometry
Notices of the American Mathematical Society **63**, No. 8 (2016), 871–874.

A sharper threshold for random groups at density one-half
Groups, Geometry, and Dynamics **10**, No. 3 (2016), 985–1005.
(with Katarzyna Jankiewicz, Shelby Kilmer, Samuel Lelièvre, John M. Mackay, and Ayla Sánchez)

Equations in nilpotent groups
Proceedings of the American Mathematical Society **143** (2015), 4723–4731. (with Hao Liang and Michael Shapiro)

Statistical hyperbolicity in Teichmüller space
Geometric and Functional Analysis, Volume 24, Issue 3 (2014), 748–795. (with Howard Masur and Spencer Dowdall)

Fine asymptotic geometry of the Heisenberg group
Indiana University Mathematics Journal 63 No. 3 (2014), 885–916. (with Christopher Mooney)

Pushing fillings in right-angled Artin groups
Journal of the LMS, Vol 87, Issue 3 (2013), 663–688. (with Aaron Abrams, Noel Brady, Pallavi Dani, and Robert Young)

Spheres in the curve complex
In the Tradition of Ahlfors and Bers VI, Contemp. Math. **590** (2013), 1–8. (with Howard Masur and Spencer Dowdall)

The sprawl conjecture for convex bodies
Experimental Mathematics, Volume 22, Issue 2 (2013), 113–122. (with Samuel Lelièvre and Christopher Mooney)

Filling loops at infinity in the mapping class group
Michigan Math. J., Vol 61, Issue 4 (2012), 867–874. (with Aaron Abrams, Noel Brady, Pallavi Dani, and Robert Young)

The geometry of spheres in free abelian groups
Geometriae Dedicata, Volume 161, Issue 1 (2012), 169–187. (with Samuel Lelièvre and Christopher Mooney)

Statistical hyperbolicity in groups
Algebraic and Geometric Topology **12** (2012) 1–18. (with Samuel Lelièvre and Christopher Mooney)

Length spectra and degeneration of flat metrics
Inventiones Mathematicae, Volume 182, Issue 2 (2010), 231–277. (with Christopher Leininger and Kasra Rafi)

Divergence of geodesics in Teichmüller space and the mapping class group
Geometric and Functional Analysis, Volume 19, Issue 3 (2009), 722–742. (with Kasra Rafi)

Curvature, stretchiness, and dynamics
In the Tradition of Ahlfors and Bers IV, Contemp. Math. **432** (2007), 19–30.

Geodesics track random walks in Teichmüller space
PhD Dissertation, University of Chicago 2005.

Science, Technology, Law, and Policy Publications & Preprints

Models, Race, and the Law
Yale Law Journal Forum, Vol. 130 (March 2021). Available online. (with Doug Spencer)

Computational Redistricting and the Voting Rights Act
Election Law Journal, Available online. (with Amariah Becker, Dara Gold, and Sam Hirsch)

Discrete geometry for electoral geography
Preprint. (with Bridget Eileen Tenner) arXiv:1808.05860

Implementing partisan symmetry: Problems and paradoxes
Political Analysis, to appear. (with Daryl DeFord, Natasha Dhamankar, Mackenzie McPike, Gabe Schoenbach, and Ki-Wan Sim) arXiv:2008:06930

Clustering propensity: A mathematical framework for measuring segregation
Preprint. (with Emilia Alvarez, Everett Meike, and Marshall Mueller; appendix by Tyler Piazza)

Locating the representational baseline: Republicans in Massachusetts
Election Law Journal, Volume 18, Number 4, 2019, 388–401.
(with Taissa Gladkova, Eugene Henninger-Voss, Ben Klingensmith, Heather Newman, and Hannah Wheelen)

Redistricting reform in Virginia: Districting criteria in context
Virginia Policy Review, Volume XII, Issue II, Spring 2019, 120–146. (with Daryl DeFord)

Geometry v. Gerrymandering
The Best Writing on Mathematics 2019, ed. Mircea Pitici. Princeton University Press.
reprinted from Scientific American, November 2018, 48–53.

Gerrymandering metrics: How to measure? What's the baseline?
Bulletin of the American Academy for Arts and Sciences, Vol. LXII, No. 2 (Winter 2018), 54–58.

Rebooting the mathematics of gerrymandering: How can geometry track with our political values?
The Conversation (online magazine), October 2017. (with Peter Levine)

A formula goes to court: Partisan gerrymandering and the efficiency gap
Notices of the American Mathematical Society **64** No. 9 (2017), 1020–1024. (with Mira Bernstein)

International mobility and U.S. mathematics
Notices of the American Mathematical Society **64**, No. 7 (2017), 682–683.

Graduate Advising in Mathematics

Nate Fisher (PhD 2021), Sunrose Shrestha (PhD 2020), Ayla Sánchez (PhD 2017), Kevin Buckles (PhD 2015), Mai Mansouri (MS 2014)

Outside committee member for Chris Coscia (PhD 2020), Dartmouth College

Postdoctoral Advising in Mathematics

Principal supervisor Thomas Weighill (2019–2020)

Co-supervisor Daryl DeFord (MIT 2018–2020), Rob Kropholler (2017–2020), Hao Liang (2013–2016)

Teaching

Courses Developed or Customized

Mathematics of Social Choice | sites.tufts.edu/socialchoice
Voting theory, impossibility theorems, redistricting, theory of representative democracy, metrics of fairness.

History of Mathematics | sites.tufts.edu/histmath
Social history of mathematics, organized around episodes from antiquity to present. Themes include materials and technologies of creation and dissemination, axioms, authority, credibility, and professionalization. In-depth treatment of mathematical content from numeration to cardinal arithmetic to Galois theory.

Reading Lab: Mathematical Models in Social Context | sites.tufts.edu/models
One hr/wk discussion seminar of short but close reading on topics in mathematical modeling, including history of psychometrics; algorithmic bias; philosophy of statistics; problems of model explanation and interpretation.

Geometric Literacy
Module-based graduate topics course. Modules have included: p-adic numbers, hyperbolic geometry, nilpotent geometry, Lie groups, convex geometry and analysis, the complex of curves, ergodic theory, the Gauss circle problem.

Markov Chains (graduate topics course)
Teichmüller Theory (graduate topics course)
Fuchsian Groups (graduate topics course)
Continued Fractions and Geometric Coding (undergraduate topics course)
Mathematics for Elementary School Teachers

Standard Courses

Discrete Mathematics, Calculus I-II-III, Intro to Proofs, Linear Algebra, Complex Analysis, Differential Geometry, Abstract Algebra, Graduate Real Analysis, Mathematical Modeling and Computation

Weekly Seminars Organized

- Geometric Group Theory and Topology
- Science, Technology, and Society Lunch Seminar

Selected Talks and Lectures

Distinguished Plenary Lecture June 2021
75th Anniversary Meeting of Canadian Mathematical Society, Ottawa, Ontario *online (COVID)*

BMC/BAMC Public Lecture April 2021
Joint British Mathematics/Applied Mathematics Colloquium, Glasgow, Scotland *online (COVID)*

AMS Einstein Public Lecture in Mathematics [March 2020]
Southeastern Sectional Meeting of the AMS, Charlottesville, VA *postponed*

Gerald and Judith Porter Public Lecture
AMS-MAA-SIAM, Joint Mathematics Meetings, San Diego, CA January 2018

Mathematical Association of America Distinguished Lecture
MAA Carriage House, Washington, DC October 2016

American Mathematical Society Invited Address
AMS Eastern Sectional Meeting, Brunswick, ME September 2016

Named University Lectures

- Parsons Lecture | UNC Asheville — October 2020
- Loeb Lectures in Mathematics | Washington University in St. Louis — [March 2020]
- Math, Stats, CS, and Society | Macalester College — October 2019
- MRC Public Lecture | Stanford University — May 2019
- Freedman Memorial Colloquium | Boston University — March 2019
- Julian Clancy Frazier Colloquium Lecture | U.S. Naval Academy — January 2019
- Barnett Lecture | University of Cincinnati — October 2018
- School of Science Colloquium Series | The College of New Jersey — March 2018
- Kieval Lecture | Cornell University — February 2018
- G. Milton Wing Lectures | University of Rochester — October 2017
- Norman Johnson Lecture | Wheaton College — September 2017
- Dan E. Christie Lecture | Bowdoin College — September 2017

Math/Computer Science Department Colloquia

- Reed College — Dec 2020
- Georgetown (CS) — Sept 2020
- Santa Fe Institute — July 2020
- UC Berkeley — Sept 2018
- Brandeis-Harvard-MIT-NEU — Mar 2018
- Northwestern University — Oct 2017
- University of Illinois — Sept 2017
- University of Utah — Aug 2017
- Wesleyan — Dec 2016
- Worcester Polytechnic Inst. — Dec 2016
- Université de Neuchâtel — Jun 2016
- Brandeis University — Mar 2016
- Swarthmore College — Oct 2015
- Bowling Green — May 2015
- City College of New York — Feb 2015
- Indiana University — Nov 2014
- the Technion — Oct 2014
- Wisconsin–Madison — Sept 2014
- Stony Brook — March 2013

Minicourses

- Integer programming and combinatorial optimization (two talks) | Georgia Tech — May 2021
- Workshop in geometric topology (main speaker, three talks) | Provo, UT — June 2017
- Growth in groups (two talks) | MSRI, Berkeley, CA — August 2016
- Hyperbolicity in Teichmüller space (three talks) | Université de Grenoble — May 2016
- Counting and growth (four talks) | IAS Women's Program, Princeton — May 2016
- Nilpotent groups (three talks) | Seoul National University — October 2014
- Sub-Finsler geometry of nilpotent groups (five talks) | Galatasaray Univ., Istanbul — April 2014

Science, Technology, and Society

- The Mathematics of Accountability | Sawyer Seminar, Anthropology, Johns Hopkins — February 2020
- STS Circle | Harvard Kennedy School of Government — September 2019
- Data, Classification, and Everyday Life Symposium | Rutgers Center for Cultural Analysis — January 2019
- Science Studies Colloquium | UC San Diego — January 2019
- Arthur Miller Lecture on Science and Ethics | MIT Program in Science, Tech, and Society — November 2018

Data Science, Computer Science, Quantitative Social Science

- Data Science for Social Good Workshop (DS4SG) | Georgia Tech (virtual) — November 2020
- Privacy Tools Project Retreat | Harvard (virtual) — May 2020
- Women in Data Science Conference | Microsoft Research New England — March 2020
- Quantitative Research Methods Workshop | Yale Center for the Study of American Politics — February 2020
- Societal Concerns in Algorithms and Data Analysis | Weizmann Institute — December 2018
- Quantitative Collaborative | University of Virginia — March 2018
- Quantitative Social Science | Dartmouth College — September 2017
- Data for Black Lives Conference | MIT — November 2017

Political Science, Geography, Law, Democracy, Fairness

- The Long 19th Amendment: Women, Voting, and American Democracy | Radcliffe Institute — Nov–Dec 2020
- "The New Math" for Civil Rights | Social Justice Speaker Series, Davidson College — November 2020
- Math, Law, and Racial Fairness | Justice Speaker Series, University of South Carolina — November 2020
- Voting Rights Conference | Northeastern Public Interest Law Program — September 2020
- Political Analysis Workshop | Indiana University — November 2019
- Program in Public Law Panel | Duke Law School — October 2019
- Redistricting 2021 Seminar | University of Chicago Institute of Politics — May 2019
- Geography of Redistricting Conference Keynote | Harvard Center for Geographic Analysis — May 2019
- Political Analytics Conference | Harvard University — November 2018
- Cyber Security, Law, and Society Alliance | Boston University — September 2018
- Clough Center for the Study of Constitutional Democracy | Boston College — November 2017
- Tech/Law Colloquium Series | Cornell Tech — November 2017
- Constitution Day Lecture | Rockefeller Center for Public Policy, Dartmouth College — September 2017

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Amicus Brief of Mathematicians, Law Professors, and Students 2019
principal co-authors: Guy-Uriel Charles and Moon Duchin
Supreme Court of the United States, in Rucho v. Common Cause - cited in dissent

Committee on Science Policy 2020–2023
American Mathematical Society

Program Committee 2020–2021
Symposium on Foundations of Responsible Computing

Presenter on Public Mapping, Statistical Modeling 2019, 2020
National Conference of State Legislatures

Committee on the Human Rights of Mathematicians 2016–2019
American Mathematical Society

Committee on The Future of Voting: Accessible, Reliable, Verifiable Technology 2017–2018
National Academies of Science, Engineering, and Medicine

Visiting Positions and Residential Fellowships

Visiting Professor Department of Mathematics — Fall 2021
Boston College | Chestnut Hill, MA

Fellow Radcliffe Institute for Advanced Study — 2018–19
Harvard University | Cambridge, MA

Member Center of Mathematical Sciences and Applications — 2018–19
Harvard University | Cambridge, MA

Visitor Microsoft Research Lab — 2018–19
MSR New England | Cambridge, MA

Research Member Geometric Group Theory program — Fall 2016
Mathematical Sciences Research Institute | Berkeley, CA

Research Member Random Walks and Asymptotic Geometry of Groups program — Spring 2014
Institut Henri Poincaré | Paris, France

Research Member Low-dimensional Topology, Geometry, and Dynamics program — Fall 2013
Institute for Computational and Experimental Research in Mathematics | Providence, RI

Research Member Geometric and Analytic Aspects of Group Theory program — May 2012
Institut Mittag-Leffler | Stockholm, Sweden

Research Member Quantitative Geometry program — Fall 2011
Mathematical Sciences Research Institute | Berkeley, CA

Postdoctoral Fellow Teichmüller "project blanc" — Spring 2009
Agence Nationale de la Recherche (Collège de France) | Paris, France

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426, 21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC.; HENRY M. MICHAUX, JR., et al.,

Plaintiffs,

REBECCA HARPER, et al.,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

AFFIDAVIT OF PROFESSOR MOON DUCHIN

NCLCV v. Hall
21 CVS 15426
LDTX159

Exhibit #
Duchin 3
12/30/21 - SL

I, Dr. Moon Duchin, having been duly sworn by an officer authorized to administer oaths, depose and state as follows:

1. I am over 18 years of age, legally competent to give this Affidavit, and have personal knowledge of the facts set forth in this Affidavit.
2. All of the quantitative work described in this Affidavit was performed by myself with the support of research assistants working under my direct supervision.

Background and qualifications

3. I hold a Ph.D. and an M.S in Mathematics from the University of Chicago as well as an A.B. in Mathematics and Women's Studies from Harvard University.
4. I am a Professor of Mathematics and a Senior Fellow in the Jonathan M. Tisch College of Civic Life at Tufts University.
5. My general research areas are geometry, topology, dynamics, and applications of mathematics and computing to the study of elections and voting. My redistricting-related work has been published in venues such as the Election Law Journal, Political Analysis, Foundations of Data Science, the Notices of the American Mathematical Society, Statistics and Public Policy, the Virginia Policy Review, the Harvard Data Science Review, Foundations of Responsible Computing, and the Yale Law Journal Forum.
6. My research has had continuous grant support from the National Science Foundation since 2009, including a CAREER grant from 2013–2018. I am currently on the editorial board of the journals Advances in Mathematics and the Harvard Data Science Review. I was elected a Fellow of the American Mathematical Society in 2017 and was named a Radcliffe Fellow and a Guggenheim Fellow in 2018.
7. A current copy of my full CV is attached to this report.
8. I am compensated at the rate of $400 per hour.

Rebuttal Report

Moon Duchin
Professor of Mathematics, Tufts University
Senior Fellow, Tisch College of Civic Life

December 28, 2021

1 Background and Introduction

I have previously submitted expert reports in NCLCV vs. Hall. I have been asked by counsel to respond to the report of Dr. Michael Barber, examining his study design and his conclusions.

1.1 Summary of Barber report

In Dr. Barber's report, he uses a new statistical sampling method called Sequential Monte Carlo (SMC) to produce a large collection (called an *ensemble*) of alternative districting plans for both bodies of the North Carolina state legislature—state Senate and state House. SMC is a method based on ideas developed in my research group,[1] but which has not been supported by any peer-reviewed publications.

Dr. Barber proceeds to build ensembles of districting plans for the purposes of comparison, but primarily does so individually on small pieces of the state: groups of counties (often called "county clusters") that correspond to groupings in the Senate and House plans recently enacted in North Carolina (SL-173 and SL-175).

- For legislative redistricting, the Barber report discusses the clusters only on an individual basis, neglecting to assemble them into the big picture for the whole state.
- Dr. Barber omits an ensemble comparison for the enacted Congressional plan, SL-174.

1.2 Summary of findings

- When assembling the statistics from Dr. Barber's own ensembles—completely granting him all methodological choices for algorithm selection and specifications—the enacted House plan is shown to be a major partisan outlier, while the NCLCV alternative plans are not (Figure 6).
- In exactly the same way, the enacted Senate plan is likewise shown to be a major partisan outlier, while the NCLCV alternative plans are not (Figure 5).
- Finally, I was able to run Barber's code to create a Congressional ensemble in the same fashion as his legislative ensembles. Here, too, the enacted plan is a significant outlier in a direction of partisan advantage that is not justified by any good-government goal (Figure 3).

[1] The McCartan–Imai article introducing SMC [5] acknowledges Deford–Duchin–Solomon [3] for "pioneer[ing] the spanning tree-based proposal used in the merge-split algorithm."

2 Ensembles and outliers

Today, the dominant method in computational redistricting analysis is to employ Markov chains to generate ensembles of thousands or millions of alternative valid redistricting plans against which to compare a given proposed plan. When a quantity of interest is measured over the ensemble, it frequently forms a "bell curve" of values, and we can then examine whether the proposed plan falls in the thick of the observed values or whether it is an extreme outlier, falling in one of the tails. If this exercise is carried out with respect to each party's representation, a telltale sign of a partisan gerrymander is when the seat share for a proposed plan falls (a) far from the corresponding vote share, and (b) far to the side of advantage for the party that controlled the line-drawing process. This is particularly problematic in a politically competitive "purple" state like North Carolina.

It is important to note that outlier status is a flag of intentionality, but not necessarily a smoking gun of wrongdoing. Being in a tails of a distribution that was created around certain design principles can often provide persuasive evidence that other principles or agendas were in play. For example, a map might be an outlier as the most compact, or the map that gives minority groups the greatest chance to elect their candidates of choice—these kinds of outlier status would not be marks of a bad plan. But being an outlier can indeed be a sign of problems, as when a plan systematically converts close voting to lopsided seat shares for the party that controls the process.

2.1 Barber methods

The creation and use of districting ensembles in the Barber report can be summarized as follows.

Step 1 *Fix a set of clusters.* Barber focuses on the county clustering found in the enacted plan, not exhaustively considering the dozens of other possibilities.

Step 2 *Partition each cluster.* Split each multi-district cluster into the corresponding number of districts using Sequential Monte Carlo sampling. Create 50,000 partitions (i.e., districting plans) for each cluster.

Step 3 *Winnow.* Selectively discard some of the partitions. Barber uses two statistics from the enacted plan (average Polsby-Popper score and county traversals) as the cutoff for inclusion.

Step 4 *Create an election index.* Barber blends the 11 up-ballot elections since 2014 into a single vote index rather than considering them one at a time. In particular, he sums the votes over all elections before taking shares, which does not control for turnout differences across elections.

Step 5 *Plot histograms and declare outliers.* Barber forms histograms counting "Democratic-leaning districts" for individual clusters, and does not present an overall compilation. His non-standard definition of "outlier" includes a full 50% of the ensemble.

In my opinion, better and more reliable results would have been obtained if several of the choices required in this study design were executed differently.

One glaring omission from Barber's methods is any consideration of the State's obligations under the Voting Rights Act of 1965, which could impact the partisan bottom line.[2] A non-exhaustive list of other potential flaws in Dr. Barber's methods includes the following.

- *Failure to consider all alternative clusterings.*
  North Carolina law dictates that districts be drawn within groupings or clusters of counties from which several districts will be formed. Sometimes, however, the General Assembly has a choice and can pick multiple groupings consistent with North Carolina law. Dr. Barber only gives cursory attention to alternative clusterings.

- *Use of sampling methodology not vetted by peer review.*
  Even when an idea is promising, peer review is an essential component of vetting. A method may appear promising in concept, but not work in practice. A method may work at small tasks—like the 34-map dataset used for testing in [5]—but not scale well to the enormous sizes needed for realistic problems. Peer review helps surface those issues, which is why the scientific community regards peer review as a mark of reliability.

- *Use of bright-line thresholds for compactness and traversals.*
  Dr. Barber's code already samples with a preference for compactness, and is fully capable of handling traversals in a similar manner.[3] Imposing sharp cutoffs for these at the level of the enacted plan creates highly misleading results.[4]

- *Use of election data in a blended rather than serial fashion.*
  If Barber records a Democratic share of 49% in his outputs, that is likely to reflect a Democratic win in some of the 11 elections and a Republican win in others—this is obscured when the results are blended to a single number. By the same token, a Democratic share of 45% in the blended election index might downplay a map that favors Republicans 11 out of 11 times, which entrenches an advantage.[5]

- *Employing a highly unconventional use of the* "*outlier*" *label.*
  As Dr. Barber himself puts it, "I consider a plan to be a partisan outlier if the number of Democratic districts generated by the plan falls outside the middle 50% of simulation results [sic]. This is a conservative definition of an outlier. In the social sciences, medicine, and other disciplines it is traditional to consider something an outlier if it falls outside the middle 95% or 90% of the comparison distribution." As I will show below in my whole-state comparisons, the enacted plans are outliers at any of these levels of significance, while the NCLCV alternative plans are not.

I will discuss the thresholding question further in §2.3. For the remainder of the report, I will set aside the other concerns and will simply assess Dr. Barber's outputs within his own methodological framework.

[2]Robust VRA consideration is fully compatible with computational redistricting, as is shown in [1].

[3]A preference for compactness is coded in the `smc_redist` parameterization in `house_clusters.R`, lines 354–356 and `senate_clusters.R`, lines 349–351.

[4]The imposition of cutoffs, which Dr. Barber calls "culling," occurs in two stages. Stage 1 (country traversals) is found in `house_clusters.R`, lines 531–536 and `senate_clusters.R`, lines 539–544. Stage 2 (average Polsby-Popper) is found in `house_clusters.R`, line 543–564 and `senate_clusters.R`, lines 552–573. An ad hoc adjustment in the Duplin and Wayne House County Grouping is found in lines 566-568 of the House code.

[5]The 49% Democratic lean occurs, for instance, in the NCLCV alternative maps in the Onslow/Pender House cluster. Vote averaging is found in the Barber replication materials in `house_clusters.R` lines 18-28 and `senate_clusters.R` lines 18-29.

2.2 Analysis methods

Reading Dr. Barber's report, it is striking that he only reported that the enacted plan often performed within the middle 50% of each small comparison while never evaluating how the individual choices aggregate at the level of the map as a whole. After all, if moderate partisan advantage is secured over and over again, it may well accrue to extreme advantage overall. In the context of a state legislature, the overall results are crucial: they determine who controls the chamber. Pursuing this in the Barber materials, I found that this is exactly what happens.

First, I was able to extract Dr. Barber's raw statistical outputs for legislative runs from his materials obtained by counsel.[6] With those, I was able to assemble his ensembles for individual clusters into a compiled ensemble for the entire state. The histogram of Senate outcomes can be found in Figure 6 and the histogram of House outcomes can be found in Figure 5. Second, I was able to run Dr. Barber's code to create an ensemble of alternative Congressional plans with exactly the algorithm and with similar specifications to those he used for his legislative demonstrations.[7] A corresponding plot of Congressional outcomes can be found in Figure 3. For all phases of analysis, Dr. Barber pulled electoral data from a free webapp called Dave's Redistricting App (`davesredistricting.org`). In replicating his analysis, I used the same data source in the same manner.

2.3 Filtered and unfiltered results

As I described above, Dr. Barber took his raw districting plan samples (50,000 maps created for each of 12 Senate cluster ensembles and 26 House cluster ensembles) and aggressively filtered them, applying a cutoff that sometimes left under ten maps out of the original set of 50,000. In fact, when Dr. Barber's filtering rule was applied in the Duplin and Wayne House County Grouping (§6.6 on p.58 of Barber Report), *zero* maps were left, because none of the randomly constructed maps had an average compactness score to match the enacted plan in that cluster. Since this is blatantly unworkable for comparison purposes, Dr. Barber made the ad hoc decision to loosen the rule to retain 2704 maps. Other cluster ensembles were filtered down to leave only 4, 6, or 2 out of 50,000 alternatives and did not receive an adjustment. The "outlier" label was then applied to these tiny sets.

To illustrate why this is methodologically unreasonable, consider JaVale McGee, a basketball center who recently signed with the Phoenix Suns of the NBA on a one-year, $5 million contract. If McGee wanted to argue that he is not unusually wealthy, he could choose to restrict the universe of comparison to Americans at least as tall as he is. Since he is 7 feet tall, this would greatly restrict the comparison pool to a relatively tiny group that also includes Mo Bamba (Orlando Magic), Joel Embiid (Philadelphia 76ers), and Brook Lopez (Milwaukee Bucks), all of whom make more money than he does. Not satisfied with this comparison, he could keep increasing the requirements by insisting on comparing to people who don't speak any more languages than he does, are no older than he is, and have lived in at least as many different cities. Eventually he will narrow the pool enough that he doesn't look like an outlier anymore.

Dr. Barber's filtering skews his sample in a similar way, because he effectively insists that maps have a statistic matching or exceeding the enacted map in every cluster—and then uses that pool to compare the enacted map. Overall, this reduces the number of plans under consideration by a factor of over 500 trillion. And it excludes options that may be better than the enacted plan overall but are less compact or have more traversals in a particular cluster.

Generally, if you are trying to argue that you look typical of a range of alternatives, it is obviously unreasonable to first require the alternatives to look like you in dozens of independent ways (i.e., in each cluster individually).

[6] His materials include the numerical outputs from his runs, but as far as I can determine he does not seem to have saved the district assignments for the individual plans in the ensemble.

[7] To be precise, the ensemble was generated at the state level for Congress, since the concept of county clusters is not applicable, and without the compactness and traversal thresholds. I ran the code exactly as Dr. Barber did, except tightening the allowed population deviation to 1% from ideal instead of 5% as in legislative maps. All other choices are identical. My congressional ensemble includes 20,000 maps rather than 50,000 just because of time limitations.

3 Findings

In this section, I will present the full histograms (or "bell curves") of all the results from Dr. Barber's methodology, compiled to the state level and shown without filtering. (Filtered ensembles can be seen in Appendix A, for comparison purposes.)

By Dr. Barber's own constructs, all three levels of districting show that **the enacted plans are partisan outliers and the NCLCV alternative plans are not**.

In the House, the enacted map is in the most extreme 0.00133 fraction of the Barber ensemble—well under 1 percent of sampled House plans are as extreme as SL-175. By contrast, the NCLCV alternative plan is in the upper .2516 share of the ensemble, not an outlier even by the Barber standard.

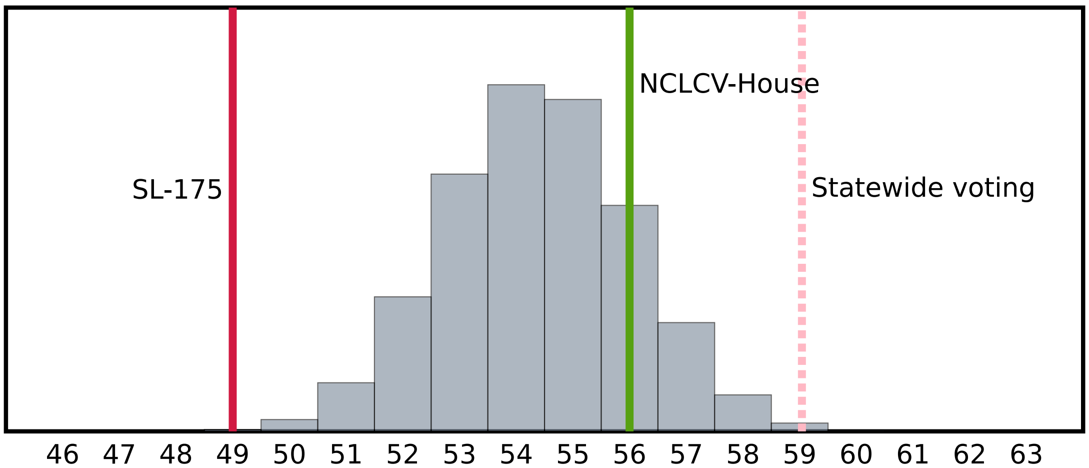

Figure 1: "Democratic-leaning seats" in Dr. Barber's House district ensemble.

At the Senate level, the enacted map is in the most extreme .007 fraction of the Barber ensemble—again, less than 1 percent of sampled plans are as extreme as SL-173. By contrast, the NCLCV alternative map is in the upper .2787 share of ensemble, not an outlier even by the Barber standard.

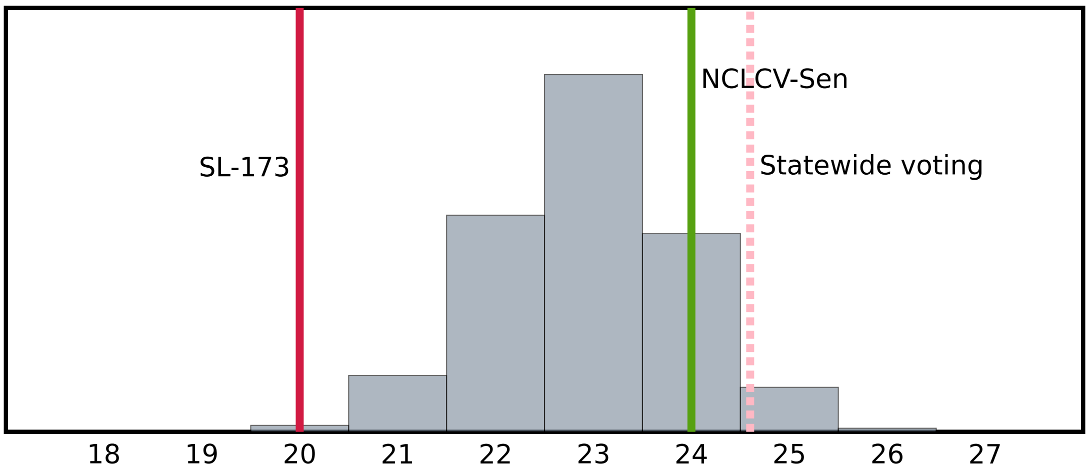

Figure 2: "Democratic-leaning seats" in Dr. Barber's Senate district ensemble.

The Congressional picture, omitted from the Barber report, is likewise crystal clear. The enacted plan is in the most extreme 0.0056 fraction of this Barber-style ensemble, while the NCLCV alternative map is very near the ensemble center—0.5620 share of the ensemble (more than half of randomly constructed maps) has an equal or greater Democratic lean.

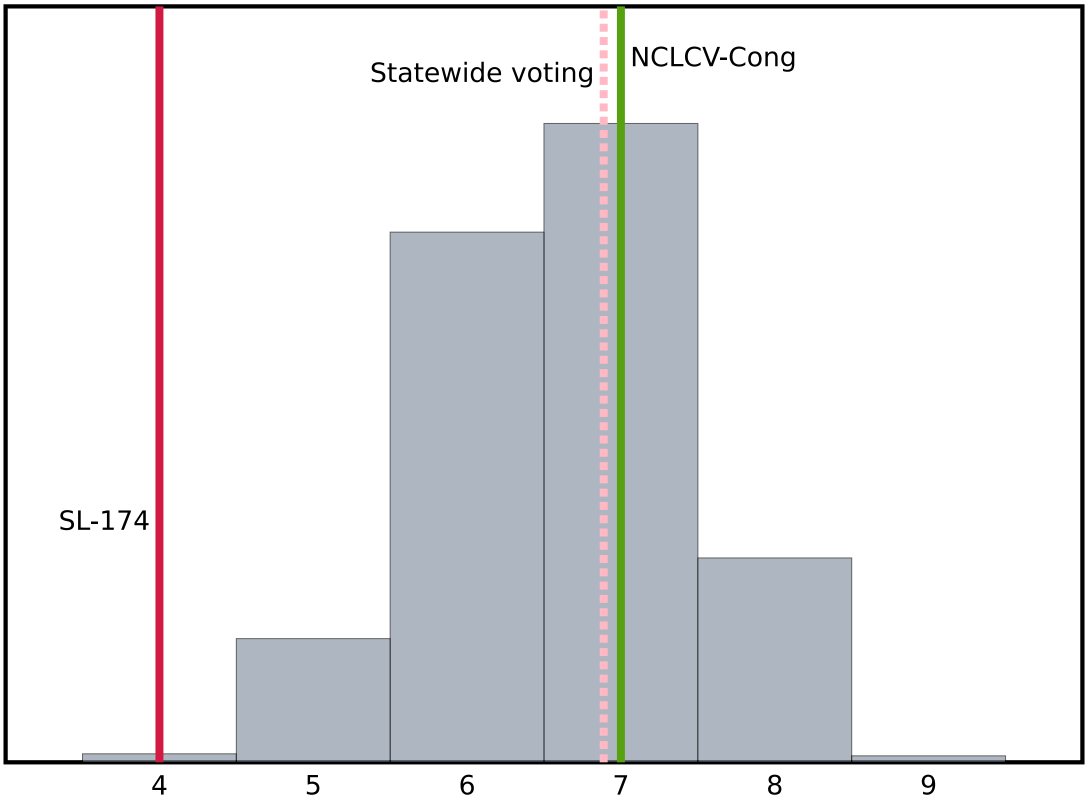

Figure 3: "Democratic-leaning seats" in a Congressional ensemble created with Dr. Barber's code, following his specifications.

4 Conclusion

Granting Dr. Barber all of his methodological choices, the enacted maps are extreme partisan outliers at all three levels, while the NCLCV alternative maps are not.

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[1] Amariah Becker, Moon Duchin, Dara Gold, and Sam Hirsch, *Computational redistricting and the Voting Rights Act.* Election Law Journal. Available online.

[2] Christopher Cooper, Blake Esselstyn, Gregory Herschlag, Jonathan Mattingly, and Rebecca Tippett, *NC General Assembly County Clusterings from the 2020 Census.* sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf

[3] Daryl DeFord, Moon Duchin, and Justin Solomon, *Recombination: A Family of Markov Chains for Redistricting*, Harvard Data Science Review. Issue 3.1, Winter 2021. Available online.

[4] Moon Duchin, Taissa Gladkova, Eugene Henninger-Voss, Heather Newman, and Hannah Wheelen, *Locating the Representational Baseline: Republicans in Massachusetts.* Election Law Journal, Volume 18, Number 4, 2019, 388–401. Available online.

[5] Cory McCartan and Kosuke Imai, *Sequential Monte Carlo for Sampling Balanced and Compact Redistricting Plans*, preprint. Available at arxiv.org/abs/2008.06131.

I declare under penalty of perjury that the foregoing is true and correct.

Executed this 28 day of December, 2021.

Professor Moon Duchin

Sworn and subscribed before me
this the 28 of December, 2021

Notary Public

Name: Simarjit Manhas

My commission expires: 02/02/2024

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California, County of Alameda
Subscribed and sworn to (or affirmed) before me
on this 28 day of December, 2021,
by Moon Duchin,
proved to me on the basis of satisfactory evidence
to be the person(s) who appeared before me.

Signature:

SIMARJIT MANHAS
COMM. #2317737
Notary Public - California
Contra Costa County
My Comm. Expires Feb. 2, 2024

Appendix A: Filtering comparison

To illustrate the skewing effects of the thresholds applied by Dr. Barber, consider a single example: the Pitt House County Cluster, where the number of Democratic-leaning seats in the sample is either 1 or 2. By thresholding compactness and traversals at the level of the enacted map, Dr. Barber is able to drop the frequency of the 2-seats outcome from roughly 25% of the sample to just 9%.

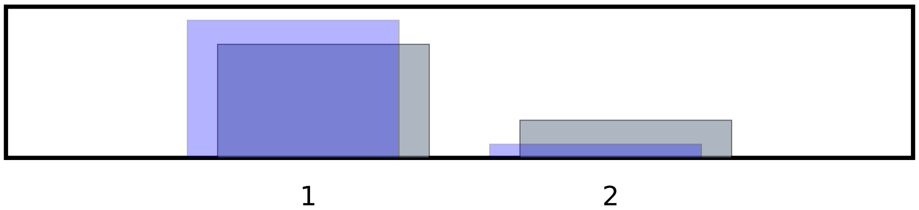

Figure 4: Just focusing on the Pitt House County Cluster (Barber report, p.42), we see that the filtering changes the outcome of 2 "Democratic-leaning seats" from occurring in roughly 25% of the full set of sampled maps (gray) to only occurring in 9% of the reduced sample (blue).

The effects of this cluster-by-cluster restriction do not wash out when aggregated to the full state, but instead add up to a noticeable shift toward the enacted plan, as demonstrated in the House and Senate figures below.

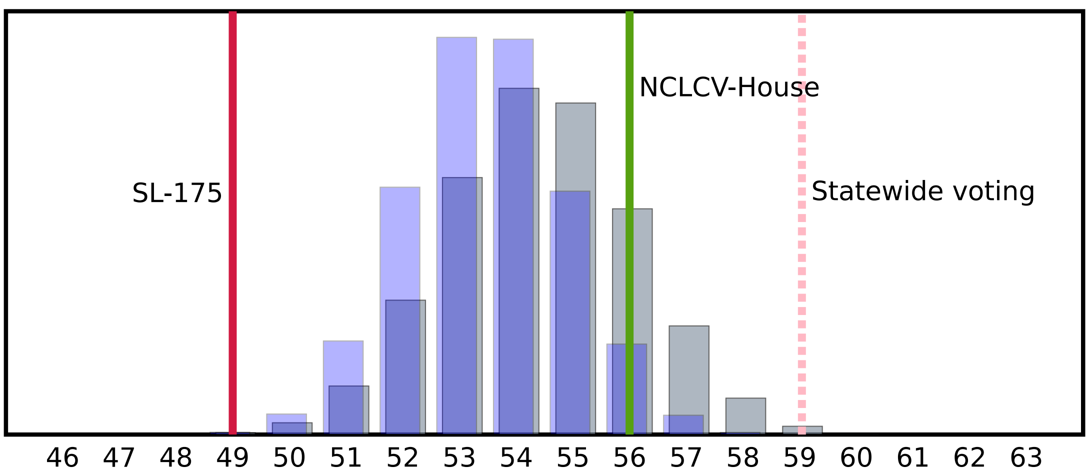

Figure 5: "Democratic-leaning seats" in Dr. Barber's House district ensemble. The unfiltered ensemble (gray) includes $50,000^{26} \approx 1.5 \cdot 10^{122}$ maps; the filtered ensemble (blue) is smaller by a factor of octillions.

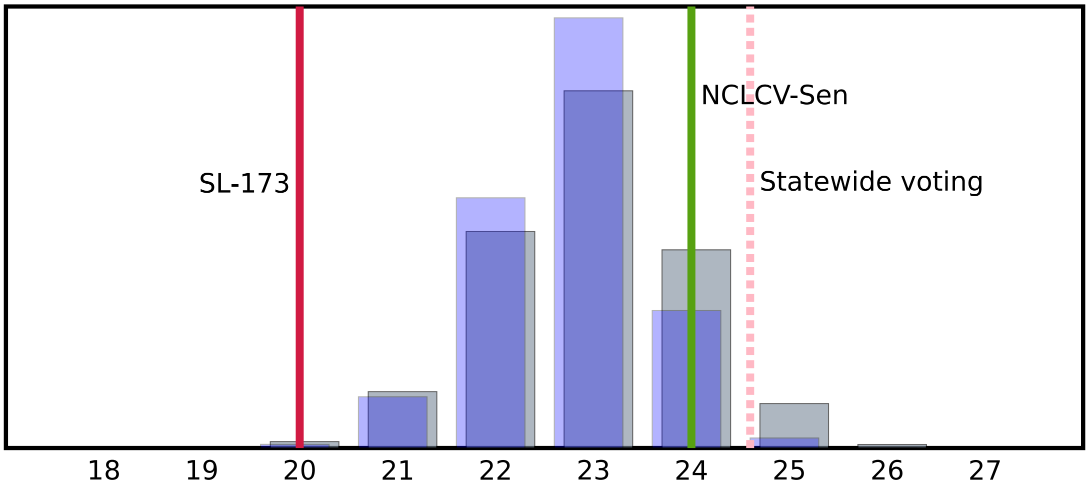

Figure 6: "Democratic-leaning seats" in Dr. Barber's Senate district ensemble. The unfiltered ensemble (gray) includes $50,000^{12} \approx 2.4 \cdot 10^{56}$ maps; the filtered ensemble (blue) is smaller by a factor of trillions.

Significantly, even the subsets of alternative plans that have been heavily limited by the cluster-by-cluster thresholds—that is, the blue bell curves instead of the gray—still show the enacted plans to be extreme outliers, while the NCLCV alternative plans are both far less extreme and comport with statewide voting.

Moon Duchin

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Mathematics · STS · Tisch College of Civic Life | Tufts University

Education

University of Chicago MS 1999, PhD 2005
Mathematics
Advisor: Alex Eskin Dissertation: *Geodesics track random walks in Teichmüller space*

Harvard University BA 1998
Mathematics and Women's Studies

Appointments

Tufts University
Professor of Mathematics 2021—
Assistant Professor, Associate Professor 2011–2021

Director | Program in Science, Technology, & Society 2015–2021
(on leave 2018–2019)

Principal Investigator | MGGG Redistricting Lab 2017—

Senior Fellow | Tisch College of Civic Life 2017—

University of Michigan
Assistant Professor (postdoctoral) 2008–2011

University of California, Davis
NSF VIGRE Postdoctoral Fellow 2005–2008

Research Interests

Data science for civil rights, computation and governance, elections, geometry and redistricting.
Science, technology, and society, science policy, technology and law.
Random walks and Markov chains, random groups, random constructions in geometry.
Large-scale geometry, metric geometry, isoperimetric inequalities.
Geometric group theory, growth of groups, nilpotent groups, dynamics of group actions.
Geometric topology, hyperbolicity, Teichmüller theory.

Awards & Distinctions

Research Professor - MSRI Program in Analysis and Geometry of Random Spaces Spring 2022
Guggenheim Fellow 2018
Radcliffe Fellow - Evelyn Green Davis Fellowship 2018–2019
Fellow of the American Mathematical Society elected 2017
NSF C-ACCEL (PI) - Harnessing the Data Revolution: Network science of Census data 2019–2020
NSF grants (PI) - CAREER grant and three standard Topology grants 2009–2022
Professor of the Year, Tufts Math Society 2012–2013
AAUW Dissertation Fellowship 2004–2005
NSF Graduate Fellowship 1998–2002
Lawrence and Josephine Graves Prize for Excellence in Teaching (U Chicago) 2002
Robert Fletcher Rogers Prize (Harvard Mathematics) 1995–1996

Mathematics Publications & Preprints

The (homological) persistence of gerrymandering
Foundations of Data Science, online first. (with Thomas Needham and Thomas Weighill)

You can hear the shape of a billiard table: Symbolic dynamics and rigidity for flat surfaces
Commentarii Mathematici Helvetici, to appear. arXiv:1804.05690
(with Viveka Erlandsson, Christopher Leininger, and Chandrika Sadanand)

Conjugation curvature for Cayley graphs
Journal of Topology and Analysis, online first. (with Assaf Bar-Natan and Robert Kropholler)

A reversible recombination chain for graph partitions
Preprint. (with Sarah Cannon, Dana Randall, and Parker Rule)

Recombination: A family of Markov chains for redistricting
Harvard Data Science Review. Issue 3.1, Winter 2021. online. (with Daryl DeFord and Justin Solomon)

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The Heisenberg group is pan-rational
Advances in Mathematics **346** (2019), 219–263. (with Michael Shapiro)

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IMRN, Vol 2018, Issue 7 (2018), 1921–1953. (with Matthew Cordes, Yen Duong, Meng-Che Ho, and Ayla Sánchez)

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The sprawl conjecture for convex bodies
Experimental Mathematics, Volume 22, Issue 2 (2013), 113–122. (with Samuel Lelièvre and Christopher Mooney)

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Models, Race, and the Law
Yale Law Journal Forum, Vol. 130 (March 2021). Available online. (with Doug Spencer)

Computational Redistricting and the Voting Rights Act
Election Law Journal, Available online. (with Amariah Becker, Dara Gold, and Sam Hirsch)

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Preprint. (with Bridget Eileen Tenner) arXiv:1808.05860

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Clustering propensity: A mathematical framework for measuring segregation
Preprint. (with Emilia Alvarez, Everett Meike, and Marshall Mueller; appendix by Tyler Piazza)

Locating the representational baseline: Republicans in Massachusetts
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(with Taissa Gladkova, Eugene Henninger-Voss, Ben Klingensmith, Heather Newman, and Hannah Wheelen)

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Bulletin of the American Academy for Arts and Sciences, Vol. LXII, No. 2 (Winter 2018), 54–58.

Rebooting the mathematics of gerrymandering: How can geometry track with our political values?
The Conversation (online magazine), October 2017. (with Peter Levine)

A formula goes to court: Partisan gerrymandering and the efficiency gap
Notices of the American Mathematical Society **64** No. 9 (2017), 1020–1024. (with Mira Bernstein)

International mobility and U.S. mathematics
Notices of the American Mathematical Society **64**, No. 7 (2017), 682–683.

Graduate Advising in Mathematics

Nate Fisher (PhD 2021), Sunrose Shrestha (PhD 2020), Ayla Sánchez (PhD 2017), Kevin Buckles (PhD 2015), Mai Mansouri (MS 2014)

Outside committee member for Chris Coscia (PhD 2020), Dartmouth College

Postdoctoral Advising in Mathematics

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75th Anniversary Meeting of Canadian Mathematical Society, Ottawa, Ontario *online (COVID)*

BMC/BAMC Public Lecture April 2021
Joint British Mathematics/Applied Mathematics Colloquium, Glasgow, Scotland *online (COVID)*

AMS Einstein Public Lecture in Mathematics [March 2020]
Southeastern Sectional Meeting of the AMS, Charlottesville, VA *postponed*

Gerald and Judith Porter Public Lecture
AMS-MAA-SIAM, Joint Mathematics Meetings, San Diego, CA January 2018

Mathematical Association of America Distinguished Lecture
MAA Carriage House, Washington, DC October 2016

American Mathematical Society Invited Address
AMS Eastern Sectional Meeting, Brunswick, ME September 2016

Named University Lectures

- Parsons Lecture | UNC Asheville — October 2020
- Loeb Lectures in Mathematics | Washington University in St. Louis — [March 2020]
- Math, Stats, CS, and Society | Macalester College — October 2019
- MRC Public Lecture | Stanford University — May 2019
- Freedman Memorial Colloquium | Boston University — March 2019
- Julian Clancy Frazier Colloquium Lecture | U.S. Naval Academy — January 2019
- Barnett Lecture | University of Cincinnati — October 2018
- School of Science Colloquium Series | The College of New Jersey — March 2018
- Kieval Lecture | Cornell University — February 2018
- G. Milton Wing Lectures | University of Rochester — October 2017
- Norman Johnson Lecture | Wheaton College — September 2017
- Dan E. Christie Lecture | Bowdoin College — September 2017

Math/Computer Science Department Colloquia

- Reed College — Dec 2020
- Georgetown (CS) — Sept 2020
- Santa Fe Institute — July 2020
- UC Berkeley — Sept 2018
- Brandeis-Harvard-MIT-NEU — Mar 2018
- Northwestern University — Oct 2017
- University of Illinois — Sept 2017
- University of Utah — Aug 2017
- Wesleyan — Dec 2016
- Worcester Polytechnic Inst. — Dec 2016
- Université de Neuchâtel — Jun 2016
- Brandeis University — Mar 2016
- Swarthmore College — Oct 2015
- Bowling Green — May 2015
- City College of New York — Feb 2015
- Indiana University — Nov 2014
- the Technion — Oct 2014
- Wisconsin–Madison — Sept 2014
- Stony Brook — March 2013

Minicourses

- Integer programming and combinatorial optimization (two talks) | Georgia Tech — May 2021
- Workshop in geometric topology (main speaker, three talks) | Provo, UT — June 2017
- Growth in groups (two talks) | MSRI, Berkeley, CA — August 2016
- Hyperbolicity in Teichmüller space (three talks) | Université de Grenoble — May 2016
- Counting and growth (four talks) | IAS Women's Program, Princeton — May 2016
- Nilpotent groups (three talks) | Seoul National University — October 2014
- Sub-Finsler geometry of nilpotent groups (five talks) | Galatasaray Univ., Istanbul — April 2014

Science, Technology, and Society

- The Mathematics of Accountability | Sawyer Seminar, Anthropology, Johns Hopkins — February 2020
- STS Circle | Harvard Kennedy School of Government — September 2019
- Data, Classification, and Everyday Life Symposium | Rutgers Center for Cultural Analysis — January 2019
- Science Studies Colloquium | UC San Diego — January 2019
- Arthur Miller Lecture on Science and Ethics | MIT Program in Science, Tech, and Society — November 2018

Data Science, Computer Science, Quantitative Social Science

- Data Science for Social Good Workshop (DS4SG) | Georgia Tech (virtual) — November 2020
- Privacy Tools Project Retreat | Harvard (virtual) — May 2020
- Women in Data Science Conference | Microsoft Research New England — March 2020
- Quantitative Research Methods Workshop | Yale Center for the Study of American Politics — February 2020
- Societal Concerns in Algorithms and Data Analysis | Weizmann Institute — December 2018
- Quantitative Collaborative | University of Virginia — March 2018
- Quantitative Social Science | Dartmouth College — September 2017
- Data for Black Lives Conference | MIT — November 2017

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- "The New Math" for Civil Rights | Social Justice Speaker Series, Davidson College — November 2020
- Math, Law, and Racial Fairness | Justice Speaker Series, University of South Carolina — November 2020
- Voting Rights Conference | Northeastern Public Interest Law Program — September 2020
- Political Analysis Workshop | Indiana University — November 2019
- Program in Public Law Panel | Duke Law School — October 2019
- Redistricting 2021 Seminar | University of Chicago Institute of Politics — May 2019
- Geography of Redistricting Conference Keynote | Harvard Center for Geographic Analysis — May 2019
- Political Analytics Conference | Harvard University — November 2018
- Cyber Security, Law, and Society Alliance | Boston University — September 2018
- Clough Center for the Study of Constitutional Democracy | Boston College — November 2017
- Tech/Law Colloquium Series | Cornell Tech — November 2017
- Constitution Day Lecture | Rockefeller Center for Public Policy, Dartmouth College — September 2017

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Advances in Mathematics
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Amicus Brief of Mathematicians, Law Professors, and Students 2019
principal co-authors: Guy-Uriel Charles and Moon Duchin
Supreme Court of the United States, in Rucho v. Common Cause - cited in dissent

Committee on Science Policy 2020–2023
American Mathematical Society

Program Committee 2020–2021
Symposium on Foundations of Responsible Computing

Presenter on Public Mapping, Statistical Modeling 2019, 2020
National Conference of State Legislatures

Committee on the Human Rights of Mathematicians 2016–2019
American Mathematical Society

Committee on The Future of Voting: Accessible, Reliable, Verifiable Technology 2017–2018
National Academies of Science, Engineering, and Medicine

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Fellow Radcliffe Institute for Advanced Study 2018–19
Harvard University | Cambridge, MA

Member Center of Mathematical Sciences and Applications 2018–19
Harvard University | Cambridge, MA

Visitor Microsoft Research Lab 2018–19
MSR New England | Cambridge, MA

Research Member Geometric Group Theory program Fall 2016
Mathematical Sciences Research Institute | Berkeley, CA

Research Member Random Walks and Asymptotic Geometry of Groups program Spring 2014
Institut Henri Poincaré | Paris, France

Research Member Low-dimensional Topology, Geometry, and Dynamics program Fall 2013
Institute for Computational and Experimental Research in Mathematics | Providence, RI

Research Member Geometric and Analytic Aspects of Group Theory program May 2012
Institut Mittag-Leffler | Stockholm, Sweden

Research Member Quantitative Geometry program Fall 2011
Mathematical Sciences Research Institute | Berkeley, CA

Postdoctoral Fellow Teichmüller "project blanc" Spring 2009
Agence Nationale de la Recherche (Collège de France) | Paris, France

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Computational Redistricting and the Voting Rights Act

Amariah Becker, Moon Duchin, Dara Gold, and Sam Hirsch

ABSTRACT

In recent years, computers have been used to generate *ensembles* of districting plans: collections of large numbers of electoral maps that are used to assess a proposed map in the context of valid alternatives. Ensemble-based outlier analysis has played a central role in recent redistricting disputes, especially regarding partisan gerrymandering. Until now, methods for generating these ensembles have enforced districting rules that are relatively simple to assess, such as population equality, but have not contended with more complex ones, such as the prohibitions against racial gerrymandering and minority vote dilution that flow from the Constitution and the Voting Rights Act (VRA). We take up the task of building ensembles of plans that respect those legal constraints. Rather than relying on demographic data alone, our method uses precinct-level returns from a large collection of recent primary and general elections. With this electoral history, we build *effectiveness scores* that identify districts where members of minority groups have had realistic opportunities to nominate and elect their preferred candidates. In a case study of Texas congressional districts, we find that detailed election data is indispensable to assessing a map's effectiveness for minority voters. Purely demographic targets, such as demanding some specific number of majority-minority districts, not only raise constitutional concerns but also are inadequate proxies for empirical effectiveness. Beyond the primary task of building VRA-conscious ensembles for comparison, we also repurpose the same algorithmic search methods to find plans that dramatically increase minority electoral opportunities. In Texas, for example, the current enacted 36-district congressional plan has perhaps 11 to 13 districts that are effective for Latino voters, Black voters, or both. We find that better mapmaking could raise that number to at least 16 without sacrificing traditional principles such as contiguity and compactness. This would nearly eliminate the historic underrepresentation of both groups throughout the state.

Keywords: redistricting, gerrymandering, Voting Rights Act, algorithmic ensembles

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Racial identification of candidates was made possible by a dataset purchased from Carl Klarner (klarnerpolitics.org).
This article is dedicated to the memory of Rice University sociology professor Chandler Davidson (1936–2021), who fought successfully for a half century to protect Latino and Black voting rights and to expand minority electoral opportunities in Texas and throughout the United States.

1. INTRODUCTION

TODAY, ONLY 107 REPRESENTATIVES in congress—fewer than a quarter of all House members—belong to a racial or language minority group.[1] If those groups were represented in proportion to their share of the nation's adult citizen population, that number would increase to 144 Representatives.[2] And this sub-proportional representation is not confined to Congress, but is replicated today in 47 of the 50 state legislatures.[3] There are two strands of conventional wisdom on the causes of this shortfall in minority representation. Either districters simply are not trying hard enough, or entrenched patterns of racial polarization in housing and voting make proportionality impossible to attain.

This article explores a third option: perhaps better tools can bring better results. Our algorithmically generated *ensembles*—collections of thousands or millions of alternative maps—show that better-designed redistricting plans could close much (though not all) of that gap and ensure that the House of Representatives and state legislatures "look more like America" than at any time in our history.

The tools to study this issue comprehensively did not exist as recently as a decade ago, when the 50 states last redistricted. Since then, algorithmic innovation and steadily improving computational power have revolutionized our ability to understand the variety of redistricting plans that could plausibly be enacted. It is now possible to generate a multitude of diverse, valid plans on a laptop overnight—and to describe how they are distributed in the universe of all possibilities. That in turn allows any plan, including one proposed for adoption, to be compared meaningfully to the available alternatives.

Not surprisingly, work in this direction has come to dominate some types of redistricting litigation in the last few years, especially lawsuits claiming that a districting plan is excessively partisan. But until now, ensemble methods have not seriously grappled with issues of race in redistricting. And these tend to be the most heavily litigated issues in the field, due to the demands imposed by the Voting Rights Act (VRA) and the Constitution's Equal Protection Clause. The legal rules addressing race in redistricting are much more complex than, say, the "one person, one vote" doctrine in federal constitutional law, or the contiguity requirements in state constitutional law. Modeling the racial rules is far from straightforward.

This article takes up that task. First, we develop methods that incorporate the legal rules involving the consideration of race in redistricting into the algorithms that generate redistricting ensembles. The main applications of these VRA-conscious ensembles would be to study the normal range of attributes of lawful plans, for instance to assess claims of partisan gerrymandering. Second, we show that the methods used to accomplish that task can also be used to draw maps that increase opportunities for minority groups to elect candidates of their choice. As it turns out, there is the potential to provide much more opportunity, at least in some states, than was previously recognized. In short, the algorithmic creation of redistricting ensembles holds the promise of not only sharpening our understanding of redistricting choices and tradeoffs, but also better fostering the aims of the Voting Rights Act, "a statute meant to hasten the waning of racism in American politics" (*Johnson* v. *De Grandy* 1994, 1020).

To that end, one of our strongest findings deserves particular emphasis. In the past, the dominant method of looking for effective minority electoral opportunity has been to use district demographics as a proxy, such as by seeking majority-Black districts to secure effective electoral opportunities for Black voters. But in our case studies, demographic share alone is a poor proxy for effectiveness; relying too heavily on demographics could inadvertently disempower minority citizens by packing them into too few districts.

Our methods will be most helpful for proactive legislatures and commissions that wish to draw legally defensible maps that will prove effective for racial and language minority groups while upholding other criteria simultaneously. The tools described here will generate examples of maps with valuable properties and will help elucidate the cost in minority electoral opportunity, if any, that results from strict application of lower-ranked criteria. Although these tools also may be helpful to

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[1]Bialik (2019). This figure refers to the 116th Congress (2019–2021).
[2]This number is based on 2019 one-year American Community Survey (ACS) data, U.S. Bureau of the Census (2019a), figured as the share of citizen voting-age population comprising those who are either Hispanic/Latino or from a non-white racial group.
[3]*See* U.S. Bureau of the Census (2019b); National Conference of State Legislatures (2020). Putting those sources together, the three exceptions are Arizona (34.4% minority citizen voting-age population vs. 38% minority legislators), Hawaii (73.2% vs. 76%), and Ohio (16.7% vs. 18%).

plaintiffs who wish to challenge existing maps under the VRA, that use is not our main focus.

We will use three main elements: a Markov chain procedure that proposes successive modifications to districting plans, an ecological-inference procedure that identifies minority-preferred candidates based on precinct-level historical election data matched to demographics, and a benchmark plan from which we can establish a presumptively acceptable number of effective districts.

Below, for our proof of concept, we will use a spanning-tree recombination procedure for the first element, a hierarchical Bayesian model for the second, and an enacted plan that has survived VRA scrutiny for the third[4]—but we emphasize that the main contribution of the current article is the overarching protocol, which is designed to be *modular*, letting users substitute in other alternatives to play these three roles. Combining these elements, our protocol defines *effective* districts for minority groups at any given threshold of confidence.

Article Outline. We begin in section 2 with a review of the burgeoning science of redistricting ensembles. Section 3 summarizes the legal rules governing the consideration of race and racial data in redistricting. Section 4 sets forth our VRA-conscious ensemble protocol, relying on recent election data to generate effectiveness scores that rate each district's likelihood of nominating and electing minority-preferred candidates. Section 5 applies this protocol to congressional redistricting in Texas, where both Latino and Black residents are numerous enough to require VRA attention. Section 6 applies techniques from statistics and machine learning to the Texas results to show the importance of using detailed electoral data. And section 7 concludes with a clear proof of concept showing that the long-standing underrepresentation of minority voters in Texas, far from being an immutable fact, can be addressed through proactive mapmaking.

Finally, we have made the corresponding software tools available for public use in our GitHub (MGGG Redistricting Lab 2020a) and through a user-friendly portal at districtr.org/VRA.

2. ENSEMBLE METHODS: ALGORITHMS FOR CREATING DISTRICTING PLANS

As Justice Kagan explained in her dissent in *Rucho v. Common Cause* (2019, 2517–23), a computer equipped with an algorithm that generates a huge number of redistricting plans could potentially create a baseline to help answer questions like:

- What is an extreme, or unfair, number of Republican (or Democratic) districts, given the partisan composition and political geography of the state's voters? or,
- What would be a typical number of competitive districts, given those same parameters? or,
- Given the new census data, can a plan comply with the "one person, one vote" principle without pairing two incumbents' homes in the same district?

And as we will soon demonstrate, an ensemble approach also can help us address questions like:

- What is a fair map for Latino and Black voters?

2.1. Illustrative example: Iowa

To see the power of redistricting ensembles, let's consider the case of Iowa. According to the 2010 census, Iowa's 99 counties contained 216,007 census blocks and 3,046,355 residents—enough for four congressional districts. Iowa's constitution simplifies the redistricting problem by mandating that "no county shall be divided in forming a congressional district," so drawing our four districts requires assigning only the 99 counties (Iowa Const. art. III, § 37). We might hope to approach the task of finding fair plans by first building all possible plans, and comparing a particular plan to the full set.

But even this modest problem of dividing 99 counties into four connected parts (four contiguous districts) is currently out of reach: no one has yet been able to find a precise answer for this problem by computer, even with a clever enumeration algorithm and a month of computing time.[5]

This problem is only compounded in most states, which build their districts from census blocks

[4]As described below, we use an implementation called GerryChain for plan generation, we use eiPack for ecological inference, and we use the current enacted Texas congressional map as our Voting Rights Act (VRA) benchmark.

[5]Indeed, even the simpler problem of partitioning a 9×9 grid into nine districts of nine units each has 706,152,947,468,301 solutions.

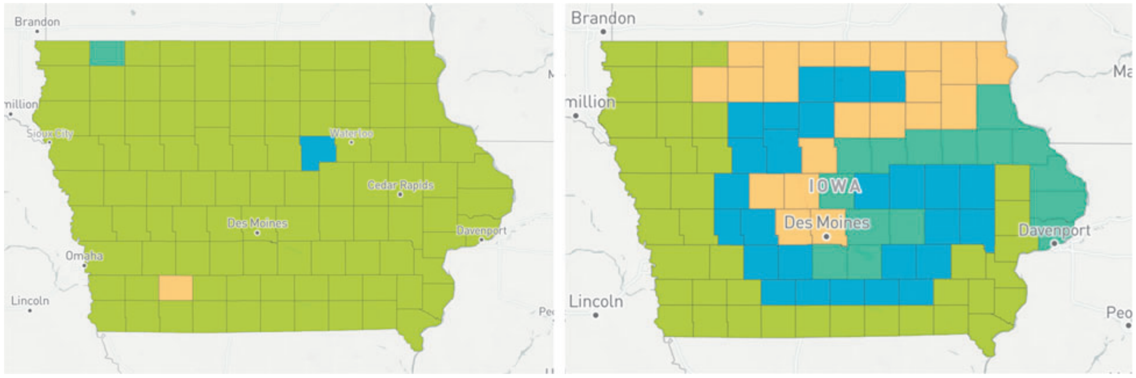

FIG. 1. These two partitions of Iowa into four connected pieces are not plausible for adoption as districting plans. The first has nearly all the state's population in a single large (*green*) district. The second more closely balances each district's population, but would likely violate Iowa law's compactness requirement.

(on average, there are more than 2,000 blocks per county). The full enumeration is subject to what is called *combinatorial explosion*, and the associated counting problem has forbidding complexity. This means not only that we lack the computing power to enumerate all plans today, but that computers likely will never be able to do so.

A second issue is that most plans in a complete enumeration would be irrelevant to the practical problem of redistricting because they would be blatantly unlawful. This is illustrated in Figure 1. The plan on the left, in which the biggest district has more than 750 times the population of the smallest one, would patently violate the federal Constitution's "one person, one vote" doctrine.[6] This means that districting plans with large population inequalities are of no practical interest, so a useful ensemble should exclude them.

The map on the right has much better population balance, but it also falls outside the plausible zone for plans. Its blue G-shaped district ("G" for gerrymandering) flaunts the mapmaker's disrespect for the traditional districting principle of compactness, which Iowa law explicitly safeguards (Iowa Code § 42.4.4).

Good ensemble methods allow us to draw a *representative sample* of compact, contiguous, population-balanced plans from the full space of possibilities—that is, a sample distributed in a known way that is suited to the law. By appealing to this sample, we can hope to address questions of partisan fairness, competitiveness, racial fairness, and all the other concerns and values we bring to bear on redistricting. To illustrate this methodology, we generated a sample of 100,000 valid Iowa congressional maps by the recombination method explained below in section 4.2, without taking partisan data into account.[7] This lets us compare the enacted plan against these alternatives in terms of votes cast for president in the November 2016 election, say. In our ensemble of compact, contiguous, population-balanced plans, nearly 75% have one safe Republican seat and three competitive seats (using a 55% majority as the line between competitive and safe). The current enacted plan has one heavily Trump-favoring district and three competitive ones, putting it in the largest category. This does not tell us by any stretch that the current plan is ideal or fair, but it does tell us that this plan is not an outlier by this way of measuring partisanship. This illustrates an elementary use of ensembles to benchmark partisan lean and competitiveness.

Similarly, ensembles can help us study how plans made without regard to race might tend to distribute a state's minority populations across districts, merely as a function of human geography. This

[6]A district-to-district population difference greater than 10% of the ideal district size is presumptively unconstitutional under the Fourteenth Amendment; for congressional districts, the standard is far stricter, under Article I of the Constitution (*Brown* v. *Thomson* 1983, 842–48; *Karcher* v. *Daggett* 1983, 730–44). The malapportioned plan in Figure 1 has top-to-bottom deviation nearly as large as the whole state, or close to 400% of ideal district size.

[7]ReCom always produces contiguous, balanced districts, and favors compact districts for reasons explained below in section 4.2.

racial baseline has been studied in a range of reports and papers, including MGGG Redistricting Lab (2018d, 2018a, 2019b, 2019a); DeFord and Duchin (2019); Duchin and Spencer (2021). But exploring the distribution of racial-group members in an ensemble is a different task from building an ensemble that takes VRA compliance into account. We will turn to that task shortly.

2.2. *Building ensembles*

Ensemble methods backed by powerful computers have proliferated in the last decade. Large ensembles of alternative plans proved critically important in federal-court cases invalidating extreme partisan gerrymanders in Ohio and Michigan (before the Supreme Court in *Rucho* held these claims nonjusticiable in federal courts) and more recently in similar state-court cases in Pennsylvania and North Carolina (*Rucho* v. *Common Cause* 2019, 2493–508; *League of Women Voters of Mich.* v. *Benson* 2019, 893–908; *Ohio A. Philip Randolph Institute* v. *Householder* 2019, 1025–62, 1082–85; *League of Women Voters* v. *Commonwealth* 2018, 770–81; *Common Cause* v. *Lewis* 2019, 17–43, 80–96).

Past ensemble methods used in litigation have focused on generating plans while controlling population balance, contiguity, compactness, and sometimes county and municipality integrity. Generating large ensembles while accounting in some way for these legitimate districting criteria helped judges decide whether one political party's disproportionate successes were due to the state's geographic features and the distribution of its voters—or to partisan manipulation of district lines. But in building their ensembles, the experts who testified in these cases did not seriously grapple with the legal requirements involving the consideration of race in redistricting.

In the Wisconsin case, for example, Democratic plaintiffs brought partisan-gerrymandering claims against a state Assembly plan that had resulted in Republicans winning 60 or more of the 99 seats, even in elections where Democratic candidates collectively received more votes than their Republican counterparts. In work prepared for the litigation and described in a subsequent article (Chen 2017), political scientist Jowei Chen built an ensemble of alternative Assembly plans to help evaluate the enacted plan and to demonstrate that the heavy advantage that Republicans enjoyed under that plan did not result inevitably from the political geography of the state's voters. Chen generated an ensemble of plans that altered boundaries for 92 of the 99 districts, while "freezing" seven heavily minority districts in and around Milwaukee, one of which had been ordered into effect to remedy a VRA violation.

Likewise, in the North Carolina cases, the experts' ensembles relied on proxies for districts' effectiveness for minority voters. For example, consider the work of one plaintiffs' expert, mathematician Jonathan Mattingly, as described in a subsequent article by his research group (Herschlag et al. 2020). Mattingly's work in North Carolina used demographic targets of 44.48% and 36.20% Black population for two congressional districts—the precise levels found in the enacted plan that the plaintiffs were challenging. He then built an ensemble by iterating a random step biased to favor plans that hit those demographic targets.[8] In addition to the effects of this tilted search, he discarded plans that fell short of those targets from the final ensemble presented in court, so that the prescribed population levels served as a minimum for all included plans.

In the context of these mid-decade partisan-gerrymandering cases, the experts' decisions to de-emphasize VRA complexities were understandable. The litigation, after all, focused on party, not race, and lawful VRA-compliant districts were already in place. But at the beginning of a new decade, with fresh census results available, that option will be foreclosed, as the minority districts from the previous map will have become either over- or under-populated due to population shifts and will thus violate "one person, one vote." So the minority districts (like all other districts) will have to be redrawn to accommodate the new census data. When generating alternative plans to create a baseline for comparison, redistricters will need to account for the delicate legal requirements imposed by the VRA and the Constitution.

For techniques that have been implemented to build VRA requirements into redistricting ensembles,

[8]Mattingly's method used a search procedure weighted to favor plans with better scores, based on a combination of population balance, compactness, county integrity, and nearness to his demographic targets for Black population.

the literature review is brief. In a new *Yale Law Journal* article called "The Race-Blind Future of Voting Rights" (Chen and Stephanopoulos 2021), Jowei Chen and legal scholar Nick Stephanopoulos take the problem of identifying suitable VRA districts head-on, defining a minority opportunity district by using a combination of partisan data (returns from the 2012 presidential general election) and demographic data (voting-age population from the 2010 census). In particular, they define a minority opportunity district to be one in which (1) the candidate of choice (typically Obama) carried the district in the general election and (2) most of the candidate's support is estimated to have come from minority voters. This is somewhat closer in spirit to the method proposed here, though this article draws dramatically different conclusions from theirs.[9]

Our method for measuring district effectiveness, described in section 4 below, will draw on a much larger collection of recent elections, pairing a primary with each general. The outcomes from these elections are the essential components of our effectiveness scores. And in section 6 we will show that the scores we develop cannot be well approximated by considering only a district's partisan lean and demographics.

2.3. *Using ensembles*

As we develop techniques for building VRA-conscious ensembles, there are two important general caveats about how and how not to use these ensembles.

Comparison, not selection. Our protocol is not designed to simulate the nuanced judgment of a seasoned voting-rights attorney. Rather, as we generate a chain of thousands of maps, we need a fast and reliable rough cut for VRA compliance. Our protocol uses a random iterative process in which districting plans are proposed, weighed, and potentially accepted into our ensemble of plans. We will be designing an in-or-out criterion that can be assessed in a fraction of a second. It is too much to expect perfection in excluding all unlawful maps and including all lawful ones, partly because the law itself is hardly a bright-line field. For example, even what seems like a rule with a clear threshold, such as the constitutional prohibition against state-legislative plans with population deviations greater than 10%, has exceptions in case law (*Cox* v. *Larios* 2004; *Unger* v. *Manchin* 2002). Nonetheless, an ensemble that includes most of the lawful maps that are proposed in the chain and rejects most of the unlawful ones will suffice for our goals of comparison and benchmarking. Ensembles should not be regarded as supplies of plans ready for immediate adoption; they are not likely to be good plans without extensive human vetting and adaptation.

Normal range, not ideal. We advocate using redistricting ensembles to learn a normal range for metrics and measures under the constraints of a set of stated redistricting rules and priorities. Ensembles allow us to justify statements such as *Plan X is an outlier in its partisan lean, taking all relevant rules into account*. While talking about normal ranges and outliers, we should avoid the temptation to valorize the top of the bell curve (or its center of mass, or any other value) as an ideal. By analogy, we can talk about people who are unusually tall or short without believing that any height is most desirable or ideal. If the 50th percentile height for American women is 5'4" and the 99th percentile height is 5'10," we can conclude that a woman who is six feet tall is unusual, and we can look for reasons (family history, diet, and so on) to explain her height. But it would be quite strange to decide that a woman who is 5'4" is a "better" height than one who is 5'5."

Justice Kagan's *Rucho* dissent skirted the edge of this temptation. She mostly reasoned from ensembles just as we will recommend here, envisioning a bell curve (in that case, of partisan advantage) and describing plans far from the bulk of the curve as presumptively impermissible: "The further out on the tail, the more extreme the partisan distortion and the more significant the vote dilution" (*Rucho* v. *Common Cause* 2019, 2518). But in the course of describing the outlier logic, she implied that plans "at or near the median" are the best of all. An outcome "smack dab in the center" (in Justice Kagan's words) may not be in any sense the most fair, however. For instance, turning to the November 2012 Obama-Romney election as a touchpoint, Obama received nearly 53% of the major-party vote in Iowa. Even if just over half

[9]For their method's details, see the full description in Chen and Stephanopoulos (2021). For a critique of their definition of minority opportunity districts and its application, see Duchin and Spencer (2021).

the congressional plans in our ensemble have three Obama-favoring districts out of four (making that the median outcome), we might still reasonably consider a map with two Obama-favoring and two Romney-favoring districts to have at least as strong a claim on fairness, given the nearly even vote split.

Likewise, there would be no reason to prefer a map that preserves intact a *median* number of whole counties or municipalities. Indeed, some states' redistricting laws expressly demand keeping the greatest practicable number of counties or municipalities intact.

The same warning, to be wary of the magnetic attraction to the middle of a bell curve, surely applies as well to racial fairness. If a state's Latino, Black, Asian American, and Native American residents have historically been (and currently remain) underrepresented, we should gravitate toward solutions that fix the shortfall rather than perpetuate it. Fortunately, federal law pushes redistricters in the right direction.

3. THE LAW OF RACE AND REDISTRICTING

The rules regarding the consideration of race in redistricting flow primarily from two sources of federal law: the Fourteenth Amendment's Equal Protection Clause and Section 2 of the Voting Rights Act, which Congress, exercising its power to enforce the Fifteenth Amendment, enacted in 1965 and significantly revised in 1982.

3.1. The Voting Rights Act prohibits minority vote dilution

Section 2 of the VRA prohibits a redistricting plan that abridges any citizen's right to vote "on account of race or color [or membership in a language-minority group]" (VRA §§ 10301(a), 10301(f)(2)). Minority plaintiffs can establish a violation of amended Section 2 by showing, "based on the totality of circumstances," that members of their racial or language-minority group "have less opportunity than other members of the electorate" to "nominat[e]" and "elect representatives of their choice" (VRA § 10301(b)).

In assessing whether a redistricting plan provides equal electoral opportunity under amended Section 2, Congress expressly permitted state redistricters and federal judges alike to consider recent election outcomes, namely "[t]he extent to which members of a protected class have been elected to office" (VRA § 10301(b)). Nothing in Section 2, however, "establishes a right to have members of a protected class elected in numbers equal to their proportion in the population." While electoral success for minority candidates is important, even more important under Section 2 is that the candidate be the "chosen representative" of a particular racial or language-minority group, regardless of the candidate's race or ethnicity (*Thornburg* v. *Gingles* 1986, 68 (plurality opinion)). And Section 2's lodestar is "equality of opportunity, not a guarantee of electoral success for minority-preferred candidates of whatever race" (*Johnson* v. *De Grandy* 1994, 1014 n.11). As the Supreme Court has explained, "minority citizens are not immune from the obligation to pull, haul, and trade to find common political ground, the virtue of which is not to be slighted in applying a statute meant to hasten the waning of racism in American politics" (*Johnson* v. *De Grandy* 1994, 1020).

In redistricting cases "the ultimate question [under Section 2] is whether a districting decision dilutes the votes of minority voters" (*Abbott* v. *Perez* 2018, 2332). District lines can dilute the voting strength of politically cohesive minority-group members either by "cracking," or dispersing, them among multiple districts where they are routinely outvoted by a bloc-voting majority, or by "packing," or concentrating, them into too few districts, wasting votes that could have mattered in neighboring districts (*Johnson* v. *De Grandy* 1994, 1007). Section 2 prohibits both cracking and packing whenever district lines combine with social and historical conditions to impair the minority group's ability to elect its preferred candidates "on an equal basis with other voters" (*Voinovich* v. *Quilter* 1993, 153).

In jurisdictions where all sizable demographic groups (majority and minority alike) consistently favor the same candidates, a redistricting plan cannot dilute minority citizens' voting strength, so Section 2 plays no role (*Thornburg* v. *Gingles* 1986, 51). But in most states, where voting is in varying degrees racially polarized, Section 2 can require replacing one or more districts that elect candidates preferred by the majority (usually, a white majority) with districts that would elect candidates preferred by one or more minority groups (*Johnson* v. *De Grandy* 1994, 1008). To prevail, Section 2 plaintiffs must prove that, under the challenged plan, a bloc-voting majority usually will defeat "candidates supported by a politically cohesive, geographically insular minority group" (*Thornburg* v. *Gingles* 1986, 49). But even with such proof, plaintiffs' challenge to a state districting plan ordinarily will fail if the plan provides effective opportunities to nominate and elect minority-preferred candidates in a number of districts *roughly proportional* to the minority group's share of the state's citizen voting-age population, or CVAP (*LULAC* v. *Perry* 2006, 436–38; *Johnson* v. *De Grandy* 1994, 1000).

One particularly useful—and simple—method for assessing minority electoral opportunities under a districting plan is to add up the votes cast for each candidate in recent *statewide* primary and general elections by district, to learn which districts gave more votes to the minority-preferred candidate than to any other candidate (*LULAC v. Perry* 2006, 428 (majority opinion), 493–94, 499–501 (Roberts, C.J., dissenting in part); *Session v. Perry* 2004, 499–501). This approach is particularly straightforward if each precinct is kept intact within a single district: simply adding up the votes for each candidate in all of a district's precincts shows, for each election, which candidate carried the district. The most difficult part of these analyses, especially in primaries, is identifying the candidate who was minority-preferred in each election, which is typically performed by a statistical-inference procedure comparing demographic patterns to voting patterns (King 1997; King, Rosen, and Tanner 1999; Elmendorf, Quinn, and Abrajano 2016). But we will take care to place actual electoral history at the center of our assessment of district effectiveness, keeping the role of statistical inference to a minimum.

3.2. The Equal Protection Clause prohibits excessive attention to race

Regardless of what techniques are used to assess minority electoral opportunities, compliance with Section 2 necessarily requires detailed consideration of race and racial data. But a state's consideration of race is constrained by the Fourteenth Amendment mandate that "[n]o State shall … deny to any person within its jurisdiction the equal protection of the laws" (U.S. Const. amend. XIV; see *Bethune-Hill* v. *Virginia State Bd. of Elections* 2017, 802). Starting in the 1990s in its *Shaw* line of cases, the Supreme Court has identified at least two ways that the excessive use of race can give rise to a presumptively unconstitutional *racial gerrymander* under the Equal Protection Clause (*Miller* v. *Johnson* 1995, 904–05, 910–17; *Shaw* v. *Reno* 1993).

First, a bizarrely noncompact district is subject to strict scrutiny under that Clause if the district's boundary is "so irrational on its face that it can be understood only as an effort to segregate voters into separate voting districts because of their race" (*Shaw* v. *Reno* 1993, 658). This type of racial predominance most often arises where a district's perimeter is defined not by the boundaries of intact precincts, for which electoral data exists, but by the boundaries of (much smaller) census blocks that have been conspicuously sorted into or out of districts according to their racial composition (Hebert et al. 2010, 66–68 & n.21; *Alabama Legislative Black Caucus* v. *Alabama* 2015, 274).

Second, although only a minority of justices have stated that the intentional creation of a majority-minority district should always be presumptively unconstitutional, a majority of the Court has held that districts violated the Equal Protection Clause because they were drawn to "maintain a particular numerical minority percentage" or to meet arbitrary or "mechanical racial targets." The Court has thus rejected a bald mandate that certain districts must have at least a 50% or a 55% Black voting-age population regardless of whether that percentage was actually shown to be necessary for the district to nominate and elect minority-preferred candidates (*Cooper* v. *Harris* 2017, 1469; *Bethune-Hill* v. *Virginia State Bd. of Elections* 2017, 799, 801–02; *Alabama Legislative Black Caucus* v. *Alabama* 2015, 267, 275; *Bush* v. *Vera* 1996, 969–72).

3.3. Implications for redistricting ensembles

These legal points have major implications for an ensemble-creation protocol keyed to compliance with the VRA and the Constitution. As an initial matter, recalling the earlier point about ensembles being far more useful for comparison than for selection, the focus here is on drawing a collection of maps that would be relatively safe from challenges under VRA Section 2, rather than on crafting a map for plaintiffs to propose when suing the state.

As a gatekeeping function before ultimately assessing the "totality of circumstances," courts generally require Section 2 plaintiffs to present an illustrative map showing that the minority group in question could constitute a literal arithmetic majority of the voting-age population (VAP) in a proposed district.[10] The Supreme Court has noted, however, that a district that falls short of the 50% threshold yet can still nominate and elect minority-preferred candidates "can … [and] should" count as a minority-effective district when assessing a state's compliance with Section 2 (*Bartlett* v. *Strickland* 2009, 24 (plurality opinion); see also *Cooper* v. *Harris* 2017, 1470). So actual electoral opportunity for minority groups—a track record of effectiveness in elections—is what matters when defending a map against a VRA challenge. Taken together, the legal points elucidated above in sections 3.1 and 3.2 suggest three crucial design principles for a VRA-conscious ensemble protocol.

(1) *Ensure effectiveness in both primaries and generals.* Aiming to weed out of an ensemble plans that violate Section 2, while retaining plans that comply, a protocol must assess whether particular districts will or will not be effective for minority-preferred candidates seeking both nomination (in primaries) and election (in generals). This assessment requires attention to both demographic data and actual election results, including precinct-level returns from primary and general elections.
(2) A*void* a priori *demographic targets.* Threshold decisions about the composition of districts should not be based on purely demographic targets—for example, requiring a certain number of districts that are at least, say, 55% Latino or 50% Black. That approach not only could lead to false positives or false negatives for district effectiveness, but could leave the methodology vulnerable to constitutional attack for excessive race-consciousness.
(3) *Maintain reasonable compactness.* To further reduce constitutional exposure, the ensemble-generating technique should admit few or no plans with bizarre district shapes.

We note that both the first and the third principles recommend the use of precincts, rather than the much smaller census blocks, when assembling districts. Precinct-based plans promote compactness and facilitate more accurate assessment of electoral history, which is fundamental to evaluating district effectiveness. And though they may not achieve perfect population equality, that fact usually should not present significant constitutional concerns.[11]

4. DESIGN OF A VRA-CONSCIOUS ENSEMBLE PROTOCOL

In this section, we will describe the design of a protocol for generating redistricting plans that comply with not only the criteria of population equality, contiguity, and reasonable compactness, but also the race-related rules mandated by the VRA and the Equal Protection Clause. The protocol begins with data preparation and culminates in the use of a constrained recombination algorithm for generating plans that meet VRA-related requirements. We propose this as a sound and detailed *VRA-conscious algorithm*, but not as *the authoritative VRA algorithm*. There may well be other ways to incorporate the legal requirements around race, and to do it well. But the methods laid out in this section come closer to the big-picture goal—building a representative sample of lawful maps—than any previous work we know. We believe that this elaborated example of one concrete, reasonable way to take account of race and the law helps illuminate some key decisions.

We recall from above that the protocol is modular with respect to three ingredients: a procedure for iteratively modifying districting plans (here, spanning-tree recombination), a procedure

[10]*See Bartlett* v. *Strickland* (2009, 6, 9–11, 20, 24–25, 26 (plurality opinion)). *Bartlett* also may be satisfied with a majority of the proposed district's *citizen* voting-age population (CVAP). And *Bartlett*'s 50% rule may not apply if the defendant drew the challenged districts with discriminatory intent, as might well be the case when a state dismantles an existing minority-effective district.

[11]Using whole precincts will rarely raise "one person, one vote" concerns for state-legislative maps. However, the Constitution imposes stricter population-equality standards for congressional maps (*Karcher* v. *Daggett* 1983, 740-41). Although the most common current practice is to draw congressional plans so that the largest and smallest districts differ by only one person, the Supreme Court has upheld plans with significantly larger deviations (*Tennant* v. *Jefferson County Comm'n* 2012, 762, 764–65; *Abrams* v. *Johnson* 1997, 99–100). In any event, a map built from whole precincts can usually be readily modified into a map with a minimal deviation by swapping a limited number of census blocks between adjacent districts.

for identifying minority-preferred candidates (here, a Bayesian hierarchical model of ecological inference), and a benchmark that prescribes a threshold number of effective districts for each minority group (here, an enacted plan that has evaded or withstood VRA scrutiny). Our choices can be swapped out for others as new methods or special circumstances warrant, leaving the overall structure intact.

4.1. Preparing data

4.1.1. Electoral and demographic data. We will require a cleaned precinct *shapefile* for the state, with election returns and demographic data joined to those precincts.[12] This can be difficult to obtain because precincts change from year to year and a longitudinal precinct shapefile is needed for the span of years covered by the election dataset. Furthermore, we may need to clean the precinct shapes to get suitable topology: to be usable as building blocks for plans, precincts must tile the state, with every resident located in one and only one precinct.[13]

The shapefile allows us to match reported vote totals to geographic units and to record which pairs of precincts are adjacent, which will be needed to ensure that districts are contiguous. For each precinct, we have joined data on total population from the 2010 decennial census, adult citizen population by race and ethnicity from the American Community Survey (ACS) five-year rolling estimates ending in each election year, and counts of votes received by each candidate for statewide election in a large set of primary and general elections.

Although our modeling concern is with districted elections for Congress and state legislatures, our analysis is based primarily on statewide (exogenous) contests. This is because the choices facing voters in districted elections vary across the state: in any given election year, some districts are uncontested, some have strong incumbents or other idiosyncrasies. When district boundaries are moved to create alternative plans, the newly proposed districts will be composed of voters who faced completely different candidate choices. It is not clear how votes for one candidate would translate to votes for a different candidate. By contrast, statewide elections allow us to make apples-to-apples comparisons across different parts of the state, since the same set of candidates competed everywhere. Ideally, we would include all statewide contests for the last ten years, but this is not always possible because of data availability and precinct instability. As we will discuss further below, this protocol is not intended for use with fewer than five general elections, grouped with the primaries (and, where applicable, primary runoffs) that preceded them.

Because our main concern here is whether minority-preferred candidates are ultimately elected to office, we *link* the primary (and primary runoff) for a given office in a given year to the general election for that same office that same year, and define success by whether the candidate who was minority-preferred in the primary succeeded at all stages of the electoral process.

We use a simplified set of racial groups: every person who identified as Hispanic/Latino on the census or ACS is classified as *Latino*. We use the term *Black* for non-Hispanic respondents who selected Black as their single racial category, and we use *White* similarly. All other respondents (those non-Hispanic persons selecting two or more races, Asian American, Native American, and so on) are grouped together and designated as *Other*. In a state with only one sizable minority group, all other minority groups may be merged into the Other category for purposes of this VRA protocol. Citizen voting-age population is denoted by CVAP, and we use HCVAP, BCVAP, WCVAP, and OCVAP to denote Hispanic/Latino, Black, White, and Other CVAP. We focus on Latino and Black voters as minority groups because our main case study involves congressional redistricting in Texas. In other states, like California, Hawaii, or Alaska, or in certain local districting projects, we might specify different racial groups for analysis.

Importantly, we make no prior assumptions about whether the voting behavior of Latino, Black, White, or Other groups will align. This is a case-by-case empirical question addressed with statistical inference.

4.1.2. Candidates of choice. As explained above, the linchpin of a vote-dilution claim under

[12]Shapefiles store data about the position and attributes of a geographic unit, such as a precinct.

[13]Cleaned and vetted shapefiles that are suitable for longitudinal data are easier to create in some states than others. For instance, the Louisiana shapefile used in this study required hundreds of person-hours of data preparation from members of the MGGG Redistricting Lab. It would be extremely difficult to obtain an analogous data product in Mississippi, for example.

the VRA is the right to replace districts where minority-preferred candidates usually lose with districts where they have a realistic opportunity to win (*Johnson* v. *De Grandy* 1994, 1020). To assess whether a district falls into the former category or the latter requires determining which candidates are preferred by members of each sizable minority group.

Because vote totals are not reported by racial group, we cannot directly determine which candidates are minority-preferred. Instead, this effort falls under the umbrella of *ecological inference* (EI). Voting preferences are never monolithic, but techniques for measuring racial polarization have been refined for decades, and they can help us estimate the degree of bloc voting. The techniques in the ecological-inference family, like all statistical-inference methods in the presence of missing data, give imperfect and uncertain answers (Elmendorf, Quinn, and Abrajano 2016). It is fundamentally important to estimate the error that is produced by techniques and keep track of how it compounds or cancels out in our high-level conclusions. As much as possible, we will opt to make gradated and not bright-line determinations from the outputs of EI.

Our VRA-conscious ensemble protocol requires identifying the candidate who was preferred by each sizable minority group in each election, together with confidence measures that these preferred candidates are correctly identified. To perform the check for minority control of a district, as well as to identify district-wide candidates of choice for newly proposed districts, we make use of not only statewide but also precinct-level vote estimates by race for each candidate (with variance estimates). Users can employ various methods to generate these estimates (e.g., using King's EI, Ecological Regression, exit polls, or voter files). Notably, this allows our protocol to immediately incorporate any future advances in inference techniques.

In the implementation described here, we generate estimates using a version of King's EI, specifically the ei.MD.bayes function from eiPack (Lau, Moore, and Kellermann 2020) which is based on the Bayesian hierarchical Multinomial Dirichlet model for $R \times C$ tables proposed in King, Rosen, and Tanner (1999).[14] For each election we run EI at the statewide level, using precinct-level input tables. The inputs for each precinct are the row and column *sums* for the $R \times C$ table of vote counts. The row sums correspond to the precinct's estimated number of adult citizens in each racial group (HCVAP, BCVAP, WCVAP, and OCVAP). The column sums are the precinct's vote totals for each candidate as well as a *None* count, which is the sum of the four CVAP figures minus the sum of the recorded vote totals for all candidates, estimating the number of nonvoters. EI then infers values for the internal cells of these tables, i.e., estimated vote counts by racial group and candidate. Inclusion of the *None* column allows the underlying model to estimate differential turnout by race; without this, EI would rely on the unrealistic assumption that adult citizens from all demographic groups were equally likely to have cast a ballot.

Each EI run generates a large random sample of estimated precinct vote counts; we can sum these across the entire state to get statewide estimates. For each racial group, the candidate with the highest average estimated vote total for a given election is identified as the group's "candidate of choice." For a measure of confidence that Candidate X was the candidate of choice for a racial group in a given election, we first take repeated draws from the EI distribution and record the frequency with which X receives the most votes from that group. We then transform this to a confidence score.[15]

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[14]Here, $R \times C$ stands for the number of rows (or racial groups) R and columns (or candidates) C.

[15]Let p be the frequency in a batch of trials with which X is observed to be the preferred candidate. We logistically transform this to a confidence score using $C(p) = 1/(1 + \exp(18 - 26p))$ to weight the election in the compound score of district effectiveness (see Table 1 below). The parameters 18 and 26 were chosen so that an election in which the draws have Candidate X ahead only 50% of the time should receive almost no weight (because it is a toss-up); but if Candidate X comes out ahead in, say, 85% of trials, the confidence should be nearly 100%. It is certainly possible to use other parameters, to skip this step and just use $C(p) = p$ as a measure of confidence, or even to forgo confidence altogether. Without some factor of this kind, however, the resulting score will have more noise due to cases where the candidate of choice is uncertain. If we do not strongly down-weight the uncertain elections, we risk a situation in which just rerunning the EI with identical settings could produce a significantly different answer. We discuss this and other robustness checks in footnote 31.

4.2. Building new plans by recombination

The science of representative sampling has advanced greatly in the past few years as ensemble methods for redistricting have matured. Using a technique known as *Markov chain Monte Carlo* (MCMC), it is now possible to efficiently create an ensemble of thousands or millions, even billions, of plausible maps. We can even sample while keeping control of the weighting that makes some kinds of plans appear more often than others. For example, we can be sure that a preference for more compact plans is designed to depend *only* on a prescribed score of compactness and on no hidden factors.[16]

The engine of our district-generation process is a Markov chain known as recombination, abbreviated ReCom, whose central idea of using spanning trees to split districts is fast becoming the standard in the field (DeFord, Duchin, and Solomon 2021; Autrey et al. 2021; McCartan and Imai 2021). We will apply it to plans built from whole precincts, the smallest geographic units for which we have accurate, detailed electoral data. Earlier MCMC methods for redistricting reassigned a single geographic unit (such as a precinct) from District A into adjacent District B at each step, creating a new plan that agreed with its predecessor on the assignment of every unit except one. (If Texas, for example, had 9,000 precincts, 8,999 would stay in their districts at each step.) By contrast, ReCom typically proposes a much larger change: at each step, two entire (adjacent) districts are merged and then re-split in a new way that is completely independent of the division in the previous plan. This means that a single ReCom step can reassign hundreds of precincts at a time. (Each of Texas's 36 congressional districts, for instance, has roughly 9,000/36, or 250, precincts, so each recombination step performs a random division of roughly 500 precincts into two new districts.) By iterating this transformation hundreds of times per minute, the map soon loses any resemblance to its starting configuration.

A ReCom step merges a random pair of adjacent districts and splits the region in a new way. Under the hood, each ReCom step uses a *spanning tree*, which is a kind of "skeleton" of the double-district created by the random merger, and then searches for a place to cut that tree to leave behind two population-balanced, connected pieces. So, by construction, all plans proposed by recombination are contiguous and maintain the desired population balance. What is less obvious is that ReCom's use of spanning trees also places an automatic priority on districts that have more internal adjacencies: so *compactness*, or a preference for plump, regular forms over thin necks or stringy appendages, is also a structural feature of the algorithm (see Figure 2) and does not have to be set as a manual choice by the programmer (DeFord, Duchin, and Solomon 2021). In fact, when the district boundaries of a plan generated by ReCom look ragged to the eye, it is often because the building-block units themselves (such as precincts) have jagged edges.[17]

Over thousands or millions of iterations, this simple method can undertake far-reaching exploration of the universe of possible plans subject to population balance, contiguity, and reasonable compactness. We will call a set of plans collected in a recombination chain an *ensemble* of plans.

Additional features and constraints can be incorporated into ReCom either with hard thresholds (i.e., validity checks) or by using probabilistic acceptance. To illustrate this, consider the traditional districting principle that counties should be kept intact when practicable. We could enforce a maximum allowable number of county splits by adding an instruction to automatically reject as invalid any proposed plan that exceeds some level of county-splitting, creating a *constrained* ensemble. A different option would be to impose a bias to the probability of acceptance, essentially flipping a weighted coin each time a proposal is generated that makes it rare but not impossible to accept plans with a large number of county splits. This would create a *biased* (or *tilted*) ensemble favoring fewer county splits.

When a proposed plan is rejected, a new plan is proposed by merging and re-splitting a freshly

[16]To be precise, the recombination algorithm used here approximately targets a known distribution called the *spanning-tree distribution*, where the probability of selecting a particular plan is proportional to a certain measure of compactness. A modified algorithm called *reversible recombination* exactly targets that steady state. See DeFord, Duchin, and Solomon 2021; Duchin and Tenner 2018; Sarah Cannon, Moon Duchin, Dana Randall, and Parker Rule 2020. "A Reversible Recombination Chain for Redistricting." On file with authors.

[17]The reasons spanning-tree partition methods produce compact districts are explored in Duchin and Tenner (2018) and DeFord, Duchin and Solomon (2021).

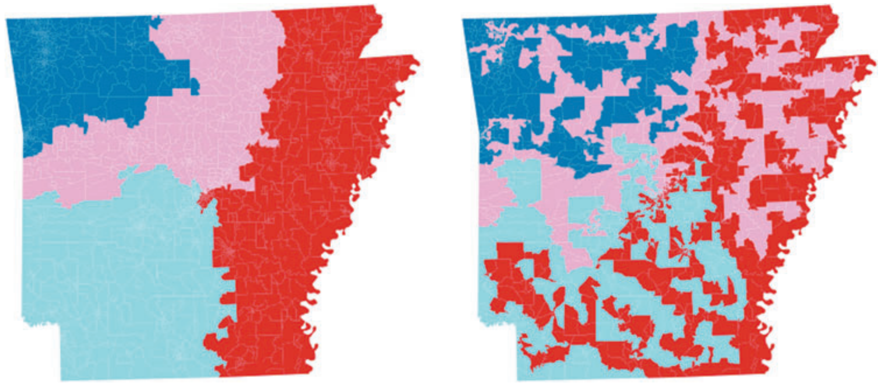

FIG. 2. If all contiguous, population-balanced plans were made equally likely, the compact plans (*left*) would be enormously outnumbered by bizarrely noncompact ones (*right*). The ReCom algorithm prefers the compact one, with a relative weight dictated *only* by its compactness score.

chosen pair of adjacent districts. This continues until some proposed plan passes the necessary tests to be accepted, at which point it is added to our ensemble. The next step proceeds from this newly accepted map, and so on until the Markov chain reaches its stopping condition (such as by collecting a prescribed number of plans). Our ensembles contain every valid plan rather than *sub-sampling*, or thinning out by accepting only every 1,000th or 10,000th plan as previous authors have done (Herschlag et al. 2020; Fifield et al. 2020). The long-range statistical properties are the same whether we use continuous sampling or sub-sampling, and we employ standard convergence heuristics from the scientific computing literature to provide evidence that our chains are run long enough for the statistics we collect to approach stationarity.[18] For more information about spanning-tree recombination and for comparisons to other methods, see DeFord, Duchin, and Solomon (2021); Becker and Solomon (2021); DeFord and Duchin (2020); McCartan and Imai (2021); and Autrey et al. (2021).[19]

Below, we will refer to district-level as well as statewide EI estimates as we build scores of district effectiveness. The district-level procedure requires some thought because of the computational cost of any calculation that occurs while the algorithm runs, rather than being performed in advance. It is not feasible to rerun EI to determine district-level candidate preferences with each newly proposed plan in a ReCom chain. We need a highly efficient calculation to retrieve both a point estimate and an estimated confidence level when a new district is formed. To handle this, we make use of the hierarchical structure of EI. The EI algorithm generates large random samples for each precinct from the distribution of possibilities produced by the underlying Bayesian model. This means that we can store outputs for each precinct in the state. Ideally, we would save the full *detailed histogram* describing the frequency with which various vote counts were estimated for each candidate and racial group in that precinct. Because this is too much information to store, we instead record the point estimate for each group's support of each candidate in addition to a simplified coarse histogram of vote counts, compressed down to just nine values, which turns out to be enough to recover the shape of the detailed histogram with remarkable fidelity, as shown in Supplementary Appendix A. During the run of the ReCom Markov chain, we can redraw samples from these coarse distributions and aggregate to the district level for each newly generated plan to determine the confidence that we have correctly identified candidates of choice.

4.3. Building raw scores of district effectiveness

We next lay out three ways to use prior election results in assigning a minority-effectiveness score

[18]Markov chains that take large steps, like ReCom, require many fewer steps to achieve approximate independence than methods that iterate very small changes.

[19]See also Sarah Cannon, Moon Duchin, Dana Randall, and Parker Rule 2020. "A Reversible Recombination Chain for Redistricting." On file with authors.

to a proposed district: an unweighted score, a score that weights elections based on statewide voting patterns, and a score that weights elections based on voting patterns restricted to the proposed district itself. We will denote these scores by s^{unw}, s^{state}, and s^{dist}, respectively. Although election-weighting schemes differ across the three effectiveness scores, each score captures the same underlying idea: the effectiveness of a district for a minority group is keyed to the district's history of voting for minority-preferred candidates running for statewide offices. Importantly, because our districts are built from whole precincts and we have prior election results matched to those precincts, no statistical inference is required to determine which candidate prevailed in each district. We simply total up the votes cast in the district for each candidate and note which candidate got the most support.

First, we need to settle on the meaning of a successful outcome for the voters of a minority group in a particular election and district. If the candidate of choice from the primary does not advance to the runoff or general, then the outcome of the general is less informative with respect to the group's preferences. Therefore, we group elections by pairing primary and general (or grouping primary–runoff–general if applicable) as Table 3 illustrates for our Texas case study. A successful election is one in which the minority-preferred candidate in the primary prevailed in both elections in the grouping (or all three, if there was a primary runoff).[20]

Our weighting scheme is keyed to the *probative* value of each statewide election in determining minority effectiveness—its value as evidence. The unweighted score treats each election equally; no election is considered more probative than any other in determining a district's effectiveness. By contrast, the statewide weighted score s^{state} and the district weighted score s^{dist} treat some statewide elections as more probative than others and weight them accordingly. These *election weighting factors* each fall on a scale from zero to one. Their product is the final weight for an election. In keeping with case law, we up-weight elections if they have certain features:

- *Recent.* More recent elections provide stronger evidence of future electoral opportunity.
- *Clear candidate of choice.* As described above in section 4.1.2, our ecological-inference outputs come with estimates of the probability that the minority-preferred candidate in the primary election has been correctly identified. Translating this to a *confidence* that EI has identified the correct candidate gives greater weight to elections in which the minority group has a clearly preferred candidate.
- *Group member preferred.* An outcome gives stronger evidence of electoral opportunity when the minority-preferred candidate is a member of the particular minority group.

The weighting factors are summarized in Table 1. We discount elections for each year of age by a multiplicative factor of $2^{-1/4} \approx .841$, so that if any one election is four years older than another, it weighs half as much. The confidence that we have correctly identified the minority-preferred candidate is the same confidence score $C(p)$ described above (see footnote 15), using draws at the state level for s^{state} and drawing from the district-level coarse histogram for s^{dist}. When gauging Latino effectiveness, we place twice as much weight on elections in which the Latino-preferred candidate is Latino; and the analogous statement holds for other minority groups. Of course, these detailed weights are choices made by the modeler. We will introduce a calibration step for our effectiveness scores in the next section that makes our outputs more robust to these parameters, and we tested this by re-running the protocol several times with slightly different choices (see footnote 31).

These weighting factors are important for the legal interpretation we intend. More recent elections are up-weighted because the predictive value of election results tends to erode over time, as older voters pass away, younger citizens reach voting age, immigrants are naturalized, people move into or out of the district, and voters change their

[20]To be precise, suppose the primary candidate of choice is Candidate X and the runoff candidate of choice is Candidate Y (who might or might not be the same person as Candidate X). Then there are three cases we count as primary success. Case one: X won the primary (in the district) and there was no runoff. Case two: X received over 50% of the vote in the primary (in the district), whether or not there was a runoff. Case three: X ranked first or second in the primary (in the district) and Y won the runoff (in the district). An election set that meets one of these primary-success conditions and in which the minority-preferred nominee wins the general election in the district is counted as a successful election in the scores below.

TABLE 1. WEIGHTING FACTORS FOR EFFECTIVENESS SCORES

Score/Factor	*Recent*	*Clear candidate of choice*	*Group member preferred*
Unweighted (s^{unw})	1	1	1
Weighted/Statewide (s^{state})	1 Most recent .841 1 year prev. .707 2 years .595 3 years .500 4 years .421 5 years, etc.	Confidence from statewide EI	1 X belongs to group, .5 otherwise
Weighted/District (s^{dist})		Confidence from district-level EI	

The weighting factors for the unweighted, statewide, and district-based effectiveness scores (s^{unw}, s^{state}, and s^{dist}, respectively). All of these are computed with respect to the primary election in an election set, because the runoff and general may not contain the most-preferred candidate for the minority group. Here, Candidate X is the minority group's candidate of choice. These factors will be combined into an election-weighting term w for all elections in the dataset.

political preferences and behaviors. Confidence in correctly identifying candidates of choice is clearly pertinent, because a wrongly identified candidate of choice undermines all subsequent conclusions we will draw. Elections where the minority-preferred candidate belongs to the minority group in question are up-weighted because they are more probative: in the words of the late Judge Richard Arnold, the VRA's guarantee of equal opportunity is not met when "[c]andidates favored by [a minority group] can win, but only if the candidates are white" (*Smith* v. *Clinton* 1988, 1318).

We now have all the ingredients for the raw effectiveness score for a given district and racial group, multiplying the three factors above to get a weight $w = w(E, D)$ for each election and district. For instance, if we have 20 elections, then each w will be .05 for the s^{unw} score, no matter the election. For the statewide score s^{state}, the elections will not all count equally, so that, for example, a recent election with an in-group candidate will weigh four times as heavily as a four-year-old election with only white candidates.

Each effectiveness score is computed similarly:

$$\text{score of district } D = s(D) \ = \sum_{E \in \mathscr{E}} w \cdot \delta$$
$$= \text{weighted share of elections won by candidate of choice,}$$

where δ is 1 if the minority-preferred candidate carried the district and 0 otherwise. This expression applies to all three kinds of effectiveness scores $s = s^{\text{unw}}, s^{\text{state}}, s^{\text{dist}}$. For example, suppose there are two election groupings separated by four years, both have equal confidence weights and feature group members, and the candidate of choice is successful in one of those two election sets. Then the statewide and district raw scores of effectiveness would be 1/3 if the success was in the earlier election and 2/3 if the success was in the later election, while the unweighted score would be 1/2. The strength of using an approach that centers on electoral effectiveness rather than demographics is that we do not make evidence-free assumptions about how large a Latino population is needed to nominate and elect Latino-preferred candidates, or similarly for other minority groups. Rather, we directly and empirically answer that question by totaling up votes, district by district. Our direct, empirical approach is better keyed to actual minority electoral opportunities, and so also comports better with federal law. The VRA's plain text does not equate a minority-effective district with a majority-minority district; rather, it demands an assessment of whether minority citizens have an equal opportunity to "nominat[e]" and "elect representatives of their choice." And our empirical approach also respects the Equal Protection Clause's prohibition against relying on racial-percentage targets when drawing districts.

4.4. *Calibrating effectiveness scores*

The raw effectiveness scores described above combine election results in three different, reasonable ways. Each score ranges from zero (never electing minority-preferred candidates) to one (always electing them). We next convert these to calibrated scores that we will use when deciding whether to accept plans into the ensemble.

At this stage, we take a *group-control factor* into account, combining it with the raw effectiveness score because it is relevant to predicting future performance and to ensuring an emphasis on electoral success for larger numbers of minority voters. It is clear from redistricting case law that majority-minority districts are not required for VRA compliance, and indeed that setting out to draw districts with a demographic target is sometimes prohibited. At the same time, a district that has only 5% Black CVAP would not be reasonably viewed as an effective opportunity district for Black voters, on par with a district with more significant Black population. We have chosen to address this issue with a factor based on the minority group's share of district CVAP.[21] Group control of the district is relevant for two reasons. First, Section 2 of the VRA focuses on a minority group's ability to play a controlling or "decisive … role in the electoral process" and not merely one of "influence" (*LULAC* v. *Perry* 2006, 446 (plurality opinion) (citation and quotation marks omitted)). Second, because Section 2 protects the voting rights of a minority group's individual members, the effectiveness of a district should in part depend on the number of those members represented by their candidate of choice.

The goal of the calibration step is to bolster the *probabilistic* interpretation of the scores, so that, for example, a district with $s = .5$ can be described as having a 50/50 chance to perform for the minority group under consideration. To lend justification to this probabilistic interpretation, we apply a standard logistic regression to normalize the raw scores based on observed success data from actual enacted districts (specifically, all congressional, state Senate, and state House elections in the last decade).[22]

By design, the calibration step helps ensure that although the elections that are used in constructing the raw effectiveness scores are statewide contests, they still reflect election outcomes in *local* (districted) elections. We think of the logistic transformation as producing a score that best captures the observed performance of congressional, state Senate, and state House districts in the last decade. Each input (raw) score falls between zero and one; after applying the logit function we obtain an output (calibrated) effectiveness score that still falls between zero and one, but is now easier to interpret. We will reuse the same notation s^{unw}, s^{state}, s^{dist} for the outputs, taking care to refer to the scores as raw or calibrated when there is a possibility of confusion.

4.5. *Counting effective districts*

To assess whether a proposed plan complies with the VRA, we will need to count effective districts, and not just report scores. We elect to define a *Latino-effective* (or *Black-effective*) district as one whose calibrated effectiveness score estimates at least a certain threshold chance of both nominating and electing a Latino-preferred (or Black-preferred) candidate.

This threshold is a parameter to be set by the modeler, and it may involve considerable discretion. One consideration may be the mapmaker's level of risk aversion, since setting a lower threshold may result in a higher number of qualifying districts that can be simultaneously drawn, but some or all of those districts will be less certain to nominate and elect minority-preferred candidates. A second consideration may be how particular districts in the current enacted map have been characterized by judges and victorious litigants in prior redistricting litigation, or how they have actually performed in prior elections. A third consideration may be the number of statewide elections in the dataset: we may choose a higher effectiveness threshold if we have a smaller set of available elections, to account for the possibility that the signal from any single election is misleading.

In our Texas case study below, we have adopted the threshold condition $s > .6$—that is, to be deemed an *effective district*, we require a greater than 60% estimated chance of nominating and electing a minority-preferred candidate. We chose this figure in view of the above considerations, and because we found that districts with $s > .6$ in any one of our three scores were quite likely to have $s > .5$ in the other two versions, increasing our confidence

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[21]Namely, our group-control factor for a district is $c = \min(2k, 1)$ where k is the group's share of CVAP. Alternatively, the modeler could set an election-specific group-control factor in several reasonable ways: as the minority group's estimated share of votes for the candidate of choice; the group's estimated share of the district's Democratic primary electorate; or the estimated group votes for the minority-preferred candidate divided by the total votes for all candidates, for example.

[22]We tune logit curves $f(x) = 1/(1 + \exp(-(ax + b)))$ so that $f(0) \geq 0, f(1) \leq 1$, and $f(c \cdot s_i) \approx \delta_i$ where s_i are the raw effectiveness scores of enacted districts, c is group control, and $\delta_i \in \{0, 1\}$ are the ground-truth outcomes (with 1 for success) for the corresponding candidates of choice. The aim is to input a raw effectiveness score s and a group-control factor c and update s to a probability of effectiveness $f(cs)$. For details and examples, see Supplementary Appendix B.

– Ex. 10348 –

that the districts selected in this way are likely to perform more often than not.[23]

4.6. *Assembling the ingredients to build a VRA-conscious ensemble*

Running on a standard laptop, ReCom generates new plans at a pace of hundreds of plans per minute in the Python implementation in (MGGG Redistricting Lab 2018b), and runs about 40 times faster in the Julia implementation in (MGGG Redistricting Lab 2020b), depending on the size of the districting problem and the tightness of the constraints.[24] The VRA-conscious protocol implemented here in Python (MGGG Redistricting Lab 2020a) reassesses district effectiveness scores at each step, which slows the process somewhat, so that our runs take about 35 steps per minute for the unweighted and statewide scores and about 15 steps per minute for the district-level score on a state the size of Texas. For a smaller state like Louisiana, the speed more than doubles.

The last question to specify our protocol is how to set the numbers of effective districts that a proposed map must contain for each minority group, to be presumptively valid under the VRA and the Constitution, and thus to be included in our ensemble. Our first guide in answering this question is the state's most recent districting plan, which may have been in effect for up to a decade and either has gone unchallenged in court or has withstood legal challenges, including VRA claims.[25] The second guide, discussed above, is *rough proportionality*, within the meaning of the Supreme Court's important VRA decisions in *Gingles* and *De Grandy*: plans are frequently judged by whether the share of effective districts is similar to each group's share of statewide CVAP.

Considering these guides, we will reject proposed plans that have fewer minority-effective districts than the benchmark plan; in other words, we will treat this threshold level of effectiveness as a *validity check* in the district-generation algorithm. For instance, if we are considering a single minority group and the benchmark plan has three districts that are effective for that group, then each plan included in the ensemble must have at least three effective districts as well. On the other hand, we would reject a proposed plan if it had so many effective districts for one minority group that it would relegate another sizable demographic group to substantially sub-proportional representation.

Surveying the protocol described in this section, the key to our approach is its close reliance on detailed, precinct-level election results from both primary and general elections. We do not assume that some *a priori* demographic threshold will cleave districts that provide minority voters with realistic electoral opportunities from districts that will not. The approach is deeply empirical, focusing on whether a specific district, regardless of its precise demographic percentages, has a recent history of consistently supporting minority-preferred candidates in both primary and general elections. To quote Justice Kagan, our protocol is "evidence-based, data-based, statistics-based. Knowledge-based, one might say" (*Rucho* v. *Common Cause* 2019, 2519 (Kagan, J., dissenting)).

5. CASE STUDY: CONGRESSIONAL DISTRICTING IN TEXAS

We applied the VRA-conscious protocol described in section 4 of this article to build 36-district Texas congressional plans.

5.1. *Data*

We downloaded the 2018 Texas precinct shapefile and statewide election returns from the Texas Legislative Council's website (Texas Legislative Council 2020). Table 2 shows summaries of the demographic data obtained from the 2010 decennial census and the ACS rolling average for the five-year span

[23]Case law does not dictate how certain we must be of district effectiveness. When analyzing Texas districts, we found that rejection sampling for effectiveness ran as efficiently at the $s > .7$ threshold as it did at $s > .6$, suggesting that a modeler could exercise considerable discretion in setting the effectiveness threshold.

[24]To be more precise, we conducted non-VRA trial runs on Texas, Virginia, and Pennsylvania congressional plans built out of precincts using identical machines (Intel(R) Xeon(R) CPU E5-2660 v2 @ 2.20GHz [Ivy Bridge, late 2013]), allowing districts to deviate from ideal population by only 1%. Over runs of various lengths and with various seeds, the Python implementation generated three to eight valid plans per second, while the Julia implementation generated 120 to 320 valid plans per second.

[25]Numbers derived from this benchmark may need to be adjusted if the state's political geography or demographics or the number of districts in a state's plan has changed (for example, due to reapportionment of congressional seats). Our protocol can be run using a different map as a benchmark if there is reason to believe the current plan violates the VRA or the Constitution.

TABLE 2. TEXAS DEMOGRAPHICS

Racial group	*Share of total population*	*Share of VAP*	*Share of CVAP*
Latino	37.62%	33.61%	29.36%
Black	11.48%	11.36%	13.08%
White	45.33%	49.64%	52.28%
Other	5.57%	5.39%	5.28%
Total count	*25,145,561*	*18,279,737*	*17,858,066*

Latino, Black, White, and Other shares of Texas residents by total population, voting-age population (VAP), and citizen voting-age population (CVAP). Total population and VAP data are taken from the 2010 decennial census, while CVAP data comes from the American Community Survey (ACS) five-year rolling average ending in 2018.

ending in 2018. (We used CVAP from ACS five-year spans ending 2016, 2014, and 2012 when assessing elections from those years.) While election data could be directly joined to the shapefile, we used the maup package to disaggregate ACS data from block groups (the smallest unit for which CVAP is available) down to census blocks and then aggregated the block-level data up to precincts (MGGG Redistricting Lab 2018c). Total population and VAP were collected from the 2010 decennial census; and because these data are available at the block level, they required no proration and could be directly aggregated up to the precinct level.

We then analyzed 21 statewide Texas elections conducted from 2012 to 2018, which are recorded in Table 3. These were all the statewide elections conducted since the last round of redistricting almost a decade ago—for federal and state offices, both executive and legislative, omitting only state judicial elections.

Ultimately, we eliminated from consideration seven of those 21 elections (struck through in the table) because there was no contest in the Democratic primary, which in Texas is a critically important stage of the electoral process for determining which candidates are minority-preferred. We were left with 14 contests: nine primary/general sets and five primary/runoff/general sets, where the runoff was conducted because no candidate garnered an outright majority of the vote in the Democratic primary.

TABLE 3. THE 14 ELECTION SETS IN THE TEXAS DATA

	2012	*2014*	*2016*	*2018*
President	P/G		P/G	
U.S. Senator	P/R/G	P/R/G		P/G
Governor		P/G		P/R/G
Lieutenant Governor		~~G~~		P/G
Attorney General		~~G~~		~~G~~
Comptroller		~~G~~		P/G
Land Commissioner		~~G~~		P/G
Ag. Commissioner		P/R/G		~~G~~
RR Commissioner	~~G~~	P/G	P/R/G	P/G

The 14 election sets in our Texas data (5 of which included a primary runoff), and the 7 general elections that we omitted because the Democratic nominee lacked any primary opposition. P means Democratic primary; R means Democratic primary runoff; and G means general election.

We also compiled district-level data for the 36 U.S. House, 31 Texas Senate, and 150 Texas House of Representatives seats, including the race and party of the winning candidates in all elections from 2012 to 2018, as well as demographic data for the districts, for use in the score calibration described in section 4.4 and carried out in section 5.3 (History, Art, and Archives, U.S. House of Representatives, Office of the Historian, 2020a, 2020b).[26]

5.2. *Racial polarization and candidates of choice*

The statewide results for general elections in Texas show a stark pattern of racial polarization. Across 14 separate contests in four election cycles, all three minority groups consistently voted Democratic, and white voters consistently voted Republican, as shown in Figure 3. In Texas, it is commonplace for more than three-quarters of white voters to vote Republican and more than three-quarters of minority voters to vote Democratic in the same election. Furthermore, this basic pattern appears to hold, to a greater or lesser degree, in every region of the state.

It therefore is not surprising that the great majority of Texas's non-white officeholders are Democrats. From 2012 through 2018, there were only two exceptions for Representatives in Congress (out of 15 Latino or Black members) and eight exceptions for Texas state Senators or Representatives (out of 83 Latino or Black state legislators).

No Democratic candidate has won a statewide general election in Texas since 1994. So none of the Latino- or Black-preferred candidates in our 14 recent contests prevailed statewide. But the vote patterns show that each of them carried a significant number of *districts* in general elections under the current Texas congressional plan and under every plan in our ensembles.

Just as the Latino-preferred and Black-preferred candidates in all 14 statewide elections were Democrats (see Figure 3), the same has held true in

[26]See also Carl Klarner. 2019. "Racial Identification of State Legislators 2001–2019." Unpublished data set. Purchased from <http://klarnerpolitics.org/>.

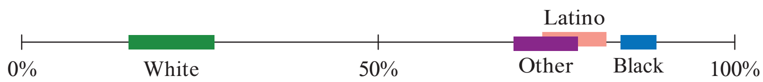

FIG. 3. The highest and lowest EI point estimates for each racial group's support of the 14 Democratic nominees in statewide general elections: White (15–27%), Other (69–78%), Latino (73–82%), and Black (84–89%).

congressional elections. The success of Latino- and Black-preferred congressional candidates in Texas therefore has hinged on their ability to win Democratic primaries (and, where applicable, primary runoffs) and then win general elections. A large majority of white voters in Texas primary elections participate in the Republican primary, while most people of color who participate in Texas primaries vote in the Democratic primary. So, for VRA purposes, we can currently forgo analysis of voting patterns in Republican primaries or Republican primary runoffs in Texas.

In Democratic primaries and primary runoffs, we found a high degree of cohesion across demographic groups. Because all 14 contests were for single-member offices (like governor), we focused on the one candidate in each Democratic primary who was preferred by each of the four demographic groups. In nine of the 14 Democratic primaries and in four of the five Democratic primary runoffs, the three minority groups (Latino, Black, Other) preferred the same candidate, as shown in Supplementary Appendix Table 7.

Given this cohesion in Democratic primaries and runoffs and especially in general elections, it might well be possible to treat Latino and Black voters, or Latino/Black/Other, as a single coalition group for VRA purposes (*Campos* v. *City of Baytown*, 1988, 1244–45). Our main analysis will treat Latino and Black voters as separate minority groups, but the same method could be adapted (and indeed simplified) for coalitional analysis.

As a final and important point relating to our EI setup, we note that we do not need to run EI on small geographies to detect regional difference.

For example, in the 2018 gubernatorial runoff, former Dallas County Sheriff Lupe Valdez and Houston's Andrew White are identified as the statewide candidates of choice for Latino voters and Black voters, respectively. But in the Dallas-Fort Worth Metroplex, Valdez carried both minority groups. As Figure 4 shows, that effect is visible in our EI outputs from a statewide run, because the hierarchical model works by computing distributions of support on each precinct. This lets us identify Valdez as the Black-preferred candidate in the Dallas-Fort Worth Metroplex while White is seen to have carried the Black vote in the Houston area.

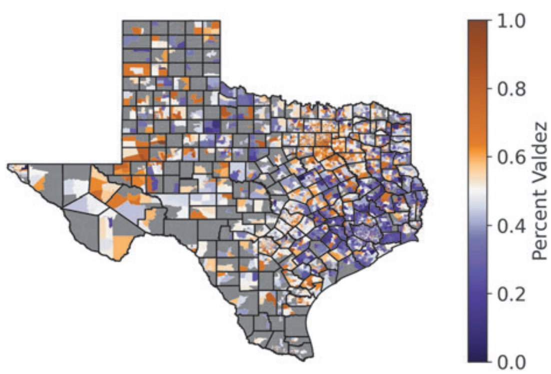

FIG. 4. The distribution of EI-estimated Black support for former Dallas County Sheriff Lupe Valdez in the 2018 gubernatorial runoff. The Dallas-Fort Worth area, in northeastern Texas, is mostly *orange* in this map, while the Houston area, in southeastern Texas, is mostly *purple.* (The map's *gray areas* contain few, if any, Black voters.) This map shows that even statewide EI can find significant regional variation in a group's voter preferences.

5.3. *Effectiveness scores and inclusion criteria*

In Texas, we have the benefit of seeing results from 33 separate contests (14 primaries, 5 primary runoffs, and 14 generals), so that 14 potential successes make up the raw effectiveness score.[27]

According to recent CVAP data (shown in Table 2 above), rough proportionality would require 10.6 districts and 4.7 districts that are effective for Latino voters and Black voters, respectively, given Texas's current congressional apportionment of 36 seats. We will round these to 11 and 5 districts, respectively. If Latino, Black, and Other voters were treated as a coalition, that coalition's proportional share would exceed 17 districts.

Using any of our three calibrated scores, Texas currently has 11 effective districts for minority groups at the 60% threshold: seven Latino-effective districts,

[27]To perform the logit calibration step described in section 4.4, we used all congressional and state-legislative winners from 2012 to 2018. This includes 145 congressional contests (36 districts), 600 state House contests (150 districts), and 77 state Senate contests (31 districts), for a total of 822 data points. This includes one special election for Congress.

Table 4. Statistics for Effective Districts in Current Texas Congressional Plan

CD	Location	HCVAP %	Latino effective s^{unw}	Latino effective s^{state}	Latino effective s^{dist}	BCVAP %	Black effective s^{unw}	Black effective s^{state}	Black effective s^{dist}	WCVAP %	Representative	Race
9	Houston	24.7	44	38	43	46.7	96	96	94	16.1	Al Green	Black
15	South Texas	73.7	95	97	97	2.5	8	9	7	22.1	Vicente Gonzalez	Latino
16	El Paso	76.0	99	99	97	4.2	11	12	10	17.5	Veronica Escobar	Latino
18	Houston	26.9	51	44	51	44.9	95	95	95	22.8	Sheila Jackson Lee	Black
20	San Antonio	65.0	97	97	97	5.6	12	12	12	25.8	Joaquin Castro	Latino
28	South Texas	69.2	86	93	96	5.5	10	12	8	23.2	Henry Cuellar	Latino
29	Houston	64.0	98	97	97	16.2	49	48	46	16.7	Sylvia R. Garcia	Latino
30	DFW	22.7	44	38	39	52.1	99+	99+	99	21.7	Eddie Bernice Johnson	Black
33	DFW	46.5	98	98	95	24.1	78	75	64	25.6	Marc A. Veasey	Black
34	South Texas	78.5	98	99	93	1.6	8	9	6	19.1	Filemon B. Vela	Latino
35	Austin/San Antonio	52.2	97	97	97	10.3	22	20	24	34.4	Lloyd Doggett	White

The population shares and calibrated effectiveness scores for the 11 districts in the current Texas congressional map that are labeled effective for Latino and/or Black voters. Scores over 60% have darker shading, and scores in the 50–60% range have lighter shading. Mark Veasey's District 33 is the only one that registers as effective for both Latino and Black voters, though Sheila Jackson Lee's District 18 and Sylvia Garcia's District 29 are close. All 11 Representatives are Democrats.

three Black-effective districts, and one district that is effective for both groups (see Table 4). If our protocol focused solely on the most recent elections (e.g., 2018), however, two additional districts—District 7, currently represented by Lizzie Fletcher, a white Democrat, and District 32, currently represented by Colin Allred, a Black Democrat—might meet the effectiveness thresholds for Latino voters or Black voters under some or all of our three calibrated scores. But in the early years of the decade (e.g., 2012 and 2014) both districts were still reliably voting for Republicans in statewide and congressional elections.

Since the current map has withstood judicial scrutiny under both the VRA and the Equal Protection Clause (*Abbott* v. *Perez* 2018, 2324–34), we require plans in our VRA-conscious ensemble to meet or exceed that map's level of effectiveness: so we require at least eight Latino-effective districts, at least four Black-effective districts, and a total of at least 11 districts that are effective for at least one of the groups. So, for example, a plan whose (Latino, Black, Both, Neither) effective-district count was (4, 0, 4, 28) would not qualify for the ensemble because it falls short of 11 minority-effective districts. In effect, this approach allows plans whose effective-district counts are (7, 3, 1, 25) or (8, 4, 0, 24), as well as plans that dominate one of those outcomes from the minority perspective by shifting districts from Neither to any of the other categories.[28]

5.4. Basic results

In this section we first present evidence to support the claim that our chains of districting plans have produced VRA-conscious ensembles whose statistics have stabilized after 100,000 steps. We then look at how the statistics from these ensembles compare to an ensemble built with no consideration of race and to an ensemble generated with demographic thresholds as a potential stand-in for VRA compliance. Put differently, we compare ensembles generated by our VRA-conscious protocol, which uses both racial and electoral data, with an ensemble built with racial but not electoral data and an ensemble built with neither racial nor electoral data.

We built five ReCom ensembles, by running each of the following kinds of chain until 100,000 maps are accepted.

(non-VRA) *No VRA consideration.* Only population equality is an explicit validity check, since contiguity is required and compactness is weighted into ReCom ensembles by construction, so the algorithm does not have to be manipulated to produce reasonably compact districts.

(unw) *Constrained by* s^{unw} *effectiveness.* Ensemble inclusion additionally requires at least eight districts over 60% Latino-effective, at least four districts over 60% Black-effective, and at least 11 total districts effective for one or both groups, using unweighted effectiveness scores.

(state) *Constrained by* s^{state} *effectiveness.* Same as above, but using statewide weighted scores.

[28] Although a map with fewer than 18 Neither districts could potentially give rise to a Section 2 claim by white plaintiffs and thus merit exclusion from an ensemble, our chain runs did not generate any such plan.

(dist) *Constrained by s^{dist} effectiveness.* Same as above, but using district weighted scores.

(CVAP) *Constrained by CVAP shares.* A plan must have at least eight districts over 45% HCVAP and at least four districts over 25% BCVAP to pass the validity check.[29]

5.4.1. Convergence heuristics and robustness checks. Neither ReCom nor any other MCMC method will work properly if it is not allowed to run long enough, or if designed in a way that thwarts convergence. In this article we have used ensembles built by including every plan that passes the validity checks and continuing until 500,000 maps are collected. We used two kinds of evidence to arrive at the conclusion that 500,000 plans are probably sufficient: first, we have confirmed that chains of that length have aggregate statistical properties that are approximately independent of their starting points, or "seeds," even when the seeds are quite different. This test is sometimes called the *multistart heuristic*. Second, for selected instances we have confirmed that an ensemble ten times as large has similar aggregate statistics. Passing these tests is not a rigorous proof of approximately representative sampling, but these are standard convergence heuristics used across applied statistics. If any ensemble method fails these tests, we can be sure that either the setup violates the conditions for a unique steady state, or we have not run the chain long enough to approach it.

For the multistart heuristic to have high value, we should choose plans that are initially very different and check to see that the ensembles converge to find the same summary statistics nevertheless. The first seed plan used for the multistart test for this Texas case study is the enacted congressional plan that is currently in effect, which came out of the court proceedings challenging the early-decade plan of the Republican legislature. To find two other seeds with exaggerated differences from the enacted plan, we turned to the Atlas of Redistricting project conducted by the politics team at FiveThirtyEight (Bycoffe et al. 2018). Seed 2 is their Texas plan drawn to favor Democrats, which is visibly quite different from the enacted plan and of course has very different partisan properties as well. Seed 3 is based on the plan FiveThirtyEight drew with an eye to compactness scores and county integrity.[30]

For the ensemble using the statewide effectiveness score, Figure 5 shows that a simple partisan statistic—the Clinton share of the major-party presidential vote from November 2016 across the 36 districts—gives roughly the same answers after 100,000 steps, whether the chain commences with the enacted plan or with either of the two other seed plans. Similar charts for s^{unw} and s^{dist} are found in Supplementary Appendix Figure 17. These are boxplots (or "box-and-whiskers plots") where for each plan the districts have been sorted from 1 (the district with the lowest Clinton share) to 36 (highest Clinton share). The boxes show the values at the 25th to 75th percentiles, with the median marked, and the whiskers are set at the 1st and 99th percentiles. Colored circles show the initial values for the enacted congressional plan (red) and the two additional seed plans (blue and green). The aggregate data collected from the three differently initialized runs is broadly consonant: across the districts, the three ensembles have medians, quartiles, and overall ranges within one or two percentage points of each other, even when the seeds began over 15 points apart. By contrast, Figure 6 focuses on the 18 districts with the highest Clinton share to show that our VRA-conscious ensembles, by any of the three scores, do perform differently than if a user either ignored the VRA entirely or used the CVAP demographic constraint as a VRA proxy.

We can also compare spatialized statistics such as the one shown in Figure 7, a record of the number of times that each precinct appeared in a district with $s^{state} > .6$. Just 1,000 steps from the starting point, the heatmaps are visibly different, showing that the chain has not run long enough for this statistic to converge. Much nearer visual correspondence is achieved after 10,000 steps, and the heatmaps are nearly indistinguishable after 100,000 steps.

Beyond the multistart trials, we also checked the same statistics (Clinton vote distribution and cutedges score) after 1 million steps. We found

[29]To build a demographic-target ensemble, we searched for maps with at least eight majority-Latino districts and at least four majority-Black districts by CVAP. Initial attempts did not produce any such maps. We then lowered the thresholds to 45% for Latino CVAP and 25% for Black CVAP. While those thresholds are somewhat arbitrary, they roughly track Table 4, as well as the results of section 6 shown in Figure 9.

[30]The FiveThirtyEight compact plan did not initially meet our VRA effectiveness requirements, so we used a heuristic-optimization run as in Supplementary Appendix H to get it past the thresholds. Both FiveThirtyEight plans had to be transferred onto our precinct units with the maup package (MGGG Redistricting Lab, 2018c).

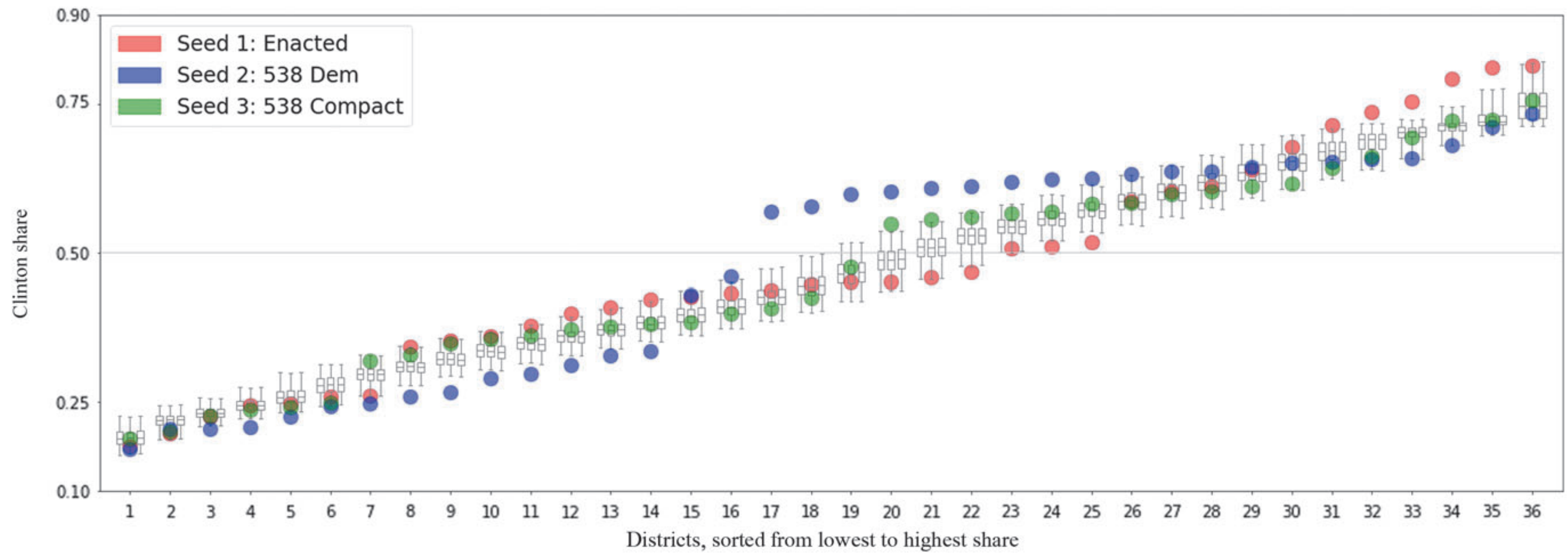

FIG. 5. In this multistart heuristic convergence test, the VRA-conscious chain for the statewide weighted effectiveness score s^{state} is run for 500,000 steps from three very different starting points. The colored dots show the Clinton share of the major-party vote from the 2016 presidential general election, district by district, in the three seed plans described in the text (with the districts sorted from lowest Clinton share to highest). The *boxes and whiskers* show Clinton share by district for each of the three ensembles—they have converged to within one or two percentage points in each district, even though the seed plans sometimes differ by 15 points or more.

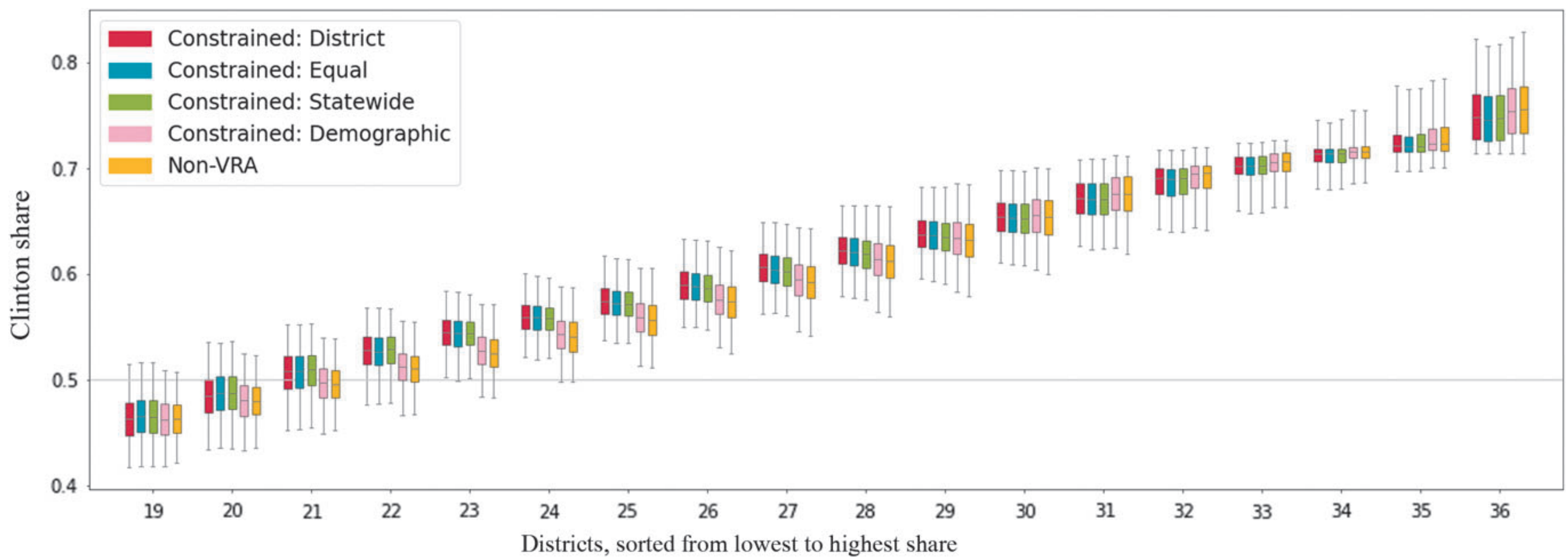

FIG. 6. Comparing the three kinds of VRA-conscious ensembles, constrained by the s^{dist}, s^{unw}, s^{state} scores, respectively, to the alternatives described in the text. Here, the Clinton share is plotted across 500,000 steps and displayed for the 18 most Democratic districts. There is a small but discernible difference that separates the partisan statistics of the VRA-conscious ensembles from those of the control ensembles, which are interestingly similar.

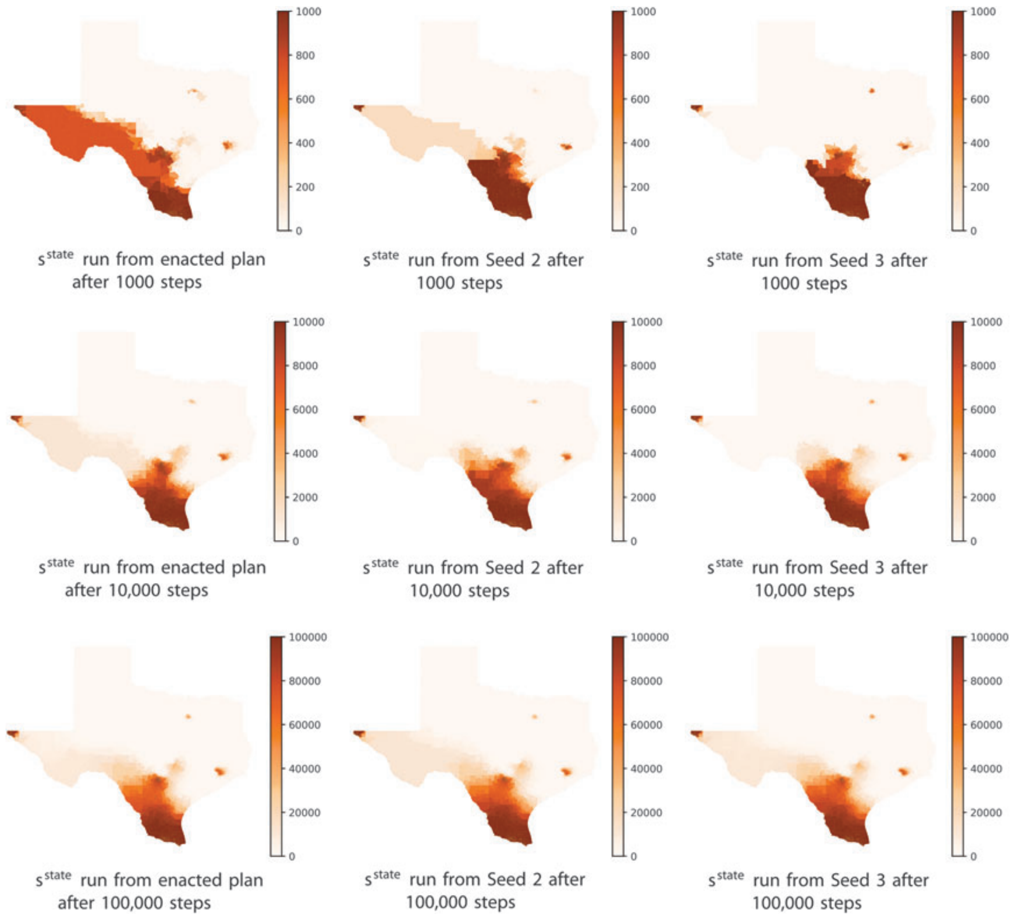

FIG. 7. The *color* of each precinct shows how many times it had appeared in a Latino-effective district after 1,000, 10,000, and 100,000 steps. These VRA-conscious ensembles are drawn with respect to the s^{state} score from the same three seed maps described in the text. There are initially significant differences across the three seeds (*top row*), but the plots converge over the course of the run (*bottom row*).

minimal difference in partisan or district-shape metrics when comparing the initial 100,000 steps, a sub-sampled 100,000-plan ensemble containing every tenth map from the set of 1 million, or the full million-plan ensemble. This raises our confidence both that the size of the sample is adequate to this level of statistical detail and that a run length in the hundreds of thousands is sufficient for convergence. Finally, we conducted slightly altered runs to confirm whether the general findings are robust to reasonable perturbations in the methodology laid out in sections 4.3, 4.4, and 4.5.[31]

[31] We conducted the following tests: using estimated share of candidate support rather than CVAP share of the district as the group-control factor *c*; replacing the confidence term for correctly identifying candidates of choice $C(p)$ with the simpler term *p*; and dropping both the group-control factor and the calibration entirely. For the alternative group-control measure, the changes to scores on Texas congressional plans were minor for both the enacted plan and generated plans. Changes also were typically small with the simplified confidence factor, but the scores became more unstable because outcomes with high EI-based uncertainty had more weight relative to clear outcomes, producing an illusion of greater electoral success on some reruns of EI. The logit calibration was valuable largely to correct for the reduction of scores by group control; we find that if we drop both of them, districts with significant shares of both Latino and Black voters are rated higher for both groups than recent electoral history warrants. Finally, we confirmed that the rate of ensemble generation is similar whether the effectiveness threshold is set at 60%, 70%, or even 75%. Taken together, these robustness runs increase our confidence that each of these parameters that requires user choice is indeed doing work in constructing a stable score that comports with electoral history, but that some of the details could be altered without breaking the protocol.

5.4.2. Comparing ensembles. In this section we compare the five ensembles defined in section 5.4 to each other, considering whether those created using our VRA-conscious protocol differ significantly from those created without electoral data or without both electoral and racial data. The answer is a definitive yes. We have already seen that the three effectiveness scores are similar to each other for the enacted plan's minority-effective districts (Table 4). Using summary statistics, we can confirm that the constrained ensembles using the three scores are similar to each other as well. But the three VRA-conscious ensembles do not resemble either the non-VRA ensemble (which uses neither electoral nor racial data) or the CVAP-shares ensemble (which uses racial, but not electoral, data as a purported stand-in for VRA compliance).

The upshot of rejecting plans with not enough effective districts is seen in Figure 8 with respect to the s^{state} score: no plan in the ensemble has fewer than eight Latino-effective or fewer than four Black-effective districts. This number of effective districts rarely happens by chance without a VRA-conscious method. Interestingly, enforcing the demographic threshold condition (bottom row) makes it somewhat more common to get at least four Black-effective districts but does not make an appreciable difference in the likelihood of creating an eighth Latino-effective district. (Supplementary Appendix F contains analogous plots for the s^{dist} and s^{unw} scores.)

Table 5 is another view of the comparison. A significant share of the plans in all the VRA-conscious ensembles pass the demographic test set forth above, but relatively few plans in the non-VRA and the

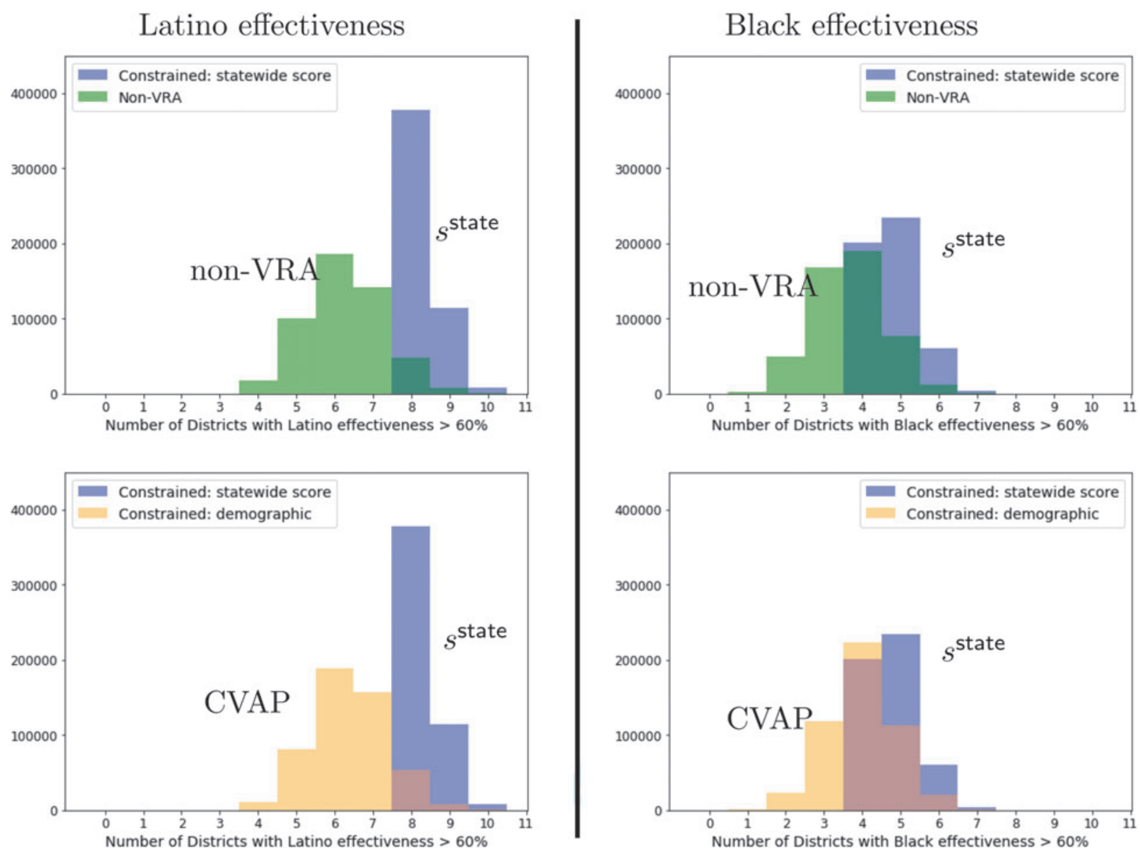

FIG. 8. The distribution of Latino- and Black-effective districts in a VRA-conscious ensemble (*purple*), compared to the non-VRA alternative (*top*, in *green*) and the CVAP-shares, demographics-based alternative (*bottom*, in *orange*). All are shown with respect to the s^{state} score. Note the very modest improvement in effectiveness for the CVAP-shares ensemble compared to the non-VRA ensemble.

TABLE 5. THE SHARE OF MAPS IN THE FIVE ENSEMBLES (COLUMNS) SATISFYING VARIOUS CRITERIA (ROWS)

		Unconstrained (non-VRA)	Constrained (s^{unw})	Constrained (s^{state})	Constrained (s^{dist})	Constrained (CVAP)
Satisfies	(s^{unw})	15%	(100%)	88%	81%	20%
effectiveness	(s^{state})	20%	98%	(100%)	94%	26%
criteria	(s^{dist})	16%	72%	78%	(100%)	22%
Satisfies demographic criteria		30%	39%	46%	51%	(100%)

For the effectiveness criteria, maps must have at least eight Latino-effective districts (effectiveness over 50% for the indicated score), at least four Black-effective districts, and at least 11 distinct districts that are effective (for one or both groups) overall. Note that each VRA-conscious variant is built to satisfy effectiveness in a chosen score at the 60% level, making it likely to pass at least 11 district effectiveness tests for the other scores at the 50% level, since the scores are similar but not identical. The demographic test in the bottom row requires a map to have at least eight districts over 45% HCVAP and at least four districts over 25% BCVAP.

CVAP-shares ensembles pass our effectiveness tests.[32] This suggests that Texas ensembles built without rich electoral data—or by imposing a racial threshold—are unlikely to reflect VRA compliance and might well contain far too many maps that violate federal law. And this problem likely cannot be cured simply by changing the threshold levels for the CVAP-shares ensemble: if the CVAP thresholds are raised, it will become harder to find plans with enough qualifying districts, and many effective districts will be missed.

Comparing the three score-based ensembles against each other shows some differences but also substantial alignment in the determinations of validity. We should not be surprised that scores that typically track each other within a few percentage points can fall on the other side of a bright-line threshold: if s^{unw} is just over .6, it can certainly happen that s^{dist} is just below that level. But most districts for which one score is over .6 have the other scores over .5, making them more likely than not to be effective for the group in question. This standard is met by more than three-quarters of the s^{state} and s^{dist} ensembles. (Again, this is part of the justification to set the effectiveness threshold for ensemble inclusion at a level buffered safely above 50%.)

Considering all the evidence so far, one might ask whether any of the three calibrated effectiveness scores is to be preferred to the other two. Our determination is that all three scores can be useful. The unweighted score has the weakest claim of the three, because on its face it omits factors that are legally and factually relevant. As for the other two scores, we think it can be valuable to consider both. The district-weighted score has more regional discernment and a more sophisticated incorporation of EI outputs; the statewide-weighted score has a simpler explanation and still takes uncertainty into account. While results for different scores are not identical, the modeling methodology is robust across three reasonable ways of weighting elections to measure district effectiveness.

6. LEARNING PATTERNS IN DISTRICT EFFECTIVENESS

We have just seen that Texas congressional ensembles using demographic data but no electoral data do not resemble ensembles generated by our VRA-conscious, heavily data-driven protocol. But what about a method that uses both demographics and electoral data but in a limited way, needing only a smaller and simpler dataset? Often, scores that seem to be complicated by taking many things into account can be closely replicated using simpler inputs. In our setting, we would like to see whether our seemingly sophisticated handling of dozens of election contests could be well approximated by pared-down district metrics. To examine this question, we now model the nonlinear relationship between effectiveness scores and lower-dimensional combinations of demographic and partisan features.

In statistics and machine learning, numerous techniques have been developed to recognize patterns in data. *Classifier* models use training data to “learn” discrete labels (like yes/no effectiveness), while *regression* models “learn” continuous-

[32]That only about half the maps in the three VRA-conscious ensembles satisfy the demographic criteria implies that it is not uncommon in Texas for Latino-effective districts to have less than 45% HCVAP or for Black-effective districts to have less than 25% BCVAP. That fact in turn suggests that, at least in some parts of the state, there is significant coalitional voting between different minority groups.

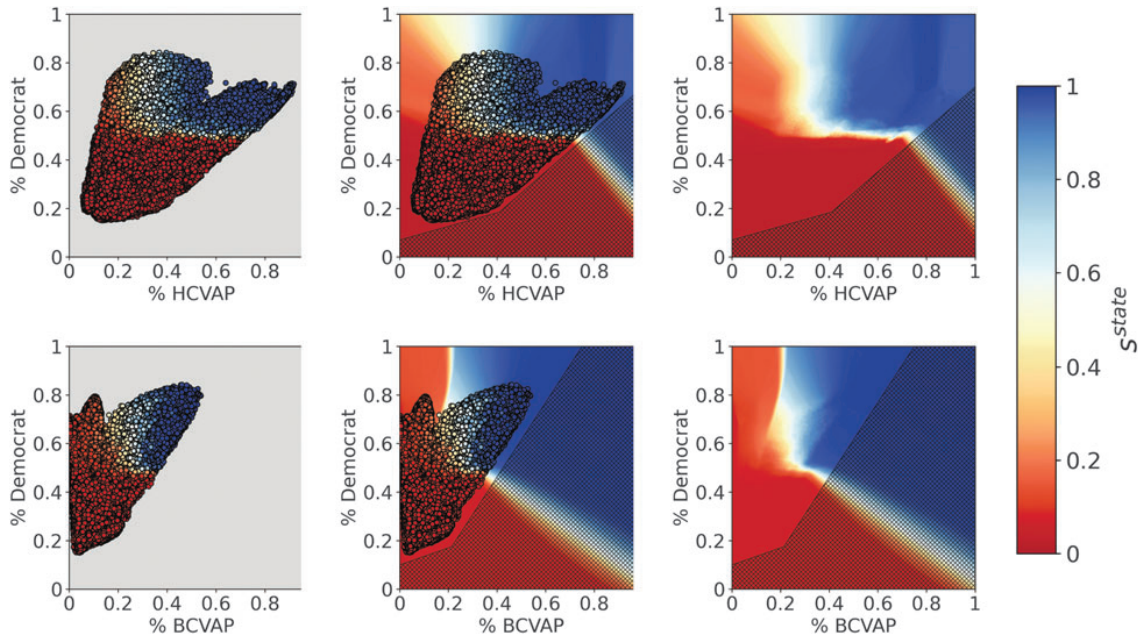

FIG. 9. The *top row* refers to effectiveness for Latino voters and to Latino CVAP; the *bottom row* to corresponding statistics for Black voters. Two-dimensional scatterplots (*left column*) show a collection of districts drawn from a non-VRA ensemble, arranged by Latino or Black CVAP share on the *x* axis and partisan lean on the *y* axis, then colored by their s^{state} score for Latino- or Black-effectiveness, respectively. The *k*-nearest-neighbors (KNN) method is "trained" on that data to infer approximate scores for all possible positions in the square (shown with the training data in the *center figures* and without it at *right*). The hatched areas in the *center and right-hand plots* contain no labeled data points, so the KNN estimates are less meaningful in those areas.

valued assignments (like effectiveness scores), on the basis of features in the data. For our examples, we are choosing to classify potential Texas congressional districts on the basis of two kinds of features:

- *Demographics*, using Latino and Black CVAP shares; and
- *Partisan lean*, obtained by averaging the Democratic shares of the 2016 and 2012 major-party presidential vote, with the more recent general election weighted twice as heavily as the older one.

We begin with a (non-VRA) ensemble of 500,000 plans, then extract the districts from each to make a large dataset, containing 997,163 districts after de-duplication. For each district, we compute its statewide weighted effectiveness score s^{state}. We randomly separate these districts into training data (80%) and data points held back for testing and validation (20%).

We attempted several kinds of models. A *k*-nearest neighbors (KNN) model assigns a value to each point based on the *k* points in the training data that are closest to its location. This can be thought of as a predicted effectiveness score for districts that may be proposed in the future. The choice of *k* is made by a validation step that attempts many different values and chooses the one that provides the highest accuracy.[33] For the regression, the learned value assigned to a point is the average value of its *k* nearest neighbors, while the yes/no classification is made by selecting the majority label among those neighbors.

The outcomes of two-dimensional KNN regression are shown in Figure 9. They show a complicated district-level relationship between effectiveness (color), Latino or Black CVAP shares (*x* axis), and partisan lean (*y* axis). If the effectiveness of districts could be captured with CVAP

[33]To be precise, we use *m*-fold cross-validation with $m = 10$, then choose the *k* for KNN with the best average r^2 and mean squared error (MSE) over those ten-fold trials. Using those values of *k*, the final accuracy estimates use the full set of training data and are then corroborated against the withheld testing data.

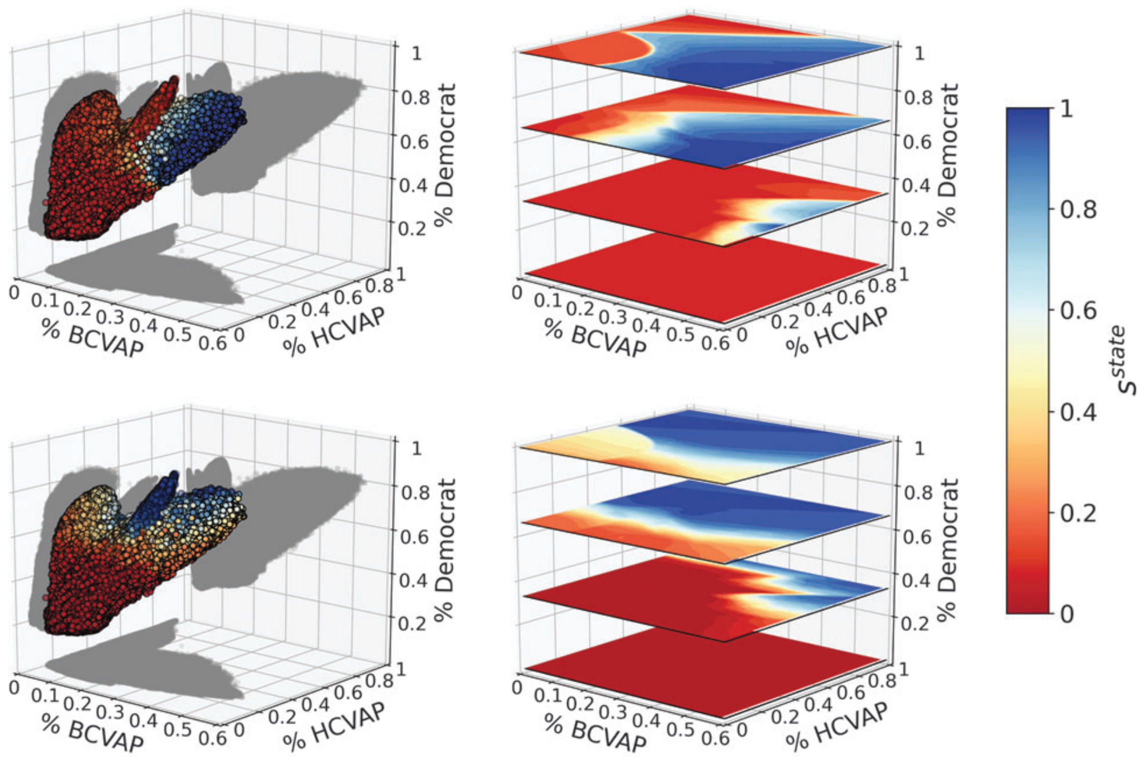

FIG. 10. KNN regression for a three-dimensional scatterplot of district effectiveness.

shares alone, we would see a vertical line dividing the effective (blue) from the ineffective (red) zones. If overall partisanship were a good predictor on its own, we might see a horizontal dividing line; this is not the case, but we note that partisanship alone is more predictive for Latino effectiveness. If effectiveness could be expressed in a simple linear relationship between partisan lean and CVAP, we would see a straight line of some slope separating the blue and red regions. Instead, we see a more complicated frontier with a large zone of ambiguity, especially in Latino effectiveness.[34]

Because Texas has two sizable minority groups, and Latino and Black voters often have overlapping electoral preferences, we might hope to do better by taking both groups' CVAP shares into account simultaneously. To this end, Figure 10 shows the same kind of regressions in three dimensions: Latino CVAP, Black CVAP, and the same measure of partisan lean. These plots still reveal complex, nonlinear frontiers and significant zones of ambiguity.

Further pattern-recognition results using various models for regression and classification are found in Supplementary Appendix G. Together, these methods indicate that scores built from our involved electoral methodology do not easily reduce to combinations of CVAP demographics and general-election partisan lean. This leads us to conclude that electoral complexity, perhaps especially the dynamics of actual primary elections, is playing an ineliminable role in our determination of district effectiveness.

7. CLOSING THE REPRESENTATION GAP

Finally, we return to where this article began: the underrepresentation of communities of color at both the federal and state level. The algorithmic techniques described in this article can be readily

[34]Grofman, Handley, and Lublin (2001) studied what amounts to effectiveness classification in a similar feature space nearly 20 years ago, positing an "elbow" or V-shaped frontier of effectiveness. For a comparison of our classification results with their framework, see Supplementary Appendix G.

reconfigured to point the way to maps that are likely to promote significant gains in minority representation.

7.1. *Searching for higher effectiveness*

Recall first that our VRA-conscious ensembles are made by imposing yes/no validity constraints rather than a probabilistic tilt or bias: the proposal of new plans is made without regard to race, and the validity criteria are given by a threshold test, with no preference for plans that exceed the threshold by a wider margin. It is therefore unsurprising that this procedure does not on its own favor the creation of plans that greatly surpass the status quo in minority electoral opportunities. But—so long as districts are population-balanced, contiguous, reasonably compact, and constructed largely or entirely from intact precincts, as is the case across all our ensembles—maps generating rough proportionality for all sizable minority groups might well be the ones that actually minimize legal exposure under both the VRA and the Equal Protection Clause.

By shifting to an algorithm that has a tilted acceptance function favoring increased minority electoral opportunities, we found it to be straightforward to create maps that fully meet (or even exceed) rough proportionality simultaneously for multiple minority groups. For example, in Texas we were able to create maps that are effective enough to typically meet rough proportionality simultaneously for both Latino and Black voters, while not sacrificing districts to double-counting—i.e., while achieving near-proportionality for people of color overall as well as for each group individually. A *heuristic optimization* algorithm can preferentially accept maps with higher minority effectiveness. We carried this out with the general "short bursts" strategy outlined in Cannon et al. 2020; for details, see Supplementary Appendix H.

To be clear: maps proposed for adoption should be developed through human deliberation based on significant community input and a broader range of criteria and values than our algorithm incorporates. No map plucked from an ensemble is likely to satisfy all human desiderata off the shelf. But just to demonstrate that a map with eight Latino-effective districts and four Black-effective districts can be replaced by one with (at least) ten and five such districts, respectively, we examine one demonstration plan found in a local search.

7.2. *A demonstration plan*

Our demonstration plan is depicted in Figure 11, and its effectiveness statistics by district are shown in Table 6.

We emphasize that this map is not intended to be an ideal map. But it does show that a carefully drawn plan could be dramatically fairer for historically underrepresented minority groups in Texas. We call it a "demonstration map" because it demonstrates that the shortfall of minority representation in the status quo map can be cured. The failure to do so can be attributed not to geography or law, but only to line-drawing.

In Table 6, we have *uncoupled* the primary and general elections, to give a more detailed view of the electoral history of these districts. In other words, this table shows the primary/runoff success independent of the general-election outcome, while our effectiveness-scoring system requires wins in both the primary (or primary and runoff) and the general, to be counted as a success. The table shows that, using any of the three scores, the demonstration plan contains at least 11, and perhaps as many as 13, effective districts for Latino voters and at least five, and perhaps as many as seven, effective districts for Black voters. Because one district in the Dallas area (District 33) and at least one in the Houston area (District 18) appear to be effective for both Black and Latino voters, the total number of minority-effective districts in the demonstration plan is 14, 15, or 16, depending on whether you rely on the unweighted, statewide, or district scores, respectively. Only one of the 16 districts is majority-white by CVAP.

Several of these 16 highlighted districts have demographics and effectiveness scores similar to those of the minority-effective districts in the current enacted plan (compare Table 4). However, in the current enacted plan, every district except Congressman Veasey's District 33 follows the rule that districts marked effective for Latino voters have HCVAP over 50% and those marked effective for Black voters have BCVAP over 40%. By contrast, the demonstration plan presented here features several effective districts with lower Latino and Black population percentages. For example, the Austin-based District 27 is a Latino-effective district with an HCVAP a shade under 40%, and the Houston-based District 9 is a Black-effective district with a BCVAP of only 28.6%. We emphasize that each

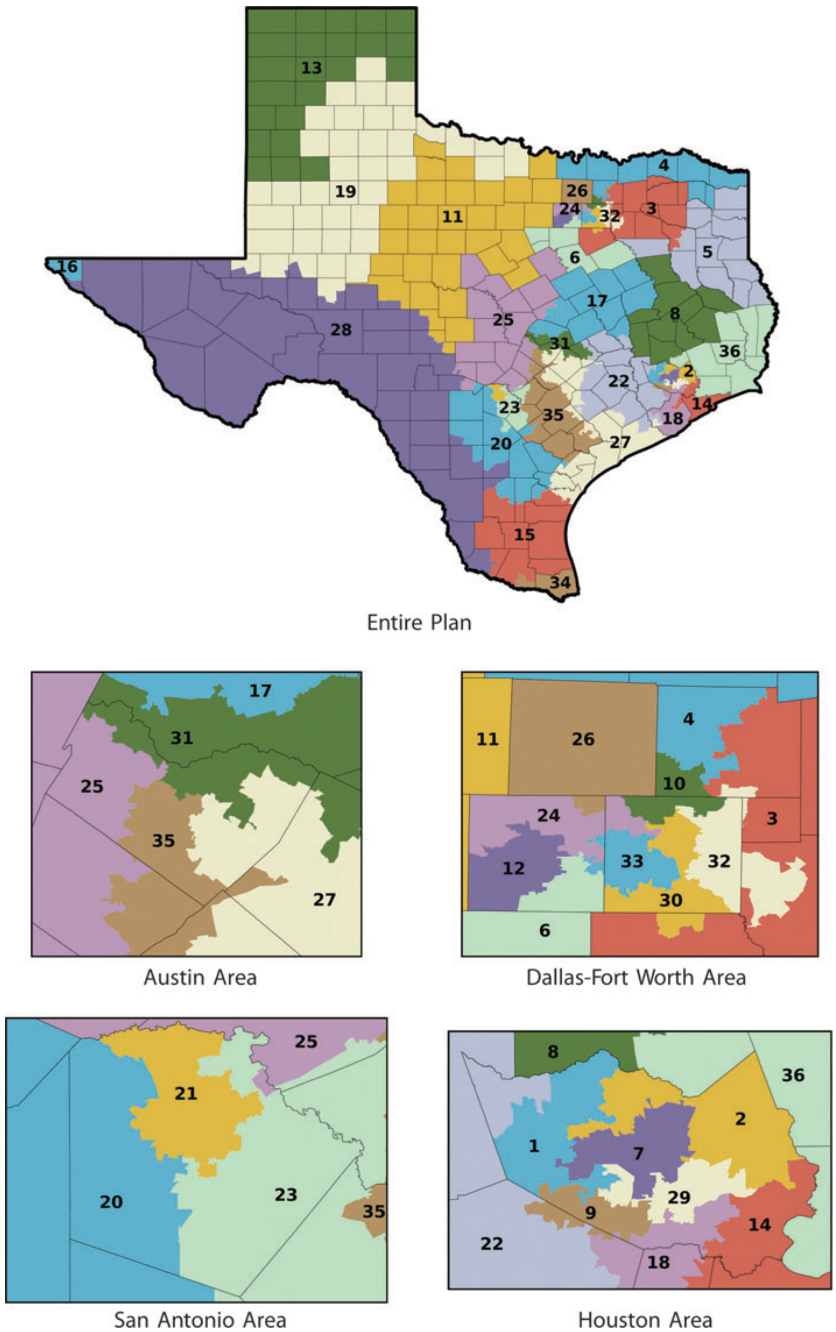

FIG. 11. An interesting demonstration plan found by heuristic optimization.

of those demonstration districts earned its effectiveness score by voting for the Latino- or Black-preferred candidates, respectively, in nearly every statewide election conducted in the last decade.

This map refutes the notion that demographics is destiny when it comes to Texas congressional districts. It contains districts that are majority-minority but not minority-effective (District 2), majority-white but Latino-effective (District 35), plurality-white but Black-effective (Districts 9, 30, and 32) or Latino-effective (Districts 27 and 29), and plurality-Latino but Black-effective

Table 6. Statistics for Effective Districts in Demonstration Texas Congressional Plan

Demonstration Plan

CD	Location	HCVAP %	Latino effective s^{unw}	Latino effective s^{state}	Latino effective s^{dist}	BCVAP %	Black effective s^{unw}	Black effective s^{state}	Black effective s^{dist}	WCVAP %	14 Primaries Latino	14 Primaries Black	14 Gen (Dem.)
7	Houston	36.5	77	65	77	25.5	70	58	31	31.4	9–13	9–10	14
9	Houston	23.3	40	30	33	28.6	78	66	75	31.5	10–12	10–12	14
15	South Texas	78.8	97	98	96	1.7	8	9	6	17.5	12–14	10–11	14
16	El Paso	76.1	99	99	97	4.2	11	12	10	17.4	13–14	11–14	14
18	Houston	32.0	66	59	63	30.7	76	77	69	30.4	10–13	10–12	14
20	San Antonio	60.6	77	82	76	5.5	10	11	9	30.9	12–14	12–13	9
21	San Antonio	47.5	35	74	79	5.6	8	8	8	42.9	12–14	10–14	7
23	San Antonio	51.1	77	82	79	10.7	14	15	14	34.7	12–14	10–12	9
27	Austin/Gulf Coast	39.8	84	85	85	8.8	17	16	18	47.7	12–13	10–14	13
28	South/West Texas	81.4	91	95	96	1.0	7	8	6	16.6	11–14	9–11	14
29	Houston	33.4	70	57	75	25.5	70	58	52	35.5	9–11	9–12	14
30	DFW	15.5	20	15	13	31.8	85	84	69	48.5	9–10	10–11	14
32	DFW	24.1	24	26	28	24.4	52	67	62	44.9	10–13	12–14	10
33	DFW	37.0	85	80	66	32.9	96	97	88	25.1	10–11	13	14
34	South Texas	86.7	97	98	97	0.4	6	7	5	12.3	11–14	9–11	14
35	Austin	30.7	62	62	67	4.8	10	10	9	60.6	11–13	9–10	14

District 27 (with statewide candidates of choice)

		Primary election		Primary runoff election		General election	
		Latino-pref.	Winner	Latino-pref.	Winner	Latino-pref.	Winner
President	2012	Obama	Obama ✓			Obama	Obama ✓
U.S. Senator	2012	Sadler	Sadler ✓	Sadler	Sadler ✓	Sadler	Sadler ✓
U.S. Senator	2014	Alameel	Alameel ✓	Alameel	Alameel ✓	Alameel	Cornyn ×
Governor	2014	Davis	Davis ✓			Davis	Davis ✓
Ag. Commissioner	2014	Friedman	Friedman ✓	Hogan	Hogan ✓	Hogan	Hogan ✓
RR Commissioner	2014	Brown	Brown ✓			Brown	Brown ✓
President	2016	Clinton	Clinton ✓			Clinton	Clinton ✓
RR Commissioner	2016	Yarbrough	Yarbrough ✓	Yarbrough	Yarbrough ✓	Yarbrough	Yarbrough ✓
U.S. Senator	2018	O'Rourke	O'Rourke ✓			O'Rourke	O'Rourke ✓
Governor	2018	Valdez	Valdez ✓	Valdez	Valdez ✓	Valdez	Valdez ✓
Lieutenant Governor	2018	Cooper	Collier ×			Collier	Collier ✓
Comptroller	2018	Mahoney	Chevalier ×			Chevalier	Chevalier ✓
Land Commissioner	2018	Suazo	Suazo ✓			Suazo	Suazo ✓
RR Commissioner	2018	McAllen	McAllen ✓			McAllen	McAllen ✓

The demonstration plan has up to 16 minority-effective districts, as shown in the top table, while the enacted plan has no more than 11 to 13 (compare Table 4 and accompanying text). Scores over 60% have darker shading, and scores in the 50–60% range have lighter shading. The frequency of primary and general election wins by minority-preferred candidates is shown in the last two columns. Because different candidates of choice can be identified by the statewide and district-specific method, the number of successes is given as a range. The bottom table shows that candidates preferred by Latino voters statewide prevailed in District 27 in 12 of the 14 primaries, 5 of the 5 runoffs, and 13 of the 14 general elections. (With the candidates of choice inferred from the district-specific method, there are 13 primary successes).

(the two coalition districts, 18 and 33). There are also districts that are reliably Democratic but are not effective for either Latino voters or Black voters (Districts 12 and 31).

Table 6 takes a single district and brings us back to the most basic facts about it: whether the minority-preferred candidates actually won the most votes. We use as an example the plurality-white but Latino-effective District 27, which starts in East Austin and stretches south toward the Gulf Coast. For 11 of the 14 offices, the candidate preferred by Latino voters statewide prevailed at every step in District 27: primary, runoff (when there was one), and general. In the 2014 general election, however, the Latino-preferred Democratic nominee David Alameel failed to carry District 27 against Republican incumbent U.S. Senator John Cornyn; and in the 2018 Democratic primaries for lieutenant governor and comptroller, the candidates preferred by Latino voters statewide (Michael Cooper and

Tim Mahoney, respectively) failed to carry the district. This district generated Latino-effectiveness scores of about 84 or 85%, far above our threshold for effectiveness (60%) but below the scores for the map's four most heavily Latino districts, which consistently exceeded 90%.

7.3. Aggregate effectiveness

The use of a search technique tailored to raise the number of minority-effective districts might lead us to wonder about the effect on the rest of the map. With respect to demographics alone, redistricting is a fixed-sum activity: there are only so many Latino citizens of voting age in the state, so building more districts with high HCVAP means there is less remaining HCVAP to distribute across the other districts. We might worry that we can only secure a larger number of effective districts by draining opportunities for coalitional influence from the rest of the state. But this is not the case. Because of the highly nonlinear relationship between demographics and effectiveness (see section 6), it is possible to create some plans with a greater overall effectiveness than others.

To see this, let us consider the sum of the effectiveness scores for all 36 Texas congressional districts. Because each district has a score between 0 and 1, the sum will fall between 0 and 36. To the extent that a group's effectiveness scores behave like probabilities of electoral success, the sum over the 36 districts can be regarded as the *expected value* for the group in a given election. This expected-value score takes into account the probability but not certainty of electoral success in the effective districts, and also includes contributions from other districts in which an effectiveness score could fall well below .5 yet still reflect real political influence and a chance to win.

The enacted plan has an expected-value score a bit under 12, driven by 11 highly effective districts. After a few thousand steps of a heuristic-

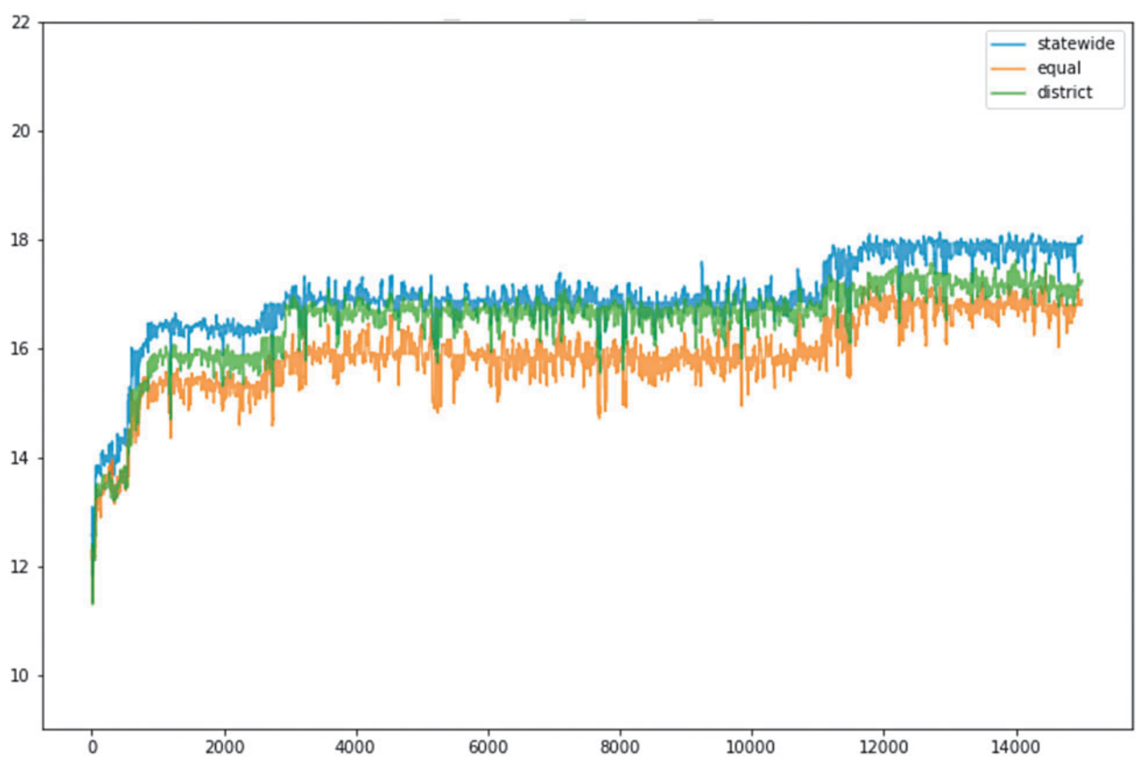

FIG. 12. This trace plot shows a kind of aggregate effectiveness for Latino and Black voters, formed by summing Latino and/or Black effectiveness scores over all 36 districts. This aggregate effectiveness trends up markedly over the course of a heuristic-optimization run that preferentially accepts plans with more districts effective for at least one minority group under the s^{state} score. This drives up the s^{state} score (in blue) most, with the other two scores following behind. (See Supplementary Appendix H for details on related optimization runs.)

optimization run (shown in Figure 12), the expected-value score is well over 15, usually over 16, and it is possible to drive the expectation up near 18 in the score being optimized. Our demonstration plan has an expectation of nearly 17, which tracks with the 16 districts highlighted in Table 6.

We find that, with respect to electoral opportunity, districting is not a fixed-sum game. We can find plans that combine Latino and Black voters with other population (including Asian American and white voters who tend to support the same candidates) in ways that lead to effective combinations. We can create safe minority districts, likely-to-elect minority districts, and some minority influence districts in a way that is especially beneficial in aggregate. This is a departure from the narrower focus on effectiveness that is directly relevant for VRA compliance, but may still point the way to a more coalitional expansion of minority opportunities beyond the demands of the law.

8. CONCLUSION

The principal goal of this project is the design and study of a protocol for building ensembles of alternative districting plans, taking closely into account the law of race and redistricting. We do this by using longitudinal electoral data, one of a choice of effectiveness scores, and a constrained district-generation algorithm.

No inclusion criterion assessed by a computer could perfectly track the conclusions of a court (not least because of variation in the judiciary itself), but ours is constructed to give us strong justification for describing it as a *representative sample* of the universe of VRA-compliant plans. We have pursued this objective in a way that also avoids overreliance on purely demographic targets that might run afoul of the Equal Protection Clause.

The structure of our protocol is described in section 4, and a detailed case study for Texas congressional districts is detailed in section 5. In section 6 we confirm that the role played by the extensive electoral data is not easily replaced by simpler proxies. And in section 7 we explore the use of similar techniques to minimize underrepresentation for minority groups—showing in particular that pushing to find plans that go the farthest to cure long-standing underrepresentation is a markedly different task from creating collections of alternatives that pass VRA muster. Studying the conditions of political and human geography that make it possible to attain near-proportionality is an interesting direction for future work.

With a detailed case study in the large, complex state of Texas, we confirm that our implementation lets us carry out the work on a time scale suitable for all stages of redistricting, from considering plans for possible adoption all the way to challenging them in litigation. We have made careful use of error estimates, performed tests of quality for ensemble generation, and confirmed robustness of the method across reasonable variations in the steps. By making our code and data public (MGGG Redistricting Lab, 2020a), we aim to make it possible for other researchers and practitioners to use this method on the ground.

This tool now makes it possible to assess proposed districting plans in racially diverse states against a baseline that takes the Voting Rights Act and the Equal Protection Clause into account. The computational tools for redistricting are continually becoming both more powerful and more refined, facilitating the creation of new maps that better meet our ideals of fairness and helping to understand maps in the context of realistic alternatives. By using novel tools in combination with renewed commitment to safeguarding minority representation, we can come closer than ever to the goal articulated by John Adams almost 250 years ago, in the midst of the American Revolution: to make our representative assemblies "in miniature an exact portrait of the people at large" (Adams, 1776, 108).

SUPPLEMENTARY MATERIAL

Supplementary Appendix

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STATE OF NORTH CAROLINA	IN THE GENERAL COURT OF JUSTICE SUPERIOR COURT DIVISION
COUNTY OF WAKE	21 CVS 015426

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, et al.,

REBECCA HARPER, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

Consolidated with
21 CVS 500085

AFFIDAVIT OF MICHAEL BARBER

Now comes affiant Michael Barber, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and am competent to testify regarding the matters discussed below.

2. For the purposes of this litigation, I have been asked by counsel for Legislative Defendants to analyze relevant data and provide my expert opinions.

3. To that end, I have personally prepared the report attached to this affidavit as Exhibit A, and swear to its authenticity and to the faithfulness of the opinions.

FURTHER THE AFFIANT SAYETH NAUGHT.

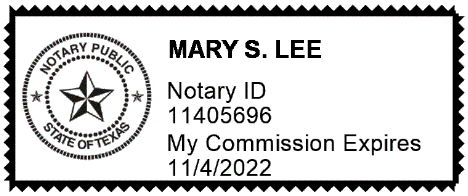
NCLCV v. Hall
21 CVS 15426
LDTX163

Executed on 22 December, 2021

DocuSigned by:
Michael Barber
82F8BEB03413425...

Michael Barber

Sworn or affirmed before me and subscribed in the presence the 22nd day of December, 2021, in the State of Texas and County of Harris.



DocuSigned by:
Mary S. Lee
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Notary Public

Exhibit A:
Expert Report of Michael Barber, PhD

Dr. Michael Barber
Brigham Young University
724 Spencer W. Kimball Tower
Provo, UT 84604
barber@byu.edu

Contents

1 Introduction and Qualifications

I have been asked by counsel for the Legislative Defendants to analyze North Carolina's recently enacted redistricting plans for the General Assembly (the "Enacted Plans") and the plans submitted by the North Carolina League of Conservation Voters (the "Duchin Plans") in the context of the partisan gerrymandering claims brought against the Legislative Defendants.[1] To do this, I implement a publicly available and peer-reviewed redistricting simulation algorithm to generate 50,000 simulated district maps in each county grouping in which there are multiple districts in both the North Carolina House of Representatives and the North Carolina Senate. The redistricting algorithm generates a representative sample of districts by following neutral redistricting criteria without regard to racial or partisan data. In this way, the simulated districts establish a comparison set of plans that use purely non-partisan redistricting inputs. I then compare the simulated plans against the Enacted Plans and the Duchin Plans by reference to election results to assess whether the partisan effects of those plans are consistent with what one would expect to see in a redistricting plan composed without reference to any partisan considerations.

In the House, these simulations show that the Enacted Plans consistently score more often within the range of the non-partisan simulated maps than the Duchin Plans. In addition, the simulations show that the Enacted Plans contain one county grouping, the Guilford County grouping in the House of Representative, that is a partisan outlier. However, this grouping largely follows the boundaries of a 2019 court-approved district plan. In contrast, the Duchin Plans generate partisan outliers in four county groupings.

In the Senate analysis both the Enacted and Duchin plans generate partisan outliers when compared to the simulated district maps in two clusters each. Furthermore, neutral redistricting criteria such as following municipal lines support the decisions by the map drawers in the Enacted Plan in more districts, while in these same districts the Duchin Plan divides Democratic-leaning municipalities into more pieces in order to combine Democratic-

[1] These plans were attached to the NCLCV complaint, filed on November 16, 2021.

leaning voters in cities with Republican voters in suburban and rural parts of North Carolina to create additional competitive or Democratic-leaning districts. Given these results, as well as the otherwise high degree of agreement between the Enacted and Duchin maps, it is my opinion that the Enacted Maps are not "extreme partisan gerrymanders" as plaintiffs allege.

I am an associate professor of political science at Brigham Young University and faculty fellow at the Center for the Study of Elections and Democracy in Provo, Utah. I received my PhD in political science from Princeton University in 2014 with emphases in American politics and quantitative methods/statistical analyses. My dissertation was awarded the 2014 Carl Albert Award for best dissertation in the area of American Politics by the American Political Science Association.

I teach a number of undergraduate courses in American politics and quantitative research methods.[2] These include classes about political representation, Congressional elections, statistical methods, and research design.

I have worked as an expert witness in a number of cases in which I have been asked to analyze and evaluate various political and elections-related data and statistical methods. Cases in which I have testified at trial or by deposition are listed in my CV, which is attached to the end of this report. I have previously provided expert reports in a number of cases related to voting, redistricting, and election-related issues: *Nancy Carola Jacobson, et al., Plaintiffs, vs. Laurel M. Lee, et al., Defendants. Case No. 4:18-cv-00262 MW-CAS (U.S. District Court for the Northern District of Florida); Common Cause, et al., Plaintiffs, vs. Lewis, et al., Defendants. Case No. 18-CVS-14001 (Wake County, North Carolina); Kelvin Jones, et al., Plaintiffs, v. Ron DeSantis, et al., Defendants, Consolidated Case No. 4:19-cv-300 (U.S. District Court for the Northern District of Florida); Community Success Initiative, et al., Plaintiffs, v. Timothy K. Moore, et al., Defendants, Case No. 19-cv-15941 (Wake County, North Carolina); Richard Rose et al., Plaintiffs, v. Brad Raffensperger, Defendant, Civil Action No. 1:20-cv-02921-SDG (U.S. District Court for the Northern Dis-*

[2]The political science department at Brigham Young University does not offer any graduate degrees.

trict of Georgia); Georgia Coalition for the People's Agenda, Inc., et. al., Plaintiffs, v. Brad Raffensberger, Defendant. Civil Action No. 1:18-cv-04727-ELR (U.S. District Court for the Northern District of Georgia); Alabama, et al., Plaintiffs, v. United States Department of Commerce; Gina Raimondo, et al., Defendants. Case No. CASE NO. 3:21-cv-00211-RAH-ECM-KCN (U.S. District Court for the Middle District of Alabama Eastern Division); League of Women Voters of Ohio, et al., Relators, v. Ohio Redistricting Commission, et al., Respondents. Case No. 2021-1193 (Supreme Court of Ohio).

In my position as a professor of political science, I have conducted research on a variety of election- and voting-related topics in American politics and public opinion. Much of my research uses advanced statistical methods for the analysis of quantitative data. I have worked on a number of research projects that use "big data" that include millions of observations, including a number of state voter files, campaign contribution lists, and data from the US Census. I have also used geographic information systems and other mapping techniques in my work with political data.

Much of this research has been published in peer-reviewed journals. I have published nearly 20 peer-reviewed articles, including in our discipline's flagship journal, *The American Political Science Review* as well as the inter-disciplinary journal,*Science Advances*. My CV, which details my complete publication record, is attached to this report as Appendix A.

The analysis and opinions I provide in this report are consistent with my education, training in statistical analysis, and knowledge of the relevant academic literature. These skills are well-suited for this type of analysis in political science and quantitative analysis more generally. My conclusions stated herein are based upon my review of the information available to me at this time. I reserve the right to alter, amend, or supplement these conclusions based upon further study or based upon the availability of additional information. I am being compensated for my time in preparing this report at an hourly rate of $400/hour. My compensation is in no way contingent on the conclusions reached as a result of my analysis. The opinions in this report are my own, and do note represent the view of Brigham Young

University.

2 Summary of Conclusions

Based on the evidence and analysis presented below, my opinions regarding the 2021 enacted redistricting plans in the North Carolina General Assembly can be summarized as follows:

- The contemporary political geography of North Carolina is such that Democratic majorities are often geographically clustered in the largest cities of the state while Republican voters often dominate the suburban and rural portions of the state.
- This is not the case in the rural northeastern region of the state, where there are also significant Democratic majorities.
- This geographic clustering in cities an in the rural northeast puts the Democratic Party at a natural disadvantage when single-member districts are drawn.
- This is further amplified by the 'county grouping' process that is unique to North Carolina's redistricting process where districts are constrained to remain within county groups.
- This disadvantage partially arises from the difficulty, and in many cases impossibility, of drawing Democratic-leaning districts in many of the county groupings that comply with constitutional requirements, even though Democratic voters make up roughly 40% of voters in these parts of the state.
- Based on a comparison between the Enacted Plan, the Duchin Plan, and a set of 50,000 simulated maps, the Enacted Plan is less of a partisan outlier than the Duchin Plan in the State House. In 39 of the 40 clusters the Enacted Plan is not a partisan outlier in

comparison to the simulation results. In 36 of the 40 clusters the Duchin Plan is not a partisan outlier in comparison to the simulation results.

- In the Senate analysis both the Enacted and Duchin plans generate partisan outliers when compared to the simulated district maps in two clusters each.

- Areas of disagreement between proposed plans often arise because the Duchin plan divides Democratic leaning municipalities into more pieces in order to combine Democratic-leaning voters with Republican voters in suburban and rural parts of the state to create additional competitive or Democratic leaning districts.

- Given these results, as well as the otherwise high degree of agreement between the Enacted and Duchin maps, it is my opinion that the Enacted Maps are not "extreme partisan gerrymanders" as plaintiffs allege.

3 Political Geography of North Carolina

For the last several decades, North Carolina has been relatively competitive in statewide elections. Democratic and Republican candidates have won the state at the presidential, gubernatorial, congressional, and state level. Figure 1 below shows the results of the average of all statewide elections in North Carolina from 2000 through 2020. These races include: president, US Senate, governor, lieutenant governor, attorney general, secretary of state, state auditor, treasurer, superintendent, commissioner of agriculture, commissioner of labor, insurance commissioner, and partisan judicial elections in 2018.[3] While not all races are up for election in each year, I create the index by averaging the two-party vote share of those races that occurred in each two-year cycle. State-level races in North Carolina occur in presidential election years while US senate races occur every six years. There were no statewide partisan races in 2006. As can be seen in the figure, the statewide Democratic margin in North Carolina peaked in 2008 at 55% of the two-party vote and reached its nadir in 2010 with 44% of the vote.

The relative stability of the statewide results over the last 10 years masks a dramatic variation in the spatial location of Democratic and Republican voters within the state. The following section details this and shows in a variety of different ways that Democratic voters are more likely to be spatially clustered in the state while Republican voters tend to live in more politically diverse areas.

Scholarship in political science has noted that the spatial distribution of voters throughout a state can have an impact on the partisan outcomes of elections when a state is, by necessity, divided into a number of legislative districts. This is largely the case because Democratic-leaning voters tend to cluster in dense, urban areas while Republican-leaning voters tend to be more equally distributed across the remainder of the state.[4] One prominent

[3]To create the index I sum by party all votes cast for each candidate in each race by year. I then take the fraction of votes cast for candidates of the two major parties that were cast for Democratic candidates in that year. There are other possible measures and methods one could use, such as considering candidate percentages before averaging or including third party voters.

[4]See for example Stephanopoulos, N. O. and McGhee, E. M., Partisan Gerrymandering and the Efficiency

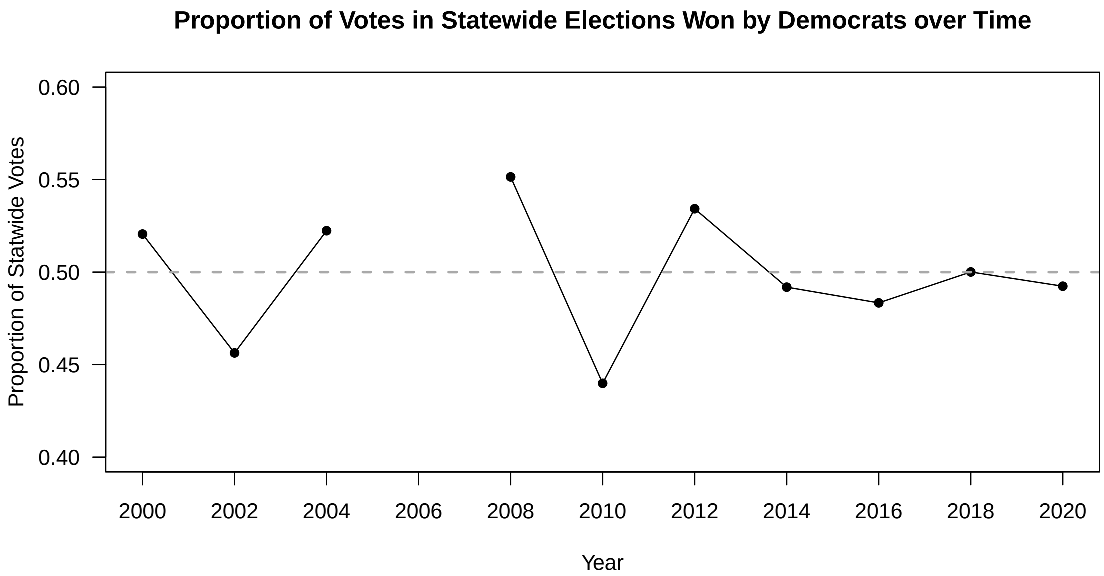


Figure 1: **Democratic Proportion of Statewide Election Contests, 2000-2020**

study of the topic (Chen and Rodden, 2013) finds that "Democrats are highly clustered in dense central city areas, while Republicans are scattered more evenly through the suburban, exurban, and rural periphery...Precincts in which Democrats typically form majorities tend to be more homogenous and extreme than Republican-leaning precincts. When these Democratic precincts are combined with neighboring precincts to form legislative districts, the nearest neighbors of extremely Democratic precincts are more likely to be similarly extreme than is true for Republican precincts. As a result, when districting plans are completed, Democrats tend to be inefficiently packed into homogenous districts."[5]

The upshot of this pattern is that political parties stand at a disadvantage when their voters are not "efficiently" distributed across the state. To understand what I mean

Gap, *The University of Chicago Law Review* 82: 831-900, (2015); Chen, J. and Rodden, J., Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures, *Quarterly Journal of Political Science* 8: 239-269, (2013); Nall, C., The Political Consequences of Spatial Policies: How Interstate Highways Facilitated Geographic Polarization, *Journal of Politics*, 77(2): 394-406, (2015); Gimple, J. and Hui, I., . Seeking politically compatible neighbors? The role of neighborhood partisan composition in residential sorting, *Political Geography* 48: 130-142 (2015); Bishop, B., *The Big Sort: Why the Clustering of Like-Minded America is Tearing Us Apart*, Houghton Mifflin Press (2008); and Jacobson, G. C., and Carson, J. L., *The Politics of Congressional Elections*, 9th ed. Lanham, MD: Rowman and Littlefield (2016).

[5]Chen, J. and Rodden, J., Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures, *Quarterly Journal of Political Science* 8: 239-269, (2013)

by efficient, imagine two different scenarios. First, imagine a party with a slim majority of voters statewide in which every precinct's vote share perfectly reflected the overall state. In other words, the party has a slight majority in every precinct that adds up to a slight majority statewide. In this case, this party's voters are extremely efficiently distributed in such a way that the party will win every single district despite only a slim majority statewide. Now imagine a different arrangement, a party who still holds a slim majority statewide, but whose voters are heavily concentrated in a few areas and sparsely populated throughout the rest of the state. In this case, despite holding a majority of votes statewide, the party will only win a few seats where their voters are heavily concentrated. The political geography of North Carolina more closely resembles the second scenario.

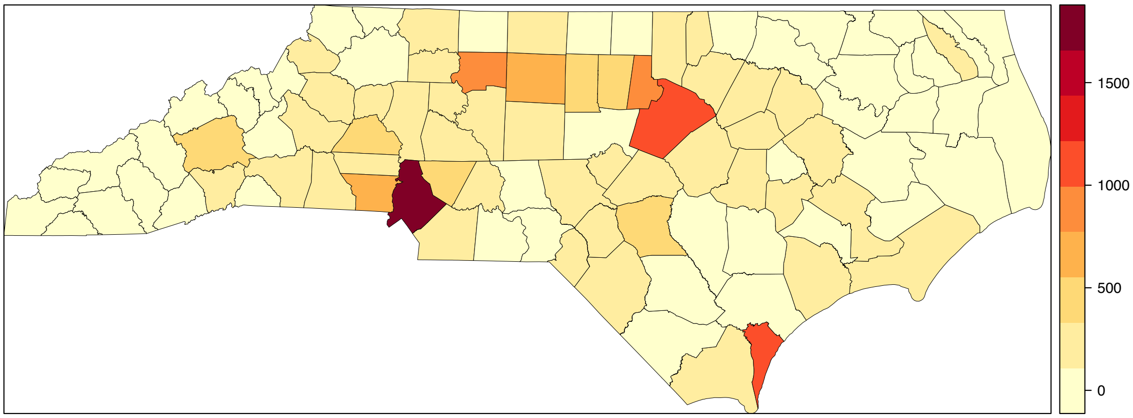
Figure 2 shows two maps of North Carolina. The top map shows the population density across counties. The bottom map shows the distribution of partisan preference across the state. Comparing the two shows that the most dense and urban counties (Wake, Mecklenburg, Durham, Guilford, Forsyth, New Hanover) in the state tend to also be where we see clusters of Blue on the bottom map.

North Carolina adds an additional wrinkle to this trend that also works to create heavily Democratic state legislative districts. Figure 2 shows that the rural counties of north eastern North Carolina are strongly Democratic.[6] This further works to facilitate the creation of strongly Democratic state legislative districts because each of these rural counties, and sometimes in combination with other adjacent rural counties, can form a legislative district. This is because the state constitution again emphasizes that counties be kept together when drawing district boundaries, and when grouping counties to collect a sufficient number of people, the minimum grouping of contiguous counties should be used. Because these rural counties all share the common feature of being strongly Democratic, any grouping of these counties together will further generate legislative districts with large majorities in support of Democratic candidates.

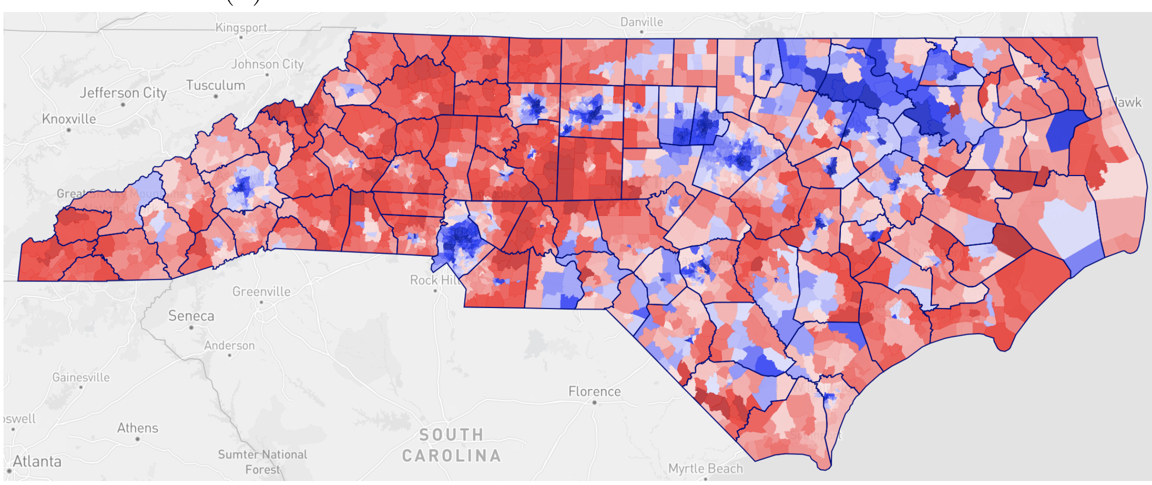
[6]This would include Vance, Warren, Halifax, Northampton, Hertford, Bertie, and Edgecomb counties.

Figure 2: **Distribution of People and Partisan Preferences in North Carolina.**

(a) Population Density of North Carolina Counties



(b) Partisan Preferences in North Carolina Counties



Note: Blue = Democratic, Red = Republican

Thus, the geographic concentration of a party's voters tends to harm that party when single-member districts are drawn by creating districts that favor that party by very large majorities, thus 'wasting' many votes in running up large majorities far beyond 50%+1.[7] This occurs in North Carolina in the urban counties of the state as well as the northeastern counties of the state where there are also sizeable Democratic majorities. Importantly, the discussion is not about *where* Democratic voters are heavily clustered together, but simply that they are. It is less important if this clustering takes place in large urban cities or in

[7]McGhee, E. (2017). Measuring Efficiency in Redistricting. Election Law Journal: Rules, Politics, and Policy, 16(4), 417–442. doi:10.1089/elj.2017.0453

rural portions of the state. The overwhelming margins for the party are what drives 'wasted votes,' which, in turn translate to fewer seats than the statewide proportion of the vote would suggest.

Another way to consider this is to look at a lower level of geography, the Voter Tabulation District (VTD), which is similar to a precinct. Figure 3 shows the distribution of partisan preferences for 11 statewide partisan elections for all VTDs in North Carolina.[8] The left panel notes VTDs where there are strong majorities for either party and labels them as "inefficient" VTDs. They are inefficient based on the discussion above that a party wastes votes if it builds majorities far beyond the needed 50%+1. Note that the distribution is not symmetric and that there are more VTDs with very large democratic majorities than there are VTDs with equally large Democratic majorities. The right panel shows the same distribution by labels "efficient" VTDs — those where a party has a majority, but not an overwhelming majority. Note here that there are many more VTDs with efficient Republican majorities than there are VTDs with efficient Democratic majorities.

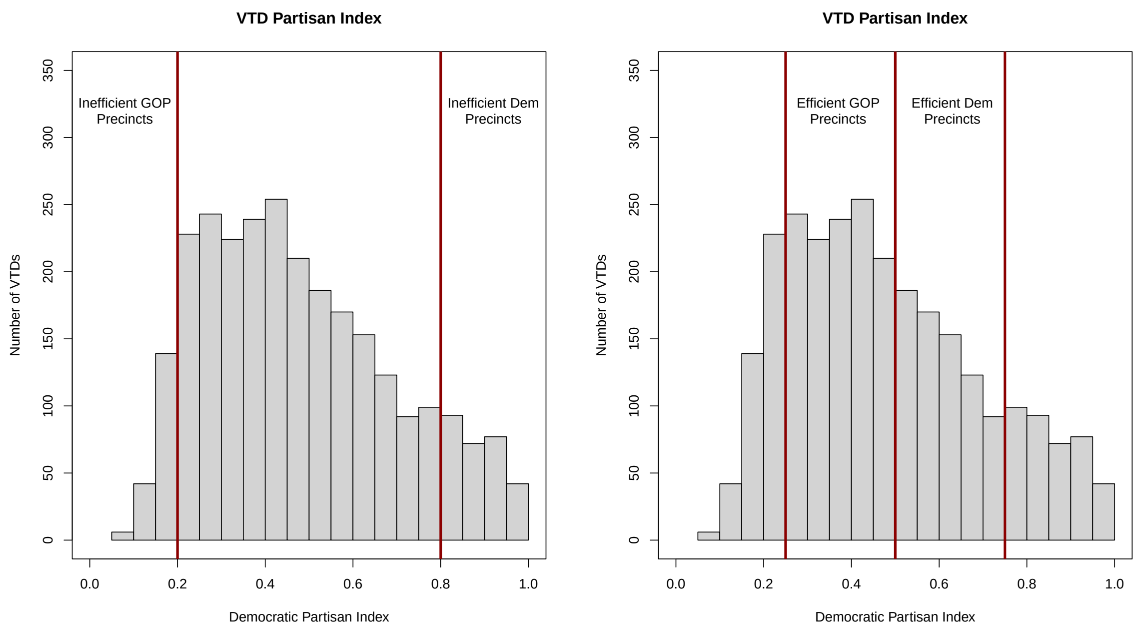
This inefficient distribution of votes would not be a problem for Democrats if districts were able to amble about the state so as to create districts that had less overwhelming Democratic support. Rodden (2019) notes this by saying: "Democrats would need a redistricting process that intentionally carved up large cities like pizza slices or spokes of a wheel, so as to combine some very Democratic urban neighborhoods with some republican exurbs in an effort to spread Democrats more efficiently across districts (pg. 155).[9]" Alternatively, as districts get larger in size (i.e. congressional districts) "Democratic communities can easily string together and overwhelm the surrounding rural Republicans (pg. 149)." However, the laws governing redistricting in North Carolina run counter to either of these strategies.

[8]I use these elections because they were the most comprehensive set of statewide elections I could obtain, given the tight time constraints, that were aggregated and matched to the level of the VTD. The elections are 2020: President, Senate, Governor, Lieutenant Governor, Attorney General; 2016: President, Senate, Governor, Lieutenant Governor, Attorney General; 2014: Senate.

[9]Rodden, Jonathan A. Why cities lose: The deep roots of the urban-rural political divide. Hachette UK, 2019.. While Rodden is specifically discussing Pennsylvania in this quote, the statement is true of any location with Democrats clustered in urban areas.

Figure 3: **Distribution of Votes Across VTDs in North Carolina.**

(a) Inefficient VTDs (b) Efficient VTDs



Note: Partisan Index based on the average of 11 statewide partisan races between 2014-2020.

North Carolina's strict rules that require districts to remain within pre-determined county clusters prohibit the type of meandering districts that Rodden describes above. Furthermore, additional restrictions requiring geographic compactness and minimizing the splitting of municipalities further eliminates the possibility of taking the strategy described above. In the end, this means that Republicans begin the redistricting process with a natural advantage due to the combination of laws requiring where and how districts are drawn combined with the particular spatial distribution of their voters. Thus, as I will show below, the advantage we observe between the expected Republican seat share in the state legislature compared to the statewide Republican vote share in the recent past is more due to geography than partisan activity by Republican map drawers.[10]

[10]Rodden (2019) notes regarding North Carolina, "Due to the presence of a sprawling knowledge-economy corridor, a series of smaller automobile cities with relatively low partisan gradients, and the distribution of rural African Americans, Democrats are relatively efficiently distributed in North Carolina at the scale of congressional districts (pg. 173)." It is important to note that this statement is not true for state legislative districts, which contain much smaller populations than congressional districts (and thus often cannot span

To measure the expected seat share in the state House and Senate, I compute a partisan index of statewide elections for 11 statewide partisan elections between 2014-2020.[11]

Figure 4 shows this for the 120 House seats. Districts are ordered from least Democratic at the bottom to most Democratic at the top. Districts with a partisan index less than 0.50 (i.e. Republican leaning) are shown as squares and districts with a partisan index greater than 0.50 (i.e. Democratic leaning) are displayed as triangles. In the House there are 71 districts with an index less than 0.50 (shown as squares) and 49 districts with an index greater than 0.50 (shown as triangles). A vertical dashed line is placed at 0.50 in each panel for reference. The grey lines around each point show the range of election outcomes for all of the 11 statewide elections used to generate the index. Districts in which the Republican candidate for statewide elections won the majority of the two-party vote share in all 11 races are colored red while districts where the Democratic candidate for statewide elections won the majority of the two-party vote share in all 11 races are colored blue. Districts where both parties have won a majority of the two-party vote share in these 11 races are colored green. Looking at the range across the index, there are 60 districts colored red (reliably Republican) in the House figure, 40 blue districts (reliable Democratic), and 20 green districts (competitive) in the House map. Using an alternative definition of competitiveness based on the closeness of the index to 0.50, there are 57 districts with an index less than 0.45, 24 districts between 0.45 and 0.55 (a commonly used range to define competitive seats), and 39 districts with an index of greater than 0.55.

Using the same method for the Senate, there are 30 squares (i.e. Republican leaning districts) and 20 triangles in the figure (i.e. Democratic leaning districts). Using the color scheme described above, there are 26 red districts (reliably Republican), 17 blue districts (reliable Democratic), and 7 green districts in the Senate map (competitive). Using an alternative definition of competitiveness based on the closeness of the index to 0.50, there

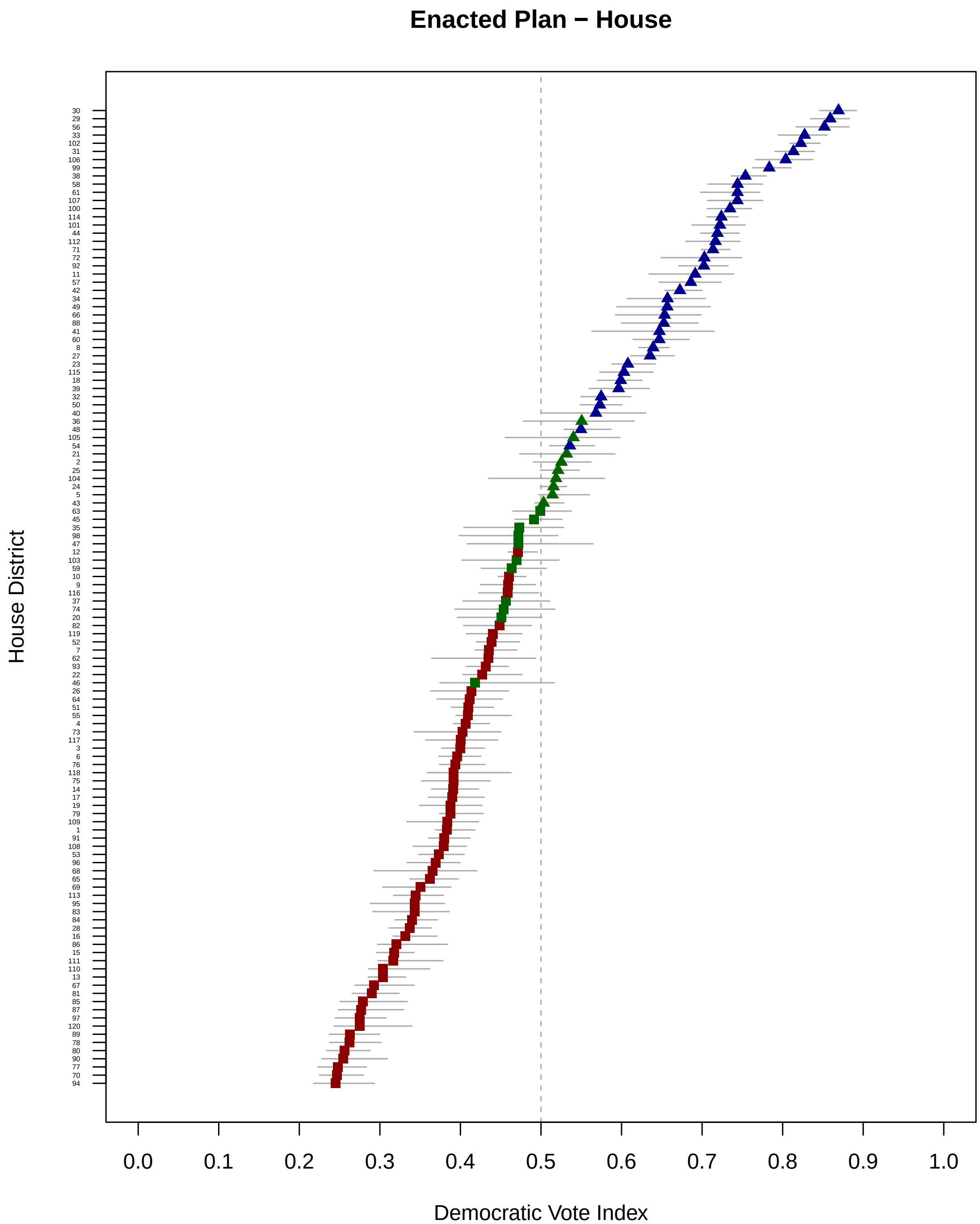
across multiple cities) and are much more constrained to remain within the county clusters, unlike the congressional district maps.

[11] The elections are 2020: President, Senate, Governor, Lieutenant Governor, Attorney General; 2016: President, Senate, Governor, Lieutenant Governor, Attorney General; 2014: Senate

are 24 districts with an index less than 0.45, 17 districts between 0.45 and 0.55, and 9 districts with an index of greater than 0.55. Figure 5 shows this for the 50 Senate seats.

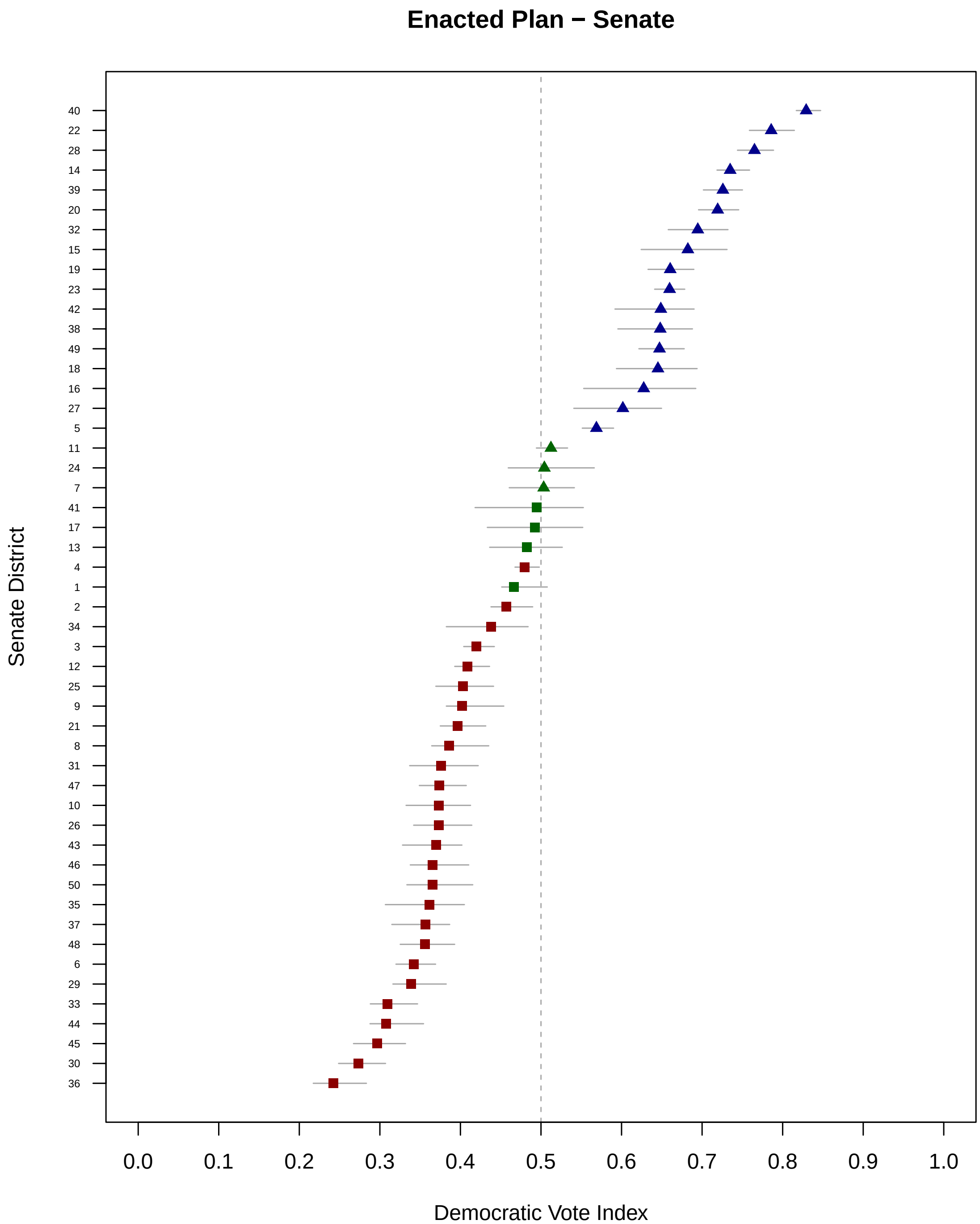
When looking at these figures, we cannot make any immediate determinations about why this distribution of seats, which has more Republican leaning districts than Democratic leaning districts, does not exactly reflect the statewide of average of votes in the state, which is much closer to parity between the parties. The reason for this is that, as discussed above, the distribution of voters who favor one party or the other is not even across the state. Furthermore, districts in North Carolina are restricted to remain within the pre-determined county clusters, further complicating the connection between district boundaries and statewide vote shares. This unique feature of North Carolina's redistricting process significantly constrains any map maker and can furthermore exacerbate the geographic disparities that exist across the state.

Figure 4: **Partisan Index of Senate Districts in 2021 Enacted Plan**



Note: Partisan Index based on the average of 11 statewide partisan races between 2014-2020. Districts with a partisan index less than .50 (i.e. Republican leaning) are shown as squares and districts with a partisan index greater than .50 (i.e. Democratic leaning) are displayed as triangles. A vertical dashed line is placed at .50 in each panel for reference. The grey lines around each point show the range of election outcomes for all of the 11 statewide elections used to generate the index. Districts in which the Republican candidate for statewide elections won the majority of the two-party vote share in all 11 races are colored red while districts where the Democratic candidate for statewide elections won the majority of the two-party vote share in all 11 races are colored blue. Districts where both parties have won a majority of the two-party vote share in these 11 races are colored green.

Figure 5: **Partisan Index of Senate Districts in 2021 Enacted Plan**



Note: Partisan Index based on the average of 11 statewide partisan races between 2014-2020. Districts with a partisan index less than .50 (i.e. Republican leaning) are shown as squares and districts with a partisan index greater than .50 (i.e. Democratic leaning) are displayed as triangles. A vertical dashed line is placed at .50 in each panel for reference. The grey lines around each point show the range of election outcomes for all of the 11 statewide elections used to generate the index. Districts in which the Republican candidate for statewide elections won the majority of the two-party vote share in all 11 races are colored red while districts where the Democratic candidate for statewide elections won the majority of the two-party vote share in all 11 races are colored blue. Districts where both parties have won a majority of the two-party vote share in these 11 races are colored green.

4 Introduction to Simulations Analysis

To gauge the range of partisan outcomes in the North Carolina General Assembly, I conduct simulated districting analyses to allow me to produce a large number of districting plans that follow traditional districting criteria using small geographic units as building blocks for hypothetical legislative districts (voting tabulation districts, or VTDs). This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to create districting plans that follow traditional districting goals without paying attention to partisanship, race, or the location of incumbent legislators.

The process of simulating districting plans has been recognized and used in a variety of redistricting cases, including in North Carolina.[12] While different people employ slightly different methods, the overall process is much the same. For my simulations, I use a program developed by Fifield et al. (2020).[13]

A significant advantage of the simulation-based approach in general is the ability to compare a proposed map to a set of maps that are drawn without consideration of criteria such as partisanship or race. If the proposed map is similar to the set of simulated maps, it is reasonable to assume that the proposed map was not drawn primarily with partisan intent. If the map differs from the simulations, it is important to recognize that a variety of factors could have played into the deviation, but the underlying idea is that a deviation from the simulations reflects a choice by the map-maker to prioritize some factor that was not

[12]See League of Women Voters of Ohio v. Ohio Redistricting Commission (2021); Harper v. Hall (2021); Common Cause v. Lewis (2019); Harper v. Lewis (2019); League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania (2018).

[13]Fifield, Benjamin, , Michael Higgins, Kosuke Imai, and Alexander Tarr. "Automated redistricting simulation using Markov chain Monte Carlo." Journal of Computational and Graphical Statistics 29, no. 4 (2020): 715-728.

Fifield, Benjamin, Kosuke Imai, Jun Kawahara, and Christopher T Kenny. 2020. "The essential role of empirical validation in legislative redistricting simulation." Statistics and Public Policy 7 (1): 52–68.

Kenny, Christopher T., Cory McCartan, Benjamin Fifield, and Kosuke Imai. 2020. redist: Computational Algorithms for Redistricting Simulation. https://CRAN.R-project.org/package= redist.

McCartan, Cory, and Kosuke Imai. 2020. "Sequential Monte Carlo for sampling balanced and compact redistricting plans." arXiv preprint arXiv:2008.06131.

made a priority in the simulations. This could include partisanship, but could also include incumbency protection, preservation of media markets, keeping particular counties, cities, or neighborhoods together that have historically been joined in districts, or some other factor that is important to a map maker or legislator involved in the process.

A major factor in the validity of the simulated maps is whether or not they constitute a representative sample of the trillions of possible maps that could be drawn.[14] If the sample produced by the simulations is not representative, then we may be comparing a proposed map to a biased selection of alternative maps, which renders the value of the comparison meaningless.

A specific benefit of the particular algorithm I use here is that the authors show mathematically and in a small-scale validation study that their method produces a representative sample of maps. With regards to this issue, the authors state:

> Yet, until recently, surprisingly few simulation algorithms have existed in the published scholarship. In fact, most of these existing studies use essentially the same Monte Carlo simulation algorithm where a geographical unit is randomly selected as a "seed" for each district and then neighboring units are added to contiguously grow this district until it reaches the pre-specified population threshold (e.g., Cirincione, Darling, and O'Rourke 2000; Chen and Rodden 2013). Unfortunately, no theoretical justification is given for these simulation algorithms, and hence they are unlikely to yield a representative sample of redistricting plans for a target population....Unlike the aforementioned standard simulation algorithms, the proposed algorithms are designed to yield a representative sample of redistricting plans under contiguity and equal population constraints.[15]

[14]Tam Cho, Wendy K., and Yan Y. Liu. "Toward a talismanic redistricting tool: A computational method for identifying extreme redistricting plans." Election Law Journal 15, no. 4 (2016): 351-366. Cho, Wendy K. Tam, and Bruce E. Cain. "Human-centered redistricting automation in the age of AI." Science 369, no. 6508 (2020): 1179-1181. McCartan, Cory, and Kosuke Imai. "Sequential Monte Carlo for sampling balanced and compact redistricting plans." arXiv preprint arXiv:2008.06131 (2020).

[15]Cirincione, C., Darling, T. A., and O'Rourke, T. G. (2000), "Assessing South Carolina's 1990s Congressional Districting," Political Geography, 19, 189–211. DOI: 10.1016/S0962-6298(99)00047-5. Chen, J., and

With a representative set of maps in hand, we can then analyze the difference between the proposed map and the simulated maps on a variety of metrics. As discussed above, it is well established that the party whose voters are more geographically compact stands at a natural disadvantage when single member districts are drawn. “The party that’s more spread out has a geographic advantage,” says applied mathematician Jonathan Mattingly of Duke University. “That’s our system.[16]” The comparison between the simulated districts and the proposed map overcomes this hurdle and allows for an apples-to-apples comparison that accounts for the unique political geography of a state, such as the spatial distribution of voters or the location and number of administrative boundaries, such a counties. Simulation methods can also incorporate a state’s other unique redistricting rules. The simulation-based approach therefore permits us to compare a particular plan to a large number of representative districting plans in the North Carolina House and Senate using criteria specific to North Carolina. In the simulations I run, I instruct the model to generate plans that adhere to the restrictions included in the North Carolina Constitution as well as the *Stephenson* criteria of roughly equal population, adherence to county cluster boundaries, minimization of county traversals within clusters, and geographic compactness.

Specifically, the model is constrained to conduct 50,000 simulations separately in each county cluster by assembling VTDs into districts that meet the redistricting criteria of equal population, contiguity, compactness, and minimal county and municipal divisions.[17] Within each cluster the model generates 50,000 maps with the number of districts equal to the number of districts allocated to that cluster that are of roughly equal population ($< 5\%$ deviation above or below the target population of 86,995 in the House and 208,788 in the Senate). The model is also instructed to generate districts that cross county boundaries as few times as possible. Of course, county populations do not always add up to round units

Rodden, J. (2013), “Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures,” Quarterly Journal of Political Science, 8, 239–269. DOI: 10.1561/100.00012033.

[16] https://www.sciencenews.org/article/gerrymandering-elections-next-gen-computer-generated-maps

[17] The simulations are not allowed to split VTDs as this is the lowest level of geography for which I have election results.

of districts, and so of necessity some county boundaries will be split. The model is further instructed that when a county boundary needs to be crossed, it should avoid splitting the county more times than necessary. After the model is run, I discard any simulations that include more county traversals than the Enacted Plan.

I also instruct the model to generate districts that are geographically compact. After the model is run, I compute the average geographic compactness of the simulated districts in the county cluster and compare that to the average geographic compactness of the Enacted Plan. I use the Polsby-Popper measure of compactness, which is a common measure of geographic compactness.[18] After the model is run, I also discard any simulations that are less compact, on average, than the Enacted Plan.

The final constraint is an instruction to avoid splitting municipal boundaries. This constraint is second order to the constraint to avoid county boundaries. In other words, the model prioritizes avoiding county splits over municipal splits. Once the county split constraint is accounted for, then the model places priority on avoidance of municipal splits. Because municipalities and VTDs do not perfectly overlap, it is difficult to calculate the exact number of municipal splits from the model. I make a simplifying assumption and assign each VTD to a municipality if any part of the VTD intersects that municipality. Furthermore, if a VTD overlaps multiple municipalities, I assign the VTD to the municipality in which the most area of the VTD is contained. In a few cases a city spans multiple counties. Here I consider each portion of the city as a separate municipality.

Once the simulated district plans are complete, I then compute the partisan lean of each district in each plan. For the partisan composition of each district I rely on the two-party election results from statewide elections disaggregated to the level of the VTD. I then reassemble these election results at the district level to compute the proportion of votes

[18]The Polsby-Popper measure is computed by taking is the ratio of the area of the district to the area of a circle whose circumference is equal to the perimeter of the district. A district's Polsby-Popper score falls with the range of [0,1] and a score closer to 1 indicates a more compact district. Polsby, Daniel D., and Robert D. Popper. 1991. "The Third Criterion: Compactness as a procedural safeguard against partisan gerrymandering." Yale Law & Policy Review 9 (2): 301–353.

in each statewide election that were won by the Democratic and Republican candidates in those districts. I compute the index of district partisanship using the two-party vote share in eleven elections from the past ten years.[19] The index is an average of all eleven of these statewide races in North Carolina from 2012-2020. Averages of multiple elections have the benefit of "washing out" the impact of any particular election, since individual elections can vary due to particular candidate features and other idiosyncrasies and particular years can vary due to national electoral waves (i.e. 2020 was a good electoral year for Democrats while 2016 was a good year for Republicans nationwide). As such, my preferred metric is the partisan index. However, I also compute the two-party vote share for each of the 11 statewide elections individually and report these as well for completeness. Occasionally, seeing how a plan or set of simulations varies across individual elections can shed light on the variation and shifts in political preferences in a locality.

5 NC House Analysis

A unique feature of the redistricting process in North Carolina is the use of "county grouping (or clusters)" wherein redistricting takes place entirely inside of each cluster. In essence, this means that the process of redistricting the state House (or Senate) in North Carolina is not a single problem in which a map maker draws 120 (or 50 for the Senate) districts throughout the state. Instead, the map maker faces many distinct redistricting problems that are all self contained. Cooper et al. (2021, "The Duke Study"), have addressed this issue using the 2020 census data and reported on the optimal set of clusters in both the House and Senate. They state, "Determining the county clusters for the NC House and for the NC Senate is the first step in the redistricting process for the NC General Assembly. The county clusters are largely algorithmically determined through an optimization procedure

[19]The particular races are 2020: President, US Senate, Governor, Lieutenant Governor, and Attorney General; 2016: President, US Senate, Governor, Lieutenant Governor, and Attorney General; 2014: US Senate. There are other partisan statewide races in these years, but I was unable to locate election results disaggregated to the VTD level.

outlined by the NC Supreme Court in *Stephenson v. Bartlett*.[20]" While there are a few choices that a map maker can make in choosing between different sets of clusters, the county cluster design significantly constrains any map maker as he or she is forced to work only within the counties contained in a given cluster. Because of this, any analysis of the Enacted Plan must consider each cluster separately, as they are independent of one another.

In the state House, there are 40 county clusters. 33 clusters containing 107 of the 120 districts are fixed based on the county cluster arrangement determined by Cooper et al. (2021, "Duke Study"). The remaining 7 clusters were selected by the General Assembly from three sets of choices between clusters.

5.1 House Groupings with only 1 District

Of the 40 county clusters, there are 13 of them composed of 31 counties in which the cluster contains only 1 House district. In these clusters there is no discretion for any map maker. The district is simply the boundaries of the county cluster. These counties collectively have a population of 1,128,328, or approximately 11% of the state's total population and account for 13 of the 120 seats in the state House.

Figure 6 shows a map of the counties that constitute these single-district clusters. Table 1 below shows each cluster, the counties included in the cluster, and the corresponding districts in the House Enacted Plan. The final two columns of the table show the partisan lean of the cluster using the 11 statewide partisan elections index discussed above and whether or not, based on that index, the cluster leans Democratic (or Republican). I classify a district (in the Enacted Plan and in the simulations as well) as being Democratic leaning if the partisan index for that district is greater than 0.50. In other words, if more than fifty percent of the ballots cast for the two major parties were for Democratic candidates, that district is classified as a Democratic leaning district. Obviously, districts with index values much larger than (smaller than) 0.50 will be more likely to elect a Democrat (Republican)

[20] https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf

than districts that are very close to 0.50.

The bottom row of the Table 1 shows the results for all 13 clusters together. Collectively these counties have a partisan index of 0.43, meaning roughly four in ten voters in these counties cast ballots for Democratic candidates in the 11 statewide races I consider here. However, the location of voters for the different parties is not uniformly distributed across these counties. Given this spatial distribution of voters across the counties, 4 of the 13 clusters lean Democratic, or roughly 30 percent. In this case, the proportion of Democratic leaning districts is lower that the proportion of voters in these counties who favor Democratic candidates. However, this is not due to any district boundaries. It is purely a function of the political geography of the state since all of these districts are entire county units and are, as such, fixed.

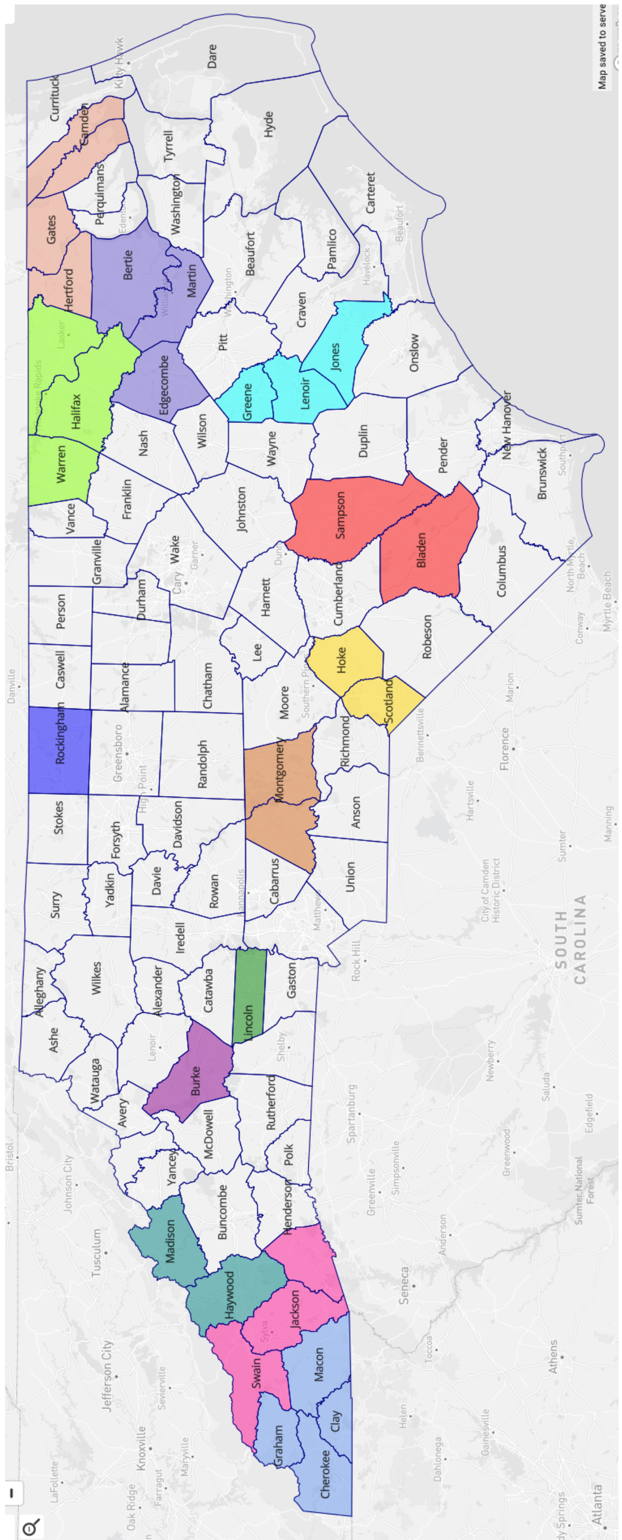


Figure 6: Map of Counties and County Clusters with only 1 House District

Table 1: County Grouping Containing 1 House District

County Cluster	# Counties	# Districts	District #	County Cluster Democratic Partisan Index	# of districts that are Democratic leaning
Rockingham	1	1	65	0.36	0
Lincoln	1	1	97	0.28	0
Burke	1	1	86	0.32	0
Bladen-Sampson	2	1	22	0.43	0
Hoke-Scotland	2	1	48	0.55	1
Haywood-Madison	2	1	118	0.40	0
Montgomery-Stanly	2	1	67	0.30	0
Bertie-Edgecomb-Martin	3	1	23	0.61	1
Greene-Jones-Lenoir	3	1	12	0.47	0
Jackson-Swain-Transylvania	3	1	119	0.44	0
Halifax-Northampton-Warren	3	1	27	0.64	1
Cherokee-Clay-Graham-Macon	4	1	120	0.28	0
Camden-Gates-Hertford-Pasquotank	4	1	5	0.52	1
Total:	31	13		0.43	4

6 House Groupings with More than 1 District:

There are 27 county clusters that contain multiple districts where a map drawer has some discretion to draw district boundaries. I consider each cluster separately in the simulations analysis because the districts are constrained to remain within each county cluster.

These clusters collectively account for 107 of the 120 districts in the North Carolina House of Representatives. In addition to calculating the number of Democratic leaning districts for the Enacted Plan, I also compute the same partisan index for the plaintiffs proposed map (hereafter, 'Duchin Map') and compare how the Enacted Map and the Duchin Map perform on this same metric.[21] An overview of the results are as follows. In these 107 districts, the Enacted Plan creates 62 districts that lean Republican and 45 districts that lean Democratic according to the statewide partisan elections index. The Duchin Plan creates 52 districts that lean Republican and 52 districts that lean Democratic according to the statewide partisan elections index.

I then place both maps in relation to the distribution of partisan outcomes from the simulated districts. In each cluster I consider the number of Democratic districts generated by each plan in comparison to the distribution of results from the simulations. I consider a plan to be a partisan outlier if the number of Democratic districts generated by the plan falls outside the middle 50% of simulation results. This is a conservative definition of an outlier. In the social sciences, medicine, and other disciplines it is traditional to consider something an outlier if it falls outside the middle 95% or 90% of the comparison distribution.

In 26 of the 27 clusters, the Enacted Map produces a number of Democratic districts that falls within the middle 50% of simulation results and are not partisan outliers. This leaves 1 cluster in which the Enacted Plan is a partisan outlier in comparison to the simulation results.[22] The Enacted Map also produces the same number of Democratic leaning districts as the modal (most common) number of Democratic leaning districts in the simulations in

[21] Plaintiffs refer to this as an "optimized map." It is unclear what this means as optimization is a choice made by the researcher as to which factors to prioritize at the expense of others.

[22] This occurs in Guilford County.

22 of the 27 clusters.

In 23 of the 27 clusters, the Duchin Map produces a number of Democratic districts that fall within the middle 50% of simulation results and are not partisan outliers. This leaves 4 clusters in which the Duchan Plan is a partisan outlier in comparison to the simulation results.[23] This is three more clusters that are partisan outliers than the Enacted Map. The Duchin Map also produces the same number of Democratic leaning districts as the modal (most common) number of Democratic leaning districts in the simulations in 20 of the 27 clusters.

By these metrics the Duchin Map is less in alignment with the results of the non-partisan simulations than the Enacted Map and is a greater partisan outlier.

In 20 of the 27 clusters the Enacted Map and the Duchin map are in agreement on the number of Democratic leaning districts.[24] This means there is disagreement in 7 of the 40 total clusters. Figure 7 shows a map of the locations in which the Enacted Plan and the Duchin Plan are in agreement on the number of Democratic leaning districts. Figure 8 shows a map of the locations in which the Enacted Plan and the Duchin Plan disagreement on the number of Democratic leaning districts.

Table 2 summarizes the results of the simulation analysis for these 27 House clusters with multiple districts. Thereafter, I present the results cluster-by-cluster.

[23] These are Brunswick-New Hanover, Cumberland, Duplin-Wayne, and Pitt

[24] These county groupings are: Davidson, Columbus-Robeson, Carteret-Craven, Nash-Wilson, Caswell-Orange, Alexander et al., Franklin et al., Alleghany et al., Beaufort et al., Anson-Union, Onslow-Pender, Harnett-Johnston, Catawba-Iredell, Durham-Person, Forsyth-Stokes, Cabarrus et al., Chatham et al., Avery et al., Mecklenburg, and Wake.

Table 2: House County Grouping Analysis Summary

County Cluster	Cluster Democratic Partisan Index	# Districts	# of Districts that are Democratic Leaning		
			Enacted Map	Duchin Map	Simulations
Davidson	0.27	2	0	0	0
Pitt	0.54	2	1	**2**	1
Alamance	0.45	2	0	1	0-1
Columbus-Robeson	0.45	2	0	0	0
Carteret-Craven	0.35	2	0	0	XXX
Duplin-Wayne	0.43	2	0	**1**	0
Nash-Wilson	0.52	2	2	2	2
Caswell-Orange	0.71	2	2	2	2
Alexander-Surry-Wilkes	0.25	2	0	0	0
Franklin-Granville-Vance	0.51	2	1	1	1
Alleghany-Ashe-Caldwell-Watauga	0.36	2	0	0	0
Beaufort-Chowan-Currituck Dare-Hyde-Pamlico Perquimans-Tyrrell-Washington	0.39	2	0	0	0
Buncombe	0.60	3	2	3	2-3
Anson-Union	0.37	3	0	0	0
Onslow-Pender	0.35	3	0	0	0
Cumberland	0.59	4	3	**4**	3
Harnett-Johnston	0.38	4	0	0	0
Catawba-Iredell	0.33	4	0	0	0
Durham-Person	0.76	4	4	4	4
Brunswick-New Hanover	0.45	4	1	**2**	1
Forsyth-Stokes	0.52	5	2	2	2-3
Cabarrus-Davie-Rowan-Yadkin	0.36	5	0	0	0
Chatham-Lee-Moore-Randolph-Richmond	0.38	5	1	1	1
Guilford	0.61	6	**4**	5	5
Avery-Cleveland-Gaston-Henderson-McDowell-Mitchell-Polk-Rutherford-Yancey	0.35	7	0	0	0
Mecklenburg	0.65	13	11	11	11-12
Wake	0.61	13	11	11	11-12
Total:		107	45	52	46-51

Note: Number of Democratic leaning districts is measured using the average two-party vote share in each district from the 11 statewide races noted earlier. Simulations range represents the middle 50% of outcomes from the simulations results. There are no simulations results conducted in Carteret-Craven cluster, see later section for explanation. Groupings where a plan falls outside the middle 50% range of the simulations are bolded.

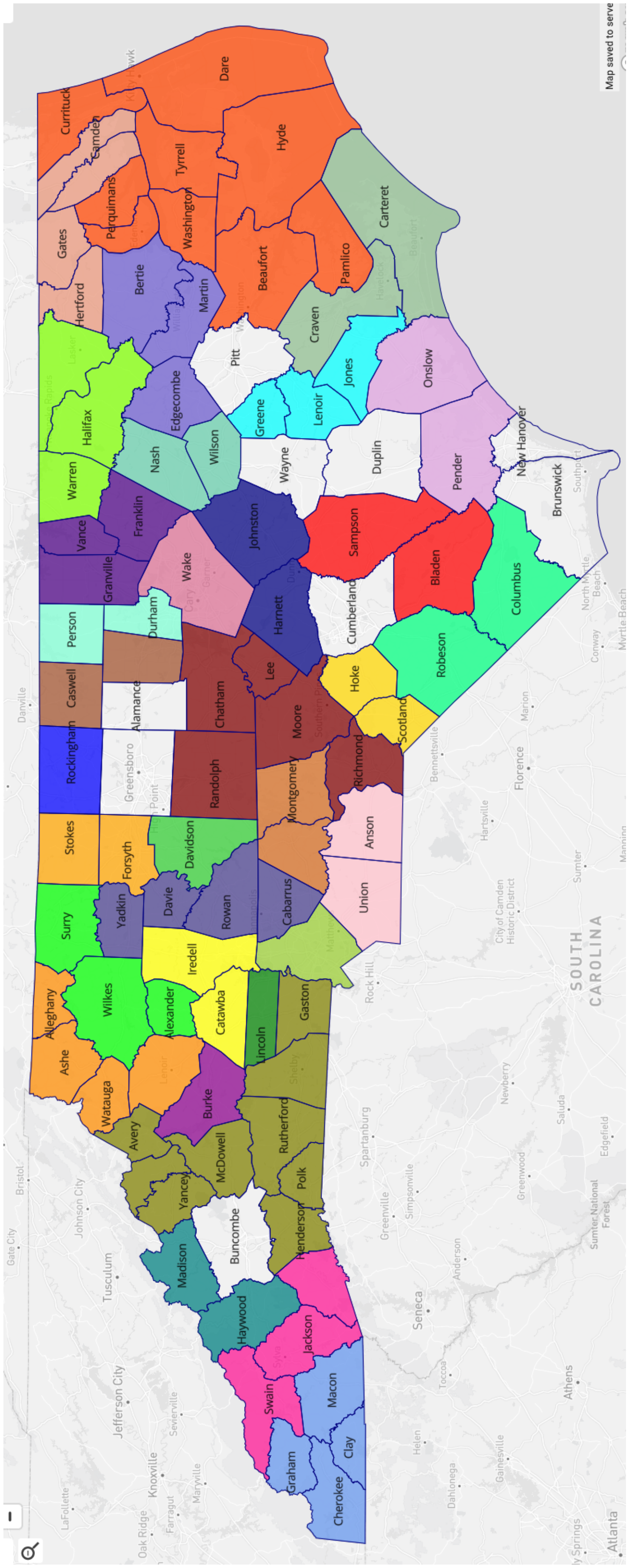


Figure 7: Map of House County Clusters Where Enacted and Duchin Plans Agree on Partisan Lean of Districts

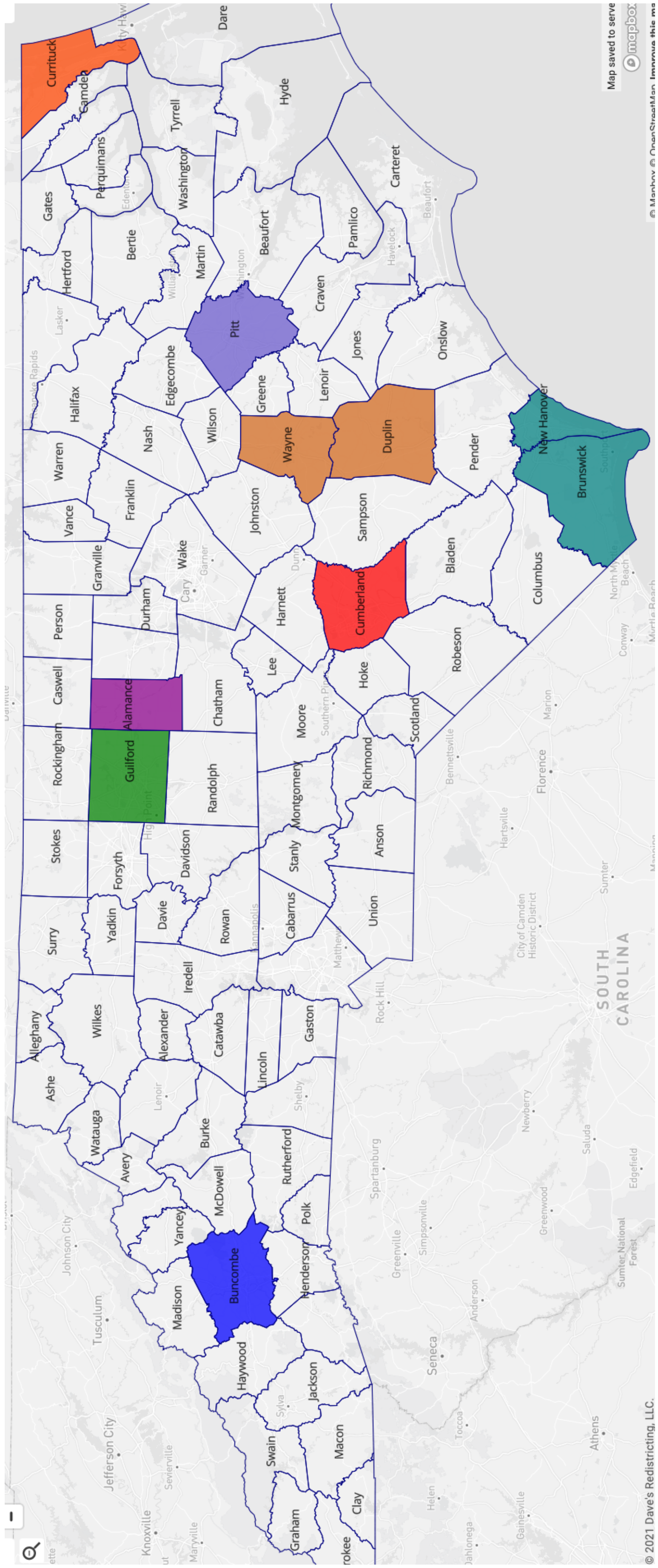


Figure 8: Map of House County Clusters Where Enacted and Duchin Plans Disagree on Partisan Lean of Districts

6.1 Davidson House County Grouping

Davidson County contains 2 districts. In the Enacted Map these are Districts 80 and 81. The county cluster has an overall partisan index of 0.27, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, in this case the county cluster is only one county (Davidson) and so the simulations are constrained to keep both districts entirely within the county, and thus, by definition there will be no county traversals in all 50,000 simulations as well as in the Enacted Map. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 37,252 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 9. A map of the Enacted Plan's districts within this cluster is shown in Figure 10.

The distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 11. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In this cluster the simulations, the Enacted Map, and the Duchin Map are in agreement, and all generate 0 Democratic leaning districts.

Table 3 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In this case there is unanimous agreement across all 11 elections.

Figure 9: **Map of Davidson House County Cluster**

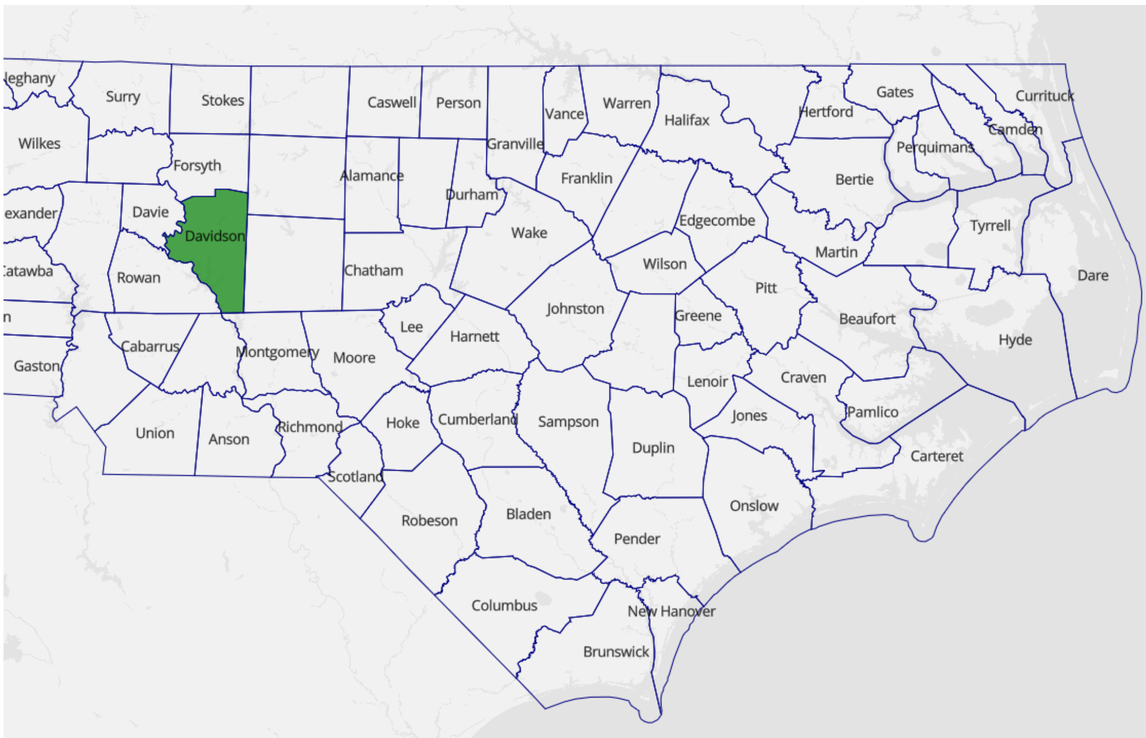
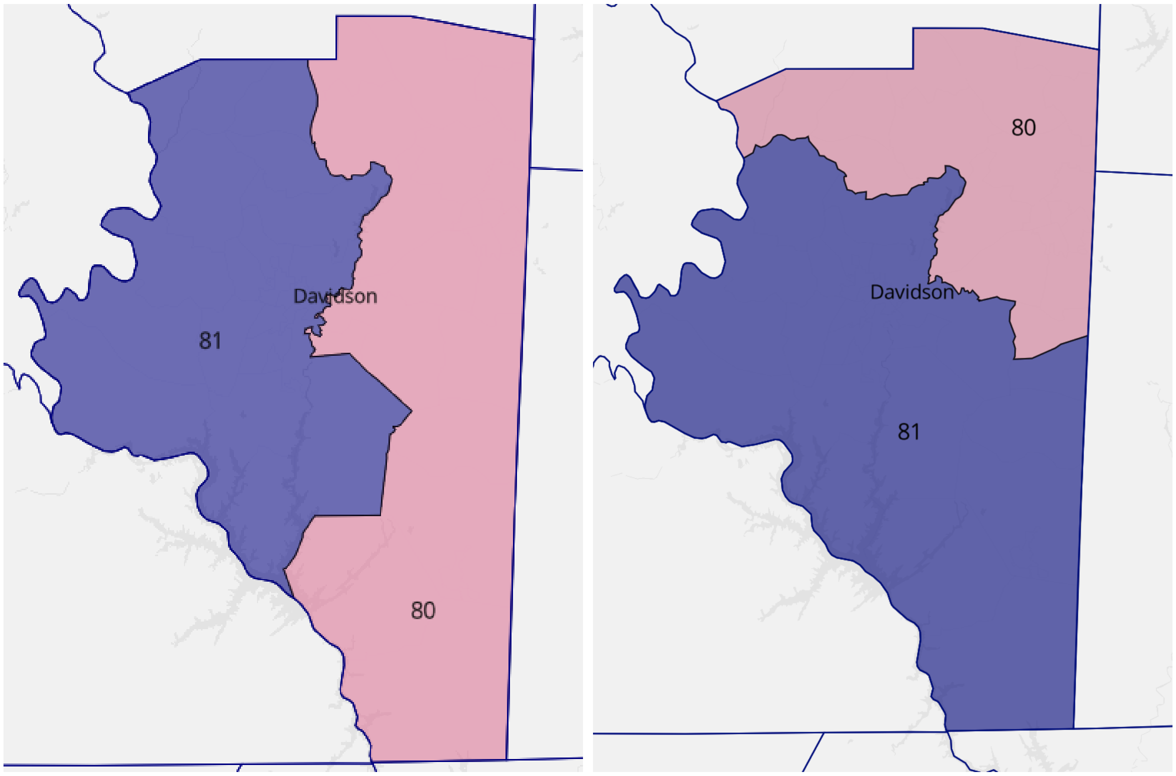


Figure 10: **Map of House Enacted Plan in Davidson County Cluster**

(a) Enacted Map (b) Duchin Map



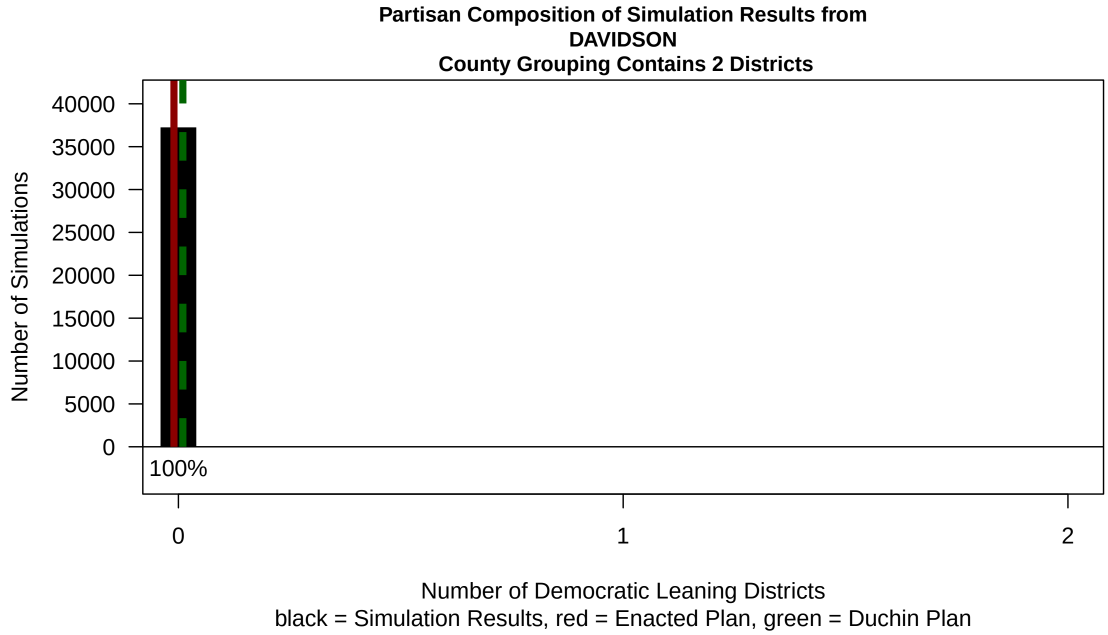
Note: The left map shows the district lines for the Enacted Map and the right map shows the district lines for the Duchin Map.

Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
80	0.26	0.28
81	0.29	0.27

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 11: **Distribution of Partisan Districts from Simulations in Davidson House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 3: Simulation Results by Individual Elections

Davidson House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.2 Pitt House County Grouping

Pitt County contains 2 districts. In the Enacted Map these are Districts 8 and 9. The county cluster has an overall partisan index of 0.54, which is slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, in this case the county cluster is only one county and so the simulations are constrained to keep both districts entirely within the county, and thus, by definition there will be no county traversals in all 50,000 simulations as well as in the Enacted Map. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 5,189 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 12. A map of the Enacted Maps' districts and the Duchin Map's district boundaries within this cluster are shown in Figure 13.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 14. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 91% of the simulations there is 1 Democratic leaning district and in the remaining 9% of the simulations there are two Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by creating one Democratic district. The Duchin Map generates two Democratic districts.

Table 4 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Demo-

cratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 12: **Map of Pitt House County Cluster**

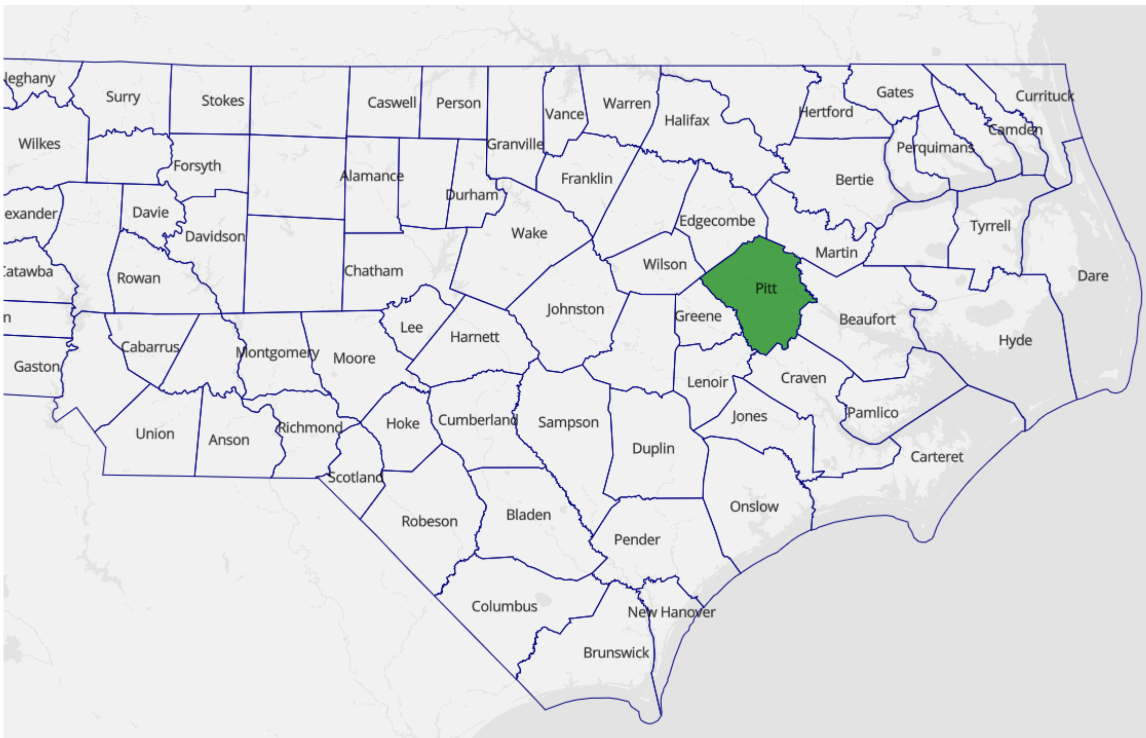
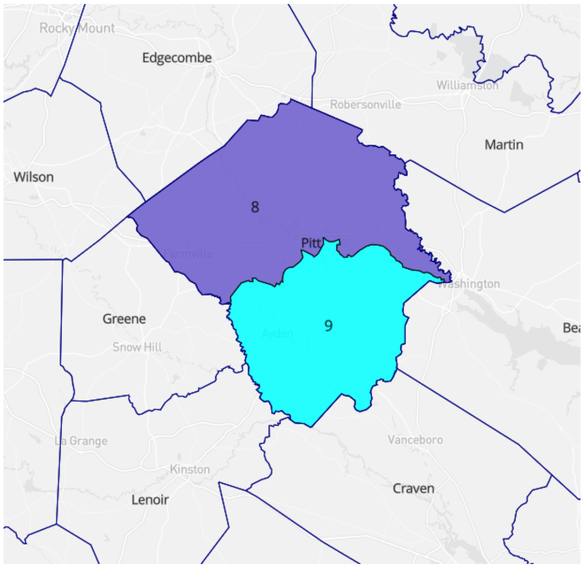
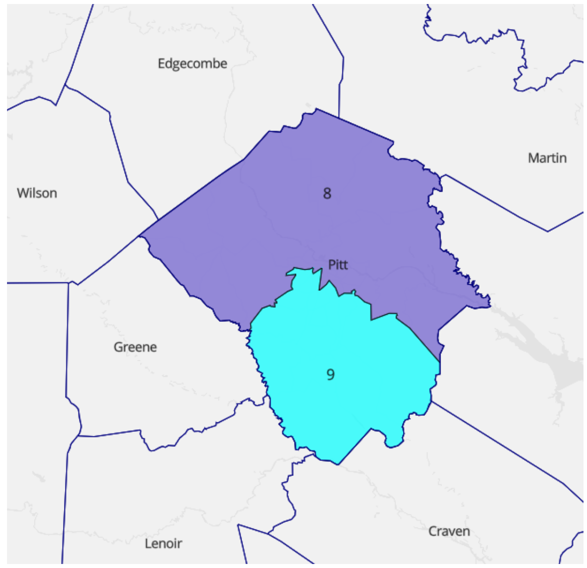


Figure 13: **Enacted Map and Duchin Map in Pitt House County Cluster**

(a) Enacted Map



(b) Duchin Map

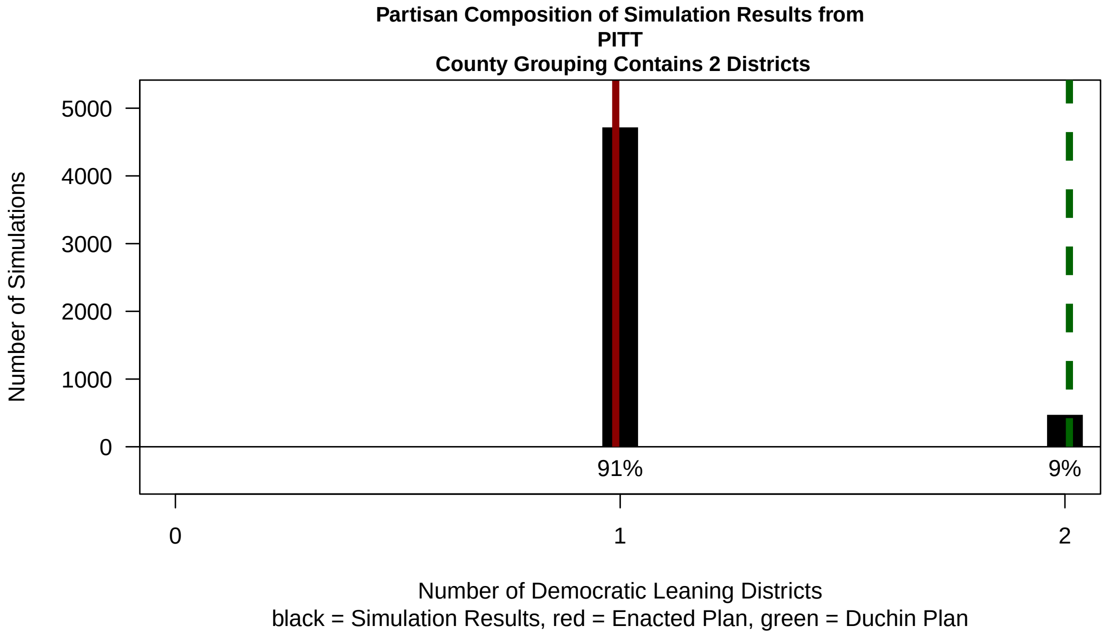


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
8	0.64	0.55
9	0.46	0.53

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 14: **Distribution of Partisan Districts from Simulations in Pitt House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 4: Simulation Results by Individual Elections

Pitt House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	**89%**	11%
2020 Senate	0%	**91%**	9%
2020 Governor	0%	**44%**	56%
2020 Lt. Governor	0%	**94%**	6%
2020 Attorney General	0%	**71%**	29%
2016 President	0%	**97%**	3%
2016 Senate	0%	**100%**	0%
2016 Governor	0%	**97%**	3%
2016 Lt. Governor	0%	**100%**	0%
2016 Attorney General	0%	**83%**	17%
2014 Senate	0%	**100%**	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 89% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

6.3 Alamance House County Grouping

Alamance County contains 2 districts. In the Enacted Map these are Districts 63 and 64. The county cluster has an overall partisan index of 0.45, which is slightly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, in this case the county cluster is only one county and so the simulations are constrained to keep both districts entirely within the county, and thus, by definition there will be no county traversals in all 50,000 simulations as well as in the Enacted Map. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 47,482 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 15. A map of the Enacted Maps' districts and the Duchin Map's district boundaries within this cluster are shown in Figure 16. I also include the map of districts in this county from the 2020 plan for comparison here.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 17. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 44% of the simulations there are 0 Democratic leaning districts and in the remaining 56% of the simulations there is 1 Democratic leaning district. The Enacted Map is within the middle 50% if the simulation results, but is not in alignment with the modal outcome of the simulations. The Duchin Map generates 1 Democratic district.

Table 5 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 10 of the 11 elections considered the Enacted Plan agrees with the modal outcome of the simulations. The only case in which it does not agree with the modal result is in the 2020 Lt. Governor's race. However, in this race the simulations were nearly equally split between generating 0 and 1 Democratic district.

The Enacted Plan is also extremely similar to the maps used in Alamance County in the 2020 elections. These districts were approved by a court in 2019. The Enacted Plan is different by only two and one half precincts - South Burlington precinct is now placed in District 64 (it was in District 63 in the 2020 map) and North Thompson and the part of Melville 3 precinct that was split into District 64 is now placed into District 63, making it whole and keeping the municipality of Swepsonville entirely in District 63.

Another consideration is that while the Enacted Plan does not generate a Democratic leaning district using the partisan index, there is one district that is effectively a 50/50 split between Republicans and Democrats. The partisan index of District 63 is 0.4994, which is about as close to a perfect split between Republican and Democratic votes as a district could get. It is very likely that both parties will win this district a number of times over the next several years.

Figure 15: **Map of Alamance House County Cluster**

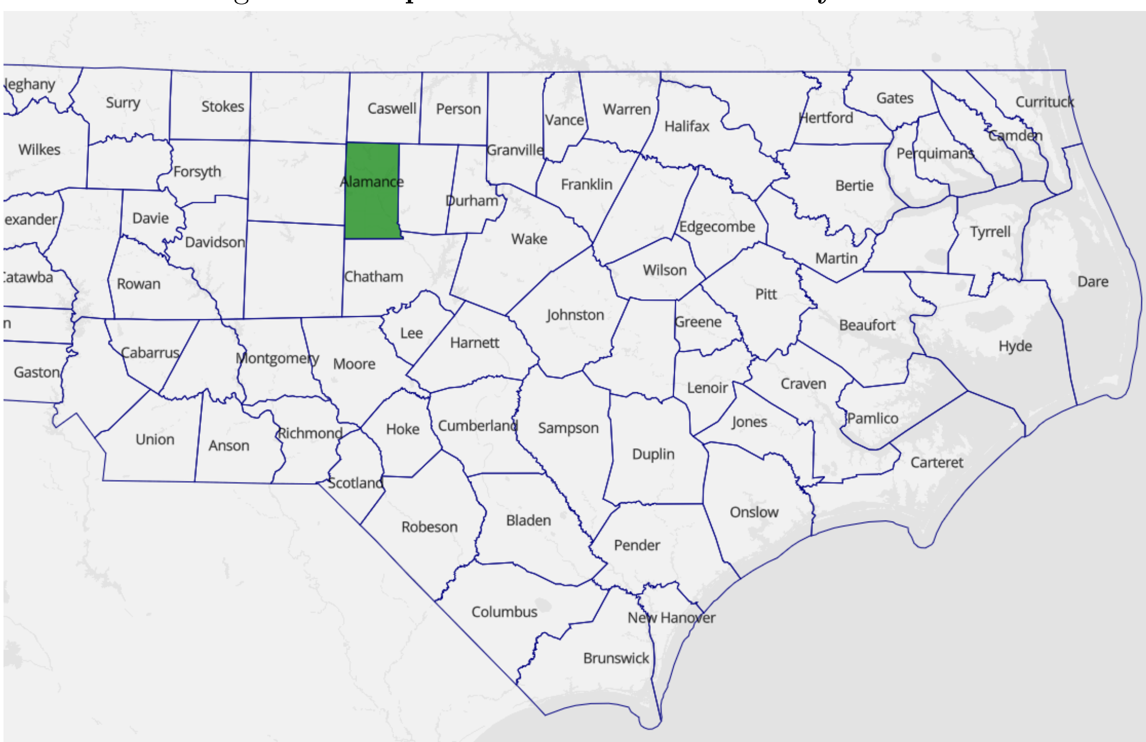
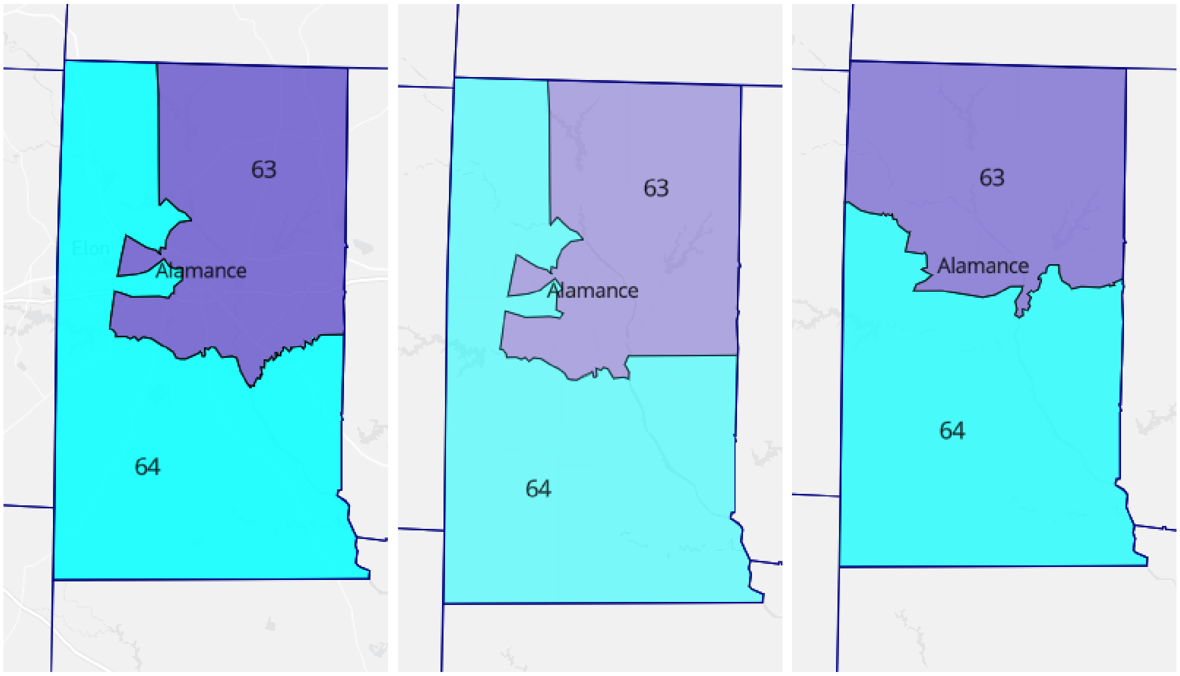


Figure 16: **Enacted Map, 2020 Map, and Duchin Map in Pitt House County Cluster**

(a) Enacted Map (b) 2020 Map (c) Duchin Map

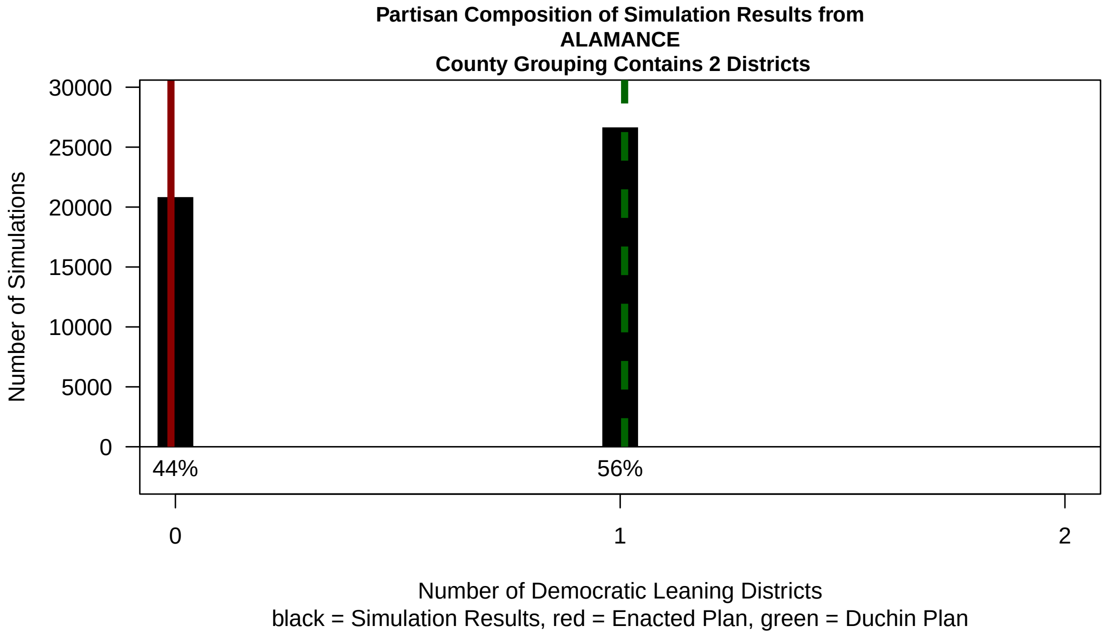


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
63	0.50	0.54
64	0.41	0.38

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 17: **Distribution of Partisan Districts from Simulations in Alamance House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 5: Simulation Results by Individual Elections

Alamance House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	40%	**60%**	0%
2020 Senate	38%	**62%**	0%
2020 Governor	3%	**97%**	0%
2020 Lt. Governor	**47%**	53%	0%
2020 Attorney General	13%	**87%**	0%
2016 President	**77%**	23%	0%
2016 Senate	**98%**	2%	0%
2016 Governor	39%	**61%**	0%
2016 Lt. Governor	**99%**	1%	0%
2016 Attorney General	42%	**58%**	0%
2014 Senate	**97%**	3%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 60% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

6.4 Columbus and Robeson House County Grouping

The Columbus-Robeson House county grouping contains 2 districts. In the Enacted Map these are Districts 46 and 47. The county cluster has an overall partisan index of 0.45, which is slightly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 46,076 remaining simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 2,664 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 18. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 19.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 20. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by creating 0 Democratic districts. The Duchin Map also generates 0 Democratic district.

Table 6 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 18: **Map of Columbus and Robeson House County Cluster**

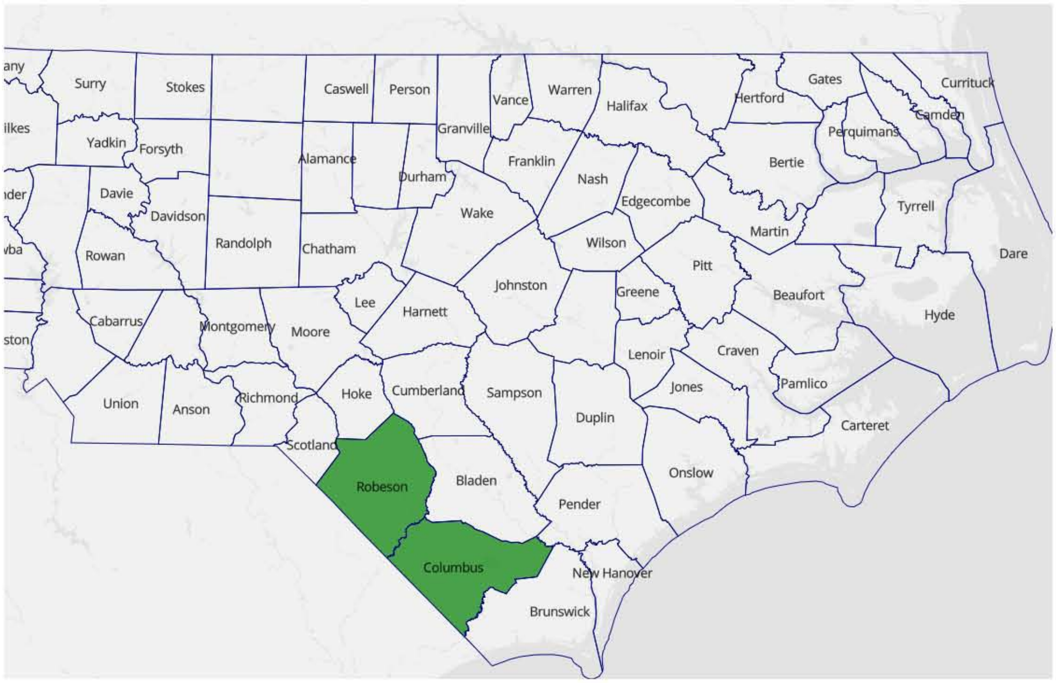
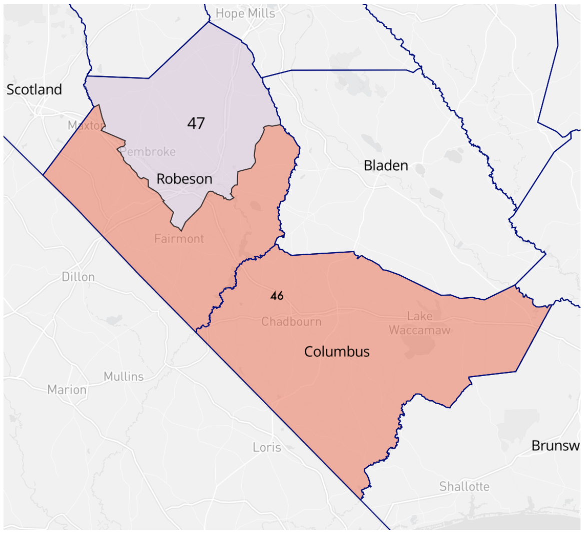
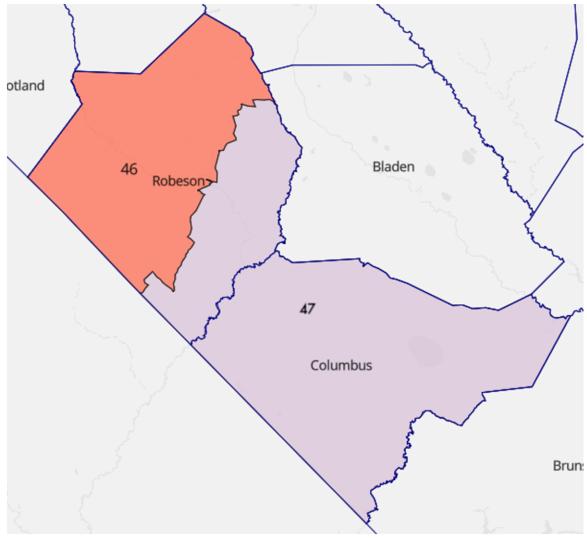


Figure 19: **Map of House Enacted Plan and Duchin Plan in Columbus and Robeson County Cluster**

(a) Enacted Map



(b) Duchin Map

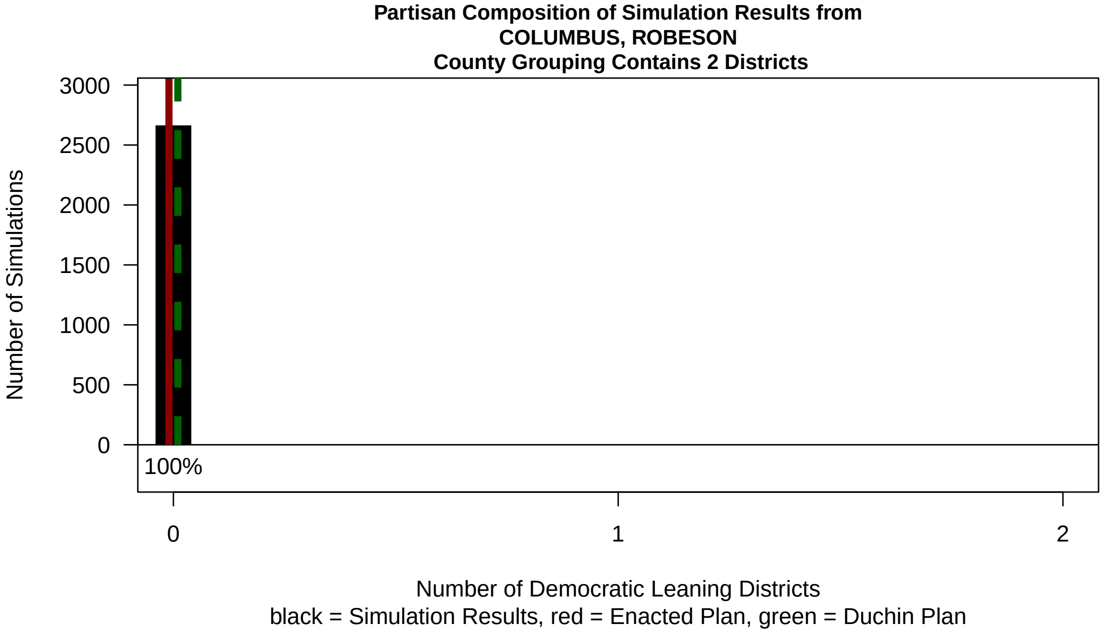


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
46	0.42	0.49
47	0.48	0.42

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 20: **Distribution of Partisan Districts from Simulations in Columbus and Robeson House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 6: Simulation Results by Individual Elections

Columbus and Robeson House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	0%	**100%**	0%
2016 Attorney General	0%	**53%**	47%
2014 Senate	0	0%	**100%**

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.5 Carteret and Craven House County Grouping

The Carteret-Craven House county grouping contains 2 districts. In the Enacted Map these are Districts 3 and 13. The county cluster has an overall partisan index of 0.35, which is strongly Republican. I do not conduct simulations in this cluster because there is no possible way to assemble VTDs in this county grouping and produce two districts that meet the equal population criteria. To do so requires splitting a VTD, something both the Enacted Plan and Duchin Plans do, but the simulations are not capable of. However, there is agreement between the Enacted Plan and the Duchin Plan, as both plans create two Republican leaning districts that are nearly identical in shape. Furthermore, given the strong Republican lean of the county grouping and relatively even distribution of partisan preferences in the county, it would be impossible to assemble any district that leans Democratic.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 21. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 22.

Figure 21: **Map of Carteret and Craven County Cluster**

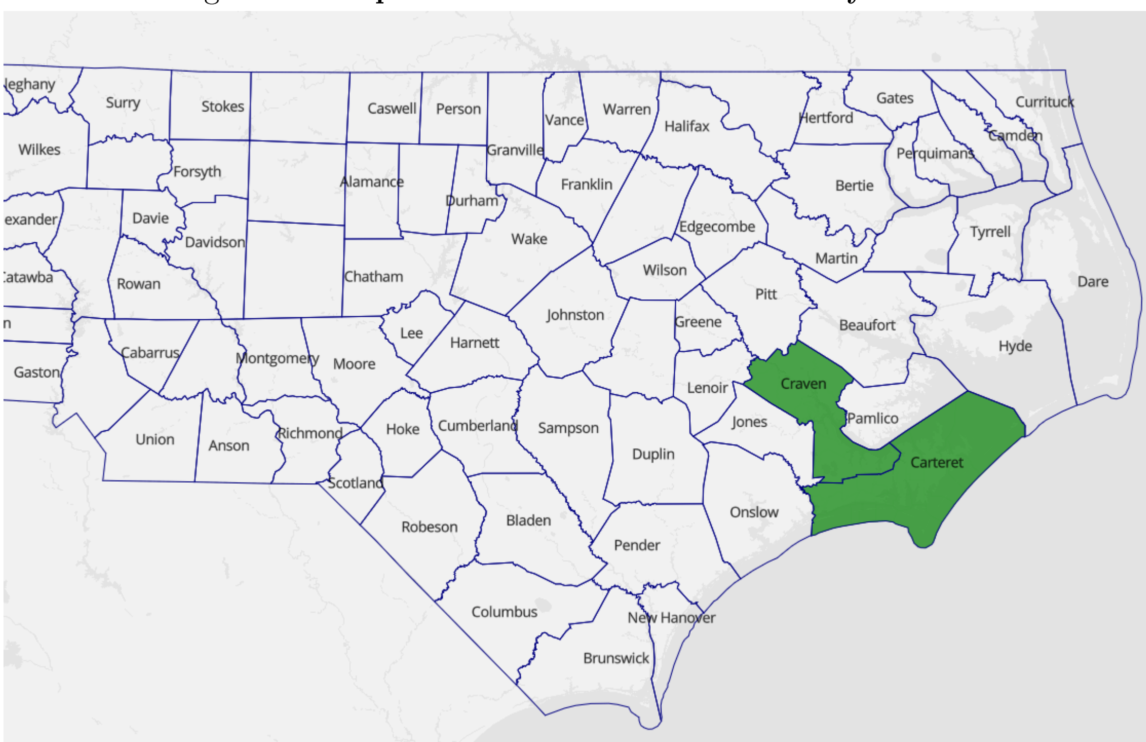
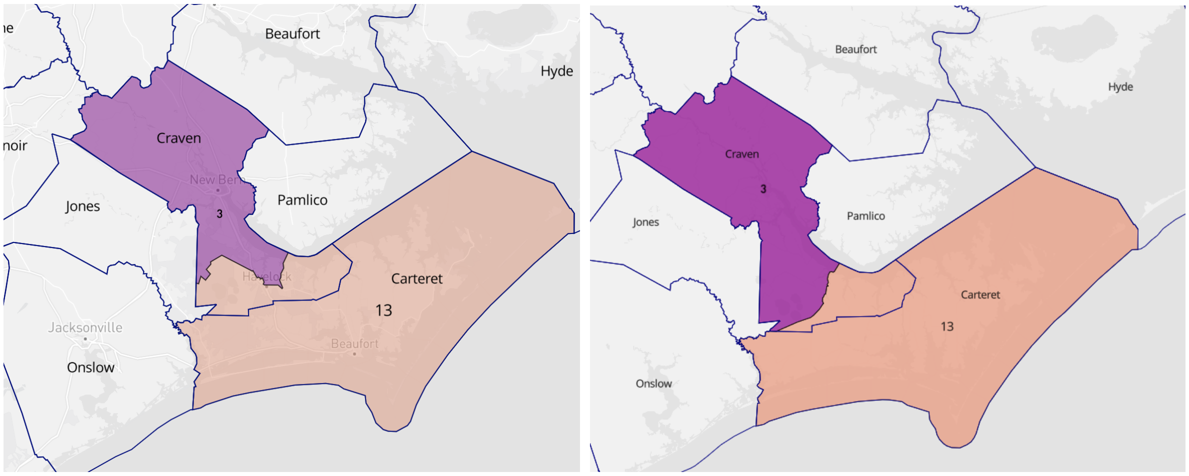


Figure 22: **Map of House Enacted Plan in Carteret and Craven County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
3	0.40	0.40
13	0.31	0.31

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

6.6 Duplin and Wayne House County Grouping

The Duplin-Wayne House county grouping contains 2 districts. In the Enacted Map these are Districts 4 and 10. The county cluster has an overall partisan index of 0.43, which is moderately Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any maps that contain more county traversals than the Enacted Plan, leaving 23,399 maps. Next, I would normally discard any simulations in which the average compactness score of the districts in the simulations that are not as large or larger than the compactness score of the Enacted Map. However, this leaves 0 simulated maps, as the Enacted Plan is more compact than any of the simulations (an average Polsby-Popper score of .50, which is very high). To have some simulations to compare to the Enacted Plan and the Duchin plan, I retained the 10% of the simulated maps that have the highest compactness score (2,704 maps).

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 23. A map of the Enacted Maps' districts and the Duchin Map's district boundaries within this cluster are shown in Figure 24.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 25. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in agreement with the simulation results and generates 0 Democratic leaning districts. The Duchin Map creates one Democratic leaning district (District 21) surrounding the town of Goldsboro. However to avoid Republican leaning VTDs in the north and western portions of Wayne County, District 4 in the Duchin Plan joins these VTDs with Duplin County to the south. This creates a district that has a northern "hook," which is much less compact than the districts in the Enacted Plan. The average Polsby-Popper score for Districts 21 and 4 in the Duchin plan is 0.32. What reason could there be for the shape of District 4? One possibility is that the district is attempting to keep Goldsboro, the largest city in Wayne County whole. However, both the Enacted and Duchin plans keep Goldsboro whole.[25] Given this, it is hard to imagine another explanation for the unusual shape of District 4 aside from an attempt to avoid Republican precincts so as to create a Democratic leaning seat in District 21.

Table 7 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the elections considered the Enacted Plan agrees with the modal (most common) outcome of the simulations.

[25] The Enacted Plan places 5 residents from Goldsboro and the Goldsboro wastewater treatment plant in District 4. The remaining 99.99% of Goldsboro is in District 10.

Figure 23: **Map of Duplin and Wayne House County Cluster**

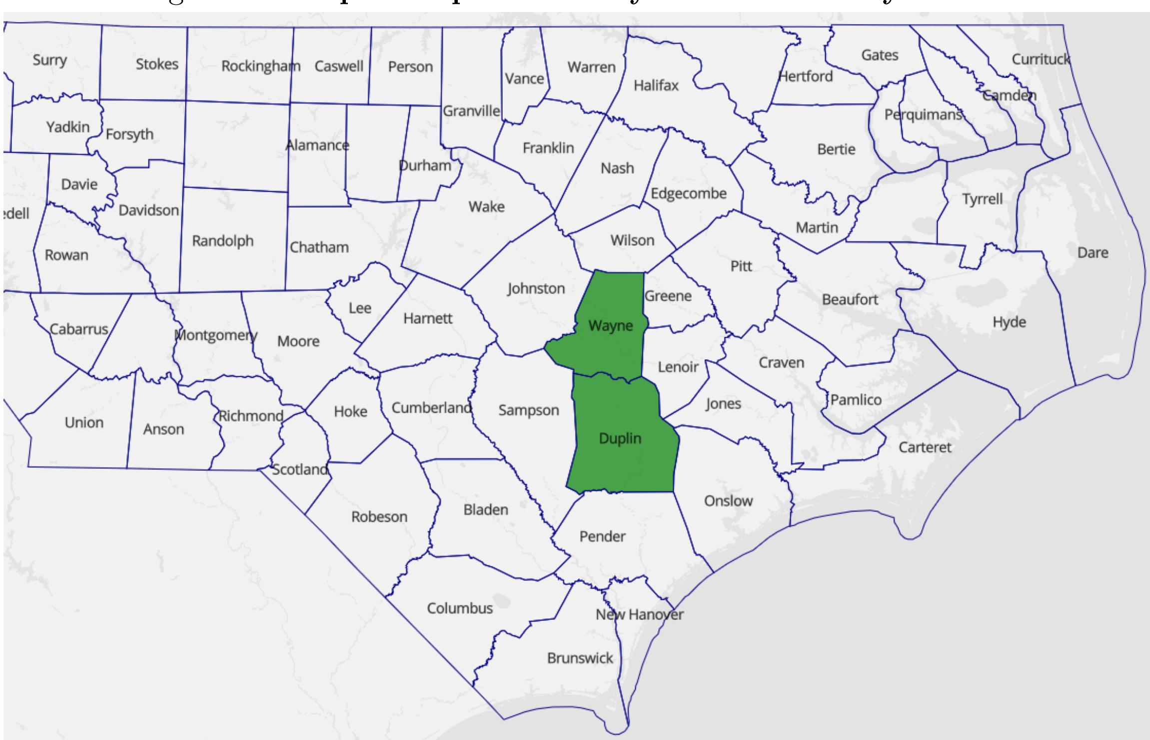
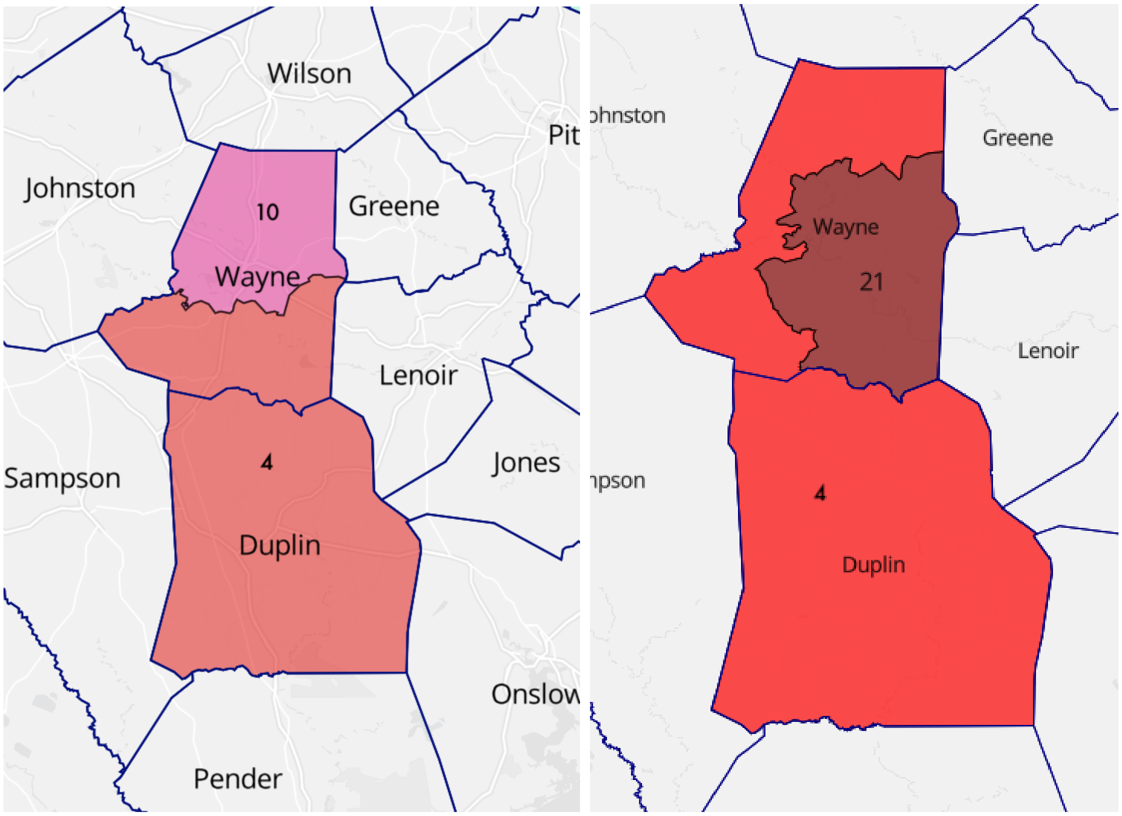


Figure 24: **Map of House Enacted Plan in Duplin and Wayne County Cluster**

(a) Enacted Map (b) Duchin Map

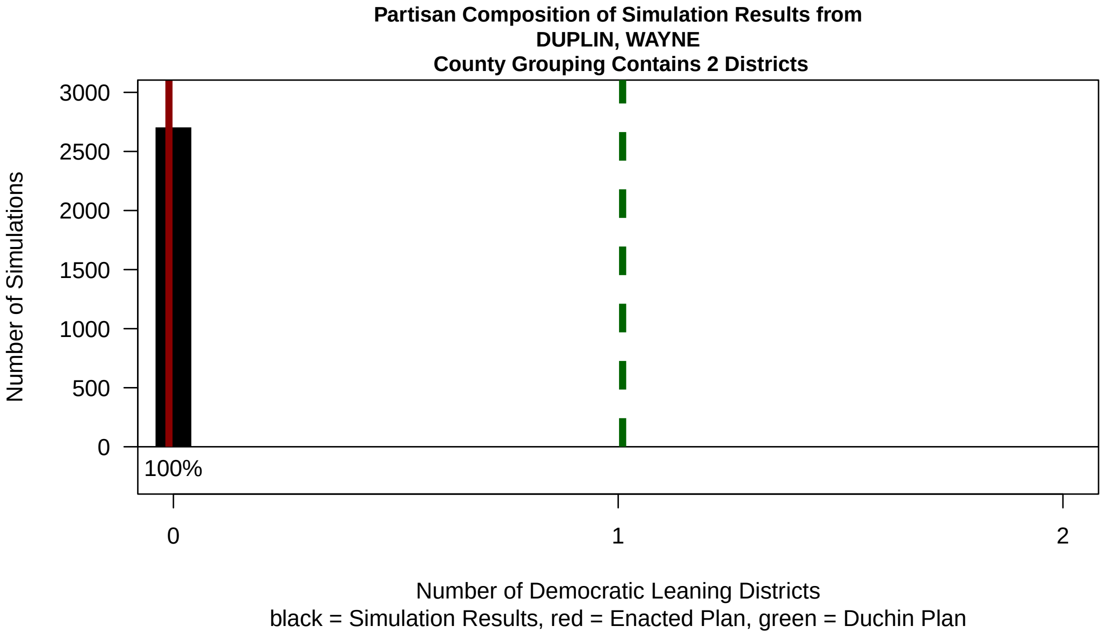


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
4	0.41	0.36
10 (21 in Duchin)	0.46	0.51

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 25: **Distribution of Partisan Districts from Simulations in Duplin and Wayne House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 7: Simulation Results by Individual Elections

Duplin and Wayne House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**95%**	5%	0%
2014 Senate	**95%**	5%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.7 Nash and Wilson House County Grouping

The Nash-Wilson House county grouping contains 2 districts. In the Enacted Map these are Districts 24 and 25. The county cluster has an overall partisan index of 0.52, which is slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 41,476 remaining simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 14,569 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 26. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 27.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 28. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 2 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 2 Democratic districts. The Duchin Map also generates 2 Democratic districts.

Table 8 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 26: **Map of Nash and Wilson House County Cluster**

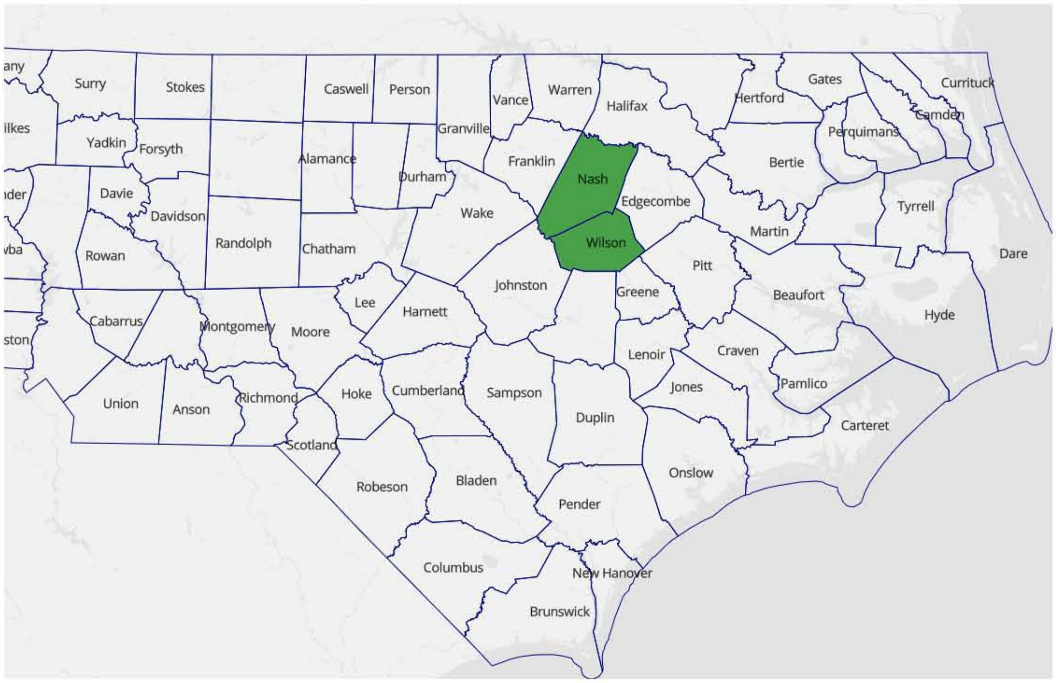
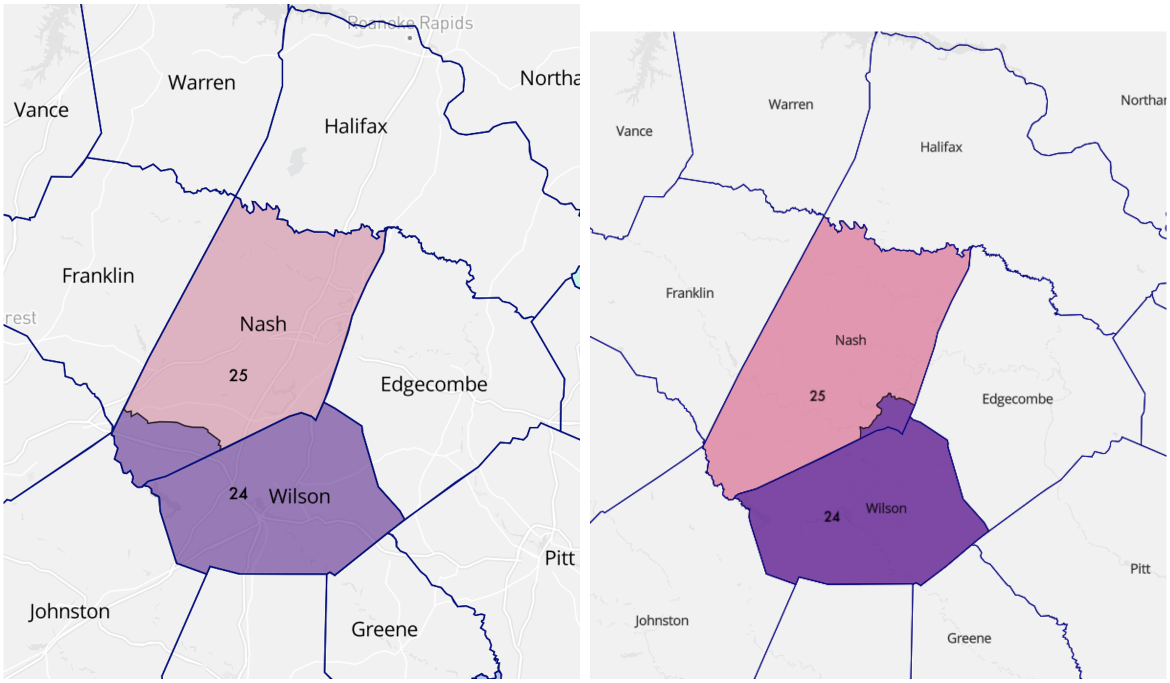


Figure 27: **Map of House Enacted Plan in Nash and Wilson County Cluster**

(a) Enacted Map (b) Duchin Map

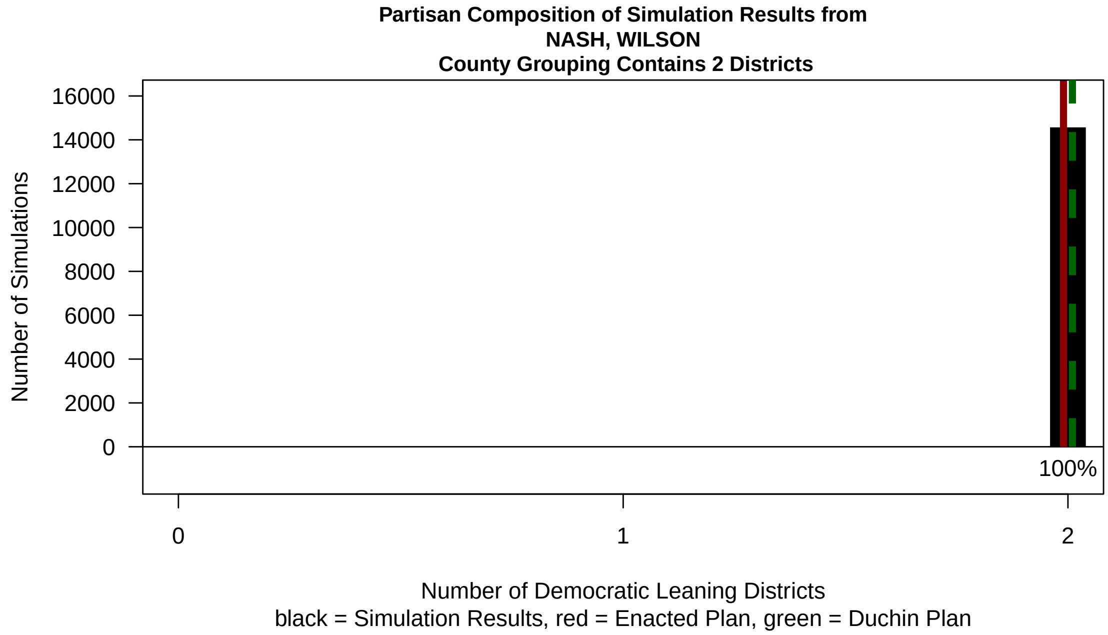


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
24	0.52	0.52
25	0.52	0.52

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 28: **Distribution of Partisan Districts from Simulations in Nash and Wilson House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 8: Simulation Results by Individual Elections

Nash and Wilson House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	**88%**	12%
2020 Senate	0%	0%	**100%**
2020 Governor	0%	0%	**100%**
2020 Lt. Governor	0%	**88%**	12%
2020 Attorney General	0%	0%	**100%**
2016 President	0%	0%	**100%**
2016 Senate	0%	0%	**100%**
2016 Governor	0%	0%	**100%**
2016 Lt. Governor	0%	0%	**100%**
2016 Attorney General	0%	0%	**100%**
2014 Senate	0%	**88%**	12%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 88% of the simulations produce 1 Democratic leaning districts. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

6.8 Caswell and Orange House County Grouping

The Caswell-Orange House county grouping contains 2 districts. In the Enacted Map these are Districts 50 and 56. The county cluster has an overall partisan index of 0.71, which is strongly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 50,000 simulated maps since in this case all of the simulation results only include one county traversal, as does the Enacted Map. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 40,012 simulated maps, each containing two districts.

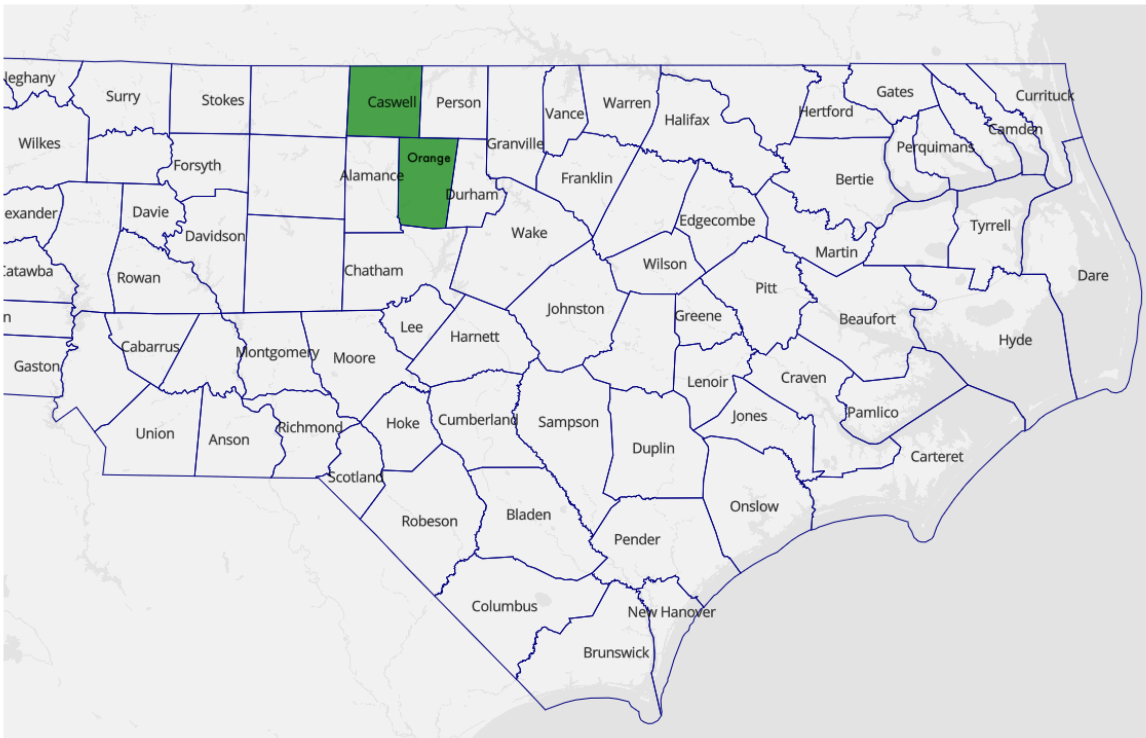
A map of the location of this county cluster in relation to the rest of the state is shown in Figure 29. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 30.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 31. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 2 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 2 Democratic districts. The Duchin Map also generates 2 Democratic districts.

Table 9 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 29: **Map of Caswell and Orange House County Cluster**



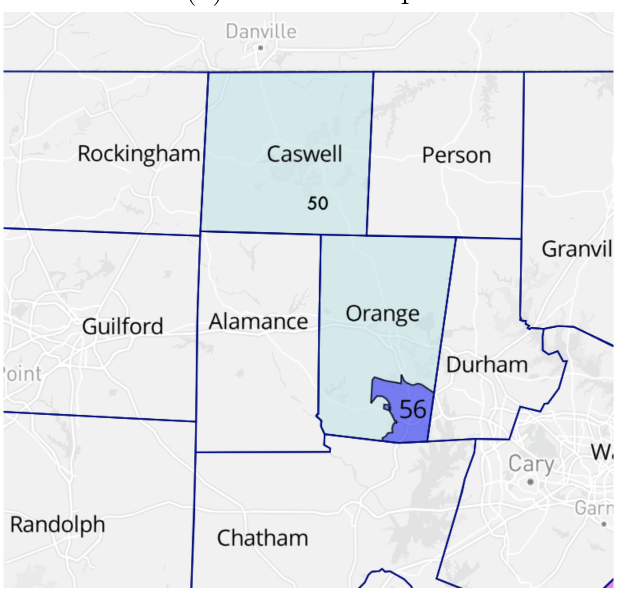
Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
50	0.57	0.56
56	0.85	0.85

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 30: **Map of House Enacted Plan in Caswell and Orange County Cluster**

(a) Enacted Map



(b) Duchin Map

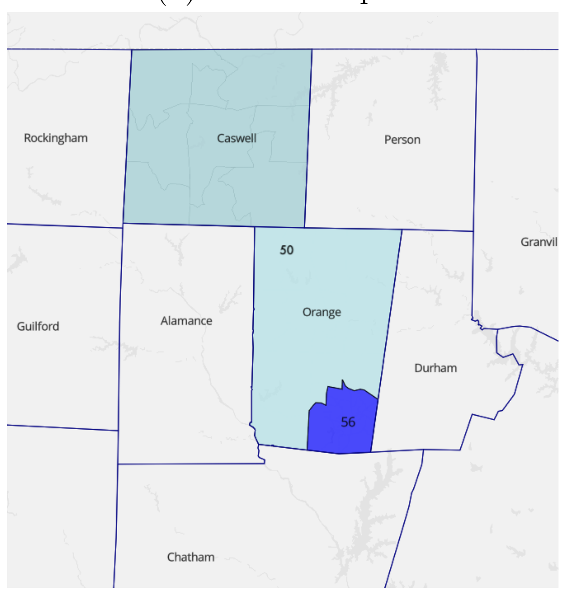
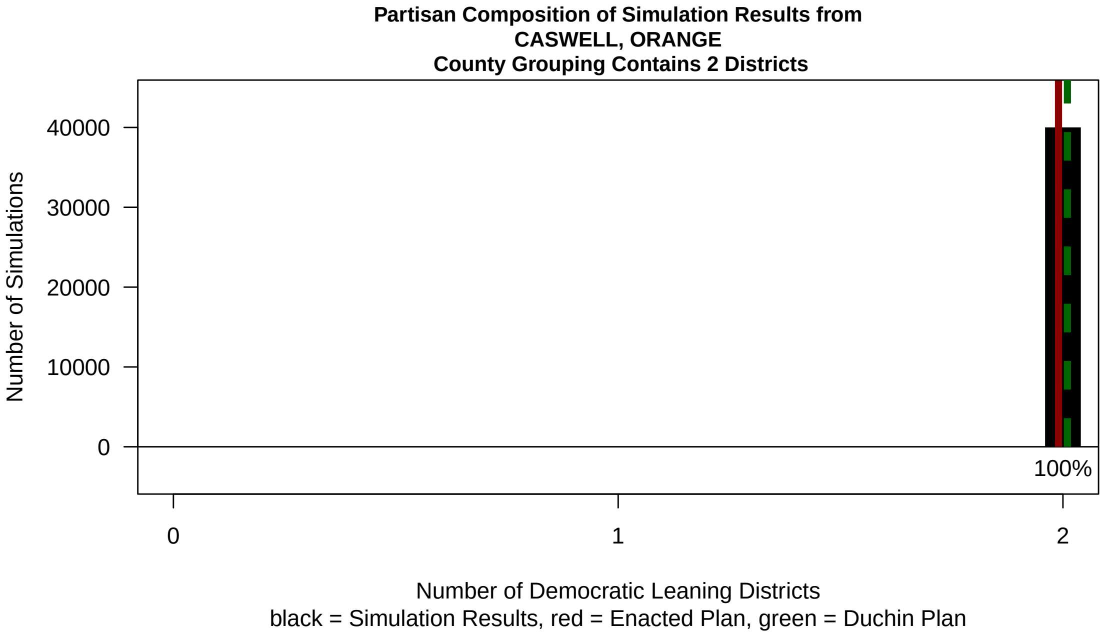


Figure 31: **Distribution of Partisan Districts from Simulations in Caswell and Orange House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 9: Simulation Results by Individual Elections

Caswell and Orange House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	0%	**100%**
2020 Senate	0%	0%	**100%**
2020 Governor	0%	0%	**100%**
2020 Lt. Governor	0%	0%	**100%**
2020 Attorney General	0%	0%	**100%**
2016 President	0%	0%	**100%**
2016 Senate	0%	0%	**100%**
2016 Governor	0%	0%	**100%**
2016 Lt. Governor	0%	0%	**100%**
2016 Attorney General	0%	0%	**100%**
2014 Senate	0%	0%	**100%**

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 2 Democratic leaning districts. The Enacted Plan does as well, as the '2 District' cell is bolded in that row.

6.9 Alexander, Surry, and Wilkes House County Grouping

The Alexander-Surry-Wilkes House county grouping contains 2 districts. In the Enacted Map these are Districts 90 and 94. The county cluster has an overall partisan index of 0.25, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 49,931 simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 20,124 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 32. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 33.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 34. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic districts. The Duchin Map also generates 0 Democratic districts.

Table 10 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 32: **Map of Alexander, Surry, and Wilkes County House County Cluster**

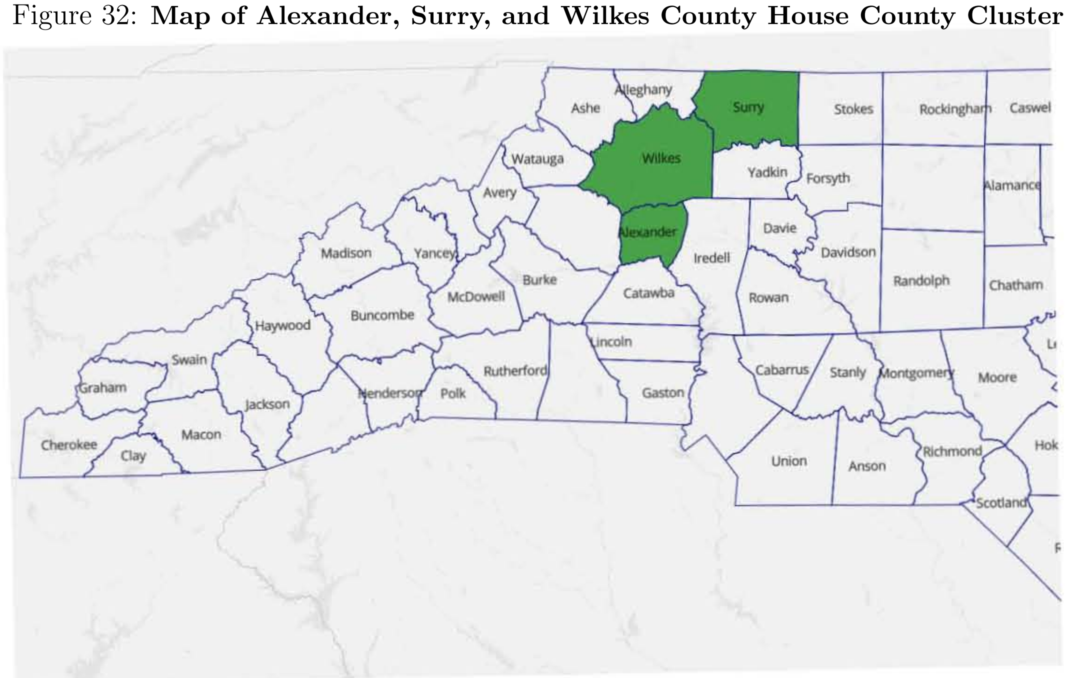
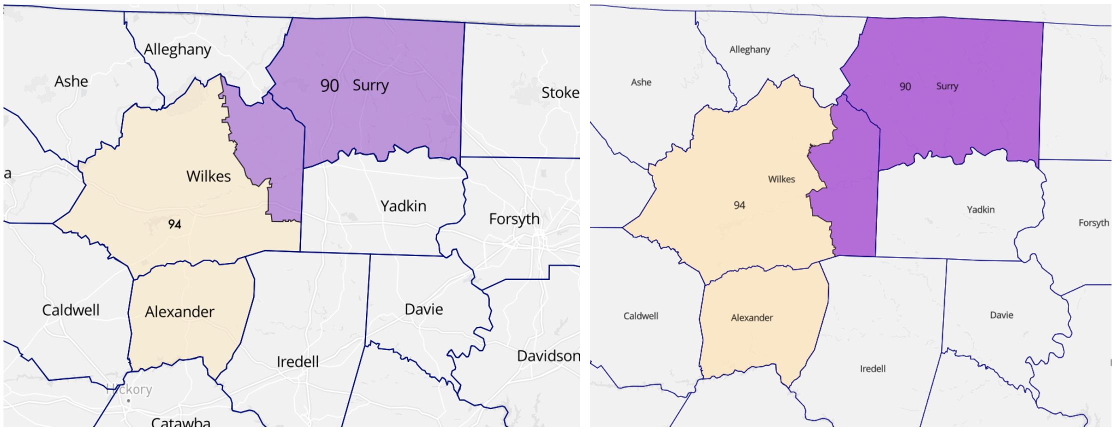


Figure 33: **Map of House Enacted Plan in Alexander, Surry, and Wilkes County Cluster**

(a) Enacted Map (b) Duchin Map

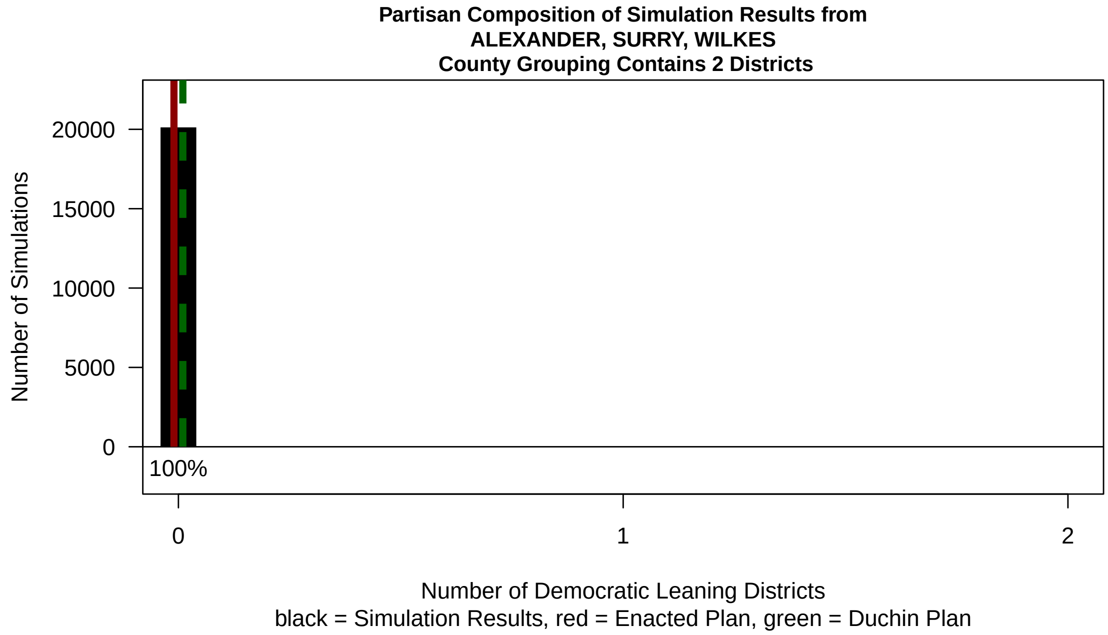


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
90	0.26	0.26
94	0.25	0.25

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 34: **Distribution of Partisan Districts from House Simulations in Alexander, Surry, and Wilkes CountyCluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 10: Simulation Results by Individual Elections

Alexander, Surry, and Wilkes House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.10 Franklin, Granville, and Vance House County Grouping

The Franklin-Granville-Vance House county grouping contains 2 districts. In the Enacted Map these are Districts 32 and 7. The county cluster has an overall partisan index of 0.51, which is very slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 17,823 simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 7,682 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 35. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 36.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 37. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there is 1 Democratic leaning district. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 1 Democratic district. The Duchin Map also generates 1 Democratic district.

Table 11 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 35: **Map of Franklin, Granville, and Vance House County Cluster**

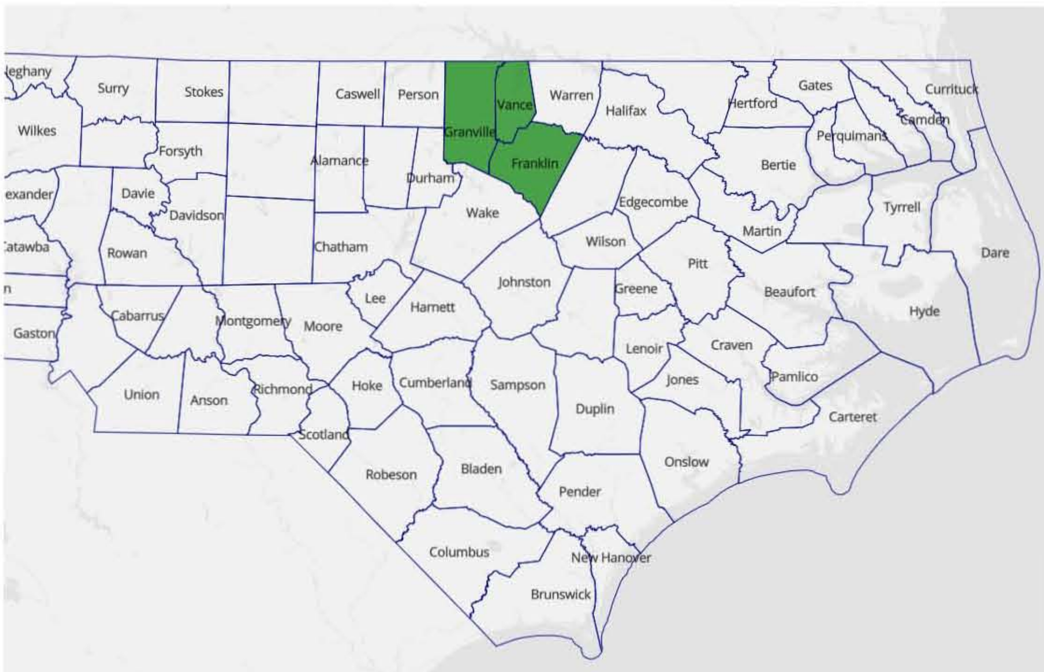
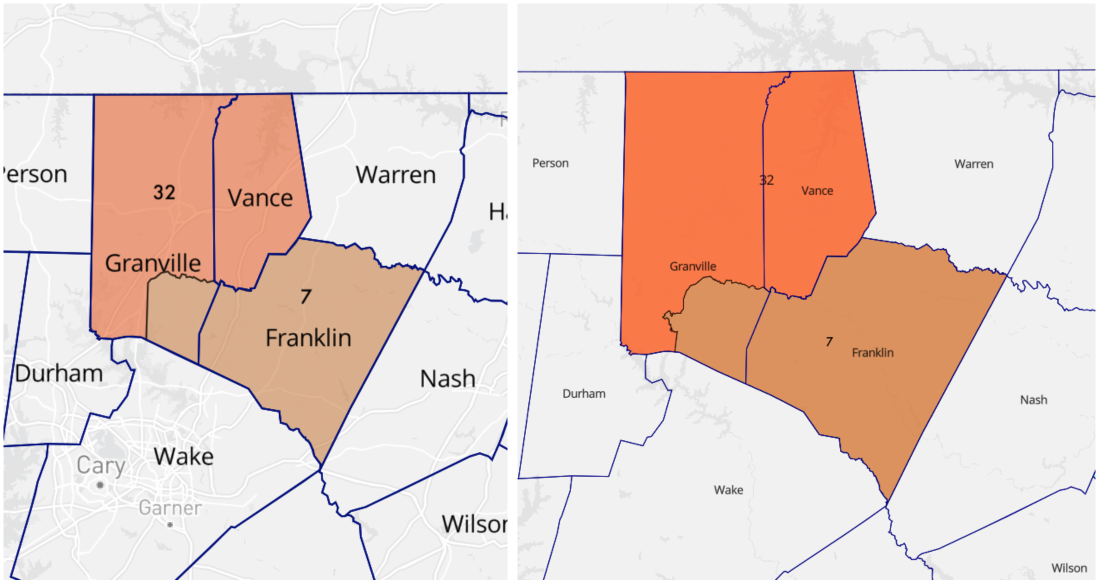


Figure 36: **Map of House Enacted Plan in Franklin, Granville, and Vance County Cluster**

(a) Enacted Map (b) Duchin Map

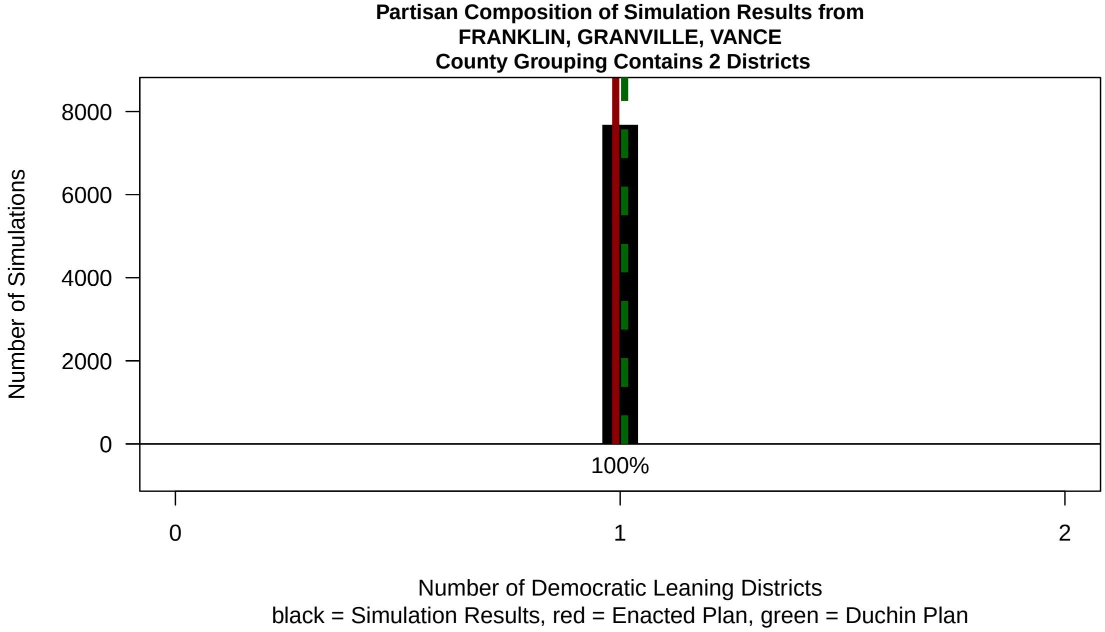


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
7	0.44	0.44
32	0.58	0.58

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 37: **Distribution of Partisan Districts from Simulations in Franklin, Granville, and Vance House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 11: Simulation Results by Individual Elections

Franklin, Granville, and Vance House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	**100%**	0%
2020 Senate	0%	**100%**	0%
2020 Governor	0%	**100%**	0%
2020 Lt. Governor	0%	**100%**	0%
2020 Attorney General	0%	**100%**	0%
2016 President	0%	**100%**	0%
2016 Senate	0%	**100%**	0%
2016 Governor	0%	**100%**	0%
2016 Lt. Governor	0%	**100%**	0%
2016 Attorney General	0%	**100%**	0%
2014 Senate	0%	**100%**	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

6.11 Alleghany, Ashe, Caldwell, and Watauga House County Grouping

The Alleghany-Ashe-Caldwell-Watauga House county grouping contains 2 districts. In the Enacted Map these are Districts 93 and 87. The county cluster has an overall partisan index of 0.36, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 47,843 simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves only six unique maps that are as compact as the Enacted Plan.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 38. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 39.

Because there are only six maps that fit the criteria I use of equal population, county traversals, and compactness equal to or better than the Enacted Map, I do not present the distribution of district partisanship for the simulations here. It is sufficient to say that in the Enacted Map, the Duchin map, and the six remaining simulations, all create 2 Republican districts and 0 Democratic leaning districts, regardless of the index or election used. Table 12 shows this below.

Figure 38: **Map of Alleghany, Ashe, Caldwell, and Watauga House County Cluster**

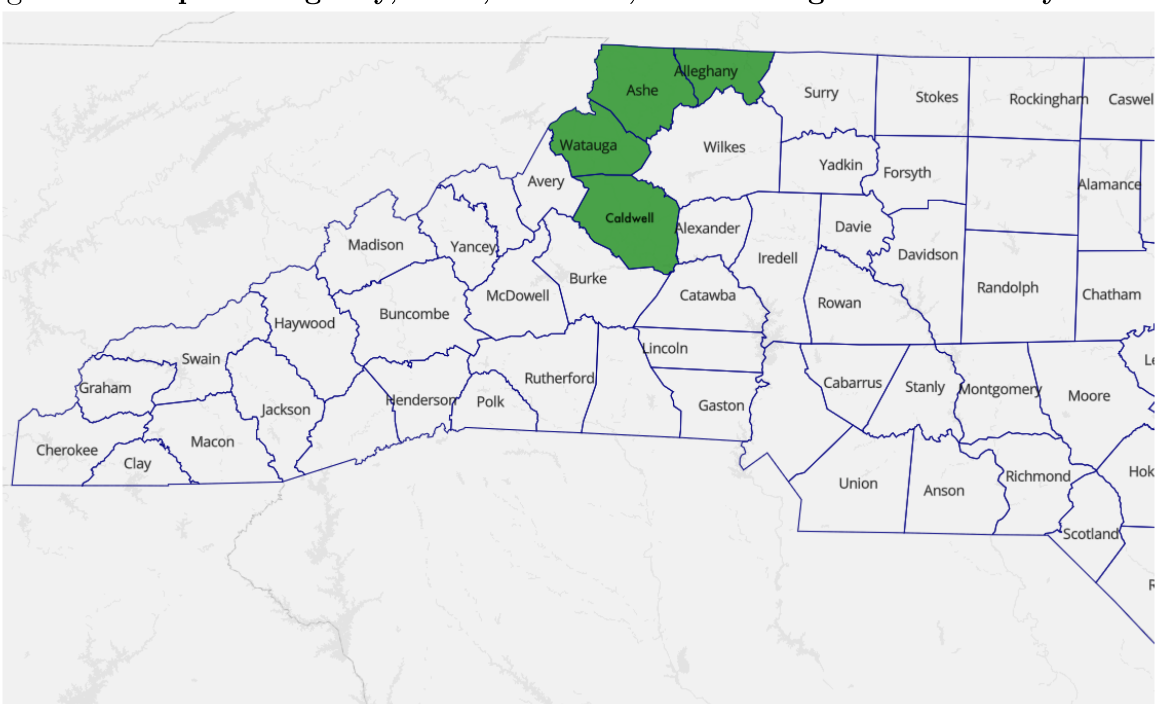
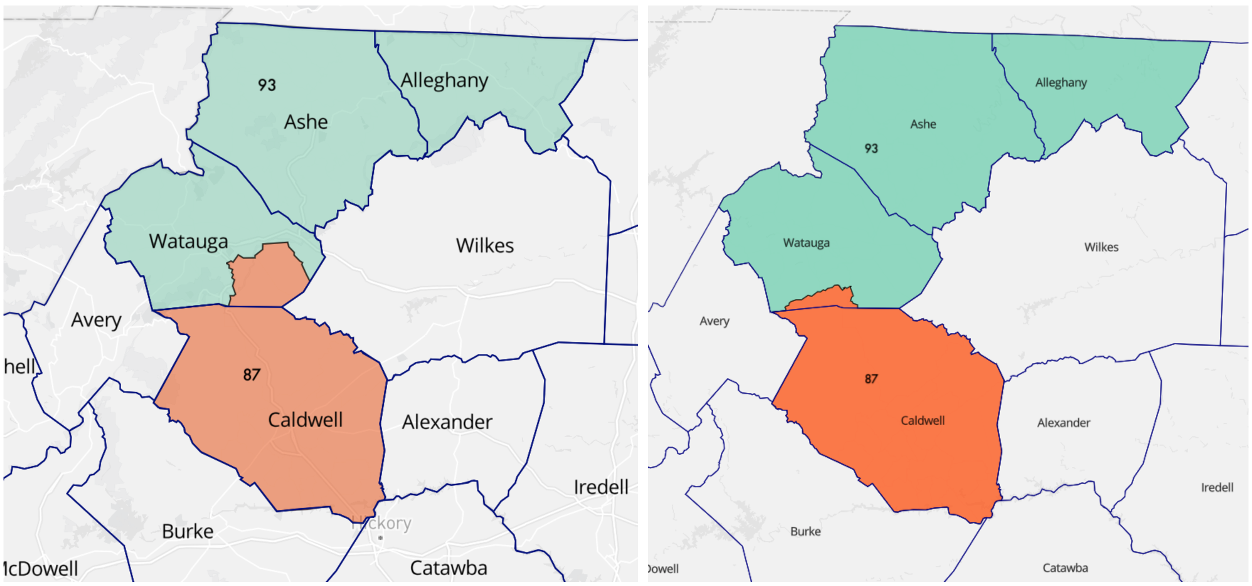


Figure 39: **Map of House Enacted Plan inAlleghany, Ashe, Caldwell, and Watauga County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
87	0.28	0.27
93	0.43	0.43

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Table 12: Simulation Results by Individual Elections

Alleghany, Ashe, Caldwell, and Watauga House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Election Indices:	Percentage of Simulations		
All Elections Index	**100%**	0%	0%
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.12 Beaufort, Chowan, Currituck, Dare, Hyde, Pamlico, Perquimans, Tyrrell, and Washington House County Grouping

The Beaufort-Chowan-Currituck-Dare-Hyde-Pamlico-Perquimans-Tyrrell-Washington House county grouping contains 2 districts. In the Enacted Map these are Districts 1 and 79. The county cluster has an overall partisan index of 0.39, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 379 simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves only two unique maps that are as compact as the Enacted Plan.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 40. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 41.

Because there are only two maps that fit the criteria I use of equal population, county traversals, and compactness equal to or better than the Enacted Map, I do not present the distribution of district partisanship for the simulations here. It is sufficient to say that in the Enacted Map, the Duchin map, and the two remaining simulations, all create 2 Republican districts and 0 Democratic leaning districts, regardless of the index or election used. Table 13 shows this below.

Figure 40: **Map of Beaufort, Chowan, Currituck, Dare, Hyde, Pamlico, Perquimans, Tyrrell, and Washington House County Cluster**

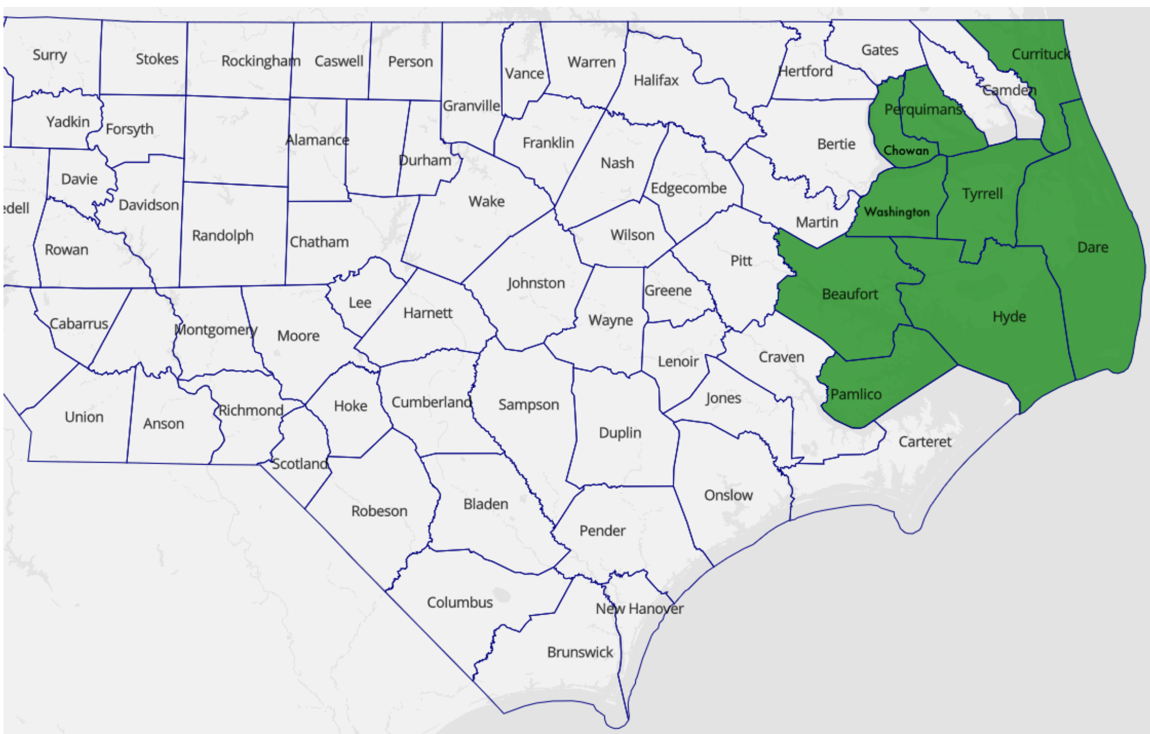
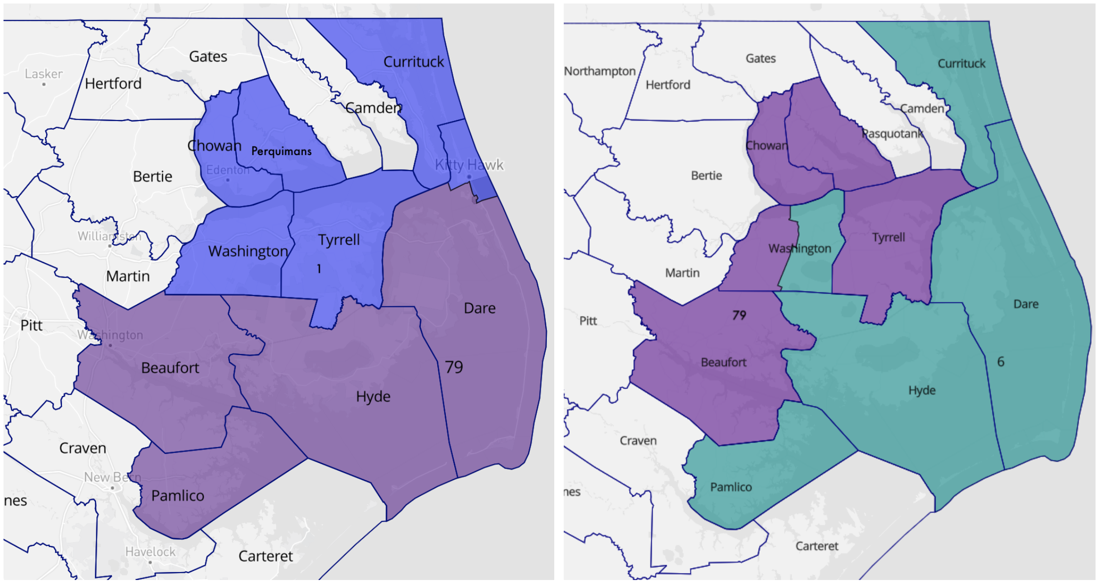


Figure 41: **Map of House Enacted Plan in Beaufort, Chowan, Currituck, Dare, Hyde, Pamlico, Perquimans, Tyrrell, and Washington County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
1 (6 in Duchin)	0.39	0.36
79	0.39	0.41

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Table 13: Simulation Results by Individual Elections

Beaufort, Chowan, Currituck, Dare, Hyde, Pamlico, Perquimans, Tyrrell, and Washington House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Election Indices:	Percentage of Simulations		
All Elections Index	**100%**	0%	0%
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.13 Buncombe House County Grouping

The Buncombe House county grouping contains 3 districts. In the Enacted Map these are Districts 114, 115, and 116. The county cluster has an overall partisan index of 0.60, which is moderately Democratic. After conducting 50,000 initial simulations to create three districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, this grouping contains only one county, so all of the simulations will contain the same number of traversals as the Enacted Map. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 38,664 simulated maps, each containing three districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 42. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 43.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 45. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 28% of the simulations there are 2 Democratic leaning districts. in 72% oft he simulations there are three Democratic leaning districts. The Enacted Map is in alignment with the minority outcome of the simulations by also creating 2 Democratic districts. The Duchin Map generates 3 Democratic districts.

Table 15 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In this case the Enacted Plan creates 2 Democratic leaning districts, regardless of the election considered. However, the frequency with which the simulations produce 2 Democratic districts varies from a low of 2% in the 2020 Governor race to a 51% majority in the 2016 Presidential race.

One consideration for why the Enacted Plan diverges from the Duchin Plan and the modal outcome of the simulations is because it keeps a larger portion of the town of Asheville, the county seat and largest city in Buncombe County, in fewer districts. Figure 44 shows a map of the city and how the two different plans divide the city. The Duchin Plan splits Asheville nearly equally across all three districts in a pie shape while the Enacted Plan keeps much more of Asheville within two districts. There is a small portion of the southern most part of the city in District 116. The tactic of dividing Democratic cities in a 'pinwheel' or 'pizza' shape and grouping those 'slices' with more Republican suburban and exurban areas is a classic tactic to generate more Democratic districts and overcome the geographic clustering that is common among Democratic voters. The Enacted Plan keeps much more of Asheville within two districts. Table 14 shows the percent of Asheville voters in each district in each plan. It is clear that the Duchin plan splits Ashville into three roughly equal parts while the Enacted Plan places a much larger majority of Asheville into only two districts.

Table 14: Division of Asheville in Enacted Plan and Duchin Plan

	Percent of Asheville in district	
District:	Enacted Plan	Duchin Plan
114	55.6	27.7
115	30.9	39.9
116	13.5	32.5
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf Population numbers for city by district for Duchin Plan from Dave's Redistricting online. https://davesredistricting.org/

Figure 42: **Map of Buncombe House County Cluster**

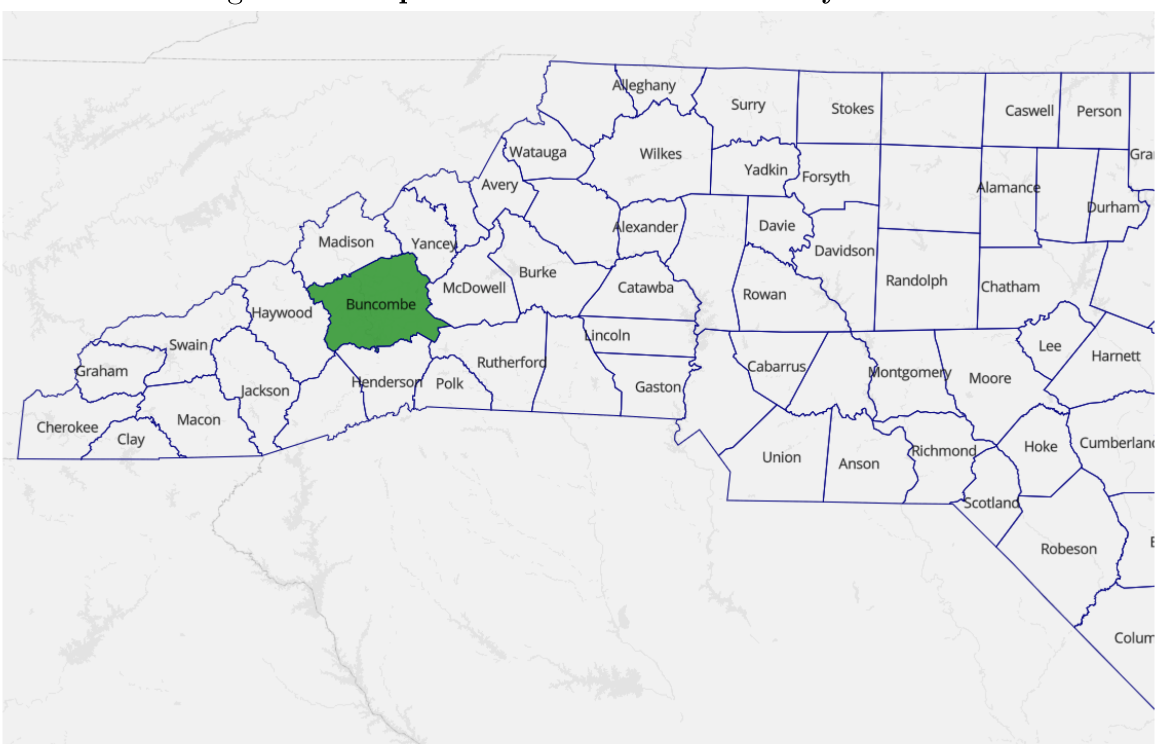
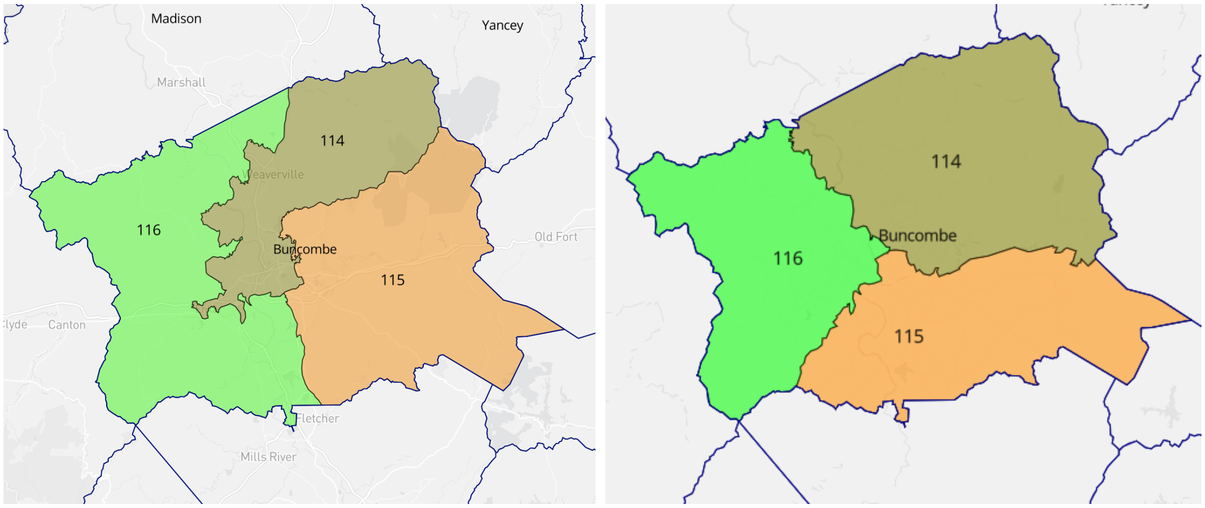


Figure 43: **Map of House Enacted Plan and Duchin Plan in Buncombe County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
114	0.72	0.62
115	0.60	0.60
116	0.46	0.57

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 44: **Map of Asheville Divisions in Buncombe County Cluster**

(a) Enacted Map (b) Duchin Map

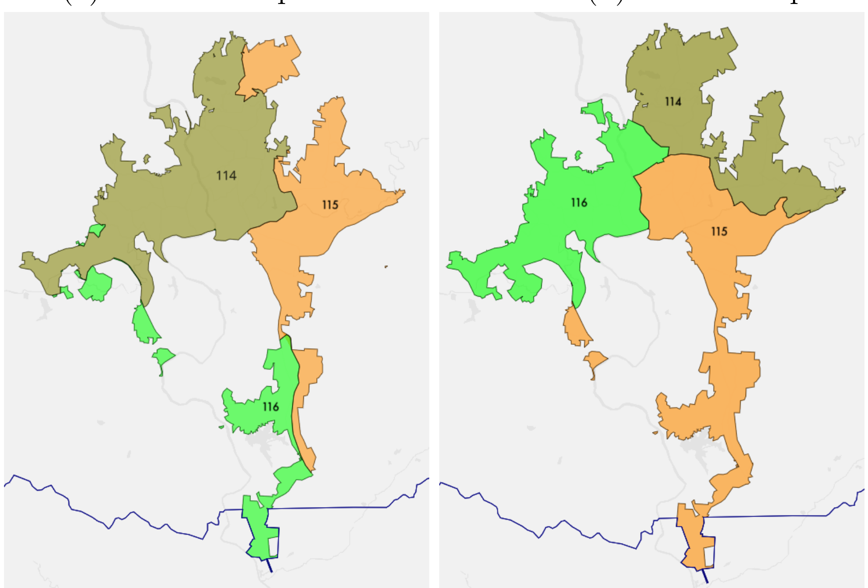
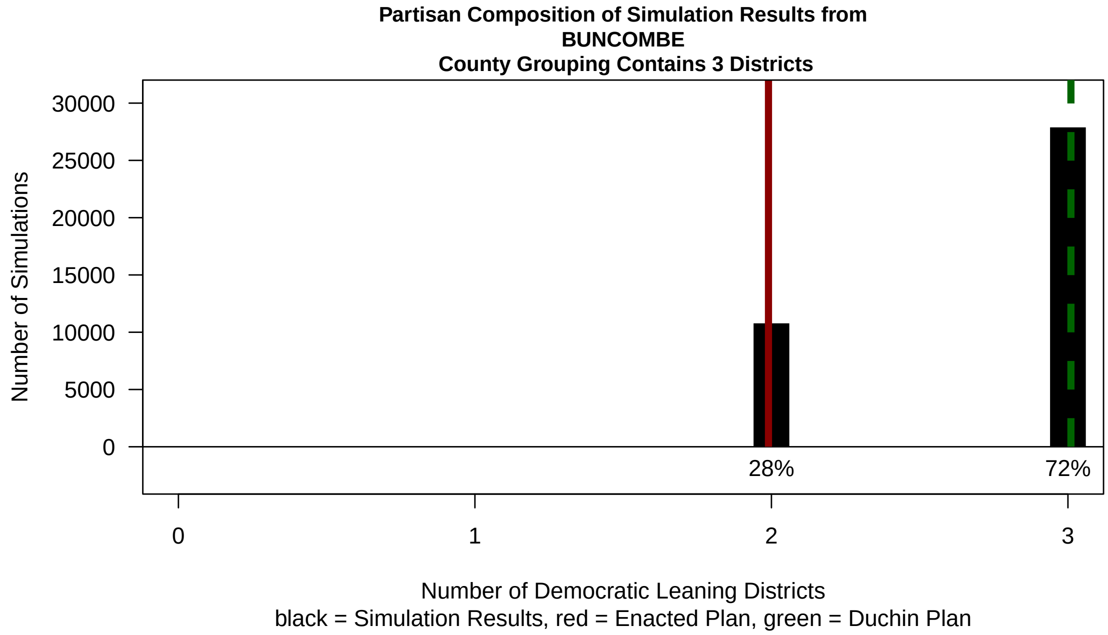


Figure 45: **Distribution of Partisan Districts from Simulations in Buncombe House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 15: Simulation Results by Individual Elections

Buncombe House County Cluster

Number of Democratic Leaning Districts:				
	0	1	2	3
Individual Elections:				
2020 President	0%	0%	**26%**	74%
2020 Senate	0%	0%	**23%**	77%
2020 Governor	0%	0%	**2%**	98%
2020 Lt. Governor	0%	0%	**31%**	69%
2020 Attorney General	0%	0%	**16%**	84%
2016 President	0%	1%	**51%**	48%
2016 Senate	0%	1%	**46%**	53%
2016 Governor	0%	0%	**12%**	88%
2016 Lt. Governor	0%	1%	**43%**	56%
2016 Attorney General	0%	0%	**20%**	80%
2014 Senate	0%	0%	**24%**	76%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 26% of the simulations produce 2 Democratic leaning districts. The Enacted Plan does as well, as the '2 Districts' cell is bolded in that row.

6.14 Anson and Union House County Grouping

The Anson-Union House county grouping contains 3 districts. In the Enacted Map these are Districts 55, 68 and 69. The county cluster has an overall partisan index of .37, which is strongly Republican. After conducting 50,000 initial simulations to create three districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 43,555 simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 20,759 simulated maps, each containing three districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 46. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 47.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 48. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic districts. The Duchin Map also generates 0 Democratic districts.

Table 16 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 46: **Map of Anson and Union House County Cluster**

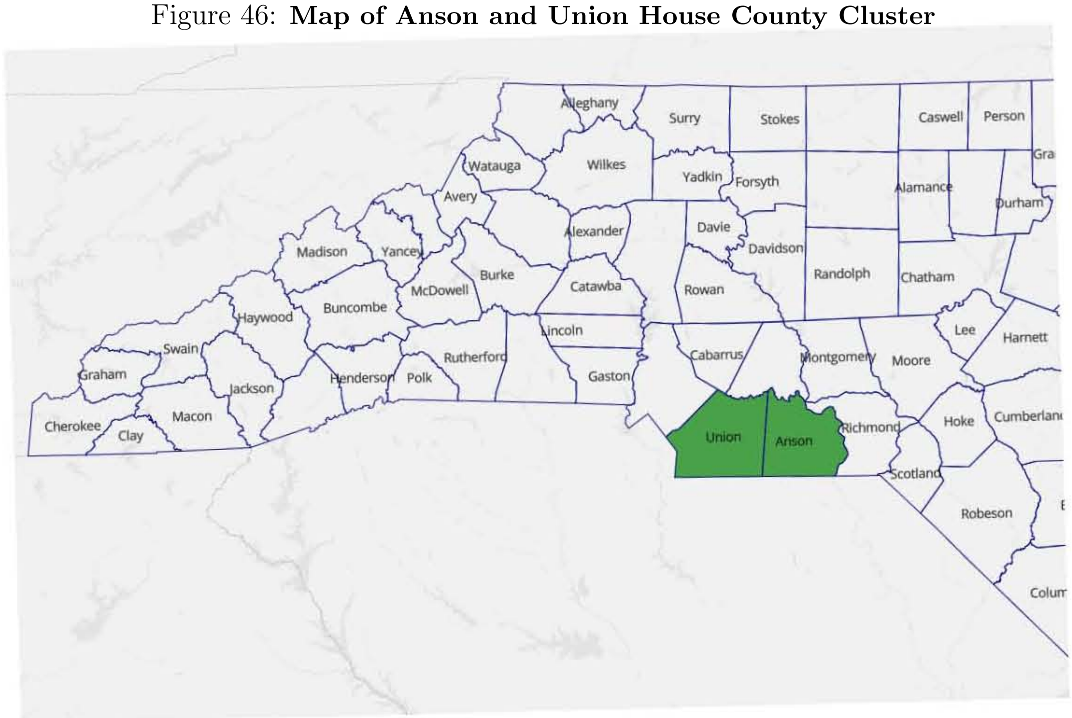
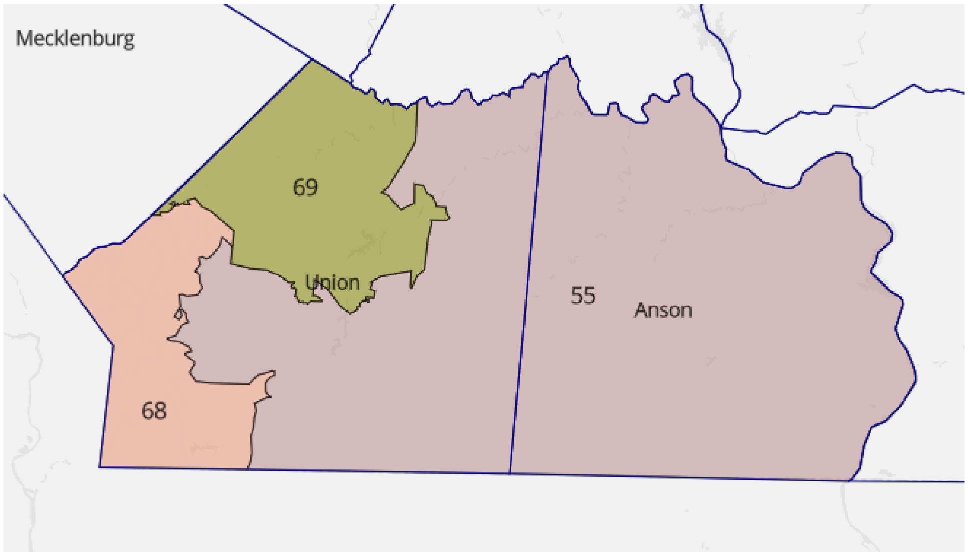
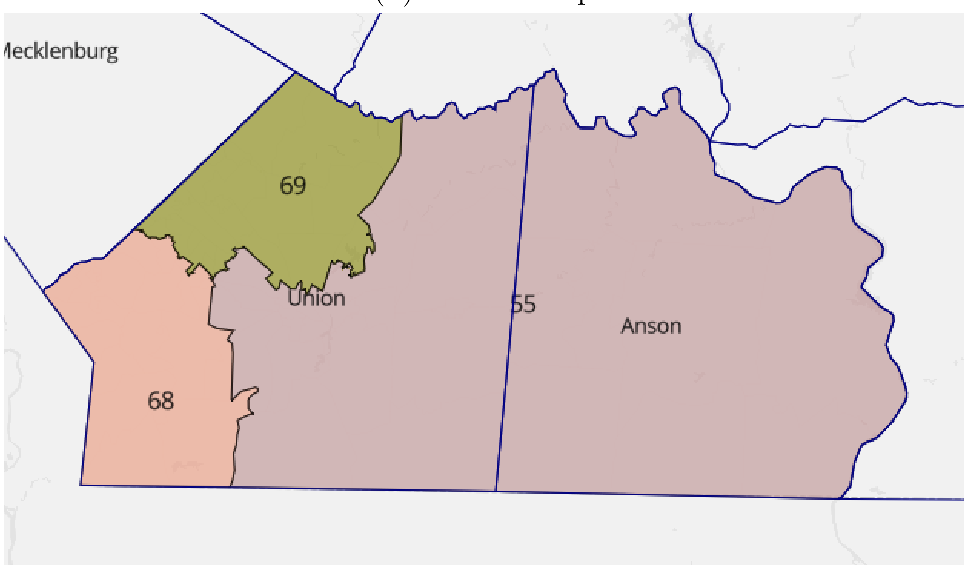


Figure 47: **Map of House Enacted Plan in Anson and Union House County Cluster**

(a) Enacted Map



(b) Duchin Map

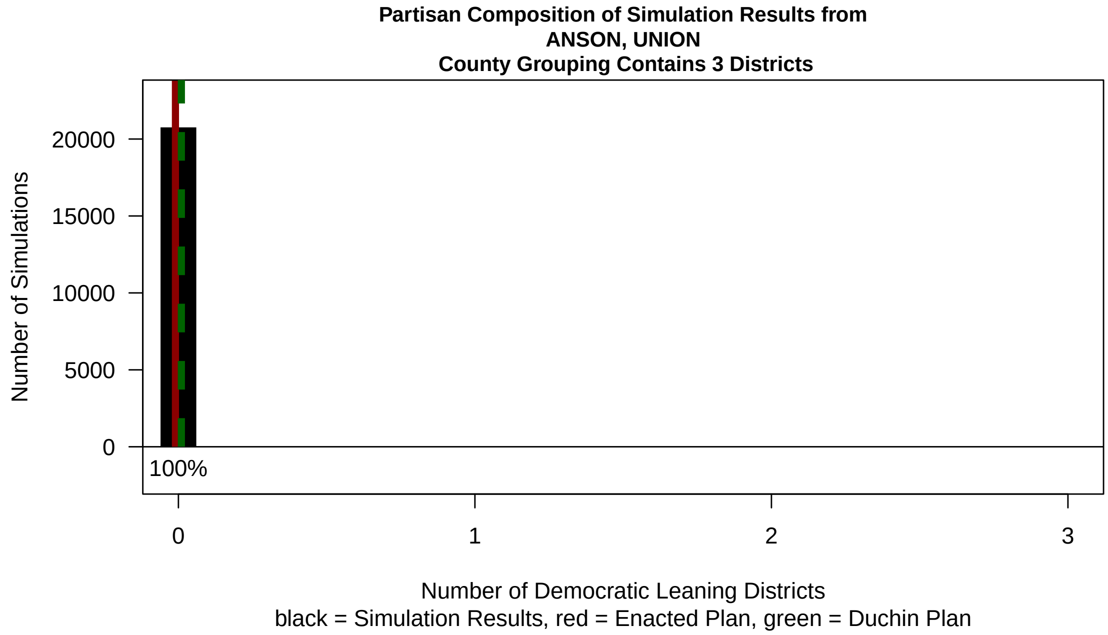


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
55	0.41	0.44
68	0.36	0.35
69	0.35	0.34

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 48: **Distribution of Partisan Districts from Simulations in Anson and Union House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 16: Simulation Results by Individual Elections

Anson and Union House County Cluster

Number of Democratic Leaning Districts:				
	0	1	2	3
Individual Elections:				
2020 President	**100%**	0%	0%	0%
2020 Senate	**100%**	0%	0%	0%
2020 Governor	**100%**	0%	0%	0%
2020 Lt. Governor	**100%**	0%	0%	0%
2020 Attorney General	**100%**	0%	0%	0%
2016 President	**100%**	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%
2014 Senate	**73%**	27%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.15 Onslow and Pender House County Grouping

The Onslow-Pender House county grouping contains 3 districts. In the Enacted Map these are Districts 14, 15, and 16. The county cluster has an overall partisan index of .35, which is heavily Republican. After conducting 50,000 initial simulations to create three districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 48,928 simulated maps. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 35,873 simulated maps, each containing three districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 49. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 50.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 51. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic districts. The Duchin Map also generates 0 Democratic districts.

Table 17 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In this case there is unanimous agreement between the modal outcome in the simulations and the Enacted Map across all 11 elections.

Figure 49: **Map of Onslow and Pender House County Cluster**

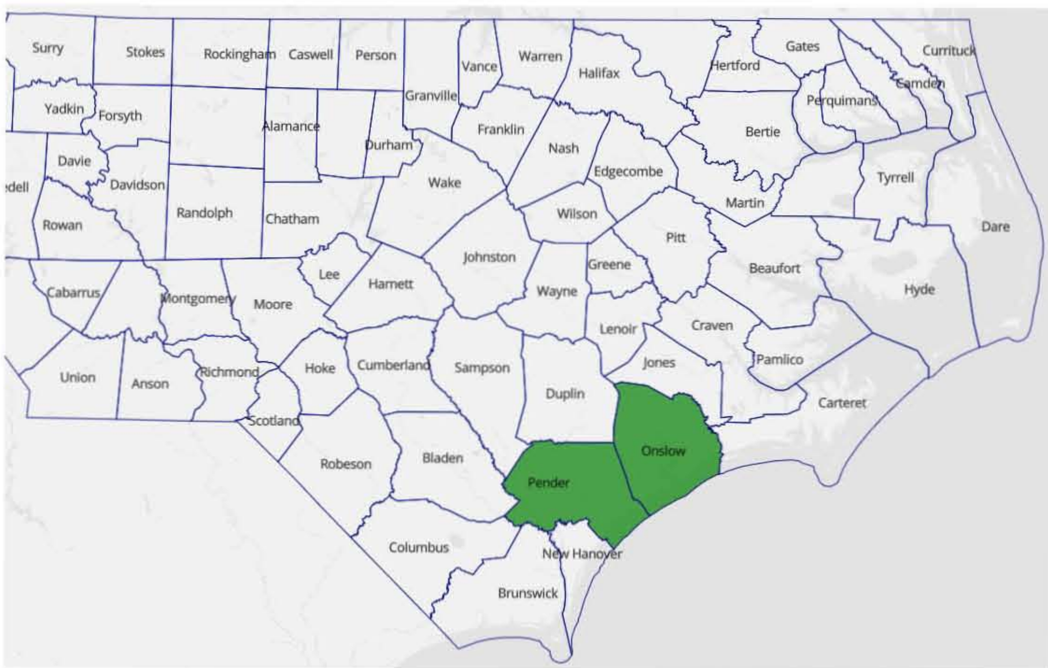
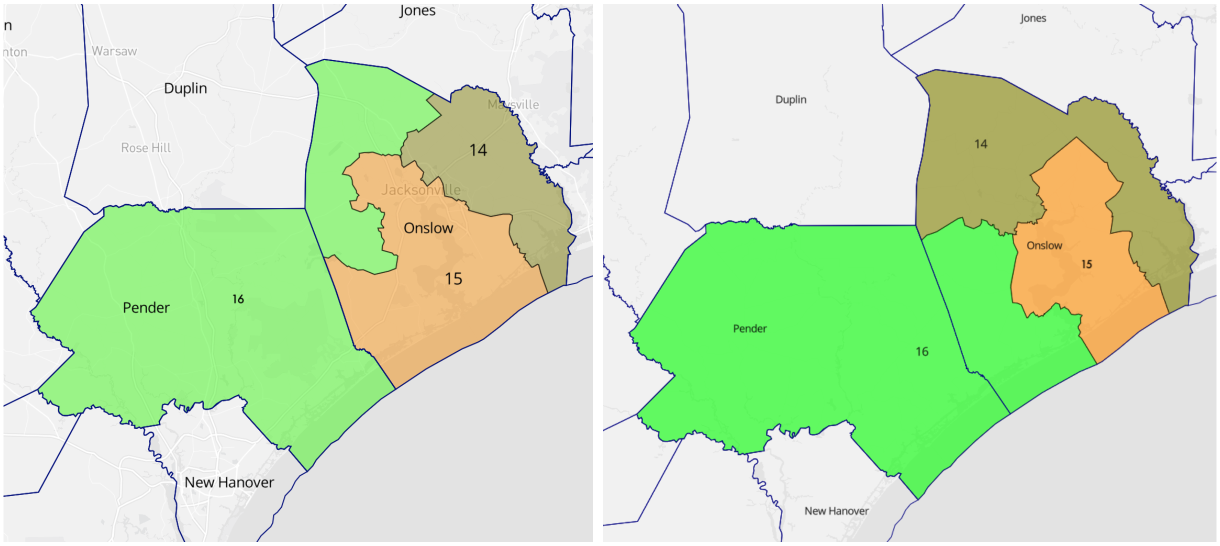


Figure 50: **Map of House Enacted Plan in Onslow and Pender County Cluster**

(a) Enacted Map (b) Duchin Map

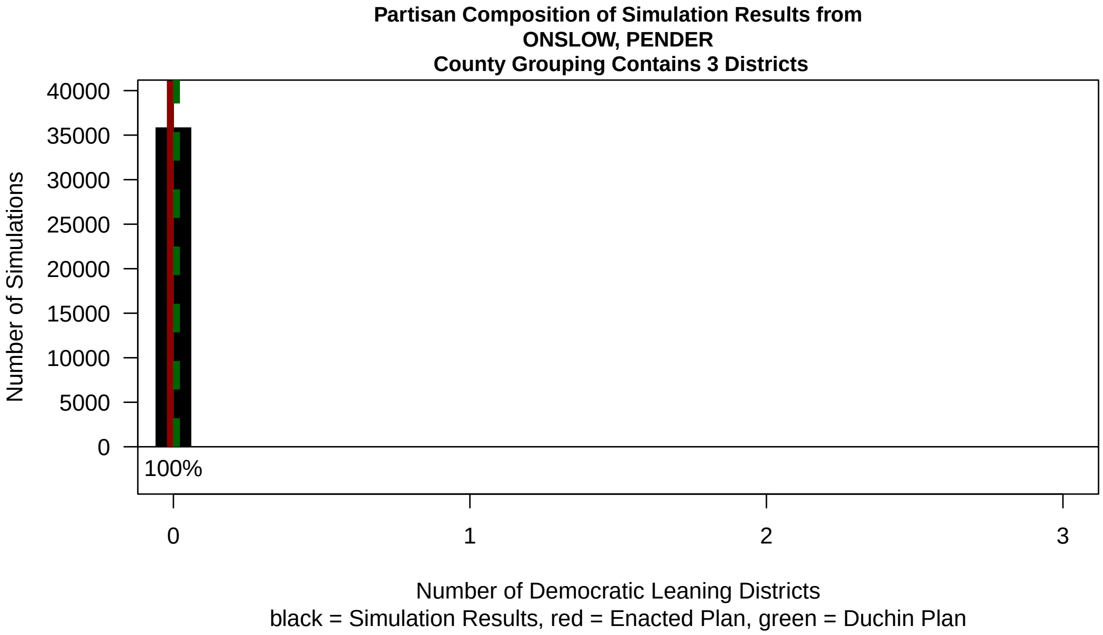


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
14	0.39	0.29
15	0.32	0.49
16	0.33	0.33

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 51: **Distribution of Partisan Districts from Simulations in Onslow and Pender House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 17: Simulation Results by Individual Elections

Onslow and Pender House County Cluster

Number of Democratic Leaning Districts:				
	0	1	2	3
Individual Elections:				
2020 President	**100%**	0%	0%	0%
2020 Senate	**100%**	0%	0%	0%
2020 Governor	**100%**	0%	0%	0%
2020 Lt. Governor	**100%**	0%	0%	0%
2020 Attorney General	**100%**	0%	0%	0%
2016 President	**100%**	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%
2014 Senate	**100%**	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.16 Cumberland House County Grouping

The Cumberland House county group contains 4 districts. In the Enacted Map these are Districts 42, 43, 44, and 45. The county cluster has an overall partisan index of .59, which is moderately Democratic. After conducting 50,000 initial simulations to create four districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, Cumberland is a single county group, and so all of the simulations have the same number of traversals as the Enacted Map. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 10,521 simulated maps, each containing four districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 52. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 53.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 55. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 82% of the simulations there are 3 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 3 Democratic districts. In 18% of the simulations there are 4 Democratic leaning districts. The Duchin Map generates 4 Democratic districts. This falls outside of the 50% range of simulation results and is thus classified as a partisan outlier result.

Table 19 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 5 of the 11 elections there is agreement between the modal outcome in the simulations and the Enacted Map. In 6 of the 11 elections the Enacted Plan results fall outside the middle 50% range of the simulations and would be classified as outliers.

One consideration for why the Enacted Plan diverges from the Duchin Plan is because it keeps a larger portion of the town of Fayetteville, the county seat and largest city in Cumberland County, in fewer districts. Figure 54 shows a map of the city and how the two different plans divide the city. The Duchin Plan splits Fayetteville nearly equally across all four districts in a pie shape. The tactic of dividing Democratic cities in a 'pinwheel' or 'pizza' shape and grouping those 'slices' with more Republican suburban and exurban areas is a classic tactic to generate more Democratic districts and overcome the geographic clustering that is common among Democratic voters. The Enacted Plan keeps much more of Fayetteville within three districts. A small portion of the southern most part of the city is located in District 45. Table 18 shows the percent of Fayetteville voters in each district in each plan. It is clear that the Duchin plan splits Fayetteville into 4 roughly equal parts while the Enacted Plan places a much larger majority of Fayetteville into only three districts.

Table 18: Division of Fayetteville in Enacted Plan and Duchin Plan

	Percent of Feyetville in district	
District:	Enacted Plan	Duchin Plan
42	31.4	33.4
43	21.4	21.5
44	39.9	26.8
45	7.3	18.3
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf Population numbers for city by district for Duchin Plan from Dave's Redistricting online. https://davesredistricting.org/

Figure 52: **Map of Cumberland House County Cluster**

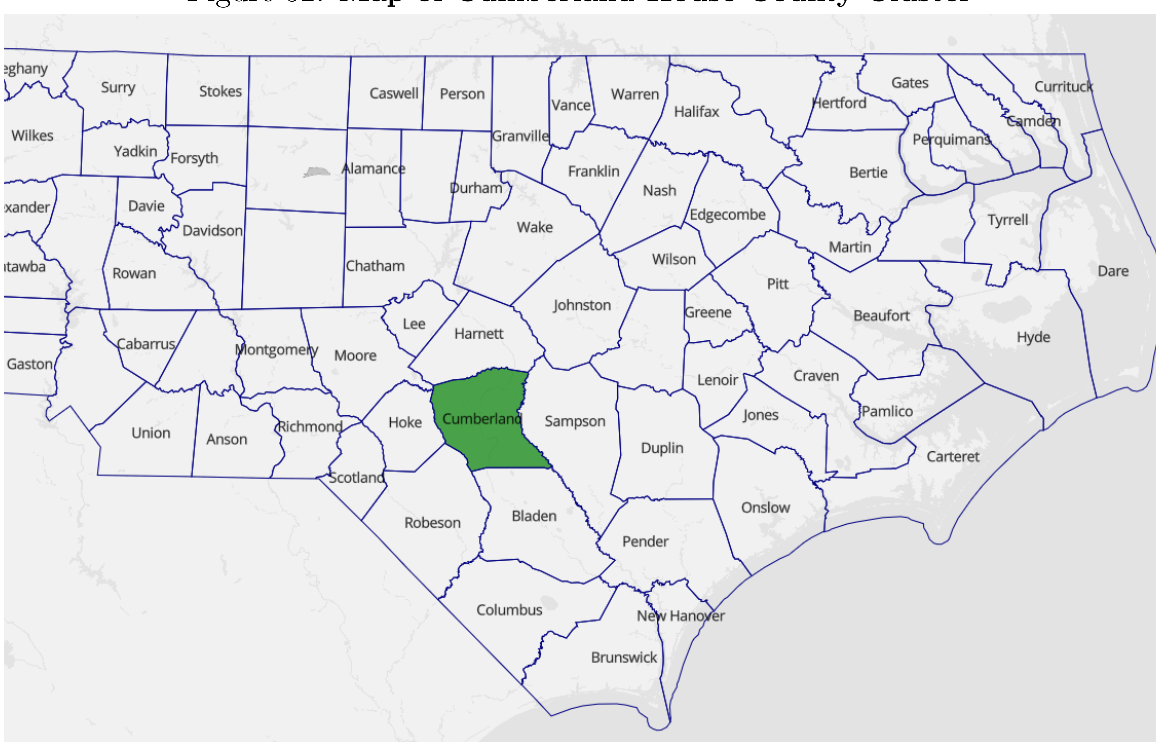
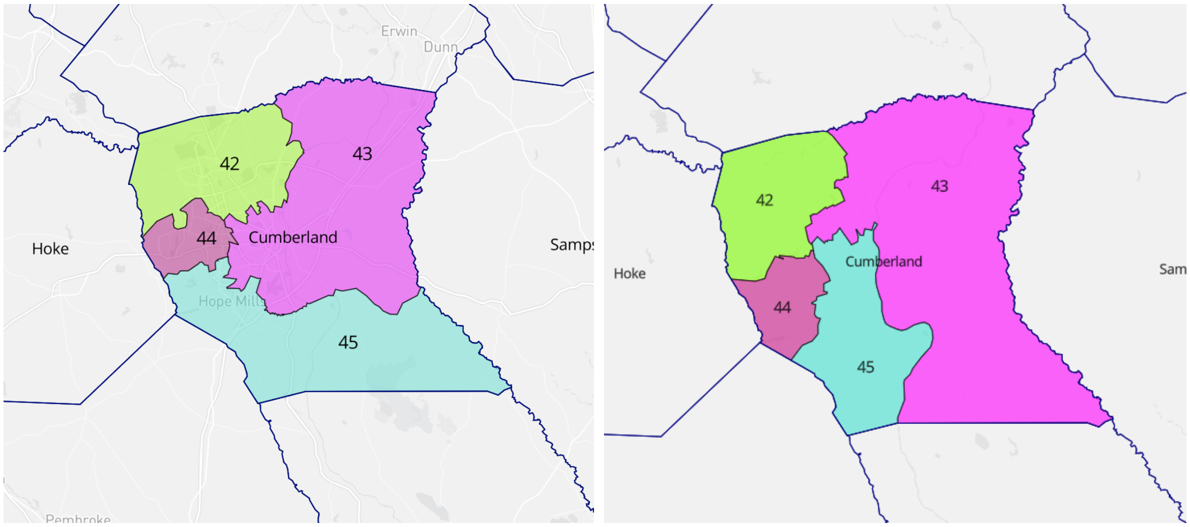


Figure 53: **Map of House Enacted Plan in Cumberland County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
42	0.67	0.72
43	0.50	0.55
44	0.72	0.60
45	0.49	0.53

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 54: **Map of Fayetteville Divisions in Cumberland County Cluster**

(a) Enacted Map (b) Duchin Map

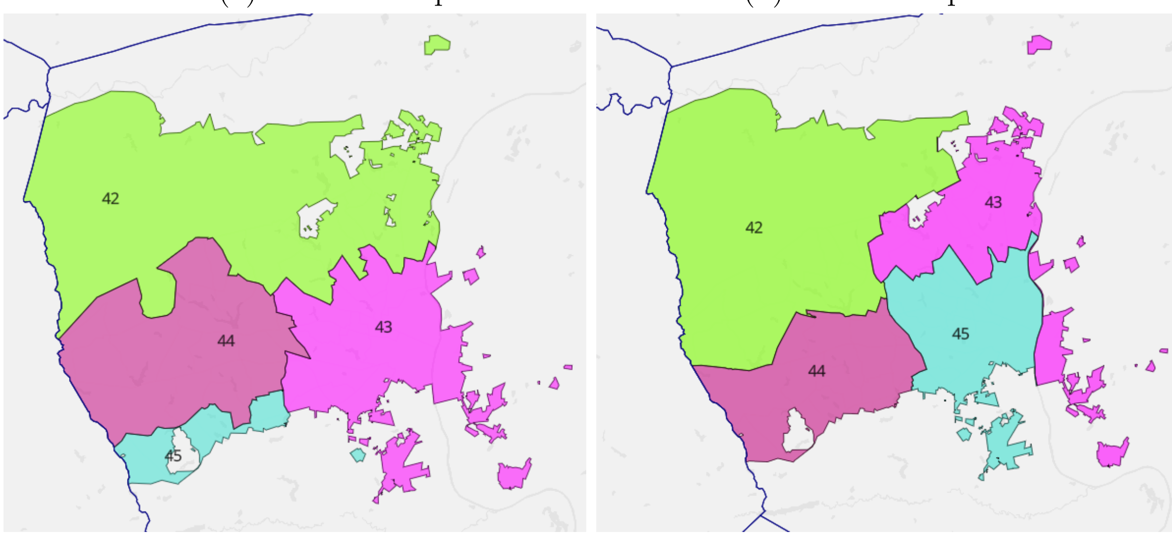
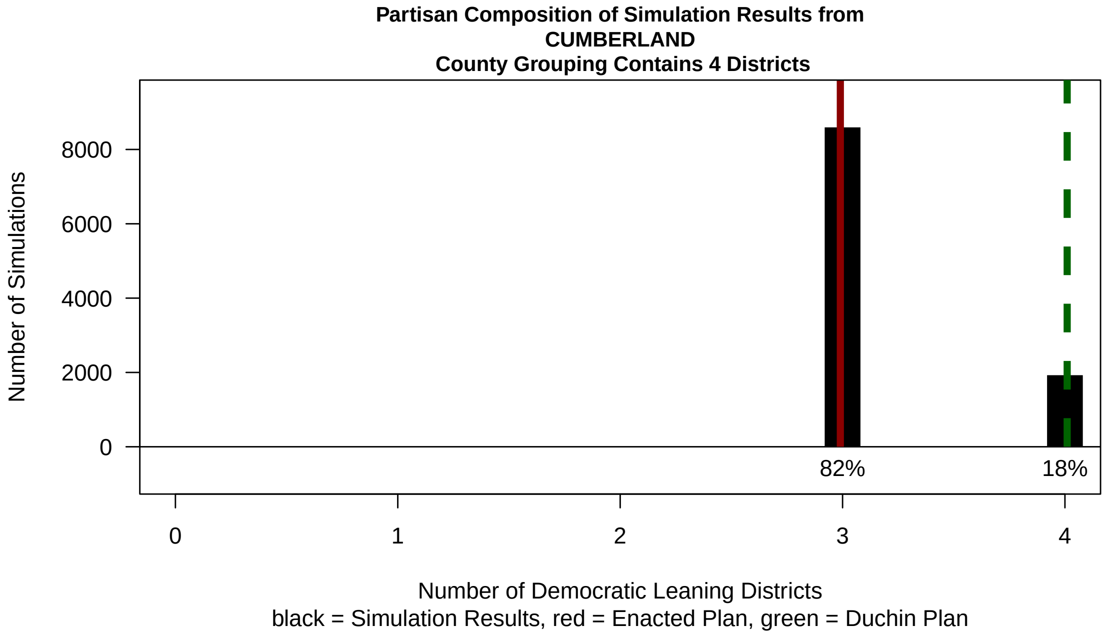


Figure 55: **Distribution of Partisan Districts from Simulations in Cumberland House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 19: Simulation Results by Individual Elections

Cumberland House County Cluster

	Number of Democratic Leaning Districts:				
	0	1	2	3	4
Individual Elections:					
2020 President	0%	0%	**0%**	91%	9%
2020 Senate	0%	0%	**0%**	88%	12%
2020 Governor	0%	0%	0%	23%	**77%**
2020 Lt. Governor	0%	0%	**0%**	90%	10%
2020 Attorney General	0%	0%	0%	49%	**51%**
2016 President	0%	0%	0%	**90%**	10%
2016 Senate	0%	0%	**0%**	94%	6%
2016 Governor	0%	0%	**0%**	94%	6%
2016 Lt. Governor	0%	0%	**0%**	94%	6%
2016 Attorney General	0%	0%	0%	**48%**	52%
2014 Senate	0%	0%	0%	**89%**	11%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 0% of the simulations produce 2 Democratic leaning districts. The Enacted Plan does as well, as the '3 Districts' cell is bolded in that row.

One thing to note regarding the instances in which the Enacted Plan does not align with the simulation results in individual elections. In all six cases the Enacted Plan creates one district (and occasionally two districts) that is extremely competitive and is effectively tied (less than 1% from 50/50), but is just below 0.50 and is thus not classified as a Democratic district. For example, in the 2020 Presidential race the Enacted Plan districts have a partisan lean of 0.719, 0.672, 0.495, and 0.492. Thus, two of the districts, while not classified as Democratic leaning will be heavily contested and both parties will likely win these districts at different times in the coming years.

6.17 Harnett and Johnston House County Grouping

The Harnett-Johnston House county group contains 4 districts. In the Enacted Map these are Districts 6, 26, 28, and 53. The county cluster has an overall partisan index of .38, which is moderately Republican. After conducting 50,000 initial simulations to create four districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 34,976 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 593 simulated maps, each containing four districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 56. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 57.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 58. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic districts. The Duchin Map also generates 0 Democratic districts.

Table 20 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In all 11 of the individual elections there is agreement between the modal outcome in the simulations and the Enacted Map.

Figure 56: **Map of Harnett and Johnston House County Cluster**

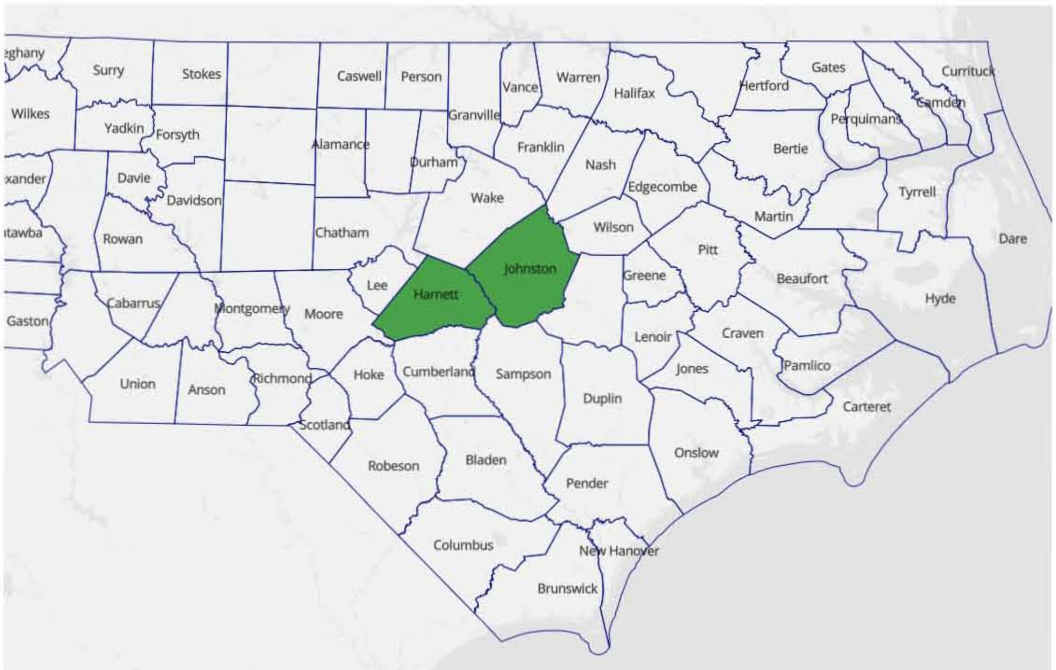
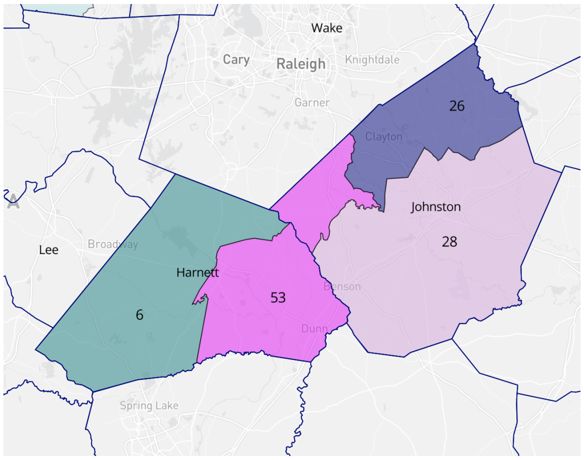
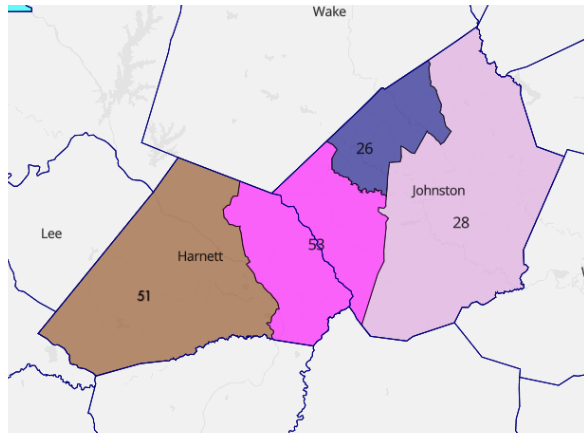


Figure 57: **Map of House Enacted Plan in Harnett and Johnston County Cluster**

(a) Enacted Map



(b) Duchin Map

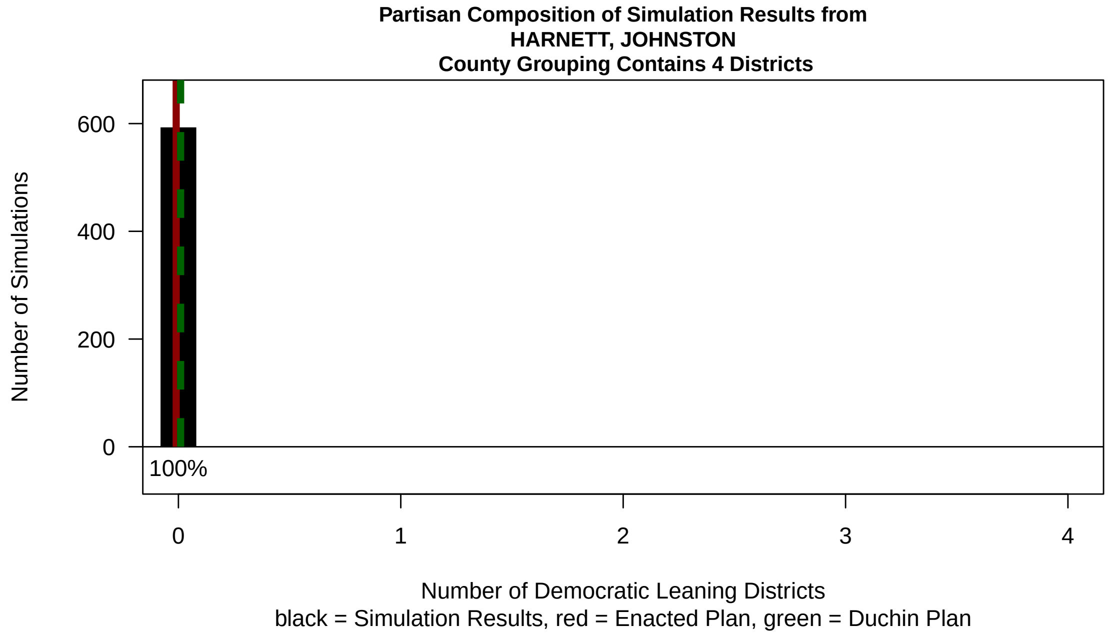


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
6 (51 in Duchin)	0.40	0.42
26	0.41	0.43
28	0.34	0.35
53	0.37	0.33

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 58: **Distribution of Partisan Districts from Simulations in Harnett and Johnston House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 20: Simulation Results by Individual Elections

Harnett and Johnston House County Cluster

	Number of Democratic Leaning Districts:				
	0	1	2	3	4
Individual Elections:					
2020 President	**100%**	0%	0%	0%	0%
2020 Senate	**100%**	0%	0%	0%	0%
2020 Governor	**100%**	0%	0%	0%	0%
2020 Lt. Governor	**100%**	0%	0%	0%	0%
2020 Attorney General	**100%**	0%	0%	0%	0%
2016 President	**100%**	0%	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%	0%
2014 Senate	**100%**	0%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.18 Catawba and Iredell House County Grouping

The Catawba-Iredell House county group contains 4 districts. In the Enacted Map these are Districts 84, 89, 95, and 96. The county cluster has an overall partisan index of .33, which is strongly Republican. After conducting 50,000 initial simulations to create four districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 14,955 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 2,944 simulated maps, each containing four districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 59. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 60.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 61. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic districts. The Duchin Map also generates 0 Democratic districts.

Table 21 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In all 11 of the individual elections there is agreement between the modal outcome in the simulations and the Enacted Map.

Figure 59: **Map of Catawba and Iredell House County Cluster**

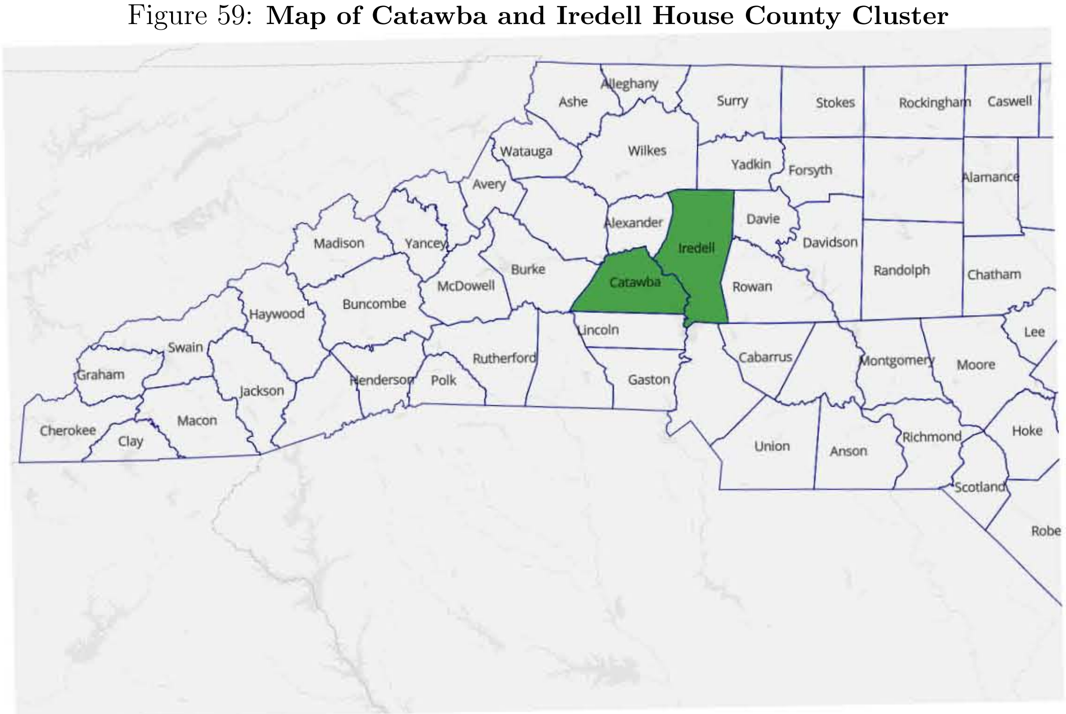
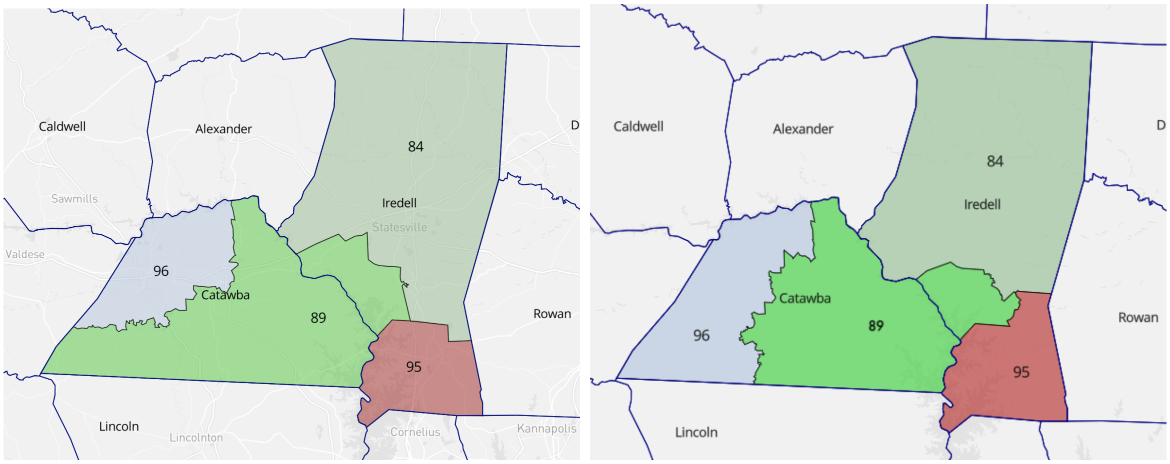


Figure 60: **Map of House Enacted Plan in Catawba and Iredell County Cluster**

(a) Enacted Map (b) Duchin Map

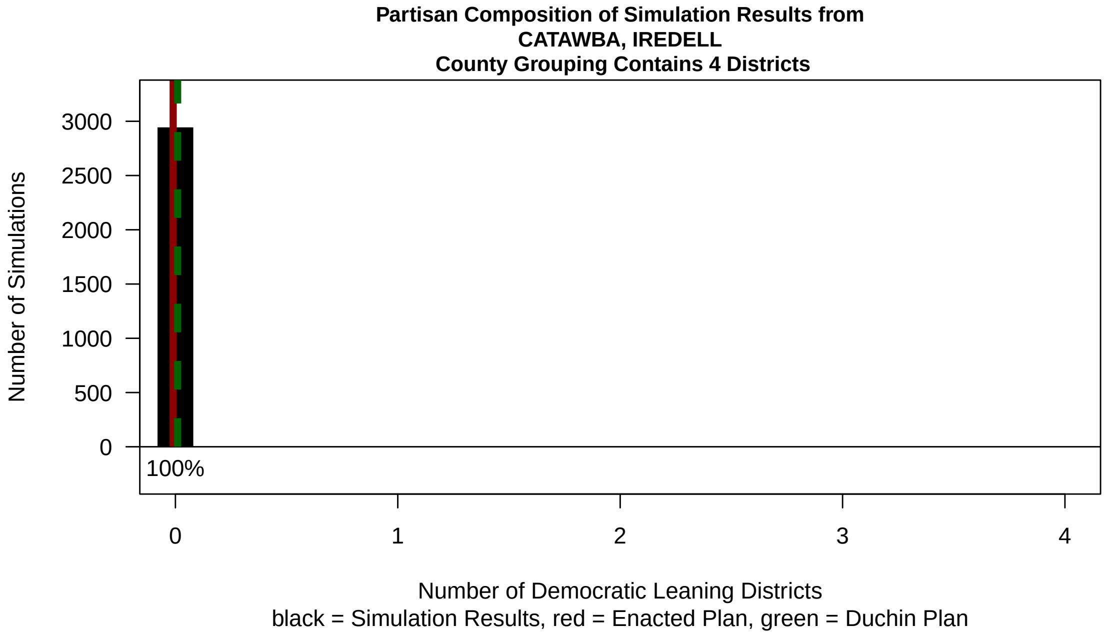


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
84	0.34	0.34
89	0.26	0.28
95	0.34	0.34
96	0.37	0.36

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 61: **Distribution of Partisan Districts from Simulations in Catawba and Iredell House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 21: Simulation Results by Individual Elections

Catawba and Iredell House County Cluster

	Number of Democratic Leaning Districts:				
	0	1	2	3	4
Individual Elections:					
2020 President	**100%**	0%	0%	0%	0%
2020 Senate	**100%**	0%	0%	0%	0%
2020 Governor	**100%**	0%	0%	0%	0%
2020 Lt. Governor	**100%**	0%	0%	0%	0%
2020 Attorney General	**100%**	0%	0%	0%	0%
2016 President	**100%**	0%	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%	0%
2014 Senate	**100%**	0%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.19 Durham and Person House County Grouping

The Durham-Person House county group contains 4 districts. In the Enacted Map these are Districts 2, 29, 30, and 31. The county cluster has an overall partisan index of .76, which is strongly Democratic. After conducting 50,000 initial simulations to create four districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 49,896 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 37,800 simulated maps, each containing four districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 62. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 63.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 64. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 4 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 4 Democratic districts. The Duchin Map also generates 4 Democratic districts.

Table 22 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In all 11 of the individual elections there is agreement between the modal outcome in the simulations and the Enacted Map.

Figure 62: **Map of Durham and Person House County Cluster**

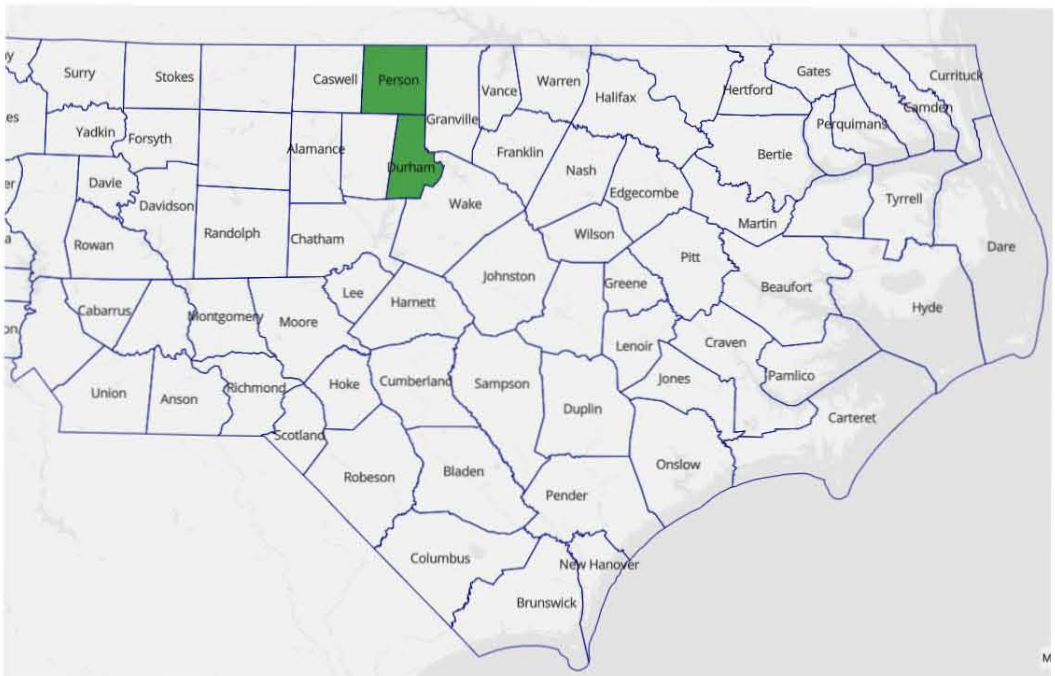
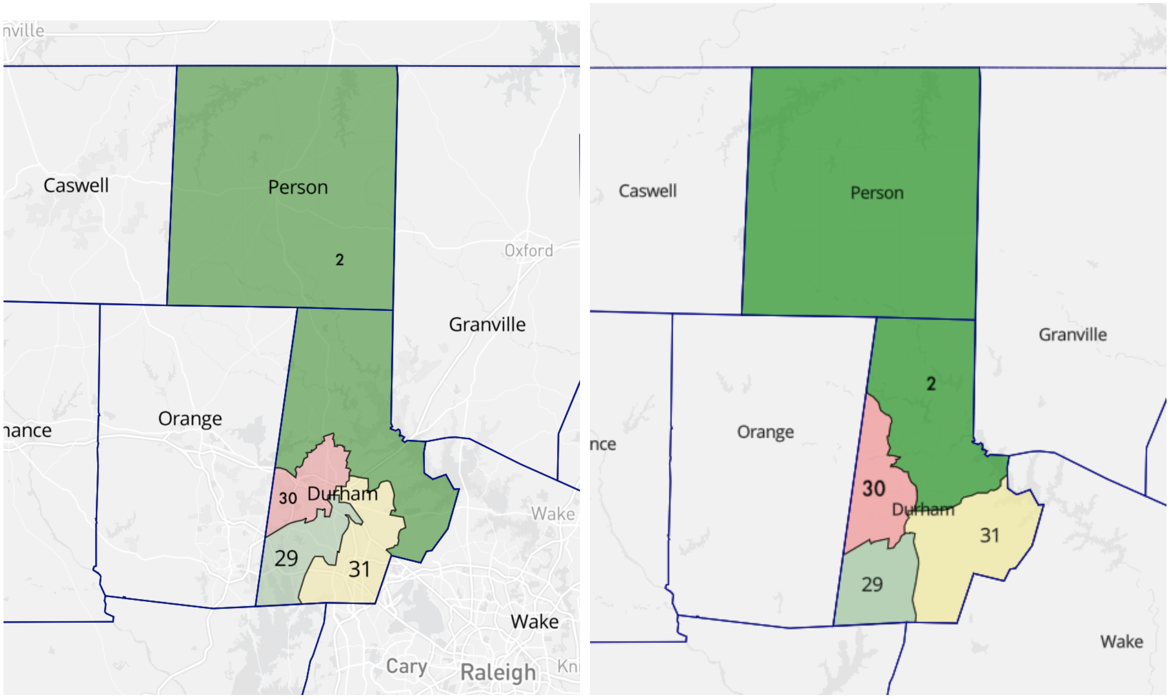


Figure 63: **Map of House Enacted Plan in Durham and Person House County Cluster**

(a) Enacted Map (b) Duchin Map

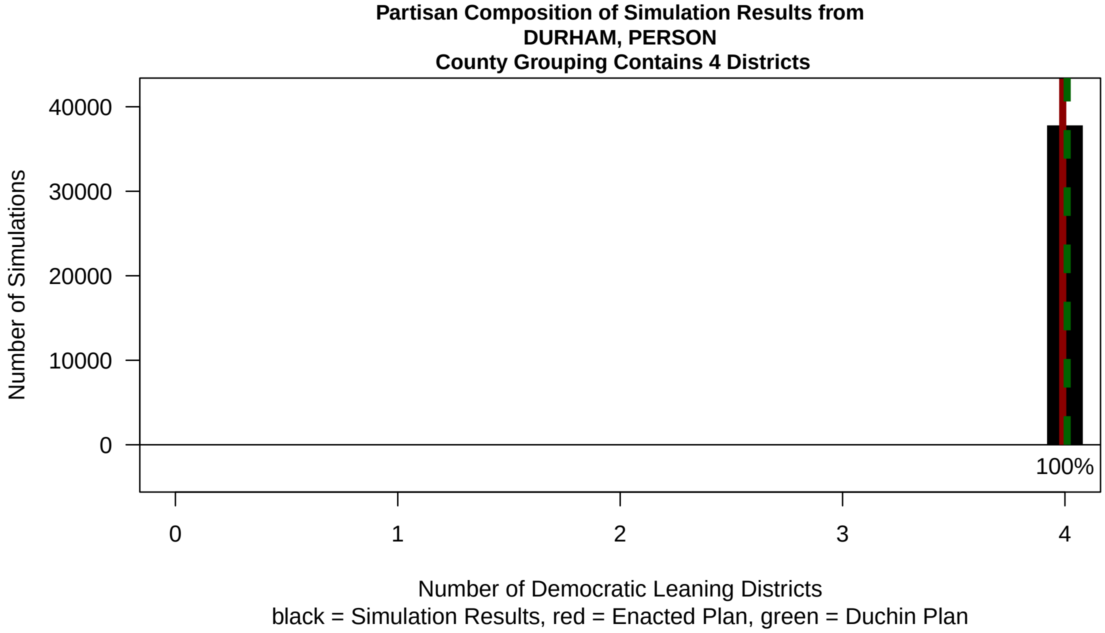


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
2	0.52	0.58
29	0.86	0.83
30	0.87	0.81
31	0.81	0.81

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 64: **Distribution of Partisan Districts from Simulations in Durham and Person House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 22: Simulation Results by Individual Elections

Durham and Person House County Cluster

	Number of Democratic Leaning Districts:				
	0	1	2	3	4
Individual Elections:					
2020 President	0%	0%	0%	0%	**100%**
2020 Senate	0%	0%	0%	0%	**100%**
2020 Governor	0%	0%	0%	0%	**100%**
2020 Lt. Governor	0%	0%	0%	0%	**100%**
2020 Attorney General	0%	0%	0%	0%	**100%**
2016 President	0%	0%	0%	0%	**100%**
2016 Senate	0%	0%	0%	**0%**	100%
2016 Governor	0%	0%	0%	0%	**100%**
2016 Lt. Governor	0%	0%	0%	**0%**	100%
2016 Attorney General	0%	0%	0%	0%	**100%**
2014 Senate	0%	0%	0%	0%	**100%**

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 4 Democratic leaning districts. The Enacted Plan does as well, as the '4 District' cell is bolded in that row.

6.20 Brunswick and New Hanover House County Grouping

The Brunswick-New Hanover House county group contains 4 districts. In the Enacted Map these are Districts 17, 18, 19, and 20. The county cluster has an overall partisan index of .45, which is Republican leaning. After conducting 50,000 initial simulations to create four districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 12,087 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 562 simulated maps, each containing four districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 65. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 66.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 67. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there is 1 Democratic leaning district. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 1 Democratic district. The Duchin Map generates 2 Democratic districts. The Duchin Map does not align with any of the simulations because it is less compact (average Polsby-Popper score of 0.35) than the Enacted Map (average Polsby-Popper score of 0.36) and the simulated maps, which are constrained to be at least as compact, on average, as the Enacted Map. This is evident by looking at the maps of the districts in the Duchin Plan. District 20 is a long and narrow district that begins south of Wilmington (the largest city in the cluster), takes in the eastern side of Wilmington, which is more Republican, and then loops around to the north west. In doing this, the Duchin map then splits the more Democratic portion of Wilmington between districts 18 and 19 in order to create two Democratic leaning districts. As a result, the town of Wilmington is a part of districts 18, 19, and 20. This is also true of the Enacted Map, however, the Enacted map does this while creating more compact districts.

Table 23 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 10 of the 11 individual elections there is agreement between the modal outcome in the simulations and the Enacted Map. In the 1 scenario in which they do not agree (2020 Governor race), the Enacted Map generates one more Democratic district than the simulations do.

Figure 65: **Map of Brunswick and New Hanover House County Cluster**

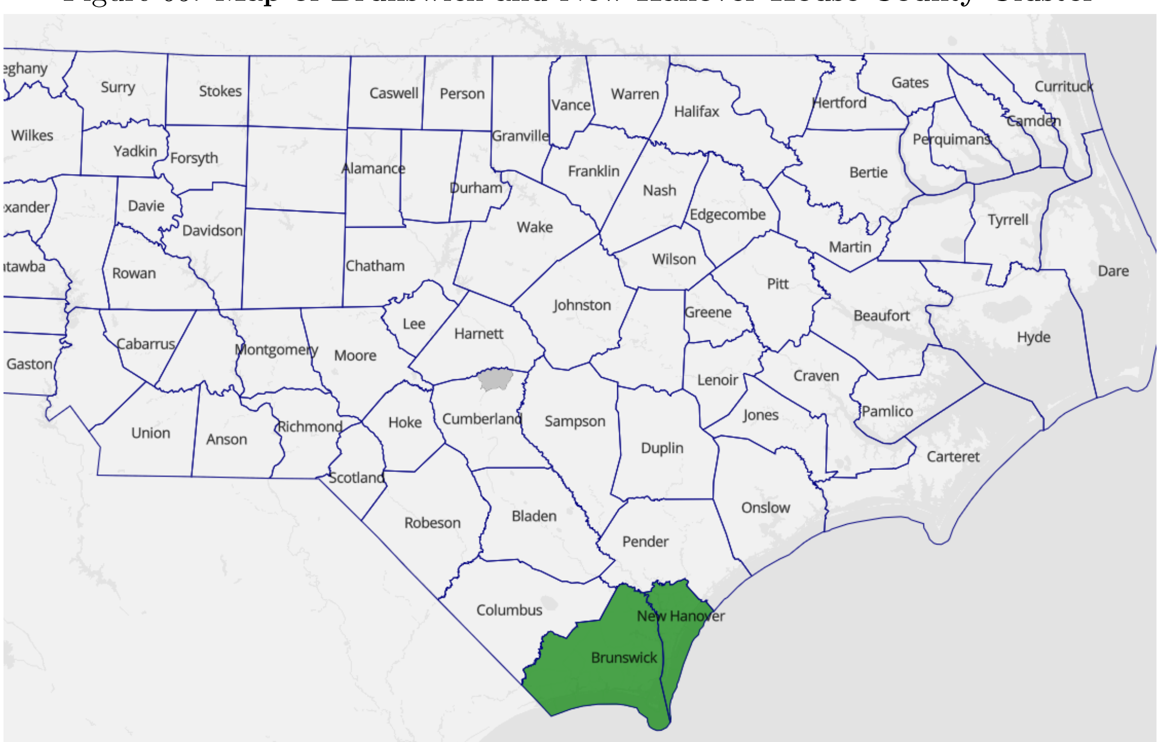
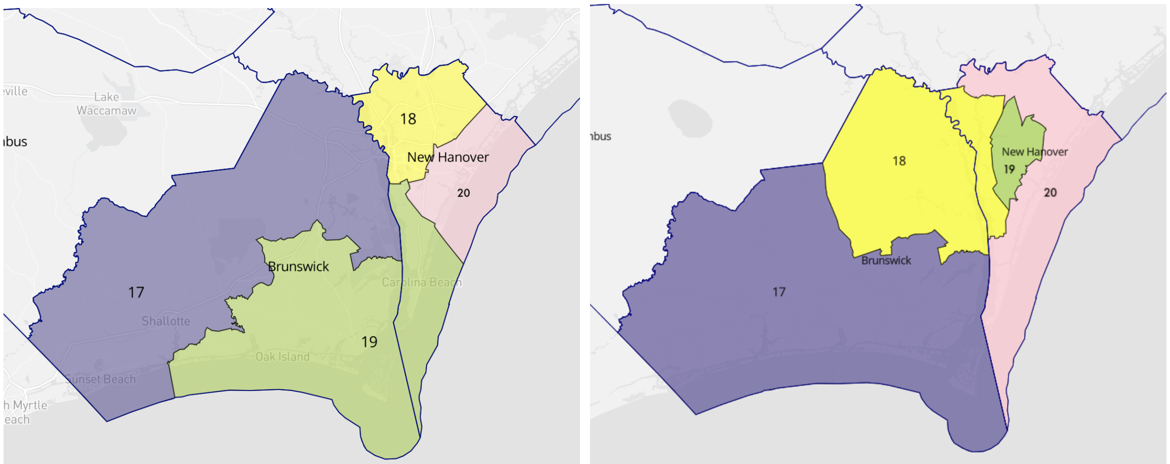


Figure 66: **Map of House Enacted Plan in Brunswick and New Hanover County Cluster**

(a) Enacted Map (b) Duchin Map

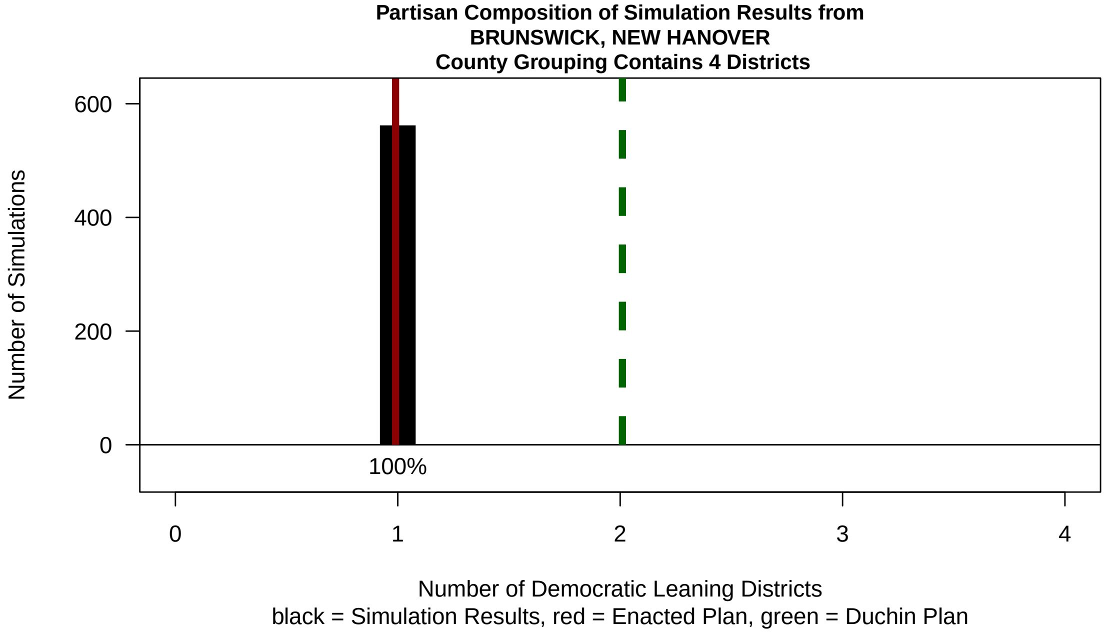


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
17	0.39	0.35
18	0.60	0.53
19	0.39	0.55
20	0.45	0.41

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 67: **Distribution of Partisan Districts from Simulations in Brunswick and New Hanover House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 23: Simulation Results by Individual Elections

Brunswick and New Hanover House County Cluster

	Number of Democratic Leaning Districts:				
	0	1	2	3	4
Individual Elections:					
2020 President	0%	**100%**	0%	0%	0%
2020 Senate	0%	**100%**	0%	0%	0%
2020 Governor	0%	100%	**0%**	0%	0%
2020 Lt. Governor	0%	**100%**	0%	0%	0%
2020 Attorney General	0%	**100%**	0%	0%	0%
2016 President	0%	**100%**	0%	0%	0%
2016 Senate	0%	**100%**	0%	0%	0%
2016 Governor	0%	**100%**	0%	0%	0%
2016 Lt. Governor	0%	**100%**	0%	0%	0%
2016 Attorney General	0%	**100%**	0%	0%	0%
2014 Senate	0%	**100%**	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

6.21 Forsyth and Stokes House County Grouping

The Forsyth-Stokes House county group contains 5 districts. In the Enacted Map these are Districts 71, 72, 74, 75, and 91. The county cluster has an overall partisan index of .52, which is slightly Democratic leaning. After conducting 50,000 initial simulations to create five districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 17,147 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 3,726 simulated maps, each containing five districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 68. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 69. I also include the 2020 map's boundaries for comparison.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 70. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 33% of the simulations there are 2 Democratic leaning districts. In 50% of the simulations there are 3 Democratic leaning districts, and in 17% of the simulations there are 4 Democratic leaning districts. The Enacted Map creates 2 Democratic districts. The Duchin Map also generates 2 Democratic districts.

Table 24 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 10 of the 11 individual elections the Enacted Map generates 2 Democratic districts. In 1 scenario (2020 Governor race), the Enacted Map generates 3 Democratic districts.

The Enacted Plan is also extremely similar to the maps used in Forsyth County in the 2020 elections. These districts were approved by a court in 2019. The county grouping was different, and Forsyth was combined with Yadkin County in 2020, however, in both plans the less populous county is kept whole and combined with a portion of Forsyth County. Within the more populated Forsyth County, the boundaries are extremely similar. The Enacted Plan is different by only 5 precincts total, and no district differs from the 2020 maps by more than a 3 precinct shift.

Figure 68: **Map of Forsyth and Stokes House County Cluster**

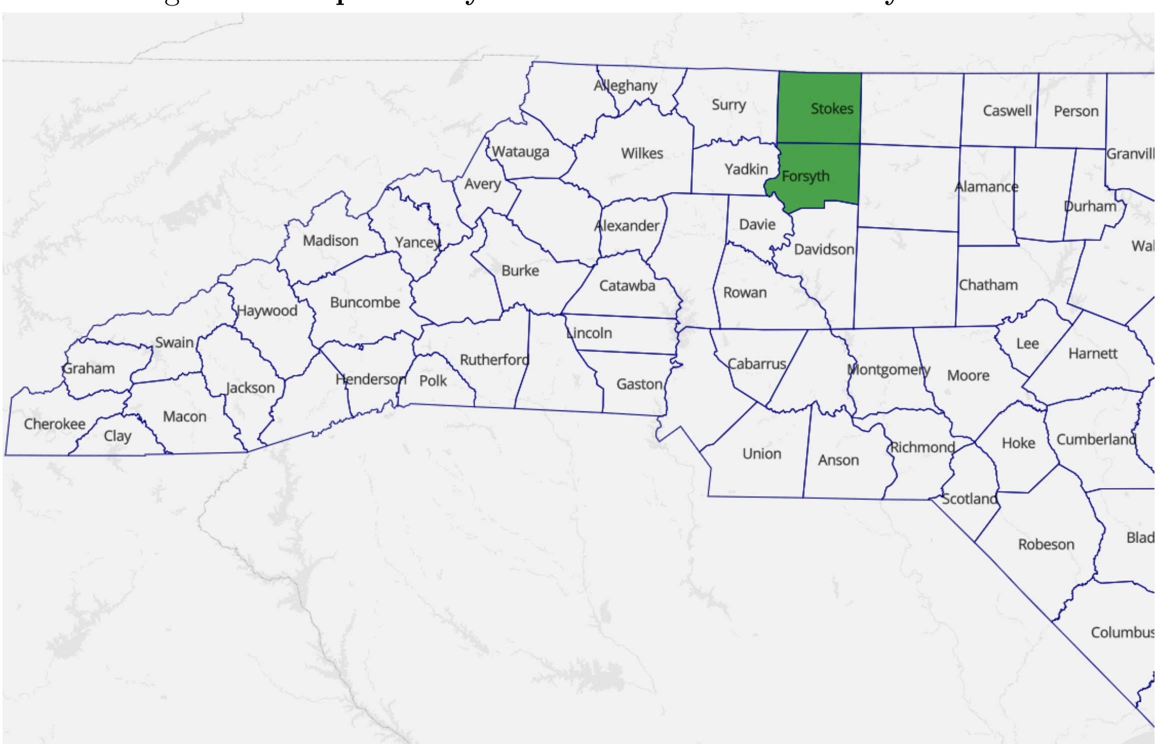
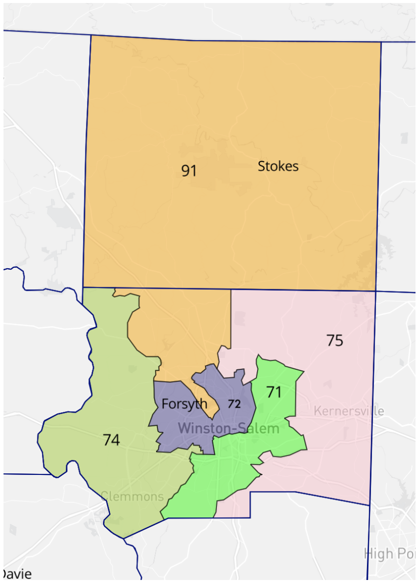
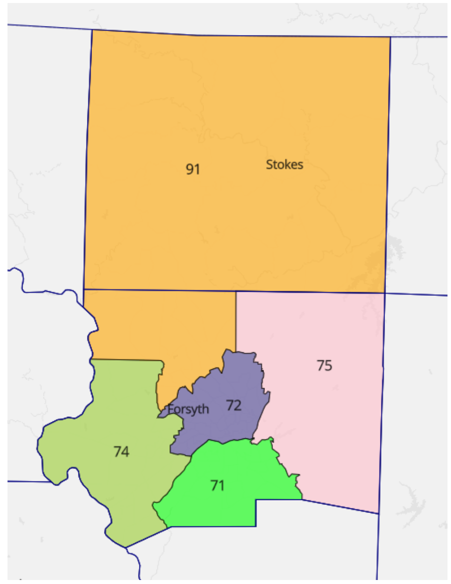


Figure 69: **Map of House Enacted Plan in Forsyth and Stokes County Cluster**

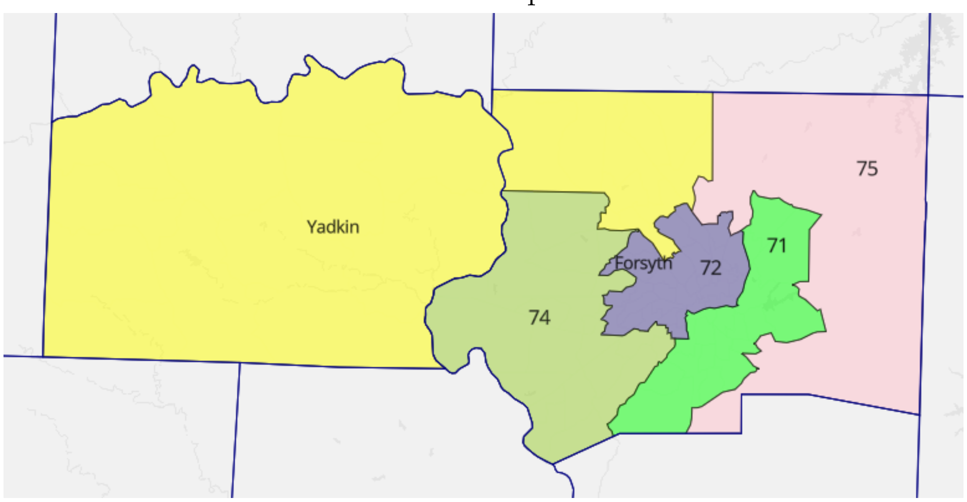
(a) Enacted Map



(b) Duchin Map



2020 Maps

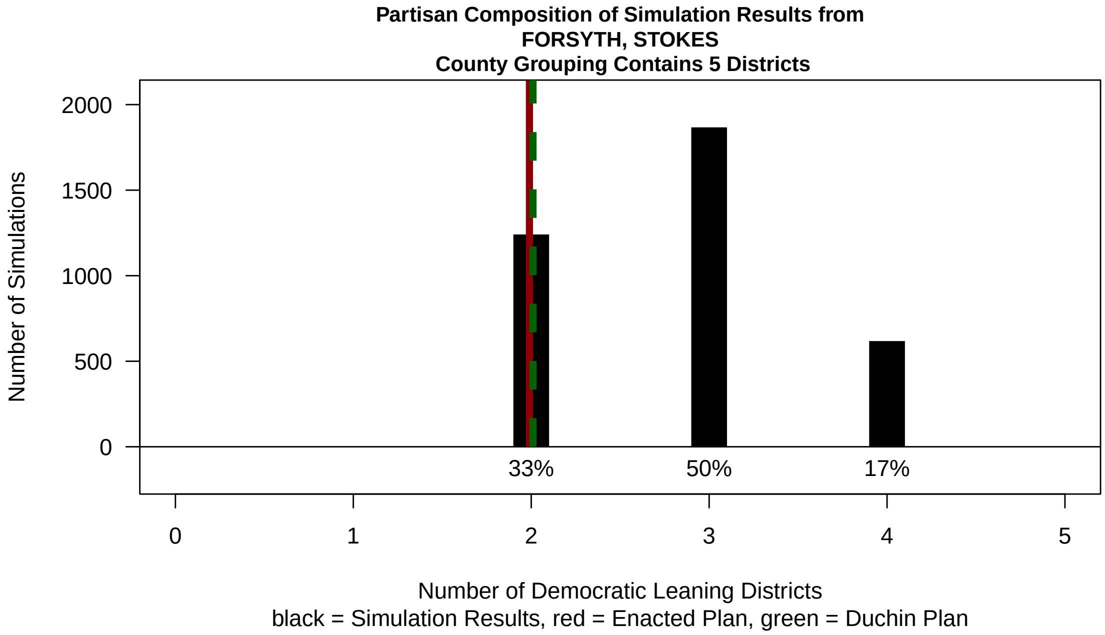


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
71	0.71	0.69
72	0.70	0.74
74	0.45	0.46
75	0.39	0.42
91	0.38	0.35

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 70: **Distribution of Partisan Districts from Simulations in Forsyth and Stokes House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 24: Simulation Results by Individual Elections

Forsyth and Stokes House County Cluster

	Number of Democratic Leaning Districts:					
	0	1	2	3	4	5
Individual Elections:						
2020 President	0%	0%	**14%**	50%	35%	0%
2020 Senate	0%	0%	**29%**	52%	19%	0%
2020 Governor	0%	0%	0%	**21%**	79%	0%
2020 Lt. Governor	0%	0%	**44%**	44%	13%	0%
2020 Attorney General	0%	0%	**30%**	52%	18%	0%
2016 President	0%	0%	**45%**	45%	11%	0%
2016 Senate	0%	5%	**67%**	28%	0%	0%
2016 Governor	0%	0%	**21%**	55%	24%	0%
2016 Lt. Governor	0%	4%	**66%**	30%	0%	0%
2016 Attorney General	0%	0%	**25%**	56%	19%	0%
2014 Senate	0%	3%	**58%**	38%	1%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 14% of the simulations produce 2 Democratic leaning districts. The Enacted Plan does as well, as the '2 District' cell is bolded in that row.

6.22 Cabarrus, Davie, Rowan, and Yadkin House County Grouping

The Cabarrus-Davie-Rowan-Yadkin House county group contains 5 districts. In the Enacted Map these are Districts 73, 76, 77, 82, and 83. The county cluster has an overall partisan index of .36, which is strongly Republican. After conducting 50,000 initial simulations to create five districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 6,649 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 283 simulated maps, each containing five districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 71. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 72.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 73. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 99% of the simulations there are 0 Democratic leaning districts. The Enacted Map creates 0 Democratic districts. The Duchin Map also generates 0 Democratic districts.

Table 25 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In all of the 11 individual elections the Enacted Map generates 0 Democratic districts and is in agreement with the majority of the simulations results in 8 of the 11 individual elections considered.

Figure 71: **Map of Cabarrus, Davie, Rowan, and Yadkin House County Cluster**

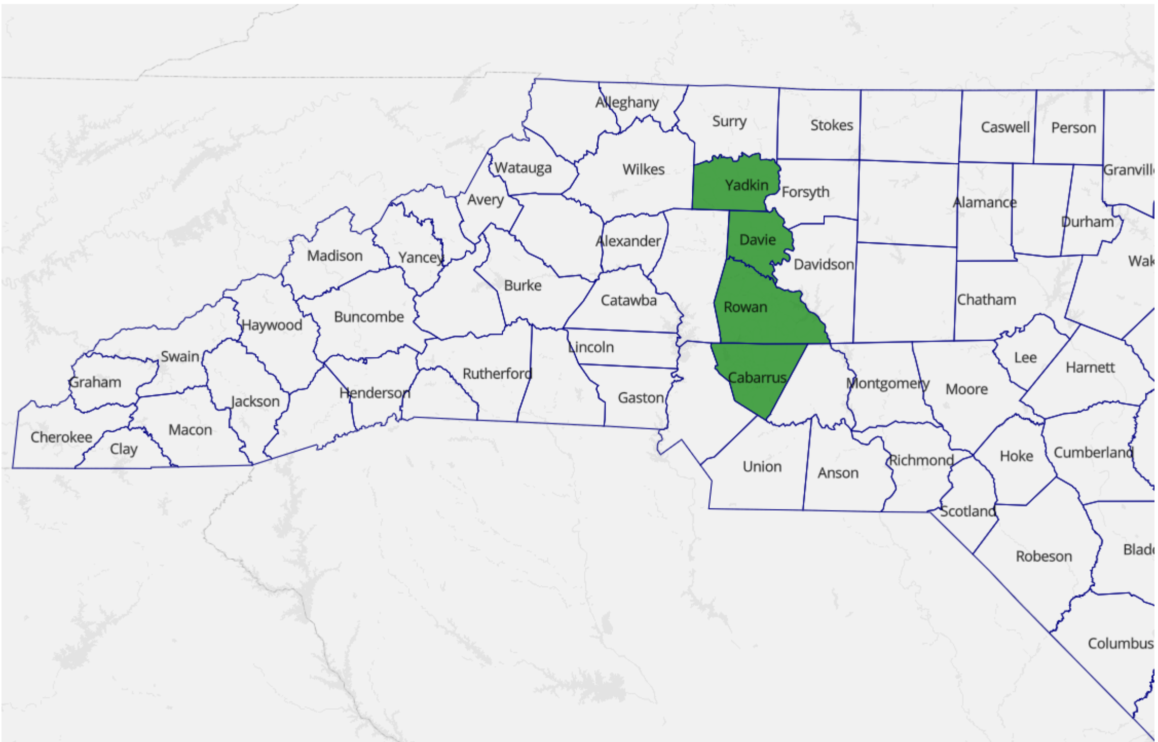
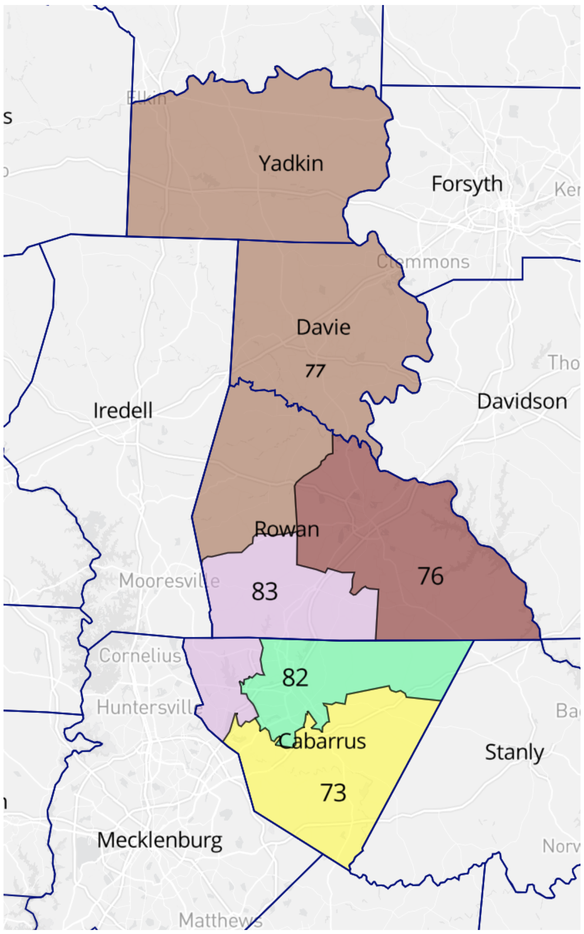
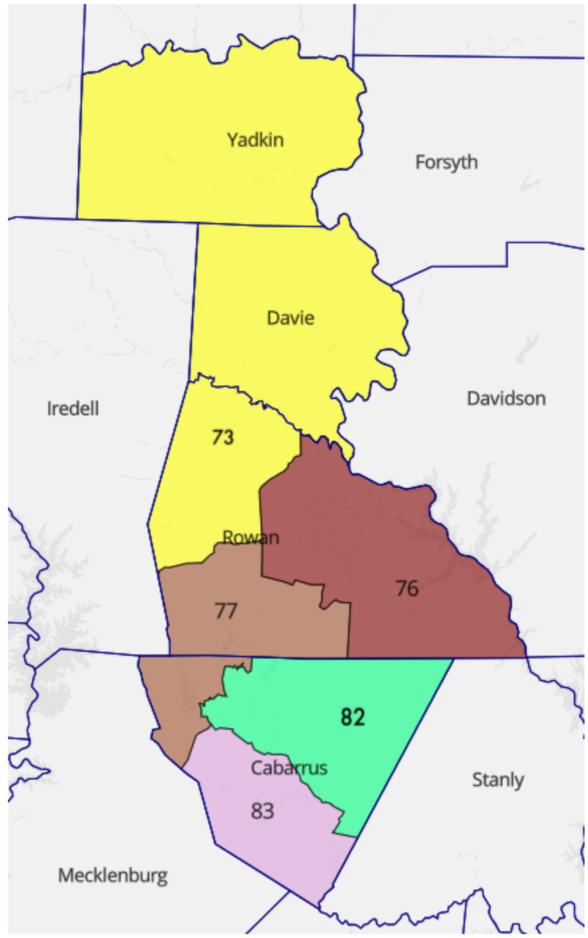


Figure 72: **Map of House Enacted Plan in Cabarrus, Davie, Rowan, and Yadkin County Cluster**

(a) Enacted Map



(b) Duchin Map

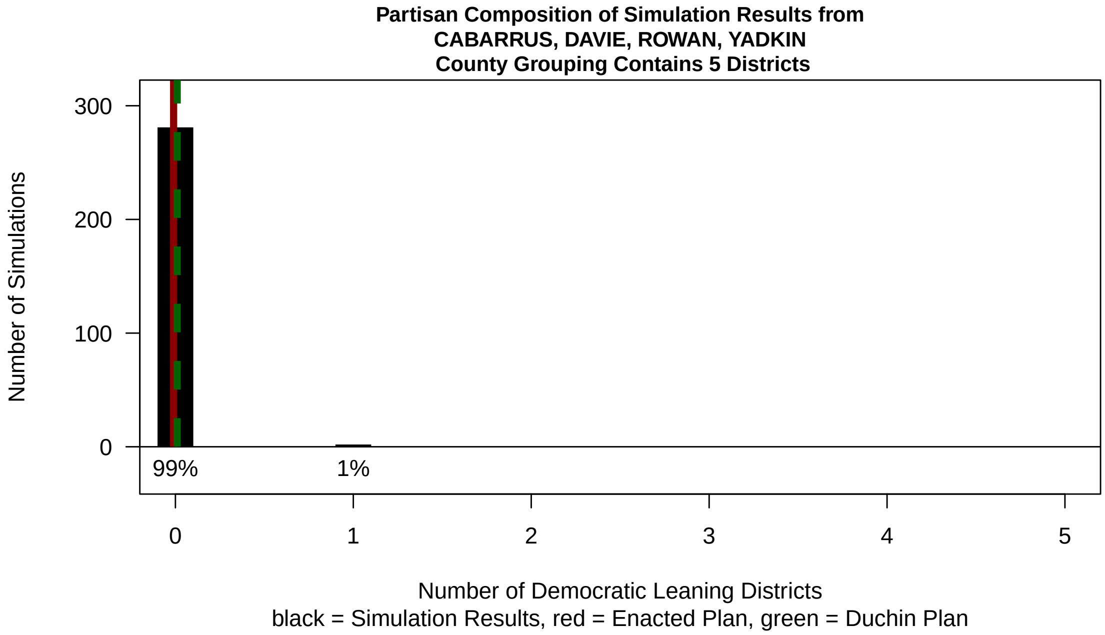


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
73	0.40	0.25
76	0.40	0.40
77	0.25	0.35
82	0.45	0.41
83	0.34	0.43

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 73: **Distribution of Partisan Districts from Simulations in Cabarrus, Davie, Rowan, and Yadkin House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 25: Simulation Results by Individual Elections

Cabarrus, Davie, Rowan, and Yadkin House County Cluster

	Number of Democratic Leaning Districts:					
	0	1	2	3	4	5
Individual Elections:						
2020 President	**10%**	90%	0%	0%	0%	0%
2020 Senate	**85%**	15%	0%	0%	0%	0%
2020 Governor	**2%**	98%	0%	0%	0%	0%
2020 Lt. Governor	**87%**	13%	0%	0%	0%	0%
2020 Attorney General	**9%**	91%	0%	0%	0%	0%
2016 President	**100%**	0%	0%	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%	0%	0%
2014 Senate	**100%**	0%	0%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 10% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.23 Chatham, Lee, Moore, Randolph, and Richmond House County Grouping

The Chatham-Lee-Moore-Randolph-Richmond House county group contains 5 districts. In the Enacted Map these are Districts 51, 52, 54, 70, and 78. The county cluster has an overall partisan index of .38, which is strongly Republican. After conducting 50,000 initial simulations to create five districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 1,868 simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 939 simulated maps, each containing five districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 74. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 75.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 76. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 18% of the simulations there are 0 Democratic leaning districts. In 82% of the simulations there is 1 Democratic leaning district. The Enacted Map creates 1 Democratic district. The Duchin Map also generates 1 Democratic district.

Table 26 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all of the 11 individual elections the Enacted Map generates 1 Democratic district and is in agreement with the majority of the simulations results in all 11 individual elections considered.

Figure 74: **Map of Chatham, Lee, Moore, Randolph, and Richmond House County Cluster**

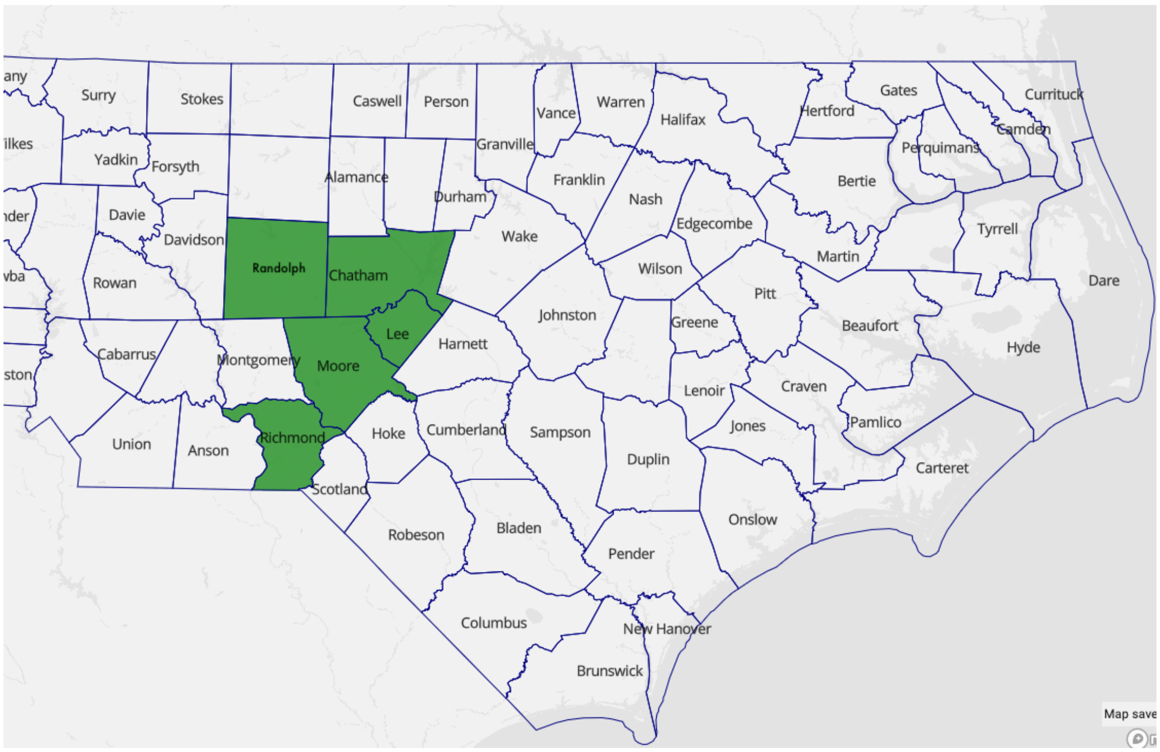
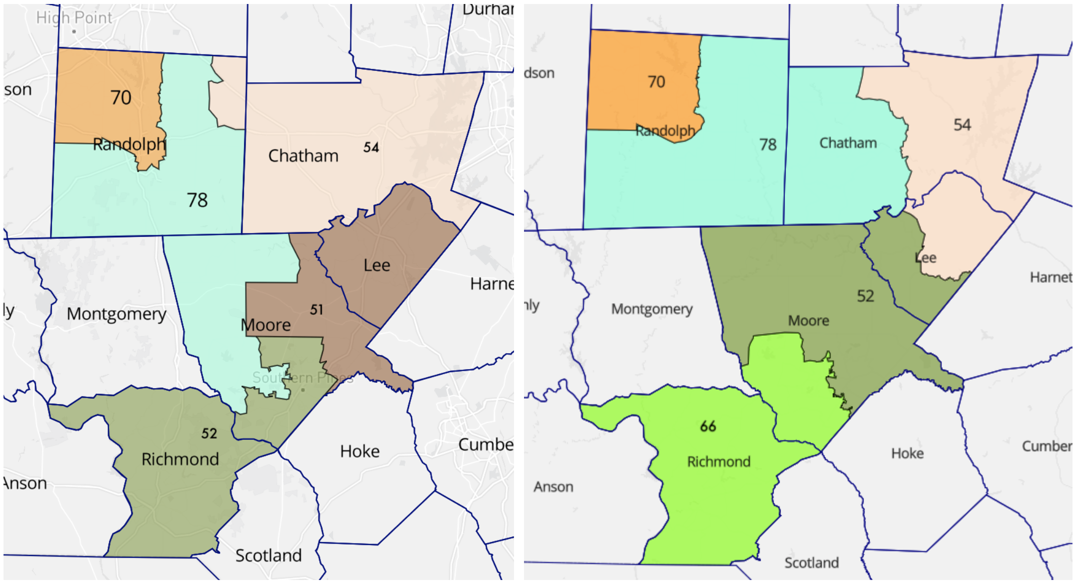


Figure 75: **Map of House Enacted Plan in Chatham, Lee, Moore, Randolph, and Richmond County Cluster**

(a) Enacted Map (b) Duchin Map

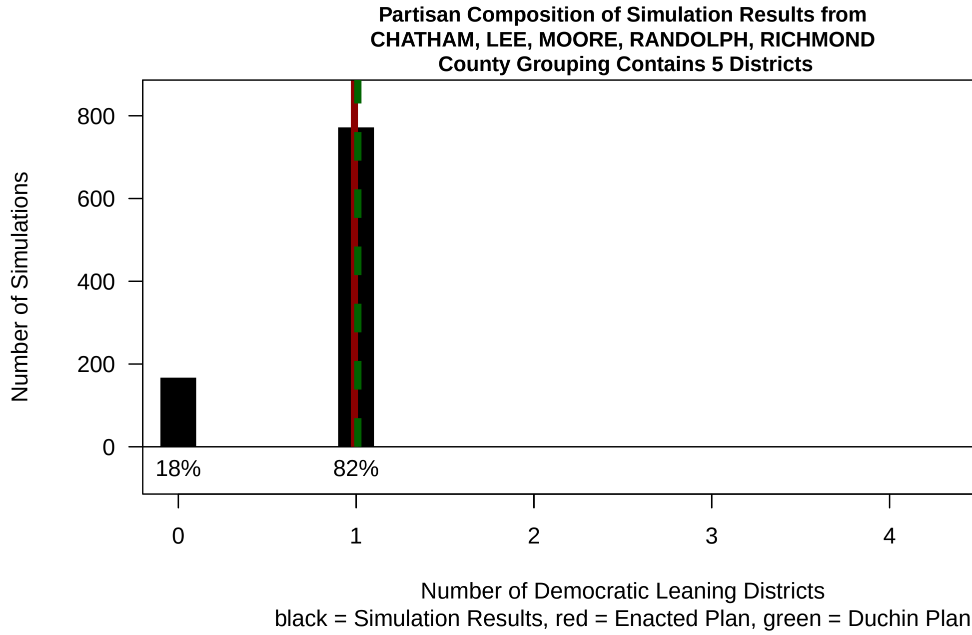


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
51(66 in Duchin)	0.41	0.42
52	0.44	0.35
54	0.54	0.58
70	0.25	0.24
78	0.26	0.27

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 76: **Distribution of Partisan Districts from Simulations in Chatham, Lee, Moore, Randolph, and Richmond House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 26: Simulation Results by Individual Elections

Chatham, Lee, Moore, Randolph, and Richmond House County Cluster

	Number of Democratic Leaning Districts:					
	0	1	2	3	4	5
Individual Elections:						
2020 President	17%	**83%**	0%	0%	0%	0%
2020 Senate	18%	**82%**	0%	0%	0%	0%
2020 Governor	0%	**100%**	0%	0%	0%	0%
2020 Lt. Governor	18%	**82%**	0%	0%	0%	0%
2020 Attorney General	15%	**85%**	0%	0%	0%	0%
2016 President	18%	**82%**	0%	0%	0%	0%
2016 Senate	19%	**81%**	0%	0%	0%	0%
2016 Governor	15%	**85%**	0%	0%	0%	0%
2016 Lt. Governor	29%	**71%**	0%	0%	0%	0%
2016 Attorney General	14%	**86%**	0%	0%	0%	0%
2014 Senate	15%	**85%**	0%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 83% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

6.24 Guilford House County Grouping

The Guilford House county group contains 6 districts. In the Enacted Map these are Districts 57, 58, 59, 60, 61, and 62. The county cluster has an overall partisan index of .61, which is strongly Democratic. After conducting 50,000 initial simulations to create six districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, this grouping contains only one county, and thus the Enacted Plan will contain as many traversals as all of the simulations. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 15,489 simulated maps, each containing six districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 77. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 78. I also include the map of districts in this county from the 2020 plan for comparison here.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 79. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 1% of the simulations there are 4 Democratic leaning districts. In 79% of the simulations there is 5 Democratic leaning district. in 21% of the simulations there are 6 Democratic districts. The Enacted Map creates 4 Democratic districts. The Duchin Map generates 5 Democratic districts.

Table 27 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Demo-

cratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 10 of the 11 individual elections the Enacted Map generates 4 Democratic districts and in 1 election (2020 Governor) the map contains 5 Democratic leaning districts.

An important point to consider when looking at the Enacted Map is that it closely adheres to the map used in Guilford County the 2020 election, which was approved by a court in 2019. The Enacted Plan is different by only four precincts. District 57 is identical across the two plans. Districts 59, 61, and 62 differ from the 2020 map by only 1 precinct each. District 60 differs from the 2020 map by 2 precincts and District 58 differs by only 3 precincts.

Figure 77: **Map of Guilford House County Cluster**

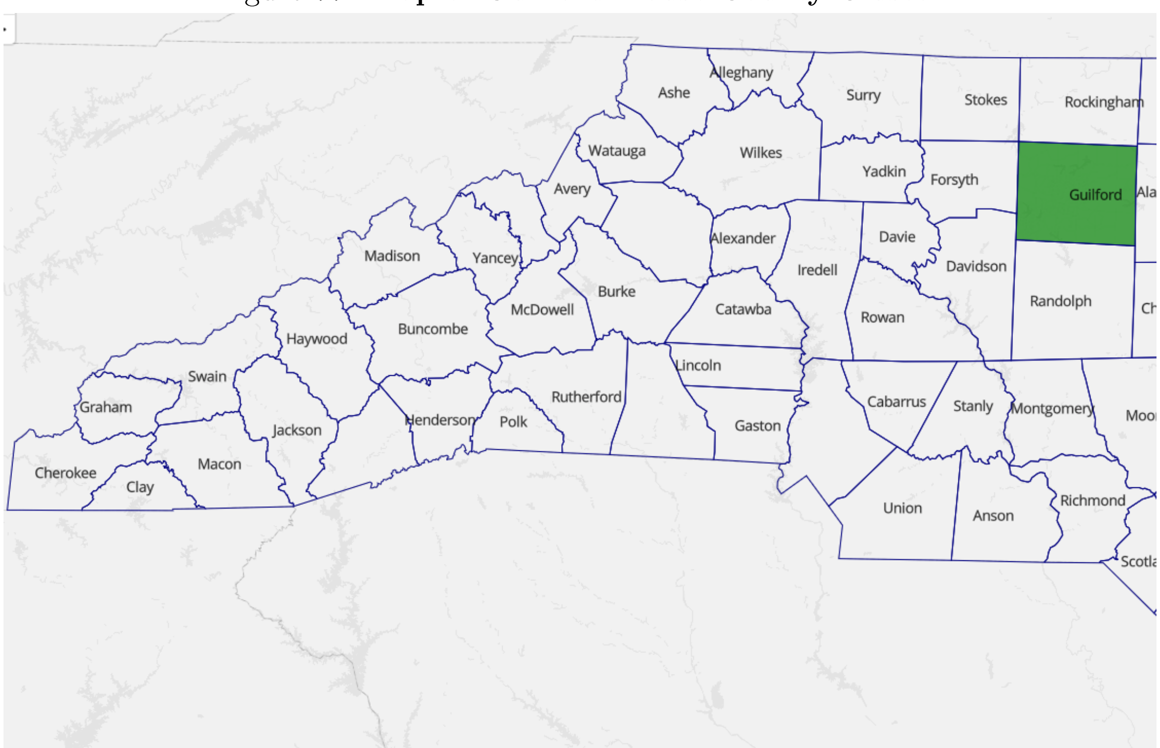
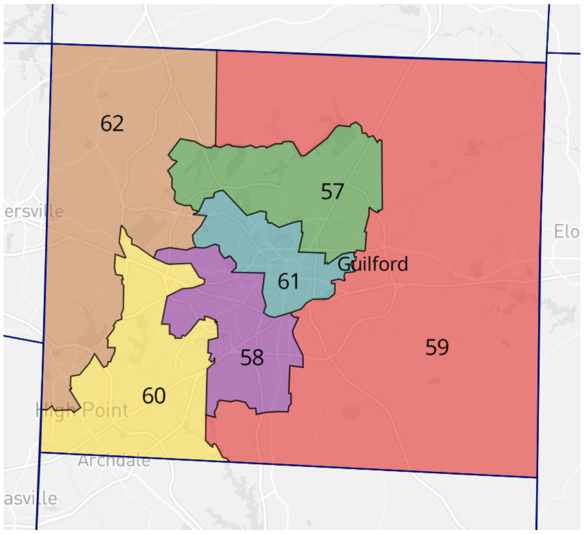
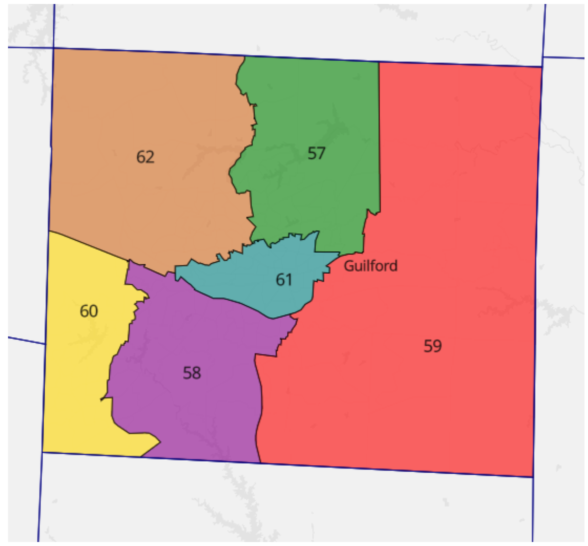


Figure 78: **Map of House Enacted Plan in Guilford County Cluster**

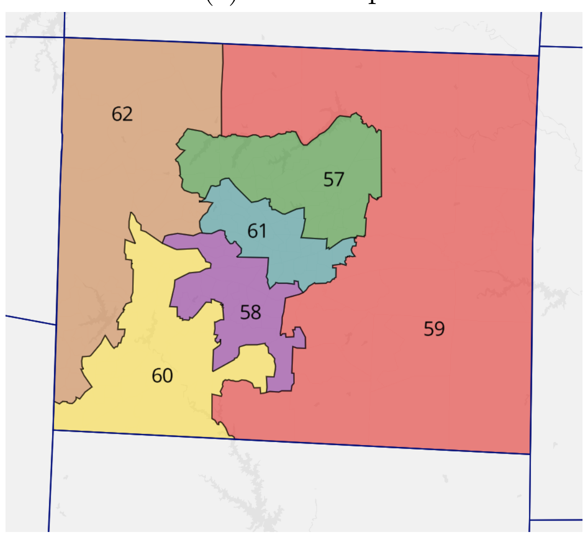
(a) Enacted Map



(b) Duchin Map



(c) 2020 Map

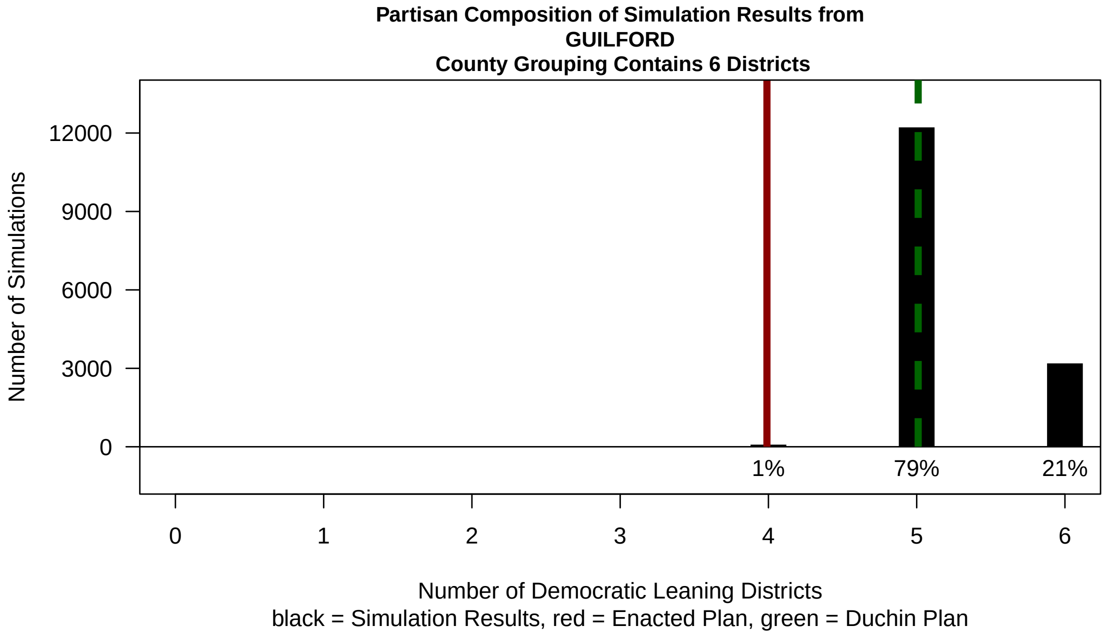


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
57	0.68	0.65
58	0.74	0.65
59	0.46	0.54
60	0.64	0.57
61	0.74	0.80
62	0.43	0.48

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 79: **Distribution of Partisan Districts from Simulations in Guilford House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 27: Simulation Results by Individual Elections

Guilford HouseCounty Cluster

	Number of Democratic Leaning Districts:						
	0	1	2	3	4	5	6
Individual Elections:							
2020 President	0%	0%	0%	0%	**0%**	41%	59%
2020 Senate	0%	0%	0%	0%	**0%**	73%	27%
2020 Governor	0%	0%	0%	0%	0%	**1%**	99%
2020 Lt. Governor	0%	0%	0%	0%	**1%**	80%	19%
2020 Attorney General	0%	0%	0%	0%	**0%**	53%	47%
2016 President	0%	0%	0%	0%	**2%**	84%	13%
2016 Senate	0%	0%	0%	0%	**7%**	90%	3%
2016 Governor	0%	0%	0%	0%	**0%**	44%	56%
2016 Lt. Governor	0%	0%	0%	0%	**8%**	90%	3%
2016 Attorney General	0%	0%	0%	0%	**1%**	82%	17%
2014 Senate	0%	0%	0%	0%	**21%**	78%	1%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 0% of the simulations produce 4 Democratic leaning districts. The Enacted Plan does, as the '1 District' cell is bolded in that row.

6.25 Avery, Cleveland, Gaston, Henderson, McDowell, Mitchell, Polk, Rutherford, and Yancey House County Grouping

The Avery-Cleveland-Gaston-Henderson-McDowell-Mitchell-Polk-Rutherford-Yancey House county group contains 7 districts. In the Enacted Map these are Districts 85, 108, 109, 110, 111, 113, and 117. The county cluster has an overall partisan index of .35, which is strongly Republican. After conducting 50,000 initial simulations to create seven districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 14,667 simulated plans. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 11,815 simulated maps, each containing seven districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 80. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 81.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 82. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map creates 0 Democratic leaning districts. The Duchin Map generates 0 Democratic leaning districts.

Table 28 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the individual elections the Enacted Map generates 0 Democratic districts and is in agreement with all of the simulated results across all 11 elections.

Figure 80: **Map of Avery, Cleveland, Gaston, Henderson, McDowell, Mitchell, Polk, Rutherford, and Yancey House County Cluster**

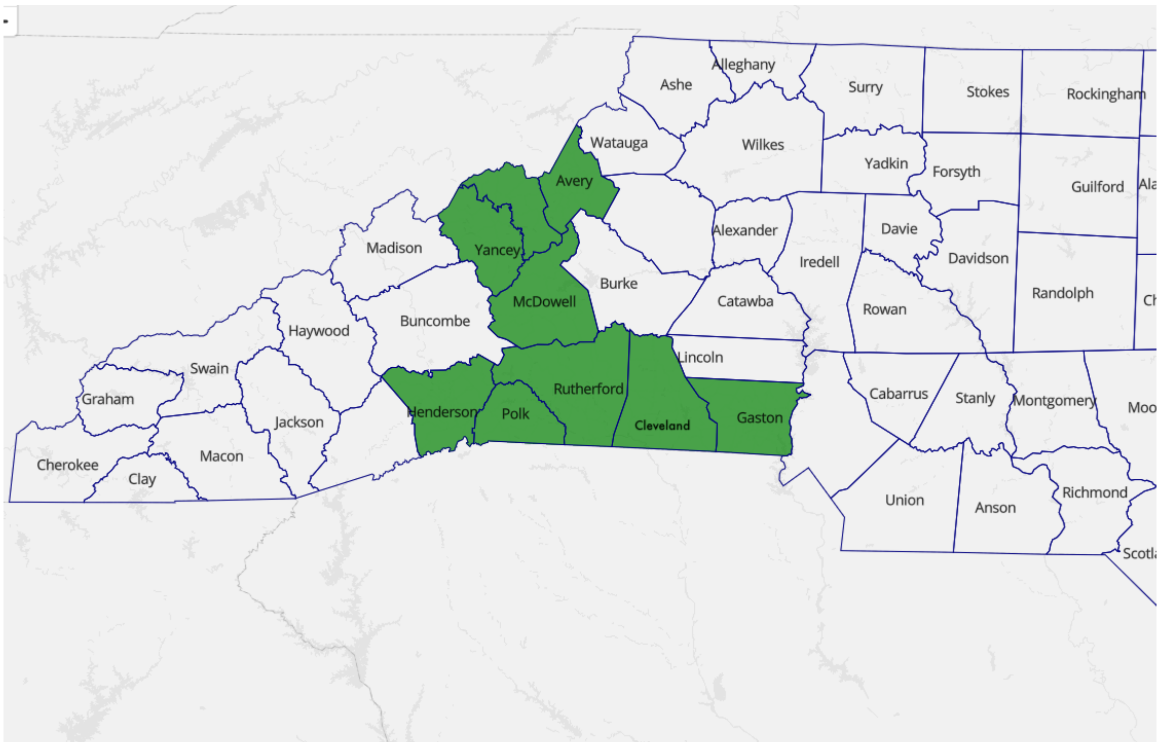
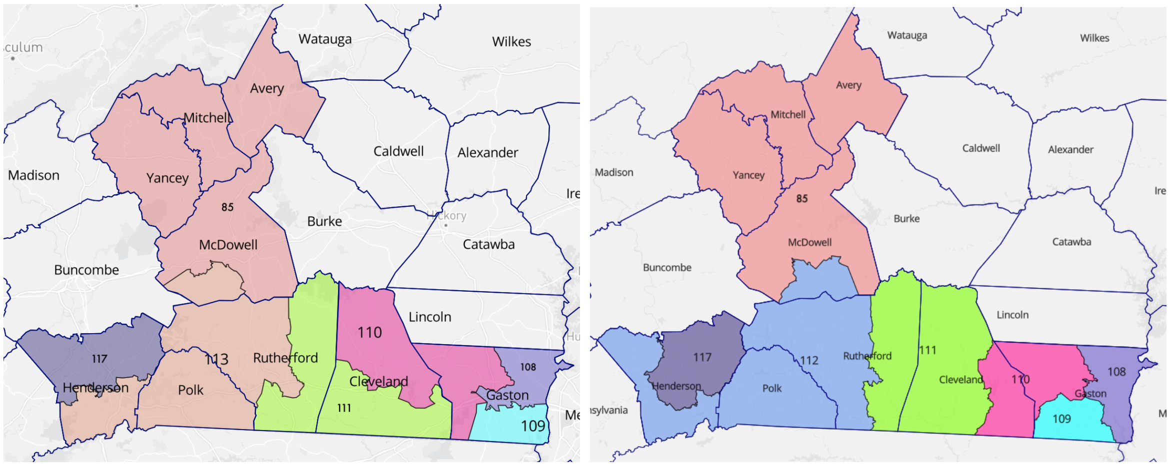


Figure 81: **Map of House Enacted Plan in Avery, Cleveland, Gaston, Henderson, McDowell, Mitchell, Polk, Rutherford, and Yancey County Cluster**

(a) Enacted Map (b) Duchin Map

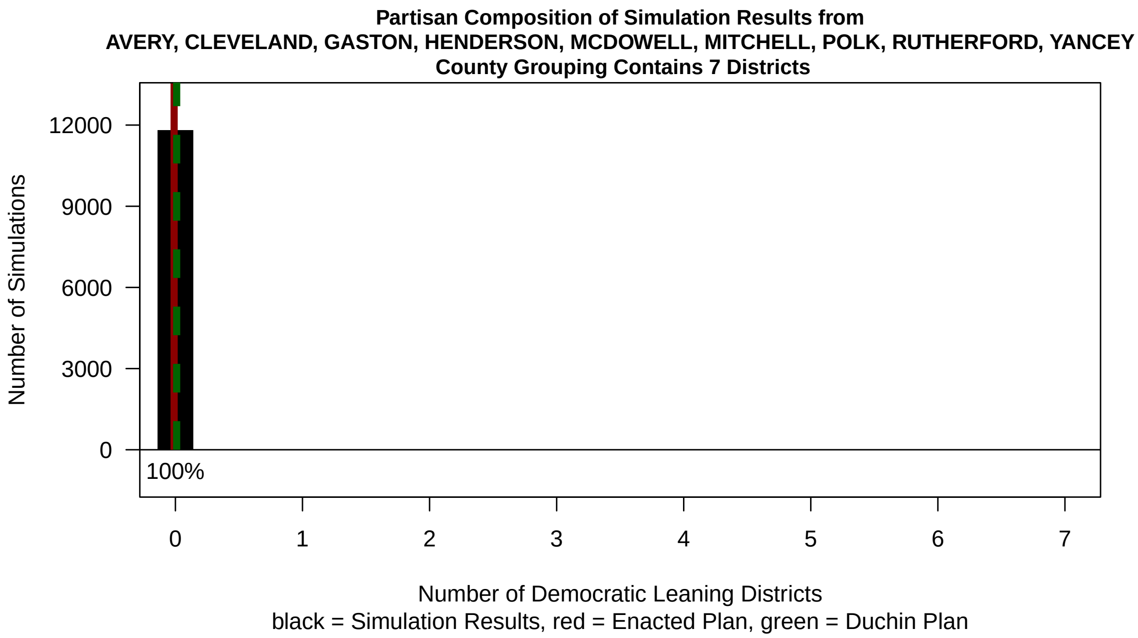


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
85	0.28	0.28
108	0.38	0.32
109	0.38	0.43
110	0.31	0.32
111	0.32	0.34
113	0.35	0.33
117	0.40	0.40

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 82: **Distribution of Partisan Districts from Simulations in Avery, Cleveland, Gaston, Henderson, McDowell, Mitchell, Polk, Rutherford, and Yancey House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 28: Simulation Results by Individual Elections

Avery, Cleveland, Gaston, Henderson, McDowell, Mitchell, Polk, Rutherford, and Yancey House County Cluster

Number of Democratic Leaning Districts:			
	0	1	2-7
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**99%**	1%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

6.26 Mecklenburg House County Grouping

The Mecklenburg House county group contains 13 districts. In the Enacted Map these are Districts 88, 92, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, and 112. The county cluster has an overall partisan index of .65, which is strongly Democratic. After conducting 50,000 initial simulations to create 13 districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, this cluster is a single county, and thus, there are no traversals. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 3,161 simulated maps, each containing 13 districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 83. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 84.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 85. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 1% of the simulations there are 10 Democratic leaning districts. In 56% of the simulations there are 11 Democratic leaning districts, and in 44% of the simulations there are 12 Democratic leaning districts. The Enacted Map aligns with the majority of simulations and creates 11 Democratic leaning districts. The Duchin Map generates 11 Democratic leaning districts as well.

Table 29 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Demo-

cratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. Across the 11 individual elections the Enacted Map generates between 9-13 Democratic districts and is in agreement with the majority of the simulated results in 7 of the 11 elections. In 10 of the 11 elections the Enacted Plan is within the middle 50% of the simulation results.

Figure 83: **Map of Mecklenburg House County Cluster**

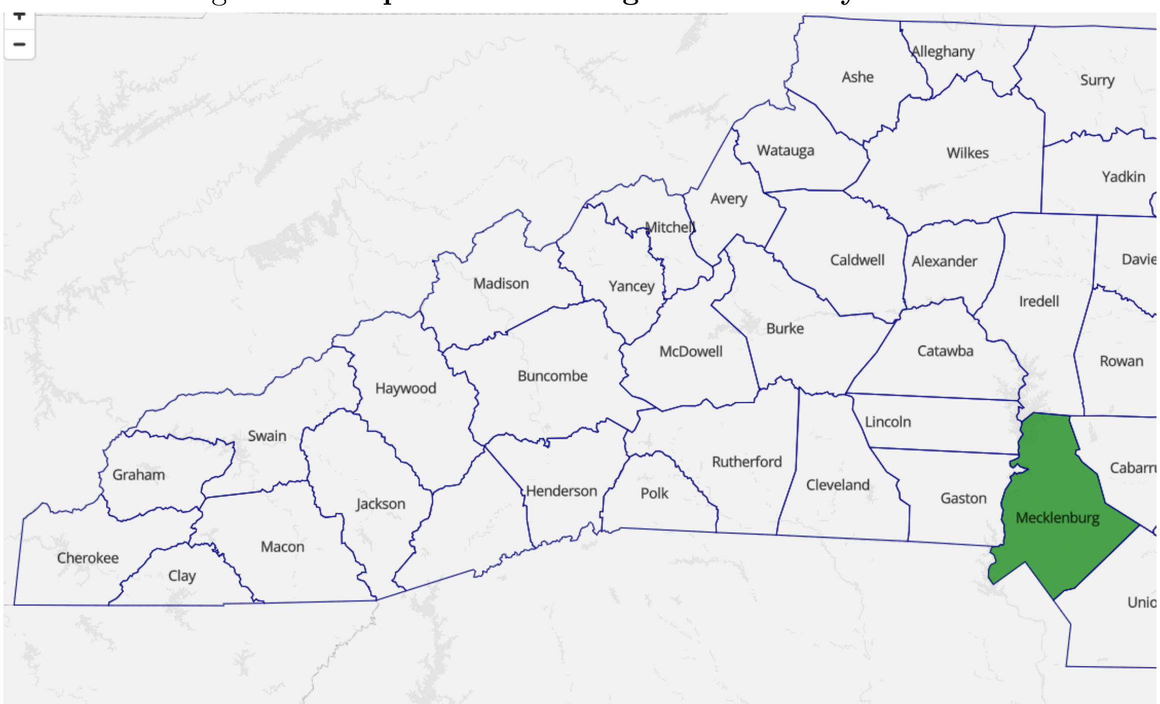
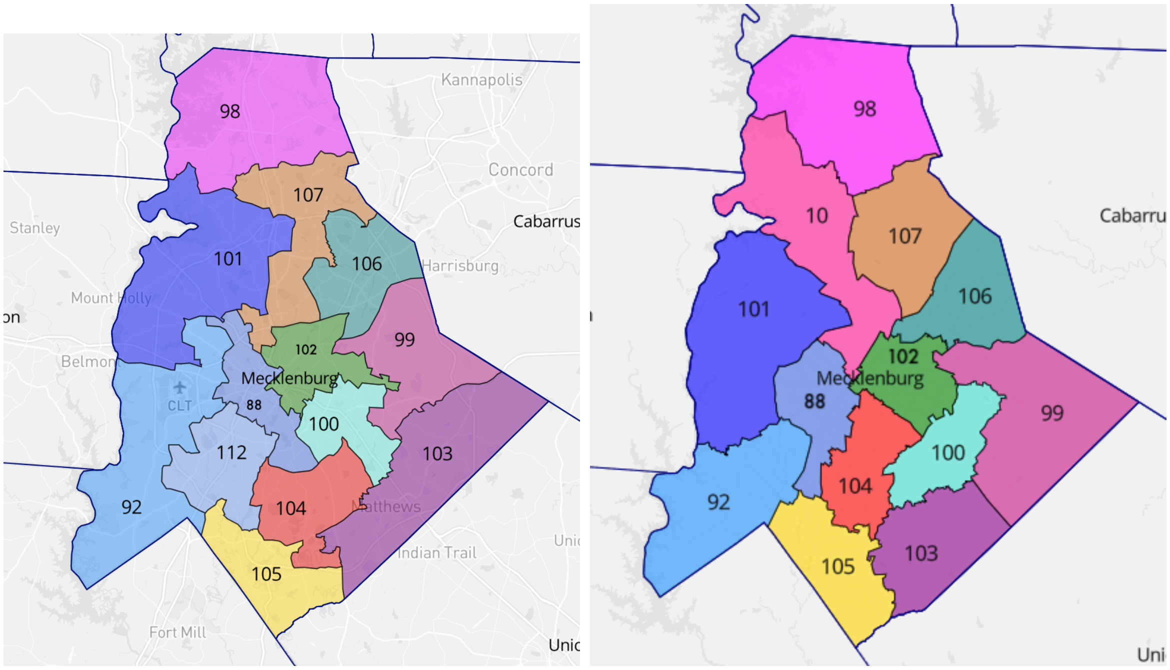


Figure 84: **Map of House Enacted Plan in Mecklenburg County Cluster**

(a) Enacted Map (b) Duchin Map

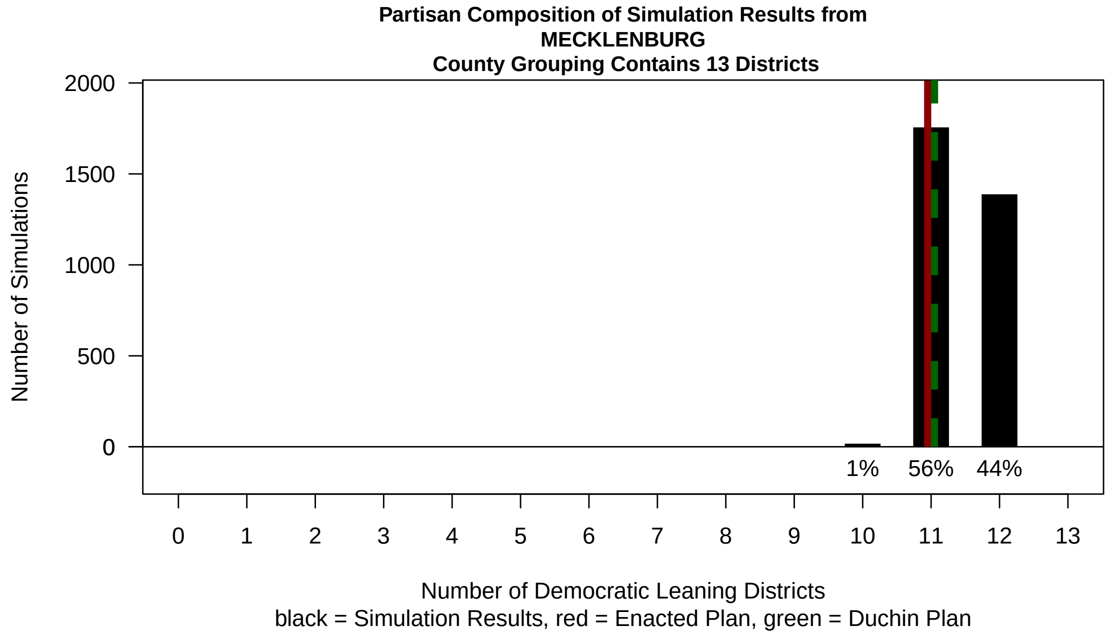


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
88	0.65	0.75
92	0.70	0.69
98	0.47	0.47
99	0.78	0.59
100	0.73	0.68
101	0.72	0.74
102	0.82	0.80
103	0.47	0.49
104	0.51	0.55
105	0.54	0.55
106	0.80	0.82
107	0.74	0.75
112 (10 in Duchin)	0.72	0.75

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 85: **Distribution of Partisan Districts from Simulations in Mecklenburg House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 29: Simulation Results by Individual Elections

Mecklenburg House County Cluster

	Number of Democratic Leaning Districts:						
	0-7	8	9	10	11	12	13
Individual Elections:							
2020 President	0%	0%	0%	0%	0%	0%	**100%**
2020 Senate	0%	0%	0%	0%	**39%**	61%	0%
2020 Governor	0%	0%	0%	0%	0%	0%	**100%**
2020 Lt. Governor	0%	0%	0%	0%	**36%**	64%	0%
2020 Attorney General	0%	0%	0%	0%	**9%**	91%	0%
2016 President	0%	0%	0%	3%	**69%**	28%	0%
2016 Senate	0%	3%	**50%**	45%	2%	0%	0%
2016 Governor	0%	0%	0%	0%	11%	**76%**	13%
2016 Lt. Governor	0%	4%	**58%**	38%	0%	0%	0%
2016 Attorney General	0%	0%	5%	**34%**	57%	4%	0%
2014 Senate	0%	4%	**60%**	35%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 13 Democratic leaning districts. The Enacted Plan does as well, as the '13 District' cell is bolded in that row.

6.27 Wake House County Grouping

The Wake House county group contains 13 districts. In the Enacted Map these are Districts 11, 21, 33, 34, 35, 36, 37, 38, 39, 40, 41, 49, and 66. The county cluster has an overall partisan index of .61, which is strongly Democratic. After conducting 50,000 initial simulations to create 13 districts in this cluster, I would normally discard any simulations that contain more county traversals than the Enacted Plan. However, this cluster is a single county, and thus, there are no traversals. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 14,305 simulated maps, each containing 13 districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 86. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 87.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 88. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 2% of the simulations there are 10 Democratic leaning districts. In 32% of the simulations there are 11 Democratic leaning districts, and in 66% of the simulations there are 12 Democratic leaning districts. The Enacted Map creates 11 Democratic leaning districts. The Duchin Map generates 11 Democratic leaning districts as well.

Table 30 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Demo-

cratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. Across the 11 individual elections the Enacted Map generates between 9-13 Democratic districts and is in agreement with the majority of the simulated results in 7 of the 11 elections.

Figure 86: **Map of Wake House County Cluster**

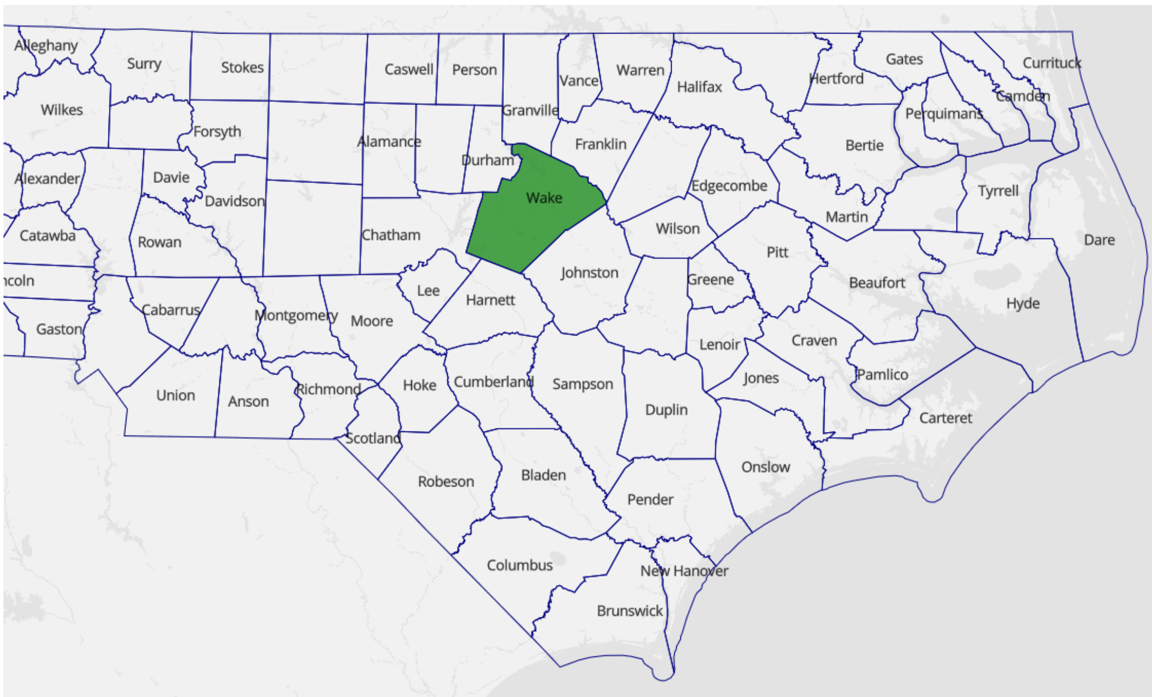
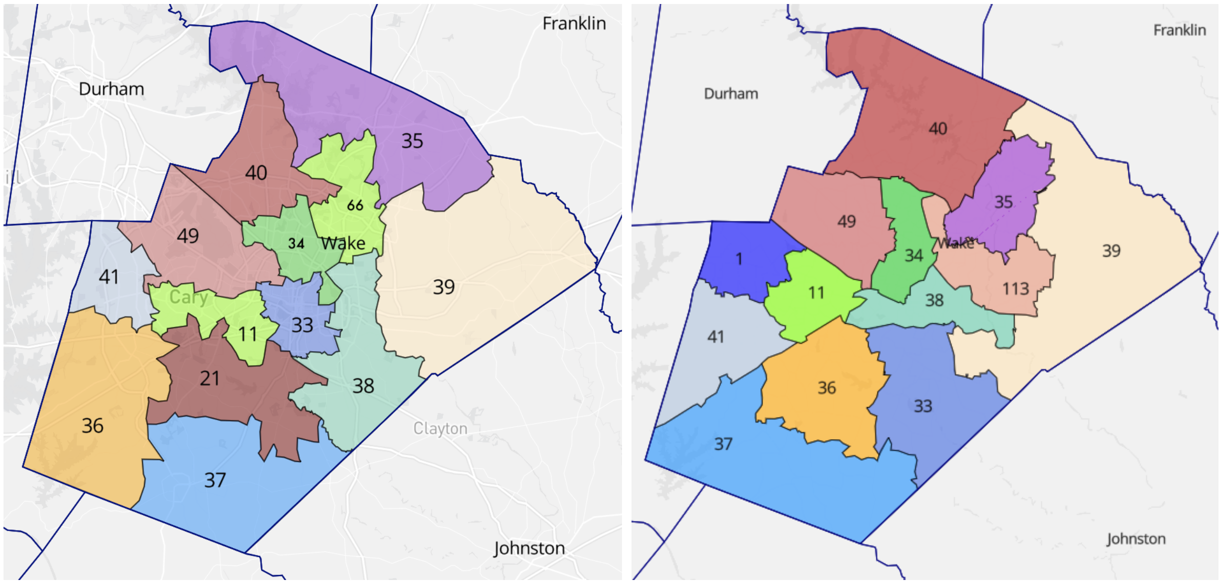


Figure 87: **Map of House Enacted Plan in Wake County Cluster**

(a) Enacted Map (b) Duchin Map

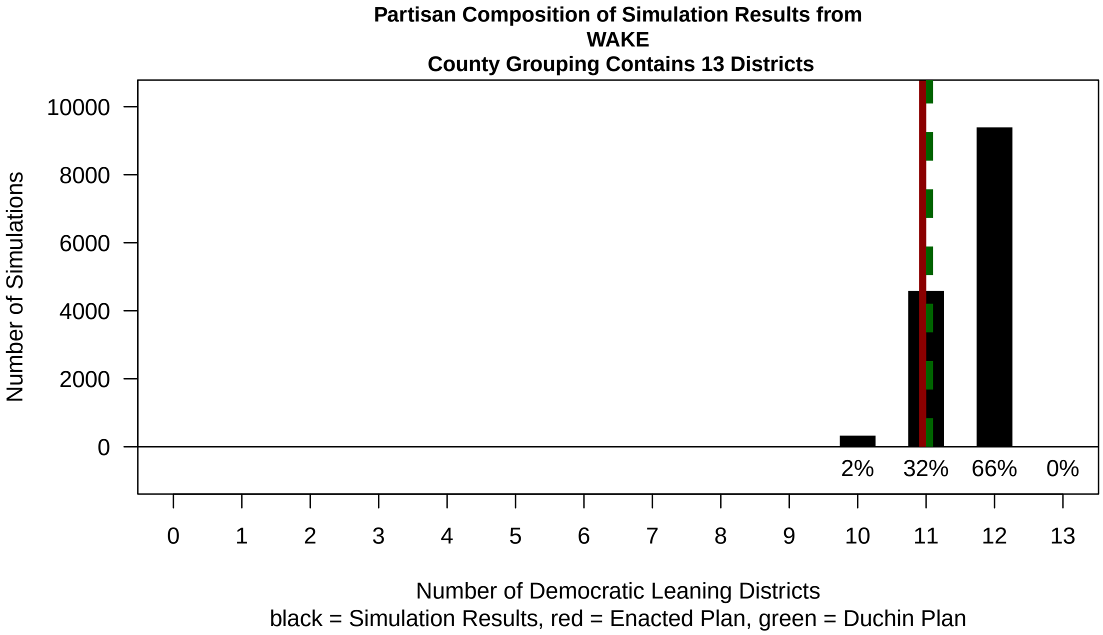


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
11	0.69	0.65
21 (1 in Duchin)	0.53	0.65
33	0.83	0.65
34	0.65	0.62
35	0.47	0.63
36	0.55	0.53
37	0.45	0.46
38	0.75	0.84
39	0.59	0.59
40	0.56	0.49
41	0.64	0.58
49	0.65	0.64
66 (113 in Duchin)	0.65	0.69

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 88: **Distribution of Partisan Districts from Simulations in Wake House County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 30: Simulation Results by Individual Elections

Wake House County Cluster

	Number of Democratic Leaning Districts:						
	0-7	8	9	10	11	12	13
Individual Elections:							
2020 President	0%	0%	0%	0%	**2%**	81%	17%
2020 Senate	0%	0%	0%	0%	**9%**	88%	2%
2020 Governor	0%	0%	0%	0%	0%	0%	**100%**
2020 Lt. Governor	0%	0%	0%	0%	**14%**	85%	0%
2020 Attorney General	0%	0%	0%	0%	**2%**	78%	20%
2016 President	0%	0%	2%	21%	**58%**	19%	0%
2016 Senate	0%	21%	**57%**	21%	1%	0%	0%
2016 Governor	0%	0%	0%	6%	**60%**	34%	0%
2016 Lt. Governor	0%	33%	**57%**	9%	0%	0%	0%
2016 Attorney General	0%	0%	2%	19%	**62%**	18%	0%
2014 Senate	0%	28%	**61%**	12%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 2% of the simulations produce 11 Democratic leaning districts. The Enacted Plan does as well, as the '11 District' cell is bolded in that row.

7 NC Senate Analysis

7.1 Senate Groupings with only 1 District

In the state Senate, there are 26 county clusters. 17 clusters containing 36 of the 50 districts are fixed based on the optimal county clusters determined by Cooper et al. (2021, 'Duke Study'). The remaining 9 clusters were selected by the General Assembly from four sets of choices between clusters as presented by the Duke Study.

In the Enacted Plan there are 14 county clusters composed of 48 counties in which the cluster contains only 1 Senate district. In these clusters there is no discretion for any map maker. The district is simply the boundaries of the county group. These counties collectively have a population of 2,906,456, or approximately 28% of the state's total population and account for 14 of the 50 seats in the state senate.

Figure 89 shows a map of the counties that constitute these single-district clusters in the Enacted Plan. Figure 90 shows a map of the countie that constitute these single-district clusters chosen in the Duchin Plan. Table 31 below shows each cluster, the counties included in the cluster, and the corresponding districts in the Senate Enacted Plan. The final two columns of the table show the partisan lean of the cluster using the 11 statewide partisan elections index discussed above and whether or not, based on that index, the cluster leans Democratic (or Republican). I classify a district (in the Enacted Plan and in the simulations as well) as being Democratic leaning if the partisan index for that district is greater than 0.50. In other words, if more than fifty percent of the ballots cast for the two major parties were for Democratic candidates, that district is classified as a Democratic leaning district. Obviously, districts with numbers much larger than (smaller than) 0.50 will be more likely to elect a Democrat (Republican) than districts that are very close to 0.50.

The bottom row of Table 31 shows the results for all 14 clusters together. Collectively these counties have a partisan index of 0.43, meaning roughly four in ten voters in these counties cast ballots for Democratic candidates in the 11 statewide races I consider here.

However, the location of voters for the different parties is not uniformly distributed across these counties. Given this spatial distribution of voters across the counties, 4 of the 14 clusters lean Democratic, or roughly 30 percent. In this case, the proportion of Democratic leaning districts is lower than the proportion of voters in these counties who favor Democratic candidates. However, this is not due to any district boundaries. It is again purely a function of the political geography of the state since all of these districts are entire county units and are, as such, fixed.

In some cases the Enacted Plan and the Duchin Plan use different county groupings from one another. This occurs in 4 cases and is shown in Table 31 below. This results in a net change of 3 counties included in single district groupings.[26]

In the Duchin Plan 5 of the 14 clusters lean Democratic, or approximately 36% of the districts. As in the Enacted Plan, the proportion of Democratic leaning districts is lower that the proportion of voters in these counties who favor Democratic candidates. However, this is not due to any district boundaries. It is again purely a function of the political geography of the state since all of these districts are entire county units and are, as such, fixed.

[26] Stokes replaces Yadkin, Henderson and Polk are replaced by McDowell and Cleveland.

Table 31: County Clusters Containing 1 Senate District

County Cluster	# Counties	District #	County Cluster Democratic Partisan Index	Democratic District
Clusters Used by Both Enacted and Duchin Plans				
Johnston	1	10	0.37	0
Onslow	1	6	0.34	0
Rowan-Stanly	2	33	0.31	0
Edgecombe-Pitt	2	5	0.57	1
Davidson-Davie	2	30	0.27	0
Caswell-Orange-Person	3	23	0.66	1
Franklin-Nash-Vance	3	11	0.51	1
Beaufort-Craven-Lenoir	3	3	0.42	0
Hoke-Robeson-Scotland	3	24	0.51	1
Greene-Wayne-Wilson	3	4	0.48	0
Clusters Used by Enacted Plan				
Henderson-Polk-Rutherford	3	48	0.36	0
Alexander-Surry-Wilkes-Yadkin	4	36	0.24	0
Carteret-Chowan-Halifax-Hyde-Martin-Pamlico-Warren-Washington	8	2	0.46	0
Bertie-Camden-Currituck-Dare-Gates-Hertford-Northampton-Pasquotank-Perquimans-Tyrrell	10	1	0.47	0
Alternative Clusters Used by Duchin Plan				
Cleveland-McDowell-Rutherford	3	47	0.32	0
Alexander-Stokes-Surry-Wilkes	4	45	0.25	0
Carteret-Chowan-Dare-Hyde-Pamlico-Pasquotank-Perquimans-Washington	8	2	0.39	0
Bertie-Camden-Currituck-Gates-Halifax-Hertford-Martin- Northampton-Tyrrell-Warren	10	1	0.54	1
Total Enacted:	48		0.43	4

Figure 89: **Map of Counties and County Clusters with only 1 Senate District in Enacted Plan**

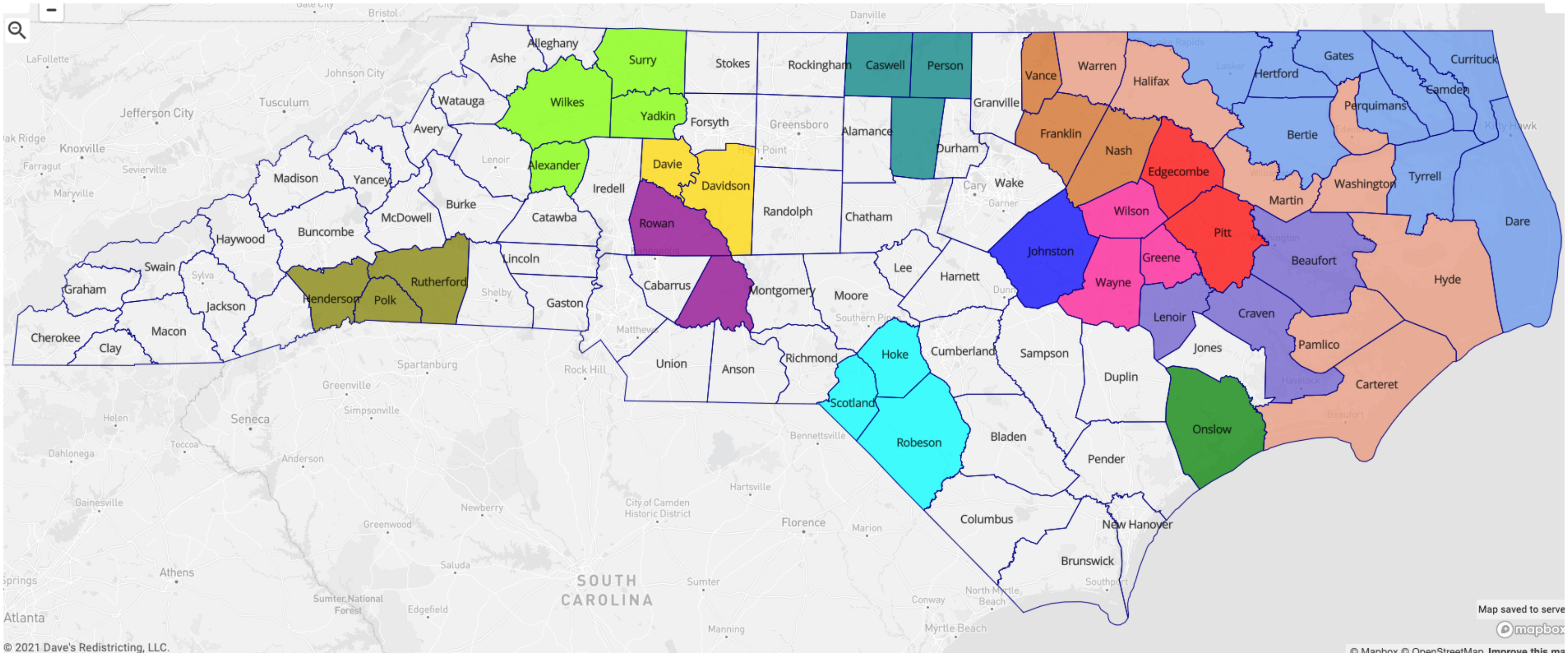
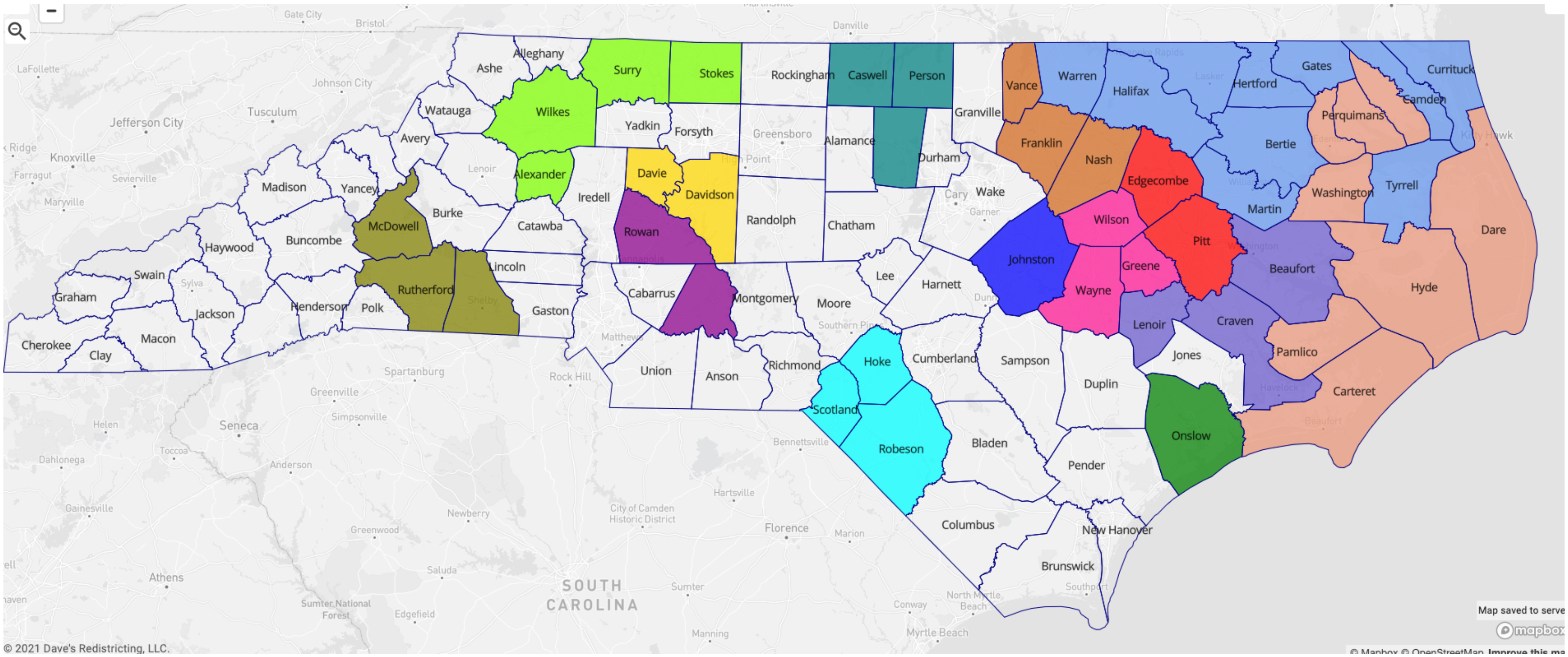


Figure 90: **Map of Counties and County Clusters with only 1 Senate District in Duchin Plan**



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8 Senate Groupings with More than 1 District:

There are 12 county groups with more than 1 district where a map drawer has some discretion to draw districts. I consider each cluster separately because the districts are constrained to remain within the county cluster as the redistricting process is North Carolina is a series of discrete redistricting problems within each county cluster.

I conduct simulations in the 12 clusters that contain more than one Senate district. These clusters collectively account for 36 of the 50 districts in the North Carolina Senate. In the Enacted Plan, 20 of these districts lean Republican and 16 lean Democratic according to the statewide partisan elections index. In addition to calculating the number of Democratic leaning districts for the Enacted Plan, I also compute the same partisan index for the plaintiffs' Duchin Plan and compare how the Enacted Plan and the Duchin Plan perform on this same metric. The Duchin Plan creates 17 districts that lean Republican and 19 districts that lean Democratic according to the statewide partisan elections index in these districts.

I then place both maps in relation to the distribution of partisan outcomes from the simulated districts. In each cluster I consider the number of Democratic districts generated by each plan in comparison to the distribution of results from the simulations. I consider a plan to be a partisan outlier if the number of Democratic districts generated by the plan falls outside the middle 50% of simulation results. This is a conservative definition of an outlier. In the social sciences, medicine, and other disciplines it is traditional to consider something an outlier if it falls outside the middle 95% or 90% of the comparison distribution.

In the Senate, the Duchin Map chooses a different set of county clusters from those that have an alternative option presented in the Cooper et al. (2021, 'Duke Study') report. This occurs in three different county groupings. As a result, in these three different clusters the Duchin Senate Map and the Enacted Senate Map are not comparable because they use different groupings of counties. I compare the remaining nine clusters that are common between the two proposals. An overview of the results are as follows.

In 10 of the 12 clusters, the Enacted Map produces a number of Democratic districts that falls within the middle 50% of simulation results and are not partisan outliers. Furthermore, the Enacted Map produces the same number of Democratic leaning districts as the modal (most common) number of Democratic leaning districts in the simulations in 10 of the 12 clusters.

In 10 of the 12 clusters, the Duchin Map produces a number of Democratic districts that fall within the middle 50% of simulation results and are not partisan outliers. Furthermore, the Duchin Map produces the same number of Democratic leaning districts as the modal (most common) number of Democratic leaning districts in the simulations in 10 of the 12 clusters.

In 6 of the 9 clusters that are common between the Enacted Map and the Duchin Map there is agreement between the two plans on the number of Democratic leaning districts.[27] This means there is disagreement in 4 of the 26 total clusters. Table 32 summarizes the results of the simulation analysis for the 12 Senate clusters with multiple districts. Figure 91 shows a map of the counties where the Enacted Plan and the Duchin Plan are in agreement on the number of Democratic leaning seats. Figure 92 shows a map of the counties where the Enacted Plan and the Duchin Plan disagree on the number of Democratic leaning seats.

Thereafter, I present the results cluster-by-cluster.

[27] These groupings are: Cumberland-Moore, Chatham-Durham, Alleghany et al., Brunswick-Columbus-New Hanover, Bladen et al., Alamance et al., and the combination of Buncombe, Burke, McDowell, Cleveland, Gaston, Lincoln, Henderson, Polk, Forsyth, Stokes, and Yadkin into four different groupings.

Table 32: Senate County Grouping Analysis Summary

County Cluster	Cluster Democratic Partisan Index	# Districts	# of Districts that are Democratic Leaning		
			Enacted Map	**Duchin Map**	**Simulations**
Clusters Used by both Enacted and Duchin Plans					
Cumberland-Moore	0.52	2	1	1	1
Chatham-Durham	0.75	2	2	2	2
Alleghany-Ashe-Avery-Caldwell-Catawba-Cherokee-Clay-Graham-Haywood-Jackson-Macon-Madison-Mitchell-Swain-Transylvania-Watauga-Yancy	0.36	2	0	0	0
Brunswick-Columbus-New Hanover	0.45	2	1	1	1
Bladen-Duplin-Harnett-Jones-Lee-Pender-Sampson	0.41	2	0	0	0
Guilford-Rockingham	0.57	3	2	**3**	2
Alamance-Anson-Cabarrus-Montgomery-Randolph-Richmond-Union	0.38	4	0	0	0
Granville-Wake	0.61	6	**4**	**5**	6
Iredell-Mecklenburg	0.60	6	**4**	5	5
Clusters Used by Enacted Plan					
Buncombe-Burke-McDowell	0.51	2	1		1
Cleveland-Gaston-Lincoln	0.34	2	0		0
Forsyth-Stokes	0.52	2	1		1
Alternative Clusters Used by Duchin Plan					
Buncombe-Henderson-Polk	0.54	2		1	1
Burke-Gaston-Lincoln	0.34	2		0	0
Forsyth-Yadkin	0.54	2		1	1
Total:		35	16	19	19

Note: Number of Democratic leaning districts is measured using the average two-party vote share in each district from the 11 statewide races noted earlier. Simulations range represents the middle 50% of outcomes from the simulations results. Clusters that fall outside of the simulation range are bolded.

Figure 91: **Map of Senate Counties Where Enacted and Duchin Plans Agree on Partisan Lean of Districts**

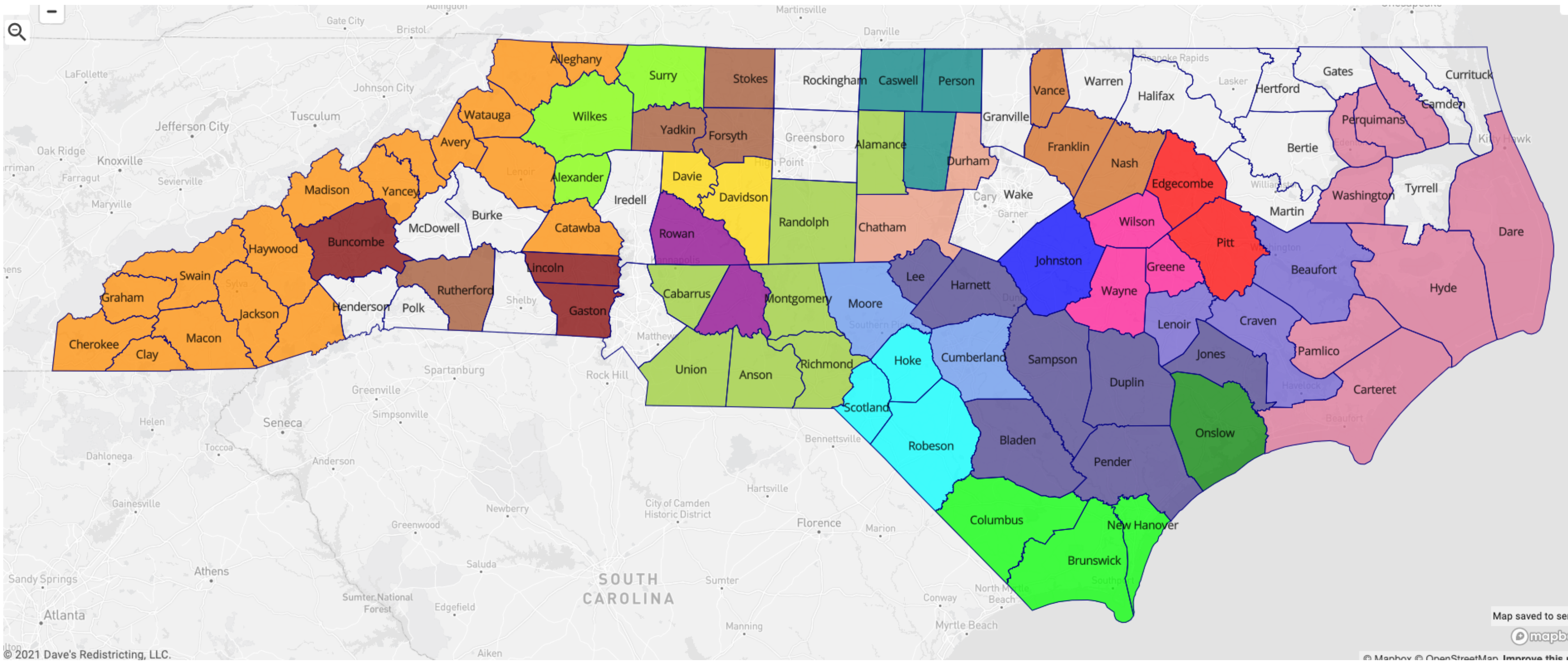
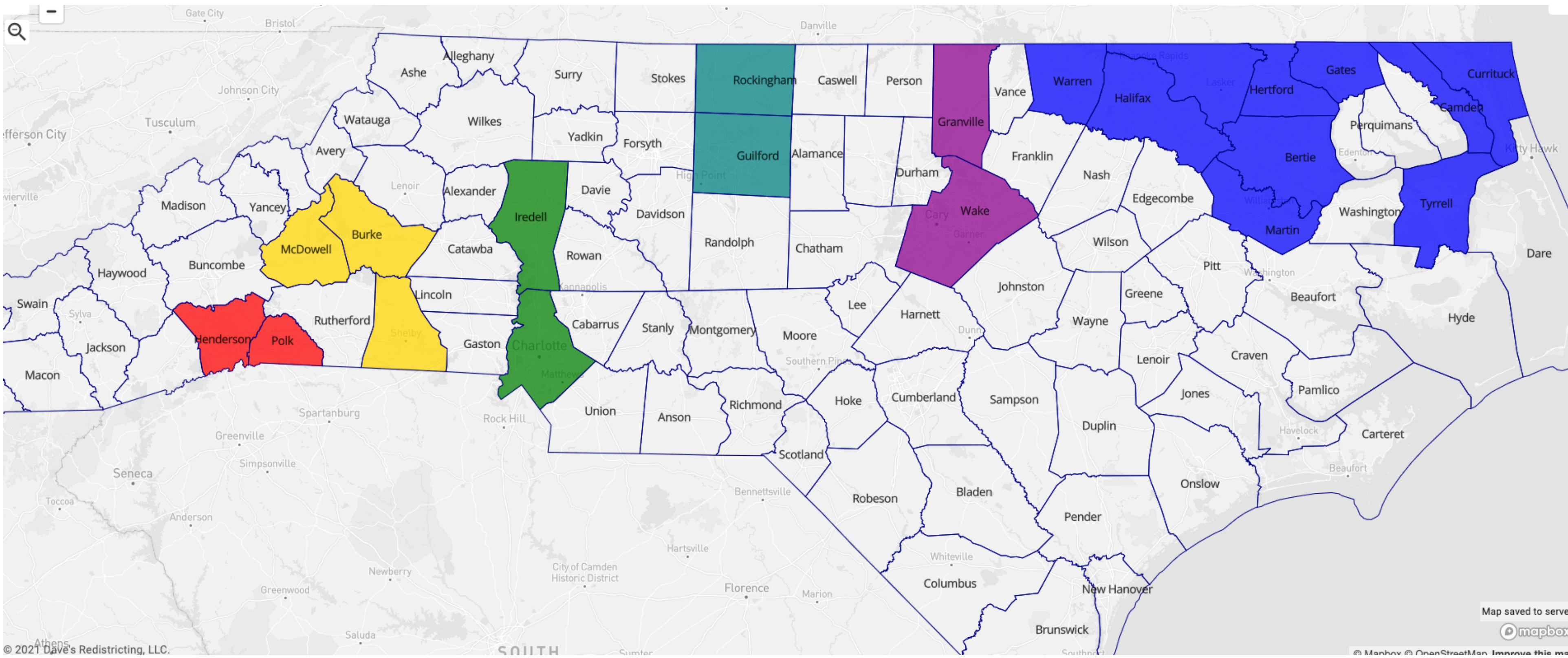


Figure 92: **Map of Senate Counties Where Enacted and Duchin Plans Disagree on Partisan Lean of Districts**



8.1 Cumberland and Moore Senate County Grouping

The Cumberland-Moore Senate county group contains 2 districts. In the Enacted Map these are Districts 19 and 21. The county cluster has an overall partisan index of .52, which is slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. All 50,000 simulations meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 42,625 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 93. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 94.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 95. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 77% of the simulations there is 1 Democratic leaning district. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 1 Democratic district. The Duchin Map also generates 1 Democratic district.

Table 33 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 10 of the 11 individual elections there is agreement between the modal outcome in the simulations and the Enacted Map.

Figure 93: **Map of Cumberland and Moore Senate County Cluster**

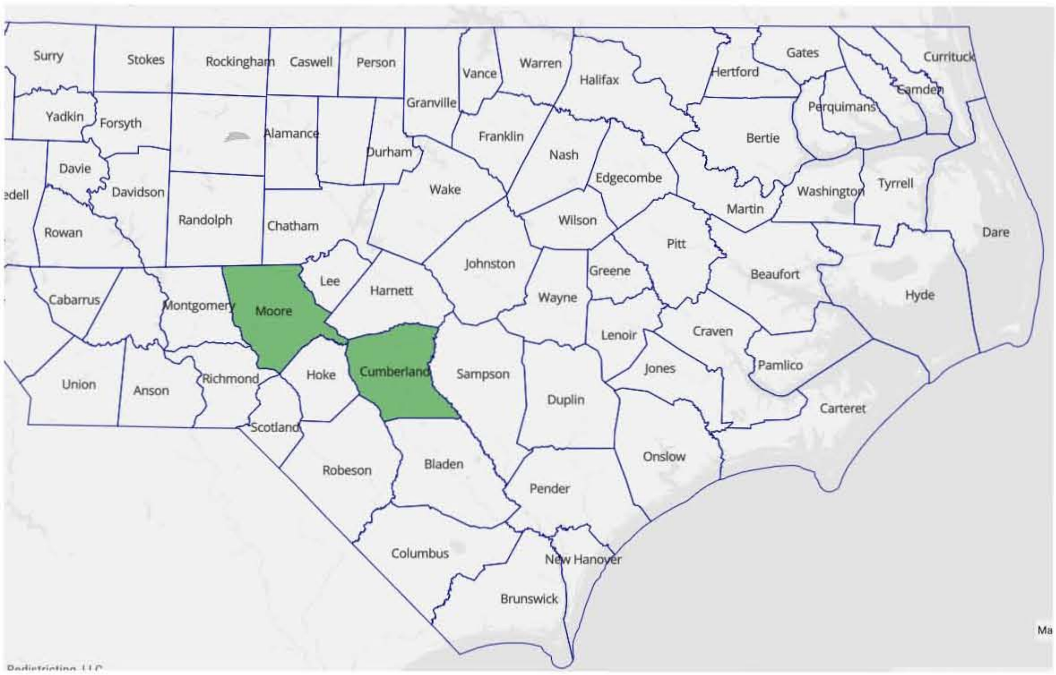
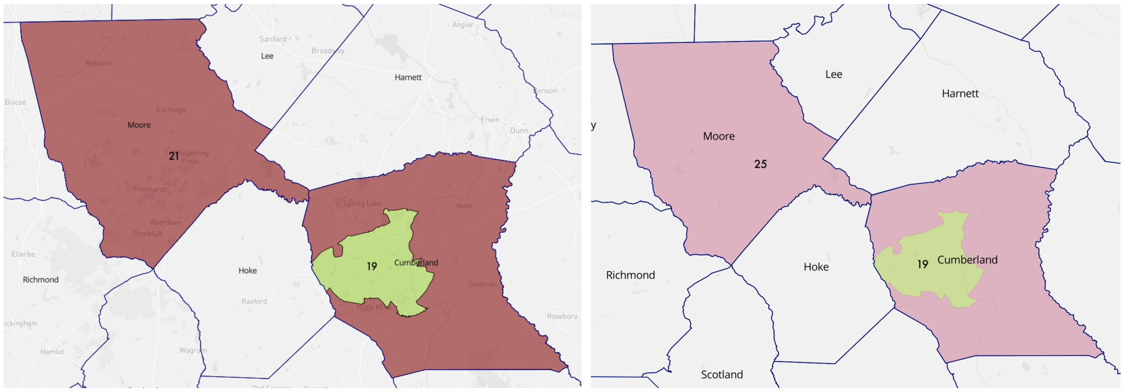


Figure 94: **Map of Enacted Plan in Cumberland and Moore Senate County Cluster**

(a) Enacted Map (b) Duchin Map

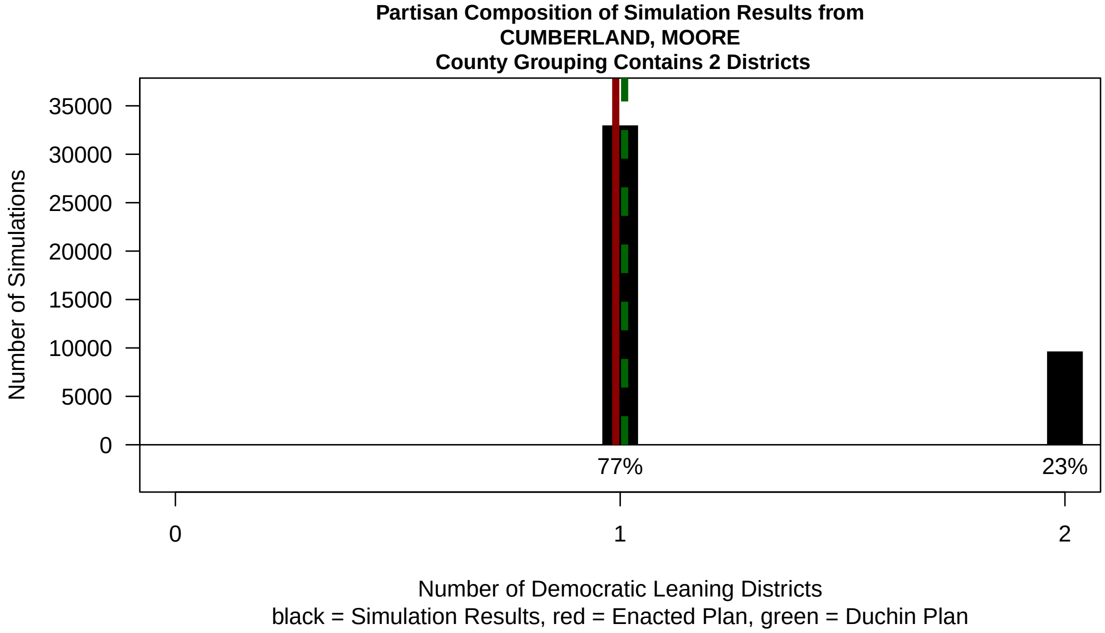


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
19	0.66	0.66
25 (21 in Duchin)	0.40	0.40

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 95: **Distribution of Partisan Districts from Simulations in Cumberland and Moore Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 33: Simulation Results by Individual Elections

Cumberland and Moore Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	**82%**	18%
2020 Senate	0%	**91%**	9%
2020 Governor	0%	**7%**	93%
2020 Lt. Governor	0%	**94%**	6%
2020 Attorney General	0%	**58%**	42%
2016 President	0%	**84%**	16%
2016 Senate	0%	**97%**	3%
2016 Governor	0%	**71%**	29%
2016 Lt. Governor	0%	**99%**	1%
2016 Attorney General	0%	**57%**	43%
2014 Senate	0%	**96%**	4%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 82% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

8.2 Chatham and Durham Senate County Grouping

The Chatham-Durham Senate county group contains 2 districts. In the Enacted Map these are Districts 20 and 22. The county cluster has an overall partisan index of .75, which is strongly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 49,721 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 1,750 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 96. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 97.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 98. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 2 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 2 Democratic leaning districts. The Duchin Map also generates 2 Democratic leaning districts.

Table 34 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In all 11 of the 11 individual elections there is agreement between the modal outcome in the simulations and the Enacted Map.

Figure 96: **Map of Chatham and Durham Senate County Cluster**

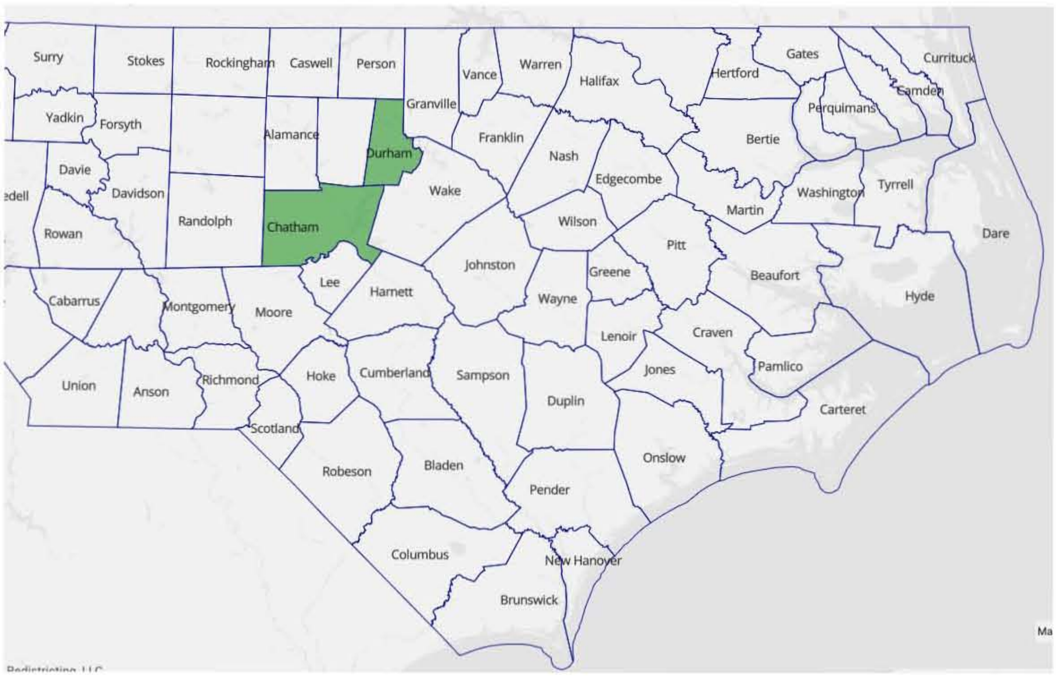
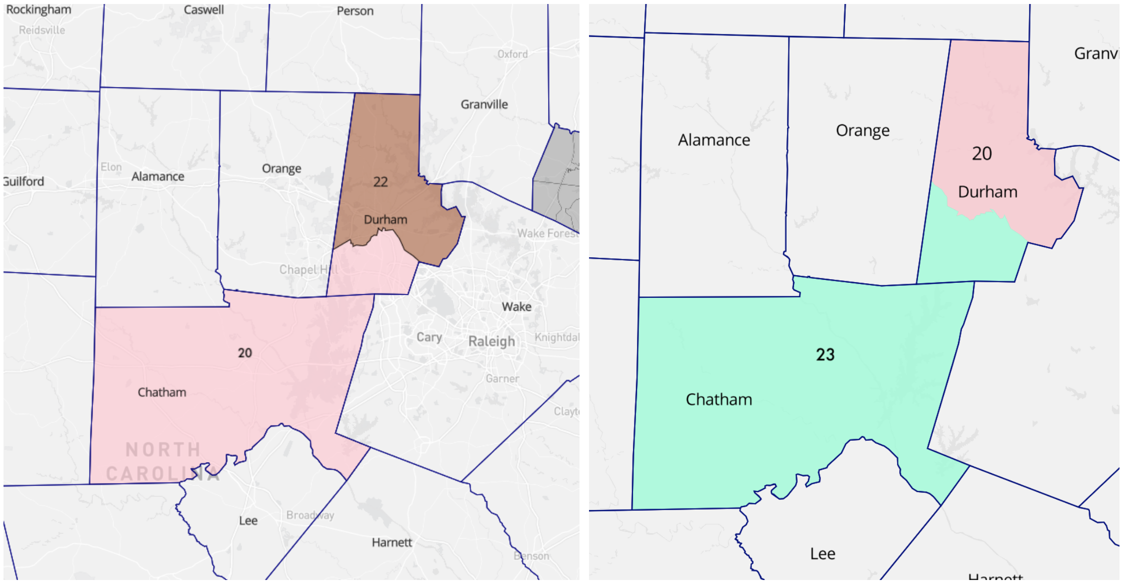


Figure 97: **Map of Enacted Plan in Chatham and Durham Senate County Cluster**

(a) Enacted Map (b) Duchin Map

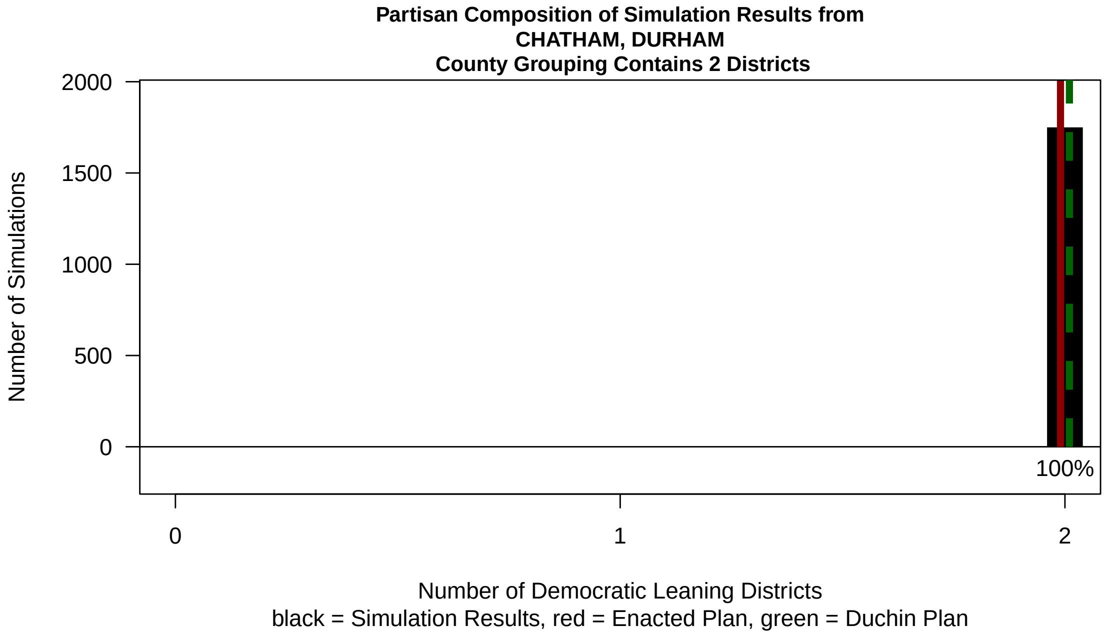


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
20 (23 in Duchin)	0.72	0.71
22 (20 in Duchin)	0.79	0.79

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 98: **Distribution of Partisan Districts from Simulations in Chatham and Durham Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 34: Simulation Results by Individual Elections

Chatham and Durham Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	0%	**100%**
2020 Senate	0%	0%	**100%**
2020 Governor	0%	0%	**100%**
2020 Lt. Governor	0%	0%	**100%**
2020 Attorney General	0%	0%	**100%**
2016 President	0%	0%	**100%**
2016 Senate	0%	0%	**100%**
2016 Governor	0%	0%	**100%**
2016 Lt. Governor	0%	0%	**100%**
2016 Attorney General	0%	0%	**100%**
2014 Senate	0%	0%	**100%**

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 2 Democratic leaning districts. The Enacted Plan does as well, as the '2 Districts' cell is bolded in that row.

8.3 Bladen, Duplin, Harnett, Jones, Lee, Pender, and Sampson Senate County Grouping

The Bladen-Duplin-Harnett-Jones-Lee-Pender-Sampson Senate county grouping contains 2 districts. In the Enacted Map these are Districts 9 and 12. The county cluster has an overall partisan index of 0.41, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. All 50,000 simulated maps meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves only one unique map that is as compact as the Enacted Plan.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 99. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 100.

Because there is only 1 map that fits the criteria I use of equal population, county traversals, and compactness equal to or better than the Enacted Map, I do not present the distribution of district partisanship for the simulations here. It is sufficient to say that in the Enacted Map, the Duchin map, and the remaining simulated map all create 2 Republican districts and 0 Democratic leaning districts, regardless of the index or election used. Table 35 shows this below.

Figure 99: **Map of Bladen, Duplin, Harnett, Jones, Lee, Pender, and Sampson Senate County Cluster**

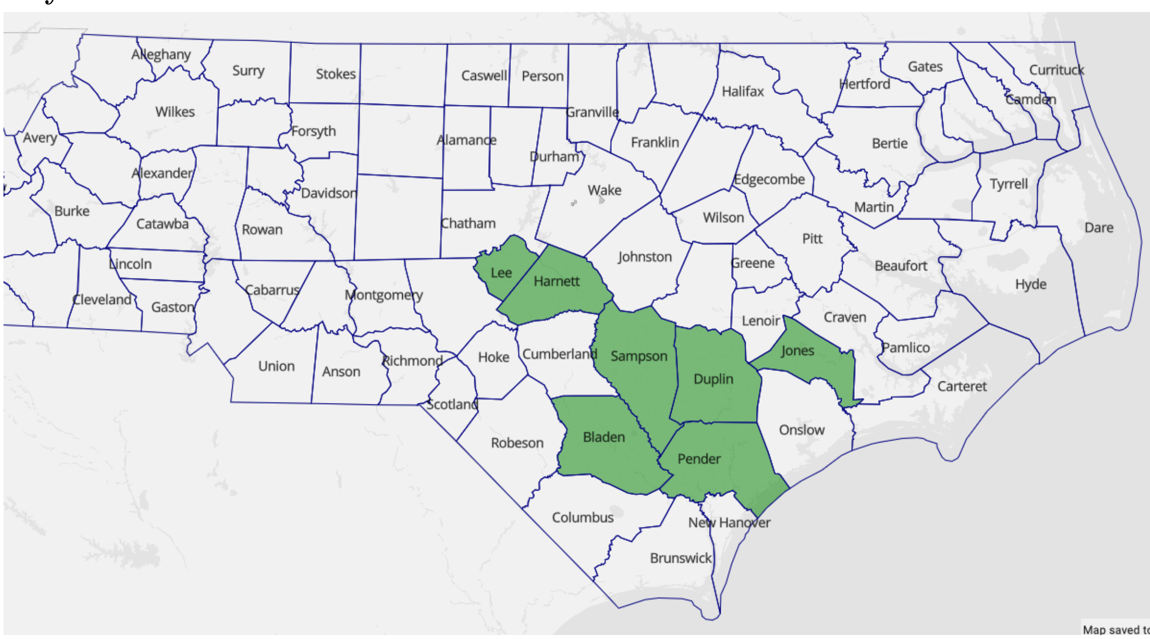
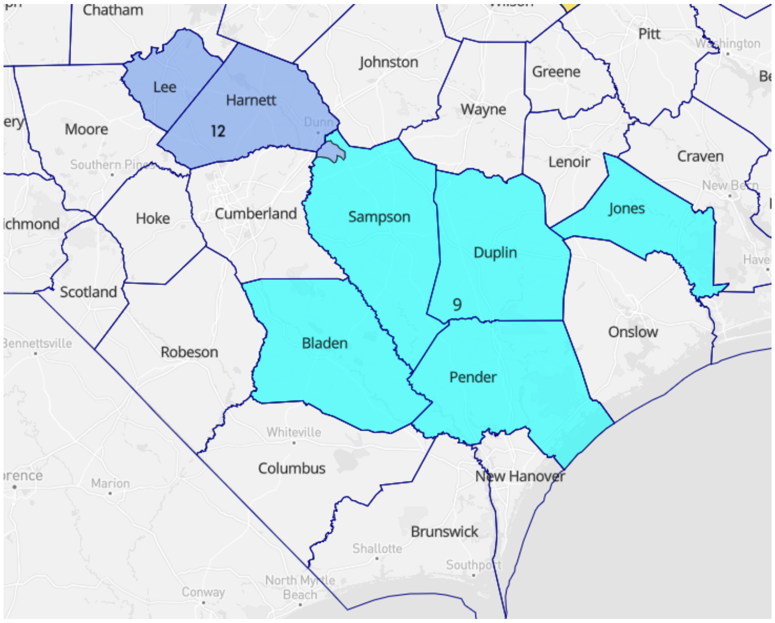
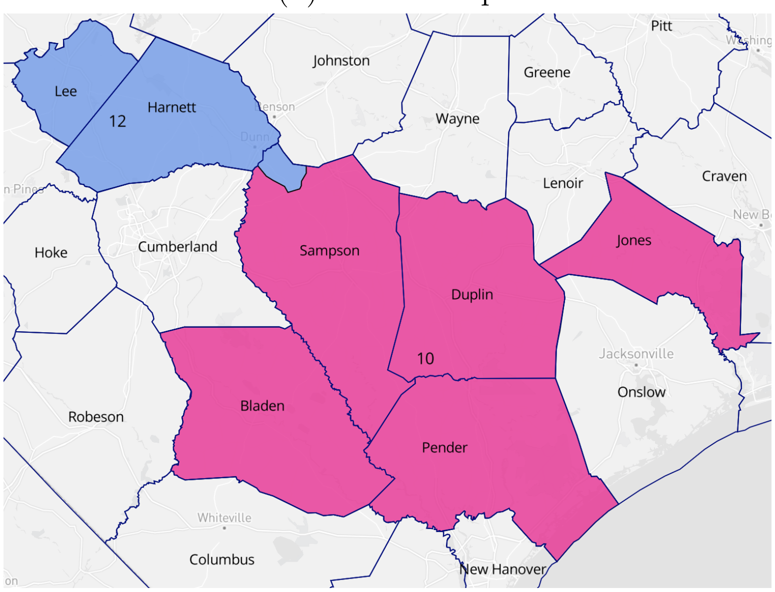


Figure 100: **Map of Enacted Plan in Bladen, Duplin, Harnett, Jones, Lee, Pender, and Sampson Senate County Cluster**

(a) Enacted Map



(b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
9 (10 in Duchin)	0.40	0.41
12	0.41	0.41

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Table 35: Simulation Results by Individual Elections

Bladen, Duplin, Harnett, Jones, Lee, Pender, and Sampson Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

8.4 Brunswick, Columbus, and New Hanover Senate County Grouping

The Brunswick-Columbus-New Hanover Senate county group contains 2 districts. In the Enacted Map these are Districts 7 and 8. The county cluster has an overall partisan index of .45, which is Republican leaning. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 31,037 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 30,499 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 101. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 102.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 103. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 77% of the simulations there is 1 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 1 Democratic leaning district. The Duchin Map also generates 1 Democratic leaning district.

Table 36 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 9 of the 11 individual elections there is agreement between the modal outcome in the simulations and the Enacted Map. In all 11 of the 11 individual elections the Enacted Plan falls within the middle 50% of the simulation results.

Figure 101: **Map of Brunswick, Columbus, and New Hanover Senate County Cluster**

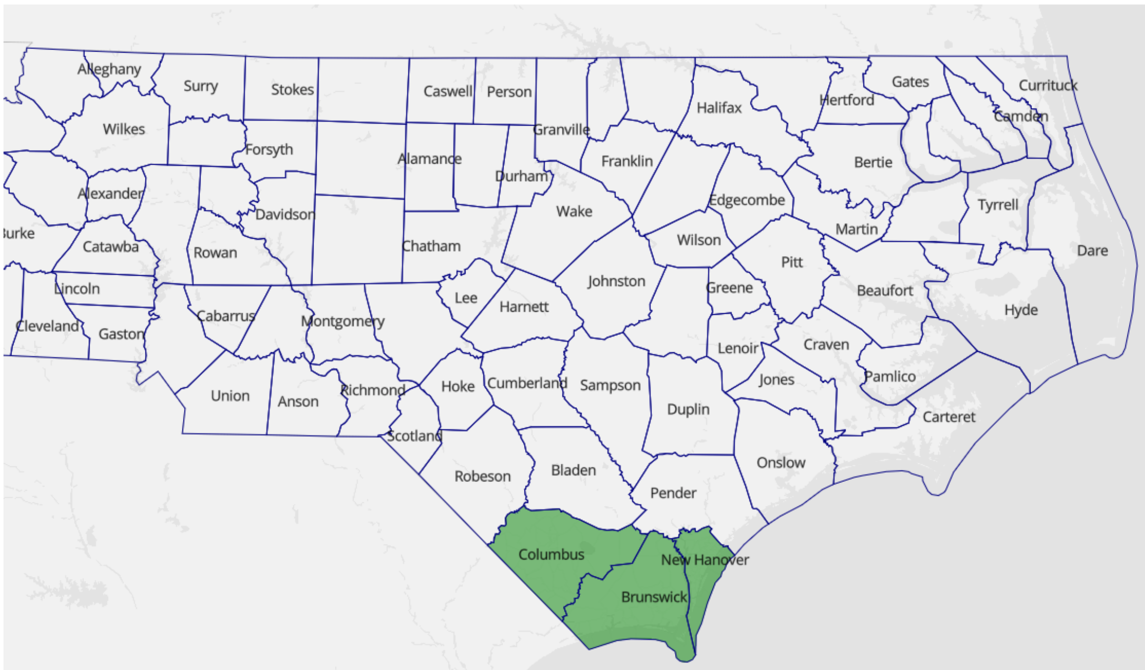
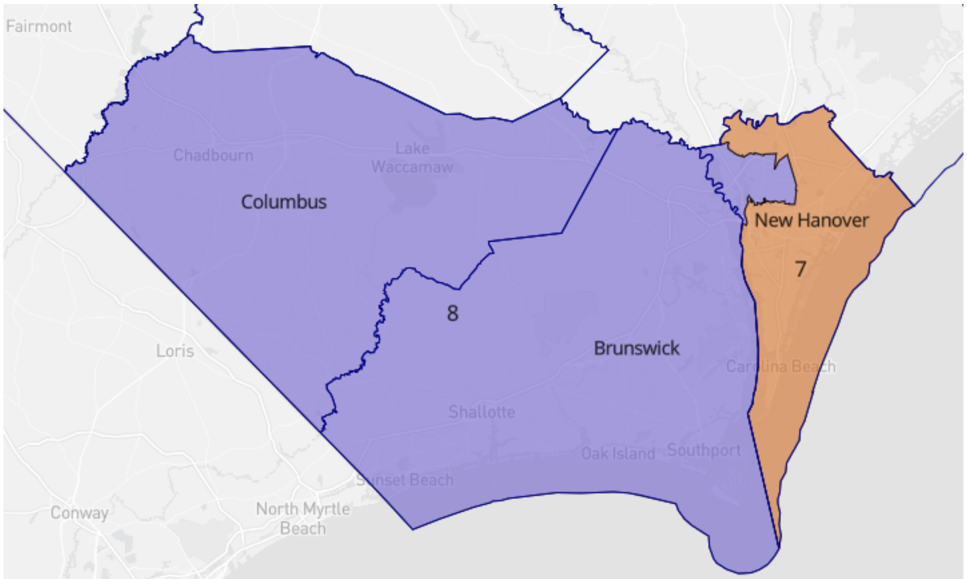
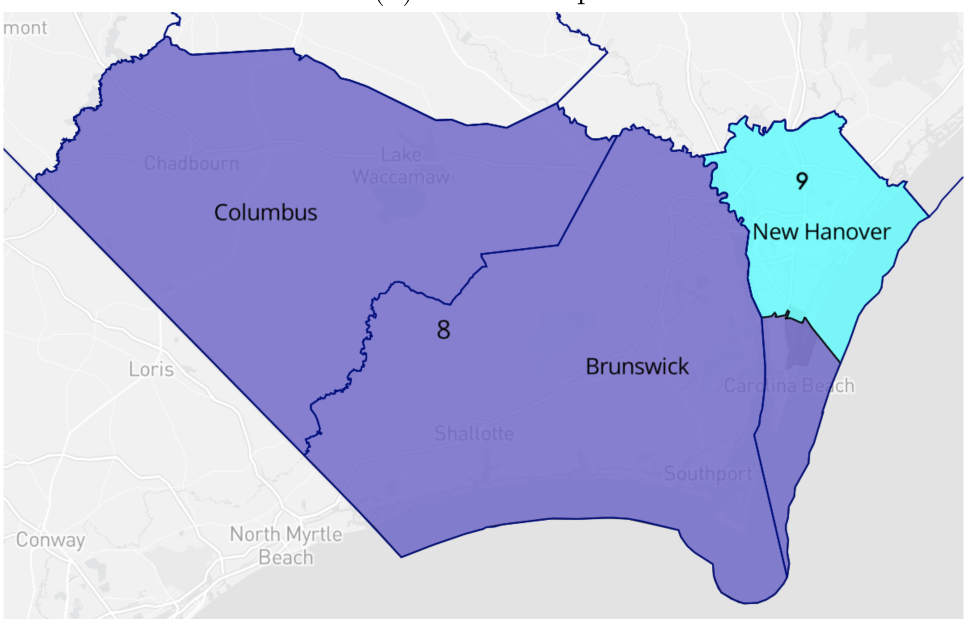


Figure 102: **Map of Enacted Plan in Brunswick, Columbus, and New Hanover Senate County Cluster**

(a) Enacted Map



(b) Duchin Map

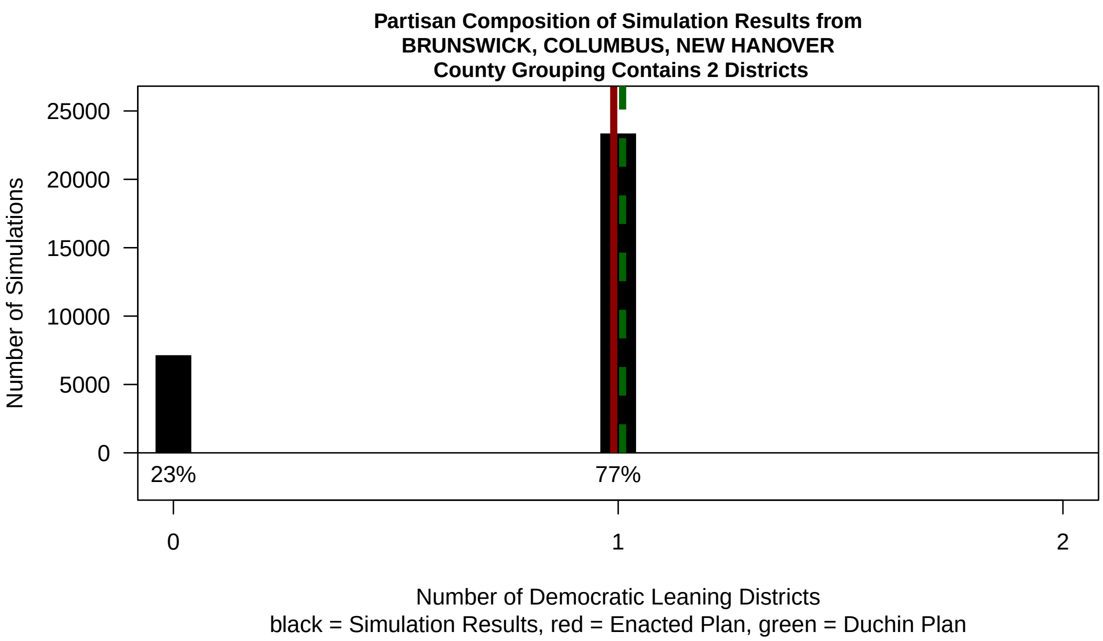


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
7 (9 in Duchin)	0.50	0.52
8	0.39	0.39

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 103: **Distribution of Partisan Districts from Simulations in Brunswick, Columbus, and New Hanover Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 36: Simulation Results by Individual Elections

Brunswick, Columbus, and New Hanover County Senate Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	13%	**87%**	0%
2020 Senate	24%	**76%**	0%
2020 Governor	0%	**100%**	0%
2020 Lt. Governor	**28%**	72%	0%
2020 Attorney General	7%	**93%**	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	3%	**97%**	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	16%	**84%**	0%
2014 Senate	**26%**	74%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 87% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

8.5 Alleghany, Ashe, Avery, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey Senate County Grouping

The Alleghany-et al. Senate county group contains 3 districts. In the Enacted Map these are Districts 47, 45, and 50. The county cluster has an overall partisan index of .35, which is strongly Republican. After conducting 50,000 initial simulations to create three districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 37,454 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 22,065 simulated maps, each containing three districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 104. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 105.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 106. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic leaning districts. The Duchin Map also generates 0 Democratic leaning districts.

Table 37 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the 11 individual elections there is agreement between the modal outcome in the simulations and the Enacted Map.

Figure 104: **Map of Alleghany, Ashe, Avery, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey Senate County Cluster**

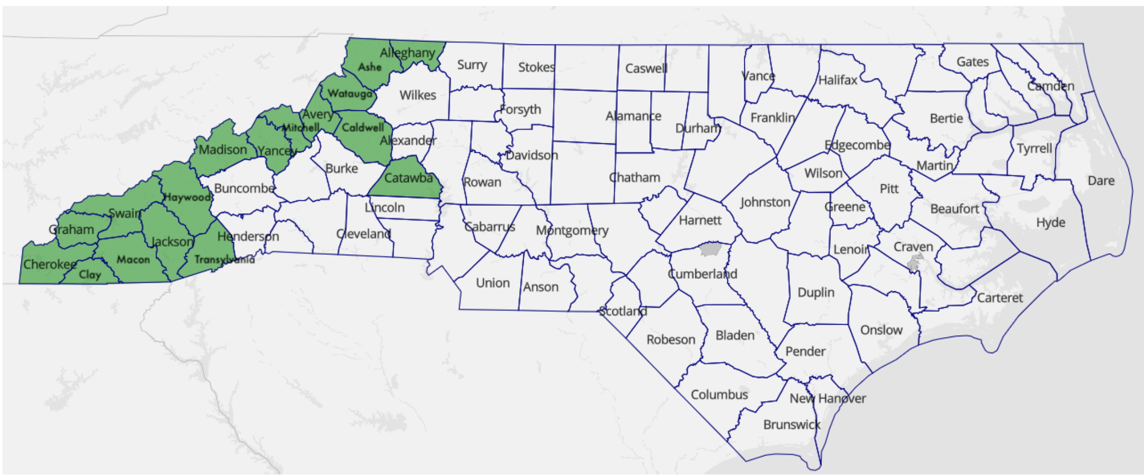
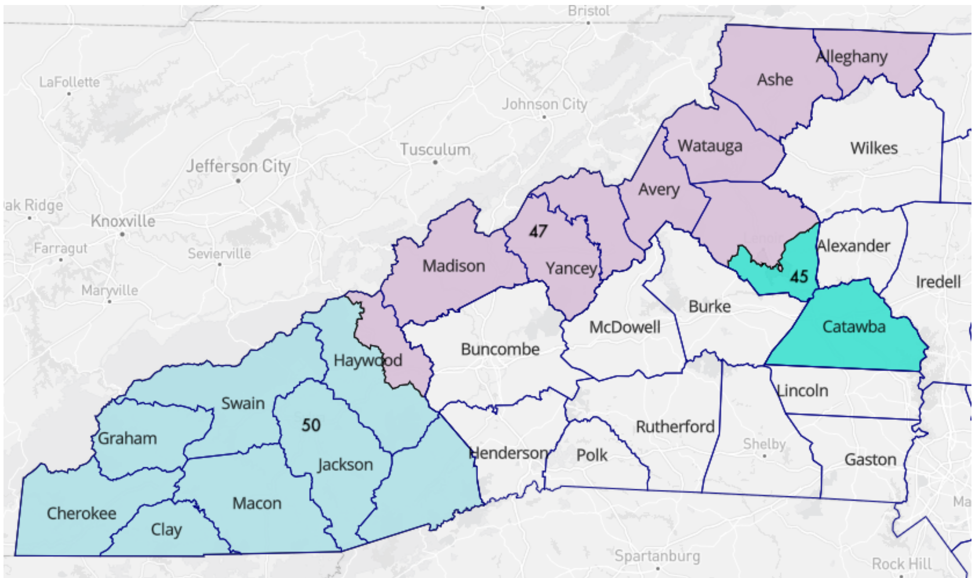
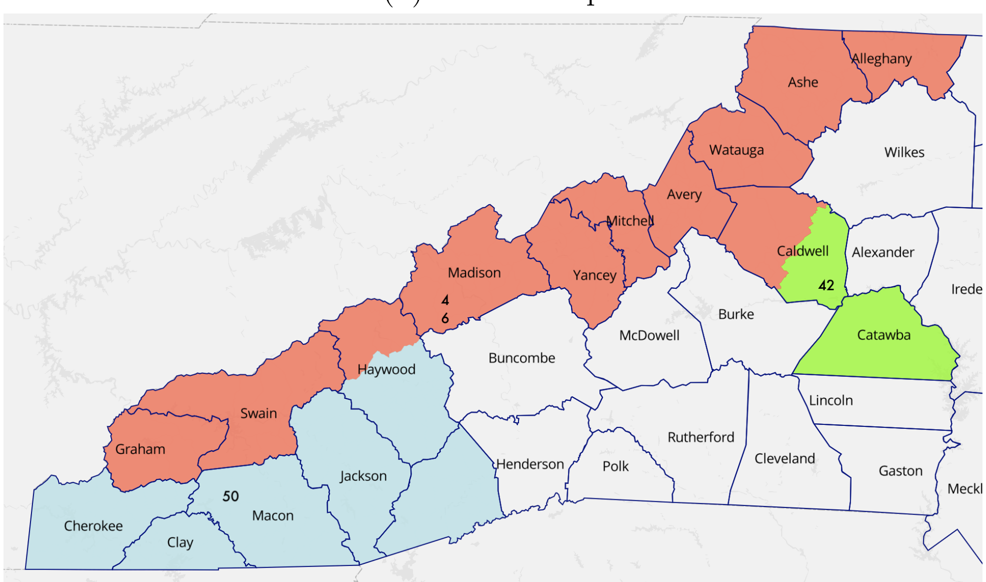


Figure 105: **Map of Enacted Plan in Alleghany, Ashe, Avery, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey Senate County Cluster**

(a) Enacted Map



(b) Duchin Map

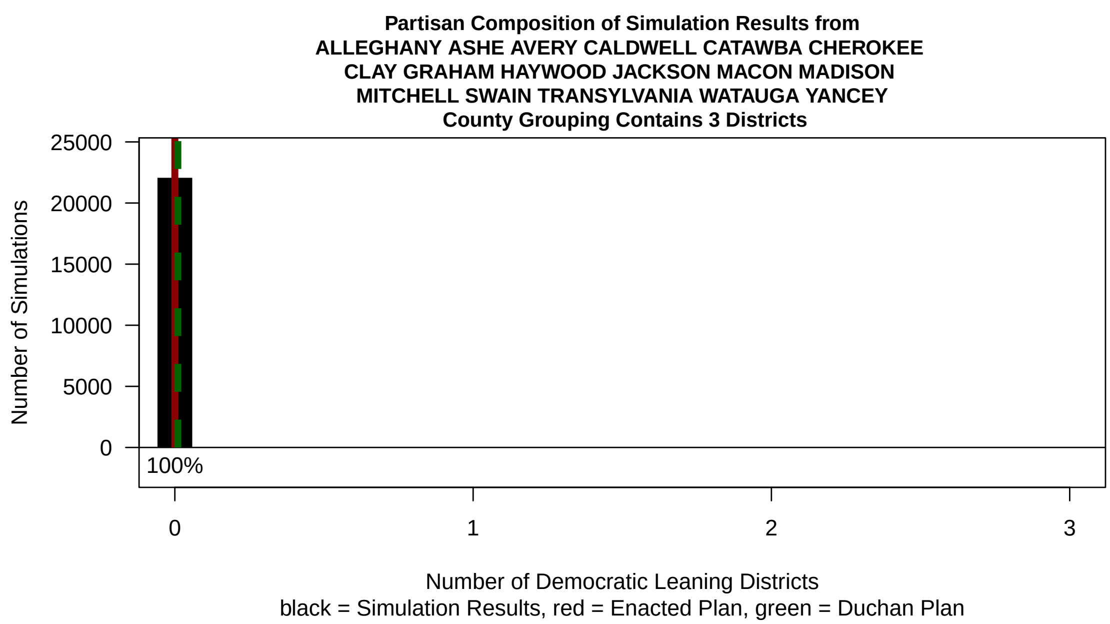


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
45 (42 in Duchin)	0.30	0.30
47 (46 in Duchin)	0.37	0.38
50	0.37	0.37

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 106: **Distribution of Partisan Districts from Simulations in Alleghany, Ashe, Avery, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 37: Simulation Results by Individual Elections

Alleghany, Ashe, Avery, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey Senate County Cluster

	Percentage of Simulations			
Number of Democratic Leaning Districts:	0	1	2	3
Individual Elections:				
2020 President	**100%**	0%	0%	0%
2020 Senate	**100%**	0%	0%	0%
2020 Governor	**100%**	0%	0%	0%
2020 Lt. Governor	**100%**	0%	0%	0%
2020 Attorney General	**100%**	0%	0%	0%
2016 President	**100%**	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%
2014 Senate	**100%**	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 Districts' cell is bolded in that row.

8.6 Guilford and Rockingham Senate County Grouping

The Guilford-Rockingham Senate county group contains 3 districts. In the Enacted Map these are Districts 26, 27, and 28. The county cluster has an overall partisan index of .57, which is solidly Democratic. After conducting 50,000 initial simulations to create three districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 37,148 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 24,667 simulated maps, each containing three districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 107. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 108.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 110. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 94% of the simulations there are 2 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 2 Democratic leaning districts. The Duchin Map generates 3 Democratic leaning districts, which only occurs in 6% of the simulations. This is outside the middle 50% of simulations and is a partisan outlier.

Table 39 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Enacted Map.

The Duchin Plan creates three Democratic leaning district by dividing the city of Greensboro, the county seat and largest city in Guilford County, into three relatively equal pieces. The Enacted Plan does not and instead keeps the vast majority of Greensboro in two districts. Most of the Democratic leaning voting in this cluster reside in Greensboro. This "pie" division of Greensboro by the Duchin Plan therefore spread Democratic voters more equally across the three districts. However, it comes at the expense of dividing a city into more districts than necessary. Table 38 shows the division of Greensboro residents across the districts in the two plans. Figure 109 shows a map of the divisions.

Table 38: Division of Greensboro in Enacted Plan and Duchin Plan

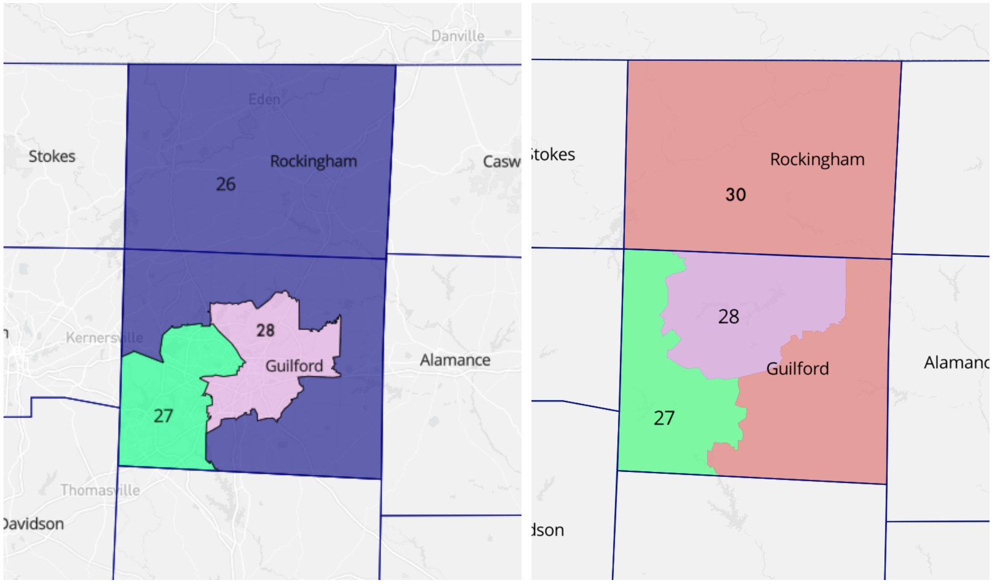
	Percent of Greensboro in district	
District:	Enacted Plan	Duchin Plan
26 (30 in Duchin)	4.3	19.6
27	30.8	20.4
28	64.9	60.0
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: `https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf` Population numbers for city by district for Duchin Plan from Dave's Redistricting online. `https://davesredistricting.org/`

Figure 107: **Map of Guilford and Rockingham Senate County Cluster**

Figure 108: **Map of Enacted Plan in Guilford and Rockingham Senate County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
26 (30 in Duchin)	0.37	0.52
27	0.60	0.58
28	0.77	0.62

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 109: **Map of Greensboro Divisions in Guilford-Rockingham Senate County Cluster**

(a) Enacted Map (b) Duchin Map

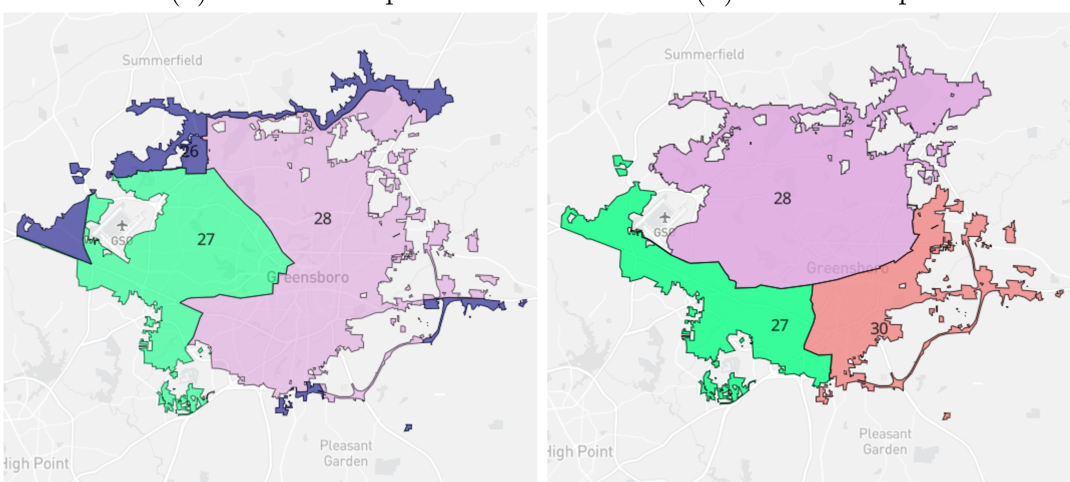
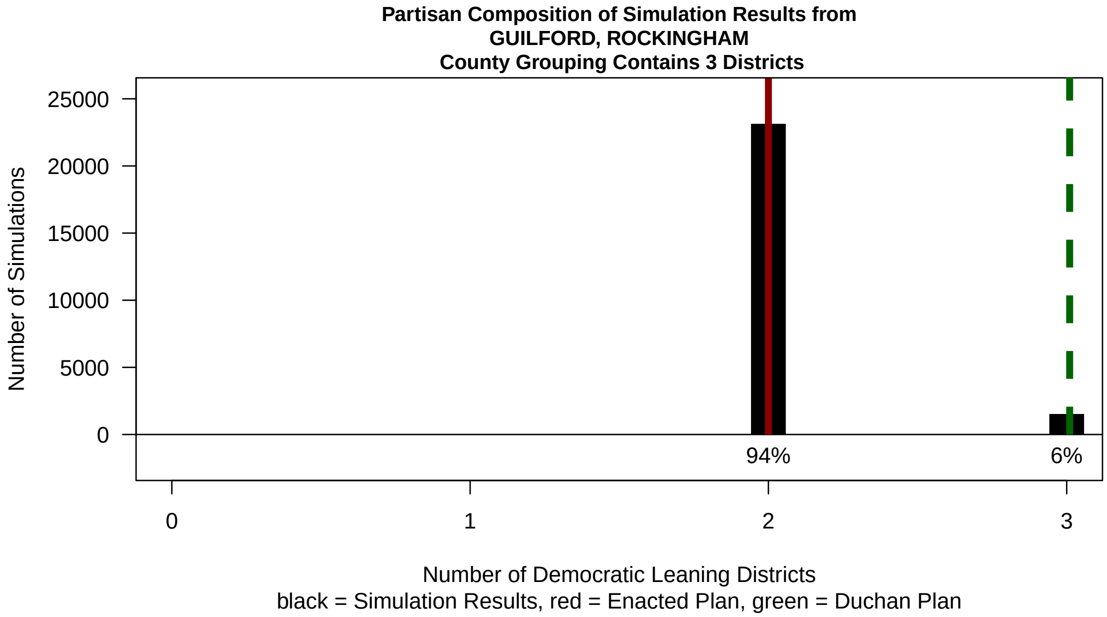


Figure 110: **Distribution of Partisan Districts from Simulations in Guilford and Rockingham Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 39: Simulation Results by Individual Elections

Guilford and Rockingham County Cluster

Number of Democratic Leaning Districts:				
	0	1	2	3
Individual Elections:				
2020 President	0%	0%	**95%**	5%
2020 Senate	0%	0%	**94%**	6%
2020 Governor	0%	0%	**57%**	43%
2020 Lt. Governor	0%	0%	**96%**	4%
2020 Attorney General	0%	0%	**93%**	7%
2016 President	0%	0%	**96%**	4%
2016 Senate	0%	1%	**96%**	3%
2016 Governor	0%	0%	**83%**	17%
2016 Lt. Governor	0%	1%	**96%**	3%
2016 Attorney General	0%	0%	**91%**	9%
2014 Senate	0%	1%	**94%**	5%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 95% of the simulations produce 2 Democratic leaning districts. The Enacted Plan does as well, as the '2 Districts' cell is bolded in that row.

8.7 Alamance, Anson, Cabarrus, Montgomery, Randolph, Richmond, and Union Senate County Grouping

The Alamance-Anson-Cabarrus-Montgomery-Randolph-Richmond-Union Senate county group contains 4 districts. In the Enacted Map these are Districts 25, 29, 34, and 35. The county cluster has an overall partisan index of .38, which is solidly Republican. After conducting 50,000 initial simulations to create four districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 35,298 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 25,747 simulated maps, each containing four districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 111. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 112.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 113. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic leaning districts. The Duchin Map also generates 0 Democratic leaning districts.

Table 40 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Demo-

cratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Enacted Map.

Figure 111: **Alamance, Anson, Cabarrus, Montgomery, Randolph, Richmond, and Union Senate County Cluster**

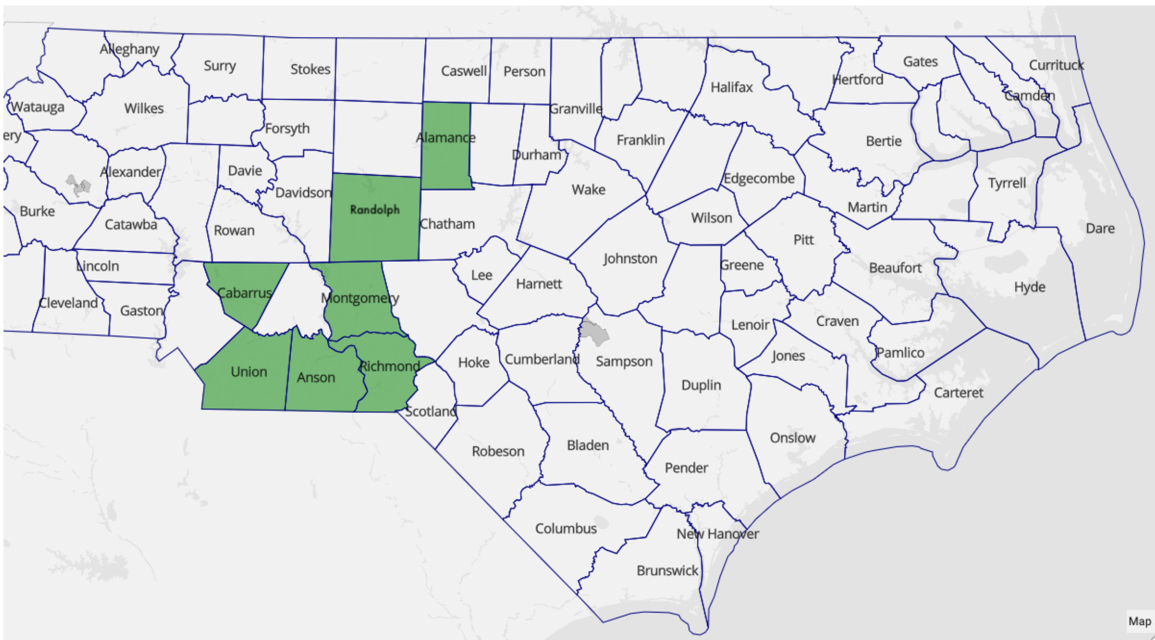
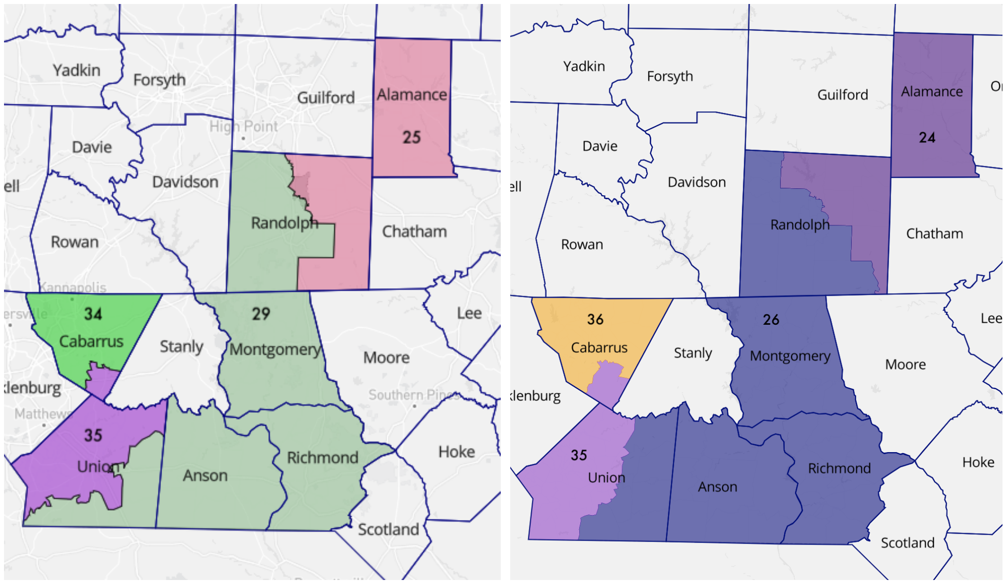


Figure 112: **Map of Enacted Plan in Alamance, Anson, Cabarrus, Montgomery, Randolph, Richmond, and Union Senate County Cluster**

(a) Enacted Map (b) Duchin Map

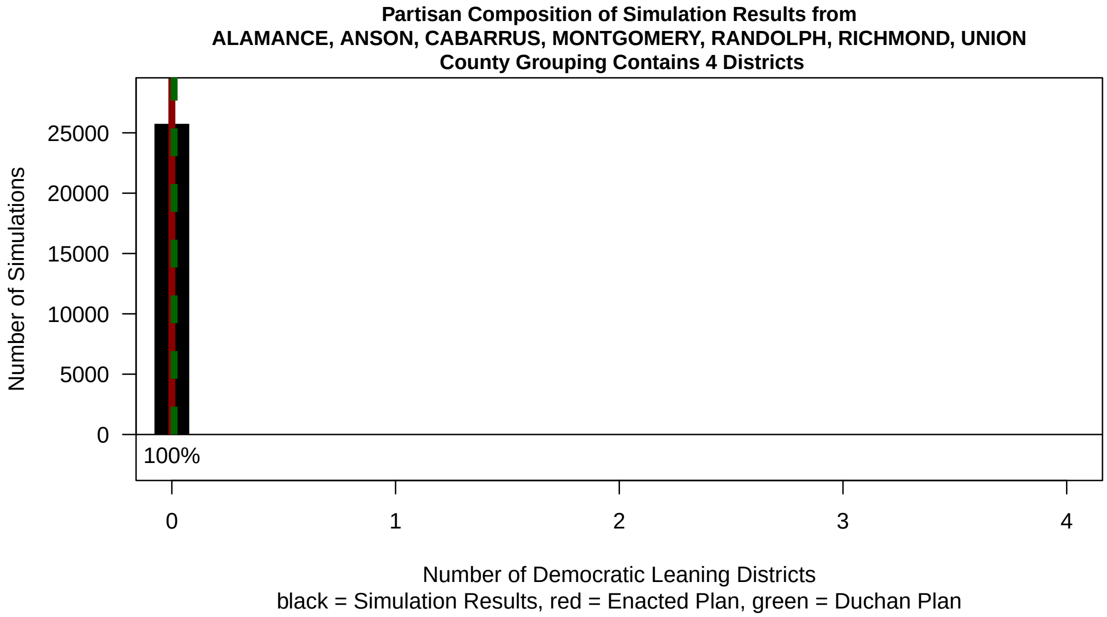


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
25 (24 in Duchin)	0.40	0.40
29 (26 in Duchin)	0.34	0.34
34 (36 in Duchin)	0.44	0.44
35	0.36	0.36

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 113: **Distribution of Partisan Districts from Simulations in Alamance, Anson, Cabarrus, Montgomery, Randolph, Richmond, and Union Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 40: Simulation Results by Individual Elections

Alamance, Anson, Cabarrus, Montgomery, Randolph, Richmond, and Union Senate County Cluster

Number of Democratic Leaning Districts:					
	0	1	2	3	4
Individual Elections:					
2020 President	**100%**	0%	0%	0%	0%
2020 Senate	**100%**	0%	0%	0%	0%
2020 Governor	**100%**	0%	0%	0%	0%
2020 Lt. Governor	**100%**	0%	0%	0%	0%
2020 Attorney General	**100%**	0%	0%	0%	0%
2016 President	**100%**	0%	0%	0%	0%
2016 Senate	**100%**	0%	0%	0%	0%
2016 Governor	**100%**	0%	0%	0%	0%
2016 Lt. Governor	**100%**	0%	0%	0%	0%
2016 Attorney General	**100%**	0%	0%	0%	0%
2014 Senate	**100%**	0%	0%	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 Districts' cell is bolded in that row.

8.8 Granville and Wake Senate County Grouping

The Granville-Wake Senate county group contains 6 districts. In the Enacted Map these are Districts 13, 14, 15, 16, 17, and 18. The county cluster has an overall partisan index of .61, which is solidly Democratic. After conducting 50,000 initial simulations to create six districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 45,850 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 2,835 simulated maps, each containing six districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 114. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 115.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 117. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 1% of the simulations there are 4 Democratic leaning districts. In 24% of the simulations there are 5 Democratic leaning districts, and in 75% of the simulations there are 6 Democratic leaning districts. The Enacted Map generates 4 Democratic leaning districts, which is an outlier from middle 50% of the simulations. The Duchin Map generates 5 Democratic leaning districts and is also classified as a partisan outlier.

Table 42 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Demo-

cratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 10 of the 11 individual elections the Enacted Plan is not in alignment with the middle 50% of the simulation results and is therefore classified as an outlier.

Why is the Enacted Plan such an outlier in this county grouping? There are two factors to consider in explaining this divergence. First, while the Enacted Plan generates 4 solidly Democratic leaning districts, the remaining two districts are not solidly Republican. Instead, they would be best classified as highly competitive. District 13 has a partisan index of 0.481 and District 17 has a partisan index of 0.489. These two districts will likely be very closely decided with candidates from both parties winning them with some regularity, given their narrow margins. This is actually quite close to the partisan lean of the Duchin Plan. While the Duchin Plan creates 5 Democratic leaning districts in the county group, there are also two very competitive districts (District 22 - partisan index of 0.499 and District 17 - partisan index of 0.505). It just happens that one of the competitive districts is just over the .50 line and is classified as Democratic leaning. Thus, both plans generate 4 solidly Democratic districts and 2 highly competitive districts. The Duchin Plan's competitive districts are just slightly more Democratic by roughly 1.7 percentage points.

The second factor to consider is that the Enacted Plan divides the city of Raleigh and groups other municipalities differently from the Duchin Plan, which has the impact of placing a greater share of its residents in fewer districts. For example, District 13 keeps the cities of Wake Forest, Rolesville, and Zebulon together in one district. Additionally, the Enacted Plan places more of Raleigh into fewer districts. This is ideal if one is trying to keep municipalities together and spread across as few districts as possible. However, because the bulk of Democratic leaning voters in this county cluster are also in the city of Raleigh, this will have the effect of creating districts that are more heavily Democratic. This, of course, has the spillover effect of making the districts that do not contain portions of Raleigh to likewise become more Republican. Figure 116 shows how the two different plans divide the city of Raleigh, and Table 41 shows that it is the case the the Duchin Plan spreads the resident of Raleigh out across more districts than does the Enacted Plan. The tactic of dividing Democratic cities in a 'pinwheel' or 'pizza' shape and grouping those 'slices' with more Republican suburban and exurban areas is a classic tactic to generate more Democratic districts and overcome the geographic clustering that is common among Democratic voters. The Enacted Plan keeps much more of Fayetteville within three districts.

Table 41: Division of Raleigh in Enacted Plan and Duchin Plan

	Percent of Raleigh in district	
District:	Enacted Plan	Duchin Plan
13 (22 in Duchin)	1.7	12.3
14	21.1	27.0
15	35.8	39.6
16	0	0
17	0	0
18	41.0	20.8
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf Population numbers for city by district for Duchin Plan from Dave's Redistricting online. https://davesredistricting.org/

Figure 114: **Granville and Wake Senate County Cluster**

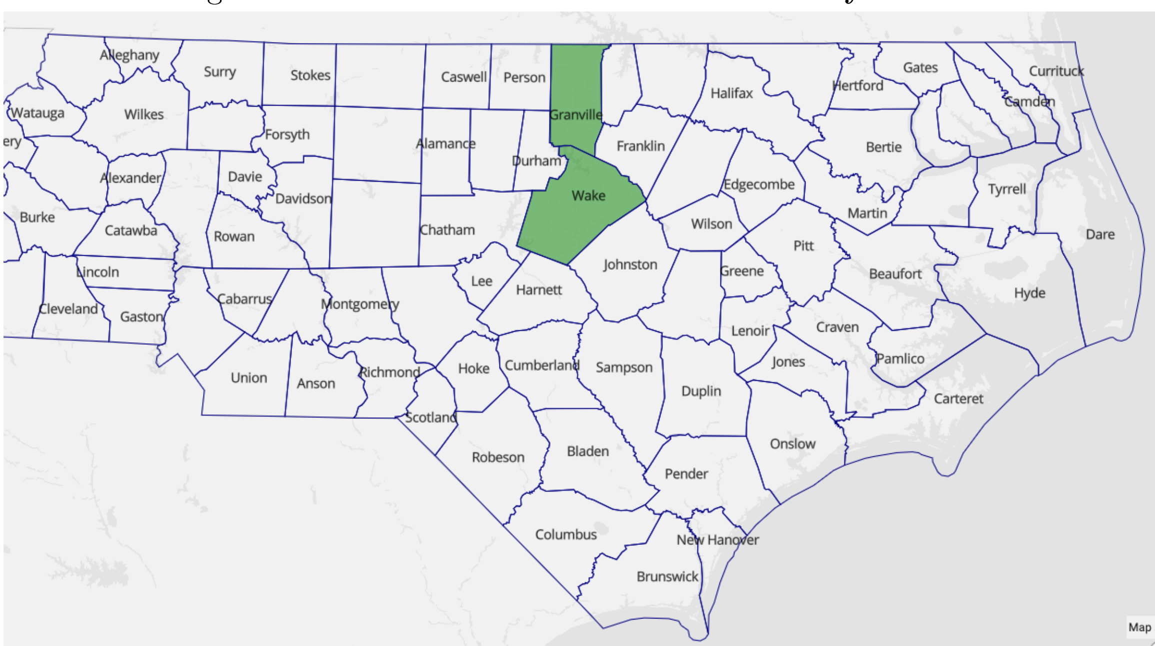
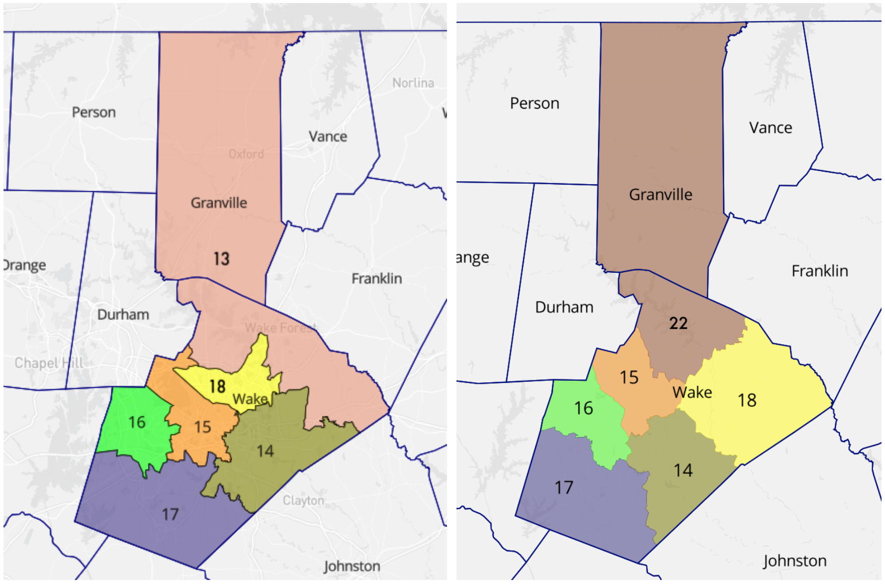


Figure 115: **Map of Enacted Plan in Granville and Wake Senate County Cluster**

(a) Enacted Map (b) Duchin Map



Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
13 (22 in Duchin)	0.48	0.50
14	0.73	0.73
15	0.68	0.64
16	0.63	0.63
17	0.49	0.51
18	0.65	0.65

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 116: **Map of Raleigh Divisions in Wake Senate County Cluster**

(a) Enacted Map (b) Duchin Map

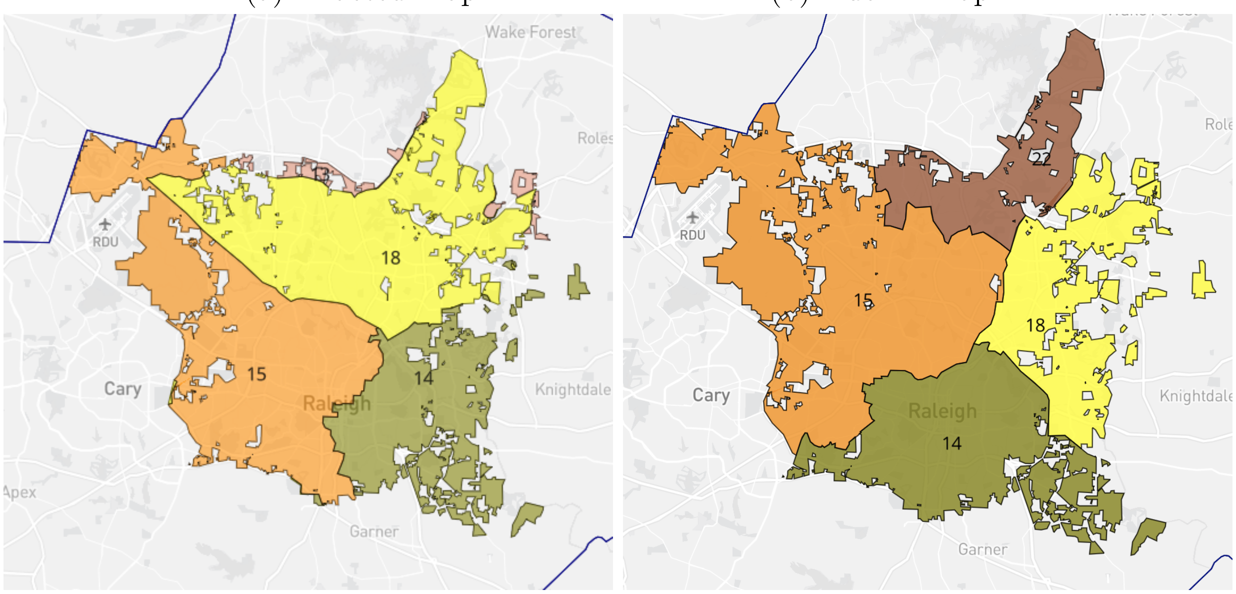
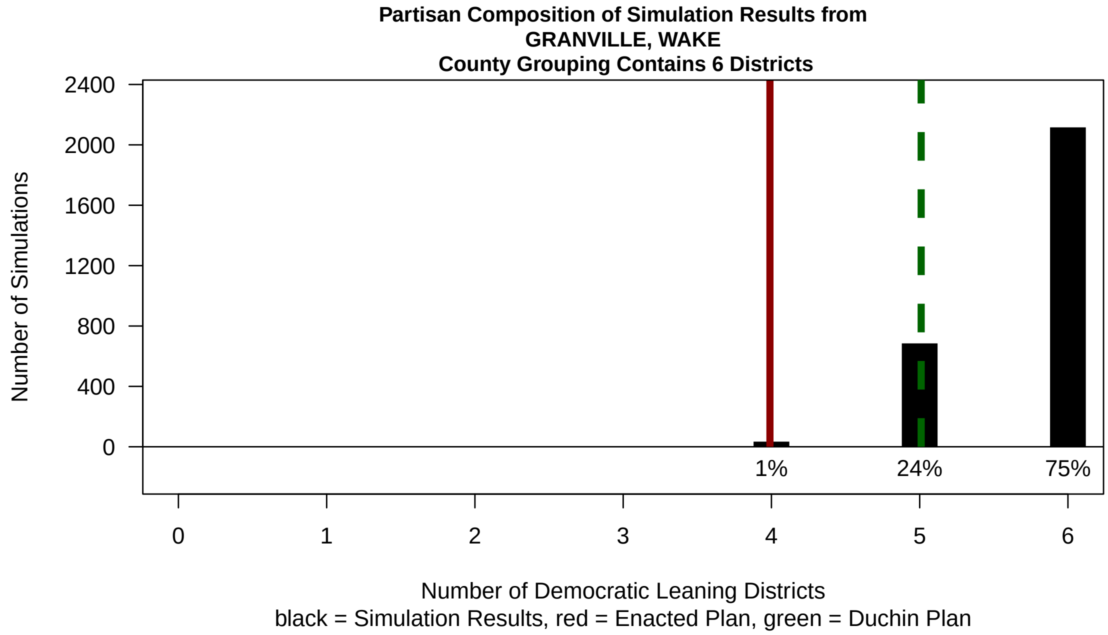


Figure 117: **Distribution of Partisan Districts from Simulations in Granville and Wake Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 42: Simulation Results by Individual Elections

Granville and Wake Senate County Cluster

	Number of Democratic Leaning Districts:						
	0	1	2	3	4	5	6
Individual Elections:							
2020 President	0%	0%	0%	0%	0%	**0%**	100%
2020 Senate	0%	0%	0%	0%	**1%**	24%	75%
2020 Governor	0%	0%	0%	0%	0%	0%	**100%**
2020 Lt. Governor	0%	0%	0%	0%	**1%**	25%	74%
2020 Attorney General	0%	0%	0%	0%	0%	**0%**	100%
2016 President	0%	0%	0%	0%	**4%**	35%	61%
2016 Senate	0%	0%	0%	0%	**19%**	70%	12%
2016 Governor	0%	0%	0%	0%	**1%**	24%	75%
2016 Lt. Governor	0%	0%	0%	11%	**13%**	71%	5%
2016 Attorney General	0%	0%	0%	0%	**1%**	26%	73%
2014 Senate	0%	0%	0%	0%	**9%**	63%	27%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 0% of the simulations produce 5 Democratic leaning districts. The Enacted Plan does, as the '5 Districts' cell is bolded in that row.

8.9 Iredell and Mecklenburg Senate County Grouping

The Iredell-Mecklenburg Senate county group contains 6 districts. In the Enacted Map these are Districts 37, 38, 39, 40, 41, and 42. The county cluster has an overall partisan index of .60, which is solidly Democratic. After conducting 50,000 initial simulations to create six districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. All 50,000 simulations meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 7,700 simulated maps, each containing six districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 118. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 119.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 120. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 5% of the simulations there are 4 Democratic leaning districts. In 95% of the simulations there are 5 Democratic leaning districts. The Enacted Map generates 4 Democratic leaning districts, which is an outlier from middle 50% of the simulations. The Duchin Map also generates 5 Democratic leaning districts.

Table 43 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted

Plan using the equivalent election. In 9 of the 11 individual elections the Enacted Plan is in alignment with the majority outcome of the simulation results.

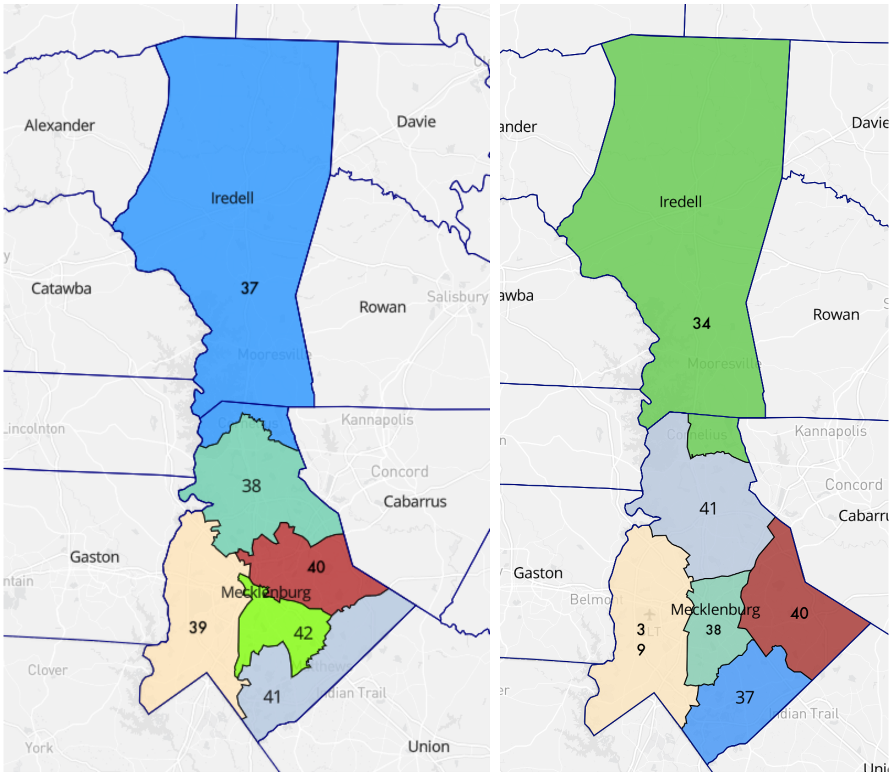
Why is the Enacted Plan an outlier in this county grouping? There are two factors to consider in explaining this divergence. First, while the Enacted Plan generates 4 solidly Democratic leaning districts, the remaining two districts are not solidly Republican. Instead, one is solidly Republican. District 37 in Iredell County has a partisan index of 0.36. The other would be best classified as highly competitive. District 41 has a partisan index of 0.490. This district will likely be very closely decided with candidates from both parties winning them with some regularity, given their narrow margins. This is actually quite close to the partisan lean of the Duchin Plan. While the Duchin Plan creates 5 Democratic leaning districts in the county group, there is also one solidly Republican district. District 34 in Iredell County has a partisan index of 0.36. The other would be best classified as highly competitive. District 37 has a partisan index of 0.526. Thus, both plans generate 4 solidly Democratic districts, 1 solidly Republican district and 1 competitive districts. The Duchin Plan's competitive districts are just slightly more Democratic by roughly 3.6 percentage points.

The second factor to consider is that the partisan index is calculated using elections from 2014-2020. Looking at Table 43 we see that the Enacted Plan is in agreement with 100% of the simulations in the five elections from the most recent election cycle. Given the trend in Mecklenburg towards more support for Democratic candidates, elections conducted under the Enacted Plan will align more consistently with the more recent elections in the index. That is, the Enacted Plan will more often generate 5 Democratic districts as is the case in 2020 than it will generate 4 Democratic districts as it did in the elections in 2016 and earlier.

Figure 118: **Iredell and Mecklenburg County Senate Cluster**

Figure 119: **Map of Enacted Plan in Iredell and Mecklenburg Senate County Cluster**

(a) Enacted Map (b) Duchin Map

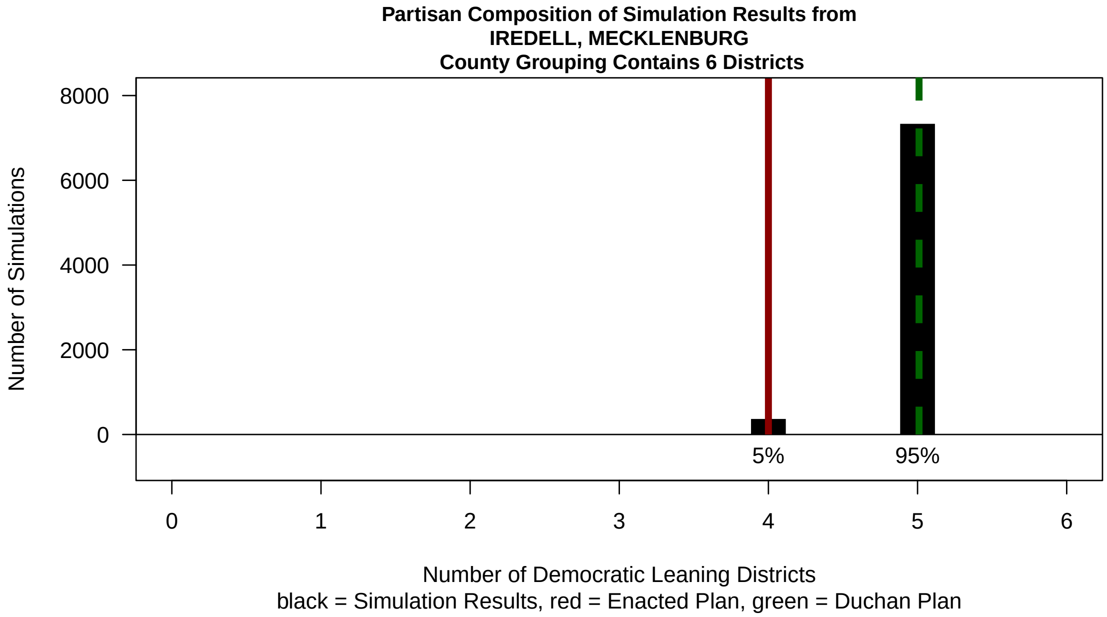


Partisan Lean of Districts

District:	Enacted Plan	Duchin Plan
37 (34 in Duchin)	0.36	0.36
38 (41 in Duchin)	0.65	0.66
39	0.73	0.73
40	0.83	0.72
41 (37 in Duchin)	0.49	0.53
42 (38 in Duchin)	0.65	0.68

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 120: **Distribution of Partisan Districts from Simulations in Iredell and Mecklenburg Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster.

Table 43: Simulation Results by Individual Elections

Iredell and Mecklenburg Senate County Cluster

	Number of Democratic Leaning Districts:						
	0	1	2	3	4	5	6
Individual Elections:							
2020 President	0%	0%	0%	0%	0%	**100%**	0%
2020 Senate	0%	0%	0%	0%	0%	**100%**	0%
2020 Governor	0%	0%	0%	0%	0%	**100%**	0%
2020 Lt. Governor	0%	0%	0%	0%	0%	**100%**	0%
2020 Attorney General	0%	0%	0%	0%	0%	**100%**	0%
2016 President	0%	0%	0%	0%	**5%**	95%	0%
2016 Senate	0%	0%	0%	0%	**96%**	4%	0%
2016 Governor	0%	0%	0%	0%	**7%**	93%	0%
2016 Lt. Governor	0%	0%	0%	0%	**99%**	1%	0%
2016 Attorney General	0%	0%	0%	0%	**51%**	49%	0%
2014 Senate	0%	0%	0%	0%	**99%**	1%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 5 Democratic leaning districts. The Enacted Plan does as well, as the '5 Districts' cell is bolded in that row.

8.10 Buncombe, Burke, and McDowell Senate County Grouping

The Buncombe-Burke-McDowell Senate county group contains 2 districts. In the Enacted Map these are Districts 46 and 49. The county cluster has an overall partisan index of .51, which is very slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 49,161 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 18,137 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 121. A map of the Enacted Map's district boundaries is shown in Figure 122. The Duchin Plan uses an alternative county grouping and is therefore not comparable to this cluster in the Enacted Plan. I analyze the Duchin Plan and the alternative cluster in a later section of this report.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 123. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there is 1 Democratic leaning district. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 1 Democratic leaning district.

Table 44 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Enacted Map.

Figure 121: **Map of Buncombe, Burke, and McDowell Senate County Cluster**

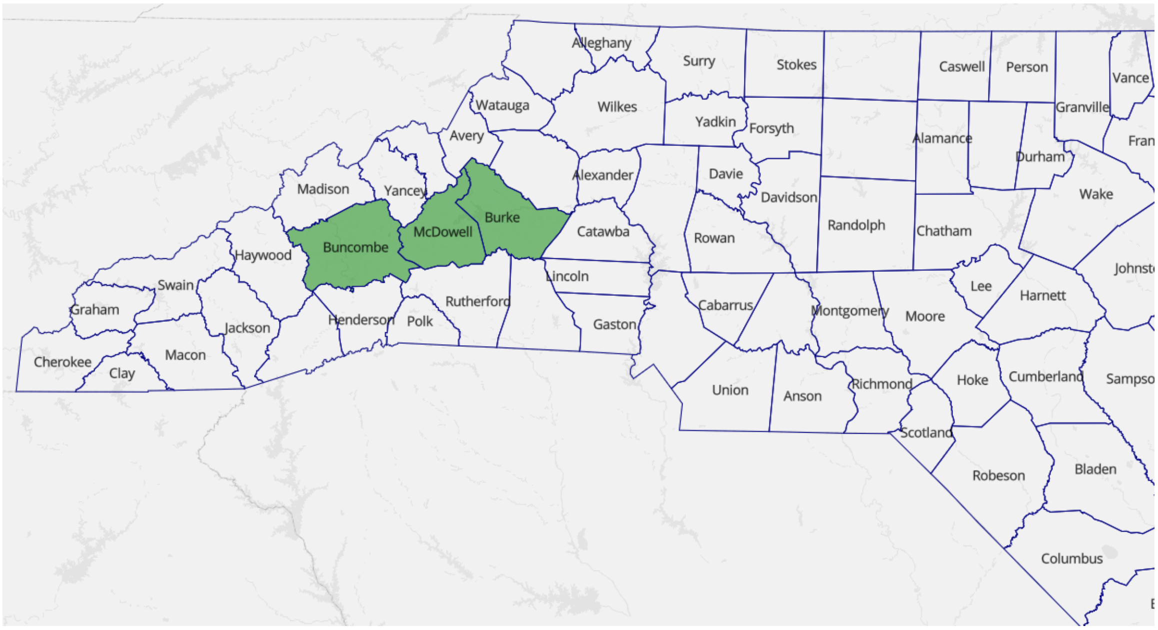
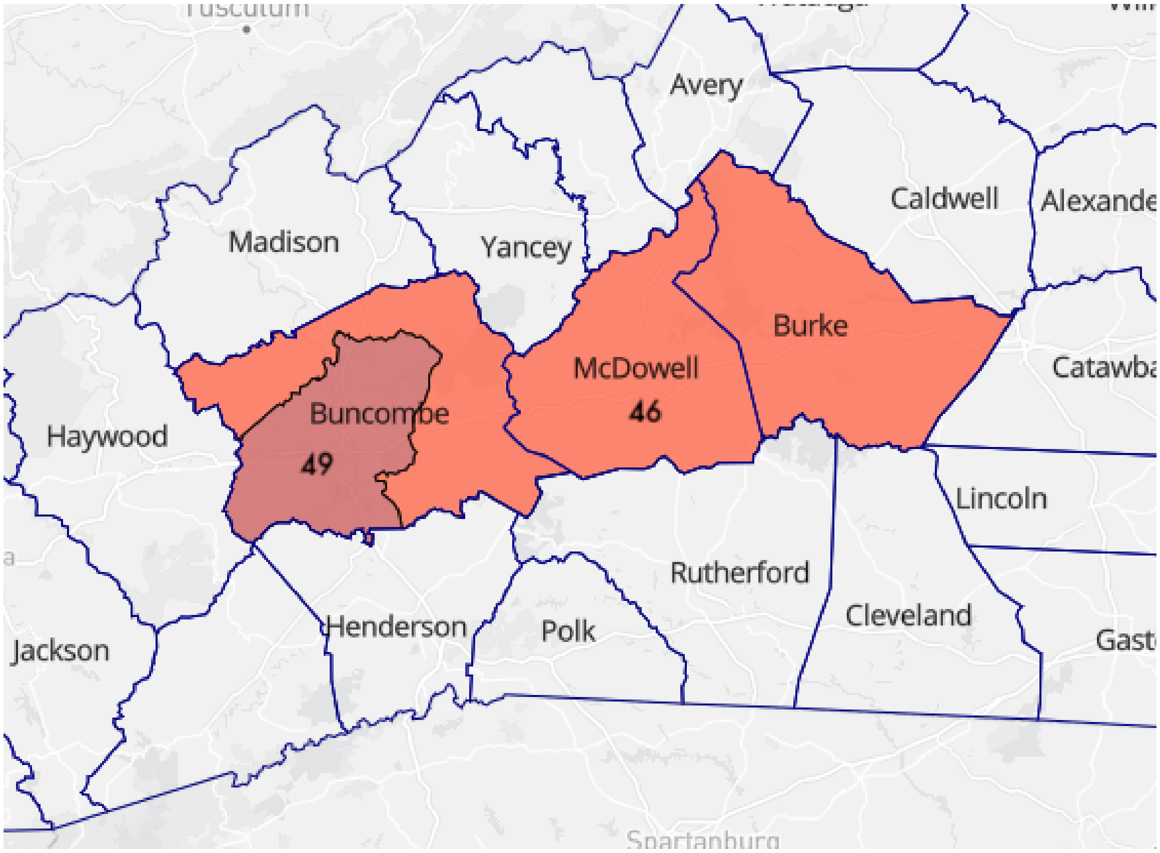


Figure 122: **Map of Enacted Plan in Buncombe, Burke, and McDowell Senate County Cluster**

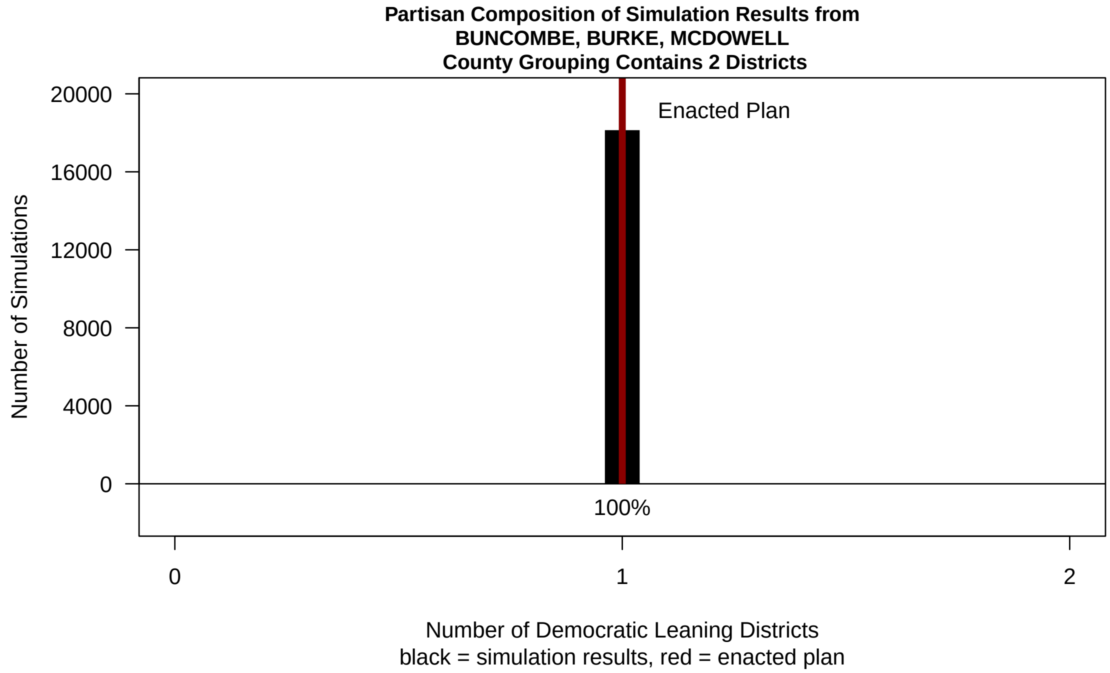


Partisan Lean of Districts

District:	Enacted Plan
46	0.37
49	0.65

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 123: **Distribution of Partisan Districts from Simulations in Buncombe, Burke, and McDowell Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster.

Table 44: Simulation Results by Individual Elections

Buncombe, Burke, and McDowell County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	**100%**	0%
2020 Senate	0%	**100%**	0%
2020 Governor	0%	**100%**	0%
2020 Lt. Governor	0%	**100%**	0%
2020 Attorney General	0%	**100%**	0%
2016 President	0%	**100%**	0%
2016 Senate	0%	**100%**	0%
2016 Governor	0%	**100%**	0%
2016 Lt. Governor	0%	**100%**	0%
2016 Attorney General	0%	**100%**	0%
2014 Senate	0%	**100%**	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

8.11 Cleveland, Gaston, and Lincoln Senate County Grouping

The Cleveland-Gaston-Lincoln Senate county group contains 2 districts. In the Enacted Map these are Districts 43 and 44. The county cluster has an overall partisan index of .34, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 4,074 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves only four unique maps that are as compact as the Enacted Plan.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 124. A map of the Enacted Map's district boundaries is shown in Figure 125. The Duchin Plan uses an alternative county grouping and is therefore not comparable to this cluster in the Enacted Plan. I analyze the Duchin Plan and the alternative cluster in a later section of this report.

Because there are only four maps that fit the criteria I use of equal population, county traversals, and compactness equal to or better than the Enacted Map, I do not present the distribution of district partisanship for the simulations here. It is sufficient to say that in the Enacted Map and the four remaining simulations, all create 2 Republican districts and 0 Democratic leaning districts, regardless of the index or election used. Table 45 shows this below.

Table 45 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In all 11 of the 11 individual elections there is unanimous agreement between the simulations and the Enacted Map.

Figure 124: **Map of Cleveland, Gaston, and Lincoln Senate County Cluster**

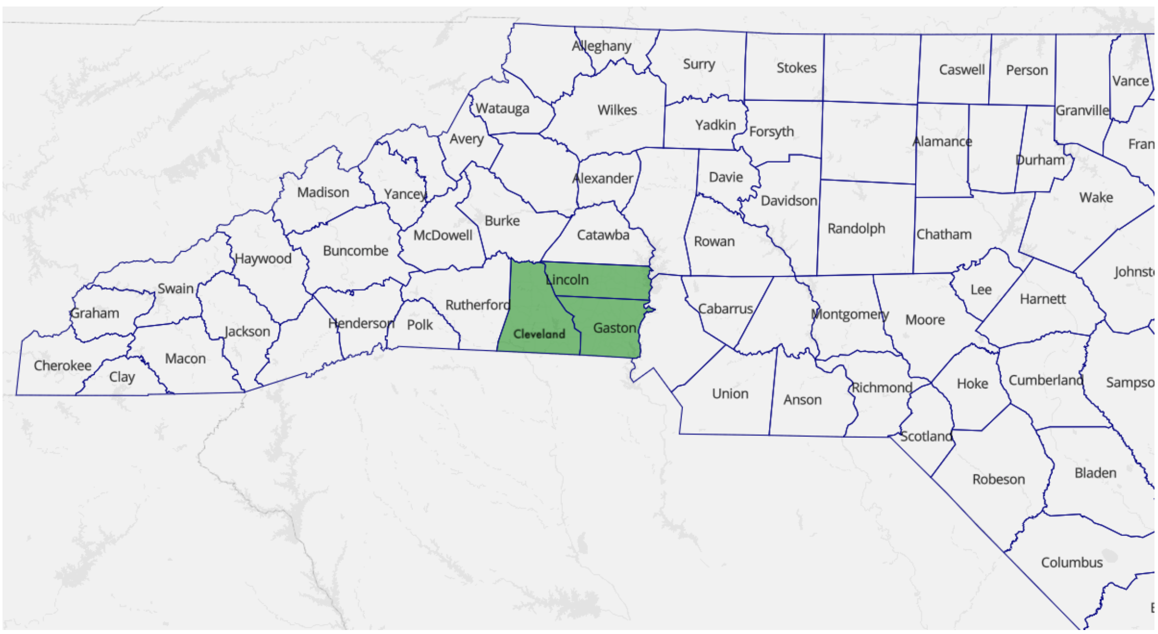
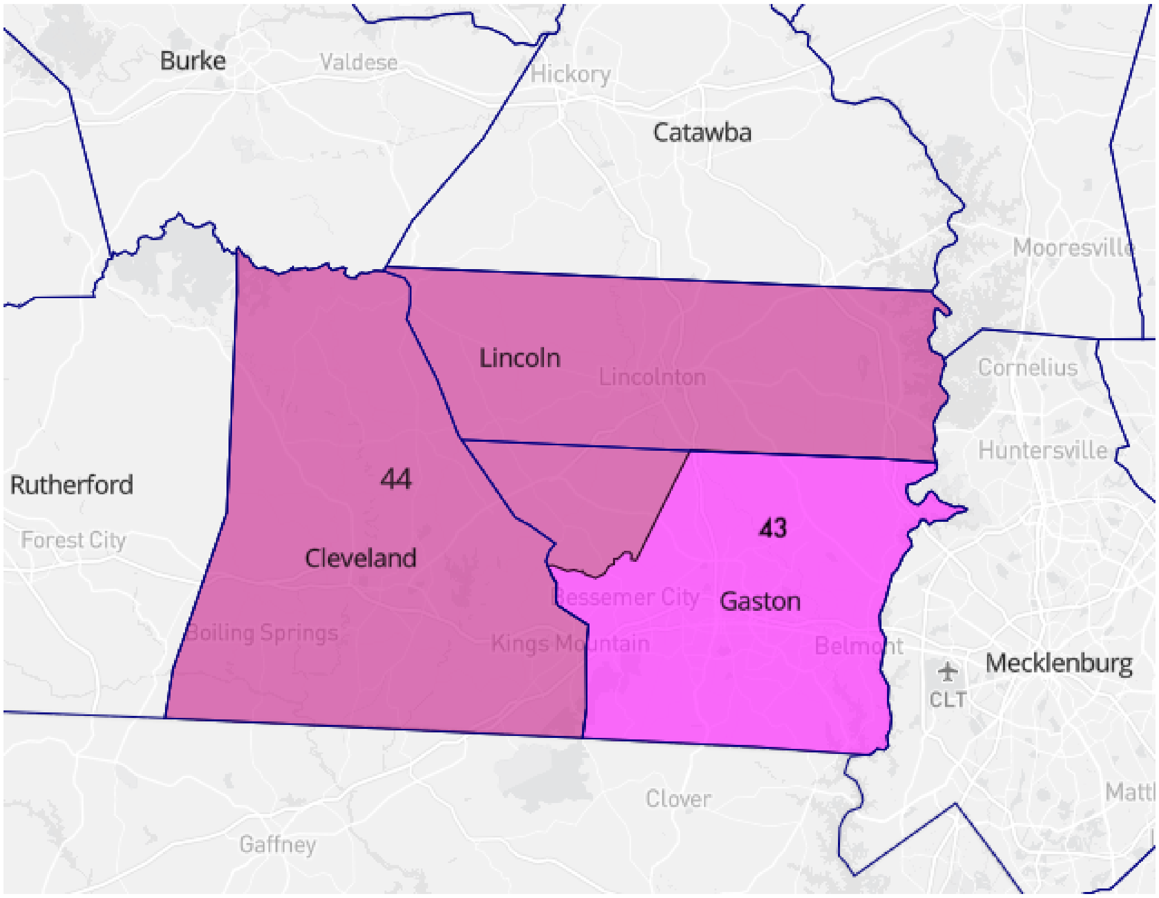


Figure 125: **Map of Enacted Plan in Cleveland, Gaston, and Lincoln Senate County Cluster**



Partisan Lean of Districts

District:	Enacted Plan
43	0.37
44	0.31

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Table 45: Simulation Results by Individual Elections

Cleveland, Gaston, and Lincoln Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Enacted Plan does as well, as the '0 District' cell is bolded in that row.

8.12 Forsyth and Stokes Senate County Grouping

The Forsyth-Stokes Senate county group contains 2 districts. In the Enacted Map these are Districts 31 and 32. The county cluster has an overall partisan index of .52, which is slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Enacted Plan. This leaves 35,085 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Enacted Map. This leaves 9,601 simulated maps, each containing two districts.

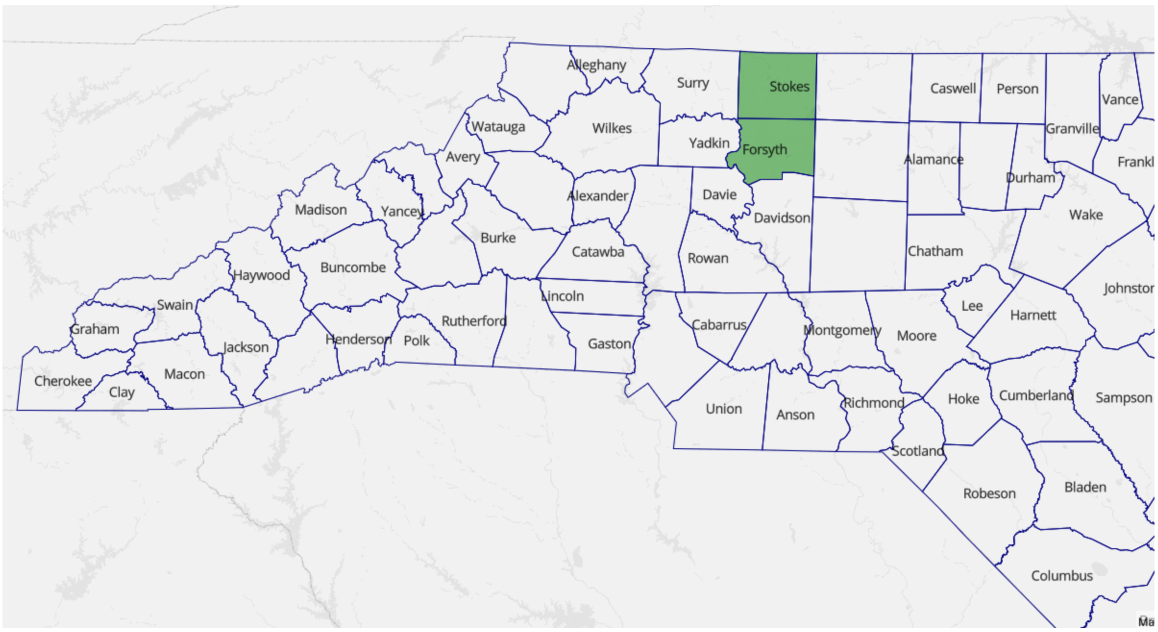
A map of the location of this county cluster in relation to the rest of the state is shown in Figure 126. A map of the Enacted Map's district boundaries is shown in Figure 127. The Duchin Plan uses an alternative county grouping and is therefore not comparable to this cluster in the Enacted Plan. I analyze the Duchin Plan and the alternative cluster in a later section of this report.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 128. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster, and the vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there is 1 Democratic leaning district. The Enacted Map is in alignment with the modal outcome of the simulations by also creating 1 Democratic leaning district.

Table 46 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded

number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. In 8 of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Enacted Map. In 9 of the 11 individual elections the Enacted Map falls inside the middle 50% of simulation results.

Figure 126: **Map of Forsyth and Stokes Senate County Cluster**



Partisan Lean of Districts

District:	Enacted Plan
31	0.38
32	0.69

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 127: **Map of Enacted Plan in Forsyth and Stokes Senate County Cluster**

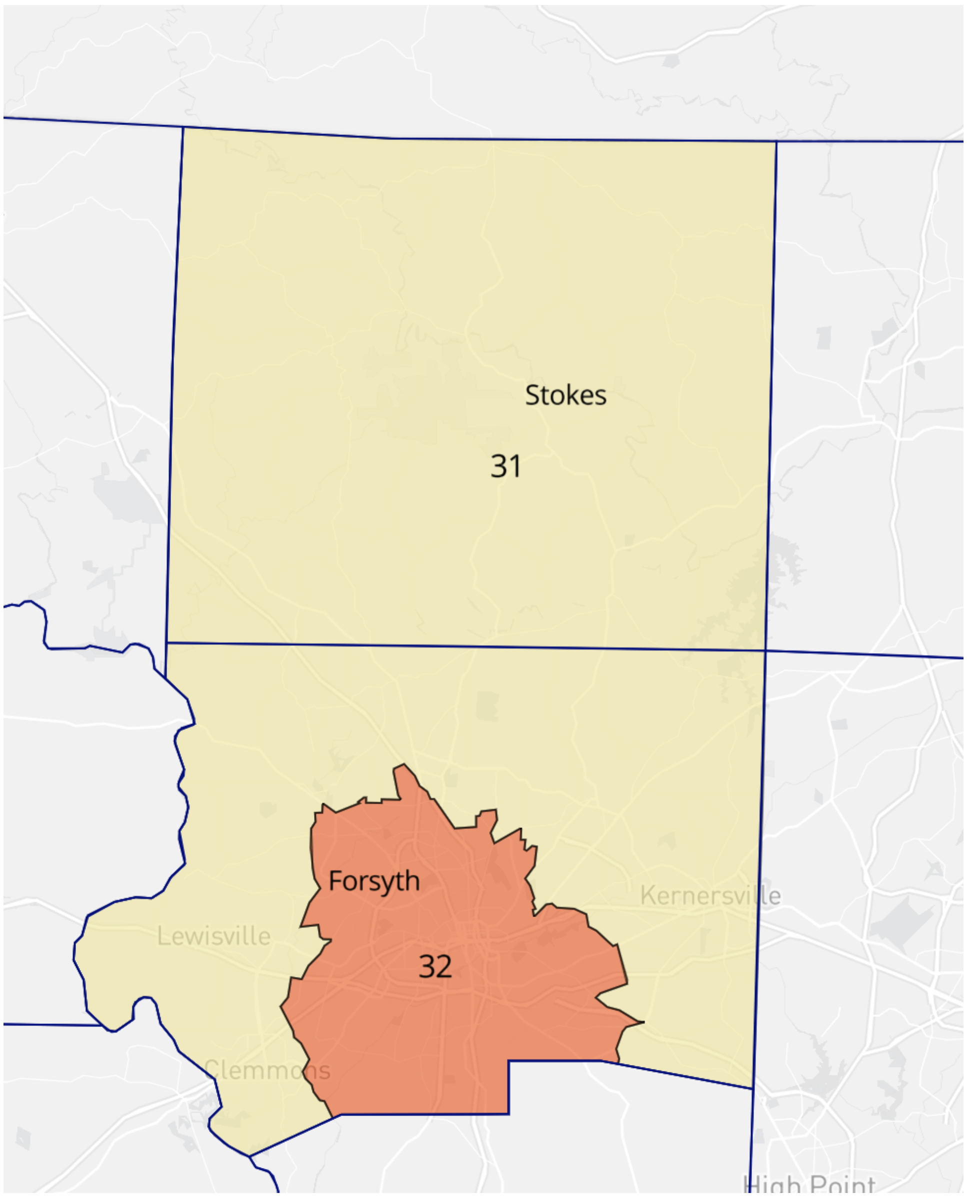
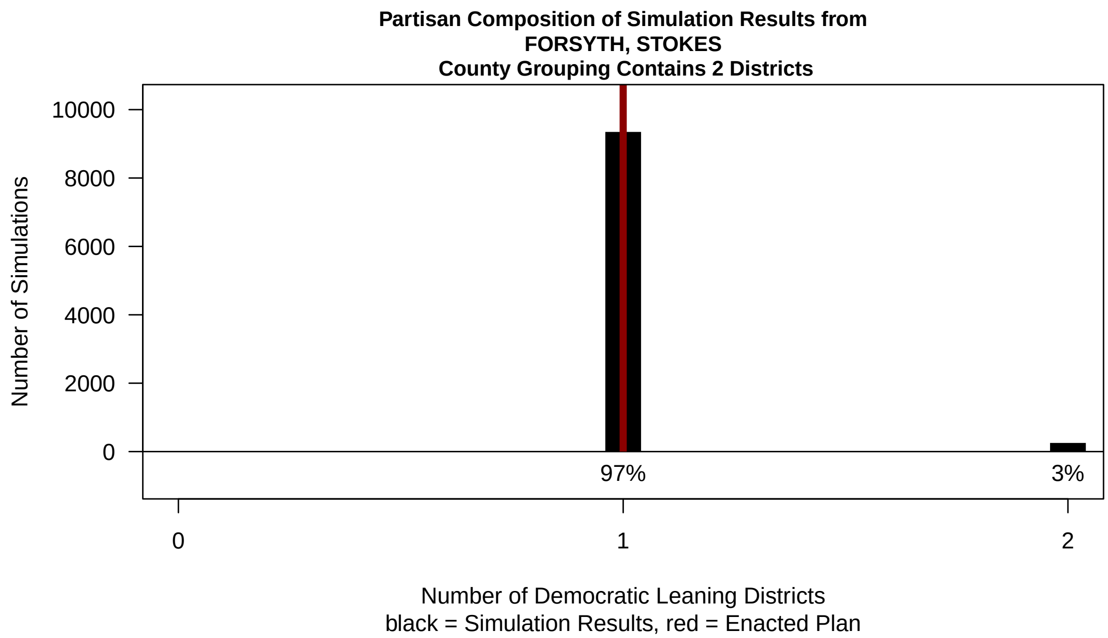


Figure 128: **Distribution of Partisan Districts from Simulations in Forsyth and Stokes Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The red vertical line shows the number of Democratic leaning seats in the Enacted Map in the same cluster.

Table 46: Simulation Results by Individual Elections

Forsyth and Stokes Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	**98%**	2%
2020 Senate	0%	**99%**	1%
2020 Governor	0%	**48%**	52%
2020 Lt. Governor	0%	**99%**	1%
2020 Attorney General	0%	**99%**	1%
2016 President	0%	**98%**	2%
2016 Senate	0%	**6%**	94%
2016 Governor	0%	**51%**	49%
2016 Lt. Governor	0%	**2%**	98%
2016 Attorney General	0%	**72%**	28%
2014 Senate	0%	**94%**	6%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Enacted Plan using the equivalent election. For example, using the 2020 Presidential election 98% of the simulations produce 1 Democratic leaning district. The Enacted Plan does as well, as the '1 District' cell is bolded in that row.

9 Comparison of Alternative Clusters to Those Chosen by the Legislature

In this section I compare the partisan index and simulations for the three alternative clusters chosen by the Duchin Plan and compare them to simulations in those same counties. The alternative clusters are very similar in their partisan indices as well as the partisan lean of the districts that are generated by the Enacted Map and the Duchin Map. This can be seen below in Table 47

Table 47: Senate Alternative County Grouping Analysis Summary

			# of Districts that are Democratic Leaning		
County Cluster	**Cluster Democratic Partisan Index**	**# Districts**	**Enacted Map**	**Duchin Map**	**Simulations**
Clusters Used by Enacted Plan					
Buncombe-Burke-McDowell	0.51	2	1		1
Cleveland-Gaston-Lincoln	0.34	2	0		0
Forsyth-Stokes	0.52	2	1		1
Alternative Clusters Used by Duchin Plan					
Buncombe-Henderson-Polk	0.54	2		1	1
Burke-Gaston-Lincoln	0.34	2		0	0
Forsyth-Yadkin	0.54	2		1	1
Total Enacted:		6	2	2	2
Total Duchin:		6	2	2	2

Note: Number of Democratic leaning districts is measured using the average two-party vote share in each district from the 11 statewide races noted earlier. Simulations range represents the middle 50% of outcomes from the simulations results. Clusters that fall outside of the simulation range are bolded.

9.1 Buncombe, Henderson, and Polk Senate Alternative County Grouping

The Buncombe-Henderson-Polk Senate alternative county group contains 2 districts. In the Duchin Map these are Districts 48 and 49. The county cluster has an overall partisan index of .53, which is slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Duchin Plan. This leaves 25,911 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Duchin Map. This leaves 17,474 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 129. A map of the Duchin Map's district boundaries is shown in Figure 130.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 132. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there is 1 Democratic leaning district. The Duchin Map is in alignment with the modal outcome of the simulations by creating 1 Democratic leaning district.

Table 49 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Duchin Plan using the equivalent election. In 7 of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Duchin Map. In 4 of the 11 individual elections the Duchin Map falls outside the middle 50% of simulation results and would be considered a statistical partisan outlier in these elections.

The Duchin Plan creates a solidly Democratic district and an additional very competitive district by dividing the city of Asheville. The Duchin Plan splits Asheville nearly equally across both districts while the Enacted Plan keeps the entirety of Asheville in one district. The tactic of dividing Democratic cities in a 'pinwheel' or 'pizza' shape and grouping those 'slices' with more Republican suburban and exurban areas is a classic tactic to generate more Democratic districts and overcome the geographic clustering that is common among Democratic voters. The Enacted Plan keeps the entirety of Asheville within one district. Table 48 shows the percent of Asheville voters in each district in each plan. It is clear that the Duchin plan splits Asheville into 2 roughly equal parts while the Enacted Plan places a much larger majority of Asheville into only 1 district. Figure 131 shows this division.

Table 48: Division of Asheville in Enacted Plan and Duchin Plan

	Percent of Asheville in district	
District:	Enacted Plan	Duchin Plan
46 (48 in Duchin)	0	42.8
49	100	57.2
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf Population numbers for city by district for Duchin Plan from Dave's Redistricting online. https://davesredistricting.org/

Figure 129: **Map of Buncombe, Henderson, and Polk Alternative Senate County Cluster**

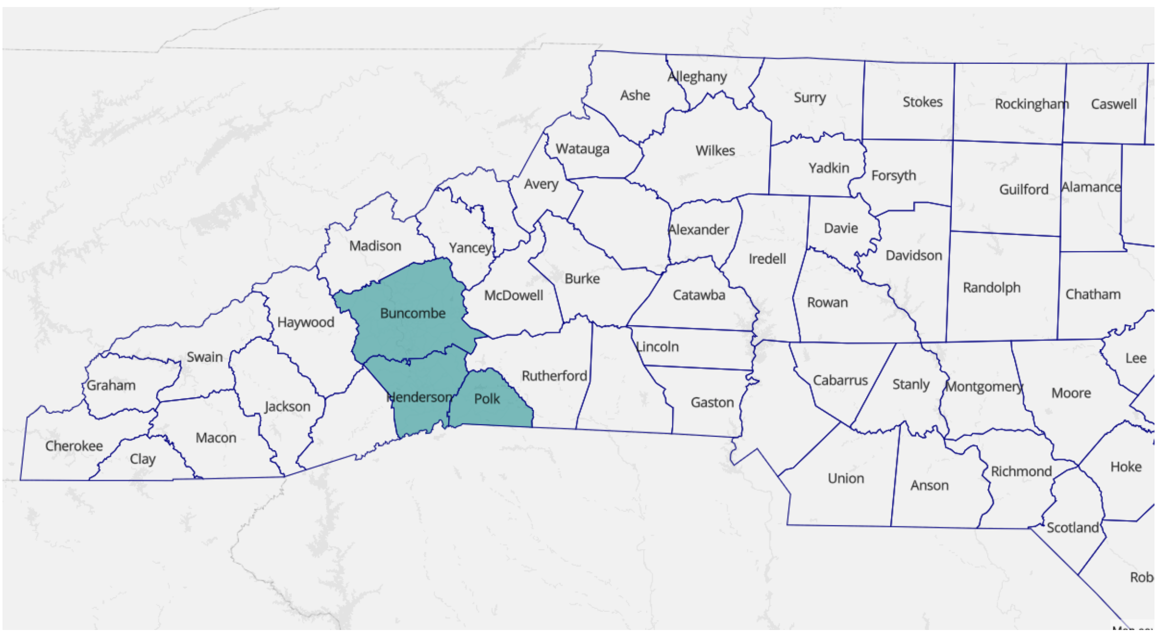
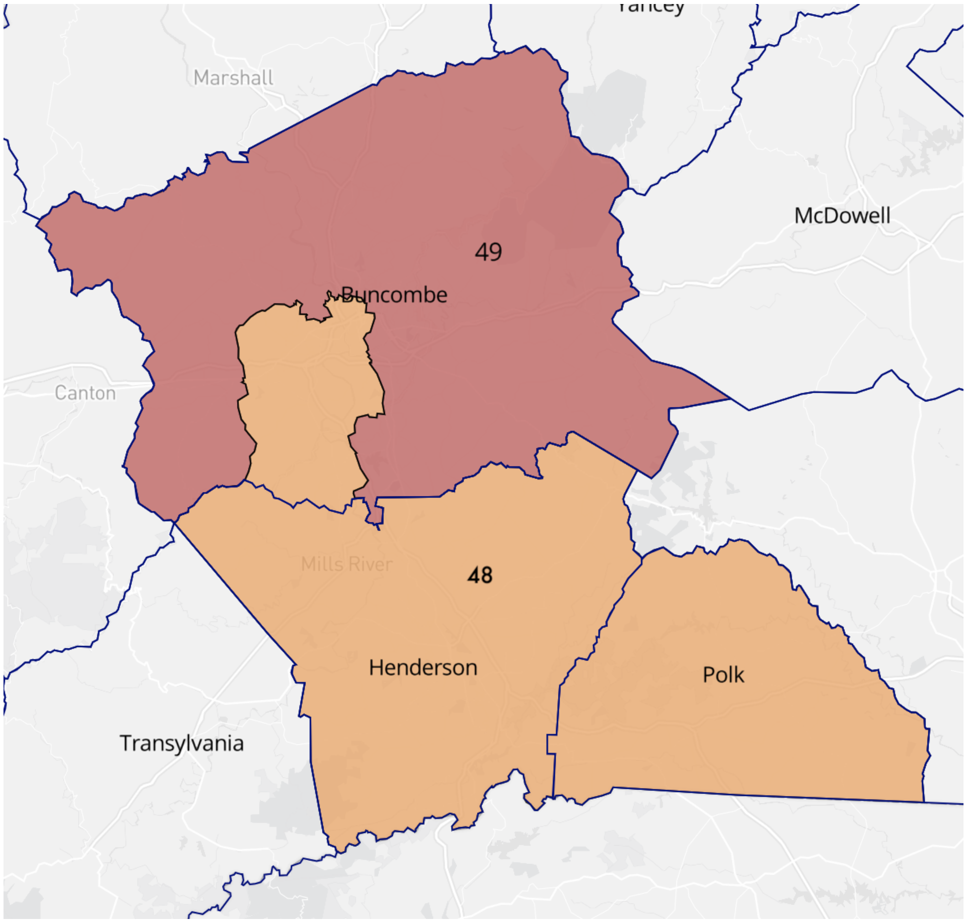


Figure 130: **Map of Duchin Plan in Buncombe, Henderson, and Polk Alternative Senate County Cluster**



Partisan Lean of Districts

District:	Enacted Plan
48	0.49
49	0.56

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 131: **Map of Division of Asheville in Enacted and Duchin Senate Plans**

(a) Enacted Map (b) Duchin Map

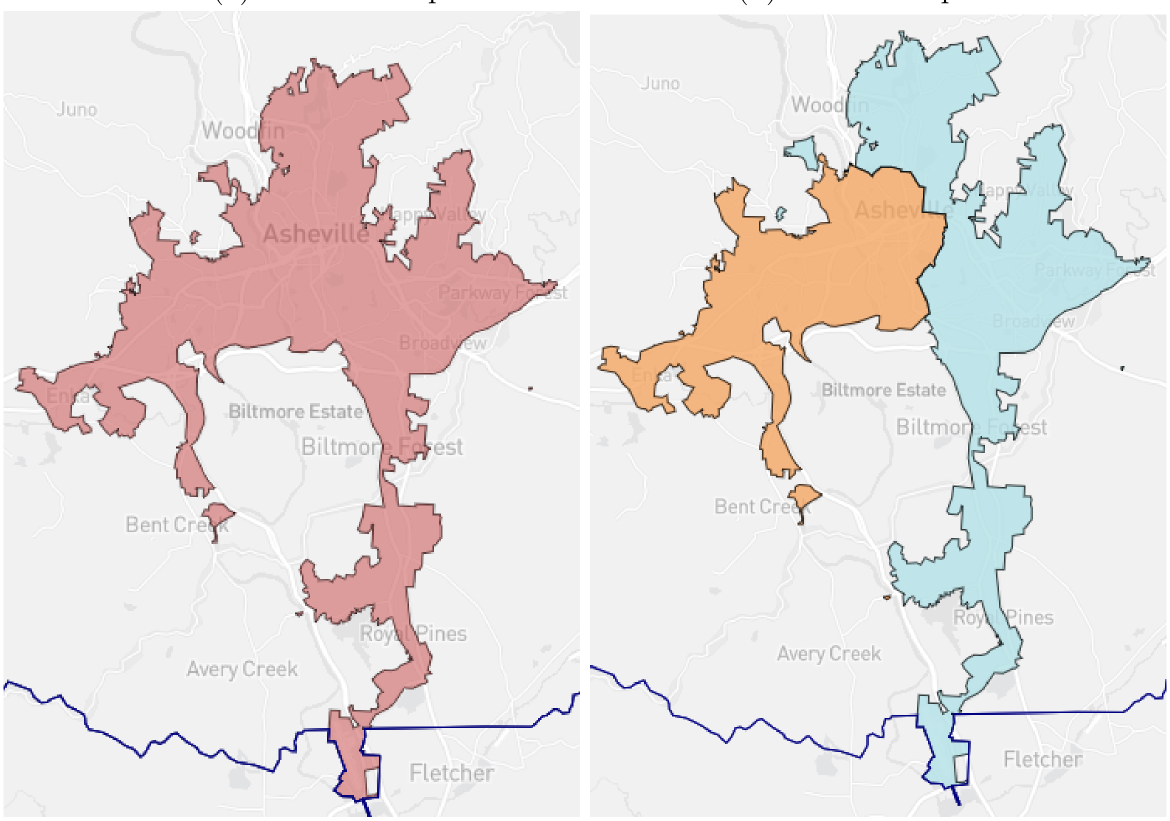
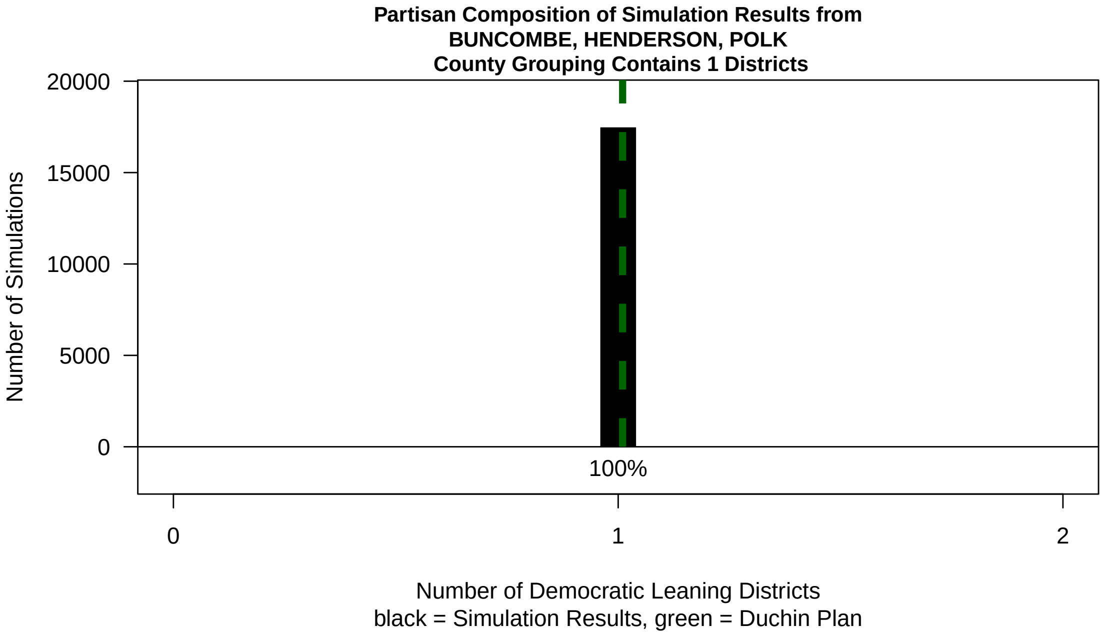


Figure 132: **Distribution of Partisan Districts from Simulations in Buncombe, Henderson, and Polk Alternative Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The green vertical line shows the number of Democratic leaning seats in the Duchin Map in the same cluster.

Table 49: Simulation Results by Individual Elections

Buncombe, Henderson, and Polk Alternative Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	100%	**0%**
2020 Senate	0%	**100%**	0%
2020 Governor	0%	93%	**7%**
2020 Lt. Governor	0%	**100%**	0%
2020 Attorney General	0%	100%	**0%**
2016 President	0%	**100%**	0%
2016 Senate	0%	**100%**	0%
2016 Governor	0%	100%	**0%**
2016 Lt. Governor	0%	**100%**	0%
2016 Attorney General	0%	**100%**	0%
2014 Senate	0%	**100%**	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Duchin Plan using the equivalent election. For example, using the 2020 Presidential election 0% of the simulations produce 2 Democratic leaning district. The Duchin Plan does, as the '2 District' cell is bolded in that row.

9.2 Burke, Gaston, and Lincoln Senate Alternative County Grouping

The Burke-Gaston-Lincoln Senate alternative county group contains 2 districts. In the Duchin Map these are Districts 43 and 44. The county cluster has an overall partisan index of .33, which is strongly Republican. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Duchin Plan. This leaves 15,719 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Duchin Map. This leaves 13,370 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 133. A map of the Duchin Map's district boundaries is shown in Figure 134.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 135. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Duchin Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic leaning districts.

Table 50 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Duchin Plan using the equivalent election. In all of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Duchin Map.

Figure 133: **Map of Burke, Gaston, and Lincoln Alternative Senate County Cluster**

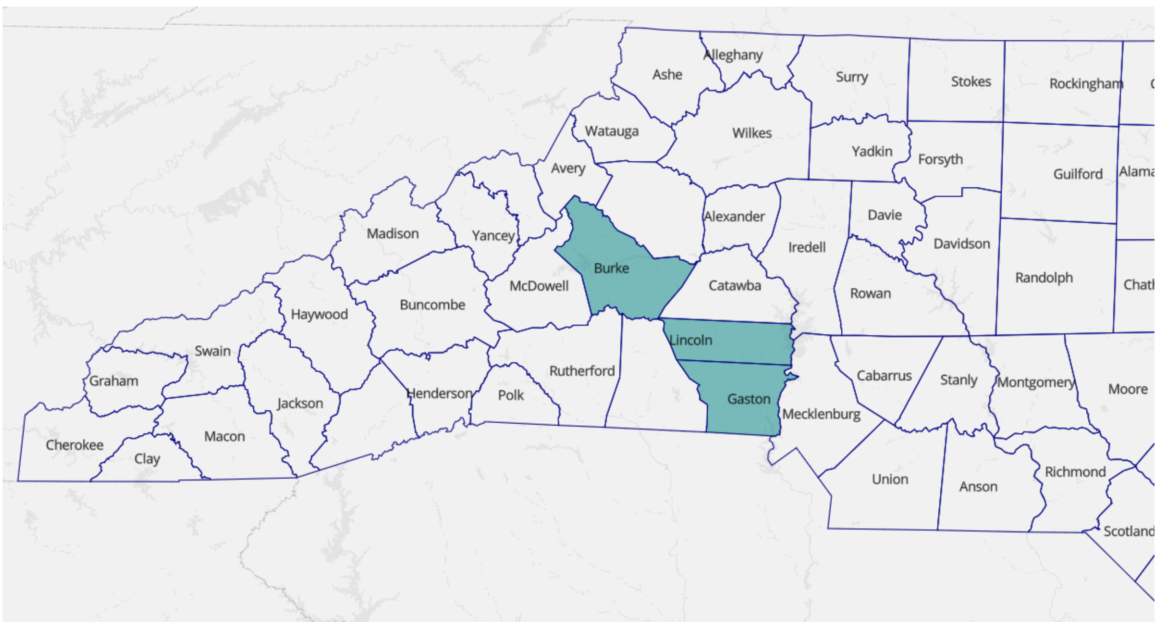
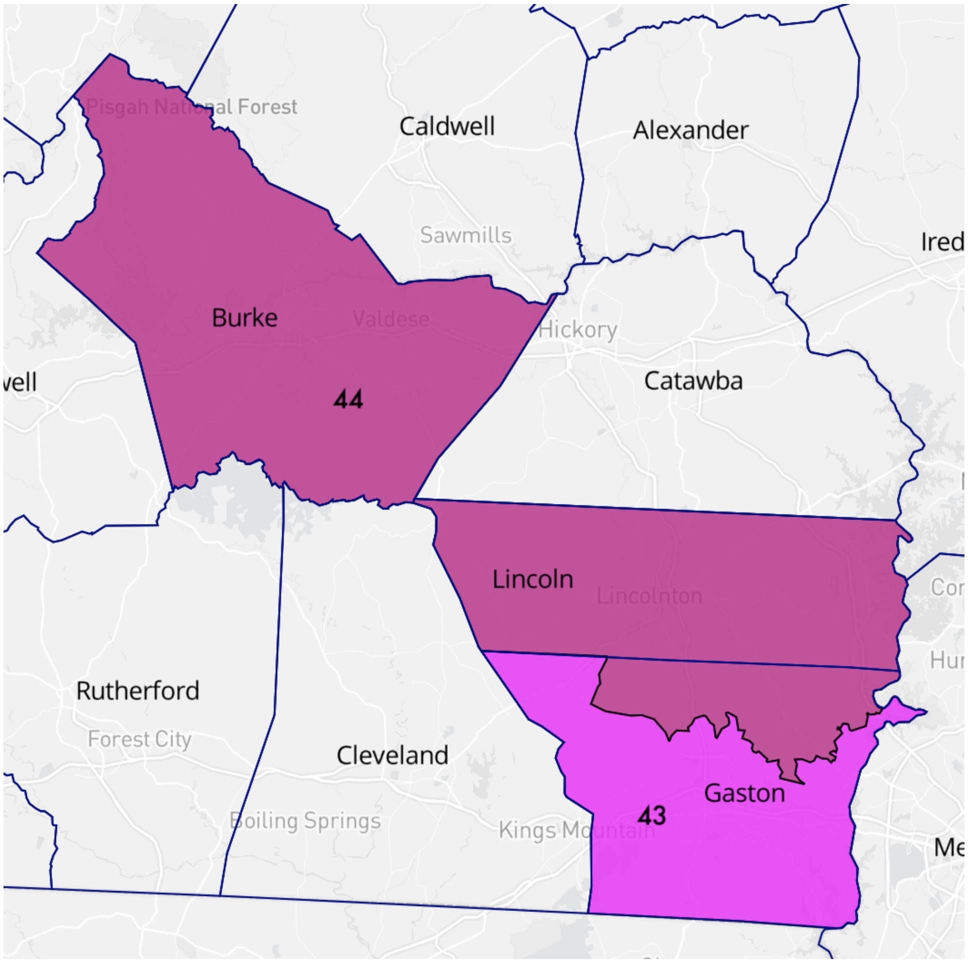


Figure 134: **Map of Duchin Plan in Burke, Gaston, and Lincoln Alternative Senate County Cluster**

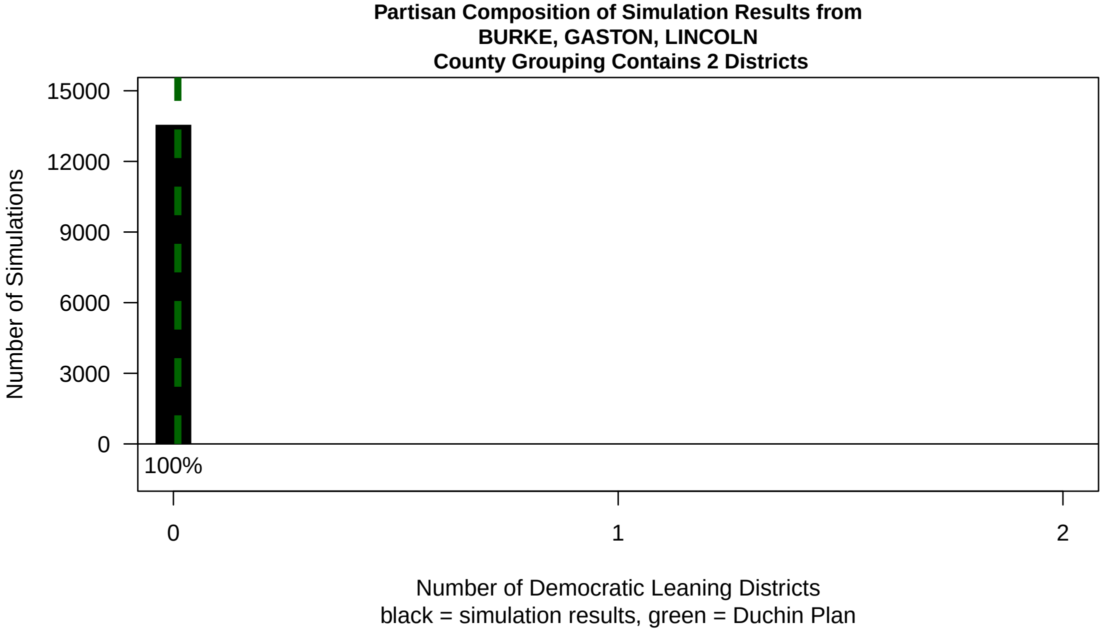


Partisan Lean of Districts

District:	Enacted Plan
43	0.38
44	0.29

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 135: **Distribution of Partisan Districts from Simulations in Burke, Gaston, and Lincoln Alternative Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The green vertical line shows the number of Democratic leaning seats in the Duchin Map in the same cluster.

Table 50: Simulation Results by Individual Elections

Burke, Gaston, and Lincoln Alternative Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	**100%**	0%	0%
2020 Senate	**100%**	0%	0%
2020 Governor	**100%**	0%	0%
2020 Lt. Governor	**100%**	0%	0%
2020 Attorney General	**100%**	0%	0%
2016 President	**100%**	0%	0%
2016 Senate	**100%**	0%	0%
2016 Governor	**100%**	0%	0%
2016 Lt. Governor	**100%**	0%	0%
2016 Attorney General	**100%**	0%	0%
2014 Senate	**100%**	0%	0%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Duchin Plan using the equivalent election. For example, using the 2020 Presidential election 100% of the simulations produce 0 Democratic leaning districts. The Duchin Plan does as well, as the '0 Districts' cell is bolded in that row.

9.3 Forsyth and Yadkin Senate Alternative County Grouping

The Forsyth and Yadkin Senate alternative county group contains 2 districts. In the Duchin Map these are Districts 31 and 32. The county cluster has an overall partisan index of .53, which is slightly Democratic. After conducting 50,000 initial simulations to create two districts in this cluster, I discard any simulations that contain more county traversals than the Duchin Plan. This leaves 48,151 simulations that meet this criteria. Next, I discard any simulations in which the average compactness score of the districts in the simulations is not as large or larger than the compactness score of the Duchin Map. This leaves 19,706 simulated maps, each containing two districts.

A map of the location of this county cluster in relation to the rest of the state is shown in Figure 136. A map of the Duchin Map's district boundaries is shown in Figure 137.

The distribution of district partisanship based on the statewide partisan elections index calculated for each of the simulation results is shown in Figure 139. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The vertical dashed green line shows the number of Democratic leaning seats in the Duchin Map in the cluster. In 100% of the simulations there are 0 Democratic leaning districts. The Duchin Map is in alignment with the modal outcome of the simulations by also creating 0 Democratic leaning districts.

Table 52 breaks apart the partisan index into the 11 constituent elections and shows the distribution of Democratic leaning seats generated if one were to look at each election separately. Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Duchin Plan using the equivalent election. In all of the 11 individual elections there is agreement between the modal (most common) outcome in the simulations and the Duchin Map.

The Duchin Plan creates a solidly Democratic district and an additional very competitive district by dividing the city of Winston-Salem. While Winston-Salem is too large to be a single district, the Duchin Plan splits Winston-Salem nearly equally across both districts while the Enacted Plan keeps a larger share of Winston-Salem in one district. The tactic of dividing Democratic cities in a 'pinwheel' or 'pizza' shape and grouping those 'slices' with more Republican suburban and exurban areas is a classic tactic to generate more Democratic districts and overcome the geographic clustering that is common among Democratic voters. The Enacted Plan keeps much more of Winston-Salem within one district. Table 51 shows the percent of Winston-Salem voters in each district in each plan. It is clear that the Duchin plan splits Winston-Salem into 2 roughly equal parts while the Enacted Plan places a much larger majority of Winston-Salem into only 1 district. Figure 138 shows this division.

Table 51: Division of Winton-Salem in Enacted Plan and Duchin Plan

	Percent of Winston-Salem in district	
District:	Enacted Plan	Duchin Plan
31	16.35	52.3
32	83.65	47.7
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf Population numbers for city by district for Duchin Plan from Dave's Redistricting online. https://davesredistricting.org/

Figure 136: **Map of Forsyth and Yadkin Alternative Senate County Cluster**

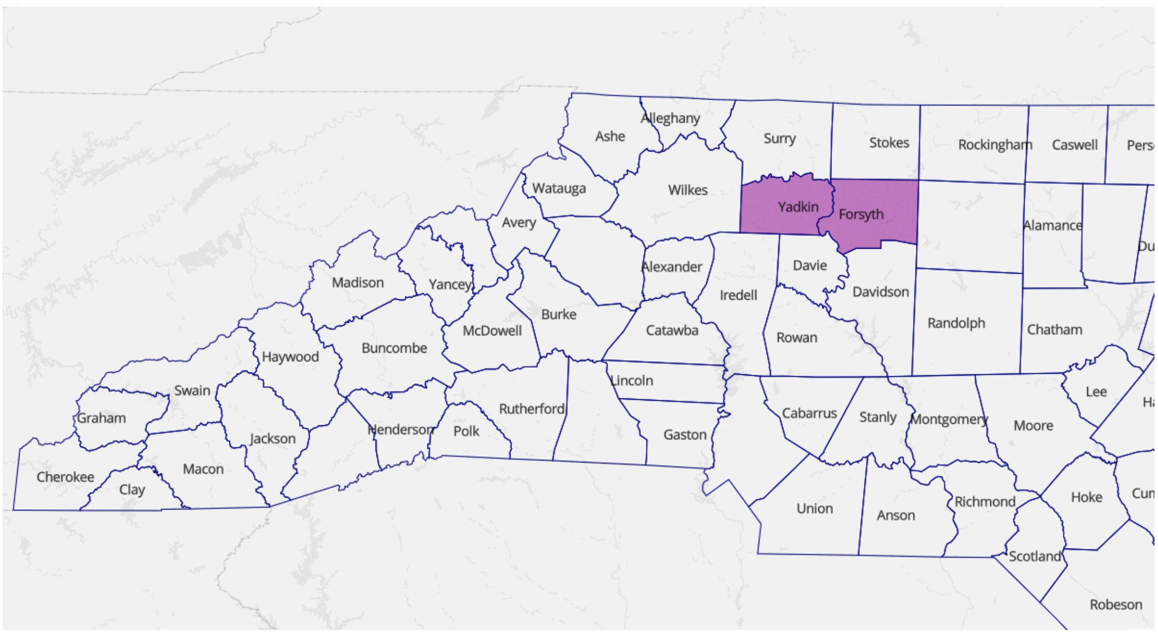


Figure 137: **Map of Duchin Plan in Forsyth and Yadkin Alternative Senate County Cluster**

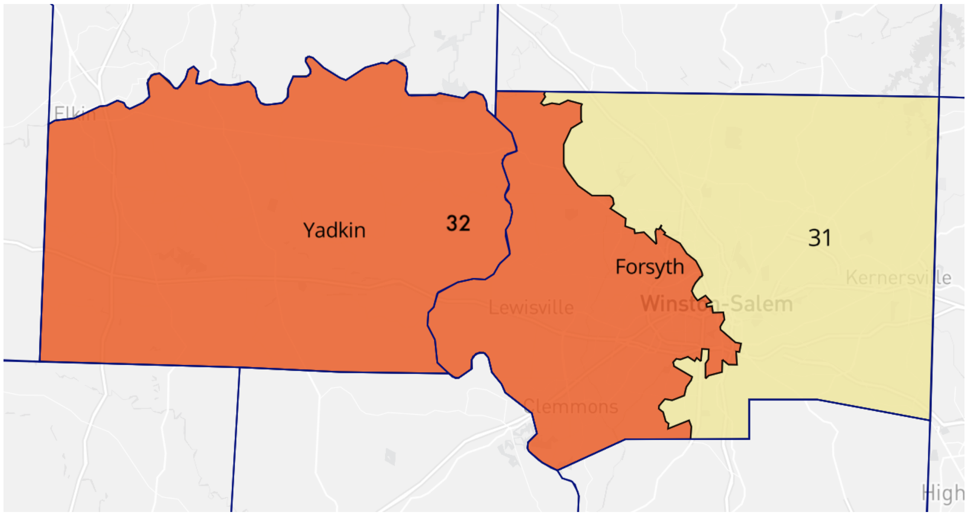
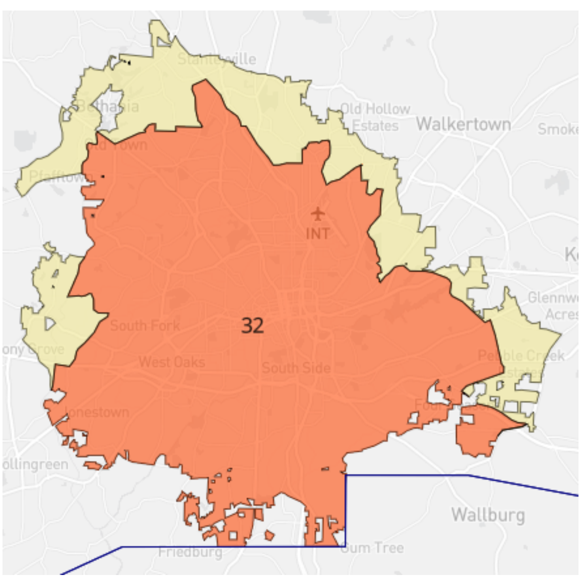
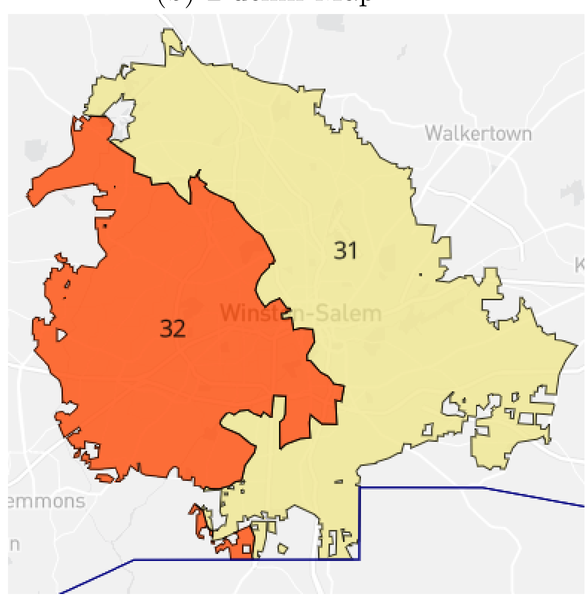


Figure 138: **Map of Division of Winston-Salem in Enacted and Duchin Senate Plans**

(a) Enacted Map



(b) Duchin Map

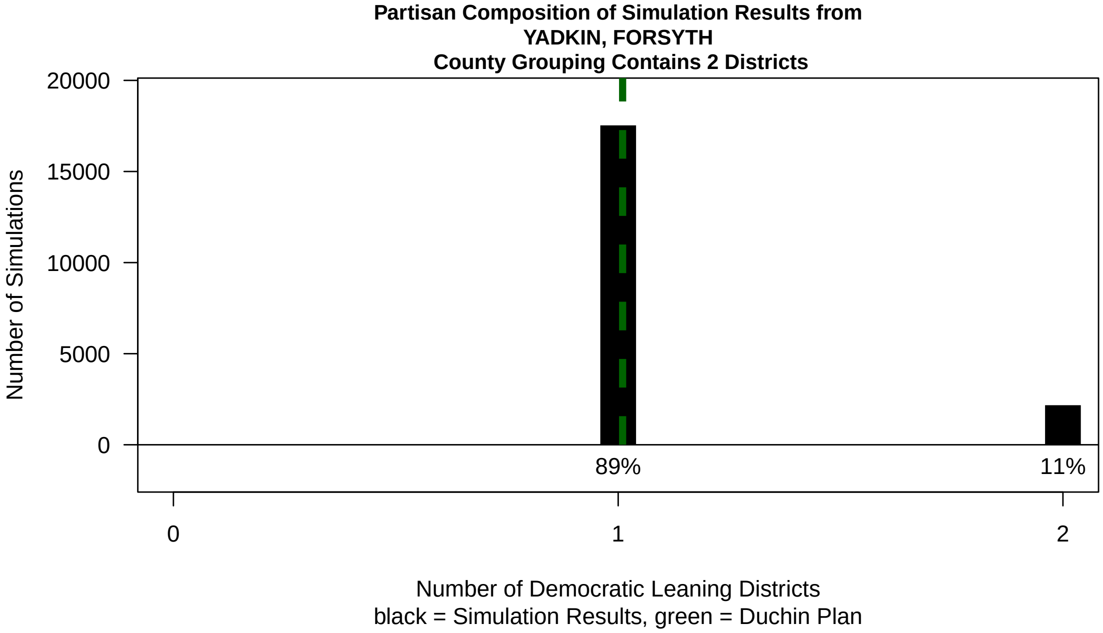


Partisan Lean of Districts

District:	Enacted Plan
31	0.58
32	0.49

Note: Partisan index is based on the two-party vote average of 11 statewide partisan elections between 2014-2020.

Figure 139: **Distribution of Partisan Districts from Simulations in Forsyth and Yadkin Alternative Senate County Cluster**



Note: Distribution of likely district partisanship based on the statewide partisan elections index calculated for each of the simulation results. The black bars show the distribution from the simulation results, with the percentage of simulations that generate each of the various possible number of Democratic seats in the cluster shown below each bar. The green vertical line shows the number of Democratic leaning seats in the Duchin Map in the same cluster.

Table 52: Simulation Results by Individual Elections

Forsyth and Yadkin Alternative Senate County Cluster

Number of Democratic Leaning Districts:			
	0	1	2
Individual Elections:			
2020 President	0%	56%	**44%**
2020 Senate	0%	**77%**	23%
2020 Governor	0%	0%	**100%**
2020 Lt. Governor	0%	**91%**	9%
2020 Attorney General	0%	**86%**	14%
2016 President	0%	**92%**	8%
2016 Senate	4%	**96%**	0%
2016 Governor	0%	62%	**38%**
2016 Lt. Governor	3%	**97%**	0%
2016 Attorney General	0%	**84%**	16%
2014 Senate	0%	**98%**	2%

Note: Each row shows the percent of simulations that produce the number of Democratic leaning districts using the election or election index indicated in the row. The bolded number in each row is the number of Democratic leaning districts produced by the Duchin Plan using the equivalent election. For example, using the 2020 Presidential election 44% of the simulations produce 2 Democratic leaning districts. The Duchin Plan does as well, as the '2 Districts' cell is bolded in that row.

10 Conclusion

Based upon my analysis of North Carolina's recently enacted redistricting plans for the General Assembly and the plans submitted by the North Carolina League of Conservation Voters, it is my opinion that the Enacted Maps are not "extreme partisan gerrymanders" as plaintiffs allege.

I come to this opinion through the use of a redistricting simulation algorithm to generate 50,000 simulated district maps in each county grouping in which there are multiple districts in both the North Carolina House of Representatives and the North Carolina Senate. The redistricting algorithm generates a representative sample of districts by following neutral redistricting criteria without regard to racial or partisan data. In this way, the simulated districts establish a comparison set of plans that use purely non-partisan redistricting inputs. I then compare the simulated plans against the Enacted Plans and the Duchin Plans by reference to election results to assess whether the partisan effects of those plans are consistent with what one would expect to see in a redistricting plan composed without reference to any partisan considerations.

In the House, these simulations show that the Enacted Plans consistently score more often within the range of the non-partisan simulated maps than the Duchin Plans. In addition, the simulations show that the Enacted Plans contain one county grouping, the Guilford County grouping in the House of Representative, that is a partisan outlier. However, this grouping largely follows the boundaries of a 2019 court-approved district plan. In contrast, the Duchin Plans generate partisan outliers in four county groupings.

In the Senate analysis both the Enacted and Duchin plans generate partisan outliers when compared to the simulated district maps in two clusters each. Furthermore, neutral redistricting criteria such as following municipal lines support the decisions by the map drawers in the Enacted Plan in more districts, while in these same districts the Duchin Plan divides Democratic-leaning municipalities into more pieces in order to combine Democratic-leaning voters in cities with Republican voters in suburban and rural parts of North Carolina to create additional competitive or Democratic-leaning districts.

Based on the evidence and analysis presented below, my opinions regarding the 2021 enacted redistricting plans in the North Carolina General Assembly can be summarized as follows:

- The contemporary political geography of North Carolina is such that Democratic majorities are often geographically clustered in the largest cities of the state while Republican voters often dominate the suburban and rural portions of the state.
- This is not the case in the rural northeastern region of the state, where there are also significant Democratic majorities.

- This geographic clustering in cities an in the rural northeast puts the Democratic Party at a natural disadvantage when single-member districts are drawn.
- This is further amplified by the 'county grouping' process that is unique to North Carolina's redistricting process where districts are constrained to remain within county groups.
- This disadvantage partially arises from the difficulty, and in many cases impossibility, of drawing Democratic-leaning districts in many of the county groupings that comply with constitutional requirements, even though Democratic voters make up roughly 40% of voters in these parts of the state.
- Based on a comparison between the Enacted Plan, the Duchin Plan, and a set of 50,000 simulated maps, the Enacted Plan is less of a partisan outlier than the Duchin Plan in the State House.
- In the Senate analysis both the Enacted and Duchin plans generate partisan outliers when compared to the simulated district maps in two clusters each.
- Areas of disagreement between proposed plans often arise because the Duchin plan divides Democratic leaning municipalities into more pieces in order to combine Democratic-leaning voters with Republican voters in suburban and rural parts of the state to create additional competitive or Democratic leaning districts.
- Given these results, as well as the otherwise high degree of agreement between the Enacted and Duchin maps, it is my opinion that the Enacted Maps are not "extreme partisan gerrymanders" as plaintiffs allege.

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Academic Appointments

Brigham Young University, Provo, UT

August 2020 - present Associate Professor, Department of Political Science
2014 - July 2020 Assistant Professor, Department of Political Science
2014 - present Faculty Scholar, Center for the Study of Elections and Democracy

Education

Princeton University Department of Politics, Princeton, NJ

Ph.D., Politics, July 2014

- Advisors: Brandice Canes-Wrone, Nolan McCarty, and Kosuke Imai
- Dissertation: "Buying Representation: the Incentives, Ideology, and Influence of Campaign Contributions on American Politics"
- 2015 Carl Albert Award for Best Dissertation, Legislative Studies Section, American Political Science Association (APSA)

M.A., Politics, December 2011

Brigham Young University, Provo, UT

B.A., International Relations - Political Economy Focus, April, 2008

- *Cum Laude*

Research Interests

American politics, congressional polarization, political ideology, campaign finance, survey research

Publications

19. **"Ideological Disagreement and Pre-emption in Municipal Policymaking"**
with Adam Dynes
Forthcoming at *American Journal of Political Science*
18. **"Comparing Campaign Finance and Vote Based Measures of Ideology"**
Forthcoming at *Journal of Politics*
17. **"The Participatory and Partisan Impacts of Mandatory Vote-by-Mail"**, with John Holbein
Science Advances, 2020. Vol. 6, no. 35, DOI: 10.1126/sciadv.abc7685
16. **"Issue Politicization and Interest Group Campaign Contribution Strategies"**, with Mandi Eatough
Journal of Politics, 2020. Vol. 82: No. 3, pp. 1008-1025

15. **“Campaign Contributions and Donors’ Policy Agreement with Presidential Candidates”**, with Brandice Canes-Wrone and Sharece Thrower
Presidential Studies Quarterly, 2019, 49 (4) 770–797

14. **“Conservatism in the Era of Trump”**, with Jeremy Pope
Perspectives on Politics, 2019, 17 (3) 719–736

13. **“Legislative Constraints on Executive Unilateralism in Separation of Powers Systems”**, with Alex Bolton and Sharece Thrower
Legislative Studies Quarterly, 2019, 44 (3) 515–548
Awarded the Jewell-Loewenberg Award for best article in the area of subnational politics published in *Legislative Studies Quarterly* in 2019

12. **“Electoral Competitiveness and Legislative Productivity”**, with Soren Schmidt
American Politics Research, 2019, 47 (4) 683–708

11. **“Does Party Trump Ideology? Disentangling Party and Ideology in America”**, with Jeremy Pope
American Political Science Review, 2019, 113 (1) 38–54

10. **“The Evolution of National Constitutions”**, with Scott Abramson
Quarterly Journal of Political Science, 2019, 14 (1) 89–114

9. **“Who is Ideological? Measuring Ideological Responses to Policy Questions in the American Public”**, with Jeremy Pope
The Forum: A Journal of Applied Research in Contemporary Politics, 2018, 16 (1) 97–122

8. **“Status Quo Bias in Ballot Wording”**, with David Gordon, Ryan Hill, and Joe Price
The Journal of Experimental Political Science, 2017, 4 (2) 151–160.

7. **“Ideologically Sophisticated Donors: Which Candidates Do Individual Contributors Finance?”**, with Brandice Canes-Wrone and Sharece Thrower
American Journal of Political Science, 2017, 61 (2) 271–288.

6. **“Gender Inequalities in Campaign Finance: A Regression Discontinuity Design”**, with Daniel Butler and Jessica Preece
Quarterly Journal of Political Science, 2016, Vol. 11, No. 2: 219–248.

5. **“Representing the Preferences of Donors, Partisans, and Voters in the U.S. Senate”**
Public Opinion Quarterly, 2016, 80: 225–249.

4. **“Donation Motivations: Testing Theories of Access and Ideology”**
Political Research Quarterly, 2016, 69 (1) 148–160.

3. **“Ideological Donors, Contribution Limits, and the Polarization of State Legislatures”**
Journal of Politics, 2016, 78 (1) 296–310.

2. **“Online Polls and Registration Based Sampling: A New Method for Pre-Election Polling”** with Quin Monson, Kelly Patterson and Chris Mann.
Political Analysis 2014, 22 (3) 321–335.

1. **“Causes and Consequences of Political Polarization”** In *Negotiating Agreement in Politics*. Jane Mansbridge and Cathie Jo Martin, eds., Washington, DC: American Political Science Association: 19–53. with Nolan McCarty. 2013.

    - Reprinted in *Solutions to Political Polarization in America*, Cambridge University Press. Nate Persily, eds. 2015
    - Reprinted in *Political Negotiation: A Handbook*, Brookings Institution Press. Jane Mansbridge and Cathie Jo Martin, eds. 2015

AVAILABLE WORKING PAPERS

"Misclassification and Bias in Predictions of Individual Ethnicity from Administrative Records" (Revise and Resubmit at *American Political Science Review*)

"Taking Cues When You Don't Care: Issue Importance and Partisan Cue Taking"
with Jeremy Pope (Revise and Resubmit)

"A Revolution of Rights in American Founding Documents"
with Scott Abramson and Jeremy Pope (Conditionally Accepted)

"410 Million Voting Records Show the Distribution of Turnout in America Today"
with John Holbein (Revise and Resubmit)

"Partisanship and Trolleyology"
with Ryan Davis (Under Review)

"Who's the Partisan: Are Issues or Groups More Important to Partisanship?"
with Jeremy Pope (Revise and Resubmit)

"Race and Realignment in American Politics"
with Jeremy Pope (Revise and Resubmit)

"The Policy Preferences of Donors and Voters"

"Estimating Neighborhood Effects on Turnout from Geocoded Voter Registration Records."
with Kosuke Imai

"Super PAC Contributions in Congressional Elections"

WORKS IN PROGRESS

"Collaborative Study of Democracy and Politics"
with Brandice Canes-Wrone, Gregory Huber, and Joshua Clinton

"Preferences for Representational Styles in the American Public"
with Ryan Davis and Adam Dynes

"Representation and Issue Congruence in Congress"
with Taylor Petersen

"Education, Income, and the Vote for Trump"
with Edie Ellison

INVITED PRESENTATIONS

"Are Mormons Breaking Up with Republicanism? The Unique Political Behavior of Mormons in the 2016 Presidential Election"

- Ivy League LDS Student Association Conference - Princeton University, November 2018, Princeton, NJ

"Issue Politicization and Access-Oriented Giving: A Theory of PAC Contribution Behavior"

- Vanderbilt University, May 2017, Nashville, TN

"Lost in Issue Space? Measuring Levels of Ideology in the American Public"

- Yale University, April 2016, New Haven, CT

"The Incentives, Ideology, and Influence of Campaign Donors in American Politics"

- University of Oklahoma, April 2016, Norman, OK

"Lost in Issue Space? Measuring Levels of Ideology in the American Public"

- University of Wisconsin - Madison, February 2016, Madison, WI

"Polarization and Campaign Contributors: Motivations, Ideology, and Policy"

- Hewlett Foundation Conference on Lobbying and Campaign Finance, October 2014, Palo Alto, CA

"Ideological Donors, Contribution Limits, and the Polarization of State Legislatures"

- Bipartisan Policy Center Meeting on Party Polarization and Campaign Finance, September 2014, Washington, DC

"Representing the Preferences of Donors, Partisans, and Voters in the U.S. Senate"

- Yale Center for the Study of American Politics Conference, May 2014, New Haven, CT

Conference Presentations

Washington D.C. Political Economy Conference (PECO):

- 2017 discussant

American Political Science Association (APSA) Annual Meeting:

- 2014 participant and discussant, 2015 participant, 2016 participant, 2017 participant, 2018 participant

Midwest Political Science Association (MPSA) Annual Meeting:

- 2015 participant and discussant, 2016 participant and discussant, 2018 participant

Southern Political Science Association (SPSA) Annual Meeting:

- 2015 participant and discussant, 2016 participant and discussant, 2017 participant

Teaching Experience

Poli 315: Congress and the Legislative Process

- Fall 2014, Winter 2015, Fall 2015, Winter 2016, Summer 2017

Poli 328: Quantitative Analysis

- Winter 2017, Fall 2017, Fall 2019, Winter 2020, Fall 2020, Winter 2021

Poli 410: Undergraduate Research Seminar in American Politics

- Fall 2014, Winter 2015, Fall 2015, Winter 2016, Summer 2017

Awards and Grants

2019 BYU Mentored Environment Grant (MEG), American Ideology Project, $30,000

2017 BYU Political Science Teacher of the Year Award

2017 BYU Mentored Environment Grant (MEG), Funding American Democracy Project, $20,000

2016 BYU Political Science Department, Political Ideology and President Trump (with Jeremy Pope), $7,500

2016 BYU Office of Research and Creative Activities (ORCA) Student Mentored Grant x 3

- Hayden Galloway, Jennica Peterson, Rebecca Shuel

2015 BYU Office of Research and Creative Activities (ORCA) Student Mentored Grant x 3

- Michael-Sean Covey, Hayden Galloway, Sean Stephenson

2015 BYU Student Experiential Learning Grant, American Founding Comparative Constitutions Project (with Jeremy Pope), $9,000

2015 BYU Social Science College Research Grant, $5,000

2014 BYU Political Science Department, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $3,000

2014 BYU Social Science College Award, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $3,000

2014 BYU Center for the Study of Elections and Democracy, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $2,000

2012 Princeton Center for the Study of Democratic Politics Dissertation Improvement Grant, $5,000

2011 Princeton Mamdouha S. Bobst Center for Peace and Justice Dissertation Research Grant, $5,000

2011 Princeton Political Economy Research Grant, $1,500

Other Scholarly Activities

Expert Witness in Nancy Carola Jacobson, et al., Plaintiffs, vs. Laurel M. Lee, et al., Defendants. Case No. 4:18-cv-00262 MW-CAS (U.S. District Court for the Northern District of Florida)

Expert Witness in Common Cause, et al., Plaintiffs, vs. LEWIS, et al., Defendants. Case No. 18-CVS-14001 (Wake County, North Carolina)

Expert Witness in Kelvin Jones, et al., Plaintiffs, v. Ron DeSantis, et al., Defendants, Consolidated Case No. 4:19-cv-300 (U.S. District Court for the Northern District of Florida)

Expert Witness in Community Success Initiative, et al., Plaintiffs, v. Timothy K. Moore, et al., Defendants, Case No. 19-cv-15941 (Wake County, North Carolina)

Expert Witness in Richard Rose et al., Plaintiffs, v. Brad Raffensperger, Defendant, Civil Action No. 1:20-cv-02921-SDG (U.S. District Court for the Northern District of Georgia)

Georgia Coalition for the People's Agenda, Inc., et. al., Plaintiffs, v. Brad Raffensberger, Defendant. Civil Action No. 1:18-cv-04727-ELR (U.S. District Court for the Northern District of Georgia)

Expert Witness in Alabama, et al., Plaintiffs, v. United States Department of Commerce; Gina Raimondo, et al., Defendants. Case No. CASE No. 3:21-cv-00211-RAH-ECM-KCN (U.S. District Court for the Middle District of Alabama Eastern Division)

Expert Witness in League of Women Voters of Ohio, et al., Relators, v. Ohio Redistricting Commission, et al., Respondents. Case No. 2021-1193 (Supreme Court of Ohio)

ADDITIONAL TRAINING — EITM 2012 at Princeton University - Participant and Graduate Student Coordinator

COMPUTER SKILLS — Statistical Programs: R, Stata, SPSS, parallel computing

Updated December 22, 2021

Rebuttal to report of Michael Barber

Wesley Pegden

December 28, 2021

1 Introduction

In his report, Michael Barber presents the results of simulated district plans as part of an analysis which purports to elicit whether the enacted House and Senate maps of North Carolina are "partisan outliers". Barber makes choices in his analysis that reduce its ability to detect gerrymandering North Carolina clusters; for example, he discusses the partisan bias of the enacted House and Senate maps through the lens of the whole number of "Democratric-lean" districts in one hypothetical election, a lens through which even the effects of extreme gerrymandering in NC county clusters—each with a small number of districts—are made to appear less dramatic.

Nevertheless, his primary analyses (Tables 2 and 32) still find the whole-state House and Senate plans to be partisan outliers compared to his simulated maps, according to the definition he lays out in his report; in particular, he reports the middle-50% of simulated maps to have 46-51 total "Democratic-lean" districts across the House clusters he analyzes, and reports that the enacted map contains 45 such districts. For the Senate he reports a middle-50% range of 19-19 total Democratic-lean districts in his simulations, and that the enacted map contains 16 such districts.

In fact, Barber incorrectly calculated the distribution of Democrat-leaning seats for the whole-state outcomes of his simulation analysis, incorrectly reporting the sums of lower- and upper-quartile seat counts in individual clusters as the lower- and upper-quartile for total statewide seats. When the distribution of "lean Democrat district" counts at the whole-state level are calculated correctly for Barber's simulations (still using the partisan index he defines), one finds that the middle-50% range for Barber's simulated maps in the House is actually 48-50 Democratic-lean districts, not 46-51 as Barber shows, and that **the enacted North Carolina House map lies in the most Republican-biased 00.18% of whole state maps composed of Barber's simulations, and the enacted North Carolina Senate map lies in the most Republican-based 00.39% of whole state maps composed of Barber's simulations.** This computation can be carried out entirely with the figures provided in Barber's report, and uses Barber's simulated maps and Barber's metric of partisan bias (number of lean-Democrat districts), calculated with Barber's own partisan voting index.

Finally, when re-analyzing Barber's simulated maps (as provided in his backup data) to compare their expected performance over a range of electoral outcomes rather than comparing the crude number of "lean Democratic districts" for a fixed election average, the differences between the enacted map and Barber's ensemble of simulated comparison maps becomes more dramatic at the cluster level as well. Through this lens, every cluster which my original analysis found to be optimized for partisanship would qualify as a partisan outlier according to Barber's "middle 50%" criterion, and many are extreme outliers, among the most Republican biased 10%, 1%, or 0.1% of maps, even in clusters where Barber reported that the enacted map was not be a partisan outlier.

2 Barber finds the enacted House and Senate maps to be outliers according to his own definition

On page 29 of his report, in the section on House clusters, Barber writes that he considers a districting plan of North Carolina to be a partisan outlier if it lies outside of the "middle 50%" of simulation results; in Barber's report, the middle 50% are the maps that lie between the 25th and 75th percentiles according to the number of lean-Democrat districts, as measured with the partisan index Barber obtains by averaging election results. He calls this a "conservative definition" of an outlier, noting that "in the social sciences, medicine, and other disciplines it is traditional to consider something an outlier if it falls outside the middle 95% or 90% of the comparison distribution."

In both of his whole-state analysis tables (Table 2 and 32), Barber's own findings report the whole map as falling outside the middle 50% of simulated outcomes for the House and Senate. For example, in the last row, labeled "Total", of Table 2 on page 31, he reports that in the 26 clusters he analyzed, the enacted map contained 45 statewide "lean-Democrat" districts according to his partisan index, while the middle 50% range of the simulated maps for the total number of seats was $46 - 51$. Similarly, in Table 32 for the Senate, he reports the enacted map scored as having a total of 16 lean-Democrat seats in the 12 clusters used by the enacted map he analyzed, while the middle 50% range for his middle 50% range for the total number of seats in his simulated maps was 19-19. By the definition he chose to offer of a partisan outlier, Barber finds the enacted House and Senate plans are partisan outliers.

3 Barber reports incorrect quartiles for totals across clusters

Recall that in his Table 2, in the last column, Barber reports the range of the "middle 50%" for the number of lean-Democratic districts for his simulations in each cluster, and, at the bottom of the column, for the total across clusters (he reports the range for this total as 46-51). Recall that the bottom of the middle-50% range is the lower quartile of the data, and the top of the range is the upper quartile.

For example, in the House:

- for the Buncombe cluster in the House map, Barber reports in Figure 45 that 28% of his simulated maps contained 2 lean-Democrat districts, while 72% contained 3.
- for the Cumberland cluster in the House map, Barber reports in Figure 55 that 82% of his simulated maps contained 3 districts, while 18% contained 4.

I summarize this information in my Table 1, below:

Cluster	0	1	2	3	4
Buncombe			28%	72%	
Cumberland				82%	18%

Table 1: Fraction of maps with various lean-Democrat-district counts, as reported by Barber for Buncombe and Cumberland county districtings.

In his Table 2, Barber correctly summarizes the middle 50% ranges for the data in each of these clusters as 2-3 and 3-3, respectively; in each case, the lower end of the range is the smallest value below which 25% of his simulated maps lie, and the upper end is the smallest value below which 75% lie.

Suppose though, just as an example, that we wished to calculate the distribution of the total number of lean-Democrat districts across just these two clusters according the Barber's simulations; this will also enable us to calculate the middle-50% of outcomes for the total lean-Democrat districts across these two clusters.

Note that for maps of these two clusters composed of maps from Barber'simulations, a total of 5, 6, or 7 lean-Democrat districts are possible. For example, 5 lean-Democrat districts can arise only by having 2 such districts in Buncombe and 3 in Cumberland, and fewer are not possible.

According to Barber's simulations, as summarized in Table 1, 28% of the maps of these two clusters would have 2 lean-Democrat districts in Buncombe, while 82% would have 3 lean-Democrat districts in Cumberland. As the districtings in each cluster can be chosen independently of each other, a total of

$$28\% \times 82\% = 22.96\%$$

of districtings of these two counties would have a total of 5 lean-Democrat districts. (Note that having fewer than 5 lean-Democrat seats happens 0% of the time, according to Barber's simulations.)

6 lean-Democrat districts can arise from having 2 lean-Democrat districts in Buncombe and 4 in Cumberland, or having 3 lean-Democrat districts in Buncombe and 3 in Cumberland. Thus according to Barber's simulation results the frequency of this outcome would be

$$28\% \times 18\% + 72\% \times 82\% = 64.08\%.$$

Finally, the likelihood of 7 lean-Democrat seats, which arise just when there are 3 lean-Democrat districts in Buncombe and 4 lean-Democrat districts in Cumberland, would be

$$72\% \times 18\% = 12.96\%,$$

(Note that altogether, 22.96%+64.08%+12.96%=100%.)

Evidently, the middle-50% range for the total of lean-Democrat seats across these two counties would be 6-6; the 6-lean-Democrat-district maps include the middle-50% of simulated maps. (6 is both the 25th percentile and the 75th percentile of the number of Democratic-lean seats in the simulated maps.)

Under Barber's incorrect approach, he would have simply added the bottom and top of the middle-50% ranges for Buncombe and Cumberland (2-3 and 3-3, respectively) to arrive at a middle-50% range for the total number of lean-Democrat-districts across these two counties; that procedure would produce a range of 5-6, which is wider than the true middle-50% range of the total number of districts across the two counties (namely 6-6), as correctly calculated above.

In general, the magnitude of this error grows larger and larger the more independent cluster-specific results are aggregated by incorrectly summing the lower and upper quartiles as a substitute for a correct calculation of the distribution of total statewide lean-Democrat districts. In Barber's report, he aggregates across 26 clusters in this way. As we will see in the next section, this has the effect of inflating the true middle-50% range of 48-50 to an incorrectly reported range of 46-51.

Technical Remark. Probability generating functions can be used to allow larger calculations of the same type as the one above to be performed using publicly web-based computer algebra systems instead of by programming or using statistical software. Note that precisely the same three calculations above would have been performed if expanding the algebraic expression

$$\begin{aligned}(.28x^2 + .72x^3)(.82x^3 + .18x^4) &= (.28 \times .82)x^5 + (.28 \times .18 + .72 \times .82)x^6 + (.72 \times .18)x^7 \\ &= .2296x^5 + .6408x^6 + .1296x^7.\end{aligned}$$

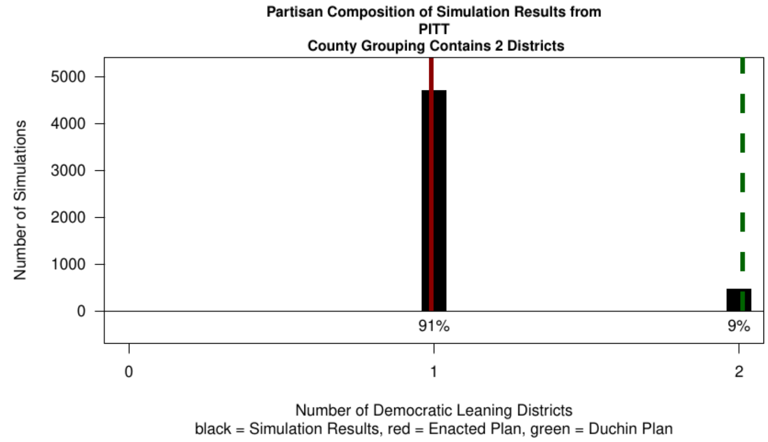
Observe that the polynomial $.28x^2 + .72x^3$ here can be seen as representing the fact that two seats occur in 28% of the maps for Buncombe, while 3 seats occur in 72% of the maps. (Similarly, then, for Cumberland and the polynomial $.82x^3 + .18x^4$.) The same answers that we found above for the fraction of simulated plans with a total of 5, 6, and 7 lean-Democrat districts, respectively, can be read off as the coefficients of x^5, x^6, and x^7, in the resulting expansion.

In the technical remark in the next section, I will point out a similar polynomial expansion which can verify the next section's calculations using public web applications, making the main findings of this rebuttal report easy to independently verify.

4 Correcting Barber's calculations

In my Table 2 on page 13 of this rebuttal report, I report the results of Barber's Figures 11, 14, 17, 20, 25, 28, 31, 34, 37, 45, 48, 51, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, and 88. Each of these figures reports, for one of the clusters Barber analyzes, the fraction of his simulated maps which achieve different numbers of "lean Democrat" districts according to the partisan index he uses. For example, in Figure 14 on page 44, Barber reports that 91% of his simulated maps had one lean-Democrat district, while the remaining 9% had 2, as seen in this reproduction below:

Figure 14: **Distribution of Partisan Districts from Simulations in Pitt House County Cluster**



This information is then reproduced in my Table 2 on page 13, as the following row:

Cluster	0	1	2	3	4	5	6	7	8	9	10	11	12
Pitt		91%	9%										

In particular, everything in my Table 2 (and the corresponding Table 3 for the Senate) is taken directly from Barber's report itself.

The data in Table 2 can then be used to calculate the distribution of the total number of lean-Democrat seats based on Barber's simulations across the 26 clusters, exactly in the same way as we did above for just 2 clusters from the data in Table 1. The result of the same calculation is the histogram shown in Figure 1. In particular, according to Barber's own simulated map set, and using his own measure of the number of lean-Democrat districts under his own partisan index, **the enacted House map exhibits more Republican bias than 99.82% of maps** composed of Barber's simulations, over the clusters Barber analyzes.

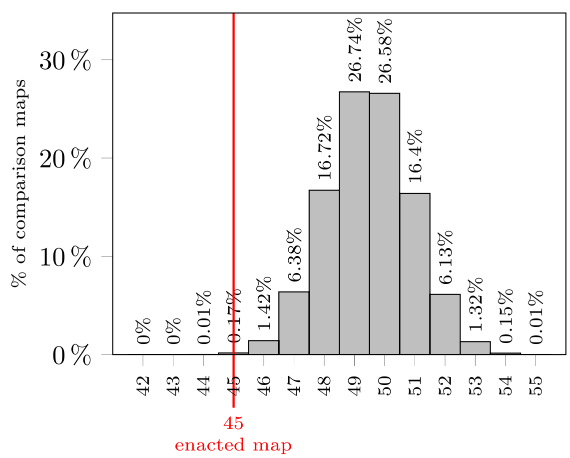


Figure 1: **Total lean-Democrat districts across Barber's House simulations**. This histogram shows the performance of Barber's simulated map set across the total set of House clusters Barber analyzes. It uses Barber's set of simulated maps, Barber's chosen metric (number of lean Democratic seats), calculated using the partisan metric Barber himself calculates in his report. The range 49-50 contains 50% of the simulated maps, the range 48-51 contains 86% of the simulated maps, and the range 47-52 contains more than 98% of the simulated maps. With 45 lean-Democratic districts across these clusters, the enacted map is in the most Republican-biased 0.18% of Barber's simulated maps.

In Table 3 I show Barber's Senate data analogous to the House data I show in Table 2. And in Figure 2, I plot the histogram showing the total of Barber's metric of Democratic-leaning districts across Barber's simulated map set, produced in the same way as I produce Figure 1 for the House. In particular, according to Barber's own simulated map set, and using his own measure of the number of lean-Democrat districts under his own partisan index, **the enacted Senate map exhibits more Republican bias than 99.61% of maps** over the clusters Barber analyzes.

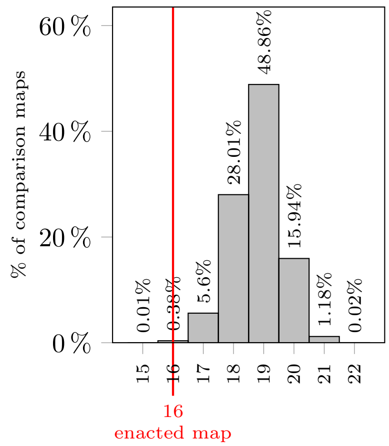


Figure 2: **Total lean-Democrat districts across Barber's Senate simulations**. This histogram shows the performance of Barber's simulated map set across the total set of Senate clusters Barber analyzes. It uses Barber's set of simulated maps, Barber's chosen metric (number of lean Democratic seats), calculated using the partisan metric Barber himself calculates in his report. The range 18-20 contains 93% of the simulated maps, and the range 17-21 contains more than 99% of the simulated maps. With 16 lean-Democrat districts, the enacted map is among the most Republican 00.39% of maps.

Technical Remark. As noted in the earlier Technical Remark, calculating the results of a histogram like Figure 1 is equivalent to expanding a certain polynomial expression. Based on the data in Table 2, (rows with only zero seats possible can be ignored), the polynomial to be expanded is

$$(.91x+.09x^2)(.44+.56x)(x^2)(x^2)(x)(.28x^2+.72x^3)(.82x^3+.18x^4)(x^4)(x)(.33x^2+.5x^3+.17x^4)(.99+.01x^1) \\ \cdots(.18+.82x)(.01x^4+.79x^5+.21x^6)(.01x^{10}+.56x^{11}+.44x^{12})(.02x^{10}+.32x^{11}+.66x^{12})$$

and publicly available tools such as `wolframalpha.com` can be used to verify that this polynomial expands to

$$5.55283\times10^{-7}x^{56}+0.0000685893x^{55}+0.00147488x^{54}+0.0131615x^{53} \\ +0.0612515x^{52}+0.163979x^{51}+0.265839x^{50}+0.267369x^{49}+0.167218x^{48}+0.0637935x^{47}+0.0141775x^{46} \\ +0.00167669x^{45}+0.000089375x^{44}+1.74341\times10^{-6}x^{43}+1.08123\times10^{-8}x^{42}$$

The histogram in Figure 1 can be read off the coefficients in this polynomial. For example, the fact that the coefficient of x^{49} is .267369 corresponds to the fact that Figure 1 reports the fraction of simulated maps with a total of 49 Democrat-leaning districts across the clusters Barber analyzes as 26.74% (rounded to two decimal places).

For the senate, from Table 3, the probability generating function is

$$(.77x+.23x^2)(x^2)(.23+.77x)(.93x^2+.06x^3)(.01x^4+.24x^5+.75x^6)(.05x^4+.95x^5)x(.97x+.03x^2),$$

which expands to

$$0.000227131x^{22}+0.0118152x^{21}+0.159415x^{20}+0.488577x^{19} \\ +0.280141x^{18}+0.0559707x^{17}+0.00377389x^{16}+0.0000807399x^{15} \quad (1)$$

giving the results shown in Figure 2.

5 A more sensitive cluster-by-cluster analysis of Barber's maps

In the previous section, I showed that even against Barber's simulated maps, using the partisan index Barber calculates, and using Barber's preferred metric for partisan bias (the number of lean-Democrat districts using that partisan index), both the enacted House and Senate plans are extreme partisan outliers.

This is true despite the fact that using the number of whole lean-Democrat districts with only a single proxy for partisanship is unlikely to capture the effects even of extreme gerrymandering in North Carolina county clusters, where a small number of seats are at stake in each, and the effects of extreme gerrymandering can be to put one or two seats into play (or take them out of contention), even in cases where districts do not change columns in a single hypothetical election.

In other words, I take Barber's single partisan index (which has a two-party statewide Democratic vote-share of XX), and analyze what would happen under his simulations, on average, if you swung the election results so that Democrats did better or worse by a normally-distributed swing matched to past statewide North Carolina elections. This is the same metric I used in my initial report.

In this section, I re-analyze Barber's results, still using his simulated maps, and still using his partisan index, but comparing maps in each cluster using the seats-expected metric (calculated with respect to that index), which evaluates how a map would be expected to perform under a range of conditions rather than one fixed hypothetical election.

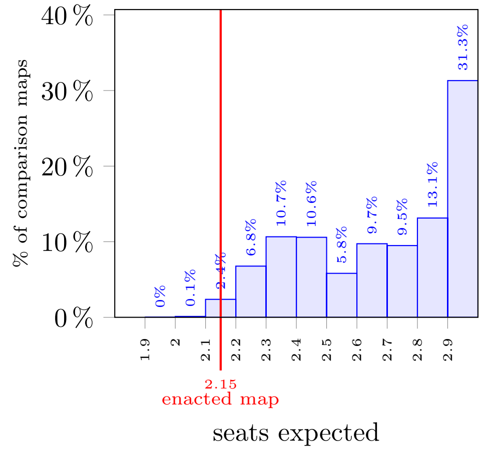
Below, I conduct this analysis for every county cluster I analyzed in my original expert report. In every cluster for which my analysis found the enacted map to be among the most optimized-for-partisanship possible maps (the first six House analyzed in the subsections below, and every Senate cluster analyzed below), Barber finds the map to be a partisan outlier according to the "middle-50%" definition he uses in his report. I summarize the outlier status of these 6+5 House and Senate clusters according to Barber's simulations in the following table:

Cluster	Enacted map among most Republican-biased...
House: Buncombe	00.797%
House: Forsyth-Stokes	00.0805%
House: Guilford	00.00646%
House: Mecklenburg	04.43%
House: Wake	05.78%
House: Pitt	24.2%
Senate: Cumberland-Moore	00.0024%
Senate: Forsyth-Stokes	00.01%
Senate: Granville-Wake	00.035%
Senate: Guilford-Rockingham	00.25%
Senate: Iredell-Mecklenburg	00.1%
	... against Barber's simulations.

Among the four remaining clusters in my report, there are two where the enacted maps are nevertheless extreme outliers against Barber's simulation sets. I summarize the results for these four clusters in the following table:

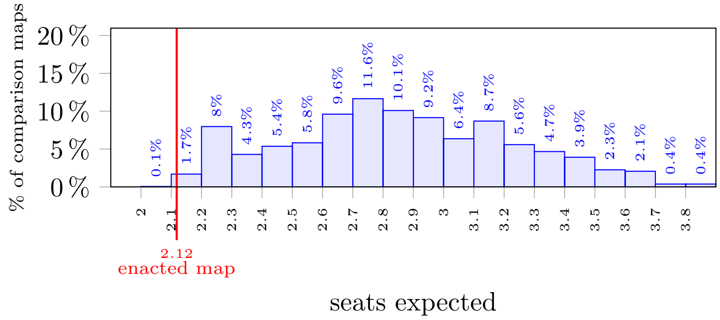
Cluster	Enacted map among most Republican-biased...
House: Alamance	39.4%
House: Brunswick-New Hanover	73.9%
House: Durham-Person	00.00265%
House: Cabarrus-Davie-Rowan-Yadkin	00.352%
	... against Barber's simulations.

5.1 House: Buncombe



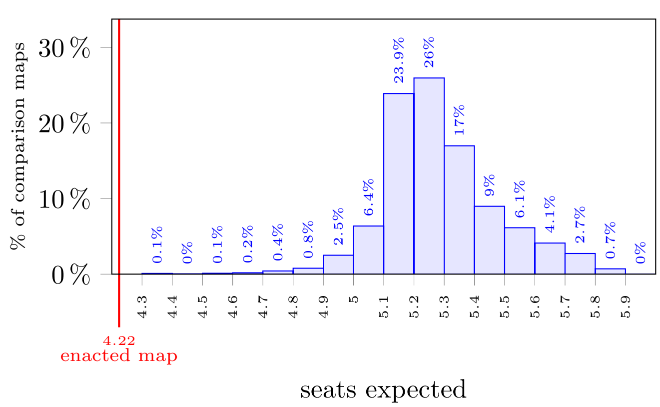
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.797% of maps.

5.2 House: Forsyth-Stokes



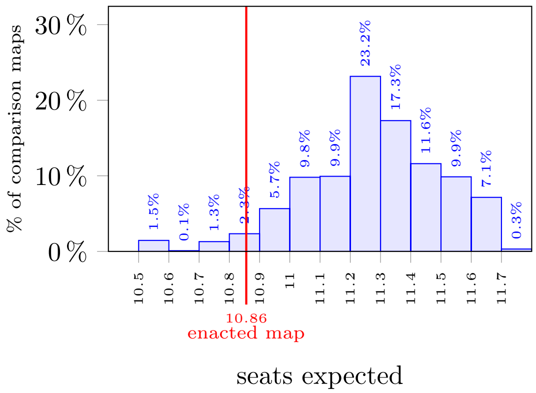
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0805% of maps.

5.3 House: Guilford



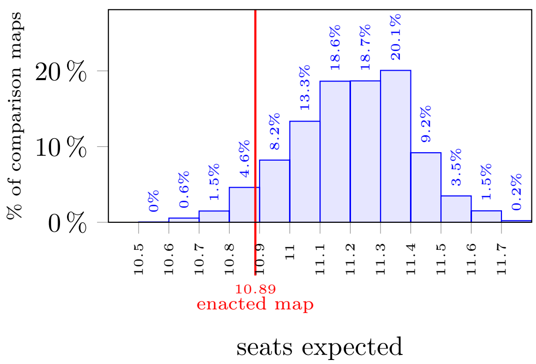
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.00646% of maps.

5.4 House: Mecklenburg



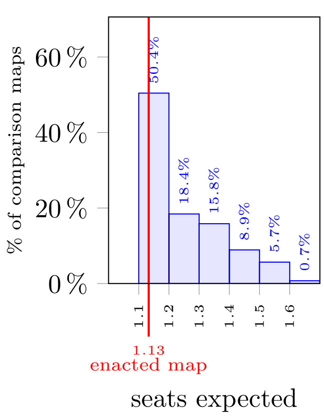
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 4.43% of maps.

5.5 House: Wake



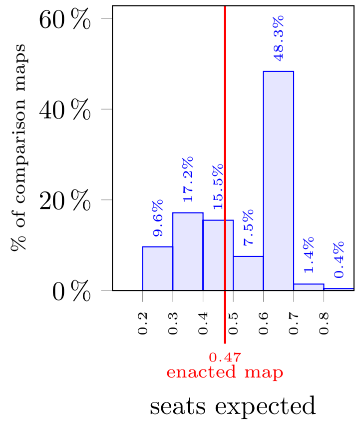
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 5.78% of maps.

5.6 House: Pitt



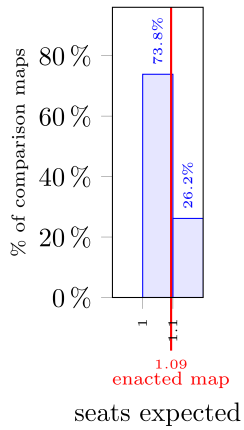
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 24.2% of maps.

5.7 House: Alamance



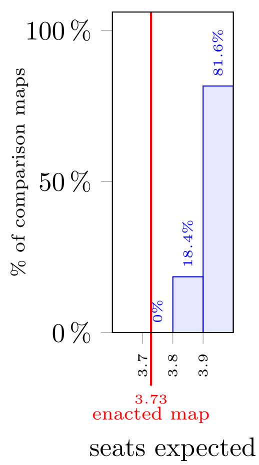
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map is not an outlier.

5.8 House: Brunswick-New Hanover



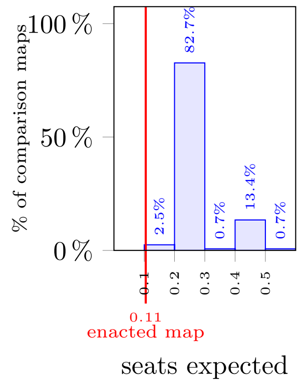
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map is not an outlier.

5.9 House: Durham-Person



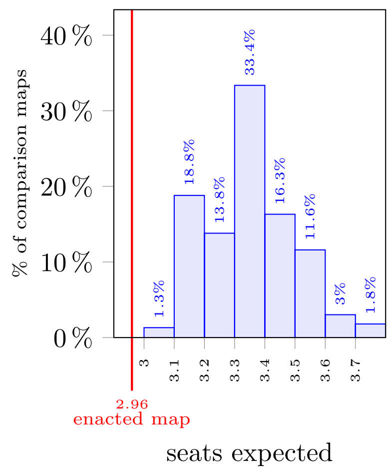
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.00265% of maps.

5.10 House: Cabarrus-Davie-Rowan-Yadkin



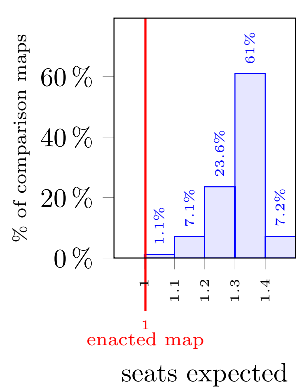
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.352% of maps.

5.11 House: Cumberland



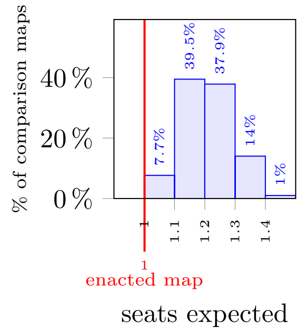
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0095% of maps.

5.12 Senate: Cumberland-Moore



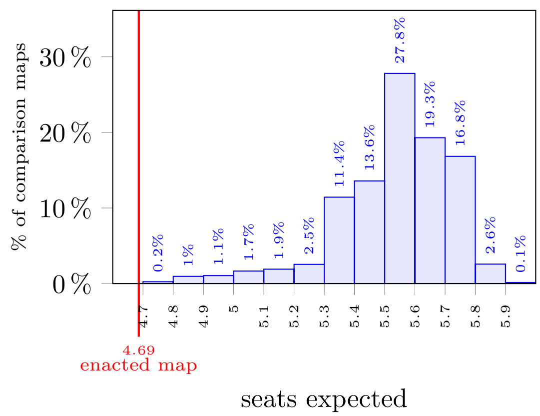
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.00235% of maps.

5.13 Senate: Forsyth-Stokes



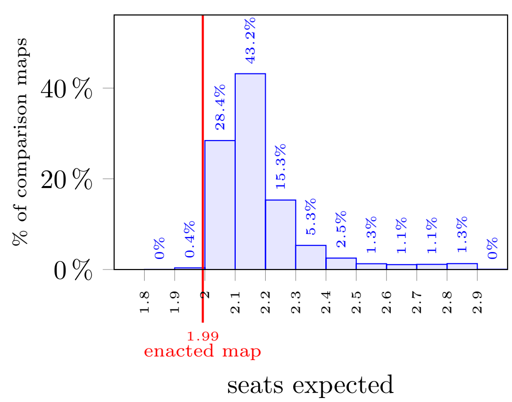
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0104% of maps.

5.14 Senate: Granville-Wake



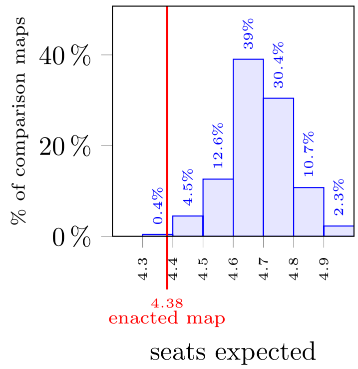
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0353% of maps.

5.15 Senate: Guilford-Rockingham



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.251% of maps.

5.16 Senate: Iredell-Mecklenburg



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.104% of maps.

Cluster	0	1	2	3	4	5	6	7	8	9	10	11	12
Davidson	100%												
Pitt		91%	9%										
Alamance	44%	56%											
Columbus-Robeson	100%												
Carteret-Craven													
Duplin-Wayne	100%												
Nash-Wilson			100%										
Caswell-Orange			100%										
Alexander-Surry-Wilkes	100%												
Franklin-Granville-Vance		100%											
Alleghany-*etc*	100%												
Beaufort-*etc*	100%												
Buncombe			28%	72%									
Anson-Union	100%												
Onslow-Pender	100%												
Cumberland				82%	18%								
Harnett-Johnston	100%												
Catawba-Iredell	100%												
Durham-Person					100%								
Brunswick-New Hanover		100%											
Forsyth-Stokes			33%	50%	17%								
Cabarrus-*etc*	99%	1%											
Chatham-*etc*	18%	82%											
Guilford					1%	79%	21%						
Avery-*etc*	100%												
Mecklenburg											1%	56%	44%
Wake											2%	32%	66%

Table 2: This table collects in one place the fraction of maps in Barber's House simulation sets realizing each number of lean-Democratic seats, as reported by Barber in his Figures 11, 14, 17, 20, 25, 28, 31, 34, 37, 45, 48, 51, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, and 88. He does not present figures for the clusters in Alleghany-Ashe-Caldwell-Watauga and Beaufort-Chowan-Currituck-Dare-Hyde-Pamlico-Perquimans-Tyrrell-Washington clusters because his 0-Democratic-district results for those clusters are based on a very small number of maps. For Carteret-Craven his method does not produce any maps.

Cluster	0	1	2	3	4	5	6
Cumberland-Moore		77%	23%				
Chatham-Durham			100%				
Alleghany-*etc*	100%						
Brunswick-Columbus-New Hanover	23%	77%					
Bladen-*etc*	100%						
Guilford-Rockingham			94%	6%			
Alamance-*etc*	100%						
Granville-Wake					1%	24%	75%
Iredell-Mecklenburg					5%	95%	
Buncombe-Burke-McDowell		100%					
Cleveland-Gaston-Lincoln	100%						
Forsyth-Stokes		97%	3%				

Table 3: This table collects in one place the fraction of maps in Barber's Senate simulation sets realizing each number of lean-Democratic seats, as reported by Barber in his Figures 95, 98, 103, 106, 110, 113, 117, 120, 123, 128. He does not present figures for the Bladen-Duplin-Harnett-Jones-Lee-Pender-Sampson and Cleveland-Gaston-Lincoln clusters because his 0-district results for these clusters are based on a small number of maps.

I hereby certify that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Wesley Pegden
12/28/2021

Response to Expert Report by Dr. Barber on the North Carolina State Legislature Redistricting Plans

Jonathan C. Mattingly

December 28, 2021

Contents

1 Introduction

The report by Dr. Michael Barber begins with a discussion of the political geography of the state of North Carolina. He emphasizes the heterogeneity of the state. While he points out the strengths of ensemble methods to separate the effect of natural clustering of votes and other effects due to political geography, Dr. Barber limits its use to analysis of the individual county clusters. Similarly, though he uses a collection of election data at the cluster level, he does not consider a diverse collection of election analyses both at the cluster level and when performing his statewide analysis. Rather, he restricts himself to a single summary statistic, namely, counting the number of Democratic-leaning districts at the individual cluster level based primarily on a composite election obtained through averaging several past statewide elections.

We complete the missing parts of Dr. Barber's analysis using data directly from his report when possible. When needed, we augment this data with an ensemble of maps obtained by running Dr. Barber's code. From this completed analysis, we see that Dr. Barber's ensemble shows both the Enacted NC House and the Enacted NC Senate to be extreme partisan outliers with a clear and systematic tilt in favor of electing Republicans.

When we focus on the structure of the enacted maps in the county clusters under Dr. Barber's analysis, we again see the same structures we observed using the Primary Ensembles from our initial report. These structures showed the enacted map to be an extreme outlier. Due to time constraints, we did not complete cluster level analysis on all clusters using Dr. Barber's simulations; we have, however, performed a cluster level analysis on a diverse collection of clusters in the NC House. Our cluster level analysis considers not only seat counts, but also the margins of victory within those seats. By examining the margins, we identify extreme partisan behavior at the cluster level using the very sampling code that Dr. Barber created.

We conclude that Dr. Barber's ensembles provide another independent verification that the enacted plans for the NC House and NC Senate are extreme gerrymanders.

2 Comment on Political Geography of State

In Section 3 of Dr. Barber's report, he discusses the political geography of the state. He made a number of statewide evaluations of the partisan structure using a single average of 11 statewide elections from 2014-2020. As his analysis in later sections makes clear, the political climate varies significantly from year to year and election to election. The average of these elections creates a new set of voting data, possibly quite district from those averaged to create it. I see no reason to elevate the behavior and properties of a map under the one particular political environment signified by this vote over other elections. It is important that the map used to translate our election votes into elected officials act in a non-biased way across a number of elections which represent different political climates seen in North Carolina, not just one.

In the rest of the report, Dr. Barber does switch to considering a number of distinct elections. However, he does not return to any aggregate statewide discussion using these individual elections and the diversity of election environments they represent. He does firmly endorse the use of a computer drawn ensemble of maps to create a base line against which the enacted map can be compared. He correctly represents that this method has the advantage of taking into account all of the political geography of the state, such as the concentrating of particular voters in some regions of the state or the preservation of counties and the like. Hence, when a map is an outlier compared to a computer drawn ensemble, these natural clustering or political geography considerations cannot be the explanation.

Dr. Barber never conducts any statewide analysis under his ensemble using different election results. However, all of the components necessary to perform such analysis are present in his report. Utilizing Dr. Barber's cluster-by-cluster ensembles, we complete the absent statewide analysis to examine the number of Democratic leaning seats under various elections. This analysis demonstrates that the enacted map *is* an extreme outlier when compared to Dr. Barber's ensemble.

3 Nonpartisan Ensemble Generated by Dr. Barber

In analyzing the North Carolina State House and Senate maps, Dr. Michael Barber generates an ensemble of non-partisan redistricting maps via the Sequential Monte Carlo (SMC) procedure in the *redist* R-package developed and maintained by a research group at Harvard University. When used to sample from a known distribution in a moderate sized problem, this method has been shown to faithfully sample the target distribution. This was validated on moderate sized examples using an enumeration algorithm developed by the same group that developed the *redist* R-package at Harvard. The method we used has similarly been validated using this and other methods. Dr. Barber used the ensemble method only at the cluster level and does not use it to perform a statewide analysis based on a statewide ensemble. Rather he just summarizes the cluster by cluster results in a few tables (Table 2 and Table 32) instead of performing any analysis which would show the cumulative effect at the statewide level. The coin flipping analogy we offer below shows why this is so inadequate. In utilizing Dr. Barber's ensemble, we demonstrate that he would have concluded the enacted map was an extreme outlier at the statewide level. This is not an endorsement of any of the particular algorithm choices he has made, but rather to demonstrate that this conclusion is available from his findings.

By taking the percentages in the cluster-by-cluster tables in Dr. Barber's report, we were able to perform the statewide analysis he neglected using his data. We were also able to perform this for the collection of different statewide elections Dr. Barber used in his analysis. This allowed us to see the behavior of the maps under different types of elections. Both of these considerations are important and we briefly discuss them individually before turning to the statewide analysis using Dr. Barber's data.

- **Importance of statewide analysis:** Dr. Barber analyzes each cluster one-by-one and concludes that the majority of them are not extreme outliers so under his election composite the map is not an outlier. However, in almost every case, he finds that the more Republican of the non-outlying options is selected. Consider the following analogy. Someone flips a coin that they claim is fair but is in fact biased to produce heads more often. They flip the coin and produce 40 heads and zero tails. On each flip, the chance of getting a head from a fair coin is 50%. Hence the outcome on each flip is not that surprising. Dr. Barber's analysis is analogous to looking at each flip alone and then claiming that the coin is fair because the outcome was a head and the chance of a fair coin producing a head was reasonable. However, taking a more global view one can an easily see that the chance of getting 40 heads in a row is astronomically small. And thus, one can conclude the coin is biased. This would even be true if there were only 35 heads and 5 tails.

  Analogously, each cluster taken individually might not be an extreme outlier, but it is extremely unlikely that all of these clusters woud exist together in a statewide map drawn without partisan intent.

  We will also see that some of the local clusters are extreme outliers in their own right using Dr. Barber's data and extending his analysis to look at the margins of victory (or the extent of the partisan lean) rather than only focusing on the number of seats won by either party (or the direction of the partisan lean). This extended analysis agrees with the finding in our initial report.

- **Often extreme behavior is apparent in only some elections:** If one wanted to rig a card game by colluding with some of the other players, the group would only need to act when none of the group was going to win. The group need only act when cards were aligned against them. Hence, the behavior of a gerrymandered map might appear typical in settings where the gerrymandering party is content with the outcome that one would typically expect without gerrymandering. Furthermore, it is possible that whatever system the card players are using is not sufficient to counteract some hands. In other words, even a card player that is cheating might not be able to win when their opponent draws a royal flush. Hence, it is not to be expected that in all cases a gerrymandered map is effective in supporting the gerrymandering party.

  In particular, one can not simply declare that a map is not gerrymandered because it is fair in some fraction (even a relatively large fraction) of the election environments. If it is clearly gerrymandered in some reasonable and pertinent election environments, then the map should be seen as gerrymandered. To do otherwise would be to argue that a casino would be happy with card players who only cheated 30% of the time and in particular did not cheat when they were already winning or had an unsalvageable hand.

In addition to generating a statewide analysis using the actual data from Dr. Barber's report, we also employ ensembles generated from the *redist* code base, set up according to Dr. Barber's analysis scripts.[1] We then show that well-established methods of probing for gerrymandering reveal that many of the individual clusters are indeed extreme gerrymanders. In doing so, we consider the partisan seat counts of each party and also extend the analysis to consider *how* the seats are won. The latter is important as it shows the degree that a given district is politically safe as well as determines how future political swings, unseen at present, might affect political outcomes. For example, atypically polarized districts can lead to maps which do not respond to the shifts in the electorate's preferences, and effectively lock in a particular outcome. Additionally, when a map has an extremely partisan structure, this can speak to the intent of the map makers even if the structure would be unlikely to affect some collection of elections such as wave elections in favor of the gerrymandering party.

[1] Dr. Barber did include a R Data file which might have included the maps he generated in his run. However, since our version of R was slightly different than his, it would not load. Hence we were forced to re-run his code.

4 Statewide Analysis of Dr. Barber's Ensemble of NC House Plans

Within each cluster, Dr. Barber presents the fraction of plans in his ensembles that would lead to a certain number of Democratic districts under each set of historic and averaged vote counts. These tables can be used to construct the probability of drawing a non-partisan plan at the statewide level that would yield a certain number of Democratic leaning districts under various elections.

Beginning with his averaged statewide vote counts, we construct the statewide probabilities of electing various numbers of representatives and present them in Figure 1 in terms of the number of Democrats elected. Only 0.177% of all of the plans in Dr. Barber's ensemble elect the same or more Republicans than the enacted plan.

Note that our count of Democrats elected includes the Democrats elected in single-district clusters, which are omitted from Dr. Barber's Table 2. So our Figure 1 reports that the enacted plan elects 49 Democrats under Dr. Barber's composite of elections, which is the four Democrats elected in single-district clusters that Dr. Barber reports in his Table 1 plus the 45 Democrats elected in multi-district clusters that Dr. Barber reports in his Table 2.

We repeat the above analysis with the 2016 and 2020 election data used by Dr. Barber. The only supplemental data we introduce is the number of single district Democratic clusters in each election which we have taken from our previous analysis. We summarize the 10 elections in Figure 2 and Table 1.

As in our previous analysis, we find that the outlier status of the ensemble has a significant impact on the amount of power the Republicans can amass in the House. For example, under the votes of the 2020 Lt. Governor race, 2016 Presidential race, and 2020 US Senate race, the ensemble breaks a Republican supermajority in 99.3937%, 98.976, and 99.992% of the plans in Dr. Barber's ensemble, respectively. However, the enacted plan would elect a Republican supermajority under each of these votes. Similarly, under the 2020 Governor race, the Republican majority would have been broken in 96.42% of the plans in Dr Barber's ensemble, yet they would have maintained the majority using the enacted map under these votes.

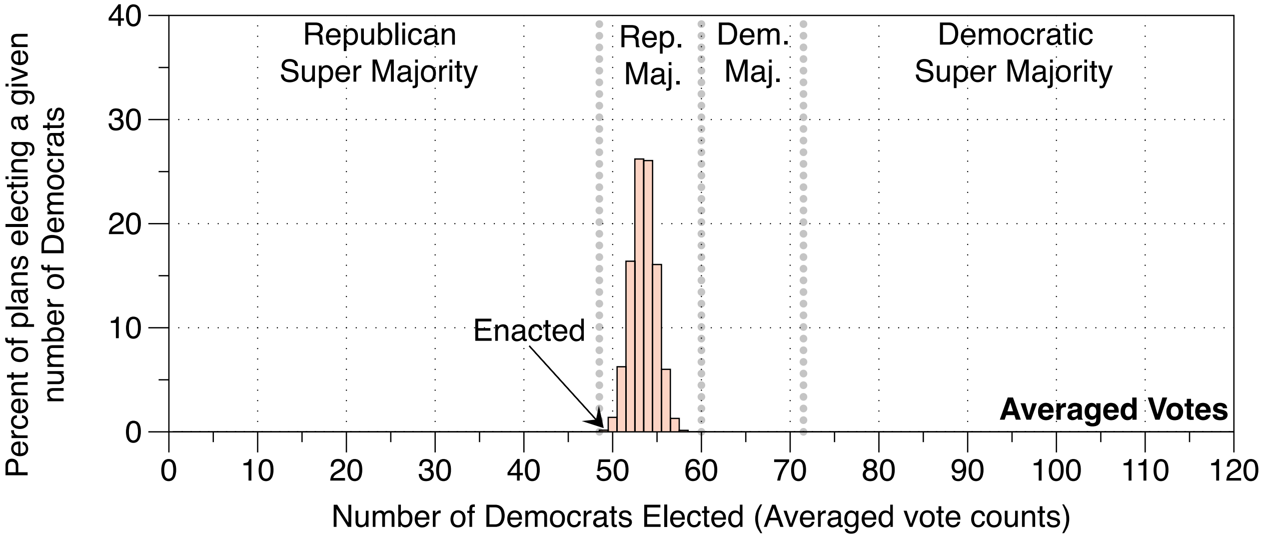


Figure 1: We compare Dr. Barber's statewide ensemble with the enacted plan under the Averaged election results used in his report. We find that only 0.177% of all of the plans in his ensemble would elect the same or more Republicans.

Election	Statewide Dem. Vote	% of Dr. Barber's Plans electing the same or more Republicans than the enacted plan
Barber's Average Vote	-	0.177%
2020 Governor	52.32%	0.204%
2016 Attorney General	50.20%	1.34%
2020 Attorney General	50.13%	0.00684%
2016 Governor	50.047%	0.215%
2020 President	49.36%	0.000146%
2020 Senate	49.14%	0.00804%
2020 Lt. Governor	48.40%	0.000377%
2016 President	48.024%	1.02%
2016 Senate	46.98%	0.223%
2016 Lt. Governor	46.59%	0.518%

Table 1: When considered at the statewide level, the ensembles produced by Dr. Barber are all extreme outliers. The chance that a plan drawn from the ensemble would elect the same or more Republicans as the enacted plan is, at most, 1.34%; in all but three of the elections it is less than 0.25%. We have ordered the elections with the election with the largest Democratic statewide vote fraction at the top and the election with largest Republican statewide vote fraction at the bottom. It is worth noting that many of the most extreme outliers happen for those between 50% and 48%. Looking at Figure 2, we see that this is the range where the Republicans would typically lose the super majority according to Dr. Barber's analysis. Though "Barber's Average Vote" which he used as a partisan index might or might not represent an actual plausible voting pattern, we have included it for comparison.

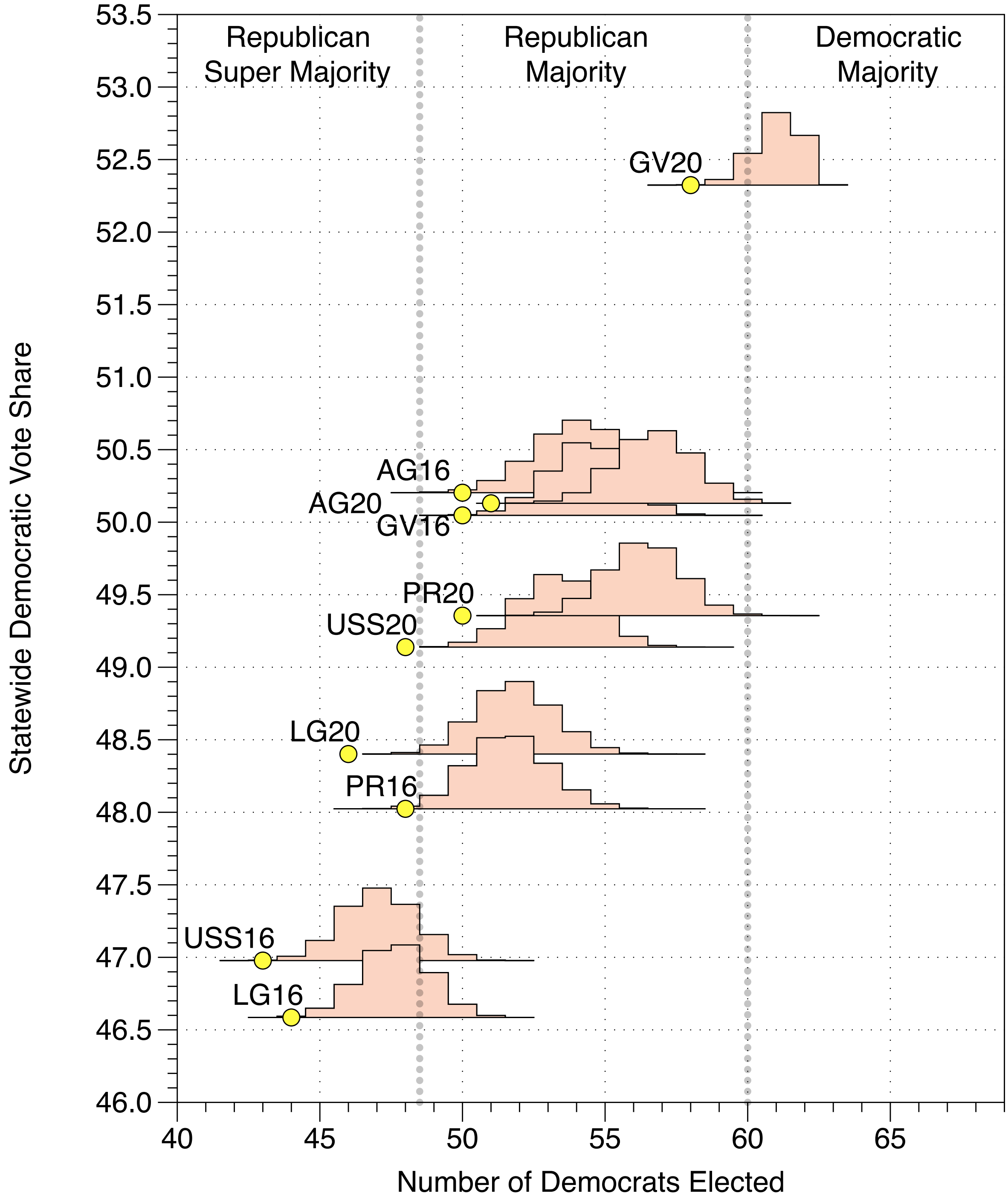


Figure 2: We compare Dr. Barber's statewide ensemble with the enacted plan under the ten 2016 and 2020 elections used in his report. Yellow dots show the result of the enacted plan. The enacted plan is an extreme outlier when considering the same data under a statewide lens. We summarize the numerical extent of the outliers in Table 1. The elections are abbreviated with the last two digits signifying the year, and the first letters representing Lt. Governor (LG), Governor (GV), President (PR), and US Senate (USS).

5 Statewide Analysis of Dr. Barber's Ensemble of NC Senate Plans

Repeating the above analysis for Dr. Barber's ensemble of Senate plans, we begin with the averaged statewide vote counts. We construct the statewide probabilities of electing various numbers of Senators and present them in Figure 3. Once again, our count of Democrats elected includes the Democrats elected in single-district Senate clusters, which are omitted from Dr. Barbers Table 32. So our Figure 3 reports that the enacted plan elects 20 Democrats under Dr. Barbers composite of elections, which is the four Democrats elected in single-district clusters that Dr. Barber reports in his Table 31 plus the 16 Democrats elected in multi-district clusters that Dr. Barber reports in his Table 32. Only 0.00385% of all of the plans in Dr. Barber's ensemble elect the same or more Republicans. Furthermore, this is the percentage of plans that lead to a Republican supermajority under these votes (which the enacted plan would produce as well). In other words, while the enacted plan always produces a Republican supermajority under Dr. Barber's analysis, only .00385% of the non-partisan plans that Dr. Barber simulates would produce a Republican supermajority.

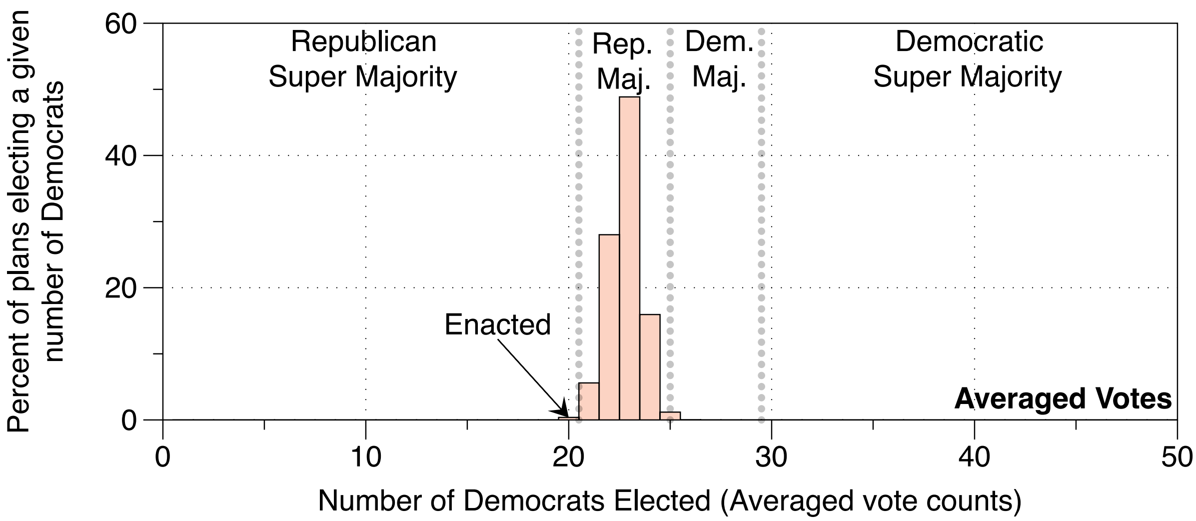


Figure 3: We compare Dr. Barber's statewide ensemble with the enacted plan under the Averaged election results used in his report. We find that only 0.00385% of all of the plans in his ensemble would elect the same or more Republicans than the enacted plan.

We repeat the above analysis with the 2016 and 2020 election data used by Dr. Barber. The only supplemental data we introduce is the number of single district Democratic clusters in each election which we have taken from our previous analysis. We summarize the 10 elections in Figure 4 and Table 2.

Again, we find that the outlier status of the ensemble has a significant impact on the amount of power the Republicans can amass in the Senate. Under the votes of the 2016 Governor race and 2016 Attorney General races, the Republicans lose their supermajority in 99.9544% and 98.9501% of the plans in Dr. Barber's ensemble, respectively. However, the enacted plan would elect a Republican supermajority under each of these voting patterns.

Election	Statewide Dem. Vote	% of Dr. Barber's Plans electing the same or more Republicans than the enacted plan
Averaged	-	0.00385%
2020 Governor	52.32%	1.92%
2016 Attorney General	50.20%	1.05%
2016 Governor	50.047%	0.047%
2020 Attorney General	50.13%	3.74%
2020 President	49.36%	9.92%
2020 Senate	49.14%	5.76%
2020 Lt. Governor	48.40%	0.250%
2016 President	48.024%	0.16%
2016 Senate	46.98%	1.22%
2016 Lt. Governor	46.59%	10.9%

Table 2: When considered at the statewide level, many of the ensembles produced by Dr. Barber are extreme outliers. In six of the ten elections, there is less than a 2% chance that a plan drawn from the ensemble would elect the same or more Republicans as the enacted plan; in three of the ten elections, there is less than a 0.251% chance that a plan drawn from the ensemble would elect the same or more Republicans than the enacted plan. As we have remarked in both our original report and in the analysis below, this *does not* mean that the enacted plan is not an extreme partisan gerrymander under the other four elections; it only indicates that the plan is not as extreme of an outlier in these elections under the particular lens of seat counts.

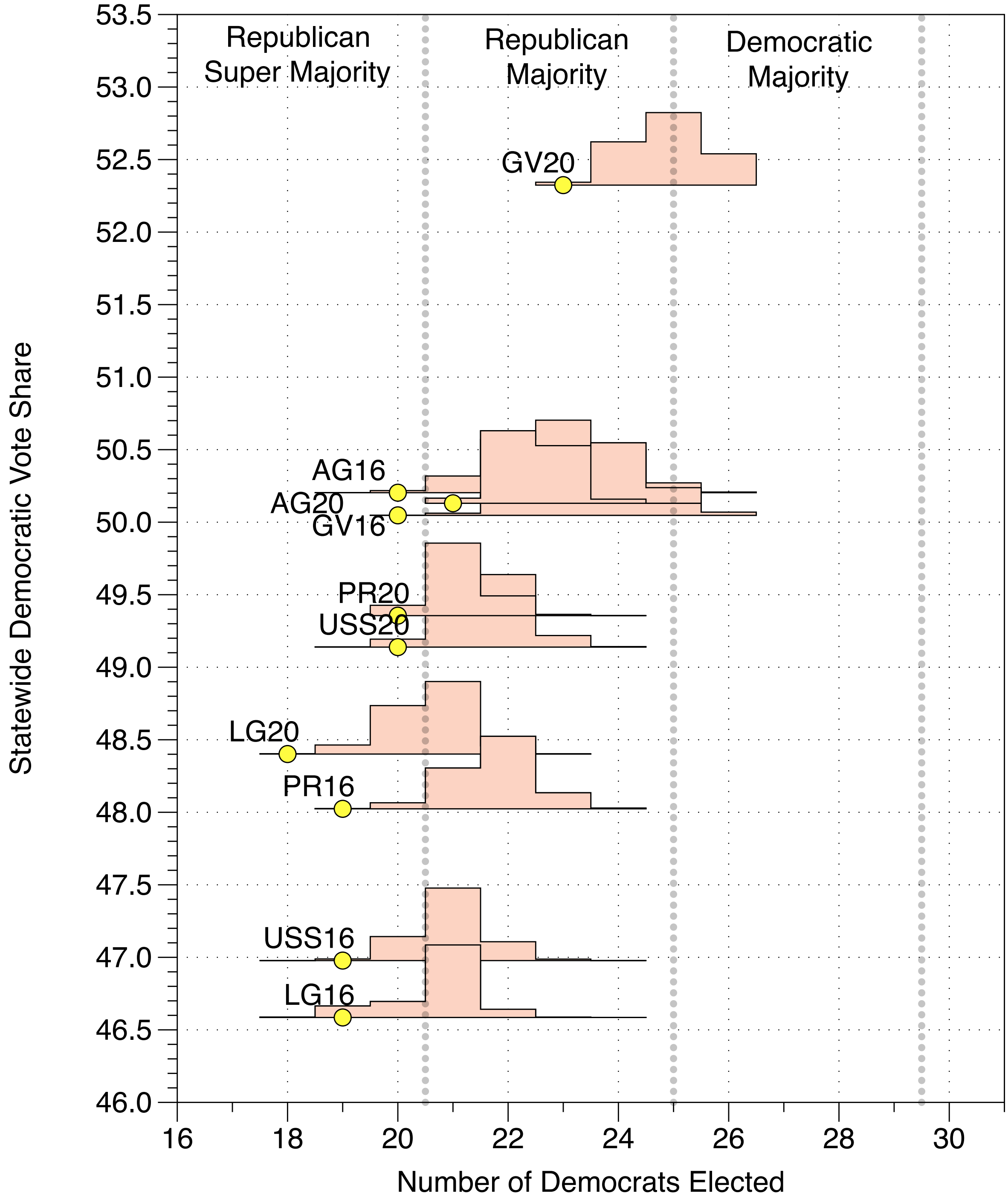


Figure 4: We compare Dr. Barber's statewide ensemble with the enacted plan under the ten 2016 and 2020 elections used in his report. Yellow dots show the result of the enacted plan. The enacted plan is an extreme outlier when considering the same data under a statewide lens. We summarize the numerical extent of the outliers in Table 1. The elections are abbreviated with the last two digits signifying the year, and the first letters representing Lt. Governor (LG), Governor (GV), President (PR), and US Senate (USS).

6 Cluster by Cluster Analysis

We now turn to examining certain clusters presented in Dr. Barber's work. We do not exhaustively examine all of the clusters. Rather, we select certain clusters to demonstrate how the lens that Dr. Barber chooses to use (namely only looking at the number of Democratic districts) yields an incomplete picture of the partisan make up of the districts even with respect to the individual districts.

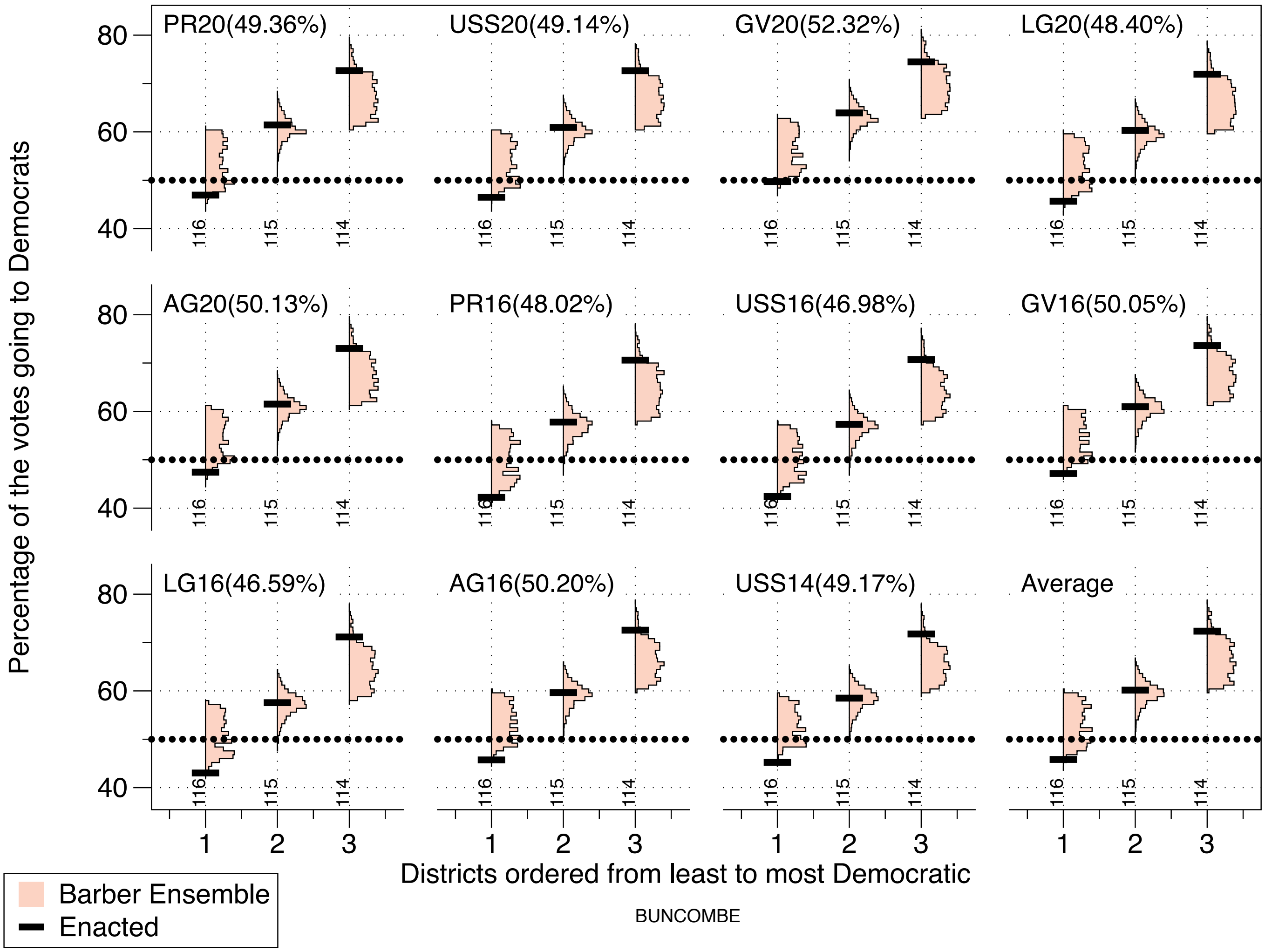
For a more complete picture, one would need to look at the actual partisan make-up of each district within a cluster. In fact, Dr. Barber reported on these values for the enacted plan, but did not compare these values to those found in his ensemble. One way of comparing these numbers is to examine the rank ordered marginal distributions of the vote fraction in each district. To do this, we order the districts from least to most Democratic (what Dr. Barber calls the Partisan Lean of Districts), and then look at the distribution of the most Republican, second most Republican, etc..., all the way until we reach the most Democratic district.

This type of analysis reveals not only how many Democratic leaning districts are within Dr. Barber's ensemble, but also *how much* they lean Democratic (or Republican). As we have demonstrated in our report, this is also relevant at a statewide level.

Note that all of our previous statewide analysis of seat counts simply relied on the numbers presented in Dr. Barber's report, i.e., the exact same ensemble that he relies on. The analysis below uses an ensemble of plans derived from running Dr. Barbers code (we were unable to extract his ensembles he used from the data he provided).[2] However, re-running his same code with his exact same input parameters should produce a comparable ensemble to the one he generated from the report, assuming that his code performs in the way he represents.

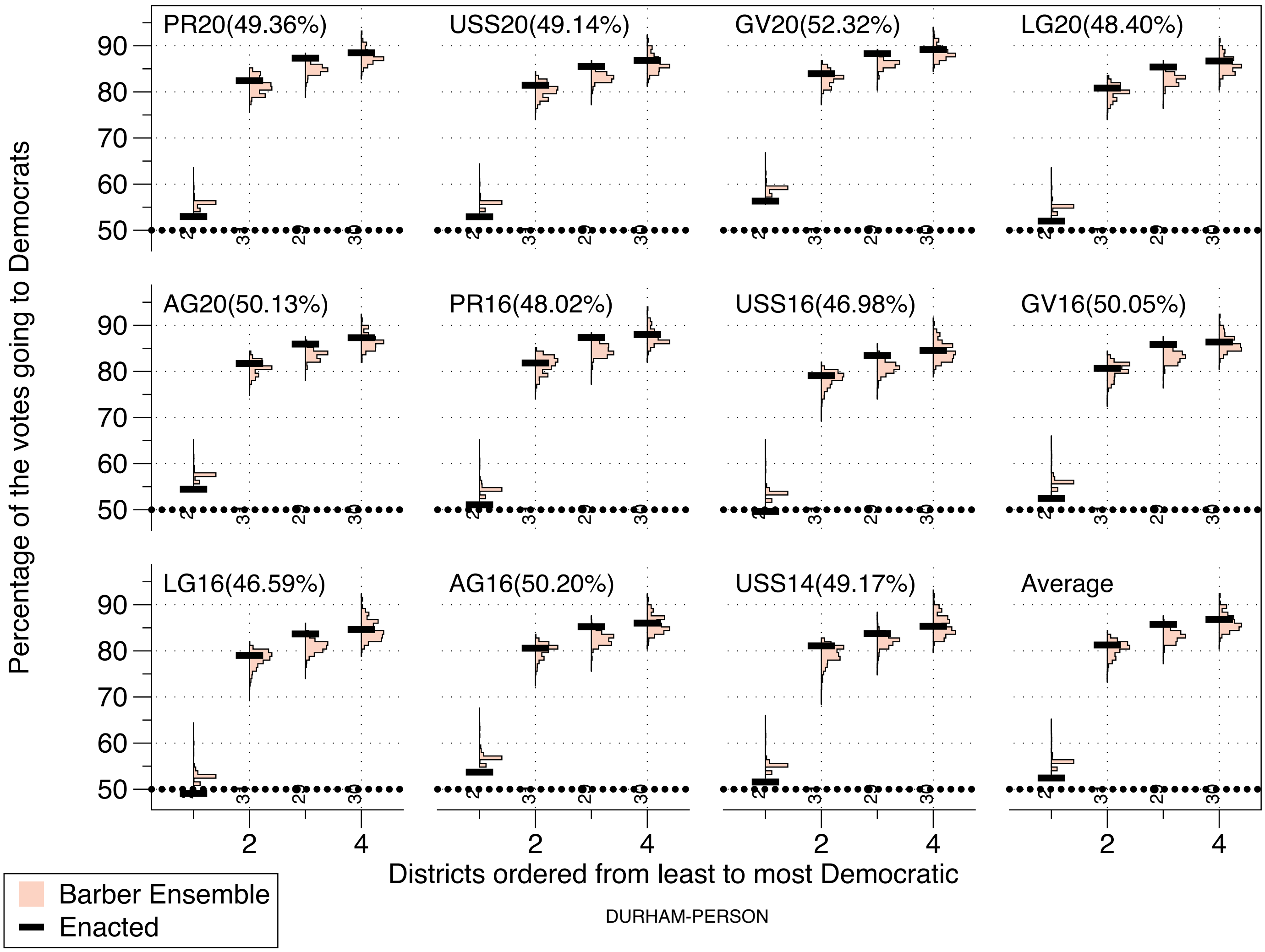
The main conclusion is that when comparing the cluster-by-cluster results from Dr. Barber's ensemble to those in our report, we find the qualitative structure to be the same. We again conclude that the enacted map is an extreme outlier when using Dr. Barber's ensemble with this additional analysis. We include a number of county clusters from the NC House. We make a number of comments in the caption of each figure. We refer the reader to our initial report to the court for a description of these Ranked-Ordered-Marginal-Histograms.

[2] We obtained the ensemble data from runs of Dr. Barber's code from Wes Pegden (CMU) who ran the code on his R installation as we did not have a computing environment able to run the code conveniently during the window when the rebuttal reports were due.



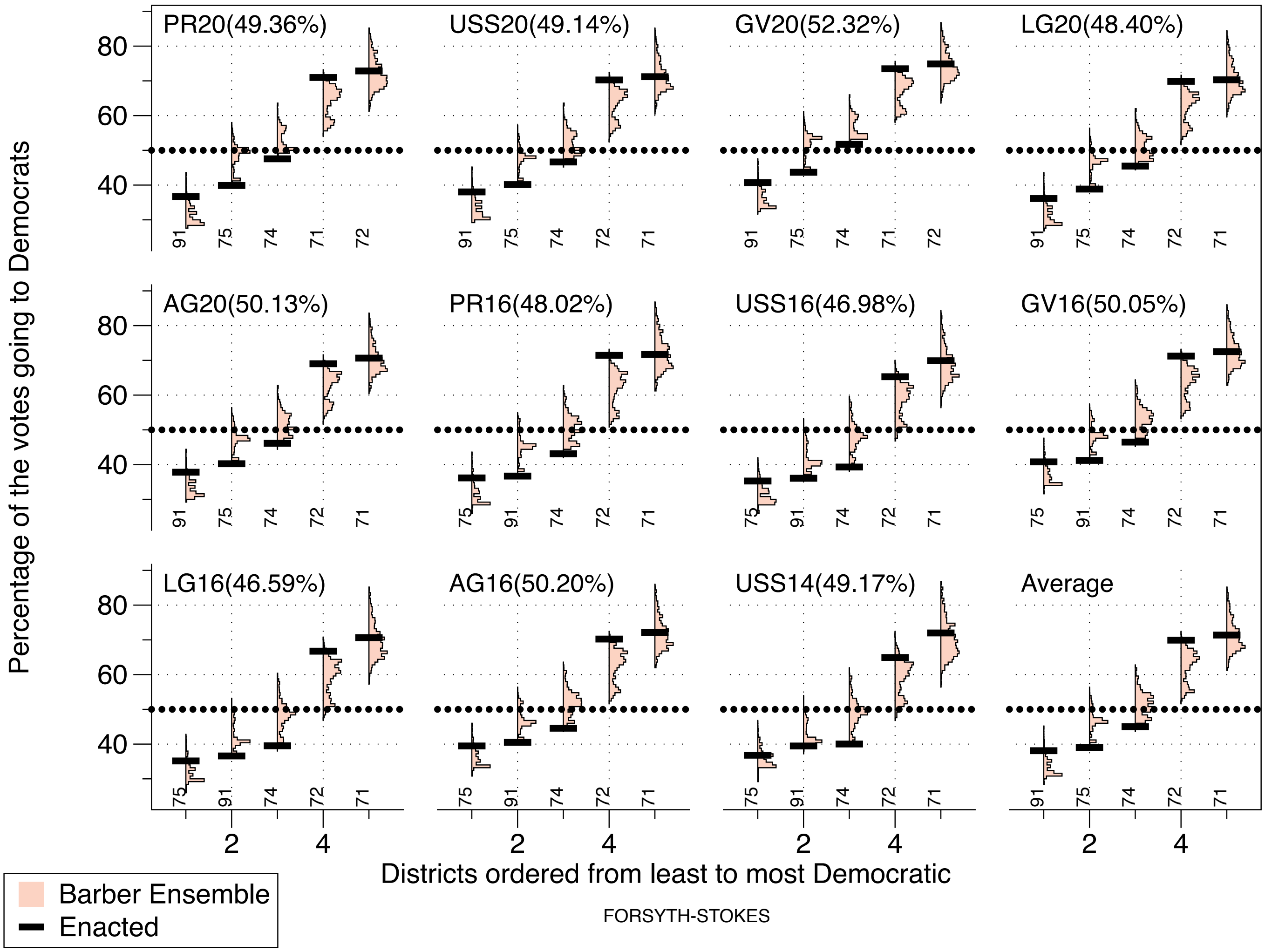
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	107	0.277	2409	6.23	38664	1	3
PR20	756	1.96	3095	8.0	38664	1	3
USS20	409	1.06	2529	6.54	38664	1	3
GV20	662	1.71	3200	8.28	38664	1	3
LG20	424	1.1	2624	6.79	38664	1	3
AG20	534	1.38	2655	6.87	38664	1	3
PR16	321	0.83	2701	6.99	38664	1	3
USS16	17	0.044	2062	5.33	38664	1	3
GV16	18	0.0466	2067	5.35	38664	1	3
LG16	18	0.0466	1998	5.17	38664	1	3
AG16	17	0.044	1992	5.15	38664	1	3
USS14	3	0.00776	1807	4.67	38664	1	3

Figure 5: In Buncombe County, the Enacted maps is an extreme outlier under Dr. Barber's ensemble. We see the same structure as we saw when compared with the probability ensemble our initial report. The most Republican district in the enacted plan has exceptionally few Democrats while the most Democratic district has exceptionally many Democrats. The result is that the Democrats never win three seats in the enacted plan under any of the elections considered, including Dr. Barber's composite "Averaged Election", even though they would typically do so under a number of elections under Dr. Barber's ensemble.



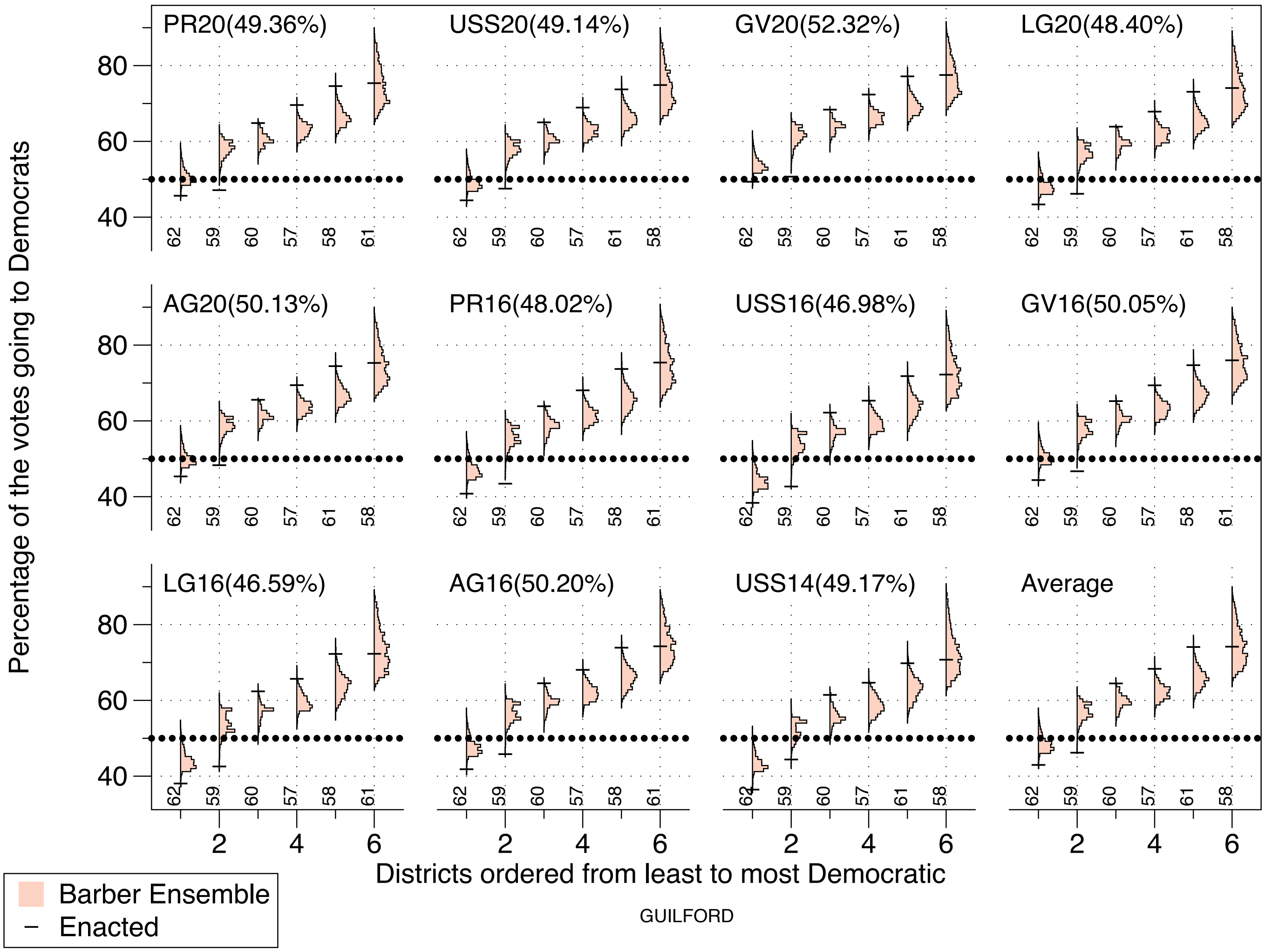
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	0	0.0	1396	3.69	37800	1	3 4
PR20	0	0.0	790	2.09	37800	1	3 4
USS20	0	0.0	1326	3.51	37800	1	3 4
GV20	0	0.0	1123	2.97	37800	1	3 4
LG20	0	0.0	1199	3.17	37800	1	3 4
AG20	0	0.0	1205	3.19	37800	1	3 4
PR16	0	0.0	1184	3.13	37800	1	3 4
USS16	0	0.0	2932	7.76	37800	1	3 4
GV16	0	0.0	1382	3.66	37800	1	3 4
LG16	0	0.0	2675	7.08	37800	1	3 4
AG16	0	0.0	1931	5.11	37800	1	3 4
USS14	0	0.0	10357	27.4	37800	1	3 4

Figure 6: In the Durham-Person cluster, we the same outlier structure in the enacted map when compared to Dr. Barber's ensemble as when compared to the primary ensemble in our orignal report. We see that the most Republican district has been depleted of Democrates. This makes the district much more competitive than it typically would be under a non-partisan redistricting plan.



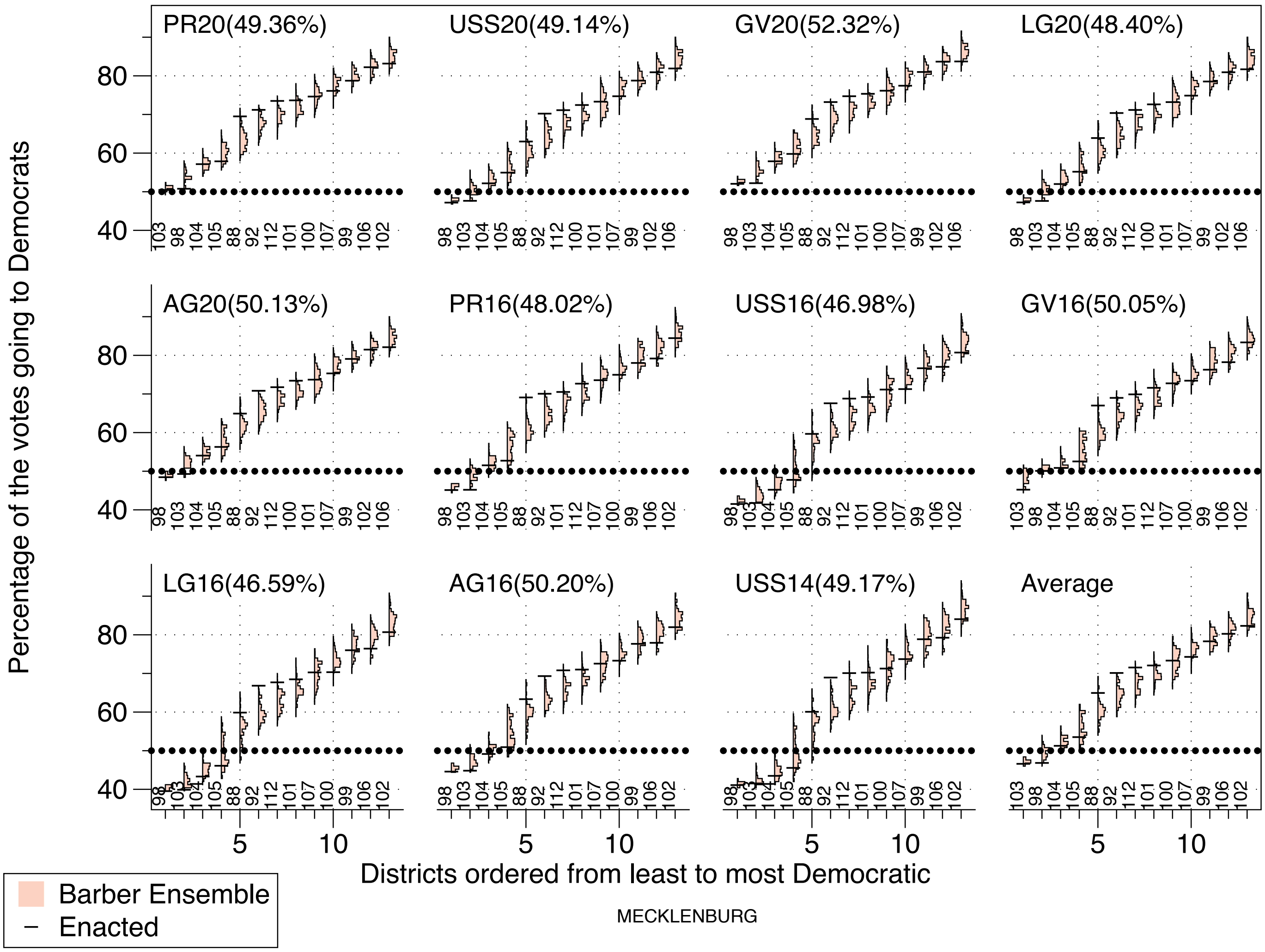
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	17	0.456	317	8.51	3726	1 2 3	4 5
PR20	4	0.107	349	9.37	3726	1 2 3	4 5
USS20	60	1.61	429	11.5	3726	1 2 3	4 5
GV20	2	0.0537	357	9.58	3726	1 2 3	4 5
LG20	21	0.564	376	10.1	3726	1 2 3	4 5
AG20	47	1.26	395	10.6	3726	1 2 3	4 5
PR16	7	0.188	284	7.62	3726	1 2 3	4 5
USS16	44	1.18	280	7.51	3726	1 2 3	4 5
GV16	11	0.295	292	7.84	3726	1 2 3	4 5
LG16	30	0.805	269	7.22	3726	1 2 3	4 5
AG16	25	0.671	263	7.06	3726	1 2 3	4 5
USS14	13	0.349	351	9.42	3726	1 2 3	4 5

Figure 7: In the Forsyth-Stokes cluster, We again see the same structure in Dr. Barber's ensemble as in the primary ensemble from our initial report. We see abnormally few Democrats in the second and third most Republican districts while we see abnormally many Democrats in the most Republican district and in the two most Democratic districts. The effect is to regularly flip the 3rd most Republican district to the republicans under the enacted map even under elections where many to almost all of the plans in Dr. Barber's ensemble would have awarded the seat to the Democrats.



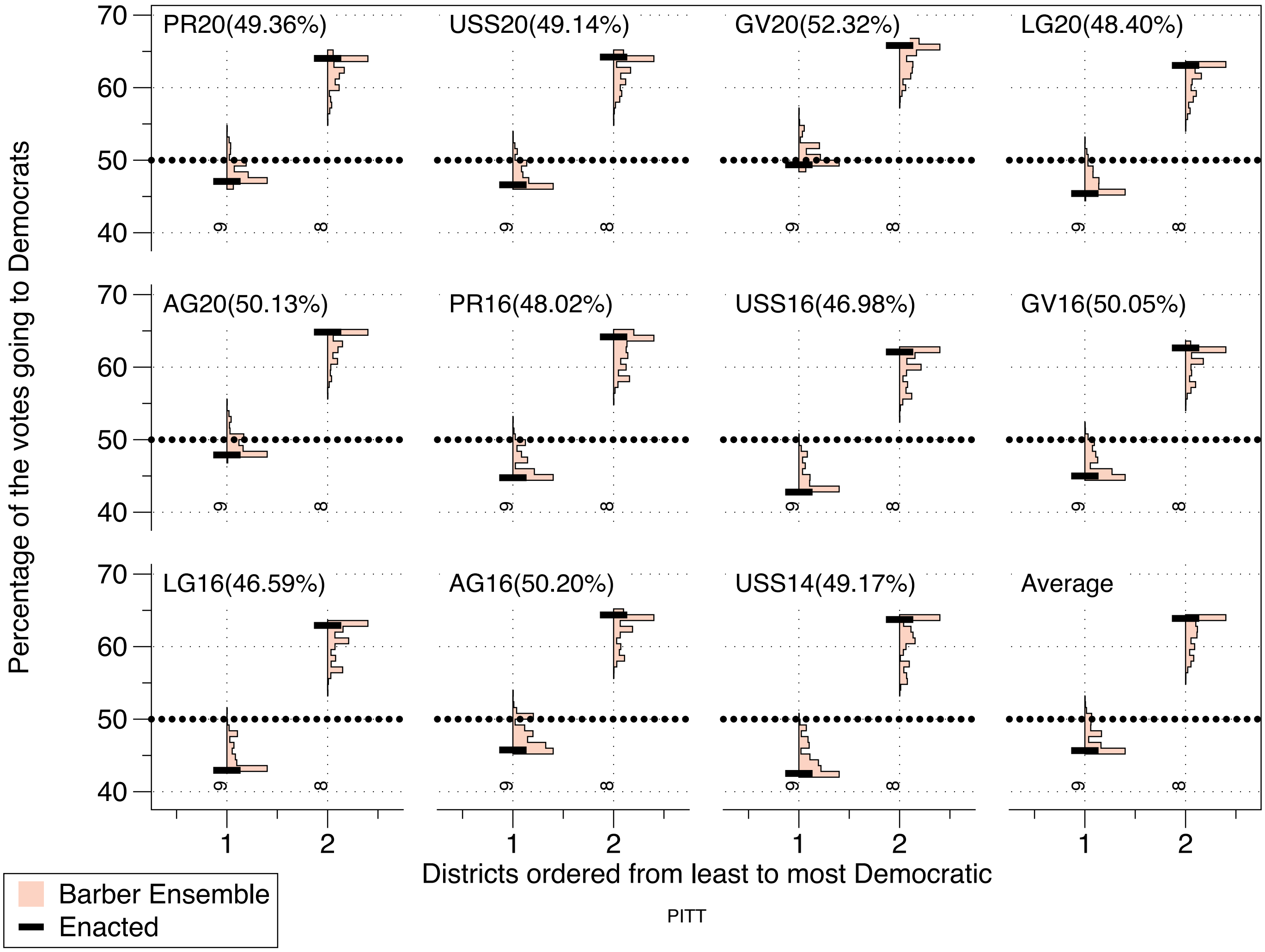
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	0	0.0	0	0.0	15489	1 2	3 4 5 6
PR20	0	0.0	0	0.0	15489	1 2	3 4 5 6
USS20	0	0.0	0	0.0	15489	1 2	3 4 5 6
GV20	0	0.0	0	0.0	15489	1 2	3 4 5 6
LG20	0	0.0	0	0.0	15489	1 2	3 4 5 6
AG20	0	0.0	0	0.0	15489	1 2	3 4 5 6
PR16	0	0.0	0	0.0	15489	1 2	3 4 5 6
USS16	0	0.0	0	0.0	15489	1 2	3 4 5 6
GV16	0	0.0	0	0.0	15489	1 2	3 4 5 6
LG16	0	0.0	0	0.0	15489	1 2	3 4 5 6
AG16	0	0.0	0	0.0	15489	1 2	3 4 5 6
USS14	0	0.0	0	0.0	15489	1 2	3 4 5 6

Figure 8: Dr. Barber did identify Guilford county as a Republican Gerrymander in the enacted map. The structure which produces this result is clear when compared with this plot of Dr. Barber's ensemble. We see that the two most Republican districts have abnormally few Democrats and the next three Republican districts have abnormally many Democrats. The effect is that the second most Republican seat reliably goes to the Republican party even though in some elections almost all of the maps in Dr. Barber's ensemble would award the seat to the Democrats. This was the same structure seen in the plots of our primary ensemble from our initial report.



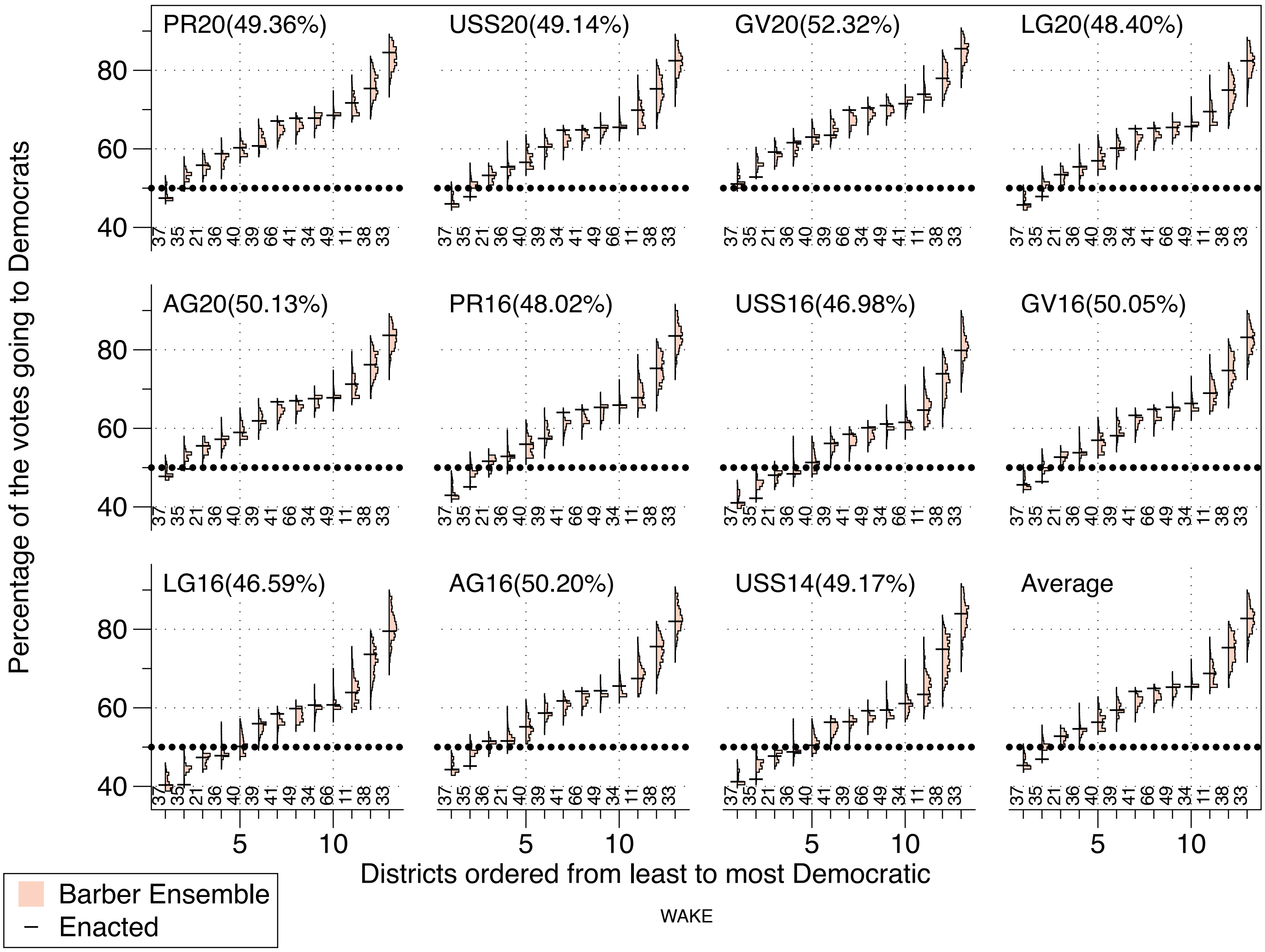
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	139	4.4	14	0.443	3161	1 2 3 4	5 6 7 8
PR20	105	3.32	18	0.569	3161	1 2 3 4	5 6 7 8
USS20	145	4.59	29	0.917	3161	1 2 3 4	5 6 7 8
GV20	114	3.61	17	0.538	3161	1 2 3 4	5 6 7 8
LG20	117	3.7	17	0.538	3161	1 2 3 4	5 6 7 8
AG20	119	3.76	17	0.538	3161	1 2 3 4	5 6 7 8
PR16	23	0.728	18	0.569	3161	1 2 3 4	5 6 7 8
USS16	74	2.34	15	0.475	3161	1 2 3 4	5 6 7 8
GV16	56	1.77	23	0.728	3161	1 2 3 4	5 6 7 8
LG16	68	2.15	18	0.569	3161	1 2 3 4	5 6 7 8
AG16	52	1.65	15	0.475	3161	1 2 3 4	5 6 7 8
USS14	153	4.84	16	0.506	3161	1 2 3 4	5 6 7 8

Figure 9: In Mecklenburg county, we again have that the four most Republican districts have abnormally few Democrats in them while the next four most Republican districts have abnormally many Democrats. This is the same structure as we saw under our primary ensemble in our initial report. The effect is that in a number of elections the Republican party wins one to two more seats than the typical plan from Dr. Barber's ensemble would award.



Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	314	6.05	1929	37.2	5189	1	2
PR20	1539	29.7	1974	38.0	5189	1	2
USS20	1525	29.4	1929	37.2	5189	1	2
GV20	1556	30.0	1974	38.0	5189	1	2
LG20	1537	29.6	1974	38.0	5189	1	2
AG20	1537	29.6	1974	38.0	5189	1	2
PR16	483	9.31	1929	37.2	5189	1	2
USS16	0	0.0	1660	32.0	5189	1	2
GV16	483	9.31	1929	37.2	5189	1	2
LG16	0	0.0	1660	32.0	5189	1	2
AG16	169	3.26	1660	32.0	5189	1	2
USS14	0	0.0	1660	32.0	5189	1	2

Figure 10: In Pitt county we see that same structure we found in our Primary ensemble repeated in Dr. Barber's ensemble. In particular, we see the districts pulled to the extremes of what is seen in Dr. Barber's ensemble. The depletion of Democrats from the more Republican district protects it from electing a Democrat in the enacted plan even though it would elect a Democrat in many of the plans in Dr. Barber's ensemble in a few of the elections we considered.



Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	159	1.11	2649	18.5	14305	1 2	3 4 5 6 7 8
PR20	140	0.979	1872	13.1	14305	1 2	3 4 5 6 7 8
USS20	209	1.46	2961	20.7	14305	1 2	3 4 5 6 7 8
GV20	145	1.01	1772	12.4	14305	1 2	3 4 5 6 7 8
LG20	159	1.11	2240	15.7	14305	1 2	3 4 5 6 7 8
AG20	165	1.15	2260	15.8	14305	1 2	3 4 5 6 7 8
PR16	137	0.958	2264	15.8	14305	1 2	3 4 5 6 7 8
USS16	196	1.37	3774	26.4	14305	1 2	3 4 5 6 7 8
GV16	220	1.54	3504	24.5	14305	1 2	3 4 5 6 7 8
LG16	196	1.37	2707	18.9	14305	1 2	3 4 5 6 7 8
AG16	205	1.43	3076	21.5	14305	1 2	3 4 5 6 7 8
USS14	287	2.01	3632	25.4	14305	1 2	3 4 5 6 7 8

Figure 11: In Wake county, we see that the number of Democrats in the first two districts is exceptionally low. Looking across the different Ranked Ordered Marginal Histograms, we see that this increases the electoral environments (as captured in different elections) in which the Republican party wins one of these two districts. In particular, Dr. Barber's ensemble would lead to the Democrats typically winning one of these two districts in cases where the enacted plan does not.

7 Comments on Sampling Methods

We now give some additional details to clarify some of the terms we used and the procedures we followed in sampling of the legislative maps in our original report in light of the discussion in Dr. Barber's report.

We recall that in the Legislative case we used parallel tempering to interpolate between a base measure equal to the uniform measure on spanning forests given the county and population constraints and a measure centered on the districts with a compactness similar to the enacted plan. The Primary ensemble for the legislative ensemble reported in the report was the latter of these two ensembles. The first of these ensembles would be the target distribution of the SMC algorithms from the *rdist* package when it is properly configured with resampling included. We took 4 million steps (proposals the Metropolis-Hastings algorithm) at the spanning tree level and 2 million steps on the other levels. We output maps every 25 steps for a total of 160,000 maps in the 4 million step case and 80,000 map in the 2 million step cases. We interpolated between the different ensembles using between 60 and 100 parallel tempering levels. We proposed switching between the parallel tempering levels every 100 steps. In some cases, we ran a number of clusters together in one sampling run and sometimes we ran them separately or is smaller subgroups in a single run. Generally we ran the larger, more compacted clusters such as Wake or Mecklenburg, in this way.[3] As described in the original report, *independent sample reservoirs* were used to split the 60 to 100 levels into computationally feasible chunks. This also improved the mixing and decorrelation properties of our algorithm. The congressional ensemble was drawn from a measure with a compactness weight against the same tree measure that the resampled rdist algorithm would sample. We used 12 parallel temping levels to move between the distribution without a compactness measure and the finial target distribution with the sampling weight. The number of steps was as specified above. The weights and other parameters used in the different run are specified in the header files of the datasets.

[3]For one run in the Senate, we only ran Granville-Wake for 1 million steps as we had strong evidence that this was sufficient for the parameter values being considered.

I declare under penalty of perjury under the laws of the state of North Carolina that the foregoing is true and correct to the best of my knowledge.

Jonathan Mattingly, 12/28/2021

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, et al.,

REBECCA HARPER, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

Consolidated with
21 CVS 500085

AFFIDAVIT OF MICHAEL BARBER

Now comes affiant Michael Barber, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and am competent to testify regarding the matters discussed below.

2. For the purposes of this litigation, I have been asked by counsel for Legislative Defendants to analyze relevant data and provide my expert opinions.

3. To that end, I have personally prepared the rebuttal report attached to this affidavit as Exhibit A, and swear to its authenticity and to the faithfulness of the opinions.

FURTHER THE AFFIANT SAYETH NAUGHT.

NCLCV v. Hall
21 CVS 15426
LDTX166

Exhibit #
Barber 4
12/30/2021
exhibitsticker.com

Executed on 28 December, 2021.

Michael Barber

Michael Barber

STATE OF FLORIDA

COUNTY OF PINELLAS

Sworn to and subscribed before me by online notarization this 28th day of December, 2021, by MICHAEL BARBER, who appeared by way of two-way audio/video communication technology, and he provided his Utah driver's license as identification.

Cynthia D. Glaros
Notary Public, State of Florida
My Commission Expires: 06/30/2022

Cynthia D. Glaros
Notary Public, State of Florida
Commission # GG228737
My Commission Expires June 30, 2022

Online Notary Public. This notarial act involved the use of online audio/video communication technology.

Reply Report of Michael Barber, PhD

Dr. Michael Barber
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Contents

1 Introduction and Qualifications

I have been asked by counsel for the Legislative Defendants to analyze and respond to reports submitted by Drs. Magleby, Pegden, Mattingly, and Cooper with regards to their analysis of North Carolina's recently enacted redistricting plans for the General Assembly (the "Enacted Plans").[1]

I do this in the following ways. First, I provide a summary of their conclusions as well as comparisons between their main results and those I produced in my original report. I also consider the specific analysis they produce for several county groupings that are singled out in their reports for additional scrutiny. I also define a measure of substantive significance to determine the degree to which the Enacted Map differs from Dr. Pegden's simulations and subsequent expected seats analysis.

The results show that there is often not agreement, even among the plaintiffs' experts, as to whether or not a county grouping's districts constitute a partisan outlier. In some cases the simulations produced by different experts come to different conclusions, and in other cases some of the experts assert an extreme partisan gerrymander, but in that same grouping the map proposed by the North Carolina League of Conservation Voters (NCLCV Map) exhibits the same qualities as the Enacted Map.

Based on the evidence and analysis presented below, my opinions regarding these reports studying the North Carolina General Assembly can be summarized as follows:

- There is significant agreement between Dr. Magley's simulation results and those produced in my original report with regard to the number of seats carried by Democrats in both the simulations and and the Enacted Plan despite some differences in our particular simulation methods.

- However, Dr. Magleby does not present county grouping by county grouping analyses,

[1] Due to the incredibly tight time constraints between the submission of reports and the deadline for submission of rebuttal reports, I only analyze Dr. Cooper's report in the House clusters and not the Senate clusters. My analysis has been provided to the best of my ability given the time constraints.

so it is not possible to compare his results with mine to identify if there are differences at this more granular level.

- In many of the 12 county groupings considered by Drs. Pegden and Mattingly in the House the Enacted Plan is either not a statistical outlier, is not substantively different from the simulations, or is in agreement with the map proposed by the NCLCV plaintiffs in the districts under dispute. Furthermore, in other cases there are reasonable explanations for the boundaries of the map that are separate from partisanship.

- In the 5 county groupings considered by plaintiffs' experts in the Senate, there is also often disagreement on whether the map constitutes a large outlier. In many of the clusters the Enacted Plan is either not a statistical outlier, is not substantively different from the simulations, or is in agreement with the map proposed by the NCLCV plaintiffs in the districts under dispute.

I am an associate professor of political science at Brigham Young University and faculty fellow at the Center for the Study of Elections and Democracy in Provo, Utah. I received my PhD in political science from Princeton University in 2014 with emphases in American politics and quantitative methods/statistical analyses. My dissertation was awarded the 2014 Carl Albert Award for best dissertation in the area of American Politics by the American Political Science Association.

I teach a number of undergraduate courses in American politics and quantitative research methods.[2] These include classes about political representation, Congressional elections, statistical methods, and research design.

I have worked as an expert witness in a number of cases in which I have been asked to analyze and evaluate various political and elections-related data and statistical methods. Cases in which I have testified at trial or by deposition are listed in my CV, which is attached to the end of this report. I have previously provided expert reports in a number of

[2] The political science department at Brigham Young University does not offer any graduate degrees.

cases related to voting, redistricting, and election-related issues: *Nancy Carola Jacobson, et al., Plaintiffs, vs. Laurel M. Lee, et al., Defendants. Case No. 4:18-cv-00262 MW-CAS (U.S. District Court for the Northern District of Florida); Common Cause, et al., Plaintiffs, vs. Lewis, et al., Defendants. Case No. 18-CVS-14001 (Wake County, North Carolina); Kelvin Jones, et al., Plaintiffs, v. Ron DeSantis, et al., Defendants, Consolidated Case No. 4:19-cv-300 (U.S. District Court for the Northern District of Florida); Community Success Initiative, et al., Plaintiffs, v. Timothy K. Moore, et al., Defendants, Case No. 19-cv-15941 (Wake County, North Carolina); Richard Rose et al., Plaintiffs, v. Brad Raffensperger, Defendant, Civil Action No. 1:20-cv-02921-SDG (U.S. District Court for the Northern District of Georgia); Georgia Coalition for the People's Agenda, Inc., et. al., Plaintiffs, v. Brad Raffensberger, Defendant. Civil Action No. 1:18-cv-04727-ELR (U.S. District Court for the Northern District of Georgia); Alabama, et al., Plaintiffs, v. United States Department of Commerce; Gina Raimondo, et al., Defendants. Case No. CASE NO. 3:21-cv-00211-RAH-ECM-KCN (U.S. District Court for the Middle District of Alabama Eastern Division); League of Women Voters of Ohio, et al., Relators, v. Ohio Redistricting Commission, et al., Respondents. Case No. 2021-1193 (Supreme Court of Ohio); Adams, et al., Relators, v. DeWine, et al., Respondents. Case No. 2021-1428 (Supreme Court of Ohio)*

In my position as a professor of political science, I have conducted research on a variety of election- and voting-related topics in American politics and public opinion. Much of my research uses advanced statistical methods for the analysis of quantitative data. I have worked on a number of research projects that use "big data" that include millions of observations, including a number of state voter files, campaign contribution lists, and data from the US Census. I have also used geographic information systems and other mapping techniques in my work with political data.

Much of this research has been published in peer-reviewed journals. I have published nearly 20 peer-reviewed articles, including in our discipline's flagship journal, *The American Political Science Review* as well as the inter-disciplinary journal,*Science Advances*. My CV, which details my complete publication record, is attached to this report as Appendix A.

The analysis and opinions I provide in this report are consistent with my education, training in statistical analysis, and knowledge of the relevant academic literature. These skills are well-suited for this type of analysis in political science and quantitative analysis more generally. My conclusions stated herein are based upon my review of the information available to me at this time. I reserve the right to alter, amend, or supplement these conclusions based upon further study or based upon the availability of additional information. I am being compensated for my time in preparing this report at an hourly rate of $400/hour. My compensation is in no way contingent on the conclusions reached as a result of my analysis. The opinions in this report are my own, and do not represent the view of Brigham Young University.

2 Review of Dr. Magleby's Report

My review of Dr. Magleby's report shows many areas in which our data and methods are similar and a few important areas where we differ in our methods. I begin with areas of similarity. As my report considered only the state legislative districts and not the congressional districts, I focus on that portion of Dr. Magleby's report as well.

My review of his report over the last several days indicates that our analysis is similar in the following ways:

- We both use a redistricting simulation algorithm to construct hypothetical legislative districts in the NC House and Senate.
- We both use data from historical elections at the level of the VTD to compute the partisan lean of the Enacted Plan as well as the simulated districts.
- We both use statewide election data to compute partisan indices.
- Using the partisan indices, we both compute the number of districts "carried" by

Democrats and Republicans as a measure of the partisan lean of the districts in the Enacted Plan and the set of simulations.

Our analysis differs in the following ways:

- While we both use a redistricting simulation algorithm to construct hypothetical legislative districts in the NC House and Senate, the exact method and computer programs differ in their construction.

- While we both use data from historical elections at the level of the VTD to compute the partisan lean of the Enacted Plan as well as the simulated districts, we use slightly different elections to generate a partisan index for each district. Professor Magleby uses the following elections in 2016 and 2020 in his index: President, US Senate, Governor, Lieutenant Governor, Attorney General, Treasurer, Secretary of State, Auditor, Agriculture Commissioner, Insurance Commissioner, Labor Commissioner, and Superintendent of Public Instruction. I also use elections for President, US Senate, Governor, Lieutenant Governor, and Attorney General. Due to the very tight time constraints of this case I was unable to obtain data for Treasurer, Secretary of State, Auditor, Agriculture Commissioner, Insurance Commissioner, Labor Commissioner, and Superintendent of Public Instruction. I also include the 2014 Senate race. However, the differences in our indices will not make a large difference given the large number of elections included in either index. Any one election carries very little weight. Finally, if the intention of simulations is to compare the Enacted Plan to a set of simulated districts, the more important factor is that the measure by which the Enacted Plan is evaluated is the same as the measure by which the simulated districts are measured. This is true of both sets of simulations.

- Professor Magleby takes a random sample of 1,000 districting plans from a larger set of simulations to use as his comparison set. From the description in his report, it appears that there is no consideration for whether the simulated districts divide more counties or are more or less compact than the Enacted Plan. In my report I only include simulations with as many or fewer county traversals and simulations in which the districts comprising the county grouping have an average compactness score that is as large or larger than the Enacted Plan.

- We both conduct simulations separately for each county grouping, however, Professor Magleby's report does not include them in his report. Because of this, I am unable to identify county groupings where the Enacted Map may differ from the simulated districts.

At the statewide level, our results are quite similar. In the State House Dr. Magelby's index predicts the Enacted Plan to have 48 Democratic districts (see Figure 1 of Magleby report). Dr. Magleby's simulations produce a distribution of seats carried by Democrats, with a peak at 52 seats carried by Democrats for a gap of 4 seats between the Enacted Plan and the modal outcome of the simulations.

My index in the House yields 49 seats carried by Democrats (see Tables 1 and 2 in Barber report). Because I consider each county grouping separately, I do not produce a single statewide histogram of seats carried by Democrats statewide, however, Tables 1 and 2 in my report show the middle 50% range of simulations across all House clusters to be 50-55 Democratic seats, which would include the modal outcome in Dr. Magleby's Figure 1. This produces a gap of 1-6 seats between the Enacted Plan and the middle 50% range of simulated plans.

In the State Senate Dr. Magelby's index predicts the Enacted Plan to have 19 Democratic districts (see Figure 3 of Magleby report). Dr. Magleby's simulations produce a distribution of seats carried by Democrats, with a peak at 22 seats carried by Democrats for a gap of 3 seats between the Enacted Plan and the modal outcome of the simulations.

My index yields 20 seats carried by Democrats in the State Senate (see Tables 31 and 32 in Barber report). Because I consider each county grouping separately, I do not produce a single statewide histogram of seats carried by Democrats statewide, however, Tables 31 and 32 in my report show the middle 50% range of simulations across all clusters to be 23 Democratic seats for a gap of 3 seats between the Enacted Plan and the modal outcome of the simulations.

3 Review of Dr. Cooper's Report

Dr. Cooper provides no quantitative analysis of the Enacted Plan aside from computing a few different partisan indices of the Enacted Plan. He does not compare the plan to any other alternative plan or set of plans, simulated or otherwise. While the partisan indices he uses are quantitative in nature, the analysis he conducts is fundamentally qualitative. For his analysis of the State House and Senate he looks at each county grouping and offers opinions and anecdotes about the boundaries of the districts as well as the supposed intentions of the legislature. However, he offers no evidence aside from his own opinion to support his assertions of the intentions of the legislature when drawing the district boundaries.

There is nothing wrong, per se, with a qualitative approach to evaluating a state's map. However, qualitative research requires the same standards and rigor as quantitative research. King, Keohane, and Verba (2021), arguably the most influential recent work on qualitative research, describe the need for rigorously defined standards in qualitative research as the following:

> We argue that nonstatistical research will produce more reliable results if researchers pay attention to the rules of scientific inference—rules that are sometimes more clearly stated in the style of quantitate research....Indeed the distinctive characteristic that sets social science apart from casual observation is that social science seeks to arrive at valid inferences by the systematic use of well-established procedures of inquiry (pg. 4).[3]

[3] King, Gary., Verba, Sidney., Keohane, Robert O.. Designing Social Inquiry: Scientific Inference in Qualitative Research, New Edition. United States: Princeton University Press, 2021.

From my review of Dr. Cooper's cluster-by-cluster analysis, there is no systematic process by which he determines if a set of districts in a county group constitute a gerrymander or not. Dr. Cooper does not describe any methods or processes that would be consistent with analysis in political science. Instead, I would describe his report as more akin to "casual observation," rather than rigorous social science. Nevertheless, I consider the particular county groups that he identifies and compare his assessment to that of my report and the other plaintiff expert reports.

4 Review of Dr. Pegden's Report

Dr. Pegden provides an analysis of the districts in the State House and Senate, as well as the congressional maps. However, I only consider the State House and Senate portion of his report. My understanding of his analysis is that he performs something akin to a simulation analysis, but in a slightly different way. Through a series of very large number of small perturbations to the existing districts that adhere to the redistricting criteria in North Carolina he creates a large set of comparison maps. He then compares the Enacted Map to this set of comparison maps using the 2020 Attorney General election as a "proxy for partisan voting patterns (pg. 9)" in two ways.

Unlike myself, Professor Magleby, and Professor Mattingly, Dr. Pegden only considers one election instead of an index or series of elections. It is unclear to me why he makes this choice since using any individual election as a proxy for future state legislative election results will be subject to the idiosyncrasies (candidate-related factors, issues specific to the office and campaign, campaign spending/advertising, etc) of the particular election chosen. While he provides alternative elections in the Appendix of his report for the 2020 Presidential election, the 2020 Lieutenant Governor election, and the 2020 Governor election, these are only included for the statewide analysis and do not look at specific county groupings in a group-by-group analysis, like is done earlier in his report.

The first analysis Dr. Pegden conducts is to determine the proportion of maps that are more "partisan" than the set of comparison maps. This fraction is treated throughout the report in a similar fashion to a reported p-value in other quantitative research in the social sciences. As Dr. Pegden states: "My method produces a rigorous p-value (statistical significance level) which precisely captures the confidence one can have in the findings of my "second level" analyses. In particular, for my statewide analyses, my second-level claims are all valid at a statistical significance of p = .002 (pg. 6)."

He also produces an additional analysis for each county grouping in which he computes the expected seat share for the Enacted Plan and compares this to the expected seat share of the set of comparison maps he produces. As he states: "When I am evaluating the partisanship of a comparison districting (to compare it to the Enacted Plan), I am interested in the number of seats we expect Democrats might win in the districting, given unknown shifts in partisan support. In particular, the metric I use is: How many seats, on average, would Democrats win in the given districting, if a random uniform swing is applied to the historical voting data being used?" This comparison is akin to a measure of substantive significance, as it helps us to understand the substantive difference between the Enacted Map and the set of comparison maps generated by Dr. Pegden's algorithm.

Substantive significance is a way of measuring the "practical significance" of a statistical finding. Gross (2015) states, "The function of statistical tests is merely to answer: Is the variation great enough for us to place some confidence in the result; or, contrarily, may the latter be merely a happenstance of the specific sample on which the test was made? The question is interesting, but it is surely secondary, auxiliary, to the main question: Does the result show a relationship which is of substantive interest because of its nature and its magnitude? "[4] As an example, suppose a drug trial discovers a drug to reduce blood pressure that produces a statistically significant effect in a randomized controlled trial. However,

[4]Gross, Justin H. "Testing What Matters (If You Must Test at All): A Context-Driven Approach to Substantive and Statistical Significance." American Journal of Political Science 59, no. 3 (2015): 775-788. quoting Kish, Leslie. 1959. "Some Statistical Problems in Research Design." American Sociological Review 24(3):328–38.

suppose that the substantive impact of this drug on patients' blood pressure remains very small. Given this, it may not be in the interests of the company to produce the drug given other considerations such as cost, potential side effects, and the opportunity costs of other activities. This would be an example of a difference between statistical and substantive significance.

The previous paragraph is relevant to Dr. Pegden's analysis because the first and second level analyses he provides are akin to measures of statistical significance while the expected seat share he computes is akin to a measure of substantive significance. Various measures of redistricting have been created and used, but agreement on any one particular measure as the ideal is lacking. Furthermore, even when a particular measure is agreed upon, what constitutes a substantively significant difference using that measure is even rarer.[5] Cain et al. summarise this issue well when they state, "Any partisan gerrymandering doctrine that the Court adopts will presumably allow states to draw maps that deviate some from the counterfactual plans. Strict adherence is not likely to be required. The critical question in applying this method then becomes: How much deviation is too much?"[6]

Given this, agreement on a strict definition of substantive significance is vanishingly rare. As a guidepost, I look at the expected seat share between the Enacted Plan and the expected seat share of the middle 50% of Dr. Pegden's simulations (in other words, the simulations which constitute the 25th to the 75th percentile). I then calculate how this difference would translate into an expectation for a party to pick up an additional seat over the 5 legislative elections that would take place over the decade in which the plan would be in place.[7] A redistricting plan is in place for a decade, so it makes sense to consider the

[5]Herschlag, Gregory, Han Sung Kang, Justin Luo, Christy Vaughn Graves, Sachet Bangia, Robert Ravier, and Jonathan C. Mattingly. "Quantifying gerrymandering in North Carolina." Statistics and Public Policy 7, no. 1 (2020): 30-38.; Stephanopoulos, Nicholas O., and Eric M. McGhee. "The measure of a metric: The debate over quantifying partisan gerrymandering." Stan. L. Rev. 70 (2018): 1503.; Warrington, Gregory S. "A comparison of partisan-gerrymandering measures." Election Law Journal: Rules, Politics, and Policy 18, no. 3 (2019): 262-281.

[6]Cain, Bruce E., Wendy K. Tam Cho, Yan Y. Liu, and Emily R. Zhang. "A Reasonable Bias Approach to Gerrymandering: Using Automated Plan Generation to Evaluate Redistricting Proposals." William & Mary Law Review 59, no. 5 (2018): 1521.

[7]I also use the middle 50% standard in my own analysis when looking at whether the Enacted Plan is

substantive differences over that time period.

5 Review of Dr. Mattingly's Report

Dr. Mattingly also produces a set of simulated districting plans and compares the Enacted Plan to this set of comparison maps. Dr. Mattingly does not produce an election index, but instead analyzes separately the results in 12 or 16 different elections in 2016 and 2020. In his statewide analysis he includes 2020: Attorney General, United States Senate, Commissioner of Insurance, Lieutenant Governor, Governor, State Treasurer, Secretary of State, State Auditor, Commissioner of Agriculture, Commissioner of Insurance, and US President; 2016: Commissioner of Agriculture, Governor, Lieutenant Governor, US Senate, and President. In his cluster-by-cluster analysis these elections are 2020: Attorney General, United States Senate, Commissioner of Insurance, Lieutenant Governor, Governor, State Treasurer, Secretary of State, State Auditor, Commissioner of Agriculture, and United States President; 2016: Lieutenant Governor and President. It is unclear to me why he does not include the other 2020 races in the cluster-by-cluster analysis.

In his analysis of the State House Dr. Mattingly produces two different "ensembles" or sets of simulations. The first set he describes as "matched" in that the simulations match the criteria used to draw the Enacted Plan. However, this is often not the case in the cluster-by-cluster analyses where the simulations often do not match the degree to which the Enacted Plan follows these criteria (See, for example, Figures 6.1.3, 6.1.9, 6.1.12, 6.1.21, 6.1.24, 6.1.27, 6.1.30, 6.1.33, 6.1.36 where the Enacted Plan splits fewer municipalities or has fewer ousted voters than a substantial number of the simulations). The simulations are often higher than the Enacted Plan in number of municipalities split, number of voters "ousted" from a district (see pg. 9 of the Mattingly report for a description of ousted voters), and the average compactness of the simulated districts is also often lower than the Enacted Plan (see

an outlier from the simulation results. This interquartile range is a commonly used measure of the central range of expected outcomes in a distribution.

Figure 7.3.1 in Mattingly Report.) Given this, I analyze the results of Dr. Mattingly's second set of simulations that are more strict regarding municipal splits and district compactness and do not consider the first set of simulations especially helpful in analyzing the Enacted Plan.

In his analysis of the State Senate the opposite is true. As in the House Dr. Mattingly produces two different "ensembles" or sets of simulations. The first set he describes are "matched" in that the simulations match the criteria used to draw the Enacted Plan. Here Dr. Mattingly notes, "We will see that the enacted NC Senate preserves municipalities to a high degree; in a way consistent with the most municipality preserving distributions we could produce. Hence, we also provide a Secondary Ensemble for the NC Senate which does not explicitly preserve municipalities (though compactness and the county preservation lead to a degree of municipality preservation.) It coincides with the primary ensemble properties in other resects" (pg. 6). Given the stated interests of the legislature in keeping municipalities whole, it is unclear to me why it would be useful to produce an analysis that intentionally violates this principle.[8] As such, I focus my comparisons on the first set of simulations in the Senate.

6 Disagreement Among Plaintiffs' Experts in House County Groupings

In this section I consider the county groupings that are singled out in the various expert reports submitted by the plaintiffs as being especially egregious examples of gerrymandering. However, as I will show, there is often disagreement even among the plaintiffs' own experts as to the presence, degree, and extent of the problem.

[8]For example, the committee hearing transcripts state: "We honored municipal boundaries. The chair made every effort to keep municipalities whole throughout the draw." See 9:43:00-9:45:00 in the committee hearing https://www.youtube.com/watch?v=7pyfVT6VOc4&t=34565s&ab_channel=NCGARedistricting and https://www.youtube.com/watch?v=GOVerOsNMm4&ab_channel=NCGARedistricting in the Senate.

6.1 Pitt House County Grouping

The Pitt county grouping contains two districts. The largest city in the cluster is Greenville, with a population of 87521, or nearly 1 district exactly (the target district population in the House is 208,788). However, creating a district that is entirely Greenville with the second district constituting everything in Pitt County that is not Greenville would create a district that resembles a donut hole (in other words, an embedded district). This type of district is also not proposed in the NCLCV proposed map. Given this, to avoid a “donut hole” scenario requires connecting the district that incorporates the majority of Greenville to the edge of the county so as to make sure this district is no longer embedded in the outer district. Simply adding a VTD to the district is not possible since no single VTD can be added without making the population of the district too large and the district highly non-compact. Thus, extending the boundaries of the district to the edge of the county necessitates splitting Greenville. The legislature chose to do this in a relatively east-west direction with northern Greenville in HD-8 and southern Greenville in HD-9.

Dr. Pegden’s report states, “My theorems imply that the enacted districting is among the most optimized-for-partisanship 11% of all alternative districting satisfying my districting criteria (in other words, 89.1% are less optimized-for-partisanship)...(pg. 21)”. 11% would not constitute a statistical outlier in a traditional scientific study.

With regards to substantive significance, Dr. Pegden’s analysis predicts the expected seats from a range of uniform swings in election outcomes in the Enacted Plan in this cluster to be 1.3 Democratic seats. To gauge the substantive significance of this result, I compare it to the 25th percentile outcome of the simulations on the same metric. This yields an expected seats of between 1.45 Democratic districts, for a difference of between .15 districts. In other words, in a series of 5 elections with varying electoral environments (some good for Democrats and some good for Republicans) in each district in the cluster, we would expect the Enacted Map to elect an additional Democrat in the county group less than 1 time, on average, than the simulated maps would do.

In Dr. Mattingly's report, all 12 elections he considers generate a strongly Democratic district (HD-8). In only 3 of the 12 elections he considers a majority of the simulations create a second Democratic district while in 9 of the 12 elections the majority of the simulations generate a Republican district. In Figure 6.1.23 the Enacted Plan agrees with the majority outcome of the simulations in 10 of the 12 elections he considers.

These results are similar to those contained in my original report. In 10 of the 11 elections I include a majority of simulations generate one Democratic District and one Republican leaning district. In 10 of the 11 elections, the Enacted Plan agrees with the majority outcome of the simulated maps.

The overall picture here is one of agreement that in the majority of cases the Enacted Plan and the simulations generate one Democratic-leaning district and one Republican-leaning district.

Dr. Cooper does not provide any analysis of the Enacted Plan aside from calculating a partisan index of the districts. However, Dr. Cooper notes that Pitt County is currently represented by two Democrats, Kandie Smith and Brian Farkas. Dr. Cooper fails to note the old (2020) districting arrangement had 3 districts in Pitt County with the third district (District 12) extending into Lenoir County and being represented by Republican Chris Humphrey.

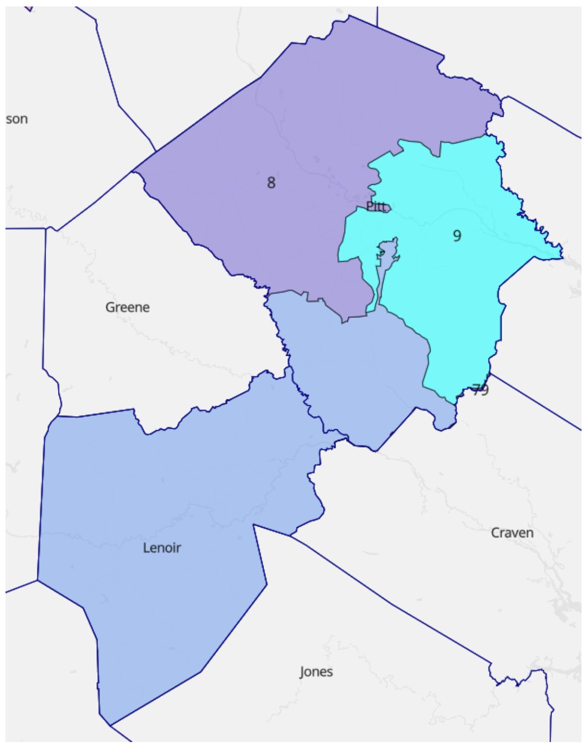


Figure 1: **2020 Districts in Pitt County**

6.2 Alamance House County Grouping

The Alamance County grouping contains two districts, HD-63 and HD-64. In this county there is disagreement between plaintiffs' experts as to whether or not the Enacted Map constitutes a gerrymander. Drs. Pegden and Mattingly do not find the map to be a partisan outlier, while Dr. Cooper objects to the particular shape of the districts.

Dr. Pegden's analysis places the Alamance County plan among the lowest quarter of districtings. He states, "In every run, the districting was in the most partisan 74% of districtings (in other words, 26.3% were less partisan, in every run) (pg. 23)." Because of this, he further states, "The Enacted Map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster (pg. 23)." Looking at the range of expected Democratic seats in this county, the Enacted Plan is actually *more* Democratic than the median simulation in Dr. Pegden's report.

Dr. Mattingly also agrees that this plan is not an outlier. He states, "From Figure 6.1.25, we see that thought [sic] the Enacted Map tends have more Democrats in the more Democratic district and less in the less democratic [sic] district it not [sic] an outlier on its own (pg. 46)."

The simulations in my initial report also agree with this assessment. In 10 of 11 elections I analyze, the partisan lean of the districts in the Enacted Plan agree with the partisan lean of the majority of the simulations run. In 6 of the 11 elections a Democrat won a majority of the two-party vote in District 63 while in 5 of the elections the Republican candidate won the majority of the votes.

However, Dr. Cooper notes the unusual shape of the district but does not mention that this shape is largely the same (different by only 2.5 precincts) as the 2019 court-approved maps.

6.3 Duplin-Wayne House County Grouping

The Duplin-Wayne County grouping contains two districts, HD-4 and HD-10.

Dr. Pegden does not provide an analysis of this county. He states, "For this cluster, my conservative approach (as discussed in Section 4.3.2) does not allow my algorithm to generate any comparison maps other than the map itself." This is interesting as it aligns with my simulations in which I found no alternative maps that had an equal (or fewer) number of county traversals and were as compact or more compact than the Enacted Plan (see pg. 58 of Barber original report).

Dr. Mattingly does not find the map to be a partisan outlier in his analysis. He states, "In the Duplin-Wayne county cluster the two districts are safely Republican under the elections considered. The Enacted Map is typical, falling in the middle of the observed democratic [sic] fraction on the Histograms (pg. 42)."

However, the proposed NCLCV Map generates one consistently Democratic-leaning district across all 11 election that I analyze. This constitutes a partisan outlier in all 11 elections I consider and would also fall outside the majority of the simulation results in all comparable elections in Dr. Mattingly's simulations as well.[9]

[9] While we do not use the same elections Dr. Mattingly and I both use the 2016 Lieutenant Governor, 2016 President, 2020 Lieutenant Governor, 2020 US Senate, 2020 President, 2020 Attorney General, and 2020 Governor races.

6.4 Buncombe House County Grouping

The Buncombe County grouping contains three districts, HD-114, HD-115, and HD-116. In this county there is agreement among experts that the Enacted Map in this county grouping generally creates two Democratic seats and 1 Republican-leaning seat. The degree to which this is a partisan outlier is less certain.

Dr. Pegden reports that the Enacted Map in this county "was in the most partisan 0.020% of districtings (in other words, 99.979% were less partisan, in every run) (pg. 16)." This is a statistically significant result. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 2.26 seats while the 25th percentile plan has an expected Democratic seats of 2.85. This leads to a substantive difference of 0.59 expected Democratic seats. Put another way, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 2 rather than 3 in this cluster) than the 25th percentile simulation roughly 3 additional times.

Dr. Mattingly's presents simulations in which the Enacted Map and the simulations agree on the creation of 2 Democratic districts in the cluster (HD-114 and HD-115). In all 12 elections considered the Enacted Map and the simulations are in agreement on the partisan lean of these two ditricts. The third district, HD-116, is the source of the disagreement. In 10 of the 12 simulations HD-116 in the Enacted Plan does not agree with the majority of the simulations in Dr. Mattingly's report (see Figure 6.1.14).

Dr. Cooper offers his assessment by saying "By shifting the current district lines where the districts meet in Asheville, however, the Enacted Map packs as many Democrats as possible into HD-114, while HD-115 stays relatively constant in terms of predicted vote share. The C-shaped HD-116 now includes most of the Republican-leaning VTDs in Buncombe..." Dr. Cooper appears to imply that a more appropriate orientation of the district lines would be to place a substantial portion of Asheville into each of the three districts.

In other words, across all three experts, the disagreement with the Enacted Plan centers on district HD-116. The "C" shape in District HD-116, as noted by Dr. Cooper, is the result of a decision to minimize the division of the city of Asheville. With a population of 94,589, the city will need to be split into two different districts, but not necessarily three. The Enacted Plan does this by placing approximately 87 percent of the city population in two districts, HD-114 and HD-115, leaving HD-116 to wrap around the the city and largely avoid its boundaries. This, however, creates the "C" shape of the district.

Finally, Dr. Cooper states, "Soon after the maps were passed, all three Democratic incumbents announced that they would be retiring and not running for office in these newly drawn districts." It is unclear to me how this fact is relevant to the shape of the new districts. If the Enacted Map create two strong Democratic districts, how is the announced retirement of all three Democratic incumbents in any way a result of the districting process, as Dr. Cooper implies? Dr. Cooper does not offer any other evidence that something else related to the new districts may have been the cause, such as double bunking, or a dramatic shift in the composition of each district from the old (2020) districts.

6.5 Cumberland House County Grouping

The Cumberland County group contains four districts, HD-42, HD-43, HD-44, and HD-45. In this cluster there is disagreement between the experts as to whether this county constitutes an extreme gerrymander.

Dr. Pegden's analysis contend the that the Enacted Plan is neither a statistically significant nor substantively significant outlier. He states, "In every run, the districting was in the most partisan 16% of districtings (in other words, 83.5% were less partisan, in every run)...The Enacted Map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster (pg. 27)."

Beyond not being statistically unique, the substantive difference in the number of expected Democratic seats is very small. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 3.21 seats while the 25th percentile plan has an expected Democratic seats of 3.25. This leads to a substantive difference of between 0.04 expected Democratic seats. In other words, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 3 rather than 4 in this cluster) than the 25th percentile simulation less than 1 additional time.

Dr. Mattingly's presents analysis in which the simulations generate two solidly Democratic districts (HD-44 and HD-42) and two districts that are closer to the .50 line with HD-43 being Democratic-leaning and HD-45 being Republican-leaning (see Figure 6.1.29 in Mattingly Report). Regarding this outcome he states, "In an ensemble that better preserves municipalities, the most Republican district is typically more republican [sic] and the second most Republican district more Democratic. This makes the Enacted Plan which squeezes the two together with an [sic] large outlier."

A closer look at Figure 6.1.29 shows that the Enacted Plan is an outlier not because it favors one party over the other, but rather because it creates more competitive races than the majority of Dr. Mattingly's simulations. While Dr. Mattingly's simulations produce a reliably Republican district in HD-45 and a reliably Democratic district in HD-43, the Enacted Plan creates neither and instead generates two very competitive districts. This produces a responsive map in which the partisanship of legislators elected to these two districts will likely shift frequently with shifting electoral preferences, something Dr. Mattingly notes is a desirable feature of a districting plan in other portions of his report (see pg. 3 and 4 of Mattingly Report).

Dr. Cooper agrees with this this when he states, "The Enacted Map creates two extremely competitive districts, HD-43 and HD-45 (with CCSC scores of D+1,334 and D+663, respectively) by splitting the Democratic-leaning City of Fayetteville into all four districts in the cluster." While his assessment of the competitiveness of these two districts is correct, he is incorrect as to the reason. Fayetteville has a population of 208,501 and as such is required to be divided into at least three districts, but not four. And while the Enacted Plan does draw parts of Fayetteville into all four districts, only 7.3 % of Fayetteville's population is placed in District 45.

Furthermore, the Enacted Plan places a much smaller proportion of Fayetteville in to the 45th district than NCLCV plaintiff's proposed map does. If Dr. Cooper's objections to dividing municipalities more than necessary is applied to this map, then plaintiff's map fares much worse than the Enacted Map. The table and figure below shows the comparison of how Fayetteville is divided in the two plans, which is also shown as Table 18 and Figure 54 in my original report.

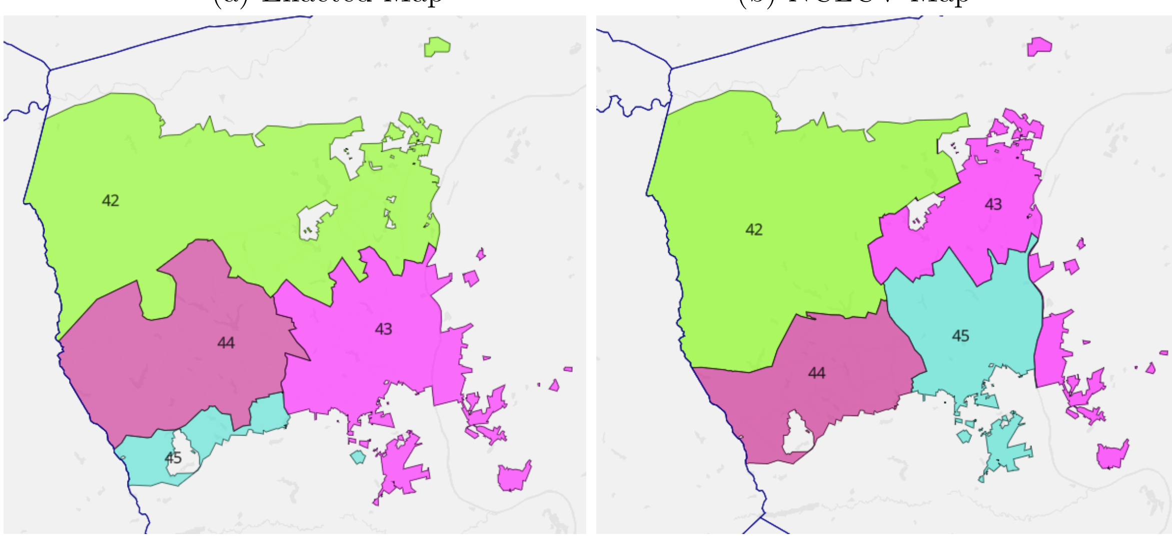
Table 1: Division of Fayetteville in Enacted Plan and NCLCV Plan

	Percent of Feyetville in district	
District:	Enacted Plan	NCLCV Plan
42	31.4	33.4
43	21.4	21.5
44	39.9	26.8
45	7.3	18.3
Total:	100%	100%

Note: Population number for city by district for Enacted Plan from: `https://ncleg.gov/Files/GIS/Plans_Main/Senate_2021/SL%202021-173%20Senate%20-%20StatPack%20Report.pdf` Population numbers for city by district for NCLCV Plan from Dave's Redistricting online. `https://davesredistricting.org/`

Figure 2: **Map of Fayetteville Divisions in Cumberland County Cluster**

(a) Enacted Map (b) NCLCV Map



6.6 Durham-Person House County Grouping

The Durham-Person County grouping contains 4 districts, HD-2, HD-29, HD-30 and HD-31. In this cluster there is disagreement with one district in particular, HD-2, which takes in the entirety of Person County to the north and the northern and eastern portions of Durham county.

Dr. Pegden's analysis of this county cluster yields the following results. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.20% of all alternative districtings satisfying my districting criteria (in other words, 99.79% are less optimized-for-partisanship)" (pg. 25).

However, the substantive effect of this difference is very small. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 3.87 seats while the 25th percentile plan has an expected Democratic seats of 3.95. This leads to a substantive difference of between 0.08 expected Democratic seats. Put another way, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 3 rather than 4 in this cluster) than the 25th percentile simulation less than 1 additional time.

Dr. Mattingly's simulations reveal three highly Democratic districts and one district that is more competitive. In the three highly Democfatic district (HD-31, HD-29, and HD-30), the Enacted Plan and the simulations are in agreement in all 12 of the 12 elections considered. In 10 of the 12 elections he considers the Enacted Plan agrees with the majority of simulations on the partisanship of the more competitive district, HD-2 (see Figure 6.1.23 of Mattingly Report).

Dr. Cooper simultaneously criticizes the map for dividing Durham across all four district while also packing Democratic into three of the four districts. He states, "The Enacted Map splits the City of Durham across all four districts but packs Democratic voters in HDs 29, 39, and 31; there is not a single Republican or competitive VTD in those districts (pg. 84)." This is a confusing complaint to offer since there are nearly no Republican VTDs in Durham County (if any at all when looking at Map 40 in Dr. Cooper's report), so it comes as no surprise that the three districts that are entirely contained in Durham County would contain no Republican-leaning VTDs. Furthermore, Dr. Cooper notes that the city of Durham is included in all four districts. However, remedying this by making sure District 2 contained no portion of Durham would only further make District 2 more Republican as the most Democratic VTDs in District 2 are those within the Durham city limits. Furthermore, the population of Durham is 283,506, which means it is large enough that it is absolutely necessary to include parts of Durham in all four districts.

6.7 Brunswick-New Hanover House County Grouping

The Brunswick-New Hanover County grouping contains 4 districts, HD-17, HD-18, HD-19, and HD-20. In this case, there is disagreement between experts as to whether this cluster constitutes an extreme gerrymander.

Dr. Pegden's analysis contends that the Enacted Plan is not a significant outlier, statistically or substantively. He states, "In every run, the districting was in the most partisan 11% of districtings (in other words, 89.4% were less partisan, in every run). The Enacted Map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster (pg. 24)."

Beyond not being unusual in comparison to the simulations to perform a statistically significant second-level analysis, the substantive difference in the expected Democratic seat share is also very small. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 1.25 seats while the 25th percentile plan has an expected Democratic seats of 1.25. This leads to a substantive difference of between 0.00 expected Democratic seats. In other words, across 5 hypothetical elections of each district in the cluster, we would not expect the Enacted Map to differ from the 25th percentile simulation at all, on average.

Dr. Mattingly argues on the other hand that the cluster is problematic. Specifically, he locates the problem in District 20. He states of this district, "The Republican party typically wins the second most democratic [sic] district [HD-20] in the Enacted Plan even though it would go to the Democrats under a number of elections when the neutral maps in the primary ensemble are used." Looking at Figure 6.1.35 in Dr. Mattingly's report we see that in 5 of the 12 elections the Enacted Plan agrees with the majority of simulations on the partisan lean of HD-20.

Dr. Cooper does not offer much by way of exposition in this cluster other than to claim that District 18 is packing Democratic voters "in and around Wilmington" and that "[t]he heavily Republican HD-19 also ensnares a Democratic-leaning VTD south of Wilmington, which keeps that VTD out of competitive HD-20 (pg. 95).” Another way to consider the “packing” referred to by Dr. Cooper is to note that District 18 keeps the communities of Hightsville, Wrightsboro, Skippers Corner, Castle Hayne, Blue Clay Farms, Northchase, Murraysville, and Kings Grant — all municipalities in and around Wilmington — together. Secondly, the “ensnared” VTD that Dr. Cooper refers to is only moderately Democratic (.56 in the 2020 Presidential election) and would make only the slightest difference in the overall partisan lean of HD-20 were it to somehow capture it from HD-19.

6.8 Forsyth-Stokes House County Grouping

The Forsyth-Stokes County grouping contains 5 districts, HD-91, HD-71, HD-72, HD-74, and HD-75. In this county there is agreement among experts that the Enacted Map in this county grouping generally creates two Democratic seats and 2 Republican-leaning seats. The partisan lean of the middle district in the Enacted Plan, HD-74, is in dispute.

Dr. Pegden's analysis contends that the Enacted Plan is a significant outlier, statistically and substantively. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.26% of all alternative districtings satisfying my districting criteria (in other words, 99.73% are less optimized-for-partisanship) (pg. 18)."

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 2.18 seats while the 25th percentile plan has an expected Democratic seats of 2.85. This leads to a substantive difference of 0.67 expected Democratic seats. Stated differently, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 2 rather than 3 in this cluster) than the 25th percentile simulation roughly 3 additional times.

Dr. Mattingly's presents simulations that contain two districts that are consistently Democratic leaning (HD-71 and HD-72) and two districts in which the distribution of simulation results are nearly always Republican leaning (HD-91 and HD-75). Thus, the outlier in his analysis lies with HD-74 where the simulations often generate both Republican and Democratic leaning districts and the Enacted Plan is more consistently Republican leaning.

However, the Enacted Plan's District 74 is very similar in shape and partisan lean to the NCLCV "optimized map." A map of the similarities in these districts is presented in Figure 69 of my original report. The partisan lean of District 74 using the election index in my original report is 0.45 while the partisan lean of District 74 in the NCLCV map is 0.46. Thus, if the Enacted Map is an extreme gerrymander due to the boundaries and partisan lean of District 74, then this criticism would also apply to the proposed NCLCV map as well.

Finally, Dr. Cooper notes of this district, "The splits of Winston-Salem do not make sense without reference to the anticipated voting behavior of the VTDs arranged into each district." However, this is not the case. The splits of Winston-Salem are largely the same as the 2020 maps, which were approved by a court in 2019. To a large degree the legislature appears to have chosen to leave the district boundaries much the same as the previous court-approved maps. Figure 69 in my original report presents this comparison between the current maps and the old maps in this cluster.

6.9 Cabarrus-Davie-Rowan-Yadkin House County Grouping

The Cabarrus County grouping contains 5 districts, HD-73, HD-76, HD-77, HD-82, and HD-83.

The layout of districts in this cluster is largely determined by the geography of the four counties in the cluster. Yadkin and Davie are sparsely populated and as such must constitute a portion of a single district (HD-77). This district then extends south into northern Rowan County, where it borders Davie County. Rowan County has a larger population - enough to sustain 1.68 districts. To minimize county traversals in the group, this implies creating a single district that is entirely contained within Rowan county and then another district that spans Rowan County and extends into northern Cabarrus County. Finally, Cabarrus County is the most populated county of the group (population = 225,804) with a population large enough to support 2.6 districts. This means that there will be two districts entirely contained in Cabarrus County with a partial district that spans Rowan and Cabarrus Counties. Because the county grouping is arranged in a linear North/South axis, this layout of districts - 1 in Yadkin and Davie, and partially in Rowan, 1 in Rowan, 1 spanning Rowan/Cabarrus, and 2 entirely in Cabarrus is the only arrangement that complies with the rules requiring the minimization of county traversals.

Thus, complaints of the districts are limited to the particular boundaries of the two and a half districts in Cabarrus county (HD-73, HD-82 and HD-83).

Dr. Pegden does not find the Enacted Plan to be a significant outlier. He states, "In every run, the districting was in the most partisan 12% of districtings (in other words, 87.7% were less partisan, in every run). The Enacted Map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster (pg. 26)."

Beyond not being unusual in comparison to the simulations to perform a statistically significant second-level analysis, the substantive difference in the expected Democratic seat share is also very small. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 0.33 seats while the 25th percentile plan has an expected

Democratic seats of 0.45. This leads to a substantive difference of 0.12 expected Democratic seats. In other words, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 0 rather than 1 in this cluster) than the 25th percentile simulation less than 1 additional time.

Dr. Mattingly's simulations produce 4 very Republican districts and one district that generates both Republican and Democratic outcomes (HD-82), depending on the election one uses to measure partisanship. He states, "In the Cabarrus-Davie-Rowan-Yadkin county cluster, there are abnormally few Democrats in the most Democratic district (district 82)." In 4 of the 12 elections he considers the Enacted Plan agrees with the majority of the simulations on the partisanship of this swing district.

One important thing to note is that the proposed NCLCV map performs worse than the Enacted Plan by this metric described by Dr. Mattingly. The most Democratic district in this plan is actually *less* Democratic than the Enacted Plan (0.43 in the NCLCV plan compared to 0.41 in the Enacted Plan using the partisan index in my original report). Thus, by Dr. Mattingly's argument, this would place the NCLCV map as more of a partisan outlier than the Enacted Plan in this county cluster.

6.10 Guilford County House County Grouping

The Guilford County grouping contains 6 districts, HD-57, HD-58, HD-59, HD-60, HD-61, and HD-62.

Dr. Pegden's analysis contends that the Enacted Plan is a significant outlier. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000089% of all alternative districtings satisfying my districting criteria (pg. 19)."

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 4.46 seats while the 25th percentile plan has an expected Democratic seats of 5.45. This leads to a substantive difference of 0.99 expected Democratic seats. In other words, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 4-5 rather than 5-6 in this cluster) than the 25th percentile simulation every time, on average.

Dr. Mattingly states of his simulations in this county: "The ensemble reliably has four democratic districts and a 5th which typically leans Republican but sometimes is competitive. Yet, the Enacted Plan gives one clearly Republican district and one which is often safely Republican and at times competitive (pg. 36)." District 59 is the district in question. Excluding HD-59, in 12 of the 12 elections the Enacted Plan agrees with the majority of Dr. Mattingly's simulations on the partisanship of the remaining 5 districts in the cluster. Thus the discussion of a potential gerrymander is focused on the composition of HD-59.

This also conforms with the simulation results in my original report. In 11 of the 11 elections I consider, the partisan lean of the districts in the Enacted Plan is one Democratic district short of the outcome in the majority of the simulations run.

However, one factor to consider is that District 59's boundaries are identical to the court-approved 2019 map's boundaries, but for one precinct, G53 (See Figure 78 in my original report for a map of the district under the two plans). District 59's population would be is too large if the map were to use the exact boundaries from 2019 based on the updated 2020 census population numbers. At the same time, District 61 and 58 are within the new population thresholds based on the new census numbers. Thus, it makes perfect sense to move one precinct from 57 into either 61 or 58 to equalize the population of these districts. Precinct G53 may have been chosen because it contains the right population size and is nearly entirely within the city of Greensboro, allowing a larger share of Greensboro to be contained within fewer districts.

6.11 Mecklenburg County House County Grouping

The Mecklenburg County cluster contains 13 districts, HD-88, HD-92, HD-98, HD-99, HD-100, HD-101, HD-102, HD-103, HD-104, HD-105, HD-106, HD-107, and HD-112.

Dr. Pegden's analysis contends that the Enacted Plan is a outlier, but not to the degree of other clusters discussed above. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 5.0% of all alternative districtings satisfying my districting criteria (in other words, 95.0% are less optimized-for-partisanship) (pg. 20)." In a traditional scientific study, the 5% boundary represents the line of a statistically significant outlier.

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 11.56 seats while the 25th percentile plan has an expected Democratic seats of 11.95. This leads to a substantive difference of 0.39 expected Democratic seats. Put another way, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 11-12 rather than 12-13 in this cluster) than the 25th percentile simulation in approximately 2 of these 5 elections, on average. In other words, the difference across this range of electoral environments is Republicans picking up an additional seat about 2 in 5 times.

Dr. Mattingly's presents simulation analysis that present the partisan distributions of the different districts and where, specifically, an outlier might occur. Figure 6.1.2 of Dr. Mattingly's report shows that in the 10 most Democratic districts in the cluster, the Enacted Plan agrees with the majority of simulations in 12 of the 12 elections considered. Both the simulations and the Enacted Plan contain 9 comfortably Democratic districts and a 10th district that is Democratic in 11 of the 12 elections considered. In the 2 most Republican districts (HD-98 and HD-103), the Enacted Plan agrees with the majority of simulations in 12 of the 12 elections considered. These two districts occasionally lean Democratic and occasionally lean Republican, but in all 12 elections the Enacted Plan's partisan lean aligns with the partisan lean of the majority of the simulations. This leaves one districts in dispute - HD-104. In District 104, the Enacted Plan agrees with the majority of the simulations in 11 of the 12 elections considered. Thus, across the 13 different districts in 12 different elections, the Enacted Plan is in alignment with the majority of the simulation results in all but 1 election (Figure 6.1.2 shows a misalignment of HD-104 with the majority of the simulations in the 2020 Commissioner of Agriculture election).

Dr. Cooper states that, "[t]he Enacted Map places no Republican VTDs in HDs 92, 99, 100, 101, 102, 106, 107, and 112, leaving every Republican-leaning VTD in HDs 88, 103, 104, and 105." Dr. Cooper omits here that there are very few Republican leaning VTDs at all on his map to begin with, they tend to be close to one another, and are concentrated in northern and southeastern Mecklenburg County. Thus it is not surprising that they are placed in relatively few of the districts given the desire for geographically compact districts. He notes the partisan composition of HDs 98 and 103 as being "carved out of the pockets of Republican voters in the north and southeast portions of the county... (pg. 68)." However, this assessment ignores the partisan geography of the cluster. District 98 is geographically compact and avoids traversing into the Charlotte city limits. Furthermore, District 103 in the southeast of the county keeps the cities of Mint Hill (there are 6 voters from this city not in District 103) and Matthews whole and together in one district.

6.12 Wake County House County Grouping

The Wake County cluster contains 13 districts, HD-11, HD-21, HD-33, HD-34, HD-35, HD-36, HD-37, HD-38, HD-39, HD-40, HD-41, HD-49, and HD-66.

Dr. Pegden's analysis contends that the Enacted Plan is a statistical outlier. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 2.2% of all alternative districtings satisfying my districting criteria (in other words, 97.8% are less optimized-for-partisanship) (pg. 22)."

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 11.62 seats while the 25th percentile plan has an expected Democratic seats of 11.85. This leads to a substantive difference of 0.23 expected Democratic seats. In other words, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 11-12 rather than 12-13 in this cluster) than the 25th percentile simulation in approximately 1 of these 5 elections, on average.

Dr. Mattingly's simulation analysis presents the partisan distributions of the different districts and where specifically an outlier might occur. Figure 6.1.5 of Dr. Mattingly's report shows that in the 10 most Democratic districts in the cluster, the Enacted Plan agrees with the majority of simulations in 12 of the 12 elections considered. In the most Republican district (HD-37), the Enacted Plan agrees with the majority of simulations in 9 of the 12 elections considered. This leaves two districts - HD-35 and HD-21. In District 35, the Enacted Plan agrees with the majority of the simulations in 7 of the 12 elections considered, and in HD-21 the Enacted Plan agrees with the majority of the simulations in 10 of the 12 elections considered. However, in the 2 elections where it is in disagreement, the Enacted Plan actually creates a *Democratic* leaning district where the majority of simulations create a Republican leaning district. Thus, the results in this cluster are mixed. Some of the Enacted Plan's districts are more Republican, on average, than the simulations and in other cases the Enacted Plan's districts are more Democratic. And in most cases there is agreement.

7 Disagreement Among Plaintiff Experts in Senate County Groupings

7.1 Cumberland and Moore Senate County Grouping

The Cumberland and Moore Senate county grouping contains two districts, SD-19 and SD-21.

Dr. Pegden's analysis contend that the Enacted Plan is a statistical outlier. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000015% of all alternative districtings satisfying my districting criteria (in other words, 99.999984% are less optimized-for-partisanship) (pg. 28)."

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 1.01 seats while the 25th percentile plan has an expected Democratic seats of 1.35. This leads to a substantive difference of 0.34 expected Democratic seats. Put differently, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 1 rather than 2 in this cluster) than the 25th percentile simulation in approximately 1-2 of these 10 elections, on average. In other words, the difference across this range of electoral environments is Republicans picking up an additional seat less than 2 in 5 times.

Dr. Mattingly states of the result of the simulations in this cluster, "The districts in the enacted are chosen to maximize the number of Democrats in the more democratic district and the number of republicans in the most Republican district. The map is an extreme outlier in both of these regards. The effect is a maximally non-responsive map." It is noteworthy that in other clusters Dr. Mattingly criticizes the map for being overly responsive (see Cumberland House grouping discussion). Despite this critique, from Figure 6.2.10 we see that in all 12 elections the Enacted Map agrees with the majority of the simulations in all districts. In not a single election do a majority of the simulations produce two Democratic seats.

It is also noteworthy that the NCLCV plaintiff's proposed plan is identical to Enacted Plan in this cluster.

7.2 Fosyth-Stokes Senate County Grouping

The Forsyth and Stokes Senate county grouping contains two districts, SD-31 and SD-32.

Dr. Pegden's analysis contend that the Enacted Plan is a statistical outlier. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.0051% of all alternative districtings satisfying my districting criteria (in other words, 99.9947% are less optimized-for-partisanship) (pg. 29)."

However, in this cluster the substantive difference in the expected Democratic seat share is nearly zero. This is a particularly good example of the importance of distinguishing between statistical and substantive significance. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 1.00 seats while the 25th percentile plan has an expected Democratic seats of 1.05. This leads to a substantive difference of 0.05 expected Democratic seats. Put another way, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 1 rather than 2 in this cluster) than the 25th percentile simulation in approximately 0 of these 5 elections, on average. In other words, the difference between the Enacted Plan and the simulations results across this range of electoral environments is effectively zero in this cluster.

Dr. Mattingly states of the result of the simulations in this cluster, "The districts in the enacted are chosen to maximize the number of Democrats in the more democratic district and the number of republicans [sic] in the most Republican district. The map is an extreme outlier in both of these regards. The effect is a maximally non-responsive map (pg. 61)." This is similar to his objection to the Cumberland-Moore cluster above, and is again noteworthy that in other clusters Dr. Mattingly criticizes the map for being overly responsive (see Cumberland House grouping discussion). Despite this critique, from Figure 6.2.7 we see that in all 12 elections the Enacted Map agrees with the majority of the simulations in all districts. In not a single election do the simulations produce two Democratic seats.

7.3 Guilford-Rockingham Senate County Grouping

The Guilford and Rockingham Senate county grouping contains 3 districts, SD-26, SD-27, and SD-28.

Dr. Pegden's analysis contend that the Enacted Plan is a statistical outlier. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.00012% of all alternative districtings satisfying my districting criteria (in other words, 99.99987% are less optimized-for-partisanship) (pg. 31)."

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 2 seats while the 25th percentile plan has an expected Democratic seats of 2.25. This leads to a substantive difference of 0.25 expected Democratic seats. Put differently, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 2 rather than 3 in this cluster) than the 25th percentile simulation in approximately 1-2 of these 10 elections, on average. In other words, the difference across this range of electoral environments is Republicans picking up an additional seat less than 2 in 5 times.

Dr. Mattingly's summary of the simulations results in this cluster are as follows: "The three districts in the Guilford-Rockingham cluster are constructed to pack an exceptional number of democrats [sic] in the most democratic [sic] district (district 28) and exceptionally few Democrats in the most Republican district (district 26). The effect is to ensure a Republican victory in the district 26, when in some elections the most republican [sic] district would be at risk of going to the Democratic Party (pg. 63)." However, in 11 of the 12 elections the Enacted Map's least Democratic district (SD-26) agrees with the majority of the simulations by electing a Republican. In only 1 of the 12 elections do the majority of his simulations produce 3 Democratic districts while the Enacted Plan produces only 2. SD-26 is less competitive (i.e. more Republican leaning) than the majority of simulations, but the inverse is also true of SD-27, which is competitive in many of the simulations and in a few rare cases elects a Republican but is more Democratic and always elects a Democrat in the Enacted Plan.

7.4 Granville-Wake Senate County Grouping

The Granville and Wake Senate county cluster contains 6 districts, SD-13, SD-14, SD-15, SD-16, SD-17, and SD-18.

Dr. Pegden's analysis contend that the Enacted Plan is a statistical outlier. He states, "My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000030% of all alternative districtings satisfying my districting criteria (in other words, 99.999969% are less optimized-for-partisanship) (pg. 30)."

The substantive difference in the expected Democratic seat share is as follows: The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 5.13 seats while the 25th percentile plan has an expected Democratic seats of 5.75. This leads to a substantive difference of 0.62 expected Democratic seats. Put another way, across 6 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 5 rather than 6 in this cluster) than the 25th percentile simulation in approximately 3 of these 5 elections, on average. In other words, the difference across this range of electoral environments is Republicans picking up an additional seat roughly 3 in 5 times.

Dr. Mattingly's presents simulations that contain four districts that are solidly Democratic in which no simulation nor the Enacted Plan produce a Republican-leaning seat (see Figure 6.2.4 in Dr. Mattingly's report). The simulations also contain two seats (SD-13 and

SD-17) in which a majority of the simulations produce a Republican-leaning seat (4 of the 12 elections considered) and in other elections produce a Democratic-leaning seat (5 of the 12 elections considered). In some cases the majority of simulations in SD-13 and SD-17 diverge with one district being majority Republican and the other producing a majority of the simulations generating a Democratic district (3 of the 12 elections). In the most Republican district the Enacted Plan agrees with the majority of the simulations in 10 of the 12 elections considered and in the second most Republican district there is agreement in 9 of the 12 elections considered.

7.5 Iredell-Mecklenburg Senate County Grouping

The Iredell and Mecklenburg Senate county cluster contains 6 districts, SD-37, SD-38, SD-39, SD-40, SD-41, and SD-42.

Dr. Pegden's analysis contend that the Enacted Plan is a statistical outlier. He states, 'My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.0057% of all alternative districtings satisfying my districting criteria (in other words, 99.9943% are less optimized-for-partisanship) (pg. 32)."

However, the substantive difference in the expected Democratic seat share is much smaller. The Enacted Map has an expected Democratic seats generated from the uniform swing analysis of 4.67 seats while the 25th percentile plan has an expected number of Democratic seats of 4.85. This leads to a substantive difference of 0.18 expected Democratic seats. In other words, across 5 hypothetical elections of each district in the cluster, we would expect the Enacted Map to elect one fewer Democrat (meaning 4 rather than 5 in this cluster) than the 25th percentile simulation in approximately 1 of these 5 elections, on average. Put another way, the difference across this range of electoral environments is Republicans picking up an additional seat roughly 1 in 5 times.

Dr. Mattingly's simulations in this cluster contain four districts that are solidly Democratic in which no majority of his simulations nor the Enacted Plan produce a Republican-leaning seat (see Figure 6.2.1 in Dr. Mattingly's report). The simulations also contain one seat (SD-37) in which a majority of the simulations produce a heavily Republican-leaning seat in all 12 elections. The Enacted Plan is in total agreement with the majority of simulations in these districts. This leaves SD-41, which is a more competitive seat in the simulations. In 9 of the 12 elections considered the partisan outcome in the Enacted Plan matches the partisan outcome in the majority of the simulations by producing a majority of the two-party vote share for the Democratic candidate.

Appendix A: Curriculum Vitae

Michael Jay Barber

CONTACT INFORMATION

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ACADEMIC APPOINTMENTS

Brigham Young University, Provo, UT

August 2020 - present Associate Professor, Department of Political Science
2014 - July 2020 Assistant Professor, Department of Political Science
2014 - present Faculty Scholar, Center for the Study of Elections and Democracy

EDUCATION

Princeton University Department of Politics, Princeton, NJ

Ph.D., Politics, July 2014

- Advisors: Brandice Canes-Wrone, Nolan McCarty, and Kosuke Imai
- Dissertation: "Buying Representation: the Incentives, Ideology, and Influence of Campaign Contributions on American Politics"
- 2015 Carl Albert Award for Best Dissertation, Legislative Studies Section, American Political Science Association (APSA)

M.A., Politics, December 2011

Brigham Young University, Provo, UT

B.A., International Relations - Political Economy Focus, April, 2008

- *Cum Laude*

RESEARCH INTERESTS

American politics, congressional polarization, political ideology, campaign finance, survey research

PUBLICATIONS

19. **"Ideological Disagreement and Pre-emption in Municipal Policymaking"** with Adam Dynes
Forthcoming at *American Journal of Political Science*
18. **"Comparing Campaign Finance and Vote Based Measures of Ideology"**
Forthcoming at *Journal of Politics*
17. **"The Participatory and Partisan Impacts of Mandatory Vote-by-Mail"**, with John Holbein
Science Advances, 2020. Vol. 6, no. 35, DOI: 10.1126/sciadv.abc7685
16. **"Issue Politicization and Interest Group Campaign Contribution Strategies"**, with Mandi Eatough
Journal of Politics, 2020. Vol. 82: No. 3, pp. 1008-1025

15. **"Campaign Contributions and Donors' Policy Agreement with Presidential Candidates"**, with Brandice Canes-Wrone and Sharece Thrower
Presidential Studies Quarterly, 2019, 49 (4) 770–797
14. **"Conservatism in the Era of Trump"**, with Jeremy Pope
Perspectives on Politics, 2019, 17 (3) 719–736
13. **"Legislative Constraints on Executive Unilateralism in Separation of Powers Systems"**, with Alex Bolton and Sharece Thrower
Legislative Studies Quarterly, 2019, 44 (3) 515–548
Awarded the Jewell-Loewenberg Award for best article in the area of subnational politics published in *Legislative Studies Quarterly* in 2019
12. **"Electoral Competitiveness and Legislative Productivity"**, with Soren Schmidt
American Politics Research, 2019, 47 (4) 683–708
11. **"Does Party Trump Ideology? Disentangling Party and Ideology in America"**, with Jeremy Pope
American Political Science Review, 2019, 113 (1) 38–54
10. **"The Evolution of National Constitutions"**, with Scott Abramson
Quarterly Journal of Political Science, 2019, 14 (1) 89–114
9. **"Who is Ideological? Measuring Ideological Responses to Policy Questions in the American Public"**, with Jeremy Pope
The Forum: A Journal of Applied Research in Contemporary Politics, 2018, 16 (1) 97–122
8. **"Status Quo Bias in Ballot Wording"**, with David Gordon, Ryan Hill, and Joe Price
The Journal of Experimental Political Science, 2017, 4 (2) 151–160.
7. **"Ideologically Sophisticated Donors: Which Candidates Do Individual Contributors Finance?"**, with Brandice Canes-Wrone and Sharece Thrower
American Journal of Political Science, 2017, 61 (2) 271–288.
6. **"Gender Inequalities in Campaign Finance: A Regression Discontinuity Design"**, with Daniel Butler and Jessica Preece
Quarterly Journal of Political Science, 2016, Vol. 11, No. 2: 219–248.
5. **"Representing the Preferences of Donors, Partisans, and Voters in the U.S. Senate"**
Public Opinion Quarterly, 2016, 80: 225–249.
4. **"Donation Motivations: Testing Theories of Access and Ideology"**
Political Research Quarterly, 2016, 69 (1) 148–160.
3. **"Ideological Donors, Contribution Limits, and the Polarization of State Legislatures"**
Journal of Politics, 2016, 78 (1) 296–310.
2. **"Online Polls and Registration Based Sampling: A New Method for Pre-Election Polling"** with Quin Monson, Kelly Patterson and Chris Mann.
Political Analysis 2014, 22 (3) 321–335.
1. **"Causes and Consequences of Political Polarization"** In *Negotiating Agreement in Politics*. Jane Mansbridge and Cathie Jo Martin, eds., Washington, DC: American Political Science Association: 19–53. with Nolan McCarty. 2013.
    - Reprinted in *Solutions to Political Polarization in America*, Cambridge University Press. Nate Persily, eds. 2015
    - Reprinted in *Political Negotiation: A Handbook*, Brookings Institution Press. Jane Mansbridge and Cathie Jo Martin, eds. 2015

AVAILABLE WORKING PAPERS

"Misclassification and Bias in Predictions of Individual Ethnicity from Administrative Records" (Revise and Resubmit at *American Political Science Review*)

"Taking Cues When You Don't Care: Issue Importance and Partisan Cue Taking"
with Jeremy Pope (Revise and Resubmit)

"A Revolution of Rights in American Founding Documents"
with Scott Abramson and Jeremy Pope (Conditionally Accepted)

"410 Million Voting Records Show the Distribution of Turnout in America Today"
with John Holbein (Revise and Resubmit)

"Partisanship and Trolleyology"
with Ryan Davis (Under Review)

"Who's the Partisan: Are Issues or Groups More Important to Partisanship?"
with Jeremy Pope (Revise and Resubmit)

"Race and Realignment in American Politics"
with Jeremy Pope (Revise and Resubmit)

"The Policy Preferences of Donors and Voters"

"Estimating Neighborhood Effects on Turnout from Geocoded Voter Registration Records."
with Kosuke Imai

"Super PAC Contributions in Congressional Elections"

WORKS IN PROGRESS

"Collaborative Study of Democracy and Politics"
with Brandice Canes-Wrone, Gregory Huber, and Joshua Clinton

"Preferences for Representational Styles in the American Public"
with Ryan Davis and Adam Dynes

"Representation and Issue Congruence in Congress"
with Taylor Petersen

"Education, Income, and the Vote for Trump"
with Edie Ellison

INVITED PRESENTATIONS

"Are Mormons Breaking Up with Republicanism? The Unique Political Behavior of Mormons in the 2016 Presidential Election"

- Ivy League LDS Student Association Conference - Princeton University, November 2018, Princeton, NJ

"Issue Politicization and Access-Oriented Giving: A Theory of PAC Contribution Behavior"

- Vanderbilt University, May 2017, Nashville, TN

"Lost in Issue Space? Measuring Levels of Ideology in the American Public"

- Yale University, April 2016, New Haven, CT

"The Incentives, Ideology, and Influence of Campaign Donors in American Politics"

- University of Oklahoma, April 2016, Norman, OK

"Lost in Issue Space? Measuring Levels of Ideology in the American Public"

- University of Wisconsin - Madison, February 2016, Madison, WI

"Polarization and Campaign Contributors: Motivations, Ideology, and Policy"

- Hewlett Foundation Conference on Lobbying and Campaign Finance, October 2014, Palo Alto, CA

"Ideological Donors, Contribution Limits, and the Polarization of State Legislatures"

- Bipartisan Policy Center Meeting on Party Polarization and Campaign Finance, September 2014, Washington, DC

"Representing the Preferences of Donors, Partisans, and Voters in the U.S. Senate"

- Yale Center for the Study of American Politics Conference, May 2014, New Haven, CT

Conference Presentations

Washington D.C. Political Economy Conference (PECO):

- 2017 discussant

American Political Science Association (APSA) Annual Meeting:

- 2014 participant and discussant, 2015 participant, 2016 participant, 2017 participant, 2018 participant

Midwest Political Science Association (MPSA) Annual Meeting:

- 2015 participant and discussant, 2016 participant and discussant, 2018 participant

Southern Political Science Association (SPSA) Annual Meeting:

- 2015 participant and discussant, 2016 participant and discussant, 2017 participant

Teaching Experience

Poli 315: Congress and the Legislative Process

- Fall 2014, Winter 2015, Fall 2015, Winter 2016, Summer 2017

Poli 328: Quantitative Analysis

- Winter 2017, Fall 2017, Fall 2019, Winter 2020, Fall 2020, Winter 2021

Poli 410: Undergraduate Research Seminar in American Politics

- Fall 2014, Winter 2015, Fall 2015, Winter 2016, Summer 2017

Awards and Grants

2019 BYU Mentored Environment Grant (MEG), American Ideology Project, $30,000

2017 BYU Political Science Teacher of the Year Award

2017 BYU Mentored Environment Grant (MEG), Funding American Democracy Project, $20,000

2016 BYU Political Science Department, Political Ideology and President Trump (with Jeremy Pope), $7,500

2016 BYU Office of Research and Creative Activities (ORCA) Student Mentored Grant x 3

- Hayden Galloway, Jennica Peterson, Rebecca Shuel

2015 BYU Office of Research and Creative Activities (ORCA) Student Mentored Grant x 3

- Michael-Sean Covey, Hayden Galloway, Sean Stephenson

2015 BYU Student Experiential Learning Grant, American Founding Comparative Constitutions Project (with Jeremy Pope), $9,000

2015 BYU Social Science College Research Grant, $5,000

2014 BYU Political Science Department, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $3,000

2014 BYU Social Science College Award, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $3,000

2014 BYU Center for the Study of Elections and Democracy, 2014 Washington DC Mayoral Pre-Election Poll (with Quin Monson and Kelly Patterson), $2,000

2012 Princeton Center for the Study of Democratic Politics Dissertation Improvement Grant, $5,000

2011 Princeton Mamdouha S. Bobst Center for Peace and Justice Dissertation Research Grant, $5,000

2011 Princeton Political Economy Research Grant, $1,500

Other Scholarly Activities

Expert Witness in Nancy Carola Jacobson, et al., Plaintiffs, vs. Laurel M. Lee, et al., Defendants. Case No. 4:18-cv-00262 MW-CAS (U.S. District Court for the Northern District of Florida)

Expert Witness in Common Cause, et al., Plaintiffs, vs. LEWIS, et al., Defendants. Case No. 18-CVS-14001 (Wake County, North Carolina)

Expert Witness in Kelvin Jones, et al., Plaintiffs, v. Ron DeSantis, et al., Defendants, Consolidated Case No. 4:19-cv-300 (U.S. District Court for the Northern District of Florida)

Expert Witness in Community Success Initiative, et al., Plaintiffs, v. Timothy K. Moore, et al., Defendants, Case No. 19-cv-15941 (Wake County, North Carolina)

Expert Witness in Richard Rose et al., Plaintiffs, v. Brad Raffensperger, Defendant, Civil Action No. 1:20-cv-02921-SDG (U.S. District Court for the Northern District of Georgia)

Georgia Coalition for the People's Agenda, Inc., et. al., Plaintiffs, v. Brad Raffensberger, Defendant. Civil Action No. 1:18-cv-04727-ELR (U.S. District Court for the Northern District of Georgia)

Expert Witness in Alabama, et al., Plaintiffs, v. United States Department of Commerce; Gina Raimondo, et al., Defendants. Case No. CASE No. 3:21-cv-00211-RAH-ECM-KCN (U.S. District Court for the Middle District of Alabama Eastern Division)

Expert Witness in League of Women Voters of Ohio, et al., Relators, v. Ohio Redistricting Commission, et al., Respondents. Case No. 2021-1193 (Supreme Court of Ohio)

Additional Training — EITM 2012 at Princeton University - Participant and Graduate Student Coordinator

Computer Skills — Statistical Programs: R, Stata, SPSS, parallel computing

Updated December 22, 2021

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426, 21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC.; HENRY M. MICHAUX, JR., et al.,

Plaintiffs,

REBECCA HARPER, et al.,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

AFFIDAVIT OF PROFESSOR MOON DUCHIN

NCLCV v. Hall
21 CVS 15426
LDTX167

Exhibit #
Barber 5
12/30/2021
exhibitsticker.com

I, Dr. Moon Duchin, having been duly sworn by an officer authorized to administer oaths, depose and state as follows:

1. I am over 18 years of age, legally competent to give this Affidavit, and have personal knowledge of the facts set forth in this Affidavit.

2. All of the quantitative work described in this Affidavit was performed by myself with the support of research assistants working under my direct supervision.

Background and qualifications

3. I hold a Ph.D. and an M.S in Mathematics from the University of Chicago as well as an A.B. in Mathematics and Women's Studies from Harvard University.

4. I am a Professor of Mathematics and a Senior Fellow in the Jonathan M. Tisch College of Civic Life at Tufts University.

5. My general research areas are geometry, topology, dynamics, and applications of mathematics and computing to the study of elections and voting. My redistricting-related work has been published in venues such as the Election Law Journal, Political Analysis, Foundations of Data Science, the Notices of the American Mathematical Society, Statistics and Public Policy, the Virginia Policy Review, the Harvard Data Science Review, Foundations of Responsible Computing, and the Yale Law Journal Forum.

6. My research has had continuous grant support from the National Science Foundation since 2009, including a CAREER grant from 2013–2018. I am currently on the editorial board of the journals Advances in Mathematics and the Harvard Data Science Review. I was elected a Fellow of the American Mathematical Society in 2017 and was named a Radcliffe Fellow and a Guggenheim Fellow in 2018.

7. A current copy of my full CV is attached to this report.

8. I am compensated at the rate of $400 per hour.

Rebuttal Report

Moon Duchin
Professor of Mathematics, Tufts University
Senior Fellow, Tisch College of Civic Life

December 28, 2021

1 Background and Introduction

I have previously submitted expert reports in NCLCV vs. Hall. I have been asked by counsel to respond to the report of Dr. Michael Barber, examining his study design and his conclusions.

1.1 Summary of Barber report

In Dr. Barber's report, he uses a new statistical sampling method called Sequential Monte Carlo (SMC) to produce a large collection (called an *ensemble*) of alternative districting plans for both bodies of the North Carolina state legislature—state Senate and state House. SMC is a method based on ideas developed in my research group,[1] but which has not been supported by any peer-reviewed publications.

Dr. Barber proceeds to build ensembles of districting plans for the purposes of comparison, but primarily does so individually on small pieces of the state: groups of counties (often called "county clusters") that correspond to groupings in the Senate and House plans recently enacted in North Carolina (SL-173 and SL-175).

- For legislative redistricting, the Barber report discusses the clusters only on an individual basis, neglecting to assemble them into the big picture for the whole state.
- Dr. Barber omits an ensemble comparison for the enacted Congressional plan, SL-174.

1.2 Summary of findings

- When assembling the statistics from Dr. Barber's own ensembles—completely granting him all methodological choices for algorithm selection and specifications—the enacted House plan is shown to be a major partisan outlier, while the NCLCV alternative plans are not (Figure 6).
- In exactly the same way, the enacted Senate plan is likewise shown to be a major partisan outlier, while the NCLCV alternative plans are not (Figure 5).
- Finally, I was able to run Barber's code to create a Congressional ensemble in the same fashion as his legislative ensembles. Here, too, the enacted plan is a significant outlier in a direction of partisan advantage that is not justified by any good-government goal (Figure 3).

[1] The McCartan–Imai article introducing SMC [5] acknowledges Deford–Duchin–Solomon [3] for "pioneer[ing] the spanning tree-based proposal used in the merge-split algorithm."

2 Ensembles and outliers

Today, the dominant method in computational redistricting analysis is to employ Markov chains to generate ensembles of thousands or millions of alternative valid redistricting plans against which to compare a given proposed plan. When a quantity of interest is measured over the ensemble, it frequently forms a "bell curve" of values, and we can then examine whether the proposed plan falls in the thick of the observed values or whether it is an extreme outlier, falling in one of the tails. If this exercise is carried out with respect to each party's representation, a telltale sign of a partisan gerrymander is when the seat share for a proposed plan falls (a) far from the corresponding vote share, and (b) far to the side of advantage for the party that controlled the line-drawing process. This is particularly problematic in a politically competitive "purple" state like North Carolina.

It is important to note that outlier status is a flag of intentionality, but not necessarily a smoking gun of wrongdoing. Being in a tails of a distribution that was created around certain design principles can often provide persuasive evidence that other principles or agendas were in play. For example, a map might be an outlier as the most compact, or the map that gives minority groups the greatest chance to elect their candidates of choice—these kinds of outlier status would not be marks of a bad plan. But being an outlier can indeed be a sign of problems, as when a plan systematically converts close voting to lopsided seat shares for the party that controls the process.

2.1 Barber methods

The creation and use of districting ensembles in the Barber report can be summarized as follows.

Step 1 *Fix a set of clusters.* Barber focuses on the county clustering found in the enacted plan, not exhaustively considering the dozens of other possibilities.

Step 2 *Partition each cluster.* Split each multi-district cluster into the corresponding number of districts using Sequential Monte Carlo sampling. Create 50,000 partitions (i.e., districting plans) for each cluster.

Step 3 *Winnow.* Selectively discard some of the partitions. Barber uses two statistics from the enacted plan (average Polsby-Popper score and county traversals) as the cutoff for inclusion.

Step 4 *Create an election index.* Barber blends the 11 up-ballot elections since 2014 into a single vote index rather than considering them one at a time. In particular, he sums the votes over all elections before taking shares, which does not control for turnout differences across elections.

Step 5 *Plot histograms and declare outliers.* Barber forms histograms counting "Democratic-leaning districts" for individual clusters, and does not present an overall compilation. His non-standard definition of "outlier" includes a full 50% of the ensemble.

In my opinion, better and more reliable results would have been obtained if several of the choices required in this study design were executed differently.

One glaring omission from Barber's methods is any consideration of the State's obligations under the Voting Rights Act of 1965, which could impact the partisan bottom line.[2] A non-exhaustive list of other potential flaws in Dr. Barber's methods includes the following.

- *Failure to consider all alternative clusterings.*
  North Carolina law dictates that districts be drawn within groupings or clusters of counties from which several districts will be formed. Sometimes, however, the General Assembly has a choice and can pick multiple groupings consistent with North Carolina law. Dr. Barber only gives cursory attention to alternative clusterings.

- *Use of sampling methodology not vetted by peer review.*
  Even when an idea is promising, peer review is an essential component of vetting. A method may appear promising in concept, but not work in practice. A method may work at small tasks—like the 34-map dataset used for testing in [5]—but not scale well to the enormous sizes needed for realistic problems. Peer review helps surface those issues, which is why the scientific community regards peer review as a mark of reliability.

- *Use of bright-line thresholds for compactness and traversals.*
  Dr. Barber's code already samples with a preference for compactness, and is fully capable of handling traversals in a similar manner.[3] Imposing sharp cutoffs for these at the level of the enacted plan creates highly misleading results.[4]

- *Use of election data in a blended rather than serial fashion.*
  If Barber records a Democratic share of 49% in his outputs, that is likely to reflect a Democratic win in some of the 11 elections and a Republican win in others—this is obscured when the results are blended to a single number. By the same token, a Democratic share of 45% in the blended election index might downplay a map that favors Republicans 11 out of 11 times, which entrenches an advantage.[5]

- *Employing a highly unconventional use of the* "*outlier*" *label.*
  As Dr. Barber himself puts it, "I consider a plan to be a partisan outlier if the number of Democratic districts generated by the plan falls outside the middle 50% of simulation results [sic]. This is a conservative definition of an outlier. In the social sciences, medicine, and other disciplines it is traditional to consider something an outlier if it falls outside the middle 95% or 90% of the comparison distribution." As I will show below in my whole-state comparisons, the enacted plans are outliers at any of these levels of significance, while the NCLCV alternative plans are not.

I will discuss the thresholding question further in §2.3. For the remainder of the report, I will set aside the other concerns and will simply assess Dr. Barber's outputs within his own methodological framework.

[2] Robust VRA consideration is fully compatible with computational redistricting, as is shown in [1].

[3] A preference for compactness is coded in the `smc_redist` parameterization in `house_clusters.R`, lines 354–356 and `senate_clusters.R`, lines 349–351.

[4] The imposition of cutoffs, which Dr. Barber calls "culling," occurs in two stages. Stage 1 (country traversals) is found in `house_clusters.R`, lines 531–536 and `senate_clusters.R`, lines 539–544. Stage 2 (average Polsby-Popper) is found in `house_clusters.R`, line 543–564 and `senate_clusters.R`, lines 552–573. An ad hoc adjustment in the Duplin and Wayne House County Grouping is found in lines 566-568 of the House code.

[5] The 49% Democratic lean occurs, for instance, in the NCLCV alternative maps in the Onslow/Pender House cluster. Vote averaging is found in the Barber replication materials in `house_clusters.R` lines 18-28 and `senate_clusters.R` lines 18-29.

2.2 Analysis methods

Reading Dr. Barber's report, it is striking that he only reported that the enacted plan often performed within the middle 50% of each small comparison while never evaluating how the individual choices aggregate at the level of the map as a whole. After all, if moderate partisan advantage is secured over and over again, it may well accrue to extreme advantage overall. In the context of a state legislature, the overall results are crucial: they determine who controls the chamber. Pursuing this in the Barber materials, I found that this is exactly what happens.

First, I was able to extract Dr. Barber's raw statistical outputs for legislative runs from his materials obtained by counsel.[6] With those, I was able to assemble his ensembles for individual clusters into a compiled ensemble for the entire state. The histogram of Senate outcomes can be found in Figure 6 and the histogram of House outcomes can be found in Figure 5. Second, I was able to run Dr. Barber's code to create an ensemble of alternative Congressional plans with exactly the algorithm and with similar specifications to those he used for his legislative demonstrations.[7] A corresponding plot of Congressional outcomes can be found in Figure 3. For all phases of analysis, Dr. Barber pulled electoral data from a free webapp called Dave's Redistricting App (`davesredistricting.org`). In replicating his analysis, I used the same data source in the same manner.

2.3 Filtered and unfiltered results

As I described above, Dr. Barber took his raw districting plan samples (50,000 maps created for each of 12 Senate cluster ensembles and 26 House cluster ensembles) and aggressively filtered them, applying a cutoff that sometimes left under ten maps out of the original set of 50,000. In fact, when Dr. Barber's filtering rule was applied in the Duplin and Wayne House County Grouping (§6.6 on p.58 of Barber Report), *zero* maps were left, because none of the randomly constructed maps had an average compactness score to match the enacted plan in that cluster. Since this is blatantly unworkable for comparison purposes, Dr. Barber made the ad hoc decision to loosen the rule to retain 2704 maps. Other cluster ensembles were filtered down to leave only 4, 6, or 2 out of 50,000 alternatives and did not receive an adjustment. The "outlier" label was then applied to these tiny sets.

To illustrate why this is methodologically unreasonable, consider JaVale McGee, a basketball center who recently signed with the Phoenix Suns of the NBA on a one-year, $5 million contract. If McGee wanted to argue that he is not unusually wealthy, he could choose to restrict the universe of comparison to Americans at least as tall as he is. Since he is 7 feet tall, this would greatly restrict the comparison pool to a relatively tiny group that also includes Mo Bamba (Orlando Magic), Joel Embiid (Philadelphia 76ers), and Brook Lopez (Milwaukee Bucks), all of whom make more money than he does. Not satisfied with this comparison, he could keep increasing the requirements by insisting on comparing to people who don't speak any more languages than he does, are no older than he is, and have lived in at least as many different cities. Eventually he will narrow the pool enough that he doesn't look like an outlier anymore.

Dr. Barber's filtering skews his sample in a similar way, because he effectively insists that maps have a statistic matching or exceeding the enacted map in every cluster—and then uses that pool to compare the enacted map. Overall, this reduces the number of plans under consideration by a factor of over 500 trillion. And it excludes options that may be better than the enacted plan overall but are less compact or have more traversals in a particular cluster.

Generally, if you are trying to argue that you look typical of a range of alternatives, it is obviously unreasonable to first require the alternatives to look like you in dozens of independent ways (i.e., in each cluster individually).

[6]His materials include the numerical outputs from his runs, but as far as I can determine he does not seem to have saved the district assignments for the individual plans in the ensemble.

[7]To be precise, the ensemble was generated at the state level for Congress, since the concept of county clusters is not applicable, and without the compactness and traversal thresholds. I ran the code exactly as Dr. Barber did, except tightening the allowed population deviation to 1% from ideal instead of 5% as in legislative maps. All other choices are identical. My congressional ensemble includes 20,000 maps rather than 50,000 just because of time limitations.

3 Findings

In this section, I will present the full histograms (or "bell curves") of all the results from Dr. Barber's methodology, compiled to the state level and shown without filtering. (Filtered ensembles can be seen in Appendix A, for comparison purposes.)

By Dr. Barber's own constructs, all three levels of districting show that **the enacted plans are partisan outliers and the NCLCV alternative plans are not**.

In the House, the enacted map is in the most extreme 0.00133 fraction of the Barber ensemble—well under 1 percent of sampled House plans are as extreme as SL-175. By contrast, the NCLCV alternative plan is in the upper .2516 share of the ensemble, not an outlier even by the Barber standard.

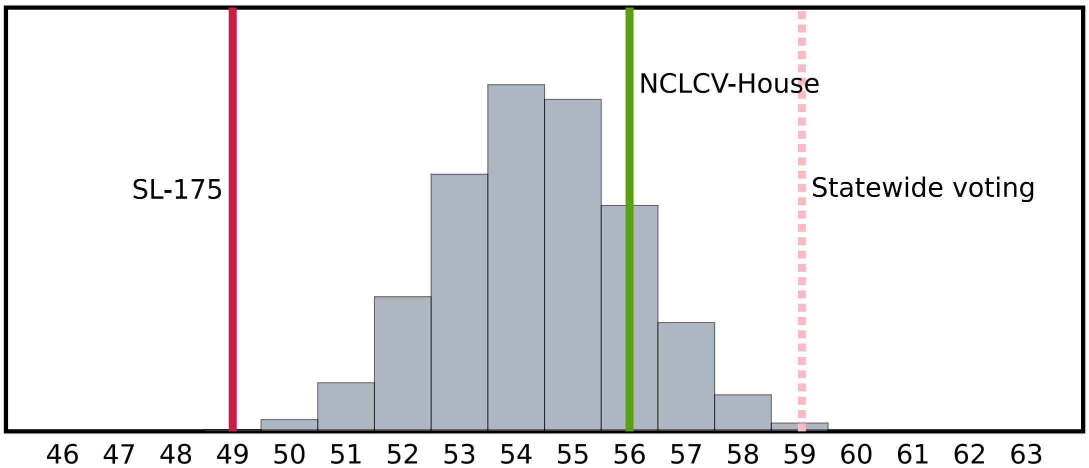

Figure 1: "Democratic-leaning seats" in Dr. Barber's House district ensemble.

At the Senate level, the enacted map is in the most extreme .007 fraction of the Barber ensemble—again, less than 1 percent of sampled plans are as extreme as SL-173. By contrast, the NCLCV alternative map is in the upper .2787 share of ensemble, not an outlier even by the Barber standard.

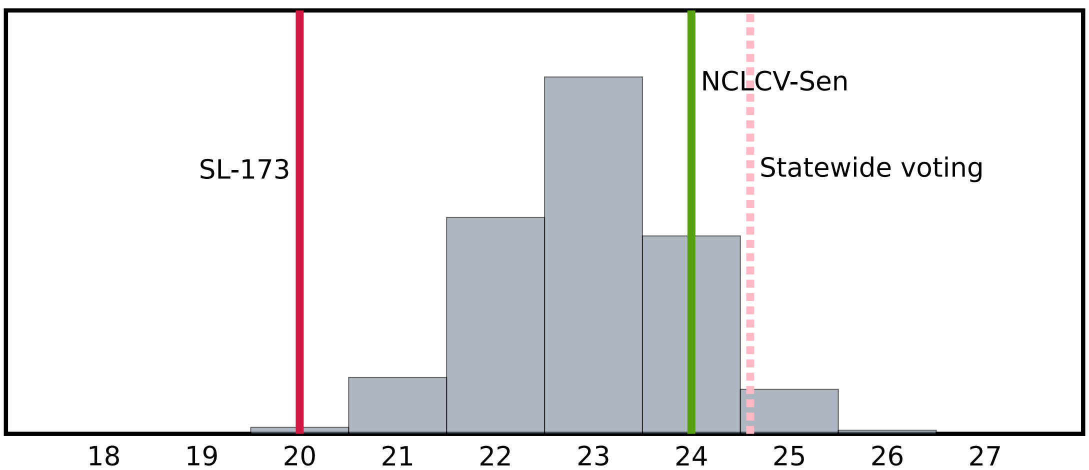

Figure 2: "Democratic-leaning seats" in Dr. Barber's Senate district ensemble.

The Congressional picture, omitted from the Barber report, is likewise crystal clear. The enacted plan is in the most extreme 0.0056 fraction of this Barber-style ensemble, while the NCLCV alternative map is very near the ensemble center—0.5620 share of the ensemble (more than half of randomly constructed maps) has an equal or greater Democratic lean.

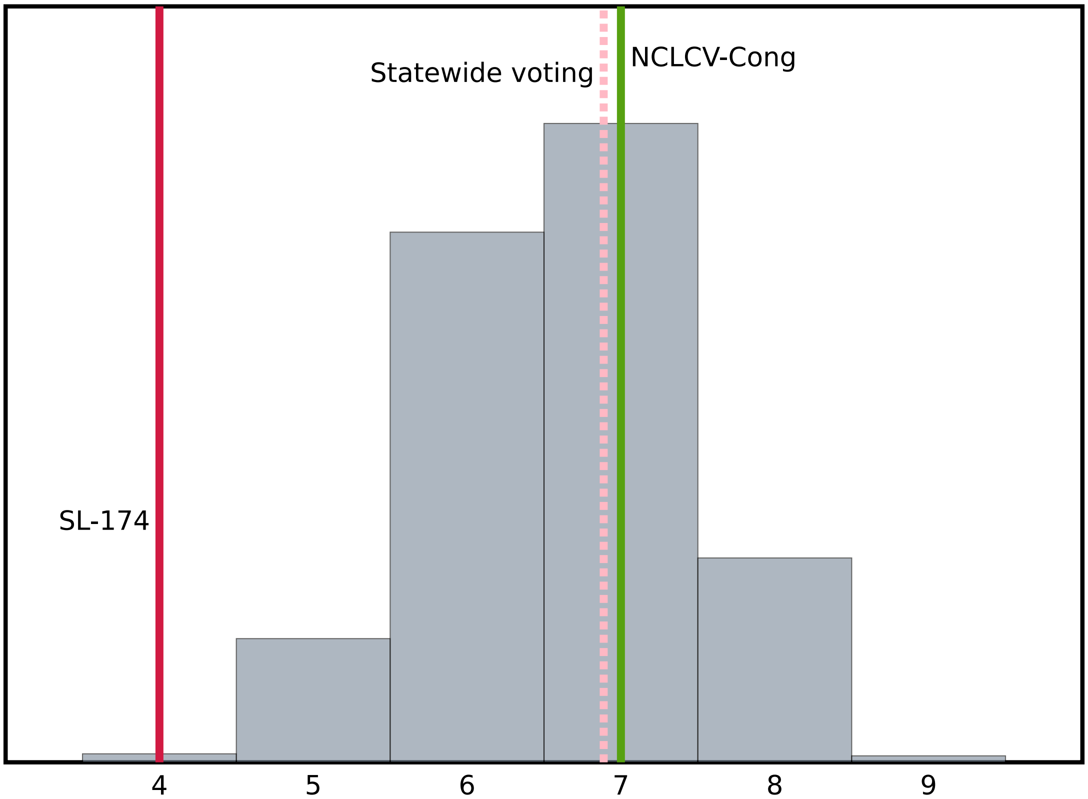

Figure 3: "Democratic-leaning seats" in a Congressional ensemble created with Dr. Barber's code, following his specifications.

4 Conclusion

Granting Dr. Barber all of his methodological choices, the enacted maps are extreme partisan outliers at all three levels, while the NCLCV alternative maps are not.

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I declare under penalty of perjury that the foregoing is true and correct.

Executed this 28 day of December, 2021.

Professor Moon Duchin

Sworn and subscribed before me
this the 28 of December, 2021

Notary Public

Name: Simarjit Manhas

My commission expires: 02/02/2024

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California, County of Alameda
Subscribed and sworn to (or affirmed) before me
on this 28 day of December, 2021,
by Moon Duchin,
proved to me on the basis of satisfactory evidence
to be the person(s) who appeared before me.
Signature:

SIMARJIT MANHAS
COMM. #2317737
Notary Public - California
Contra Costa County
My Comm. Expires Feb. 2, 2024

Appendix A: Filtering comparison

To illustrate the skewing effects of the thresholds applied by Dr. Barber, consider a single example: the Pitt House County Cluster, where the number of Democratic-leaning seats in the sample is either 1 or 2. By thresholding compactness and traversals at the level of the enacted map, Dr. Barber is able to drop the frequency of the 2-seats outcome from roughly 25% of the sample to just 9%.

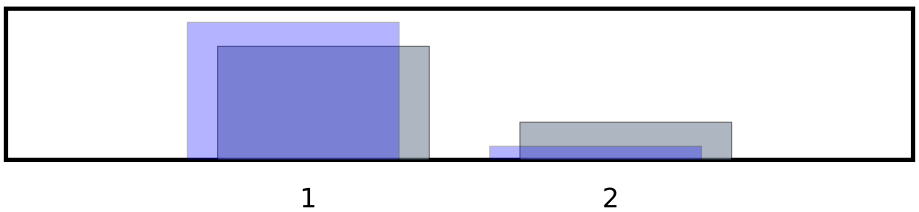

Figure 4: Just focusing on the Pitt House County Cluster (Barber report, p.42), we see that the filtering changes the outcome of 2 "Democratic-leaning seats" from occurring in roughly 25% of the full set of sampled maps (gray) to only occurring in 9% of the reduced sample (blue).

The effects of this cluster-by-cluster restriction do not wash out when aggregated to the full state, but instead add up to a noticeable shift toward the enacted plan, as demonstrated in the House and Senate figures below.

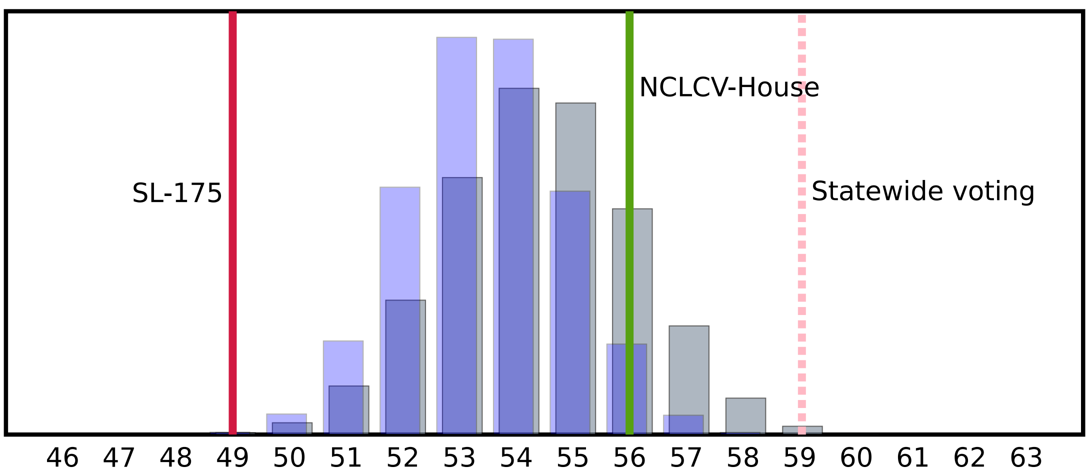

Figure 5: "Democratic-leaning seats" in Dr. Barber's House district ensemble. The unfiltered ensemble (gray) includes $50,000^{26} \approx 1.5 \cdot 10^{122}$ maps; the filtered ensemble (blue) is smaller by a factor of octillions.

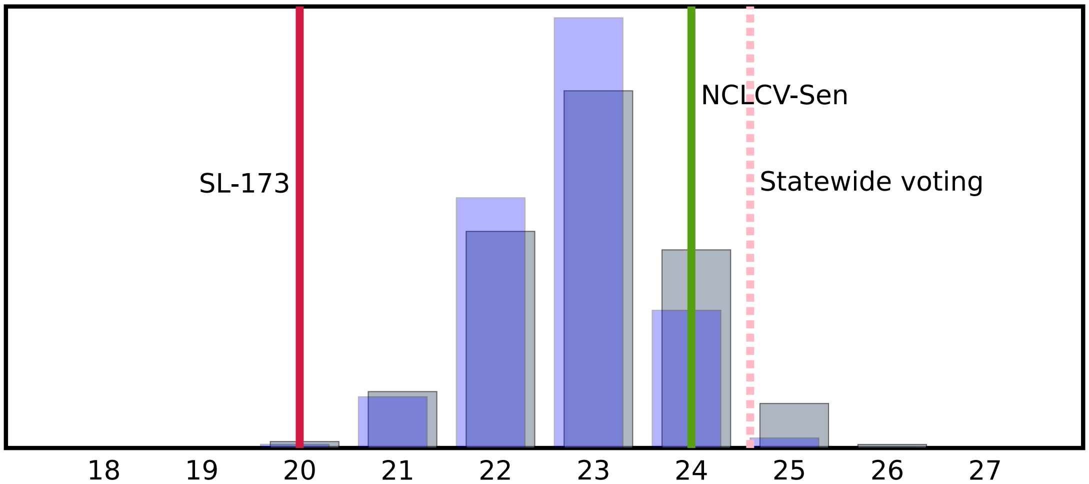

Figure 6: "Democratic-leaning seats" in Dr. Barber's Senate district ensemble. The unfiltered ensemble (gray) includes $50,000^{12} \approx 2.4 \cdot 10^{56}$ maps; the filtered ensemble (blue) is smaller by a factor of trillions.

Significantly, even the subsets of alternative plans that have been heavily limited by the cluster-by-cluster thresholds—that is, the blue bell curves instead of the gray—still show the enacted plans to be extreme outliers, while the NCLCV alternative plans are both far less extreme and comport with statewide voting.

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Education

University of Chicago MS 1999, PhD 2005
Mathematics
Advisor: Alex Eskin Dissertation: *Geodesics track random walks in Teichmüller space*

Harvard University BA 1998
Mathematics and Women's Studies

Appointments

Tufts University
Professor of Mathematics 2021—
Assistant Professor, Associate Professor 2011–2021

Director | Program in Science, Technology, & Society 2015–2021
(on leave 2018–2019)

Principal Investigator | MGGG Redistricting Lab 2017—

Senior Fellow | Tisch College of Civic Life 2017—

University of Michigan
Assistant Professor (postdoctoral) 2008–2011

University of California, Davis
NSF VIGRE Postdoctoral Fellow 2005–2008

Research Interests

Data science for civil rights, computation and governance, elections, geometry and redistricting.
Science, technology, and society, science policy, technology and law.
Random walks and Markov chains, random groups, random constructions in geometry.
Large-scale geometry, metric geometry, isoperimetric inequalities.
Geometric group theory, growth of groups, nilpotent groups, dynamics of group actions.
Geometric topology, hyperbolicity, Teichmüller theory.

Awards & Distinctions

Research Professor - MSRI Program in Analysis and Geometry of Random Spaces Spring 2022
Guggenheim Fellow 2018
Radcliffe Fellow - Evelyn Green Davis Fellowship 2018–2019
Fellow of the American Mathematical Society elected 2017
NSF C-ACCEL (PI) - Harnessing the Data Revolution: Network science of Census data 2019–2020
NSF grants (PI) - CAREER grant and three standard Topology grants 2009–2022
Professor of the Year, Tufts Math Society 2012–2013
AAUW Dissertation Fellowship 2004–2005
NSF Graduate Fellowship 1998–2002
Lawrence and Josephine Graves Prize for Excellence in Teaching (U Chicago) 2002
Robert Fletcher Rogers Prize (Harvard Mathematics) 1995–1996

Mathematics Publications & Preprints

The (homological) persistence of gerrymandering
Foundations of Data Science, online first. (with Thomas Needham and Thomas Weighill)

You can hear the shape of a billiard table: Symbolic dynamics and rigidity for flat surfaces
Commentarii Mathematici Helvetici, to appear. arXiv:1804.05690
(with Viveka Erlandsson, Christopher Leininger, and Chandrika Sadanand)

Conjugation curvature for Cayley graphs
Journal of Topology and Analysis, online first. (with Assaf Bar-Natan and Robert Kropholler)

A reversible recombination chain for graph partitions
Preprint. (with Sarah Cannon, Dana Randall, and Parker Rule)

Recombination: A family of Markov chains for redistricting
Harvard Data Science Review. Issue 3.1, Winter 2021. online. (with Daryl DeFord and Justin Solomon)

Census TopDown: The impact of differential privacy on redistricting
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Random nilpotent groups I
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Hyperbolic groups
chapter in *Office Hours with a Geometric Group Theorist*, eds. M.Clay,D.Margalit, Princeton U Press (2017), 177–203.

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Pushing fillings in right-angled Artin groups
Journal of the LMS, Vol 87, Issue 3 (2013), 663–688. (with Aaron Abrams, Noel Brady, Pallavi Dani, and Robert Young)

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In the Tradition of Ahlfors and Bers VI, Contemp. Math. **590** (2013), 1–8. (with Howard Masur and Spencer Dowdall)

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Filling loops at infinity in the mapping class group
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The geometry of spheres in free abelian groups
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Length spectra and degeneration of flat metrics
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Curvature, stretchiness, and dynamics
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Science, Technology, Law, and Policy Publications & Preprints

Models, Race, and the Law
Yale Law Journal Forum, Vol. 130 (March 2021). Available online. (with Doug Spencer)

Computational Redistricting and the Voting Rights Act
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Discrete geometry for electoral geography
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Implementing partisan symmetry: Problems and paradoxes
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Locating the representational baseline: Republicans in Massachusetts
Election Law Journal, Volume 18, Number 4, 2019, 388–401.
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Rebooting the mathematics of gerrymandering: How can geometry track with our political values?
The Conversation (online magazine), October 2017. (with Peter Levine)

A formula goes to court: Partisan gerrymandering and the efficiency gap
Notices of the American Mathematical Society **64** No. 9 (2017), 1020–1024. (with Mira Bernstein)

International mobility and U.S. mathematics
Notices of the American Mathematical Society **64**, No. 7 (2017), 682–683.

Graduate Advising in Mathematics

Nate Fisher (PhD 2021), Sunrose Shrestha (PhD 2020), Ayla Sánchez (PhD 2017), Kevin Buckles (PhD 2015), Mai Mansouri (MS 2014)

Outside committee member for Chris Coscia (PhD 2020), Dartmouth College

Postdoctoral Advising in Mathematics

Principal supervisor Thomas Weighill (2019–2020)

Co-supervisor Daryl DeFord (MIT 2018–2020), Rob Kropholler (2017–2020), Hao Liang (2013–2016)

Teaching

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Mathematics of Social Choice | sites.tufts.edu/socialchoice
Voting theory, impossibility theorems, redistricting, theory of representative democracy, metrics of fairness.

History of Mathematics | sites.tufts.edu/histmath
Social history of mathematics, organized around episodes from antiquity to present. Themes include materials and technologies of creation and dissemination, axioms, authority, credibility, and professionalization. In-depth treatment of mathematical content from numeration to cardinal arithmetic to Galois theory.

Reading Lab: Mathematical Models in Social Context | sites.tufts.edu/models
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Geometric Literacy
Module-based graduate topics course. Modules have included: p-adic numbers, hyperbolic geometry, nilpotent geometry, Lie groups, convex geometry and analysis, the complex of curves, ergodic theory, the Gauss circle problem.

Markov Chains (graduate topics course)
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Fuchsian Groups (graduate topics course)
Continued Fractions and Geometric Coding (undergraduate topics course)
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BMC/BAMC Public Lecture April 2021
Joint British Mathematics/Applied Mathematics Colloquium, Glasgow, Scotland *online (COVID)*

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AMS-MAA-SIAM, Joint Mathematics Meetings, San Diego, CA January 2018

Mathematical Association of America Distinguished Lecture
MAA Carriage House, Washington, DC October 2016

American Mathematical Society Invited Address
AMS Eastern Sectional Meeting, Brunswick, ME September 2016

Named University Lectures

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- Math, Stats, CS, and Society | Macalester College — October 2019
- MRC Public Lecture | Stanford University — May 2019
- Freedman Memorial Colloquium | Boston University — March 2019
- Julian Clancy Frazier Colloquium Lecture | U.S. Naval Academy — January 2019
- Barnett Lecture | University of Cincinnati — October 2018
- School of Science Colloquium Series | The College of New Jersey — March 2018
- Kieval Lecture | Cornell University — February 2018
- G. Milton Wing Lectures | University of Rochester — October 2017
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- Dan E. Christie Lecture | Bowdoin College — September 2017

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- Georgetown (CS) — Sept 2020
- Santa Fe Institute — July 2020
- UC Berkeley — Sept 2018
- Brandeis-Harvard-MIT-NEU — Mar 2018
- Northwestern University — Oct 2017
- University of Illinois — Sept 2017
- University of Utah — Aug 2017
- Wesleyan — Dec 2016
- Worcester Polytechnic Inst. — Dec 2016
- Université de Neuchâtel — Jun 2016
- Brandeis University — Mar 2016
- Swarthmore College — Oct 2015
- Bowling Green — May 2015
- City College of New York — Feb 2015
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- Workshop in geometric topology (main speaker, three talks) | Provo, UT June 2017
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- Hyperbolicity in Teichmüller space (three talks) | Université de Grenoble May 2016
- Counting and growth (four talks) | IAS Women's Program, Princeton May 2016
- Nilpotent groups (three talks) | Seoul National University October 2014
- Sub-Finsler geometry of nilpotent groups (five talks) | Galatasaray Univ., Istanbul April 2014

Science, Technology, and Society

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- STS Circle | Harvard Kennedy School of Government September 2019
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- Science Studies Colloquium | UC San Diego January 2019
- Arthur Miller Lecture on Science and Ethics | MIT Program in Science, Tech, and Society November 2018

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- Privacy Tools Project Retreat | Harvard (virtual) May 2020
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- Quantitative Research Methods Workshop | Yale Center for the Study of American Politics February 2020
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- Quantitative Collaborative | University of Virginia March 2018
- Quantitative Social Science | Dartmouth College September 2017
- Data for Black Lives Conference | MIT November 2017

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- The Long 19th Amendment: Women, Voting, and American Democracy | Radcliffe Institute Nov–Dec 2020
- "The New Math" for Civil Rights | Social Justice Speaker Series, Davidson College November 2020
- Math, Law, and Racial Fairness | Justice Speaker Series, University of South Carolina November 2020
- Voting Rights Conference | Northeastern Public Interest Law Program September 2020
- Political Analysis Workshop | Indiana University November 2019
- Program in Public Law Panel | Duke Law School October 2019
- Redistricting 2021 Seminar | University of Chicago Institute of Politics May 2019
- Geography of Redistricting Conference Keynote | Harvard Center for Geographic Analysis May 2019
- Political Analytics Conference | Harvard University November 2018
- Cyber Security, Law, and Society Alliance | Boston University September 2018
- Clough Center for the Study of Constitutional Democracy | Boston College November 2017
- Tech/Law Colloquium Series | Cornell Tech November 2017
- Constitution Day Lecture | Rockefeller Center for Public Policy, Dartmouth College September 2017

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Amicus Brief of Mathematicians, Law Professors, and Students 2019
principal co-authors: Guy-Uriel Charles and Moon Duchin
Supreme Court of the United States, in Rucho v. Common Cause - cited in dissent

Committee on Science Policy 2020–2023
American Mathematical Society

Program Committee 2020–2021
Symposium on Foundations of Responsible Computing

Presenter on Public Mapping, Statistical Modeling 2019, 2020
National Conference of State Legislatures

Committee on the Human Rights of Mathematicians 2016–2019
American Mathematical Society

Committee on The Future of Voting: Accessible, Reliable, Verifiable Technology 2017–2018
National Academies of Science, Engineering, and Medicine

Visiting Positions and Residential Fellowships

Visiting Professor Department of Mathematics Fall 2021
Boston College | Chestnut Hill, MA

Fellow Radcliffe Institute for Advanced Study 2018–19
Harvard University | Cambridge, MA

Member Center of Mathematical Sciences and Applications 2018–19
Harvard University | Cambridge, MA

Visitor Microsoft Research Lab 2018–19
MSR New England | Cambridge, MA

Research Member Geometric Group Theory program Fall 2016
Mathematical Sciences Research Institute | Berkeley, CA

Research Member Random Walks and Asymptotic Geometry of Groups program Spring 2014
Institut Henri Poincaré | Paris, France

Research Member Low-dimensional Topology, Geometry, and Dynamics program Fall 2013
Institute for Computational and Experimental Research in Mathematics | Providence, RI

Research Member Geometric and Analytic Aspects of Group Theory program May 2012
Institut Mittag-Leffler | Stockholm, Sweden

Research Member Quantitative Geometry program Fall 2011
Mathematical Sciences Research Institute | Berkeley, CA

Postdoctoral Fellow Teichmüller "project blanc" Spring 2009
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ELECTION LAW JOURNAL
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Original Articles

Considering the Prospects for Establishing a Packing Gerrymandering Standard

Robin E. Best, Shawn J. Donahue, Jonathan Krasno, Daniel B. Magleby, and Michael D. McDonald

ABSTRACT

Courts have found it difficult to evaluate whether redistricting authorities have engaged in constitutionally impermissible partisan gerrymandering. The knotty problem is that no proposed standard has found acceptance as a convincing means for identifying whether a districting plan is a partisan gerrymander with knowable unconstitutional effects. We review five proposed standards for curbing gerrymandering. We take as our perspective how easily manageable and effective each would be to apply at the time a redistricting authority decides where to draw the lines or, post hoc, when a court is asked to decide whether an unconstitutional gerrymander has been enacted. We conclude that, among the five proposals, an equal vote weight standard offers the best prospects for identifying the form of unconstitutional gerrymanders that all but ensure one party is relegated to perpetual minority status.

Keywords: gerrymander, vote dilution, efficiency gap, partisan symmetry

Partisan gerrymandering has become such a dark art that retired Justice John Paul Stevens proposed a constitutional amendment to curb it (Stevens 2014). After the 2000 round of redistricting, David Mayhew pointed to five cases of deft gerrymandering—Florida, Michigan, Ohio, Pennsylvania, and Texas (Mayhew 2011, 24; see also Toobin 2003), to which three others could have been added—California, Illinois, and South Carolina (McDonald and Best 2015, 321). After the 2012 round of redistricting, credible gerrymandering allegations have been leveled at no fewer than ten states: Florida, Georgia, Illinois, Louisiana, Maryland, North Carolina, Ohio, Pennsylvania, Tennessee, and Texas (Fang 2014). One could likely add Michigan and Wisconsin without any stretch of credibility. In all these cases the party in power is suspected of designing districts to perpetuate their majority control of a congressional delegation or state legislative chamber almost regardless of what a majority of voters would decide were they not pre-organized in clusters favoring the party in power. The artistry, of this sordid sort, is accomplished through so-called packing gerrymanders. Very many partisans of one stripe are crammed into a small number of districts while partisans of the other stripe are given strong but not overwhelming majorities in the larger number of remaining districts.

Justice Stevens' call for a constitutional amendment comes in the face of two frustrations. Only a few states have shown a willingness to police partisan gerrymandering on their own, and courts have been unable to craft a diagnostic standard that identifies whether a districting plan produces constitutional harm. Needless to say, the wait for a constitutional amendment requires as much patience as the wait for states to adopt rules themselves. Instead

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of waiting, we ask whether any of five recent proposals to assess partisan gerrymandering might be able to supply redistricting authorities in the first instance or courts, if needed later, with a manageable and effective diagnostic tool.

The five proposals are

(1) an *efficiency gap* test (Stephanopoulos and McGhee 2014);
(2) a test *comparing seats won to neutral expectations* (Chen and Rodden 2013a);
(3) an *equal vote weight* test (McDonald and Best 2015);
(4) a *partisan symmetry* test (Grofman and King 2007); and
(5) a *three-prong* test (Wang 2016).

Manageability refers to the clarity and ease with which an analyst can observe a standard's proposed showing of effect. Why? Absent a clear and easily observed effect, debatable aspects of the principal facts leave a conclusion in doubt. *Effectiveness* refers to the accuracy by which a standard's proposed showing of effect identifies gerrymandering as the cause of violating a constitutionally protected right. Why? Absent an accurate assessment of gerrymandering as the cause, doubts about the possibility of false negative or false positive inferences overtake a conclusion.

The next section lays a conceptual foundation by using the language of the Supreme Court to identify the constitutional harm packing gerrymanders can inflict. The third section, first, details the principles of manageability and effectiveness we use to evaluate each proposed standard and, next, describes the types of vote dilution the different standards are designed to uncover. The fourth section describes the reasoning associated with each of the five standards and, through a series of hypotheticals, offers preliminary evaluations of their manageability and effectiveness. Because hypotheticals are useful for illustrating general principles but are prone to doubts about how they operate in actual applications, the fifth section extends the evaluations by applying each standard to state senate districting plans in North Carolina and Iowa. North Carolina is a case where the intention to gain partisan advantage is acknowledged; Iowa is the poster child for a districting process that has neither the intent nor the effect of producing a partisan gerrymander. Thus, reliance on these two cases provides opportunities to check for false negative (North Carolina) and false positive (Iowa) readings.

While arguably manageable, we find that counting wasted votes (aka, the efficiency gap test) relies on a dubious definition of wasted votes and is decidedly ineffective because wasted votes occur for reasons other than gerrymandering. Comparing seats won to neutral expectations requires a set of neutrally drawn districts, a process that can encounter manageability problems due the black-box computer algorithms they require, and they can suffer effectiveness problems because a disadvantaged party hamstrung by a cracking gerrymander can win seats at or even above expectations when its votes amount to less than a majority. The equal vote weight test is manageable and mostly effective but not as aggressive as might be preferred. Testing for partisan symmetry is mostly effective but not entirely manageable because its reading of gerrymanders requires reliance on nonfactual hypotheticals. Finally, the three-prong approach fails on its own terms because the prongs do not fit together as a coherent whole and, worse, the prongs can operate at cross-purposes. All in all, the reviews lead to this conclusion: the equal vote weight standard is the most easily manageable and effective at identifying packing gerrymandering as the cause of a constitutional harm: diluting the votes of one set of partisans.

PARTISAN GERRYMANDERS OF THE PACKING VARIETY

All five proposed standards have been aimed at identifying packing gerrymanders.[1] As remarked, packing gerrymanders concentrate a large number of the disadvantaged party's voters in a small number of districts. When one party's voters are packed

[1]Wasted votes were the primary evidence of effect in a Wisconsin State Senate challenge (*Whitford v. Gill* 2016). Comparing wins was used in a challenge to Florida's congressional districts (*Romo v. Detzner* 2014). The equal vote weight standard was proposed by amici (Hebert and Lang 2015) at the remedy stage of the Virginia litigation that earlier found the State's congressional districts to be an unconstitutional racial gerrymander (*Page v. Virginia State Board of Elections* 2014). Seat-denominated symmetry was proposed to the Supreme Court by amici (King et al. 2005) for consideration in *LULAC v. Perry* (2006). One of the three prongs was proposed by amici (Wang 2015) in *Harris v. Arizona Redistricting Commission* (2016).

into a few districts, the packed partisans hold overwhelming majorities in those districts. Packing gerrymanders also serve to spread the packed party's remaining voters over a large number of districts where they constitute sizable but ineffective minorities.[2] By way of example, a competitive jurisdiction with 10 districts and a vote typically expected to split 52 percent Democrat and 48 percent Republican might enact a packing gerrymander by granting Republicans two districts that are 100 percent Republican and next set up the remaining eight so that they split 35 versus 65, Republican versus Democrat. The result is two safe Republican seats and eight safe Democratic seats, a seat split that would likely hold even if votes shifted substantially in the Republicans' favor. Notice that packing uses cracking at a second step. In the example, two districts are packed with Republicans; this recasts the system-wide percentages among the other eight, which are then cracked, safely for Democrats, so they all divide 35–65.

In theory an optimal partisan gerrymander can be shown to involve pure cracking (Freidman and Holden 2008), but as Owen and Grofman have shown, for reasons both of a party's desire for legislative majority control and of it and its individual candidate's risk aversion, an optimal gerrymander under competitive circumstances relies on packing (Owen and Grofman 1988; see also Gul and Pesendorfer 2010).[3] In any case, as we have noted (fn. 1), the five proposed standards have been aimed at packing gerrymanders and so, too, has the Supreme Court's attention in three major partisan gerrymandering decisions, *Davis v. Bandermer* (1986), *Veith v. Jubelirer* (2004), and *LULAC v. Perry* (2006).[4]

Justice Scalia, announcing the Court's judgment in *Veith*, defined gerrymandering as "[t]he practice of dividing a geographical area into electoral districts, often of highly irregular shape, to give a political party an unfair advantage by diluting the opposition's voting strength" (*Vieth v. Jubelirer*, 2004, 271 n. 1, quoting *Black's Law Dictionary* 1999, 696). Finding intention and observing weirdly shaped districts are seldom difficult (as in *Davis v. Bandemer* 1986; *Veith v. Jubilier* 2004, *LULAC v. Perry* 2006), but finding a standard that identifies a party's unfair advantage because the opposition party's votes have been diluted has proved elusive.

In *Bandemer*, Justice White explained the Court majority's holding of justiciability of partisan gerrymandering in response to a caution from Justice O'Connor. She worried that judicial attempts to police partisan gerrymandering would have courts give preference to proportionality. Justice White and the majority disagreed; justiciability of packing forms of partisan gerrymandering rests on the Court's preference not for proportionality but, rather, for ensuring that popular "majorities are not consigned to minority status" (*Davis v. Bandemer* 125, n. 9).[5] Such majority-to-minority consignment would signal vote dilution because turning a majority into a minority occurs only if the votes of those in the vote majority count less than those in the vote minority.

The Court's disagreement with Justice O'Connor came in a context of whether its approach to racial gerrymandering could also apply to partisan gerrymandering. It can, but with an important

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[2]Gerrymandering is a term used to cover a large range of electoral manipulations. Aside from the packing gerrymander focus under review here, pure cracking gerrymanders spread one party's votes evenly across districts so that they constitute sizable but losing minorities in all districts. These are most effective, least risky, in jurisdictions with lopsided competition. At-large and multi-member district plurality elections with their super-majoritarian effects are referred to as institutional gerrymandering (Dixon 1971, 54). Creating under-populated districts for one versus the other partisan group is a form of malapportionment gerrymandering (Brunell 2012; *see also Harris v. Arizona Redistricting Commission* 2016). Creating a district adverse to or favorable to particular candidates are "personalized" gerrymanders or, when the candidates in question are incumbents, "incumbent-displacement" gerrymanders (Owen and Grofman 1988, 14–16). Each has its own means and methods for accomplishing its manipulation and thus is best approached with its own form of precisely aimed standard for detection.

[3]Freidman and Holden's terminology can be misleading in that their title advises never cracking. Notice, however, they have in mind an uncommon meaning of cracking. They come at the issue from an approach that assigns individuals to districts and from there advises placing (packing in their meaning) the most staunch opposition partisans in districts with one's own staunch supporters. "Intuitively, extreme Democrats can be neutralized by matching them with a slightly larger mass of extreme Republicans" (Freidman and Holden 2008, 115). Discussions of gerrymandering normally refer to this as cracking or dispersal gerrymanders—spreading opposition partisans over many districts to deny them majority control in as many as possible (*see, e.g.*, Owen and Grofman 1988, 6).

[4]The Court considered allegations of a different form of partisan manipulation in *Harris v. Arizona Redistricting Commission* (2016). There, as remarked on in note 2, *supra*, the issue was neither packing nor cracking, as such, but malapportionment partisan manipulation by systematically underpopulating districts favoring Democrats (*see* Brunell 2012 for a general discussion of this form of manipulation).

[5]In relation to purely cracking forms of gerrymander, Justice White refers to the Court's concern for ensuring "significant minority voices are heard" (*Davis v. Bandemer* 1986, n. 9).

qualifying complication. In the same term that *Bandemer* was decided, the Court spelled out a three-prong test for racial gerrymandering (*Thornburg v. Gingles* 1986). While the allegation of racial vote dilution involved several of North Carolina's multi-member districts, the *Gingles* standard could be (and later was) extended to strictly single-member district plans (*Growe v. Emison* 1993; *Voinovich v. Quilter* 1993; *Johnson v. DeGrandy* 1994). It calls for comparing the actual number of majority-minority districts to the number that could reasonably be expected to exist when a fair set of single-member districts is drawn.[6]

On its face, it would appear simple to transfer that diagnostic to partisan gerrymandering. One could ask whether Democrats and Republicans have won a number of districts compared to what could be expected under a fair set of compact and contiguous single-member districts. The resemblance is not quite as straightforward as it appears, however. Unlike counting people based on race or language minority status, where the relevant number is determined and essentially fixed by census count, vote counts vary from one election to another. In a packing gerrymander, an unfair allocation of seats of, say, 40 percent when a party wins 50 percent of the vote is readily apparent. However, when the same party receives only 40 percent of the vote and wins the same 40 percent of the seats, the plan would appear eminently fair. This sort of variable result could occur in a packing gerrymander precisely because a packing gerrymander is designed to grant the disadvantaged party some minority percentage of seats over a wide range of vote percentages. As we shall demonstrate, taking account of this understanding of how packing gerrymanders operate in differential ways when votes vary between low and high is a difficult problem that the five standards propose to but sometimes fail to resolve.

EVALUATIVE FRAMEWORK

We are looking for an easily manageable and effective standard for identifying packing gerrymanders that dilute the voting weights of one party's voters. Easy manageability refers to a diagnostic method that calls for a clear and self-evident observation of the facts as the basis upon which the ultimate inference is to rest. The more directly observable the facts, the more indisputable are the foundation stones of what everyone observes. Indubitably, such transparency fades to ambiguity the more the prescribed method requires leveraging assumptions. The fourth section identifies assumptions each standard relies on to establish the factual underpinning it calls for.

Effectiveness refers to a diagnostic method that avoids errors. A false negative error occurs when a method fails to identify a gerrymander even though the choice of where to place the district lines actually caused vote dilution. A false positive error occurs in either of two ways: a proposed standard identifies vote dilution when there is none, or it identifies gerrymandering as the cause of vote dilution when the cause is attributable to something else. In addition to highlighting assumptions relevant to manageability, the fourth section identifies possible reasons to be concerned about inferential errors. Because possible reasons for doubt are potentially more hypothetical than real, the fifth section evaluates effectiveness in two applications. If we accept that North Carolina's senate districts are a partisan gerrymander, which the state acknowledges, and Iowa's senate districts are not a partisan gerrymander, which most observers acknowledge, then a standard that fails to identify North Carolina's gerrymander or misidentifies Iowa's districts as a gerrymander is committing error. Moreover, if a standard sometimes identifies the same set of districts as a gerrymander with respect to some elections and a non-gerrymander with respect to other elections, we know with assurance it is committing errors.

As for the concept of vote dilution, it must be said that four of the five standards have in mind their own particular meaning. The discussions and analyses accept each standard's definition, and thus we evaluate manageability and effectiveness on each standard's own terms of what it means to dilute votes.

Comparing parties' wasted votes considers dilution to occur when one party's voters cast more

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[6]Justice Brennan explained the Court's rationale this way. "The reason that a minority group making such a challenge must show, as a threshold matter, that it is sufficiently large and geographically compact to constitute a majority in a single-member district is this: Unless minority voters possess the potential to elect representatives in the absence of the challenged structure or practice, they cannot claim to have been injured by that structure or practice" (*Thornburg v. Gingles* 1986, 50 n. 17).

unneeded votes in the senses that they go to loosing candidates or exceed what is necessary to win a seat. If votes for one party are more likely to count for nothing, that party has more votes with zero weight and thus more votes that are diluted to a maximum extent. The comparison of wins standard sees dilution as existing to the extent that one set of partisan votes do not count as much as they should because they elect fewer of their party's candidates than would be expected under neutrally drawn districting procedures. This is the direct analogue to the approach taken by the Court in racial gerrymandering. The equal vote weight standard is a vote-denominated symmetry idea that says vote dilution is foretold by comparing the median district to mean district vote percentage. If all votes count the same, the median and mean have the same numerical value; if the median and mean differ, votes for the two major parties count differently as a consequence of being divided into districts. The partisan symmetry standard aims at non-dilution in the sense that whatever seat percentage one party wins with a given vote percentage, the other party is expected to win that same percentage of seats with that same percentage of votes. The idea here is that the same resources, votes, reap the same rewards, seats; otherwise, the two sets of voters are not counting equally. The three-prong test has more expansive interests that include vote dilution but carry concerns beyond just that concept. Its focus includes (1) seat-vote outcomes that hue towards proportional representation; (2) seat shifts that are responsive to vote shifts; and, (3) depending on competitiveness, a non-gerrymandered plan that either preserves symmetry or ensures the predominant party's district vote percentages are not too similar.

FIVE STANDARDS

Efficiency gap

Counting and comparing wasted votes is the basis for the efficiency gap standard proposed by Stephanopoulos and McGhee (2015; see McGhee 2014 for the underlying social science thinking). The approach proceeds from the insight that both winners and losers "waste" votes by inefficient allocation in an election. That is, any votes above the 50% +1 for the winner plus all votes for the loser are wasted in that they contribute nothing of determinative importance to deciding who wins. In a single-district election decided by a 60–40 margin, the winner wastes 10 percentage points above 50% (setting aside ties for the sake of simplicity), while the loser wastes all 40 percentage points. Comparing the magnitude of the waste on both sides, 10 versus 40, shows an efficiency gap (of 30 points) favoring the winner. McGhee and Stephanopoulos argue that in a non-gerrymandered system both sides waste the same number of votes, so ideally the efficiency gap should equal zero.

Their claim has an appealing label along with a seemingly simple, straightforward, and intuitive procedure for calculating a numerical indicator. Nevertheless, it runs into manageability difficulties in two regards: (1) it assumes wasted votes are to be counted in an odd way, and (2) it has no secure baseline for establishing the degree of wasted votes that indicates a gerrymander. Effectiveness difficulties arise for three reasons: (1) votes are wasted for reasons other than gerrymandering; (2) the wasted vote gap co-varies with a party's vote percentage; and (3) the method seeks to cover both cracking and packing gerrymanders in one calculation and thereby can allow some amount of cracking to disguise an undue amount of packing.

Even though the arithmetic required is simple, and in that sense would seem to clear the manageability bar, the efficiency gap's definition of votes wasted by the winning candidate is disputable.[7] In particular, decades ago Andrew Hacker, who refers to the winner's wasted votes as *excess* votes, defines them as one more than the votes received by the losing candidate (Hacker 1964, 55–7). McGhee (2014) and Stephanopoulos and McGhee (2015) define a winner's excess/surplus/wasted votes as votes beyond 50% +1. It runs into a second manageability problem when deciding how many wasted votes signal a gerrymander. Because no democratic or legal principle answers the question of how many wasted votes are needed to say a plan is a gerrymander, the approach calls for comparisons to the historical record in the same jurisdiction and contemporaneous results in other jurisdictions. Such relative baselines beg the question of whether what occurred previously in the same jurisdiction or

[7]Judge Greisbach, dissenting in *Whitford*, goes so far as to call the efficiency gap's method of counting excess wasted votes "absurd" (*Whitford v. Gill* 2016, 150).

is occurring contemporaneously in other jurisdictions are results contaminated by gerrymandering.[8]

The efficiency gap runs into three problems related to its effectiveness. First, and simply, under single-member district rules votes are wasted for reasons other than gerrymandering. One needs to look no further than a simple example of a congressional district in a one-district state such as Delaware to see this. Unless the vote splits 75–25, one party wastes more votes than the other, this despite the fact that a gerrymander is impossible in a one-district state. Maybe the efficiency gap is useful only in multi-district situations, but that can't be true either. Therein resides the efficiency gap's second effectiveness problem. In a three-district state, a symmetrical distribution of 48–52–56 has a gap of +8.3 in favor of the majority party and is, by the eight-point criterion, a gerrymander. Of course, if the vote shifts uniformly to 46–50–54, there is no gerrymander, even though it is the same districting plan. Then, if votes shift another two points to 44–48–52, the gerrymander would be said to run in the direction opposite of what was inferred from the original 48–52–56 distribution. In this scenario, the relative distribution of partisan voters did not change—neither party became relatively more (or less) packed—and yet the efficiency gap registered a substantial shift in partisan advantage. In fewer words, reading a gerrymander from the efficiency gap can and often will vary depending on the underlying percentage level of the votes a party receives.

A third effectiveness problem has to do with the translation of votes to seats, the seat-vote ratio. Assuming equal turnout in all districts, a majoritarian seat-vote ratio of two to one is sufficient for equalizing wasted votes—i.e., having a seat percentage in excess of 50 equal to two times the vote percentage in excess of 50 produces an equal number of wasted votes (McGhee 2014, 79–80; Stephanopoulos and McGhee 2015, 853). For example, winning 60 percent of the seats (10 points above 50) in association with winning 55 percent of the votes (five points above 50) indicates there is no gerrymander. However, that is not necessarily so. A majoritarian seat-vote correspondence of two-to-one can occur even when a packing gerrymander is in place. Hence, a two-to-one seat-vote ratio is not a sufficient condition to conclude there is no gerrymander. For example, consider a 40–40–60–65–70 vote distribution. The distribution is asymmetrical (median 60 and mean 55), but the efficiency gap shows an equal number of wasted votes. Votes are five points above 50, and seats are ten points above 50; the majoritarian ratio is two-to-one even though the distribution is asymmetrical. Thus, despite its proponents' claims to the contrary, the efficiency gap standard does not comport with nor arise from the idea of partisan symmetry.[9]

The wasted vote approach has clear intuitive appeal. Nevertheless, it has several downsides. One, its computation poses a manageability problem because it relies on a shaky definition of what it means to waste a vote, given the alternative way of counting excess votes (as in Hacker 1964; *Whitford v. Gill*, 2016, 150–2, Greisbach dissenting). Two, it underachieves on the question of manageability because evaluation of the wasted vote computation requires using a relative comparison to the historical record of elections in the same jurisdiction or to elections in other jurisdictions. A historical comparison is liable to perpetuate gerrymanders in earlier years; comparison to other jurisdictions leaves one wondering whether the baseline involves a mix of fair and unfair outcomes elsewhere. What's more, it can under-reach and overreach on questions of effectiveness for three reasons, each functionally related to its implications that single-member district elections are fair if and only if they operate with a seat-vote majoritarian ratio of two to one. Under-reaching occurs when it offers a false negative reading of gerrymandering because, despite substantial packing, the majoritarian ratio is two to one. It overreaches when it offers a false positive reading of gerrymandering by indicting a districting plan as a gerrymander because it has many competitive districts that slightly favor one party and thus a majoritarian ratio greater than two to one.

Comparing wins

This approach identifies diluted votes as winning fewer seats than expected in districting plans

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[8]In some applications an efficiency gap beyond ± 8 indicates a gerrymander (Stephanopoulos and McGhee 2015, 831). In other applications, a gap beyond ± 7 is deemed indicative (Jackman 2015, 5). As applied to congressional districts, it is designed to be applied only to delegations of eight or more members; in this context a gerrymander is indicated, not by any particular magnitude of the gap, but when one party would have been expected to win two or more seats than it actually did win (Stephanopoulos and McGhee, 2015, 835–6).

[9]*See* Stephanopoulos and McGhee (2015, 834 and passim) for claims about the relationship between symmetry and the efficiency gap.

produced through partisan blind line-drawing. If an enacted plan is an outlier in a partisan-blind null set's expected seat distribution, one can infer that it was probably intended to hold a partisan advantage. This closely aligns with the Court's racial gerrymandering standard that asks for a comparison between how many districts a group actually wins and how many the group would win under a fairly drawn single-member district plan. Its manageability problem arises in association with the black-box nature of the computer algorithm needed to establish the factual baseline for comparison. Its effectiveness can be left wanting because the match of observed versus expected wins (or districts carried) depends on the vote percentage a party wins.

The basic idea behind generating the comparisons is to use a computer to draw a large number of districting plans. Using computers for this purpose is an idea that has been floated at least since William Vickrey made the point more than a half-century ago (Vickrey 1961). A few pioneers succeeded in advancing the idea in modest ways in the 1960s and 1970s (Nagel 1965; Engstrom and Wildgen 1977); then, with advances in processing speed, the approach was ready for a full-scale application years later (e.g., Cirincione, Darling, and O'Rouke, 2000; Altman and McDonald 2011; Chen and Rodden 2013a)—at least it seemed ready in the run up to the Florida proceedings involving the State's congressional districts. Both Thomas Darling along with Jowei Chen and Jonathan Rodden produced null sets in advance of the Florida trial (see Darling 2013; Chen and Rodden 2013b; 2014), and Rodden testified at length. In the end, however, neither the reports nor Rodden's testimony received any mention by the trial court or in subsequent court decisions (*Romo v. Detzner* 2014; *League of Women Voters of Florida v. Detzner* 2015).

For what it says about manageability, the Florida courts' silence is disquieting. It may have been benign. In the face of the smoking gun evidence of partisan maneuvering that violated Florida's newly operative state-constitution intent standard, the court might well have reasoned that nothing as sophisticated as a computer-generated null set was needed.[10] Perhaps, however, the court was dissuaded from crediting the method with probative value because one report identified a few contiguity problems (Hodge 2013) and another report, plus testimony, questioned whether the Chen-Rodden null set was randomly generated since no one can know the characteristics of the population of all possible plans (McCarty 2013; 2014). Or, perhaps and more simply, the black-box nature of the method left the court unsure what reliable conclusions could be drawn.

Because the null set approach has yet to be tried and tested in a full form application, questions about its effectiveness are open. Still, this much can be said. Not enough thought has gone into how the null set could be used to detect gerrymandering beyond forming a baseline to say whether an enacted plan is an outlier in the null set distribution and, on that basis, probably indicates a gerrymander. Engstrom and Wildgen (1977, 469–70) evaluate a plan in regard to how many competitive districts it contains. Cirincione et al. (2000), Darling (2013), along with Chen and Rodden (2013a, 2014), evaluate a plan in regard to the number of districts in which each racial group or political party holds a majority. We have to suppose that focusing solely on the central tendency is not enough. Why? Depending on the vote percentage won by a disadvantaged party, the expected number of competitive districts or of majority-held districts varies and might well include seat outcomes that square with the expectation—i.e., the central tendency—but involve packing.

As an example of the problem associated with a focus on seats won (more precisely, districts carried), consider Chen and Rodden's attempt to indicate a gerrymander by counting President Bush's 2000 or John McCain's 2008 district wins across Florida, in their academic and trial-related work, respectively (Chen and Rodden 2013a, 2013b, 2014). As noticed and noted by both Darling (2013) and McCarty (McCarty 2013, 2014), a match or mismatch between expected and observed number of districts carried is not a per se robust and structural feature of a districting plan. The match or mismatch varies depending on the vote percentage won. A packing gerrymander that all but guarantees that a party win, say, 40 percent of the districts whether it wins, say, 40, 50, or 60 percent of the vote—which is the type of result a packing gerrymander can and often does produce—will sometimes match the expected number of districts carried and

[10]The facts revealed such damning evidence as Republican legislators and their operatives enlisting mapmaking confederates to submit "citizen constructed plans" under fake names and writing scripts for "concerned citizens" to present the operatives' ideas at public meetings (*Romo v. Detzner* 2014, 20–31).

other times will not. In different words, the contours of a districting plan interact with a party's system-wide level of vote support to produce more, equal, or fewer than expected wins. As a consequence, the interaction produces variable readings of gerrymandering under the expected wins standard.[11]

Using computer-generated districts to form a null set holds promise. It removes all but inadvertent partisan effects in its construction of a null set and thus supplies a strong basis for probabilistic inferences about intentions. One problem it has to overcome is making the computer processing more intuitive and transparent. Another pressing matter is choosing a benchmark other than the expected number of competitive districts or the number of district wins. The approach supplies a useful tool, but we need to figure out how to make it transparent and how to use it effectively.

Equal vote weight

The *equal vote weight standard* relies on two observed facts: (1) compare the median district vote percentage to the mean district vote percentage received by the party, and (2) check whether majority rule is violated. When one group of partisans is relatively more packed than the other, a districting plan has the potential to violate the widely embraced principle of equal vote weights and, from the unequal weights, to entrench one party in majority status. Manageability of the equal vote weight standard is straightforward inasmuch as the essential facts are directly observable. Its effectiveness can be challenged, however, because its requirement to observe a violation of majority rule is not as assertive as some ideas about gerrymandering might require.

In all, the standard for a factual identification of a gerrymander rests on three manageable ideas.

(1) *Leading indicator:* Asymmetrical packing exists when the median district vote percentage for one party is persistently lower than its mean district vote percentage.

(2) *Objectionable harm:* A vote weight inequality is clearly identifiable when one set of partisan voters casts a majority of the votes but carries less than a majority of the districts, because violating majority rule occurs only when all votes do not count equally.[12]

(3) *Cause:* District line placements are the known cause of the unequal vote weights. Votes counted system-wide contribute equally to the count. Counting votes after division into districts changes only the manner of counting. To the extent the two forms of counting do not produce the same result, the difference must be caused by the line placements.

Manageable as it is with respect to the required facts, tying its focus to violating majority rule is an arguable shortcoming of its potential effectiveness. Equal median and mean district vote percentages indicate only average symmetry, not full-scale symmetry. Reaching for a full- or at least a fuller-scale approach would be more aggressive. For example, a five-district plan applied to two-party competition that has (expected) Republican district vote percentages of 44, 46, 51, 52, and 62 is symmetrical via the equal vote weight standard but asymmetrical under a full-scale symmetry requirement (i.e., as recorded by partisan symmetry considered next—see below). The median and mean are both 51. Thus, average symmetry is upheld inasmuch as deviations above and below the mean of 51 both average six. Majority rule is also preserved; the vote majority holds a three-to-two seat majority. Full-scale symmetry goes wanting, however, because something like uniform vote swings would result in Republicans winning only three seats with 52 percent of the vote—an upward shift of one point resulting in a 45, 47, 52, 53, 63 distribution—but Democrats win four seats when they have 52 percent of the vote—after a downward shift of three points resulting in a 41, 43, 48, 49, 59 distribution. While majority rule is maintained under both vote swings, the idea of equality is not as aggressive as it might be in the sense that different rewards (seats) can be acquired from the same resources (votes).

[11]Darling analyzed his 5,000-map null set for nine pre-2012 statewide Florida elections in addition to the McCain-Obama presidential contest. For the McCain-Obama contest he found, as did Chen and Rodden, the expected number of McCain wins under the 2012 lines was 14, whereas the enacted districting plan had McCain winning 17—a result observed in less than one percent of the null set plans. However, Darling's analysis of the nine other elections showed the actual versus expected wins either matched (three elections), differed by one in favor of Republicans (three elections), or differed by one or two in favor of Democrats (three elections)—*see* Darling (2013, 16).

[12]As McDonald and Best point out, violation of majority rule is evaluated against the two-party statewide vote percentage and not the district mean vote percentage, in order to ensure that the evaluation does not conflate a violation due to turnout bias with a violation due to gerrymandering bias (McDonald and Best 2015, 318).

The equal vote standard has pros and cons. Its required factual finding is easily observed: compare the median and mean district percentages and check for violations of majority rule. However, it is not as aggressively effective as some might demand. It can be charged with under-reaching by not accounting for situations when vote shifts produce different seat outcomes while winning the same vote percentage.

Partisan symmetry

A proposal for a partisan symmetry constructed on the basis of fair seat-vote translations at various levels of vote splits goes back decades (Gelman and King 1994). It has found favor among political scientists (e.g., Engstrom 2013; McGann at al. 2015, 2016). To some extent it has also found favor among members of the Supreme Court in *LULAC v. Perry* (2006; for a detailed discussion of the Justices' reactions see Grofman and King 2007, 1–6). Its effectiveness would not be much in doubt were it not for the assumptions required to establish baseline hypothetical seat results for making comparisons between the two parties.

The approach, which could be called a seat-denominated symmetry standard, relies on an equal opportunity notion of fairness. Within practical and probabilistically knowable limits, each party is expected to win the same seat percentage for the same vote percentage. Suppose Democrats win 35 of 50 seats, 70 percent, with 55 percent of the vote. Seat-denominated symmetry requires that Republicans win 70 percent of the seats (35 of 50) when they win 55 percent of the vote. This notion of a partisan symmetry standard shares the same concern for asymmetry that violates majority rule as the equal vote weight approach, but it adds a requisite symmetrical operation of the swing ratio. At an even 50:50 vote split, seats should split 50:50, and in the competitive range of two-party vote splits, perhaps inside the 40 to 60 range, if Democrats win five more seats with 53 percent of the vote, then Republicans should be expected to add five seats when their vote is three points above 50. Its attention to the swing ratio bears a similarity to the wasted vote approach; however, it differs by being agnostic about the magnitude of the ratio, provided that the effect of the swing is symmetric.

One way to see the standard's manageability problem is from the example used to point to a shortcoming of the equal vote weight approach. There we had a five-district Democratic two-party vote percentage distribution of 44, 46, 51, 52, and 62. The median and mean are equal, and therefore a vote-denominated indicator of asymmetry is missing. However, as discussed, a three-point uniform shift in favor of the Republicans, moving the median and mean to 54, leaves them with three district wins, while a three-point swing in favor of Democrats leads to four district wins. That, of course, depends on the uniformity of the vote swing. If the swing is non-uniform—i.e., if it is mixed in the sense that some districts swing more than others—we need to know more, much more. Getting an assured handle on what else we need to know was the apparent stopping point for Justice Kennedy when he remarked favorably on the partisan symmetry approach but said courts are "wary of adopting a constitutional standard that invalidates a map based on unfair results that would occur in a hypothetical state of affairs" (*LULAC v. Perry* 2006, 420).

The partisan symmetry standard is more comprehensive than the equal vote weight standard. To realize the added value of it comprehensiveness, however, it can under reach in practice by requiring a supporting analysis that makes some decision makers wary of relying on it because it requires leveraging a variety of not easy to evaluate assumptions embedded in computationally intensive analysis of vote swings.

Three prongs

Because gerrymandering is a complex concept, it might seem to be a good idea to use multiple criteria to evaluate whether one has been enacted. Such is the apparent thought standing behind Samuel Wang's proposed three-prong test (Wang 2016). The three prongs are grounded in concerns for (a) a less than justifiable degree of seat-vote proportionality, (b) under-responsiveness of seat shifts to vote shifts, and (c) asymmetry in the vote distribution.

(1) *Excess seat test:* Seat-to-vote responsiveness is within a range between proportionality and what could be expected from the seat-vote relationship in other states (plus allowance for random variation).
(2) *Lopsided outcomes test:* Unequal average lopsidedness in the vote distribution is evaluated by comparing average values of each party's

winning margin above 50 (plus allowance for random variation).

(3) *Reliable wins test (two forms):* In a competitive jurisdiction a party's median district percentage equals its mean district percentage (plus allowance for random variation); in a non-competitive jurisdiction the dominant party's standard deviation of the vote percentages equals the standard deviation of the party's vote from simulations based on other jurisdictions (plus allowance for random variation).

Having three prongs gives the appearance of a more comprehensive set of concerns than the preceding four approaches. That much can be granted, but having three prongs creates at least two manageability problems. One is reliance on election results from other jurisdictions as a basis for comparison. As with the wasted vote approach, an external standard begs the question of whether what occurs in the jurisdiction in question is the consequence of something particular to the jurisdiction other than the manner in which the jurisdiction was divided into districts. Second, Wang advises that the three prongs can be used "separately or combined" (Wang 2016, 1308). Questions naturally follow: Is satisfying one of the prongs enough to say no gerrymander exists? Is violating one of the prongs enough to say a gerrymander has been enacted?

Wang's advice to use his three prongs independently or in combination also carries with it an effectiveness problem. The different prongs can provide indications running in opposite directions. For example, a five-district distribution of 40, 40, 60, 60, 60 satisfies both proportionality (prong 1) and equal average lopsidedness (prong 2) but fails the symmetry standard of prong 3 (median 60 and mean = 52). Likewise, a swing ratio could reside within the bounds of acceptable proportionality but fail on both lopsidedness and symmetry. And a districting plan could fail the lopsidedness test simply because an election-swing moves the vote percentage away from 50 percent even in the absence of gerrymandering. A second effectiveness problem also relates to a lack of clarity regarding which prongs apply. Requiring failure on all three prongs simultaneously leaves an opportunity for mapmakers to satisfy any one prong while enacting a gerrymander that would be indicated by either or both of the other two prongs. In all, and in other words, the three prongs lack a coherent framework that allows them to work together.

Evaluating gerrymanders through three different tests has an intuitive appeal. Nevertheless, it raises difficult questions for both manageability and effectiveness because, as it stands, no compelling coordinating principle supplies clarity about whether a gerrymander exists according to any or all three prongs.

TWO APPLICATIONS

Argument is instructive but not enough when evaluating standards to be applied not just in theory but also in fact. Below we put all five standards to the test in the contexts of North Carolina's and Iowa's post-2011 enacted state senate districts. We want to see whether any of the five produce false negative or false positive diagnoses.

We select North Carolina and Iowa because one case is rather assuredly a gerrymander (North Carolina) and the other is rather assuredly not (Iowa). That's because North Carolina's post-2011 districts are acknowledged by the state itself, assembly members, and, later, the courts to have been drawn with pro-Republican partisan advantage as one goal (*Dickson v. Rucho* 2014, 3). Iowa's redistricting process is often held up as an exemplar of neutral redistricting. Thus, we have opportunities to check on false negative (North Carolina) and false positive (Iowa) readings.

North Carolina

The North Carolina State Senate is a 50-member body elected every two years from 50 single-member districts. Following the 2010 elections, Republicans took control of the state senate and house for the first time since 1870. The 2010 census data were delivered in March 2011, and in July the legislature passed bills establishing state senate districts for the 2012 elections.[13] Those elections saw Republicans win 66 percent of the senate seats (33 of 50) with 52.8 percent of the vote. Two years

[13]While a Democrat, Beverly Perdue, occupied the governor's office, North Carolina's redistricting bills are not subject to gubernatorial veto.

later, 2014, Republicans won 70 percent of the seats with 54.9 percent of the vote.[14] Both are substantial seat victories, 16 to 20 points in seats beyond 50 percent for votes just three to five percentage points beyond 50. But important facts militate against reading too much into the senate results by themselves. Forty percent of the seats went uncontested by one or the other major parties: 19 of 50 in 2012 and 21 of 50 in 2014. This sort of non-competitiveness, we have to think, reflects anticipated wins/losses as a consequence of the way the district lines were drawn in the first place, more so than a statement of accurate fact about the partisan disposition of the districts. More generally, prospective candidates in each of the various districts have to be thought to take account of their prospects of winning, in part—likely in substantial part—depending on a district's partisan leanings.

We can avoid the problem of district-by-district state senate election competition being endogenous to the enacted lines by turning to elections for statewide office (often referred to as *exogenous* elections) aggregated into separate counts within each of the 50 districts. The North Carolina General Assembly provides election returns for each of nine statewide offices elected in 2012 (the nine are identified in Table 1) aggregated to U.S. Census Defined Block Groups.[15] All nine elections resulted in vote percentage splits within a reasonably competitive range. We use these nine as the elections holding the most probative value for revealing whether the district lines are a pro-Republican gerrymander. In addition, with the state board supplying election returns for all nine election results disaggregated to the precinct level, we can run a large number of null set applications to generate expectations based on 50 districts drawn through a partisan-blind procedure.[16] This has a direct benefit for evaluating the observed versus expected district wins. In relation to two other proposed standards (not including the partisan symmetry and the three-prong tests) it has two additional benefits. The expectations provide a baseline for what partisan residential patterns alone could be expected to produce in regard to wasted votes and equal vote weights.

As a visual prelude, Figure 1 presents two histograms, one for the gubernatorial election, the least competitive of our nine elections, and the other for the lieutenant governor, the most competitive of our nine elections. Both distributions are bimodal. Just about two-thirds of the districts reside at percentages favorable to the Republicans regardless of whether Democrats won 44.2 or 49.9 percent of the vote. Indeed, when the vote percentage shifts in the Democrats' favor by 5.7 points, from 44.2 Democratic percent for governor to 49.9 percent Democratic for lieutenant governor, the gain in districts carried by the Democratic candidate is a mere one district. The electoral playing field is tilted substantially in favor of Republicans, leaving Democrats with a rather steep hill to climb before having any realistic prospect of winning a majority of districts.

Table 1 reports the Democratic two-party vote percentage for the nine statewide offices (column #1) and the relevant numbers for the five proposed standards (columns #2 through #6). The competitiveness noted above can be seen in the vote percentages; they range between 44.2–55.8 and 54.2–45.8, Democrat-Republican, two-party splits.

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[14]Data from North Carolina State Board of Elections Nov 6, 2012 General Election Official Results and November 4, 2014 Official General Election Results are posted on the State Board of Elections (SBoE) website.

[15]We rely on the North Carolina General Assembly's (NCGA) 2016 Redistricting Base Data provided through the NCGA's website (NCGA.net). The state provides returns for statewide contests for the 2008 through 2014 general elections. These data are collected at the voter tabulation district (VTD) level (a Bureau of the Census term for a polling area such as a precinct) level; however, several VTDs in close proximity to military bases in North Carolina reported unusually high numbers of votes and contained unusually high numbers of residents. These extremely large VTDs caused problems for our development of a null set of neutral maps because districts containing extremely these large VTDs were liable to exceed reasonable levels of population parity. To circumvent this problem, we disaggregate the returns reported by the NCGA to census blocks. We achieve this by using the spatial join utility in the QGIS software package to determine into which VTD a census block falls (Quantum GIS Development Team 2016). We then assigned votes to a block according to the proportion of the VTD population that resides within the block. We then re-aggregate block level returns to the block groups.

[16]We use a neutral redistricting algorithm proposed by Daniel Magleby and Daniel Mosesson to draw a null set of maps of legislative districts for both North Carolina and Iowa (Magleby and Mosesson 2016). The null set we develop is partisan blind in that the maps that make up the distribution were drawn without reference to any factors besides geographic contiguity and population parity. The analysis uses a graph partitioning algorithm to randomly group geographic units (block groups in North Carolina and VTDs in Iowa). While maintaining district contiguity, it then uses a second algorithm to shift geographic units randomly between districts until all districts in a given plan have roughly equal populations. We repeat the process to draw 50,000 maps of North Carolina and Iowa's state senate districts. For the analysis presented here, we utilize the 25,000 maps with the lowest difference in population across districts. Among the maps included in our sample, the maximum population deviation is within ± 4.5%.

Table 1. Results of Applying Five Standards for Evaluating Whether North Carolina's Senate Districts Are a Gerrymander

Office	#1 Obs Dem 2-pty vote %	#2 Wasted votes Obs	#2 Wasted votes Exp	#3 District wins Obs	#3 District wins Exp	#4 Equal vote weight Obs	#4 Equal vote weight Exp	#5 Partisan symmetry Dem Seat Advantage	#6 3-prong test Prong 1	#6 3-prong test Prong 2
Governor	44.2	6.8	13.2 (2.9)	16	15.3 (1.40)	−5.8	−1.6 (.91)	−8.5	2.02	−.44 (−0.22)
Lt Gov	49.9	16.5	5.8 (3.0)	17	21.5 (1.44)	−5.7	−2.0 (.95)	−9.5	1.80	9.22 (5.02)
Auditor	53.7	14.8	−1.6 (2.8)	21	26.9 (1.41)	−5.2	−1.8 (.99)	−8.2	1.72	11.36 (5.72)
Agri Comm	46.8	10.2	12.5 (2.8)	17	16.9 (1.35)	−7.1	−2.8 (.90)	−10.0	1.95	3.25 (1.74)
Insur Comm	51.9	16.2	2.3 (2.9)	19	24.1 (1.40)	−6.4	−2.2 (.98)	−9.5	1.81	10.11 (5.15)
Labor Comm	46.7	11.7	11.7 (2.9)	16	17.3 (1.39)	−6.1	−2.5 (.76)	−9.2	2.09	4.31 (2.33)
Sec of State	53.8	13.3	−3.1 (2.8)	22	27.7 (1.40)	−4.7	−1.8 (.82)	−8.5	1.97	10.49 (4.76)
Supt Pubic Ed	54.2	10.0	−3.9 (2.7)	24	28.3 (1.36)	−4.7	−1.7 (.88)	−8.1	1.91	9.38 (4.09)
Treasurer	53.8	15.1	−1.2 (2.9)	21	26.8 (1.45)	−5.3	−2.1 (.96)	−8.7	1.99	8.48 (3.86)

#1 = Percentages are for the statewide two-party vote.
#2 = Wasted votes are the difference in Dem vs Rep votes cast for a losing candidate plus votes above 50% +1 as a percentage of total two-party votes—i.e., {(Dem wasted – Rep wasted) / Total two-party votes} * 100. Positive numbers indicate more Dems wasted more votes.
#3 = District wins are the number of districts carried by the Dem candidate, observed and expected, with expectations based on 25,000 computer-generated results. Numbers in parentheses are the standard deviation of expectations among the 25,000 neutral plans.
#4 = Equal vote weights record the difference between the median district two-party Dem percentage and the mean two-party district Dem percentage. Negative numbers indicate Dem disadvantage, with the magnitude indicating approximately the percentage points above 50 Dems would need to carry a majority of districts. The column of expected results is the median-mean difference attributable to residential patterns, with standard deviations in parentheses.
#5 = Partisan symmetry is the average difference in Dem–Rep expected number of seats won in a competitive range of vote percentage (40 to 60) if each party won the same vote percentage. Negative numbers indicate Dems are expected to win fewer seats with the same vote percentage as Reps.
#6 = Prong 1 of the three-prong test is the estimated seat-vote swing ratio—e.g., a 2.02 value means a vote gain of one point brings a seat gain of 2.02 points. Prong 2 is the difference between Dem and Rep vote percentages above 50% in districts won by Dems vs Reps. Negative numbers indicate Dems have more extreme lopsided winning percentages. Numbers in parentheses are *t*-test values; values above 1.68 are statistically significant at $p < .05$, one-tail.

Efficiency gap. Applying the efficiency gap calculations produces mixed results for detecting a gerrymander. Eight of the nine elections show wasted vote percentage magnitudes exceeding the suggested demarcation line of 8.0, with the gubernatorial election falling below that line. What is one to say of these results? Sometimes the North Carolina senate districts appear to be a gerrymander, but once in a while they don't. The conclusion depends on which election one looks to as evidence. Notice,

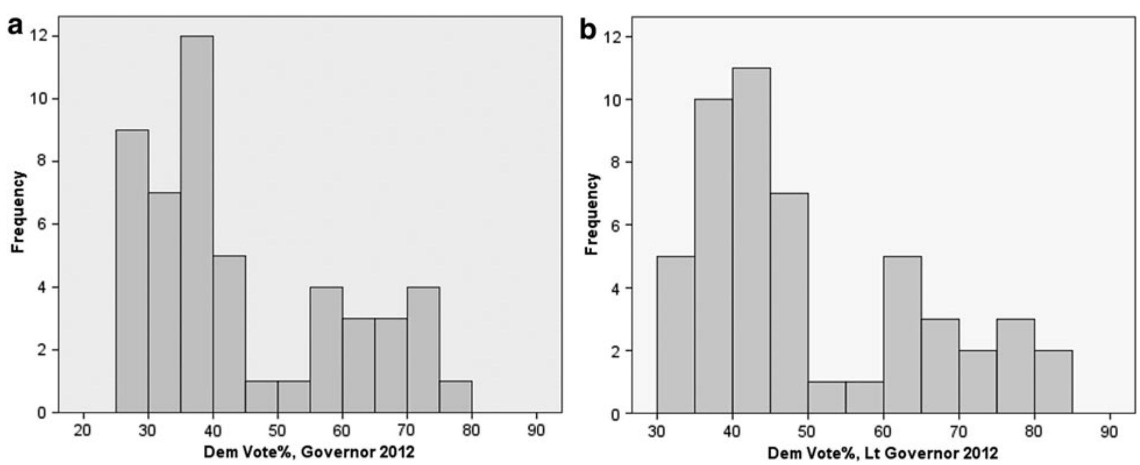

FIG. 1. Distribution of Democratic two-party vote percentages among North Carolina's state senate districts: 2012 governor and lieutenant governor elections. **(a)** *Left panel:* Dem Statewide % = 44.2; Dem Mean % = 44.4; Dem Median % = 38.6; Std. Dev. = 15.6; Dem Vote % > 50 = 16 of 50. **(b)** *Right panel:* Dem Statewide % = 49.9; Dem Mean % = 50.0; Dem Median % = 44.3; Std. Dev. = 15.0; Dem Vote % > 50 = 17 of 50.

also, the expected values rise and fall depending on the levels of the two-party vote. That is a serious problem because it tells us the magnitude of the wasted vote calculations depend on the vote percentage and not just whether the districts are gerrymandered. And notice that, despite being above the 8.0 threshold, two elections (commissioners of agriculture and labor) are not statistically distinguishable from expectations drawn for neutral plans.

What gives rise to the false negative reading from the gubernatorial election? The reason is directly related to the wasted vote requirement of a responsiveness ratio (aka, swing ratio) in the neighborhood of 2.0. When, as in North Carolina's gubernatorial election, Democrats win 44.2 percent of the vote, the wasted vote requirement for fairness is to have the Democrats winning 38.4 percent of the seats—i.e., the vote difference from 50 is 44.2 – 50 = –5.8. Two times that difference is –5.8 * 2 = –11.2, and an equal number of wasted votes would require that Democrats win 38.4 percent of the districts, since −11.6 + 50 = 38.4. Adding or subtracting the standard's requirement to be within eight points of the "fair" outcome implies that seat percentages in the range of 30.4 to 46.4 (38.4 ± 8) indicate no gerrymander effect. Given that a packing gerrymander might well be designed to grant Democrats some outcome in the vicinity of a third of the seats for a range of vote percentages, weak Democratic vote performances can fall within the safe-harbor range of the wasted vote standard. On the flip side, when Democrats receive something close to or exceeding 50 percent of the vote, a gerrymander effect becomes apparent, because seats are restricted to something such as 30 to 45 percent even when Democrats' votes approach or go above a majority. In short, the wasted vote standard can provide false negative readings in certain circumstances precisely because a gerrymander has been fashioned to allow one party to win a circumscribed minority number of districts unless and until it can win especially large vote majorities.

Comparing wins. The standard of counting the number of district wins suffers from the same shortcoming as the wasted vote standard. We see in Table 1 that in the three elections Democrats won with between 44 and 47 percent of the vote (governor, commissioner of agriculture, and commissioner of labor), they won close to the number of districts expected. When Democrats win votes in the vicinity of a majority or above, their shortfalls in seats are clear to see—just as when using the wasted vote standard. Put differently, when Democrats cast a minority of votes below 47, the safe seats granted to them by the gerrymander disguise the fact of the gerrymander. In short, comparing observed and expected district wins is subject to false negative readings under some circumstances.

Equal vote weights. This standard shows a consistent bias against Democrats. The median-mean differences run between 4.7 and 7.1 points adverse to Democrats, implying they would need something approaching 54.7 to 57.1 percent of the vote in order to carry a majority of districts—i.e., (50 + 4.7) to (50 + 7.1). Among the five elections when Democrats actually won a statewide vote majority, these various statewide candidates never carried a majority of the districts.[17] And, while the column of numbers on median-mean difference expectations shows Republicans have a natural 1.5- to 3.0-point advantage simply due to residential patterns, observed advantages attributable to gerrymandering fall far outside those expectations. Indeed, in none of the nine elections is the observed median-mean difference anywhere close to expectations. In the best-case circumstances, the secretary of state election, only 3 of 25,000 neutral maps (.012%, twelve-thousands of one percent) have a median-mean difference as large as the actual –4.7 value. In four elections, no expected value, among the 25,000 per election, is as large as the one observed. All indications from the equal vote weights standard indicate a rather harsh gerrymander favorable to Republicans, adverse to Democrats.

Partisan symmetry. As Justice Kennedy stated in *Veith*, the partisan symmetry standard runs into manageability problems because it relies on hypothetical estimates for the number of seats that would be won were one versus the other party to win the same vote percentage. We address the seat-denominated symmetry question in two ways, one more and one less factual. The facts from among our nine elections show that in the lieutenant governor's election the vote splits 49.9 to 50.1. Partisan symmetry would expect Democrats to win 24 or 25

[17]Turnout bias never exceeds 0.8 percent, and among the nine elections it averages 0.17 percent favoring Democrats.

seats for such an evenly split vote. They actually won only 17 districts. Furthermore, in three elections that Democrats won with 53.7 or 53.8 vote percentages (auditor, secretary of state, and treasurer), they won 21 or 22 seats. By way of contrast, in close to comparable circumstances, when Republicans won 53.2 or 53.3 percent of the vote (agriculture and labor commissioners), they won 33 or 34 seats. Clearly, large discrepancies in equal opportunities exist in the seat-vote relationship. Very similar resources (vote percentages) carry with them hugely different seat rewards. Through this more factual version of applying the seat-denominated symmetry standard we arrive at a clear indication of gerrymandering. Democrats win far fewer seats than Republicans when they win something close to the same vote percentages.

The less factual analysis takes a form more closely aligned with that described by Grofman and King (2007). We construct it through four steps: (1) accept as given the vote percentages and the number of districts won for each of our nine elections, (2) allow for hypothetical uniform vote swings so that they range from 40 and 60, (3) record the number of districts carried by Democrats at each of the 21 percentage points, and (4) compare the differences when both Democrats and Republicans won 40, 41, 42, … , 60 percent of the vote. The seat-denominated column in Table 1 records the results. On average, across the 21 percentage points, Democrats are at an eight- to nine-seat disadvantage despite, hypothetically, winning the same vote percentages as Republicans. Moreover, were we to restrict the comparisons to a vote range of 45 to 55, the Democrats' seat disadvantage runs, on average, between 13 and 15 districts. By this second form of analysis, too, the partisan standard indicates a substantial pro-Republican gerrymander.

Three prongs. Vote-denominated symmetry is the third prong in the proposed test. As discussed, by that prong we see an indication of a pro-Republican gerrymander.

Prong 1, the excess seats test, calls for calculating "whether the outcome … was disproportional relative to the seats/votes curve" by checking whether "the actual seats and the simulated number of seats" correspond beyond chance deviations (see Wang 2016, 1306). One method of checking is to revisit the district wins comparison in the null set test. That would tell us that in some elections district wins are in line with expectations but some are not. Another check is through a simulated seats/votes curve based on the simulation analysis we described for the less factual version of the partisan symmetry analysis but, here, by reporting the seat/vote slope value. Those results show seat/vote relationships between 1.7 and 2.1 (column 5 of Table 1). All results are within the range of one and three, which the standard supposes indicates no gerrymander (Wang 2016, 1286–89).

The reason for the sometime false negative readings from comparing actual and expected seat results is similar to the reasons we reported for the wasted votes and null set comparisons. The expectation ebbs and flows depending on the level of the vote, and when the disadvantaged party's votes are below 47, the districts the gerrymander grants to that party turn out to be about as expected in a non-gerrymandered plan. As the disadvantaged party votes rise to something approaching or beyond a majority, however, few additional districts are won. In fewer words, North Carolina created an effective packing gerrymander, and an associated consequence of packing gerrymanders is to reduce seat responsiveness toward proportional seat-to-vote results. The disadvantaged party wins its granted set of packed districts with relatively small statewide vote percentages, but as its vote percentages approach and go above 50, to say 54 or 55, the seats gains respond only modestly. All in all, therefore, we have to conclude the prong 1 test cannot be considered an effective standard by which to evaluate whether a packing gerrymander was enacted in North Carolina. It is prone to false negative readings because the standard it sets for a non-gerrymander is actually an outcome we expect a gerrymander to produce.

Prong 2 also runs into a problem, where again the problem is a failure to take account of how a gerrymander functions as vote percentages for the disadvantaged party vary between low versus high. It calls for a comparison of average vote percentages above 50 for districts won by Democrats compared to districts won by Republicans. To check whether the comparisons show systematic differences going beyond mere chance, prong 2 applies t-tests for the differences between two means. In contradiction of a pro-Republican gerrymander that North Carolina enacted, applying prong 2 to the Governor's election shows a difference slightly adverse to Republicans, not Democrats. The difference is not statistically significant, and therefore the inference indicated from the gubernatorial election is that there is no gerrymander. Put differently, the prong 2 results tell us that sometimes the North Carolina senate districts appear to be a gerrymander, but sometimes they do not. The conclusion depends on which election is analyzed.

North Carolina Summary. North Carolina's senate districts were drawn for the purpose, in part, of providing Republicans with electoral advantage. Prong 1 of the three-prong standard misses that fact completely. The wasted vote, district wins, and prong 2 of the three-prong standard are not fully reliable indicators of that advantage. More often than not they indicate a Republican advantage, but depending on the size of statewide vote percentage they can, and in North Carolina do, give false negative readings. At the very least we have to conclude that indicators of gerrymandering that vary depending on how the vote splits are undesirable. More to the point, the false negatives exist because packing gerrymanders are intended to produce the seat outcome that the standards misidentify—i.e., packing gerrymanders grant the disadvantaged party some minority number of seats whether their vote percentage is small or substantial. The two symmetry standards, on the other hand, provide consistent indicators of North Carolina's designed partisan advantage. No false negatives appear. Thus, in application to North Carolina the symmetry standards are the dependable indicators, at least in the sense of avoiding false negatives.

Iowa

The Iowa Senate is a 50-member body elected to four-year terms from 50 single-member districts. Elections are staggered, with 25 members elected in presidential years and 25 elected in presidential midterms. Iowa's Legislative Service Agency (LSA) and its subordinate affiliated redistricting commission serve in an advisory capacity by presenting congressional and state legislative districts for the legislature's approval/disapproval, subject to veto by the governor.[18] The LSA is required to ignore partisan-related information of party registration, voting patterns, incumbency, candidate residences, and the like. The process has long drawn praise for its fair-mindedness (*Economist* 2002; Martin 2016).

Following the 2010 round of redistricting, the combined 2012 and 2014 senate elections saw the Democrats win 52 percent of the seats (26 of 50) with only 46.5 percent of the vote. As we noted in regard to North Carolina, however, the senate elections themselves do not offer especially probative evidence because the choices by candidates about whether and how to compete depend on where the lines are located. In Iowa, for instance, nearly one-third of all districts (16 of 50) went uncontested. Among the 34 districts contested by major-party candidates, Democrats cast 51.2 percent of the vote and won 20 districts. Thus, as with North Carolina, the more probative evidence is drawn from analyses of Iowa's statewide elections, here ten of them between 2008 and 2012.

As prelude, Figure 2 presents two vote percentage histograms: one for the secretary of state and the other for the treasurer, the two most competitive elections among our ten. The obvious fact apparent in both graphs is that Iowa has a large number of competitive districts. The numbers of districts in a competitive vote percentage range between 45 and 55 are 26 (secretary of state) and 27 (treasurer). Notice, also, a difference of just 4.4 vote points is associated with seat splits of 17 Democratic and 33 Republican versus 38 Democratic and 12 Republican. Small vote shifts apparently bring large district win rewards.

The numbers relevant to evaluating the five standards are reported in Table 2. Our various analyses track the same path as those reported and discussed for the North Carolina application.

Efficiency gap. The news about whether the wasted vote standard provides the correct reading of no gerrymander in Iowa is mixed. Nine of ten values exceed the suggested line of demarcation for distinguishing a gerrymander from a non-gerrymander, i.e., a value below −8 or above +8. If analysts rely on just one exogenous election to evaluate a gerrymandering allegation, they are likely to arrive at a false positive conclusion. If, however, two or more elections are investigated and each party wins a vote majority in at least one of the elections, it would be possible to see that the wasted votes rise and fall depending on whether a party receives a vote majority or minority. In Iowa, Democrats

[18]If disapproved, the Legislative Service Agency (LSA) is required to draw new maps. After three disapprovals, the legislature is allowed to draw new maps, but this has not occurred since implementation in the 1980 round of redistricting.

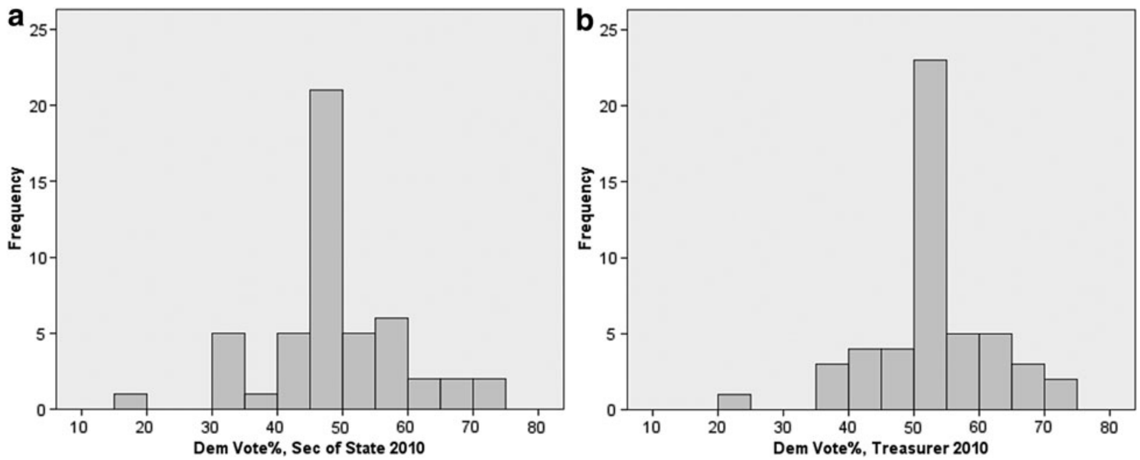

FIG. 2. Distribution of Democratic two-party vote percentages among Iowa's state senate districts: 2010 secretary of state and treasurer elections. **(a)** *Left panel:* Dem Statewide % = 48.5; Dem Mean % = 48.7; Dem Median % = 48.3; Std. Dev. = 10.0; Dem Vote % > 50 = 17 of 50. **(b)** *Right panel:* Dem Statewide % = 52.9; Dem Mean % = 53.0; Dem Median % = 52.8; Std. Dev. = 8.8; Dem Vote % > 50 = 38 of 50.

waste fewer votes than Republicans (indicated by the negative values in column 2) when they win a vote majority but waste more votes (positive values in column 2) when Republicans win a vote majority.

Comparing wins. Comparing actual district wins to expected wins from maps drawn using a neutral process comes close to getting to the right conclusion that Iowa's senate districts are not a gerrymander. The observed results are never too far

Table 2. Results of Applying 5 Standards for Evaluating Whether Iowa's Senate Districts Are a Gerrymander

	#1	*#2 Wasted votes*		*#3 District wins*		*#4 Equal vote weight*		*#5 Partisan symmetry*	*#6 3-prong test*	
Office	*Obs Dem 2-pty vote%*	*Obs*	*Exp*	*Obs*	*Exp*	*Obs*	*Exp*	*Dem Seat Disdvantage*	*#1*	*#2*
Pres 2012	53.0	−9.6	−8.6 (2.8)	33	32.4 (1.37)	.47	0.1 (.48)	.2	4.60	1.26 (0.71)
Pres 2008	54.8	−7.8	−12.7 (2.7)	34	36.4 (1.32)	.40	−0.3 (.50)	−.2	4.98	4.87 (2.75)
U.S. Senate 10	34.1	14.4	9.0 (1.2)	2	2.3 (0.63)	−.88	−1.14 (.55)	.2	4.82	−11.20 (−1.99)
U.S. Senate 08	62.7	−22.6	−24.6 (1.2)	49	48.6 (0.59)	.47	0.4 (.46)	0	5.91	2.00 (0.29)
Governor	45.0	17.1	15.9 (2.1)	12	12.6 (1.04)	.42	−0.5 (.44)	.2	4.63	−0.60 (−.29)
Sec of State	48.5	13.1	8.7 (3.2)	17	19.3 (1.60)	−.38	−0.3 (.43)	−.2	5.15	2.20 (1.07)
Treasurer	52.9	−20.8	−17.4 (3.1)	38	35.0 (1.53)	−.25	0.1 (.39)	−.9	5.50	−1.42 (−0.67)
Auditor	43.5	22.7	25.0 (2.5)	11	11.1 (1.14)	−.11	−0.1 (.61)	.7	4.36	−3.41 (−1.55)
Sec of Agri	37.1	15.7	15.0 (1.8)	5	5.00 (1.01)	−1.93	−1.6 (.63)	1.1	3.90	−9.39 (−2.57)
Atty Gen	55.6	−21.7	−18.7 (2.6)	41	39.5 (1.28)	−.11	0.2 (.42)	−.6	5.20	0.78 (0.33)

#1 = Percentages are for the statewide two-party vote.
#2 = Wasted votes are the difference in Dem vs Rep votes cast for a losing candidate plus votes above 50% +1 as a percentage of total two-party votes—i.e., {(Dem wasted – Rep wasted) / Total two-party votes} * 100. Positive/negative numbers indicate more Dems/Reps wasted more votes.
#3 = District wins are the number of districts carried by the Dem candidate, observed and expected, with expectations based on 25,000 computer generated results. Numbers in parentheses are the standard deviation of expectations among the 25,000 neutral plans.
#4 = Equal vote weights record the difference between the median district two-party Dem percentage and the mean two-party district Dem percentage. Negative numbers indicate Dem disadvantage, with the magnitude indicating approximately the percentage points above 50 Dems would need to carry a majority of districts. The column of expected results is the median-mean difference attributable to residential patterns, with standard deviations in parentheses.
#5 = Partisan symmetry is the average difference in Dem–Rep expected number of seats won in a competitive range of vote percentage (40 to 60) if each party won the same vote percentage. Negative numbers indicate Dems are expected to win fewer seats with the same vote percentage as Reps.
#6 = Prong 1 of the three-prong test is the estimated seat-vote swing ratio—e.g., a 4.60 value means a vote gain of one point brings a seat gain of 4.60 points. Prong 2 is the difference between Dem and Rep vote percentages above 50% in districts won by Dems vs Reps. Negative numbers indicate Dems have more extreme lopsided winning percentages. Numbers in parentheses are *t*-test values; values above 2.02 are statistically significant at $p < .05$, two-tails.

off expectations. For six of ten elections, the difference is just a fraction of one seat. The one hitch is that two elections are statistically significantly different from expectations (i.e., more than 1.65 standard deviations removed from expectations). Because the differences run in both partisan directions—once with Democrats carrying fewer than expected (treasurer) and once with Republicans carrying fewer (president 2008)—an evaluation of several elections could be used to demonstrate no systematic favoritism serving to advantage one but not the other party. So, even though the comparison of wins standard generally avoids false positives more often than not, the statistical significance consideration is a reminder that it is worthwhile to apply the standard to more than one exogenous election.

Equal vote weight. The equal vote weight standard (aka vote-denominated symmetry) reaches the correct conclusion of no Iowa gerrymander. The median-mean differences are small; they run in different directions (six negative versus four positive); and never is majority rule violated.[19] All this leaves the no gerrymander conclusion on secure footing.

Partisan symmetry. Seat-denominated symmetry involves a degree of ambiguity but essentially reaches the right conclusion. By the method that pairs comparable situations where Democrats and Republicans win the same vote percentage, four comparisons come close to filling the bill: (1) President 2008 vs Governor, (2) Attorney General vs Governor, (3) Treasurer vs Secretary of State, and (4) U.S. Senator vs Secretary of Agriculture. In order, respectively,

(1) D vote % 54.8 and R vote % 55.0 → D seats = 34 vs R seats = 38
(2) D vote % 55.6 and R vote % 55.0 → D seats = 41 vs R seats = 38
(3) D vote % 52.9 and R vote % 51.5 → D seats = 38 vs R seats = 33
(4) D vote % 62.7 and R vote % 62.9 → D seats = 49 vs R seats = 45

The results in any one election are three, four, or five seats off—hence the ambiguity—but one election shows a Republican advantage and the other three a Democratic advantage. In other words, there is no indication of a persistent partisan advantage running in one direction. Alternatively, applying the less factual, simulation analysis reported in Table 2's column 6 (see the details of how this approach works in our discussion of the North Carolina analysis, above), we see mostly fractional seat differences with none amounting to as many as two seats. On this evidence, seat-denominated symmetry indicates about as little of a gerrymandering seat effect as one might imagine in a fair set of districts, but with a touch of ambiguity.

Three prongs. The third prong of the three-prong test has already been covered as it repeats the calculation of the equal vote weight test. On that score, the test indicates no gerrymandering. One version of evaluating the first prong, from the standpoint of a party winning more or fewer seats than expected, also indicates there is no gerrymander inasmuch as that is what the district wins test indicates (i.e., from column 3). That follows, however, when the expectation is based on the null set. Compared to outcomes in other elections nationwide (Wang 2016, 1289–92), the rather large seat swings in response to vote shifts might very well lead to a different conclusion. As can be seen in the prong 1 column of the three-prong test, simulated seat-vote relationships have values above 3.90. All ten simulated slopes are beyond the test's zone of acceptability (Wang 2016, 1286). Taking all of these considerations on board makes it difficult to say what conclusion should be drawn from the prong 1 test.

Finally, prong 2 offers mixed readings. Two of ten differences in the lopsidedness of district-win percentages are statistically significant—viz., president 2008 and secretary of agriculture. On the one hand, because one significant result shows a Democratic win is too lopsided and the other shows a Republican win is too lopsided, one could conclude the lopsidedness shows no partisan favoritism and thus no gerrymandering. On the other hand, the results more generally show that comparing lopsidedness is not a reliable indicator of gerrymandering in any case. Large vote percentage outcomes for a party, as in Iowa's 2010 U.S. Senate and secretary of agriculture elections, can produce disparities in lopsidedness as the result of the vote percentages, not as a result of gerrymandering.

[19]As is true for North Carolina (fn. 17), turnout bias in Iowa does not amount to much. It favors Democrats in all ten elections but never exceeds 0.6 percent and averages just 0.22 percent.

Iowa summary. Iowa's senate districts are widely viewed as fair. All five standards could be made to confirm that they are. Three of the five arrive at that conclusion only as contingencies, however. By way of counting wasted votes in any one election, the results actually look like a gerrymander. The important fact revealed by this contingency is that counting wasted votes and checking whether they exceed the proposed threshold of ± 8 is not anything close to a standard for identifying a gerrymander because wasted votes exceed the threshold for reasons other than gerrymandering. In Iowa they occur in nine of ten elections because many senate districts are highly competitive, something that is neither an ill in and of itself nor something that operates to the detriment of only one party. That same high degree district competitiveness hampers prong 1 of the three-prong approach, and prong 2 is subject to false positives simply when one party wins considerably more votes than the other. Comparing observed to expected wins fares better. It usually arrives at the right conclusion, though it is subject to possible false positive reading as in two of ten elections when the differences are not large but nevertheless statistically significant. Both the equal vote weight and partisan symmetry standards offer credible readings of Iowa's non-gerrymander. One finds no indication of a gerrymander from the equal vote weight standard and, at most, not so much a false positive reading as a degree of ambiguity from the partisan symmetry standard. In all, on questions of avoiding false positives, just as with avoiding false negatives, the two symmetry standards are the dependable indicators, one slightly more so (equal vote weight) and the other slightly less so (partisan symmetry).

DISCUSSION

What have we learned? The two symmetry standards hold the best prospects for identifying a packing gerrymander that dilutes the votes of one party's voters relative to the vote weight enjoyed by the other party's voters. Between the two, the equal vote weight standard is the more convincing as it more readily meets manageability and effectiveness considerations. Considered as matters of principle and checked against hypotheticals, the equal vote weight standard is faulted only for not being aggressive enough to cover the contingency that, while a districting plan is fair in the sense of not violating majority rule, it could miss the fact that one party can expect more seats when it wins a vote majority with X percent of the vote compared to when the other party wins the same X percent of the vote. This lack of aggression has to be balanced against the less manageable partisan symmetry standard, which relies on observed outcomes where the votes are mirror images—e.g., 45–55 and 55–45—or engages in hypothetical projections of what reasonably could be expected to result were votes to shift in some particular way. Also, as the Iowa application illustrates, the equal vote weight standard avoids a few of the modest ambiguities that arise when the partisan symmetry standard is applied.[20]

The three other standards leave much to be desired. Each suffers manageability problems: wasted votes for both its arguable counting procedure and its need to look externally to create a relative metric by which to say whether a gerrymander exists; comparing observed versus expected wins for its black box computer algorithms; and the three-prong test for its possible internal contradictions. All three also suffer effectiveness problems, each and all, in essence, because their results vary depending on the level of the vote each party receives. Their missing effectiveness is especially damning because it means these three approaches misapprehend a key feature of how packing gerrymanders work. Packing gerrymanders grant the disadvantaged party some number of seats that can look fair when that party wins a modest vote percentage but is clearly unfair when the same or similar limited number of seats is all it wins with vote totals approaching or exceeding a majority. The series of false negative readings in the North Carolina applications make this shortcoming ever so clear. To be sure, each of the three can be saved from full-scale rejection. When applied to the "right" mix of elections each can be argued to come to the right conclusion. At that juncture, however, there is nothing to be gained over applying the symmetry standards and

[20]In application, the choice does not need to be treated as a stark either/or. The equal vote choice is easier to manage and, in most cases, is highly likely to reach the same conclusion were one, instead, to apply the partisan symmetry standard. When and where circumstances warrant, a need for the greater aggressiveness of the partisan symmetry approach can be explained and the case for its broader notion of vote dilutions can be pressed.

something to be lost by doubts and arguments about just what is the "right" mix of elections.

CONCLUSION

The ballot box is the essential institution of any democracy, with more than a few thousand up through hundreds of millions of people coming together to exercise self-government. It is remarkable that centuries beyond the widespread recognition that gerrymandering can be and has been used to distort the self-governing process we are still struggling to find ways to identify and combat it. Our evaluation of five proposals for curbing packing gerrymanders reveals both the difficulties and possibilities.

Our focus has been on packing, as it is the most commonly alleged form. Its clear harm to democratic principles protected by the U.S. Constitution is unequal treatment of voters by implicitly assigning them different vote weights. Its contra-democratic systemic consequence is relegation of a popular majority to minority status. The three proposals of computing the efficiency gap, comparing wins, and applying a three-prong test encounter manageability problems. More damning, the three ask for evidence of gerrymandering that, when the specified evidence does not appear, can actually be absent because a gerrymander has been wrought—i.e., the false negative readings North Carolina's senate districts. Just as damning for two of the three proposals, not including comparing wins, is their asking for evidence that when it does appear it is for reasons other than gerrymandering—i.e., the false positive readings of Iowa's senate districts. The two symmetry-based standards, equal vote weights and partisan symmetry, are both more or less easily manageable—the equal vote weight test is the more manageable of the two. By argument and confrontation with evidence we have shown both to be effective at identifying when the placement of lines is the cause of diluting votes—here, again, with the equal vote weight standard providing more clarity—i.e., avoiding the arguable claims that could be focused on why a party did not win more seats at each and various level of its votes. On this review, it is clear that the equal vote weight symmetry standard offers the best prospects for redistricting authorities and courts to confront the perniciousness we know as packing partisan gerrymanders.

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NC CAPITOL

From plausible to insulting, election experts weigh in on NC voting district maps

Tags: redistricting, Congressional redistricting, NCCapitol

Posted November 11, 2021 6:00 a.m. EST

Updated November 11, 2021 8:52 a.m. EST

By Travis Fain, WRAL statehouse reporter

Exhibit #
Taylor 01
12/31/2021
exhibitsticker.com

RALEIGH, N.C. — The rules Republican lawmakers came up with to guide this year's redraw of North Carolina congressional and legislative district maps forbade them from using election results or "partisan considerations" in the drawing.

And Republican lawmakers in the House and the Senate said last week they complied with those guidelines.

So, what are the chances, in a place where statewide elections ping-pong between Republicans and Democrats, that lawmakers managed to draw state House and Senate maps that protect Republican majorities – plus a congressional map likely to elect 10, and maybe 11, Republicans out of 14 U.S. House districts – without this data to guide them?

"Very long odds indeed," said Walter Olson, a senior fellow at the Cato Institute, a Libertarian think tank in Washington, D.C.

"Do they think we're stupid?" said Steven Greene, a political science professor at North Carolina State University

WRAL News reached out to 10 political scientists, mathematicians, attorneys and redistricting experts, inside and outside of North Carolina, attached to organizations with varied political leanings, to ask one question: Was it possible to draw these districts without election or partisan data?

Their answers fell into three basic buckets: surely not, surely they could and maybe.

Catawba College political science professor Michael Bitzer posited that consultants looked at political data and fed lawmakers pre-drawn maps, pulling an end-run around the prohibition. Bitzer, a long-time observer of North Carolina politics and its redistricting battles, said that's his theory "until proven or shown otherwise, which I'm sure will come out in some kind of evidentiary hearing or deposition."

Indeed, there will be hearings and depositions. Two lawsuits already have been filed challenging the maps. More could come.

Republican leaders say no such tactics were employed.

"Republican lawmakers did not use any consultants in drawing or preparing to draw the maps," Pat Ryan, a spokesman for Senate President Pro Tem Phil Berger, said in an email. "No consultants were involved in the map-drawing process, period."

Dylan Reel, a spokesman for House Rules Chairman Destin Hall, who oversaw map drawing in the House, said the same thing: "No consultants were involved, period."

Another theory for some: Lawmakers are so familiar with voters' leanings that they don't need detailed election data to gerrymander a map. They can do it from memory.

“Clearly, they go into map-drawing knowing stuff about certain areas,” said Andrew Taylor, another N.C. State political science professor.

“Obviously, you could create maps with greater precision (with that data). … But the reality is map makers have been gerrymandering for a long time,” said Michael Li, senior counsel for the left-leaning Brennan Center for Justice’s Democracy Program in New York.

Bitzer said this doesn’t explain the lopsidedness Republicans came up with.

“We can look at a map and generalize in distinct areas, but when you get down to putting this precinct here and that precinct there … maybe some refresher information might be helpful,” he said.

Minority lawmakers likely to lose out under partisan NC district maps

Several experts said it’s entirely possible to draw these Republican-favoring districts without hard data, even in a state politically divided enough to bounce between the two major parties in statewide elections.

“Not only is it possible, but it’s also probable,” said Charles Blahous, senior research strategist at the Mercatus Center at George Mason University, in Fairfax, Va.

“It is very plausible,” said David McLennan, a Meredith College professor and director of the Meredith Poll.

The way people have sorted themselves – liberals living in cities, conservatives in more rural areas – makes it simple, McLennan and others said.

This is not the same thing as saying there was no partisan intent.

“Greensboro, for example, has been trending Democratic, so cracking Greensboro voters into three different congressional districts easily dilutes Democratic chances for winning a congressional seat in that area,” said McLennan, a frequent WRAL contributor.

Andy Jackson, director of the Civitas Center for Public Integrity, part of the conservative John Locke Foundation, said there are, potentially, other explanations for the ways Republican lawmakers drew the maps. Keeping cities together, for example, yields C-shaped districts in the unincorporated areas.

“You’ve got a neutral criteria (that could explain it),” Jackson said. “Anything beyond that, you’re having to get into people’s heads.”

Many turned to math in their analyses, and particularly work at Duke and Princeton universities, where researchers created a universe of potential maps for the state. Compare those millions of maps, and you see the outliers. See the outliers, and one could divine intent.

“The set of a million alternative maps that were drawn following redistricting rules but without partisan considerations and election results yielded a distribution that shows 11-3 and 10-4 are outliers,” said Ari Goldbloom-Helzner, a computational research analyst at Princeton.

Put another way: “Nearly impossible for the congressional map in North Carolina to look the way it did via blind redistricting,” said Doug Spencer, a University of Colorado professor in election law.

Olson, at the Cato Institute, said much the same thing: “The chances that a process truly blinded to politics would have resulted in this combination of maps appears infinitesimal.”

Li, at the Brennan Center, called North Carolina’s new congressional map “breathtakingly brazen.”

“I’ve watched this around the country,” he said. “In other places, Republicans have been a little bit more modest. ... In North Carolina, Republicans have said, 'We’ll go back to the buffet. We’ll grab a little more.'”

RECOMMENDED

Tags: redistricting, Congressional redistricting, NCCapitol

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CAROLINA JOURNAL

OPINION: DAILY JOURNAL

Redistricting, gerrymandering, and legislating from the bench

Andy Taylor
in Daily Journal

October 17, 2019
1:00AM

I have written about gerrymandering in these pages before, but the recent Superior Court ruling that the state's legislative districts constitute an unconstitutional partisan gerrymander makes me want to do it again.

This is a prime example of judicial overreach and regrettable encroachment of quantitative social science into legal decision making. I don't think there's any doubt the state legislative map in question was a gerrymander in the technical sense of the word — that is, the maps were drawn by legislators intent on maximizing their party's representation in the General Assembly. But how on earth did the court see it as violation of the N.C. Constitution?

I'm not going to take on the arguments about whether the plaintiffs enjoyed legal standing or gerrymandering is justiciable. Let me focus on the court's proposition that the map in question violates three important elements of the state's constitution: Its "equal protection," "free elections," and "free speech" and related "free assembly" provisions.

First: How does a partisan gerrymandering treat voters unequally? Everyone gets one vote. All voters in the jurisdiction get the same ballot. Of course, outcomes are always unequal, some voters will select winners, others losers regardless of the district's composition.

In fact, if voting rights are so sacred and should be weighted equally, the U.S. Supreme Court needs to reverse its 2016 ruling in *Evenwel v. Abbot*. In this case it upheld legislative districts should be the same size by total population, not number of eligible voters. This is how you "dilute" votes.

Next, all the things that seem to impinge on "free elections" as generally understood have nothing to do with gerrymandering. These include registration and voter ID requirements, interminable lines at the polls, a limited choice of candidates, and little or distorted information about the contest.

Finally, the free speech and assembly arguments are just as contorted. Any restrictions on political speech and organization — such as campaign finance rules, municipal ordinances concerning protesting, etc. — are also unrelated to map-drawing. People are of course members of political minorities all the time, just ask the Libertarians. Don't like it? Make your party more appealing or switch allegiances.

To demonstrate how these are not free, fair, or equal elections, the court used a favorite phrase of the anti-gerrymander crowd; that politicians are choosing voters rather than the other way around. I hate to be snarky, but that is what districting is. Legislators don't choose the candidates, either. The state's filing rules are very relaxed, and we also have primary elections for party nominees. A "sweetheart" gerrymander, one in which all incumbents regardless of party are safe and happy, is a clearer sign legislators as a class are "selecting their own voters". As "double-bunking" — districts pitting incumbent against incumbent — and many preemptive retirements demonstrated, this was not the case with the map under consideration.

Predictably, the court fell back on a fictitious right to choose representatives in competitive elections to bring about proportional outcomes — or where the shares of a party's seats in a legislature and total vote are roughly the same. But it showed tremendous ignorance of how to produce such a system. The concepts of competition and proportionality are different and often inversely correlated.

Take for example a 100-seat legislature in a state evenly divided between Democrats and Republicans. We could plausibly create 100 50-50 seats and all would be highly competitive. But a small swing toward one party might give us something close to a 100-0 legislature, in which the governing party only got, say, 53% of the vote. We can ensure total proportionately with 50 100% Democratic districts and 50 100% Republican districts. Now that's a partisan gerrymander. By the way, does Massachusetts have free congressional elections in which Republicans regularly get about 35% of the statewide vote but no seats?

Why do the maps get blamed for the kinds of outcomes the court believes are harmful? Why don't parties just nominate candidates appealing to a district's voters? In the 1960s and 1970s, both Democrats and Republicans could win in just about any kind of place. The court's allies say partisan gerrymanders cause polarization. If so, why is the U.S. Senate so polarized? In fact, homogenous districts in heterogeneous states can force the parties to run a diverse slate of candidates and therefore reach out to many different political interests.

The legislature's motive, maligned by the court, is irrelevant as well. The district maps were legislation. Give me an example of a vote on important matters of public policy —including those affecting voting and other constitutional rights — where lawmakers aren't driven by partisan considerations.

I find partisan gerrymanders distasteful. But the court has taken a legitimate technical definition of the practice built on solid social science and forced it into law. That is legislating from the bench. There is now a similar case against North Carolina's congressional districts. Get ready for more.

Andy Taylor is a professor of political science at the School of International and Public Affairs at N.C. State University. He does not speak for the university.

categories: **Civil Society**, **History**, **North Carolina**, **Opinion**, **Politics & Elections**

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I see @will_doran has @newsobserver story quoting @chriscooperwcu on partisan gerrymandering. Why, despite, a NC court ruling to the contrary, I believe partisan gerrymandering is NOT unconstitutional.

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2

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STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, et al.,

REBECCA HARPER, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

Consolidated with
21 CVS 500085

AFFIDAVIT OF ANDREW J. TAYLOR

Now comes affiant Andrew J. Taylor, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and am competent to testify regarding the matters discussed below.

2. For the purposes of this litigation, I have been asked by counsel for Legislative Defendants to analyze relevant data and provide my expert opinions.

3. To that end, I have personally prepared the report attached to this affidavit as Exhibit A, and swear to its authenticity and to the faithfulness of the opinions.

FURTHER THE AFFIANT SAYETH NAUGHT.

Executed on 22 December, 2021

Andrew J. Taylor

Sworn or affirmed before me and subscribed in the presence the 22nd day of December, 2021, in the state of NC and County of Wake.

CHRISTINE A. MCCAFFREY
Notary Public, North Carolina
Wake County
My Commission Expires
May 08, 2024

Christine A. McCaffrey
Notary Public

Exhibit A:

Expert Report of Dr. Andrew J. Taylor, Ph.D.

Dr. Andrew Taylor
North Carolina State University
Professor- School of Public and International Affairs
Caldwell Hall 277B
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ataylor@ncsu.edu

TABLE OF CONTENTS

I. Introduction and Qualifications

I have been hired by the legislative defendants to provide expert testimony in the consolidated cases of *Harper et al v. Hall et al* and *North Carolina League of Conservation et al v. Hall et al*. More specifically, I have been asked by the legislative defendants to provide my opinion regarding the congressional and state legislative districting plans enacted by the North Carolina General Assembly in 2021 deploying my knowledge of North Carolina political history and legislative politics, comparative politics, and American national and state politics and policy.

I am a tenured professor of political science at North Carolina State University. I received my Ph.D. from the University of Connecticut in 1995 and have taught at NC State for the 26 years since then—the past fourteen as a full professor. I teach an array of courses in American politics and served as chair of the Department of Political Science from 2006 to 2010 and President of the North Carolina Political Science Association in 2012-13. I have written four books and published extensively in political science journals. I have authored 28 peer-reviewed articles and numerous book chapters, reports, and other published work.

I have expertise in political science matters related to these cases. I use a diverse array of methodologies in my work, including different statistical techniques. I have been interviewed by scores of media outlets about issues relating to redistricting and North Carolina politics and policy and given dozens of talks to political and civic groups on these topics over the past quarter century. Some of my academic research analyses these matters. I believe the principal reason I have been hired as an expert in these cases is that my extensive experience and broad interests in American, North Carolina, comparative, and state politics enable me to offer an integrated and panoramic social scientific understanding of the large and complex questions before the court. My CV, which lists my complete credentials, is attached to this report as Appendix A.

The analyses and opinions I provide in this report are based upon my education in social science methods and knowledge of the relevant academic literature. These skills are well-suited to this analysis. My conclusions stated herein are based upon my review of the information available to me at this time. In my professional judgment this is sufficient basis for my opinions notwithstanding the unusually short period I have been given to write this report. I reserve the right to alter, amend, or supplement these conclusion based upon further study or based upon the availability of additional information and within the confines of the court's truncated scheduling order. I am being compensated for my time in preparing this report at the rate of $425/hour. My compensation is in no way contingent on the conclusions reached as a result of my analysis. The opinions in this report are my own, and do not represent the view of North Carolina State University.

II. Executive Summary

The substantive part of the report is divided into five sections: "The Redistricting Process in North Carolina in 2021", "*Common Cause v. Lewis* and the Constitution of the State of North Carolina", "Proportionality, Competitiveness, and the Properties of a 'Partisan

Gerrymander'", "Additional Conceptual and Analytical Considerations", and "A Recent History of North Carolina Party Politics". My findings are:

i. Regarding the process used by the North Carolina General Assembly to conduct redistricting in 2021.

- Compared to those of other states, the Constitution of North Carolina provides its state legislature with considerable authority and latitude in the formation and enactment of district plans.
- In 2021, the state legislature deployed a process that was comparatively transparent, open, and participatory.

ii. Regarding the case of *Common Cause v. Lewis*, the Constitution of North Carolina, and the plaintiffs' related claims.

- The constitutional provisions that describe Article I rights the plaintiffs believe to have been violated in these cases by the enacted plans—"the free elections" clause, "the equal protection" clause, "the freedom of speech" clause, and "the freedom of assembly" clause—are derived from practices and ideas unrelated to concerns about partisanship and redistricting.
- Political scientists' common understanding of the concept of a "partisan gerrymander" is different from the discipline's understanding of free elections, equal elections, the freedom of speech, and the freedom of assembly.

- Political scientists consider many other political rights that states, including North Carolina, restrict to be constitutive of free elections, equal elections, the freedom of speech, and the freedom of assembly—common burdens on these rights include ballot access, voter registration rules, fair access to the media, campaign finance regulations, etc.

iii. Regarding methods and principles used by political scientists to identify a "partisan gerrymander".

- The plaintiffs wish to see different qualities in the enacted plans particularly proportionality and district competitiveness, but these are often contradictory and elusive and proportionality, at least, is not intrinsic to our electoral system.
- The various methods political scientists use to evaluate district plans generate different results and, in turn, conclusions regarding the extent to which a plan is a "partisan gerrymander"—that is, the choice of method can be determinative of an investigator's assessment.
- "Partisan gerrymandering" is an abstract and complex political science concept that defies clear standards for decisive analysis.

iv. Regarding additional analytical and conceptual challenges facing political scientists as they evaluate district plans.

- There exists a "natural gerrymander" created by the uneven distribution of the general population across the state and within crucial units of redistricting such as counties, voting tabulation districts (VTDs), and "communities of interest" and the concentration of Democratic voters in urban areas and Republican voters in rural areas.

- The choice of "baseline" statewide elections to evaluate the partisan nature of district plans is arbitrary and can have material effects on the assessment of a plan.
- Terms like "community" are vague and of little practical utility to political scientists offering a principled and objective analysis of enacted district plans.

v. Regarding North Carolina party politics.

- The geographic character of the North Carolina Democratic and Republican parties' support has changed dramatically over the past thirty years, with implications for electoral competitiveness.
- Much of this is a function of discretionary decisions made by state and national party leaders, elected officials, and activists and very little of it can be attributed to redistricting practices.

III. The Redistricting Process in North Carolina in 2021

i. Method

In this section, I use my knowledge and a survey of the academic literature to analyze the manner in which the General Assembly conducted the redistricting of North Carolina's congressional and Senate and House districts in 2021, a matter the plaintiffs in *Harper* and *NCLCV* have placed at the center of their complaint. The approach, typical in political science, is to place the legislature's actions in historical and comparative state perspective.

ii. Constitutional Context

The U.S. Bureau of the Census released data to the states so that they could begin their redistricting on August 12, 2021 (they were released in easier-to-use form on September 16). This was much later than initially intended (the original statutory deadline to complete delivery of redistricting was March 31, 2021) because of the coronavirus pandemic and data anomalies. Under the authority of the Constitution of the State of North Carolina (Article II §§3, 5), the North Carolina General Assembly has the responsibility to redraw district lines for the state's U.S. House districts and state legislative districts. This power is the General Assembly's alone. It must exercise this "at the first regular session convening after the return of every decennial census of population taken by order of Congress following the decennial national census". It cannot avoid the charge. For both the congressional and state legislative maps, unlike roughly half of the states, North Carolina law grants authority to enact district plans to neither non-partisan institutional legislative staff nor a commission with all or some members who are either non-legislators or appointed by officers outside of the legislature.[1]

Moreover, Article II, § 22 of the Constitution states redistricting plans are not ordinary legislation. Like Connecticut, Florida, Maryland, Mississippi (in the case of the

[1] The Constitution mentions congressional redistricting only in passing in Article II, § 22 (5) (c). Here it states the congressional district plan is a bill not subject to gubernatorial amendment.

state legislature) and Connecticut (in the case of Congress), the maps are not presented to the Governor. The executive cannot exercise its veto power.[2] But even in these other states, the legislature's power to devise plans is limited somewhat. In Connecticut, a two-thirds majority of both chambers is needed to approve plans and if the legislature misses statutory deadlines a nine-member back-up commission is charged with drawing the maps. In Maryland, the Governor submits a map the legislature can ignore, but if the legislature misses a legal deadline back-up procedures take effect and its power to draw the plan is consequently curtailed. Ultimately, the Governor's plan is enacted absent the legislature approving theirs. Mississippi has a back-up commission consisting of non-legislative members.

In drawing its state legislative districts, Florida uses a process most like North Carolina's. There, however, state legislative district maps are automatically submitted to the Florida Supreme Court for approval. In the event that the court rejects the lines, the legislature is given a second chance to draft a plan. If the legislature cannot approve a state legislative redistricting plan, the state attorney general must then ask the state supreme court to draft one. It is only in North Carolina that the legislature expressing its will through a simple majority vote in both chambers has sole authority under state law to

[2] The people approved an amendment to the Constitution bringing about the executive veto in 1996. Legislative Democrats were generally against the proposal. Governors, particularly Jim Martin and Jim Hunt, and legislative Republicans were in favor. A compromise was struck in which, unlike a large majority of the states' governors, North Carolina's governor would not have the line-item veto. Veto overrides would also require only a vote of three-fifths of members of both legislative bodies (most states require two-thirds) and redistricting legislation would not be subject to the veto (Christensen 2008, 246; Fleer 1994, 115-6; *New York Times* 1995).

draw congressional and state legislative maps.[3] These rules were affirmed when the current Constitution was written in 1971, a time when the Democratic Party enjoyed large and electorally-secure majorities in the General Assembly.[4]

The mandates that limit the North Carolina legislature's discretion are therefore unrelated to process. They concern the content of the maps and are directed by federal and state statutory and constitutional law and court decisions. Many of them were recited by the "Criteria Adopted by the Committees" approved at a joint meeting of the General Assembly's House Committee on Redistricting and Senate Committee on Redistricting and Elections on August 12, 2021.[5] I will return to them throughout the report. Probably the most important are that the districts be single-member and contain equal population, be contiguous and compact in shape, minimize the traversal of county lines and splitting of voting tabulation districts (VTDs or essentially precincts or wards), and be sensitive to what are frequently called "communities of interest".[6]

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[3] There are a number of reputable and comprehensive reference sources for this information freely available on the Internet. These include the site of the National Conference of State Legislatures (https://www.ncsl.org/research/redistricting.aspx), the site of academics Justin Levitt and Doug Spencer (https://redistricting.lls.edu/), and the Princeton Gerrymandering Project (https://gerrymander.princeton.edu/). The Congressional Research Service's report, "Congressional Redistricting 2021: Legal Framework" (https://crsreports.congress.gov/product/pdf/LSB/LSB10639) provides a nice overview to the role of federal law in the process.

[4] The Constitution of 1971 was "an extensive editorial revision of the entire constitution incorporating relatively noncontroversial substantive changes without altering the fundamental character of the document" (Fleer 1994, 51). Proposed changes regarding executive power were rejected by the people.

[5] https://www.ncleg.gov/documentsites/committees/Senate2021-154/2021/08-12-2021/Criteria.adopted.8.12.pdf

[6] In 2021, there are 14 U.S. House districts apportioned by federal law and 50 state Senate and 120 state House districts as directed by Article II §§2, 4 of the Constitution of North Carolina.

For the 2021 redistricting cycle, the House and Senate redistricting committees did adopt criteria concerning the configuration of the maps, however. These criteria were more stringent than those of 2011 and presumably recommended to the committees by legislators' understanding of federal and state law and court decisions and in anticipation of potential legal challenges to the congressional and state legislative district plans. Most notably, the committees prohibited the use of election-result data and data identifying the race of individuals. In *Cooper v. Harris* in 2017, the U.S. Supreme Court ruled that in drawing two congressional districts after the 2010 census, the North Carolina General Assembly used race as "the predominant factor", an action that did not survive the "strict scrutiny" jurisprudential standard.[7] In 2018, it essentially reiterated this in a case involving state legislative districts.[8] Legislators were also instructed this year not to use "partisan considerations". In *Common Cause v. Lewis* in 2019, a three-judge Superior Court panel essentially ruled that drawing state district lines for the clear purpose of advantaging the majority party's interests violated the North Carolina Constitution.[9] Both *Cooper* and *Common Cause* resulted in the General Assembly having to draw remedial maps.

iii. Addressing the Plaintiffs' Claims

The plaintiffs claim the redistricting process was inadequate in some way. In the *Harper* complaint, they assert, "Legislative Defendants undertook an opaque and

[7] 137 S.Ct. 1455 (2017).
[8] *North Carolina v. Covington*, 138 S.Ct. 2548 (2018)
[9] 373 N.C. 258 (N.C. 2019).

constricted redistricting process".[10] It would be fair to ask: Compared to what? Based upon my experience and extensive review, there exist no comprehensive systematic studies of how state legislatures have conducted their redistricting over the past several decades. Political science research has focused exclusively on the substance of maps. Indeed, a recent study in *Political Research Quarterly* on the determinants of state and federal redistricting cases omits any measure of the rules or procedures used by state legislatures in the formulation of district plans. The researchers focus on the form the maps take and political, social, and racial characteristics of states and find that, incidentally, among the variables generating a material effect are the size of the African-American population and the number of cases the state has been party to previously (Gimpel, Hightower, and Wohlfarth. 2021). This helps us understand why North Carolina has become the target of so many redistricting suits since 2010.

The National Conference of State Legislatures (NCSL) has observed, however, that before the 2010 cycle the processes used by state legislatures to draw congressional and state legislative maps were not unlike the processes used to write and approve regular legislation.[11] In North Carolina, both chambers of the General Assembly publish journals containing information about bills, amendments, and votes as per Article II, § 17 of the state Constitution. In recent years, citizens have been able to view and listen to live video and audio streams of proceedings on the General Assembly's website. The website contains other information, including bills filed and notices of committee meetings. This

[10] Verified complaint in *Harper v. Hall*.
[11] https://www.ncsl.org/research/redistricting/into-the-thicket-a-redistricting-starter-kit-for-legislative-staff.aspx

is a dramatic improvement in terms of transparency on the situation prior to 2000 when the institution was considerably more opaque.

NCSL does observe a change from 2010. State legislatures are increasingly making the redistricting process transparent and participatory. The two practices most frequently used to facilitate this are "listening tours" and receiving district plan proposals directly from the public. These are both things the North Carolina General Assembly did in 2021. Although restricted by the coronavirus pandemic, the late release of the census data, and compressed timeline (an original filing deadline of December 17, 2021 and primary originally scheduled on March 8, 2022), the redistricting committees held 13 public hearings across the state and a further four over two days in October once maps had been proposed. This was in addition to the usual input members of the public are free to provide lawmakers on ordinary legislation.[12] The General Assembly also livestreamed proceedings on its website. It maintained a public redistricting workroom with a dedicated terminal that anyone could schedule to use. The maps citizens drew became part of the public record.

All members of the House and Senate had the opportunity to debate and then vote on three readings of the three bills (SB 740 for the congressional plan, HB 976 for the state House plan, and SB 739 for the state Senate plan). In sum, with the exception of the dramatic use of a lottery machine to help determine the state legislative plans from among five alternatives, the 2019 court-ordered process to redraw maps was practically

[12] Article I § 12 of the Constitution permits the people "to instruct their representatives and to apply to the General Assembly for redress of grievances".

identical to the 2021 process, particularly with regards to public participation and the openness of committee and floor proceedings. Several Democratic state legislators characterized what happened in 2019 as exceptionally fair and transparent (Bitzer 2021, 136).

The final recorded votes on the third reading of the three 2021 redistricting plans were: Congressional plan 65-49 in the House and 27-22 in the Senate; state Senate plan 65-49 in the House and 26-19 in the Senate; and state House plan 67-49 in the House and 25-21 in the Senate.[13] As far as we know, none of the proceedings violated the state constitutional requirements in Article II, § 12, 17, 18, 19 that pertain to member responsibilities and rights in the consideration of legislation.[14]

The plaintiffs claim the maps were drawn as the result of "partisan considerations".[15] As with many high-profile votes in today's partisan American legislatures, the recorded votes were partisan and no Republicans voted against any of the maps and no Democrats voted in favor of any of them. The state Senate plan, however, was altered by two floor amendments offered by Democratic senators.[16] Moreover, regardless of the motivations for individual members' votes in this matter, the North Carolina General Assembly itself is not uniquely partisan and polarized. To date, in the 2021-22 session more than 75

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[13] These votes can be found on the North Carolina General Assembly's website, https://www.ncleg.gov/Legislation/Votes/2021

[14] These have to do with members' oath to discharge their duties as legislators (Section 12), requiring the bodies keep a journal of their proceedings (Section 17), essentially permitting any member to oppose legislative action and have that opposition made public record (Section 18), and allowing for recorded votes (Section 19).

[15] Verified complaint in *Harper v. Hall*, p. 12.

[16] They were Sen. Natasha Marcus and Sen. Ben Clark.

percent of House roll-call votes and 80 percent of Senate roll-call votes have had in excess of 60 percent of members on one side. According to widely-cited research using roll-call and survey data from state legislatures and a recognized ideal-point estimation statistical technique to place individual legislators on a single liberal-to-conservative ideological dimension, the difference in median annual ideology scores between House Republicans and Democrats and Senate Republicans and Democrats from 2010-18 are just slightly higher than the national average (North Carolina House 1.64, other states' houses 1.63; North Carolina Senate 1.66, other states' senates 1.61). The North Carolina House has become more partisan and polarized according to these measures since 2010 (from 1993 to 2009 its mean difference score was 1.26, compared to the national 1.37) but the state's Senate has actually become less partisan and polarized (from 1993 to 2009 its mean difference score was 1.72, compared to the national 1.36) (Shor and McCarty 2011).[17]

IV. *Common Cause v. Lewis* and The Constitution of the State of North Carolina

i. Method

Here, I use my knowledge and experience as a political scientist and examine the comparative and historical political science literature to ascertain whether it is reasonable to argue, as the plaintiffs do, that the enacted plans are in violation of state constitutional provisions concerning "free elections", "equal protection", "freedom of speech", and

[17] Shor and McCarty's updated data can be found at: https://americanlegislatures.com/data/

"freedom of assembly". My opinion is not legal, rather I draw on these concepts as understood historically and by the political science literature to evaluate their relationship with the plaintiffs' assertions.

ii. *Common Cause* and the Plaintiffs' Complaints

In 2019, a three-judge panel of a Superior Court in Wake County ruled the 2017 state House and Senate district plans to be unconstitutional "extreme partisan gerrymanders". The essence of the decision in *Common Cause v. Lewis* was that the maps violated three state constitutional provisions: The "free elections" clause (Article I, §10), the "equal protection" clause (Article I, § 19), and, together, the "freedom of speech" and "freedom of assembly" clauses (Article I, § 14 and Article I § 12). The plaintiffs in *Harper* and *NCLCV* claim forcefully the district plans violate these provisions of the North Carolina Constitution.

The Court in *Common Cause* seemed to be taking its lead from a 2018 Pennsylvania decision. In *League of Women Voters of Pennsylvania et al v. Commonwealth of Pennsylvania et al*, the Supreme Court found that state's 2011 congressional district plan violated Article I, § 5 of its Constitution that asserts, "Elections shall be free and equal; and no power, civil or military, shall at any time interfere to prevent the free exercise of the right of suffrage."[18] In *Common Cause*, the Superior Court invoked North Carolina's "free elections" constitutional provision, despite its omission of the term "equal". Perhaps sensitive to the difference and to draw a more direct connection between the

[18] 178 A.3d 737 (Pa. 2018).

North Carolina and Pennsylvania situations, it asserted the plans before it were also in violation of the Constitution of North Carolina's Article I, § 19 guaranteeing "equal protection".

This reference to the equal protection clause is important. First, it should be noted the relevant provision reads that, "No person shall be denied the equal protection of the laws; nor shall any person be subjected to discrimination by the State because of race, color, religion, or national origin." There is no reference to anything remotely related to partisanship. Second, the part of the XIV Amendment of the U.S. Constitution the North Carolina provision mimics has almost exclusively been deployed in connection with government action that is considered discriminatory on the grounds of characteristics like gender, age, national origin, and, especially, race (Arazia 2018). It is interesting that all the plaintiffs in both cases introduce themselves as Democratic voters and most of the plaintiffs in *NCLCV* also present themselves as Black voters. The two characteristics, race and partisanship, should not be conflated. Race is an established constitutionally suspect category that receives strict scrutiny when states legislate on matters related to fundamental rights like voting. It is also a significant and explicit factor in federal restrictions on the redistricting process, such as those enumerated in the Voting Rights Act and the now established principle that, to use Justice Anthony Kennedy's descriptor in *Miller v. Johnson*, race cannot without justification be the "predominant" factor motivating the drawing of districts.[19] Partisanship, by contrast, is not innate, immutable, or central to a person's being. Voting for candidates of a particular party is a choice and

[19] 515 U.S. 900 (1995).

purely incidental to most people's lives. It is something that could be used to describe the class of people the plaintiffs consider "Democratic voters" for little more than a few minutes every two, perhaps even every four, years.

iii. The State Constitution and the Derivation of the Rights in Question

As the Court observed in *Common Cause*, the origins of several of the constitutional rights it invoked can be found far back in the state's history. It noted the source of the "free elections clause" is located in the North Carolina Declaration of Rights of 1776, which in turn borrowed it from the English Bill of Rights of 1689 (Orth 1992).[20] It also claimed North Carolina's embrace of free elections drew inspiration from language in other state constitutions, including Pennsylvania's.[21] The 1868 North Carolina Constitution, written following the Civil War, contained a "free elections clause" in its Article I §, 10—although the words "ought to" were in place of today's "shall".

If the origins of the provision go back to 1776, it was established prior to any meaningful American understanding of the term "gerrymander" which was largely popularized following the 1810 redistricting cycle when the Governor of Massachusetts Elbridge Gerry signed a state legislative district plan that was said to greatly favor his Democratic-Republican Party (Engstrom 2013, 21-22). In 1868, and even in 1971 when today's Constitution was established, the concept of a "partisan gerrymander" does not

[20] It should be noted, however, that it was not until the passage of the "Great" Reform Act in 1832 that Britain rid itself of "rotten boroughs", districts with very small constituencies that often elected members of parliament who were essentially selected by a single or small group of powerful residents (Evans 1994).
[21] *Common Cause v. Lewis*, 303.

appear to have been addressed or contemplated by convention delegates and the state's population. With the exception of the short "fusionist" period of the 1890s when Republicans had control of the General Assembly and the governorship, North Carolina was a solidly one-party state for more than a century following the Civil War. It was not until 1972 that North Carolina elected its first Republican Governor and U.S. Senator of the twentieth century and 1994 that it elected that party's first state legislative majority by giving Republicans control of the House.[22]

The same logic applies to the "freedom of assembly" provision. Article I, § 25 of the 1868 Constitution reads, "The people have the right to assemble together to consult for their common good, to instruct their representatives, and to apply to the Legislature for the redress of grievances". Given this was written in 1868, it seems difficult to imagine the authors were contemplating partisan gerrymandering as a practice in contravention of the freedom of assembly.

The "freedom of speech" wording was only written into the Constitution in 1971. It was tacked on to the beginning of the "freedom of the press" clause which occupied Article I, § 20 of the 1868 Constitution—and, like "free elections", the 1971 Constitution believed it "shall" as opposed to "ought" "never be restrained". Again, the origins suggest no intent to include the concept of a "partisan gerrymander".[23] In summary,

[22] Kruman (1983, 154) discusses partisan battles over redistricting in North Carolina between Democrats and Whigs in the early 1850s. The Civil War and the demise of Reconstruction, however, made North Carolina a solidly Democratic state.

[23] Today, Article I, § 14 reads, "Freedom of speech and of the press are two of the great bulwarks of liberty and therefore shall never be restrained, but every person shall be held responsible for their abuse."

based upon my review as a political scientist of North Carolina's political history, there seems no support for the drawing of a connection between the constitutional rights of free elections, equal protection, freedom of speech, and freedom of assembly on one hand and partisan redistricting practices on the other.

iv. State Constitutions and the "Partisan Gerrymander"

In fact, when states expressly wish to prohibit partisan gerrymandering, they establish laws to that effect. Academics Justin Levitt and Doug Spencer estimate 19 states have statutes or constitutional provisions restricting the practice of "undue partisanship" in state legislative redistricting, 17 have such statutes or constitutional provisions addressing congressional redistricting.[24] The following examples provide just a flavor of how this can be done if a state so desires. Article III, § 20 of the Florida State Constitution states, "No apportionment plan or individual district shall be drawn with the intent to favor or disfavor a political party." Article III, § 3 of the Missouri State Constitution states, "Districts shall be drawn in a manner that achieves… partisan fairness." The entire eleventh article of the Ohio State Constitution is devoted to redistricting and Section 6, Clause A states, "No general assembly district plan shall be drawn primarily to favor or disfavor a political party". Article IV, Part 2, § 1(14) of the Arizona State Constitution reads, "to the extent practicable, competitive districts be favored where doing so would not significantly detract from" criteria such as equal population, compactness, and the

[24] https://redistricting.lls.edu/redistricting-101/where-are-the-lines-drawn/#partisan+outcomes

protection of communities of interest. North Carolina has no constitutional provision related to the partisan make-up or competitiveness of districts.

Moreover, the U.S. Supreme Court ruled in 2019 in a case involving North Carolina that partisan gerrymandering was outside the ambit of the federal courts as a politically non-justiciable question.[25] As a result, therefore, state courts are left to determine whether their statutes and constitutions, absent a provision related to partisan redistricting practices, prohibit partisan gerrymandering. Prior to *Common Cause*, they had only done this definitively once, in the 2018 Pennsylvania case.

v. Political Science and the Concepts of "Free Elections", "Equal Elections", "Freedom of Speech", and "Freedom of Assembly"

As a political scientist, I find it hard to think of American practices of redistricting, regardless of how skewed in a partisan sense the outcomes seem, to be evidently inconsistent with the principles of "free elections", "equal elections", "freedom of speech", and "freedom of assembly". To explain, let me take each of these concepts in turn, beginning with "free elections".

Freedom House, a highly respected non-profit, non-partisan, non-governmental organization that conducts research and advocacy on democracy, political freedom, and human rights, clearly dislikes what it calls "partisan gerrymandering".[26] The

[25] *Rucho v. Common Cause*, 139 S.Ct. 2484 (2019). There was a companion case out of Maryland, *Benisek v. Lamone*, 139 S.Ct. 2484 (2019).
[26] See, for example, https://freedomhouse.org/sites/default/files/2021-03/US_Democracy_Report_FINAL_03222021.pdf

methodology it uses to conduct its "Freedom in the World" analysis, however, includes "partisan gerrymandering" specifically in response to the following question it asks of countries: "Are the electoral laws and framework fair, and are they implemented impartially by the relevant election management bodies?" The phenomenon is not used to evaluate how countries respond to this question: "Were the current national legislative representatives elected through free and fair elections?"[27] In the numerous political science reference materials that describe free elections, the key characteristics are things such as whether elections are called in a timely manner, candidates have access to the media, members of the public can vote without undue pressure or intimidation, ballots are cast in secret, and the vote count is transparent and timely.

The Economist's *Democracy Index* which clearly places "free elections" at the heart of its understanding of democracy, makes no mention of redistricting in its methodology. Its unfortunate assessment in 2020 was that the United States is a "flawed democracy" noting that although "Americans have become much more engaged in politics in recent years" they show "low levels of trust in institutions and political parties, deep dysfunction in the functioning of government, increasing threats to freedom of expression, and a degree of societal polarization that makes consensus almost impossible to achieve".[28] It is plausible some political scientists believe redistricting contributes to some of these outcomes, but there is a significant amount of research that casts doubt on the argument partisan gerrymandering is a principal cause of polarization in American politics—the

[27] https://freedomhouse.org/reports/freedom-world/freedom-world-research-methodology
[28] https://www.eiu.com/n/campaigns/democracy-index-2020/

dramatic polarization of the U.S. Senate furnishes crucial evidence in that regard McCarty, Poole, and Rosenthal 2009). Interestingly, the country's only non-partisan legislature, Nebraska's unicameral body, is also polarized. Here antagonistic legislative groups are galvanized by campaign contribution patterns and candidate recruitment processes that mirror states with formal partisan politics (Masket and Shor 2015).

In the American context, there are many other practices that vary considerably across states and are more integral to the concept of free elections than what is typically called a "partisan gerrymandering". These include rules related to voter access and election integrity such as registration and voter identification requirements, absentee and early voting rules, and the location and number of polling places. These freedoms are routinely regulated by state law and court decisions.

Freedom, moreover, infers choice. As a result, when assessing whether elections are free we should also consider the character of the ballot given to voters. Ballot access and candidate filing rules are crucial in this regard. So is the number of candidates on the ballot and the availability of accurate and useful information about each of them. If voters have very little freedom of choice in U.S. House and state legislative elections our electoral system is to blame. Much of the time they have only two alternatives, a Democratic or Republican candidate. Others desiring the label "Democrat" or "Republican" are forcibly eliminated from consideration by a primary and candidates from other parties are kept off the general election ballot by restrictive rules. Although the Libertarian Party has official standing in North Carolina, the only independent candidate to appear on a statewide election ballot here was Ross Perot in 1992.

What about "equal elections"? Each person has one vote to elect one legislator who has one vote in the legislature. More specifically, the existing restrictions on the redistricting process exist to ensure elections be equal. The choice of legislative candidates is the same for all voters in a district and, most importantly, the General Assembly must establish districts with equal or nearly equal populations. The law does currently tolerate tangible inequalities in elections, however. In the recent *Evenwel v. Abbott* case, the Supreme Court strongly advised states to conform to settled practice and draw their districts with equal population, not equal numbers of eligible voters.[29] Eligible individuals are also given different chances to vote by their registration status—you must be registered in order to vote. Other plausibly unequal treatment includes distance from the place of polling and the length of time it takes to vote once there.

Unequal outcomes are inherent to our winner-take-all or first-past-the-post single-member-districts electoral system—North Carolina cannot draw at-large or multi-member districts.[30] There is one winner in the election for each seat in the U.S. House and North Carolina House and Senate. If the election is contested, there is also at least one loser. The winner is selected by a plurality of voters in the district. The remaining voters who cast a ballot selected a loser.

I will return to the notion of "wasted votes" and the related frequently used quantitative indicator of partisan gerrymanders, the "efficiency gap", later. But I think it

[29] 136 S. Ct. 1120 (2016).
[30] The intent was largely to protect the political interests of minorities. The case that ended multi-member districts in North Carolina was *Stephenson v. Bartlett*, 355 N.C. 354 (2002).

should be noted the plaintiffs also talk about certain citizens having their votes "wasted" and imply they are treated unequally. Wasted votes are those cast for the losing candidates or the winning candidate above those needed to win, in other words the difference in votes received by the winner and the second-place finisher minus one. Wasted votes are intrinsic to our system.[31] It is not, therefore, citizens who waste or do not waste votes when they register their choice of candidates on the ballot. They are exercising a fundamental right. It is the parties who waste them by winning seats by large margins or losing seats by slim ones.

My response to the argument the district plans violate the North Carolina Constitution's provisions regarding "free speech" and "free assembly" is similar. Political scientists do not conceptualize partisan gerrymandering in terms of the suppression of speech or the ability to organize freely. According to the *Oxford Concise Dictionary of Politics*, "freedom of speech" is the "liberty to express opinions and ideas without hindrance, and especially without fear of punishment" and "freedom of association" is "the freedom of individuals to associate as an end in itself or with the view to pursuing common projects, e.g. churches, trade unions, political parties, and sporting clubs" (McLean and McMillan 2003, 208-9). When they study legal restrictions on political speech and organization in the American context, political scientists examine

[31] If the goal had been to eliminate wasted votes, through their Constitution the people of North Carolina would have adopted a system of proportional representation in which seat shares are a faithful representation of the proportion of total statewide votes each party received. If the plaintiffs' intent is to provide "Democratic voters" the "opportunity… to elect the candidates of their choice in the districts and/or clusters where they reside" (Verified complaint in *NCLCV*, p. 12) then they should desire plans with highly uncompetitive districts where each individual Democratic voter is very likely to select the winner.

matters such as campaign finance, candidate nomination procedures, rules regulating canvassing, rallies, and protests, media entities' compliance with the federal requirement they provide equal time to any opposing candidates who request it, and so on. State laws that unfavorably treat citizens who wish to organize or vote for third or minor parties, such as those shaping the electoral system and restricting access to the ballot, are perhaps the most important examples. There are no restrictions on North Carolina Democrats' ability to assemble in the way they exist for North Carolina Constitution Party or Green Party members. As of early 2021, those two parties were no longer formally recognized by the state as political parties, consequently stripping them of numerous organizational advantages state Democrats (and Republicans and Libertarians for that matter) enjoy.

V. Proportionality, Competitiveness, and the Properties of a "Partisan Gerrymander"

i. Method

In this section, I deploy my knowledge of the political science methodology used to explore partisanship and redistricting. I survey the academic literature and explain and evaluate various principles and techniques.

ii. Political Science and Partisan Redistricting

The "partisan gerrymander" or manipulation of the redistricting process to bring about unfair partisan outcomes is an abstract political science construct. The concept has evolved over several decades with the contributions of many academics.[32] It lacks a

[32] For a good overview, see Burden and Smidt (2020).

precise operational definition. It seems to have a number of elements, although there is no consensus as to what these are and several appear to contradict each other. Unless investigators make personal and arbitrary decisions as to what principles to apply, it is prohibitively difficult to undertake a comprehensive comparison of a district plan to both others and some absolute desired standard.

Political scientists have tried to systematize an intellectual approach to the partisan gerrymander. In their efforts to facilitate real-world evaluation of district plans, they have created a series of indicators that purport to permit analysts to gauge the extent to which one is gerrymandered. Measures are generally interested in detecting something called "partisan bias", a broad gauge of whether a party received more seats than it should have given some exogenous standard of acceptability. Some emphasize proportionality or "responsiveness".[33] Beyond that, however, the indicators vary greatly. Some suffer measurement problems.

iii. Proportionality and Competitiveness

The arguments of critics of district plans, including it seems to me the *Harper* and *NCLCV* plaintiffs, are demonstrative of the intellectual minefield that is this effort to identify a partisan gerrymander. They often assert district plans have two important

[33] Both partisan bias and responsiveness focus on the "seats-votes curve" or the proportion of seats and votes won by a party when the two pieces of data are plotted against one another. Partisan bias is only concerned with the proportion of seats won when we place a party at 50 percent of the vote (this must be estimated using a computer algorithm), models interested in proportionality look at the entire curve. In both cases, significant asymmetry in the left and right hand sides of the curve (that is either side of 50 percent of the vote) is interpreted as a sign of a gerrymander.

deficiencies: They produce outcomes in which the share of the legislative body's seats won by a party is not proportionate with its share of the aggregate statewide vote and/or they produce too many districts where there is little meaningful competition between the major parties' candidates. Many of these critics, including the plaintiffs here who on several occasions complain the enacted plans' lack of proportionality and too few competitive districts, want maps to exhibit both qualities.

Before I examine the problems of trying to have a district plan exhibit both proportionality and competitiveness, I should emphasize proportionality was not an objective of the designers of our electoral system. Disproportionate outcomes in terms of seats are a feature not a bug. I have a deep knowledge of the modern political history and elections of the nation I grew up in, the United Kingdom. It has similar political values as the United States and an identical first-past-the-post plurality system of single-member districts for elections to its House of Commons. In the most recent general election of December 2019, the Conservative Party won 56.2 percent of the seats to form the government (legislative majority) with 43.6 percent of the vote. The Labor Party was second, but its 32.1 percent of the vote gave it 32.2 percent of the seats. The Liberal Democrats who received 11.6 percent of the national vote in third place won 1.7 percent of the seats while the Scottish National Party's (SNP) 3.9 percent of the vote secured it 7.4 percent of the seats. Labor's main response has been to change its leader and resolve to recruit better candidates and campaign more skillfully in districts it was defeated, especially those it lost narrowly or whose seats its members had occupied in the previous parliament. The Conservatives do the same when they are out of government. The

Liberal-Democrats have not bemoaned redistricting, but continue their long-standing efforts within the political process to make the electoral system more proportional. The SNP has retained its traditional strategy of focusing on its home base in Scotland's 59 districts.

As a practical matter, proportionality is not that important to the representation of the parties in government anyway. Our electoral system is described as "winner-take-all" for a reason. It is explicitly majoritarian. In *Common Cause*, the Court paid particular attention to the plaintiffs' argument that the plan made it very difficult for the Democrats to win legislative majorities.[34] It understood that in the General Assembly, majority status is of critical importance and the majority party sees rapidly diminishing returns from winning each additional seat beyond 26 in the Senate and 61 in the House. This is because both bodies are hierarchically organized giving great power to the leader of the majority party and, unlike the U.S. Senate with its filibuster for example, prohibit meaningful minority party obstruction (Cooper 2008). Moreover, the proportional distribution of seats in the North Carolina U.S. House delegation matters little to the overall partisan composition of Congress. North Carolina has only 14 of the 435 districts.

A central problem for critics of district maps like the plaintiffs in *Harper* and *NCLCV* is that proportionality and competitiveness are often incompatible. By trying to increase one, you can reduce the other, but not always in predictable ways. To

[34] *Common Cause v. Lewis*, p. 313.

understand this theoretically, consider a hypothetical state where we assert 50 percent of its voters are Democrats and 50 percent Republicans. The voters are distributed across the state in such a way we can draw very different types of maps. We can draw a map for a 100-member legislative body to ensure perfect proportionality. In this case, the plan would have 50 solid (perhaps even near 100%) "Democratic" districts and 50 solid "Republican" districts. No contests would be competitive. Alternatively we can draw 100 competitive districts, each with roughly half of its voters Democrats and the other half Republicans. Here, however, even a small statewide uniform swing towards one of the parties could result in it winning a very large majority even if the aggregate vote was something like 53 percent to 47 percent in its favor.

There are numerous illustrations of the tension between proportionality and competitiveness in American elections. The 2012 congressional elections immediately following the 2010 redistricting cycle furnish a good example. Nobody claimed the Massachusetts U.S. House plan in the 2010 cycle was gerrymandered; indeed the Center for Public Integrity gave it a grade of 'A'.[35] But in 2012 Republicans won 30 percent of the statewide vote and only one contest could reasonably be considered competitive. The party's candidate lost that race and Democrats captured all nine of the state's seats. In Iowa, where the non-partisan redistricting process produced maps after the 2010 census that in the 2012 congressional election resulted in a statewide 50 percent to 47 percent advantage for Republicans and an even split between the major parties of the four seats,

[35] See, https://publicintegrity.org/politics/state-politics/massachusetts-gets-c-grade-in-2012-state-integrity-investigation/.

no race was decided by less than nine percentage points. In Illinois in 2012, five of its 18 congressional districts were decided by less than ten points (a reasonable indicator of competitiveness these days), but the Democrats won two-thirds of them with 57 percent of the vote.

iv. Often-Cited Political Science Methods Used to Indicate a "Partisan Gerrymander"

Three of the most prominent measures political scientists use to explore the potential gerrymandered qualities of a district plan demonstrate the real-world challenge of accounting for different features like proportionality and competitiveness in a single indicator. The "efficiency gap" developed by Nicholas Stephanopoulos of the University of Chicago Law School and Eric McGhee a political scientist at the Public Policy Institute of California is a frequently used analytical tool in the investigation of district maps popularized when litigants and judges discussed it in the Wisconsin case that eventually became *Gill v. Whitford* decided by the U.S. Supreme Court in 2018 (Stephanopoulos and McGhee 2018). It takes the absolute difference in the total number of Democratic wasted votes and Republican wasted votes in a district plan and divides it by the total number of votes cast in all districts. Stephanopoulos and McGhee (2018) estimate that any figure in excess of about .08 (or eight percent) constitutes a partisan gerrymander in favor of the party with the fewest wasted votes. But the efficiency gap tends to punish competitiveness if the outcomes break decisively for one party. This is because parties waste a large number of votes in losing close elections and very few in winning them. Proportionality can also be penalized. Take a hypothetical legislature with five districts containing 100 voters each, where Republicans win 60 percent of the aggregate vote (300 votes) and three seats (60 percent). If the results were 85-15, 65-35, 65-35, 45-55, and 40-60 with Republican votes listed first, the efficiency gap would be .198 indicating a large gerrymander in favor of Democrats. Here the problem is parties waste a great deal of votes relative to their opposition when they win by large margins.

In the "mean-median difference" test, analysts subtract the median percentage recorded by a party's candidates in all of the districts in a plan from the mean percentage. When a party's median vote share is lower than its mean, it might be considered a victim of gerrymandering where its voters are unfairly concentrated (McDonald and Best 2015). But this approach does little to convey proportionality or competitiveness under many conditions, including in states where there is either little or a great deal of variance in the parties' performances across districts (Burden and Smidt 2020; Stephanopoulos and McGhee 2018).

The mean-median difference test is also particularly sensitive. In a study comparing different methods, Jonathan Krasno et al's (2019) analysis of the Wisconsin Assembly map drawn in 2011 using results from 13 statewide elections in the two cycles immediately preceding and following the redistricting revealed the mean-median difference was the method by far the most likely to indicate "substantial" partisan gerrymanders.

A third test, "lopsided margins", simply compares the mean margins of victory in all districts for each of the parties. The party with the larger margins of victory is most likely to have its voters concentrated and therefore subjected to a gerrymander. Analysts can then use a t-test to see if the difference in the means for the parties is statistically significant (Wang 2016). This helps us get a grasp of competitiveness, but not always proportionality.

v. Summary

The value placed on proportionately and competitiveness by analysts of district plans, including the plaintiffs in *Harper* and *NCLCV*, highlight an important problem with judicial efforts to address partisan gerrymandering. Partisan gerrymandering is an abstract and complex concept that defies clear standards suitable for decisive intellectual analysis by political scientists. The reality of a first-past-the-post electoral system with single-member districts make it prohibitively difficult to discover districts that maximize both proportionality and competitiveness using available statistical techniques. Map-drawers, who are generally not political scientists, therefore often find it difficult to know which tools to use when evaluating competing plans. They discover their attempts to promote one desired principle like proportionality often undermine their efforts to promote another like competitiveness. My understanding of the social science of identifying partisan gerrymanders does not make me question it as derisively as Chief Justice John Roberts when he described the efficiency-gap measure as "gobbledygook" in oral arguments during *Whitford*. However, I believe even if judges think they have the power to reject maps drawn by the states on the basis that they constitute a partisan gerrymander, the objectives of litigants are often too broad and conflicted and the tools we have to analyze district plans too numerous, complex, and problematic to provide necessary clear and satisfactory direction.

VI. Additional Conceptual and Analytical Considerations

i. Method

In this section, I assess "baselines" that permit meaningful evaluation of district plans. To do this, I use my knowledge of North Carolina political history and survey the political science literature on methods.

ii. The Clustered General Population

The difficulty of generating transparent and objective standards for what constitutes a partisan gerrymander in the opinion of political scientists is relevant to this section as well. Here, I explicitly address the issue of what "baselines" to use or, in other words, what assumptions we should take into the exercise of constructing and evaluating district plans.

The first task is to account for the real world. Whether the issue involves general redistricting criteria like compactness, contiguity, and the maintenance of communities of interest, VTDs, or municipalities, or generally understood characteristics of partisan gerrymanders such as disproportionality or a lack of competitiveness, it is fair to ask not how any potential plan compares to an absolute standard but the "state of nature" or what we might call the "natural gerrymander". North Carolinians are spread unevenly within an oddly-shaped state. Some counties, communities, and VTDs are relatively small, others are quite large. Some are densely populated, others sparsely populated. So, for example, when we talk about a plan's performance with regards compactness, it is important to note the extent to which dividing the state into 14, 50, or 120 evenly populated chunks mitigates against the principle. Many observers use the Polsby-Popper measure of compactness which reports results on a scale of 0 to 1. The congressional, state House, and state Senate plans enacted by the state legislature have Polsby-Popper mean scores of .30, .35, and .34 respectively. Is this unreasonably different from the state of nature? It is impossible to know, but from a basic examination of the three maps by someone with an understanding of the location of North Carolina's urban and rural areas they look, with a few plausible exceptions, quite compact.[36]

iii. The Partisan Clustering of the Voting-Age Population

What is more, Democratic and Republican voters are clustered. Democrats tend to live with other Democrats and Republicans with other Republicans. Democrats dominate the cities, Republicans small towns and rural areas of the state. Political scientists have various theories about why this is so. It could be the product of people with similar demographic characteristics like income, education, or race living together or people being persuaded to agree with their neighbors or moving to a place with more agreeable neighbors (Levendusky 2009; Rodden 2019). Regardless, the phenomenon poses significant challenges to legislators.

Published research demonstrates the problem. In a recent analysis of North Carolina, Gimpel and Harbridge-Yong (2020) reveal conceivable racial, occupational, geophysical, and sociocultural communities of interest tend to be homogenous in their partisan affiliations. To maintain many of them you must "pack" Democratic or Republican voters.

[36] There is another different but simpler measure of the compactness called the Reock test which essentially looks to see what proportion of the area of a circle drawn around its perimeter a district occupies.

iv. The Use of Election Data to Identify Democratic and Republican Voters

The second question regarding the establishment of baseline assumptions required to evaluate a district plan is the identification of Democratic and Republican voters. Analysts have sensibly moved away from using party registration data because of the large number of unaffiliated voters and the reality that the act of registering to vote is very different from that of casting one. So, although the criteria adopted by the North Carolina House and Senate redistricting committees in 2021 explicitly prevented legislators from using "election data", we, as observers, have the luxury of election results. But which ones should we use? Many, including the plaintiffs in these two cases, utilize recent statewide contests as their benchmark. They take the precinct-level returns from these elections and superimpose the enacted plans on them to determine hypothetically how many seats each party would receive.

Statewide elections for different offices or held at different times, even if observations are only two or four years apart, can produce significantly different outcomes. Votes are not fixed. The candidates, campaigns, office sought after, and contemporaneous political conditions mean voters do not consistently reveal themselves as Democrats or Republicans since many split their votes between the parties. In 2020, for example, Gov. Roy Cooper, a Democrat, beat Republican Lt. Gov. Dan Forest by 4.5 percentage points. In the presidential race that year, President Donald Trump the Republican defeated his Democratic opponent, former Vice President Joe Biden, by 1.3 percentage points. There was significant talk of "Cooper-Trump" voters, one North Carolina political scientist estimated roughly eight to twelve percent said they would vote this way shortly before the election.[37] Turnout can also vary considerably and many voters participate in only one or a few of the elections used for analysis. When measured as a proportion of registered voters, turnout increased six percentage points over 2016 in the 2020 North Carolina election for president. Turnout also varies geographically. Eighty percent of registered voters in Wake County cast a ballot in 2020, only 62 percent of their counterparts in Robeson County did.

Research on Ohio and Wisconsin, two states at the epicenter of redistricting battles, demonstrates the problem of what election(s) to use. The Krasno et al (2019) paper cited earlier revealed that, in addition to the choice of diagnostic method, the choice of election had a material effect on whether an analyst could reasonably describe the 2010 Wisconsin state district plan as a gerrymander or not. Redistricting experts Micah Altman and Michael McDonald examined the competiveness of various Ohio congressional district plans drawn after the 2010 census. "District competitiveness", a component of a formula reformers used to judge the maps somewhat arbitrarily set at 55-45 or less, provided diverse outcomes depending on the baseline election data used (Altman and McDonald 2017).

This problem also afflicts a recent approach to the analysis of district plans I did not consider in the previous section. Armed with sophisticated software, researchers can now use computer algorithms to generate large numbers of alternative maps by combining VTDs that are contiguous and equal in population. This method can produce thousands of maps that, although generally ignoring criteria such as compactness and the maintenance of other

[37] This was Christopher Cooper of Western Carolina University (McElroy 2020).

jurisdictions like counties and communities of interest, are drawn without knowledge of partisan voting patterns. Any particular map is said to demonstrate an intolerable partisan gerrymander if it produces returns that are distant from those of the mean or median of all the computer-generated maps (Chen and Rodden 2015).[38]

Finally, the problem of baseline election results also afflicts *post facto* analyses of district plans. Goedert (2017) has shown that plans considered partisan gerrymanders often produce more competitive elections than those considered "bipartisan". This is the result of the so-called "dummymander", where the majority party in the state legislature enacts plans in which its voters are distributed so thinly across districts that although it might enjoy considerable advantages in theory and the short-term, the minority benefits in the longer term, especially in the aftermath of "wave" elections. Grofman and Brunell (2005) argue this is what happened to the 1990 Democratic "gerrymander" of North Carolina congressional districts. From the perspective of later in the decade, therefore, a plan that originally seemed biased in favor of the state legislative majority party can appear biased toward the opposition. It is not, therefore, what is usually called a partisan gerrymander.

This concern with the choice of baseline elections motivated Stephanopoulos and McGhee's efficiency gap. They claim a principal strength of their method is that it does not use exogenous election results but the outcomes of the actual legislative contests fought using the plan in question. This is not without problems, however. It is difficult to know

[38] This was the method by which the North Carolina Senate drew state legislative maps following the order from the Court in *Common Cause*. It took five simulated maps and selected between them by lottery.

what to do with uncontested races when calculating statewide party vote totals. Moreover, because candidates win their seats with a plurality of the vote, they have no incentive to maximize. This undermines our capacity to understand the true statewide Democratic and Republican votes under a plan.

v. The Concept of "Community"

One last point regarding analytical challenges. The plaintiffs in *NCLCV* refer repeatedly to the belief that legislators' district plans should have maintained "communities" of Democratic voters and, especially, Black citizens. What precisely constitutes a "community of interest" for the purposes of redistricting has long been disputed. The term is unavoidably vague. Communities are ill-defined and surely many of them overlap or are nested within others. It is therefore impossible to understand whether the plaintiffs' optimized maps are really an improvement in the number of communities maintained, regardless of the central feature of such communities.

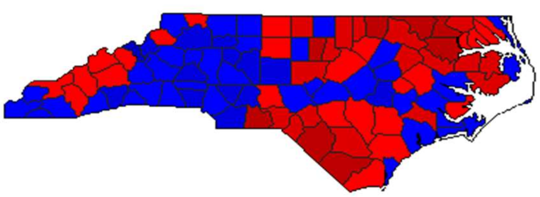
VII. A Recent History of North Carolina Party Politics

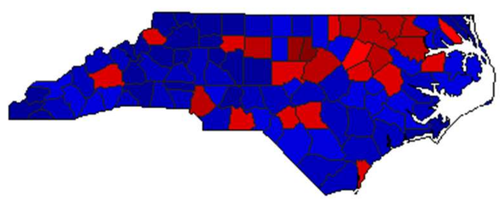
i. Method

In this final section, I deploy my knowledge of and survey the academic literature on party politics, particularly in North Carolina.

ii. The Changing Geographic Character of North Carolina Democratic and Republican Voters

The two figures below show county returns for the competitive 1992 (left) and 2020 (right) presidential elections in North Carolina. The data are taken from uselectionatlas.org, a highly reputable source of presidential election data. The counties won by the Democratic candidates (Bill Clinton and Joe Biden) are marked in red (unfortunately the site prefers to give the parties the colors opposite to those assigned to them in today's popular culture) and those won by the Republicans (George H.W. Bush and Donald Trump) in blue. Deeper shading denotes a larger margin of victory. Bush beat Clinton in North Carolina in 1992 by 0.8 percentage points (Ross Perot won 13.7 percent of the vote) and Trump beat Biden in 2020 by 1.3 percentage points.





Clinton (red) v. Bush (blue), 1992

Biden (red) v. Trump (blue), 2020

Note the significant differences. Some areas, such as the counties in northeastern North Carolina and the foothills surrounding Charlotte voted for the same party in both elections, but most of southeast North Carolina became Republican. This is also true of a lot of rural counties in the center and far western part of the state. At the same time, urban areas became more Democratic. In 1992, Bush won Forsyth and Mecklenburg counties and narrowly lost Wake. Trump was defeated in all three in 2020, in Mecklenburg and Wake by around 30 percentage points.

The contrasting figures demonstrate a significant change in North Carolina's political geography. Democrats used to do well in rural areas, especially in the eastern part of the state. Republicans were competitive in urban and suburban areas. That is no longer true. The transformation is not the result of redistricting. Neither, clearly, were the significant gains Republicans made in congressional and state legislative seats in North Carolina in the 1990s and first decade of this century.

How does this happen? Much of it is a function of slow social and economic forces that only reveal themselves over several decades or redistricting cycles. Most individuals vote for candidates of the party with which they identify—according to 2020 exit polls around 95 percent of self-proclaimed Democrats and Republicans in North Carolina voted for the presidential candidate of the party they linked themselves to. But it can also be explained by choices that parties and their leaders, candidates, and activists make. North Carolina's population is changing rapidly with large numbers of newcomers entering the state annually, the state grew by about nine percent or 850,000 people between 2010 and 2018. They are ripe for socialization into its politics. Today, North Carolina has about 2.3 million unaffiliated voters (roughly a third of the total) whose allegiances are up for grabs.

The Shor-McCarty (Shor and McCarty 2011) measures of state legislative party ideology cited earlier, moreover, reveal that between 2008 and 2018 the median North Carolina House Democrat moved .215 points to the left and the median Senate Democrat .008 points to the left. At the same time research showed North Carolina public opinion to be moving in the opposite direction (Berry et al 1998).[39] Other research suggests Democratic national elites are today to the left of Democratic voters (Furnas and LaPira 2021). Decisions made by the parties' organizational leaders, elected officials, and activists have significantly contributed to these developments.

Candidates are certainly captive to the reputation of the party whose label they must run with on the ballot (Grynaviski 2013). However, it is also true voters are responsive to candidates' positions on particular issues and their skills as campaigners.[40] They also engage in spatial voting or the exercise of choosing the candidate they feel is closer to them ideologically.[41] On balance, this extensive research suggests that parties can greatly influence primary outcomes and by nominating candidates suited to their political surroundings can markedly improve their chances of winning in a district (Hassell 2017). Alternatively, party leaders and motivated activists can leave in place internal rules and procedures and go to the courts to move district lines to benefit their candidates so they may continue to select the same individuals to represent their party in general elections.

VIII. Conclusion

There are two analytical approaches to the investigation of the phenomenon typically called a "partisan gerrymander". Researchers can examine individual districts or the larger

[39] Updated data can be found at: https://rcfording.com/state-ideology-data/
[40] This is a huge literature. A good example is Herrnson and Curry (2011).
[41] This is also a large literature. An influential work is Jessee (2012).

district plan. I have chosen the latter. I have done this for two reasons. First, it is more consistent with my expertise. I am not a mathematician or computer scientist like some of the plaintiffs, but I have spent over two decades observing and writing about American and North Carolina politics and have broad and deep understanding of the complex issues and academic literature on state legislatures, elections, and redistricting. Second, the considerable time constraints placed on me prohibits a detailed district-by-district statistical analysis of the congressional, state Senate, and state House plans.

In the first section of my report, I argue that the process used by the North Carolina General Assembly to create and enact the district plans was consistent with the provisions of the Constitution of North Carolina that speak directly to redistricting. The second section covers my evaluation of the plaintiffs' claims that the plans violate political science's understanding of free elections, equal protection, freedom of speech, and freedom of assembly. Next, I explain the difficulty of identifying plans afflicted with a "partisan gerrymander", the problems with the methods used in these types of studies, and the contradictions between various characteristics—namely proportionality and district-level competitiveness of the parties—many would like to see maps exhibit. In the fourth section, I address additional issues with conceptualization and analysis, particularly those of baseline assumptions. I conclude with a brief look at the state political parties and how they enjoy agency in general elections the critics of district plans imply they do not.

The plaintiffs in *NCLCV* claim to have "harnessed the power of high-performance computers, and employed cutting-edge computational methods and resources, to draw alternative maps".[42] They claim their plans "avoid the partisan gerrymandering and racial vote dilution that mark the Enacted Plans (those approved by the state legislature), while also improving on the Enacted Plans' compliance with the laws and legitimate policies governing redistricting in North Carolina." The plaintiffs state the General Assembly's plans should be rejected because they "cannot withstand the scrutiny of math and science".[43]

I believe as an expert in the field of political science, the plaintiffs in *NCLCV* have much less command of other subjects more central to redistricting. Their approach glosses over the challenges posed by the evaluation of district maps for properties of partisan gerrymandering. There is no clear consensus among political scientists on the meaning of a partisan gerrymander as a political concept. The choice of baselines necessary for this analysis is a contentious exercise. General and voting-age populations live in such ways as to give states features that contribute to what many might call a natural gerrymander. The preferences of individual voters are often undiscernible, but when they do present themselves they can be fluid and vary temporally and across offices. Candidates and political parties are not helpless in structuring voters' behavior. We understand a partisan plan is measured along several dimensions, but we cannot fully agree on the importance to assign to each one and therefore what is the best way to assess a district map. We also know that efforts to maximize along different dimensions can sometimes be complementary and at other times incompatible.

More importantly, I believe based upon my analysis of North Carolina's political history, the state's redistricting tradition compels the enacted plans. The question is not whether the

[42] Verified complaint in *NCLCV v. Hall*, p. 62.
[43] Verified complaint in *NCLCV v. Hall*, p. 4.

plaintiffs' plans are in some way superior. It is whether the enacted plans are lawful. The process the North Carolina General Assembly used was consistent with the framework of redistricting in the state, a bar that is low given the uniquely considerable latitude the state's statutes and constitution give the legislature to consider and approve maps. Political concepts cited by the plaintiffs have little-to-nothing to do with common understandings of the practice of redistricting as it is done in North Carolina or the United States. Those who want different redistricting outcomes should work through the political process to obtain them. The people can elect different legislators or alter other critical features of our politics that make the results of legislative elections so distasteful to them. The people can change the law to provide us with a new method of drawing single-member districts such as the independent non-partisan redistricting committee of House Bill 69 that, in 2019, gathered 66 co-sponsors from both parties. Or, alternatively, the people can enact a thorough overhaul of their electoral system by amending their constitution. For the courts to make such a change is inconsistent with the principle of separation of powers or the manner in which the state's constitution has historically been applied.

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Grynaviski, Jeffrey D. 2013. *Partisan Bonds: Political Reputations and Legislative Accountability*, New York: Cambridge University Press.

Hassell, Hans J.G. 2017. *The Party's Primary: Control of Congressional Nominations*. New York: Cambridge University Press.

Herrnson, Paul S. and James M. Curry. 2011. "Issue Voting and Partisan Defections in Congressional Elections," *Legislative Studies Quarterly* 36: 281-307.

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Kruman, Marc W. 1983. *Parties and Politics in North Carolina, 1836-65*. Baton Rouge: Louisiana State University Press.

Levitsky, Steven and Daniel Ziblatt. 2018. *How Democracies Die*, New York: Crown.

Levendusky, Matthew. 2009. *The Partisan Sort: How Liberals Became Democrats and Conservatives Became Republicans*, Chicago: University of Chicago Press.

Masket, Seth and Boris Shor. 2015. “Polarization without Parties: Term Limits and Legislative Partisanship in Nebraska’s Unicameral Legislature.” *State Politics and Policy*, 15: 67-90.

McCarty, Nolan, Keith T. Poole, and Howard Rosenthal. 2009. “Does Gerrymandering Cause Polarization?” *American Journal of Political Science*, 53: 666-80.

McDonald, Michael D. and Robin E. Best. 2015. “Unfair Partisan Gerrymanders in Politics and Law: A Diagnostic Applied to Six Cases,” *Election Law Journal*, 14: 312-30.

McElroy, Michael. 2020. “Somebody Voted for Roy Cooper and Donald Trump. Who Are These Voters?” *Cardinal and Pine*, November 30, https://cardinalpine.com/story/somebody-voted-for-roy-cooper-and-donald-trump-who-are-these-voters/

McLean, Iain and Alistair McMillan, eds., 2003. *Oxford Concise Dictionary of Politics*, 3rd. ed., New York: Oxford University Press.

New York Times. 1995. “Last Governor Without Veto Could Get It.”. February 12, https://advance.lexis.com/api/document?collection=news&id=urn:contentItem:3S89-W820-008G-F1CJ-00000-00&context=1516831.

Orth, John V. 1992. “North Carolina Constitutional History”. *North Carolina Law Review*, 70: 1759-82, 1797-8.

Rodden, Jonathan A. 2015. *Why Cities Lose: The Deep Roots of the Urba-Rural Political Divide*. New York: Basic Books.

Shor, Boris and Nolan McCarty. 2011. "The Ideological Mapping of American Legislatures." *American Political Science Review*, 105: 530-51.

Stephanopoulos, Nicholas and Eric McGhee. 2018. "The Measure of a Metric: The Debate Over Quantifying Partisan Gerrymandering," *Stanford Law Review*, 70:1503-68.

Wang, Samuel S-H. 2016. "Three Practical Tests for Gerrymandering: Application to Maryland and Wisconsin," *Election Law Journal*, 15: 367-84.

APPENDIX A

December 2021

ANDREW JOHN TAYLOR

Professor
North Carolina State University
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School of Public and International Affairs
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Professional Experience

Professor of Political Science, North Carolina State University, 2007-Present
Chair, Department of Political Science, North Carolina State University, 2006-10
Associate Professor of Political Science, North Carolina State University, 2001-7
Assistant Professor of Political Science, North Carolina State University, 1995-2001
Adjunct Instructor of Political Science, University of Connecticut at Hartford, 1991-5

Education

Ph.D. Political Science, University of Connecticut, 1995.
M.A. Government, Lehigh University, Bethlehem, Pennsylvania, 1990.
B.A. American Studies (Politics and Government), University of Kent at Canterbury, United Kingdom, 1988.

Publications
Books:

The End of Consensus: Diversity, Neighborhoods, and the Politics of Public School Assignments (Chapel Hill: University of North Carolina Press, 2015) with Toby L. Parcel
(Reviewed in *Teachers' College Record*, *Contemporary Sociology*, *Southern Spaces*, *Social Forces*)

Congress: A Performance Appraisal (Boulder, CO: Westview Press, 2013)
(Subject of New Books in Political Science podcast, Huffington Post piece; reviewed in *Political Science Quarterly*)

The Floor in Congressional Life (Ann Arbor: University of Michigan Press, 2012)
(Reviewed in *Party Politics*, *Political Science Quarterly*, *Congress and the Presidency*, *Perspectives on Politics*)

Elephant's Edge: The Republicans as a Ruling Party (Westport, CT: Praeger, 2005)
(Reviewed in *New York Times*, *Political Science Quarterly*, *Perspectives on Politics*; starred review in *Library Journal*, highly recommended by *Choice*; discussed in articles in *Los Angeles Times*, *New York Daily News*)

Publications (cont.):
Articles in Refereed Academic Journals:

"The Individual-Level Origins of Congressional Corruption Scandals," *American Politics Research*, 48 (July 2020): 442-54. (with Michael D. Cobb).

"Partisan Affiliation in Political Science: Insights from Florida and North Carolina," *PS: Political Science and Politics*, 52 (October 2019): 706-10 (with Lonna Rae Atkeson).

"Legislative Seniority in the Partisan Congress," *Social Science Quarterly*, 100 (June 2019): 1297-1307.

"The Revolution in Federal Procurement, 1980-Present," *Business and Politics*, 21 (March 2019): 27-52.

"Proximity and the Principle-Policy Gap in White Racial Attitudes: Insight from Views of Student Assignment Policies in Wake County, North Carolina," *Social Science Research*, 79 (February 2019): 95-103 (with Toby L. Parcel).

"Which U.S. House Members Present Their Legislative Records? Models of Electoral Accountability and the Content of Press Releases," *Congress and the Presidency*, 44 (1, 2017): 102-19.

"An Absence of Malice: The Limited Utility of Campaigning Against Party Corruption," *American Politics Research*, 43 (November 2015): 923-51 (with Michael D. Cobb).

"Bill Passage Speed in the U.S. House: A Test of a Vote-Buying Model of the Legislative Process," *Journal of Legislative Studies*, 3 (September 2014): 285-304.

"Paging Congressional Democrats: It Was the Immorality Stupid," *PS: Political Science and Politics*, 47 (April 2014): 351-6 (with Michael D. Cobb).

"When Congress Asserts Itself: Examining Legislative Challenges to Executive Power," *The Forum*, 10:2 (Article 2), July 2012.

"Does Presidential Primary and Caucus Order Affect Policy? Evidence from Federal Procurement Spending," *Political Research Quarterly*, 63 (June 2010): 398-409.

"Strategic Inter-cameral Behavior and the Sequence of Congressional Lawmaking," *American Politics Research*, 36 (May 2008): 451-74.

"The Presidential Pork Barrel and the Conditioning Effect of Term," *Presidential Studies Quarterly*, 38 (March 2008): 97-110.

"Size, Power, and Electoral Systems: Exogenous Determinants of Legislative Procedural Choice," *Legislative Studies Quarterly*, 31 (August 2006): 323-45.

Publications (cont.):
Articles in Refereed Academic Journals (cont.):

"The Personal and Political in Repeat Congressional Candidacies," *Political Research Quarterly*, 58 (December 2005): 599-607. (with Robert G. Boatright).

"Conditional Party Government and Campaign Contributions: Insights from the Tobacco and Alcoholic Beverage Industries," *American Journal of Political Science*, 47 (April 2003): 293-304.

"Are Women Legislators Less Effective? Evidence from the U.S. House in the 103rd-105th Congresses," *Political Research Quarterly*, 56 (March 2003): 19-27. (with Alana Jeydel).

"The Ideological Roots of Deficit Reduction Policy," *Review of Policy Research*, 19 (Winter 2002): 11-29.

"A New Democrat? The Economic Performance of the Clinton Presidency," *The Independent Review*, 5 (Winter 2001): 387-408. (with John W. Burns).

"Congress as Principal: Exploring Bicameral Differences in Agent Oversight," *Congress and the Presidency*, 28 (Fall 2001): 141-59.

"The Mythical Causes of the Republican Supply-Side Economics Revolution," *Party Politics*, 6 (October 2000): 419-40. (with John W. Burns).

"The Congressional Budget Process in an Era of Surpluses," *PS: Political Science and Politics*, 33 (September 2000): 575-80. (Reprinted in, Michael LeMay, *Public Administration: Clashing Values in the Administration of Public Policy*, (Belmont, CA: Wadsworth/Thomson Learning, 2005)).

"Explaining Government Productivity," *American Politics Quarterly*, 26 (October 1998): 439-58.

"Domestic Agenda Setting, 1947-1994," *Legislative Studies Quarterly*, 23 (August 1998): 373-97.

"The Legislative Strategies of Independent and Third Party Executives," *Southeastern Political Review*, 26 (March 1998): 3-23.

"The Ideological Development of the Parties in Washington, 1947-1994," *Polity*, 19 (Winter 1996): 273-92.

"The Ideological Development of the Modern Republican President," *Presidential Studies Quarterly*, 26 (Spring 1996): 374-9.

"Historical Analogies in the Congressional Foreign Policy Process," *Journal of Politics*, 57 (May 1995): 460-8. (with John T. Rourke).

Publications (cont.):
Chapters in Edited Volumes:

"Legislative Speech in Presidential Systems," in Hanna Back, Marc Debus, and Jorge M. Fernandes (eds.) *The Politics of Legislative Debate*, (New York: Oxford University Press, 2021), pp. 51-71.

"Leading the Minority: Guiding Policy Change through Legislative Waters," in Sean Q. Kelly and Frank H. Mackaman (eds.) *Robert H. Michel: Leading the Republican House Minority*, (Lawrence: University Press of Kansas, 2019), pp. 115-139.

"A Study in Contrasts: Race, Politics, and the History of School Assignment Policies in Charlotte-Mecklenburg and Wake County, North Carolina," in Roslyn Arlin Mickelson, Stephen Samuel Smith, and Amy Hawn Nelson (eds.) *Yesterday, Today, and Tomorrow. School Desegregation and Resegregation in Charlotte*, (Harvard Education Press, 2015), pp. 85-100. (with Toby L. Parcel and Joshua A. Hendrix).

"Voting on the Floor: Members' Most Fundamental Right," in Jamie Carson (ed.), *New Directions in Congressional Politics*, (New York: Routledge, 2011), pp. 143-62.

Other Academic Publications:

"The 2020 Elections in North Carolina", *Political Economy in the Carolinas*, forthcoming.

"The Expert in American Life", *National Affairs*, (Fall 2021, No. 49), 141-55.

"Reforming the Appropriations Process", *National Affairs* (Spring 2019, No. 39), 33-49.

"How Far Is Too Far? Gender, Emotional Capital and Children's Public School Assignments", *Socius*, 2 (2016) (with Toby L. Parcel and Joshua A. Hendrix).

"The Challenge of Diverse Public Schools," *Contexts*, 15 (Winter 2016): 42-47 (with Toby L. Parcel and Joshua A. Hendrix).

"Power Divisions in Governments," in Frank N. Magill (ed.), *Survey of Social Science: Government and Politics Series* (Pasadena CA: Salem Press, 1995), 1578-83.

"Teaching Politics Panoramically: American Government and the Case Method," *PS: Political Science and Politics*, 27 (September 1994): 535-7.

"A Proper British Revolution? How the Public Views Constitutional Reform," *The Public Perspective*, July/August 1994, 31-4. (with W. Wayne Shannon).

Conference Papers

American Political Science Association, 2021, 2018, 2017, 2015, 2014, 2013, 2010, 2006, 2005, 2004, 2003, 2002, 2001, 1999, 1998, 1997, 1996, 1994.

Midwest Political Science Association, 2021, 2018, 2017, 2015, 2013, 2012, 2011, 2010, 2008, 2007, 2006, 2005, 2003, 2002, 2001, 1996, 1994, 1992.

Southern Political Science Association, 2021, 2020, 2019, 2017, 2016, 2001, 1998, 1997.

Western Political Science Association, 2019.

Citadel Symposium on Southern Politics, 2020.

Northeastern Political Science Association, 1992, 1991.

New England Political Science Association, 1992.

North Carolina Political Science Association, 2003, 1999, 1996.

World Association for Public Opinion Research, 1994.

Selected Major Grants and Other Revenue Generated (Extramural and NCSU Intramural)

John William Pope Foundation and Charles G. Koch Charitable Foundation for, "The Free and Open Societies Project" - $327,250 total: 2022, ($73,000), 2021 ($98,750), 2020 ($155,500).

U.S. Embassy, London, "Build Your Own Campaign" program for British high school students, 2016 - $56,138.

John William Pope Foundation for, "The Economic, Legal, and Political Foundations of Free Societies" (with Steve Margolis) - $1.638 million total: 2014, ($426,000 overall, $268,000 for teaching and research in political science); 2009 ($700,000 overall, $274,200 for political science), 2004 ($511,500 overall, $214,000 for political science).

Fidelity Investments, support for NCPSA meeting, 2014 - $5,000 (in kind).

Dail Endowment in Political Science, 2013 - $145,800.

NCSU School of Public and International Affairs Summer Grant - $10,000 total: 2013 ($5,000), 2012 ($5,000).

Charles G. Koch Charitable Foundation, "Programs in the Classical Liberal Tradition," and other projects (with Steve Margolis before 2017) - $219,500 total: 2018 ($63,000); 2017 ($74,200); 2015 ($23,300); 2014 ($19,000); 2013 ($18,000), 2012 ($9,000), 2011 ($9,000), 2010 ($4,000).

NCSU Distance Education and Learning Technology Applications IDEA Grant, $10,500 total 2009 ($8,000), 2003 ($2,500).

U.S. Department of State for, "U.S. Elections Program for Brazilian Fulbrighters" (with Michael Bustle, David McNeill, and Richard Kearney), 2008 - $75,000.

Dirksen Congressional Center Congressional Research Award - $3,663 total: 2003 ($3,163), 1994 ($500).

NCSU University and College of Humanities and Social Sciences (CHASS) Summer Grants - $17,000 total: 2003 ($5,000), 1999 ($4,000), 1997 ($4,000), 1996 ($4,000).

Invited Academic Talks

University of North Carolina at Chapel Hill, 3/03.
East Carolina University, 10/04.
University of North Carolina at Greensboro, 9/09.
University of Surrey (UK), 5/11.
NC State College of Education, 2/13, 3/15.
Shanghai Jiao Tong University (China), 4/16.
Wake Forest University, 10/16.
National Affairs (Capitol Hill, Washington DC), 6/19.

Principal Administrative and Leadership Appointments

Director, Free and Open Societies Project, 2019-Present

- Approx. $100k annual budget
- Speaker series, student group, student seminars, free speech conference, research assistants, undergrad research grants, internship support, social media presence

Co-Director, The Economic, Legal and Political Foundations of Free Societies program, 2004-2018; Director 2018-2019

- Approx. $85k annual budget
- Speaker series, student group, student seminars, faculty and grad students research support, undergrad research grants, internship support

Chair, Department of Political Science, 2006-10.

- Instrumental in establishment of School of Public and International Affairs
- Managed $2 million budget
- Approx. 600 majors
- Quadrupled the number of women in tenure-track positions
- Demonstrable improvement in majors' experiences according to exit surveys
- Established formal and transparent rules on program assessment, faculty annual evaluation processes, teaching loads, promotion and tenure guidelines, adjunct and summer school pay

Director, M.A. Program in Political Science, 1997-99; 2000-5

Professional Honors

NCSU CHASS's Outstanding Research Award, 2013-14.
Nominated for NCSU Alumni Association Outstanding Research Award, 2013-14.
President of North Carolina Political Science Association, 2012-13.
John W. Pope Center for Higher Education Policy's "Spirit of Free Inquiry" Award (for course, Public Choice and Political Institutions), 2010.
NCSU Libraries "Fantastic Faculty" honoree, 2008-9.
NCSU Outstanding Extension Service Award, 1999-2000, 2003-4.
NCSU CHASS's Lonnie and Carol Poole Award for Excellence in Teaching, 1998-9.
Nominated for NCSU CHASS's Outstanding Junior Faculty Award, 1997-8, 1998-9.
Oral Parks Award for best Faculty Paper presented at the 1996 North Carolina Political Science Association meeting, 1997.
Phi Kappa Phi 1995.
Phi Beta Kappa 1995.
University of Connecticut Excellence in Teaching Award, 1993.

Teaching and Mentoring

North Carolina State University, Fall 1995-Present.
Courses taught:

- Introduction to American Government (Undergraduate, honors, distance ed., UNC Global Blended Learning Program in China)
- The Presidency and Congress (Undergraduate, distance ed.)
- American Parties and Interest Groups (Undergraduate)
- Public Policy Process (Doctoral program)
- Seminar in American Politics (Undergraduate and graduate)
- Legislative Process (Undergraduate)
- Workshop in Politics (Undergraduate)
- Public Choice and Political Institutions (Undergraduate)
- The Classical Liberal Tradition (Undergraduate and honors)
- The Conservative Tradition in the West (Undergraduate and honors)
- Election 2020 (Honors)

- Ph.D. dissertation committees (Public Administration & Economics at NCSU, Political Science at UNC): 9 (including one chair)
- Master's theses supervised: 5
- Undergraduate honors thesis supervised: 12 (including runner-up Pi Sigma Alpha national competition for best Honor's thesis)
- Park Scholars Mentor: 2010-16
- Taught distance education courses since 1997-8, pioneer in the development of such courses at NC State

University of Connecticut, Spring 1991-Spring 1995
Courses taught (in addition to those taught at N.C. State):

- Constitutional Interpretation
- Introduction to Comparative Politics

Fellowships

American Political Science Association Congressional Fellow (Steiger Fellow), 1999-2000:

- Steiger fellow, named for Rep. Bill Steiger (R-WI), who served 1966-78
- given to fellow best equipped to promote the interests of Congress as an institution and who best represents Steiger's values; a man of "exceptional talent, drive, and integrity"

University of Connecticut Pre-Doctoral Fellowships, 1990-1, 1991-2, 1992-3 ($6,000 each).

Select University and Professional Service

Heterodox Academy Political Science Community Co-Leader, 2021-Present
School of Public and International Affairs, Executive Committee, 2021-Present
Campus Conversations Project, 2021-Present
Chair, Presidential Politics Division, Southern Political Science Association, 2022, 2001
Secretary, Classical Liberals of the Carolinas, 2019-Present
Apex High School Academy of Information Technology, Board Member, 2018-Present
Institute for Humane Studies (IHS), Graduate Student & Early Career Mentoring, 2017-Present.
NCSU Faculty Advisor, Leaders for Political Dialogue, 2017-Present.
Senior Editor, *Political Economy of the Carolinas*, 2017-Present.
NCSU School of Public and International Affairs Task Force Chair, Methods 2015-16; F&A Distribution, 2015-16.
NCSU Honors Advisory Board & Admissions Committee, 2014-2018.
Treasurer, North Carolina Political Science Association, 2014-Present.
Program Chair, North Carolina Political Science Association Meeting, 2014.
Co-Chair NCSU CHASS Dean's "Heart of the Matter" Initiative, 2013-15.
NCSU Reappointment, Promotion, and Tenure Committee, 2012-14.
Chair NCSU CHASS Reappointment, Promotion, and Tenure Committee, 2011-12.
NCSU CHASS Associate Director of Development Search Committee, 2011.
American Political Science Association's Albert Dissertation Prize Committee, 2009-10.
The Foundation for Ethics in Public Service, Advisory Board, 2009-12.
NCSU CHASS Committee on Extension, Engagement, and Economic Development, 2008-12.
Coordinator, RTI-NCSU CHASS initiative, 2006-12.
American Political Science Association's Legislative Studies Section Fenno Book Prize Committee, 2015-16, 2005-6.
NCSU Department of Political Science and Public Administration/School of Public and International Affairs Dean's Head/Director Search Committee, 1997-8, 2005-6, 2011-12.
NCSU Department of Political Science and Public Administration Scholars, Honors, and Study Abroad Committee, 2004-6.
NCSU CHASS Research Committee, 2004-7.
NCSU Washington Internship Committee, 2004-7.
NCSU CHASS Curriculum Committee, 2002-4.
Faculty adviser, Truman Scholars Program, NCSU, 2001-4.
NCSU Courses and Curricula Committee, 2002-4.
NCSU Department of Political Science and Public Administration "Structural Issues" Committee (recommended the creation of School of Public and International Affairs), 2000-2.
NCSU CHASS Graduate Studies Committee, Chair, 1998-9.
NCSU Department of Political Science and Public Administration Ph.D. Steering Committee, 1998-2001.
Faculty advisor, NCSU College Republicans 1996-9, 2000-Present; North Carolina Student Legislature, 2005-2012; Young Americans for Liberty 2016-18, 2020-Present; College Libertarians 2018-Present; Society for Politics, Economics, and the Law (SPEL), 2019-Present; Young Americans for Freedom, 2020-Present; The FreePack, 2021-Present.
NCSU Department of Political Science and Public Administration/School of Public and International Affairs Faculty Search Committee, 1995-6, 1998-9, 2000-1, 2001-2 (chair), 2007-8 (chair), 2011-12, 2013-14 (chair).

Book Reviews

The Polarizers: Postwar Architects of our Partisan Era, by Sam Rosenfeld, *Party Politics*, 26 (2020): 264-5.

The Coddling of the American Mind: How Good Intentions and Bad Ideas are Setting Up a Generation for Failure, by Greg Lukianoff and Jonathan Haidt, *Political Economy in the Carolinas*, 2 (2019): 118-20.

Politics Over Process: Partisan Conflict and Post-Passage Processes in the U.S. Congress, by Hong Min Park, Steven S. Smith, and Ryan J. Vander Wielen, *Congress and the Presidency*, 46 (2, 2019): 344-45.

Defying the Odds: The 2016 Elections and American Politics, by James W. Ceaser, Andrew E. Busch, and John J. Pitney, Jr., *American Review of Politics*, 36 (2, 2018): 109-10.

The Rise and Fall of the Voting Rights Act, by Charles S. Bullock III, Ronald Keith Gaddie, and Justin J. Wert, *The North Carolina Historical Review*, 84 (January 2017): 120-1.

Legislating in the Dark: Information and Power in the House of Representatives, by James M. Curry, *Congress and the Presidency* 43 (3, 2016): 401-3.

The Senate Syndrome: The Evolution of Procedural Warfare in the Modern U.S. Senate, by Steven S. Smith, *Perspectives on Politics*, 13 (December 2015): 1168-9.

Seeking a New Majority: The Republican Party and American Politics, 1960-1980, edited by Robert Mason and Iwan Morgan, *Party Politics*, 21 (May 2015): 494-5.

The Challenge of Congressional Representation, by Richard F. Fenno, *Perspectives on Politics* 12 (June 2014): 490-1.

The Tea Party: Three Principles, by Elizabeth Price Foley, *American Review of Politics* 34 (Spring and Summer 2013): 151-3.

Painting Dixie Red: Where, When, Why and How the South Became Republican, ed. by Glenn Feldman, *The North Carolina Historical Review*, 79 (October 2012): 457-8.

*The Roots of Modern Conservatism: Dewey, Taft, and the Battle for the Soul of the Republican Party***,** by Michael Bowen, *The North Carolina Historical Review*, 79 (April 2012): 231-2.

On Thinking Institutionally, by Hugh Heclo, *Modern Age*, 52 (Spring 2010): 158-60.

The New Politics of North Carolina, edited by Christopher A. Cooper and H. Gibbs Knotts, *The North Carolina Historical Review*, 76 (January 2009): 108.

The Paradox of Tar Heel Politics: The Personalities, Elections, and Events that Shaped Modern North Carolina, by Rob Christensen, *The North Carolina Historical Review*, 75 (October 2008): 451-2.

The Right Talk: How Conservatives Transformed the Great Society into the Economic Society, by Mark A. Smith, *Perspectives on Politics*, 6 (September 2008): 611-12.

*Politics and Religion in the White South***,** ed. by Glenn Feldman, *The North Carolina Historical Review*, 73 (April 2006): 288-9.

Vicious Cycle: Presidential Decision Making in the American Political Economy, by Constantine J. Spiliotes, *The Independent Review*, 8 (Summer 2003): 135-8.

The Political Party Matrix: The Persistence of Organization, by J.P. Monroe, *American Political Science Review* 96 (June 2002): 430.

Party Decline in America: Policy, Politics, and the Fiscal State, by John J. Coleman, *Congress and the Presidency* 24 (Spring 1997): 97-9.

Cultivating Congress: Constituents, Issues, and Interests in Agricultural Policymaking, by William P. Browne, *Journal of Politics* 58 (November 1996): 1222-4.

Other Professional Activities
Media Commentary:
Hundreds of appearances on television and radio; source for and quoted in hundreds of print stories. Principally: *The News and Observer* (Raleigh, NC), WRAL-5 (Raleigh, NC), WTVD-11 (Raleigh, NC), WPTF-680 (Raleigh, NC), WUNC-TV (RTP, NC), Public Radio WUNC (Chapel Hill, NC), News Channel 14 North Carolina, Curtis Media Group radio stations (particularly *Carolina Newsmakers* and *The Commentators*) Carolina Journal, NC Spin.
Other Appearances: *The Hartford Courant*, *The Washington Times*, WLFL-22 (Raleigh, NC), Australian Broadcasting Corp., BBC Radio Humberside, Knight-Ridder Newspapers, *The Fayetteville Observer-Times*, *Apex Herald,* WTRG 100.7 (Raleigh, NC), *The Citizen-Times* (Asheville, NC), *The Winston-Salem Journal*, Associated Press, *Durham Herald-Sun*, *Laurinburg* (NC) *Exchange*, *Triangle Tribune* (Durham, NC), *McDowell News* (Marion, NC), *Hendersonville* (NC) *Times-News*, *Transylvania Times* (Brevard, NC), *Kiplinger Letter* (Washington, D.C.), *Charlotte Observer*, Fox News Channel (national cable news), *Greensboro* (NC) *News and Record*, Cox Newspapers, WQDR 94.7 (Raleigh, NC), WXIT-1200 (Boone, NC), *Wilmington* (NC) *Star-News*, *Congressional Quarterly*, Reuters, *Christian Science Monitor*, *Boston Globe*, *Rocky Mount* (NC) *Telegram*, National Public Radio ("All Things Considered", "Marketplace", "1A"), NBC-6 (Charlotte, NC), *The Los Angeles Times*, *North Carolina Political Review*, *The New York Times*, *Dallas Morning News*, *Burlington* (NC) *Times-News*, *National Journal's Congress Daily/A.M.*, *The Cook Report*, Open/net (NC state government tv show), *Dagens Nyheter* (Swedish newspaper), *Politics in America*, Elizabeth City (NC) *Daily Advance*, Freedom Newspapers, Greenville (NC) *Daily Reflector* (Reflector.com), *Triangle Business Journal*, *Eastern Wake News*, Vermont Public Radio, *Daily Herald* (Roanoke Rapids, NC), *High Point* (NC) *Enterprise*, *Wall Street Journal*, *Pittsburgh Post-Gazette*, NewsTalk 106 (Dublin, Ireland), *The Sunday Times* (of London), Nippon tv. (Japan), State Government Radio (NC), Fairchild Publications, Scripps-Howard, ABCNews.com, *Washington Post*, Newhouse Newspapers, *Nubian Message*, CNBC-Asia, *Carolina Journal* Radio, *The Pamlico* (NC) *News*, *New York Daily News*, Public Radio WFAE (Charlotte), *Atlanta Journal-Constitution*, Salon.com, *Chattanooga Times Free Press*, WTN 99.7 (Nashville), *US News and World Report*, News Radio 1020 KDKA (Pittsburgh), *Indianapolis Star*, *Virginia Pilot*, Bloomberg News, *National Journal*, WBT 1110 (Charlotte news), *Daily Dispatch* (Henderson, NC), *Time* Magazine, *Correio Brazilienese* (Brazilian newspaper), C-SPAN, News Talk WDBO-580 (Orlando), Public Radio WHYY (Philadelphia), CNNMoney.com, *O Estado de Sao Paulo* (Brazilian newspaper), VoterRadio.com, *Frankfurter Allgemeine Zeitung* (German newspaper), *Charlotte Magazine*, Delaware Talk Radio, *The Guardian* (U.K. paper), *The Weekly Standard*, Waterbury (CT) *Republican-American*, *USA Today*, EFE (Spanish language news agency), BBC Radio 4, *The Scotsman* (Scottish national paper), *Tax News and Analysis*, *Triangle Tribune*, *San Francisco Chronicle*, Agence France Press, Moneynews.com, *Arab Times* (Kuwaiti English newspaper), The *Gulf Times* (Qatari English newspaper), The *Khaleej Times* (English newspaper out of UAE), *The County Compass* (Bayboro, NC), CashWorks Productions (documentary, "Obama in NC"), *Pravda* (Slovakian newspaper), WXII-12 (Winston-Salem), Voice America Talk Radio, *The Independent Weekly*, *Politico*, WRAL-FM 101.5 (Raleigh), *The Daily Beast*, *Lee County (NC) Star-Tribune*, Carolina Journalism Network, *Excelsior* (Mexican newspaper), *Globe and Mail* (Canada), WERC-AM 960 (Birmingham, AL), WRDU 106.1 (Raleigh, NC), *Wilson* (NC) *Times*, *Christian Post*, Investor Place media, *World Magazine*, BBC.com, *Cary News*, *The State* (South Carolina), *Clayton* (NC) *News-Star*, *Governing Magazine*, WRAL.com, *Raleigh Public Record*, *Business Journal* (Charlotte), *Walter Magazine*, *Wake County Times*, *Roll Call*, *Duplin* (NC) *Times*, CNN, *National Review Online*, *Creative Loafing* (Charlotte), WSJS-600 (Greensboro, NC), *East Wake News*, *Charlotte Business Journal*, Jewish Telegraphic Agency, Brookings Institution, msnbc.com,

Other Professional Activities (cont.)
Media Commentary (cont.):
Irish Times, NC SPIN, GreenWire, *International Business Times*, *The Hill*, FoxNews.com, WCHL (Chapel Hill), *Daily Signal*, CNNPolitics.com, FoxNewsLatino.com, *CQ Weekly*, *The American Prospect*, *Talking Points Memo*, Townhall.com, *Rhino Times* (Greensboro, NC), Ozy.com, *Philanthropy Journal*, EnergyWire, *Garner-Cleveland Record*, *Politico Magazine*, Freedom Action Network Radio, Domecast, *Route Fifty*, *Chapel Hill News*, *Raleigh Magazine*, *Slate*, *North State Journal*, *NC Capital Connections*, *Mother Jones*, *Sierra Magazine*, Alhurra, tvnewscheck.com, Market Watch, *The Atlantic*, *Inside Higher Ed*, *Modern Healthcare*, BBC North America, CBC French Language Service, Inside Climate News, WLOS-ABC 13 (Asheville), HBO, *Piedmont Sundial*, *Asheboro Courier-Tribune*, *School Reform News*, *Robesonian*, *Sanford Herald*, NBCNews.com, *Clarin* (Argentine newspaper), NC Policy Watch, Martin Center for Academic Renewal, *Allegheny News*, *Education Week*, WWNC (Asheville, NC), Sinclair Broadcast Group, *The Hill*, Pew-Stateline, Ifobae (Argentinian news website), WGHP Fox 8 (Greensboro, NC), E&E News, States Newsroom.com, *New Statesman* (UK), CNBC.com, YLE (Finnish tv), France 24, Americans for Limited Government, WNCT (Greenville, NC).
Major Contributions:

- Called "the leading talking head of Tar Heel politics," *News and Observer*, 11/05.
- Stories on which I have provided extensive analysis: presidential, congressional, gubernatorial, and local elections; presidential impeachments; UK politics including elections and Brexit; North Carolina politics; policy issues including education, government spending, taxes, health care, agriculture etc.
- Newspaper op-ed topics (mainly for *News and Observer* and prior to 2010) include: establishment of Connecticut income tax, Republican party politics, the flat tax, third party politics, North Carolina tobacco politics, reform of North Carolina legislature, John Edwards as possible Gore vice president, effect of 2000 election on voting procedures, ability of George W. Bush to govern, proposals for political reform in North Carolina, U.S. and war on terrorism, 2002 North Carolina U.S. Senate race, John Edwards 2004 presidential campaign, reform of NC House, 2006 election, 2008 North Carolina presidential primary, earmarks in Congress, land-use law in North Carolina.
- Column in *Carolina Journal* 2009-13, 2015-21 (monthly), 2021-present (periodic) (40,000 print subscribers, 40,000 unique monthly visitors to website, picked up by newspapers all over North Carolina with est. 300,000 circulation), topics include: NC and the stimulus, financing of elections, legislative term limits, merit pay for teachers, institutional thinking, tobacco industry, political leadership in NC, health care reform, American and French economic models, the role of a public university, 2010 elections, Newt Gingrich, the filibuster, 2010 NC Senate race, Wake County school board politics, 2012 primaries, "bailout fatigue", Obama performance, donors to conservative causes, education reform, NC congressional delegation, 112th Congress, conservatism today, conservatives and foreign policy, municipal government, election administration, Anglo-American relationship, performance of NC General Assembly, Washington debt deal, income and voting, 2012 presidential race, ethics in politics, Romney presidential candidacy, NC same-sex marriage amendment, juridical democracy, runoff elections, Romney's choice of Ryan, errors in conservatives' thinking, 2012 election postmortem, gender differences in politics, UNC system, the Tea Party, unemployment in NC, Margaret Thatcher, Republican governance in NC, polarization in NC, voter identification, classical republicanism,

Other Professional Activities (cont.)
Media Commentary (cont.):
Major contributions (cont.)

- higher education funding, William F. Buckley Jr., party competition, diversity on campus, growth and equality, Trump candidacy, ideology in 2016, Brexit referendum, Republican strategy in 2016, China's challenge, conservative values, science politics, Democrats' "electoral lock", Obama and race, Trump election win, McCrory election loss, advocacy and force in politics, fake news, border-adjustment tax, public's sour mood, Millennials and politics, technocracy, 2018 midterm forecast, state Republicans' economic performance, the party system, political language, viewpoint diversity, Trump and Britain, partisan gerrymander, NRA in politics, Facebook, citizenship and census, NC teacher rally, counties in NC politics, 2018 referendums, Steyer and Trump, political nostalgia, NC's important members of Congress, 2018 midterm analysis, ballot harvesting, Trump's deals, direct democracy, federal deficit, slavery and the Electoral College, Corbynism, 2019 Supreme Court term, 2020 Democratic presidential contest, NC redistricting case, politics of 1970s, impeachment, partisan foreign policy, NC budget stalemate, 2020 NC Senate race, coronavirus and the Establishment, coronavirus in NC, slavery reparations, 25 years of NC politics, 2020 House elections in NC, Fed and inflation, 2020 election, Electoral College reform, Democrats' advantages, NC school districts, Biden's economics, UNC and Hannah-Jones, felon voting rights.

Periodic Reviews:
Policy Studies Journal, *Southeastern Political Review*, St Martin's Press, *Legislative Studies Quarterly*, *American Politics Quarterly/Research*, Worth Publishers, *Journal of Politics*, *American Journal of Political Science*, *Social Science Quarterly*, Houghton-Mifflin, *Political Studies*, *Political Research Quarterly*, *The Independent Review*, National Science Foundation, *American Political Science Review*, Praeger, *Political Behavior*, Compass Point Books, *Journal of Agricultural and Resource Economics*, *Congress and the Presidency*, *Public Choice*, Congressional Quarterly Press, University of Michigan Press, *Politics* (U.K.), *Journal of Public Administration and Policy Research*, *State Politics and Policy Quarterly*, Oxford University Press, John F. Blair Publishing, Palgrave MacMillan, *Journal of Political Marketing*, W.W. Norton, *Government and Opposition*, *PS: Political Science and Politics*, Emerald Press, *American Behavioral Scientist*.

Testimony and Consultancy:

- NC House Committee on Elections
- Coalition to End Gerrymandering
- *CSI v. Moore*

Tenure and Promotion Reviews:
University of Minnesota-Morris, UNC-Greensboro, Clark University, Lehigh University, Clemson University, University of Arkansas, University of Houston-Victoria, UNC-Charlotte.

Group Membership and Professional Activism:

- Foundation for Individual Rights in Education (FIRE) – instrumental in securing NC State "Green Light" status
- Heterodox Academy

Periodic Blog Entries:

- LSE American Politics and Policy Blog, IHS Learn Liberty Blog, LegBranch, The James G. Martin Center for Academic Renewal, Brookings Institution's FixGov Blog

Public Addresses:

- Triangle International Visitor's Council/International Focus (1996-2015), numerous and regular talks on American politics given to academics, journalists, practitioners, and politicians from all over the world.
- NCSU Presbyterian Campus Ministry Peace Lunch Forum, 9/95, 11/98, 11/00, 11/04, 2/06, 3/08, 11/08, 11/16.
- CHASS Dean's Advisory Board, 4/96, 11/98.
- B'nai Brith, 10/96, 12/98, 3/04.
- Area elementary schools, 11/96, 11/00, 10/09, 6/11.
- Beth Myer Jewish Women's Group, 11/96.
- Area Rotary clubs, 11/96, 3/99, 5/99, 6/08x2, 1/10, 2/16, 9/16, 7/18, 3/19.
- NCSU Alumni Association, 10/96, 11/96, 1/99, 4/99, 9/00, 4/01, 3/04, 10/08, 5/09, 8/12, 9/16.
- NCSU Osher Lifelong Learning Program, 10/96, 10/98. 10/00, 1/08, 9/08, 10/19.
- International Visitor's Council moderator in debate between British M.P.s and North Carolina state legislators, 9/98.
- Area high schools, 1/98, 3/99, 9/00, 9/02, 10/02, 2/03, 09/04, 12/04, 2/16, 10/16, 1/18, 2/18, 9/18, 11/18, 1/19, 3/19, 5/19x2, 12/19, 10/20, 11/21.
- Wake County Men's Democratic Club, 11/98.
- Wake County Young Republicans, 3/99, 9/99.
- Wake County National Association of Retired Federal Employees, 4/99, 9/04, 9/14.
- John Locke Foundation, 6/99, 10/05, 1/08, 10/08, 6/09, 1/13, 7/15, 2/18, 2/19, 3/21, 10/21, 11/21.
- Hugh O'Brian Youth Leadership Seminar, 6/99, 6/01, 6/02, 6/09.
- Russian Leadership Program, 9/99, 5/02.
- Research Triangle English Speaking Union, 9/99.
- Canadian Parliamentary Interns, Washington, D.C., 4/00.
- Raleigh Jaycees Political Forum, 10/00.
- St. Augustine's College, 10/00.
- Area residents' association, 10/00.
- NCSU honors/scholars students/Caldwell Fellows/student leadership, 10/00, 4/02, 1/04, 2/04, 2/06 (D.C. trip), 10/08, 10/10, 10/12, 3/15, 9/15, 3/16, 10/16, 11/16, 11/18, 9/19, 10/20.
- Wake County Republican Men's Club, 11/00, 5/06, 1/07.
- Wake County Republican Women's Club, 11/00, 3/02, 9/05, 10/15, 10/19.
- Raleigh Chamber of Commerce, 11/00, 11/08, 3/12, 4/13.
- NCSU retired faculty, 1/01, 3/04, 11/08, 2/16.
- Area Kiwanis clubs, 3/01, 12/06, 2/17, 11/21.
- NCSU Graduate School Board of Directors, 3/01.
- Republican Club of Fearrington Village, 10/01.
- North Carolina Youth Legislative Assembly, 3/02.
- Westinghouse Retirement Group, 8/02, 2/03.
- NCSU CHASS-sponsored public event, 9/02, 10/08, 11/16, 9/19.
- North Carolina World Trade Association, 10/02.
- European Marshall Memorial Fellowship Program, 10/02.
- Area Optimist club, 1/03.

Other Professional Activities (cont.)
Public Addresses (cont.):

- Wake Forest Daughters of the American Revolution, 4/03.
- Adventures in Learning, 5/03.
- Wake County Citizens for Effective Government, 2/04.
- Moderator, North Carolina Republican Party gubernatorial debate, 4/04, 11/07.
- Group of Fifty, 11/04.
- NCSU Society for Politics, Economics and the Law, 11/04, 10/05, 2/08, 9/11, 9/12, 3/13, 4/14, 9/14, 9/15, 9/16, 10/18, 9/20.
- NC Leadership Forum, 11/05, 11/08, 11/09, 11/18, 11/19, 11/20.
- Quail Ridge Books, 1/06, 4/15.
- North Carolina Young Lobbyists Association, 5/06, 1/07.
- Raleigh Public Relations Society, 5/06.
- Western Wake Republican Club, 6/06, 1/08, 11/08, 10/10, 5/12, 10/14, 4/16, 4/18, 11/20.
- Young Presidents' Organization, 10/06, 11/19, 12/19.
- Adventures in Ideas, UNC-CH, 2/07.
- North Carolina Association of Electric Cooperatives, 3/07, 9/12.
- Raleigh Exchange Club, 9/07.
- North Carolina Aggregates Association, 6/08.
- U.S. Small Business Administration, 9/08.
- North Carolina Professional Lobbyists Association, 10/08, 11/14, 10/17, 10/19.
- NCSU CHASS "Back to School" Day, 10/08.
- Canadian Consulate, 10/08, 8/09, 2/10.
- NCSU's Friends of the Libraries, 10/08.
- Fulbright Visitors, 10/08.
- NC FREE, 10/08, 6/21.
- UNC Leadership Seminar for State Legislators, 11/08.
- NCSU Harrelson Lecture, 1/09.
- North Carolina Bar Association, 2/09.
- Garner First Presbyterian, 3/09, 3/11.
- NCSU University Club, 3/09.
- Foundation for Ethics in Public Service, 11/09.
- North Carolina Retail Merchants' Association, 4/10.
- Civitas Institute (now merged with Locke Foundation), 6/10, 12/18, 6/20.
- NCSU Office of International Affairs, 7/10.
- UNC System Council on Federal Relations, 8/10, 9/12.
- North Carolina Association of County Commissioners, 8/10, 11/10, 5/14.
- Wake Tech Community College Retirees, 10/10.
- North Carolina Free Enterprise Foundation, 10/10, 10/14, 4/16, 9/16.
- North Carolina Institute for Constitutional Law, 11/10.
- NCSU Development Coalition, 1/11, 10/16.
- Carolina Country Club History Group, 3/11, 10/11, 1/12, 9/12, 10/12, 11/12, 1/14, 2/14, 3/14, 10/14, 11/14, 9/15, 2/16, 3/16, 11/16, 3/17, 10/17, 2/18, 9/18, 11/18, 3/19, 11/19, 1/20, 2/20, 9/21.

Other Professional Activities (cont.)
Public Addresses (cont.):

- Morgan Stanley, 6/11, 10/16.
- NCSU Constitution Day, 10/11.
- Carolina Country Club, 1/12, 8/16.
- Cisco Systems, 3/12.
- National Council for International Visitors, 8/12.
- North Carolina Housing Finance Agency, 8/12.
- National Guard, 9/12.
- North Carolina Museum of History, 10/12, 8/13.
- North Carolina School of Science and Mathematics, 10/12.
- Japanese Embassy, 10/12, 2/20.
- NCSU Lawyers' Association, 11/12.
- AARP, 11/12.
- Bailey and Dixon LLP Election Conference, 10/13.
- UNC Law School, 9/14.
- North Carolina Community College Conference, 10/14.
- International Center for Journalists, 10/14.
- Poole College of Management, 11/14, 12/16.
- NC Beverage Association, 5/15.
- Martin Center (previously Pope Center) for Academic Renewal, 7/15, 10/15, 6/16, 7/17, 6/18, 9/18, 7/19, 8/20, 3/21, 8/21.
- NCSU Holtzman Forum, 11/15.
- Central Carolina Community College, 11/15.
- Great Decisions, Foreign Policy Association, 2/16.
- NCSU Cultural Exchange Network, 3/16.
- VFW-NCSU Leadership in the Public Sector panel, 4/16.
- Durham Central Park Cohousing Community, 5/16.
- Golden Corral group, 9/16.
- Singaporean Embassy, 9/16.
- American Forest and Paper Association, 11/16.
- NC League of Municipalities Board, 12/16.
- North Carolina Public Health Association, 5/17.
- NCSU Department of Social Work Spring Summit, 3/18.
- National Speech and Debate Association, 6/18, 5/19.
- Carolina Preserve, 2/19.
- National Affairs & R Street Institute, 6/19.
- Issues Confronting Our Nation, 10/19.
- British Embassy, 11/19.
- British American Business Council, 6/20.
- Hindu Society of North Carolina, Seniors' Club, 9/20.
- UK Political Tours, 10/20.
- Life Plan Group, 11/20.
- Foundation for Economic Education, 4/21.
- Carolina Meadows, 4/21.
- Sigma Chi NC STEM Fellowship, 7/21.

Other Professional Activities (cont.)
Public Addresses (cont.):

- Citizen Redistricting North Carolina, 10/21.
- Meridian International Center, 12/21.

Expert Report on North Carolina's Enacted Congressional Districts

Christopher A. Cooper

November 29, 2021

Introduction

My name is Christopher A. Cooper. I have been asked to provide a brief analysis of the partisan characteristics of North Carolina's congressional maps, enacted on November 4, 2021, for purposes of Plaintiffs' motion for preliminary relief in *Harper v. Hall*, No. 21 CVS 500085. I am conducting this analysis as a private citizen and am not speaking for my employer, nor am I conducting this work on university time, or using university resources.

I am the Robert Lee Madison Distinguished Professor of Political Science and Public Affairs at Western Carolina University, where I have been a tenured or tenure-track professor since 2002. I hold a PhD and MA in Political Science from the University of Tennessee, Knoxville and a BA in Political Science and Sociology from Winthrop University. My academic research focuses on state politics and policy, elections, and southern politics—with particular application to North Carolina. To date, I have published over 50 academic journal articles and book chapters, co-edited one book, and co-authored one book (both with the University of North Carolina Press). I teach courses on state and local politics, political parties, campaigns, and elections, southern politics, research methods, and election administration. In 2013, I was named the North Carolina Professor of the Year by the Carnegie Foundation for the Advancement of Teaching and I have received Western Carolina University's highest honors in teaching (Board of Governors Teaching Award) and scholarship (University Scholar).

Much of my academic and applied research relates to North Carolina politics and policy and I am a frequent source for news media seeking comments about politics in the Old North State. My quotes have appeared in national and international outlets including the New York Times, Washington Post, Politico, BBC, and the New Yorker, as well as in North Carolina-based outlets including the News and Observer, Charlotte Observer, Asheville Citizen Times, Carolina Journal, Spectrum News, and National Public Radio affiliates in Chapel Hill, Charlotte, and Asheville. I have written over 100 op-eds on North Carolina, southern and national elections and politics, including pieces in the Atlanta Journal Constitution, NBC.com, the News and Observer, Charlotte Observer, and Asheville Citizen Times, and regularly give talks about North Carolina politics, North Carolina elections, and the redistricting process to groups throughout the state. I previously served as an expert witness in *Common Cause v. Lewis*.

I am being compensated at a rate of $300 per hour.

The bulk of the analysis that follows analyzes the consequences of the choices made district by district. Before proceeding into this analysis, however, a few points of context:

- North Carolina is, by virtually any measure, a "purple state" with healthy two-party competition. The North Carolina Governor is a Democrat, while the US Senators are Republicans. There are more registered Democrats than Republicans in the state, and in the 2020 election, the two-party vote share difference between Trump and Biden was the smallest of any state that Donald Trump won.

- North Carolina does not show as much evidence of "natural clustering" as other states. According to Stanford University political geographer Jonathan Rodden, "Due to the presence of a sprawling knowledge-economy corridor, a series of smaller automobile cities with relative low partisan gradients, and the distribution of rural African Americans, Democrats are relatively efficiently distributed in North Carolina at the scale of congressional districts."[1] In other words, massive partisan disparities in election outcomes in favor of one party or the other cannot be discounted as simply a result of where Democrats and Republicans happen to live.

- Gerrymandering, drawing districts to benefit one party at the expense of the other, is generally accepted as a threat to democracy in North Carolina and across the nation. This statement is true regardless of partisanship. For example, a 2018 Elon Poll found that just 10% of registered voters in North Carolina believe the current redistricting system is "mostly fair." A recent op-ed in the *News and Observer* by Republican Carter Wrenn and Democrat Gary Pearce illustrates bi-partisan agreement on the evils of gerrymandering in clear terms. They explain, "We agree that gerrymandering is a major problem that undermines the foundations of our democracy. We agree that districts shouldn't be drawn to help one political party, no more than college basketball games should be rigged to favor one team."[2] The preference for fair maps is not a partisan one.

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[1] Rodden, Jonathan, Why Cities Lose (New York: Basic Books, 2019), 173.

[2] Gary Pearce and Carter Wrenn. "We're usually on opposite sides of political battles. But we agree on NC voting maps." News and Observer. October 21, 2021.

While the district-by-district analysis is key to understanding the ways in which the map will translate into advantage for one party or the other in any given district, the map is best thought of as a single organism, rather than 14 separate congressional districts---when one district moves in one direction, another district must shift in response. As a result, it is worth pausing and considering some of the general characteristics of the map before moving into a district-by-district analysis.

- North Carolina earned an additional congressional seat because of population growth that occurred mostly in urban areas: according to an analysis of U.S. census data by the News and Observer, more than 78% of North Carolina's population growth came from the Triangle area and the Charlotte metro area.[3] Despite that fact, the number of Democratic seats actually *decreases* in the current map, as compared to the last map. The last map produced 5 Democratic winss and 8 Republican wins; this map is expected to produce 3 Democratic wins, 10 Republican wins and 1 competitive seat.

- Democratic strongholds Mecklenburg, Guilford, and Wake Counties are each divided across three districts, despite the fact that there is no population-based reason to divide them this many times. In the previous map, Mecklenburg was divided into two districts, Wake into two districts, and Guilford fell completely in one district. The strategic splits in the enacted map ensure that large numbers of voters will have no chance of being represented by a member of their own party. These splits will also lead to voter confusion and fractured representational linkages. The shaded red-and-blue maps that follow this introductory section provide a graphical representation of each of these county splits.

- The map produces geographic contortions that combine counties in ways that, in some circumstances, have never existed before.

- The double-bunking that occurs in the enacted map advantages the Republican Party. A Republican (Virginia Foxx) and a Democrat (Kathy Manning) are both drawn into in an overwhelmingly Republican district, thus virtually guaranteeing that the Democrat (Manning) will lose her seat. There are no cases where two Republican incumbents seeking re-election are double-bunked. The map also produces at least one district with no incumbents, but that district overwhelmingly favors the Republican Party.

- Neutral, third-party observers have been uniform in their negative assessment of the map. For example, The Princeton Gerrymandering Project gives the map an "F" overall, an "F" in partisan fairness and a "C" in competitiveness. Dave's Redistricting App assess the map as "very bad" in proportionality and "bad" in terms of competitiveness. Both of these groups are nonpartisan and have given similar grades to Democratic gerrymanders in other states.

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[3] David Raynor, Tyler Dukes, and Gavin Off. "From population to diversity, see for yourself how NC changed over 10 years." News and Observer, Oct. 18, 2021, https://www.newsobserver.com/news/local/article253546964.html.

In the text that follows, I refer to the "current" maps as the maps that were used in the 2020 election and the "enacted" maps as the maps that have been approved by the North Carolina General Assembly for use in the 2022 elections. While I conducted all of the analysis that follows and wrote all of the verbiage, the shaded red-and-blue maps were produced by John Holden, a GIS expert, using a composite measure of partisanship that I selected and describe below.

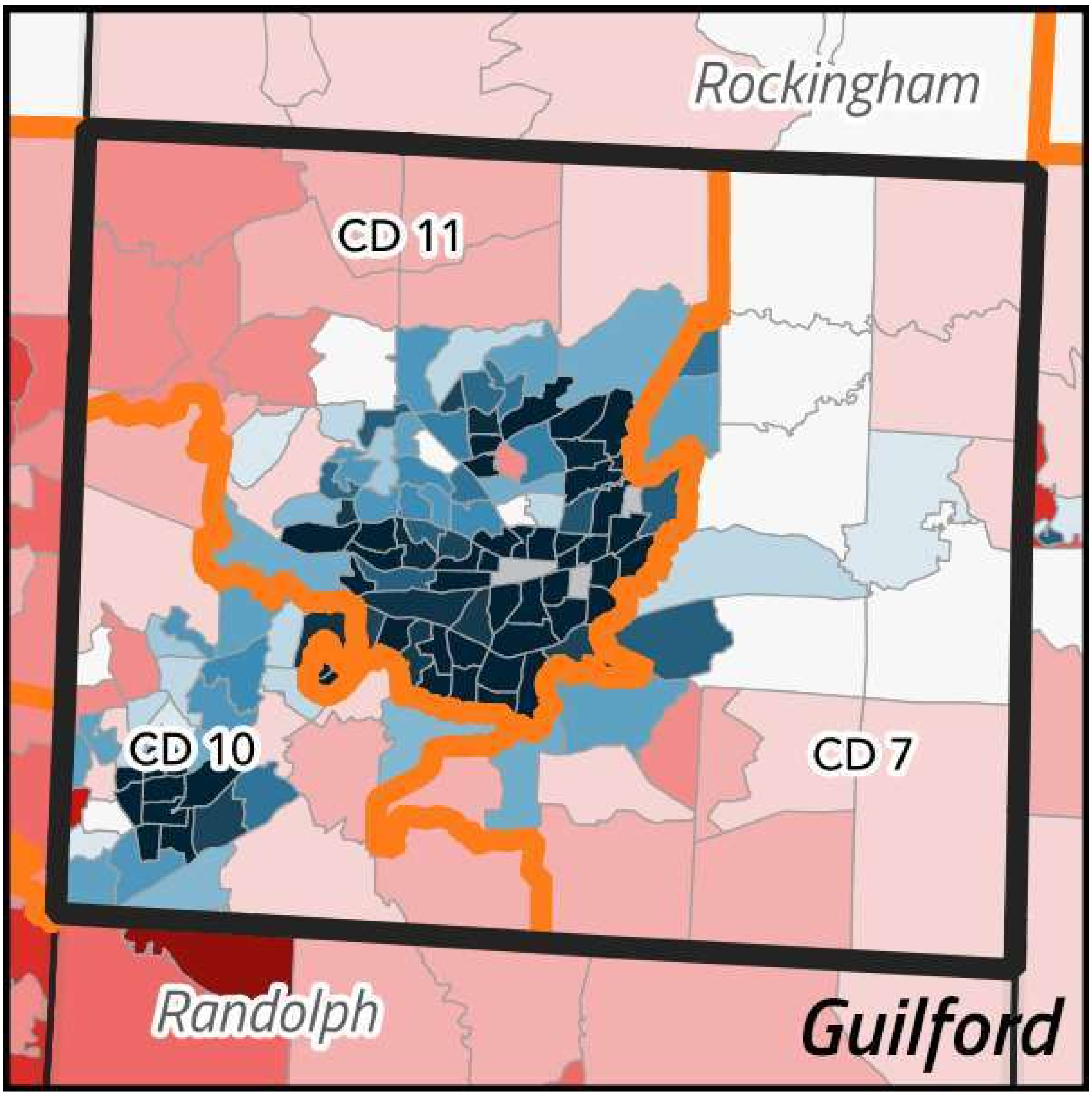
I use three different metrics in the analysis that follows. The first is the Cook Political Report's Partisan Voter Index (PVI), a standard metric of the expected "lean" of a district using a composite of past elections. The second is a metric created for this analysis that combines the results of the Secretary of Labor and Attorney General races, the two closest Council of State races in North Carolina in 2020, into one measure, which I term the Competitive Council of State Composite (CCSC). This measure allows us to use relatively low-profile elections to get a sense of the "true partisanship" of the district. It is presented below as the raw difference in votes and is used in the shaded red-and-blue maps that follow. Finally, I mention the percent of the electorate that voted for Donald Trump in the 2020 election to give yet another sense of the partisan lean of the district. As the table below shows, the metrics all tell a similar story: the enacted map will produce 10 Republican seats, 3 Democratic seats, and one competitive seat. At most, the enacted map could be expected to elect four Democrats to office in 2022—fewer than in the current map and far below Democratic representation statewide, or the results of other recent statewide elections.

Table 1. Summary Data for Each Enacted Congressional District

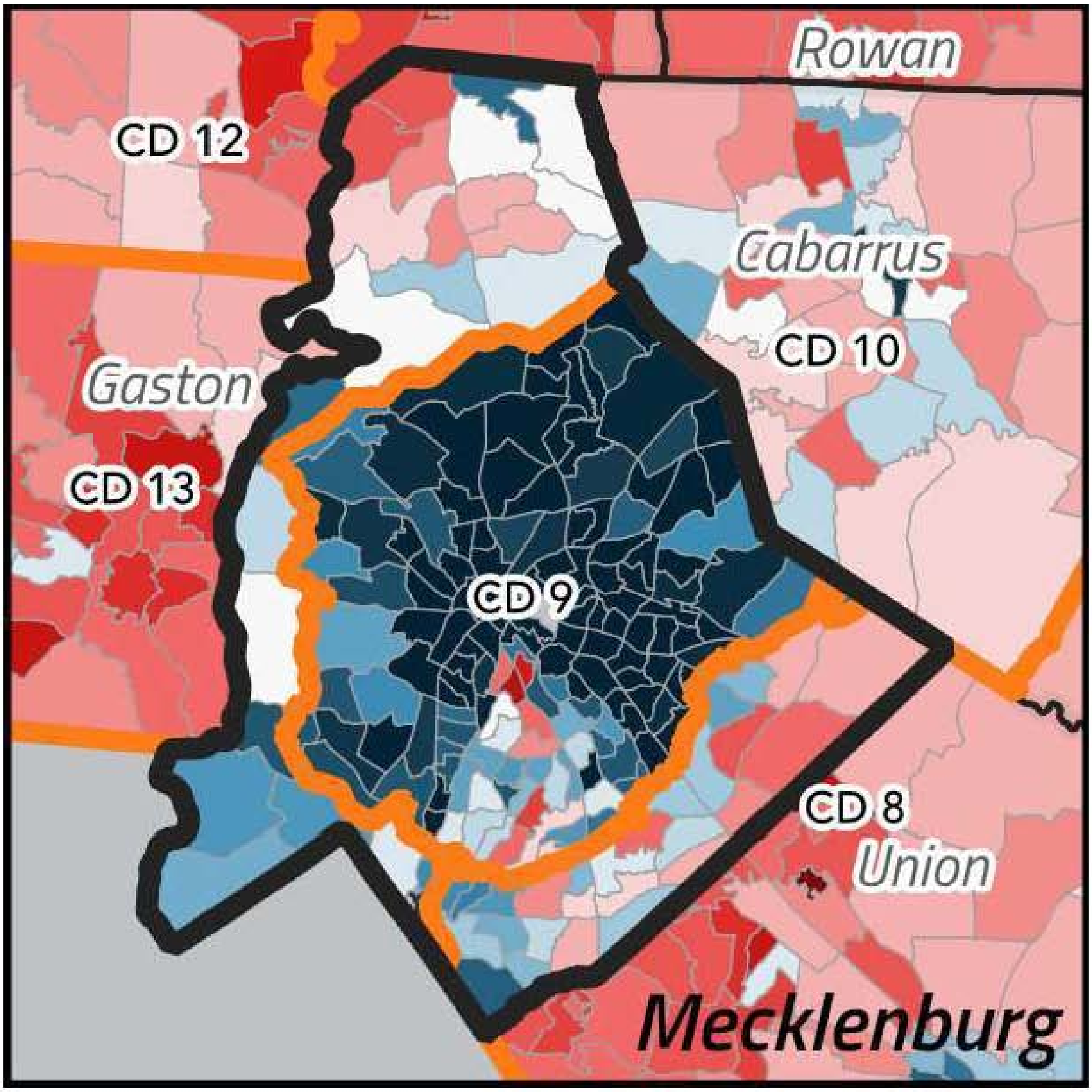
District	PVI	CCSC	Trump Perc
1	R+10	R + 98,969	57%
2	Even	D +40,396	48%
3	R+10	R +111,451	58%
4	R+5	R + 28,045	53%
5	D+12	D +227,327	34%
6	D+22	D + 374,786	25%
7	R+11	R + 115,682	57%
8	R+11	R +125,842	57%
9	D+23	D + 325,717	25%
10	R+14	R + 156,833	60%
11	R+9	R + 94,407	57%
12	R+9	R + 102,404	56%
13	R+13	R + 150,187	60%
14	R+7	R + 58,387	53%

I begin by showing shaded red-and-blue maps demonstrating the trisection of Wake County, Mecklenburg County, and Guilford County. These maps show county lines in black, VTD lines in gray, and district lines in orange. The red and blue shading represents the relative vote margin using my CCSC composite—the composite of the Secretary of Labor and Attorney General races in North Carolina in 2020—in each VTD, with darker blue shading representing larger Democratic vote margins and darker shades of red indicating larger Republican vote margins (both normalized by acreage).

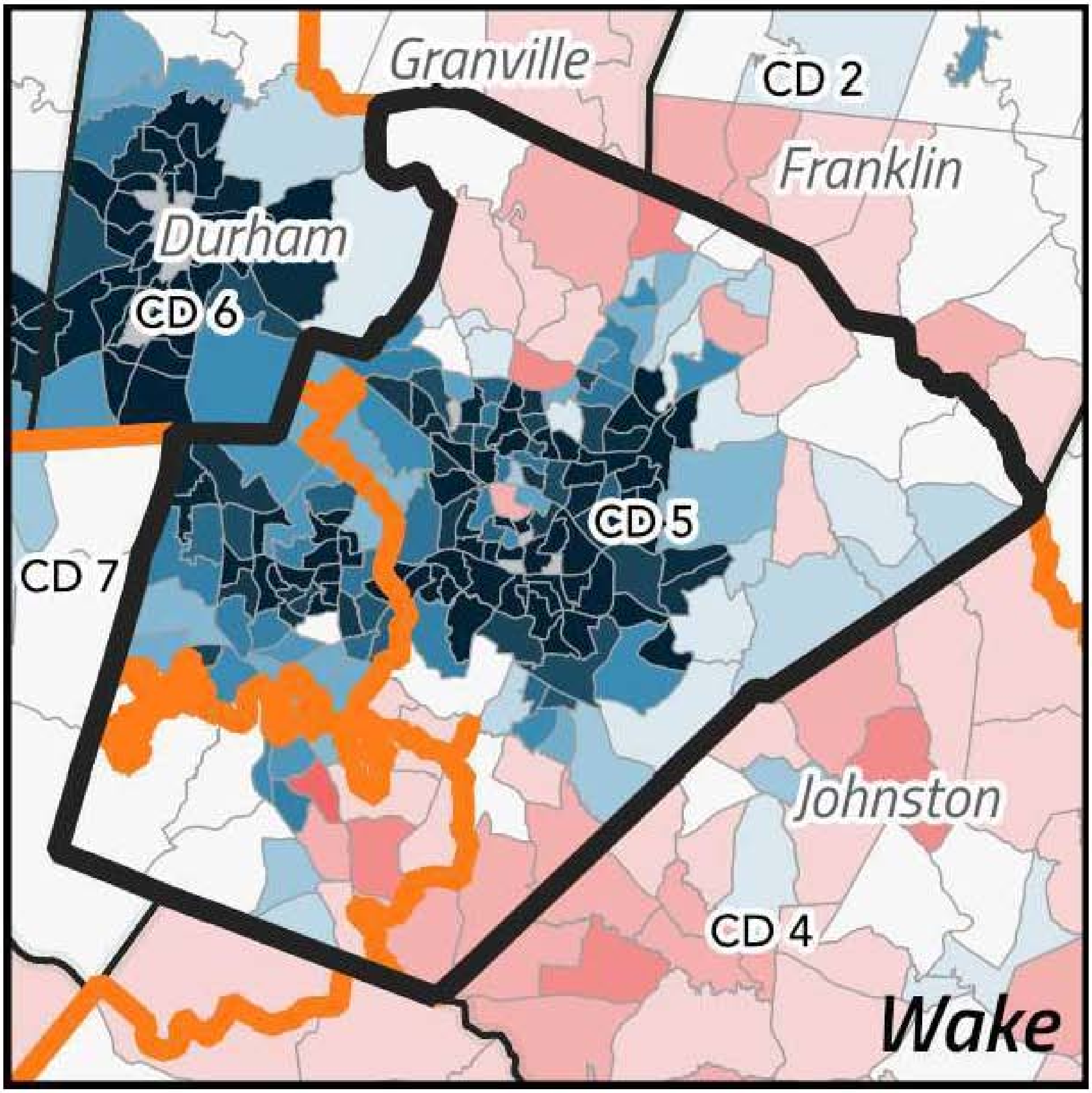
Map 1. Close-Up of Wake County VTD CCSC estimates across three districts



Map 2. Close-Up of Mecklenburg County VTD CCSC estimates across three districts



Map 3. Close-Up of Guilford County VTD CCSC estimates across three districts

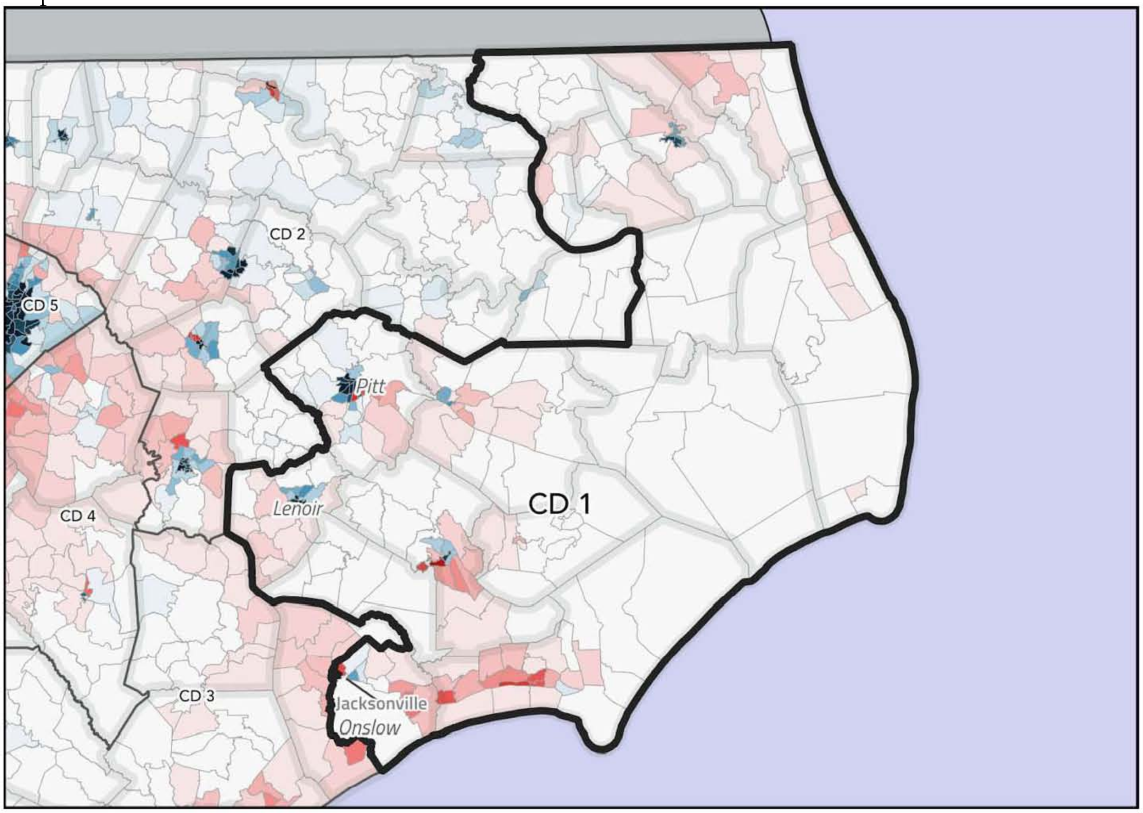


NC-1

The enacted 1st congressional district is mostly comprised of the current NC-3, but also includes part of the current NC-1. Most potential congressional districts in this part of North Carolina would likely lean towards the Republican Party, but to create extra advantage for the Republican Party in other parts of the map, the current map brings the Democratic-leaning areas of Pitt County into District 1, thus removing them from NC-2 and allowing NC-2 to become much more competitive for the Republican Party.

Despite moving the district line westward to include the Democratic portion of Pitt County, the enacted district remains virtually a guaranteed Republican victory with a PVI of R+10 (the current NC-3 is R+14). No Democratic member of Congress in the country represents a district that leans this far towards the Republican Party.

Map 4: VTD CCSC estimates for NC-1



NC-2

The enacted 2nd congressional district includes the core of the current NC-1, along with portions of the current NC-4 and NC-13 districts. The area that largely comprises the new 2nd district is currently represented by Democrat GK Butterfield and is considered a D +12 district by the Cook Political Report, making it a safe Democratic seat. Butterfield has the longest uninterrupted tenure of any member of North Carolina's congressional delegation. Under the enacted map, however, Butterfield's district changes radically, loses many of its Democratic strongholds (including the aforementioned loss of the Democratic areas in Pitt County) and now picks up enough Republican voters to move the district to "even," according to the Cook Political Report. For example, it picks up Caswell County, which does not include a single Democratic-leaning VTD, according to the 2020 Attorney General/Secretary of Labor "CCSC" composite in the map shown below. The 2020 Presidential vote share and composite score reinforce that this is an extremely competitive district. This is an enormous shift for what was formerly a Democratic stronghold.

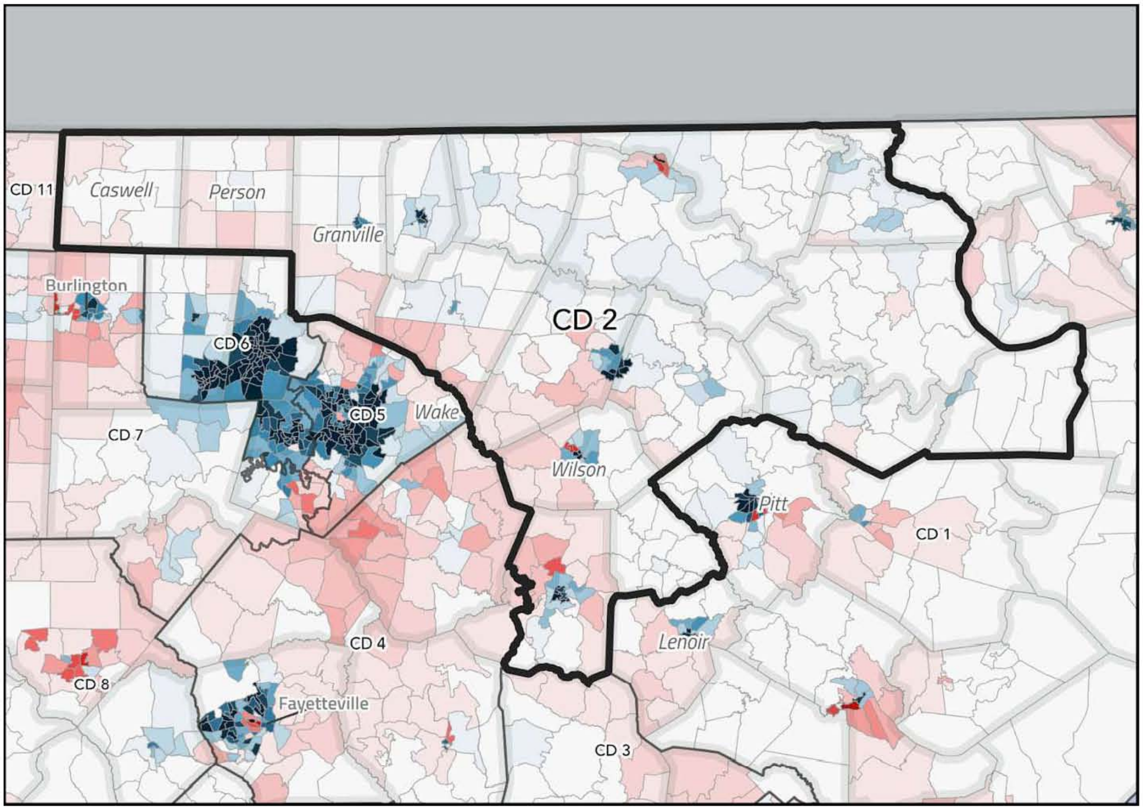
In addition to producing a clear partisan shift, the district is difficult to understand from a communities of interest perspective. The enacted district no longer includes any of Pitt County nor the campus of East Carolina University, which provided much of the economic engine of the district, and now stretches from the Albemarle Sound to the Raleigh-Durham-Chapel Hill metropolitan area, and eventually terminates in Caswell County, just northeast of Greensboro. Notably, Washington County and Caswell Counties have never been paired together in a congressional map in the history of North Carolina, further illustrating how little these counties have in common.

At a micro-level, the changes will split communities in important ways. For example, the cut-out in Wayne County, just west of Goldsboro, NC, splits the students and families in Westwood Elementary School (which is located in NC-2) into two separate districts (NC-2 and NC-4). At one point, NC-2 passes through a narrow cut-off between the Neuse River to Old Smithfield Road that is less than one-third of a mile wide.

After the maps were enacted, G.K. Butterfield announced that he will not seek re-election,[4] making the district even more likely to shift to the Republican Party. If the Republicans take over this seat, it will be the first time that this part of North Carolina has been represented by a Republican since the late 19th Century.

[4] Bryan Anderson, "Democrat Rep. Butterfield to Retire, New District is a Toss-Up." Associate Press News. https://apnews.com/article/elections-voting-north-carolina-voting-rights-redistricting-e221c0732f457b2273f54ef102424eca

Map 5. VTD CCSC estimates for NC-2



NC-3

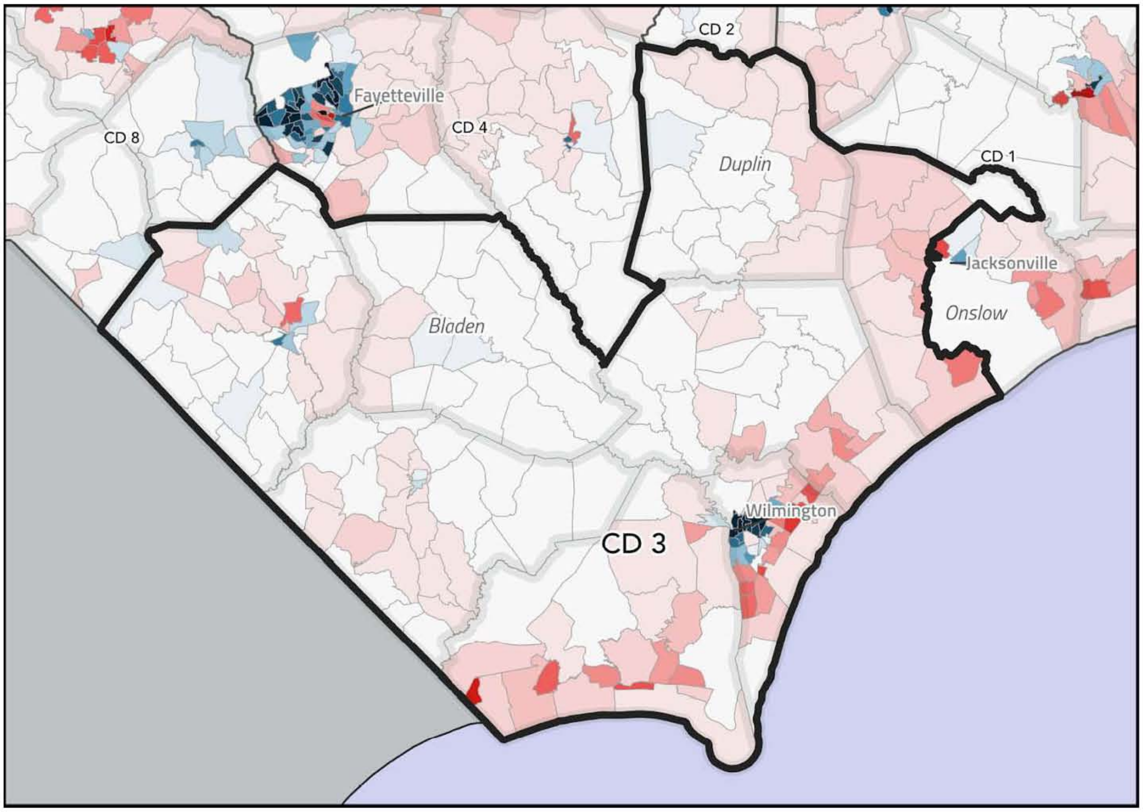
The enacted third congressional district is mostly carved out of the current 7th congressional district, but also includes portions of the 3rd, and 9th districts. The current 7th district is considered R+11 by the Cook Political Report.

This district once again denies North Carolina's Sandhills a consistent district of their own, despite repeated calls during the redistricting process,[5] and instead places portions of the Sandhills with the coastal enclave in and around Wilmington. The enacted map also creates an odd appendage in Onslow County that, as described in the section on NC-1, makes little sense from a communities of interest perspective.

The enacted district will almost certainly elect a Republican. It is slightly less Republican than the current NC-7 but still is considered R+10 district by the Cook Political Report, favored the Republicans by over 110,000 votes in the 2020 Attorney General/Secretary of Labor "CCSC" composite, and Donald Trump won the district with 58% of the vote. It is currently represented by Republican David Rouzer and is expected to remain in Republican hands.

[5] See, for example, Dreilinger, Danielle, "1 woman, 1 North Carolina address, 5 congressional districts. As North Carolina prepares to add a 14th congressional seat, Sandhills residents asked: why can't it be theirs? *Fayetteville Observer*. Nov 5, 2021.

Map 6. VTD CCSC estimates for NC-3



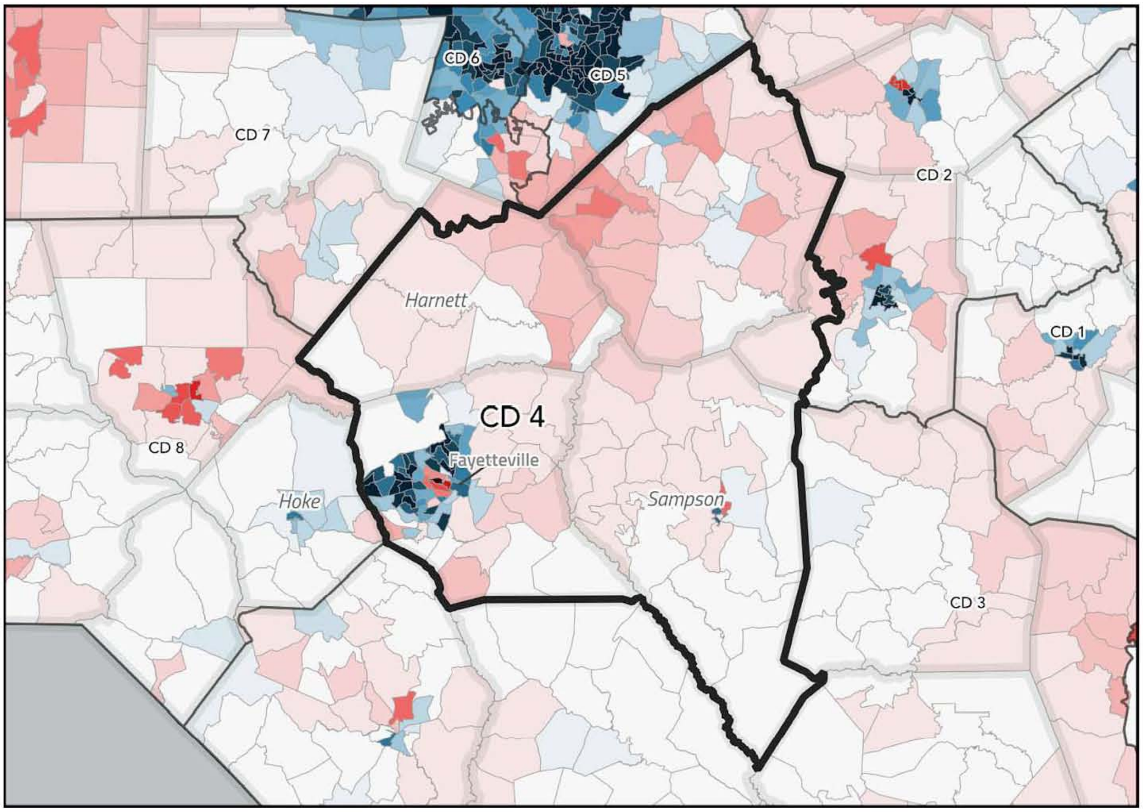
NC-4

The enacted 4th congressional district is carved out of a pocket of North Carolina that includes Johnston County and a portion of Harnett County, both of which are adjacent to Wake County, as well as portions of the Sandhills. The district is carved out of leftover portions from districts 7 and 8 which were R+11 and R+6, respectively. It combines the Democratic-leaning area of Fayetteville with those areas to create a Republican-leaning district.

In addition to the carve out of Republican-leaning VTDs in Wayne County referenced above, this district takes a series of confusing jogs in the Northwest part of Harnett County. A citizen driving Southwest on Cokesbury Road would begin in NC-7, then rest on the line between NC-7 and NC-3, then into NC-4, then back on the line between the two, just before Cokesbury turns into Kipling Road whereupon the driver would move back into NC-7.

This district, which has no incumbent, is considered an R+5 district by the Cook Political Report, gave 53% of its vote share to Donald Trump in 2020, and gave an advantage to Republicans of about 28,000 votes in the 2020 Attorney General/Secretary of Labor "CCSC" composite.

Map 7. VTD CCSC estimates for NC-4

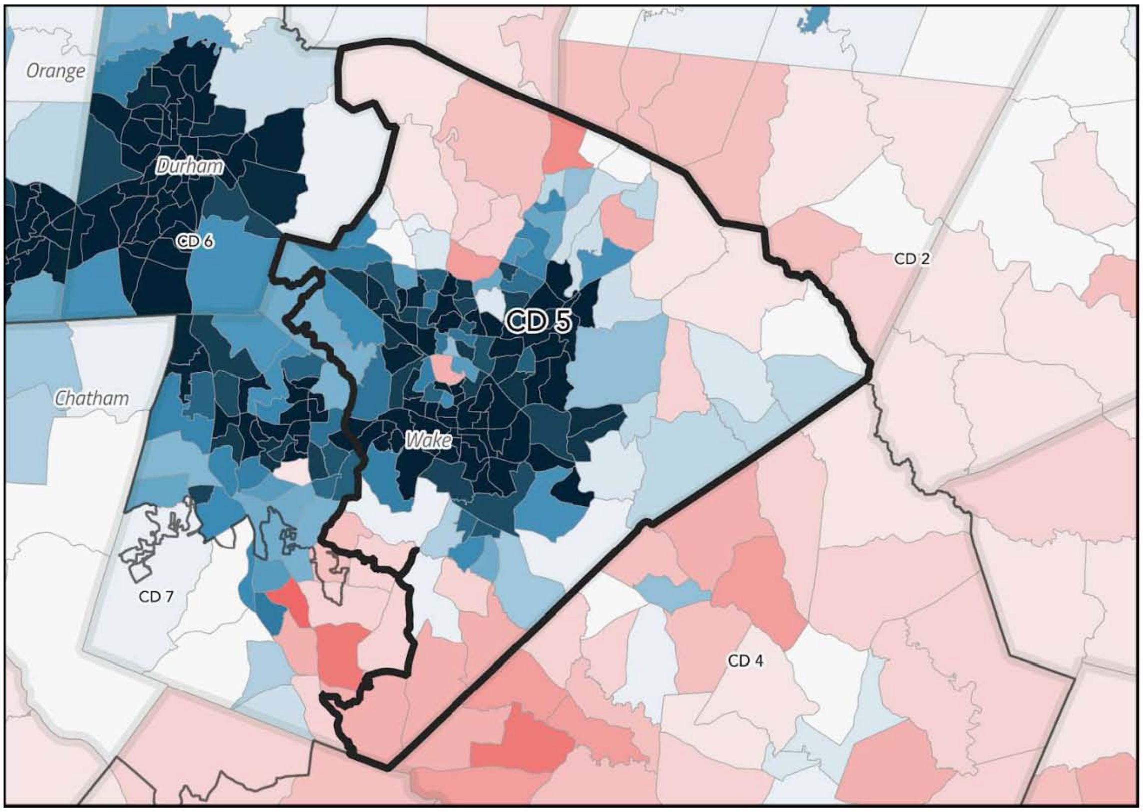


NC-5

The enacted map cracks Democrats in Wake County into three districts. Unlike NC-6 and NC-7, NC-5 is situated completely within Wake County and is made up of portions of current NC-2 and NC-4, districts that were D+12 and D+16. The effects of this are to pack Democratic voters into one district, thus increasing the probability that Republicans can win at least one of the adjacent districts. The enacted district is rated by the Cook Political Report as D+12, the CCSC shows a Democratic advantage of over 227,000 votes and Donald Trump won just 34% of the vote.

This map clearly splits communities of interest. In one particularly egregious example, a small vein runs up Fayetteville Road by McCuller's Crossroads in Fuquay-Varina, where the vein itself is in NC-7 and the areas on either side of it are in NC-5.

Map 8. VTD CCSC estimates for NC-5

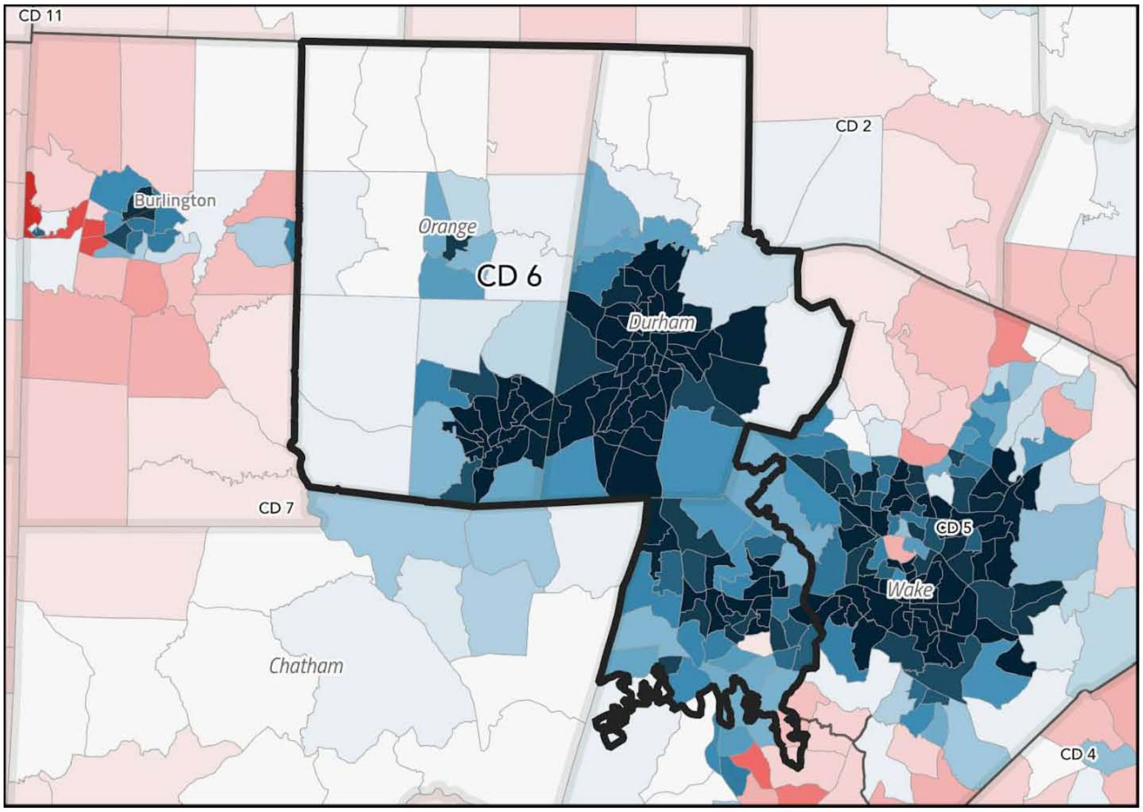


NC-6

The 6th district packs all of Orange, Durham counties and part of Wake County together into one overwhelmingly Democratic district, which is created out of portions of the current Districts 4 and 2 (previously D+16 and D+12, respectively). As the map below demonstrates, the district only includes four marginally Republican VTDs, according to the 2020 Attorney General/Secretary of Labor "CCSC" composite. Cook Political Report estimates this to be a D+22 district, Democrats had more than a 374,000 vote advantage in the CCSC and Donald Trump won only 25% of the vote in 2020. This district packs a greater proportion of Democratic voters in a single district than any district from the previous map. This district, like NC-5, includes Wake County, which is divided across three districts in the enacted map. The packing of Democrats in this district enables adjacent districts, in particular NC-7, to be drawn in ways that make it easier for Republican candidates to win.

The contours of this district border with NC-7 on the southern end splits communities of interest in almost comical ways. In one example, a person traveling south on New Hill Olive Chapel Road would, in a matter of a few miles, move from enacted NC-7 to the line between NC-6 and -7, back into NC-7, through NC-6, back into NC-7, back to the border between the two, back into NC-7, back to the border between the two, then back into NC-7. The contours of these lines are confusing to voters, and, as the map demonstrates, serve to pack as many Democratic precincts as possible into NC-6.

Map 9. VTD CCSC estimates for NC-6

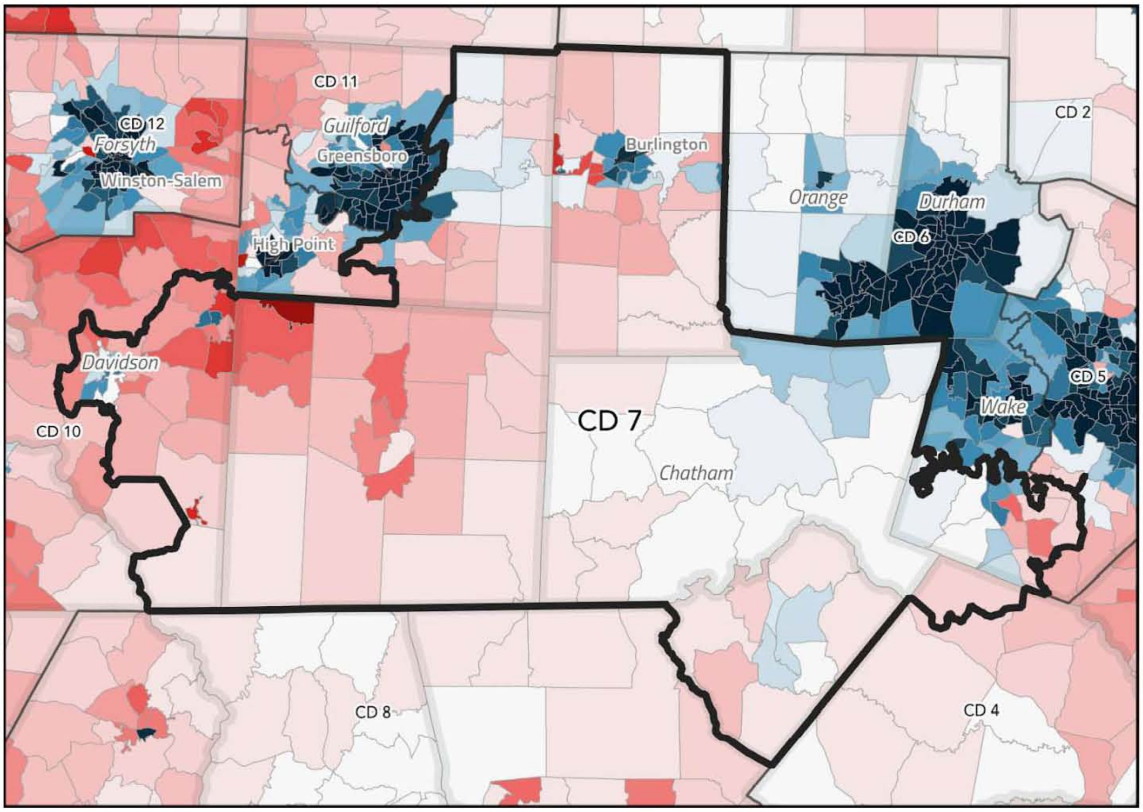


NC-7

The enacted 7th district includes the Republican-leaning Randolph, Alamance, Chatham and Lee Counties as well as portions of Guilford, Wake, and Davidson Counties. It is carved out of districts 13, 6, 4 and 2 from the current map. This district as it is drawn splits both Guilford and Wake Counties (each of which of is divided three times in the map as a whole). Despite including portions of two of the most Democratic counties in North Carolina, the district studiously avoids the Democratic-leaning areas of both counties. The eastern portion of the district in Wake County, near Apex, takes the unusual and confusing contours described in the description of NC-6 above.

The enacted NC-7 is considered R + 11 by the Cook Political Report, it gave Republicans a 115,682 vote advantage in the CCSC, and Donald Trump won 57% of the vote in this district. A Democratic candidate has virtually no chance of victory in the enacted 7th.

Map 10: VTD CCSC estimates for NC-7

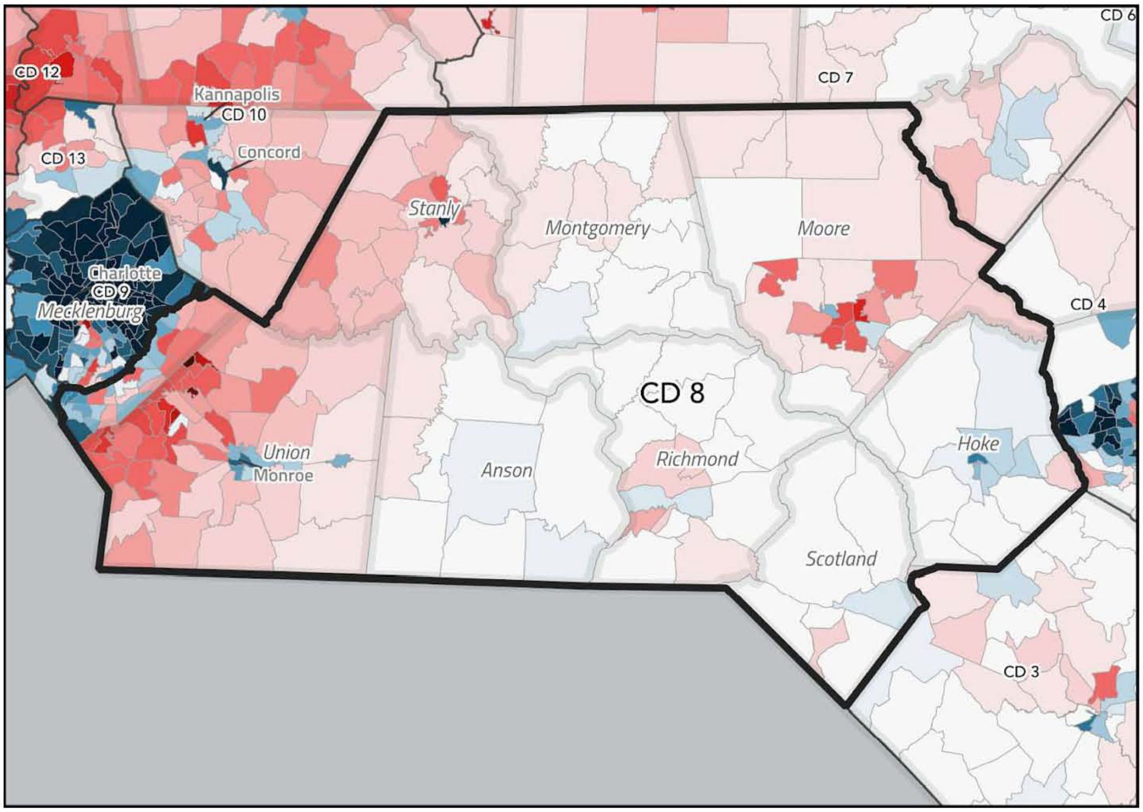


NC-8

The 8th congressional district stretches from the Sandhills into Mecklenburg County and includes portions of the current 9th, 12th, and 8th districts. The core of the district comes from NC-9, currently R+6. The enacted NC-8 includes the entirety of Scotland, Hoke, Moore, Montgomery, Anson, Union, and Stanley counties as well as the southern and eastern edge of Mecklenburg County. Although it includes portions of Mecklenburg County, one of the most Democratic-leaning areas in the state, as well as Democratic municipalities of Union, Anson, and Hoke, the 8th district is unlikely to elect a Democrat under any reasonable scenario. The enacted map stops just shy of the some of the darkest blue VTDs in Mecklenburg County.

The Cook Political Report calls the enacted NC-8 an R+11 district, the CCSC shows that the Republican candidate garnered over 115,000 more votes than the Democratic candidates for the two closest Council of State races, and Donald Trump won approximately 57% of the vote in the 2020 election.

Map 11: VTD CCSC estimates for NC-8



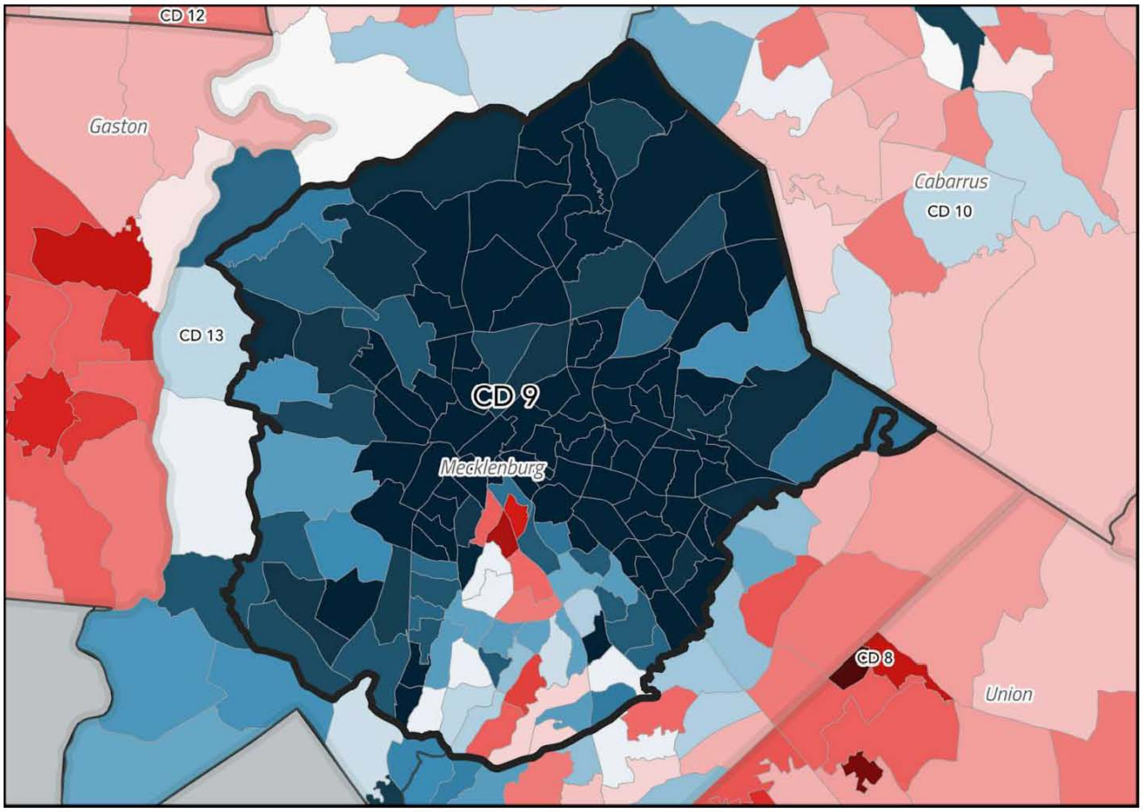
NC-9

The core of the enacted 9th congressional district come from NC-12, but it also includes portions of the current NC-9. The result is the most packed district in the enacted map. The Cook Political Report rates the enacted NC-9 as a D+23 district, meaning that it leans more heavily towards the Democratic Party than any district in the last map. Donald Trump won just 25% of the vote in this district in the 2020 Presidential election and the CCSC indicates that the Democrats won over 325,000 more votes than the Republicans in the two closest Council of State races in 2020.

As with all examples of packing, the key to understanding this district is its effects on the surrounding districts. By ensuing that the Democratic candidate in NC-9 wins by an overwhelming margin, Republican voters will be more efficiently distributed across other districts, where they can affect the outcome. This ensures that neighboring district 8, for example, will not be competitive. This also has the effect of ensuring that Republican voters in NC-9 have no chance of securing representation from a member of their own party.

The geographic contortions of this district are most apparent on its western edge, where a mere 8 miles separates the western edge of district 9 and the Mecklenburg County line.

Map 12. VTD CCSC estimates for NC-9

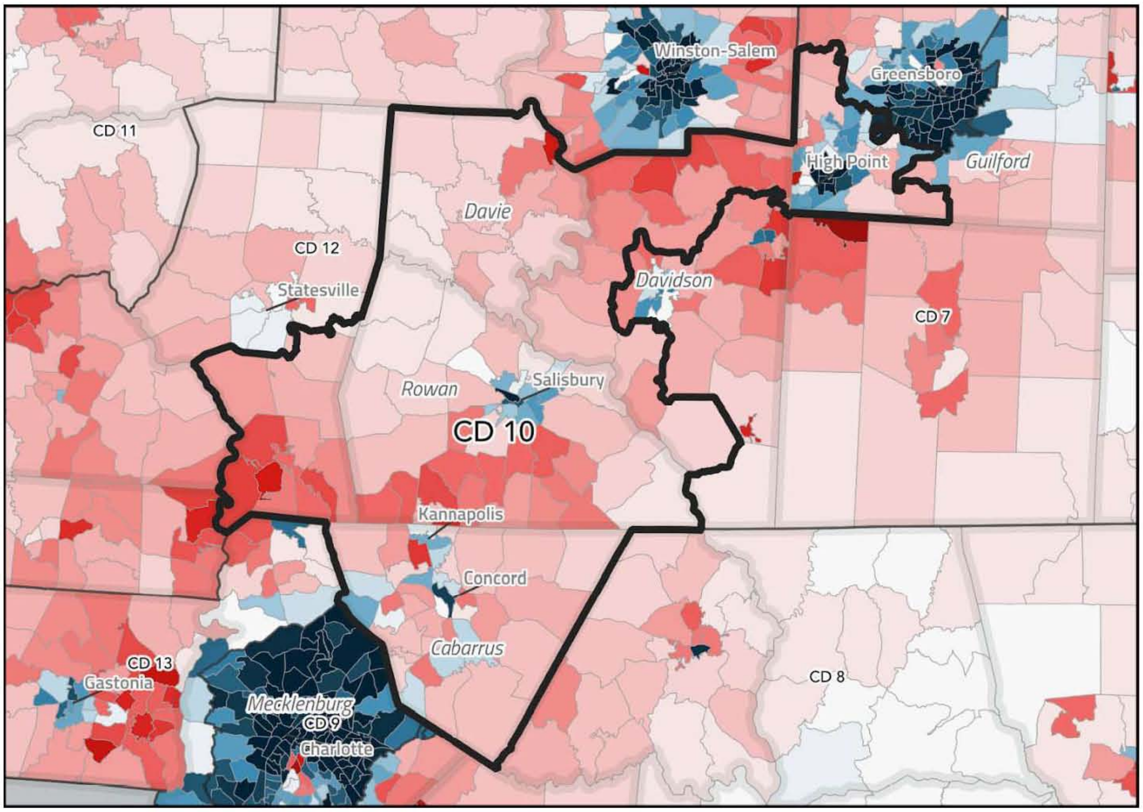


NC-10

The enacted NC-10 includes all of Rowan, Cabarrus and David County and parts of Iredell, Davidson and Guilford Counties. It is drawn out of portions of the current 10th, 9th, 6th, and 13th districts. Despite the inclusion of carefully curated portions of Democratic Guilford County, this district is a safe Republican seat and effectively removes any possibility that Democratic voters in High Point, Salisbury, Kannapolis, Concord, and Cabarrus can elect a member of their own political party. The Cook Political Report rates this district as R+14, the CCSC indicates that Republicans won more than 156,000 additional votes in the two key council of state races, and Donald Trump won over 60% of the Presidential vote in the enacted district.

The enacted NC-10 includes High Point, while NC-11 includes most of Greensboro and NC-12 contains Winston-Salem, meaning that the enacted map splits all three points of North Carolina's Piedmont Triad into separate congressional districts that favor Republicans. In the current map, this community of interest is together in NC-6, represented by Democrat Kathy Manning.

Map 13: VTD CCSC estimates for NC-10



NC-11

The enacted 11th congressional district is carved out of the 5th, 10th, and 6th districts. This map places a portion of Guilford County, including the City of Greensboro in a district with Rockingham, Stokes, Surrey, Alleghany, Ashe, Wilkes, Caldwell, and Alexander counties as well as a tiny boot-shaped sliver of Watauga County.

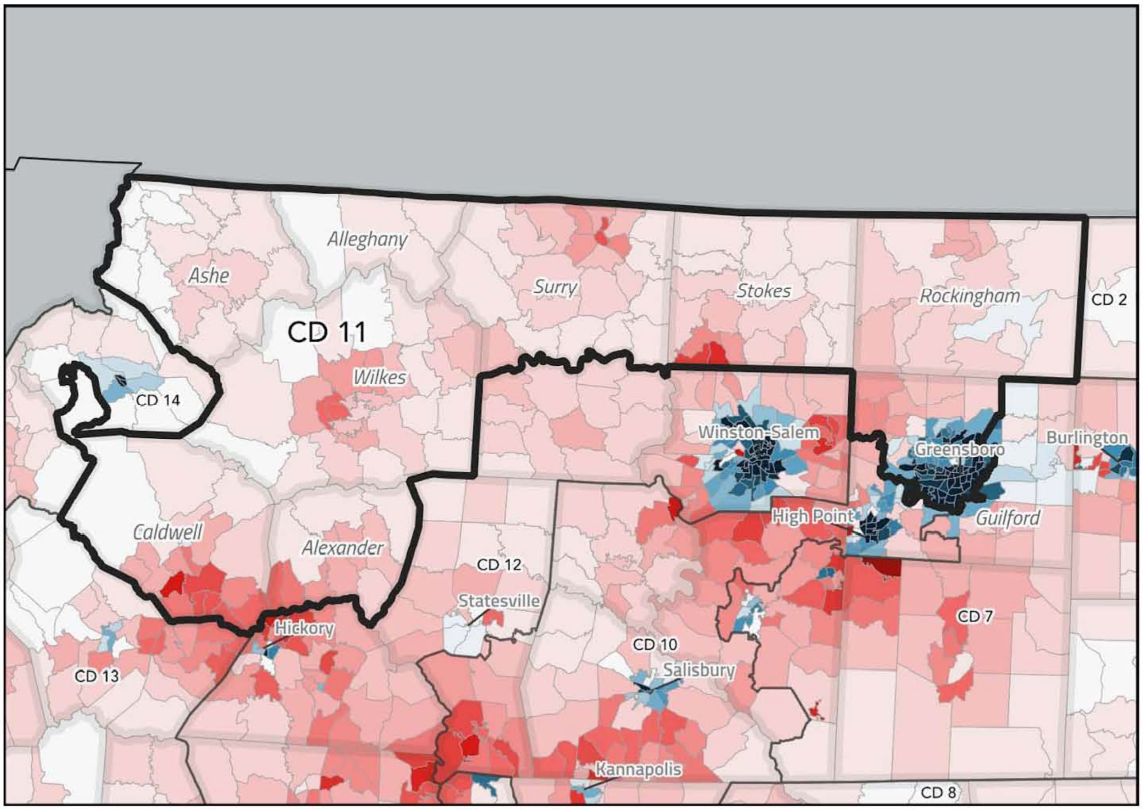
As discussed elsewhere, the enacted map splits Guilford County across three districts (the 10th, 11th, and 7th) and puts all three points of the Piedmont triad in separate districts. By placing most of Greensboro in this overwhelmingly Republican district, this ensures that the City of Greensboro, among the most Democratic and racially diverse cities in the state of North Carolina, will not be represented by a Democrat.

The enacted district is rated by Cook as R+9, 57% of the district voted for Donald Trump in the 2020 election, and Republicans held a 94,000 vote lead in the two closest Council of State elections. No Democrat in the current Congress represents a district that leans this heavily Republican.

It is difficult to imagine any sense in which this district has shared interests. Geographically, it spans radically different parts of the state. Greensboro is firmly in the Piedmont, resting at under 900 feet elevation. Watauga and Ashe counties, by comparison, reside in the high country, with elevations that consistently run above 5500 feet. The corners of the district have different area codes, are served by different media markets, and share virtually no characteristics in common other than the fact that they are both within North Carolina. In the history of North Carolina, Caldwell and Rockingham Counties have never shared a congressional representative.

In addition to its geographic span, the enacted district stands out for its double-bunking of Republican Virginia Foxx and Democrat Kathy Manning. To shoe-horn Virginia Foxx into the new district, the mapmakers carved out a tiny sliver of Watauga County to allow her house to fall into the redrawn district. This passage is so narrow, in fact, that is connected by a stretch of land that is roughly 3 miles wide and requires a traverse of the Daniel Boone Scout Trail.

Map 14: VTD CCSC estimates for NC-11

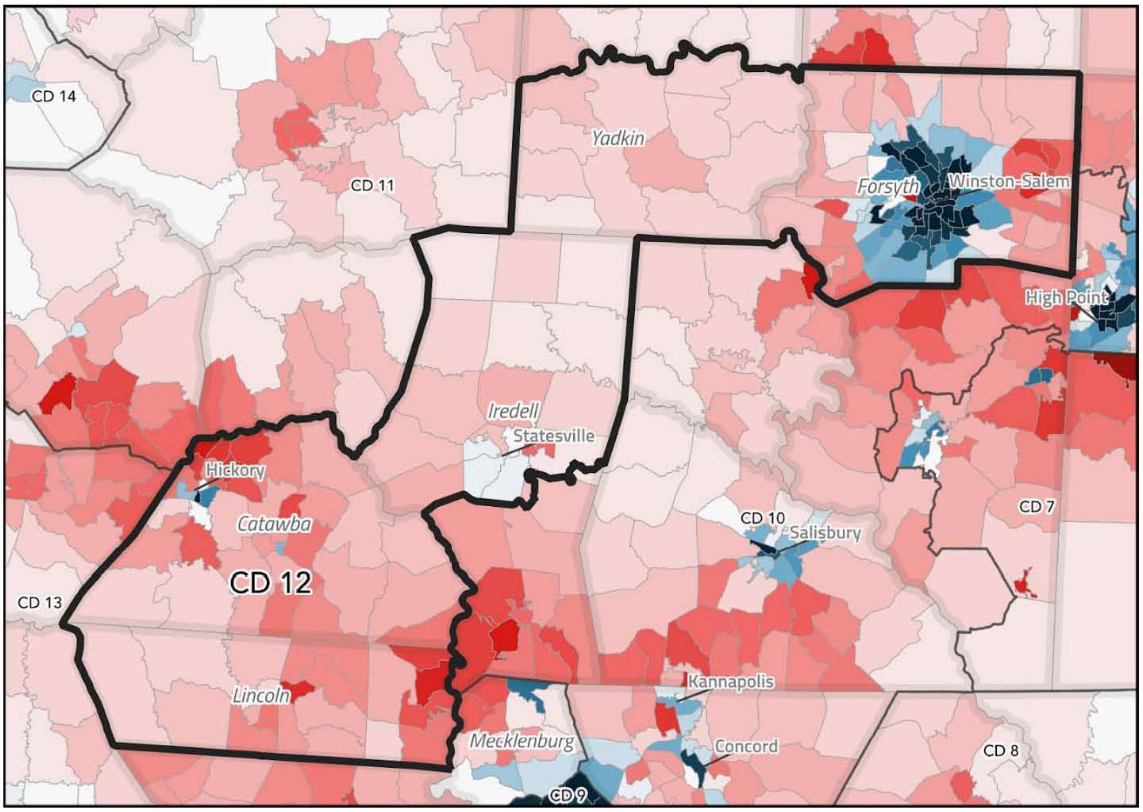


NC-12

The 12th congressional district stretches from Lincoln County at the southwestern corner through Catawba, the Northern part of Iredell, Yadkin, and Forsyth Counties. As the map below makes clear, by including Winston-Salem with this overwhelmingly red swath of geography and walling it off from Democratic voters in High Point, the enacted map ensures that Republican member of Congress Patrick McHenry, who lives at the southeast corner of this district, will maintain his seat and the Democratic voters in Winston-Salem will have virtually no chance to elect a member of their own party.

The Cook Political Report rates this district as R+9, Republicans had over a 100,000 vote margin in the two closest Council of State races, and Donald Trump won over 56% of the vote in this district.

Map 15: VTD CCSC estimates for NC-12



NC-13

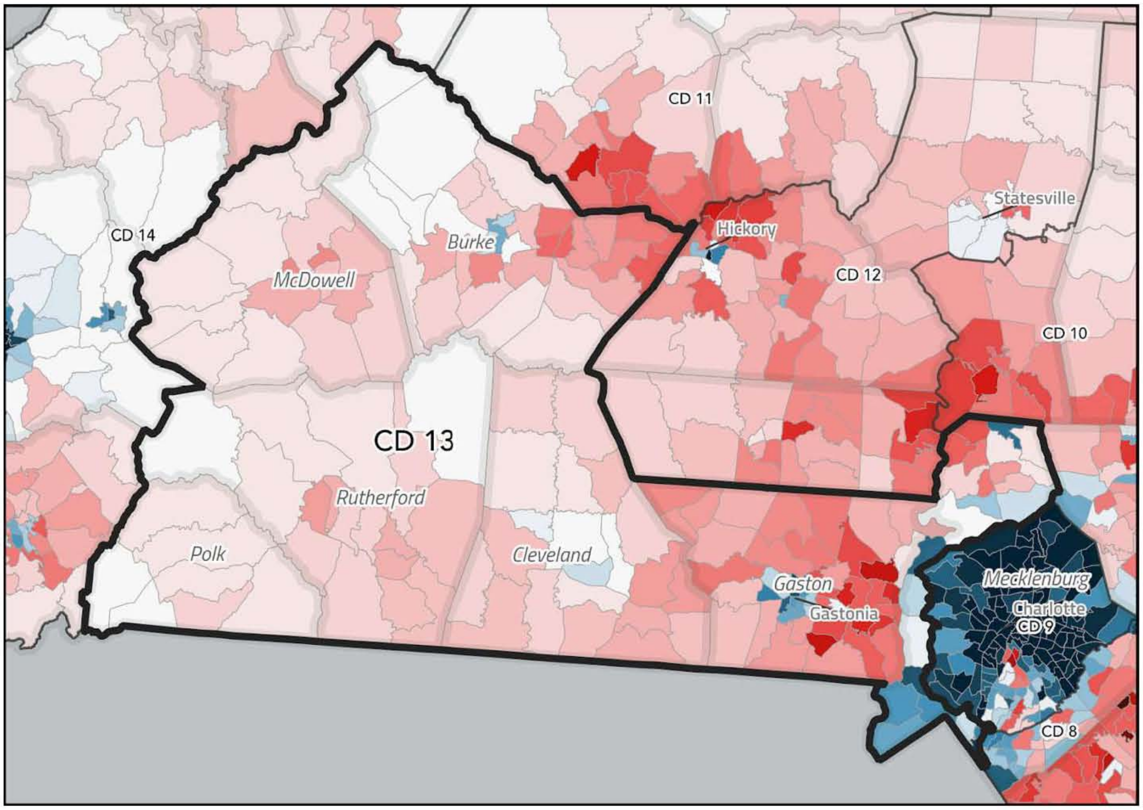
The 13th congressional district is carved out of portions of the old 11th, 5th, and 12th, and 10th districts. As the map that follows demonstrates, the district includes Polk, Rutherford, McDowell, Burke, Cleveland, Gaston, and part of Mecklenburg County.

The district was generally understood to be created for Republican Speaker of the House Tim Moore who lives in Cleveland County—the *Charlotte Observer*'s editorial board even referred to it as "Moore's designer district."[6] Republican Madison Cawthorn recently announced that he will run in the 13th, and Moore soon noted that he would stay in the General Assembly. While the specifics of the candidates have changed, the fact that this is a Republican district that will elected a Republican candidate has not. This district was rated by the Cook Political Report as R+13, has a CCSC of R+150,187 votes, and gave 60% of its votes to Donald Trump in 2020.

As mentioned in the discussion of NC-9, the narrow passageway that is necessary to squeeze NC-13 into Mecklenburg County only consists of a few miles at one point--stretching from a Food Lion to the Mecklenburg County line. The enacted district also creates unusual pairings of counties that share little in common. For example, Polk and Mecklenburg Counties have never resided in the same district.

[6] https://www.charlotteobserver.com/opinion/article255769626.html

Map 16. VTD CCSC estimates for NC-13

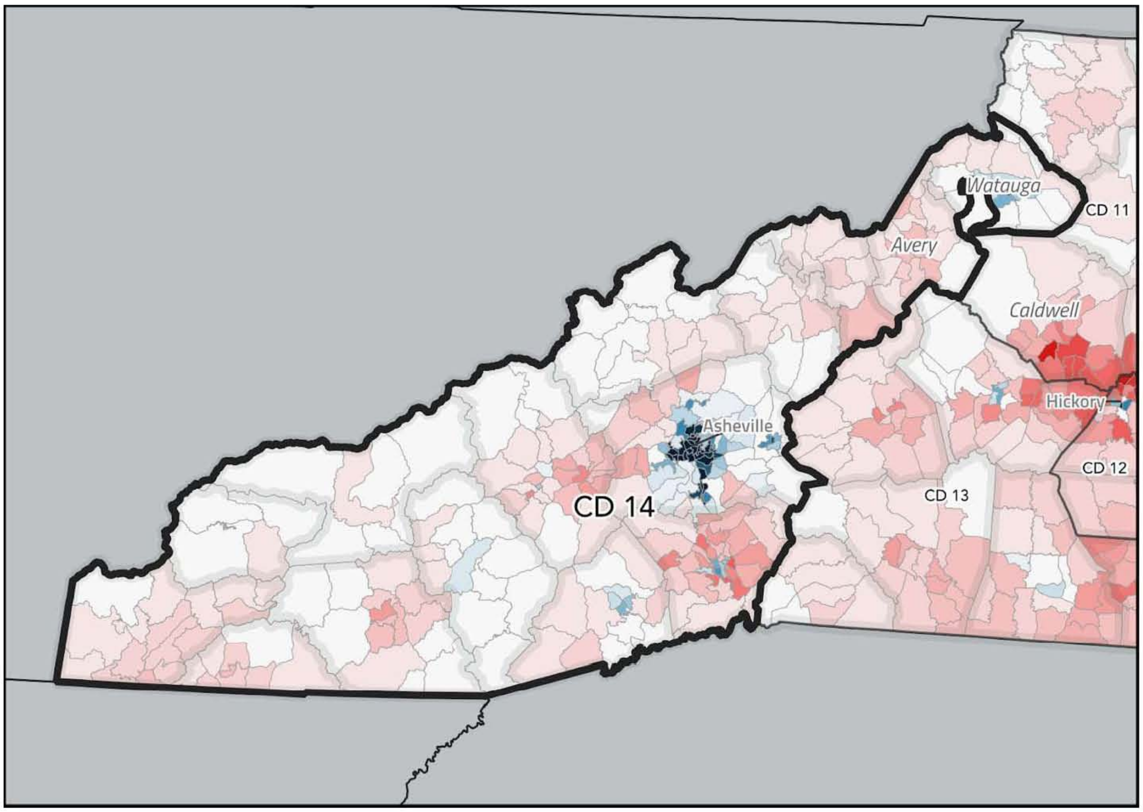


NC-14

The enacted 14th district includes most of the 11th congressional district and includes part of Watauga County, which previously sat in the 5th congressional district. The former 11th congressional district also lost the Republican strongholds of Polk and McDowell counties, as well as part of Rutherford County. These changes shifted the district slightly in the Democratic direction (from a PVI of R+9 to R+7), although not enough to give a Democratic candidate a reasonable chance of victory. No Democrat in Congress represents a district that has a PVI score that leans this heavily towards the Republican Party. As a result, the 14th is expected to stay squarely in Republican hands.

Geographically, the 14th is a sprawling district that includes three media markets. Traversing the district from its western end in Murphy to its northeastern corner in Stony Fork would take approximately four hours. Perhaps because of the geographic incompatibility, Watauga has not been in a district with the western end of the state since 1871—before Graham and Swain Counties were even in existence. Adequately representing this massive swath of geography would be difficult for any member of Congress—Republican or Democrat.

Map 17. VTD CCSC estimates for NC-14



Conclusion

After analyzing the characteristics of the map as a whole as well as the characteristics of each district in isolation, it is clear that the enacted map will increase the number of Republican members of Congress and decrease the number of Democratic members of Congress in North Carolina's congressional delegation. Democratic voters in the vast majority of the districts will have no chance at representation from a member of their own party and Republican voters in the districts that pack Democrats will have no chance of representation from a member of their own party. This is not a result of natural packing, or geographic clustering, but rather because the congressional district lines shifted in ways that, taken together, benefit the Republican Party. Not only does the enacted map create a substantial partisan advantage for which there is no apparent explanation other than gerrymandering, but it unnecessarily splits communities of interest and will alters representational linkages in ways that, in some cases, have never been seen in North Carolina's history.

Christopher A Cooper

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Christopher A. Cooper

Expert Report on North Carolina's Enacted Congressional and General Assembly Districts

Christopher A. Cooper

December 23, 2021

Introduction

My name is Christopher A. Cooper. I have been asked to provide an analysis of the partisan characteristics of North Carolina's congressional and General Assembly maps, enacted on November 4, 2021. I am conducting this analysis as a private citizen and am not speaking for my employer, nor am I conducting this work on university time, or using university resources.

I am the Robert Lee Madison Distinguished Professor of Political Science and Public Affairs at Western Carolina University, where I have been a tenured or tenure-track professor since 2002. I hold a PhD and MA in Political Science from the University of Tennessee, Knoxville and a BA in Political Science and Sociology from Winthrop University. My academic research focuses on state politics and policy, elections, and southern politics—with particular application to North Carolina. To date, I have published over 50 academic journal articles and book chapters, co-edited one book focused on North Carolina (*The New Politics of The Old North State*), and co-authored one book related to politics in the South, including North Carolina (both books with the University of North Carolina Press). I teach courses on state and local politics, political parties, campaigns, and elections, southern politics, research methods, and election administration. In 2013, I was named the North Carolina Professor of the Year by the Carnegie Foundation for the Advancement of Teaching and I have received Western Carolina University's highest honors in teaching (Board of Governors Teaching Award), and scholarship (University Scholar). My current curriculum vitae is attached as Attachment A.

Much of my academic and applied research relates to North Carolina politics and policy and I am a frequent source for news media seeking comments about politics in the Old North State. My quotes have appeared in national and international outlets including *The New York Times*, *The Washington Post*, Politico, BBC, NPR's *All Things Considered*, and *The New Yorker*, as well as in North Carolina-based outlets including *The News and Observer*, *The Charlotte Observer*, *Asheville-Citizen Times*, *Carolina Journal*, *Spectrum News*, and NPR affiliates in Chapel Hill, Charlotte, and Asheville. I have written over 100 op-eds on North Carolina, southern and national elections and politics, including pieces in *The Atlanta Journal-Constitution*, NBC.com, *The News and Observer*, *The Charlotte Observer*, and *Asheville Citizen-Times*, and I regularly give talks about North Carolina politics, North Carolina elections, and the redistricting process to groups throughout the state. I previously served as an expert witness in *Common Cause v. Lewis*, 18-CVS-014001 (N.C. Super. Ct. Sep. 3, 2019).

I am being compensated at a rate of $300 per hour.

North Carolina is a state defined by competitive two-party politics in terms of its citizens and in its elections for statewide elective offices. Its congressional and state legislative delegations, by contrast, have defied this evidence of competitiveness and moderation and have leaned heavily towards the party in control of the General Assembly, despite the fact that Democrats and Republicans garner similar numbers of statewide votes.

This difference cannot be explained away as a result of where Democrats and Republicans happen to live. As Stanford political geographer Jonathan Rodden demonstrated, North Carolina does not show as much evidence of "natural clustering" as other states. "Due to the presence of a sprawling knowledge-economy corridor, a series of smaller automobile cities with relative low partisan gradients, and the distribution of rural African Americans, Democrats are relatively efficiently distributed in North Carolina at the scale of congressional districts."[1] Looking across all 50 states, Political Scientists Alex Keena, Michael Latner, Anthony J. McGann, and Charles Anthony Smith come to a similar conclusion at the state legislative level: "It is clear that geographical considerations such as the urban concentration of Democrats cannot explain away partisan gerrymandering. There is strong evidence that it is indeed possible to draw unbiased (or almost unbiased) districting plans, even in states with large and densely clustered city dwellers."[2]

As I demonstrate in the analysis that follows, the available evidence indicates that this gap in representation is due to partisan gerrymandering, drawing lines to benefit one party at the expense of the other. While a small deviation from established political patterns is not necessarily evidence of gerrymandering, the differences observed in North Carolina's political outcomes are large and sustained.

Gerrymandering is generally accepted as a threat to democracy in North Carolina and across the nation. This statement is true regardless of partisanship. For example, a 2018 Elon Poll found that just 10% of registered voters in North Carolina believe the current redistricting system is "mostly fair."[3] A more recent poll found that 72% of North Carolinians believe gerrymandering is "a very serious problem" or "a somewhat serious problem" while only 6% believe it is "not a problem." The same poll (which, it should be noted, includes question wording that references both Democratic and Republican gerrymandering) found that 74% of North Carolinians "support efforts by the courts to ensure maps are fair and constitutional."[4] Yet another recent poll found that 89% of North Carolina voters "oppose drawing voting districts to help one political party or certain politicians win an election."[5] A recent op-ed in *The News and Observer* by Republican Carter Wrenn and Democrat Gary Pearce illustrates bi-partisan agreement on the evils of gerrymandering in clear terms. They explain, "We agree that gerrymandering is a major problem that undermines the foundations of our democracy. We agree that districts shouldn't be drawn to help one political party,

[1] Rodden, Jonathan, *Why Cities Lose* (New York: Basic Books, 2019), 173.
[2] Keena, Alex, Michael Latner Anthony J. McGann, and Charles Anthony Smith, *Gerrymandering in the States: Partisanship, Race and the Transformation of American Federalism* (New York: Cambridge University Press, 2021), 86.
[3] Elon Poll, "The State of Political Knowledge in North Carolina," February 12-15, 2018, *available at* https://www.elon.edu/u/elon-poll/wp-content/uploads/sites/819/2019/02/Elon-Poll-Report-022318.pdf.
[4] Public Policy Polling, "North Carolina Survey Results," December 6-7, 2021, *available at* https://progressncaction.org/wp-content/uploads/2021/12/NorthCarolinaResults.pdf.
[5] RepresentUs, "North Carolina Polling: Voters See Gerrymandering as a Major Problem, Want Reform," August 9, 2021, *available at* https://represent.us/wp-content/uploads/2021/08/Rep-US-Polling-Memo-North-Carolina-0821.pdf.

no more than college basketball games should be rigged to favor one team."[6] The preference for fair maps—those not gerrymandered to achieve a partisan advantage—is not a partisan one.

Summary of Key Findings

- North Carolina is, by virtually any measure, a "purple state" with healthy two-party competition at the statewide level. The North Carolina Governor is a Democrat, while the U.S. Senators are Republicans. There are more registered Democrats than Republicans in the state, and in the 2020 election, the two-party vote share difference between Donald Trump and Joe Biden was the smallest of any state that Trump won.

- North Carolina has a history of gerrymandering for partisan gain.[7] North Carolina's maps since 2011, in particular, have demonstrated clear partisan bias[8] that has implications for democracy. Immediately after the 2011 redistricting cycle, North Carolina's democracy weakened considerably, according to one scholar, moving from a democracy score that placed the Old North State roughly in the middle of the pack to one near the bottom of the country.[9]

- As a result of the 2020 census, North Carolina earned an additional congressional seat because of population growth that occurred mostly in urban areas, which tend to favor Democrats: according to an analysis of U.S. census data by *The News and Observer*, more than 78% of North Carolina's population growth over the last decade came from the Triangle area and the Charlotte metro area.[10] Despite that fact, the number of anticipated Democratic seats actually *decreases* in the current congressional map, as compared to the last map enacted in late 2019 and used in the 2020 elections. The last map produced 5 Democratic wins and 8 Republican wins; this map is expected to produce 3 Democratic wins, 10 Republican wins and 1 competitive seat.

- In the congressional map, Democratic strongholds Mecklenburg, Guilford, and Wake counties are each divided across three districts, despite the fact that there is no population-based reason to divide them this many times. In the previous congressional map, Mecklenburg was divided into two districts, Wake into two districts, and Guilford fell completely in one district. The strategic splits in the enacted map ensure that large numbers of voters will have no chance of being represented by a member of their own party. These splits will also lead to voter confusion and fractured representational linkages.

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[6] Gary Pearce and Carter Wrenn, "We're usually on opposite sides of political battles. But we agree on NC voting maps." *The News and Observer*, October 21, 2021, available at https://www.newsobserver.com/opinion/article255145572.html.
[7] Bitzer, J. Michael, *Redistricting and Gerrymandering in North Carolina: Battlelines in the Tar Heel State* (Palgrave Macmillan, 2021).
[8] *See, e.g.*, Keena, Alex, Michael Latner Anthony J. McGann, and Charles Anthony Smith, *Gerrymandering in the States: Partisanship, Race and the Transformation of American Federalism* (New York: Cambridge University Press, 2021), 86.
[9] Grumbach, Jacob M. "Laboratories of Democratic Backsliding." (Unpublished Manuscript: University of Washington, 2021), *available at* https://sites.google.com/view/jakegrumbach/working-papers. Insights from this manuscript are forthcoming in *Laboratories Against Democracy*, Princeton University Press (https://press.princeton.edu/books/hardcover/9780691218458/laboratories-against-democracy).
[10] David Raynor, Tyler Dukes, and Gavin Off, "From population to diversity, see for yourself how NC changed over 10 years." *The News and Observer*, October 18, 2021, *available at* https://www.newsobserver.com/news/local/article253546964.html.

- The enacted congressional map produces geographic contortions that combine counties in ways that, in some circumstances, have never existed before.

- The double-bunking that occurs in the enacted congressional map advantages the Republican Party. A Republican (Virginia Foxx) and a Democrat (Kathy Manning) are both drawn into in an overwhelmingly Republican district (congressional district 11), thus virtually guaranteeing that the Democrat (Manning) will lose her seat. There are no cases where two Republican incumbents seeking re-election are double-bunked. The map also produces at least one district with no incumbents, but that district (congressional district 4) overwhelmingly favors the Republican Party.

- Despite the application of the *Stephenson v. Bartlett* county clustering rule, the mapmakers had considerable leeway in drawing the vast majority of North Carolina House and Senate districts. The enacted district lines "pack" Democratic leaning voters into a small number of districts, thus producing a few Democratic districts with large electoral margins. The district lines "crack" the remaining Democratic voters across the remaining districts, so that Democratic voters cannot comprise a majority of any of those districts. Conversely, the maps distribute Republican VTDs more efficiently, to translate those Republican votes into a greater number of anticipated seats. These practices ultimately result in large Republican seat advantages in the General Assembly—advantages that far outweigh the Republicans' share of the aggregate vote between the two parties. These maps are likely to lead to a General Assembly that will not represent the will of the people of the state.

- Neutral, third-party observers have been uniform in their negative assessment of the enacted maps. For example, The Princeton Gerrymandering Project assessed a grade of "F" in partisan fairness and "C" in competitiveness for all three maps. Dave's Redistricting App (DRA) assesses the congressional map as "very bad" in proportionality and "bad" in terms of competitiveness. While the House and Senate maps fare slightly better in terms of proportionality according to DRA, DRA assesses both maps to be "bad" in terms of competitiveness. Both The Princeton Gerrymandering Project and DRA are nonpartisan and have given similar grades to Democratic gerrymanders in other states.

North Carolina's Partisan Competitiveness

North Carolina has long been known for political moderation and competitive two-party politics. In 1960, Political Scientist V.O. Key noted North Carolina's distinctiveness from the rest of the South, owing to its comparatively competitive two-party politics.[11] North Carolina journalist Rob Christensen and Wake Forest University Political Scientist Jack Fleer noted more recently that the state enjoys "two strong and competitive parties."[12] Work by contemporary observers reinforces the notion that North Carolina is a competitive two-party state where statewide offices are winnable for either major political party.[13]

Two-Party Competition in Election Results

As I have written previously, one way to gauge the state's relative moderation and two-party competitiveness is simply to look at electoral results from races where gerrymandering is not possible—races where people are elected at the state level, rather than by districts that are subject to gerrymandering. The most prominent example of such an election, of course, is the U.S. presidential election.

The figure below plots North Carolina's presidential election results as ranked alongside those from other states, ranging from the state where the Democratic candidate received the largest vote share (1) to the state where the Democratic candidate receive the smallest vote share (50). Here, we see that North Carolina is best described as a competitive two-party state that sits roughly in the middle of the country in terms of partisan voting patterns. In 2000, North Carolina had the 32nd highest vote share for the Democratic candidate for president. In 2004, Democratic presidential candidate John Kerry received his 30th highest vote share in North Carolina. In 2008, then-presidential candidate Barack Obama's vote share in North Carlina was 28th highest in the country. In 2012, incumbent President Obama's vote share in North Carolina was 27th highest in the country. In 2016, North Carolina had the 26th highest Democratic vote share in the country and in 2020, it was the 27th highest.

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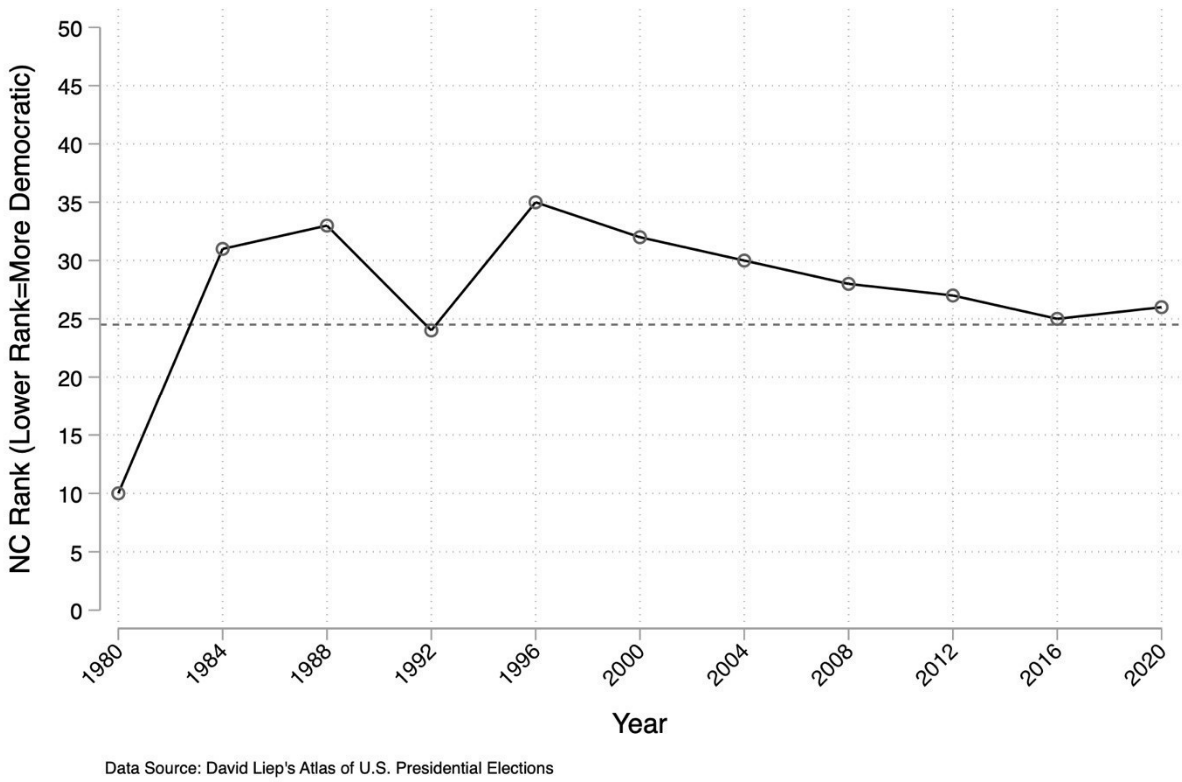
[11] *See* Key, V.O., Jr., *Southern Politics in State and Nation* (Knoxville: University of Tennessee Press, 1960).

[12] Christensen, Rob, and Jack D. Fleer, "North Carolina: Between Helms and Hunt No Majority Emerges," in Alexander P. Lamis, ed. *Southern Politics in the 1990s* (Baton Rouge: Louisiana State University Press, 1999), 106.

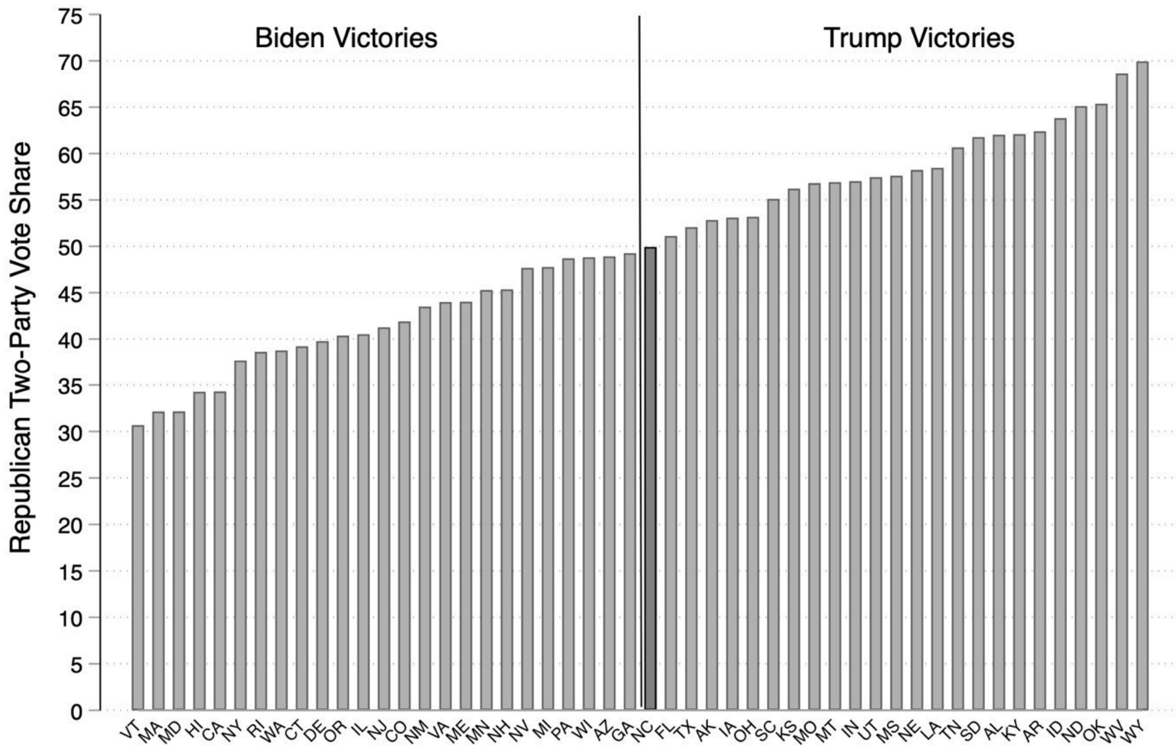
[13] Bitzer, J. Michael, and Charles Prysby, "North Carolina," in Charles S. Bullock III, and Mark J. Rozell, eds., *The New Politics of the Old South*, 7th Edition (Rowman and Littlefield, 2021).

Figure 1. North Carolina Rank in Democratic Vote Share for President Among the 50 States



In the 2020 election, North Carolina was perched on the razor's edge between Republican and Democrat—Donald Trump's two-party vote share was the smallest in North Carolina of any state he won in 2020. If any state can be described as "purple" or "competitive" in modern American politics, it is North Carolina.

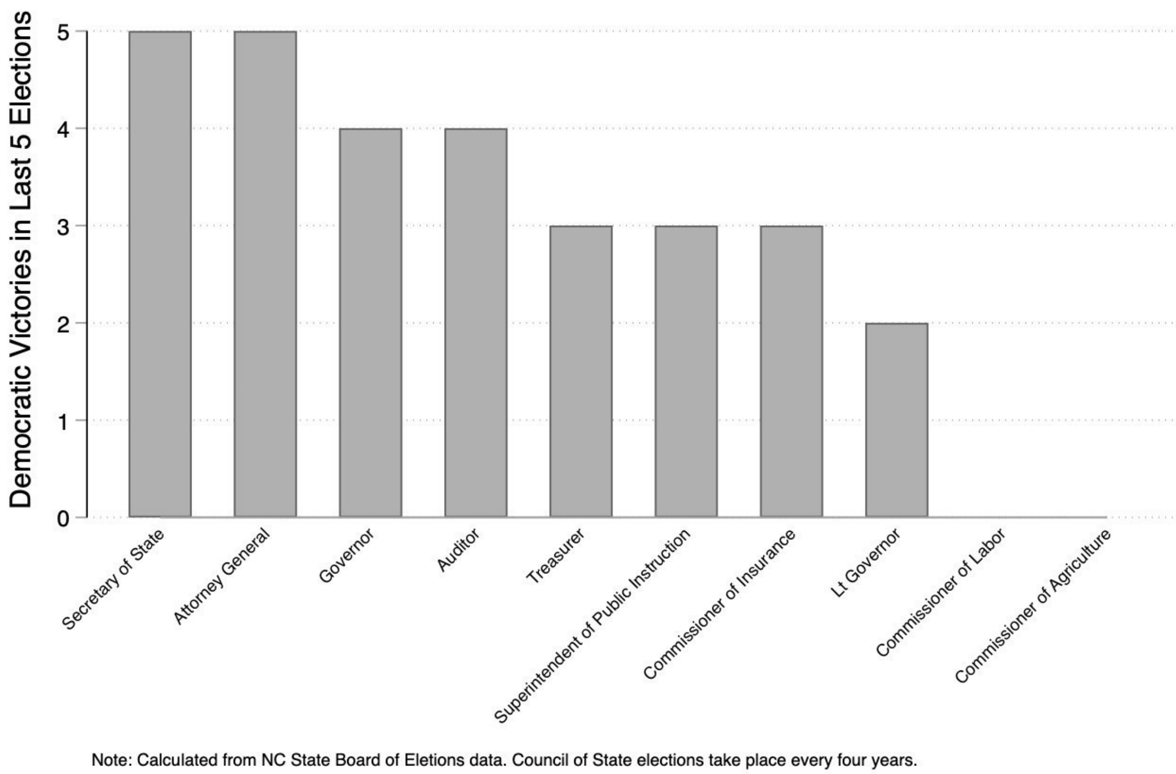
Figure 2. Two-Party Vote Share in the 2020 Presidential Election



Another way to understand North Carolina's competitiveness is to examine election results at the Council of State—ten members of the Executive branch who vary in prominence but are all elected in partisan quadrennial elections. These include the Governor, Lieutenant Governor, Secretary of State, State Auditor, State Treasurer, Superintendent of Public Instruction, Attorney General, Commissioner of Agriculture, Commissioner of Labor, and Commissioner of Insurance.

The result of these elections over the past five election cycles demonstrates once again that North Carolina enjoys significant partisan competition. Democrats have won 29 out of 50 Council of State elections since 2004.

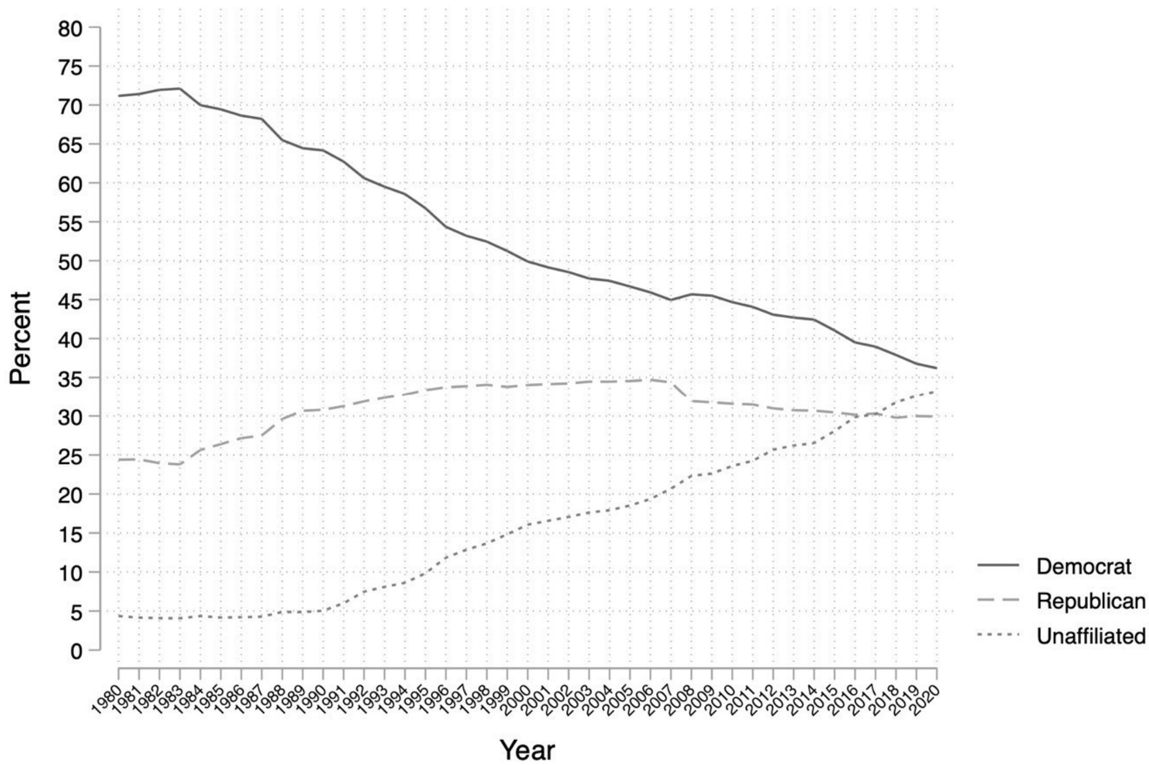
Figure 3. Results of The Last Five Council of State Elections



Two-Party Competition and Moderation in the Electorate

North Carolina has considerable two-party competition in terms of voter registration. As the figure below indicates, Republican Party identification has never exceeded Democratic Party identification in the history of the state. While this is certainly not a sign of a liberal, Democratic state, it is similarly belies any contention that North Carolina is a conservative, Republican state.

Figure 4. Voter Registration in North Carolina



Partisan identification is, of course, just one indicator of the political lean of a state's citizens. And, given the rise in Unaffiliated voters in North Carolina, it is an increasingly noisy indicator.[14] Existing measures of statewide public opinion, however, come to the same conclusion: North Carolina does not lean heavily towards one party or ideology. One measure of state-level public opinion finds that North Carolina falls near the middle of the distribution of state-level political ideology as the 24th most liberal state in the country.[15] Another widely accepted measure finds that North Carolina is the 25th most liberal state in the country.[16]

Legislative Votes and Seats in the Aggregate

Historically, North Carolina's legislative delegation has not reflected these patterns of two-party competition and moderation. As the following three graphs demonstrate, North Carolinians consistently give about half of their two-party vote share to each party, yet the Republicans dominate in terms of legislative representation. This suggests that the representational linkage between voters and North Carolina's legislative representatives is weaker than between the voters and various other elected offices.

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[14] Although using partisan identification as an indicator of voter preference can be problematic given that people generally change their voting pattern before changing partisan identification, North Carolina's party registration data is consistent with its moderate statewide voting patterns, as illustrated by the other measures included in this report.
[15] Berry, William D., Evan J. Ringquist, Richard C. Fording, and Russell L. Hanson, "Measuring Citizen and Government Ideology in the American States, 1960-93." *American Journal of Political Science* 42(1998): 327-48. Raw data are available at https://rcfording.com/state-ideology-data/.
[16] Tausanovitch, Chris, and Christopher Warshaw, "Measuring Constituent Policy Preference in Congress, State Legislatures, and Cities." *The Journal of Politics* 75(2013): 330-342. *See* http://www.americanideologyproject.com for data.

Figure 5. Comparing Votes and Seats in North Carolina's Congressional Delegation, 2012-2020

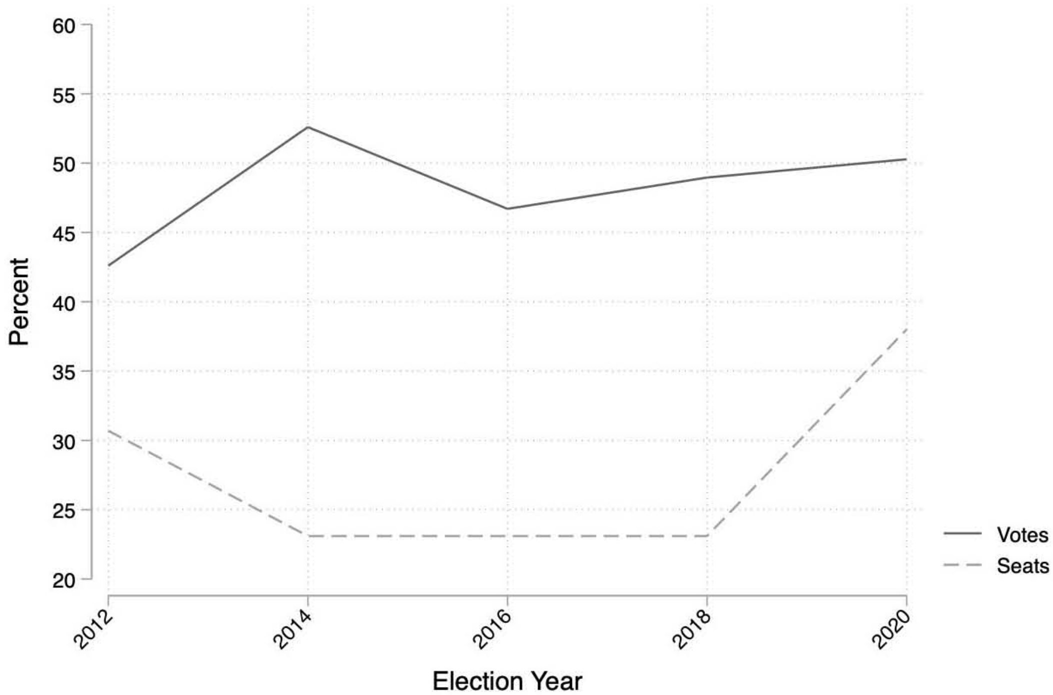


Figure 6. Comparing Votes and Seats in the North Carolina Senate, 2012-2020

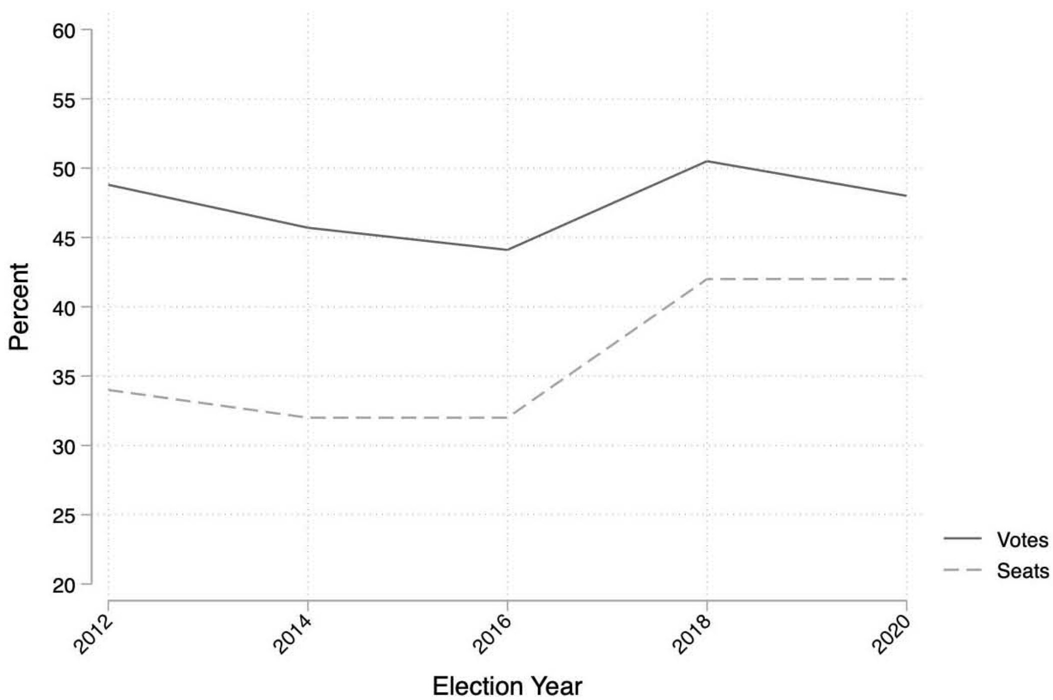
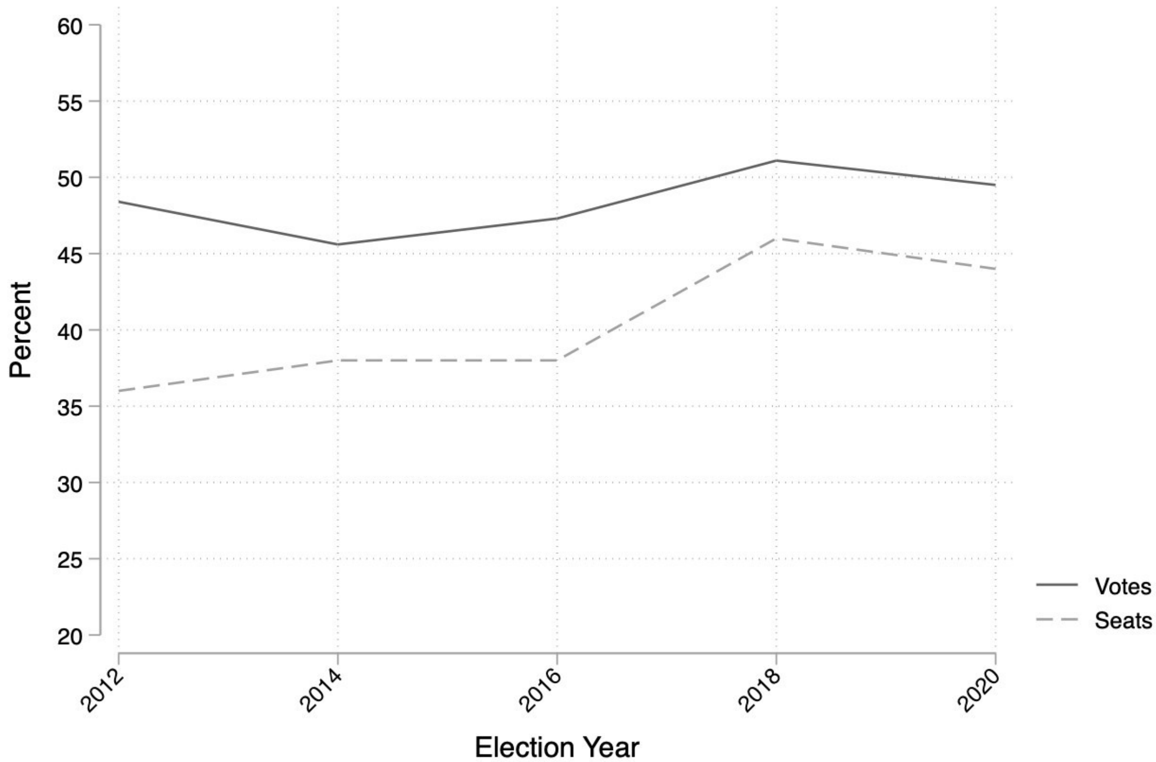


Figure 7. Comparing Votes and Seats in the North Carolina House, 2012-2020



Policy Outcomes

While North Carolina's statewide electoral outcomes, public opinion estimates, and party registration data all suggest a state that falls near the middle of the ideological and partisan spectrum in terms of citizen policy preferences, the partisanship of North Carolina's congressional and General Assembly delegations run counter to these measures. Further, available evidence suggests that the policy behavior and ideology of state legislators and members of Congress in North Carolina are at odds with statewide measures of two-party competition and ideological moderation. Estimates of voting patterns at the General Assembly[17] and congressional[18] levels reinforce that both delegations have moved in an increasingly conservative direction, while the aggregate public opinion of the citizenry has remained relatively constant. *See* figures 8 and 9 below.

[17] Data are from Schor, Boris, and Nolan McCarty. 2020. American Legislatures Project, *available at* https://americanlegislatures.com.
[18] Lewis, Jeffrey B., Keith Poole, Howard Rosenthal, Adam Boche, Aaron Rudkin, and Luke Sonnet (2021). *Voteview: Congressional Roll-Call Votes Database*. https://voteview.com/.

Figure 8. Chamber Estimates of North Carolina General Assembly Ideology, 1995-2018

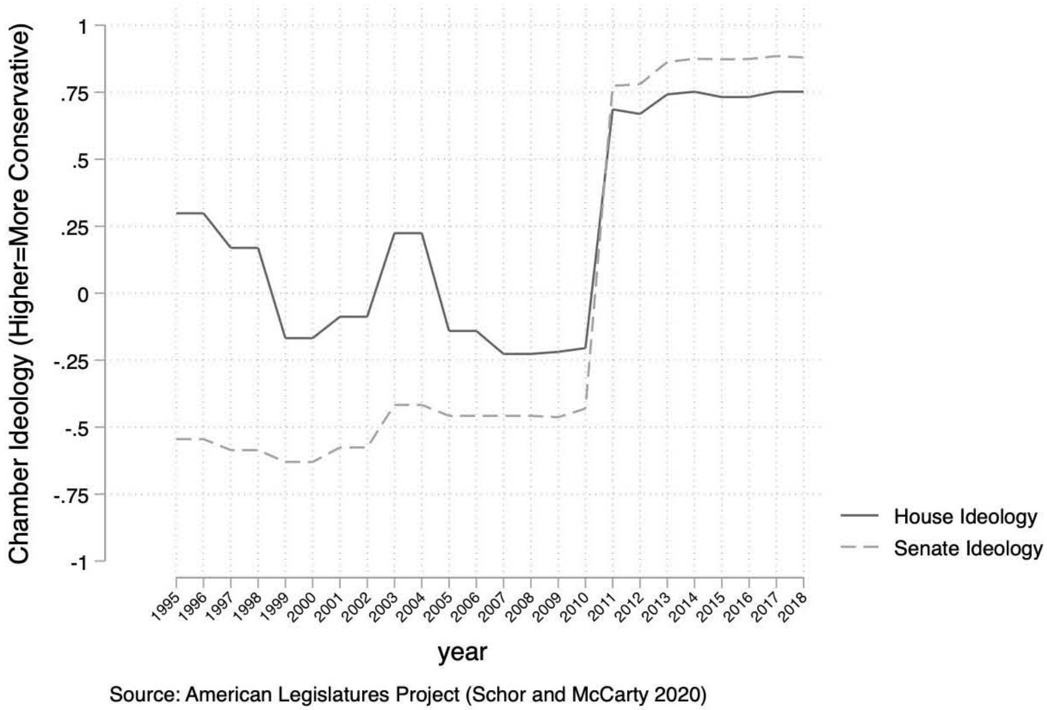
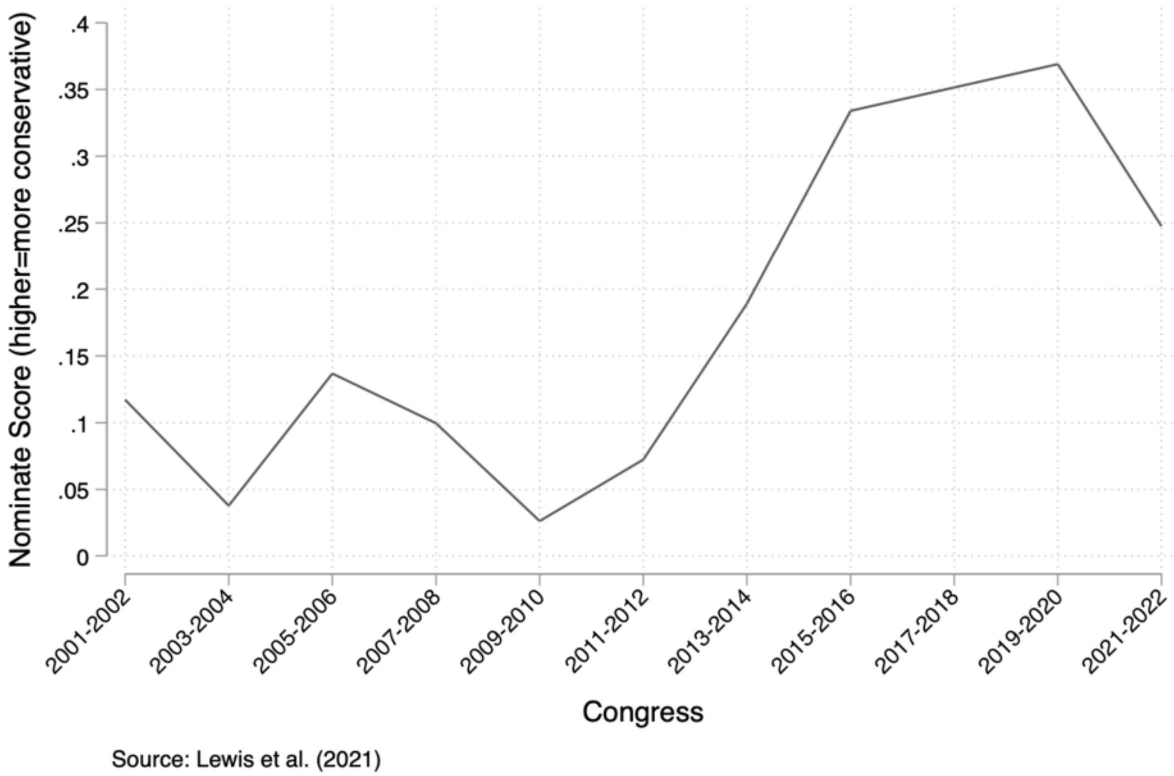


Figure 9. Nominate scores of North Carolina's congressional delegation, 2001-2002 Congress through 2021-2022 Congress



In a forthcoming book, Political Scientist Jacob Grumbach finds that North Carolina experienced significant democratic backsliding in recent years—"among the most democratic states in the year 2000, but by 2018, they are close to the bottom."[19] It is important to note that Grumbach's measure is one of "small d" democratic backsliding—he does not measure partisanship, but rather a state's propensity to adhere to basic norms of democracy.

Taken together, these complementary measures of North Carolina voters' behaviors, ideological preferences, and partisanship indicate that North Carolina is a politically moderate state that enjoys two-party competition for the vast majority of elected offices. Beginning in 2011, however, North Carolina's congressional and General Assembly delegations have run counter to this trend, both in terms of partisanship and expressed policy preferences.

[19] Grumbach, Jacob M., "Laboratories of Democratic Backsliding," (Unpublished Manuscript: University of Washington, 2021), *available at* https://sites.google.com/view/jakegrumbach/working-papers. *See* a graph focusing on North Carolina's democratic backsliding on pg. 13. Insights from this manuscript are forthcoming in *Laboratories Against Democracy*, Princeton University Press (https://press.princeton.edu/books/hardcover/9780691218458/laboratories-against-democracy).

District Analysis

The remainder of this report is devoted to examinations of specific districts (in the case of Congress) and county "clusters" (in the case of the General Assembly). In the text that follows, I refer to the "current" maps as the maps that were used in the 2020 election and the "enacted" maps as the maps that have been approved by the North Carolina General Assembly for use in the 2022 elections. While I conducted all of the analysis that follows and wrote all of the verbiage, the shaded red-and-blue maps were produced by John Holden, a geographic information system (GIS) expert, using a "CCSC" measure of partisanship that I selected and describe below. Mr. Holden also produced the other maps in the following pages that show the effect of the district lines on certain municipalities.

I use a few different metrics in the analysis that follows. The first is the Cook Political Report's Partisan Voter Index (PVI), a standard metric of the expected "lean" of a congressional district using a composite of past elections. The second is the Civitas Political Index (CPI), a measure of partisan district lean for state legislative districts derived from prior Council of State votes. The CPI places each district on a scale from D+1 (a district that has a slight Democratic tilt) to D+36 (a district with an overwhelming Democratic tilt), with mirrored results on the Republican side indicated with an "R" instead of a "D." The third is a metric created for this analysis that combines the results of the 2020 Secretary of Labor and Attorney General races, the two closest Council of State races in North Carolina that year, into one measure, which I term the Competitive Council of State Composite (CCSC).[20] This measure allows for the use of relatively low-profile elections to get a sense of the "true partisanship" of the district. It is presented below as the raw difference in votes and is used in the shaded red-and-blue maps that follow. From time to time, I mention the percent of the electorate that voted for Donald Trump in the 2020 election to give yet another sense of the partisan lean of the district, county, or cluster.

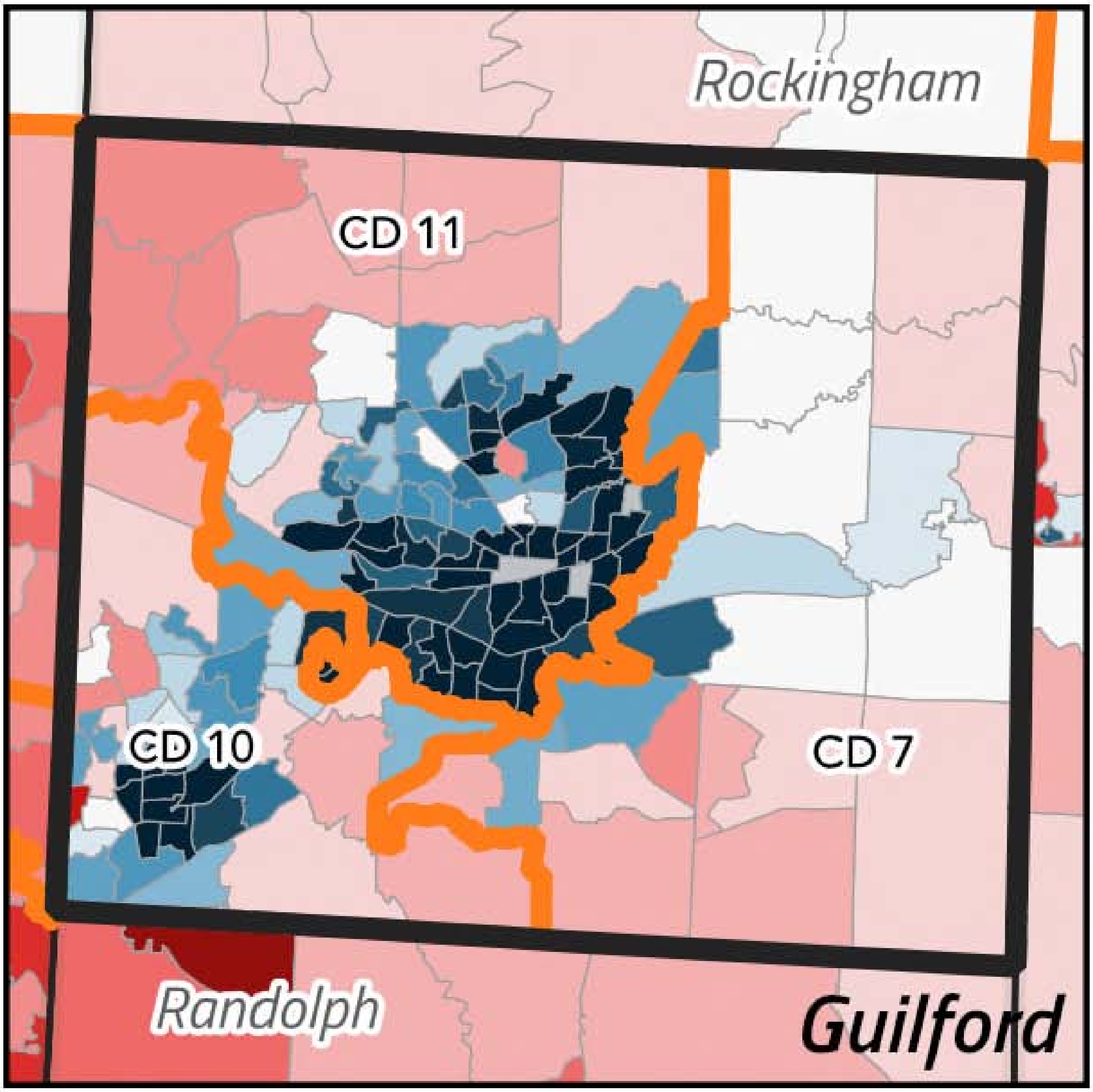
Congressional District Analysis

I begin by showing shaded red-and-blue maps demonstrating the trisection of Wake County, Mecklenburg County, and Guilford County by the congressional district lines (maps 1, 2, and 3 below). These maps show county lines in black, VTD lines in gray, and district lines in orange. The red-and-blue shading represents the relative vote margin using my CCSC—the composite results of the Secretary of Labor and Attorney General races in 2020—in each VTD, with darker blue shading representing larger Democratic vote margins and darker red shading indicating larger Republican vote margins (both normalized by acreage).

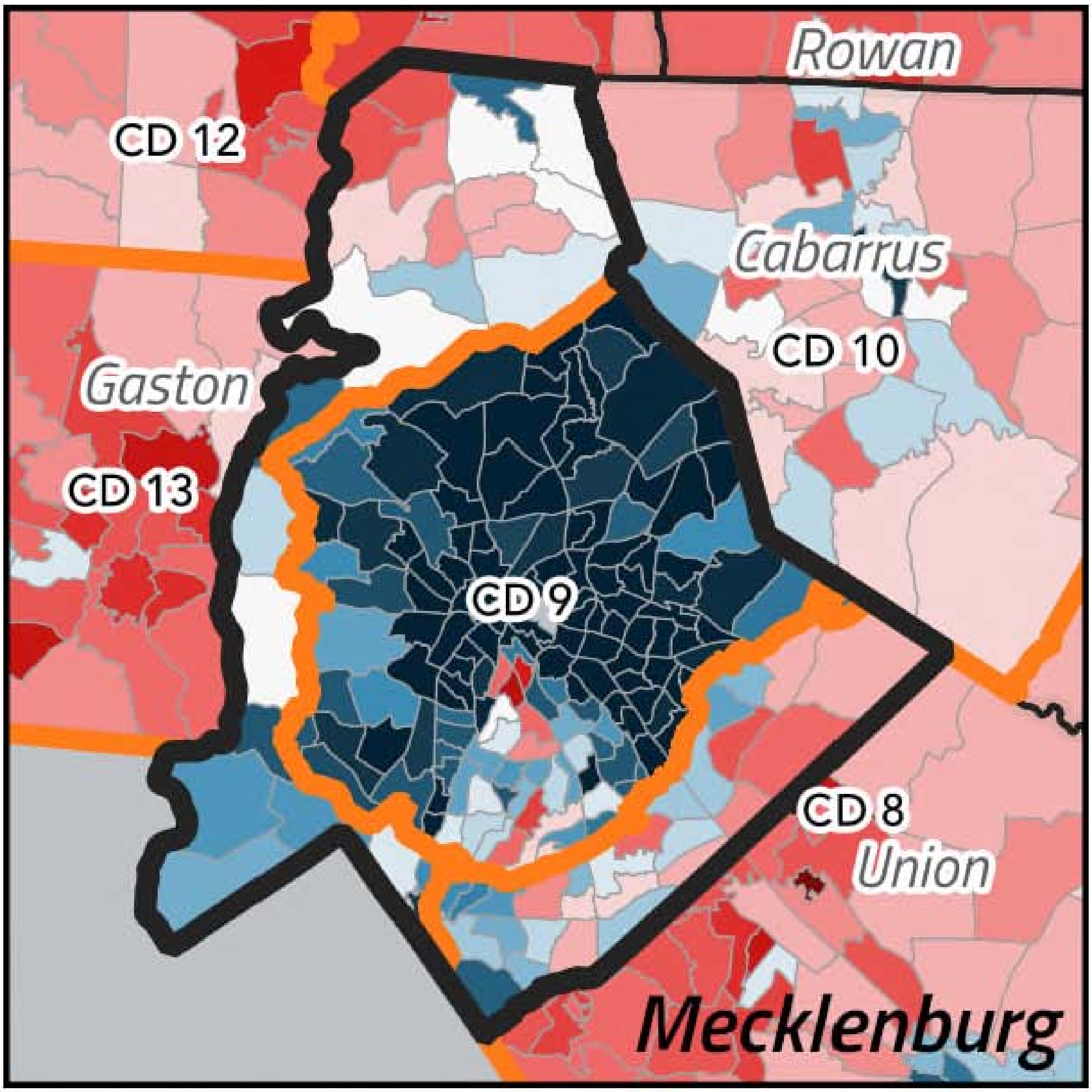
While district-by-district analysis is important, the congressional map is best understood as a single organism, rather than 14 separate entities—as one district moves in one direction, another must respond. This means that the unnecessary division of Mecklenburg, Guilford, and Wake counties across multiple congressional districts, achieved by the cracking and packing of Democratic voters in those counties, has ripple effects throughout the map. Map 4 shows the entirety of the congressional map with red-and-blue CCSC shading.

[20] The election data utilized for the CCSC metric, including to generate the red-and-blue shading on the maps that follow, was obtained from the North Carolina State Board of Elections website. *See* https://www.ncsbe.gov/results-data/election-results/historical-election-results-data.

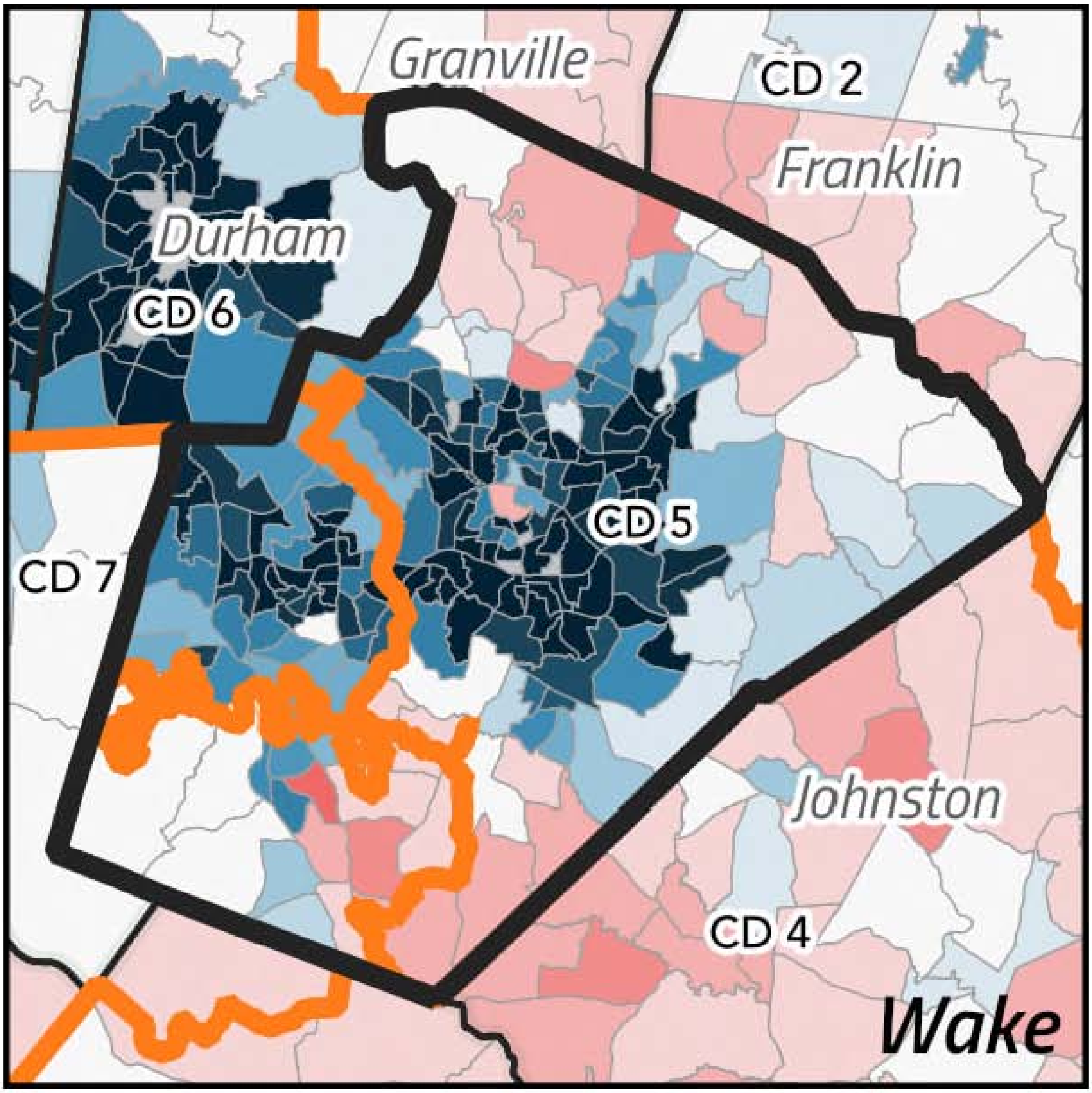
Map 1. Close-up of Guilford County VTD CCSC, split across three districts



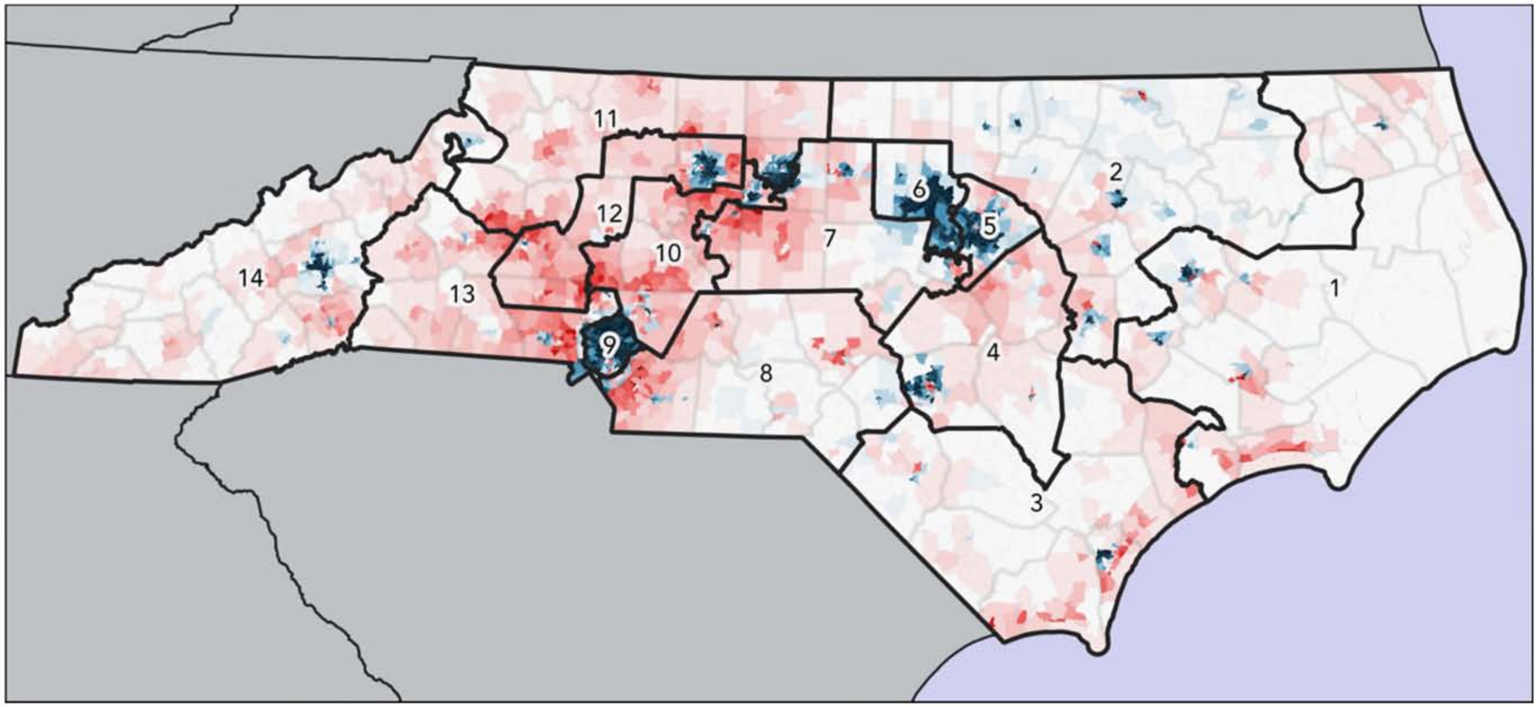
Map 2. Close-up of Mecklenburg County VTD CCSC, split across three districts



Map 3. Close-up of Wake County VTD CCSC, split across three districts



Map 4. Statewide overview of the enacted congressional map



As the table below shows, the PVI, CCSC, and Trump Percentage all tell a similar story: the enacted map will produce 10 Republican seats, 3 Democratic seats, and 1 competitive seat. At most, the enacted map could be expected to elect four Democrats to office in 2022—fewer than in the current map and far below what one would expect based on Democratic representation statewide or the results of other recent statewide elections.

Table 1. Summary Data for Each Enacted Congressional District

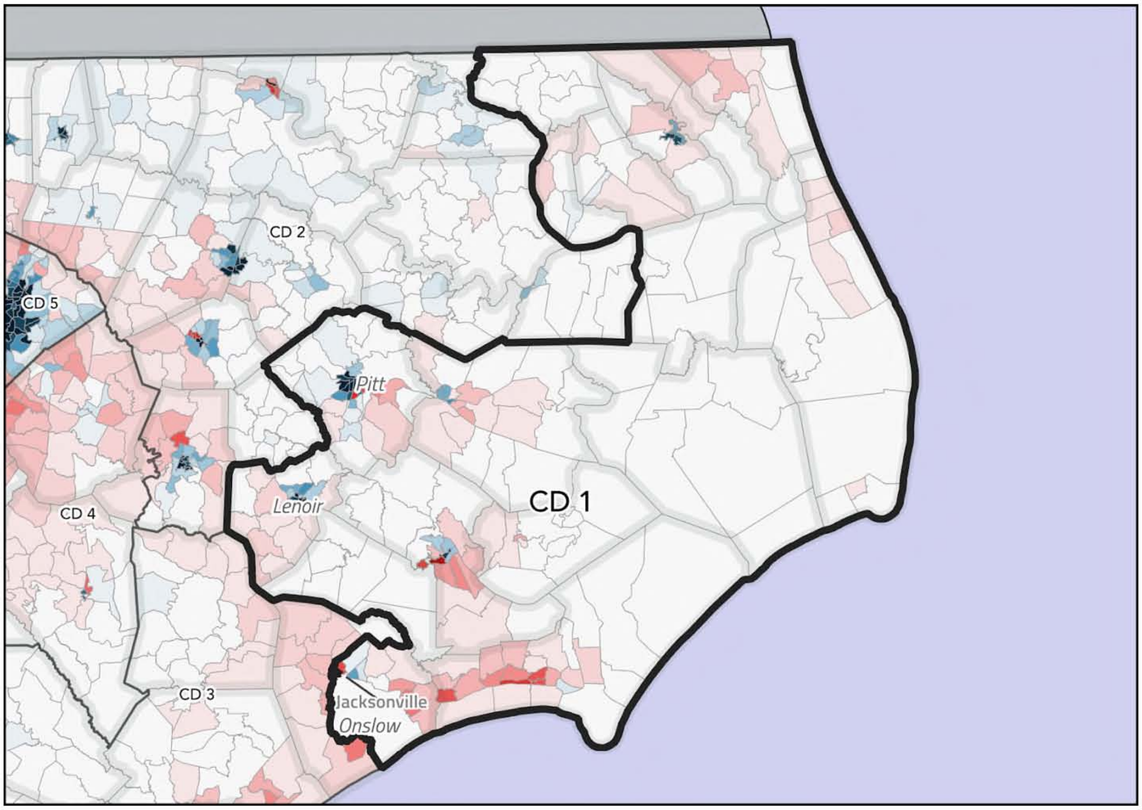
District	PVI	CCSC	Trump Perc
1	R+10	R +98,969	57%
2	Even	D +40,396	48%
3	R+10	R +111,451	58%
4	R+5	R +28,045	53%
5	D+12	D +227,327	34%
6	D+22	D +374,786	25%
7	R+11	R +115,682	57%
8	R+11	R +125,842	57%
9	D+23	D +325,717	25%
10	R+14	R +156,833	60%
11	R+9	R +94,407	57%
12	R+9	R +102,404	56%
13	R+13	R +150,187	60%
14	R+7	R +58,387	53%

NC-1

The enacted 1st congressional district is mostly comprised of the current NC-3, but also includes part of the current NC-1. Most potential congressional districts in this part of North Carolina would likely lean towards the Republican Party, but to create extra advantage for the Republican Party in other parts of the map, the current map brings the Democratic-leaning areas of Pitt County into NC-1, thus removing them from NC-2 and allowing NC-2 to become much more competitive for the Republican Party.

Despite moving the district line westward to include the Democratic portion of Pitt County, the enacted district remains virtually a guaranteed Republican victory with a PVI of R+10 (the current NC-3 is R+14). No Democratic member of Congress in the country represents a district that leans this far towards the Republican Party.

Map 5. VTD CCSC for NC-1



NC-2

The enacted 2nd congressional district includes the core of the current NC-1, along with portions of the current NC-4 and NC-13. The area that largely comprises the new NC-2 is currently represented by Democrat G.K. Butterfield and is considered a D+12 district by the Cook Political Report, making it a safe Democratic seat. Butterfield has the longest uninterrupted tenure of any member of North Carolina's congressional delegation. Under the enacted map, however, Butterfield's district changes radically, loses many of its Democratic strongholds (including the aforementioned loss of the Democratic areas in Pitt County) and now picks up enough Republican voters to move the district to "even," according to the Cook Political Report. For example, NC-2 picks up Caswell County, which does not include a single Democratic-leaning VTD, according to the 2020 Attorney General/Secretary of Labor CCSC in the map shown below. The 2020 Presidential vote share and CCSC score reinforce that this is an extremely competitive district. This is an enormous shift for what was formerly a Democratic stronghold.

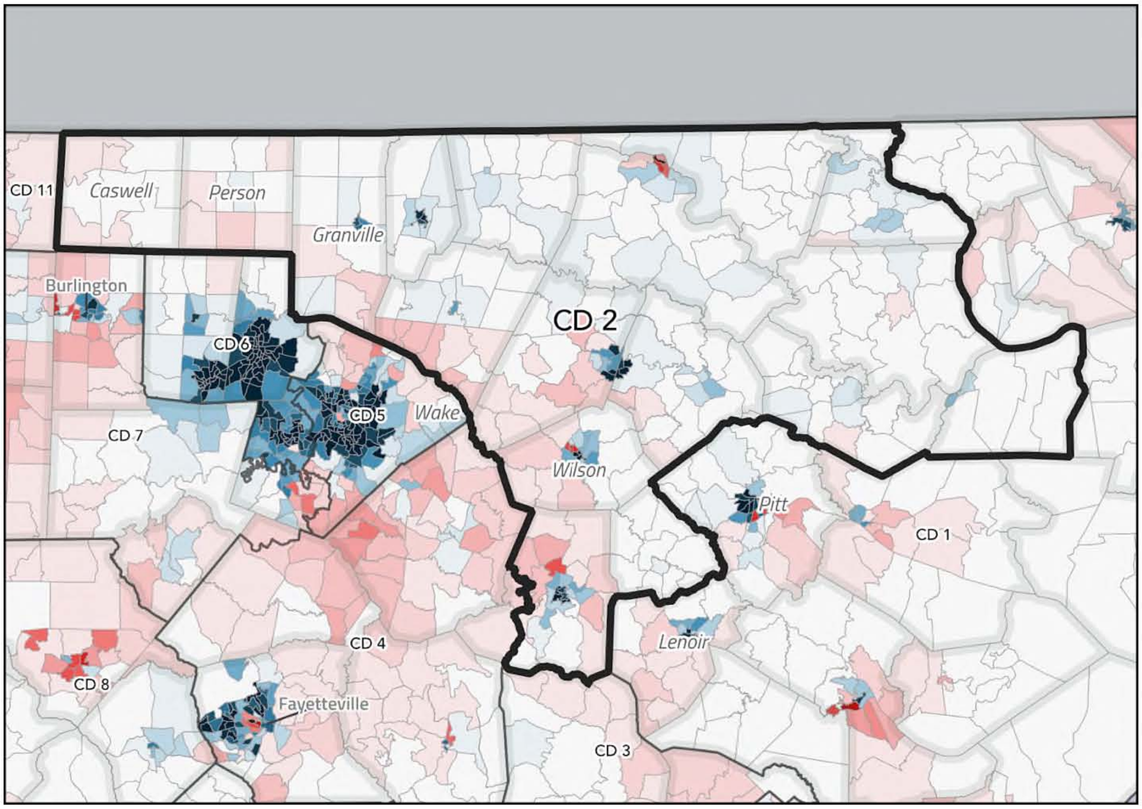
In addition to producing a clear partisan shift, the district is difficult to understand from a communities of interest perspective. The enacted district no longer includes any of Pitt County, nor does it include the campus of East Carolina University, which provided much of the economic engine of the district. The district now stretches from the Albemarle Sound to the Raleigh-Durham-Chapel Hill metropolitan area and eventually terminates in Caswell County, just northeast of Greensboro. Notably, Washington County and Caswell County have never been paired together in a congressional map in the history of North Carolina, further illustrating how little these counties have in common.

At a micro-level, the changes will split communities in important ways. For example, the cut-out in Wayne County, just west of Goldsboro, splits the students and families in Westwood Elementary School (which is located in NC-2) into two separate districts (NC-2 and NC-4). At one point, NC-2 passes through a narrow cut-off between the Neuse River to Old Smithfield Road that is less than one-third of a mile wide.

After the maps were enacted, G.K. Butterfield announced that he will not seek re-election,[21] making the district even more likely to shift to the Republican Party. If the Republicans take over this seat, it will be the first time that this part of North Carolina has been represented by a Republican since the late 19th Century.

[21] Bryan Anderson, "Democrat Rep. Butterfield to Retire, New District is a Toss-Up," *Associate Press News*, *available at* https://apnews.com/article/elections-voting-north-carolina-voting-rights-redistricting-e221c0732f457b2273f54ef102424eca.

Map 6. VTD CCSC for NC-2



NC-3

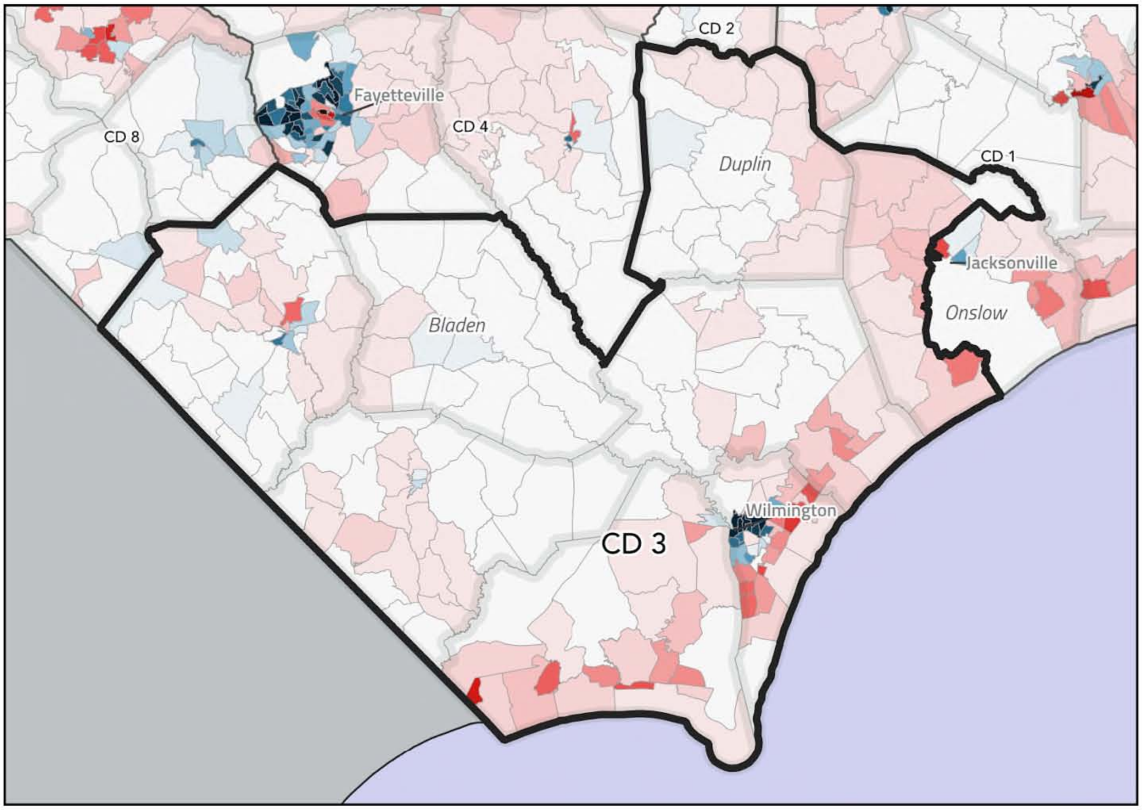
The enacted 3rd congressional district is mostly carved out of the current 7th congressional district, but also includes portions of the current 3rd and 9th districts. The current 7th district is considered R+11 by the Cook Political Report.

As enacted, this district once again denies North Carolina's Sandhills a consistent district of their own, despite repeated calls during the redistricting process,[22] and instead places portions of the Sandhills with the coastal enclave in and around Wilmington. The enacted map also creates an odd appendage in Onslow County that, as described in the section on NC-1, makes little sense from a communities of interest perspective.

The enacted district will almost certainly elect a Republican. It is slightly less Republican than the current NC-7 but still is considered R+10 by the Cook Political Report. It favored the Republicans by over 110,000 votes in the 2020 Attorney General/Secretary of Labor CCSC, and Donald Trump won the district with 58% of the vote. It is currently represented by Republican David Rouzer and is expected to remain in Republican hands.

[22] *See, e.g.*, Dreilinger, Danielle, "1 woman, 1 North Carolina address, 5 congressional districts. As North Carolina prepares to add a 14th congressional seat, Sandhills residents asked: why can't it be theirs? *Fayetteville Observer*. November 5, 2021.

Map 7. VTD CCSC for NC-3



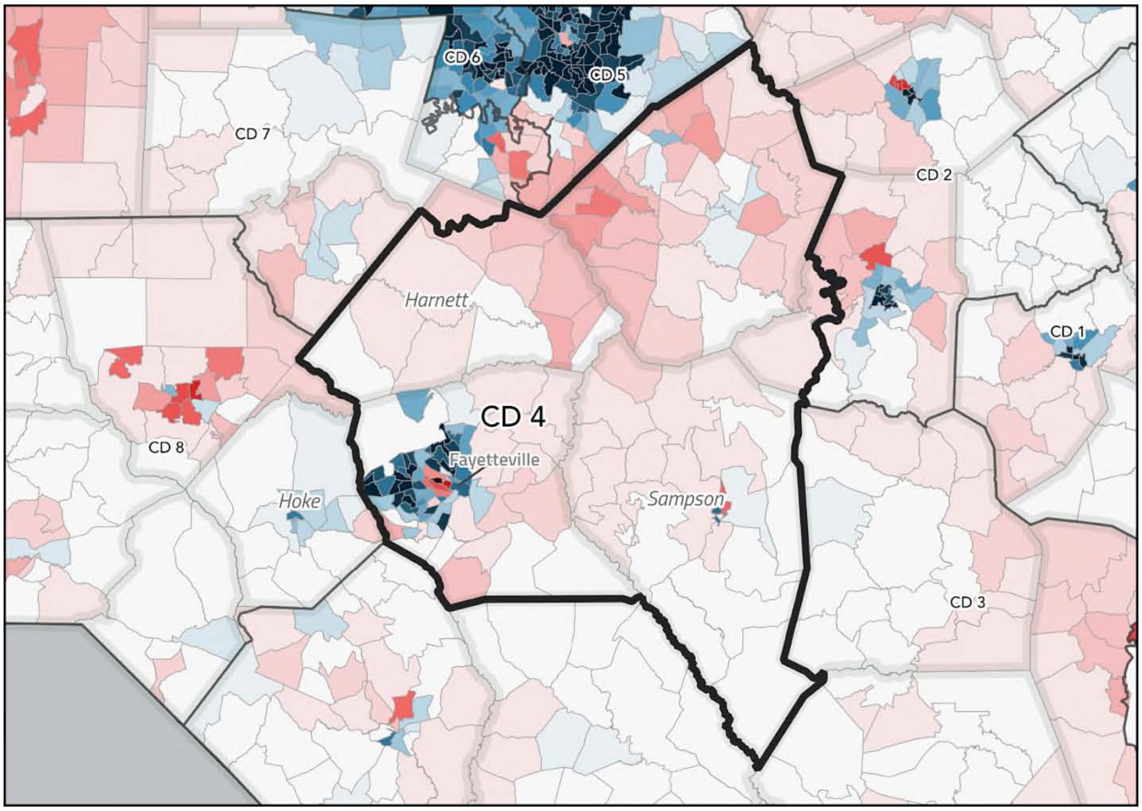
NC-4

The enacted 4th congressional district is carved out of a pocket of North Carolina that includes Johnston County and a portion of Harnett County, both of which are adjacent to Wake County, as well as portions of the Sandhills. The district is pieced together out of leftover portions from current districts 7 and 8, which were R+11 and R+6, respectively. It combines the Democratic-leaning area of Fayetteville with those areas to create a Republican-leaning district.

In addition to the carve out of Republican-leaning VTDs in Wayne County referenced above, this district takes a series of confusing jogs in the northwest part of Harnett County. A citizen driving southwest on Cokesbury Road would begin in NC-7, then rest on the line between NC-7 and NC-4, then into NC-4, then back on the line between the two, just before Cokesbury turns into Kipling Road whereupon the driver would move back into NC-4.

This district, which has no incumbent, is considered an R+5 district by the Cook Political Report, gave 53% of its vote share to Donald Trump in 2020, and gave an advantage to Republicans of about 28,000 votes in the 2020 Attorney General/Secretary of Labor CCSC.

Map 8. VTD CCSC for NC-4

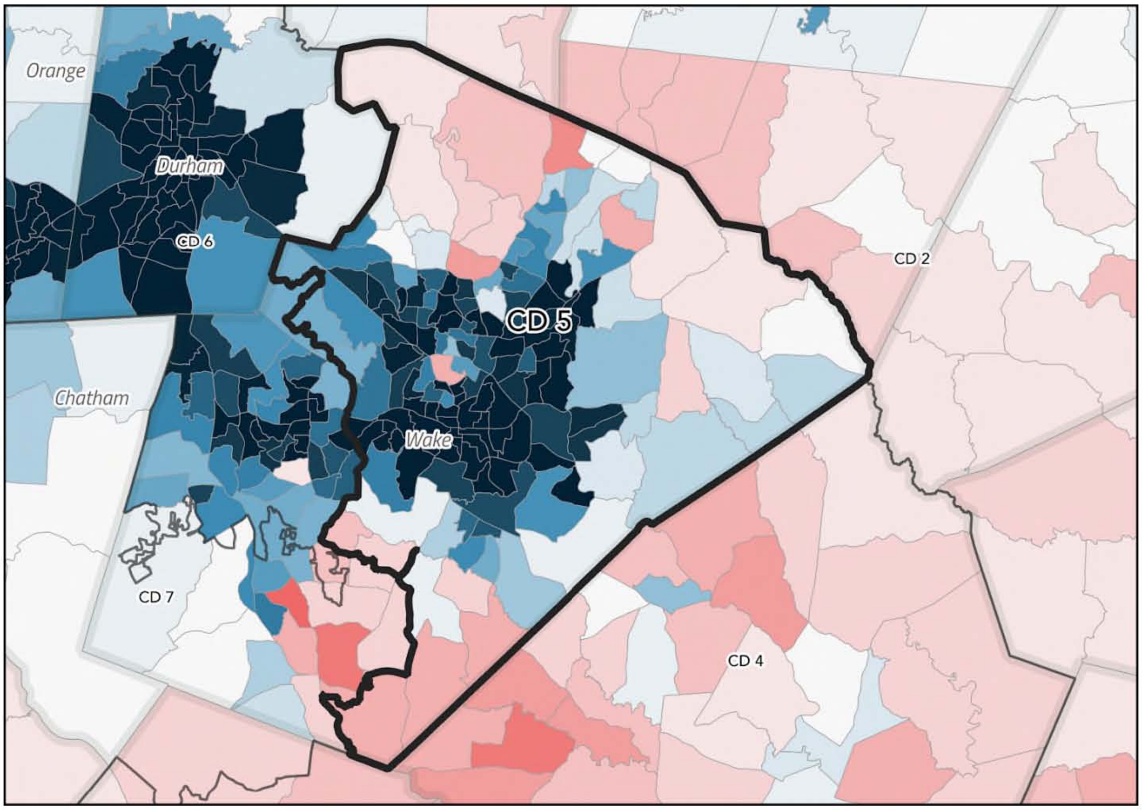


NC-5

The enacted map cracks Democrats in Wake County into three districts (NC-5, NC-6, and NC-7). Unlike NC-6 and NC-7, NC-5 is situated completely within Wake County and is made up of portions of current NC-2 and NC-4, districts that were D+12 and D+16. The effects of this are to pack Democratic voters into one district, thus increasing the probability that Republicans can win at least one of the adjacent districts. The enacted district is rated by the Cook Political Report as D+12, the CCSC shows a Democratic advantage of over 227,000 votes, and Donald Trump won just 34% of the vote.

This map clearly splits communities of interest. In one particularly egregious example, a small vein runs up Fayetteville Road by McCullers Crossroads in Fuquay-Varina, where the vein itself is in NC-7 and the areas on either side of it are in NC-5.

Map 9. VTD CCSC for NC-5

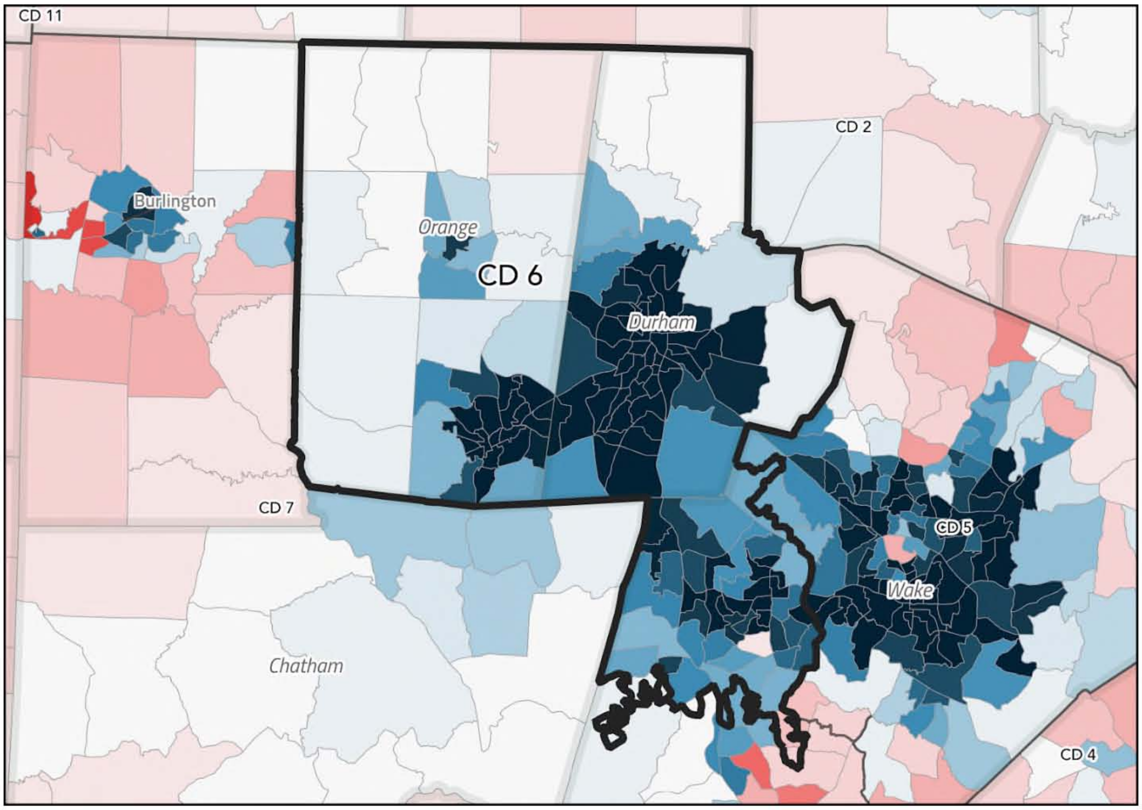


NC-6

The 6th district packs all of Orange and Durham counties and part of Wake County together into one overwhelmingly Democratic district, which is created out of portions of the current NC-4 and NC-2 (D+16 and D+12, respectively). As the map below demonstrates, the enacted NC-6 only includes four marginally Republican VTDs, according to the 2020 Attorney General/Secretary of Labor CCSC. Cook Political Report estimates this to be a D+22 district, Democrats had more than a 374,000 vote advantage in the CCSC and Donald Trump won only 25% of the vote in 2020. This district packs a greater proportion of Democratic voters in a single district than any district from the previous map. This district, like NC-5, includes Wake County, which is divided across three districts in the enacted map. The packing of Democrats in this district enables adjacent districts, in particular NC-7, to be drawn in ways that make it easier for Republican candidates to win.

The contours of this district bordering NC-7, on the southern end, split communities of interest in almost comical ways. In one example, a person traveling south on New Hill Olive Chapel Road would, in a matter of a few miles, move from NC-7 to the line between NC-6 and NC-7, back into NC-7, through NC-6, back into NC-7, back to the border between the two, back into NC-7, back to the border between the two, then back into NC-7. The contours of these lines are confusing to voters, and, as the map demonstrates, serve to pack as many Democratic precincts as possible into NC-6.

Map 10. VTD CCSC for NC-6

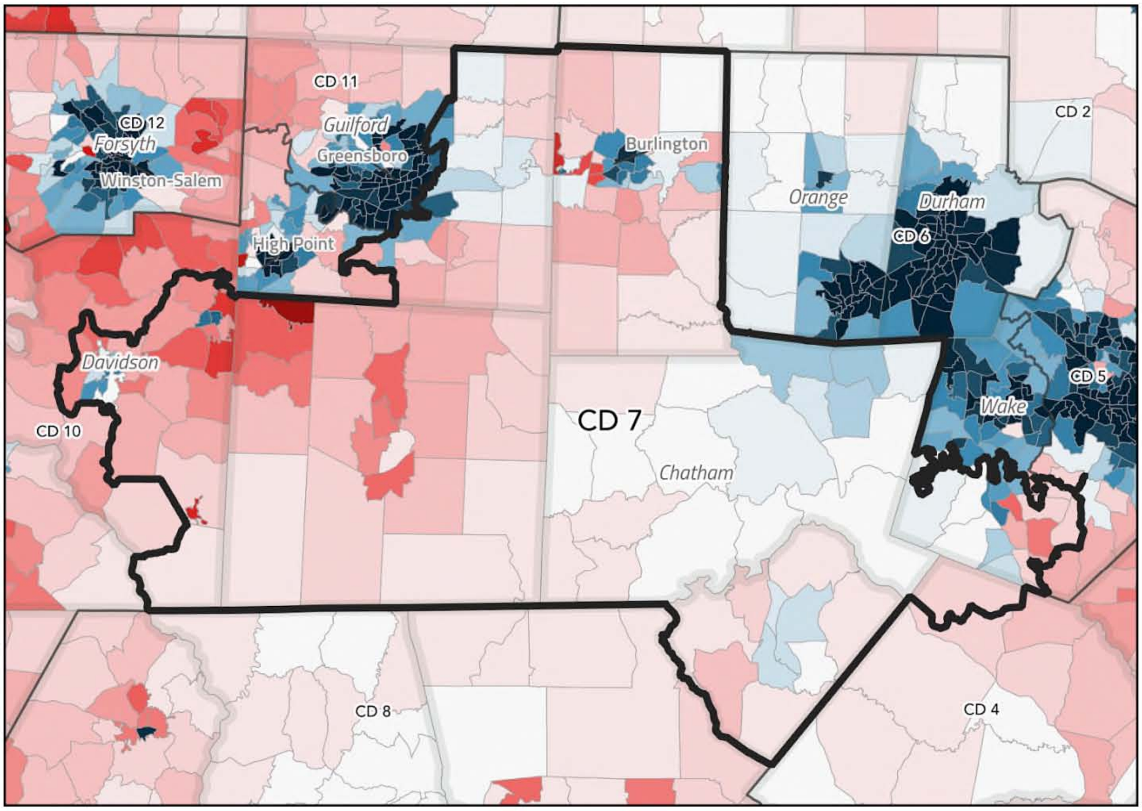


NC-7

The enacted 7th district includes the Republican-leaning Randolph, Alamance, Chatham, and Lee counties as well as portions of Guilford, Wake, and Davidson counties. It is carved out of current districts 13, 6, 4, and 2. As it is drawn, NC-7 splits both Guilford and Wake counties (each of which of is divided three times in the map as a whole). Despite including portions of two of the most Democratic counties in North Carolina, the district studiously avoids the Democratic-leaning areas of both counties. The eastern portion of the district in Wake County, near Apex, takes the unusual and confusing contours described in the description of NC-6 above.

The enacted NC-7 is considered R + 11 by the Cook Political Report, it gave Republicans a 115,682 vote advantage in the CCSC, and Donald Trump won 57% of the vote in this district. A Democratic candidate has virtually no chance of victory in the enacted 7th.

Map 11. VTD CCSC for NC-7

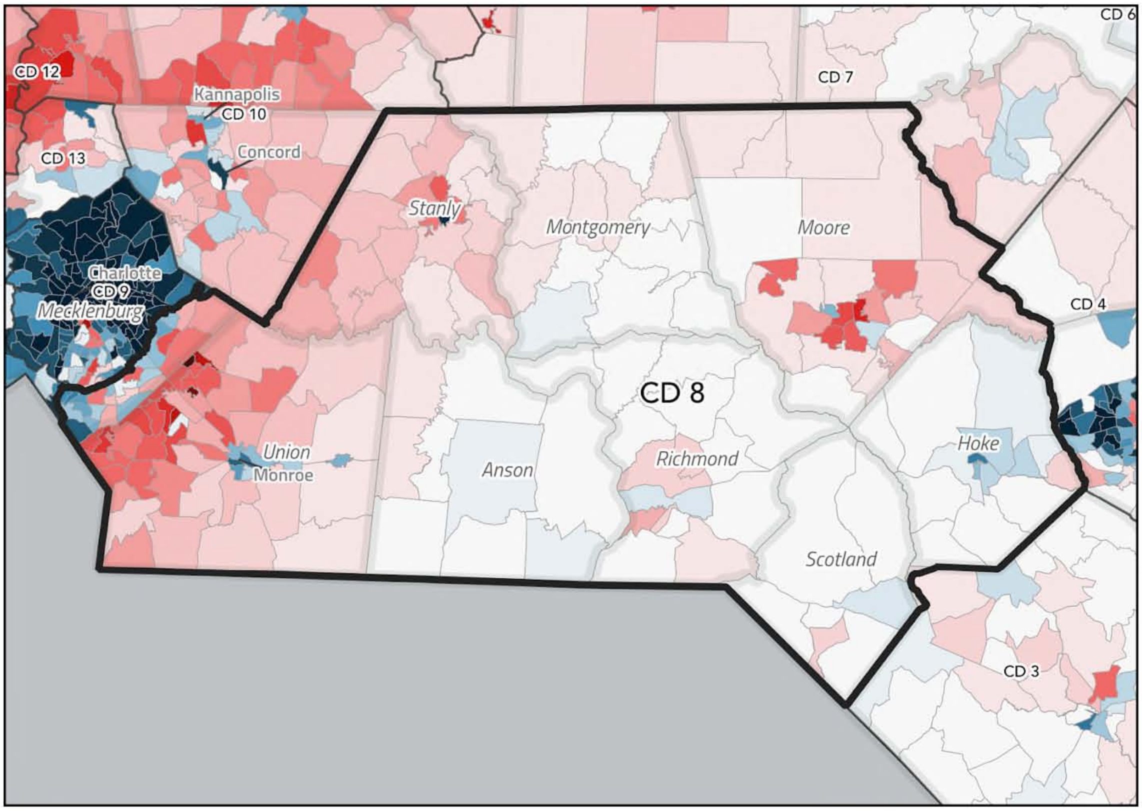


NC-8

The 8th district stretches from the Sandhills into Mecklenburg County and includes portions of the current 9th, 12th, and 8th districts. The core of the district comes from the current 9th district, which is R+6. The enacted NC-8 includes the entirety of Scotland, Hoke, Moore, Montgomery, Richmond, Anson, Union, and Stanley counties as well as the southern and eastern edge of Mecklenburg County. Although it includes portions of Mecklenburg County, one of the most Democratic-leaning areas in the state, as well as Democratic municipalities in Union, Anson, and Hoke, the 8th district is unlikely to elect a Democrat under any reasonable scenario. The enacted map stops just shy of the some of the darkest blue VTDs in Mecklenburg County.

The Cook Political Report calls the enacted NC-8 an R+11 district, the CCSC shows that the Republican candidate garnered over 115,000 more votes than the Democratic candidates for the two closest Council of State races, and Donald Trump won approximately 57% of the vote in the 2020 election.

Map 12. VTD CCSC for NC-8



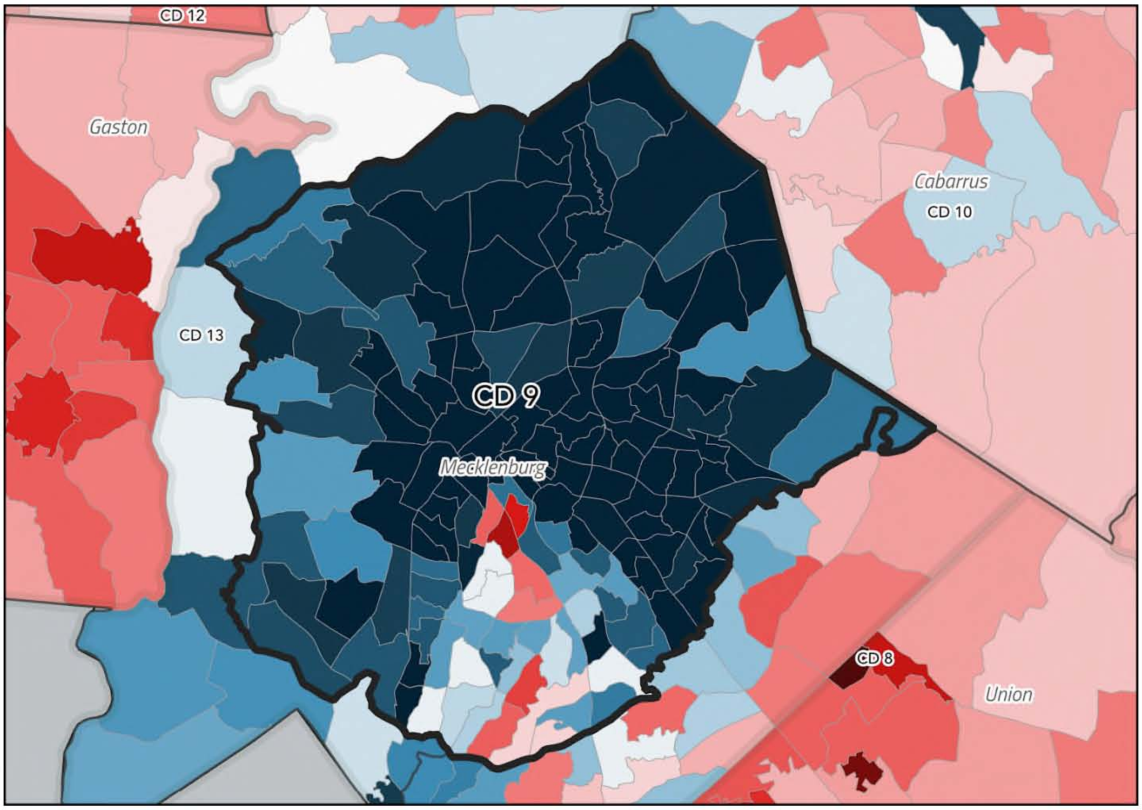
NC-9

The core of the enacted 9th congressional district comes from the current NC-12, but it also includes portions of the current NC-9. The result is the most packed district in the enacted map. The Cook Political Report rates the enacted NC-9 as a D+23 district, meaning that it leans more heavily towards the Democratic Party than any district in the last map. Donald Trump won just 25% of the vote in this district in the 2020 Presidential election and the CCSC indicates that the Democrats won over 325,000 more votes than the Republicans in the two closest Council of State races in 2020.

As with all examples of packing, the key to understanding this district is its effects on the surrounding districts. By ensuing that the Democratic candidate in NC-9 wins by an overwhelming margin, Republican voters will be more efficiently distributed across other districts, where they can have a greater affect on the outcome than they would otherwise. This ensures that neighboring NC-8, for example, will not be competitive. This also has the effect of ensuring that Republican voters in NC-9 have no chance of securing representation from a member of their own party.

The geographic contortions of this district are most apparent on its western edge, where a mere eight miles separates the western edge of NC-9 and the Mecklenburg County line.

Map 13. VTD CCSC for NC-9

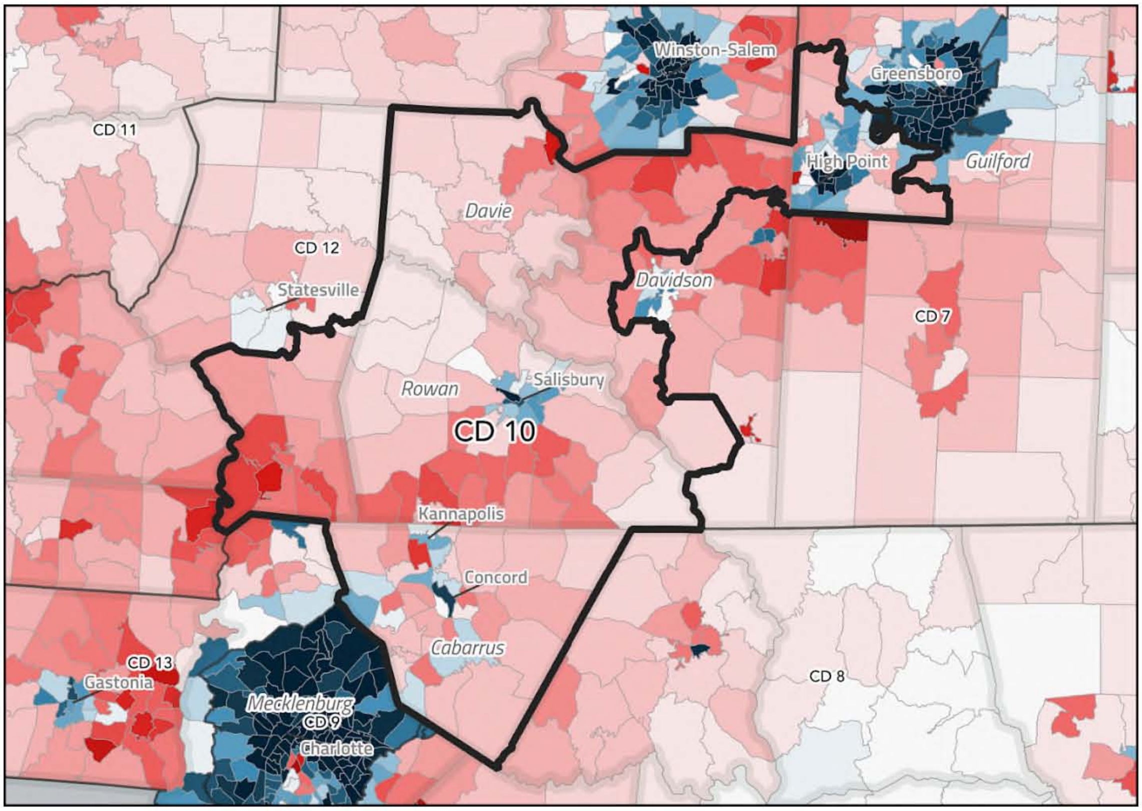


NC-10

The enacted NC-10 includes all of Rowan, Cabarrus, and Davie counties and parts of Iredell, Davidson, and Guilford counties. It is drawn out of portions of the current 10th, 9th, 6th, and 13th districts. Despite the inclusion of carefully curated portions of Democratic Guilford County, this district is a safe Republican seat and effectively removes any possibility that Democratic voters in High Point, Salisbury, Kannapolis, Concord, and elsewhere in Cabarrus can elect a member of their own political party. The Cook Political Report rates this district as R+14, the CCSC indicates that Republicans won more than 156,000 additional votes in the two key council of state races, and Donald Trump won over 60% of the Presidential vote in the enacted district.

NC-10 includes High Point, while NC-11 includes most of Greensboro and NC-12 contains Winston-Salem, meaning that the enacted map splits all three points of North Carolina's Piedmont Triad into separate congressional districts that favor Republicans. In the current map, this community of interest is together in NC-6, represented by Democrat Kathy Manning.

Map 14. VTD CCSC for NC-10



NC-11

The enacted 11th congressional district is carved out of the current 5th, 10th, and 6th districts. This map places a portion of Guilford County, including the City of Greensboro, in a district with Rockingham, Stokes, Surry, Alleghany, Ashe, Wilkes, Caldwell, and Alexander counties as well as a tiny boot-shaped sliver of Watauga County.

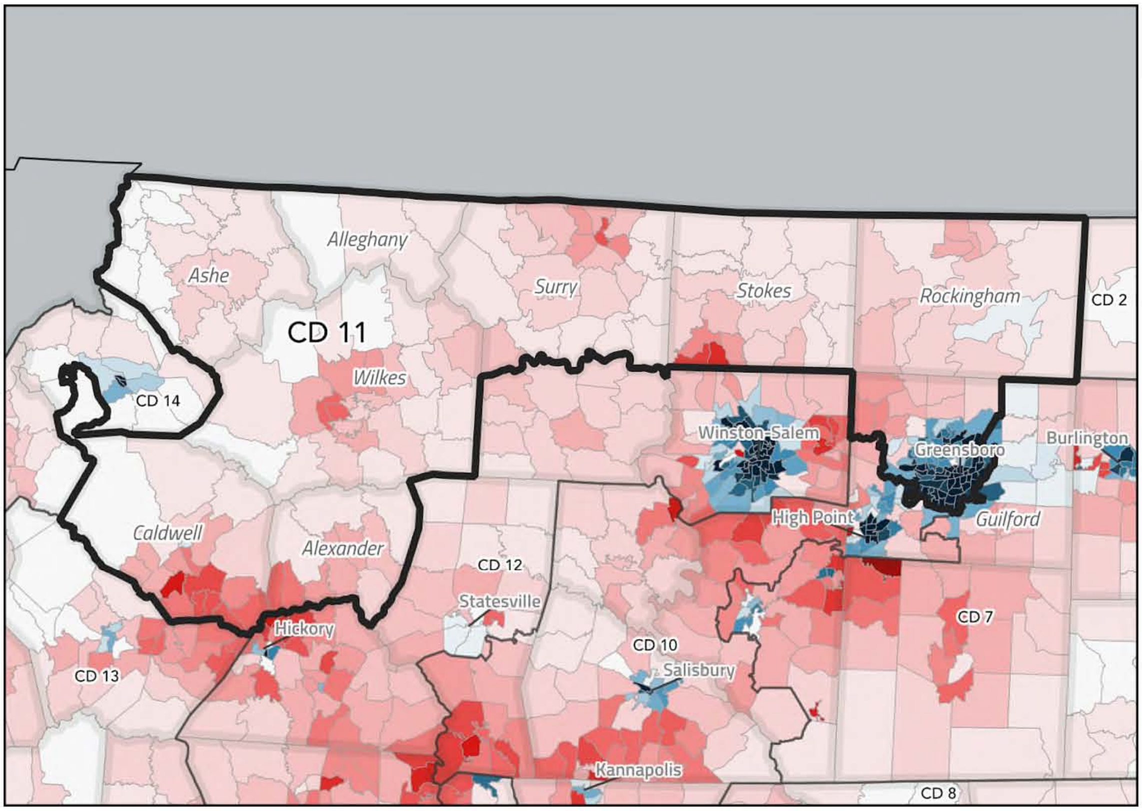
As discussed elsewhere, the enacted map splits Guilford County across three districts (the 10th, 11th, and 7th) and puts all three points of the Piedmont Triad in separate districts. By placing most of Greensboro in this overwhelmingly Republican district, the map ensures that the City of Greensboro, among the most Democratic and racially diverse cities in the state of North Carolina, will not be represented by a Democrat.

The enacted district is rated by Cook as R+9, 57% of the district voted for Donald Trump in the 2020 election, and Republicans held a 94,000 vote lead in the two closest Council of State elections. No Democrat in the current Congress represents a district that leans this heavily Republican.

It is difficult to imagine any sense in which some of the locations in this district have shared community interests. Geographically, NC-11 spans radically different parts of the state. Greensboro is firmly in the Piedmont, resting at under 900 feet elevation. Watauga and Ashe counties, by comparison, reside in the high country, with elevations that consistently run above 5,500 feet. The corners of the district have different area codes, are served by different media markets, and share virtually no characteristics in common other than the fact that they are both within North Carolina. In the history of North Carolina, Caldwell and Rockingham counties have never shared a congressional representative.

In addition to its geographic span, the enacted district stands out for its double-bunking of Republican Virginia Foxx and Democrat Kathy Manning. To shoe-horn Foxx into the new district, the mapmakers carved out a tiny sliver of Watauga County to allow her house to fall into the redrawn district. This passage is so narrow, in fact, that it is connected by a stretch of land that is roughly three miles wide and requires a traverse of the Daniel Boone Scout Trail.

Map 15. VTD CCSC for NC-11

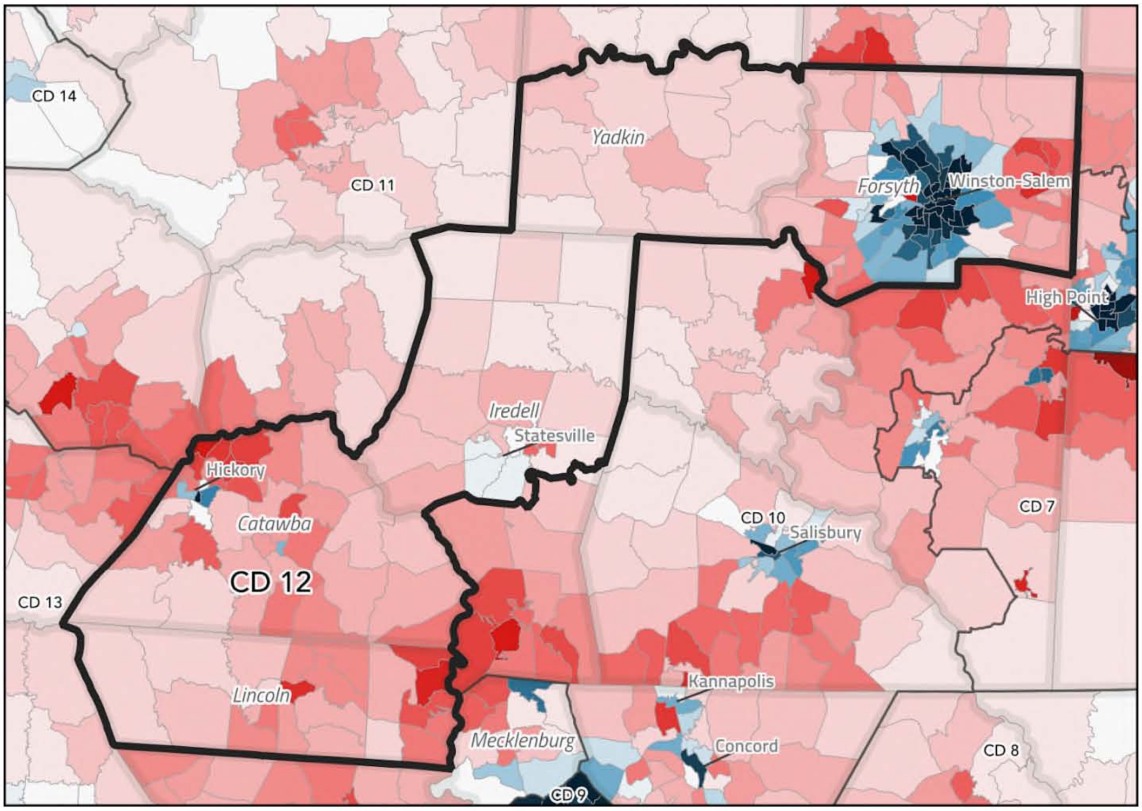


NC-12

The 12th congressional district stretches from Lincoln County at the southwestern corner, through Catawba, the northern part of Iredell, Yadkin, and Forsyth counties. As the map below makes clear, by including Winston-Salem with this overwhelmingly red swath of geography and walling it off from Democratic voters in High Point, the enacted map ensures that Republican Congressman Patrick McHenry, who lives at the southeast corner of this district, will maintain his seat and the Democratic voters in Winston-Salem will have virtually no chance to elect a member of their own party.

The Cook Political Report rates this district as R+9, Republicans had over a 100,000 vote margin in the two closest Council of State races, and Donald Trump won over 56% of the vote in this district.

Map 16. VTD CCSC for NC-12



NC-13

The 13th congressional district is carved out of portions of the current 11th, 5th, 12th, and 10th districts. As the map that follows demonstrates, the district includes Polk, Rutherford, McDowell, Burke, Cleveland, and Gaston counties, as well as part of Mecklenburg County.

The district was generally understood to be created for Republican Speaker of the House Tim Moore who lives in Cleveland County—*The Raleigh News and Observer and Charlotte Observer*'s editorial board even referred to it as "Moore's designer district."[23] Republican Madison Cawthorn recently announced that he will run in the 13th, and Moore soon noted that he would stay in the General Assembly. While the specifics of the candidates have changed, the fact that this is a Republican district that will elect a Republican candidate has not. This district was rated by the Cook Political Report as R+13, has a CCSC of R+150,187 votes, and gave 60% of its votes to Donald Trump in 2020.

As mentioned in the discussion of NC-9, the narrow passageway that is necessary to squeeze NC-13 into Mecklenburg County only consists of a few miles at one point—stretching from a Food Lion to the Mecklenburg County line. The enacted district also creates unusual pairings of counties that share little in common. For example, Polk and Mecklenburg counties have never resided in the same district.

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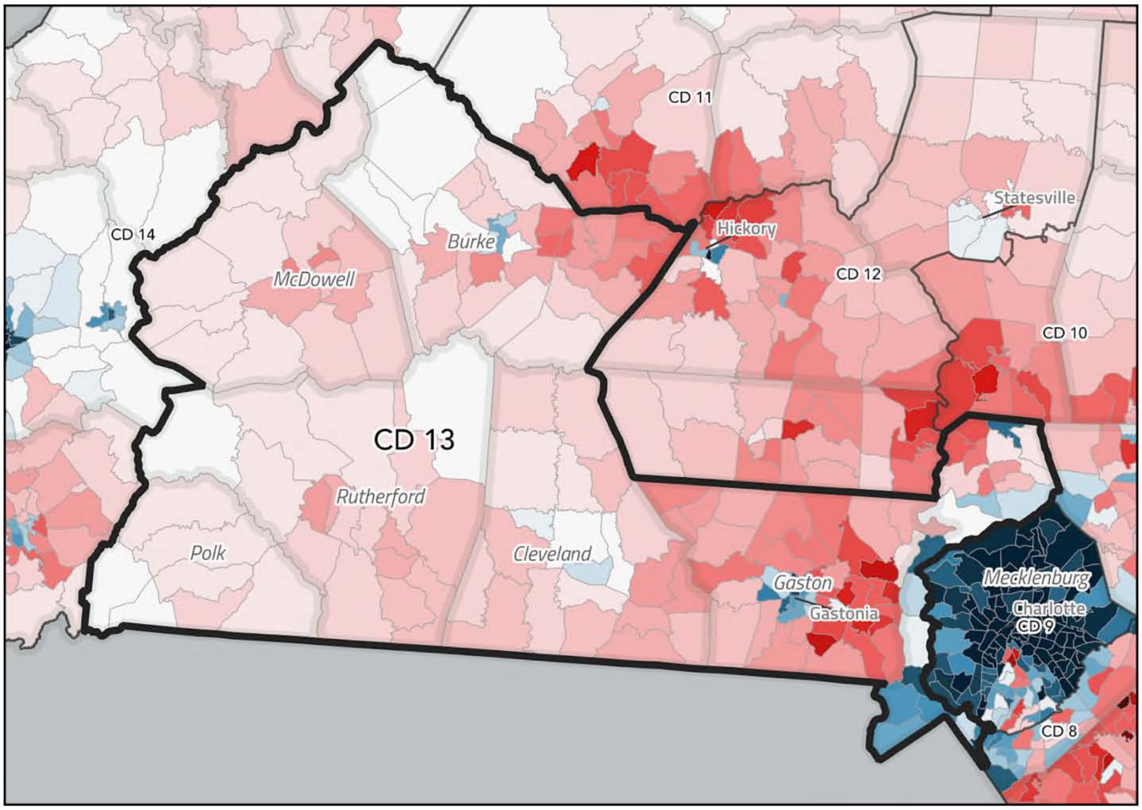
[23] "Try not to Laugh at What Madison Cawthorn Just Did to NC Republicans," *Charlotte Observer*, November 13, 2021, https://www.charlotteobserver.com/opinion/article255769626.html.

Map 17. VTD CCSC for NC-13

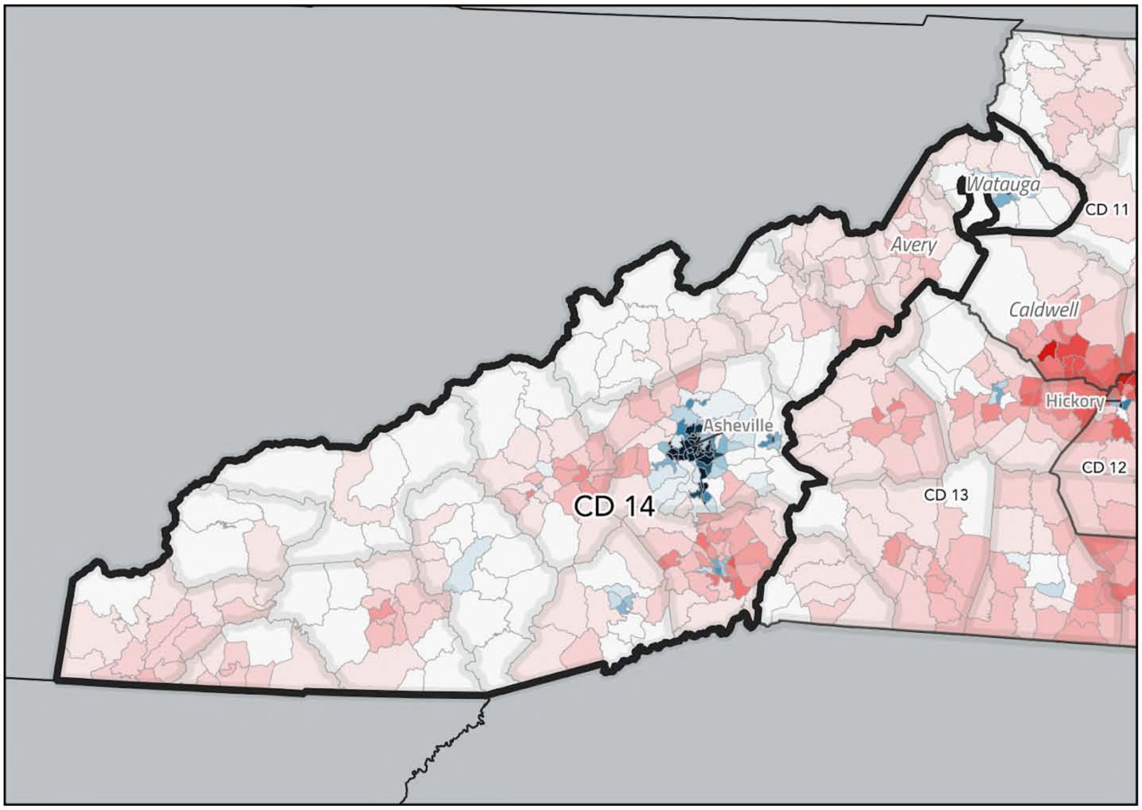


NC-14

The enacted 14th district includes most of the current 11th district as well as part of Watauga County, which previously sat in the 5th district. The current 11th district also lost the Republican strongholds of Polk and McDowell counties, as well as part of Rutherford County, which are now in the 13th district. These changes shifted the enacted NC-14 slightly in the Democratic direction (from a PVI of R+9 to R+7), although not enough to give a Democratic candidate a reasonable chance of victory. No Democrat in Congress represents a district that has a PVI score that leans this heavily towards the Republican Party. As a result, the 14th is expected to stay squarely in Republican hands.

Geographically, the 14th is a sprawling district that includes three media markets. Traversing the district from its western end in Murphy to its northeastern corner in Stony Fork would take approximately four hours. Perhaps because of the geographic incompatibility, Watauga County has not been in a district with the western end of the state since 1871—before Graham and Swain counties were even in existence. Adequately representing this massive swath of geography would be difficult for any member of Congress—Republican or Democrat.

Map 18. VTD CCSC for NC-14



General Assembly District Maps

Unlike the Congressional maps, the North Carolina House and Senate maps are minimally constrained by the *Stephenson* county clustering rule. This requires that in order to ensure relative population equality, "all counties get assigned to a distinct 'group' or 'cluster,' which can consist of either a single county or a number of adjacent counties."[24] Some districts, therefore, are contained in single district clusters that cannot be altered. For the remaining districts, however, mapmakers may have one or more types of discretion. There were four different groupings of counties where mapmakers were left to choose between more than one optimal cluster in the Senate map (yielding a total of 16 different potential county cluster maps) and three such county groupings in the House map (yielding a total of eight different potential county cluster maps).[25] And in all clusters where the population allowed for more than one district, the mapmakers had discretion over how to draw lines *within* the cluster.

In all, the General Assembly district maps benefit the Republican Party.

[24] Blake Esselstyn, "A 'Stephenson' explainer," September 2019, *available at* https://frontwater.maps.arcgis.com/apps/Cascade/index.html?appid=a408ed66ea0944308e85fe60e6e940aa.

[25] *See* Christopher Cooper, Blake Esselstyn, Gregory Herschlag, Jonathan Mattingly, and Rebecca Tippett, "NC General Assembly County Clusterings from the 2020 Census," *available at* https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf.

Senate Districts

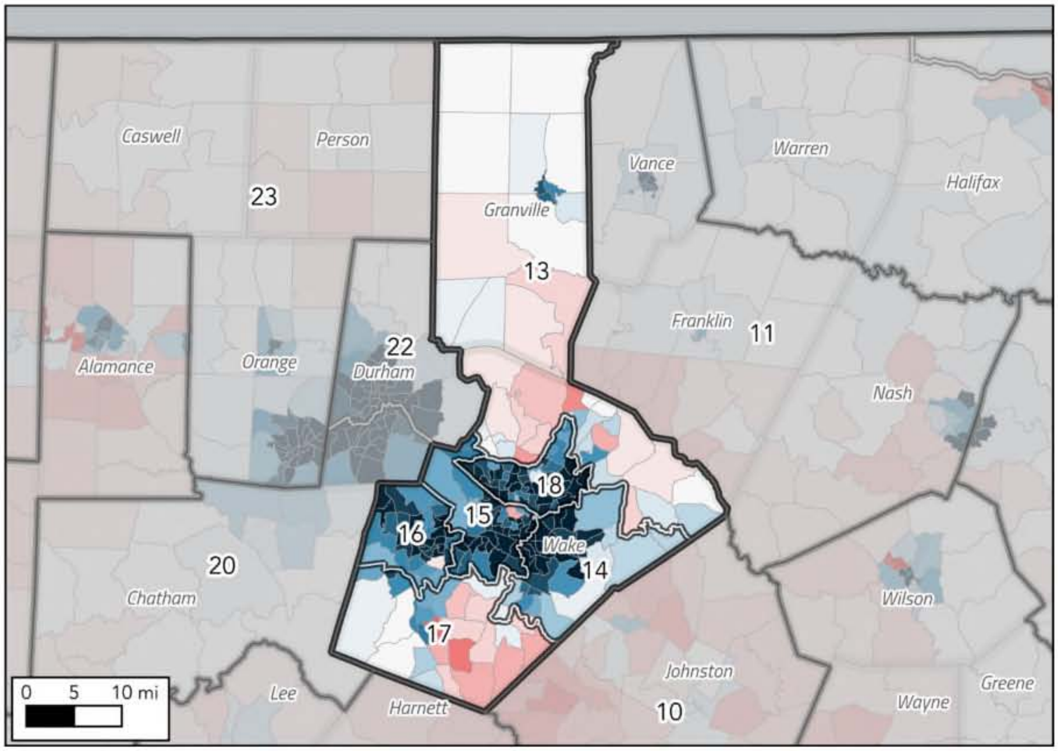
SDs 13, 14, 15, 16, 17, and 18: Granville and Wake County Cluster

Senate districts 13, 14, 15, 16, 17, and 18 are located in a cluster with Wake and Granville counties. Wake County gave 63.5% of its two-party vote share to Joe Biden in 2020. Wake County voters also supported the Democratic candidate for every statewide office and there are no Republicans on the Wake County Commission. On the other hand, Granville County is one of the most purple counties in North Carolina, supporting Donald Trump for President and Democrat Roy Cooper for Governor in 2020.

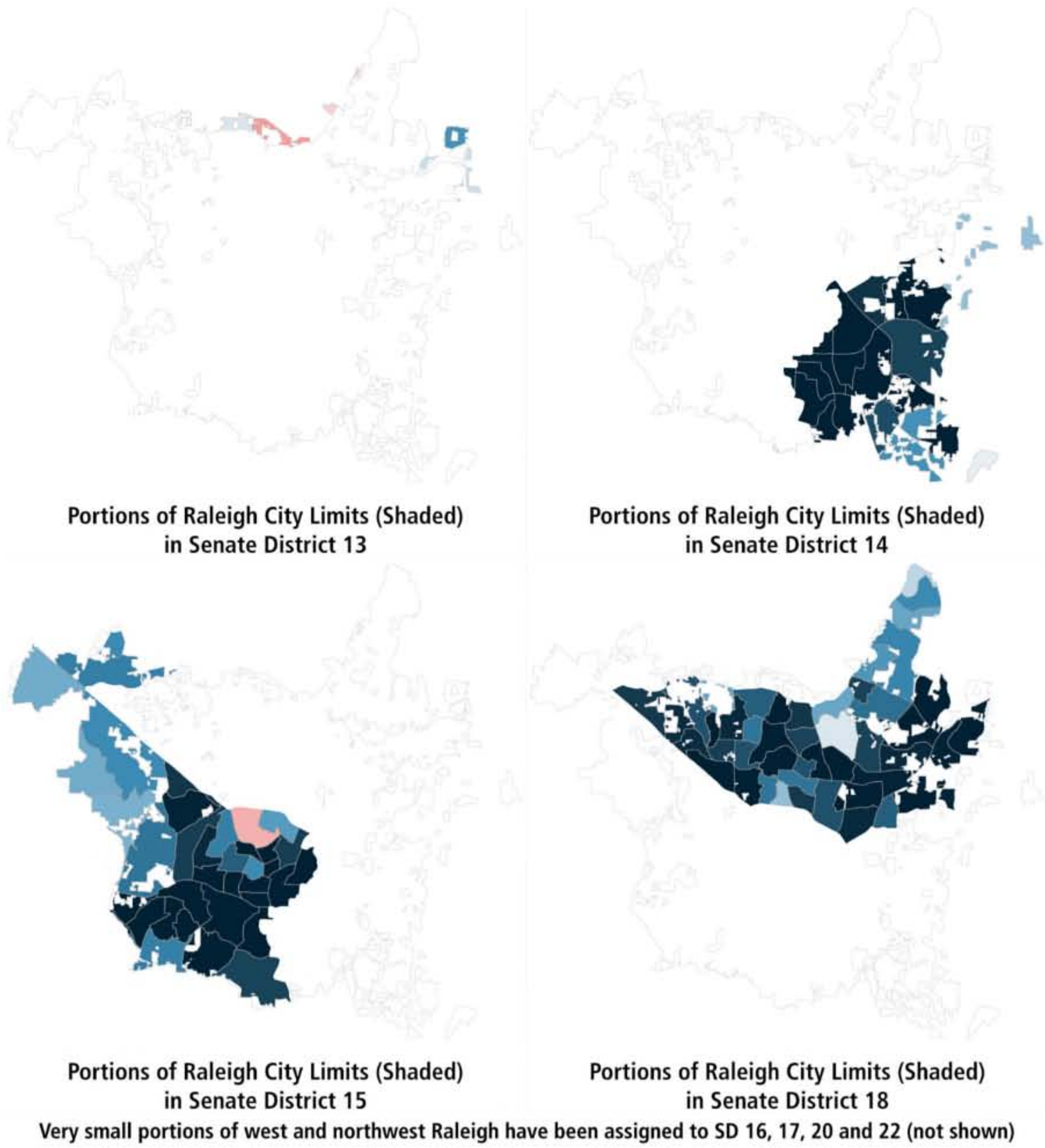
The enacted map packs Democratic VTDs in SDs 14, 15, 16, and 18 (according to the CPI, D+24, D+19, D+16, and D+15, with CCSC scores of D+93,699, D+81,915, D+59,594, and D+68,225, respectively), creating an artificially competitive SD-17 and SD-13 (both of which have a CPI score of 0, indicating no lean and a CCSC score of D+ 3,574 and R+3,686 votes, respectively). SD-13 is created by including all of Granville County and pairing it with Republican VTDs on the northern and northeastern portions of Wake County, avoiding the blue VTDs in North Raleigh, which are left in SD-18 by creating a horn-shaped section that juts up into SD-13.

The second map in this series (Map 20) demonstrates the ways in which the City of Raleigh is strategically divided across four Senate districts.

Map 19. VTD CCSC for the Granville and Wake County Cluster



Map 20. Map of Raleigh Municipal Splits

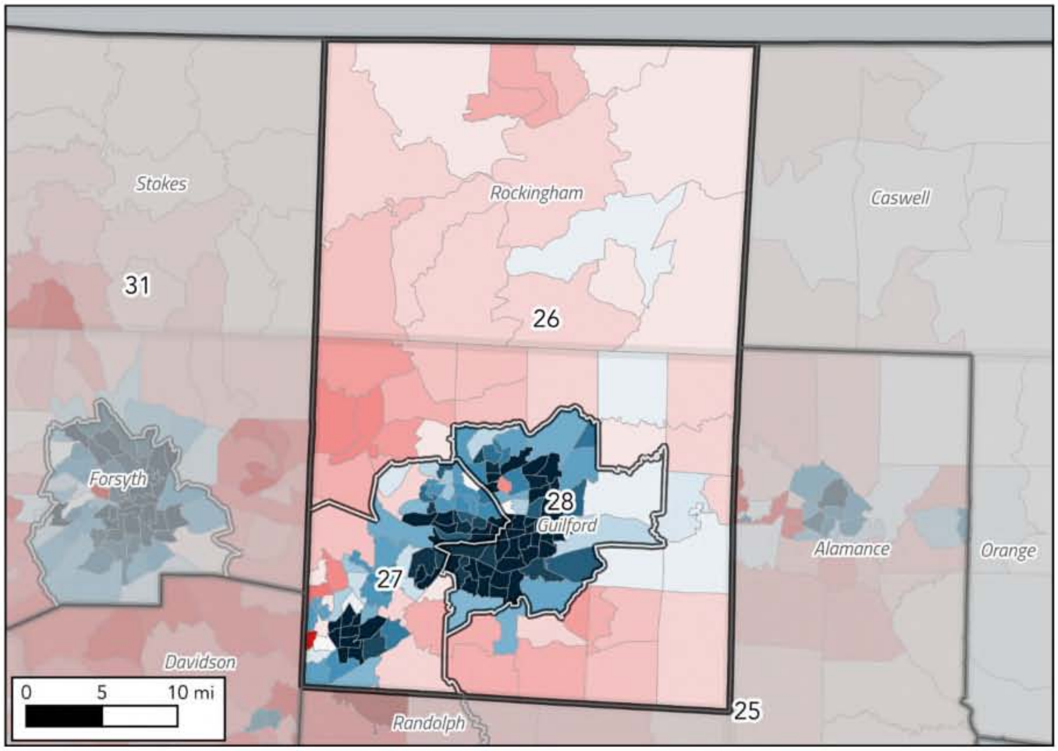


SDs 26, 27, and 28: Guilford and Rockingham County Cluster

Senate districts 26, 27, and 28 are located in a county cluster with Rockingham and Guilford counties. Rockingham County leans heavily towards the Republican Party whereas Guilford is among the most Democratic counties in North Carolina. In 2020, Guilford gave 61.7% of its vote share for President to Joe Biden, the 8th highest in the state. Guilford voters also voted for the Democratic candidate by overwhelming margins in every race decided at the county level in 2020.

The enacted map packs Democrats in SD-27 and SD-28. SD-27 is estimated to be D+12 by the CPI and has a D+50,846 CCSC score; whereas SD-28 is D+27 and has a D+104,632 advantage according to the CCSC. SD-26, on the other hand, includes all of Rockingham County and then extends southwest into Guilford County until it meets the Piedmont Triad International Airport, and east and south until it meets the eastern and southern borders of the county. SD-26's sprawling C-shape allows for a safe Republican (R+11, R+54,396) district by connecting the northern and southern portions of this cluster together.

Map 21. VTD CCSC for the Guilford and Rockingham County Cluster

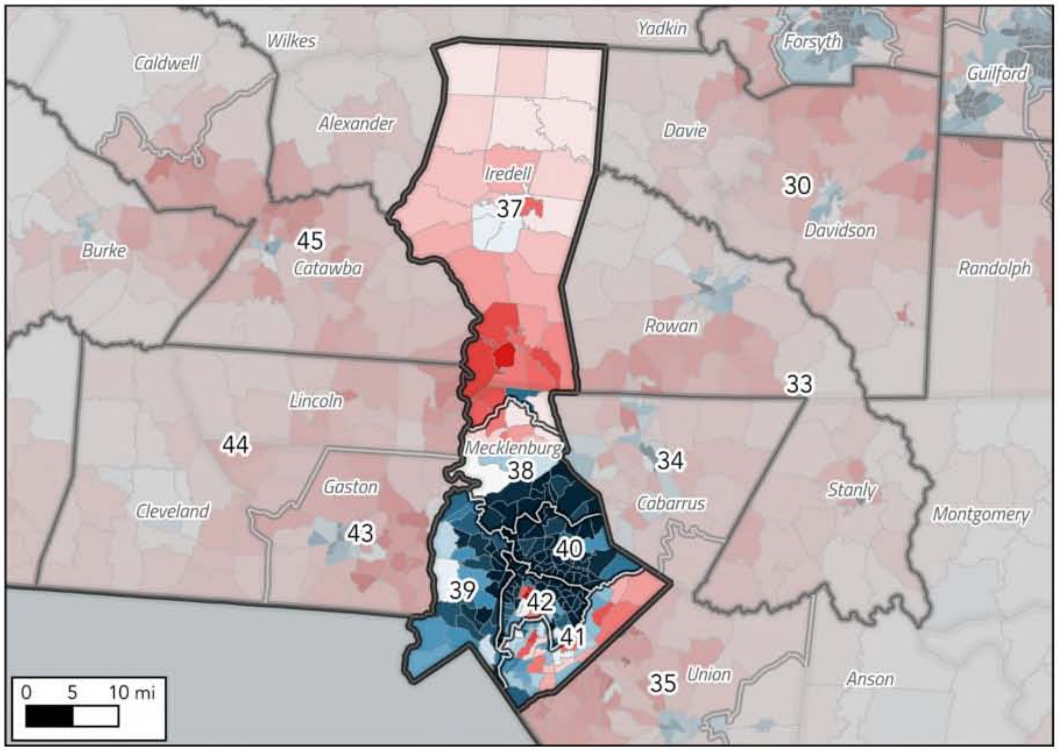


SDs 37, 38, 39, 40, 41, and 42: Iredell and Mecklenburg County Cluster

Senate districts 37, 38, 39, 40, 41, and 42 are located in a grouping that includes Iredell and Mecklenburg counties. Mecklenburg County is the second most populous and among the most Democratic counties in North Carolina. In the 2020 Presidential election, only two other North Carolina counties gave a larger proportion of their two-party vote share to Joe Biden. Every member of Mecklenburg's current state legislative delegation is a Democrat, all nine county commissioners are Democrats, and Democratic candidates received the plurality of the votes in every county-wide contest. It is clearly a Democratic stronghold, and is trending even more so in that direction.

As you can see below, the enacted map packs Democratic voters into SDs 39 and 40; neither includes a single Republican VTD and they are heavily Democratic based on CPI (D+23 and D+33, respectively) and the CCSC scores (D+71,497 and D+90,354, respectively). SDs 38 and 42 are also considered "Safe Democratic" seats (D+17, D+71,597 and D+15, D+65,179, respectively). SD-41, however, is considered a "Toss-up" seat (D+1, D+5,474) and SD-37 is a "Safe Republican" seat (R+13, 64,380). By packing Mecklenburg's Democratic voters in SDs 38, 39, 40, and 42, the mapmakers allowed for SD-41, in the south of Mecklenburg County, to be artificially competitive, while still ensuring that SD-37 remains a safely Republican district. SD-37 is also notable because it double-bunks Democrat Natasha Marcus and Republican Vickie Sawyer into the same district; Marcus' home rests approximately one mile from the border with SD-38.

Map 22. VTD CCSC for the Iredell and Mecklenburg County Cluster

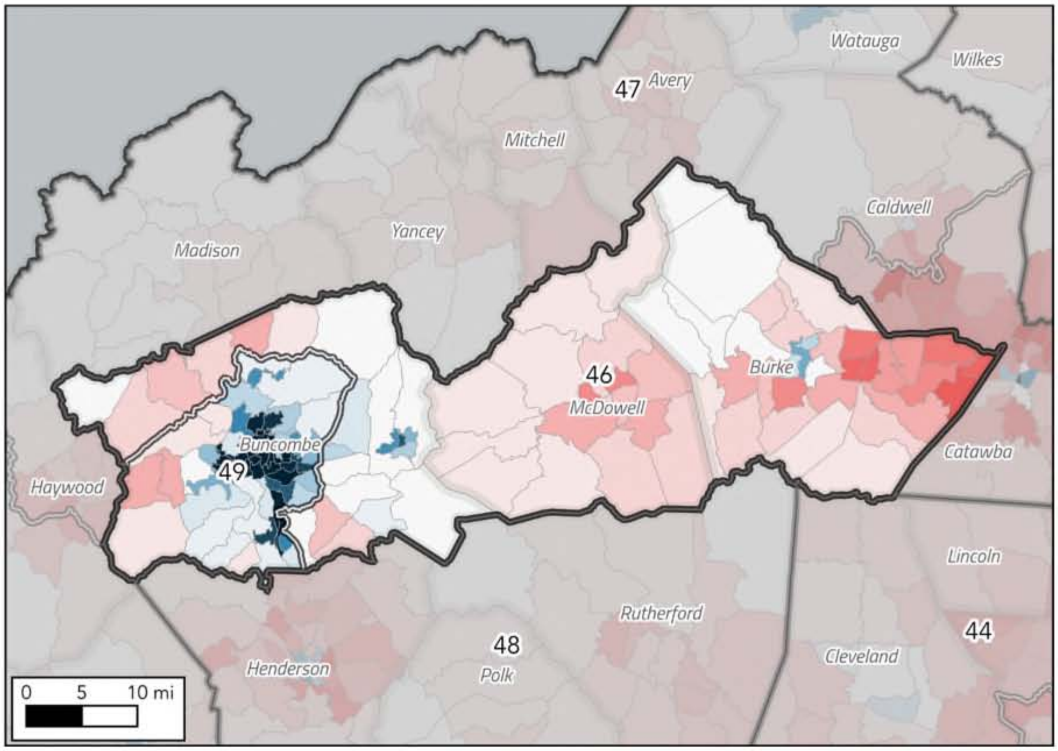


SDs 46 and 49: Buncombe, Burke, and McDowell County Cluster

Senate districts 46 and 49 are located in a county cluster with Buncombe, Burke, and McDowell counties. The map-drawers had considerable discretion here, however, as they could have instead paired Buncombe County with Henderson County, a much more natural fit since northern Henderson County, in particular, has become a bedroom community of Asheville (in Buncombe), and has considerable shared natural interests. Instead, Buncombe is paired with McDowell and Burke counties. It would take someone an hour and 45 minutes to pass from Sandy Mush on the west side this cluster to Hickory on the east side, and would almost certainly necessitate driving through both Senate districts. The enacted map also separates Asheville from the Asheville Watershed.

The effect of this choice is to pack Democratic voters in SD-49 (D+16), leaving the geographically expansive SD-46 to favor the Republican Party (R+13). By pairing Henderson with Polk and Rutherford counties in the cluster to the south, the map also creates a district heavily favored for the Republican Party in that cluster, SD-48. After the maps were enacted, incumbent Republican Chuck Edwards (currently in the Senate district covering Buncombe, Henderson, and Transylvania counties) announced he would be running for Congress and Republican State House Representative Tim Moffitt (whose current House district is in Henderson County) announced he would be running for Edwards' vacated Senate seat.

Map 23. VTD CCSC for the Buncombe, Burke, and McDowell County Cluster

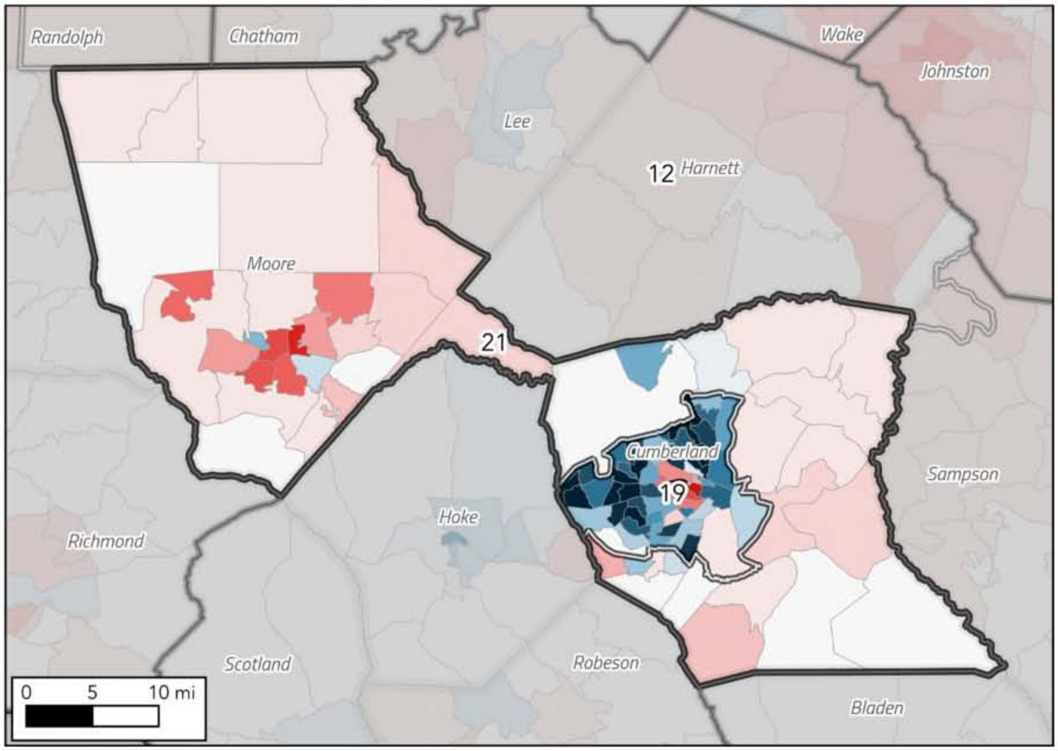


SDs 19 and 21: Cumberland and Moore County Cluster

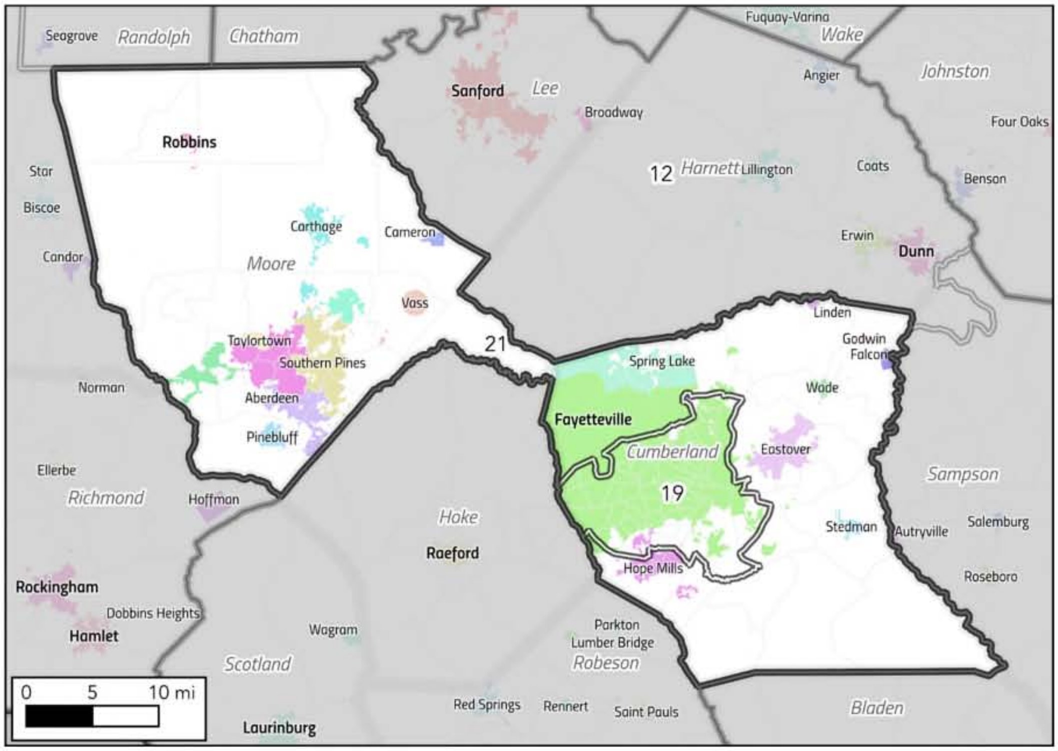
Senate districts 19 and 21 are located in a county cluster with Cumberland and Moore counties. The enacted map packs Democratic voters in and around Fayetteville into SD-19, a district that is rated D+17 by the CPI and advantaged the Democratic Party by 64,539 votes in the CCSC. SD-21 is then left to favor the Republican Party by R+9 and 41,391 votes.

As demonstrated in Map 25, the enacted map splits Fayetteville and Hope Mills across two districts and, as Map 24's red-and-blue shading displays, the district boundaries are careful to separate off Democratic voters and VTDs in SD-19 from adjacent Republican VTDs.

Map 24. VTD CCSC for the Cumberland and Moore County Cluster



Map 25. Municipal Splits for the Cumberland and Moore County Cluster



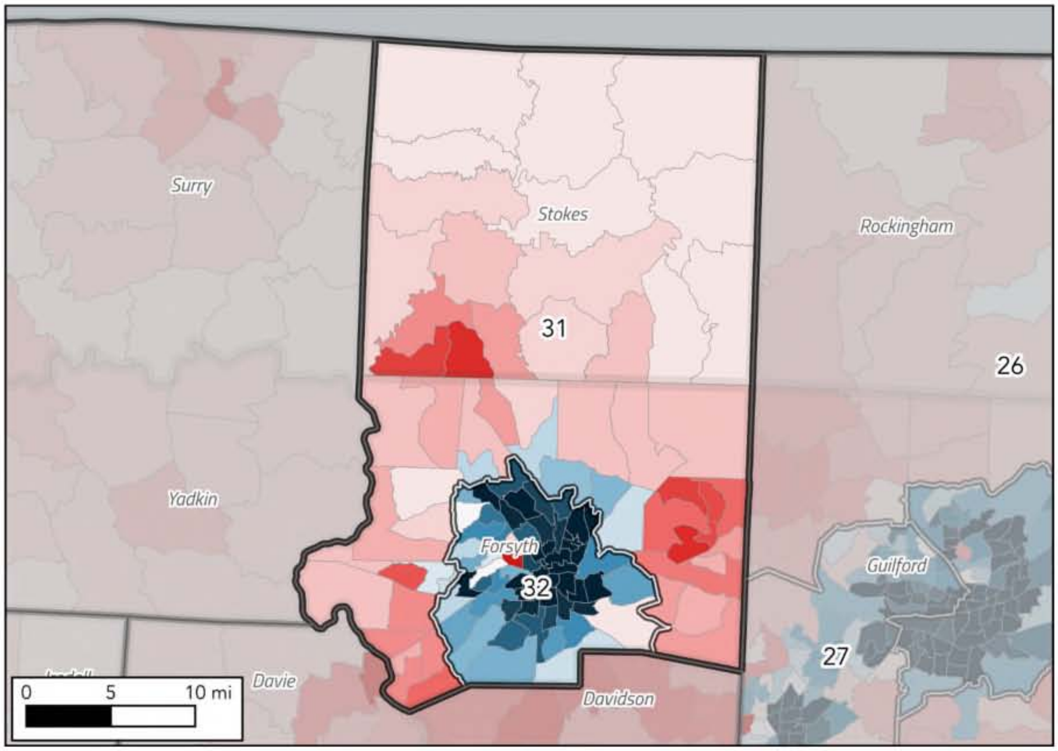
SDs 31 and 32: Forsyth and Stokes County Cluster

Senate districts 31 and 32 are located in a county cluster with Forsyth and Stokes counties. A few choices created the partisan effects of this cluster. First was the choice of the cluster, itself. The mapmakers had a choice about whether to pair Forsyth with Stokes or with Yadkin to the west. Yadkin has a lower Republican vote advantage per the CCSC. Therefore the decision to pair Forsyth with Stokes, instead, helped tip the scales towards a Republican advantage. The decisions made within the cluster reinforced that advantage.

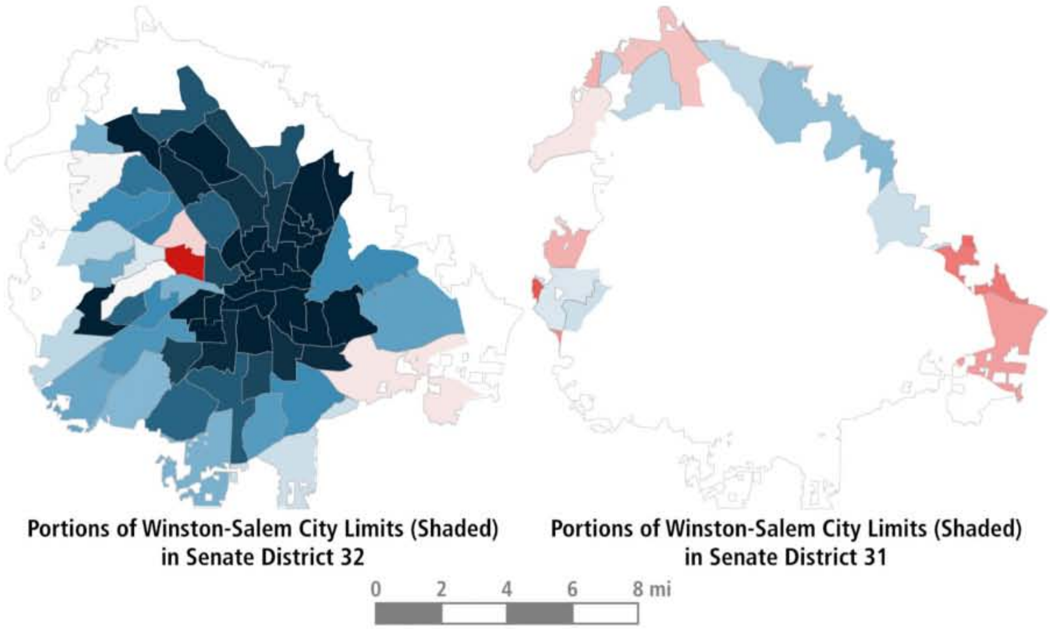
In a now familiar pattern, the enacted map packs Democratic voters in SD-32 (D+20, D+77,058) and leaves the remaining district in the cluster squarely in Republican hands. SD-31 favors the Republican Party by R+11; the CCSC favors the Republican Party by 58,073 votes.

Map 27 displays the strategic split in Winston-Salem with the most Democratic VTDs in that city packed into SD-32 while Republican SD-31 captures the more Republican VTDs on the city's edges.

Map 26. VTD CCSC for the Forsyth and Stokes County Cluster



Map 27. Map of Winston-Salem Municipal Splits

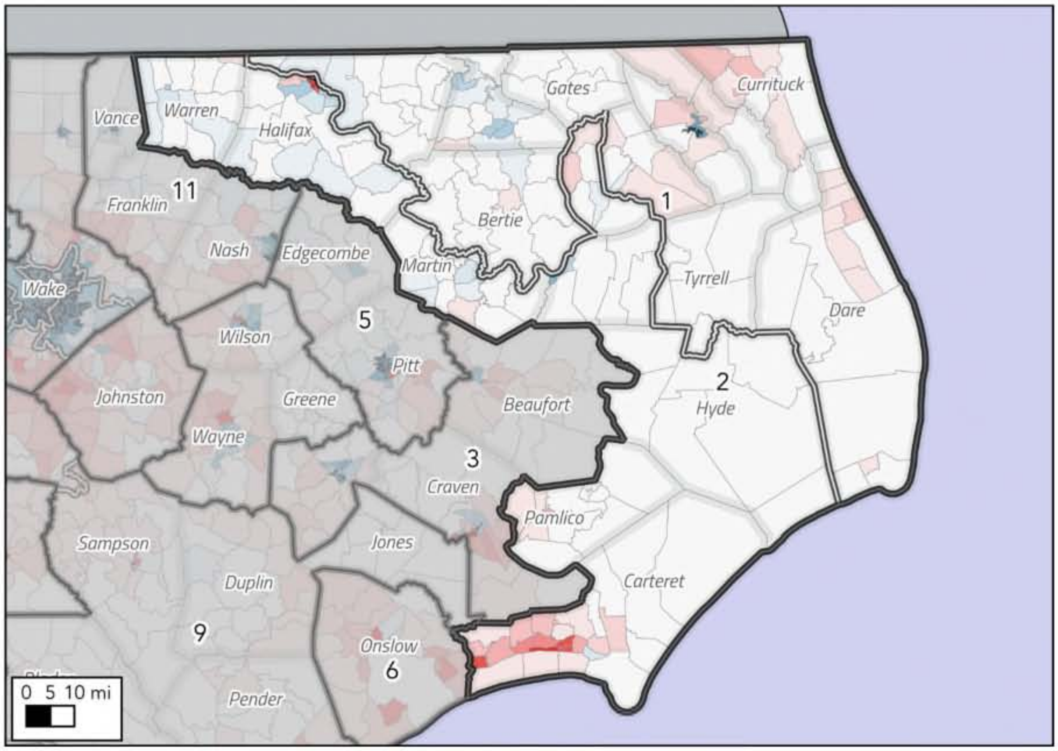


SDs 1 and 2: Northeastern County Clusters

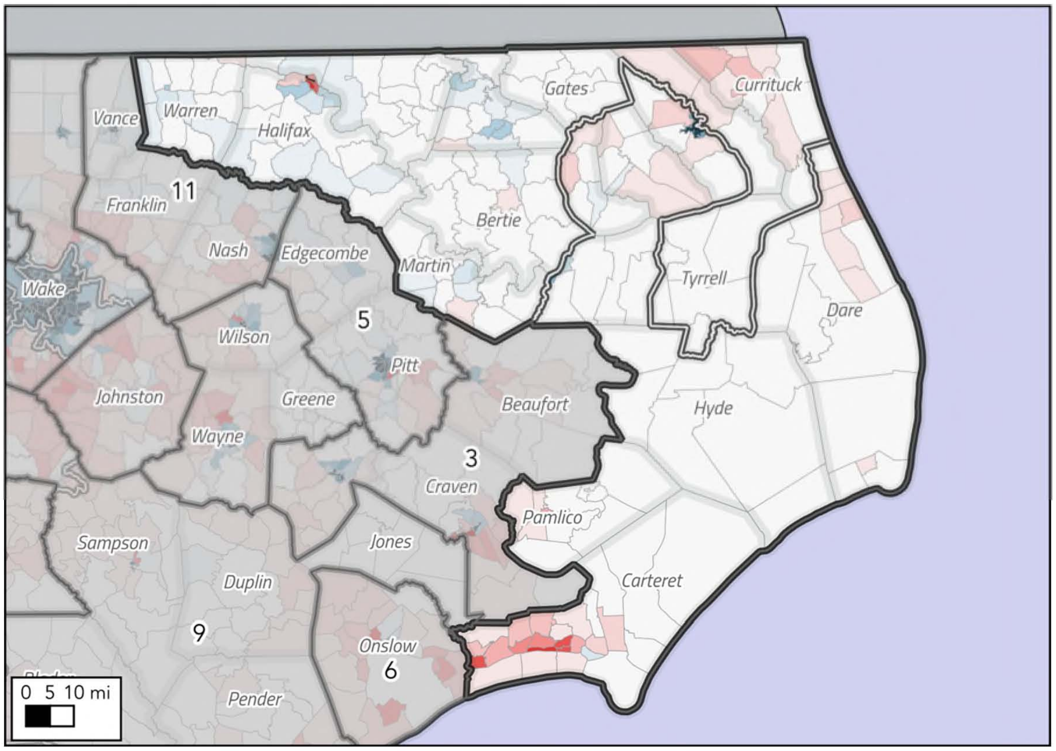
Senate districts 1 and 2 are located in two adjacent county clusters that contain Bertie, Halifax, Hertford, Northampton, and Warren counties. Many of these counties are among the most racially diverse in the state.

The mapmakers had one consequential choice to make here—the choice of which counties would be included within each cluster (the size of each cluster is such that the clusters can contain only one district, each). The choice of cluster helped tilt the scales in the direction of the Republican Party, as evidenced in Maps 28 and 29 below. If the map-drawers had chosen the alternative county cluster configuration (Map 29), the result would have been much more likely to favor the Democratic Party in one district (with a projected CCSC score of D+10,270) and the Republican Party in the other district (with a projected CCSC score of R+49,916). Instead, the enacted map pairs more Republican voters together resulting in two districts that lean towards the Republican Party (SD-1: R+2, R+16,350; SD-2: R+4, R+23,296), despite the competitiveness of most of the VTDs in this cluster.

Map 28. VTD CCSC for the Northeastern County Clusters



Map 29. Potential Northeastern County Clusters That Were Not Selected



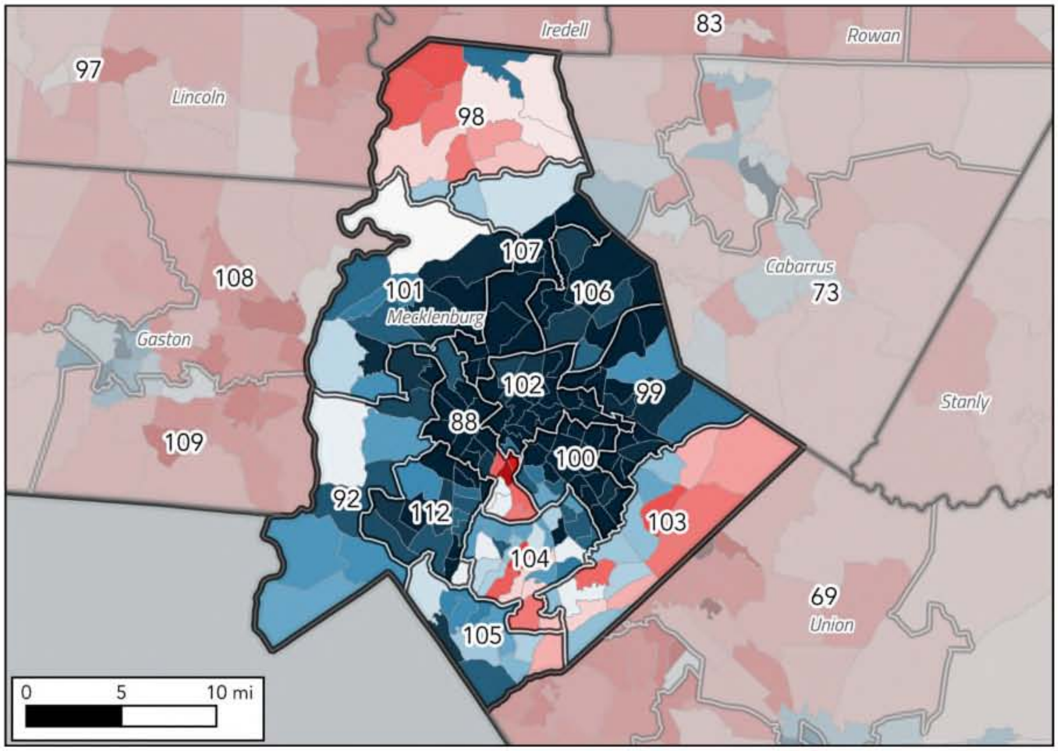
House Districts

HDs 88, 92, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, and 112: Mecklenburg County Cluster

Mecklenburg County is the home of Charlotte as well as six other municipalities. As noted above, Mecklenburg County is dominated by Democratic voters and is becoming even more so as the county continues to grow in population.

The enacted map places no Republican VTDs in HDs 92, 99, 100, 101, 102, 106, 107, and 112, leaving every Republican-leaning VTD in HDs 88, 103, 104, and 105. This arrangement provides Republican candidates the greatest probability of victory possible in this sea of blue. In particular, HDs 98 and 103 are carved out of the pockets of Republican voters in the north and southeast portions of the county so as to be particularly favorable to Republicans. HD-98 is rated by CPI as R+5 and HD-103 is rated as even, with CCSC scores of R+4,359 and R+2,645, respectively.

Map 30. VTD CCSC for the Mecklenburg County Cluster



HDs 11, 21, 33, 34, 35, 36, 37, 38, 39, 40, 41, and 49: Wake County Cluster

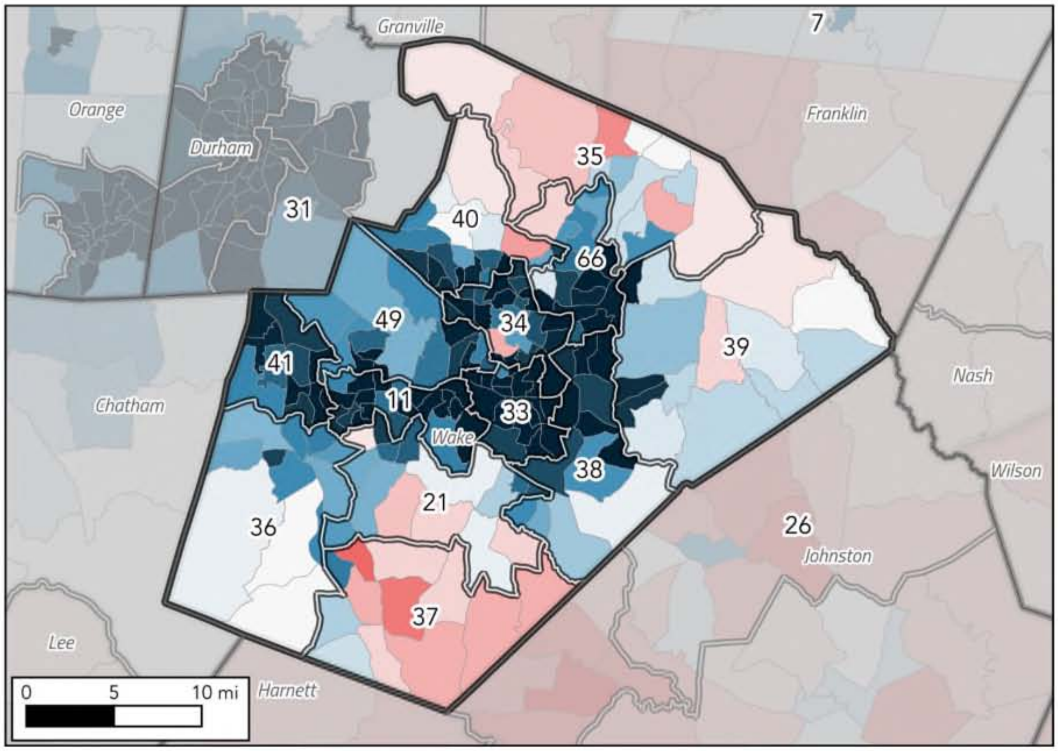
House districts 11, 21, 33, 34, 35, 36, 37, 38, 39, 40, 41, and 49 are located in the Democratic stronghold of Wake County, which includes Raleigh and 11 other municipalities. As noted above, Wake County gave 63.5% of its two-party vote share to Joe Biden in 2020 and supported Democratic candidates for every statewide office. There are no Republicans on the county commission.

The enacted map packs Democrats into as few districts as possible, creating contorted districts that, in the case of HDs 11, 33, 36, 38, 41, and 49, include no Republican VTDs. This leaves HD-37 as a Republican leaning district, which will benefit the Republican candidate Erin Pare, who narrowly defeated a Democrat in the last election. These district boundaries also increase the probability that a Republican can defeat the Democratic incumbent Terence Everitt in HD-35, in the northern portion of Wake County. HD-37 is rated as R+3 by the CPI and has a R+6,400 score; HD-35 is rate as R+1 by the CPI and has a R+2,264 CCSC score.

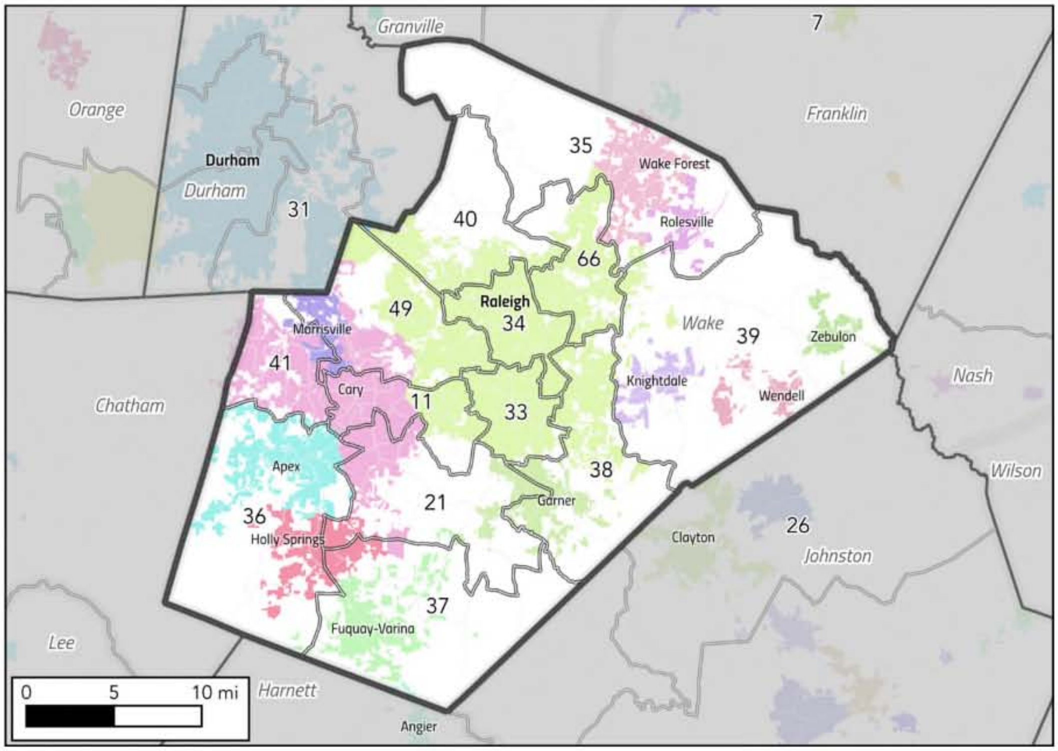
The partisan effects of small decisions are particularly apparent in the spike that juts up from HD-66 into HD-35, keeping the Democratic VTDs in that spike fenced off from the more Republican-leaning VTDs in HD-35. If the district lines took a slightly different jog here, it would increase the probability of Everitt securing re-election.

As Map 32 indicates, the enacted map also splits a number of cities both large (Raleigh, shaded in light green, split across nine districts; Cary, shaded in pink, split across four districts) and small (Garner, Fuquay-Varina, Apex, Holly Springs, and Morrisville). The district boundaries appear calculated to provide a partisan advantage for Republican candidates rather than adhere to any municipal boundaries.

Map 31. VTD CCSC for the Wake County Cluster



Map 32. Municipal Splits in the Wake County Cluster

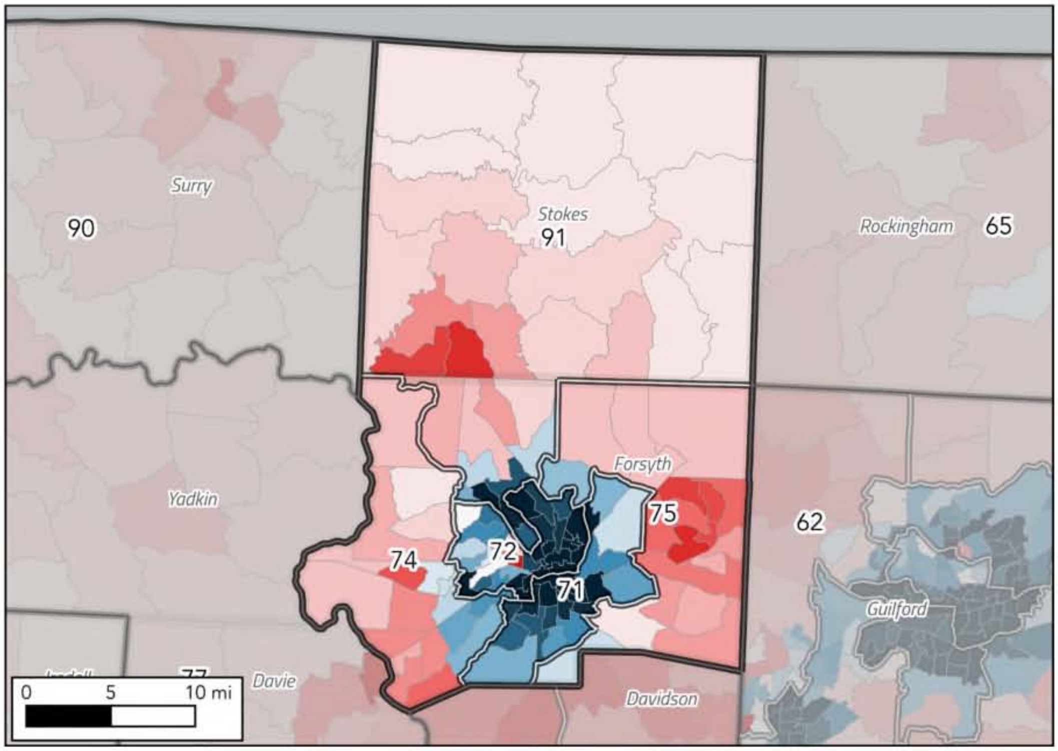


HDs 71, 72, 74, 75, and 91: Forsyth and Stokes County Cluster

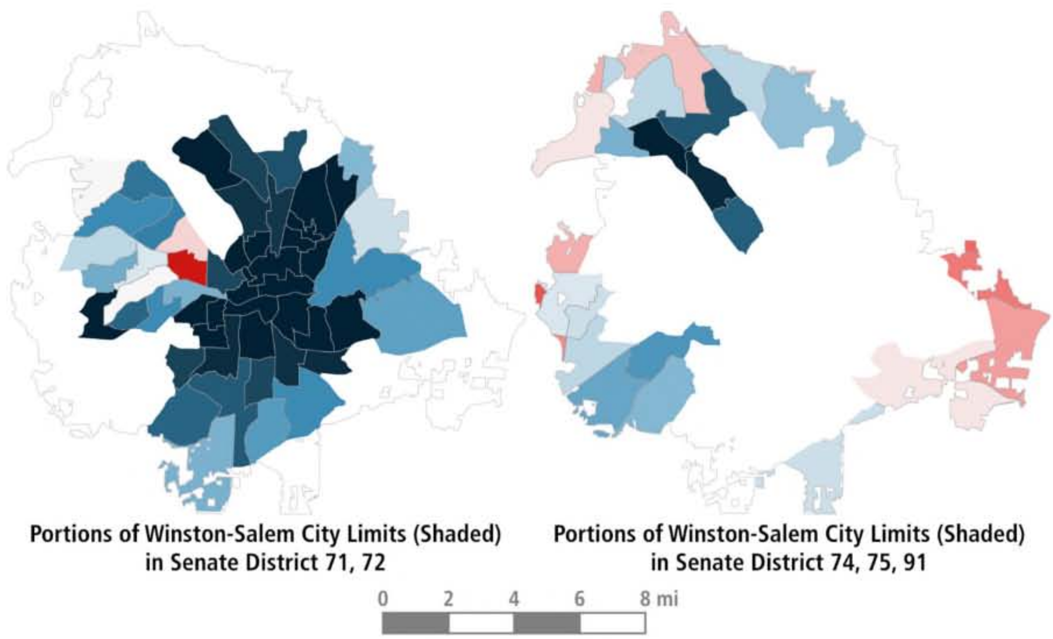
House districts 71, 72, 74, 75, and 91 are located in Forsyth and Stokes counties. The enacted map splits Winston-Salem across all five districts in this cluster and packs Democratic voters into HDs 71 and 72 (HD-71 does not include a single Republican VTD), leaving HD-75 and HD-91 almost certain to elect a Republican and HD-74 as a Republican leaning district (with a CPI score of R+3 and a CCSC score of R+7,846).

The splits of Winston-Salem do not make sense without reference to the anticipated voting behavior of the VTDs arranged into each district. For example, HD-91 includes all of Republican-leaning Stokes County, but instead of joining Stokes with a broader expanse of northern Forsyth County to create a more compact district, HD-91 juts down into the center of Winston-Salem, picking up some of the most Democratic VTDs in the cluster (which include Bethabara Moravian Church, Arts Council Theatre, and Mision Hispana VTDs—43.8% of the population in the latter VTD identifies as black and 29.5% identifies as Hispanic), ensuring that Democratic voters in the core of Winston-Salem have essentially no chance at electing a member of their own party, and dividing a major North Carolina city unnecessarily. But this arrangement does allow HD-74, to the west, and HD-75, to the east, to lean in favor of Republican candidates, despite their proximity to the deep pocket of Democratic voters in the city that those districts overlap with on their outer edges.

Map 33. VTD CCSC for the Forsyth and Stokes County Cluster



Map 34. Detail of Winston-Salem Splits



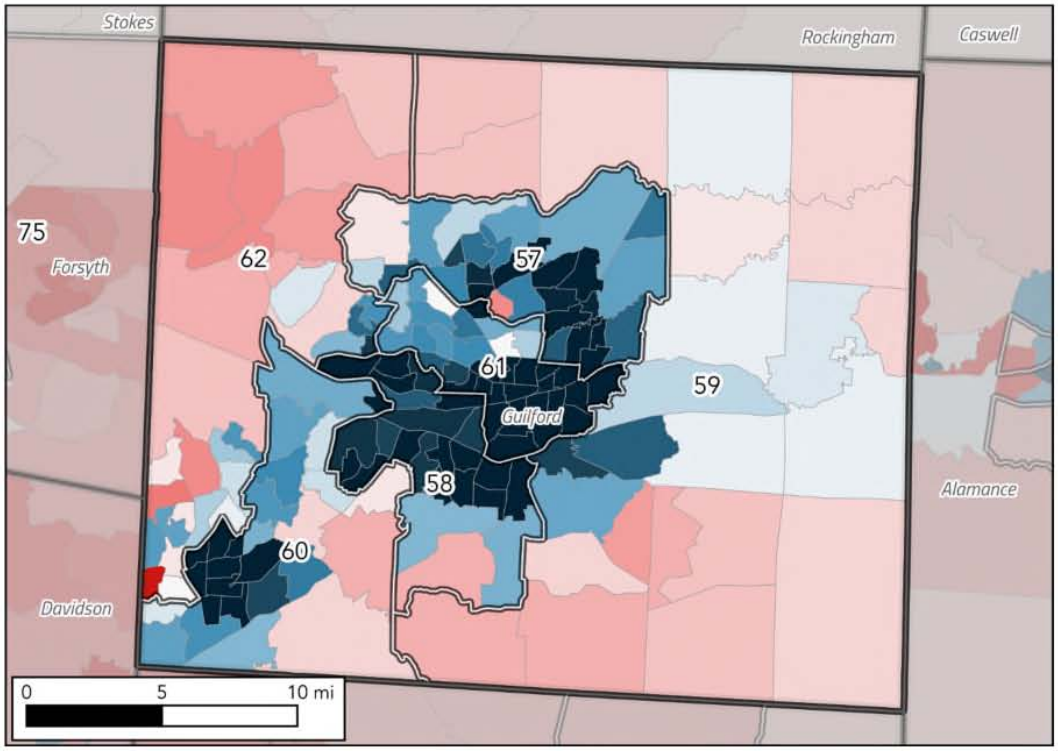
HDs 57, 58, 59, 60, 61, and 62: Guilford County Cluster

HDs 57, 58, 59, 60, 61, and 62 are all contained within the Democratic stronghold of Guilford County, which contains Greensboro and High Point. As noted above, Guilford County voters have provided Democratic candidates large margins of victory in recent state- and county-wide elections.

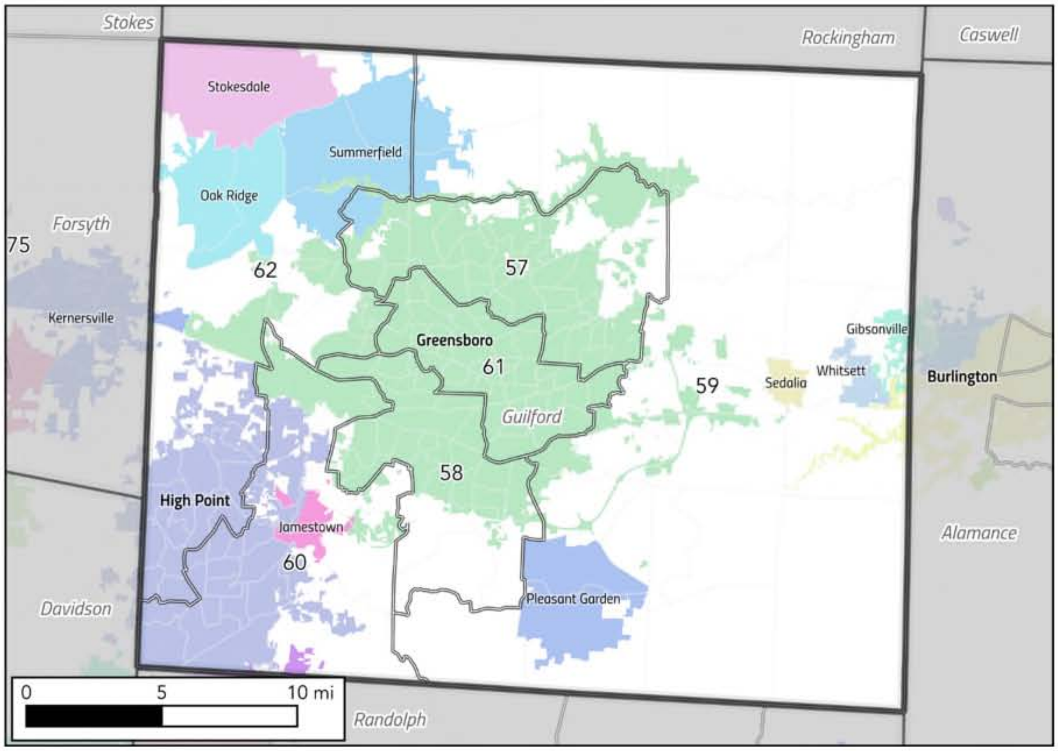
The enacted map packs Democratic voters into HDs 57, 58, 60, and 61. By studiously avoiding the Democratic leaning VTDs in the center of the county, HD-59 creates a reverse C shape that pieces together the southern and northern VTDs in an arrangement that creates district rated as R+2 by CPI, with a R+4,794 CCSC score. Meanwhile, HD-62 rests on the western edge of the county and includes pieces of both Greensboro and High Point, while avoiding the most Democratic areas of these cities. HD-62 is rated by the CPI as R+5 and has a CCSC score of R+11,030.

The enacted map splits Greensboro across all six districts and splits the city of High Point across two districts and Summerfield across three districts (*see* Map 36).

Map 35. VTD CCSC for the Guilford County Cluster



Map 36. Municipal Splits in the Guilford County Cluster



HDs 114, 115, and 116: Buncombe County Cluster

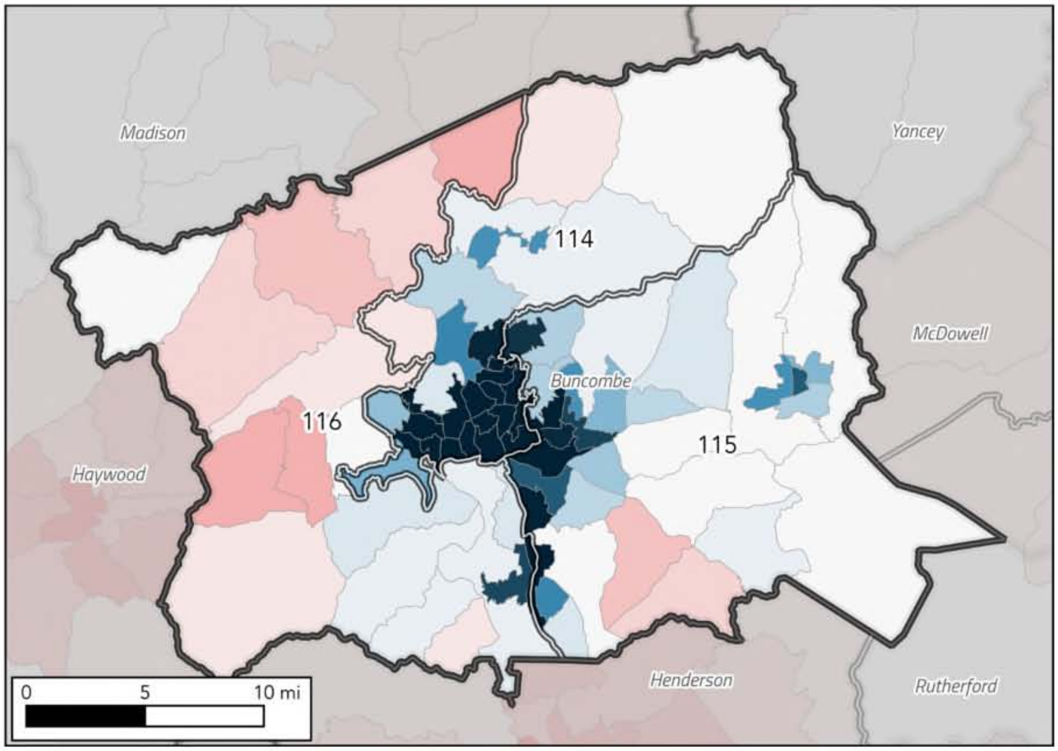
Buncombe County is located in Western North Carolina. It is anchored by Asheville, but also includes five other municipalities—Montreat, Biltmore Forest, Black Mountain, Woodfin, and Weaverville. Due to the *Stephenson* rule, Buncombe County is a single county cluster that must include three districts. Within the county, however, there were a number of choices the map-drawers had before them.

Buncombe is an overwhelmingly Democratic county and has been trending more Democratic each year. In 2020, 60.7% of the county's two-party vote share went to Joe Biden, the 10th highest in the state. Buncombe voters voted for the Democratic candidate in every county-wide contest in 2021 and Buncombe's county commission includes only one Republican.

In both the current map and the enacted map, Buncombe County includes HDs 114, 115, and 116. All three districts are currently represented by Democrats, with Susan Fisher in HD-114, John Ager in HD-115, and Brian Turner in HD-116. By shifting the current district lines where the districts meet in Asheville, however, the enacted map packs as many Democrats as possible into HD-114, while HD-115 stays relatively constant in terms of predicted vote share. The C-shaped HD-116 now includes most of the Republican-leaning VTDs in Buncombe, transforming it from a safely Democratic district into a district that leans towards the Republican Party (HD-116 is rated by CPI as R+3 and has a CCSC score of R+5,800).

The enacted map also places the pocket of overwhelmingly white voters of Biltmore Forest in the competitive HD-116, while the traditionally African American community of Shiloh to the east is left in HD-115. Soon after the maps were passed, all three Democratic incumbents announced that they would be retiring and not running for office in these newly drawn districts.

Map 37. VTD CCSC for the Buncombe County Cluster

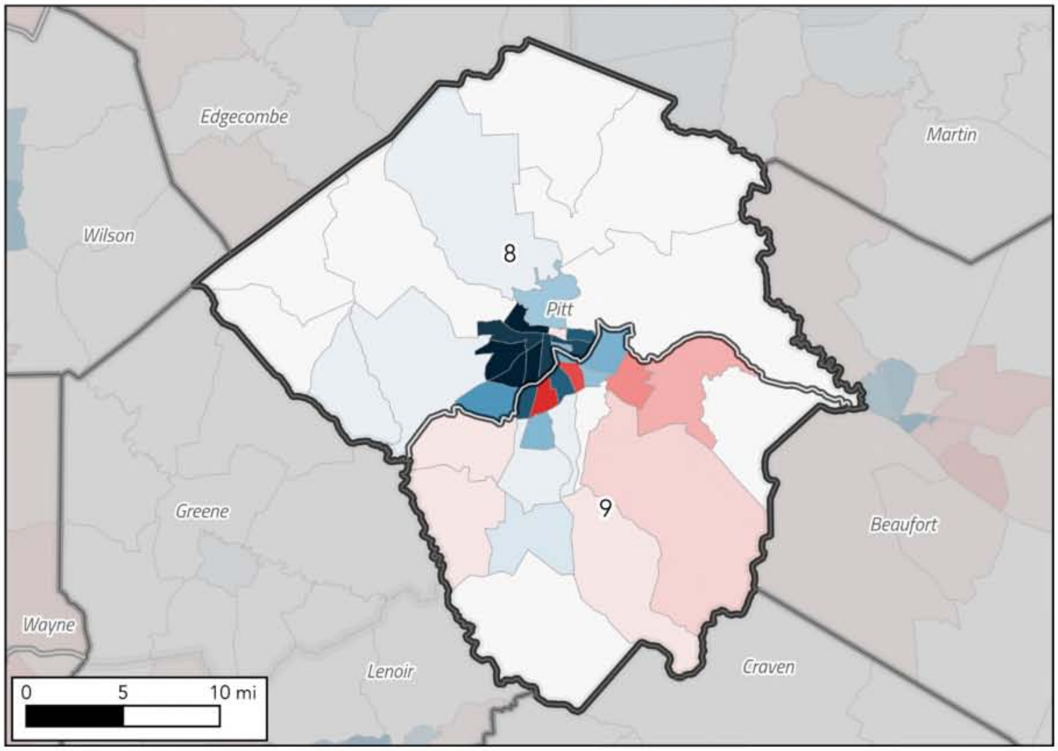


HDs 8 and 9: Pitt County Cluster

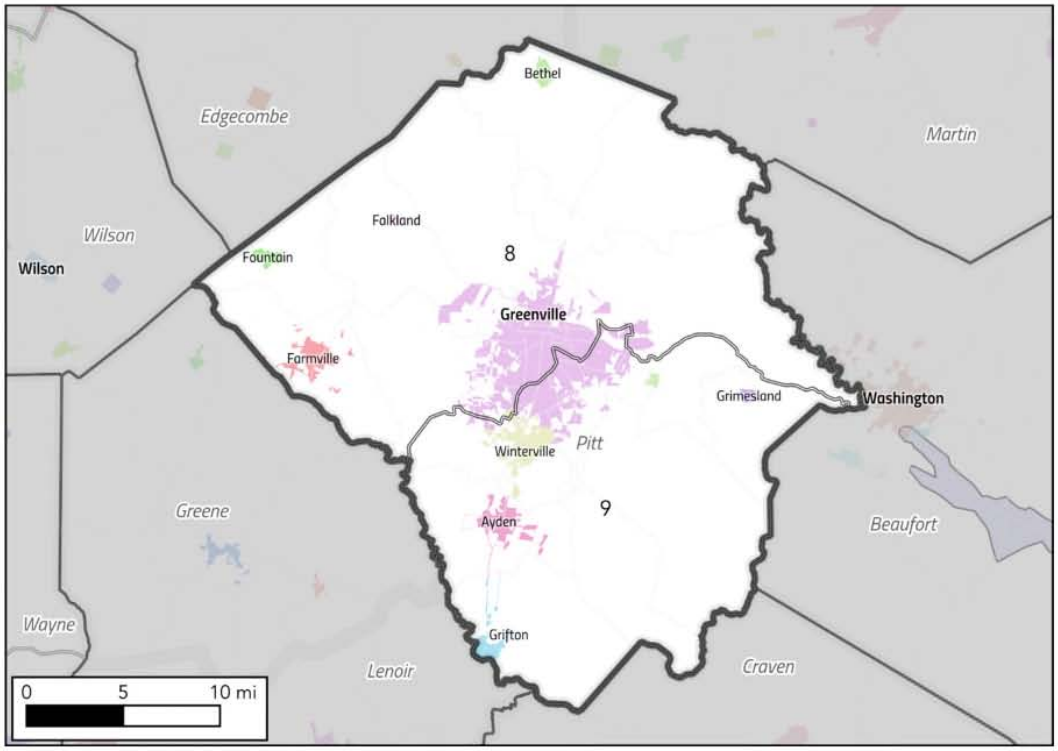
HD 8 and 9 are located in Pitt County, a county that gave 55% of its vote share to Joe Biden in the 2020 election, making it the 19th most Democratic county in the state according to this metric. The county is currently represented by two Democrats: Kandie Smith in HD-8 and Brian Farkas in HD-9.

By splitting Greenville at a particularly consequential location, the enacted map packs most Democrats in that city into HD-8 and fences them off from two Republican-leaning VTDs in HD-9. This particular division of Greenville makes HD-8 a much safer seat for Democrats and allows for a Republican-leaning district in Farkas' HD-9, which is rated by the CPI as R+3 and has a CCSC score of R+4,503. These district boundaries are difficult to explain with reference to communities of interest or natural geography. For example, students in East Carolina University's College of Health and Human Performance would take classes in HD-9, while their residence halls would be in HD-8. Similarly, as students walked from the ECU Hill District to Dowdy-Ficklen Stadium on Saturdays to watch the Pirates, they would be entering not only a sea of purple-clad football fans, but a different House district as well.

Map 38. VTD CCSC for the Pitt County Cluster



Map 39. Municipal Splits in the Pitt County Cluster

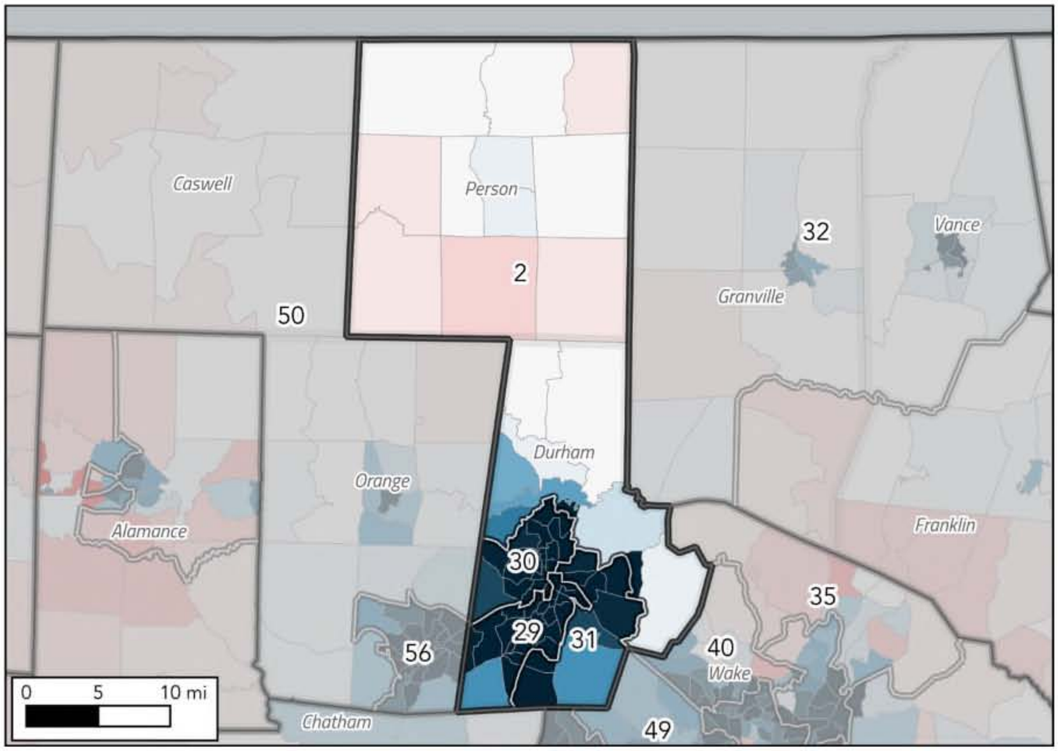


HDs 2, 29, 30, and 31: Durham and Person County Cluster

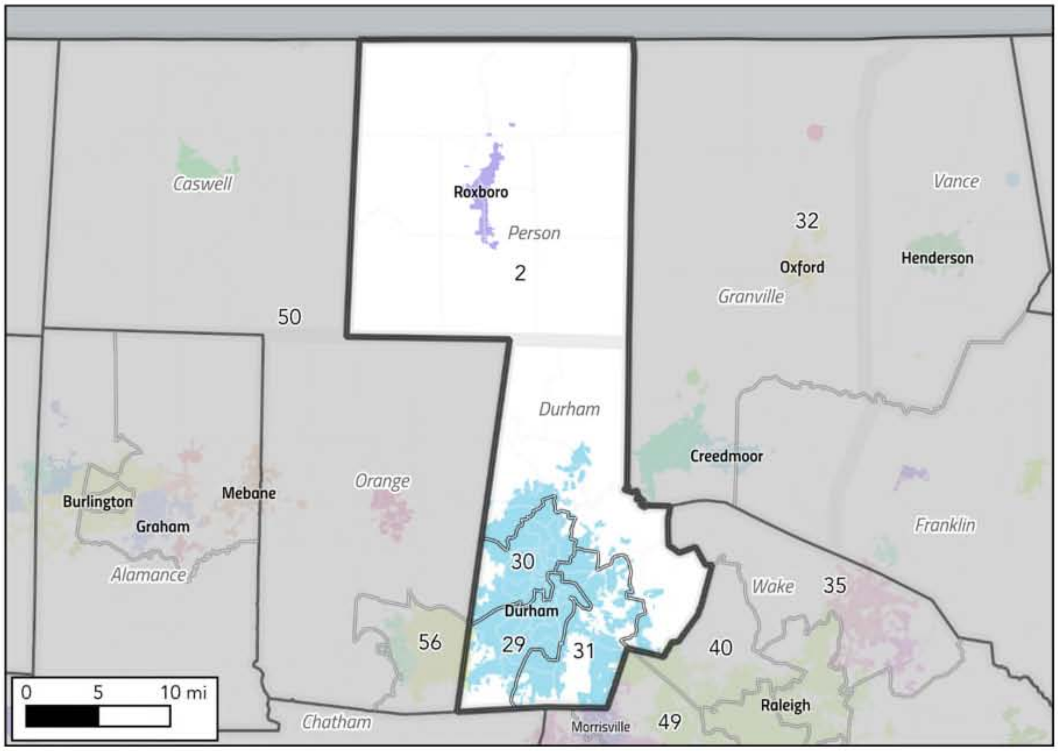
House districts 2, 29, 30, and 31 are located in a cluster with Durham and Person counties. While Person County leans towards the Republican Party, Durham County is the most Democratic county in the state, by almost any metric. Durham County gave 81.6% of its two-party vote share to Joe Biden in the 2020 election and voted overwhelmingly for Democratic candidates in every county-wide election.

The enacted map splits the City of Durham across all four districts but packs Democratic voters in HDs 29, 39, and 31; there is not a single Republican or competitive VTD in those districts. Meanwhile, HD-2 grabs all of the less Democratic and more competitive VTDs within Durham County, studiously avoiding the darkest blue VTDs in the northern end of the City of Durham. The result of these district boundaries that pack Democratic voters in the three districts in the south of Durham County is a claw-shaped appendage that allows HD-2 to be as competitive for the Republican Party as possible, giving the Republican incumbent a chance in this largely blue cluster.

Map 40. VTD CCSC for the Durham and Person County Cluster



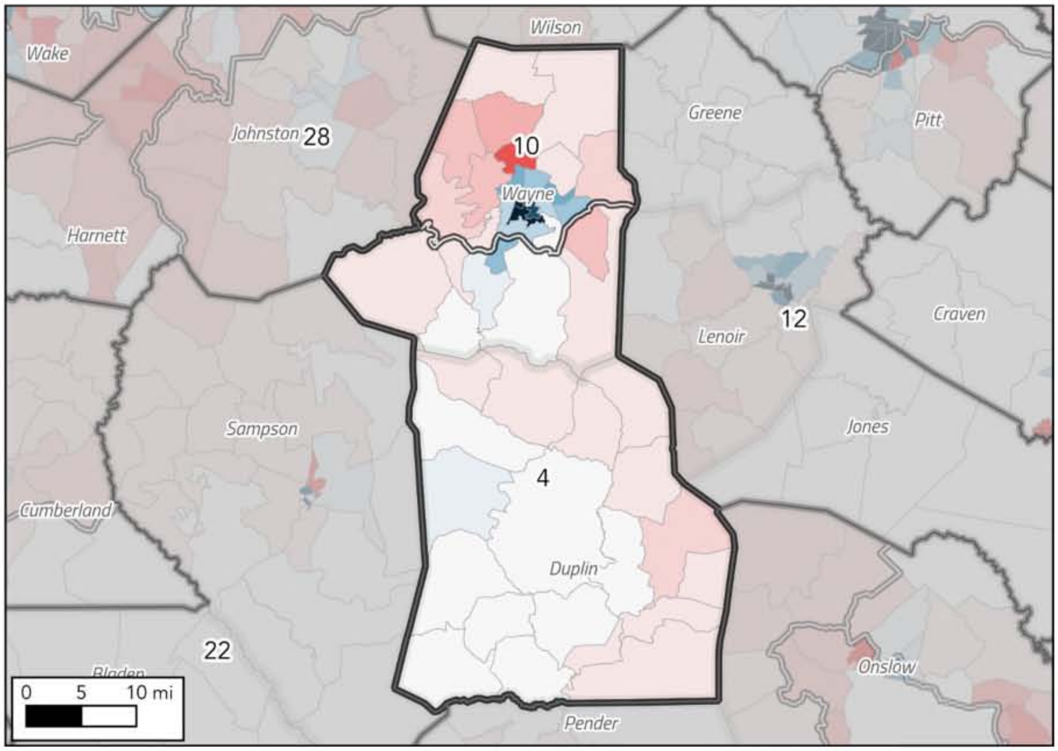
Map 41. Municipal Splits in the Durham and Person County Cluster



HDs 4 and 10: Duplin and Wayne County Cluster

House districts 4 and 10 are located in Duplin and Wayne counties, southeast of Wake County. The district boundary that runs through Wayne County ensures that there will be two Republican districts. HD-4 is rated R+8 by the CPI and advantages the Republican Party by 14,079 votes, according to the CCSC. HD-10 is rated R+3 by the CPI, with a R+4,951 CCSC advantage.

Map 42. VTD CCSC for the Duplin and Wayne County Cluster

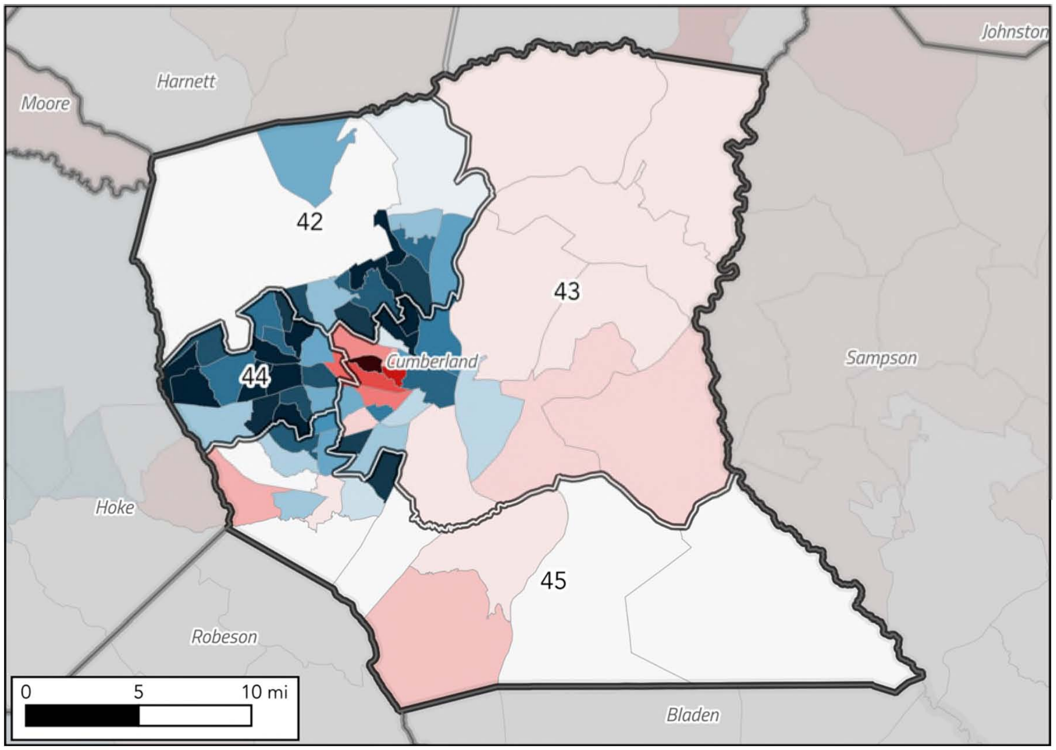


HDs 42, 43, 44, and 45: Cumberland County Cluster

Cumberland County is a heavily Democratic county, home to Fayetteville. Cumberland gave 58% of its two-party vote share to Joe Biden in 2020 and has not given the plurality of its votes for President to a Republican since 2004.

The enacted map creates two extremely competitive districts, HD-43 and HD-45 (with CCSC scores of D+1,334 and D+663, respectively) by splitting the Democratic-leaning City of Fayetteville into all four districts in the cluster. HD-43 picks up the most Republican VTDs in Fayetteville in a pattern that has partisan implications, making that district more competitive for first-term incumbent Republican Diane Wheatley. The district boundaries are also potentially confusing to voters. A citizen driving north on The All American Freeway would, in the span of about 3.5 miles, move from HD-43 to HD-44, then split the border between HD-43 and HD-44, then back into HD-44, form the border between HD-44 and HD-42, then move fully into HD-42. HD-45 includes the Republican and competitive VTDs on the south side of the county and moves into Fayetteville, but narrowly avoids the most Democratic-leaning VTDs in the city.

Map 43. VTD CCSC for the Cumberland County Cluster

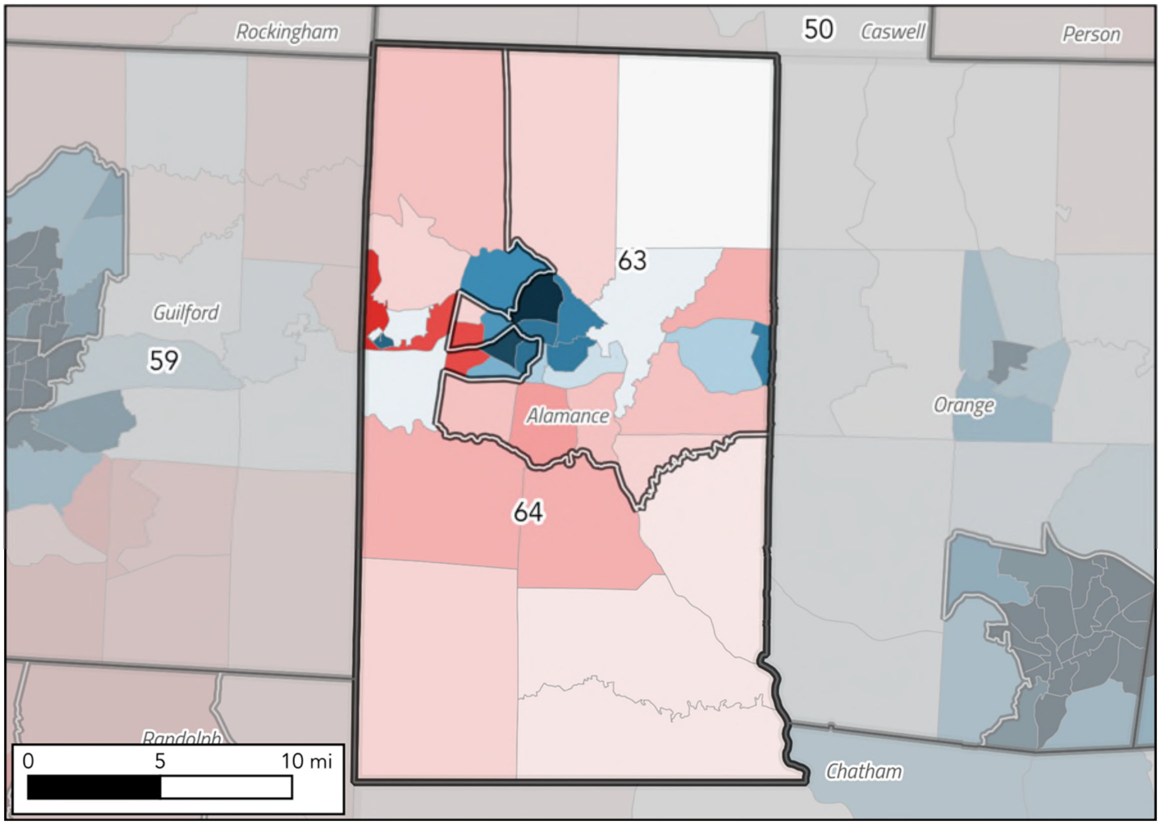


HDs 63 and 63: Alamance County Cluster

Alamance County is located between Guilford and Orange counties and includes the municipalities of Burlington, Graham, Mebane, Elon, Gibsonville, Green Level, Haw River, Ossipee, Swepsonville, and Alamance. The enacted map creates a heavily Republican HD-64 (R+8, R+13,572) and a competitive HD-63 (D+1, D+1,877) that could be challenging for the re-election of Democrat Ricky Hurtado, the only Latino legislator in North Carolina's General Assembly.

The enacted map takes a series of odd jogs around the City of Burlington in which three heavily Democratic VTDs are drawn into the heavily Republican HD-64, thus reducing the influence of those voters and leaving them walled off from HD-63 where they would be more likely to make a difference in the electoral outcome in a close district. This dovetail pattern does not follow municipal boundaries or other traditional communities of interest. At one point, the gap created between HD-63 and HD-64 is a mere three blocks wide.

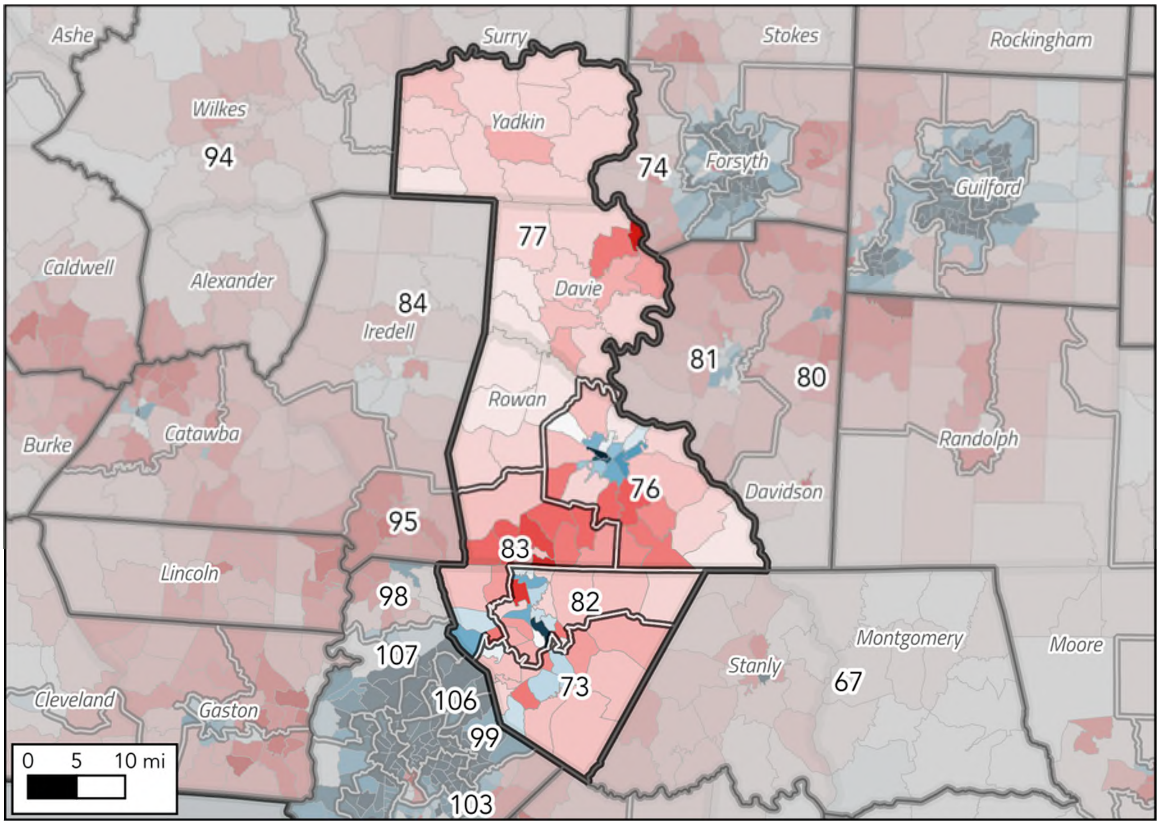
Map 44. VTD CCSC for the Alamance County Cluster



HDs 73, 76, 77, 82, and 83: Cabarrus, Davie, Rowan, and Yadkin County Cluster

This cluster is located northeast of Mecklenburg County. While the composition of these counties suggests that Republicans are likely to have an advantage in some of the potential districts in this cluster, the enacted map creates five Republican districts, ranging from a CPI of R+3 and CCSC score of R+5,578 to a CPI of R+25 and CCSC score of R+51,128. HD-82, which includes Concord and Kannapolis and is the most competitive district in the cluster as drawn, conspicuously excludes Democratic VTDs near the northeastern border of Mecklenburg County, which are placed in HDs 83 and 73.

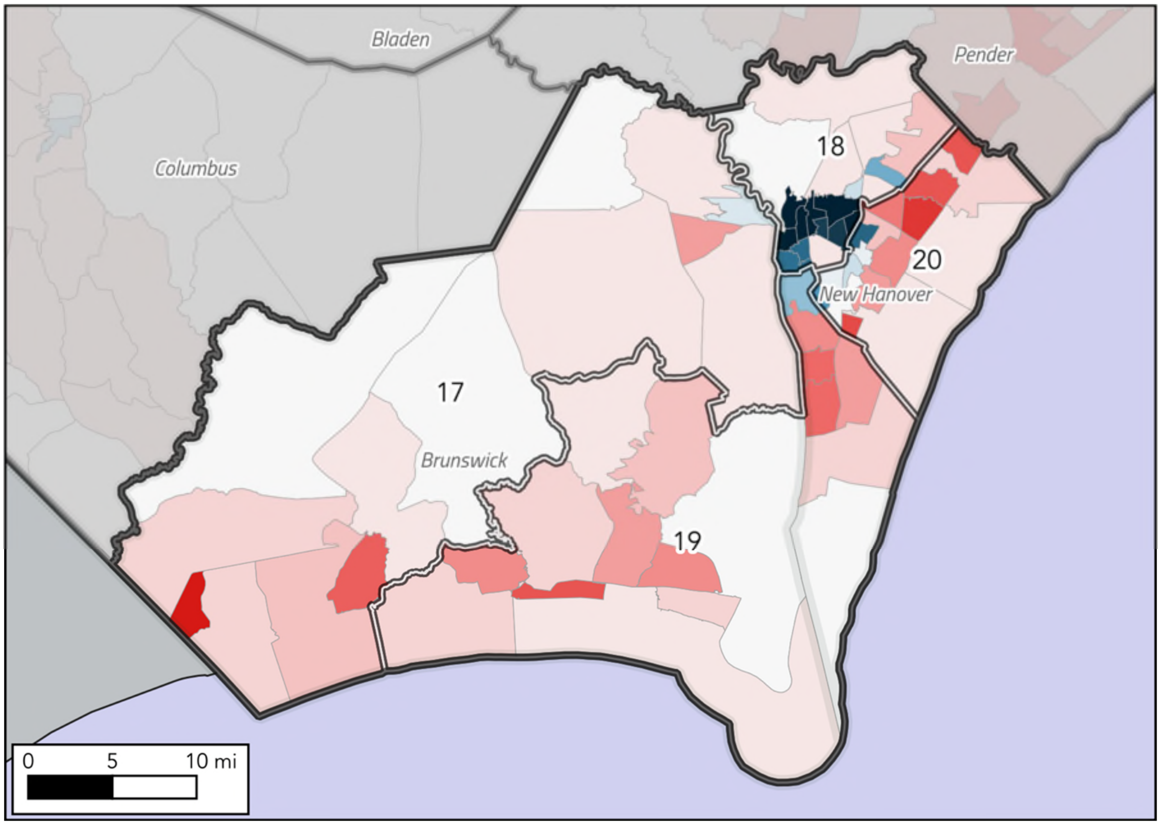
Map 45. VTD CCSC for the Cabarrus, Davie, Rowan, and Yadkin County Cluster



HDs 17, 18, 19, and 20: Brunswick and New Hanover County Cluster

The Brunswick-New Hanover cluster is located in eastern North Carolina and includes four House districts. Three of the four (HD-17, HD-19, and HD-20) lean towards the Republican Party, while HD-18 (D+11, D+20,338) packs Democratic voters in and around Wilmington, making the adjacent HD-20 (R+3, R+7,728) more competitive. The heavily Republican HD-19 also ensnares a Democratic-leaning VTD south of Wilmington, which keeps that VTD out of competitive HD-20.

Map 46. VTD CCSC for the Brunswick and New Hanover County Cluster



Conclusion

After analyzing the characteristics of all three maps as a whole, as well as the characteristics of each district in isolation, it is clear that the enacted maps will increase the number of Republicans in Congress and in the General Assembly, while decreasing the number of Democrats. Democratic voters in the vast majority of the congressional districts will have no chance at representation from a member of their own party and Republican voters in the congressional districts that pack Democrats will have no chance of representation from a member of their own party. Democratic voters are similarly disadvantaged in the Senate and House county clusters addressed above. This is not a result of natural packing or geographic clustering, but rather because the map-makers drew district lines in ways that, taken together, benefit the Republican Party. Not only do the enacted maps artificially create a substantial partisan advantage for which there is no apparent explanation other than gerrymandering, but the enacted maps also unnecessarily split communities of interest and will alter representational linkages in ways that, in some cases, have never been seen in North Carolina's history.

Christopher A. Cooper

Attachment A

December, 2021

Christopher A. Cooper

EDUCATION

Ph.D., University of Tennessee, Political Science (2002)

M.A., University of Tennessee, Political Science (1999)

B.A., Winthrop University, Political Science and Sociology (1997)

ACADEMIC POSITIONS

Madison Distinguished Professor (July 2019-Present)

Professor of Political Science and Public Affairs, Western Carolina University *(*2014-Present)

Associate Professor of Political Science and Public Affairs, Western Carolina University (2008-2014)

Associate Professor of Psychology (by Courtesy), Western Carolina University (2011-present)

Faculty Fellow, Institute for the Economy and the Future Western Carolina University (2002-2006)

Assistant Professor of Political Science and Public Affairs, Western Carolina University (2002-2008)

ADMINISTRATIVE POSITIONS

Director, Public Policy Institute, Western Carolina University (July 2008-July 2011; July 2021-present)

Department Head, Department of Political Science and Public Affairs, Western Carolina University (July 2012-July 2021; Interim from July 2011-June 2012)

Director, Master of Public Affairs (M.P.A.) Program, Western Carolina University (2005-2010)

INTERNATIONAL TEACHING

Guest Lecturer, Ludwigsburg University of Education, Ludwigsburg, Germany (May, 2018)

Guest Lecturer, Middelburg Center for Transatlantic Studies, Middelburg, the Netherlands (December, 2009; June 2012)

AWARDS

North Carolina Professor of the Year, Carnegie Foundation for the Advancement of Teaching (2013)

Board of Governors Teaching Award, WCU (2013)

University Scholar, WCU (2011)

Chancellor's Award for Engaged Teaching, WCU (2007)

Teaching-Research Award, WCU (2006)

Outstanding Achievement—Teaching, Service Learning Department (2005)

Oral Parks Award for the best faculty paper presented at the 2003 meeting of the North Carolina Political Science Association.

Artinian Professional Development Grant, Southern Political Science Association (2004; 2006)

Provost's Citation for Extraordinary Professional Promise, University of Tennessee (2002)

ADDITIONAL TRAINING

Social Network Analysis course through the Inter-university Consortium for Political and Social Research, Chapel Hill, NC (2010)

Spit Camp, Salimetrics, Inc, State College, PA (2010)

Deliberative Polling Institute, Stanford University (2008)

Hierarchical Linear Model course through the Inter-university Consortium for Political and Social Research, Amherst, MA (2005)

Summer Institute in Experimental Methods, Yale University (2003)

CATI and Ci3 training (2003)

Summer Institute in Political Psychology, Ohio State University (1999)

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**Virtual*

"The Rise of the Unaffiliated Voter in North Carolina." Presented at the State of the Parties 2020 and Beyond Virtual Conference. Ray C. Bliss Institute for Applied Politics, University of Akron. November, 2021 (with J. Michael Bitzer, Whitney Ross Manzo, and Susan Roberts).*

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"Roundtable: North Carolina and the 2020 Election." North Carolina Political Science Association. February 2021.*

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"Cooper, Christopher A., Scott Huffmon, and, H. Gibbs Knotts. "The Politics of Southern Identity" Presented at the Biennial Meeting of the Southern Studies Forum. Odense, Denmark. April, 2019

"Heritage v. Hate: Assessing Opinions in Debate Over Confederate Monuments and Memorials." Presented at the Annual Meeting of the South Carolina Political Science Association. February, 2019 (with Scott H. Huffmon, H. Gibbs Knotts, and Seth McKee).

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"Beyond Dixie: Race, Region, and Support for the South Carolina Confederate Flag." Presented at the Annual Meeting of the North Carolina Political Science Association. Pembroke, NC. March, 2005 (with H. Gibbs Knotts).

"Media Bias and American Statehouse Reporting." Presented at the Annual Meeting of the Southern Political Science Association. New Orleans, LA. January, 2005 (with Martin Johnson).

"The Impact of Institutional Design on State Legislative Representation." Presented at the 4th Annual Conference on State Politics and Policy. Kent, OH. April, 2004 (with Lilliard Richardson).

"Defining Dixie: Searching for a Better Measure of the Modern Political South." Presented at the 2004 Citadel Symposium on Southern Politics. March, 2004 (with H. Gibbs Knotts).
[Also presented at the Annual Meeting of the North Carolina Political Science Association. Elon University. March, 2004.]

"Negotiating Newsworthiness: Organized Interests and Journalists in the States." Presented at the Annual Meeting of the Southern Political Science Association. New Orleans, LA. January, 2004 (with Anthony J. Nownes).

"State Legislators in the Internet Age." Presented at the Annual Meeting of the American Political Science Association. Philadelphia, PA. August, 2003. (with Lilliard Richardson).

"Descriptive Representation in Multi-Member Districts, 1975-2002." Presented at the Annual Meeting of the Midwest Political Science Association. Chicago, IL. April, 2003 (with Lilliard Richardson).

"The Consequences of Multi-Member Districts in the State Legislature." Presented at the 3rd Annual Meeting of the Conference on State Politics and Policy. Tucson, AZ. March, 2003 (with Lilliard Richardson).

"I Learned it From Jay Leno: Entertainment Media in the 2000 Election." Presented at the Annual Meeting of the South Carolina Political Science Association. Rock Hill, SC. February 2003 (with Mandi Bates). Also presented at the Annual Meeting of the North Carolina Political Science Association. Elon, NC.

"Do Advertorials Work?" Presented at the Annual Meeting of the Southern Political Science Association. Savannah, GA. November 2002 (with Anthony Nownes).

"Legislative Representation in the Face of Direct Democracy." Presented at the 2nd Annual Conference on State Politics and Policy. Milwaukee, WI. May, 2002 (with Lilliard E. Richardson).

"Local Citizen Groups." Presented at the Annual Meeting of the Western Political Science Association. Long Beach, CA. March 2002 (with Anthony J. Nownes).

"Internet Use in the State Legislature." Presented at the Annual Meeting of the Western Political Science Association. Las Vegas, NV. March, 2001.

"Media Consumption in the State Legislature." Presented at the Annual Meeting of the Western Political Science Association. Las Vegas, NV. March 2001.

"Media and the State Legislature." Presented at the Annual Meeting of the American Political Science Association. Washington, DC. September, 2000.

"Depictions of Public Service in Children's Literature." Presented at the Annual Meeting of the International Society for Political Psychology. Seattle, WA (with Marc Schwerdt). July, 2000.

"Former State Legislators in the U.S. Congress During the 1990's." Presented at the Annual Meeting of the Southern Political Science Association. Atlanta, GA. (with Lilliard E. Richardson). August, 1999.

INVITED TALKS AND COMMUNITY SPEAKING ENGAGEMENTS

**Virtual*

"State and Local Government in NC," Leadership Asheville. December, 2021.

"The Resilience of Southern Identity." West Forum, Winthrop University. November, 2021 (with Gibbs Knotts).

"Running Elections in NC—an Insider's Perspective." Panel for Carolina Public Press. November, 2021.*

"North Carolina Politics Primer." Presented to Leadership Asheville Seniors. November, 2021.*

Co-host and Co-Moderator for Sylva Town Commission Debate. October, 2021*

"Redistricting." Presented to Politica. October, 2021*

"The Swain County Electorate." Presented to Indivisible, Swain County.*

"The Jackson County Electorate." Presented to the Jackson County NC Democratic Women.

"Introduction to North Carolina Government." Presented at the Science Policy Bootcamp and NC STEM Policy Fellowship Orientation. Sigma Chi.* June, 2021.

"The Landscape of North Carolina Politics." Presented to the NC League of Municipalities Conference, April, 2021.*

"Politics 2021" Presented to the Hendersonville Rotary. February, 2021.*

"Election Recap." Presented to NC Association of City and County Managers." February, 2021.*

"State and Local Government in North Carolina." Presented to Leadership Asheville, January 2021.*

"Election 2020: In the Rear View Mirror." Presented to Leadership Asheville Foundation. November, 2020.*

"Election 2020: In the Rear View Mirror." Presented to Sylva Rotary. November, 2020.*

"Election 2020." Presented to Leadership Asheville Seniors. October, 2020.*

"North Carolina Politics." Presented to University of Chicago Harris School Alumni Association. October 2020. *

"Election Data." Guest Lecture for Gerry Cohen's Election Law Class at the Duke University Sanford School of Public Policy. October, 2020. *

"Election 2020." City of Burlington, NC. October 2020. *

"Election 2020" Haywood Sunrise Rotary Club. October, 2020. *

Election 2020 from the Bottom Up." Asheville Chamber of Commerce Executive Committee. September 2020. *

"Election 2020." Policy on Tap. Asheville Chamber of Commerce. September 2020.

"North Carolina Elections 2020." Folkmoot. Waynesville, NC. September, 2020. *

"Measuring, Mapping and Interpreting Southern Identity." Guest Lecture for Derek Alderman's Geography of the South class. University of Tennessee, Knoxville. *

"Thoughts on Election 2020." Leadership Asheville Buzz Breakfast. August, 2020). *

"Local, Regional, and State Political Climate." Asheville Rotary Club. July, *

"Political Polarization: Causes and Consequences." Givens Estate. May, 2020; *

"Gerrymandering." Hinton Rural Life Center. February, 2020.

"Elections 2020." Hendersonville Rotary Club.

Moderator, 11th Congressional District Democratic Forum. Jackson County Library. February, 2020.

"State and Local Elections 2020." Presented at the Leadership Asheville Foundation. January, 2020.

"North Carolina Redistricting." Presented at the Asheville Chamber of Commerce. December, 2019.

"State and Local Government." Presented at Leadership Asheville. December, 2019.

"Politics 2020." Roundable on NC Spin (UNC-TV)

"A User's Guide to the 2020 Election." Presented at Life@WCU (two presentations). November, 2019.

"The Resilience of Southern Identity." Presented at Clemson University's Osher Lifelong Learning Institute. (with Gibbs Knotts). November 8, 2019.

"The Resilience of Southern Identity." Presented at the West Forum, Winthrop University. November, 2018.

"2018 Elections." Presented to the Foundation Board of Blue Ridge Public Radio. November, 2018.

"2018 Elections." Roundtable on NC Spin (UNC-TV).

"The Future of the Two-Party System." Presented at Leadership Asheville Foundation. October, 2018

"The 2018 Election" Presented at the Beth HaTePhelia Congregation Brotherhood Luncheon. October, 2018

"The 2018 Constitutional Amendments." Presented at the Cathedral of All Souls. Asheville, NC. October, 2018.

"Elections and North Carolina Politics in 2018." Presented at the NC Local Government Budget Officers Association Annual Summer Meeting. Atlantic Beach, NC. July 2018.

"State and Local Government in North Carolina." Leadership Asheville. December, 2018.

"Politics 2017." Presented at Life@WCU (two presentations). November, 2018.

Moderated 11th Congressional District Democratic Primary Debate. Canton, NC. April, 2018.

"The Resilience of Southern Identity." Madstone Café and Books. September, 2017.

Moderated Asheville City Council Debate. Givens Estate. August, 2017.

"Politics in Western North Carolina." Presented at the Hinton Rural Life Center. June, 2017.

"Redistricting." Presented at the FairVote Forum, Haywood Community College. June, 2017.

"Redistricting." Presented to the Asheville Chamber of Commerce. May, 2017.

"Man is, by Nature, a Political Animal." Presented at the Science Café. Sylva, NC. March, 2017.

"State of State Politics." Presented to Leadership Asheville Foundation Luncheon. March, 2017.

"Raising Your Voice: Contacting Your Representatives in a Polarized Age." Presented at the Haywood County Library. March, 2017.

"Politics 2017." Presented to the NC City/County Manager's Association in Durham, NC. February 2017.

"Election 2016." Presented at the WCU Alumni Association Meeting in Charlotte, NC. October, 2016.

Speaker and Moderator for Buncombe County Commissioner Debate. October, 2016.

"Election 2016." Presented at the WCU Alumni Association Meeting in Atlanta, NC. October, 2016.

"Election 2016." Presented at the South Asheville Rotary Club. October, 2016.

"Election 2016." Presented at the Buncombe County Rotary Club. October, 2016.

"Election 2016." Presented at the Sylva Rotary Club. October, 2016.

"Election 2016." Presented at Beth Hatephelia Brotherhood Lunch. October, 2016.

"Politics 2016." Presented at Life@WCU. Cullowhee and Asheville. October 2016.

"Political Polarization." Presented to the Buncombe County League of Women Voters. June 2016.

"Congress Today." Presented at Life@WCU. Cullowhee, and Asheville. November, 2015.

"Politics 2015." Presented at the Highlands Leadership Series. Highlands, NC. July, 2015.

"Politics in North Carolina." Presentation to the Nonprofit Pathways Policy Conference. January, 2015.

"Polarization in Politics." Presented at the Givens Estate, Asheville, NC. June 2015.

"Politics Today in North Carolina." Presented at Leadership Asheville. Asheville, NC. February, 2015.

"North Carolina For Nonprofits." Presented at the Nonprofit Pathways Public Policy Briefing. January 2015.

"Regional Outlook Report." Presented at Lead WNC, Cullowhee, NC. November, 2014.

"North Carolina Politics." Presented at Leadership Asheville, Asheville, NC. November, 2014.

"Election 2014." Presented at Beth Hatephelia Synagogue. Asheville, NC. October 2014.

"Electoral Politics in the United States." Presented to the Finance Directors for America's Motor Speedways. October, 2013.

"The Current State of American Civics." 2nd Annual Social Work Conference: Citizenship and Civility: Working Together for Practical Advocacy in a Polarized Era. May, 2013.

"Election 2012." Presented at Sylva Rotary Club. Sylva, NC, October, 2012.

"Election 2012." Presented at Leadership Asheville. Asheville, NC, October, 2012.

"Election 2012." Keynote address to the Motor Speedway Finance Officers. September, 2012.

"Election 2012 in North Carolina." Keynote address to the North Carolina Association of Electrical Cooperatives. September, 2012.

"Election 2012." Keynote address to the North Carolina City/County Manager's Association Summer Meeting. June, 2012.

"What Do The Data Tell Us About Hunger?" Presented at Leadership Asheville. Asheville NC, April, 2012.

"Public Opinion on Second Home Development." Presented at the Symposium on Second Home Development. Asheville, NC April, 2011.

"North Carolina Politics" (with Gibbs Knotts). Presented to the Association of North Carolina Budget Officers. Grove Park Inn, Asheville, NC. 2010.

"Engaged Scholarship and the Public Policy Institute." Presented to the Morehead State Leadership Institute, 2009.

"Progressivism in North Carolina Politics" (with Gibbs Knotts). Presented at the John Locke Foundation. Raleigh, NC, June, 2008.

"Political Change in Western North Carolina." Presented at the Economic Forecast Forum, sponsored by the NC Association of Bankers and the NC Chamber of Commerce. Raleigh, NC, January, 2008.

"Multi-Member Districts." Electoral Reform: 2006 and Beyond Conference. Columbus, OH, January, 2007.

"Rhetoric on Representation." University of California, Riverside, November, 2006.

"The Importance of Undergraduate Research." Presentation to the Winthrop University Undergraduate Research Expo. February, 2006.

"Perspectives on Economic Development Research." Presentation to Business Librarians in North Carolina. August, 2005.

"The Importance of a Political Science Education." Presentation to Winthrop University Pi Sigma Alpha Chapter Keynote speaker, Pi Sigma Alpha initiation, Winthrop University, February 2003.

CONTRACTS AND GRANTS

"Policymaking in the Shadows: Collaborative Governance, University Governing Boards and the New Politics of Higher Education." Graduate School and Research. $5000.

"Opt-In Survey." 2013. $8,896.

"Public Opinion on the Town Square Property in Black Mountain, NC." 2010. $6,000.

"French Broad River Congestion Management Plan." 2010. Subcontract from The Louis Berger Group. $5000.

"Evaluating Health Risk in Yancey County Schools." 2010. $500.

"Know Your Region." A Contract with the US Economic Development Administration. 2009. Co-PI with John Hensley. $50,000.

"American Youth Congress." 2009. NC Civic Education Consortium/Z Smith Reynolds. $6000.

"Voter Education Initiative." 2008. NC Campus Compact. $500.

"Citizen Satisfaction in Buncombe County." 2007. $16,577.

"Evaluating Health Risk in Yancey County Schools." 2007. $500.

"Regional Outlook Report." 2007. Internal Contract with the Institute for the Economy and the Future. $6,500.

WCU Summer Research Fellowship. 2007. $1500.

Co-Principal Investigator (with H. Gibbs Knotts). Sponsored contract with the city of Asheville, NC to consult about the design of a citizen satisfaction survey. $3,000.

WCU Summer Research Grant, 2001. $5000.

Yates Dissertation Fellowship, UTK, 2001. $5000.

Undergraduate Education Improvement Grant, UTK Department of Political Science, 2001. $1000.

Dissertation Fellowship, UTK Department of Political Science, 2001. $700.

TEACHING

COURSES TAUGHT

Election Administration (Graduate)
State and Local Governance (Graduate)
Political Analysis (Undergraduate)
State and Local Government (Undergraduate, Traditional and Distance Education)
Political Parties, Campaigns and Elections (Undergraduate)
Research Methods for Public Affairs (Graduate)
Southern Politics (Undergraduate)
Public Policy Analysis (Graduate)
Public Affairs Capstone Experience (Graduate)
Public Affairs Administration (Graduate)
Simulation in American Politics (Undergraduate)
Election 2012 (Undergraduate)
Interdisciplinary Approaches to the Study of Politics (Undergraduate, Freshman Seminar)
Introduction to American Government (Undergraduate)
Mass Media and American Politics (Undergraduate)
Civic Engagement (Undergraduate)
The University Experience (Undergraduate)
Advanced Writing in Political Science (Undergraduate)
Public Administration (Undergraduate)
Internship in Political Science (Undergraduate)
Co-op in Political Science (Undergraduate)
MPA Internship Experience (Graduate)
Metropolitan Government (Graduate)
Capstone in Public Affairs (Graduate)
A variety of independent studies on state politics and elections

THESIS & DISSERTATION COMMITTEES

Christopher Franklin (EdD, 2016)
John Luke McCord (MA, Psychology, 2016, Chair)
Amy Jones (EdD, 2014)
Whitney Bridges-Campbell (MA, Psychology, 2013)
Kimberlee Cooper (MA, Psychology, 2013)
David Solomon (MA, Psychology 2012)
Christopher Holden (MA, Psychology, 2012)
Jenny Smith (MA, HHP, 2011)
Benjamin Locklair (MA, Psychology, 2011)

Brandon Rice (MA, English, 2010)
Andrew Johnson (MA, Psychology , 2010)
Heidi Turlington (MA HHP, 2009)
Joe Hurley (MA, History 2006)

SERVICE

SERVICE TO THE PROFESSION

External Reviewer for Tenure and/or Promotion Cases at:
Furman University
University of Minnesota, Duluth

External Program Reviewer for:
Missouri State University Political Science, MPA, and International Studies
Tennessee Tech University Political Science
University of West Florida Political Science
Western Carolina University Higher Education Student Affairs MA Program
Western Carolina University International Programs and Services
Western Carolina University Mountain Heritage Center

Editorial Boards, Disciplinary Committees, and Section Chair Duties at Conferences

Editorial Board, Journal of Election Administration Research and Practice (2021-)
Editorial Board, Social Science Journal (2021-)
Executive Committee Member, North Carolina Political Science Association (2021-)
Chair, State Politics and Policy Quarterly Best Paper Award Committee (2021-2022)
Chair, Student Paper Committee, North Carolina Political Science Association (2021-)
Consultant, Greensboro History Museum Project Democracy 20/20 Exhibit (2021)
Section Chair for State and Local Politics Section of the Southern Political Science Association (2008)

Reviewer for [since 2010]:
American Journal of Political Science
American Political Science Review
American Politics Research
American Review of Politics
American Review of Public Administration
American Sociological Review
Association of American Geographers
Congress and the Presidency
European Journal of Personality
Geography Compass
Group Processes and Intergroup Relations
International Journal of Health Policy and Management
International Journal for the Scholarship of Teaching and Learning
International Public Management Journal
International Review of Public Administration
Journal of Appalachian Studies
Journal of Food Science Education
Journal of Hate Studies
Journal of Information Technology and Politics

Journal of Political Science
Journal of Political Science Education
Journal of Politics
Journal of Public and Nonprofit Affairs
Journal of Public Administration Research and Theory
Journal of Public Affairs Education
Justice System Journal
Landscape Research
Legislative Studies Quarterly
Personality and Individual Differences
PLOS ONE
Political Behavior
Political Communication
Political Research Quarterly
Politics and Policy
PS: Political Science and Politics
Public Administration Review
Public Opinion Quarterly
Public Budgeting and Finance
Public Management Review
Public Personnel Management
Public Performance and Management Review
Review of Public Personnel Administration
Social Science Journal
Social Science Quarterly
Social Forces
Southeastern Geographer
State and Local Government Review
State Politics and Policy Quarterly
Social Problems
Social Science and Medicine
Social Science Journal
Southeastern Geographer
Southern Cultures
Urban Affairs Review
Oxford University Press
University of South Carolina Press
Routledge
Rowman and Littlefield
Palgrave McMillan
CQ Press
Carnegie Foundation for the Advancement of Teaching
National Science Foundation

Discussant and Panel Chair Duties at Conferences

Discussant for panel on "Congressional Politics." Citadel Symposium on Southern Politics. March, 2020.

Discussant for panel on "Electoral Reform in North Carolina." North Carolina Political Science Association. February, 2011.

Chair for panel on "Economic Development Policies." North Carolina Political Science Association. Durham, NC. February, 2010.

Chair for panel on "The Future of State Politics." Southern Political Science Association. New Orleans, LA. January, 2008.

Discussant for panel on "Electoral Reform." American Political Science Association. Chicago, IL. September, 2007.

Discussant for panel on "Disaster: Politics and Policy." Policy History Conference. Charlottesville, VA. June, 2006.

Chair and Discussant for panel on "Issues in Electoral Politics." North Carolina Political Science Association. High Point, NC. March, 2006.

Discussant for panel on "Issues in American Politics." North Carolina Political Science Association. High Point, NC. March, 2006.

Discussant for panel on "North Carolina Politics." Citadel Symposium on Southern Politics. Charleston, SC. February, 2006.

Chair and discussant for panel on "State Policy. American Political Science Association. Washington, DC. September, 2005.

Discussant for panel on state politics. Annual Meeting of the Midwest Political Science Association. Chicago, IL. April, 2005.

Chair and Discussant for panel on "Electoral Politics." Annual Meeting of the North Carolina Political Science Association. Cullowhee, NC. March, 2004.

Discussant, "State Legislative Elections." Annual Meeting of the Southern Political Science Association. New Orleans, LA. January, 2004.

Discussant and Chair, "Highlighting Student Research." Annual Meeting of the South Carolina Political Science Association. Rock Hill, SC. February 2003.

Discussant and Chair, "Media Coverage of Elections and Representation." Annual Meeting of the Southern Political Science Association. November, 2002.

UNIVERSITY, COLLEGE & DEPARTMENT SERVICE

Current and Continuing

- Dept. of Political Science, Tenure, Promotion and Reappointment Committee (2008-present)
- MPA Committee (2002-present)
- Coulter Faculty Commons Advisory Board (2016-)
- University Collegial Review Committee (2020-)
- Congressional Internship Selection Committee (2018-)
- Committee on National and International Scholarships and Awards (2020-)
- Chair, Search Committee to hire Government Affairs Liaison/Deputy Chief of Staff

Previous Service

- Pathfinders Task Force to Select New Learning Management System (2020)
- Provost Search Committee (2020)
- Bookstore Director Search Committee (2020)
- Student Assessment of Instruction Task Force (2018-2019)
- Task Force to Select New Assessment Software (2018-2019)
- Regional Conference Planning Committee (2012-2016)
- Editor, Faculty Forum (2016-2019)
- COACHE survey task force (2015-2016)
- Facilitator, Leadership Summit (2015)
- Faculty Senate (2009-2015)
- SAI Standardization Task Force (2015)
- Academic Policy Review Council (2013-2015)
- Arts and Sciences Tenure, Promotion and Reappointment Committee (2008-2014)
- Chair, Search Committee for Public Administration Faculty (2015)
- Book Store Task Force (2014)
- Search Committee for Public Administration Faculty (2014)
- Search Committee to hire an Assistant Professor in Public Administration (2012-2013)
- Chair, search committee to hire a visiting assistant professor in International Relations
- Chair, search committee to hire a lecturer in American Politics and Global Issues
- Search Committee for Research Development Specialist (2014)
- Search Committee for Human Geography (2014)
- Chair, Search Committee to hire Comparative Politics Faculty (2013)
- Chair, Faculty Affairs Caucus (2010-2011; 2012-2013)
- Dean of Arts and Sciences Search Committee (2012-2013
- Faculty Affairs Caucus (2009-2014)
- Faculty Senate Planning Team (2010-2011; 2012-2013)
- Chair, 2020 Commission Subcommittee on Community Partnerships (2012)
- Chair, Search Committee to hire an Administrative Support Associate in the Department of Political Science and Public Affairs (2012)
- Chair, Search Committee to hire a Research Support Associate in the Coulter Faculty Center (2011)
- Search Committee to hire an Assistant Professor in Parks and Recreation Management (2012)
- Search Committee to hire an Assistant Professor in Public Administration (2012)
- Search Committee to hire a Visiting Assistant Professor in Public Administration (2012)
- College of Business Research Award Committee (2012)
- Institutional Review Board (2005-2011)
- Mountain Heritage Center Program Assessment Team (201!)
- Chair, American Democracy Project (2010-2011)
- Arts and Sciences Program Prioritization Task Force (2011)
- Cullowhee Revitalization Task Force (2010)
- Chair, Department Graduate Recruitment Committee
- Chair, Department Graduate Comps Committee
- Chair, Department Graduate Internship Committee
- International Relations Search Committee (2010)

- WCU/Dillsboro Partnership Task Force (2009-2010)
- QEP Assessment Committee (2007-2010)
- Arts and Sciences Teaching Award Committee (2009-2010)
- Co-Chair Social Science Research Forum (2007-2010)
- Chair, MPA Director Search Committee (2009-2010)
- Public Administration Search Committee (2009-2010)
- Chair, MPA Director Search Committee (2008-2009)
- Public Administration Search Committee (2008-2009)
- International Relations Search Committee (2008-2009)
- Chair, Graduate Research Grant subcommittee of the Research Council (2008)
- College Restructuring Task Force (2008-2009)
- Athletics Committee (2006-2009)
- Graduate Council (2006-2009)
- Research Council (2005-2008)
- Chair, Graduate Research Grant subcommittee of the Research Council (2008)
- Co-chair, Integration of Learning Award subcommittee of the Student Learning Committee (2008)
- Outreach and Engagement Committee for UNC-Tomorrow (2008)
- Humphrey Fellows Steering Committee (2007-2008)
- Chair, Public Administration Search Committee (2007-2008)
- Chair, Institutional Review Board (2005-2007)
- Chair, Public Administration Visiting Search Committee (2007)
- Public Law visiting assistant professor search committee (2006)
- International Relations visiting instructor search committee (2006)
- Congress to Campus Coordinator (2006)
- President, University Club (2006-2007)
- Arts and Sciences Strategic Planning Committee (2005-2007)
- Arts and Sciences Dean's Advisory Board (2006-2007)
- Committee Chair, National Youth Congress (April, 2005)
- Scholarship of Teaching and Learning Committee (2005-2006)
- Committee on Student Learning (2005-2008)
- ICPSR Representative for WCU (2004-2007)
- Created and Directed WCU faculty Quantitative Research Forum (2004-2005)
- Congress to Campus Coordinator (2004)
- Center for Regional Development Director Search Committee (2003)
- Public Administration Search Committee (2003)
- Co-op and Internship Coordinator, Dept. of Political Science, WCU (2002-2006)
- Webmaster, WCU Department of Political Science (2002-2007)

MEDIA APPEARANCES, ON-CAMPUS AND COMMUNITY SPEAKING

**Virtual*

- Quoted thousands of times in such media outlets including BBC (TV and Radio), CNN, Fox News, *New York Times*, *National Public Radio (All Things Considered, Weekend All Things Considered, Morning Edition), Christian Science Monitor*, Vox, *Washington Post, Wall Street Journal, Financial Times, ESPN.com, USA Today, Detroit Free Press, Raleigh News and Observer, Boston Herald*, *Business Insider, Asheville-Citizen*

Times, Charlotte Observer, Winston Salem Journal, National Journal, Rock Hill Herald, Smoky Mountain News, Hendersonville Times, Sylva Herald, Mountain Express, Yahoo Singapore News, Carolina Journal, Blue Ridge Public Radio, WUNC, WFAE, Roll Call, Waynesville Mountaineer, Voice of America, Zoomer Radio (Toronto, Canada), WLOS TV (Asheville, NC), WATV, WRAL (Raleigh, NC), WCNC (Charlotte, NC), WFSC, WJLA (Washington DC) and KISS FM, Spectrum News and many more.

Exhibit 8

NCLCV v. Hall
21 CVS 15426
LDTX176

Exhibit #
Cooper 4
JH-12/30/2021
exhibitsticker.com

Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

Criteria Adopted by the Committees

- **Equal Population.** The Committees will use the 2020 federal decennial census data as the sole basis of population for the establishment of districts in the 2021 Congressional, House, and Senate plans. The number of persons in each legislative district shall be within plus or minus 5% of the ideal district population, as determined under the most recent federal decennial census. The number of persons in each congressional district shall be as nearly as equal as practicable, as determined under the most recent federal decennial census.

- **Contiguity.** No point contiguity shall be permitted in any 2021 Congressional, House, and Senate plan. Congressional, House, and Senate districts shall be compromised of contiguous territory. Contiguity by water is sufficient.

- **Counties, Groupings, and Traversals.** The Committees shall draw legislative districts within county groupings as required by *Stephenson v. Bartlett*, 355 N.C. 354, 562 S.E.2d 377 (2002) (*Stephenson I*), *Stephenson v. Bartlett*, 357 N.C. 301, 582 S.E.2d 247 (2003) (*Stephenson II*), *Dickson v. Rucho*, 367 N.C. 542, 766 S.E.2d 238 (2014) (*Dickson I*) and *Dickson v. Rucho*, 368 N.C. 481, 781 S.E. 2d 460 (2015) (*Dickson II*). Within county groupings, county lines shall not be traversed except as authorized by *Stephenson I*, *Stephenson II*, *Dickson I*, and *Dickson II*.

  Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking. If a county is of sufficient population size to contain an entire congressional district within the county's boundaries, the Committees shall construct a district entirely within that county.

- **Racial Data.** Data identifying the race of individuals or voters *shall not* be used in the construction or consideration of districts in the 2021 Congressional, House, and Senate plans. The Committees will draw districts that comply with the Voting Rights Act.

- **VTDs.** Voting districts ("VTDs") should be split only when necessary.

- **Compactness.** The Committees shall make reasonable efforts to draw legislative districts in the 2021 Congressional, House and Senate plans that are compact. In doing so, the Committee may use as a guide the minimum Reock ("dispersion") and Polsby-Popper ("permiter") scores identified by Richard H. Pildes and Richard G. Neimi in *Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances After Shaw v. Reno*, 92 Mich. L. Rev. 483 (1993).

- **Municipal Boundaries.** The Committees may consider municipal boundaries when drawing districts in the 2021 Congressional, House, and Senate plans.

Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

- **Election Data.** Partisan considerations and election results data *shall not* be used in the drawing of districts in the 2021 Congressional, House, and Senate plans.

- **Member Residence.** Member residence may be considered in the formation of legislative and congressional districts.

- **Community Consideration.** So long as a plan complies with the foregoing criteria, local knowledge of the character of communities and connections between communities may be considered in the formation of legislative and congressional districts.

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, et al.,

REBECCA HARPER, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

Consolidated with
21 CVS 500085

AFFIDAVIT OF SEAN P. TRENDE

Now comes affiant Sean P. Trende, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and am competent to testify regarding the matters discussed below.

2. For the purposes of this litigation, I have been asked by counsel for Legislative Defendants to analyze relevant data and provide my expert opinions.

3. To that end, I have personally prepared the rebuttal report attached to this affidavit as Exhibit A, and swear to its authenticity and to the faithfulness of the opinions.

FURTHER THE AFFIANT SAYETH NAUGHT.

NCLCV v. Hall
21 CVS 15426
LDTX179

Exhibit #
Cooper 7
JH-12/30/2021
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Executed on 28 December, 2021.

Sean P. Trende

Sean P. Trende

STATE OF FLORIDA

COUNTY OF PINELLAS

Sworn to and subscribed before me by online notarization this 28th day of December, 2021, by SEAN P. TRENDE, who appeared by way of two-way audio/video communication technology, and he provided his Ohio driver's license as identification.

Cynthia D. Glaros
Notary Public, State of Florida
My Commission Expires: 06/30/2022

Cynthia D. Glaros
Notary Public, State of Florida
Commission # GG228737
My Commission Expires June 30, 2022

Online Notary Public. This notarial act involved the use of online audio/video communication technology.

Exhibit A

EXPERT REBUTTAL REPORT OF SEAN TRENDE

Now comes affiant Sean P. Trende, having been first duly cautioned and sworn, deposes and states as follows:

1. I am over the age of 18 and am competent to testify regarding the matters discussed below.

2. I currently reside at 1146 Elderberry Loop, Delaware, OH 43015. My e-mail is trende.3@buckeyemail.osu.edu.

3. I have been retained in this matter by the Legislative Defendants, and am being compensated at $400.00 per hour for my work in this case.

4. My *curriculum vitae* is attached to this report as Exhibit 1.

EXPERT CREDENTIALS

5. I am currently enrolled as a doctoral candidate in political science at The Ohio State University. I have completed all of my coursework and have passed comprehensive examinations in both methods and American Politics. My coursework for my Ph.D. and M.A.S. included, among other things, classes on G.I.S. systems, spatial statistics, issues in contemporary redistricting, machine learning, non-parametric hypothesis tests and probability theory. I expect to receive my Ph.D. in May of 2021. My dissertation focuses on applications of spatial statistics to political questions.

6. I joined RealClearPolitics in January of 2009 after practicing law for eight years. I assumed a fulltime position with RealClearPolitics in March of 2010. My title is Senior Elections Analyst. RealClearPolitics is a company of around 40 employees, with offices in Washington D.C. It produces one of the most heavily trafficked political websites in the world, which serves as a one-stop shop for political analysis from all sides of the political spectrum

and is recognized as a pioneer in the field of poll aggregation. It produces original content, including both data analysis and traditional reporting. It is routinely cited by the most influential voices in politics, including David Brooks of *The New York Times*, Brit Hume of *Fox News*, Michael Barone of *The Almanac of American Politics*, Paul Gigot of *The Wall Street Journal*, and Peter Beinart of *The Atlantic*.

7. My main responsibilities with RealClearPolitics consist of tracking, analyzing, and writing about elections. I collaborate in rating the competitiveness of Presidential, Senate, House, and gubernatorial races. As a part of carrying out these responsibilities, I have studied and written extensively about demographic trends in the country, exit poll data at the state and federal level, public opinion polling, and voter turnout and voting behavior.

8. In particular, understanding the way that districts are drawn and how geography and demographics interact is crucial to predicting United States House of Representatives races, so much of my time is dedicated to that task.

9. I am currently a Visiting Scholar at the American Enterprise Institute, where my publications focus on the demographic and coalitional aspects of American Politics. My first paper focused on the efficiency gap, a metric for measuring the fairness of redistricting plans.

10. I am the author of *The Lost Majority: Why the Future of Government is up For Grabs and Who Will Take It.* In this book, I explore realignment theory. It argues that realignments are a poor concept that should be abandoned. As part of this analysis, I conducted a thorough analysis of demographic and political trends beginning in the 1920s and continuing through the modern times, noting the fluidity and fragility of the coalitions built by the major political parties and their candidates.

11. I co-authored the 2014 *Almanac of American Politics*. The Almanac is considered the foundational text for understanding congressional districts and the representatives of those districts, as well as the dynamics in play behind the elections. PBS's Judy Woodruff described the book as "the oxygen of the political world," while NBC's Chuck Todd noted that "[r]eal political junkies get two *Almanacs*: one for the home and one for the office." My focus was researching the history of and writing descriptions for many of the newly-drawn districts, including tracing the history of how and why they were drawn the way that they were drawn.

12. I have spoken on these subjects before audiences from across the political spectrum, including at the Heritage Foundation, the American Enterprise Institute, the CATO Institute, the Bipartisan Policy Center, and the Brookings Institution. In 2012, I was invited to Brussels to speak about American elections to the European External Action Service, which is the European Union's diplomatic corps. I was selected by the United States Embassy in Sweden to discuss the 2016 elections to a series of audiences there, and was selected by the United States Embassy in Spain to fulfil a similar mission in 2018. I was invited to present by the United States Embassy in Italy, but was unable to do so because of my teaching schedule.

13. In the winter of 2018, I taught American Politics and the Mass Media at Ohio Wesleyan University. I taught Introduction to American Politics at The Ohio State University for three semesters from Fall of 2018 to Fall of 2019. In the Springs of 2020 and 2021, I taught Political Participation and Voting Behavior at The Ohio State University. This course spent several weeks covering all facets of redistricting: How maps are drawn, debates over what constitutes a fair map, measures of redistricting quality, and similar topics.

14. It is my policy to appear on any major news outlet that invites me, barring scheduling conflicts. I have appeared on both Fox News and MSNBC to discuss electoral and

demographic trends. I have been cited in major news publications, including *The New York Times*, *The Washington Post*, *The Los Angeles Times*, *The Wall Street Journal*, and *USA Today*.

15. I sit on the advisory panel for the "States of Change: Demographics and Democracy" project. This project is sponsored by the Hewlett Foundation and involves three premier think tanks: The Brookings Institution, the Bipartisan Policy Center, and the Center for American Progress. The group takes a detailed look at trends among eligible voters and the overall population, both nationally and in key states, to explain the impact of these changes on American politics, and to create population projections, which the Census Bureau abandoned in 1995. In 2018, I authored one of the lead papers for the project: "In the Long Run, We're All Wrong," available at https://bipartisanpolicy.org/wp-content/uploads/2018/04/BPC-Democracy-States-of-Change-Demographics-April-2018.pdf.

16. I previously authored an expert report in *Dickson v. Rucho*, No. 11-CVS-16896 (N.C. Super Ct., Wake County), which involved North Carolina's 2012 General Assembly and Senate maps. Although I was not called to testify, it is my understanding that my expert report was accepted without objection. I also authored an expert report in *Covington v. North Carolina*, Case No. 1:15-CV-00399 (M.D.N.C.), which involved almost identical challenges in a different forum. Due to what I understand to be a procedural quirk, where my largely identical report from *Dickson* had been inadvertently accepted by the plaintiffs into the record when they incorporated parts of the *Dickson* record into the case, I was not called to testify.

17. I authored two expert reports in *NAACP v. McCrory*, No. 1:13CV658 (M.D.N.C.), which involved challenges to multiple changes to North Carolina's voter laws, including the elimination of a law allowing for the counting of ballots cast in the wrong precinct. I was

admitted as an expert witness and testified at trial. My testimony discussed the "effect" prong of the Voting Rights Act claim. I did not examine the issues relating to intent.

18. I authored reports in *NAACP v. Husted*, No. 2:14-cv-404 (S.D. Ohio), and *Ohio Democratic Party v. Husted*, Case 15-cv-01802 (S.D. Ohio), which dealt with challenges to various Ohio voting laws. I was admitted and testified at trial in the latter case (the former case settled). The judge in the latter case ultimately refused to consider one opinion, where I used an internet map-drawing tool to show precinct locations in the state. Though no challenge to the accuracy of the data was raised, the judge believed I should have done more work to check that the data behind the application was accurate.

19. I served as a consulting expert in *Lee v. Virginia Board of Elections*, No. 3:15-cv-357 (E.D. Va. 2016), a voter identification case. Although I would not normally disclose consulting expert work, I was asked by defense counsel to sit in the courtroom during the case and review testimony. I would therefore consider my work *de facto* disclosed.

20. I filed an expert report in *Mecinas v. Hobbs*, No. CV-19-05547-PHX-DJH (D. Ariz. 2020). That case involved a challenge to Arizona's ballot order statute. Although the judge ultimately did not rule on a motion in limine in rendering her decision, I was allowed to testify at the hearing.

21. I authored two expert reports in *Feldman v. Arizona*, No. CV-16-1065-PHX-DLR (D. Ariz.). Plaintiffs in that case challenged an Arizona law prohibiting the collection of voted ballots by third parties that were not family members or caregivers and the practice of most of the state's counties to require voters to vote in their assigned precinct. My reports and testimony were admitted. Part of my trial testimony was struck in that case for reasons unrelated to the merits of the opinion; counsel for the state elicited it while I was on the

witness stand and it was struck after Plaintiffs were not able to provide a rebuttal to the new evidence.

22. I authored an expert report in *Smith v. Perrera*, No. 55 of 2019 (Belize). In that case I was appointed as the court's expert by the Supreme Court of Belize. In that case I was asked to identify international standards of democracy as they relate to malapportionment claims, to determine whether Belize's electoral divisions (similar to our congressional districts) conformed with those standards, and to draw alternative maps that would remedy any existing malapportionment.

23. I authored expert reports in *A. Philip Randolph Institute v. Smith*, No. 1:18-cv-00357-TSB (S.D. Ohio), *Whitford v. Nichol*, No. 15-cv-421-bbc (W.D. Wisc.), and *Common Cause v. Rucho*, NO. 1:16-CV-1026-WO-JEP (M.D.N.C.), which were efficiency gap-based redistricting cases filed in Ohio, Wisconsin and North Carolina.

24. I also authored an expert report in the cases of *Ohio Organizing Collaborative, et al v. Ohio Redistricting Commission, et al* (No. 2021-1210); *League of Women Voters of Ohio, et al v. Ohio Redistricting Commission, et al* (No. 2021-1192); *Bria Bennett, et al v. Ohio Redistricting Commission, et al* (No. 2021-1198). These cases are pending in original action before the Supreme Court of Ohio.

25. I currently serve as one of two special masters appointed by the Supreme Court of Virginia to redraw the districts that will elect the commonwealth's representatives to the House of Delegates, state Senate, and U.S. Congress.

<u>SUMMARY OF WORK PERFORMED</u>

26. I certify that the images attached as Exhibit 2 are true and correct copies of images that I created and that I describe below.

27. To create these images, I first examined the Complaints filed by plaintiffs in this action. I examined whether districts were challenged as either partisan gerrymanders or districts that diluted minority voting power. If I determined a district was challenged, I coded it as a "1."

28. I then downloaded shapefiles for the enacted Congressional, State Senate and House of Representatives from the legislative redistricting website, https://www.ncleg.gov/Redistricting.

29. Using R, a widely utilized statistical programming tool with which I have extensive familiarity through work and coursework, I color-coded the districts by plaintiff group, based upon who challenged which districts. This produced the accompanying maps.

Exhibit 1

SEAN P. TRENDE
1146 Elderberry Loop
Delaware, OH 43015
strende@realclearpolitics.com

EDUCATION

Ph.D., The Ohio State University, Political Science, expected 2022.

M.A.S. (Master of Applied Statistics), The Ohio State University, 2019.

J.D., Duke University School of Law, *cum laude,* 2001; Duke Law Journal, Research Editor.

M.A., Duke University, *cum laude*, Political Science, 2001. Thesis titled *The Making of an Ideological Court: Application of Non-parametric Scaling Techniques to Explain Supreme Court Voting Patterns from 1900-1941*, June 2001.

B.A., Yale University, with distinction, History and Political Science, 1995.

PROFESSIONAL EXPERIENCE

Law Clerk, Hon. Deanell R. Tacha, U.S. Court of Appeals for the Tenth Circuit, 2001-02.

Associate, Kirkland & Ellis, LLP, Washington, DC, 2002-05.

Associate, Hunton & Williams, LLP, Richmond, Virginia, 2005-09.

Associate, David, Kamp & Frank, P.C., Newport News, Virginia, 2009-10.

Senior Elections Analyst, RealClearPolitics, 2009-present.

Columnist, Center for Politics Crystal Ball, 2014-17.

Gerald R. Ford Visiting Scholar, American Enterprise Institute, 2018-present.

BOOKS

Larry J. Sabato, ed., *The Blue Wave*, Ch. 14 (2019).

Larry J. Sabato, ed., *Trumped: The 2016 Election that Broke all the Rules* (2017).

Larry J. Sabato, ed., *The Surge:2014's Big GOP Win and What It Means for the Next Presidential Election*, Ch. 12 (2015).

Larry J. Sabato, ed., *Barack Obama and the New America*, Ch. 12 (2013).

Barone, Kraushaar, McCutcheon & Trende, *The Almanac of American Politics 2014* (2013).

The Lost Majority: Why the Future of Government is up for Grabs – And Who Will Take It (2012).

PREVIOUS EXPERT TESTIMONY

Dickson v. Rucho, No. 11-CVS-16896 (N.C. Super. Ct., Wake County) (racial gerrymandering).

Covington v. North Carolina, No. 1:15-CV-00399 (M.D.N.C.) (racial gerrymandering).

NAACP v. McCrory, No. 1:13CV658 (M.D.N.C.) (early voting).

NAACP v. Husted, No. 2:14-cv-404 (S.D. Ohio) (early voting).

Ohio Democratic Party v. Husted, Case 15-cv-01802 (S.D. Ohio) (early voting).

Lee v. Virginia Bd. of Elections, No. 3:15-cv-357 (E.D. Va.) (early voting).

Feldman v. Arizona, No. CV-16-1065-PHX-DLR (D. Ariz.) (absentee voting).

A. Philip Randolph Institute v. Smith, No. 1:18-cv-00357-TSB (S.D. Ohio) (political gerrymandering).

Whitford v. Nichol, No. 15-cv-421-bbc (W.D. Wisc.) (political gerrymandering).

Common Cause v. Rucho, No. 1:16-CV-1026-WO-JEP (M.D.N.C.) (political gerrymandering).

Mecinas v. Hobbs, No. CV-19-05547-PHX-DJH (D. Ariz.) (ballot order effect).

Fair Fight Action v. Raffensperger, No. 1:18-cv-05391-SCJ (N.D. Ga.) (statistical analysis).

Pascua Yaqui Tribe v. Rodriguez, No. 4:20-CV-00432-TUC-JAS (D. Ariz.) (early voting).

COURT APPOINTMENTS

Appointed as Voting Rights Act expert by Arizona Independent Redistricting Commission

Appointed redistricting expert by the Supreme Court of Belize in *Smith v. Perrera*, No. 55 of 2019 (one-person-one-vote).

INTERNATIONAL PRESENTATIONS AND EXPERIENCE

Panel Discussion, European External Action Service, Brussels, Belgium, *Likely Outcomes of 2012 American Elections.*

Selected by U.S. Embassies in Sweden, Spain, and Italy to discuss 2016 and 2018 elections to think tanks and universities in area (declined Italy due to teaching responsibilities).

Selected by EEAS to discuss 2018 elections in private session with European Ambassadors.

TEACHING

American Democracy and Mass Media, Ohio Wesleyan University, Spring 2018.

Introduction to American Politics, The Ohio State University, Autumn 2018, 2019, 2020, Spring 2018.

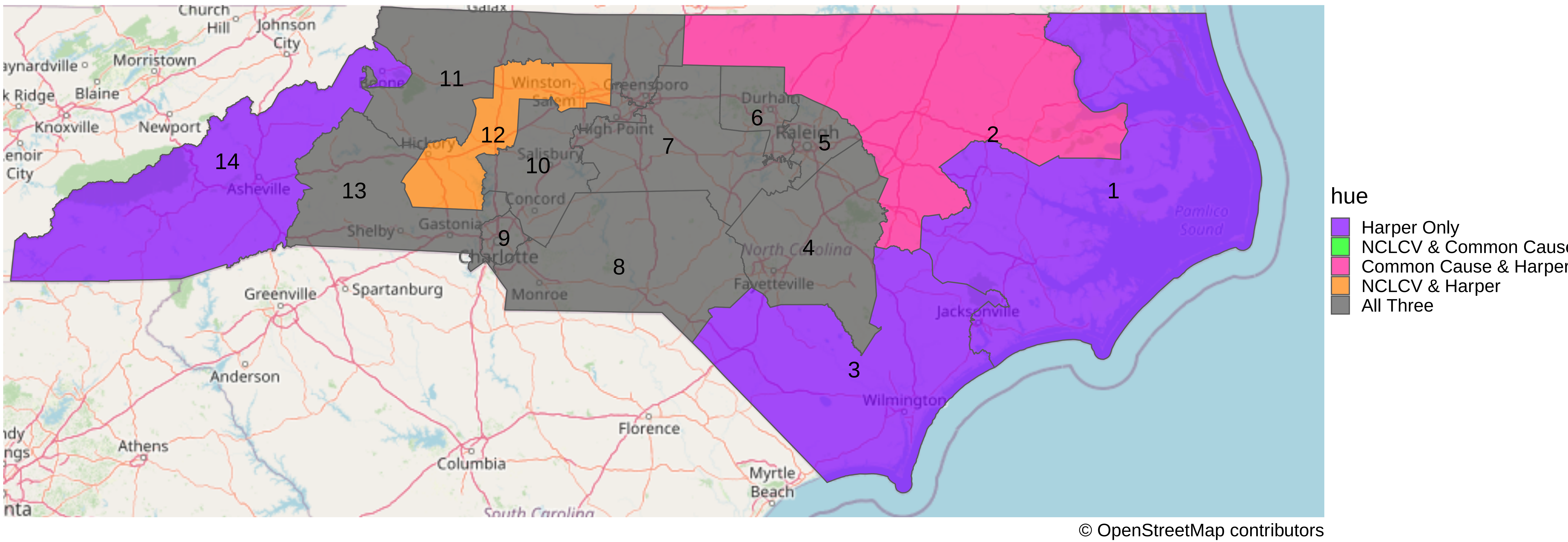
Political Participation and Voting Behavior, Spring 2020, Spring 2021.

REAL CLEAR POLITICS COLUMNS

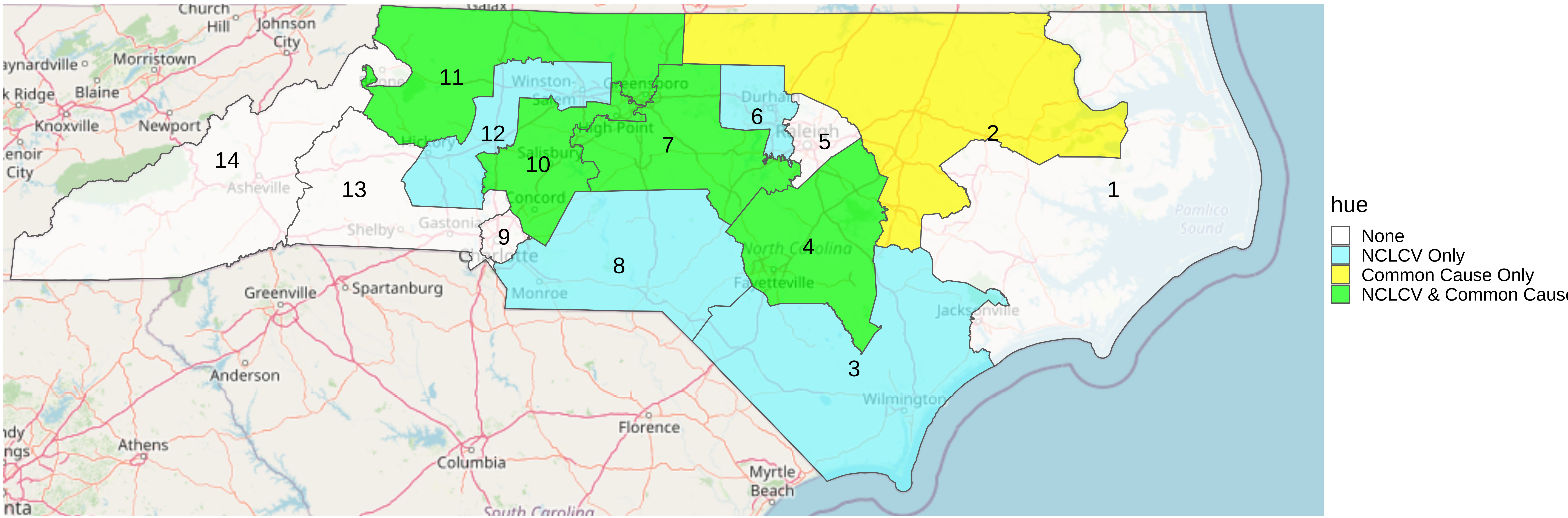
Full archives available at http://www.realclearpolitics.com/authors/sean_trende/

Exhibit 2

Congressional Districts Challenged As Political Gerrymanders, By Plaintiff Group



Congressional Districts Challenged In Racial Vote Dilution Claim, By Plaintiff Group



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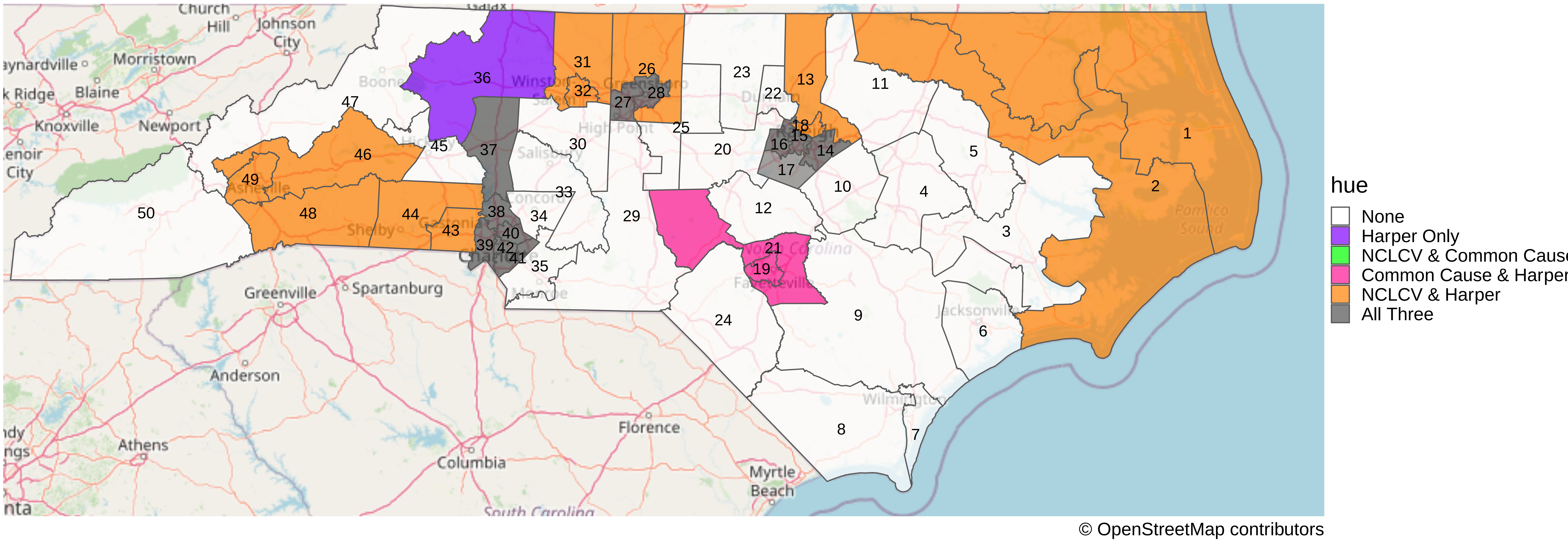
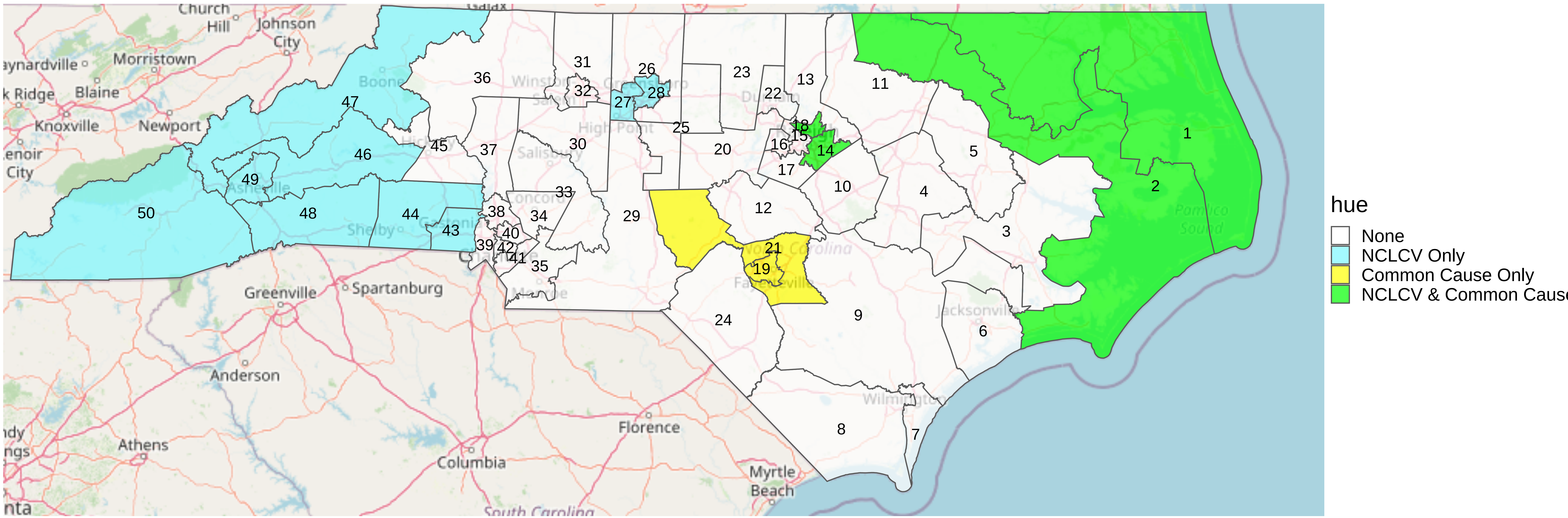
State Senate Districts Challenged As Political Gerrymanders, By Plaintiff Group



State Senate Districts Challenged In Racial Vote Dilution Claim, By Plaintiff Group



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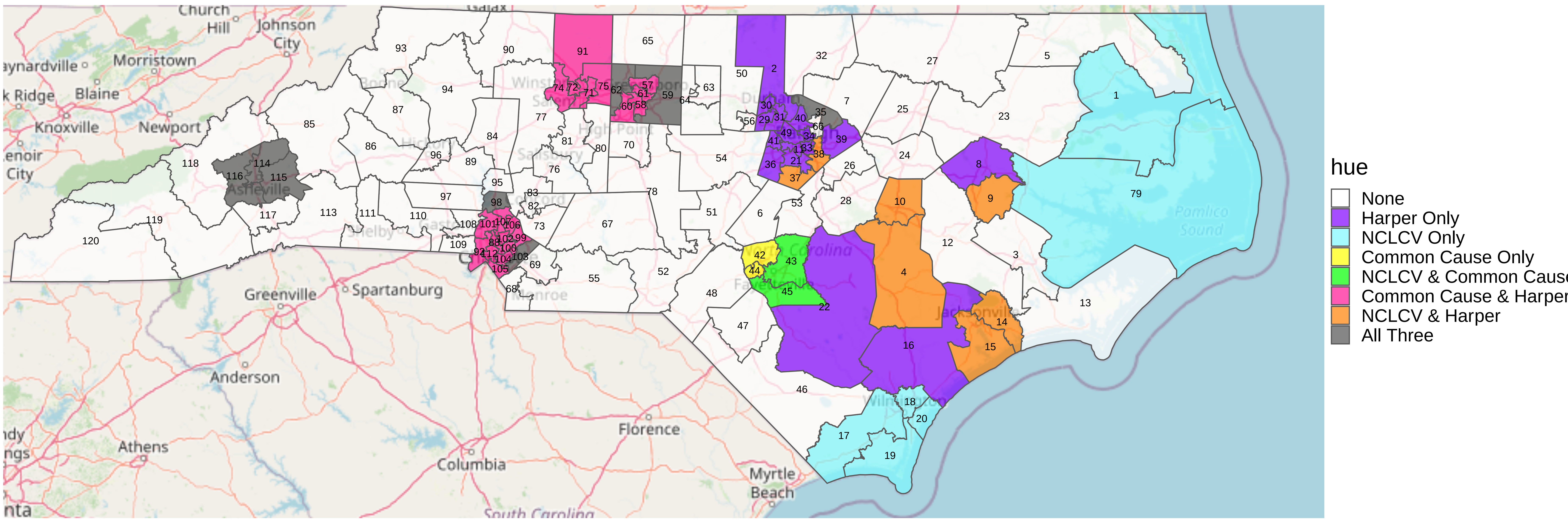
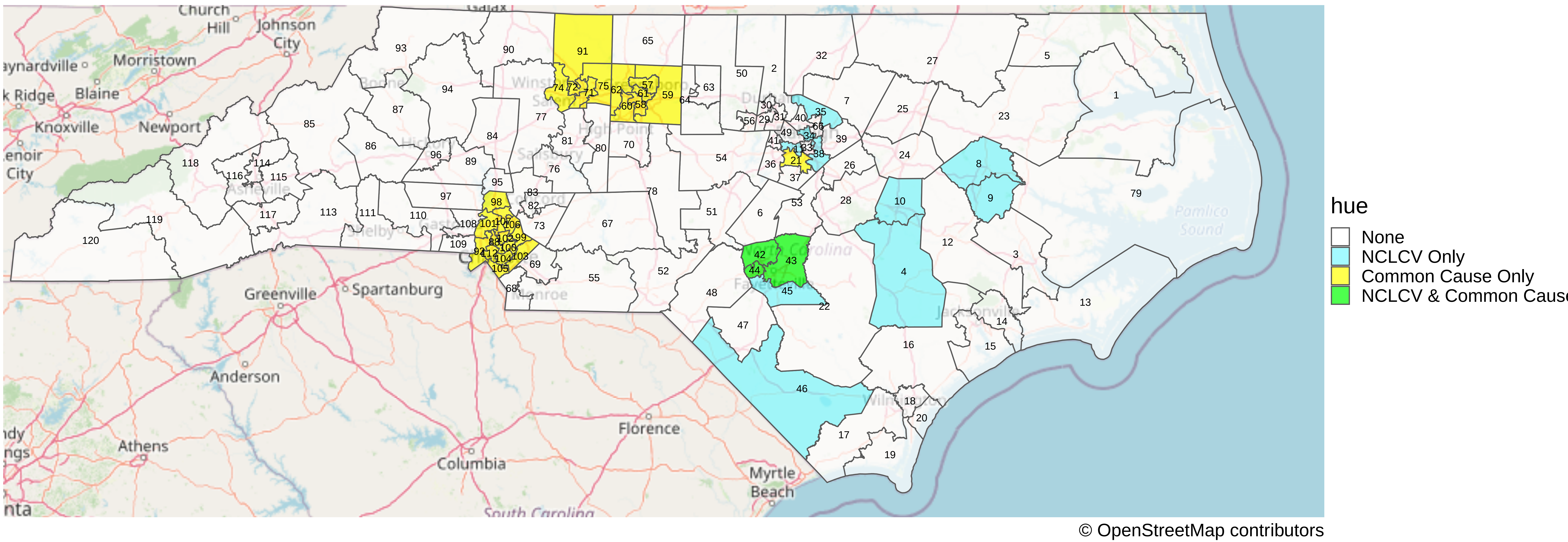
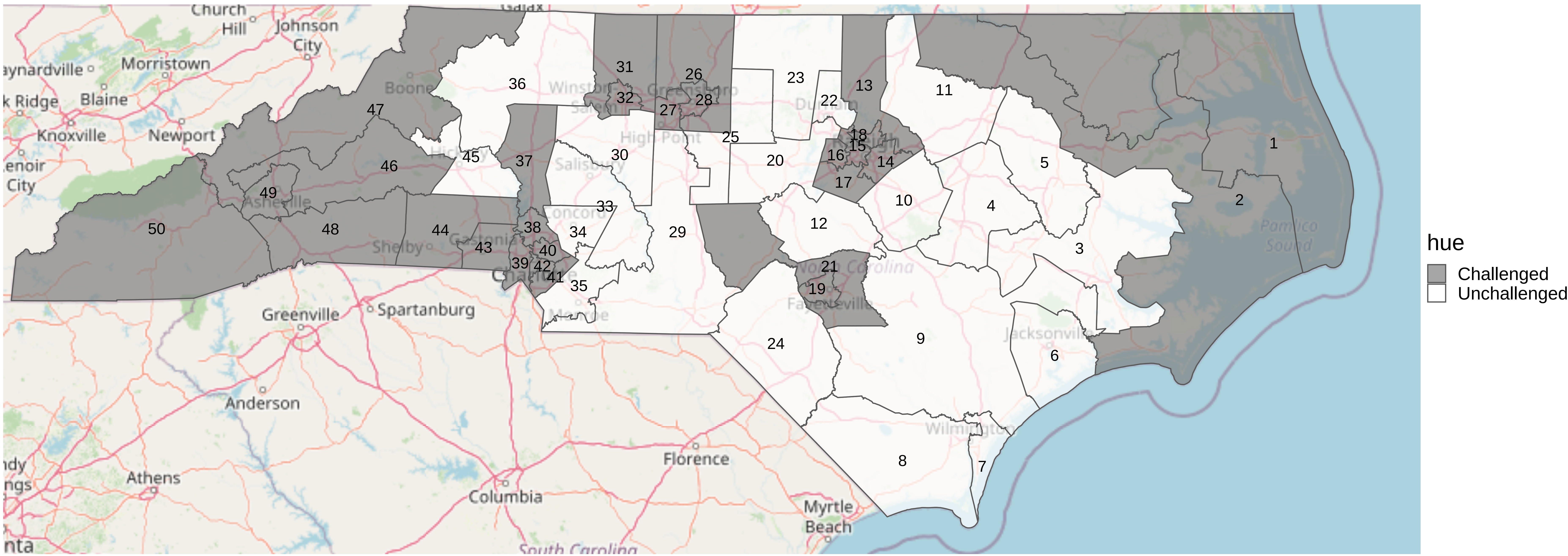
State House Districts Challenged As Political Gerrymanders, By Plaintiff Group



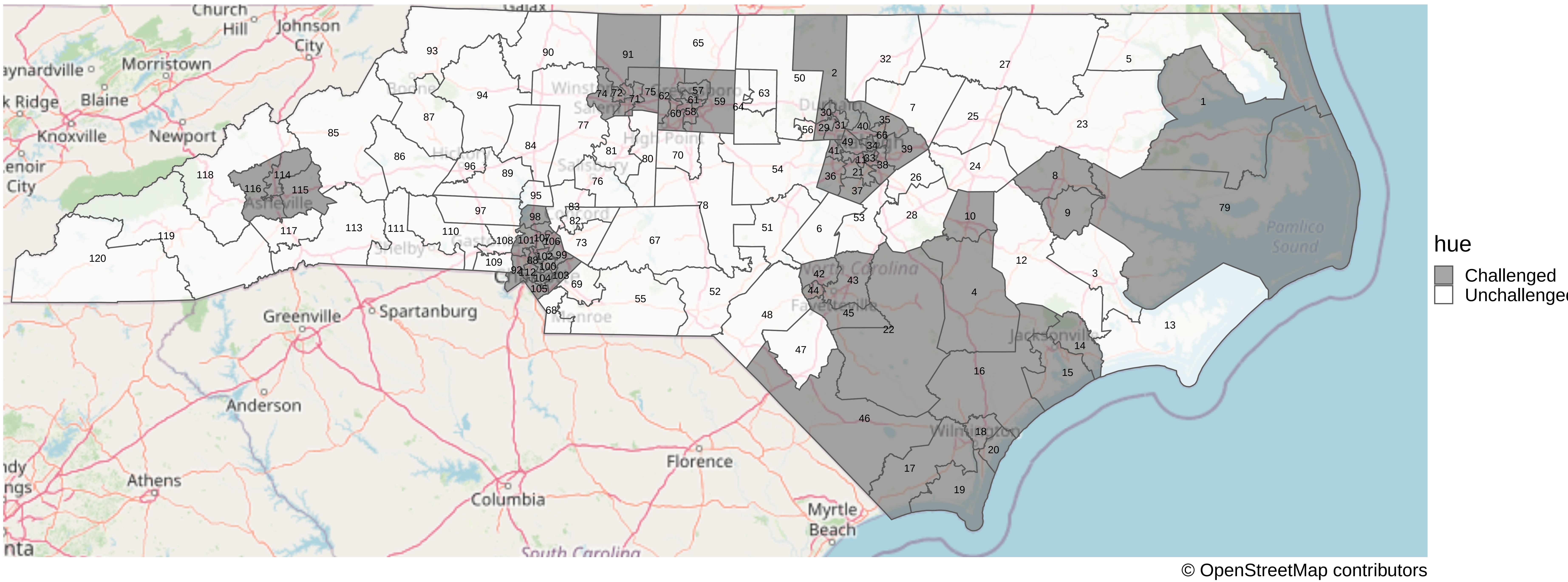
State House Districts Challenged In Racial Vote Dilution Claim, By Plaintiff Group



All State Senate Districts Challenged, By Plaintiff Group



All State House Districts Challenged, By Plaintiff Group



PEGDEN 1

Preliminary analysis of SL 2021-174 Congressional districting

Wesley Pegden

November 29, 2021

1 Qualifications

I am an associate professor in the department of Mathematical Sciences at Carnegie Mellon University, where I have been a member of the faculty since 2013. I received my Ph.D. in Mathematics from Rutgers University in 2010 under the supervision of József Beck, and I am an expert on stochastic processes and discrete probability. My research has been funded by the National Science Foundation and the Sloan Foundation. A list of my publications with links to online manuscripts is also available at my website at `http://math.cmu.edu/~wes`. I am an expert on the use of Markov Chains for the rigorous analysis of gerrymandering, and have published papers[1] developing techniques for this application in *Proceedings of the National Academy of Sciences* and *Statistics and Public Policy*, hereafter referred to by [CFP] and [CFMP], respectively.

I testified as an expert witness in the *League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* case in which the 2011 Congressional districting was found to be an unconstitutional partisan gerrymander, and as well as the *Common Cause v. Lewis* case in North Carolina. I previously served as a member of the bipartisan Pennsylvania Redistricting Reform Commission under appointment by the governor.

2 Executive Summary

I was asked to conduct a preliminary analysis of whether the S.L. 2021-174 Congressional Districting passed in North Carolina drawn in a way which made extreme use of partisan considerations.

To conduct my analysis, I take the enacted plan as a starting point and make a sequence of many small random changes to the district boundaries. This methodology is intended to detect whether the district lines were carefully drawn to optimize partisan considerations; in particular, if the plans in question were not intentionally drawn to maximize partisan advantage, then making small random changes should not significantly decrease the plan's partisan bias.

Specifically, my method begins with the enacted plan and uses a Markov Chain—a sequence of random changes—to generate billions of comparison districtings against which I compare the enacted plans. These comparison districtings are generated by making a sequence of small random changes to the enacted plans themselves, and preserve districting criteria such as population deviation, compactness, and splitting of counties.

The analysis I conduct of the enacted plan using this data has two levels. The first level of my analysis consists simply of comparing the partisan properties of the enacted plans to the large sets of comparison maps produced by my Markov Chain, and I report how unusual the enacted plans are with respect to their partisan properties, against this comparison set. **Quantitatively, I find the enacted S.L. 2021-174 Congressional plan exhibits greater partisan bias than 99.99% of the billions of comparison districtings of North Carolina produced by my algorithm.**

[1]

- M. Chikina, A. Frieze, W. Pegden. Assessing significance in a Markov Chain without mixing, in *Proceedings of the National Academy of Sciences* **114** (2017) 2860–2864
- M. Chikina, A. Frieze, J. Mattingly, W. Pegden. Separating effect from significance in Markov chain tests, in *Statistics and Public Policy* **7** (2020) 101–114.

The next level of my analysis uses the mathematical results I have developed with my co-authors in [CFP] and [CFMP] to translate the results of the above comparison into a statement about how the enacted plans compare against *all* other districtings of North Carolina satisfying the districting criteria I consider in this report. In other words, the theorem that I use in the second level analysis allows me to compare the enacted plan against not only the billions of plans that my simulations produce through making small random changes, but also against all other possible districtings of North Carolina satisfying the districting criteria I consider.

Consider the following: when I make a sequence of small random changes to an enacted plan as described above, this can be viewed as a test of whether the partisan bias in the current districting is fragile, in the sense that it evaporates when the boundary lines of the district are perturbed. The theorems proved in [CFP] and [CFMP] establish that it is mathematically impossible for the political geography of a state to cause such a result. That is: while political geography might conceivably interact with districting criteria to create a situation where typical districtings of a state are biased in favor of one party, it is mathematically impossible for the political geography of a state to interact with districting criteria to create a situation where typical districtings of a state exhibit a *fragile* or *optimized* partisan bias, which quickly evaporates when small changes are made. This allows us to rigorously demonstrate that a districting is optimized with respect to partisanship, and is an outlier among *all* districtings of a state satisfying the criteria I consider, with respect to this property.

2.1 Comparison Criteria

The comparison districtings used by method are required to satisfy various criteria in ways that constrain them to be similar in several respects to the enacted map being evaluated. For the preliminary analysis, all comparison maps were constrained to have population deviation at most 2%, and to have compactness scores at good as the enacted map, up to an error of at most 2%, no more precinct splits than the enacted map, and no more county traversals than the enacted map. These restrictions are denoted "conditions A" in the results below. I also conducted three additional tests which additionally constrain the number of municipality splits ("conditions B"), additionally constrain incumbents protected by the enacted map to be protected by all comparison maps ("conditions C"), or additionally constrain both ("conditions D").

2.2 Note on Population Deviation

My method does not simulate the results of elections for hypothetical elections at the per-person level, and thus do not enforce 1-person population deviation on districts (instead using a cutoff like 2%, as described above), as direct voter preference data is not available at sufficient granularity. Note that this same limitation faces mapmakers who might try to draw a favorable districting for their party; a practical approach is to first use the available data to draw a "coarse" map with the desired properties, and then make small changes to the map (e.g., which split VTDs) to satisfy the population constraint.

I verify that the distinction between 1-person and 2% population deviation do not drive the results of my analysis in two ways.

First, I simply redo my most constrained analysis ("Conditions D") with a 1% population deviation constraint, and obtain similar results.

Second, I analyze a course VTD-level version of the enacted map (itself with nearly 2% population deviation), and show that even this coarse version of the enacted map is an extreme outlier with respect to partisan bias, before small changes are made to it to produce the enacted 1-person-deviation map. This demonstrates that the course VTD-level "blueprint" for the map is an extreme outlier, optimized for partisan considerations, among alternative VTD-level maps with similar population deviation, even before the small changes used to achieve 1-person deviation are accounted for.

These results are shown in Section 3.

2.3 Election data

The partisan characteristics of each of the billions of maps generated by my algorithm is compared to that of the enacted map through the lens of historical election data. I use the 2020 Attorney General race as a proxy for expected partisan voting patterns given knowledge available at the time the disputed plan was drawn.

2.4 Comparison metric

Using the election data indicated above, my analysis compares the partisanship of districtings according to **the average number of seats Republicans would expect to win in the districting**, based on a random uniform swing model with the historical voting data I use.

The *uniform swing* is a simple model frequently used to make predictions about the number of seats a party might win in an election, based on partisan voting data. Suppose, for example, that given data from a previous Congressional election in North Carolina, we would like to predict how many seats Republicans will win in an upcoming Congressional election with the same districting, assuming that at a statewide level, we expect them to outperform by 1.5 percentage points their results from the last election.

A uniform swing would simply add 1.5 percentage points to Republican performance in every district in data from the last election, and then evaluate how many seats would be won with these shifted voting outcomes.

When I am evaluating the partisanship of a comparison districting (to compare it to the enacted plan), I am interested in the number of seats we expect Republicans might win in the districting, given unknown shifts in partisan support. In particular, the metric I use is:

> How many seats, on average, would Republicans win in the given districting, if a random[2] uniform swing is applied to the historical voting data being used?

2.5 First level analysis

The first level of my analysis simply uses the procedure described above to generate a large set of comparison districtings against which one can compare the enacted plan. As discussed above, these comparison maps adhere to districting criteria in ways that constrain them to be similar in several respects to the enacted map being evaluated.

We will see below that in hundreds of runs of my algorithm, the enacted plan is found to be exhibit more partisan bias than 99.99% of comparison maps, i.e., it is among the most partisan 00.01% of found by the algorithm, since $100\% - 99.99\% = 00.01\%$.

The first level of my analysis simply reports the comparison of the enacted map to the comparison districtings produced in these runs. Even without applying the mathematical theorems we have developed in [CFP] and [CFMP], this gives strong, intuitively clear evidence of intent to create partisan bias in the districting: if the districting had not been drawn to carefully optimize its partisan bias, we would expect naturally that making small random changes to the districting would not have such a dramatic and consistent partisan effect.

2.6 Second level analysis

In the first level of my analysis, I compare enacted plans to comparison districtings produced by my algorithm (which makes random changes to the existing map while preserving districting criteria).

The next level of my analysis goes further than this, and enables a rigorous comparison to *all* alternative districtings of North Carolina satisfying the districting criteria I consider here. It does this by comparing how optimized for partisanship an evaluated plan is to how optimized alternative plans are.

2.6.1 Defining "optimized for partisanship"

Roughly speaking, when I say that a districting is *optimized for partisanship*, I mean that its partisan characteristics are highly sensitive to small random changes to the boundary lines.

[2] The random choice of my uniform swing is made from a normal distribution whose standard deviation is 4 percentage points, which is roughly the standard deviation of the swing in the past five North Carolina gubernatorial elections.

Formally, when I say that a districting is *optimized for partisanship* in this report, I mean that there is a high probability that when I make small random changes to the districting, its partisanship will be an extreme outlier among the comparison maps produced by the small random changes.

The yardstick I use to measure this property of a given map is the *ε-fragility* of a map. Given a small threshold ε like $\varepsilon = 00.01\%$, I can ask: what is the probability that when I make a sequence of small random changes to the map, the map will be in the most extreme ε fraction of maps encountered in the sequence of random changes? The probability of this occurrence is the ε-fragility of the map, and it is this probability that I use to quantify how optimized for partisanship a map is.

In other words, **one districting is considered more optimized for partisanship than another if it is more likely to have its partisan qualities consistently reduced when making a random sequence of small changes to its boundary lines.**

2.6.2 Comparing an enacted plan to the set of *all* alternatives

My analysis enables a rigorous comparison of an enacted plan to **all possible districting plans of the state** satisfying the districting criteria I consider, with respect to how optimized for partisanship the districtings are.

My method produces a rigorous p-value (statistical significance level) which precisely captures the confidence one can have in the findings of my "second level" analyses. In particular my second-level claims in this report are all valid at a statistical significance of $p = .002$. This means that the probability that I would report an incorrect number (for example, claiming that a districting is among the most optimized for partisanship 00.01% of all districtings, when in fact it is merely among the most 00.015% optimized for partisanship) is at most 00.2%. To put this in context, clinical trials seeking regulatory approval for new medications frequently target a significance level of $p = .05$ (5%), a much looser standard than I hold myself to in this report.

2.6.3 Some intuition for why this is possible

It should be emphasized that it may seem remarkable that I can make a rigorous quantifiable comparison to *all* possible districtings, without actually generating all such districtings; this is the role of our theorems from [CFP] and [CFMP], which have simple proofs which have been verified by the mathematical community.

To give some nontechnical intuition for why this kind of analysis is possible, these results roughly work by showing that in a very general sense, it is not possible for an appreciable fraction of districtings of a state to appear optimized for partisanship in the sense defined in Section 2.6.1. In other words, it is *mathematically impossible* for any state, with any political geography of voting preferences and any choice of districting criteria, to have the property that a significant fraction of the possible districtings of the state satisfying the chosen districting criteria appear optimized for partisanship (as measured by their ε-fragility).

2.7 Results

For each of the four conditions described in 2.1, I did $2^{35} \approx 34$ billion steps. In this section I give the first-level and second-level analyses of these results, along with the output of each run.

2.7.1 Conditions A

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999943%	9	99.999943%	17	99.99971%	25	99.9998%
2	99.999973%	10	99.999908%	18	99.999987%	26	99.9999953%
3	99.99978%	11	99.99972%	19	99.99992%	27	99.999962%
4	99.9998%	12	99.99933%	20	99.9994%	28	99.99964%
5	99.999901%	13	99.999927%	21	99.999988%	29	99.999979%
6	99.99967%	14	99.999962%	22	99.99904%	30	99.99964%
7	99.999985%	15	99.999983%	23	99.9999965%	31	99.9989%
8	99.999908%	16	99.99977%	24	99.999986%	32	99.999976%

- **First level analysis:** In *every* run, the districting was in the most partisan 00.0011% of districtings (in other words, 99.9989% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted Congressional districting is among the most optimized-for-partisanship 00.003% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.997% are less optimized for partisanship), measured by their ε-fragility for $\varepsilon = 00.0011\%$.

2.7.2 Conditions B

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999989%	9	99.9995%	17	99.999943%	25	99.9978%
2	99.9986%	10	99.99999981%	18	99.99982%	26	99.999915%
3	99.99962%	11	99.999955%	19	99.99929%	27	99.99957%
4	99.999901%	12	99.999959%	20	99.9985%	28	99.99998%
5	99.999914%	13	99.99988%	21	99.99945%	29	99.999972%
6	99.9999982%	14	99.9988%	22	99.99976%	30	99.999935%
7	99.99986%	15	99.999964%	23	99.99979%	31	99.99964%
8	99.999926%	16	99.9989%	24	99.999996%	32	99.999958%

- **First level analysis:** In *every* run, the districting was in the most partisan 00.0021% of districtings (in other words, 99.9979% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted Congressional districting is among the most optimized-for-partisanship 00.0063% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.9937% are less optimized for partisanship), measured by their ε-fragility for $\varepsilon = 00.0021\%$.

2.7.3 Conditions C

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999998%	9	99.999938%	17	99.999965%	25	99.9999941%
2	99.99964%	10	99.99982%	18	99.99945%	26	99.99982%
3	99.9978%	11	99.99987%	19	99.999924%	27	99.999957%
4	99.9995%	12	99.99984%	20	99.99987%	28	99.99984%
5	99.99998%	13	99.99921%	21	99.999956%	29	99.99987%
6	99.99979%	14	99.99961%	22	99.99949%	30	99.99955%
7	99.999979%	15	99.99972%	23	99.99962%	31	99.99988%
8	99.99982%	16	99.999921%	24	99.99938%	32	99.99984%

- **First level analysis:** In *every* run, the districting was in the most partisan 00.0022% of districtings (in other words, 99.9978% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted Congressional districting is among the most optimized-for-partisanship 00.0065% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.9935% are less optimized for partisanship), measured by their ε-fragility for $\varepsilon = 00.0022\%$.

2.7.4 Conditions D

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9997%	9	99.99976%	17	99.99958%	25	99.99979%
2	99.99989%	10	99.999924%	18	99.9999942%	26	99.999986%
3	99.99962%	11	99.99982%	19	99.99963%	27	99.9978%
4	99.99976%	12	99.9999986%	20	99.9999983%	28	99.99969%
5	99.99988%	13	99.99979%	21	99.99954%	29	99.9995%
6	99.99958%	14	99.999986%	22	99.999904%	30	99.999984%
7	99.999986%	15	99.99954%	23	99.99989%	31	99.999955%
8	99.999956%	16	99.999965%	24	99.99971%	32	99.999962%

- **First level analysis:** In *every* run, the districting was in the most partisan 00.0022% of districtings (in other words, 99.9978% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted Congressional districting is among the most optimized-for-partisanship 00.0065% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.9935% are less optimized for partisanship), measured by their ε-fragility for $\varepsilon = 00.0022\%$.

3 Conclusion

Based on my analysis, I find the enacted S.L. 2021-174 Congressional plan is optimized for Republican partisan bias to an extreme degree, moreso than 99.99% of all alternative districtings satisfying the criteria I examined in this report.

Appendix: Population deviation analysis

In this section we show results from running our algorithm under conditions discussed in Section 2.2.

First, we use the most restrictive "Conditions D" but impose a requirement of $\leq 1\%$ population deviation, obtaining the following results:

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9986%	9	99.99947%	17	99.9975%	25	99.99907%
2	99.99939%	10	99.99987%	18	99.999928%	26	99.99969%
3	99.999961%	11	99.99958%	19	99.99973%	27	99.99984%
4	99.99923%	12	99.9999969%	20	99.99929%	28	99.9996%
5	99.99963%	13	99.9999%	21	99.99916%	29	99.999998%
6	99.9998%	14	99.99989%	22	99.99922%	30	99.99983%
7	99.9989%	15	99.99982%	23	99.9988%	31	99.998%
8	99.999911%	16	99.9988%	24	99.99934%	32	99.99945%

Next, we run our algorithm on a coarse "whole-precinct" version of the enacted map. This is the districting obtained by assigning each split VTD to the district with which its intersection is greatest, and is a coarse starting point from which one can obtain a 1-person deviation map by carefully splitting VTD's. Its population deviation from ideal is 1.8%. In the results below, we see that this coarse version of the enacted map also exhibits extreme partisan bias, demonstrating that the appearance of partisan bias is not created by the maps adherence to strict constraints on population deviation.

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99937%	9	99.99942%	17	99.99942%	25	99.99939%
2	99.99949%	10	99.99917%	18	99.9997%	26	99.99941%
3	99.9989%	11	99.99942%	19	99.99988%	27	99.99992%
4	99.99921%	12	99.9989%	20	99.99987%	28	99.99986%
5	99.9982%	13	99.99926%	21	99.99976%	29	99.99981%
6	99.99924%	14	99.999904%	22	99.99969%	30	99.999903%
7	99.9995%	15	99.99972%	23	99.99904%	31	99.99954%
8	99.99976%	16	99.9996%	24	99.99976%	32	99.99951%

I hereby certify that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Wesley Pegden
11/29/21

– Ex. 11053 –

PEGDEN 2

An analysis of North Carolina's legislative districtings: Expert Report

Wesley Pegden

December 23, 2021

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1 Qualifications

I am an associate professor in the department of Mathematical Sciences at Carnegie Mellon University, where I have been a member of the faculty since 2013. I received my Ph.D. in Mathematics from Rutgers University in 2010 under the supervision of József Beck, and I am an expert on stochastic processes and discrete probability. My research has been funded by the National Science Foundation and the Sloan Foundation. A current CV with a list of publications is attached as Exhibit A. A list of my publications with links to online manuscripts is also available at my website at `http://math.cmu.edu/~wes`.

I am an expert on the use of Markov Chains for the rigorous analysis of gerrymandering, and have published papers[1] developing techniques for this application in *Proceedings of the National Academy of Sciences* and *Statistics and Public Policy*, hereafter referred to by [CFP] and [CFMP], respectively.

I testified as an expert witness in the *League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* case in which the 2011 Congressional districting was found to be an unconstitutional partisan gerrymander, and as well as the *Common Cause v. Lewis* case in North Carolina. I previously served as a member of the bipartisan Pennsylvania Redistricting Reform Commission under appointment by the governor. I am being compensated at a rate of $325 per hour for my work on the current case.

2 Executive Summary

I was asked to analyze whether the proposed Congressional, state House, and state Senate districtings of North Carolina were drawn in a way which made extreme use of partisan considerations.

To conduct my analysis, I take the enacted plan as a starting point and make a sequence of many small random changes to the district boundaries. This methodology is intended to detect whether the district lines were carefully drawn to optimize partisan considerations; in particular, if the plans in question were not intentionally drawn to maximize partisan advantage, then making random changes should not significantly decrease the plan's partisan bias.

Specifically, my method begins with the enacted plan and uses a Markov Chain—a sequence of random changes—to generate trillions of comparison districtings against which I compare the enacted plans. These comparison districtings are generated by making a sequence of small random changes to the enacted plans themselves, and preserve districting criteria such as population deviation, compactness, and splitting of counties, municipalities, and precincts, among other criteria (a complete list is given in Section 4.3.1).

The analysis I conduct of the enacted plan using this data has two levels. The first level of my analysis consists simply of comparing the partisan properties of the enacted plans to the large sets of comparison maps produced by my Markov Chain, and I report how unusual the enacted plans are with respect to their partisan properties, against this comparison set. **Quantitatively, for the enacted Congressional, House, and Senate plans, I find that they have a greater partisan bias than** 99.99999%**,** 99.99999%**, and** 99.97% **of the trillions of districtings produced by my algorithm, respectively.**

The next level of my analysis uses the mathematical theorems I have developed with my co-authors in [CFP] and [CFMP] to translate the results of the above comparison into a statement about how the enacted plans compare against *all* other districtings of North Carolina satisfying the districting criteria I consider in this report. In other words, the theorem that I use in the second level analysis allows me to compare the enacted plan against not only the trillions of plans that my simulations produce through making small random changes, but also against all other possible districtings of North Carolina satisfying the districting criteria I consider.

Consider the following: when I make a sequence of small random changes to an enacted plan as described above, this can be viewed as a test of whether the partisan bias in the current districting is fragile, in the sense that it evaporates when the boundary lines of the district are perturbed. As discussed in Section B, our

[1]

- M. Chikina, A. Frieze, W. Pegden. Assessing significance in a Markov Chain without mixing, in *Proceedings of the National Academy of Sciences* **114** (2017) 2860–2864
- M. Chikina, A. Frieze, J. Mattingly, W. Pegden. Separating effect from significance in Markov chain tests, in *Statistics and Public Policy* **7** (2020) 101–114.

theorems in [CFP] and [CFMP] establish that it is mathematically impossible for the political geography of a state to cause such a result. That is: while political geography might conceivably interact with districting criteria to create a situation where typical districtings of a state are biased in favor of one party, it is mathematically impossible for the political geography of a state to interact with districting criteria to create a situation where typical districtings of a state appear to be *optimized for partisan bias*, in the sense that their bias is fragile and evaporates when small random changes are made. This allows us to rigorously demonstrate that a districting is optimized for partisanship, and is an outlier among *all* districtings of a state satisfying the criteria I consider, with respect to this property.

Quantitatively, my second-level analysis establishes that the enacted plans here are more optimized for partisanship than 99.9999% of all possible Congressional districtings satisfying the districting criteria I account for in my analysis, more than 99.9999% of all possible House districtings satisfying those criteria, and more than 99.9% of all Senate districtings satisfying those criteria. Thus the chance of drawing districtings that are as optimized with respect to their partisan properties as the current House and Senate districtings of North Carolina *without* using partisan considerations is exceedingly small.

In particular, I find that **North Carolina's Congressional, House and Senate districtings were drawn in a way which made extreme use of partisan considerations, a finding which is mathematically impossible to be caused by the interaction of political geography and the districting criteria I consider.**

3 Topic of Expert Report

The question motivating my analysis in this case is: "*How significant a role did partisanship play in the drawing of the enacted Congressional, House and Senate districts of North Carolina?*"

My analysis approaches this question in a rigorous and quantifiable way. In short, I identify how much of an outlier the present districting lines are, with respect to how carefully they are drawn to line up with partisan goals. *A priori*, it is possible that political geography might conceivably interact with districting criteria to bias typical districtings for one party or another. But my analysis provides a rigorous quantifiable answer to the question of the extent to which partisanship was used in the districting process, whose validity *does not depend on the political geography of North Carolina*.

Apart from whole-state analyses of the enacted Congressional, House and Senate plans of North Carolina, I was also asked to conduct separate analyses of the following specific House and Senate clusters:

House:

- Mecklenburg
- Wake
- Forsyth-Stokes
- Guilford
- Buncombe
- Pitt
- Duplin-Wayne
- Alamance
- Durham-Person
- Cumberland
- Cabarrus-Davie-Rowan-Yadkin
- Brunswick-New Hanover

Senate:

- Iredell-Mecklenburg
- Granville-Wake
- Forsyth-Stokes
- Cumberland-Moore
- Guilford-Rockingham

4 Quantifying intentional and excessive use of partisanship

My approach begins with a simple idea: I make small random changes to the boundaries of enacted plans (while maintaining districting criteria) and study the effect this has on the partisan bias of the map. More specifically:

- I begin from the enacted plan I am evaluating, and then repeatedly:
  1. Randomly select a geographical unit (e.g., a voting precinct) on the boundary of two districts, and check: if I change which district this geographic unit belongs to, will the resulting districting still satisfy the districting criteria laid out in Section 4.3.1? If so, I make the change.
  2. Using historical voting data as a proxy for partisan voting patterns, evaluate the partisanship of the districting resulting from the previous step.
- These two steps are repeated many times, resulting in a sequence of districtings, each produced by a small random change to the districting preceding it, with the enacted map I am evaluating as the starting point for the sequence.

This procedure is implemented as a computer algorithm which carries out trillions of the above steps for a districting map.

4.1 First level analysis

The first level of my analysis simply uses the above procedure to generate a large set of comparison districtings against which one can compare the enacted plan. For example, for the Congressional districting, I conducted 32 runs of the above procedure. A "run" in this context consists of a single consecutive sequence of small random changes to the enacted plan, producing a set of comparison districtings. For example, for the Congressional districting, each run consisted of carrying out Steps 1 and 2 in the procedure above $2^{40} \approx 1$ trillion times. As discussed in later sections, these comparison maps adhere to districting criteria in ways that constrain them to be similar in several respects to the enacted map being evaluated. For example, the comparison districtings will preserve the same counties and municipalities preserved by the enacted plan.

In total for this districting, I conducted 32 such runs. I then show the results of these runs in a table, like this:

Congressional districting

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999947%	9	99.9999909%	17	99.9999955%	25	99.999995%
2	99.999968%	10	99.99999966%	18	99.9999973%	26	99.9999961%
3	99.9999988%	11	99.9999943%	19	99.99999972%	27	99.99999977%
4	99.99999931%	12	99.999988%	20	99.9999999981%	28	99.99999979%
5	99.99999999927%	13	99.999988%	21	99.9999999962%	29	99.9999981%
6	99.9999959%	14	99.9999987%	22	99.99999919%	30	99.9999941%
7	99.99999984%	15	99.999996%	23	99.9999908%	31	99.99999901%
8	99.9999999947%	16	99.999985%	24	99.999981%	32	99.9999969%

For example, we see here that in the first run, 99.9999947% of the comparison districtings exhibited less Republican bias than the enacted Congressional districting. Moreover, in *every* run, more than 99.999968% of the comparison districtings exhibited less Republican bias than the enacted plan.

The first level of my analysis simply reports this comparison of the enacted map to the comparison districtings produced in these runs. Even without applying the mathematical theorems we have developed in [CFP] and [CFMP], this gives strong, intuitively clear evidence that the district lines were intentionally drawn to optimize partisan advantage in the enacted plan: if the districting had not been drawn to carefully optimize its partisan bias, we would expect naturally that making small random changes to the districting would not have such a dramatic and consistent partisan effect.

4.2 Second level analysis

In the first level of my analysis, I compare enacted plans to comparison districtings produced by my algorithm (which makes random changes to the existing map while preserving districting criteria).

The next level of my analysis goes further than this, and enables a rigorous comparison to *all* alternative districtings of North Carolina satisfying the districting criteria I consider here. It does this by comparing how "optimized for partisanship" an evaluated plan is to how "optimized for partisanship" alternative plans are.

4.2.1 Defining "optimized for partisanship"

Roughly speaking, when I say that a districting is *optimized for partisanship*, I mean that its partisan characteristics are highly sensitive to small random changes to the boundary lines.

Formally, when I say that a districting is *optimized for partisanship* in this report, I mean that there is a high probability that when I make small random changes to the districting, its partisanship will be an extreme outlier among the comparison maps produced by the small random changes.

The yardstick I use to measure this property of a given map is the *ε-fragility* of a map. Given a small threshold ε—for example, 00.000031%, for the analysis of the Congressional districting given above—I can ask: what is the probability that when I make a sequence of small random changes to the map, the map will be in the most extreme ε fraction of maps encountered in the sequence of random changes? The probability of this occurrence is the ε-fragility of the map, and it is this probability that I use to quantify how optimized for partisanship a map appears to be.

In other words, **one districting is considered more optimized for partisanship than another if it is more likely to have its partisan bias consistently reduced when making a random sequence of small changes to its boundary lines.**

4.2.2 Comparing an enacted plan to the set of *all* alternatives

My analysis enables a rigorous comparison of an enacted plan to **all possible districting plans of the state** satisfying the districting criteria I consider, with respect to how optimized for partisanship the districtings are. I can report the maximum fraction of all such possible redistricting plans which could appear as optimized for partisanship as the enacted plan, in the sense of the test described above. For example, I report that the enacted Congressional districting of North Carolina is among the most optimized-for-partisanship 00.000031% of **all possible House districtings of North Carolina** satisfying the districting criteria I consider here, as measured by it's ε-fragility.

My method produces a rigorous p-value (statistical significance level) which precisely captures the confidence one can have in the findings of my "second level" analyses. In particular, for my statewide analyses, my second-level claims are all valid at a statistical significance of $p = .002$. This means that the probability that I would report an incorrect number (for example, claiming that a districting is among the most optimized-for-partisanship 00.01% of all districtings, when in fact it is merely among the most 00.015% optimized-for-partisanship) is at most 00.2%. To put this in context, clinical trials seeking regulatory approval for new medications frequently target a significance level of $p = .05$ (5%), a looser standard of statistical significance than I hold myself to in this report.

4.2.3 Some intuition for why this is possible

It may seem remarkable that I can make a rigorous quantifiable comparison to *all* possible districtings, without actually generating all such districtings; this is the role of our theorems from [CFP] and [CFMP], which have simple proofs which have been verified by the mathematical community.

To give some nontechnical intuition for why this kind of analysis is possible, these results roughly work by showing that in a very general sense, it is not possible for an appreciable fraction of districtings of a state to appear optimized for partisanship in the sense defined in Section 4.2.1. In other words, it is *mathematically impossible* for any state, with any political geography of voting preferences and any choice of districting criteria, to have the property that a significant fraction of the possible districtings of the state satisfying the chosen districting criteria appear optimized for partisanship (as measured by their ε-fragility).

4.3 Implementation details

Here I specify the particulars of the random changes my algorithm makes to a map, my implementation of districting criteria, and my method of comparing the partisanship of a districting to that of districtings encountered on the sequence of random changes.

4.3.1 Districting criteria

All comparison maps produced by my algorithm are required to satisfy the following districting criteria:

(a) **Contiguity**: I require comparison districtings to contain only contiguous districts.

(b) **Compact districts**: I require comparison districtings to be at least as compact as the enacted plan being evaluated, up to an error of 5%. Districting compactness is quantified by taking the average, over each district, of the ratio of the perimeter squared to the area (Polsby-Popper reciprocal).

(c) **County clusters**: For the House and Senate plans, I require comparison maps to respect the same county clustering as used by the enacted House and Senate plans.

(d) **Country traversals**: I require comparison districts to not contain more county traversals than the enacted plan. Additionally, I constrain the total length of all district boundary which is not also county boundary to be at most that of the enacted map, up to an error of 5%.

(e) **Municipality preservation:** There are at most as many municipal splits as in the enacted plan.

(f) **VTD preservation:** The total number of VTD splits in comparison districtings must not exceed the total number of VTD splits in the enacted plan.

(g) **Incumbency protection:** Any incumbent who, in the enacted plan, is not paired with any other incumbent must remain unpaired in the comparison districtings.

(h) **Population deviation**: For House and Senate districtings, I require comparison districtings to have district populations within 5% of the ideal district population. For the Congressional districting, I use a 2% threshold in my main analysis. I discuss robustness of my Congressional analysis to differences in population criteria in Section 5.0.2. Population is measured by the 2020 decennial Census.

4.3.2 A conservative application of the criteria

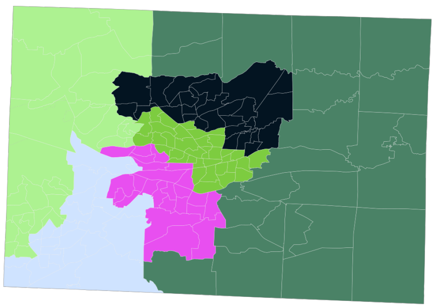
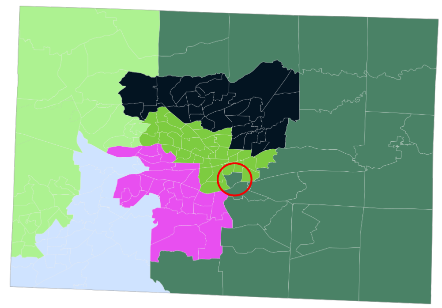
It is important to note that my analysis is designed to avoid second-guessing the mapmakers' choices in how they implemented the districting criteria. In particular, while it is reasonable to ask whether the mapmakers could have drawn districtings which adhered better to nonpartisan criteria (more compact, preserving more municipalities, *etc*), my approach is different, and much more conservative.

In particular, my analysis asks the question: even if we accept that the mapmakers have made appropriate choices with respect to nonpartisan criteria such as compactness, population deviation, municipality preservation, incumbency protection, and so on, does their plan nevertheless stand out with respect to its *partisan* qualities?

Note that, for example, I choose my compactness threshold within 5% of value of the enacted map. And with respect to incumbents, I do not try to protect as many incumbents as are protected in the enacted map, but exactly the same incumbents as protected by the mapmakers. With respect to municipality preservation, I am not trying to answer the question: "if the mapmakers had tried to preserve more municipalities, would this have resulted in a more favorable districting for Democrats?" Instead, I am asking, among all alternative districtings of North Carolina with the same *nonpartisan* characteristics as the enacted map—their compactness, how many municipalities they preserve, etc.—whether the enacted plan is an extreme outlier with respect to the extent to which it is optimized for partisanship.

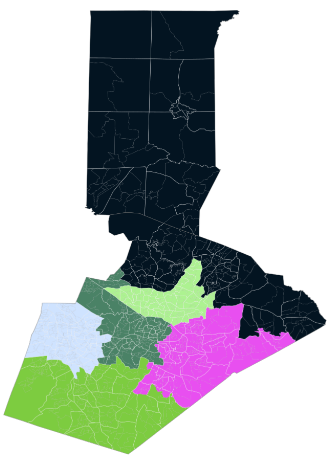
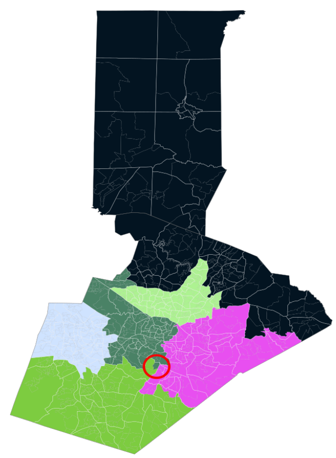
5 Random Changes

As described earlier, my method involves making small random changes to a map. For example, depicted here is a small random change made to the enacted House districting within the Guilford county cluster:


⟶


The geographical units used for these small random changes in this district are voting tabulation districts—VTDs. In particular, at each step of the sequence of random changes for the house districting within Guilford county, I move a randomly VTD that is at the boundary of two districts from one of those districts to the other (unless it would violate the constraints laid out in Section 4.3.1.

For House and Senate clusters that split VTDs, my analysis operates below the VTD level. In particular, my procedure in these case manipulates sub-VTD units (referred to hereafter as geounits). These are compact combinations of Census Blocks which respect VTD and district lines and contain on average approximately 1000 people. In particular, there are an average of around 4 geounits per VTD. In the following example from the Granville-Wake senate districting, we see an example of a random change at the geounit level:


⟶


The thick white lines here indicate current VTD boundaries. A geounit within an already broken VTD has changed district membership. When analyzing any districting at the below-VTD level, my algorithm constrains comparison maps to split at most as many VTDs as the enacted map.

For my whole-state analyses, my algorithm operates at the VTD level. This means that the algorithm is prohibited from splitting any VTD's not split in the enacted map. In Section E, I include runs where the Congressional districting is analyzed at the geounit level.

In each run, my chain generates comparison maps from a given enacted plan by making billions or trillions of these small changes to the enacted plan, while preserving districting criteria in specific ways chosen by the mapmakers, as discussed in Section 4.3.2.

These random changes can be either be made one-at-a-time or with several steps made simultaneously; the latter allows comparison maps to be generated when any single move would lead to a violation of the constraints laid out in Section 4.3.1 (e.g., because population would become too imbalanced), but combinations of moves can be found which would preserve all these criteria. My mathematical analysis applies equally well when using these "multi-move swaps" and I could analyze all clusters in this way if I wanted to, but the algorithm is slower in this mode. In general, in the interest of efficiency, I conduct all state-level analysis with single-move swaps, cluster-level VTD-level runs with multi-move swaps, and cluster-level geounit runs with single-move swaps, but additionally use multi-move swaps any time it enables the algorithm to generate more comparison maps.

Technical details of my implementation of these multi-moves are found in Appendix A. A related implementation detail for VTD splitting is also discussed there.

5.0.1 The *seats expected* metric for comparing districtings

As described in Section 4.2.1, my definition of optimized for partisanship involves comparing the partisanship of an enacted plan to the partisanship of comparison districtings produced from it by a sequence of random changes. Here I describe the *seats expected* metric of partisanship I use for this comparison throughout this report. In short, the seats expected metric for the districting is **the average number of seats Democrats would expect to win in the districting**, based on a uniform swing model with the historical voting data I use.

The *uniform swing* is a simple model frequently used to make predictions about the number of seats a party might win in an election, based on partisan voting data. Suppose, for example, that given data from the last North Carolina House election, we would like to predict how many seats Democrats will win in an upcoming House election (with the same districting), assuming that at a statewide level, we expect them to outperform by 1.5 percentage points their results from the last election.

A uniform swing would simply add 1.5 percentage points to Democrat performance in every district in data from the last election, and then evaluate how many seats would be won with these shifted voting outcomes.

When I am evaluating the partisanship of a comparison districting (to compare it to the enacted plan), I am interested in the number of seats we expect Democrats might win in the districting, given unknown shifts in partisan support. In particular, the metric I use is:

> How many seats, on average, would Democrats win in the given districting, if a random uniform swing is applied to the historical voting data being used?

As an example, let us consider the enacted Congressional plan, using the 2020 Attorney General election as a proxy for partisan voting patterns. Using these results as a direct proxy for future voting patterns, the enacted map would produce a 4:10 split of Democrat:Republican seats. If the Democrat vote share was increased by 1.68% in every district, the split would change to 5:9, and if it was increased by 3.05%, the split would rise to 6:8.

The random choice of my uniform swing is made from a normal distribution whose standard deviation is 4 percentage points, which is roughly the standard deviation of the swing in the past five North Carolina gubernatorial elections. The Figure 1 visualizes the probabilities that this distribution assigns to the various seat splits which would arise from the enacted Congressional map under uniform swings of the 2020 Attorney General election:

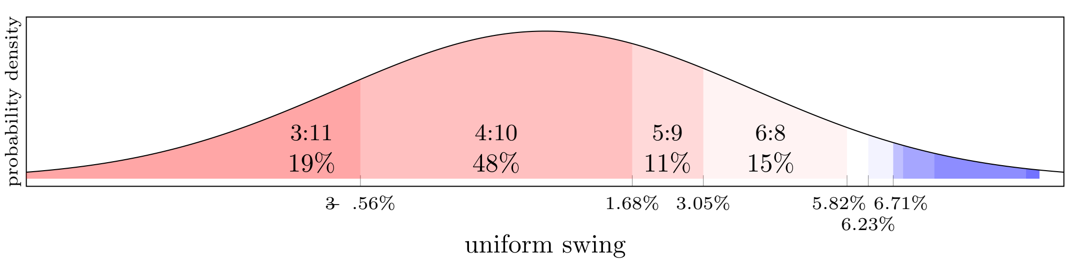


Figure 1: A normally distributed uniform swing applied to the enacted Congressional districting.

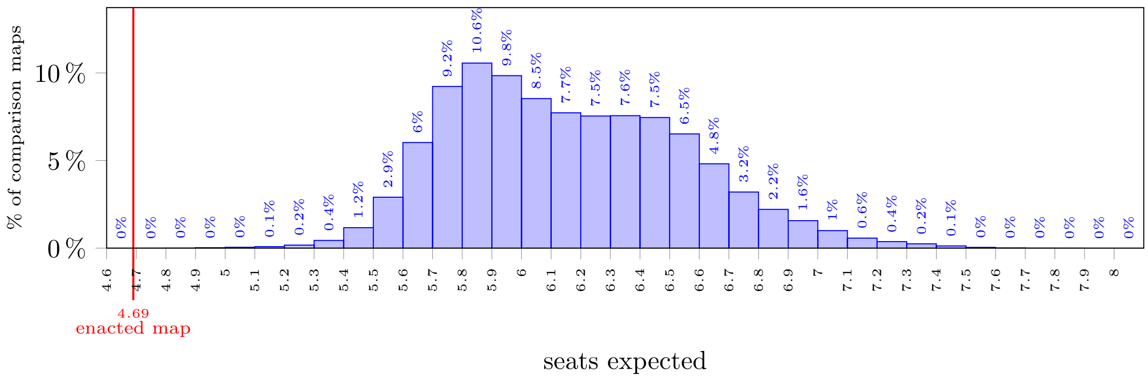
In particular, we can list the probability of any number of Democratic seats for the enacted Congressional plan according to this uniform swing model using the 2020 Attorney General race:

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
0.0%	0.0%	0.0%	19%	48%	11%	15%	1.3%	1.3%	0.1%	0.5%	1.2%	2.0%	0.1%	0.9%

The weighted average of these seat outcomes is computed as

$$.19 \times 3 + .48 \times 4 + .11 \times 5 + .15 \times 6 + .013 \times +.013 \times 8 + .001 \times 9 + .005 \times 10 + .012 \times 11 + .02 \times 12 + .001 \times 13 + .009 \times 14 = 4.69. \quad (1)$$

This "seats expected" number for the Congressional plan shows up in our analysis page for the Congressional districting (page 13), in a histogram we reproduce here for the purpose of illustration:



It is important to note that **my method does not evaluate the fairness of a districting by whether it produces a "small" or "large" number of seats for one party, or whether the uniform swing score calculated in this way is lower or higher than would be expected in a system of proportional representation**. Instead, this score is merely a metric used to **compare** one map to another. The only way these scores are used in my method is to evaluate which of two maps may be more advantageous to a particular political party, and when I find that a districting made extreme use of partisan consideration, it means that the enacted map is extreme outlier with respect to how optimized for partisanship it is **compared to the set of alternative comparison districtings of North Carolina** satisfying the districting criteria I impose.

5.0.2 Note on Population Deviation

My method does not simulate the results of hypothetical elections at the per-person level, and I do not enforce 1-person population deviation on Congressional districts. Instead, I use a cutoff 2%, as described above. I verify that the distinction between 1-person and 2% population deviation do not drive the results of my analysis in two ways.

First, in Section E, I show a run my whole Congressional analysis exactly the same way but with a 1% population deviation constraint and obtain similar results. I also show a geounit-level analysis which operates at just 0.5% population deviation and still finds the enacted plan to be an extreme outlier.

Second, I analyze a coarse VTD-level version of the enacted map (itself with nearly 2% population deviation), and show that even this coarse version of the enacted map is an extreme outlier with respect to partisan bias, before small changes are made to it to produce the enacted 1-person-deviation map. This demonstrates that the coarse VTD-level "blueprint" for the map is an extreme outlier, optimized for partisan considerations, among alternative VTD-level maps with similar population deviation, even before the small changes used to achieve 1-person deviation are accounted for.

Finally, I note that by design, the seats-expected metric I use is not sensitive to the kinds of small changes that need to be made to districts to equalize population. This can already be seen by comparing the seats-expected metric for the enacted Congressional plan to the "VTD-level blueprint" version we analyze in Section C.8. As calculated above, the enacted map, with 1-person popluation deviation, scores 4.69 on the seats expected metric. The whole-VTD level blueprint, which has 1.8% population deviation, scores 4.70 by the same metric, as seen in the plot in C.8. This difference of 0.01 is much smaller than the sizes of differences in the seats-expected metric that are driving the results in my report.

5.1 A note on comparing results

Four my cluster-by-cluster analysis of the House and Senate districtings, we will see that even among clusters for which we find that the enacted plan is an extreme outlier, there is quite a bit of variation from cluster to cluster for how extreme an outlier we find the enacted plan to be.

For example, in our second-level analysis of the Guilford county house districting, we find that it is among the most optimized-for-partisanship 00.000089% of all alternative districtings of the county satisfying our districting criteria, while for the Mecklenburg county districting, we find that it is among the most optimized-for-partisanship 5% of districtings.

Because it is tempting to compare results from cluster to cluster, it is important to emphasize that the mathematical results we employ in these findings are one-directional. In particular, while they imply that the Mecklenburg cluster is among the most optimized-for-partisanship 5% of districtings, they do *not* imply that it could not also be among the most optimized-for-partisanship 00.000089%.

What we know from my analysis is that we have extreme statistical certainty that the Guilford cluster districting is among the most optimized-for-partisanship 00.004% of all districtings satisfying the criteria I consider, and we have extreme statistical certainty that the Mecklenburg cluster is among the most optimized-for-partisanship 5% of all districtings satisfying the criteria. The Mecklenburg cluster may be even more of an outlier, but my analysis does not address this latter question in either direction.

It should also be noted that it is natural to expect that my very conservative application of the districting criteria (discussed in Section 4.3.2) will affect some clusters more than others. In some clusters (e.g., Duplin/Wayne), it even prevents any comparison districtings from being generated by my algorithm at all. Of course, this should not seen as settling in either direction the question of whether the enacted map of the Duplin/Wayne cluster is gerrymandered.

6 Results of Analysis

The following pages show the results of my analysis for the enacted Congressional, state House, and state Senate districting plans.

Each page has the following components:

Comparison map examples

I show four maps in each case. The first map is the enacted map. The other three are examples of comparison maps used by by method. In each case, these maps are either the final map from runs 1, 2 and 3, or, from just the first run, the last map, the map from the halfway point of the run, and the run from the 25% point of the run.

Results

Under results I show a **table**, with an entry for each run conducted for the districting. The table shows the fraction of maps in that run that exhibited less partisan bias in favor of Republicans than the enacted map under evaluation. In particular, this is the fraction of maps for which the "seats expected" metric was higher than for the enacted map. For example, on the next page, we will see that in the first run, 99.9999947% of comparisons exhibited less partisan bias in favor of Republicans than the enacted plan.

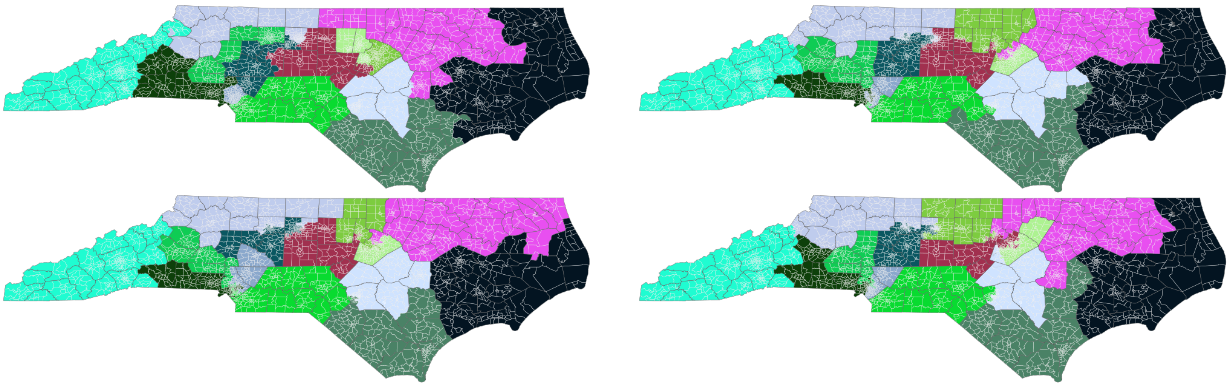
Below this table I show a **histogram** which plots the number of comparison maps whose "seats expected" value fell in various ranges. For example, on the next page, we see that 10.6% of comparison maps had a seats-expected value between 5.8 and 5.9. The histogram also shows the seats-expected value for the enacted map, which for the Congressional districting is 4.69. Note that the computation of this value 4.69 was illustrated earlier in Section 5.0.1. The same computation can be applied to every comparison map to build the histogram of resulting seats-expected values.

I present in each case a **First-level analysis**, which is simply a summary of the how the enacted map compares to the set of comparison districtings generated by my algorithm. For example, for the Congressional map, we will see that in every one of the 32 runs I conducted, 99.999968% of maps produced exhibited less partisan bias than the enacted map itself.

After this I present the **Second-level analysis**, which is a rigorous evaluation of how the enacted map compares to *all* alternative districtings of North Carolina satisfying the districting criteria I consider here. For example, for the Congressional districting as evaluated on the next page, we see that it is more optimized-for-partisanship than 99.999905% of *all* alternative districtings of North Carolina satisfying the criteria I impose as outlined in Section 4.3.1.

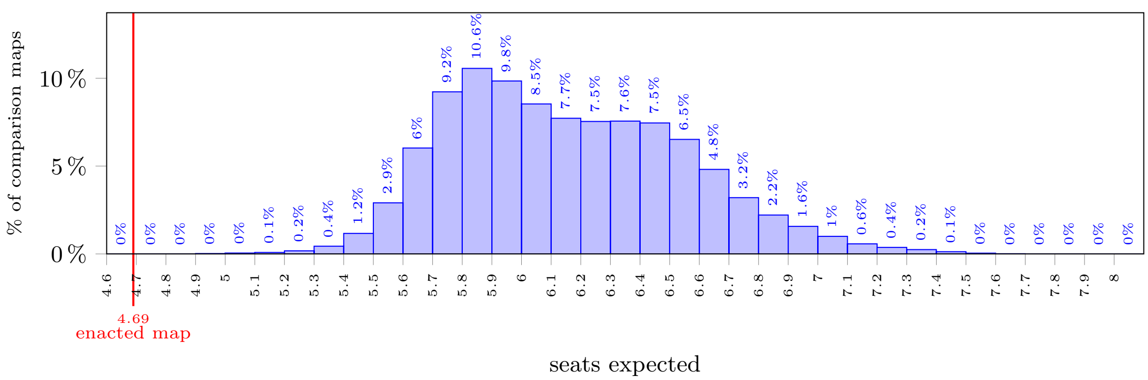
6.1 Congressional districting

6.1.1 Comparison map examples



6.1.2 Results

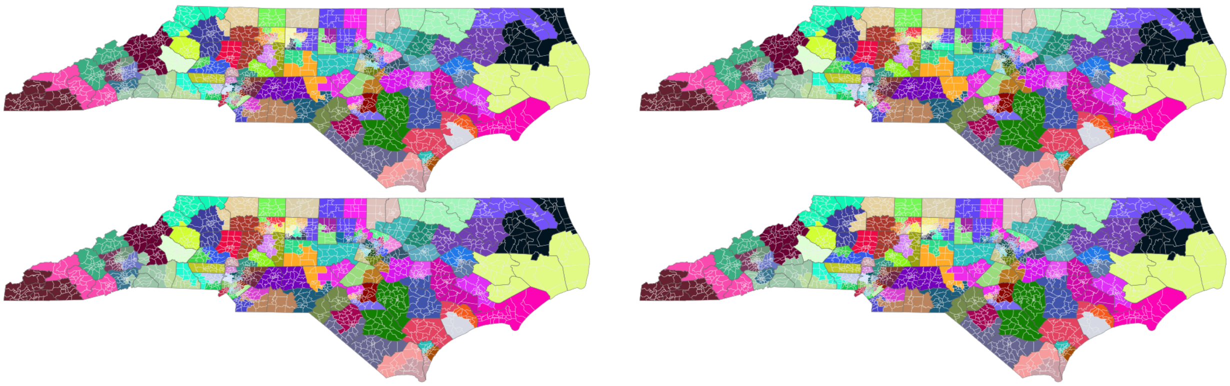
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999947%	9	99.9999909%	17	99.9999955%	25	99.999995%
2	99.999968%	10	99.99999966%	18	99.9999973%	26	99.9999961%
3	99.9999988%	11	99.9999943%	19	99.99999972%	27	99.99999977%
4	99.99999931%	12	99.999988%	20	99.9999999981%	28	99.99999979%
5	99.99999999927%	13	99.999988%	21	99.9999999962%	29	99.9999981%
6	99.9999959%	14	99.9999987%	22	99.99999919%	30	99.9999941%
7	99.99999984%	15	99.999996%	23	99.9999908%	31	99.99999901%
8	99.9999999947%	16	99.999985%	24	99.999981%	32	99.9999969%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.000031% of districtings (in other words, 99.999968% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted House districting is among the most optimized-for-partisanship 0.000094% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.999905% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.000031\%$.

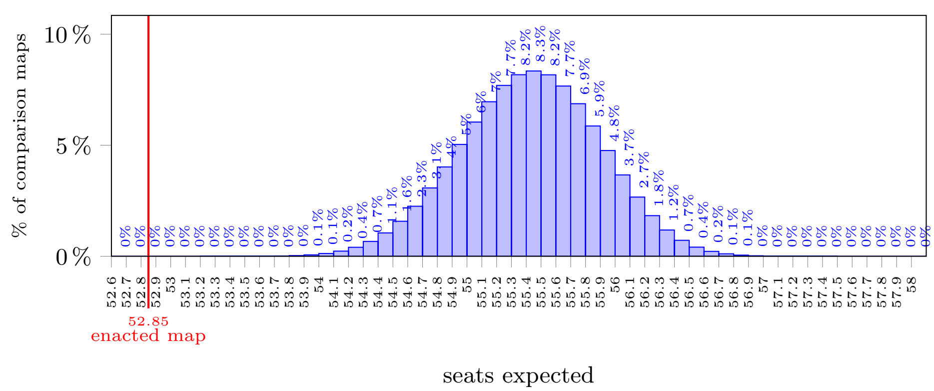
6.2 House districting

6.2.1 Comparison map examples



6.2.2 Results

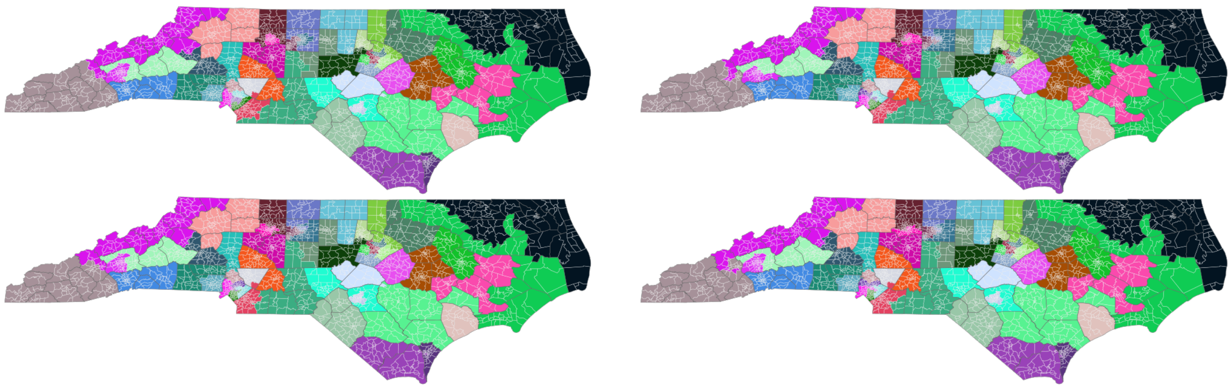
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999999985%	9	99.99999957%	17	99.9999989%	25	99.9999989%
2	99.99999942%	10	99.99999904%	18	99.99999966%	26	99.9999918%
3	99.99999997%	11	99.9999984%	19	99.99999982%	27	99.99999984%
4	99.9999969%	12	99.9999986%	20	99.9999986%	28	99.9999988%
5	99.9999975%	13	99.99999989%	21	99.9999935%	29	99.99999987%
6	99.9999999959%	14	99.99999996%	22	99.9999999967%	30	99.99999908%
7	99.999999985%	15	99.9999984%	23	99.9999975%	31	99.9999966%
8	99.999999951%	16	99.99999954%	24	99.999999939%	32	99.999999939%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.0000081% of districtings (in other words, 99.9999918% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000024% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.999975% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.0000081\%$.

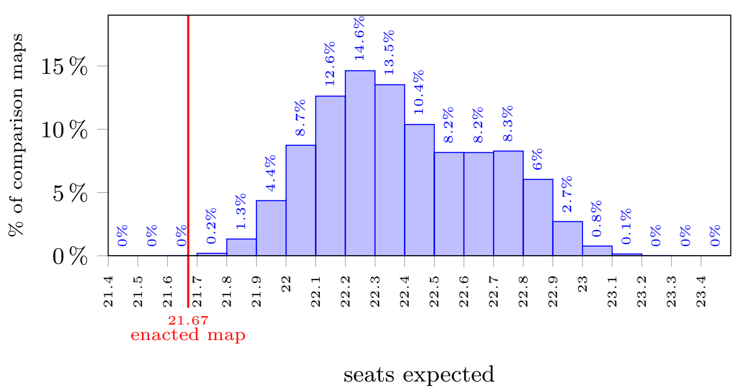
6.3 Senate districting

6.3.1 Comparison map examples



6.3.2 Results

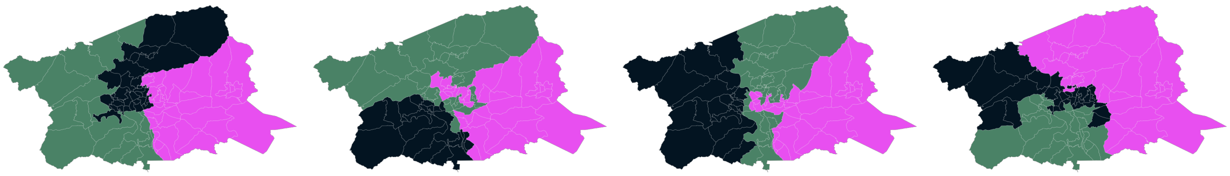
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.988%	9	99.9974%	17	99.9977%	25	99.998%
2	99.9988%	10	99.9958%	18	99.9987%	26	99.9948%
3	99.9938%	11	99.9985%	19	99.9988%	27	99.987%
4	99.9981%	12	99.9957%	20	99.978%	28	99.9988%
5	99.9929%	13	99.988%	21	99.9982%	29	99.9979%
6	99.9916%	14	99.989%	22	99.9978%	30	99.9981%
7	99.9957%	15	99.9974%	23	99.9976%	31	99.99914%
8	99.9973%	16	99.997%	24	99.9975%	32	99.9978%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.021% of districtings (in other words, 99.978% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.065% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.934% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.021\%$.

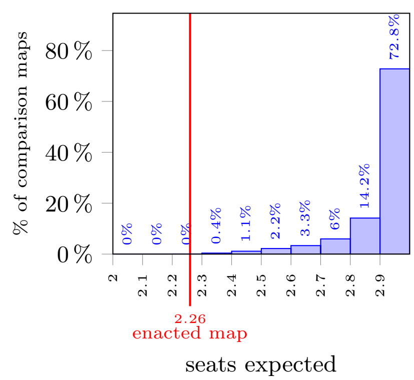
6.4 House Cluster: Buncombe

6.4.1 Comparison map examples



6.4.2 Results

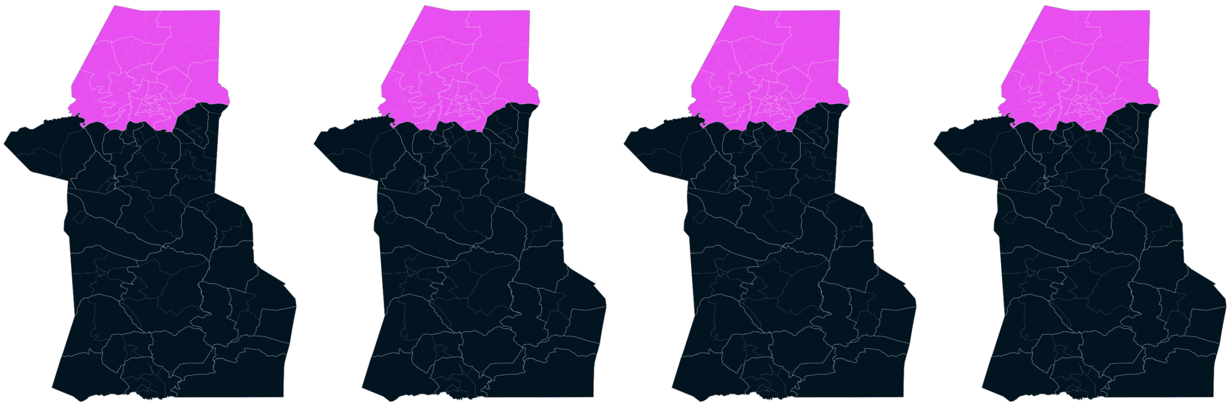
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.979%	9	99.979%	17	99.979%	25	99.98%
2	99.98%	10	99.98%	18	99.979%	26	99.979%
3	99.98%	11	99.98%	19	99.98%	27	99.979%
4	99.98%	12	99.98%	20	99.98%	28	99.98%
5	99.98%	13	99.98%	21	99.98%	29	99.98%
6	99.979%	14	99.98%	22	99.98%	30	99.98%
7	99.98%	15	99.98%	23	99.98%	31	99.979%
8	99.979%	16	99.98%	24	99.98%	32	99.979%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.020% of districtings (in other words, 99.979% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.061% of all alternative districtings satisfying my districting criteria (in other words, 99.938% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.020\%$.

6.5 House Cluster:Duplin/Wayne

6.5.1 Comparison map examples

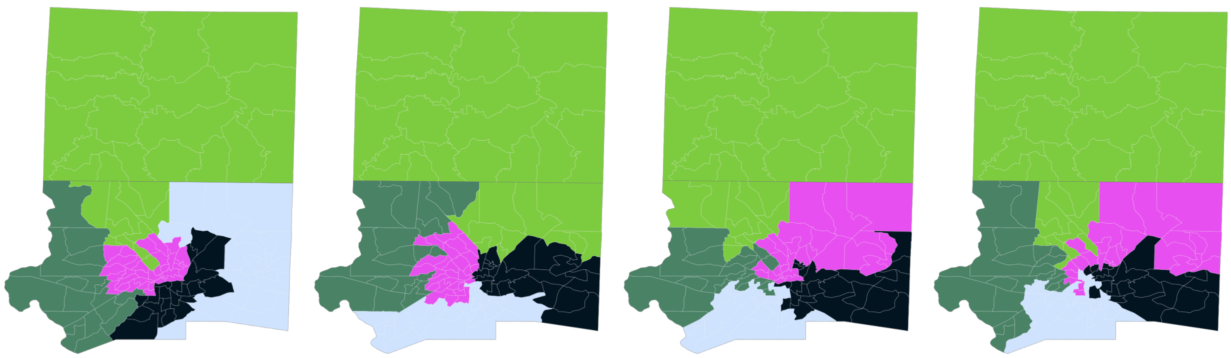


6.5.2 Results

- For this cluster, my conservative approach (as discussed in Section 4.3.2) does not allow my algorithm to generate any comparison maps other than the map itself.

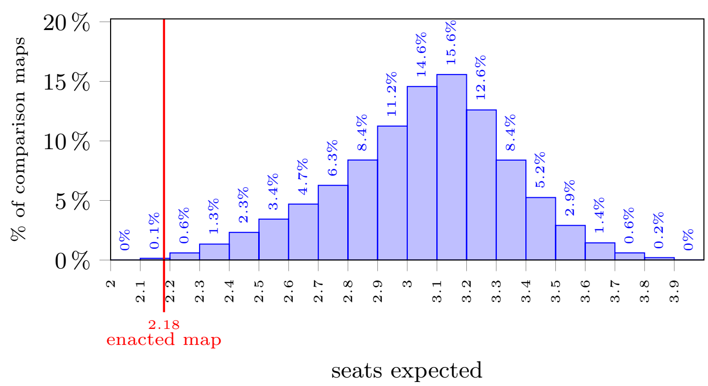
6.6 House Cluster: Forsyth-Stokes

6.6.1 Comparison map examples



6.6.2 Results

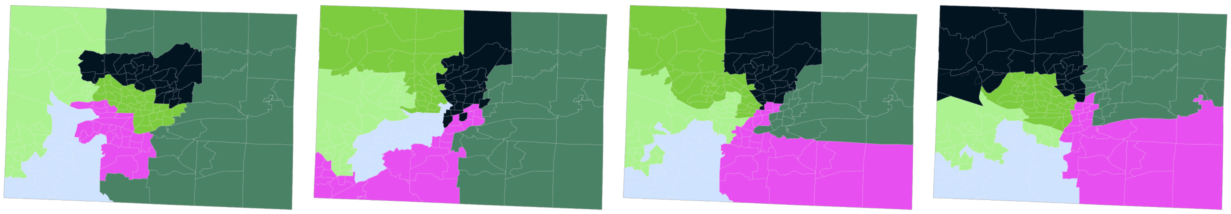
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.913%	9	99.912%	17	99.915%	25	99.914%
2	99.914%	10	99.914%	18	99.914%	26	99.913%
3	99.917%	11	99.912%	19	99.916%	27	99.914%
4	99.916%	12	99.912%	20	99.914%	28	99.912%
5	99.913%	13	99.914%	21	99.913%	29	99.915%
6	99.913%	14	99.914%	22	99.914%	30	99.914%
7	99.913%	15	99.912%	23	99.914%	31	99.917%
8	99.913%	16	99.916%	24	99.915%	32	99.915%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.087% of districtings (in other words, 99.912% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.26% of all alternative districtings satisfying my districting criteria (in other words, 99.73% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.087\%$.

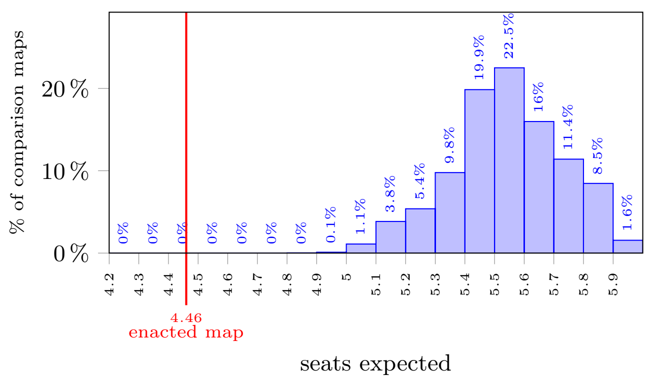
6.7 House Cluster: Guilford

6.7.1 Comparison map examples



6.7.2 Results

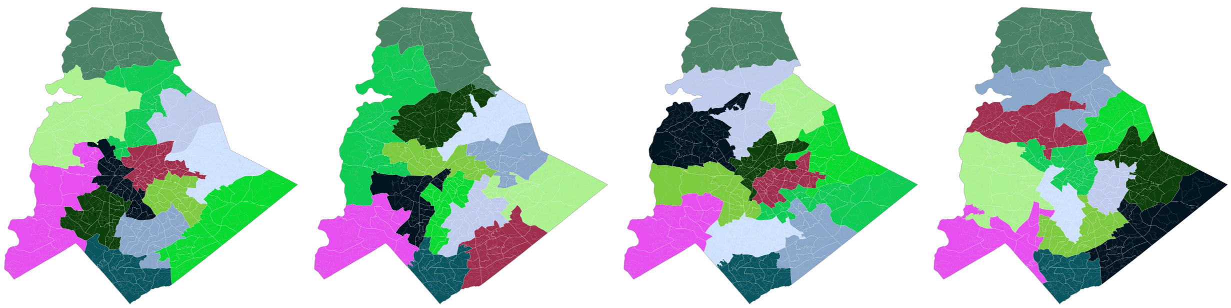
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999989%	9	99.999982%	17	99.999979%	25	99.999972%
2	99.999982%	10	99.999979%	18	99.999978%	26	99.999979%
3	99.999972%	11	99.999978%	19	99.999981%	27	99.999978%
4	99.999986%	12	99.999981%	20	99.999984%	28	99.999979%
5	99.999975%	13	99.999986%	21	99.999983%	29	99.999982%
6	99.999982%	14	99.99998%	22	99.999979%	30	99.999982%
7	99.999981%	15	99.99997%	23	99.999983%	31	99.999982%
8	99.999982%	16	99.999976%	24	99.999981%	32	99.999984%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.000029% of districtings (in other words, 99.99997% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000089% of all alternative districtings satisfying my districting criteria (in other words, 99.99991% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.000029\%$.

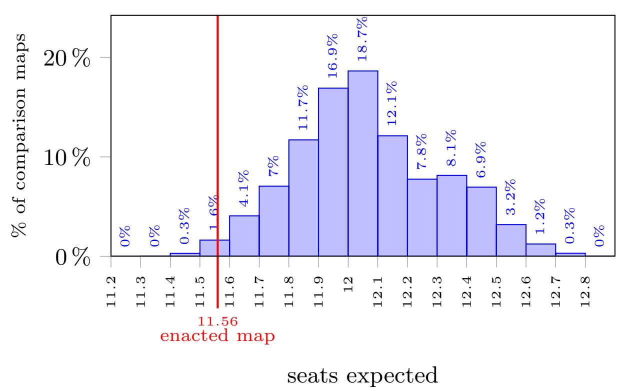
6.8 House Cluster: Mecklenburg

6.8.1 Comparison map examples



6.8.2 Results

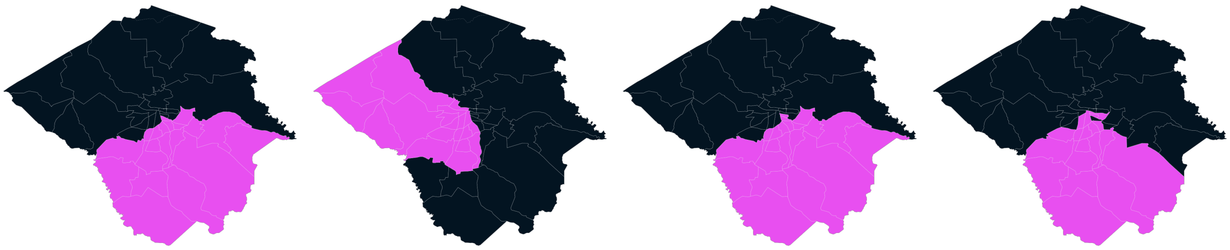
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	98.7%	9	98.6%	17	98.4%	25	98.9%
2	99.36%	10	99.15%	18	99.%	26	98.3%
3	98.7%	11	98.7%	19	98.4%	27	98.8%
4	99.14%	12	99.17%	20	99.17%	28	98.5%
5	98.4%	13	99.05%	21	98.8%	29	99.08%
6	99.33%	14	99.02%	22	98.9%	30	98.9%
7	98.5%	15	99.%	23	98.9%	31	99.12%
8	98.9%	16	99.17%	24	98.9%	32	99.2%



- **First level analysis:** In *every* run, the districting was in the most partisan 1.7% of districtings (in other words, 98.3% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 5.0% of all alternative districtings satisfying my districting criteria (in other words, 95.0% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 1.7\%$.

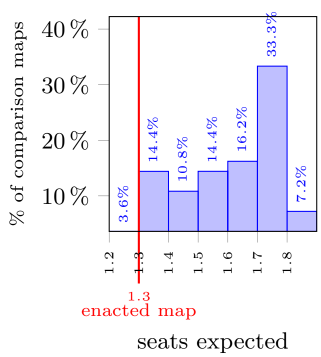
6.9 House Cluster: Pitt

6.9.1 Comparison map examples



6.9.2 Results

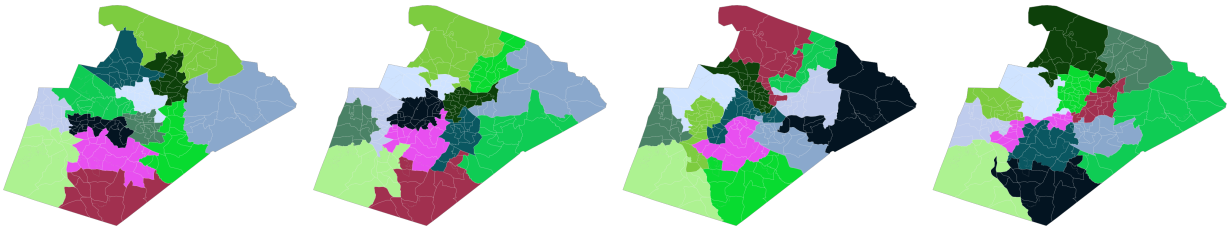
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	96.3%	9	96.4%	17	96.3%	25	96.4%
2	96.3%	10	96.3%	18	96.3%	26	96.3%
3	96.4%	11	96.4%	19	96.3%	27	96.4%
4	96.4%	12	96.4%	20	96.3%	28	96.3%
5	96.4%	13	96.4%	21	96.3%	29	96.4%
6	96.3%	14	96.3%	22	96.4%	30	96.3%
7	96.3%	15	96.3%	23	96.4%	31	96.4%
8	96.3%	16	96.4%	24	96.4%	32	96.4%



- **First level analysis:** In *every* run, the districting was in the most partisan 3.6% of districtings (in other words, 96.3% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 11% of all alternative districtings satisfying my districting criteria (in other words, 89.1% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 3.6\%$.

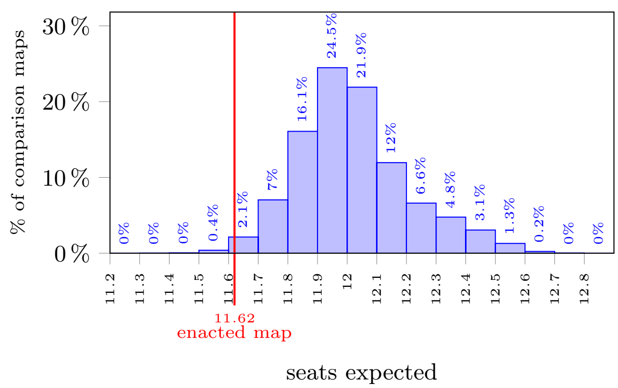
6.10 House Cluster: Wake

6.10.1 Comparison map examples



6.10.2 Results

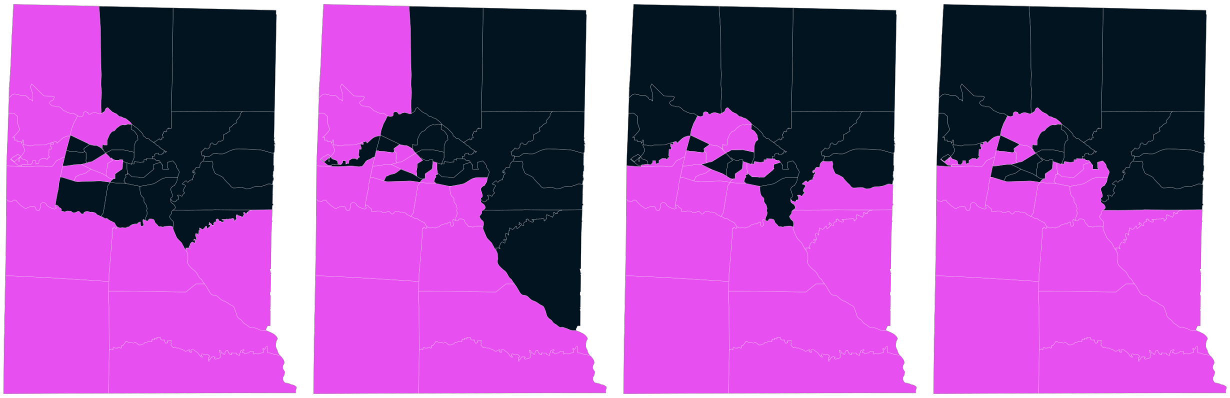
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.38%	9	99.34%	17	99.37%	25	99.35%
2	99.33%	10	99.35%	18	99.36%	26	99.36%
3	99.34%	11	99.33%	19	99.33%	27	99.34%
4	99.32%	12	99.34%	20	99.35%	28	99.33%
5	99.35%	13	99.34%	21	99.33%	29	99.35%
6	99.33%	14	99.27%	22	99.31%	30	99.36%
7	99.34%	15	99.34%	23	99.32%	31	99.36%
8	99.34%	16	99.36%	24	99.35%	32	99.35%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.72% of districtings (in other words, 99.27% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 2.2% of all alternative districtings satisfying my districting criteria (in other words, 97.8% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.72\%$.

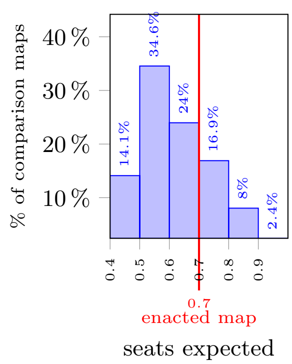
6.11 House Cluster: Alamance

6.11.1 Comparison map examples



6.11.2 Results

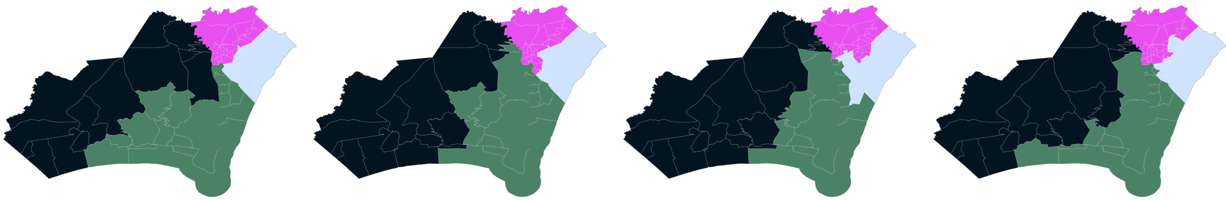
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	26.3%	9	26.4%	17	26.3%	25	26.4%
2	26.3%	10	26.3%	18	26.4%	26	26.3%
3	26.3%	11	26.3%	19	26.3%	27	26.3%
4	26.4%	12	26.3%	20	26.3%	28	26.3%
5	26.4%	13	26.4%	21	26.4%	29	26.3%
6	26.3%	14	26.3%	22	26.4%	30	26.4%
7	26.4%	15	26.3%	23	26.3%	31	26.3%
8	26.4%	16	26.4%	24	26.4%	32	26.4%



- **First level analysis:** In *every* run, the districting was in the most partisan 74% of districtings (in other words, 26.3% were less partisan, in *every* run).
- **Second level analysis:** The enacted map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster.

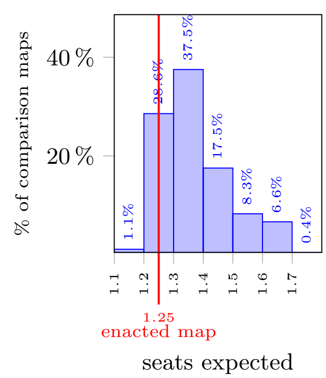
6.12 House Cluster: Brunswick/New Hanover

6.12.1 Comparison map examples



6.12.2 Results

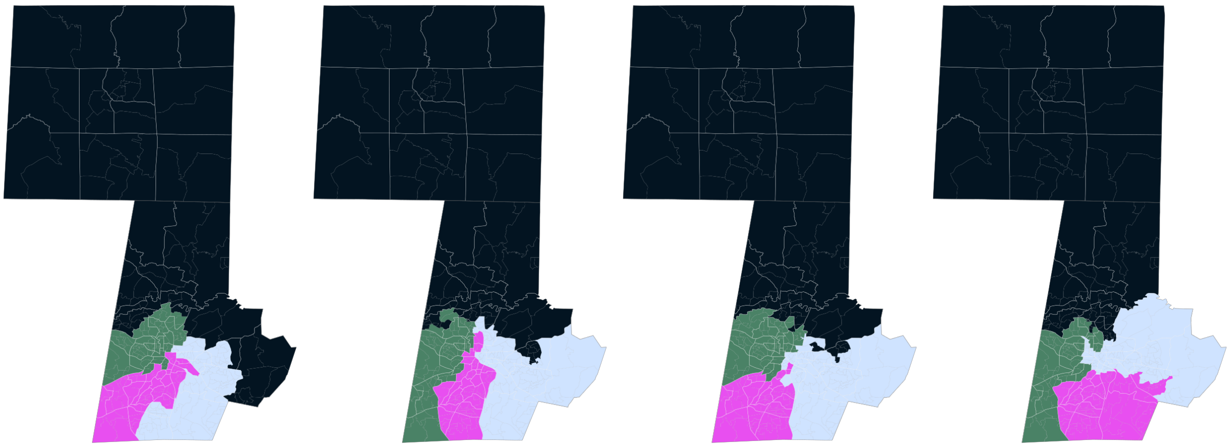
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	89.4%	9	89.5%	17	89.5%	25	89.5%
2	89.4%	10	89.5%	18	89.4%	26	89.5%
3	89.5%	11	89.5%	19	89.5%	27	89.4%
4	89.4%	12	89.4%	20	89.4%	28	89.5%
5	89.4%	13	89.5%	21	89.5%	29	89.5%
6	89.5%	14	89.6%	22	89.5%	30	89.4%
7	89.4%	15	89.5%	23	89.5%	31	89.5%
8	89.5%	16	89.4%	24	89.4%	32	89.5%



- **First level analysis:** In *every* run, the districting was in the most partisan 11% of districtings (in other words, 89.4% were less partisan, in *every* run).
- **Second level analysis:** The enacted map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster.

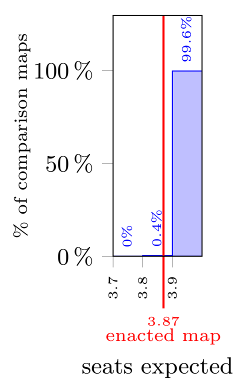
6.13 House Cluster: Durham/Person

6.13.1 Comparison map examples



6.13.2 Results

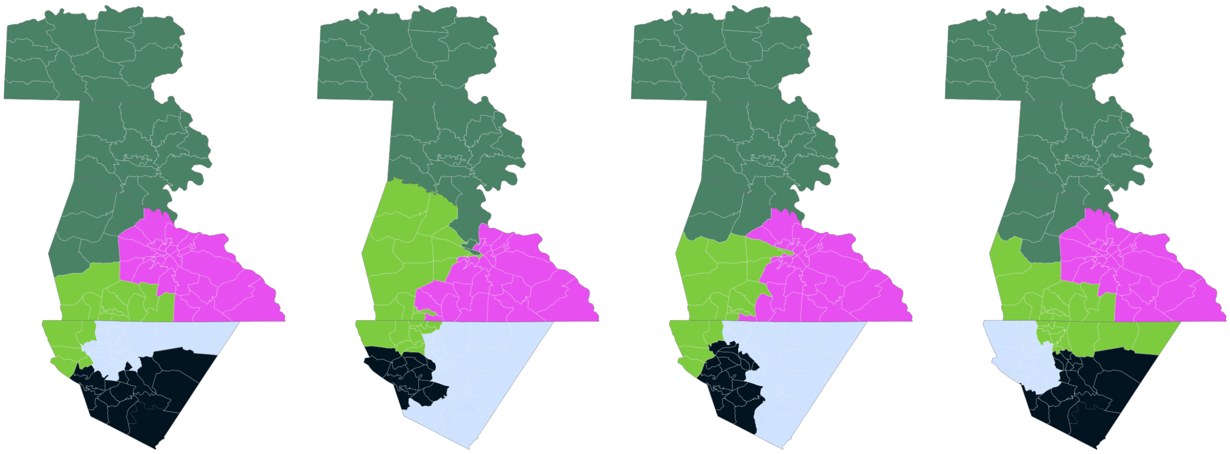
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.936%	9	99.935%	17	99.938%	25	99.935%
2	99.933%	10	99.937%	18	99.937%	26	99.933%
3	99.937%	11	99.94%	19	99.934%	27	99.939%
4	99.932%	12	99.933%	20	99.934%	28	99.936%
5	99.933%	13	99.936%	21	99.936%	29	99.937%
6	99.936%	14	99.935%	22	99.938%	30	99.933%
7	99.937%	15	99.933%	23	99.937%	31	99.94%
8	99.936%	16	99.936%	24	99.934%	32	99.934%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.067% of districtings (in other words, 99.932% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.20% of all alternative districtings satisfying my districting criteria (in other words, 99.79% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.067\%$.

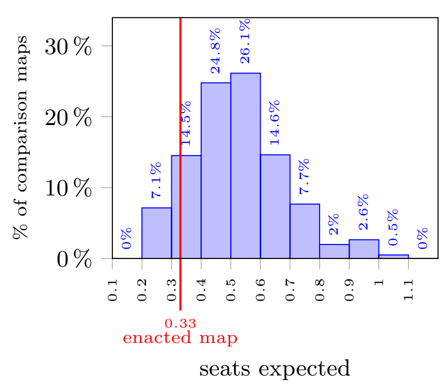
6.14 House Cluster: Cabarrus/Davie/Rowan/Yadkin

6.14.1 Comparison map examples



6.14.2 Results

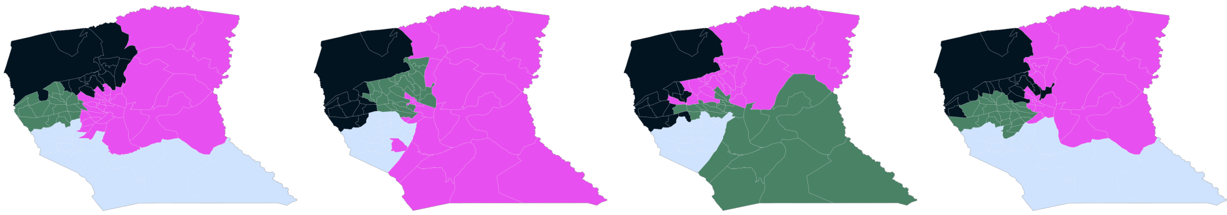
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	89.0%	9	90.0%	17	88.5%	25	89.9%
2	90.0%	10	88.9%	18	89.0%	26	88.6%
3	90.1%	11	88.7%	19	89.4%	27	89.9%
4	88.4%	12	89.8%	20	89.3%	28	88.9%
5	89.7%	13	89.4%	21	92.8%	29	89.5%
6	88.6%	14	89.2%	22	89.1%	30	87.7%
7	89.5%	15	88.8%	23	89.1%	31	90.2%
8	90.0%	16	90.0%	24	88.7%	32	90.4%



- **First level analysis:** In *every* run, the districting was in the most partisan 12% of districtings (in other words, 87.7% were less partisan, in *every* run).
- **Second level analysis:** The enacted map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster.

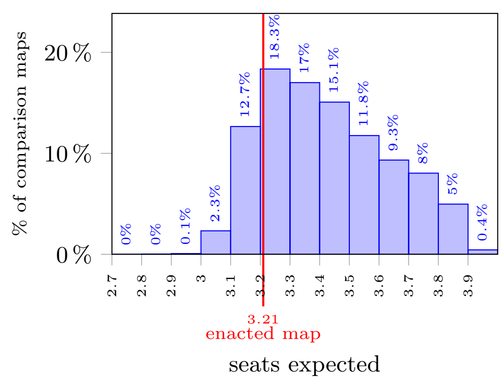
6.15 House Cluster: Cumberland

6.15.1 Comparison map examples



6.15.2 Results

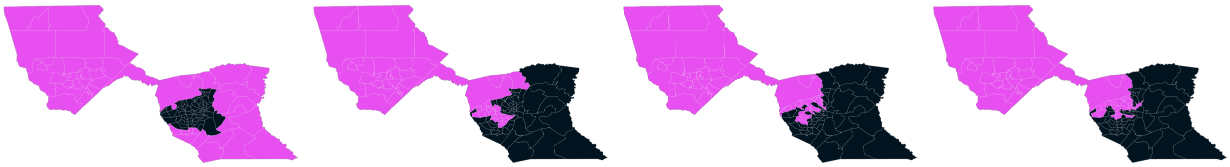
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	83.6%	9	83.8%	17	83.8%	25	84.0%
2	83.7%	10	83.9%	18	83.6%	26	83.5%
3	83.8%	11	83.8%	19	83.7%	27	83.8%
4	83.7%	12	83.6%	20	83.7%	28	83.8%
5	83.6%	13	83.7%	21	84.0%	29	83.7%
6	83.7%	14	83.6%	22	83.9%	30	83.6%
7	83.5%	15	83.8%	23	83.7%	31	83.9%
8	83.7%	16	83.8%	24	83.6%	32	83.9%



- **First level analysis:** In *every* run, the districting was in the most partisan 16% of districtings (in other words, 83.5% were less partisan, in *every* run).
- **Second level analysis:** The enacted map is not unusual enough in the first-level analysis to enable a statistically significant second-level analysis of this cluster.

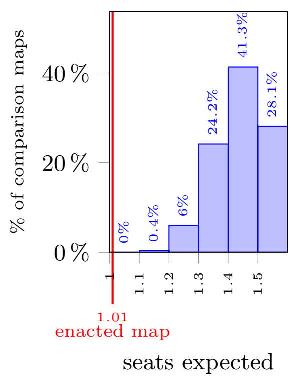
6.16 Senate Cluster: Cumberland Moore

6.16.1 Comparison map examples



6.16.2 Results

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999968%	9	99.9999962%	17	99.9999963%	25	99.9999954%
2	99.9999961%	10	99.9999965%	18	99.9999969%	26	99.9999955%
3	99.999998%	11	99.9999954%	19	99.9999967%	27	99.999997%
4	99.9999953%	12	99.9999961%	20	99.9999969%	28	99.9999952%
5	99.9999969%	13	99.9999957%	21	99.9999971%	29	99.9999959%
6	99.9999969%	14	99.9999949%	22	99.9999961%	30	99.9999956%
7	99.9999966%	15	99.9999964%	23	99.9999961%	31	99.9999961%
8	99.9999966%	16	99.9999959%	24	99.9999977%	32	99.9999965%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.0000050% of districtings (in other words, 99.9999949% were less partisan, in *every* run).

- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000015% of all alternative districtings satisfying my districting criteria (in other words, 99.999984% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.0000050\%$.

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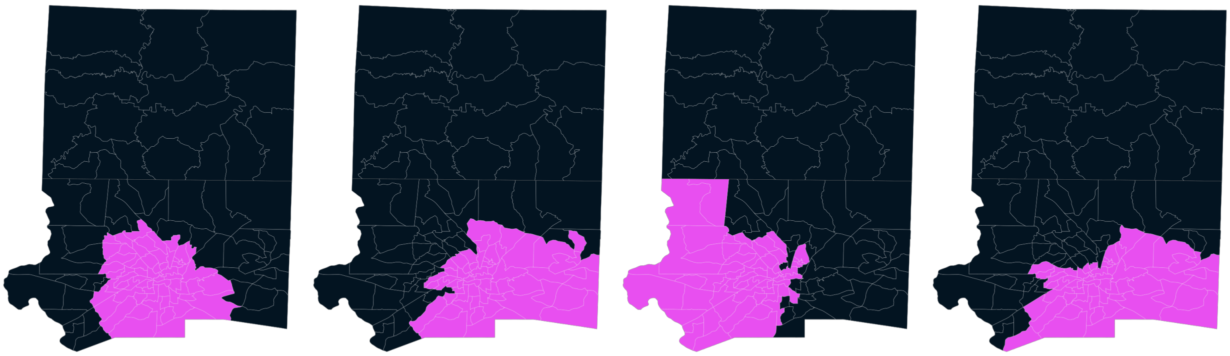
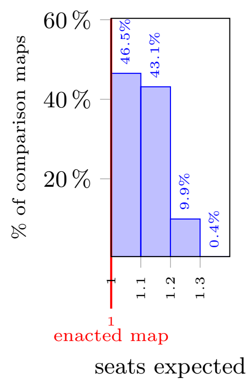
6.17 Senate Cluster: Forsyth-Stokes

6.17.1 Comparison map examples



6.17.2 Results

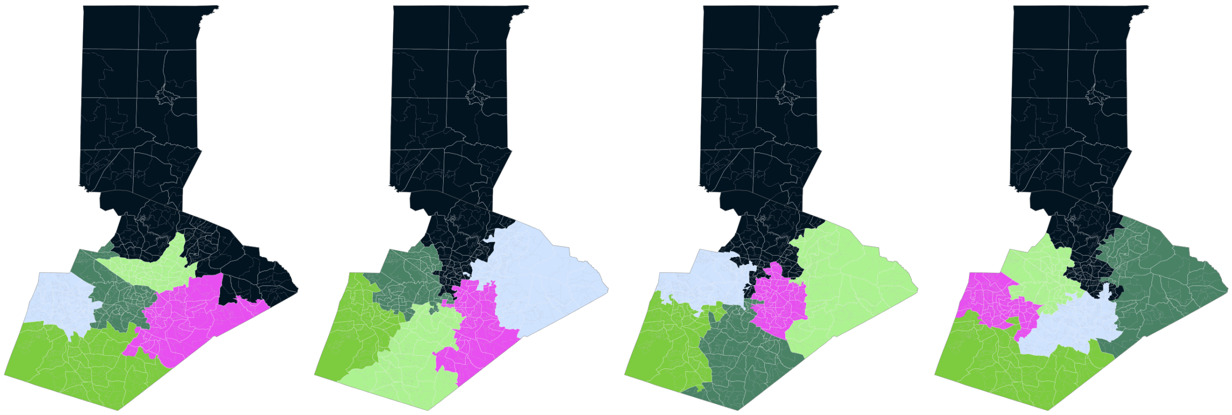
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9983%	9	99.9983%	17	99.9983%	25	99.9983%
2	99.9984%	10	99.9984%	18	99.9984%	26	99.9983%
3	99.9982%	11	99.9983%	19	99.9984%	27	99.9983%
4	99.9982%	12	99.9984%	20	99.9983%	28	99.9984%
5	99.9983%	13	99.9983%	21	99.9983%	29	99.9983%
6	99.9984%	14	99.9983%	22	99.9983%	30	99.9984%
7	99.9984%	15	99.9983%	23	99.9983%	31	99.9984%
8	99.9984%	16	99.9984%	24	99.9984%	32	99.9983%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.0016% of districtings (in other words, 99.9983% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.0051% of all alternative districtings satisfying my districting criteria (in other words, 99.9947% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.0016\%$.

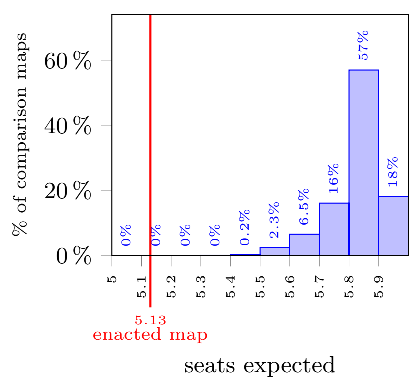
6.18 Senate Cluster: Granville-Wake

6.18.1 Comparison map examples



6.18.2 Results

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99999934%	9	99.99999921%	17	99.99999999936%	25	99.9999971%
2	99.9999984%	10	99.99999999936%	18	99.99999913%	26	99.9999975%
3	99.99999917%	11	99.99999966%	19	99.9999967%	27	99.99999909%
4	99.99999999945%	12	99.9999979%	20	99.99999963%	28	99.999989%
5	99.99999974%	13	99.9999989%	21	99.9999999984%	29	99.99999999954%
6	99.999999939%	14	99.9999976%	22	99.99999948%	30	99.9999968%
7	99.9999999982%	15	99.9999947%	23	99.9999984%	31	99.99999999945%
8	99.9999995%	16	99.99999969%	24	99.99999967%	32	99.99999971%

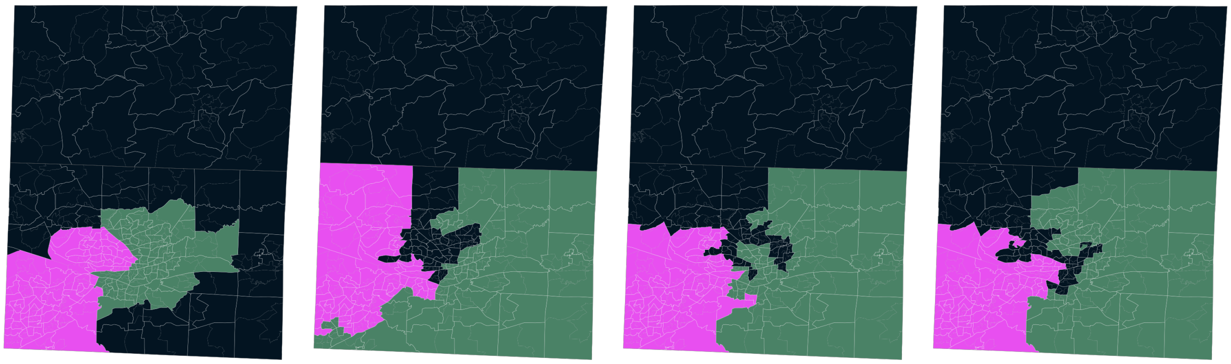


- **First level analysis:** In *every* run, the districting was in the most partisan 0.000010% of districtings (in other words, 99.999989% were less partisan, in *every* run).

- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000030% of all alternative districtings satisfying my districting criteria (in other words, 99.999969% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.000010\%$.

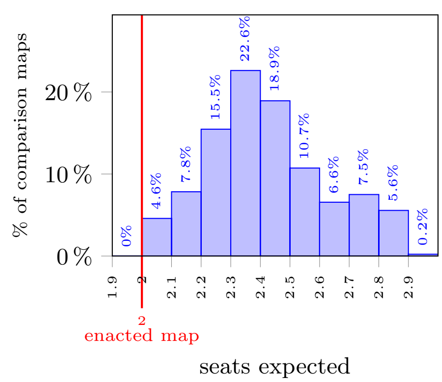
6.19 Senate Cluster: Guilford-Rockingham

6.19.1 Comparison map examples



6.19.2 Results

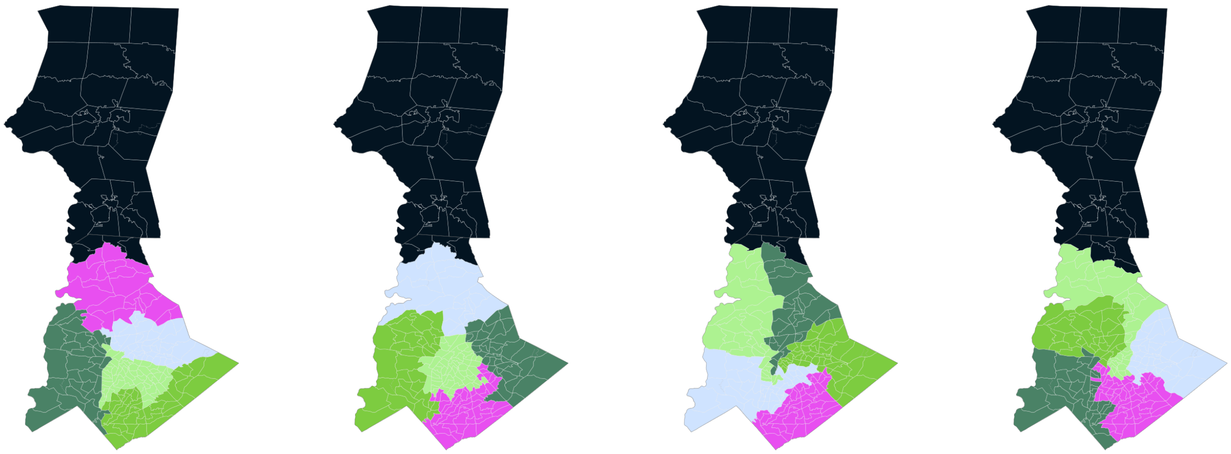
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999979%	9	99.9999971%	17	99.999989%	25	99.999984%
2	99.999975%	10	99.999999976%	18	99.9999929%	26	99.99999949%
3	99.9999991%	11	99.9999944%	19	99.999988%	27	99.999967%
4	99.999984%	12	99.99998%	20	99.99998%	28	99.999995%
5	99.999976%	13	99.9999978%	21	99.99996%	29	99.999957%
6	99.9999922%	14	99.999978%	22	99.999979%	30	99.9999999957%
7	99.9999997%	15	99.999986%	23	99.9999964%	31	99.9999935%
8	99.999967%	16	99.9999939%	24	99.999983%	32	99.9999984%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.000042% of districtings (in other words, 99.999957% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.00012% of all alternative districtings satisfying my districting criteria (in other words, 99.99987% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.000042\%$.

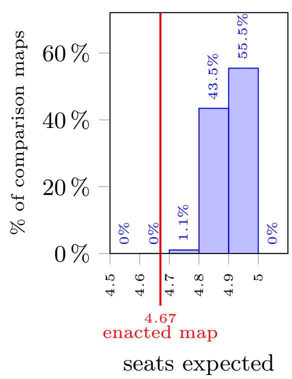
6.20 Senate Cluster: Iredell-Mecklenburg

6.20.1 Comparison map examples



6.20.2 Results

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9981%	9	99.9983%	17	99.9982%	25	99.9982%
2	99.9982%	10	99.9983%	18	99.9982%	26	99.9983%
3	99.9982%	11	99.9981%	19	99.9981%	27	99.9981%
4	99.9982%	12	99.9982%	20	99.9982%	28	99.9982%
5	99.9981%	13	99.9982%	21	99.9982%	29	99.9982%
6	99.9983%	14	99.9982%	22	99.9982%	30	99.9982%
7	99.9982%	15	99.9982%	23	99.9982%	31	99.9982%
8	99.9982%	16	99.9982%	24	99.9982%	32	99.9981%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.0019% of districtings (in other words, 99.998% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.0057% of all alternative districtings satisfying my districting criteria (in other words, 99.9943% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.0019\%$.

7 Seat preservation analyses

In this section I present analyses of clusters for which my main analysis does not achieve high confidence of gerrymandering with respect to the seats-expected metric. These are the districtings in the following House clusters:

- Alamance
- Brunswick/New Hanover
- Cabarrus/Davie/Rowan/Yadkin
- Cumberland

Note that the motivation for the seat-expected metric is to detect partisan gerrymandering aimed at maximizing the expected total number of seats belonging to one party in a representative body (Congress, the North Carolina house, or the North Carolina senate). But there may be other conceivable partisan goals, such as facilitating the re-election of particular representatives in particular districts, which may be orthogonal to or (at least not perfectly correlated with) the goal of maximizing expected representation from one party, and thus which would not be detected by the seats-expected metric.

The metric I use in this section to re-analyze these districtings is the *wave threshold* for a particular seat count. In particular, for a given number of seats x, the wave threshold for x is the smallest uniform swing which can be applied to election data (here, the 2020 Attorney General race) which would result in $x + 1$ Democratic seats. Put differently, this is the threshold such that for any smaller uniform swing, the Democrats will win at most x seats. Referring back to Figure 1, we see that for the enacted Congressional districting of North Carolina, the wave thresholds for $x = 3, 4, 5$, and 6 are -3.56%, 1.68%, 3.05%, and 5.82%, respectively. In particular, even in an election in which voter patterns mirror the 2020 Attorney General race **with all Democratic vote shares increased by an additional** 5.81 **percentage points**, the enacted Congressional districting would still produce only 6 Democrat representatives.

The wave threshold metric can capture partisan goals which may be washed out in the seats-expected metric. For example, if a 5-district cluster is proposed to be districted to optimize the chance that three Republican incumbents all can save their seats, this may or may not result in an increase in the seats-expected metric (for example, if the alternative was to have 4 lean-Republican competitive districts, the extent of the lean would determine how the proposed and alternative districtings would compare under the seats expected metric). But such a plan would be expected to stand out as being highly unusual with respect to the wave threshold for 2 Democratic seats, as it would be an extreme outlier with respect to how difficult it would be for Democrats to capture more than 2 seats in the cluster.

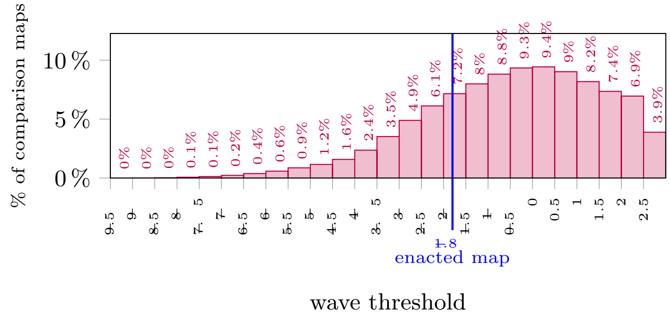
All wave-threshold histograms are shown with red bars, to visually distinguish them from the seats-expected histograms shown elsewhere in the report. Note that unlike for the seats-expected histograms, a Republican bias in the enacted map with respect to a particular wave threshold is indicated by the enacted map showing as an outlier on the righthand side of the plot.

[Report continues on next page for formatting reasons]

7.1 Alamance

The comparison maps generated by my algorithm were similar to the enacted map with respect to their wave threshold for both possible seat values (results here shown for the wave threshold for 0 seats):

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	25.2%	9	25.2%	17	25.1%	25	25.2%
2	25.2%	10	25.0%	18	25.1%	26	25.2%
3	25.2%	11	25.1%	19	25.1%	27	25.2%
4	25.2%	12	25.2%	20	25.1%	28	25.2%
5	25.3%	13	25.2%	21	25.3%	29	25.3%
6	25.2%	14	25.2%	22	25.2%	30	25.2%
7	25.2%	15	25.1%	23	25.3%	31	25.3%
8	25.2%	16	25.2%	24	25.2%	32	25.2%



7.2 Brunswick/New Hanover

Despite the fact that my algorithm did not detect large differences between the enacted districting and comparison districtings of this cluster, the enacted map is an extreme outlier among the comparison maps generated by my algorithm with respect to the wave threshold for two seats. In particuliar, for the enacted map in this cluster, Democratic performance could increase by 10.1 percentage points in every district without Democrats capturing more than two seats. In every run of my algorithm, 99.72% of comparison maps would allow Democrats to capture a third seat with a smaller wave.

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.987%	9	99.94%	17	99.9956%	25	99.83%
2	99.99%	10	99.907%	18	99.9957%	26	99.79%
3	99.929%	11	99.85%	19	99.8%	27	99.975%
4	99.88%	12	99.9912%	20	99.922%	28	99.85%
5	99.86%	13	99.77%	21	99.961%	29	99.83%
6	99.934%	14	99.89%	22	99.952%	30	99.92%
7	99.73%	15	99.87%	23	99.97%	31	99.946%
8	99.96%	16	99.72%	24	99.911%	32	99.961%

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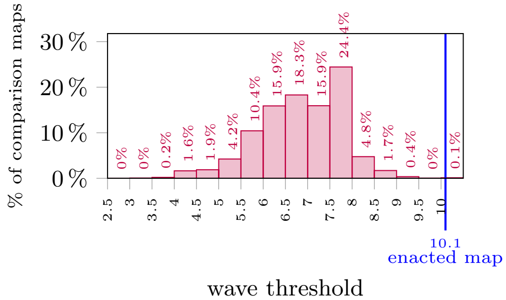
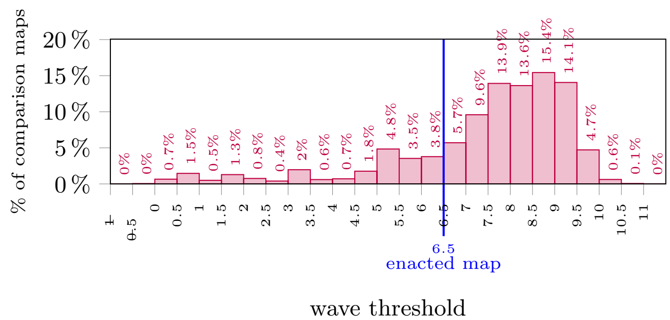

% of comparison maps
30 %
20 %
10 %
0 %
0%
0%
0.2%
1.6%
1.9%
4.2%
10.4%
15.9%
18.3%
15.9%
24.4%
4.8%
1.7%
0.4%
0%
0.1%
2.5
3
3.5
4
4.5
5
5.5
6
6.5
7
7.5
8
8.5
9
9.5
10
10.1
enacted map
wave threshold

7.3 Cabarrus/Davie/Rowan/Yadkin

The comparison maps generated by my algorithm were similar to the enacted map with respect to their wave threshold for all seat values (results here shown for the wave threshold for 1 seat):

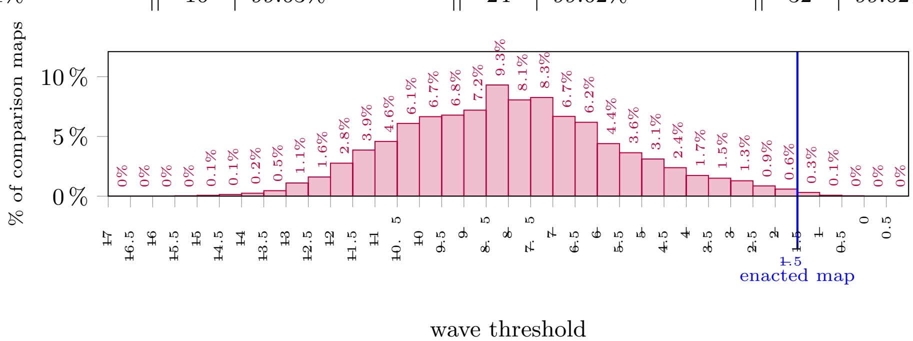
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	26.3%	9	20.7%	17	22.0%	25	22.3%
2	22.6%	10	23.1%	18	21.4%	26	20.8%
3	19.4%	11	27.6%	19	23.3%	27	20.2%
4	20.7%	12	21.2%	20	25.7%	28	22.0%
5	18.8%	13	23.4%	21	21.8%	29	22.1%
6	21.9%	14	25.4%	22	20.8%	30	22.3%
7	24.3%	15	20.0%	23	22.9%	31	22.4%
8	20.4%	16	19.9%	24	23.1%	32	23.8%



7.4 Cumberland

Despite the fact that my algorithm did not detect large differences between the enacted districting and comparison districtings of this cluster, the enacted map is an extreme outlier among the comparison maps generated by my algorithm with respect to the wave threshold for two seats.

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.61%	9	99.62%	17	99.62%	25	99.64%
2	99.64%	10	99.64%	18	99.62%	26	99.63%
3	99.61%	11	99.61%	19	99.61%	27	99.63%
4	99.62%	12	99.62%	20	99.63%	28	99.6%
5	99.59%	13	99.62%	21	99.64%	29	99.63%
6	99.61%	14	99.59%	22	99.63%	30	99.62%
7	99.61%	15	99.62%	23	99.62%	31	99.6%
8	99.61%	16	99.63%	24	99.62%	32	99.62%



Appendix A Multimoves / Precinct splits

As discussed in Section 5 my algorithm can be set to allow multiple changes to a map to occur in one step, when this is necessary to produce a sufficiently rich set of comparison maps.

Here I describe details of this technique so that technical experts can understand how precisely our method works. These details are not necessary to understand the basic mechanics of the method, which are simply that:

- Multiple changes may be made to a map in a single step,
- The result of the changes must always be a valid comparison map, in the sense that it complies with the districting criteria we consider in our report, and
- Our implementation of multiple moves does not bias the algorithm to any map or family of maps.

For technical experts: these multiple moves can be implemented with a Metropolis-Hastings approach. In particular, a score function based on the deviation of an invalid map from the compactness and population thresholds can be defined. *The score function is set to be equal for all maps satisfying the districting criteria.* With this choice, a uniform stationary distribution can be constructed on the space of maps satisfying the districting criteria. The Metropolis-Hastings chain will occasionally leave the feasible region of the map-space for some number of steps before returning to the feasible region. The collection of steps made outside the feasible region can be performed in a single step, to give a single multi-move which transforms one valid map into another valid map.

A related implementation detail concerns precinct splits. When operating at the geounit level but preserving the maximum number of precinct splits, I can allow the chain at intermediate points to have one more split than is allowed, while discarding these intermediate, invalid comparison maps. For example, in a map which currently splits two specific precincts, the chain is allowed to produce a valid comparison map by changing the district membership of another precinct. Note that this does not change the number of precinct splits, but viewed in terms of single geounit moves, it passes through a set of maps with a greater number of precinct splits. As in the case of multimoves discussed above, these intermediate maps are not part of the comparison set, and we can view the precinct swap as a single multimove of geounit swaps.

Finally, I note that when operating below the precinct level in House clusters with split precincts, my algorithm imposes an additional compactness-like constraint on any precinct splits, which is simply that the length of the precinct split is not large relative to the perimeter of the precinct itself. (The enacted plan satisfies this constraint in all cases.)

Appendix B Theorems

The second level analyses in my report are calculated using the theorems from [CFMP]; in particular, Theorem 1.5 from that manuscript suffices for all of my second-level findings here.

In plain language, that theorem says that if I conduct m runs, and observe that in every run the enacted plan is in the bottom ε fraction of comparison maps, then I can conclude that the enacted plan is among the most carefully crafted α fraction of *all* maps satisfying the districting criteria (not just those encountered by the algorithm), measured by their ε-fragility, at a statistical significance calculated with the formula

$$p = \left(\frac{2\varepsilon}{\alpha}\right)^{m/2}.$$

In this report, I frequently have $m = 32$ runs and choose α to simply be 3 times as big as ε. In this case, we see that we can conclude that the enacted plan is among the most carefully crafted 3ε of all maps, at a statistical significance of

$$p = \left(\frac{2}{3}\right)^{16} \approx .0015 < .002.$$

Note that, for example, if we used instead a threshold of $\alpha = 4\varepsilon$, this would give significance of

$$p = \left(\frac{2}{4}\right)^{16} \approx .000015,$$

and taking a threshold of $\alpha = 6\varepsilon$ would give

$$p = \left(\frac{2}{6}\right)^{16} \approx .00000002,$$

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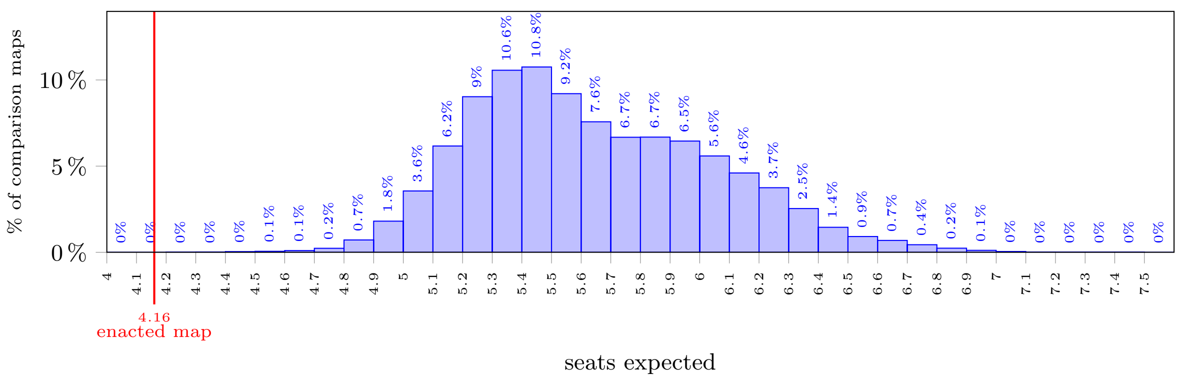
Appendix C Robustness Checks, Congressional districting

C.1 Robustness to election data

Here I show results when my analysis of the Congressional map is repeated with other elections in place of the 2020 Attorney General election as my proxy for partisan voting patterns.

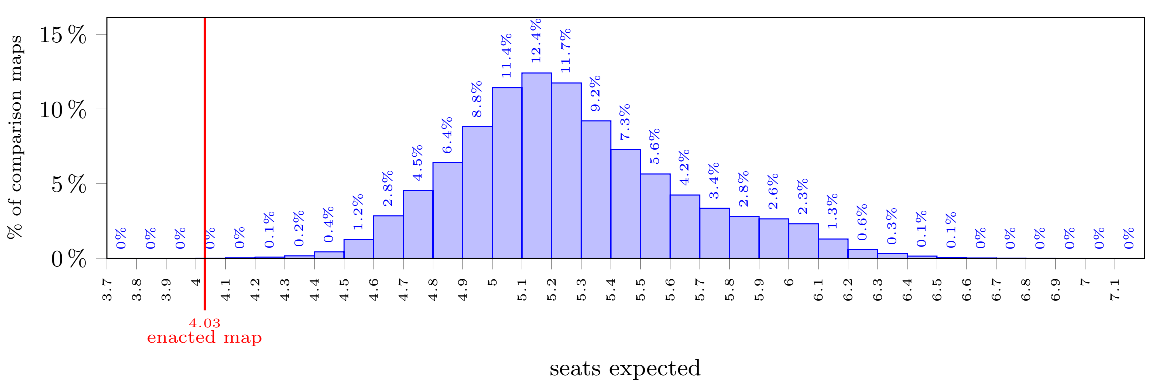
C.1.1 Results with 2020 Presidential election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999925%	5	99.999986%	9	99.9999908%	13	99.9999926%
2	99.999921%	6	99.999999968%	10	99.9999932%	14	99.999988%
3	99.9999955%	7	99.999984%	11	99.9999979%	15	99.9999989%
4	99.9999933%	8	99.99995%	12	99.9999999981%	16	99.999978%



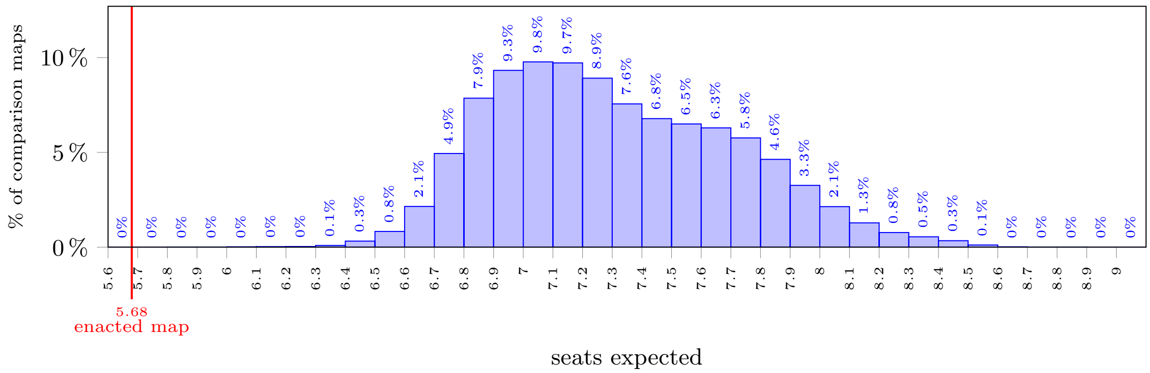
C.1.2 Results with 2020 Lieutenant Governor election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999973%	5	99.999937%	9	99.999942%	13	99.999982%
2	99.99985%	6	99.9999964%	10	99.99901%	14	99.999978%
3	99.999905%	7	99.99954%	11	99.9999928%	15	99.999934%
4	99.999964%	8	99.99975%	12	99.9995%	16	99.9998%



C.1.3 Results with 2020 Governor election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999989%	5	99.9999979%	9	99.9999975%	13	99.99999923%
2	99.9999914%	6	99.9999999922%	10	99.99999974%	14	99.99999968%
3	99.9999996%	7	99.999999934%	11	99.999999994%	15	99.999999982%
4	99.999999966%	8	99.9999982%	12	99.9999999981%	16	99.999999961%



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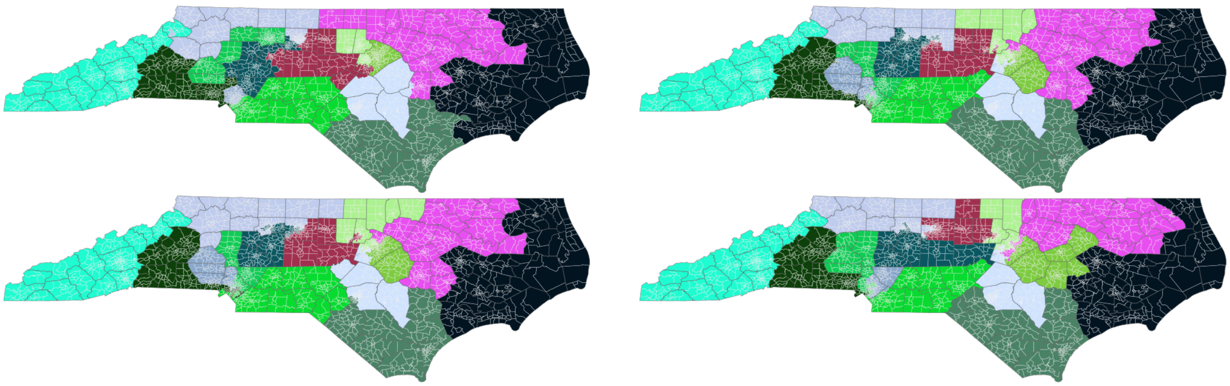
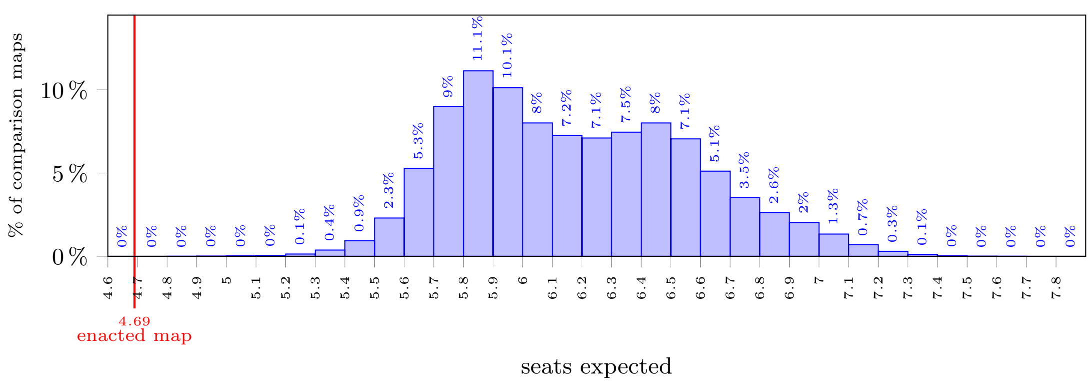
C.2 Robustness to incumbency protection

Here I show results when my analysis of the Congressional map is repeated without ensuring the protection of incumbents.

C.2.1 Comparison map examples



Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999998%	5	99.99999918%	9	99.9999976%	13	99.999982%
2	99.999999901%	6	99.9999978%	10	99.999989%	14	99.99999901%
3	99.9999986%	7	99.999999961%	11	99.9999967%	15	99.99999977%
4	99.9999967%	8	99.9999954%	12	99.9999999981%	16	99.9999986%



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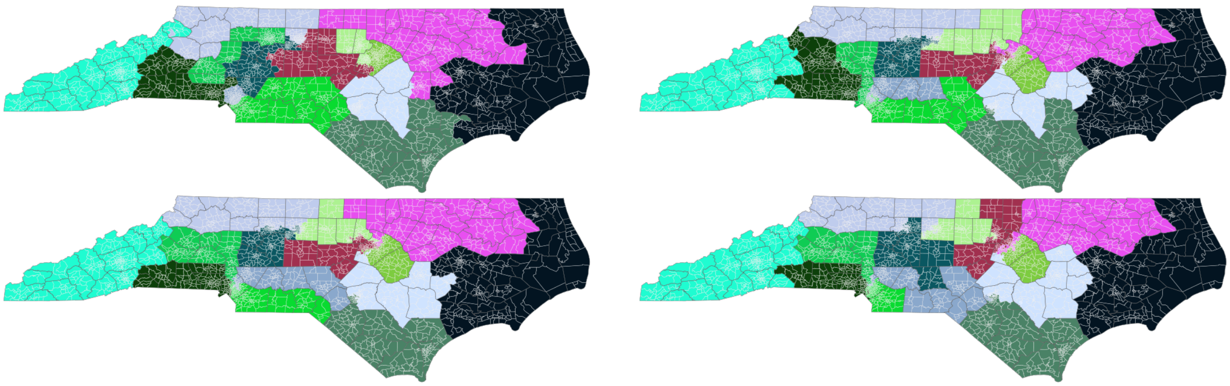
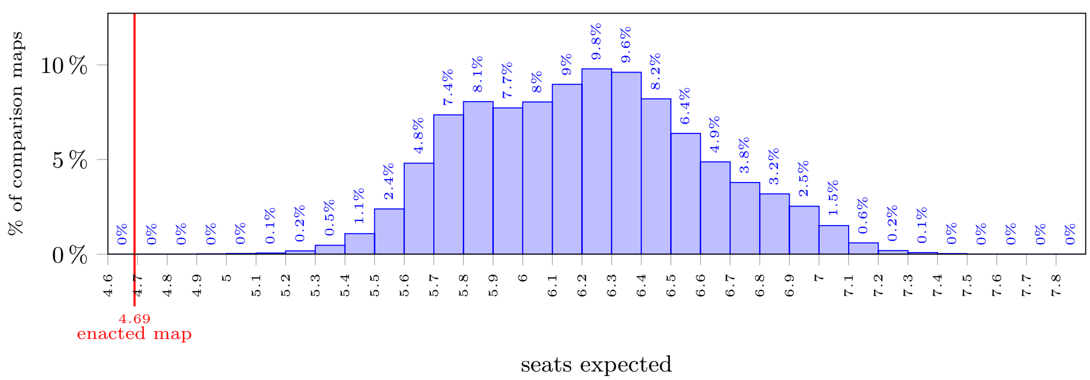
C.3 Robustness to compactness: 0% Polsby-Popper threshold

Here I show results when my analysis of the Congressional map is repeated with a 0% threshold for compactness in place of the 5% error I allow in my primary analysis.

C.3.1 Comparison map examples



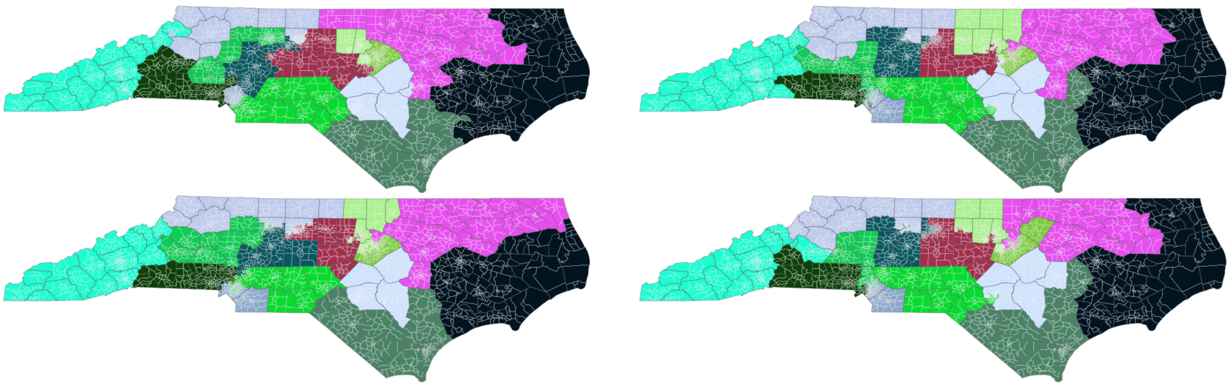
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99999989%	5	99.9999997%	9	99.9999975%	13	99.999979%
2	99.9999984%	6	99.99999983%	10	99.9999968%	14	99.9999968%
3	99.9999933%	7	99.9999962%	11	99.9999968%	15	99.9999983%
4	99.999986%	8	99.9999983%	12	99.99999954%	16	99.9999984%



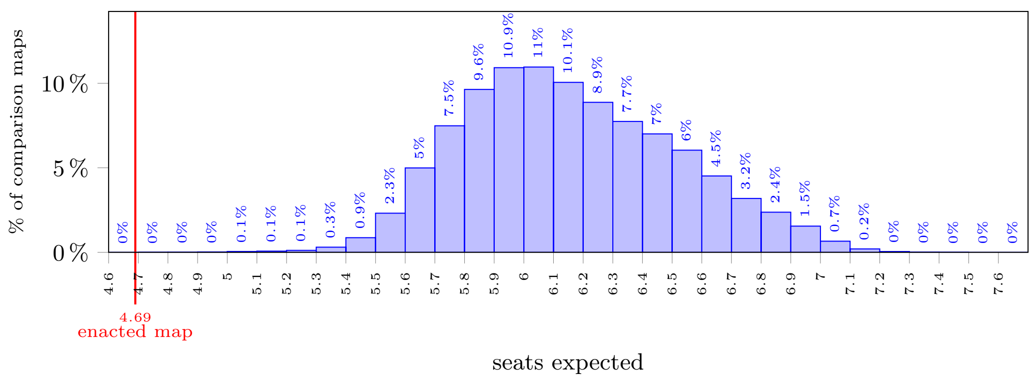
C.4 Robustness to compactness: 10% Polsby-Popper threshold

Here I show results when my analysis of the Congressional map is repeated with a 10% threshold for compactness in place of the 5% error I allow in my primary analysis.

C.4.1 Comparison map examples



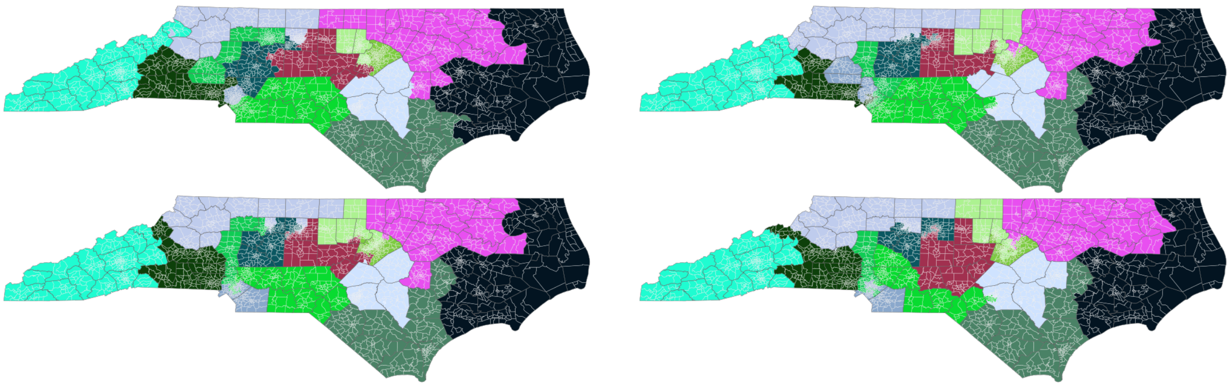
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999988%	5	99.9999974%	9	99.999982%	13	99.9999976%
2	99.9999989%	6	99.9999989%	10	99.9999954%	14	99.9999985%
3	99.9999961%	7	99.999999946%	11	99.9999965%	15	99.99999983%
4	99.99999981%	8	99.9999973%	12	99.9999999981%	16	99.99999985%



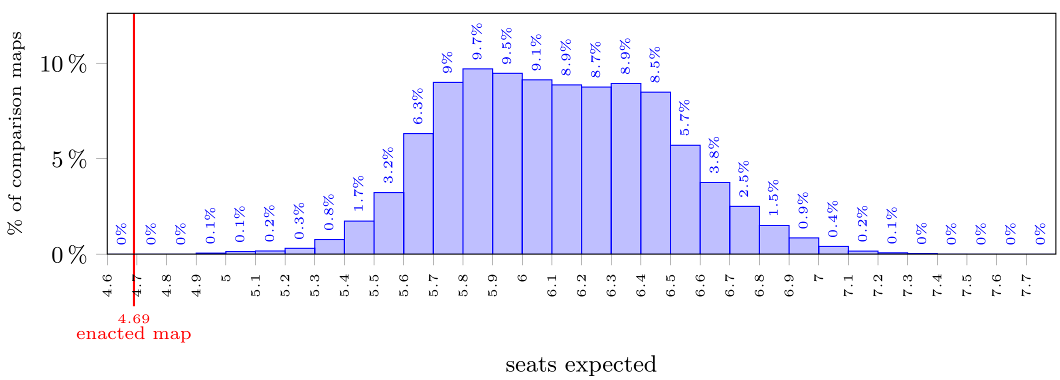
C.5 Robustness to compactness 5% Perimeter compactness

Here I show results when my analysis of the Congressional map is repeated with a completely different compactness score, based just on the total perimeter of all districts in the districting.

C.5.1 Comparison map examples



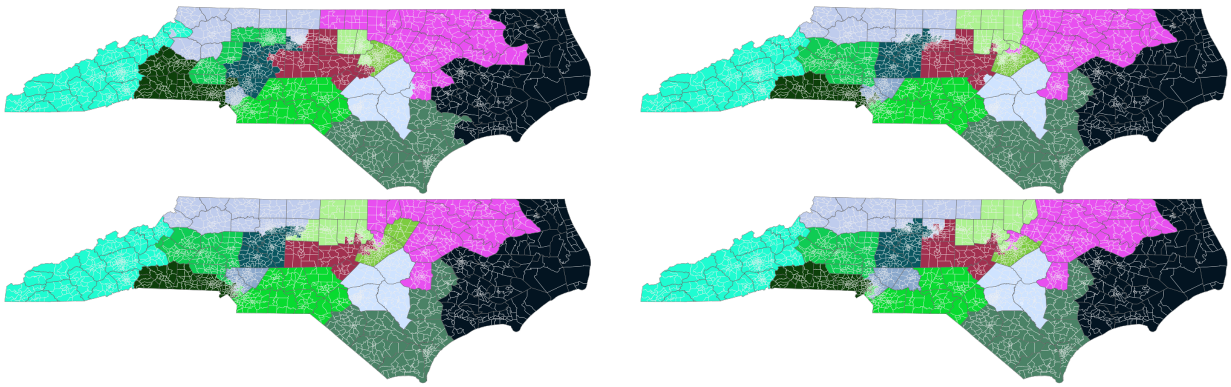
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999988%	5	99.9999968%	9	99.999998%	13	99.9999976%
2	99.99999948%	6	99.9999949%	10	99.9999978%	14	99.9999986%
3	99.99999941%	7	99.9999999976%	11	99.999982%	15	99.99999983%
4	99.99999981%	8	99.9999906%	12	99.9999999981%	16	99.9999963%



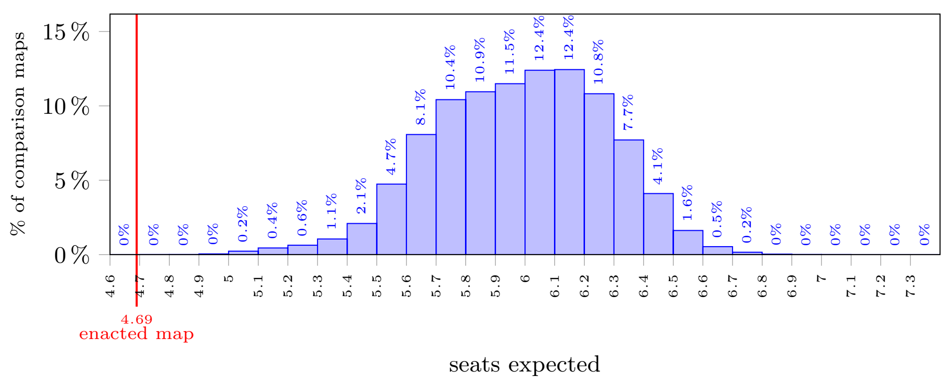
C.6 Robustness to 1% population deviation

Here I show results when my analysis of the Congressional map is repeated with a 1% population deviation constraint instead of a 2% population deviation constraint.

C.6.1 Comparison map examples



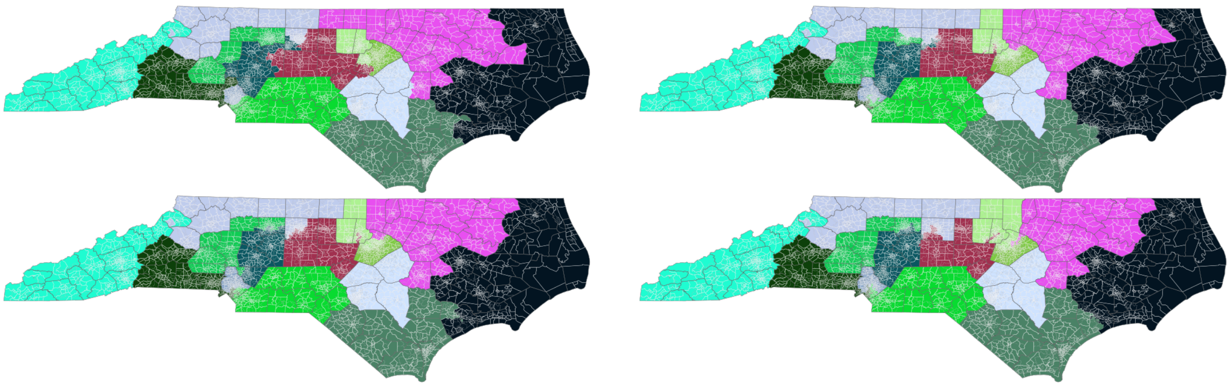
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999911%	5	99.999999907%	9	99.9999983%	13	99.999914%
2	99.9999966%	6	99.99999999945%	10	99.99978%	14	99.9999988%
3	99.999949%	7	99.9999986%	11	99.999989%	15	99.999971%
4	99.9999935%	8	99.999951%	12	99.999934%	16	99.999997%



C.7 Geounit analysis

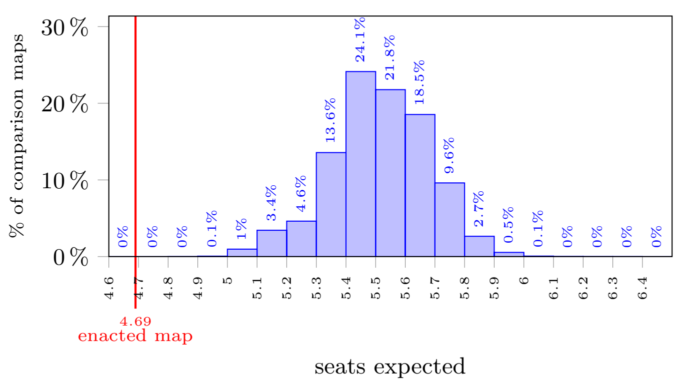
Here I show results when my analysis of the Congressional map is repeated at the geounit level, with a 0.5% population deviation constraint.

C.7.1 Comparison map examples



C.7.2 Results

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999952%	5	99.999987%	9	99.999962%	13	99.9999952%
2	99.999989%	6	99.999986%	10	99.9999964%	14	99.9999962%
3	99.999967%	7	99.9999924%	11	99.999974%	15	99.999926%
4	99.999964%	8	99.999996%	12	99.999977%	16	99.9999935%

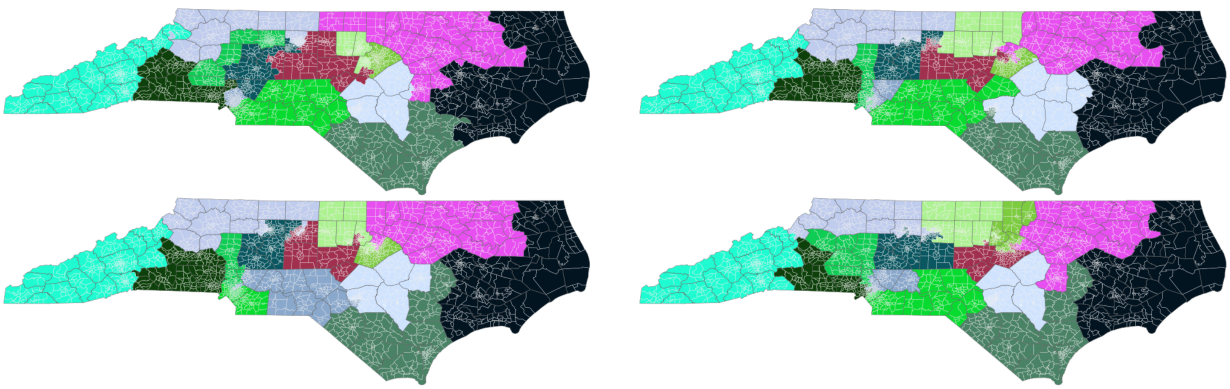


- **First level analysis:** In *every* run, the districting was in the most partisan 0.000073% of districtings (in other words, 99.999926% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.00022% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.99977% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.000073\%$.

C.8 Analysis of VTD-level blueprint

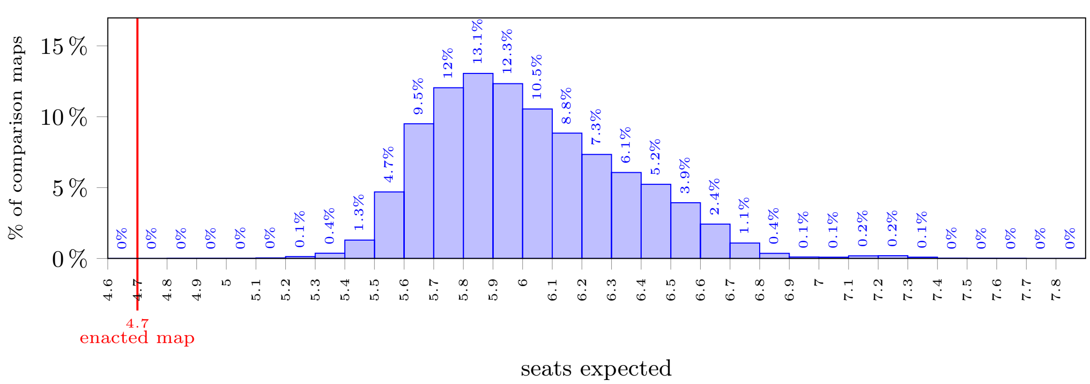
Here I show results when my analysis of the Congressional map is performed not on the precise enacted map, but a whole-VTD-level blueprint for the enacted map obtained by assigning each split VTD to the district it has the greatest intersection with.

C.8.1 Comparison map examples



C.8.2 Results

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999982%	9	99.99999969%	17	99.9999991%	25	99.9999986%
2	99.99999947%	10	99.9999952%	18	99.99999944%	26	99.9999998%
3	99.9999957%	11	99.999986%	19	99.999978%	27	99.9999977%
4	99.9999907%	12	99.999979%	20	99.9999959%	28	99.9999976%
5	99.9999981%	13	99.9999986%	21	99.99999946%	29	99.99999958%
6	99.99999954%	14	99.999984%	22	99.9999971%	30	99.999986%
7	99.9999917%	15	99.9999977%	23	99.9999974%	31	99.9999969%
8	99.9999917%	16	99.9999961%	24	99.9999942%	32	99.9999958%



- **First level analysis:** In *every* run, the districting was in the most partisan 0.000021% of districtings (in other words, 99.999978% were less partisan, in *every* run).
- **Second level analysis:** My theorems imply that the enacted districting is among the most optimized-for-partisanship 0.000064% of all alternative districtings of North Carolina satisfying my districting criteria (in other words, 99.999935% are less optimized-for-partisanship), measured by their ε-fragility for $\varepsilon = 0.000021\%$.

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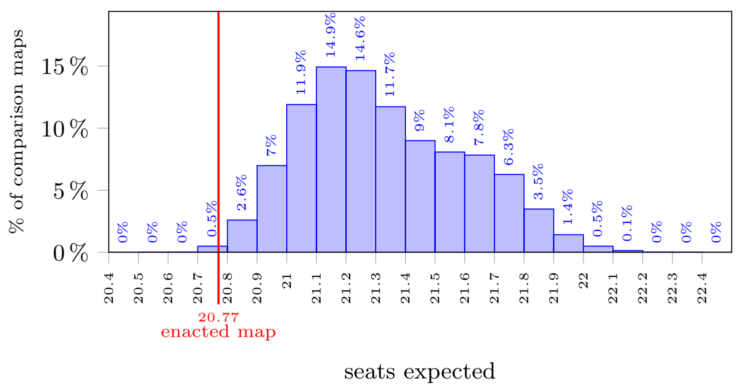
Appendix D Robustness Checks, Senate districting

D.1 Robustness to election data

Here I show results when my analysis of the Senate map is repeated with other elections in place of the 2020 Attorney General election as my proxy for partisan voting patterns.

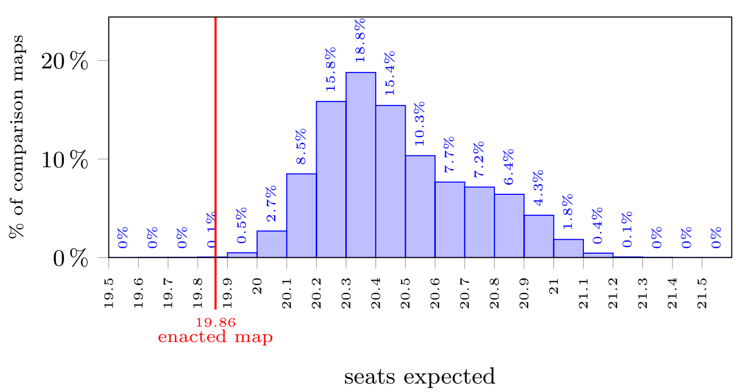
D.1.1 Results with 2020 Presidential election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.65%	5	99.78%	9	99.79%	13	99.8%
2	99.81%	6	99.79%	10	99.82%	14	99.73%
3	99.75%	7	99.79%	11	99.81%	15	99.66%
4	99.8%	8	99.75%	12	99.75%	16	99.81%



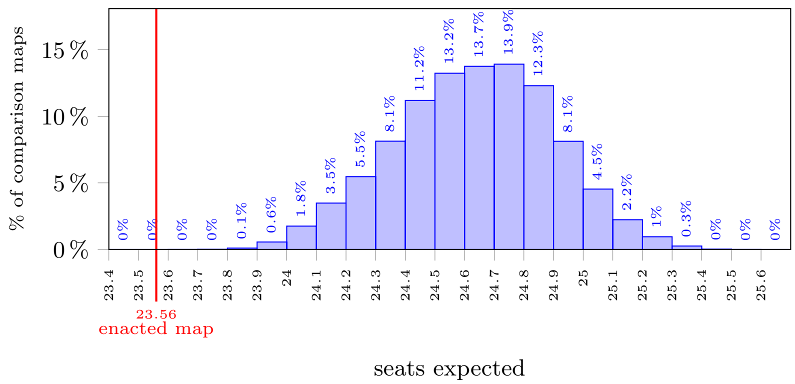
D.1.2 Results with 2020 Lieutenant Governor election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.943%	5	99.987%	9	99.9912%	13	99.9911%
2	99.996%	6	99.982%	10	99.9955%	14	99.977%
3	99.973%	7	99.994%	11	99.9958%	15	99.944%
4	99.9927%	8	99.983%	12	99.89%	16	99.995%



D.1.3 Results with 2020 Governor election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99999936%	5	99.9999996%	9	99.9999998%	13	99.999999973%
2	99.999999949%	6	99.9999974%	10	99.9999987%	14	99.9999985%
3	99.99999978%	7	99.9999999929%	11	99.9999998%	15	99.999999961%
4	99.9999989%	8	99.9999999969%	12	99.999999973%	16	99.9999985%

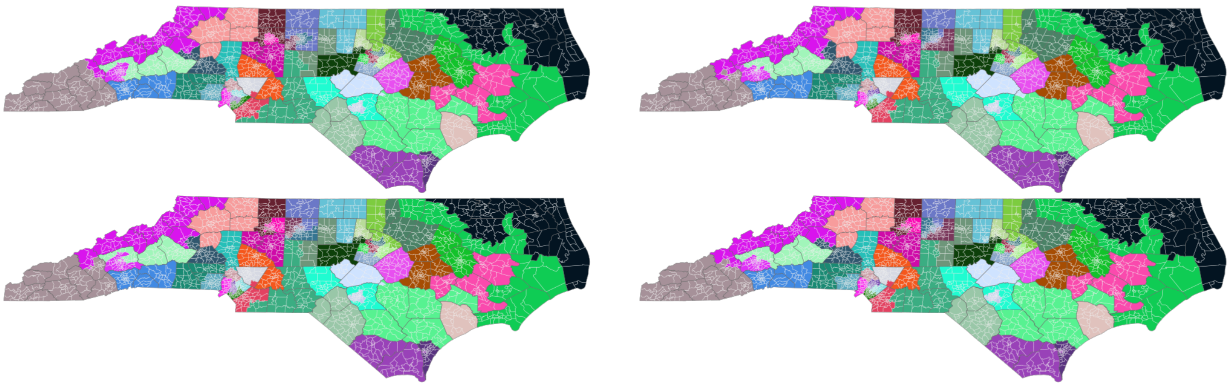


[Report continues on next page for formatting reasons]

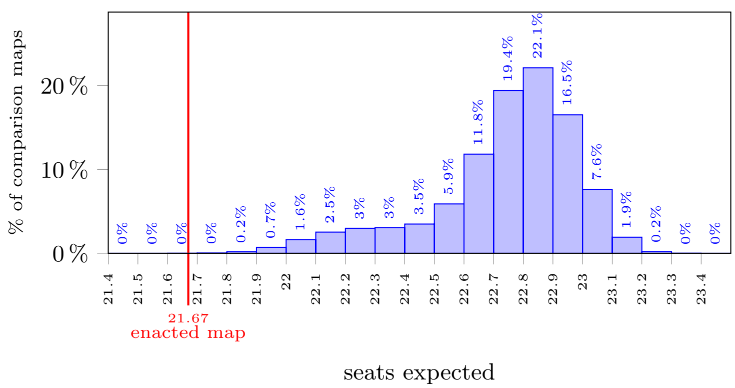
D.2 Robustness to incumbency protection

Here I show results when my analysis of the Senate map is repeated without ensuring the protection of incumbents.

D.2.1 Comparison map examples



Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9998%	5	99.9993%	9	99.99989%	13	99.99906%
2	99.99988%	6	99.99985%	10	99.99968%	14	99.9987%
3	99.99971%	7	99.999907%	11	99.9998%	15	99.99928%
4	99.99922%	8	99.9985%	12	99.99976%	16	99.9943%

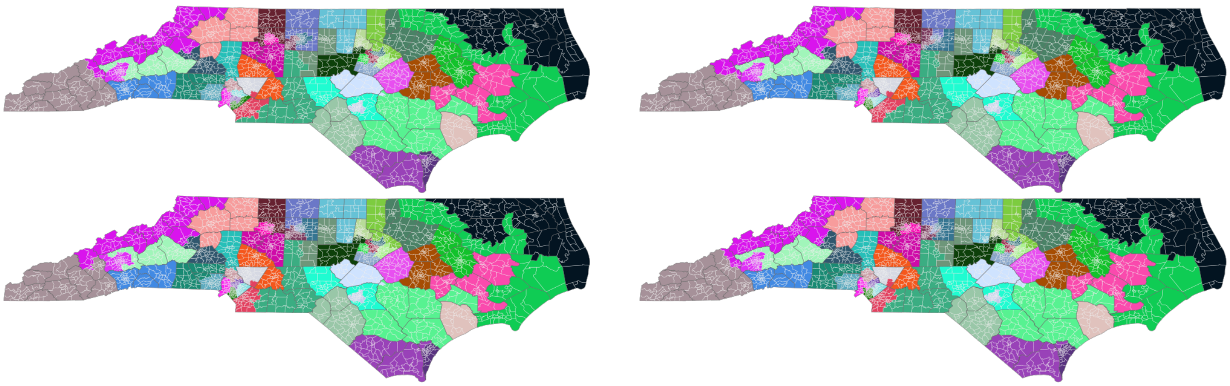


PEGDEN 2

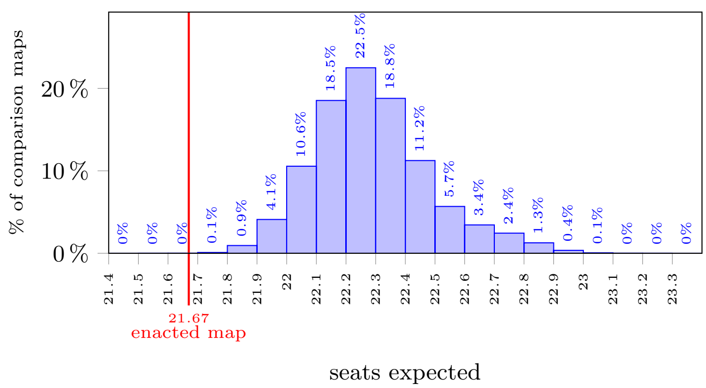
D.3 Compactness: 0% Polsby-Popper threshold

Here I show results when my analysis of the Senate map is repeated with a 0% threshold for compactness in place of the 5% error I allow in my primary analysis.

D.3.1 Comparison map examples



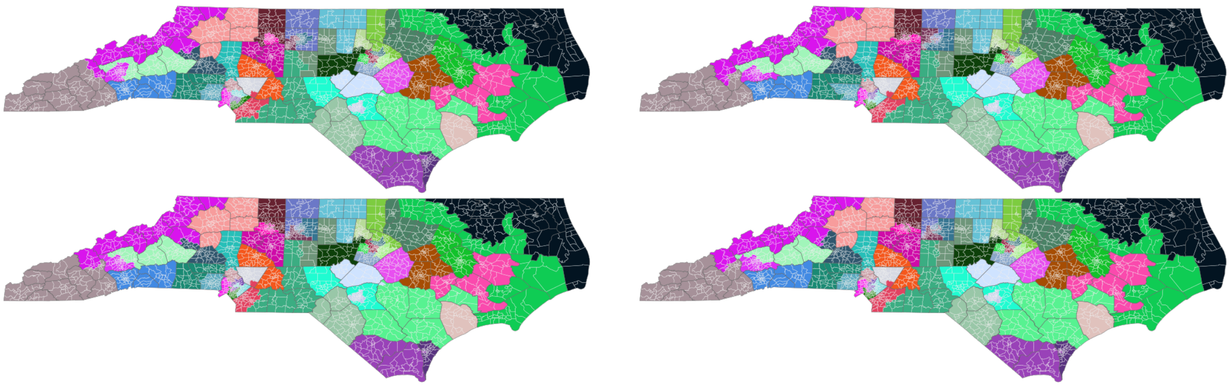
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9979%	5	99.9978%	9	99.995%	13	99.9986%
2	99.99909%	6	99.9968%	10	99.9982%	14	99.9989%
3	99.9968%	7	99.99933%	11	99.9987%	15	99.9973%
4	99.99927%	8	99.9979%	12	99.99923%	16	99.9976%



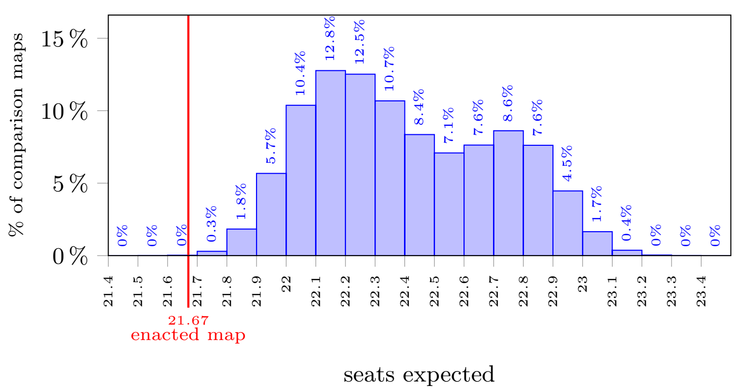
D.4 Compactness: 10% Polsby-Popper threshold

Here I show results when my analysis of the Senate map is repeated with a 10% threshold for compactness in place of the 5% error I allow in my primary analysis.

D.4.1 Comparison map examples



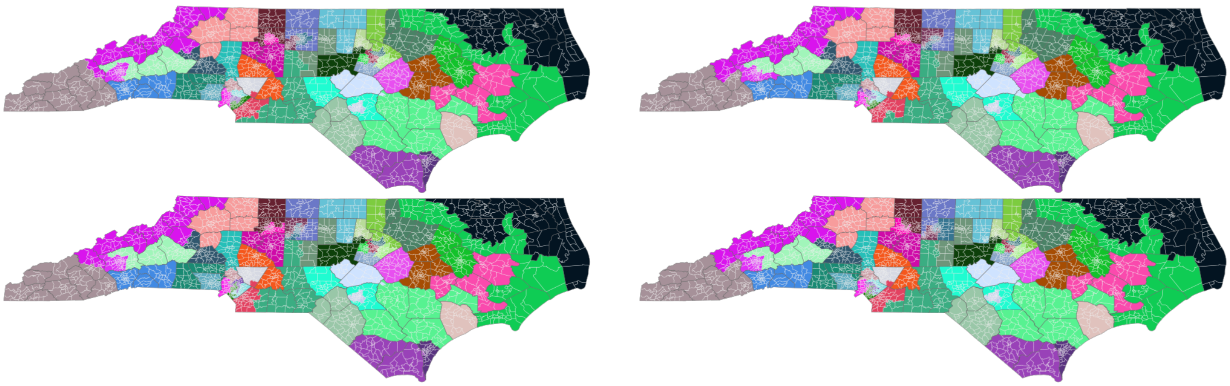
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9963%	5	99.992%	9	99.971%	13	99.98%
2	99.9928%	6	99.986%	10	99.985%	14	99.9917%
3	99.988%	7	99.993%	11	99.9924%	15	99.978%
4	99.987%	8	99.9957%	12	99.9908%	16	99.9969%



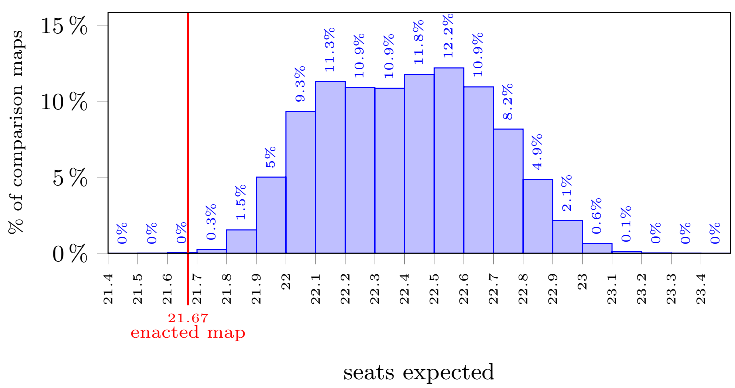
D.5 Compactness 5% Perimeter compactness

Here I show results when my analysis of the Senate map is repeated with a completely different compactness score, based just on the total perimeter of all districts in the districting.

D.5.1 Comparison map examples



Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9913%	5	99.985%	9	99.988%	13	99.9907%
2	99.9907%	6	99.989%	10	99.988%	14	99.982%
3	99.9949%	7	99.9929%	11	99.986%	15	99.981%
4	99.989%	8	99.989%	12	99.987%	16	99.9919%



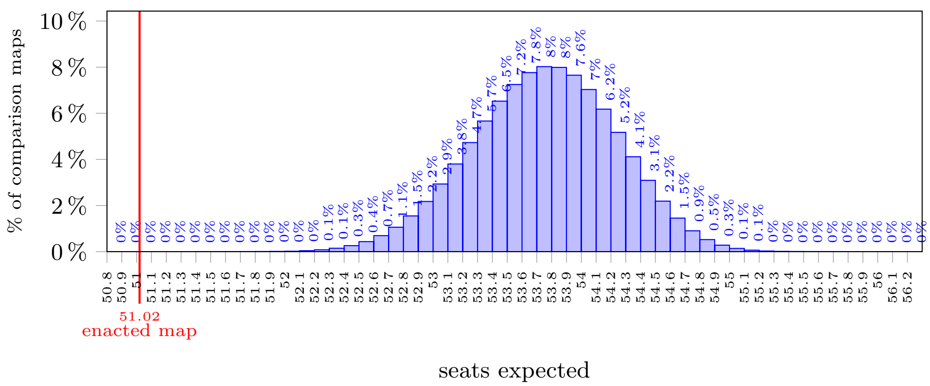
Appendix E Robustness Checks, House districting

E.1 Robustness to election data

Here I show results when my analysis of the House map is repeated with other elections in place of the 2020 Attorney General election as my proxy for partisan voting patterns.

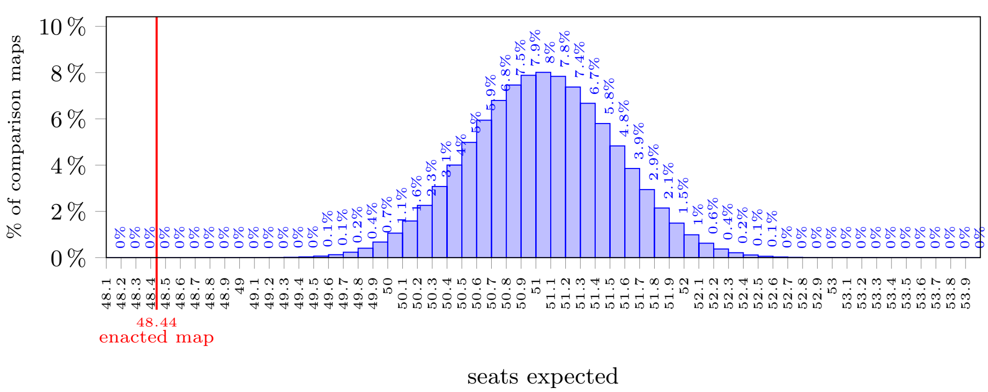
E.1.1 Results with 2020 Presidential election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.999999985%	5	99.99999945%	9	99.9999986%	13	99.99999986%
2	99.999999981%	6	99.99999948%	10	99.99999912%	14	99.999999976%
3	99.99999997%	7	99.999999963%	11	99.99999986%	15	99.99999984%
4	99.9999969%	8	99.9999981%	12	99.9999985%	16	99.9999989%



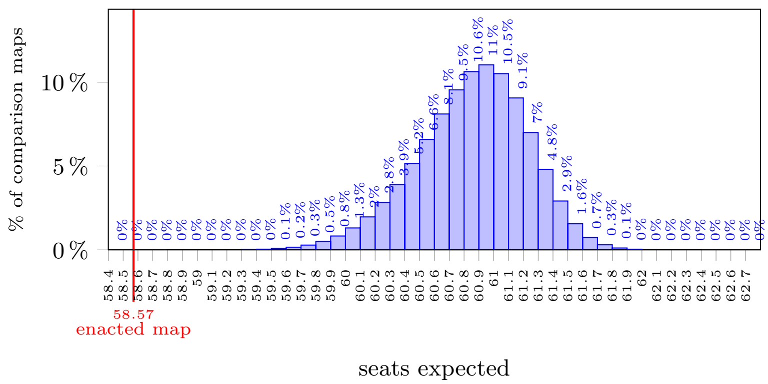
E.1.2 Results with 2020 Lieutenant Governor election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99999988%	5	99.9999983%	9	99.999997%	13	99.9999957%
2	99.999981%	6	99.9999926%	10	99.9999979%	14	99.9999905%
3	99.99999907%	7	99.9999927%	11	99.9999974%	15	99.99999914%
4	99.9999969%	8	99.999993%	12	99.9999981%	16	99.99999924%



E.1.3 Results with 2020 Governor election

Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999985%	5	99.999999931%	9	99.999999975%	13	99.99999986%
2	99.999999984%	6	99.9999994%	10	99.9999986%	14	99.99999988%
3	99.99999997%	7	99.999999986%	11	99.9999998%	15	99.99999948%
4	99.9999985%	8	99.99999985%	12	99.99999914%	16	99.99999989%

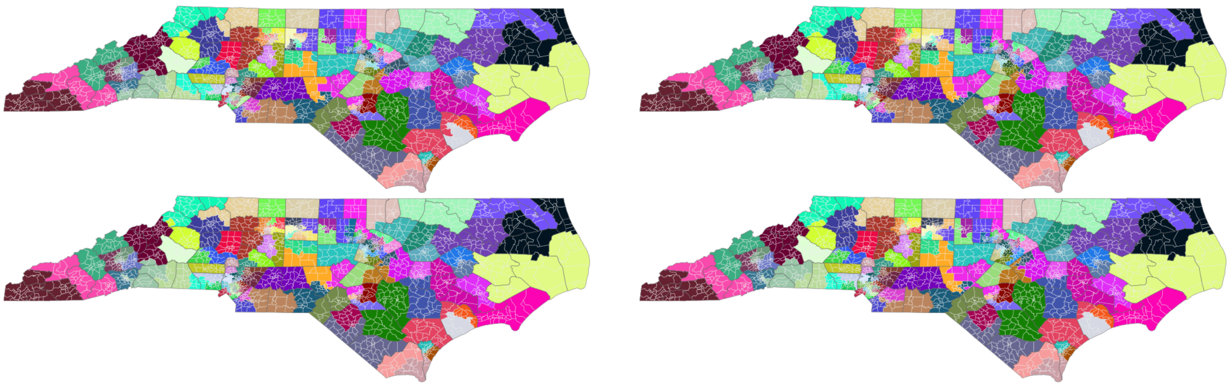


[Report continues on next page for formatting reasons]

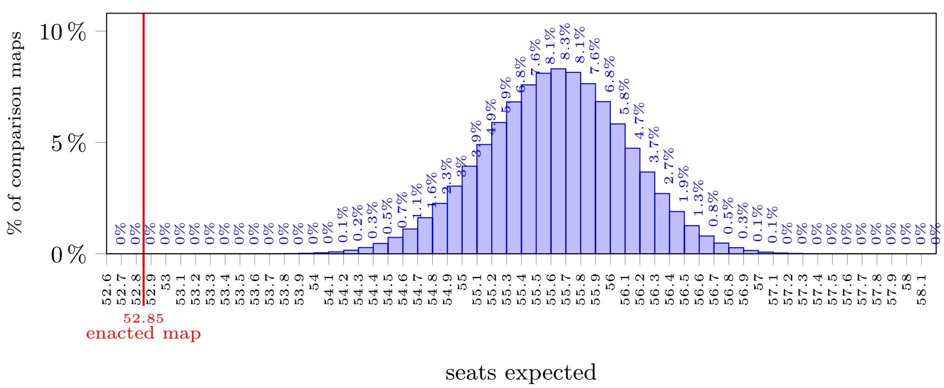
E.2 Robustness to incumbency protection

Here I show results when my analysis of the House map is repeated without ensuring the protection of incumbents.

E.2.1 Comparison map examples



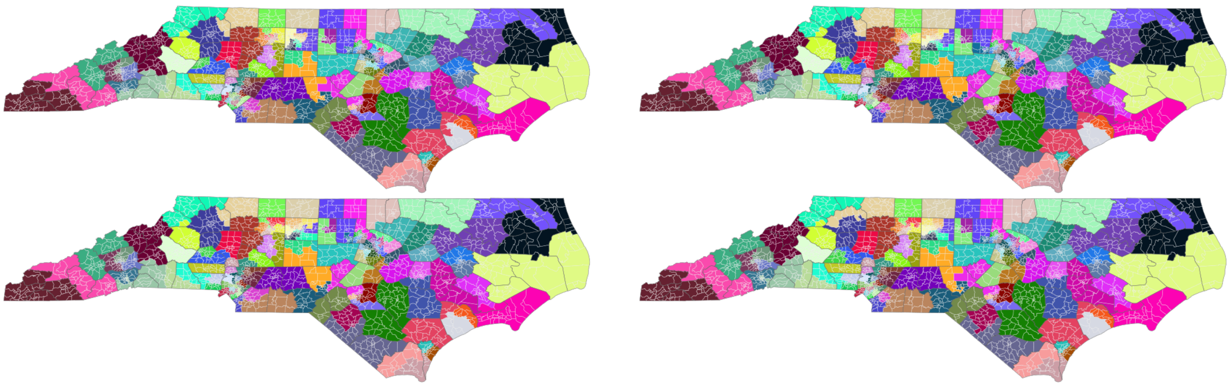
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99999987%	5	99.9999933%	9	99.99999967%	13	99.99999989%
2	99.999999981%	6	99.9999962%	10	99.99999944%	14	99.99999981%
3	99.99999997%	7	99.9999968%	11	99.9999944%	15	99.99999%
4	99.999999908%	8	99.99999961%	12	99.999999963%	16	99.99999947%



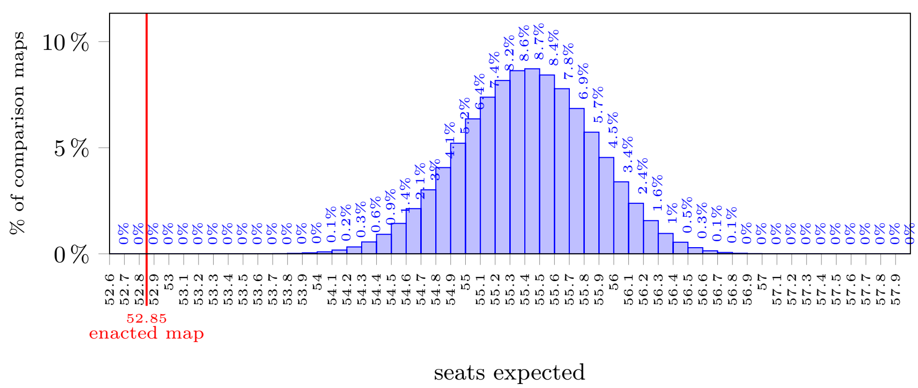
E.3 Compactness: 0% Polsby-Popper threshold

Here I show results when my analysis of the House map is repeated with a 0% threshold for compactness in place of the 5% error I allow in my primary analysis.

E.3.1 Comparison map examples



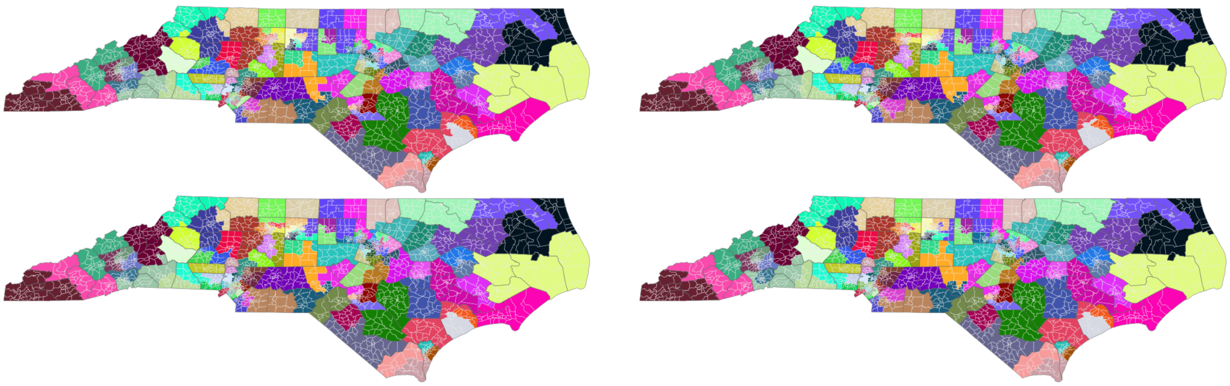
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999996%	5	99.99999927%	9	99.9999987%	13	99.9999978%
2	99.99999982%	6	99.999999941%	10	99.9999966%	14	99.9999986%
3	99.999987%	7	99.9999971%	11	99.9999963%	15	99.99999975%
4	99.9999912%	8	99.9999988%	12	99.99999928%	16	99.9999968%



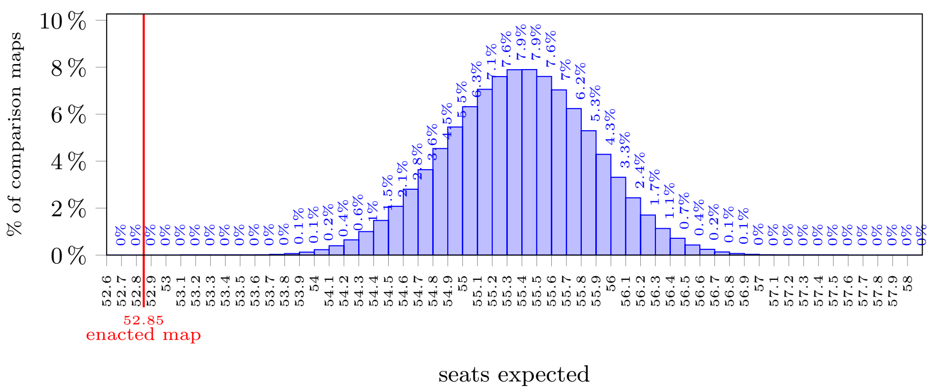
E.4 Compactness: 10% Polsby-Popper threshold

Here I show results when my analysis of the House map is repeated with a 10% threshold for compactness in place of the 5% error I allow in my primary analysis.

E.4.1 Comparison map examples



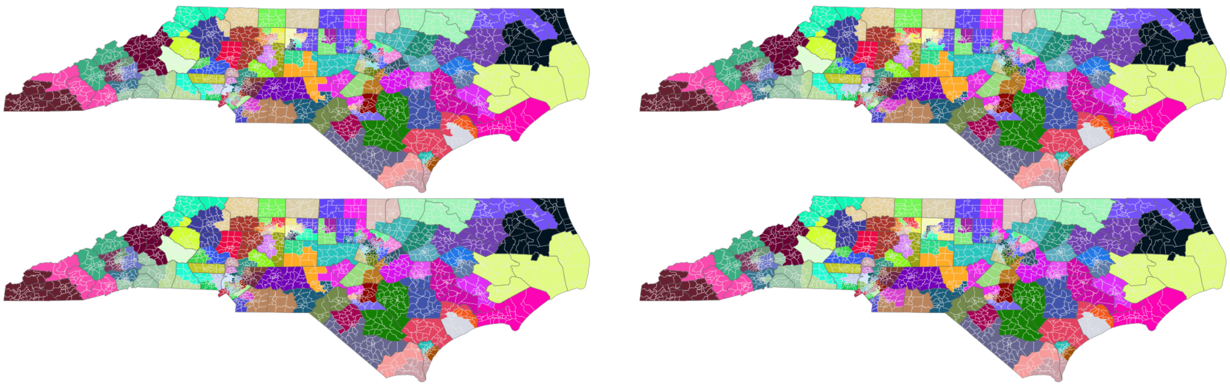
Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.9999904%	5	99.9999989%	9	99.999999917%	13	99.9999983%
2	99.999999957%	6	99.9999971%	10	99.9999983%	14	99.99999989%
3	99.9999948%	7	99.9999999916%	11	99.999988%	15	99.99999962%
4	99.9999987%	8	99.9999955%	12	99.9999922%	16	99.9999974%



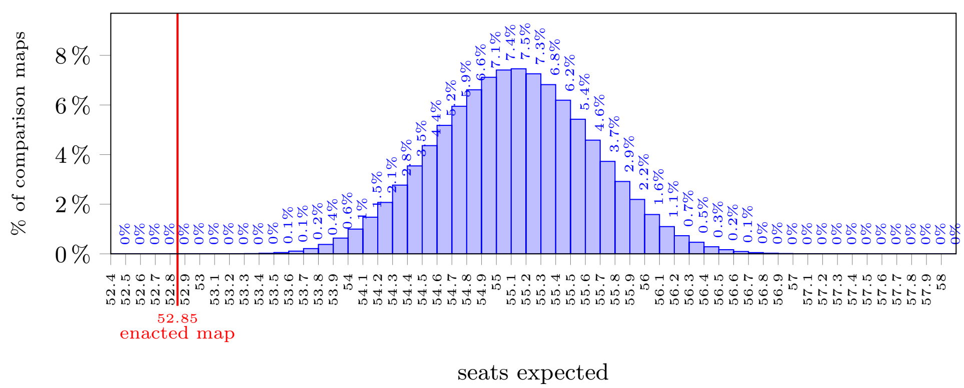
E.5 Compactness 5% Perimeter compactness

Here I show results when my analysis of the House map is repeated with a completely different compactness score, based just on the total perimeter of all districts in the districting.

E.5.1 Comparison map examples



Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan	Run	Percentage of comparison maps less partisan than enacted plan
1	99.99985%	5	99.999957%	9	99.999988%	13	99.999953%
2	99.999977%	6	99.999976%	10	99.999978%	14	99.99991%
3	99.99988%	7	99.9999904%	11	99.999968%	15	99.999981%
4	99.999978%	8	99.999951%	12	99.999925%	16	99.99995%



I hereby certify that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Wesley Pegden
12/23/2021

PEGDEN 3

Rebuttal to report of Michael Barber

Wesley Pegden

December 28, 2021

1 Introduction

In his report, Michael Barber presents the results of simulated district plans as part of an analysis which purports to elicit whether the enacted House and Senate maps of North Carolina are "partisan outliers". Barber makes choices in his analysis that reduce its ability to detect gerrymandering North Carolina clusters; for example, he discusses the partisan bias of the enacted House and Senate maps through the lens of the whole number of "Democratric-lean" districts in one hypothetical election, a lens through which even the effects of extreme gerrymandering in NC county clusters—each with a small number of districts—are made to appear less dramatic.

Nevertheless, his primary analyses (Tables 2 and 32) still find the whole-state House and Senate plans to be partisan outliers compared to his simulated maps, according to the definition he lays out in his report; in particular, he reports the middle-50% of simulated maps to have 46-51 total "Democratic-lean" districts across the House clusters he analyzes, and reports that the enacted map contains 45 such districts. For the Senate he reports a middle-50% range of 19-19 total Democratic-lean districts in his simulations, and that the enacted map contains 16 such districts.

In fact, Barber incorrectly calculated the distribution of Democrat-leaning seats for the whole-state outcomes of his simulation analysis, incorrectly reporting the sums of lower- and upper-quartile seat counts in individual clusters as the lower- and upper-quartile for total statewide seats. When the distribution of "lean Democrat district" counts at the whole-state level are calculated correctly for Barber's simulations (still using the partisan index he defines), one finds that the middle-50% range for Barber's simulated maps in the House is actually 48-50 Democratic-lean districts, not 46-51 as Barber shows, and that **the enacted North Carolina House map lies in the most Republican-biased 00.18% of whole state maps composed of Barber's simulations, and the enacted North Carolina Senate map lies in the most Republican-based 00.39% of whole state maps composed of Barber's simulations.** This computation can be carried out entirely with the figures provided in Barber's report, and uses Barber's simulated maps and Barber's metric of partisan bias (number of lean-Democrat districts), calculated with Barber's own partisan voting index.

Finally, when re-analyzing Barber's simulated maps (as provided in his backup data) to compare their expected performance over a range of electoral outcomes rather than comparing the crude number of "lean Democratic districts" for a fixed election average, the differences between the enacted map and Barber's ensemble of simulated comparison maps becomes more dramatic at the cluster level as well. Through this lens, every cluster which my original analysis found to be optimized for partisanship would qualify as a partisan outlier according to Barber's "middle 50%" criterion, and many are extreme outliers, among the most Republican biased 10%, 1%, or 0.1% of maps, even in clusters where Barber reported that the enacted map was not be a partisan outlier.

2 Barber finds the enacted House and Senate maps to be outliers according to his own definition

On page 29 of his report, in the section on House clusters, Barber writes that he considers a districting plan of North Carolina to be a partisan outlier if it lies outside of the "middle 50%" of simulation results; in Barber's report, the middle 50% are the maps that lie between the 25th and 75th percentiles according to the number of lean-Democrat districts, as measured with the partisan index Barber obtains by averaging election results. He calls this a "conservative definition" of an outlier, noting that "in the social sciences, medicine, and other disciplines it is traditional to consider something an outlier if it falls outside the middle 95% or 90% of the comparison distribution."

In both of his whole-state analysis tables (Table 2 and 32), Barber's own findings report the whole map as falling outside the middle 50% of simulated outcomes for the House and Senate. For example, in the last row, labeled "Total", of Table 2 on page 31, he reports that in the 26 clusters he analyzed, the enacted map contained 45 statewide "lean-Democrat" districts according to his partisan index, while the middle 50% range of the simulated maps for the total number of seats was $46 - 51$. Similarly, in Table 32 for the Senate, he reports the enacted map scored as having a total of 16 lean-Democrat seats in the 12 clusters used by the enacted map he analyzed, while the middle 50% range for his middle 50% range for the total number of seats in his simulated maps was 19-19. By the definition he chose to offer of a partisan outlier, Barber finds the enacted House and Senate plans are partisan outliers.

3 Barber reports incorrect quartiles for totals across clusters

Recall that in his Table 2, in the last column, Barber reports the range of the "middle 50%" for the number of lean-Democratic districts for his simulations in each cluster, and, at the bottom of the column, for the total across clusters (he reports the range for this total as 46-51). Recall that the bottom of the middle-50% range is the lower quartile of the data, and the top of the range is the upper quartile.

For example, in the House:

- for the Buncombe cluster in the House map, Barber reports in Figure 45 that 28% of his simulated maps contained 2 lean-Democrat districts, while 72% contained 3.
- for the Cumberland cluster in the House map, Barber reports in Figure 55 that 82% of his simulated maps contained 3 districts, while 18% contained 4.

I summarize this information in my Table 1, below:

Cluster	0	1	2	3	4
Buncombe			28%	72%	
Cumberland				82%	18%

Table 1: Fraction of maps with various lean-Democrat-district counts, as reported by Barber for Buncombe and Cumberland county districtings.

In his Table 2, Barber correctly summarizes the middle 50% ranges for the data in each of these clusters as 2-3 and 3-3, respectively; in each case, the lower end of the range is the smallest value below which 25% of his simulated maps lie, and the upper end is the smallest value below which 75% lie.

Suppose though, just as an example, that we wished to calculate the distribution of the total number of lean-Democrat districts across just these two clusters according the Barber's simulations; this will also enable us to calculate the middle-50% of outcomes for the total lean-Democrat districts across these two clusters.

Note that for maps of these two clusters composed of maps from Barber'simulations, a total of 5, 6, or 7 lean-Democrat districts are possible. For example, 5 lean-Democrat districts can arise only by having 2 such districts in Buncombe and 3 in Cumberland, and fewer are not possible.

According to Barber's simulations, as summarized in Table 1, 28% of the maps of these two clusters would have 2 lean-Democrat districts in Buncombe, while 82% would have 3 lean-Democrat districts in Cumberland. As the districtings in each cluster can be chosen independently of each other, a total of

$$28\% \times 82\% = 22.96\%$$

of districtings of these two counties would have a total of 5 lean-Democrat districts. (Note that having fewer than 5 lean-Democrat seats happens 0% of the time, according to Barber's simulations.)

6 lean-Democrat districts can arise from having 2 lean-Democrat districts in Buncombe and 4 in Cumberland, or having 3 lean-Democrat districts in Buncombe and 3 in Cumberland. Thus according to Barber's simulation results the frequency of this outcome would be

$$28\% \times 18\% + 72\% \times 82\% = 64.08\%.$$

Finally, the likelihood of 7 lean-Democrat seats, which arise just when there are 3 lean-Democrat districts in Buncombe and 4 lean-Democrat districts in Cumberland, would be

$$72\% \times 18\% = 12.96\%,$$

(Note that altogether, 22.96%+64.08%+12.96%=100%.)

Evidently, the middle-50% range for the total of lean-Democrat seats across these two counties would be 6-6; the 6-lean-Democrat-district maps include the middle-50% of simulated maps. (6 is both the 25th percentile and the 75th percentile of the number of Democratic-lean seats in the simulated maps.)

Under Barber's incorrect approach, he would have simply added the bottom and top of the middle-50% ranges for Buncombe and Cumberland (2-3 and 3-3, respectively) to arrive at a middle-50% range for the total number of lean-Democrat-districts across these two counties; that procedure would produce a range of 5-6, which is wider than the true middle-50% range of the total number of districts across the two counties (namely 6-6), as correctly calculated above.

In general, the magnitude of this error grows larger and larger the more independent cluster-specific results are aggregated by incorrectly summing the lower and upper quartiles as a substitute for a correct calculation of the distribution of total statewide lean-Democrat districts. In Barber's report, he aggregrates across 26 clusters in this way. As we will see in the next section, this has the effect of inflating the true middle-50% range of 48-50 to an incorrectly reported range of 46-51.

Technical Remark. Probability generating functions can be used to allow larger calculations of the same type as the one above to be performed using publicly web-based computer algebra systems instead of by programming or using statistical software. Note that precisely the same three calculations above would have been performed if expanding the algebraic expression

$$\begin{aligned}(.28x^2 + .72x^3)(.82x^3 + .18x^4) &= (.28 \times .82)x^5 + (.28 \times .18 + .72 \times .82)x^6 + (.72 \times .18)x^7 \\ &= .2296x^5 + .6408x^6 + .1296x^7.\end{aligned}$$

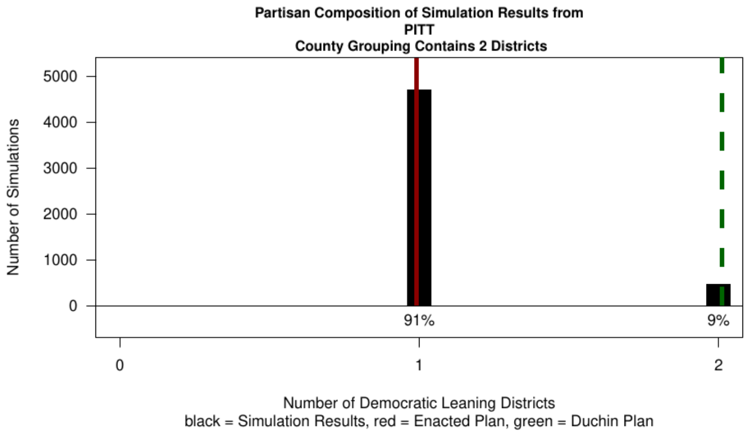
Observe that the polynomial $.28x^2 + .72x^3$ here can be seen as representing the fact that two seats occur in 28% of the maps for Buncombe, while 3 seats occur in 72% of the maps. (Similarly, then, for Cumberland and the polynomial $.82x^3 + .18x^4$.) The same answers that we found above for the fraction of simulated plans with a total of 5, 6, and 7 lean-Democrat districts, respectively, can be read off as the coefficients of x^5, x^6, and x^7, in the resulting expansion.

In the technical remark in the next section, I will point out a similar polynomial expansion which can verify the next section's calculations using public web applications, making the main findings of this rebuttal report easy to independently verify.

4 Correcting Barber's calculations

In my Table 2 on page 13 of this rebuttal report, I report the results of Barber's Figures 11, 14, 17, 20, 25, 28, 31, 34, 37, 45, 48, 51, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, and 88. Each of these figures reports, for one of the clusters Barber analyzes, the fraction of his simulated maps which achieve different numbers of "lean Democrat" districts according to the partisan index he uses. For example, in Figure 14 on page 44, Barber reports that 91% of his simulated maps had one lean-Democrat district, while the remaining 9% had 2, as seen in this reproduction below:

Figure 14: **Distribution of Partisan Districts from Simulations in Pitt House County Cluster**



This information is then reproduced in my Table 2 on page 13, as the following row:

Cluster	0	1	2	3	4	5	6	7	8	9	10	11	12
Pitt		91%	9%										

In particular, everything in my Table 2 (and the corresponding Table 3 for the Senate) is taken directly from Barber's report itself.

The data in Table 2 can then be used to calculate the distribution of the total number of lean-Democrat seats based on Barber's simulations across the 26 clusters, exactly in the same way as we did above for just 2 clusters from the data in Table 1. The result of the same calculation is the histogram shown in Figure 1. In particular, according to Barber's own simulated map set, and using his own measure of the number of lean-Democrat districts under his own partisan index, **the enacted House map exhibits more Republican bias than 99.82% of maps** composed of Barber's simulations, over the clusters Barber analyzes.

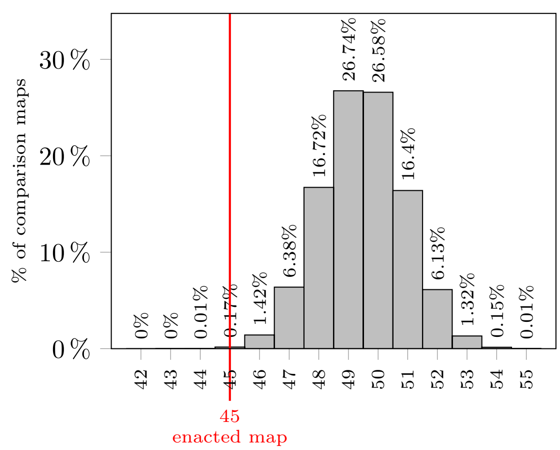


Figure 1: **Total lean-Democrat districts across Barber's House simulations**. This histogram shows the performance of Barber's simulated map set across the total set of House clusters Barber analyzes. It uses Barber's set of simulated maps, Barber's chosen metric (number of lean Democratic seats), calculated using the partisan metric Barber himself calculates in his report. The range 49-50 contains 50% of the simulated maps, the range 48-51 contains 86% of the simulated maps, and the range 47-52 contains more than 98% of the simulated maps. With 45 lean-Democratic districts across these clusters, the enacted map is in the most Republican-biased 0.18% of Barber's simulated maps.

In Table 3 I show Barber's Senate data analogous to the House data I show in Table 2. And in Figure 2, I plot the histogram showing the total of Barber's metric of Democratic-leaning districts across Barber's simulated map set, produced in the same way as I produce Figure 1 for the House. In particular, according to Barber's own simulated map set, and using his own measure of the number of lean-Democrat districts under his own partisan index, **the enacted Senate map exhibits more Republican bias than 99.61% of maps** over the clusters Barber analyzes.

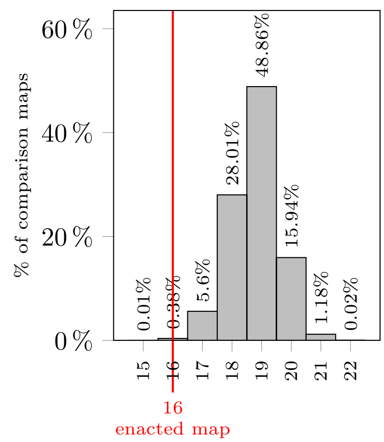


Figure 2: **Total lean-Democrat districts across Barber's Senate simulations**. This histogram shows the performance of Barber's simulated map set across the total set of Senate clusters Barber analyzes. It uses Barber's set of simulated maps, Barber's chosen metric (number of lean Democratic seats), calculated using the partisan metric Barber himself calculates in his report. The range 18-20 contains 93% of the simulated maps, and the range 17-21 contains more than 99% of the simulated maps. With 16 lean-Democrat districts, the enacted map is among the most Republican 00.39% of maps.

Technical Remark. As noted in the earlier Technical Remark, calculating the results of a histogram like Figure 1 is equivalent to expanding a certain polynomial expression. Based on the data in Table 2, (rows with only zero seats possible can be ignored), the polynomial to be expanded is

$$(.91x+.09x^2)(.44+.56x)(x^2)(x^2)(x)(.28x^2+.72x^3)(.82x^3+.18x^4)(x^4)(x)(.33x^2+.5x^3+.17x^4)(.99+.01x^1)$$
$$\cdots(.18+.82x)(.01x^4+.79x^5+.21x^6)(.01x^{10}+.56x^{11}+.44x^{12})(.02x^{10}+.32x^{11}+.66x^{12})$$

and publicly available tools such as `wolframalpha.com` can be used to verify that this polynomial expands to

$$5.55283\times 10^{-7}\ x^{56}+0.0000685893x^{55}+0.00147488x^{54}+0.0131615x^{53}$$
$$+0.0612515x^{52}+0.163979x^{51}+0.265839x^{50}+0.267369x^{49}+0.167218x^{48}+0.0637935x^{47}+0.0141775x^{46}$$
$$+0.00167669x^{45}+0.000089375x^{44}+1.74341\times 10^{-6}\ x^{43}+1.08123\times 10^{-8}\ x^{42}$$

The histogram in Figure 1 can be read off the coefficients in this polynomial. For example, the fact that the coefficient of x^{49} is .267369 corresponds to the fact that Figure 1 reports the fraction of simulated maps with a total of 49 Democrat-leaning districts across the clusters Barber analyzes as 26.74% (rounded to two decimal places).

For the senate, from Table 3, the probability generating function is

$$(.77x+.23x^2)(x^2)(.23+.77x)(.93x^2+.06x^3)(.01x^4+.24x^5+.75x^6)(.05x^4+.95x^5)x(.97x+.03x^2),$$

which expands to

$$0.000227131x^{22}+0.0118152x^{21}+0.159415x^{20}+0.488577x^{19}$$
$$+0.280141x^{18}+0.0559707x^{17}+0.00377389x^{16}+0.0000807399x^{15} \quad (1)$$

giving the results shown in Figure 2.

5 A more sensitive cluster-by-cluster analysis of Barber's maps

In the previous section, I showed that even against Barber's simulated maps, using the partisan index Barber calculates, and using Barber's preferred metric for partisan bias (the number of lean-Democrat districts using that partisan index), both the enacted House and Senate plans are extreme partisan outliers.

This is true despite the fact that using the number of whole lean-Democrat districts with only a single proxy for partisanship is unlikely to capture the effects even of extreme gerrymandering in North Carolina county clusters, where a small number of seats are at stake in each, and the effects of extreme gerrymandering can be to put one or two seats into play (or take them out of contention), even in cases where districts do not change columns in a single hypothetical election.

In other words, I take Barber's single partisan index (which has a two-party statewide Democratic vote-share of XX), and analyze what would happen under his simulations, on average, if you swung the election results so that Democrats did better or worse by a normally-distributed swing matched to past statewide North Carolina elections. This is the same metric I used in my initial report.

In this section, I re-analyze Barber's results, still using his simulated maps, and still using his partisan index, but comparing maps in each cluster using the seats-expected metric (calculated with respect to that index), which evaluates how a map would be expected to perform under a range of conditions rather than one fixed hypothetical election.

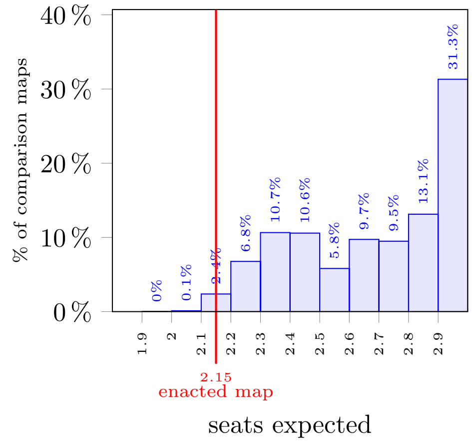
Below, I conduct this analysis for every county cluster I analyzed in my original expert report. In every cluster for which my analysis found the enacted map to be among the most optimized-for-partisanship possible maps (the first six House analyzed in the subsections below, and every Senate cluster analyzed below), Barber finds the map to be a partisan outlier according to the "middle-50%" definition he uses in his report. I summarize the outlier status of these 6+5 House and Senate clusters according to Barber's simulations in the following table:

Cluster	Enacted map among most Republican-biased...
House: Buncombe	00.797%
House: Forsyth-Stokes	00.0805%
House: Guilford	00.00646%
House: Mecklenburg	04.43%
House: Wake	05.78%
House: Pitt	24.2%
Senate: Cumberland-Moore	00.0024%
Senate: Forsyth-Stokes	00.01%
Senate: Granville-Wake	00.035%
Senate: Guilford-Rockingham	00.25%
Senate: Iredell-Mecklenburg	00.1%
	... against Barber's simulations.

Among the four remaining clusters in my report, there are two where the enacted maps are nevertheless extreme outliers against Barber's simulation sets. I summarize the results for these four clusters in the following table:

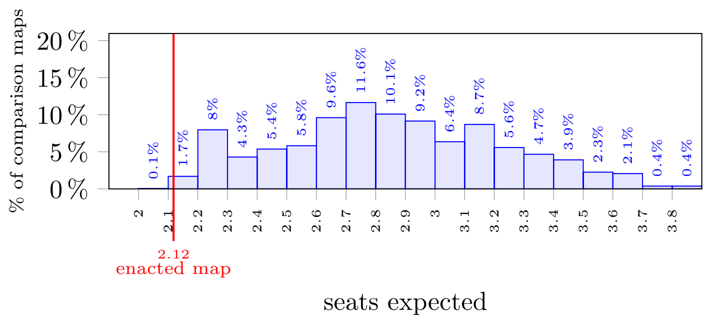
Cluster	Enacted map among most Republican-biased...
House: Alamance	39.4%
House: Brunswick-New Hanover	73.9%
House: Durham-Person	00.00265%
House: Cabarrus-Davie-Rowan-Yadkin	00.352%
	... against Barber's simulations.

5.1 House: Buncombe



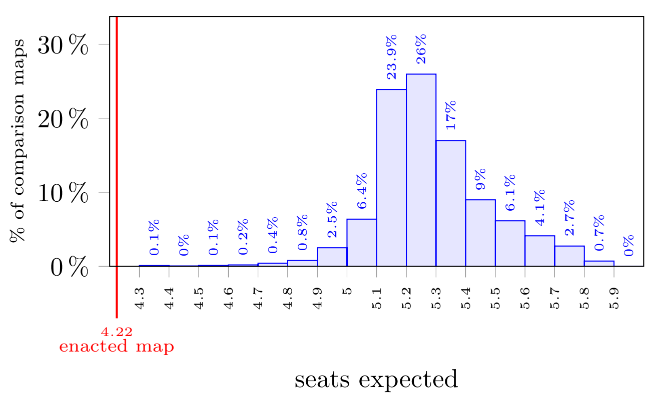
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.797% of maps.

5.2 House: Forsyth-Stokes



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0805% of maps.

5.3 House: Guilford



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.00646% of maps.

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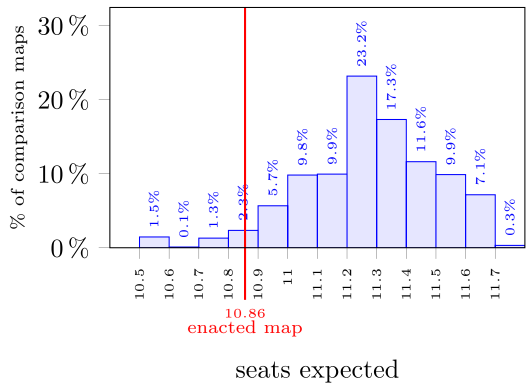
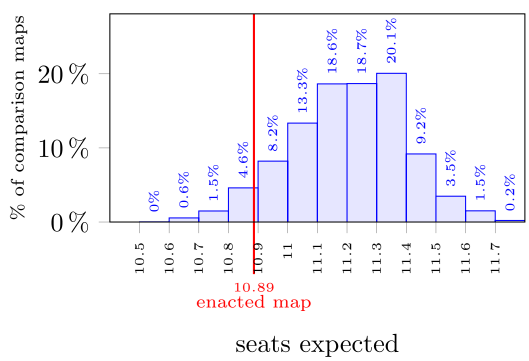
5.4 House: Mecklenburg



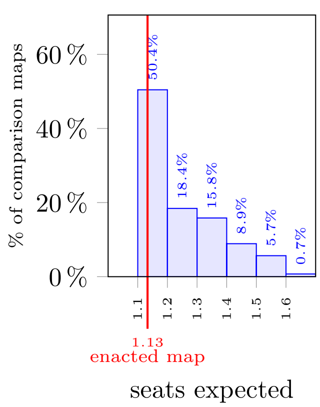
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 4.43% of maps.

5.5 House: Wake



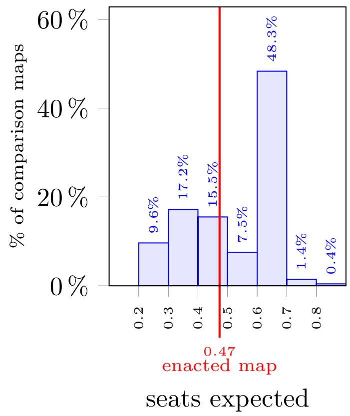
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 5.78% of maps.

5.6 House: Pitt



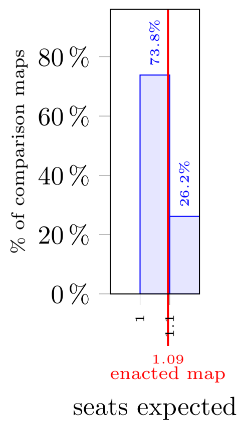
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 24.2% of maps.

5.7 House: Alamance



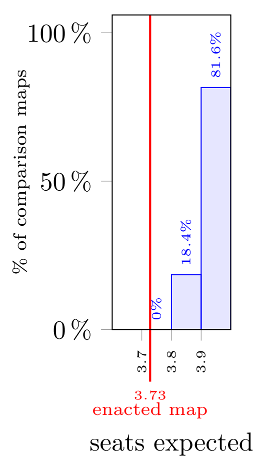
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map is not an outlier.

5.8 House: Brunswick-New Hanover



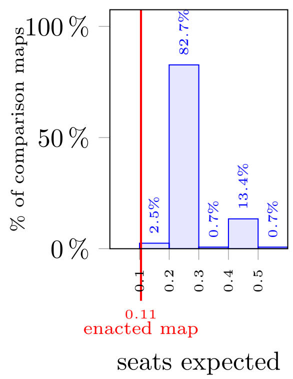
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map is not an outlier.

5.9 House: Durham-Person



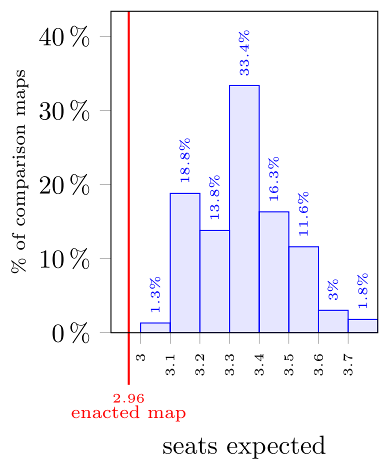
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.00265% of maps.

5.10 House: Cabarrus-Davie-Rowan-Yadkin



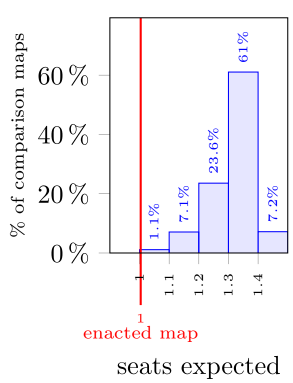
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.352% of maps.

5.11 House: Cumberland



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0095% of maps.

5.12 Senate: Cumberland-Moore



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.00235% of maps.

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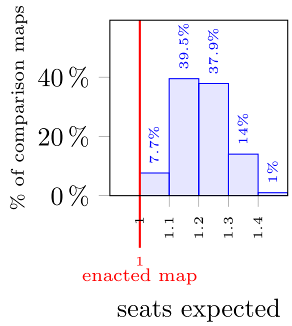
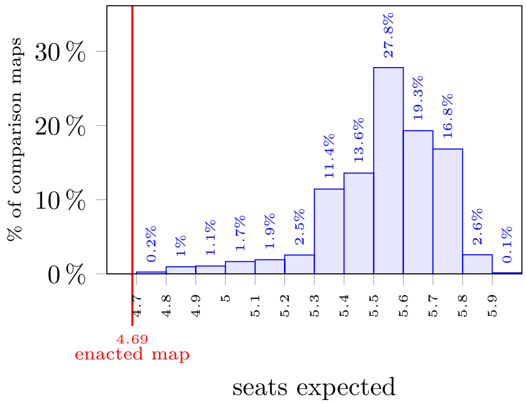
5.13 Senate: Forsyth-Stokes



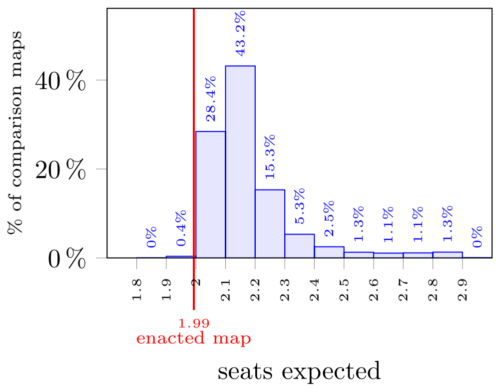
Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0104% of maps.

5.14 Senate: Granville-Wake



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.0353% of maps.

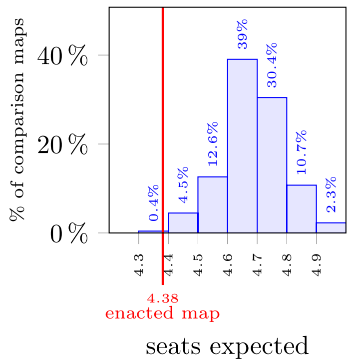
5.15 Senate: Guilford-Rockingham



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.251% of maps.

PEGDEN 3

5.16 Senate: Iredell-Mecklenburg



Against the comparison-set of Barber's simulated maps for this cluster, the enacted map in this cluster is among the most Republican-biased 0.104% of maps.

– Ex. 11124 –

PEGDEN 3

Cluster	0	1	2	3	4	5	6	7	8	9	10	11	12
Davidson	100%												
Pitt		91%	9%										
Alamance	44%	56%											
Columbus-Robeson	100%												
Carteret-Craven													
Duplin-Wayne	100%												
Nash-Wilson			100%										
Caswell-Orange			100%										
Alexander-Surry-Wilkes	100%												
Franklin-Granville-Vance		100%											
Alleghany-*etc*	100%												
Beaufort-*etc*	100%												
Buncombe			28%	72%									
Anson-Union	100%												
Onslow-Pender	100%												
Cumberland				82%	18%								
Harnett-Johnston	100%												
Catawba-Iredell	100%												
Durham-Person					100%								
Brunswick-New Hanover		100%											
Forsyth-Stokes			33%	50%	17%								
Cabarrus-*etc*	99%	1%											
Chatham-*etc*	18%	82%											
Guilford					1%	79%	21%						
Avery-*etc*	100%												
Mecklenburg											1%	56%	44%
Wake											2%	32%	66%

Table 2: This table collects in one place the fraction of maps in Barber's House simulation sets realizing each number of lean-Democratic seats, as reported by Barber in his Figures 11, 14, 17, 20, 25, 28, 31, 34, 37, 45, 48, 51, 55, 58, 61, 64, 67, 70, 73, 76, 79, 82, 85, and 88. He does not present figures for the clusters in Alleghany-Ashe-Caldwell-Watauga and Beaufort-Chowan-Currituck-Dare-Hyde-Pamlico-Perquimans-Tyrrell-Washington clusters because his 0-Democratic-district results for those clusters are based on a very small number of maps. For Carteret-Craven his method does not produce any maps.

Cluster	0	1	2	3	4	5	6
Cumberland-Moore		77%	23%				
Chatham-Durham			100%				
Alleghany-*etc*	100%						
Brunswick-Columbus-New Hanover	23%	77%					
Bladen-*etc*	100%						
Guilford-Rockingham			94%	6%			
Alamance-*etc*	100%						
Granville-Wake					1%	24%	75%
Iredell-Mecklenburg					5%	95%	
Buncombe-Burke-McDowell		100%					
Cleveland-Gaston-Lincoln	100%						
Forsyth-Stokes		97%	3%				

Table 3: This table collects in one place the fraction of maps in Barber's Senate simulation sets realizing each number of lean-Democratic seats, as reported by Barber in his Figures 95, 98, 103, 106, 110, 113, 117, 120, 123, 128. He does not present figures for the Bladen-Duplin-Harnett-Jones-Lee-Pender-Sampson and Cleveland-Gaston-Lincoln clusters because his 0-district results for these clusters are based on a small number of maps.

I hereby certify that the foregoing statements are true and correct to the best of my knowledge, information, and belief.

Wesley Pegden
12/28/2021

PEGDEN 5

Population Deviation Report

District Plan: SL 2021-175 House

District	Seats	Ideal Pop	Actual Pop	Deviation	Deviation %
1	1	86,995	84,330	-2,665	-3.06%
2	1	86,995	90,793	3,798	4.37%
3	1	86,995	85,099	-1,896	-2.18%
4	1	86,995	83,095	-3,900	-4.48%
5	1	86,995	82,953	-4,042	-4.65%
6	1	86,995	87,332	337	0.39%
7	1	86,995	83,510	-3,485	-4.01%
8	1	86,995	85,793	-1,202	-1.38%
9	1	86,995	84,450	-2,545	-2.93%
10	1	86,995	82,953	-4,042	-4.65%
11	1	86,995	86,298	-697	-0.80%
12	1	86,995	84,745	-2,250	-2.59%
13	1	86,995	83,307	-3,688	-4.24%
14	1	86,995	86,538	-457	-0.53%
15	1	86,995	87,578	583	0.67%
16	1	86,995	90,663	3,668	4.22%
17	1	86,995	89,763	2,768	3.18%
18	1	86,995	91,245	4,250	4.89%
19	1	86,995	91,041	4,046	4.65%
20	1	86,995	90,346	3,351	3.85%
21	1	86,995	86,179	-816	-0.94%
22	1	86,995	88,642	1,647	1.89%
23	1	86,995	88,865	1,870	2.15%
24	1	86,995	87,220	225	0.26%
25	1	86,995	86,534	-461	-0.53%
26	1	86,995	89,947	2,952	3.39%
27	1	86,995	84,735	-2,260	-2.60%
28	1	86,995	85,389	-1,606	-1.85%
29	1	86,995	91,212	4,217	4.85%
30	1	86,995	91,165	4,170	4.79%
31	1	86,995	90,760	3,765	4.33%
32	1	86,995	88,633	1,638	1.88%
33	1	86,995	83,049	-3,946	-4.54%
34	1	86,995	83,679	-3,316	-3.81%
35	1	86,995	88,374	1,379	1.59%
36	1	86,995	90,166	3,171	3.65%
37	1	86,995	90,867	3,872	4.45%
38	1	86,995	88,226	1,231	1.42%
39	1	86,995	90,164	3,169	3.64%
40	1	86,995	83,175	-3,820	-4.39%
41	1	86,995	89,887	2,892	3.32%
42	1	86,995	85,537	-1,458	-1.68%
43	1	86,995	82,956	-4,039	-4.64%
44	1	86,995	[illegible]	[illegible]	-4.25%

PEGDEN 5

NC General Assembly

Population Deviation Report

District Plan: SL 2021-175 House

District	Seats	Ideal Pop	Actual Pop	Deviation	Deviation %
45	1	86,995	82,938	-4,057	-4.66%
46	1	86,995	83,445	-3,550	-4.08%
47	1	86,995	83,708	-3,287	-3.78%
48	1	86,995	86,256	-739	-0.85%
49	1	86,995	86,157	-838	-0.96%
50	1	86,995	85,345	-1,650	-1.90%
51	1	86,995	83,073	-3,922	-4.51%
52	1	86,995	84,383	-2,612	-3.00%
53	1	86,995	86,899	-96	-0.11%
54	1	86,995	83,475	-3,520	-4.05%
55	1	86,995	87,005	10	0.01%
56	1	86,995	86,087	-908	-1.04%
57	1	86,995	90,615	3,620	4.16%
58	1	86,995	90,808	3,813	4.38%
59	1	86,995	90,361	3,366	3.87%
60	1	86,995	89,735	2,740	3.15%
61	1	86,995	90,201	3,206	3.69%
62	1	86,995	89,579	2,584	2.97%
63	1	86,995	86,399	-596	-0.69%
64	1	86,995	85,016	-1,979	-2.27%
65	1	86,995	91,096	4,101	4.71%
66	1	86,995	83,189	-3,806	-4.37%
67	1	86,995	88,255	1,260	1.45%
68	1	86,995	88,138	1,143	1.31%
69	1	86,995	85,179	-1,816	-2.09%
70	1	86,995	89,118	2,123	2.44%
71	1	86,995	84,874	-2,121	-2.44%
72	1	86,995	86,949	-46	-0.05%
73	1	86,995	90,649	3,654	4.20%
74	1	86,995	84,857	-2,138	-2.46%
75	1	86,995	84,220	-2,775	-3.19%
76	1	86,995	89,815	2,820	3.24%
77	1	86,995	90,628	3,633	4.18%
78	1	86,995	86,365	-630	-0.72%
79	1	86,995	83,163	-3,832	-4.40%
80	1	86,995	84,864	-2,131	-2.45%
81	1	86,995	84,066	-2,929	-3.37%
82	1	86,995	90,771	3,776	4.34%
83	1	86,995	90,742	3,747	4.31%
84	1	86,995	86,773	-222	-0.26%
85	1	86,995	90,863	3,868	4.45%
86	1	86,995	87,570	575	0.66%
87	1	86,995	85,758	-1,237	-1.42%
88	1	86,995	82,834	-4,161	-4.78%

PEGDEN 5

NC General Assembly

Population Deviation Report

District Plan: SL 2021-175 House

District	Seats	Ideal Pop	Actual Pop	Deviation	Deviation %
89	1	86,995	85,577	-1,418	-1.63%
90	1	86,995	82,937	-4,058	-4.66%
91	1	86,995	86,210	-785	-0.90%
92	1	86,995	85,031	-1,964	-2.26%
93	1	86,995	86,445	-550	-0.63%
94	1	86,995	90,835	3,840	4.41%
95	1	86,995	85,366	-1,629	-1.87%
96	1	86,995	89,587	2,592	2.98%
97	1	86,995	86,810	-185	-0.21%
98	1	86,995	86,827	-168	-0.19%
99	1	86,995	87,647	652	0.75%
100	1	86,995	87,197	202	0.23%
101	1	86,995	86,426	-569	-0.65%
102	1	86,995	86,179	-816	-0.94%
103	1	86,995	87,132	137	0.16%
104	1	86,995	86,520	-475	-0.55%
105	1	86,995	85,822	-1,173	-1.35%
106	1	86,995	82,824	-4,171	-4.79%
107	1	86,995	88,237	1,242	1.43%
108	1	86,995	86,263	-732	-0.84%
109	1	86,995	87,762	767	0.88%
110	1	86,995	88,397	1,402	1.61%
111	1	86,995	89,894	2,899	3.33%
112	1	86,995	82,806	-4,189	-4.82%
113	1	86,995	89,058	2,063	2.37%
114	1	86,995	89,685	2,690	3.09%
115	1	86,995	90,262	3,267	3.76%
116	1	86,995	89,505	2,510	2.89%
117	1	86,995	91,035	4,040	4.64%
118	1	86,995	83,282	-3,713	-4.27%
119	1	86,995	90,212	3,217	3.70%
120	1	86,995	84,907	-2,088	-2.40%
Totals:	**120**		**10,439,388**		

PEGDEN 5

NC General Assembly

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Alamance	63	171,415	86,399	86,399	50.40 %	100.00 %
	64	171,415	85,016	85,016	49.60 %	100.00 %
Alexander	94	36,444	90,835	36,444	100.00 %	40.12 %
Alleghany	93	10,888	86,445	10,888	100.00 %	12.60 %
Anson	55	22,055	87,005	22,055	100.00 %	25.35 %
Ashe	93	26,577	86,445	26,577	100.00 %	30.74 %
Avery	85	17,806	90,863	17,806	100.00 %	19.60 %
Beaufort	79	44,652	83,163	44,652	100.00 %	53.69 %
Bertie	23	17,934	88,865	17,934	100.00 %	20.18 %
Bladen	22	29,606	88,642	29,606	100.00 %	33.40 %
Brunswick	17	136,693	89,763	89,763	65.67 %	100.00 %
	19	136,693	91,041	46,930	34.33 %	51.55 %
Buncombe	114	269,452	89,685	89,685	33.28 %	100.00 %
	115	269,452	90,262	90,262	33.50 %	100.00 %
	116	269,452	89,505	89,505	33.22 %	100.00 %
Burke	86	87,570	87,570	87,570	100.00 %	100.00 %
Cabarrus	73	225,804	90,649	90,649	40.14 %	100.00 %
	82	225,804	90,771	90,771	40.20 %	100.00 %
	83	225,804	90,742	44,384	19.66 %	48.91 %
Caldwell	87	80,652	85,758	80,652	100.00 %	94.05 %
Camden	5	10,355	82,953	10,355	100.00 %	12.48 %
Carteret	13	67,686	83,307	67,686	100.00 %	81.25 %
Caswell	50	22,736	85,345	22,736	100.00 %	26.64 %
Catawba	89	160,610	85,577	71,023	44.22 %	82.99 %
	96	160,610	89,587	89,587	55.78 %	100.00 %
Chatham	54	76,285	83,475	76,285	100.00 %	91.39 %
Cherokee	120	28,774	84,907	28,774	100.00 %	33.89 %
Chowan	1	13,708	84,330	13,708	100.00 %	16.26 %
Clay	120	11,089	84,907	11,089	100.00 %	13.06 %
Cleveland	110	99,519	88,397	34,479	34.65 %	39.00 %
	111	99,519	89,894	65,040	65.35 %	72.35 %
Columbus	46	50,623	83,445	50,623	100.00 %	60.67 %
Craven	3	100,720	85,099	85,099	84.49 %	100.00 %
	13	100,720	83,307	15,621	15.51 %	18.75 %
Cumberland	42	334,728	85,537	85,537	25.55 %	100.00 %
	43	334,728	82,956	82,956	24.78 %	100.00 %
	44	334,728	83,297	83,297	24.88 %	100.00 %
	45	334,728	82,938	82,938	24.78 %	100.00 %
Currituck	1	28,100	84,330	28,100	100.00 %	33.32 %
Dare	1	36,915	84,330	15,269	41.36 %	18.11 %
	79	36,915	83,163	21,646	58.64 %	26.03 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Data Source: 2020 Census Redistricting Data (Public Law 94-171) Summary File - North Carolina
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PEGDEN 5

NC General Assembly

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Davidson	80	168,930	84,864	84,864	50.24 %	100.00 %
	81	168,930	84,066	84,066	49.76 %	100.00 %
Davie	77	42,712	90,628	42,712	100.00 %	47.13 %
Duplin	4	48,715	83,095	48,715	100.00 %	58.63 %
Durham	2	324,833	90,793	51,696	15.91 %	56.94 %
	29	324,833	91,212	91,212	28.08 %	100.00 %
	30	324,833	91,165	91,165	28.07 %	100.00 %
	31	324,833	90,760	90,760	27.94 %	100.00 %
Edgecombe	23	48,900	88,865	48,900	100.00 %	55.03 %
Forsyth	71	382,590	84,874	84,874	22.18 %	100.00 %
	72	382,590	86,949	86,949	22.73 %	100.00 %
	74	382,590	84,857	84,857	22.18 %	100.00 %
	75	382,590	84,220	84,220	22.01 %	100.00 %
	91	382,590	86,210	41,690	10.90 %	48.36 %
Franklin	7	68,573	83,510	68,573	100.00 %	82.11 %
Gaston	108	227,943	86,263	86,263	37.84 %	100.00 %
	109	227,943	87,762	87,762	38.50 %	100.00 %
	110	227,943	88,397	53,918	23.65 %	61.00 %
Gates	5	10,478	82,953	10,478	100.00 %	12.63 %
Graham	120	8,030	84,907	8,030	100.00 %	9.46 %
Granville	7	60,992	83,510	14,937	24.49 %	17.89 %
	32	60,992	88,633	46,055	75.51 %	51.96 %
Greene	12	20,451	84,745	20,451	100.00 %	24.13 %
Guilford	57	541,299	90,615	90,615	16.74 %	100.00 %
	58	541,299	90,808	90,808	16.78 %	100.00 %
	59	541,299	90,361	90,361	16.69 %	100.00 %
	60	541,299	89,735	89,735	16.58 %	100.00 %
	61	541,299	90,201	90,201	16.66 %	100.00 %
	62	541,299	89,579	89,579	16.55 %	100.00 %
Halifax	27	48,622	84,735	48,622	100.00 %	57.38 %
Harnett	6	133,568	87,332	87,332	65.38 %	100.00 %
	53	133,568	86,899	46,236	34.62 %	53.21 %
Haywood	118	62,089	83,282	62,089	100.00 %	74.55 %
Henderson	113	116,281	89,058	25,246	21.71 %	28.35 %
	117	116,281	91,035	91,035	78.29 %	100.00 %
Hertford	5	21,552	82,953	21,552	100.00 %	25.98 %
Hoke	48	52,082	86,256	52,082	100.00 %	60.38 %
Hyde	79	4,589	83,163	4,589	100.00 %	5.52 %
Iredell	84	186,693	86,773	86,773	46.48 %	100.00 %
	89	186,693	85,577	14,554	7.80 %	17.01 %
	95	186,693	85,366	85,366	45.73 %	100.00 %
Jackson	119	43,109	90,212	43,109	100.00 %	47.79 %

PEGDEN 5

NC General Assembly

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Johnston	26	215,999	89,947	89,947	41.64 %	100.00 %
	28	215,999	85,389	85,389	39.53 %	100.00 %
	53	215,999	86,899	40,663	18.83 %	46.79 %
Jones	12	9,172	84,745	9,172	100.00 %	10.82 %
Lee	51	63,285	83,073	63,285	100.00 %	76.18 %
Lenoir	12	55,122	84,745	55,122	100.00 %	65.04 %
Lincoln	97	86,810	86,810	86,810	100.00 %	100.00 %
Macon	120	37,014	84,907	37,014	100.00 %	43.59 %
Madison	118	21,193	83,282	21,193	100.00 %	25.45 %
Martin	23	22,031	88,865	22,031	100.00 %	24.79 %
McDowell	85	44,578	90,863	39,684	89.02 %	43.67 %
	113	44,578	89,058	4,894	10.98 %	5.50 %
Mecklenburg	88	1,115,482	82,834	82,834	7.43 %	100.00 %
	92	1,115,482	85,031	85,031	7.62 %	100.00 %
	98	1,115,482	86,827	86,827	7.78 %	100.00 %
	99	1,115,482	87,647	87,647	7.86 %	100.00 %
	100	1,115,482	87,197	87,197	7.82 %	100.00 %
	101	1,115,482	86,426	86,426	7.75 %	100.00 %
	102	1,115,482	86,179	86,179	7.73 %	100.00 %
	103	1,115,482	87,132	87,132	7.81 %	100.00 %
	104	1,115,482	86,520	86,520	7.76 %	100.00 %
	105	1,115,482	85,822	85,822	7.69 %	100.00 %
	106	1,115,482	82,824	82,824	7.42 %	100.00 %
	107	1,115,482	88,237	88,237	7.91 %	100.00 %
	112	1,115,482	82,806	82,806	7.42 %	100.00 %
Mitchell	85	14,903	90,863	14,903	100.00 %	16.40 %
Montgomery	67	25,751	88,255	25,751	100.00 %	29.18 %
Moore	51	99,727	83,073	19,788	19.84 %	23.82 %
	52	99,727	84,383	41,437	41.55 %	49.11 %
	78	99,727	86,365	38,502	38.61 %	44.58 %
Nash	24	94,970	87,220	8,436	8.88 %	9.67 %
	25	94,970	86,534	86,534	91.12 %	100.00 %
New Hanover	18	225,702	91,245	91,245	40.43 %	100.00 %
	19	225,702	91,041	44,111	19.54 %	48.45 %
	20	225,702	90,346	90,346	40.03 %	100.00 %
Northampton	27	17,471	84,735	17,471	100.00 %	20.62 %
Onslow	14	204,576	86,538	86,538	42.30 %	100.00 %
	15	204,576	87,578	87,578	42.81 %	100.00 %
	16	204,576	90,663	30,460	14.89 %	33.60 %
Orange	50	148,696	85,345	62,609	42.11 %	73.36 %
	56	148,696	86,087	86,087	57.89 %	100.00 %
Pamlico	79	12,276	83,163	12,276	100.00 %	14.76 %

PEGDEN 5

NC General Assembly

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Pasquotank	5	40,568	82,953	40,568	100.00 %	48.90 %
Pender	16	60,203	90,663	60,203	100.00 %	66.40 %
Perquimans	1	13,005	84,330	13,005	100.00 %	15.42 %
Person	2	39,097	90,793	39,097	100.00 %	43.06 %
Pitt	8	170,243	85,793	85,793	50.39 %	100.00 %
	9	170,243	84,450	84,450	49.61 %	100.00 %
Polk	113	19,328	89,058	19,328	100.00 %	21.70 %
Randolph	54	144,171	83,475	7,190	4.99 %	8.61 %
	70	144,171	89,118	89,118	61.81 %	100.00 %
	78	144,171	86,365	47,863	33.20 %	55.42 %
Richmond	52	42,946	84,383	42,946	100.00 %	50.89 %
Robeson	46	116,530	83,445	32,822	28.17 %	39.33 %
	47	116,530	83,708	83,708	71.83 %	100.00 %
Rockingham	65	91,096	91,096	91,096	100.00 %	100.00 %
Rowan	76	146,875	89,815	89,815	61.15 %	100.00 %
	77	146,875	90,628	10,702	7.29 %	11.81 %
	83	146,875	90,742	46,358	31.56 %	51.09 %
Rutherford	111	64,444	89,894	24,854	38.57 %	27.65 %
	113	64,444	89,058	39,590	61.43 %	44.45 %
Sampson	22	59,036	88,642	59,036	100.00 %	66.60 %
Scotland	48	34,174	86,256	34,174	100.00 %	39.62 %
Stanly	67	62,504	88,255	62,504	100.00 %	70.82 %
Stokes	91	44,520	86,210	44,520	100.00 %	51.64 %
Surry	90	71,359	82,937	71,359	100.00 %	86.04 %
Swain	119	14,117	90,212	14,117	100.00 %	15.65 %
Transylvania	119	32,986	90,212	32,986	100.00 %	36.56 %
Tyrrell	1	3,245	84,330	3,245	100.00 %	3.85 %
Union	55	238,267	87,005	64,950	27.26 %	74.65 %
	68	238,267	88,138	88,138	36.99 %	100.00 %
	69	238,267	85,179	85,179	35.75 %	100.00 %
Vance	32	42,578	88,633	42,578	100.00 %	48.04 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Data Source: 2020 Census Redistricting Data (Public Law 94-171) Summary File - North Carolina
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PEGDEN 5

NC General Assembly

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Wake	11	1,129,410	86,298	86,298	7.64 %	100.00 %
	21	1,129,410	86,179	86,179	7.63 %	100.00 %
	33	1,129,410	83,049	83,049	7.35 %	100.00 %
	34	1,129,410	83,679	83,679	7.41 %	100.00 %
	35	1,129,410	88,374	88,374	7.82 %	100.00 %
	36	1,129,410	90,166	90,166	7.98 %	100.00 %
	37	1,129,410	90,867	90,867	8.05 %	100.00 %
	38	1,129,410	88,226	88,226	7.81 %	100.00 %
	39	1,129,410	90,164	90,164	7.98 %	100.00 %
	40	1,129,410	83,175	83,175	7.36 %	100.00 %
	41	1,129,410	89,887	89,887	7.96 %	100.00 %
	49	1,129,410	86,157	86,157	7.63 %	100.00 %
	66	1,129,410	83,189	83,189	7.37 %	100.00 %
Warren	27	18,642	84,735	18,642	100.00 %	22.00 %
Washington	1	11,003	84,330	11,003	100.00 %	13.05 %
Watauga	87	54,086	85,758	5,106	9.44 %	5.95 %
	93	54,086	86,445	48,980	90.56 %	56.66 %
Wayne	4	117,333	83,095	34,380	29.30 %	41.37 %
	10	117,333	82,953	82,953	70.70 %	100.00 %
Wilkes	90	65,969	82,937	11,578	17.55 %	13.96 %
	94	65,969	90,835	54,391	82.45 %	59.88 %
Wilson	24	78,784	87,220	78,784	100.00 %	90.33 %
Yadkin	77	37,214	90,628	37,214	100.00 %	41.06 %
Yancey	85	18,470	90,863	18,470	100.00 %	20.33 %
			Total:	**10,439,388**		

Number of split counties: 36
Display: all counties

PEGDEN 5

NC General Assembly

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
1	Chowan	84,330	13,708	13,708	16.26 %	100.00 %
	Currituck	84,330	28,100	28,100	33.32 %	100.00 %
	Dare	84,330	36,915	15,269	18.11 %	41.36 %
	Perquimans	84,330	13,005	13,005	15.42 %	100.00 %
	Tyrrell	84,330	3,245	3,245	3.85 %	100.00 %
	Washington	84,330	11,003	11,003	13.05 %	100.00 %
2	Durham	90,793	324,833	51,696	56.94 %	15.91 %
	Person	90,793	39,097	39,097	43.06 %	100.00 %
3	Craven	85,099	100,720	85,099	100.00 %	84.49 %
4	Duplin	83,095	48,715	48,715	58.63 %	100.00 %
	Wayne	83,095	117,333	34,380	41.37 %	29.30 %
5	Camden	82,953	10,355	10,355	12.48 %	100.00 %
	Gates	82,953	10,478	10,478	12.63 %	100.00 %
	Hertford	82,953	21,552	21,552	25.98 %	100.00 %
	Pasquotank	82,953	40,568	40,568	48.90 %	100.00 %
6	Harnett	87,332	133,568	87,332	100.00 %	65.38 %
7	Franklin	83,510	68,573	68,573	82.11 %	100.00 %
	Granville	83,510	60,992	14,937	17.89 %	24.49 %
8	Pitt	85,793	170,243	85,793	100.00 %	50.39 %
9	Pitt	84,450	170,243	84,450	100.00 %	49.61 %
10	Wayne	82,953	117,333	82,953	100.00 %	70.70 %
11	Wake	86,298	1,129,410	86,298	100.00 %	7.64 %
12	Greene	84,745	20,451	20,451	24.13 %	100.00 %
	Jones	84,745	9,172	9,172	10.82 %	100.00 %
	Lenoir	84,745	55,122	55,122	65.04 %	100.00 %
13	Carteret	83,307	67,686	67,686	81.25 %	100.00 %
	Craven	83,307	100,720	15,621	18.75 %	15.51 %
14	Onslow	86,538	204,576	86,538	100.00 %	42.30 %
15	Onslow	87,578	204,576	87,578	100.00 %	42.81 %
16	Onslow	90,663	204,576	30,460	33.60 %	14.89 %
	Pender	90,663	60,203	60,203	66.40 %	100.00 %
17	Brunswick	89,763	136,693	89,763	100.00 %	65.67 %
18	New Hanover	91,245	225,702	91,245	100.00 %	40.43 %
19	Brunswick	91,041	136,693	46,930	51.55 %	34.33 %
	New Hanover	91,041	225,702	44,111	48.45 %	19.54 %
20	New Hanover	90,346	225,702	90,346	100.00 %	40.03 %
21	Wake	86,179	1,129,410	86,179	100.00 %	7.63 %
22	Bladen	88,642	29,606	29,606	33.40 %	100.00 %
	Sampson	88,642	59,036	59,036	66.60 %	100.00 %
23	Bertie	88,865	17,934	17,934	20.18 %	100.00 %
	Edgecombe	88,865	48,900	48,900	55.03 %	100.00 %
	Martin	88,865	22,031	22,031	24.79 %	100.00 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Data Source: 2020 Census Redistricting Data (Public Law 94-171) Summary File - North Carolina
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PEGDEN 5

NC General Assembly

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
24	Nash	87,220	94,970	8,436	9.67 %	8.88 %
	Wilson	87,220	78,784	78,784	90.33 %	100.00 %
25	Nash	86,534	94,970	86,534	100.00 %	91.12 %
26	Johnston	89,947	215,999	89,947	100.00 %	41.64 %
27	Halifax	84,735	48,622	48,622	57.38 %	100.00 %
	Northampton	84,735	17,471	17,471	20.62 %	100.00 %
	Warren	84,735	18,642	18,642	22.00 %	100.00 %
28	Johnston	85,389	215,999	85,389	100.00 %	39.53 %
29	Durham	91,212	324,833	91,212	100.00 %	28.08 %
30	Durham	91,165	324,833	91,165	100.00 %	28.07 %
31	Durham	90,760	324,833	90,760	100.00 %	27.94 %
32	Granville	88,633	60,992	46,055	51.96 %	75.51 %
	Vance	88,633	42,578	42,578	48.04 %	100.00 %
33	Wake	83,049	1,129,410	83,049	100.00 %	7.35 %
34	Wake	83,679	1,129,410	83,679	100.00 %	7.41 %
35	Wake	88,374	1,129,410	88,374	100.00 %	7.82 %
36	Wake	90,166	1,129,410	90,166	100.00 %	7.98 %
37	Wake	90,867	1,129,410	90,867	100.00 %	8.05 %
38	Wake	88,226	1,129,410	88,226	100.00 %	7.81 %
39	Wake	90,164	1,129,410	90,164	100.00 %	7.98 %
40	Wake	83,175	1,129,410	83,175	100.00 %	7.36 %
41	Wake	89,887	1,129,410	89,887	100.00 %	7.96 %
42	Cumberland	85,537	334,728	85,537	100.00 %	25.55 %
43	Cumberland	82,956	334,728	82,956	100.00 %	24.78 %
44	Cumberland	83,297	334,728	83,297	100.00 %	24.88 %
45	Cumberland	82,938	334,728	82,938	100.00 %	24.78 %
46	Columbus	83,445	50,623	50,623	60.67 %	100.00 %
	Robeson	83,445	116,530	32,822	39.33 %	28.17 %
47	Robeson	83,708	116,530	83,708	100.00 %	71.83 %
48	Hoke	86,256	52,082	52,082	60.38 %	100.00 %
	Scotland	86,256	34,174	34,174	39.62 %	100.00 %
49	Wake	86,157	1,129,410	86,157	100.00 %	7.63 %
50	Caswell	85,345	22,736	22,736	26.64 %	100.00 %
	Orange	85,345	148,696	62,609	73.36 %	42.11 %
51	Lee	83,073	63,285	63,285	76.18 %	100.00 %
	Moore	83,073	99,727	19,788	23.82 %	19.84 %
52	Moore	84,383	99,727	41,437	49.11 %	41.55 %
	Richmond	84,383	42,946	42,946	50.89 %	100.00 %
53	Harnett	86,899	133,568	46,236	53.21 %	34.62 %
	Johnston	86,899	215,999	40,663	46.79 %	18.83 %
54	Chatham	83,475	76,285	76,285	91.39 %	100.00 %
	Randolph	83,475	144,171	7,190	8.61 %	4.99 %

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NC General Assembly

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
55	Anson	87,005	22,055	22,055	25.35 %	100.00 %
	Union	87,005	238,267	64,950	74.65 %	27.26 %
56	Orange	86,087	148,696	86,087	100.00 %	57.89 %
57	Guilford	90,615	541,299	90,615	100.00 %	16.74 %
58	Guilford	90,808	541,299	90,808	100.00 %	16.78 %
59	Guilford	90,361	541,299	90,361	100.00 %	16.69 %
60	Guilford	89,735	541,299	89,735	100.00 %	16.58 %
61	Guilford	90,201	541,299	90,201	100.00 %	16.66 %
62	Guilford	89,579	541,299	89,579	100.00 %	16.55 %
63	Alamance	86,399	171,415	86,399	100.00 %	50.40 %
64	Alamance	85,016	171,415	85,016	100.00 %	49.60 %
65	Rockingham	91,096	91,096	91,096	100.00 %	100.00 %
66	Wake	83,189	1,129,410	83,189	100.00 %	7.37 %
67	Montgomery	88,255	25,751	25,751	29.18 %	100.00 %
	Stanly	88,255	62,504	62,504	70.82 %	100.00 %
68	Union	88,138	238,267	88,138	100.00 %	36.99 %
69	Union	85,179	238,267	85,179	100.00 %	35.75 %
70	Randolph	89,118	144,171	89,118	100.00 %	61.81 %
71	Forsyth	84,874	382,590	84,874	100.00 %	22.18 %
72	Forsyth	86,949	382,590	86,949	100.00 %	22.73 %
73	Cabarrus	90,649	225,804	90,649	100.00 %	40.14 %
74	Forsyth	84,857	382,590	84,857	100.00 %	22.18 %
75	Forsyth	84,220	382,590	84,220	100.00 %	22.01 %
76	Rowan	89,815	146,875	89,815	100.00 %	61.15 %
77	Davie	90,628	42,712	42,712	47.13 %	100.00 %
	Rowan	90,628	146,875	10,702	11.81 %	7.29 %
	Yadkin	90,628	37,214	37,214	41.06 %	100.00 %
78	Moore	86,365	99,727	38,502	44.58 %	38.61 %
	Randolph	86,365	144,171	47,863	55.42 %	33.20 %
79	Beaufort	83,163	44,652	44,652	53.69 %	100.00 %
	Dare	83,163	36,915	21,646	26.03 %	58.64 %
	Hyde	83,163	4,589	4,589	5.52 %	100.00 %
	Pamlico	83,163	12,276	12,276	14.76 %	100.00 %
80	Davidson	84,864	168,930	84,864	100.00 %	50.24 %
81	Davidson	84,066	168,930	84,066	100.00 %	49.76 %
82	Cabarrus	90,771	225,804	90,771	100.00 %	40.20 %
83	Cabarrus	90,742	225,804	44,384	48.91 %	19.66 %
	Rowan	90,742	146,875	46,358	51.09 %	31.56 %
84	Iredell	86,773	186,693	86,773	100.00 %	46.48 %

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District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
85	Avery	90,863	17,806	17,806	19.60 %	100.00 %
	McDowell	90,863	44,578	39,684	43.67 %	89.02 %
	Mitchell	90,863	14,903	14,903	16.40 %	100.00 %
	Yancey	90,863	18,470	18,470	20.33 %	100.00 %
86	Burke	87,570	87,570	87,570	100.00 %	100.00 %
87	Caldwell	85,758	80,652	80,652	94.05 %	100.00 %
	Watauga	85,758	54,086	5,106	5.95 %	9.44 %
88	Mecklenburg	82,834	1,115,482	82,834	100.00 %	7.43 %
89	Catawba	85,577	160,610	71,023	82.99 %	44.22 %
	Iredell	85,577	186,693	14,554	17.01 %	7.80 %
90	Surry	82,937	71,359	71,359	86.04 %	100.00 %
	Wilkes	82,937	65,969	11,578	13.96 %	17.55 %
91	Forsyth	86,210	382,590	41,690	48.36 %	10.90 %
	Stokes	86,210	44,520	44,520	51.64 %	100.00 %
92	Mecklenburg	85,031	1,115,482	85,031	100.00 %	7.62 %
93	Alleghany	86,445	10,888	10,888	12.60 %	100.00 %
	Ashe	86,445	26,577	26,577	30.74 %	100.00 %
	Watauga	86,445	54,086	48,980	56.66 %	90.56 %
94	Alexander	90,835	36,444	36,444	40.12 %	100.00 %
	Wilkes	90,835	65,969	54,391	59.88 %	82.45 %
95	Iredell	85,366	186,693	85,366	100.00 %	45.73 %
96	Catawba	89,587	160,610	89,587	100.00 %	55.78 %
97	Lincoln	86,810	86,810	86,810	100.00 %	100.00 %
98	Mecklenburg	86,827	1,115,482	86,827	100.00 %	7.78 %
99	Mecklenburg	87,647	1,115,482	87,647	100.00 %	7.86 %
100	Mecklenburg	87,197	1,115,482	87,197	100.00 %	7.82 %
101	Mecklenburg	86,426	1,115,482	86,426	100.00 %	7.75 %
102	Mecklenburg	86,179	1,115,482	86,179	100.00 %	7.73 %
103	Mecklenburg	87,132	1,115,482	87,132	100.00 %	7.81 %
104	Mecklenburg	86,520	1,115,482	86,520	100.00 %	7.76 %
105	Mecklenburg	85,822	1,115,482	85,822	100.00 %	7.69 %
106	Mecklenburg	82,824	1,115,482	82,824	100.00 %	7.42 %
107	Mecklenburg	88,237	1,115,482	88,237	100.00 %	7.91 %
108	Gaston	86,263	227,943	86,263	100.00 %	37.84 %
109	Gaston	87,762	227,943	87,762	100.00 %	38.50 %
110	Cleveland	88,397	99,519	34,479	39.00 %	34.65 %
	Gaston	88,397	227,943	53,918	61.00 %	23.65 %
111	Cleveland	89,894	99,519	65,040	72.35 %	65.35 %
	Rutherford	89,894	64,444	24,854	27.65 %	38.57 %
112	Mecklenburg	82,806	1,115,482	82,806	100.00 %	7.42 %

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
113	Henderson	89,058	116,281	25,246	28.35 %	21.71 %
	McDowell	89,058	44,578	4,894	5.50 %	10.98 %
	Polk	89,058	19,328	19,328	21.70 %	100.00 %
	Rutherford	89,058	64,444	39,590	44.45 %	61.43 %
114	Buncombe	89,685	269,452	89,685	100.00 %	33.28 %
115	Buncombe	90,262	269,452	90,262	100.00 %	33.50 %
116	Buncombe	89,505	269,452	89,505	100.00 %	33.22 %
117	Henderson	91,035	116,281	91,035	100.00 %	78.29 %
118	Haywood	83,282	62,089	62,089	74.55 %	100.00 %
	Madison	83,282	21,193	21,193	25.45 %	100.00 %
119	Jackson	90,212	43,109	43,109	47.79 %	100.00 %
	Swain	90,212	14,117	14,117	15.65 %	100.00 %
	Transylvania	90,212	32,986	32,986	36.56 %	100.00 %
120	Cherokee	84,907	28,774	28,774	33.89 %	100.00 %
	Clay	84,907	11,089	11,089	13.06 %	100.00 %
	Graham	84,907	8,030	8,030	9.46 %	100.00 %
	Macon	84,907	37,014	37,014	43.59 %	100.00 %
			Total:	**10,439,388**		

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Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Aberdeen	52	8,516	84,383	8,516	100.00 %	10.09 %
	78	8,516	86,365	0	0.00 %	0.00 %
Ahoskie	5	4,891	82,953	4,891	100.00 %	5.90 %
Alamance	64	988	85,016	988	100.00 %	1.16 %
Albemarle	67	16,432	88,255	16,432	100.00 %	18.62 %
Alliance	79	733	83,163	733	100.00 %	0.88 %
Andrews	120	1,667	84,907	1,667	100.00 %	1.96 %
Angier	6	5,265	87,332	4,709	89.44 %	5.39 %
	37	5,265	90,867	556	10.56 %	0.61 %
Ansonville	55	440	87,005	440	100.00 %	0.51 %
Apex	11	58,780	86,298	0	0.00 %	0.00 %
	21	58,780	86,179	556	0.95 %	0.65 %
	36	58,780	90,166	57,843	98.41 %	64.15 %
	41	58,780	89,887	381	0.65 %	0.42 %
Arapahoe	79	416	83,163	416	100.00 %	0.50 %
Archdale	60	11,907	89,735	380	3.19 %	0.42 %
	70	11,907	89,118	11,527	96.81 %	12.93 %
Archer Lodge	26	4,797	89,947	4,797	100.00 %	5.33 %
Asheboro	70	27,156	89,118	25,890	95.34 %	29.05 %
	78	27,156	86,365	1,266	4.66 %	1.47 %
Asheville	114	94,589	89,685	52,596	55.60 %	58.65 %
	115	94,589	90,262	29,236	30.91 %	32.39 %
	116	94,589	89,505	12,757	13.49 %	14.25 %
Askewville	23	184	88,865	184	100.00 %	0.21 %
Atkinson	16	296	90,663	296	100.00 %	0.33 %
Atlantic Beach	13	1,364	83,307	1,364	100.00 %	1.64 %
Aulander	23	763	88,865	763	100.00 %	0.86 %
Aurora	79	455	83,163	455	100.00 %	0.55 %
Autryville	22	167	88,642	167	100.00 %	0.19 %
Ayden	9	4,977	84,450	4,977	100.00 %	5.89 %
Badin	67	2,024	88,255	2,024	100.00 %	2.29 %
Bailey	24	568	87,220	568	100.00 %	0.65 %
Bakersville	85	450	90,863	450	100.00 %	0.50 %
Bald Head Island	19	268	91,041	268	100.00 %	0.29 %
Banner Elk	85	1,049	90,863	1,049	100.00 %	1.15 %
Bath	79	245	83,163	245	100.00 %	0.29 %
Bayboro	79	1,161	83,163	1,161	100.00 %	1.40 %
Bear Grass	23	89	88,865	89	100.00 %	0.10 %
Beaufort	13	4,464	83,307	4,464	100.00 %	5.36 %
Beech Mountain	85	675	90,863	62	9.19 %	0.07 %
	93	675	86,445	613	90.81 %	0.71 %
Belhaven	79	1,410	83,163	1,410	100.00 %	1.70 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Belmont	108	15,010	86,263	1,868	12.45 %	2.17 %
	109	15,010	87,762	13,142	87.55 %	14.97 %
Belville	17	2,406	89,763	2,406	100.00 %	2.68 %
Belwood	110	857	88,397	857	100.00 %	0.97 %
Benson	28	3,967	85,389	3,967	100.00 %	4.65 %
	53	3,967	86,899	0	0.00 %	0.00 %
Bermuda Run	77	3,120	90,628	3,120	100.00 %	3.44 %
Bessemer City	110	5,428	88,397	5,428	100.00 %	6.14 %
Bethania	74	344	84,857	0	0.00 %	0.00 %
	91	344	86,210	344	100.00 %	0.40 %
Bethel	8	1,373	85,793	1,373	100.00 %	1.60 %
Beulaville	4	1,116	83,095	1,116	100.00 %	1.34 %
Biltmore Forest	116	1,409	89,505	1,409	100.00 %	1.57 %
Biscoe	67	1,848	88,255	1,848	100.00 %	2.09 %
Black Creek	24	692	87,220	692	100.00 %	0.79 %
Black Mountain	115	8,426	90,262	8,426	100.00 %	9.34 %
Bladenboro	22	1,648	88,642	1,648	100.00 %	1.86 %
Blowing Rock	87	1,376	85,758	96	6.98 %	0.11 %
	93	1,376	86,445	1,280	93.02 %	1.48 %
Boardman	46	166	83,445	166	100.00 %	0.20 %
Bogue	13	695	83,307	695	100.00 %	0.83 %
Boiling Spring Lakes	19	5,943	91,041	5,943	100.00 %	6.53 %
Boiling Springs	111	4,615	89,894	4,615	100.00 %	5.13 %
Bolivia	19	149	91,041	149	100.00 %	0.16 %
Bolton	46	519	83,445	519	100.00 %	0.62 %
Boone	87	19,092	85,758	595	3.12 %	0.69 %
	93	19,092	86,445	18,497	96.88 %	21.40 %
Boonville	77	1,185	90,628	1,185	100.00 %	1.31 %
Bostic	111	355	89,894	355	100.00 %	0.39 %
Brevard	119	7,744	90,212	7,744	100.00 %	8.58 %
Bridgeton	3	349	85,099	349	100.00 %	0.41 %
Broadway	6	1,267	87,332	0	0.00 %	0.00 %
	51	1,267	83,073	1,267	100.00 %	1.53 %
Brookford	96	442	89,587	442	100.00 %	0.49 %
Brunswick	46	973	83,445	973	100.00 %	1.17 %
Bryson City	119	1,558	90,212	1,558	100.00 %	1.73 %
Bunn	7	327	83,510	327	100.00 %	0.39 %
Burgaw	16	3,088	90,663	3,088	100.00 %	3.41 %
Burlington	59	57,303	90,361	1,822	3.18 %	2.02 %
	63	57,303	86,399	25,917	45.23 %	30.00 %
	64	57,303	85,016	29,564	51.59 %	34.77 %
Burnsville	85	1,614	90,863	1,614	100.00 %	1.78 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Butner	32	8,397	88,633	8,397	100.00 %	9.47 %
Cajah's Mountain	87	2,722	85,758	2,722	100.00 %	3.17 %
Calabash	17	2,011	89,763	2,011	100.00 %	2.24 %
Calypso	4	327	83,095	327	100.00 %	0.39 %
Cameron	51	244	83,073	244	100.00 %	0.29 %
Candor	67	813	88,255	813	100.00 %	0.92 %
	78	813	86,365	0	0.00 %	0.00 %
Canton	118	4,422	83,282	4,422	100.00 %	5.31 %
Cape Carteret	13	2,224	83,307	2,224	100.00 %	2.67 %
Carolina Beach	19	6,564	91,041	6,564	100.00 %	7.21 %
Carolina Shores	17	4,588	89,763	4,588	100.00 %	5.11 %
Carrboro	50	21,295	85,345	174	0.82 %	0.20 %
	56	21,295	86,087	21,121	99.18 %	24.53 %
Carthage	51	2,775	83,073	2,747	98.99 %	3.31 %
	52	2,775	84,383	28	1.01 %	0.03 %
Cary	11	174,721	86,298	43,537	24.92 %	50.45 %
	21	174,721	86,179	30,622	17.53 %	35.53 %
	36	174,721	90,166	0	0.00 %	0.00 %
	37	174,721	90,867	2,012	1.15 %	2.21 %
	41	174,721	89,887	74,074	42.40 %	82.41 %
	49	174,721	86,157	20,767	11.89 %	24.10 %
	54	174,721	83,475	3,709	2.12 %	4.44 %
Casar	110	305	88,397	305	100.00 %	0.35 %
Castalia	25	264	86,534	264	100.00 %	0.31 %
Caswell Beach	19	395	91,041	395	100.00 %	0.43 %
Catawba	89	702	85,577	702	100.00 %	0.82 %
Cedar Point	13	1,764	83,307	1,764	100.00 %	2.12 %
Cedar Rock	87	301	85,758	301	100.00 %	0.35 %
Cerro Gordo	46	131	83,445	131	100.00 %	0.16 %
Chadbourn	46	1,574	83,445	1,574	100.00 %	1.89 %
Chapel Hill	29	61,960	91,212	2,906	4.69 %	3.19 %
	56	61,960	86,087	59,054	95.31 %	68.60 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Charlotte	88	874,579	82,834	82,834	9.47 %	100.00 %
	92	874,579	85,031	63,762	7.29 %	74.99 %
	99	874,579	87,647	79,113	9.05 %	90.26 %
	100	874,579	87,197	87,197	9.97 %	100.00 %
	101	874,579	86,426	64,526	7.38 %	74.66 %
	102	874,579	86,179	86,179	9.85 %	100.00 %
	103	874,579	87,132	23,590	2.70 %	27.07 %
	104	874,579	86,520	86,520	9.89 %	100.00 %
	105	874,579	85,822	71,156	8.14 %	82.91 %
	106	874,579	82,824	79,717	9.11 %	96.25 %
	107	874,579	88,237	67,298	7.69 %	76.27 %
	112	874,579	82,806	82,687	9.45 %	99.86 %
Cherryville	110	6,078	88,397	6,078	100.00 %	6.88 %
Chimney Rock Village	113	140	89,058	140	100.00 %	0.16 %
China Grove	83	4,434	90,742	4,434	100.00 %	4.89 %
Chocowinity	79	722	83,163	722	100.00 %	0.87 %
Claremont	89	1,692	85,577	1,692	100.00 %	1.98 %
Clarkton	22	614	88,642	614	100.00 %	0.69 %
Clayton	26	26,307	89,947	26,307	100.00 %	29.25 %
	38	26,307	88,226	0	0.00 %	0.00 %
	39	26,307	90,164	0	0.00 %	0.00 %
Clemmons	74	21,163	84,857	21,163	100.00 %	24.94 %
Cleveland	77	846	90,628	846	100.00 %	0.93 %
Clinton	22	8,383	88,642	8,383	100.00 %	9.46 %
Clyde	118	1,368	83,282	1,368	100.00 %	1.64 %
Coats	53	2,155	86,899	2,155	100.00 %	2.48 %
Cofield	5	267	82,953	267	100.00 %	0.32 %
Colerain	23	217	88,865	217	100.00 %	0.24 %
Columbia	1	610	84,330	610	100.00 %	0.72 %
Columbus	113	1,060	89,058	1,060	100.00 %	1.19 %
Como	5	67	82,953	67	100.00 %	0.08 %
Concord	73	105,240	90,649	32,447	30.83 %	35.79 %
	82	105,240	90,771	48,723	46.30 %	53.68 %
	83	105,240	90,742	24,070	22.87 %	26.53 %
Conetoe	23	198	88,865	198	100.00 %	0.22 %
Connelly Springs	86	1,529	87,570	1,529	100.00 %	1.75 %
Conover	89	8,421	85,577	424	5.04 %	0.50 %
	96	8,421	89,587	7,997	94.96 %	8.93 %
Conway	27	752	84,735	752	100.00 %	0.89 %
Cooleemee	77	940	90,628	940	100.00 %	1.04 %
Cornelius	98	31,412	86,827	31,412	100.00 %	36.18 %
Cove City	3	378	85,099	378	100.00 %	0.44 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Cramerton	108	5,296	86,263	96	1.81 %	0.11 %
	109	5,296	87,762	5,200	98.19 %	5.93 %
Creedmoor	7	4,866	83,510	2,065	42.44 %	2.47 %
	32	4,866	88,633	2,801	57.56 %	3.16 %
Creswell	1	207	84,330	207	100.00 %	0.25 %
Crossnore	85	143	90,863	143	100.00 %	0.16 %
Dallas	110	5,927	88,397	5,927	100.00 %	6.70 %
Danbury	91	189	86,210	189	100.00 %	0.22 %
Davidson	95	15,106	85,366	378	2.50 %	0.44 %
	98	15,106	86,827	14,728	97.50 %	16.96 %
Dellview	110	6	88,397	6	100.00 %	0.01 %
Denton	80	1,494	84,864	1,494	100.00 %	1.76 %
Dillsboro	119	213	90,212	213	100.00 %	0.24 %
Dobbins Heights	52	687	84,383	687	100.00 %	0.81 %
Dobson	90	1,462	82,937	1,462	100.00 %	1.76 %
Dortches	25	1,082	86,534	1,082	100.00 %	1.25 %
Dover	3	349	85,099	349	100.00 %	0.41 %
Drexel	86	1,760	87,570	1,760	100.00 %	2.01 %
Dublin	22	267	88,642	267	100.00 %	0.30 %
Duck	1	742	84,330	742	100.00 %	0.88 %
Dunn	53	8,446	86,899	8,446	100.00 %	9.72 %
Durham	2	283,506	90,793	25,167	8.88 %	27.72 %
	29	283,506	91,212	87,035	30.70 %	95.42 %
	30	283,506	91,165	89,671	31.63 %	98.36 %
	31	283,506	90,760	81,220	28.65 %	89.49 %
	40	283,506	83,175	269	0.09 %	0.32 %
	49	283,506	86,157	0	0.00 %	0.00 %
	50	283,506	85,345	144	0.05 %	0.17 %
Earl	111	198	89,894	198	100.00 %	0.22 %
East Arcadia	22	418	88,642	418	100.00 %	0.47 %
East Bend	77	634	90,628	634	100.00 %	0.70 %
East Laurinburg	48	234	86,256	234	100.00 %	0.27 %
Eastover	43	3,656	82,956	3,656	100.00 %	4.41 %
East Spencer	76	1,567	89,815	1,567	100.00 %	1.74 %
Eden	65	15,421	91,096	15,421	100.00 %	16.93 %
Edenton	1	4,460	84,330	4,460	100.00 %	5.29 %
Elizabeth City	5	18,631	82,953	18,631	100.00 %	22.46 %
Elizabethtown	22	3,296	88,642	3,296	100.00 %	3.72 %
Elkin	90	4,122	82,937	4,122	100.00 %	4.97 %
Elk Park	85	542	90,863	542	100.00 %	0.60 %
Ellenboro	111	723	89,894	723	100.00 %	0.80 %
Ellerbe	52	864	84,383	864	100.00 %	1.02 %

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Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Elm City	24	1,218	87,220	1,218	100.00 %	1.40 %
	25	1,218	86,534	0	0.00 %	0.00 %
Elon	64	11,336	85,016	11,336	100.00 %	13.33 %
Emerald Isle	13	3,847	83,307	3,847	100.00 %	4.62 %
Enfield	27	1,865	84,735	1,865	100.00 %	2.20 %
Erwin	53	4,542	86,899	4,542	100.00 %	5.23 %
Eureka	10	214	82,953	214	100.00 %	0.26 %
Everetts	23	150	88,865	150	100.00 %	0.17 %
Fair Bluff	46	709	83,445	709	100.00 %	0.85 %
Fairmont	46	2,191	83,445	2,191	100.00 %	2.63 %
	47	2,191	83,708	0	0.00 %	0.00 %
Fairview	69	3,456	85,179	3,456	100.00 %	4.06 %
Faison	4	784	83,095	784	100.00 %	0.94 %
	22	784	88,642	0	0.00 %	0.00 %
Faith	76	819	89,815	819	100.00 %	0.91 %
Falcon	22	324	88,642	0	0.00 %	0.00 %
	43	324	82,956	324	100.00 %	0.39 %
Falkland	8	47	85,793	47	100.00 %	0.05 %
Fallston	110	627	88,397	627	100.00 %	0.71 %
Farmville	8	4,461	85,793	4,461	100.00 %	5.20 %
Fayetteville	42	208,501	85,537	65,401	31.37 %	76.46 %
	43	208,501	82,956	44,532	21.36 %	53.68 %
	44	208,501	83,297	83,293	39.95 %	100.00 %
	45	208,501	82,938	15,275	7.33 %	18.42 %
Flat Rock	113	3,486	89,058	3,486	100.00 %	3.91 %
Fletcher	117	7,987	91,035	7,987	100.00 %	8.77 %
Fontana Dam	120	13	84,907	13	100.00 %	0.02 %
Forest City	111	7,377	89,894	0	0.00 %	0.00 %
	113	7,377	89,058	7,377	100.00 %	8.28 %
Forest Hills	119	303	90,212	303	100.00 %	0.34 %
Fountain	8	385	85,793	385	100.00 %	0.45 %
Four Oaks	28	2,158	85,389	2,158	100.00 %	2.53 %
Foxfire	52	1,288	84,383	0	0.00 %	0.00 %
	78	1,288	86,365	1,288	100.00 %	1.49 %
Franklin	120	4,175	84,907	4,175	100.00 %	4.92 %
Franklinton	7	2,456	83,510	2,456	100.00 %	2.94 %
Franklinville	78	1,197	86,365	1,197	100.00 %	1.39 %
Fremont	10	1,196	82,953	1,196	100.00 %	1.44 %
Fuquay-Varina	6	34,152	87,332	0	0.00 %	0.00 %
	21	34,152	86,179	30	0.09 %	0.03 %
	36	34,152	90,166	16	0.05 %	0.02 %
	37	34,152	90,867	34,106	99.87 %	37.53 %

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District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Gamewell	87	3,702	85,758	3,702	100.00 %	4.32 %
Garland	22	595	88,642	595	100.00 %	0.67 %
Garner	21	31,159	86,179	11,789	37.83 %	13.68 %
	33	31,159	83,049	14	0.04 %	0.02 %
	37	31,159	90,867	0	0.00 %	0.00 %
	38	31,159	88,226	19,356	62.12 %	21.94 %
Garysburg	27	904	84,735	904	100.00 %	1.07 %
Gaston	27	1,008	84,735	1,008	100.00 %	1.19 %
Gastonia	108	80,411	86,263	28,480	35.42 %	33.02 %
	109	80,411	87,762	44,448	55.28 %	50.65 %
	110	80,411	88,397	7,483	9.31 %	8.47 %
Gatesville	5	267	82,953	267	100.00 %	0.32 %
Gibson	48	449	86,256	449	100.00 %	0.52 %
Gibsonville	59	8,920	90,361	4,642	52.04 %	5.14 %
	64	8,920	85,016	4,278	47.96 %	5.03 %
Glen Alpine	86	1,529	87,570	1,529	100.00 %	1.75 %
Godwin	43	128	82,956	128	100.00 %	0.15 %
Goldsboro	4	33,657	83,095	5	0.01 %	0.01 %
	10	33,657	82,953	33,652	99.99 %	40.57 %
Goldston	54	234	83,475	234	100.00 %	0.28 %
Graham	63	17,157	86,399	17,157	100.00 %	19.86 %
Grandfather Village	85	95	90,863	95	100.00 %	0.10 %
Granite Falls	87	4,965	85,758	4,965	100.00 %	5.79 %
Granite Quarry	76	2,984	89,815	2,984	100.00 %	3.32 %
Grantsboro	79	692	83,163	692	100.00 %	0.83 %
Greenevers	4	567	83,095	567	100.00 %	0.68 %
Green Level	63	3,152	86,399	3,152	100.00 %	3.65 %
Greensboro	57	299,035	90,615	83,540	27.94 %	92.19 %
	58	299,035	90,808	84,725	28.33 %	93.30 %
	59	299,035	90,361	13,852	4.63 %	15.33 %
	60	299,035	89,735	8,829	2.95 %	9.84 %
	61	299,035	90,201	90,201	30.16 %	100.00 %
	62	299,035	89,579	17,888	5.98 %	19.97 %
Greenville	8	87,521	85,793	52,881	60.42 %	61.64 %
	9	87,521	84,450	34,640	39.58 %	41.02 %
Grifton	9	2,448	84,450	2,301	94.00 %	2.72 %
	12	2,448	84,745	147	6.00 %	0.17 %
Grimesland	9	386	84,450	386	100.00 %	0.46 %
Grover	111	802	89,894	802	100.00 %	0.89 %
Halifax	27	170	84,735	170	100.00 %	0.20 %
Hamilton	23	306	88,865	306	100.00 %	0.34 %
Hamlet	52	6,025	84,383	6,025	100.00 %	7.14 %

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Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Harmony	84	543	86,773	543	100.00 %	0.63 %
Harrells	4	160	83,095	0	0.00 %	0.00 %
	22	160	88,642	160	100.00 %	0.18 %
Harrellsville	5	85	82,953	85	100.00 %	0.10 %
Harrisburg	73	18,967	90,649	18,967	100.00 %	20.92 %
Hassell	23	49	88,865	49	100.00 %	0.06 %
Havelock	3	16,621	85,099	5,986	36.01 %	7.03 %
	13	16,621	83,307	10,635	63.99 %	12.77 %
Haw River	63	2,252	86,399	2,252	100.00 %	2.61 %
Hayesville	120	461	84,907	461	100.00 %	0.54 %
Hemby Bridge	69	1,614	85,179	1,614	100.00 %	1.89 %
Henderson	32	15,060	88,633	15,060	100.00 %	16.99 %
Hendersonville	113	15,137	89,058	623	4.12 %	0.70 %
	117	15,137	91,035	14,514	95.88 %	15.94 %
Hertford	1	1,934	84,330	1,934	100.00 %	2.29 %
Hickory	86	43,490	87,570	79	0.18 %	0.09 %
	87	43,490	85,758	32	0.07 %	0.04 %
	89	43,490	85,577	0	0.00 %	0.00 %
	96	43,490	89,587	43,379	99.74 %	48.42 %
Highlands	119	1,072	90,212	12	1.12 %	0.01 %
	120	1,072	84,907	1,060	98.88 %	1.25 %
High Point	60	114,059	89,735	66,033	57.89 %	73.59 %
	62	114,059	89,579	41,288	36.20 %	46.09 %
	70	114,059	89,118	8	0.01 %	0.01 %
	75	114,059	84,220	84	0.07 %	0.10 %
	80	114,059	84,864	6,646	5.83 %	7.83 %
High Shoals	110	595	88,397	595	100.00 %	0.67 %
Hildebran	86	1,679	87,570	1,679	100.00 %	1.92 %
Hillsborough	50	9,660	85,345	9,660	100.00 %	11.32 %
Hobgood	27	268	84,735	268	100.00 %	0.32 %
Hoffman	52	418	84,383	418	100.00 %	0.50 %
Holden Beach	17	921	89,763	0	0.00 %	0.00 %
	19	921	91,041	921	100.00 %	1.01 %
Holly Ridge	15	4,171	87,578	4,171	100.00 %	4.76 %
Holly Springs	21	41,239	86,179	11,892	28.84 %	13.80 %
	36	41,239	90,166	17,734	43.00 %	19.67 %
	37	41,239	90,867	11,613	28.16 %	12.78 %
Hookerton	12	413	84,745	413	100.00 %	0.49 %
Hope Mills	43	17,808	82,956	64	0.36 %	0.08 %
	45	17,808	82,938	17,744	99.64 %	21.39 %
Hot Springs	118	520	83,282	520	100.00 %	0.62 %
Hudson	87	3,780	85,758	3,780	100.00 %	4.41 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Huntersville	98	61,376	86,827	38,677	63.02 %	44.54 %
	101	61,376	86,426	5,893	9.60 %	6.82 %
	107	61,376	88,237	16,806	27.38 %	19.05 %
Indian Beach	13	223	83,307	223	100.00 %	0.27 %
Indian Trail	55	39,997	87,005	2,376	5.94 %	2.73 %
	68	39,997	88,138	15,036	37.59 %	17.06 %
	69	39,997	85,179	22,585	56.47 %	26.51 %
Jackson	27	430	84,735	430	100.00 %	0.51 %
Jacksonville	14	72,723	86,538	28,456	39.13 %	32.88 %
	15	72,723	87,578	44,267	60.87 %	50.55 %
Jamestown	60	3,668	89,735	3,668	100.00 %	4.09 %
Jamesville	23	424	88,865	424	100.00 %	0.48 %
Jefferson	93	1,622	86,445	1,622	100.00 %	1.88 %
Jonesville	77	2,308	90,628	2,308	100.00 %	2.55 %
Kannapolis	82	53,114	90,771	33,907	63.84 %	37.35 %
	83	53,114	90,742	19,207	36.16 %	21.17 %
Kelford	23	203	88,865	203	100.00 %	0.23 %
Kenansville	4	770	83,095	770	100.00 %	0.93 %
Kenly	24	1,491	87,220	198	13.28 %	0.23 %
	28	1,491	85,389	1,293	86.72 %	1.51 %
Kernersville	62	26,449	89,579	502	1.90 %	0.56 %
	71	26,449	84,874	0	0.00 %	0.00 %
	75	26,449	84,220	25,947	98.10 %	30.81 %
Kill Devil Hills	1	7,656	84,330	7,118	92.97 %	8.44 %
	79	7,656	83,163	538	7.03 %	0.65 %
King	91	7,197	86,210	7,197	100.00 %	8.35 %
Kings Mountain	110	11,142	88,397	1,118	10.03 %	1.26 %
	111	11,142	89,894	10,024	89.97 %	11.15 %
Kingstown	110	656	88,397	656	100.00 %	0.74 %
Kinston	12	19,900	84,745	19,900	100.00 %	23.48 %
Kittrell	32	132	88,633	132	100.00 %	0.15 %
Kitty Hawk	1	3,689	84,330	3,689	100.00 %	4.37 %
Knightdale	38	19,435	88,226	0	0.00 %	0.00 %
	39	19,435	90,164	19,435	100.00 %	21.56 %
Kure Beach	19	2,191	91,041	2,191	100.00 %	2.41 %
La Grange	12	2,595	84,745	2,595	100.00 %	3.06 %
Lake Lure	113	1,365	89,058	1,365	100.00 %	1.53 %
Lake Park	69	3,269	85,179	3,269	100.00 %	3.84 %
Lake Santeetlah	120	38	84,907	38	100.00 %	0.04 %
Lake Waccamaw	46	1,296	83,445	1,296	100.00 %	1.55 %
Landis	83	3,690	90,742	3,690	100.00 %	4.07 %
Lansing	93	126	86,445	126	100.00 %	0.15 %

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Municipality - District Report

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Lasker	27	64	84,735	64	100.00 %	0.08 %
Lattimore	111	406	89,894	406	100.00 %	0.45 %
Laurel Park	113	2,250	89,058	0	0.00 %	0.00 %
	117	2,250	91,035	2,250	100.00 %	2.47 %
Laurinburg	48	14,978	86,256	14,978	100.00 %	17.36 %
Lawndale	110	570	88,397	570	100.00 %	0.64 %
Leggett	23	37	88,865	37	100.00 %	0.04 %
Leland	17	22,908	89,763	22,908	100.00 %	25.52 %
Lenoir	87	18,352	85,758	18,352	100.00 %	21.40 %
Lewiston Woodville	23	426	88,865	426	100.00 %	0.48 %
Lewisville	74	13,381	84,857	13,381	100.00 %	15.77 %
Lexington	80	19,632	84,864	0	0.00 %	0.00 %
	81	19,632	84,066	19,632	100.00 %	23.35 %
Liberty	54	2,655	83,475	2,655	100.00 %	3.18 %
Lilesville	55	395	87,005	395	100.00 %	0.45 %
Lillington	6	4,735	87,332	882	18.63 %	1.01 %
	53	4,735	86,899	3,853	81.37 %	4.43 %
Lincolnton	97	11,091	86,810	11,091	100.00 %	12.78 %
Linden	43	136	82,956	136	100.00 %	0.16 %
Littleton	27	559	84,735	559	100.00 %	0.66 %
Locust	67	4,537	88,255	3,996	88.08 %	4.53 %
	73	4,537	90,649	541	11.92 %	0.60 %
Long View	86	5,088	87,570	735	14.45 %	0.84 %
	96	5,088	89,587	4,353	85.55 %	4.86 %
Louisburg	7	3,064	83,510	3,064	100.00 %	3.67 %
Love Valley	84	154	86,773	154	100.00 %	0.18 %
Lowell	108	3,654	86,263	3,654	100.00 %	4.24 %
	109	3,654	87,762	0	0.00 %	0.00 %
Lucama	24	1,036	87,220	1,036	100.00 %	1.19 %
Lumber Bridge	47	82	83,708	82	100.00 %	0.10 %
Lumberton	46	19,025	83,445	350	1.84 %	0.42 %
	47	19,025	83,708	18,675	98.16 %	22.31 %
McAdenville	108	890	86,263	890	100.00 %	1.03 %
Macclesfield	23	413	88,865	413	100.00 %	0.46 %
McDonald	46	94	83,445	94	100.00 %	0.11 %
McFarlan	55	94	87,005	94	100.00 %	0.11 %
Macon	27	110	84,735	110	100.00 %	0.13 %
Madison	65	2,129	91,096	2,129	100.00 %	2.34 %
Maggie Valley	118	1,687	83,282	1,687	100.00 %	2.03 %
Magnolia	4	831	83,095	831	100.00 %	1.00 %
Maiden	89	3,736	85,577	3,736	100.00 %	4.37 %
	97	3,736	86,810	0	0.00 %	0.00 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Municipalities derive from the 2020 Census Redistricting Data (P.L. 94-171) Shapefiles. Population figures are based on the associated Summary File.
[G20-MuniDist] - Generated 11/4/2021

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Manteo	79	1,600	83,163	1,600	100.00 %	1.92 %
Marietta	46	111	83,445	111	100.00 %	0.13 %
Marion	85	7,717	90,863	7,717	100.00 %	8.49 %
Marshall	118	777	83,282	777	100.00 %	0.93 %
Mars Hill	118	2,007	83,282	2,007	100.00 %	2.41 %
Marshville	55	2,522	87,005	2,522	100.00 %	2.90 %
Marvin	68	6,358	88,138	6,358	100.00 %	7.21 %
Matthews	103	29,435	87,132	29,435	100.00 %	33.78 %
Maxton	46	2,110	83,445	1,902	90.14 %	2.28 %
	48	2,110	86,256	208	9.86 %	0.24 %
Mayodan	65	2,418	91,096	2,418	100.00 %	2.65 %
Maysville	12	818	84,745	818	100.00 %	0.97 %
Mebane	50	17,797	85,345	3,171	17.82 %	3.72 %
	63	17,797	86,399	14,626	82.18 %	16.93 %
Mesic	79	144	83,163	144	100.00 %	0.17 %
Micro	28	458	85,389	458	100.00 %	0.54 %
Middleburg	32	101	88,633	101	100.00 %	0.11 %
Middlesex	24	912	87,220	912	100.00 %	1.05 %
Midland	73	4,684	90,649	4,684	100.00 %	5.17 %
	103	4,684	87,132	0	0.00 %	0.00 %
Midway	80	4,742	84,864	3,469	73.15 %	4.09 %
	81	4,742	84,066	1,273	26.85 %	1.51 %
Mills River	117	7,078	91,035	7,078	100.00 %	7.78 %
Milton	50	155	85,345	155	100.00 %	0.18 %
Mineral Springs	55	3,159	87,005	2,293	72.59 %	2.64 %
	68	3,159	88,138	866	27.41 %	0.98 %
Minnesott Beach	79	530	83,163	530	100.00 %	0.64 %
Mint Hill	69	26,450	85,179	6	0.02 %	0.01 %
	99	26,450	87,647	0	0.00 %	0.00 %
	103	26,450	87,132	26,444	99.98 %	30.35 %
Misenheimer	67	650	88,255	650	100.00 %	0.74 %
Mocksville	77	5,900	90,628	5,900	100.00 %	6.51 %
Momeyer	25	277	86,534	277	100.00 %	0.32 %
Monroe	55	34,562	87,005	12,650	36.60 %	14.54 %
	69	34,562	85,179	21,912	63.40 %	25.72 %
Montreat	115	901	90,262	901	100.00 %	1.00 %
Mooresboro	111	293	89,894	293	100.00 %	0.33 %
Mooresville	84	50,193	86,773	205	0.41 %	0.24 %
	95	50,193	85,366	49,988	99.59 %	58.56 %
Morehead City	13	9,556	83,307	9,556	100.00 %	11.47 %
Morganton	86	17,474	87,570	17,474	100.00 %	19.95 %

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Morrisville	11	29,630	86,298	0	0.00 %	0.00 %
	31	29,630	90,760	207	0.70 %	0.23 %
	41	29,630	89,887	14,239	48.06 %	15.84 %
	49	29,630	86,157	15,184	51.25 %	17.62 %
Morven	55	329	87,005	329	100.00 %	0.38 %
Mount Airy	90	10,676	82,937	10,676	100.00 %	12.87 %
Mount Gilead	67	1,171	88,255	1,171	100.00 %	1.33 %
Mount Holly	108	17,703	86,263	17,703	100.00 %	20.52 %
Mount Olive	4	4,198	83,095	4,198	100.00 %	5.05 %
Mount Pleasant	73	1,671	90,649	1,671	100.00 %	1.84 %
Murfreesboro	5	2,619	82,953	2,619	100.00 %	3.16 %
Murphy	120	1,608	84,907	1,608	100.00 %	1.89 %
Nags Head	79	3,168	83,163	3,168	100.00 %	3.81 %
Nashville	25	5,632	86,534	5,632	100.00 %	6.51 %
Navassa	17	1,367	89,763	1,367	100.00 %	1.52 %
New Bern	3	31,291	85,099	31,291	100.00 %	36.77 %
Newland	85	715	90,863	715	100.00 %	0.79 %
New London	67	607	88,255	607	100.00 %	0.69 %
Newport	13	4,364	83,307	4,364	100.00 %	5.24 %
Newton	89	13,148	85,577	13,148	100.00 %	15.36 %
	96	13,148	89,587	0	0.00 %	0.00 %
Newton Grove	22	585	88,642	585	100.00 %	0.66 %
Norlina	27	920	84,735	920	100.00 %	1.09 %
Norman	52	100	84,383	100	100.00 %	0.12 %
North Topsail Beach	15	1,005	87,578	1,005	100.00 %	1.15 %
Northwest	17	703	89,763	703	100.00 %	0.78 %
North Wilkesboro	94	4,382	90,835	4,382	100.00 %	4.82 %
Norwood	67	2,367	88,255	2,367	100.00 %	2.68 %
Oakboro	67	2,128	88,255	2,128	100.00 %	2.41 %
Oak City	23	266	88,865	266	100.00 %	0.30 %
Oak Island	19	8,396	91,041	8,396	100.00 %	9.22 %
Oak Ridge	62	7,474	89,579	7,474	100.00 %	8.34 %
Ocean Isle Beach	17	867	89,763	867	100.00 %	0.97 %
Old Fort	85	811	90,863	811	100.00 %	0.89 %
Oriental	79	880	83,163	880	100.00 %	1.06 %
Orrum	46	59	83,445	59	100.00 %	0.07 %
Ossipee	64	536	85,016	536	100.00 %	0.63 %
Oxford	32	8,628	88,633	8,628	100.00 %	9.73 %
Pantego	79	164	83,163	164	100.00 %	0.20 %
Parkton	47	504	83,708	504	100.00 %	0.60 %
Parmele	23	243	88,865	243	100.00 %	0.27 %
Patterson Springs	111	571	89,894	571	100.00 %	0.64 %

PEGDEN 5

NC General Assembly

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Peachland	55	390	87,005	390	100.00 %	0.45 %
Peletier	13	769	83,307	769	100.00 %	0.92 %
Pembroke	47	2,823	83,708	2,823	100.00 %	3.37 %
Pikeville	10	712	82,953	712	100.00 %	0.86 %
Pilot Mountain	90	1,440	82,937	1,440	100.00 %	1.74 %
Pinebluff	52	1,473	84,383	1,473	100.00 %	1.75 %
Pinehurst	52	17,581	84,383	8	0.05 %	0.01 %
	78	17,581	86,365	17,573	99.95 %	20.35 %
Pine Knoll Shores	13	1,388	83,307	1,388	100.00 %	1.67 %
Pine Level	28	2,046	85,389	2,046	100.00 %	2.40 %
Pinetops	23	1,200	88,865	1,200	100.00 %	1.35 %
Pineville	105	10,602	85,822	10,602	100.00 %	12.35 %
	112	10,602	82,806	0	0.00 %	0.00 %
Pink Hill	12	451	84,745	451	100.00 %	0.53 %
Pittsboro	54	4,537	83,475	4,537	100.00 %	5.44 %
Pleasant Garden	59	5,000	90,361	5,000	100.00 %	5.53 %
Plymouth	1	3,320	84,330	3,320	100.00 %	3.94 %
Polkton	55	2,250	87,005	2,250	100.00 %	2.59 %
Polkville	110	516	88,397	516	100.00 %	0.58 %
Pollocksville	12	268	84,745	268	100.00 %	0.32 %
Powellsville	23	189	88,865	189	100.00 %	0.21 %
Princeton	28	1,315	85,389	1,315	100.00 %	1.54 %
Princeville	23	1,254	88,865	1,254	100.00 %	1.41 %
Proctorville	46	121	83,445	121	100.00 %	0.15 %
Raeford	48	4,559	86,256	4,559	100.00 %	5.29 %
Raleigh	2	467,665	90,793	1,326	0.28 %	1.46 %
	11	467,665	86,298	40,792	8.72 %	47.27 %
	21	467,665	86,179	13	0.00 %	0.02 %
	31	467,665	90,760	233	0.05 %	0.26 %
	33	467,665	83,049	82,480	17.64 %	99.31 %
	34	467,665	83,679	83,503	17.86 %	99.79 %
	35	467,665	88,374	6,171	1.32 %	6.98 %
	38	467,665	88,226	56,840	12.15 %	64.43 %
	39	467,665	90,164	13,011	2.78 %	14.43 %
	40	467,665	83,175	57,345	12.26 %	68.94 %
	49	467,665	86,157	47,783	10.22 %	55.46 %
	66	467,665	83,189	78,168	16.71 %	93.96 %
Ramseur	78	1,774	86,365	1,774	100.00 %	2.05 %
Randleman	70	4,595	89,118	4,595	100.00 %	5.16 %
Ranlo	108	4,511	86,263	4,500	99.76 %	5.22 %
	110	4,511	88,397	11	0.24 %	0.01 %
Raynham	46	60	83,445	60	100.00 %	0.07 %

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Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Red Cross	67	762	88,255	762	100.00 %	0.86 %
Red Oak	25	3,342	86,534	3,342	100.00 %	3.86 %
Red Springs	47	3,087	83,708	3,087	100.00 %	3.69 %
	48	3,087	86,256	0	0.00 %	0.00 %
Reidsville	65	14,583	91,096	14,583	100.00 %	16.01 %
Rennert	47	275	83,708	275	100.00 %	0.33 %
Rhodhiss	86	997	87,570	639	64.09 %	0.73 %
	87	997	85,758	358	35.91 %	0.42 %
Richfield	67	582	88,255	582	100.00 %	0.66 %
Richlands	16	2,287	90,663	2,287	100.00 %	2.52 %
Rich Square	27	894	84,735	894	100.00 %	1.06 %
River Bend	3	2,902	85,099	2,902	100.00 %	3.41 %
Roanoke Rapids	27	15,229	84,735	15,229	100.00 %	17.97 %
Robbins	78	1,168	86,365	1,168	100.00 %	1.35 %
Robbinsville	120	597	84,907	597	100.00 %	0.70 %
Robersonville	23	1,269	88,865	1,269	100.00 %	1.43 %
Rockingham	52	9,243	84,383	9,243	100.00 %	10.95 %
Rockwell	76	2,302	89,815	2,302	100.00 %	2.56 %
Rocky Mount	23	54,341	88,865	15,414	28.37 %	17.35 %
	25	54,341	86,534	38,927	71.63 %	44.98 %
Rolesville	35	9,475	88,374	9,467	99.92 %	10.71 %
	39	9,475	90,164	8	0.08 %	0.01 %
Ronda	90	438	82,937	438	100.00 %	0.53 %
Roper	1	485	84,330	485	100.00 %	0.58 %
Roseboro	22	1,163	88,642	1,163	100.00 %	1.31 %
Rose Hill	4	1,371	83,095	1,371	100.00 %	1.65 %
Rosman	119	701	90,212	701	100.00 %	0.78 %
Rowland	46	885	83,445	885	100.00 %	1.06 %
Roxboro	2	8,134	90,793	8,134	100.00 %	8.96 %
Roxobel	23	187	88,865	187	100.00 %	0.21 %
Rural Hall	91	3,351	86,210	3,351	100.00 %	3.89 %
Ruth	113	347	89,058	347	100.00 %	0.39 %
Rutherford College	86	1,226	87,570	1,226	100.00 %	1.40 %
	87	1,226	85,758	0	0.00 %	0.00 %
Rutherfordton	113	3,640	89,058	3,640	100.00 %	4.09 %
St. Helena	16	417	90,663	417	100.00 %	0.46 %
St. James	19	6,529	91,041	6,529	100.00 %	7.17 %
St. Pauls	47	2,045	83,708	2,045	100.00 %	2.44 %
Salemburg	22	457	88,642	457	100.00 %	0.52 %
Salisbury	76	35,540	89,815	35,540	100.00 %	39.57 %
Saluda	113	631	89,058	631	100.00 %	0.71 %
Sandy Creek	17	248	89,763	248	100.00 %	0.28 %

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NC General Assembly

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Sandyfield	46	430	83,445	430	100.00 %	0.52 %
Sanford	51	30,261	83,073	30,261	100.00 %	36.43 %
Saratoga	24	353	87,220	353	100.00 %	0.40 %
Sawmills	87	5,020	85,758	5,020	100.00 %	5.85 %
Scotland Neck	27	1,640	84,735	1,640	100.00 %	1.94 %
Seaboard	27	542	84,735	542	100.00 %	0.64 %
Seagrove	78	235	86,365	235	100.00 %	0.27 %
Sedalia	59	676	90,361	676	100.00 %	0.75 %
Selma	28	6,317	85,389	6,317	100.00 %	7.40 %
Seven Devils	85	313	90,863	38	12.14 %	0.04 %
	93	313	86,445	275	87.86 %	0.32 %
Seven Springs	4	55	83,095	55	100.00 %	0.07 %
Severn	27	191	84,735	191	100.00 %	0.23 %
Shallotte	17	4,185	89,763	4,185	100.00 %	4.66 %
Sharpsburg	23	1,697	88,865	215	12.67 %	0.24 %
	24	1,697	87,220	421	24.81 %	0.48 %
	25	1,697	86,534	1,061	62.52 %	1.23 %
Shelby	110	21,918	88,397	4,409	20.12 %	4.99 %
	111	21,918	89,894	17,509	79.88 %	19.48 %
Siler City	54	7,702	83,475	7,702	100.00 %	9.23 %
Simpson	9	390	84,450	390	100.00 %	0.46 %
Sims	24	275	87,220	275	100.00 %	0.32 %
Smithfield	28	11,292	85,389	11,292	100.00 %	13.22 %
Snow Hill	12	1,481	84,745	1,481	100.00 %	1.75 %
Southern Pines	52	15,545	84,383	15,545	100.00 %	18.42 %
	78	15,545	86,365	0	0.00 %	0.00 %
Southern Shores	1	3,090	84,330	3,090	100.00 %	3.66 %
Southport	19	3,971	91,041	3,971	100.00 %	4.36 %
Sparta	93	1,834	86,445	1,834	100.00 %	2.12 %
Speed	23	63	88,865	63	100.00 %	0.07 %
Spencer	76	3,308	89,815	3,308	100.00 %	3.68 %
Spencer Mountain	108	0	86,263	0	0.00 %	0.00 %
Spindale	113	4,225	89,058	4,225	100.00 %	4.74 %
Spring Hope	25	1,309	86,534	1,309	100.00 %	1.51 %
Spring Lake	42	11,660	85,537	11,660	100.00 %	13.63 %
Spruce Pine	85	2,194	90,863	2,194	100.00 %	2.41 %
Staley	54	397	83,475	397	100.00 %	0.48 %
Stallings	68	16,112	88,138	0	0.00 %	0.00 %
	69	16,112	85,179	15,728	97.62 %	18.46 %
	103	16,112	87,132	384	2.38 %	0.44 %
Stanfield	67	1,585	88,255	1,585	100.00 %	1.80 %
Stanley	108	3,963	86,263	3,963	100.00 %	4.59 %

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NC General Assembly

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Stantonsburg	24	762	87,220	762	100.00 %	0.87 %
Star	67	806	88,255	806	100.00 %	0.91 %
Statesville	84	28,419	86,773	28,415	99.99 %	32.75 %
	89	28,419	85,577	4	0.01 %	0.00 %
Stedman	43	1,277	82,956	1,277	100.00 %	1.54 %
Stem	32	960	88,633	960	100.00 %	1.08 %
Stokesdale	62	5,924	89,579	5,924	100.00 %	6.61 %
Stoneville	65	1,308	91,096	1,308	100.00 %	1.44 %
Stonewall	79	214	83,163	214	100.00 %	0.26 %
Stovall	32	324	88,633	324	100.00 %	0.37 %
Sugar Mountain	85	371	90,863	371	100.00 %	0.41 %
Summerfield	57	10,951	90,615	746	6.81 %	0.82 %
	59	10,951	90,361	2,509	22.91 %	2.78 %
	62	10,951	89,579	7,696	70.28 %	8.59 %
Sunset Beach	17	4,175	89,763	4,175	100.00 %	4.65 %
Surf City	15	3,867	87,578	334	8.64 %	0.38 %
	16	3,867	90,663	3,533	91.36 %	3.90 %
Swansboro	14	3,744	86,538	3,744	100.00 %	4.33 %
Swepsonville	63	2,445	86,399	2,445	100.00 %	2.83 %
Sylva	119	2,578	90,212	2,578	100.00 %	2.86 %
Tabor City	46	3,781	83,445	3,781	100.00 %	4.53 %
Tarboro	23	10,721	88,865	10,721	100.00 %	12.06 %
Tar Heel	22	90	88,642	90	100.00 %	0.10 %
Taylorsville	94	2,320	90,835	2,320	100.00 %	2.55 %
Taylortown	52	634	84,383	4	0.63 %	0.00 %
	78	634	86,365	630	99.37 %	0.73 %
Teachey	4	448	83,095	448	100.00 %	0.54 %
Thomasville	70	27,183	89,118	521	1.92 %	0.58 %
	80	27,183	84,864	26,662	98.08 %	31.42 %
Tobaccoville	74	2,578	84,857	824	31.96 %	0.97 %
	91	2,578	86,210	1,754	68.04 %	2.03 %
Topsail Beach	16	461	90,663	461	100.00 %	0.51 %
Trenton	12	238	84,745	238	100.00 %	0.28 %
Trent Woods	3	4,074	85,099	4,074	100.00 %	4.79 %
Trinity	70	7,006	89,118	7,006	100.00 %	7.86 %
Troutman	84	3,698	86,773	885	23.93 %	1.02 %
	89	3,698	85,577	2,813	76.07 %	3.29 %
Troy	67	2,850	88,255	2,850	100.00 %	3.23 %
Tryon	113	1,562	89,058	1,562	100.00 %	1.75 %
Turkey	22	213	88,642	213	100.00 %	0.24 %
Unionville	69	6,643	85,179	6,643	100.00 %	7.80 %
Valdese	86	4,689	87,570	4,689	100.00 %	5.35 %

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Vanceboro	3	869	85,099	869	100.00 %	1.02 %
Vandemere	79	246	83,163	246	100.00 %	0.30 %
Varnamtown	19	525	91,041	525	100.00 %	0.58 %
Vass	51	952	83,073	952	100.00 %	1.15 %
Waco	110	310	88,397	310	100.00 %	0.35 %
Wade	43	638	82,956	638	100.00 %	0.77 %
Wadesboro	55	5,008	87,005	5,008	100.00 %	5.76 %
Wagram	48	615	86,256	615	100.00 %	0.71 %
Wake Forest	7	47,601	83,510	1,504	3.16 %	1.80 %
	35	47,601	88,374	46,097	96.84 %	52.16 %
	66	47,601	83,189	0	0.00 %	0.00 %
Walkertown	71	5,692	84,874	3,176	55.80 %	3.74 %
	75	5,692	84,220	2,516	44.20 %	2.99 %
Wallace	4	3,413	83,095	3,413	100.00 %	4.11 %
	16	3,413	90,663	0	0.00 %	0.00 %
Wallburg	80	3,051	84,864	3,051	100.00 %	3.60 %
Walnut Cove	91	1,586	86,210	1,586	100.00 %	1.84 %
Walnut Creek	4	1,084	83,095	1,084	100.00 %	1.30 %
Walstonburg	12	193	84,745	193	100.00 %	0.23 %
Warrenton	27	851	84,735	851	100.00 %	1.00 %
Warsaw	4	2,733	83,095	2,733	100.00 %	3.29 %
Washington	79	9,875	83,163	9,875	100.00 %	11.87 %
Washington Park	79	392	83,163	392	100.00 %	0.47 %
Watha	16	181	90,663	181	100.00 %	0.20 %
Waxhaw	55	20,534	87,005	0	0.00 %	0.00 %
	68	20,534	88,138	20,534	100.00 %	23.30 %
Waynesville	118	10,140	83,282	10,140	100.00 %	12.18 %
Weaverville	114	4,567	89,685	4,567	100.00 %	5.09 %
Webster	119	372	90,212	372	100.00 %	0.41 %
Weddington	68	13,181	88,138	13,172	99.93 %	14.94 %
	69	13,181	85,179	4	0.03 %	0.00 %
	103	13,181	87,132	5	0.04 %	0.01 %
Weldon	27	1,444	84,735	1,444	100.00 %	1.70 %
Wendell	39	9,793	90,164	9,793	100.00 %	10.86 %
Wentworth	65	2,662	91,096	2,662	100.00 %	2.92 %
Wesley Chapel	55	8,681	87,005	3,868	44.56 %	4.45 %
	68	8,681	88,138	4,813	55.44 %	5.46 %
West Jefferson	93	1,279	86,445	1,279	100.00 %	1.48 %
Whispering Pines	52	4,987	84,383	4,987	100.00 %	5.91 %
Whitakers	23	627	88,865	290	46.25 %	0.33 %
	25	627	86,534	337	53.75 %	0.39 %
White Lake	22	843	88,642	843	100.00 %	0.95 %

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NC General Assembly

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Whiteville	46	4,766	83,445	4,766	100.00 %	5.71 %
Whitsett	59	584	90,361	584	100.00 %	0.65 %
Wilkesboro	94	3,687	90,835	3,687	100.00 %	4.06 %
Williamston	23	5,248	88,865	5,248	100.00 %	5.91 %
Wilmington	18	115,451	91,245	48,680	42.17 %	53.35 %
	19	115,451	91,041	8,207	7.11 %	9.01 %
	20	115,451	90,346	58,564	50.73 %	64.82 %
Wilson	24	47,851	87,220	47,851	100.00 %	54.86 %
Wilson's Mills	26	2,534	89,947	0	0.00 %	0.00 %
	28	2,534	85,389	2,534	100.00 %	2.97 %
Windsor	23	3,582	88,865	3,582	100.00 %	4.03 %
Winfall	1	555	84,330	555	100.00 %	0.66 %
Wingate	55	4,055	87,005	4,055	100.00 %	4.66 %
Winston-Salem	71	249,545	84,874	77,631	31.11 %	91.47 %
	72	249,545	86,949	86,867	34.81 %	99.91 %
	74	249,545	84,857	32,409	12.99 %	38.19 %
	75	249,545	84,220	22,818	9.14 %	27.09 %
	91	249,545	86,210	29,820	11.95 %	34.59 %
Winterville	8	10,462	85,793	44	0.42 %	0.05 %
	9	10,462	84,450	10,418	99.58 %	12.34 %
Winton	5	629	82,953	629	100.00 %	0.76 %
Woodfin	114	7,936	89,685	7,648	96.37 %	8.53 %
	116	7,936	89,505	288	3.63 %	0.32 %
Woodland	27	557	84,735	557	100.00 %	0.66 %
Wrightsville Beach	20	2,473	90,346	2,473	100.00 %	2.74 %
Yadkinville	77	2,995	90,628	2,995	100.00 %	3.30 %
Yanceyville	50	1,937	85,345	1,937	100.00 %	2.27 %
Youngsville	7	2,016	83,510	2,016	100.00 %	2.41 %
Zebulon	26	6,903	89,947	0	0.00 %	0.00 %
	39	6,903	90,164	6,903	100.00 %	7.66 %
			Total:	**6,017,605**		

Number of split municipalities: 112

Display: all municipalities

PEGDEN 5

NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Aberdeen	52	8,516	84,383	8,516	100.00 %	10.09 %
	78	8,516	86,365	0	0.00 %	0.00 %
Ahoskie	5	4,891	82,953	4,891	100.00 %	5.90 %
Alamance	64	988	85,016	988	100.00 %	1.16 %
Albemarle	67	16,432	88,255	16,432	100.00 %	18.62 %
Alliance	79	733	83,163	733	100.00 %	0.88 %
Andrews	120	1,667	84,907	1,667	100.00 %	1.96 %
Angier (Harnett)	6	4,709	87,332	4,709	100.00 %	5.39 %
Angier (Wake)	37	556	90,867	556	100.00 %	0.61 %
Ansonville	55	440	87,005	440	100.00 %	0.51 %
Apex	11	58,780	86,298	0	0.00 %	0.00 %
	21	58,780	86,179	556	0.95 %	0.65 %
	36	58,780	90,166	57,843	98.41 %	64.15 %
	41	58,780	89,887	381	0.65 %	0.42 %
Arapahoe	79	416	83,163	416	100.00 %	0.50 %
Archdale (Guilford)	60	380	89,735	380	100.00 %	0.42 %
Archdale (Randolph)	70	11,527	89,118	11,527	100.00 %	12.93 %
Archer Lodge	26	4,797	89,947	4,797	100.00 %	5.33 %
Asheboro	70	27,156	89,118	25,890	95.34 %	29.05 %
	78	27,156	86,365	1,266	4.66 %	1.47 %
Asheville	114	94,589	89,685	52,596	55.60 %	58.65 %
	115	94,589	90,262	29,236	30.91 %	32.39 %
	116	94,589	89,505	12,757	13.49 %	14.25 %
Askewville	23	184	88,865	184	100.00 %	0.21 %
Atkinson	16	296	90,663	296	100.00 %	0.33 %
Atlantic Beach	13	1,364	83,307	1,364	100.00 %	1.64 %
Aulander	23	763	88,865	763	100.00 %	0.86 %
Aurora	79	455	83,163	455	100.00 %	0.55 %
Autryville	22	167	88,642	167	100.00 %	0.19 %
Ayden	9	4,977	84,450	4,977	100.00 %	5.89 %
Badin	67	2,024	88,255	2,024	100.00 %	2.29 %
Bailey	24	568	87,220	568	100.00 %	0.65 %
Bakersville	85	450	90,863	450	100.00 %	0.50 %
Bald Head Island	19	268	91,041	268	100.00 %	0.29 %
Banner Elk	85	1,049	90,863	1,049	100.00 %	1.15 %
Bath	79	245	83,163	245	100.00 %	0.29 %
Bayboro	79	1,161	83,163	1,161	100.00 %	1.40 %
Bear Grass	23	89	88,865	89	100.00 %	0.10 %
Beaufort	13	4,464	83,307	4,464	100.00 %	5.36 %
Beech Mountain (Avery)	85	62	90,863	62	100.00 %	0.07 %
Beech Mountain (Watauga)	93	613	86,445	613	100.00 %	0.71 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Belhaven	79	1,410	83,163	1,410	100.00 %	1.70 %
Belmont	108	15,010	86,263	1,868	12.45 %	2.17 %
	109	15,010	87,762	13,142	87.55 %	14.97 %
Belville	17	2,406	89,763	2,406	100.00 %	2.68 %
Belwood	110	857	88,397	857	100.00 %	0.97 %
Benson (Harnett)	53	0	86,899	0	0.00 %	0.00 %
Benson (Johnston)	28	3,967	85,389	3,967	100.00 %	4.65 %
Bermuda Run	77	3,120	90,628	3,120	100.00 %	3.44 %
Bessemer City	110	5,428	88,397	5,428	100.00 %	6.14 %
Bethania	74	344	84,857	0	0.00 %	0.00 %
	91	344	86,210	344	100.00 %	0.40 %
Bethel	8	1,373	85,793	1,373	100.00 %	1.60 %
Beulaville	4	1,116	83,095	1,116	100.00 %	1.34 %
Biltmore Forest	116	1,409	89,505	1,409	100.00 %	1.57 %
Biscoe	67	1,848	88,255	1,848	100.00 %	2.09 %
Black Creek	24	692	87,220	692	100.00 %	0.79 %
Black Mountain	115	8,426	90,262	8,426	100.00 %	9.34 %
Bladenboro	22	1,648	88,642	1,648	100.00 %	1.86 %
Blowing Rock (Caldwell)	87	91	85,758	91	100.00 %	0.11 %
Blowing Rock (Watauga)	87	1,285	85,758	5	0.39 %	0.01 %
	93	1,285	86,445	1,280	99.61 %	1.48 %
Boardman	46	166	83,445	166	100.00 %	0.20 %
Bogue	13	695	83,307	695	100.00 %	0.83 %
Boiling Spring Lakes	19	5,943	91,041	5,943	100.00 %	6.53 %
Boiling Springs	111	4,615	89,894	4,615	100.00 %	5.13 %
Bolivia	19	149	91,041	149	100.00 %	0.16 %
Bolton	46	519	83,445	519	100.00 %	0.62 %
Boone	87	19,092	85,758	595	3.12 %	0.69 %
	93	19,092	86,445	18,497	96.88 %	21.40 %
Boonville	77	1,185	90,628	1,185	100.00 %	1.31 %
Bostic	111	355	89,894	355	100.00 %	0.39 %
Brevard	119	7,744	90,212	7,744	100.00 %	8.58 %
Bridgeton	3	349	85,099	349	100.00 %	0.41 %
Broadway (Harnett)	6	0	87,332	0	0.00 %	0.00 %
Broadway (Lee)	51	1,267	83,073	1,267	100.00 %	1.53 %
Brookford	96	442	89,587	442	100.00 %	0.49 %
Brunswick	46	973	83,445	973	100.00 %	1.17 %
Bryson City	119	1,558	90,212	1,558	100.00 %	1.73 %
Bunn	7	327	83,510	327	100.00 %	0.39 %
Burgaw	16	3,088	90,663	3,088	100.00 %	3.41 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Burlington (Alamance)	63	55,481	86,399	25,917	46.71 %	30.00 %
	64	55,481	85,016	29,564	53.29 %	34.77 %
Burlington (Guilford)	59	1,822	90,361	1,822	100.00 %	2.02 %
Burnsville	85	1,614	90,863	1,614	100.00 %	1.78 %
Butner	32	8,397	88,633	8,397	100.00 %	9.47 %
Cajah's Mountain	87	2,722	85,758	2,722	100.00 %	3.17 %
Calabash	17	2,011	89,763	2,011	100.00 %	2.24 %
Calypso	4	327	83,095	327	100.00 %	0.39 %
Cameron	51	244	83,073	244	100.00 %	0.29 %
Candor (Montgomery)	67	813	88,255	813	100.00 %	0.92 %
Candor (Moore)	78	0	86,365	0	0.00 %	0.00 %
Canton	118	4,422	83,282	4,422	100.00 %	5.31 %
Cape Carteret	13	2,224	83,307	2,224	100.00 %	2.67 %
Carolina Beach	19	6,564	91,041	6,564	100.00 %	7.21 %
Carolina Shores	17	4,588	89,763	4,588	100.00 %	5.11 %
Carrboro	50	21,295	85,345	174	0.82 %	0.20 %
	56	21,295	86,087	21,121	99.18 %	24.53 %
Carthage	51	2,775	83,073	2,747	98.99 %	3.31 %
	52	2,775	84,383	28	1.01 %	0.03 %
Cary (Chatham)	54	3,709	83,475	3,709	100.00 %	4.44 %
Cary (Wake)	11	171,012	86,298	43,537	25.46 %	50.45 %
	21	171,012	86,179	30,622	17.91 %	35.53 %
	36	171,012	90,166	0	0.00 %	0.00 %
	37	171,012	90,867	2,012	1.18 %	2.21 %
	41	171,012	89,887	74,074	43.32 %	82.41 %
	49	171,012	86,157	20,767	12.14 %	24.10 %
Casar	110	305	88,397	305	100.00 %	0.35 %
Castalia	25	264	86,534	264	100.00 %	0.31 %
Caswell Beach	19	395	91,041	395	100.00 %	0.43 %
Catawba	89	702	85,577	702	100.00 %	0.82 %
Cedar Point	13	1,764	83,307	1,764	100.00 %	2.12 %
Cedar Rock	87	301	85,758	301	100.00 %	0.35 %
Cerro Gordo	46	131	83,445	131	100.00 %	0.16 %
Chadbourn	46	1,574	83,445	1,574	100.00 %	1.89 %
Chapel Hill (Durham)	29	2,906	91,212	2,906	100.00 %	3.19 %
Chapel Hill (Orange)	56	59,054	86,087	59,054	100.00 %	68.60 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Charlotte	88	874,579	82,834	82,834	9.47 %	100.00 %
	92	874,579	85,031	63,762	7.29 %	74.99 %
	99	874,579	87,647	79,113	9.05 %	90.26 %
	100	874,579	87,197	87,197	9.97 %	100.00 %
	101	874,579	86,426	64,526	7.38 %	74.66 %
	102	874,579	86,179	86,179	9.85 %	100.00 %
	103	874,579	87,132	23,590	2.70 %	27.07 %
	104	874,579	86,520	86,520	9.89 %	100.00 %
	105	874,579	85,822	71,156	8.14 %	82.91 %
	106	874,579	82,824	79,717	9.11 %	96.25 %
	107	874,579	88,237	67,298	7.69 %	76.27 %
	112	874,579	82,806	82,687	9.45 %	99.86 %
Cherryville	110	6,078	88,397	6,078	100.00 %	6.88 %
Chimney Rock Village	113	140	89,058	140	100.00 %	0.16 %
China Grove	83	4,434	90,742	4,434	100.00 %	4.89 %
Chocowinity	79	722	83,163	722	100.00 %	0.87 %
Claremont	89	1,692	85,577	1,692	100.00 %	1.98 %
Clarkton	22	614	88,642	614	100.00 %	0.69 %
Clayton (Johnston)	26	26,307	89,947	26,307	100.00 %	29.25 %
Clayton (Wake)	38	0	88,226	0	0.00 %	0.00 %
	39	0	90,164	0	0.00 %	0.00 %
Clemmons	74	21,163	84,857	21,163	100.00 %	24.94 %
Cleveland	77	846	90,628	846	100.00 %	0.93 %
Clinton	22	8,383	88,642	8,383	100.00 %	9.46 %
Clyde	118	1,368	83,282	1,368	100.00 %	1.64 %
Coats	53	2,155	86,899	2,155	100.00 %	2.48 %
Cofield	5	267	82,953	267	100.00 %	0.32 %
Colerain	23	217	88,865	217	100.00 %	0.24 %
Columbia	1	610	84,330	610	100.00 %	0.72 %
Columbus	113	1,060	89,058	1,060	100.00 %	1.19 %
Como	5	67	82,953	67	100.00 %	0.08 %
Concord	73	105,240	90,649	32,447	30.83 %	35.79 %
	82	105,240	90,771	48,723	46.30 %	53.68 %
	83	105,240	90,742	24,070	22.87 %	26.53 %
Conetoe	23	198	88,865	198	100.00 %	0.22 %
Connelly Springs	86	1,529	87,570	1,529	100.00 %	1.75 %
Conover	89	8,421	85,577	424	5.04 %	0.50 %
	96	8,421	89,587	7,997	94.96 %	8.93 %
Conway	27	752	84,735	752	100.00 %	0.89 %
Cooleemee	77	940	90,628	940	100.00 %	1.04 %
Cornelius	98	31,412	86,827	31,412	100.00 %	36.18 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Cove City	3	378	85,099	378	100.00 %	0.44 %
Cramerton	108	5,296	86,263	96	1.81 %	0.11 %
	109	5,296	87,762	5,200	98.19 %	5.93 %
Creedmoor	7	4,866	83,510	2,065	42.44 %	2.47 %
	32	4,866	88,633	2,801	57.56 %	3.16 %
Creswell	1	207	84,330	207	100.00 %	0.25 %
Crossnore	85	143	90,863	143	100.00 %	0.16 %
Dallas	110	5,927	88,397	5,927	100.00 %	6.70 %
Danbury	91	189	86,210	189	100.00 %	0.22 %
Davidson (Iredell)	95	378	85,366	378	100.00 %	0.44 %
Davidson (Mecklenburg)	98	14,728	86,827	14,728	100.00 %	16.96 %
Dellview	110	6	88,397	6	100.00 %	0.01 %
Denton	80	1,494	84,864	1,494	100.00 %	1.76 %
Dillsboro	119	213	90,212	213	100.00 %	0.24 %
Dobbins Heights	52	687	84,383	687	100.00 %	0.81 %
Dobson	90	1,462	82,937	1,462	100.00 %	1.76 %
Dortches	25	1,082	86,534	1,082	100.00 %	1.25 %
Dover	3	349	85,099	349	100.00 %	0.41 %
Drexel	86	1,760	87,570	1,760	100.00 %	2.01 %
Dublin	22	267	88,642	267	100.00 %	0.30 %
Duck	1	742	84,330	742	100.00 %	0.88 %
Dunn	53	8,446	86,899	8,446	100.00 %	9.72 %
Durham (Durham)	2	283,093	90,793	25,167	8.89 %	27.72 %
	29	283,093	91,212	87,035	30.74 %	95.42 %
	30	283,093	91,165	89,671	31.68 %	98.36 %
	31	283,093	90,760	81,220	28.69 %	89.49 %
Durham (Orange)	50	144	85,345	144	100.00 %	0.17 %
Durham (Wake)	40	269	83,175	269	100.00 %	0.32 %
	49	269	86,157	0	0.00 %	0.00 %
Earl	111	198	89,894	198	100.00 %	0.22 %
East Arcadia	22	418	88,642	418	100.00 %	0.47 %
East Bend	77	634	90,628	634	100.00 %	0.70 %
East Laurinburg	48	234	86,256	234	100.00 %	0.27 %
East Spencer	76	1,567	89,815	1,567	100.00 %	1.74 %
Eastover	43	3,656	82,956	3,656	100.00 %	4.41 %
Eden	65	15,421	91,096	15,421	100.00 %	16.93 %
Edenton	1	4,460	84,330	4,460	100.00 %	5.29 %
Elizabeth City (Camden)	5	38	82,953	38	100.00 %	0.05 %
Elizabeth City (Pasquotank)	5	18,593	82,953	18,593	100.00 %	22.41 %
Elizabethtown	22	3,296	88,642	3,296	100.00 %	3.72 %
Elk Park	85	542	90,863	542	100.00 %	0.60 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

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Elkin (Surry)	90	4,049	82,937	4,049	100.00 %	4.88 %
Elkin (Wilkes)	90	73	82,937	73	100.00 %	0.09 %
Ellenboro	111	723	89,894	723	100.00 %	0.80 %
Ellerbe	52	864	84,383	864	100.00 %	1.02 %
Elm City (Nash)	25	0	86,534	0	0.00 %	0.00 %
Elm City (Wilson)	24	1,218	87,220	1,218	100.00 %	1.40 %
Elon	64	11,336	85,016	11,336	100.00 %	13.33 %
Emerald Isle	13	3,847	83,307	3,847	100.00 %	4.62 %
Enfield	27	1,865	84,735	1,865	100.00 %	2.20 %
Erwin	53	4,542	86,899	4,542	100.00 %	5.23 %
Eureka	10	214	82,953	214	100.00 %	0.26 %
Everetts	23	150	88,865	150	100.00 %	0.17 %
Fair Bluff	46	709	83,445	709	100.00 %	0.85 %
Fairmont	46	2,191	83,445	2,191	100.00 %	2.63 %
	47	2,191	83,708	0	0.00 %	0.00 %
Fairview	69	3,456	85,179	3,456	100.00 %	4.06 %
Faison (Duplin)	4	784	83,095	784	100.00 %	0.94 %
Faison (Sampson)	22	0	88,642	0	0.00 %	0.00 %
Faith	76	819	89,815	819	100.00 %	0.91 %
Falcon (Cumberland)	43	324	82,956	324	100.00 %	0.39 %
Falcon (Sampson)	22	0	88,642	0	0.00 %	0.00 %
Falkland	8	47	85,793	47	100.00 %	0.05 %
Fallston	110	627	88,397	627	100.00 %	0.71 %
Farmville	8	4,461	85,793	4,461	100.00 %	5.20 %
Fayetteville	42	208,501	85,537	65,401	31.37 %	76.46 %
	43	208,501	82,956	44,532	21.36 %	53.68 %
	44	208,501	83,297	83,293	39.95 %	100.00 %
	45	208,501	82,938	15,275	7.33 %	18.42 %
Flat Rock	113	3,486	89,058	3,486	100.00 %	3.91 %
Fletcher	117	7,987	91,035	7,987	100.00 %	8.77 %
Fontana Dam	120	13	84,907	13	100.00 %	0.02 %
Forest City	111	7,377	89,894	0	0.00 %	0.00 %
	113	7,377	89,058	7,377	100.00 %	8.28 %
Forest Hills	119	303	90,212	303	100.00 %	0.34 %
Fountain	8	385	85,793	385	100.00 %	0.45 %
Four Oaks	28	2,158	85,389	2,158	100.00 %	2.53 %
Foxfire	52	1,288	84,383	0	0.00 %	0.00 %
	78	1,288	86,365	1,288	100.00 %	1.49 %
Franklin	120	4,175	84,907	4,175	100.00 %	4.92 %
Franklinton	7	2,456	83,510	2,456	100.00 %	2.94 %
Franklinville	78	1,197	86,365	1,197	100.00 %	1.39 %

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Fremont	10	1,196	82,953	1,196	100.00 %	1.44 %
Fuquay-Varina (Harnett)	6	0	87,332	0	0.00 %	0.00 %
Fuquay-Varina (Wake)	21	34,152	86,179	30	0.09 %	0.03 %
	36	34,152	90,166	16	0.05 %	0.02 %
	37	34,152	90,867	34,106	99.87 %	37.53 %
Gamewell	87	3,702	85,758	3,702	100.00 %	4.32 %
Garland	22	595	88,642	595	100.00 %	0.67 %
Garner	21	31,159	86,179	11,789	37.83 %	13.68 %
	33	31,159	83,049	14	0.04 %	0.02 %
	37	31,159	90,867	0	0.00 %	0.00 %
	38	31,159	88,226	19,356	62.12 %	21.94 %
Garysburg	27	904	84,735	904	100.00 %	1.07 %
Gaston	27	1,008	84,735	1,008	100.00 %	1.19 %
Gastonia	108	80,411	86,263	28,480	35.42 %	33.02 %
	109	80,411	87,762	44,448	55.28 %	50.65 %
	110	80,411	88,397	7,483	9.31 %	8.47 %
Gatesville	5	267	82,953	267	100.00 %	0.32 %
Gibson	48	449	86,256	449	100.00 %	0.52 %
Gibsonville (Alamance)	64	4,278	85,016	4,278	100.00 %	5.03 %
Gibsonville (Guilford)	59	4,642	90,361	4,642	100.00 %	5.14 %
Glen Alpine	86	1,529	87,570	1,529	100.00 %	1.75 %
Godwin	43	128	82,956	128	100.00 %	0.15 %
Goldsboro	4	33,657	83,095	5	0.01 %	0.01 %
	10	33,657	82,953	33,652	99.99 %	40.57 %
Goldston	54	234	83,475	234	100.00 %	0.28 %
Graham	63	17,157	86,399	17,157	100.00 %	19.86 %
Grandfather Village	85	95	90,863	95	100.00 %	0.10 %
Granite Falls	87	4,965	85,758	4,965	100.00 %	5.79 %
Granite Quarry	76	2,984	89,815	2,984	100.00 %	3.32 %
Grantsboro	79	692	83,163	692	100.00 %	0.83 %
Green Level	63	3,152	86,399	3,152	100.00 %	3.65 %
Greenevers	4	567	83,095	567	100.00 %	0.68 %
Greensboro	57	299,035	90,615	83,540	27.94 %	92.19 %
	58	299,035	90,808	84,725	28.33 %	93.30 %
	59	299,035	90,361	13,852	4.63 %	15.33 %
	60	299,035	89,735	8,829	2.95 %	9.84 %
	61	299,035	90,201	90,201	30.16 %	100.00 %
	62	299,035	89,579	17,888	5.98 %	19.97 %
Greenville	8	87,521	85,793	52,881	60.42 %	61.64 %
	9	87,521	84,450	34,640	39.58 %	41.02 %
Grifton (Lenoir)	12	147	84,745	147	100.00 %	0.17 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Grifton (Pitt)	9	2,301	84,450	2,301	100.00 %	2.72 %
Grimesland	9	386	84,450	386	100.00 %	0.46 %
Grover	111	802	89,894	802	100.00 %	0.89 %
Halifax	27	170	84,735	170	100.00 %	0.20 %
Hamilton	23	306	88,865	306	100.00 %	0.34 %
Hamlet	52	6,025	84,383	6,025	100.00 %	7.14 %
Harmony	84	543	86,773	543	100.00 %	0.63 %
Harrells (Duplin)	4	0	83,095	0	0.00 %	0.00 %
Harrells (Sampson)	22	160	88,642	160	100.00 %	0.18 %
Harrellsville	5	85	82,953	85	100.00 %	0.10 %
Harrisburg	73	18,967	90,649	18,967	100.00 %	20.92 %
Hassell	23	49	88,865	49	100.00 %	0.06 %
Havelock	3	16,621	85,099	5,986	36.01 %	7.03 %
	13	16,621	83,307	10,635	63.99 %	12.77 %
Haw River	63	2,252	86,399	2,252	100.00 %	2.61 %
Hayesville	120	461	84,907	461	100.00 %	0.54 %
Hemby Bridge	69	1,614	85,179	1,614	100.00 %	1.89 %
Henderson	32	15,060	88,633	15,060	100.00 %	16.99 %
Hendersonville	113	15,137	89,058	623	4.12 %	0.70 %
	117	15,137	91,035	14,514	95.88 %	15.94 %
Hertford	1	1,934	84,330	1,934	100.00 %	2.29 %
Hickory (Burke)	86	79	87,570	79	100.00 %	0.09 %
Hickory (Caldwell)	87	32	85,758	32	100.00 %	0.04 %
Hickory (Catawba)	89	43,379	85,577	0	0.00 %	0.00 %
	96	43,379	89,587	43,379	100.00 %	48.42 %
High Point (Davidson)	80	6,646	84,864	6,646	100.00 %	7.83 %
High Point (Forsyth)	75	84	84,220	84	100.00 %	0.10 %
High Point (Guilford)	60	107,321	89,735	66,033	61.53 %	73.59 %
	62	107,321	89,579	41,288	38.47 %	46.09 %
High Point (Randolph)	70	8	89,118	8	100.00 %	0.01 %
High Shoals	110	595	88,397	595	100.00 %	0.67 %
Highlands (Jackson)	119	12	90,212	12	100.00 %	0.01 %
Highlands (Macon)	120	1,060	84,907	1,060	100.00 %	1.25 %
Hildebran	86	1,679	87,570	1,679	100.00 %	1.92 %
Hillsborough	50	9,660	85,345	9,660	100.00 %	11.32 %
Hobgood	27	268	84,735	268	100.00 %	0.32 %
Hoffman	52	418	84,383	418	100.00 %	0.50 %
Holden Beach	17	921	89,763	0	0.00 %	0.00 %
	19	921	91,041	921	100.00 %	1.01 %
Holly Ridge	15	4,171	87,578	4,171	100.00 %	4.76 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Holly Springs	21	41,239	86,179	11,892	28.84 %	13.80 %
	36	41,239	90,166	17,734	43.00 %	19.67 %
	37	41,239	90,867	11,613	28.16 %	12.78 %
Hookerton	12	413	84,745	413	100.00 %	0.49 %
Hope Mills	43	17,808	82,956	64	0.36 %	0.08 %
	45	17,808	82,938	17,744	99.64 %	21.39 %
Hot Springs	118	520	83,282	520	100.00 %	0.62 %
Hudson	87	3,780	85,758	3,780	100.00 %	4.41 %
Huntersville	98	61,376	86,827	38,677	63.02 %	44.54 %
	101	61,376	86,426	5,893	9.60 %	6.82 %
	107	61,376	88,237	16,806	27.38 %	19.05 %
Indian Beach	13	223	83,307	223	100.00 %	0.27 %
Indian Trail	55	39,997	87,005	2,376	5.94 %	2.73 %
	68	39,997	88,138	15,036	37.59 %	17.06 %
	69	39,997	85,179	22,585	56.47 %	26.51 %
Jackson	27	430	84,735	430	100.00 %	0.51 %
Jacksonville	14	72,723	86,538	28,456	39.13 %	32.88 %
	15	72,723	87,578	44,267	60.87 %	50.55 %
Jamestown	60	3,668	89,735	3,668	100.00 %	4.09 %
Jamesville	23	424	88,865	424	100.00 %	0.48 %
Jefferson	93	1,622	86,445	1,622	100.00 %	1.88 %
Jonesville	77	2,308	90,628	2,308	100.00 %	2.55 %
Kannapolis (Cabarrus)	82	42,846	90,771	33,907	79.14 %	37.35 %
	83	42,846	90,742	8,939	20.86 %	9.85 %
Kannapolis (Rowan)	83	10,268	90,742	10,268	100.00 %	11.32 %
Kelford	23	203	88,865	203	100.00 %	0.23 %
Kenansville	4	770	83,095	770	100.00 %	0.93 %
Kenly (Johnston)	28	1,293	85,389	1,293	100.00 %	1.51 %
Kenly (Wilson)	24	198	87,220	198	100.00 %	0.23 %
Kernersville (Forsyth)	71	25,947	84,874	0	0.00 %	0.00 %
	75	25,947	84,220	25,947	100.00 %	30.81 %
Kernersville (Guilford)	62	502	89,579	502	100.00 %	0.56 %
Kill Devil Hills	1	7,656	84,330	7,118	92.97 %	8.44 %
	79	7,656	83,163	538	7.03 %	0.65 %
King (Forsyth)	91	591	86,210	591	100.00 %	0.69 %
King (Stokes)	91	6,606	86,210	6,606	100.00 %	7.66 %
Kings Mountain (Cleveland)	110	10,032	88,397	8	0.08 %	0.01 %
	111	10,032	89,894	10,024	99.92 %	11.15 %
Kings Mountain (Gaston)	110	1,110	88,397	1,110	100.00 %	1.26 %
Kingstown	110	656	88,397	656	100.00 %	0.74 %
Kinston	12	19,900	84,745	19,900	100.00 %	23.48 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Kittrell	32	132	88,633	132	100.00 %	0.15 %
Kitty Hawk	1	3,689	84,330	3,689	100.00 %	4.37 %
Knightdale	38	19,435	88,226	0	0.00 %	0.00 %
	39	19,435	90,164	19,435	100.00 %	21.56 %
Kure Beach	19	2,191	91,041	2,191	100.00 %	2.41 %
La Grange	12	2,595	84,745	2,595	100.00 %	3.06 %
Lake Lure	113	1,365	89,058	1,365	100.00 %	1.53 %
Lake Park	69	3,269	85,179	3,269	100.00 %	3.84 %
Lake Santeetlah	120	38	84,907	38	100.00 %	0.04 %
Lake Waccamaw	46	1,296	83,445	1,296	100.00 %	1.55 %
Landis	83	3,690	90,742	3,690	100.00 %	4.07 %
Lansing	93	126	86,445	126	100.00 %	0.15 %
Lasker	27	64	84,735	64	100.00 %	0.08 %
Lattimore	111	406	89,894	406	100.00 %	0.45 %
Laurel Park	113	2,250	89,058	0	0.00 %	0.00 %
	117	2,250	91,035	2,250	100.00 %	2.47 %
Laurinburg	48	14,978	86,256	14,978	100.00 %	17.36 %
Lawndale	110	570	88,397	570	100.00 %	0.64 %
Leggett	23	37	88,865	37	100.00 %	0.04 %
Leland	17	22,908	89,763	22,908	100.00 %	25.52 %
Lenoir	87	18,352	85,758	18,352	100.00 %	21.40 %
Lewiston Woodville	23	426	88,865	426	100.00 %	0.48 %
Lewisville	74	13,381	84,857	13,381	100.00 %	15.77 %
Lexington	80	19,632	84,864	0	0.00 %	0.00 %
	81	19,632	84,066	19,632	100.00 %	23.35 %
Liberty	54	2,655	83,475	2,655	100.00 %	3.18 %
Lilesville	55	395	87,005	395	100.00 %	0.45 %
Lillington	6	4,735	87,332	882	18.63 %	1.01 %
	53	4,735	86,899	3,853	81.37 %	4.43 %
Lincolnton	97	11,091	86,810	11,091	100.00 %	12.78 %
Linden	43	136	82,956	136	100.00 %	0.16 %
Littleton	27	559	84,735	559	100.00 %	0.66 %
Locust (Cabarrus)	73	541	90,649	541	100.00 %	0.60 %
Locust (Stanly)	67	3,996	88,255	3,996	100.00 %	4.53 %
Long View (Burke)	86	735	87,570	735	100.00 %	0.84 %
Long View (Catawba)	96	4,353	89,587	4,353	100.00 %	4.86 %
Louisburg	7	3,064	83,510	3,064	100.00 %	3.67 %
Love Valley	84	154	86,773	154	100.00 %	0.18 %
Lowell	108	3,654	86,263	3,654	100.00 %	4.24 %
	109	3,654	87,762	0	0.00 %	0.00 %
Lucama	24	1,036	87,220	1,036	100.00 %	1.19 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Lumber Bridge	47	82	83,708	82	100.00 %	0.10 %
Lumberton	46	19,025	83,445	350	1.84 %	0.42 %
	47	19,025	83,708	18,675	98.16 %	22.31 %
Macclesfield	23	413	88,865	413	100.00 %	0.46 %
Macon	27	110	84,735	110	100.00 %	0.13 %
Madison	65	2,129	91,096	2,129	100.00 %	2.34 %
Maggie Valley	118	1,687	83,282	1,687	100.00 %	2.03 %
Magnolia	4	831	83,095	831	100.00 %	1.00 %
Maiden (Catawba)	89	3,736	85,577	3,736	100.00 %	4.37 %
Maiden (Lincoln)	97	0	86,810	0	0.00 %	0.00 %
Manteo	79	1,600	83,163	1,600	100.00 %	1.92 %
Marietta	46	111	83,445	111	100.00 %	0.13 %
Marion	85	7,717	90,863	7,717	100.00 %	8.49 %
Mars Hill	118	2,007	83,282	2,007	100.00 %	2.41 %
Marshall	118	777	83,282	777	100.00 %	0.93 %
Marshville	55	2,522	87,005	2,522	100.00 %	2.90 %
Marvin	68	6,358	88,138	6,358	100.00 %	7.21 %
Matthews	103	29,435	87,132	29,435	100.00 %	33.78 %
Maxton (Robeson)	46	1,902	83,445	1,902	100.00 %	2.28 %
Maxton (Scotland)	48	208	86,256	208	100.00 %	0.24 %
Mayodan	65	2,418	91,096	2,418	100.00 %	2.65 %
Maysville	12	818	84,745	818	100.00 %	0.97 %
McAdenville	108	890	86,263	890	100.00 %	1.03 %
McDonald	46	94	83,445	94	100.00 %	0.11 %
McFarlan	55	94	87,005	94	100.00 %	0.11 %
Mebane (Alamance)	63	14,626	86,399	14,626	100.00 %	16.93 %
Mebane (Orange)	50	3,171	85,345	3,171	100.00 %	3.72 %
Mesic	79	144	83,163	144	100.00 %	0.17 %
Micro	28	458	85,389	458	100.00 %	0.54 %
Middleburg	32	101	88,633	101	100.00 %	0.11 %
Middlesex	24	912	87,220	912	100.00 %	1.05 %
Midland (Cabarrus)	73	4,684	90,649	4,684	100.00 %	5.17 %
Midland (Mecklenburg)	103	0	87,132	0	0.00 %	0.00 %
Midway	80	4,742	84,864	3,469	73.15 %	4.09 %
	81	4,742	84,066	1,273	26.85 %	1.51 %
Mills River	117	7,078	91,035	7,078	100.00 %	7.78 %
Milton	50	155	85,345	155	100.00 %	0.18 %
Mineral Springs	55	3,159	87,005	2,293	72.59 %	2.64 %
	68	3,159	88,138	866	27.41 %	0.98 %
Minnesott Beach	79	530	83,163	530	100.00 %	0.64 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Mint Hill (Mecklenburg)	99	26,444	87,647	0	0.00 %	0.00 %
	103	26,444	87,132	26,444	100.00 %	30.35 %
Mint Hill (Union)	69	6	85,179	6	100.00 %	0.01 %
Misenheimer	67	650	88,255	650	100.00 %	0.74 %
Mocksville	77	5,900	90,628	5,900	100.00 %	6.51 %
Momeyer	25	277	86,534	277	100.00 %	0.32 %
Monroe	55	34,562	87,005	12,650	36.60 %	14.54 %
	69	34,562	85,179	21,912	63.40 %	25.72 %
Montreat	115	901	90,262	901	100.00 %	1.00 %
Mooresboro	111	293	89,894	293	100.00 %	0.33 %
Mooresville	84	50,193	86,773	205	0.41 %	0.24 %
	95	50,193	85,366	49,988	99.59 %	58.56 %
Morehead City	13	9,556	83,307	9,556	100.00 %	11.47 %
Morganton	86	17,474	87,570	17,474	100.00 %	19.95 %
Morrisville (Durham)	31	207	90,760	207	100.00 %	0.23 %
Morrisville (Wake)	11	29,423	86,298	0	0.00 %	0.00 %
	41	29,423	89,887	14,239	48.39 %	15.84 %
	49	29,423	86,157	15,184	51.61 %	17.62 %
Morven	55	329	87,005	329	100.00 %	0.38 %
Mount Airy	90	10,676	82,937	10,676	100.00 %	12.87 %
Mount Gilead	67	1,171	88,255	1,171	100.00 %	1.33 %
Mount Holly	108	17,703	86,263	17,703	100.00 %	20.52 %
Mount Olive (Duplin)	4	5	83,095	5	100.00 %	0.01 %
Mount Olive (Wayne)	4	4,193	83,095	4,193	100.00 %	5.05 %
Mount Pleasant	73	1,671	90,649	1,671	100.00 %	1.84 %
Murfreesboro	5	2,619	82,953	2,619	100.00 %	3.16 %
Murphy	120	1,608	84,907	1,608	100.00 %	1.89 %
Nags Head	79	3,168	83,163	3,168	100.00 %	3.81 %
Nashville	25	5,632	86,534	5,632	100.00 %	6.51 %
Navassa	17	1,367	89,763	1,367	100.00 %	1.52 %
New Bern	3	31,291	85,099	31,291	100.00 %	36.77 %
New London	67	607	88,255	607	100.00 %	0.69 %
Newland	85	715	90,863	715	100.00 %	0.79 %
Newport	13	4,364	83,307	4,364	100.00 %	5.24 %
Newton	89	13,148	85,577	13,148	100.00 %	15.36 %
	96	13,148	89,587	0	0.00 %	0.00 %
Newton Grove	22	585	88,642	585	100.00 %	0.66 %
Norlina	27	920	84,735	920	100.00 %	1.09 %
Norman	52	100	84,383	100	100.00 %	0.12 %
North Topsail Beach	15	1,005	87,578	1,005	100.00 %	1.15 %
North Wilkesboro	94	4,382	90,835	4,382	100.00 %	4.82 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Northwest	17	703	89,763	703	100.00 %	0.78 %
Norwood	67	2,367	88,255	2,367	100.00 %	2.68 %
Oak City	23	266	88,865	266	100.00 %	0.30 %
Oak Island	19	8,396	91,041	8,396	100.00 %	9.22 %
Oak Ridge	62	7,474	89,579	7,474	100.00 %	8.34 %
Oakboro	67	2,128	88,255	2,128	100.00 %	2.41 %
Ocean Isle Beach	17	867	89,763	867	100.00 %	0.97 %
Old Fort	85	811	90,863	811	100.00 %	0.89 %
Oriental	79	880	83,163	880	100.00 %	1.06 %
Orrum	46	59	83,445	59	100.00 %	0.07 %
Ossipee	64	536	85,016	536	100.00 %	0.63 %
Oxford	32	8,628	88,633	8,628	100.00 %	9.73 %
Pantego	79	164	83,163	164	100.00 %	0.20 %
Parkton	47	504	83,708	504	100.00 %	0.60 %
Parmele	23	243	88,865	243	100.00 %	0.27 %
Patterson Springs	111	571	89,894	571	100.00 %	0.64 %
Peachland	55	390	87,005	390	100.00 %	0.45 %
Peletier	13	769	83,307	769	100.00 %	0.92 %
Pembroke	47	2,823	83,708	2,823	100.00 %	3.37 %
Pikeville	10	712	82,953	712	100.00 %	0.86 %
Pilot Mountain	90	1,440	82,937	1,440	100.00 %	1.74 %
Pine Knoll Shores	13	1,388	83,307	1,388	100.00 %	1.67 %
Pine Level	28	2,046	85,389	2,046	100.00 %	2.40 %
Pinebluff	52	1,473	84,383	1,473	100.00 %	1.75 %
Pinehurst	52	17,581	84,383	8	0.05 %	0.01 %
	78	17,581	86,365	17,573	99.95 %	20.35 %
Pinetops	23	1,200	88,865	1,200	100.00 %	1.35 %
Pineville	105	10,602	85,822	10,602	100.00 %	12.35 %
	112	10,602	82,806	0	0.00 %	0.00 %
Pink Hill	12	451	84,745	451	100.00 %	0.53 %
Pittsboro	54	4,537	83,475	4,537	100.00 %	5.44 %
Pleasant Garden	59	5,000	90,361	5,000	100.00 %	5.53 %
Plymouth	1	3,320	84,330	3,320	100.00 %	3.94 %
Polkton	55	2,250	87,005	2,250	100.00 %	2.59 %
Polkville	110	516	88,397	516	100.00 %	0.58 %
Pollocksville	12	268	84,745	268	100.00 %	0.32 %
Powellsville	23	189	88,865	189	100.00 %	0.21 %
Princeton	28	1,315	85,389	1,315	100.00 %	1.54 %
Princeville	23	1,254	88,865	1,254	100.00 %	1.41 %
Proctorville	46	121	83,445	121	100.00 %	0.15 %
Raeford	48	4,559	86,256	4,559	100.00 %	5.29 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Raleigh (Durham)	2	1,559	90,793	1,326	85.05 %	1.46 %
	31	1,559	90,760	233	14.95 %	0.26 %
Raleigh (Wake)	11	466,106	86,298	40,792	8.75 %	47.27 %
	21	466,106	86,179	13	0.00 %	0.02 %
	33	466,106	83,049	82,480	17.70 %	99.31 %
	34	466,106	83,679	83,503	17.92 %	99.79 %
	35	466,106	88,374	6,171	1.32 %	6.98 %
	38	466,106	88,226	56,840	12.19 %	64.43 %
	39	466,106	90,164	13,011	2.79 %	14.43 %
	40	466,106	83,175	57,345	12.30 %	68.94 %
	49	466,106	86,157	47,783	10.25 %	55.46 %
	66	466,106	83,189	78,168	16.77 %	93.96 %
Ramseur	78	1,774	86,365	1,774	100.00 %	2.05 %
Randleman	70	4,595	89,118	4,595	100.00 %	5.16 %
Ranlo	108	4,511	86,263	4,500	99.76 %	5.22 %
	110	4,511	88,397	11	0.24 %	0.01 %
Raynham	46	60	83,445	60	100.00 %	0.07 %
Red Cross	67	762	88,255	762	100.00 %	0.86 %
Red Oak	25	3,342	86,534	3,342	100.00 %	3.86 %
Red Springs (Hoke)	48	0	86,256	0	0.00 %	0.00 %
Red Springs (Robeson)	47	3,087	83,708	3,087	100.00 %	3.69 %
Reidsville	65	14,583	91,096	14,583	100.00 %	16.01 %
Rennert	47	275	83,708	275	100.00 %	0.33 %
Rhodhiss (Burke)	86	639	87,570	639	100.00 %	0.73 %
Rhodhiss (Caldwell)	87	358	85,758	358	100.00 %	0.42 %
Rich Square	27	894	84,735	894	100.00 %	1.06 %
Richfield	67	582	88,255	582	100.00 %	0.66 %
Richlands	16	2,287	90,663	2,287	100.00 %	2.52 %
River Bend	3	2,902	85,099	2,902	100.00 %	3.41 %
Roanoke Rapids	27	15,229	84,735	15,229	100.00 %	17.97 %
Robbins	78	1,168	86,365	1,168	100.00 %	1.35 %
Robbinsville	120	597	84,907	597	100.00 %	0.70 %
Robersonville	23	1,269	88,865	1,269	100.00 %	1.43 %
Rockingham	52	9,243	84,383	9,243	100.00 %	10.95 %
Rockwell	76	2,302	89,815	2,302	100.00 %	2.56 %
Rocky Mount (Edgecombe)	23	15,414	88,865	15,414	100.00 %	17.35 %
Rocky Mount (Nash)	25	38,927	86,534	38,927	100.00 %	44.98 %
Rolesville	35	9,475	88,374	9,467	99.92 %	10.71 %
	39	9,475	90,164	8	0.08 %	0.01 %
Ronda	90	438	82,937	438	100.00 %	0.53 %
Roper	1	485	84,330	485	100.00 %	0.58 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Rose Hill	4	1,371	83,095	1,371	100.00 %	1.65 %
Roseboro	22	1,163	88,642	1,163	100.00 %	1.31 %
Rosman	119	701	90,212	701	100.00 %	0.78 %
Rowland	46	885	83,445	885	100.00 %	1.06 %
Roxboro	2	8,134	90,793	8,134	100.00 %	8.96 %
Roxobel	23	187	88,865	187	100.00 %	0.21 %
Rural Hall	91	3,351	86,210	3,351	100.00 %	3.89 %
Ruth	113	347	89,058	347	100.00 %	0.39 %
Rutherford College (Burke)	86	1,226	87,570	1,226	100.00 %	1.40 %
Rutherford College (Caldwell)	87	0	85,758	0	0.00 %	0.00 %
Rutherfordton	113	3,640	89,058	3,640	100.00 %	4.09 %
Salemburg	22	457	88,642	457	100.00 %	0.52 %
Salisbury	76	35,540	89,815	35,540	100.00 %	39.57 %
Saluda (Henderson)	113	11	89,058	11	100.00 %	0.01 %
Saluda (Polk)	113	620	89,058	620	100.00 %	0.70 %
Sandy Creek	17	248	89,763	248	100.00 %	0.28 %
Sandyfield	46	430	83,445	430	100.00 %	0.52 %
Sanford	51	30,261	83,073	30,261	100.00 %	36.43 %
Saratoga	24	353	87,220	353	100.00 %	0.40 %
Sawmills	87	5,020	85,758	5,020	100.00 %	5.85 %
Scotland Neck	27	1,640	84,735	1,640	100.00 %	1.94 %
Seaboard	27	542	84,735	542	100.00 %	0.64 %
Seagrove	78	235	86,365	235	100.00 %	0.27 %
Sedalia	59	676	90,361	676	100.00 %	0.75 %
Selma	28	6,317	85,389	6,317	100.00 %	7.40 %
Seven Devils (Avery)	85	38	90,863	38	100.00 %	0.04 %
Seven Devils (Watauga)	93	275	86,445	275	100.00 %	0.32 %
Seven Springs	4	55	83,095	55	100.00 %	0.07 %
Severn	27	191	84,735	191	100.00 %	0.23 %
Shallotte	17	4,185	89,763	4,185	100.00 %	4.66 %
Sharpsburg (Edgecombe)	23	215	88,865	215	100.00 %	0.24 %
Sharpsburg (Nash)	25	1,061	86,534	1,061	100.00 %	1.23 %
Sharpsburg (Wilson)	24	421	87,220	421	100.00 %	0.48 %
Shelby	110	21,918	88,397	4,409	20.12 %	4.99 %
	111	21,918	89,894	17,509	79.88 %	19.48 %
Siler City	54	7,702	83,475	7,702	100.00 %	9.23 %
Simpson	9	390	84,450	390	100.00 %	0.46 %
Sims	24	275	87,220	275	100.00 %	0.32 %
Smithfield	28	11,292	85,389	11,292	100.00 %	13.22 %
Snow Hill	12	1,481	84,745	1,481	100.00 %	1.75 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Southern Pines	52	15,545	84,383	15,545	100.00 %	18.42 %
	78	15,545	86,365	0	0.00 %	0.00 %
Southern Shores	1	3,090	84,330	3,090	100.00 %	3.66 %
Southport	19	3,971	91,041	3,971	100.00 %	4.36 %
Sparta	93	1,834	86,445	1,834	100.00 %	2.12 %
Speed	23	63	88,865	63	100.00 %	0.07 %
Spencer	76	3,308	89,815	3,308	100.00 %	3.68 %
Spencer Mountain	108	0	86,263	0	0.00 %	0.00 %
Spindale	113	4,225	89,058	4,225	100.00 %	4.74 %
Spring Hope	25	1,309	86,534	1,309	100.00 %	1.51 %
Spring Lake	42	11,660	85,537	11,660	100.00 %	13.63 %
Spruce Pine	85	2,194	90,863	2,194	100.00 %	2.41 %
St. Helena	16	417	90,663	417	100.00 %	0.46 %
St. James	19	6,529	91,041	6,529	100.00 %	7.17 %
St. Pauls	47	2,045	83,708	2,045	100.00 %	2.44 %
Staley	54	397	83,475	397	100.00 %	0.48 %
Stallings (Mecklenburg)	103	384	87,132	384	100.00 %	0.44 %
Stallings (Union)	68	15,728	88,138	0	0.00 %	0.00 %
	69	15,728	85,179	15,728	100.00 %	18.46 %
Stanfield	67	1,585	88,255	1,585	100.00 %	1.80 %
Stanley	108	3,963	86,263	3,963	100.00 %	4.59 %
Stantonsburg	24	762	87,220	762	100.00 %	0.87 %
Star	67	806	88,255	806	100.00 %	0.91 %
Statesville	84	28,419	86,773	28,415	99.99 %	32.75 %
	89	28,419	85,577	4	0.01 %	0.00 %
Stedman	43	1,277	82,956	1,277	100.00 %	1.54 %
Stem	32	960	88,633	960	100.00 %	1.08 %
Stokesdale	62	5,924	89,579	5,924	100.00 %	6.61 %
Stoneville	65	1,308	91,096	1,308	100.00 %	1.44 %
Stonewall	79	214	83,163	214	100.00 %	0.26 %
Stovall	32	324	88,633	324	100.00 %	0.37 %
Sugar Mountain	85	371	90,863	371	100.00 %	0.41 %
Summerfield	57	10,951	90,615	746	6.81 %	0.82 %
	59	10,951	90,361	2,509	22.91 %	2.78 %
	62	10,951	89,579	7,696	70.28 %	8.59 %
Sunset Beach	17	4,175	89,763	4,175	100.00 %	4.65 %
Surf City (Onslow)	15	334	87,578	334	100.00 %	0.38 %
Surf City (Pender)	16	3,533	90,663	3,533	100.00 %	3.90 %
Swansboro	14	3,744	86,538	3,744	100.00 %	4.33 %
Swepsonville	63	2,445	86,399	2,445	100.00 %	2.83 %
Sylva	119	2,578	90,212	2,578	100.00 %	2.86 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Tabor City	46	3,781	83,445	3,781	100.00 %	4.53 %
Tar Heel	22	90	88,642	90	100.00 %	0.10 %
Tarboro	23	10,721	88,865	10,721	100.00 %	12.06 %
Taylorsville	94	2,320	90,835	2,320	100.00 %	2.55 %
Taylortown	52	634	84,383	4	0.63 %	0.00 %
	78	634	86,365	630	99.37 %	0.73 %
Teachey	4	448	83,095	448	100.00 %	0.54 %
Thomasville (Davidson)	80	26,662	84,864	26,662	100.00 %	31.42 %
Thomasville (Randolph)	70	521	89,118	521	100.00 %	0.58 %
Tobaccoville (Forsyth)	74	2,578	84,857	824	31.96 %	0.97 %
	91	2,578	86,210	1,754	68.04 %	2.03 %
Tobaccoville (Stokes)	91	0	86,210	0	0.00 %	0.00 %
Topsail Beach	16	461	90,663	461	100.00 %	0.51 %
Trent Woods	3	4,074	85,099	4,074	100.00 %	4.79 %
Trenton	12	238	84,745	238	100.00 %	0.28 %
Trinity	70	7,006	89,118	7,006	100.00 %	7.86 %
Troutman	84	3,698	86,773	885	23.93 %	1.02 %
	89	3,698	85,577	2,813	76.07 %	3.29 %
Troy	67	2,850	88,255	2,850	100.00 %	3.23 %
Tryon	113	1,562	89,058	1,562	100.00 %	1.75 %
Turkey	22	213	88,642	213	100.00 %	0.24 %
Unionville	69	6,643	85,179	6,643	100.00 %	7.80 %
Valdese	86	4,689	87,570	4,689	100.00 %	5.35 %
Vanceboro	3	869	85,099	869	100.00 %	1.02 %
Vandemere	79	246	83,163	246	100.00 %	0.30 %
Varnamtown	19	525	91,041	525	100.00 %	0.58 %
Vass	51	952	83,073	952	100.00 %	1.15 %
Waco	110	310	88,397	310	100.00 %	0.35 %
Wade	43	638	82,956	638	100.00 %	0.77 %
Wadesboro	55	5,008	87,005	5,008	100.00 %	5.76 %
Wagram	48	615	86,256	615	100.00 %	0.71 %
Wake Forest (Franklin)	7	1,504	83,510	1,504	100.00 %	1.80 %
Wake Forest (Wake)	35	46,097	88,374	46,097	100.00 %	52.16 %
	66	46,097	83,189	0	0.00 %	0.00 %
Walkertown	71	5,692	84,874	3,176	55.80 %	3.74 %
	75	5,692	84,220	2,516	44.20 %	2.99 %
Wallace (Duplin)	4	3,413	83,095	3,413	100.00 %	4.11 %
Wallace (Pender)	16	0	90,663	0	0.00 %	0.00 %
Wallburg	80	3,051	84,864	3,051	100.00 %	3.60 %
Walnut Cove	91	1,586	86,210	1,586	100.00 %	1.84 %
Walnut Creek	4	1,084	83,095	1,084	100.00 %	1.30 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Walstonburg	12	193	84,745	193	100.00 %	0.23 %
Warrenton	27	851	84,735	851	100.00 %	1.00 %
Warsaw	4	2,733	83,095	2,733	100.00 %	3.29 %
Washington	79	9,875	83,163	9,875	100.00 %	11.87 %
Washington Park	79	392	83,163	392	100.00 %	0.47 %
Watha	16	181	90,663	181	100.00 %	0.20 %
Waxhaw	55	20,534	87,005	0	0.00 %	0.00 %
	68	20,534	88,138	20,534	100.00 %	23.30 %
Waynesville	118	10,140	83,282	10,140	100.00 %	12.18 %
Weaverville	114	4,567	89,685	4,567	100.00 %	5.09 %
Webster	119	372	90,212	372	100.00 %	0.41 %
Weddington (Mecklenburg)	103	5	87,132	5	100.00 %	0.01 %
Weddington (Union)	68	13,176	88,138	13,172	99.97 %	14.94 %
	69	13,176	85,179	4	0.03 %	0.00 %
Weldon	27	1,444	84,735	1,444	100.00 %	1.70 %
Wendell	39	9,793	90,164	9,793	100.00 %	10.86 %
Wentworth	65	2,662	91,096	2,662	100.00 %	2.92 %
Wesley Chapel	55	8,681	87,005	3,868	44.56 %	4.45 %
	68	8,681	88,138	4,813	55.44 %	5.46 %
West Jefferson	93	1,279	86,445	1,279	100.00 %	1.48 %
Whispering Pines	52	4,987	84,383	4,987	100.00 %	5.91 %
Whitakers (Edgecombe)	23	290	88,865	290	100.00 %	0.33 %
Whitakers (Nash)	25	337	86,534	337	100.00 %	0.39 %
White Lake	22	843	88,642	843	100.00 %	0.95 %
Whiteville	46	4,766	83,445	4,766	100.00 %	5.71 %
Whitsett	59	584	90,361	584	100.00 %	0.65 %
Wilkesboro	94	3,687	90,835	3,687	100.00 %	4.06 %
Williamston	23	5,248	88,865	5,248	100.00 %	5.91 %
Wilmington	18	115,451	91,245	48,680	42.17 %	53.35 %
	19	115,451	91,041	8,207	7.11 %	9.01 %
	20	115,451	90,346	58,564	50.73 %	64.82 %
Wilson	24	47,851	87,220	47,851	100.00 %	54.86 %
Wilson's Mills	26	2,534	89,947	0	0.00 %	0.00 %
	28	2,534	85,389	2,534	100.00 %	2.97 %
Windsor	23	3,582	88,865	3,582	100.00 %	4.03 %
Winfall	1	555	84,330	555	100.00 %	0.66 %
Wingate	55	4,055	87,005	4,055	100.00 %	4.66 %

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NC General Assembly

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Winston-Salem	71	249,545	84,874	77,631	31.11 %	91.47 %
	72	249,545	86,949	86,867	34.81 %	99.91 %
	74	249,545	84,857	32,409	12.99 %	38.19 %
	75	249,545	84,220	22,818	9.14 %	27.09 %
	91	249,545	86,210	29,820	11.95 %	34.59 %
Winterville	8	10,462	85,793	44	0.42 %	0.05 %
	9	10,462	84,450	10,418	99.58 %	12.34 %
Winton	5	629	82,953	629	100.00 %	0.76 %
Woodfin	114	7,936	89,685	7,648	96.37 %	8.53 %
	116	7,936	89,505	288	3.63 %	0.32 %
Woodland	27	557	84,735	557	100.00 %	0.66 %
Wrightsville Beach	20	2,473	90,346	2,473	100.00 %	2.74 %
Yadkinville	77	2,995	90,628	2,995	100.00 %	3.30 %
Yanceyville	50	1,937	85,345	1,937	100.00 %	2.27 %
Youngsville	7	2,016	83,510	2,016	100.00 %	2.41 %
Zebulon (Johnston)	26	0	89,947	0	0.00 %	0.00 %
Zebulon (Wake)	39	6,903	90,164	6,903	100.00 %	7.66 %
			Total:	**6,017,605**		

Number of municipalities split within counties: 81

Display: all municipalities

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NC General Assembly

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
1	Columbia	84,330	610	610	0.72 %	100.00 %
	Creswell	84,330	207	207	0.25 %	100.00 %
	Duck	84,330	742	742	0.88 %	100.00 %
	Edenton	84,330	4,460	4,460	5.29 %	100.00 %
	Hertford	84,330	1,934	1,934	2.29 %	100.00 %
	Kill Devil Hills	84,330	7,656	7,118	8.44 %	92.97 %
	Kitty Hawk	84,330	3,689	3,689	4.37 %	100.00 %
	Plymouth	84,330	3,320	3,320	3.94 %	100.00 %
	Roper	84,330	485	485	0.58 %	100.00 %
	Southern Shores	84,330	3,090	3,090	3.66 %	100.00 %
	Winfall	84,330	555	555	0.66 %	100.00 %
2	Durham (Durham)	90,793	283,093	25,167	27.72 %	8.89 %
	Raleigh (Durham)	90,793	1,559	1,326	1.46 %	85.05 %
	Roxboro	90,793	8,134	8,134	8.96 %	100.00 %
3	Bridgeton	85,099	349	349	0.41 %	100.00 %
	Cove City	85,099	378	378	0.44 %	100.00 %
	Dover	85,099	349	349	0.41 %	100.00 %
	Havelock	85,099	16,621	5,986	7.03 %	36.01 %
	New Bern	85,099	31,291	31,291	36.77 %	100.00 %
	River Bend	85,099	2,902	2,902	3.41 %	100.00 %
	Trent Woods	85,099	4,074	4,074	4.79 %	100.00 %
	Vanceboro	85,099	869	869	1.02 %	100.00 %
4	Beulaville	83,095	1,116	1,116	1.34 %	100.00 %
	Calypso	83,095	327	327	0.39 %	100.00 %
	Faison (Duplin)	83,095	784	784	0.94 %	100.00 %
	Goldsboro	83,095	33,657	5	0.01 %	0.01 %
	Greenevers	83,095	567	567	0.68 %	100.00 %
	Harrells (Duplin)	83,095	0	0	0.00 %	0.00 %
	Kenansville	83,095	770	770	0.93 %	100.00 %
	Magnolia	83,095	831	831	1.00 %	100.00 %
	Mount Olive (Duplin)	83,095	5	5	0.01 %	100.00 %
	Mount Olive (Wayne)	83,095	4,193	4,193	5.05 %	100.00 %
	Rose Hill	83,095	1,371	1,371	1.65 %	100.00 %
	Seven Springs	83,095	55	55	0.07 %	100.00 %
	Teachey	83,095	448	448	0.54 %	100.00 %
	Wallace (Duplin)	83,095	3,413	3,413	4.11 %	100.00 %
	Walnut Creek	83,095	1,084	1,084	1.30 %	100.00 %
	Warsaw	83,095	2,733	2,733	3.29 %	100.00 %
5	Ahoskie	82,953	4,891	4,891	5.90 %	100.00 %
	Cofield	82,953	267	267	0.32 %	100.00 %
	Como	82,953	67	67	0.08 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
5	Elizabeth City (Camden)	82,953	38	38	0.05 %	100.00 %
	Elizabeth City (Pasquotank)	82,953	18,593	18,593	22.41 %	100.00 %
	Gatesville	82,953	267	267	0.32 %	100.00 %
	Harrellsville	82,953	85	85	0.10 %	100.00 %
	Murfreesboro	82,953	2,619	2,619	3.16 %	100.00 %
	Winton	82,953	629	629	0.76 %	100.00 %
6	Angier (Harnett)	87,332	4,709	4,709	5.39 %	100.00 %
	Broadway (Harnett)	87,332	0	0	0.00 %	0.00 %
	Fuquay-Varina (Harnett)	87,332	0	0	0.00 %	0.00 %
	Lillington	87,332	4,735	882	1.01 %	18.63 %
7	Bunn	83,510	327	327	0.39 %	100.00 %
	Creedmoor	83,510	4,866	2,065	2.47 %	42.44 %
	Franklinton	83,510	2,456	2,456	2.94 %	100.00 %
	Louisburg	83,510	3,064	3,064	3.67 %	100.00 %
	Wake Forest (Franklin)	83,510	1,504	1,504	1.80 %	100.00 %
	Youngsville	83,510	2,016	2,016	2.41 %	100.00 %
8	Bethel	85,793	1,373	1,373	1.60 %	100.00 %
	Falkland	85,793	47	47	0.05 %	100.00 %
	Farmville	85,793	4,461	4,461	5.20 %	100.00 %
	Fountain	85,793	385	385	0.45 %	100.00 %
	Greenville	85,793	87,521	52,881	61.64 %	60.42 %
	Winterville	85,793	10,462	44	0.05 %	0.42 %
9	Ayden	84,450	4,977	4,977	5.89 %	100.00 %
	Greenville	84,450	87,521	34,640	41.02 %	39.58 %
	Grifton (Pitt)	84,450	2,301	2,301	2.72 %	100.00 %
	Grimesland	84,450	386	386	0.46 %	100.00 %
	Simpson	84,450	390	390	0.46 %	100.00 %
	Winterville	84,450	10,462	10,418	12.34 %	99.58 %
10	Eureka	82,953	214	214	0.26 %	100.00 %
	Fremont	82,953	1,196	1,196	1.44 %	100.00 %
	Goldsboro	82,953	33,657	33,652	40.57 %	99.99 %
	Pikeville	82,953	712	712	0.86 %	100.00 %
11	Apex	86,298	58,780	0	0.00 %	0.00 %
	Cary (Wake)	86,298	171,012	43,537	50.45 %	25.46 %
	Morrisville (Wake)	86,298	29,423	0	0.00 %	0.00 %
	Raleigh (Wake)	86,298	466,106	40,792	47.27 %	8.75 %
12	Grifton (Lenoir)	84,745	147	147	0.17 %	100.00 %
	Hookerton	84,745	413	413	0.49 %	100.00 %
	Kinston	84,745	19,900	19,900	23.48 %	100.00 %
	La Grange	84,745	2,595	2,595	3.06 %	100.00 %
	Maysville	84,745	818	818	0.97 %	100.00 %

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District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
12	Pink Hill	84,745	451	451	0.53 %	100.00 %
	Pollocksville	84,745	268	268	0.32 %	100.00 %
	Snow Hill	84,745	1,481	1,481	1.75 %	100.00 %
	Trenton	84,745	238	238	0.28 %	100.00 %
	Walstonburg	84,745	193	193	0.23 %	100.00 %
13	Atlantic Beach	83,307	1,364	1,364	1.64 %	100.00 %
	Beaufort	83,307	4,464	4,464	5.36 %	100.00 %
	Bogue	83,307	695	695	0.83 %	100.00 %
	Cape Carteret	83,307	2,224	2,224	2.67 %	100.00 %
	Cedar Point	83,307	1,764	1,764	2.12 %	100.00 %
	Emerald Isle	83,307	3,847	3,847	4.62 %	100.00 %
	Havelock	83,307	16,621	10,635	12.77 %	63.99 %
	Indian Beach	83,307	223	223	0.27 %	100.00 %
	Morehead City	83,307	9,556	9,556	11.47 %	100.00 %
	Newport	83,307	4,364	4,364	5.24 %	100.00 %
	Peletier	83,307	769	769	0.92 %	100.00 %
	Pine Knoll Shores	83,307	1,388	1,388	1.67 %	100.00 %
14	Jacksonville	86,538	72,723	28,456	32.88 %	39.13 %
	Swansboro	86,538	3,744	3,744	4.33 %	100.00 %
15	Holly Ridge	87,578	4,171	4,171	4.76 %	100.00 %
	Jacksonville	87,578	72,723	44,267	50.55 %	60.87 %
	North Topsail Beach	87,578	1,005	1,005	1.15 %	100.00 %
	Surf City (Onslow)	87,578	334	334	0.38 %	100.00 %
16	Atkinson	90,663	296	296	0.33 %	100.00 %
	Burgaw	90,663	3,088	3,088	3.41 %	100.00 %
	Richlands	90,663	2,287	2,287	2.52 %	100.00 %
	St. Helena	90,663	417	417	0.46 %	100.00 %
	Surf City (Pender)	90,663	3,533	3,533	3.90 %	100.00 %
	Topsail Beach	90,663	461	461	0.51 %	100.00 %
	Wallace (Pender)	90,663	0	0	0.00 %	0.00 %
	Watha	90,663	181	181	0.20 %	100.00 %
17	Belville	89,763	2,406	2,406	2.68 %	100.00 %
	Calabash	89,763	2,011	2,011	2.24 %	100.00 %
	Carolina Shores	89,763	4,588	4,588	5.11 %	100.00 %
	Holden Beach	89,763	921	0	0.00 %	0.00 %
	Leland	89,763	22,908	22,908	25.52 %	100.00 %
	Navassa	89,763	1,367	1,367	1.52 %	100.00 %
	Northwest	89,763	703	703	0.78 %	100.00 %
	Ocean Isle Beach	89,763	867	867	0.97 %	100.00 %
	Sandy Creek	89,763	248	248	0.28 %	100.00 %
	Shallotte	89,763	4,185	4,185	4.66 %	100.00 %

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District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
17	Sunset Beach	89,763	4,175	4,175	4.65 %	100.00 %
18	Wilmington	91,245	115,451	48,680	53.35 %	42.17 %
19	Bald Head Island	91,041	268	268	0.29 %	100.00 %
	Boiling Spring Lakes	91,041	5,943	5,943	6.53 %	100.00 %
	Bolivia	91,041	149	149	0.16 %	100.00 %
	Carolina Beach	91,041	6,564	6,564	7.21 %	100.00 %
	Caswell Beach	91,041	395	395	0.43 %	100.00 %
	Holden Beach	91,041	921	921	1.01 %	100.00 %
	Kure Beach	91,041	2,191	2,191	2.41 %	100.00 %
	Oak Island	91,041	8,396	8,396	9.22 %	100.00 %
	Southport	91,041	3,971	3,971	4.36 %	100.00 %
	St. James	91,041	6,529	6,529	7.17 %	100.00 %
	Varnamtown	91,041	525	525	0.58 %	100.00 %
	Wilmington	91,041	115,451	8,207	9.01 %	7.11 %
20	Wilmington	90,346	115,451	58,564	64.82 %	50.73 %
	Wrightsville Beach	90,346	2,473	2,473	2.74 %	100.00 %
21	Apex	86,179	58,780	556	0.65 %	0.95 %
	Cary (Wake)	86,179	171,012	30,622	35.53 %	17.91 %
	Fuquay-Varina (Wake)	86,179	34,152	30	0.03 %	0.09 %
	Garner	86,179	31,159	11,789	13.68 %	37.83 %
	Holly Springs	86,179	41,239	11,892	13.80 %	28.84 %
	Raleigh (Wake)	86,179	466,106	13	0.02 %	0.00 %
22	Autryville	88,642	167	167	0.19 %	100.00 %
	Bladenboro	88,642	1,648	1,648	1.86 %	100.00 %
	Clarkton	88,642	614	614	0.69 %	100.00 %
	Clinton	88,642	8,383	8,383	9.46 %	100.00 %
	Dublin	88,642	267	267	0.30 %	100.00 %
	East Arcadia	88,642	418	418	0.47 %	100.00 %
	Elizabethtown	88,642	3,296	3,296	3.72 %	100.00 %
	Faison (Sampson)	88,642	0	0	0.00 %	0.00 %
	Falcon (Sampson)	88,642	0	0	0.00 %	0.00 %
	Garland	88,642	595	595	0.67 %	100.00 %
	Harrells (Sampson)	88,642	160	160	0.18 %	100.00 %
	Newton Grove	88,642	585	585	0.66 %	100.00 %
	Roseboro	88,642	1,163	1,163	1.31 %	100.00 %
	Salemburg	88,642	457	457	0.52 %	100.00 %
	Tar Heel	88,642	90	90	0.10 %	100.00 %
	Turkey	88,642	213	213	0.24 %	100.00 %
	White Lake	88,642	843	843	0.95 %	100.00 %
23	Askewville	88,865	184	184	0.21 %	100.00 %
	Aulander	88,865	763	763	0.86 %	100.00 %

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23	Bear Grass	88,865	89	89	0.10 %	100.00 %
	Colerain	88,865	217	217	0.24 %	100.00 %
	Conetoe	88,865	198	198	0.22 %	100.00 %
	Everetts	88,865	150	150	0.17 %	100.00 %
	Hamilton	88,865	306	306	0.34 %	100.00 %
	Hassell	88,865	49	49	0.06 %	100.00 %
	Jamesville	88,865	424	424	0.48 %	100.00 %
	Kelford	88,865	203	203	0.23 %	100.00 %
	Leggett	88,865	37	37	0.04 %	100.00 %
	Lewiston Woodville	88,865	426	426	0.48 %	100.00 %
	Macclesfield	88,865	413	413	0.46 %	100.00 %
	Oak City	88,865	266	266	0.30 %	100.00 %
	Parmele	88,865	243	243	0.27 %	100.00 %
	Pinetops	88,865	1,200	1,200	1.35 %	100.00 %
	Powellsville	88,865	189	189	0.21 %	100.00 %
	Princeville	88,865	1,254	1,254	1.41 %	100.00 %
	Robersonville	88,865	1,269	1,269	1.43 %	100.00 %
	Rocky Mount (Edgecombe)	88,865	15,414	15,414	17.35 %	100.00 %
	Roxobel	88,865	187	187	0.21 %	100.00 %
	Sharpsburg (Edgecombe)	88,865	215	215	0.24 %	100.00 %
	Speed	88,865	63	63	0.07 %	100.00 %
	Tarboro	88,865	10,721	10,721	12.06 %	100.00 %
	Whitakers (Edgecombe)	88,865	290	290	0.33 %	100.00 %
	Williamston	88,865	5,248	5,248	5.91 %	100.00 %
	Windsor	88,865	3,582	3,582	4.03 %	100.00 %
24	Bailey	87,220	568	568	0.65 %	100.00 %
	Black Creek	87,220	692	692	0.79 %	100.00 %
	Elm City (Wilson)	87,220	1,218	1,218	1.40 %	100.00 %
	Kenly (Wilson)	87,220	198	198	0.23 %	100.00 %
	Lucama	87,220	1,036	1,036	1.19 %	100.00 %
	Middlesex	87,220	912	912	1.05 %	100.00 %
	Saratoga	87,220	353	353	0.40 %	100.00 %
	Sharpsburg (Wilson)	87,220	421	421	0.48 %	100.00 %
	Sims	87,220	275	275	0.32 %	100.00 %
	Stantonsburg	87,220	762	762	0.87 %	100.00 %
	Wilson	87,220	47,851	47,851	54.86 %	100.00 %
25	Castalia	86,534	264	264	0.31 %	100.00 %
	Dortches	86,534	1,082	1,082	1.25 %	100.00 %
	Elm City (Nash)	86,534	0	0	0.00 %	0.00 %
	Momeyer	86,534	277	277	0.32 %	100.00 %
	Nashville	86,534	5,632	5,632	6.51 %	100.00 %

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District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
25	Red Oak	86,534	3,342	3,342	3.86 %	100.00 %
	Rocky Mount (Nash)	86,534	38,927	38,927	44.98 %	100.00 %
	Sharpsburg (Nash)	86,534	1,061	1,061	1.23 %	100.00 %
	Spring Hope	86,534	1,309	1,309	1.51 %	100.00 %
	Whitakers (Nash)	86,534	337	337	0.39 %	100.00 %
26	Archer Lodge	89,947	4,797	4,797	5.33 %	100.00 %
	Clayton (Johnston)	89,947	26,307	26,307	29.25 %	100.00 %
	Wilson's Mills	89,947	2,534	0	0.00 %	0.00 %
	Zebulon (Johnston)	89,947	0	0	0.00 %	0.00 %
27	Conway	84,735	752	752	0.89 %	100.00 %
	Enfield	84,735	1,865	1,865	2.20 %	100.00 %
	Garysburg	84,735	904	904	1.07 %	100.00 %
	Gaston	84,735	1,008	1,008	1.19 %	100.00 %
	Halifax	84,735	170	170	0.20 %	100.00 %
	Hobgood	84,735	268	268	0.32 %	100.00 %
	Jackson	84,735	430	430	0.51 %	100.00 %
	Lasker	84,735	64	64	0.08 %	100.00 %
	Littleton	84,735	559	559	0.66 %	100.00 %
	Macon	84,735	110	110	0.13 %	100.00 %
	Norlina	84,735	920	920	1.09 %	100.00 %
	Rich Square	84,735	894	894	1.06 %	100.00 %
	Roanoke Rapids	84,735	15,229	15,229	17.97 %	100.00 %
	Scotland Neck	84,735	1,640	1,640	1.94 %	100.00 %
	Seaboard	84,735	542	542	0.64 %	100.00 %
	Severn	84,735	191	191	0.23 %	100.00 %
	Warrenton	84,735	851	851	1.00 %	100.00 %
	Weldon	84,735	1,444	1,444	1.70 %	100.00 %
	Woodland	84,735	557	557	0.66 %	100.00 %
28	Benson (Johnston)	85,389	3,967	3,967	4.65 %	100.00 %
	Four Oaks	85,389	2,158	2,158	2.53 %	100.00 %
	Kenly (Johnston)	85,389	1,293	1,293	1.51 %	100.00 %
	Micro	85,389	458	458	0.54 %	100.00 %
	Pine Level	85,389	2,046	2,046	2.40 %	100.00 %
	Princeton	85,389	1,315	1,315	1.54 %	100.00 %
	Selma	85,389	6,317	6,317	7.40 %	100.00 %
	Smithfield	85,389	11,292	11,292	13.22 %	100.00 %
	Wilson's Mills	85,389	2,534	2,534	2.97 %	100.00 %
29	Chapel Hill (Durham)	91,212	2,906	2,906	3.19 %	100.00 %
	Durham (Durham)	91,212	283,093	87,035	95.42 %	30.74 %
30	Durham (Durham)	91,165	283,093	89,671	98.36 %	31.68 %
31	Durham (Durham)	90,760	283,093	81,220	89.49 %	28.69 %

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31	Morrisville (Durham)	90,760	207	207	0.23 %	100.00 %
	Raleigh (Durham)	90,760	1,559	233	0.26 %	14.95 %
32	Butner	88,633	8,397	8,397	9.47 %	100.00 %
	Creedmoor	88,633	4,866	2,801	3.16 %	57.56 %
	Henderson	88,633	15,060	15,060	16.99 %	100.00 %
	Kittrell	88,633	132	132	0.15 %	100.00 %
	Middleburg	88,633	101	101	0.11 %	100.00 %
	Oxford	88,633	8,628	8,628	9.73 %	100.00 %
	Stem	88,633	960	960	1.08 %	100.00 %
	Stovall	88,633	324	324	0.37 %	100.00 %
33	Garner	83,049	31,159	14	0.02 %	0.04 %
	Raleigh (Wake)	83,049	466,106	82,480	99.31 %	17.70 %
34	Raleigh (Wake)	83,679	466,106	83,503	99.79 %	17.92 %
35	Raleigh (Wake)	88,374	466,106	6,171	6.98 %	1.32 %
	Rolesville	88,374	9,475	9,467	10.71 %	99.92 %
	Wake Forest (Wake)	88,374	46,097	46,097	52.16 %	100.00 %
36	Apex	90,166	58,780	57,843	64.15 %	98.41 %
	Cary (Wake)	90,166	171,012	0	0.00 %	0.00 %
	Fuquay-Varina (Wake)	90,166	34,152	16	0.02 %	0.05 %
	Holly Springs	90,166	41,239	17,734	19.67 %	43.00 %
37	Angier (Wake)	90,867	556	556	0.61 %	100.00 %
	Cary (Wake)	90,867	171,012	2,012	2.21 %	1.18 %
	Fuquay-Varina (Wake)	90,867	34,152	34,106	37.53 %	99.87 %
	Garner	90,867	31,159	0	0.00 %	0.00 %
	Holly Springs	90,867	41,239	11,613	12.78 %	28.16 %
38	Clayton (Wake)	88,226	0	0	0.00 %	0.00 %
	Garner	88,226	31,159	19,356	21.94 %	62.12 %
	Knightdale	88,226	19,435	0	0.00 %	0.00 %
	Raleigh (Wake)	88,226	466,106	56,840	64.43 %	12.19 %
39	Clayton (Wake)	90,164	0	0	0.00 %	0.00 %
	Knightdale	90,164	19,435	19,435	21.56 %	100.00 %
	Raleigh (Wake)	90,164	466,106	13,011	14.43 %	2.79 %
	Rolesville	90,164	9,475	8	0.01 %	0.08 %
	Wendell	90,164	9,793	9,793	10.86 %	100.00 %
	Zebulon (Wake)	90,164	6,903	6,903	7.66 %	100.00 %
40	Durham (Wake)	83,175	269	269	0.32 %	100.00 %
	Raleigh (Wake)	83,175	466,106	57,345	68.94 %	12.30 %
41	Apex	89,887	58,780	381	0.42 %	0.65 %
	Cary (Wake)	89,887	171,012	74,074	82.41 %	43.32 %
	Morrisville (Wake)	89,887	29,423	14,239	15.84 %	48.39 %
42	Fayetteville	85,537	208,501	65,401	76.46 %	31.37 %

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District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
42	Spring Lake	85,537	11,660	11,660	13.63 %	100.00 %
43	Eastover	82,956	3,656	3,656	4.41 %	100.00 %
	Falcon (Cumberland)	82,956	324	324	0.39 %	100.00 %
	Fayetteville	82,956	208,501	44,532	53.68 %	21.36 %
	Godwin	82,956	128	128	0.15 %	100.00 %
	Hope Mills	82,956	17,808	64	0.08 %	0.36 %
	Linden	82,956	136	136	0.16 %	100.00 %
	Stedman	82,956	1,277	1,277	1.54 %	100.00 %
	Wade	82,956	638	638	0.77 %	100.00 %
44	Fayetteville	83,297	208,501	83,293	100.00 %	39.95 %
45	Fayetteville	82,938	208,501	15,275	18.42 %	7.33 %
	Hope Mills	82,938	17,808	17,744	21.39 %	99.64 %
46	Boardman	83,445	166	166	0.20 %	100.00 %
	Bolton	83,445	519	519	0.62 %	100.00 %
	Brunswick	83,445	973	973	1.17 %	100.00 %
	Cerro Gordo	83,445	131	131	0.16 %	100.00 %
	Chadbourn	83,445	1,574	1,574	1.89 %	100.00 %
	Fair Bluff	83,445	709	709	0.85 %	100.00 %
	Fairmont	83,445	2,191	2,191	2.63 %	100.00 %
	Lake Waccamaw	83,445	1,296	1,296	1.55 %	100.00 %
	Lumberton	83,445	19,025	350	0.42 %	1.84 %
	Marietta	83,445	111	111	0.13 %	100.00 %
	Maxton (Robeson)	83,445	1,902	1,902	2.28 %	100.00 %
	McDonald	83,445	94	94	0.11 %	100.00 %
	Orrum	83,445	59	59	0.07 %	100.00 %
	Proctorville	83,445	121	121	0.15 %	100.00 %
	Raynham	83,445	60	60	0.07 %	100.00 %
	Rowland	83,445	885	885	1.06 %	100.00 %
	Sandyfield	83,445	430	430	0.52 %	100.00 %
	Tabor City	83,445	3,781	3,781	4.53 %	100.00 %
	Whiteville	83,445	4,766	4,766	5.71 %	100.00 %
47	Fairmont	83,708	2,191	0	0.00 %	0.00 %
	Lumber Bridge	83,708	82	82	0.10 %	100.00 %
	Lumberton	83,708	19,025	18,675	22.31 %	98.16 %
	Parkton	83,708	504	504	0.60 %	100.00 %
	Pembroke	83,708	2,823	2,823	3.37 %	100.00 %
	Red Springs (Robeson)	83,708	3,087	3,087	3.69 %	100.00 %
	Rennert	83,708	275	275	0.33 %	100.00 %
	St. Pauls	83,708	2,045	2,045	2.44 %	100.00 %
48	East Laurinburg	86,256	234	234	0.27 %	100.00 %
	Gibson	86,256	449	449	0.52 %	100.00 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM [G20-DMbC] - Generated 11/4/2021
Municipalities derive from the 2020 Census Redistricting Data (P.L. 94-171) Shapefiles. Population figures are based on the associated Summary File.
Note that for the purposes of this report, portions of municipalities in different counties are treated separately.
Districts included: All

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48	Laurinburg	86,256	14,978	14,978	17.36 %	100.00 %
	Maxton (Scotland)	86,256	208	208	0.24 %	100.00 %
	Raeford	86,256	4,559	4,559	5.29 %	100.00 %
	Red Springs (Hoke)	86,256	0	0	0.00 %	0.00 %
	Wagram	86,256	615	615	0.71 %	100.00 %
49	Cary (Wake)	86,157	171,012	20,767	24.10 %	12.14 %
	Durham (Wake)	86,157	269	0	0.00 %	0.00 %
	Morrisville (Wake)	86,157	29,423	15,184	17.62 %	51.61 %
	Raleigh (Wake)	86,157	466,106	47,783	55.46 %	10.25 %
50	Carrboro	85,345	21,295	174	0.20 %	0.82 %
	Durham (Orange)	85,345	144	144	0.17 %	100.00 %
	Hillsborough	85,345	9,660	9,660	11.32 %	100.00 %
	Mebane (Orange)	85,345	3,171	3,171	3.72 %	100.00 %
	Milton	85,345	155	155	0.18 %	100.00 %
	Yanceyville	85,345	1,937	1,937	2.27 %	100.00 %
51	Broadway (Lee)	83,073	1,267	1,267	1.53 %	100.00 %
	Cameron	83,073	244	244	0.29 %	100.00 %
	Carthage	83,073	2,775	2,747	3.31 %	98.99 %
	Sanford	83,073	30,261	30,261	36.43 %	100.00 %
	Vass	83,073	952	952	1.15 %	100.00 %
52	Aberdeen	84,383	8,516	8,516	10.09 %	100.00 %
	Carthage	84,383	2,775	28	0.03 %	1.01 %
	Dobbins Heights	84,383	687	687	0.81 %	100.00 %
	Ellerbe	84,383	864	864	1.02 %	100.00 %
	Foxfire	84,383	1,288	0	0.00 %	0.00 %
	Hamlet	84,383	6,025	6,025	7.14 %	100.00 %
	Hoffman	84,383	418	418	0.50 %	100.00 %
	Norman	84,383	100	100	0.12 %	100.00 %
	Pinebluff	84,383	1,473	1,473	1.75 %	100.00 %
	Pinehurst	84,383	17,581	8	0.01 %	0.05 %
	Rockingham	84,383	9,243	9,243	10.95 %	100.00 %
	Southern Pines	84,383	15,545	15,545	18.42 %	100.00 %
	Taylortown	84,383	634	4	0.00 %	0.63 %
	Whispering Pines	84,383	4,987	4,987	5.91 %	100.00 %
53	Benson (Harnett)	86,899	0	0	0.00 %	0.00 %
	Coats	86,899	2,155	2,155	2.48 %	100.00 %
	Dunn	86,899	8,446	8,446	9.72 %	100.00 %
	Erwin	86,899	4,542	4,542	5.23 %	100.00 %
	Lillington	86,899	4,735	3,853	4.43 %	81.37 %
54	Cary (Chatham)	83,475	3,709	3,709	4.44 %	100.00 %
	Goldston	83,475	234	234	0.28 %	100.00 %

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54	Liberty	83,475	2,655	2,655	3.18 %	100.00 %
	Pittsboro	83,475	4,537	4,537	5.44 %	100.00 %
	Siler City	83,475	7,702	7,702	9.23 %	100.00 %
	Staley	83,475	397	397	0.48 %	100.00 %
55	Ansonville	87,005	440	440	0.51 %	100.00 %
	Indian Trail	87,005	39,997	2,376	2.73 %	5.94 %
	Lilesville	87,005	395	395	0.45 %	100.00 %
	Marshville	87,005	2,522	2,522	2.90 %	100.00 %
	McFarlan	87,005	94	94	0.11 %	100.00 %
	Mineral Springs	87,005	3,159	2,293	2.64 %	72.59 %
	Monroe	87,005	34,562	12,650	14.54 %	36.60 %
	Morven	87,005	329	329	0.38 %	100.00 %
	Peachland	87,005	390	390	0.45 %	100.00 %
	Polkton	87,005	2,250	2,250	2.59 %	100.00 %
	Wadesboro	87,005	5,008	5,008	5.76 %	100.00 %
	Waxhaw	87,005	20,534	0	0.00 %	0.00 %
	Wesley Chapel	87,005	8,681	3,868	4.45 %	44.56 %
	Wingate	87,005	4,055	4,055	4.66 %	100.00 %
56	Carrboro	86,087	21,295	21,121	24.53 %	99.18 %
	Chapel Hill (Orange)	86,087	59,054	59,054	68.60 %	100.00 %
57	Greensboro	90,615	299,035	83,540	92.19 %	27.94 %
	Summerfield	90,615	10,951	746	0.82 %	6.81 %
58	Greensboro	90,808	299,035	84,725	93.30 %	28.33 %
59	Burlington (Guilford)	90,361	1,822	1,822	2.02 %	100.00 %
	Gibsonville (Guilford)	90,361	4,642	4,642	5.14 %	100.00 %
	Greensboro	90,361	299,035	13,852	15.33 %	4.63 %
	Pleasant Garden	90,361	5,000	5,000	5.53 %	100.00 %
	Sedalia	90,361	676	676	0.75 %	100.00 %
	Summerfield	90,361	10,951	2,509	2.78 %	22.91 %
	Whitsett	90,361	584	584	0.65 %	100.00 %
60	Archdale (Guilford)	89,735	380	380	0.42 %	100.00 %
	Greensboro	89,735	299,035	8,829	9.84 %	2.95 %
	High Point (Guilford)	89,735	107,321	66,033	73.59 %	61.53 %
	Jamestown	89,735	3,668	3,668	4.09 %	100.00 %
61	Greensboro	90,201	299,035	90,201	100.00 %	30.16 %
62	Greensboro	89,579	299,035	17,888	19.97 %	5.98 %
	High Point (Guilford)	89,579	107,321	41,288	46.09 %	38.47 %
	Kernersville (Guilford)	89,579	502	502	0.56 %	100.00 %
	Oak Ridge	89,579	7,474	7,474	8.34 %	100.00 %
	Stokesdale	89,579	5,924	5,924	6.61 %	100.00 %
	Summerfield	89,579	10,951	7,696	8.59 %	70.28 %

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63	Burlington (Alamance)	86,399	55,481	25,917	30.00 %	46.71 %
	Graham	86,399	17,157	17,157	19.86 %	100.00 %
	Green Level	86,399	3,152	3,152	3.65 %	100.00 %
	Haw River	86,399	2,252	2,252	2.61 %	100.00 %
	Mebane (Alamance)	86,399	14,626	14,626	16.93 %	100.00 %
	Swepsonville	86,399	2,445	2,445	2.83 %	100.00 %
64	Alamance	85,016	988	988	1.16 %	100.00 %
	Burlington (Alamance)	85,016	55,481	29,564	34.77 %	53.29 %
	Elon	85,016	11,336	11,336	13.33 %	100.00 %
	Gibsonville (Alamance)	85,016	4,278	4,278	5.03 %	100.00 %
	Ossipee	85,016	536	536	0.63 %	100.00 %
65	Eden	91,096	15,421	15,421	16.93 %	100.00 %
	Madison	91,096	2,129	2,129	2.34 %	100.00 %
	Mayodan	91,096	2,418	2,418	2.65 %	100.00 %
	Reidsville	91,096	14,583	14,583	16.01 %	100.00 %
	Stoneville	91,096	1,308	1,308	1.44 %	100.00 %
	Wentworth	91,096	2,662	2,662	2.92 %	100.00 %
66	Raleigh (Wake)	83,189	466,106	78,168	93.96 %	16.77 %
	Wake Forest (Wake)	83,189	46,097	0	0.00 %	0.00 %
67	Albemarle	88,255	16,432	16,432	18.62 %	100.00 %
	Badin	88,255	2,024	2,024	2.29 %	100.00 %
	Biscoe	88,255	1,848	1,848	2.09 %	100.00 %
	Candor (Montgomery)	88,255	813	813	0.92 %	100.00 %
	Locust (Stanly)	88,255	3,996	3,996	4.53 %	100.00 %
	Misenheimer	88,255	650	650	0.74 %	100.00 %
	Mount Gilead	88,255	1,171	1,171	1.33 %	100.00 %
	New London	88,255	607	607	0.69 %	100.00 %
	Norwood	88,255	2,367	2,367	2.68 %	100.00 %
	Oakboro	88,255	2,128	2,128	2.41 %	100.00 %
	Red Cross	88,255	762	762	0.86 %	100.00 %
	Richfield	88,255	582	582	0.66 %	100.00 %
	Stanfield	88,255	1,585	1,585	1.80 %	100.00 %
	Star	88,255	806	806	0.91 %	100.00 %
	Troy	88,255	2,850	2,850	3.23 %	100.00 %
68	Indian Trail	88,138	39,997	15,036	17.06 %	37.59 %
	Marvin	88,138	6,358	6,358	7.21 %	100.00 %
	Mineral Springs	88,138	3,159	866	0.98 %	27.41 %
	Stallings (Union)	88,138	15,728	0	0.00 %	0.00 %
	Waxhaw	88,138	20,534	20,534	23.30 %	100.00 %
	Weddington (Union)	88,138	13,176	13,172	14.94 %	99.97 %
	Wesley Chapel	88,138	8,681	4,813	5.46 %	55.44 %

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69	Fairview	85,179	3,456	3,456	4.06 %	100.00 %
	Hemby Bridge	85,179	1,614	1,614	1.89 %	100.00 %
	Indian Trail	85,179	39,997	22,585	26.51 %	56.47 %
	Lake Park	85,179	3,269	3,269	3.84 %	100.00 %
	Mint Hill (Union)	85,179	6	6	0.01 %	100.00 %
	Monroe	85,179	34,562	21,912	25.72 %	63.40 %
	Stallings (Union)	85,179	15,728	15,728	18.46 %	100.00 %
	Unionville	85,179	6,643	6,643	7.80 %	100.00 %
	Weddington (Union)	85,179	13,176	4	0.00 %	0.03 %
70	Archdale (Randolph)	89,118	11,527	11,527	12.93 %	100.00 %
	Asheboro	89,118	27,156	25,890	29.05 %	95.34 %
	High Point (Randolph)	89,118	8	8	0.01 %	100.00 %
	Randleman	89,118	4,595	4,595	5.16 %	100.00 %
	Thomasville (Randolph)	89,118	521	521	0.58 %	100.00 %
	Trinity	89,118	7,006	7,006	7.86 %	100.00 %
71	Kernersville (Forsyth)	84,874	25,947	0	0.00 %	0.00 %
	Walkertown	84,874	5,692	3,176	3.74 %	55.80 %
	Winston-Salem	84,874	249,545	77,631	91.47 %	31.11 %
72	Winston-Salem	86,949	249,545	86,867	99.91 %	34.81 %
73	Concord	90,649	105,240	32,447	35.79 %	30.83 %
	Harrisburg	90,649	18,967	18,967	20.92 %	100.00 %
	Locust (Cabarrus)	90,649	541	541	0.60 %	100.00 %
	Midland (Cabarrus)	90,649	4,684	4,684	5.17 %	100.00 %
	Mount Pleasant	90,649	1,671	1,671	1.84 %	100.00 %
74	Bethania	84,857	344	0	0.00 %	0.00 %
	Clemmons	84,857	21,163	21,163	24.94 %	100.00 %
	Lewisville	84,857	13,381	13,381	15.77 %	100.00 %
	Tobaccoville (Forsyth)	84,857	2,578	824	0.97 %	31.96 %
	Winston-Salem	84,857	249,545	32,409	38.19 %	12.99 %
75	High Point (Forsyth)	84,220	84	84	0.10 %	100.00 %
	Kernersville (Forsyth)	84,220	25,947	25,947	30.81 %	100.00 %
	Walkertown	84,220	5,692	2,516	2.99 %	44.20 %
	Winston-Salem	84,220	249,545	22,818	27.09 %	9.14 %
76	East Spencer	89,815	1,567	1,567	1.74 %	100.00 %
	Faith	89,815	819	819	0.91 %	100.00 %
	Granite Quarry	89,815	2,984	2,984	3.32 %	100.00 %
	Rockwell	89,815	2,302	2,302	2.56 %	100.00 %
	Salisbury	89,815	35,540	35,540	39.57 %	100.00 %
	Spencer	89,815	3,308	3,308	3.68 %	100.00 %
77	Bermuda Run	90,628	3,120	3,120	3.44 %	100.00 %
	Boonville	90,628	1,185	1,185	1.31 %	100.00 %

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77	Cleveland	90,628	846	846	0.93 %	100.00 %
	Cooleemee	90,628	940	940	1.04 %	100.00 %
	East Bend	90,628	634	634	0.70 %	100.00 %
	Jonesville	90,628	2,308	2,308	2.55 %	100.00 %
	Mocksville	90,628	5,900	5,900	6.51 %	100.00 %
	Yadkinville	90,628	2,995	2,995	3.30 %	100.00 %
78	Aberdeen	86,365	8,516	0	0.00 %	0.00 %
	Asheboro	86,365	27,156	1,266	1.47 %	4.66 %
	Candor (Moore)	86,365	0	0	0.00 %	0.00 %
	Foxfire	86,365	1,288	1,288	1.49 %	100.00 %
	Franklinville	86,365	1,197	1,197	1.39 %	100.00 %
	Pinehurst	86,365	17,581	17,573	20.35 %	99.95 %
	Ramseur	86,365	1,774	1,774	2.05 %	100.00 %
	Robbins	86,365	1,168	1,168	1.35 %	100.00 %
	Seagrove	86,365	235	235	0.27 %	100.00 %
	Southern Pines	86,365	15,545	0	0.00 %	0.00 %
	Taylortown	86,365	634	630	0.73 %	99.37 %
79	Alliance	83,163	733	733	0.88 %	100.00 %
	Arapahoe	83,163	416	416	0.50 %	100.00 %
	Aurora	83,163	455	455	0.55 %	100.00 %
	Bath	83,163	245	245	0.29 %	100.00 %
	Bayboro	83,163	1,161	1,161	1.40 %	100.00 %
	Belhaven	83,163	1,410	1,410	1.70 %	100.00 %
	Chocowinity	83,163	722	722	0.87 %	100.00 %
	Grantsboro	83,163	692	692	0.83 %	100.00 %
	Kill Devil Hills	83,163	7,656	538	0.65 %	7.03 %
	Manteo	83,163	1,600	1,600	1.92 %	100.00 %
	Mesic	83,163	144	144	0.17 %	100.00 %
	Minnesott Beach	83,163	530	530	0.64 %	100.00 %
	Nags Head	83,163	3,168	3,168	3.81 %	100.00 %
	Oriental	83,163	880	880	1.06 %	100.00 %
	Pantego	83,163	164	164	0.20 %	100.00 %
	Stonewall	83,163	214	214	0.26 %	100.00 %
	Vandemere	83,163	246	246	0.30 %	100.00 %
	Washington	83,163	9,875	9,875	11.87 %	100.00 %
	Washington Park	83,163	392	392	0.47 %	100.00 %
80	Denton	84,864	1,494	1,494	1.76 %	100.00 %
	High Point (Davidson)	84,864	6,646	6,646	7.83 %	100.00 %
	Lexington	84,864	19,632	0	0.00 %	0.00 %
	Midway	84,864	4,742	3,469	4.09 %	73.15 %
	Thomasville (Davidson)	84,864	26,662	26,662	31.42 %	100.00 %

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80	Wallburg	84,864	3,051	3,051	3.60 %	100.00 %
81	Lexington	84,066	19,632	19,632	23.35 %	100.00 %
	Midway	84,066	4,742	1,273	1.51 %	26.85 %
82	Concord	90,771	105,240	48,723	53.68 %	46.30 %
	Kannapolis (Cabarrus)	90,771	42,846	33,907	37.35 %	79.14 %
83	China Grove	90,742	4,434	4,434	4.89 %	100.00 %
	Concord	90,742	105,240	24,070	26.53 %	22.87 %
	Kannapolis (Cabarrus)	90,742	42,846	8,939	9.85 %	20.86 %
	Kannapolis (Rowan)	90,742	10,268	10,268	11.32 %	100.00 %
	Landis	90,742	3,690	3,690	4.07 %	100.00 %
84	Harmony	86,773	543	543	0.63 %	100.00 %
	Love Valley	86,773	154	154	0.18 %	100.00 %
	Mooresville	86,773	50,193	205	0.24 %	0.41 %
	Statesville	86,773	28,419	28,415	32.75 %	99.99 %
	Troutman	86,773	3,698	885	1.02 %	23.93 %
85	Bakersville	90,863	450	450	0.50 %	100.00 %
	Banner Elk	90,863	1,049	1,049	1.15 %	100.00 %
	Beech Mountain (Avery)	90,863	62	62	0.07 %	100.00 %
	Burnsville	90,863	1,614	1,614	1.78 %	100.00 %
	Crossnore	90,863	143	143	0.16 %	100.00 %
	Elk Park	90,863	542	542	0.60 %	100.00 %
	Grandfather Village	90,863	95	95	0.10 %	100.00 %
	Marion	90,863	7,717	7,717	8.49 %	100.00 %
	Newland	90,863	715	715	0.79 %	100.00 %
	Old Fort	90,863	811	811	0.89 %	100.00 %
	Seven Devils (Avery)	90,863	38	38	0.04 %	100.00 %
	Spruce Pine	90,863	2,194	2,194	2.41 %	100.00 %
	Sugar Mountain	90,863	371	371	0.41 %	100.00 %
86	Connelly Springs	87,570	1,529	1,529	1.75 %	100.00 %
	Drexel	87,570	1,760	1,760	2.01 %	100.00 %
	Glen Alpine	87,570	1,529	1,529	1.75 %	100.00 %
	Hickory (Burke)	87,570	79	79	0.09 %	100.00 %
	Hildebran	87,570	1,679	1,679	1.92 %	100.00 %
	Long View (Burke)	87,570	735	735	0.84 %	100.00 %
	Morganton	87,570	17,474	17,474	19.95 %	100.00 %
	Rhodhiss (Burke)	87,570	639	639	0.73 %	100.00 %
	Rutherford College (Burke)	87,570	1,226	1,226	1.40 %	100.00 %
	Valdese	87,570	4,689	4,689	5.35 %	100.00 %
87	Blowing Rock (Caldwell)	85,758	91	91	0.11 %	100.00 %
	Blowing Rock (Watauga)	85,758	1,285	5	0.01 %	0.39 %
	Boone	85,758	19,092	595	0.69 %	3.12 %

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87	Cajah's Mountain	85,758	2,722	2,722	3.17 %	100.00 %
	Cedar Rock	85,758	301	301	0.35 %	100.00 %
	Gamewell	85,758	3,702	3,702	4.32 %	100.00 %
	Granite Falls	85,758	4,965	4,965	5.79 %	100.00 %
	Hickory (Caldwell)	85,758	32	32	0.04 %	100.00 %
	Hudson	85,758	3,780	3,780	4.41 %	100.00 %
	Lenoir	85,758	18,352	18,352	21.40 %	100.00 %
	Rhodhiss (Caldwell)	85,758	358	358	0.42 %	100.00 %
	Rutherford College (Caldwell)	85,758	0	0	0.00 %	0.00 %
	Sawmills	85,758	5,020	5,020	5.85 %	100.00 %
88	Charlotte	82,834	874,579	82,834	100.00 %	9.47 %
89	Catawba	85,577	702	702	0.82 %	100.00 %
	Claremont	85,577	1,692	1,692	1.98 %	100.00 %
	Conover	85,577	8,421	424	0.50 %	5.04 %
	Hickory (Catawba)	85,577	43,379	0	0.00 %	0.00 %
	Maiden (Catawba)	85,577	3,736	3,736	4.37 %	100.00 %
	Newton	85,577	13,148	13,148	15.36 %	100.00 %
	Statesville	85,577	28,419	4	0.00 %	0.01 %
	Troutman	85,577	3,698	2,813	3.29 %	76.07 %
90	Dobson	82,937	1,462	1,462	1.76 %	100.00 %
	Elkin (Surry)	82,937	4,049	4,049	4.88 %	100.00 %
	Elkin (Wilkes)	82,937	73	73	0.09 %	100.00 %
	Mount Airy	82,937	10,676	10,676	12.87 %	100.00 %
	Pilot Mountain	82,937	1,440	1,440	1.74 %	100.00 %
	Ronda	82,937	438	438	0.53 %	100.00 %
91	Bethania	86,210	344	344	0.40 %	100.00 %
	Danbury	86,210	189	189	0.22 %	100.00 %
	King (Forsyth)	86,210	591	591	0.69 %	100.00 %
	King (Stokes)	86,210	6,606	6,606	7.66 %	100.00 %
	Rural Hall	86,210	3,351	3,351	3.89 %	100.00 %
	Tobaccoville (Forsyth)	86,210	2,578	1,754	2.03 %	68.04 %
	Tobaccoville (Stokes)	86,210	0	0	0.00 %	0.00 %
	Walnut Cove	86,210	1,586	1,586	1.84 %	100.00 %
	Winston-Salem	86,210	249,545	29,820	34.59 %	11.95 %
92	Charlotte	85,031	874,579	63,762	74.99 %	7.29 %
93	Beech Mountain (Watauga)	86,445	613	613	0.71 %	100.00 %
	Blowing Rock (Watauga)	86,445	1,285	1,280	1.48 %	99.61 %
	Boone	86,445	19,092	18,497	21.40 %	96.88 %
	Jefferson	86,445	1,622	1,622	1.88 %	100.00 %
	Lansing	86,445	126	126	0.15 %	100.00 %
	Seven Devils (Watauga)	86,445	275	275	0.32 %	100.00 %

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93	Sparta	86,445	1,834	1,834	2.12 %	100.00 %
	West Jefferson	86,445	1,279	1,279	1.48 %	100.00 %
94	North Wilkesboro	90,835	4,382	4,382	4.82 %	100.00 %
	Taylorsville	90,835	2,320	2,320	2.55 %	100.00 %
	Wilkesboro	90,835	3,687	3,687	4.06 %	100.00 %
95	Davidson (Iredell)	85,366	378	378	0.44 %	100.00 %
	Mooresville	85,366	50,193	49,988	58.56 %	99.59 %
96	Brookford	89,587	442	442	0.49 %	100.00 %
	Conover	89,587	8,421	7,997	8.93 %	94.96 %
	Hickory (Catawba)	89,587	43,379	43,379	48.42 %	100.00 %
	Long View (Catawba)	89,587	4,353	4,353	4.86 %	100.00 %
	Newton	89,587	13,148	0	0.00 %	0.00 %
97	Lincolnton	86,810	11,091	11,091	12.78 %	100.00 %
	Maiden (Lincoln)	86,810	0	0	0.00 %	0.00 %
98	Cornelius	86,827	31,412	31,412	36.18 %	100.00 %
	Davidson (Mecklenburg)	86,827	14,728	14,728	16.96 %	100.00 %
	Huntersville	86,827	61,376	38,677	44.54 %	63.02 %
99	Charlotte	87,647	874,579	79,113	90.26 %	9.05 %
	Mint Hill (Mecklenburg)	87,647	26,444	0	0.00 %	0.00 %
100	Charlotte	87,197	874,579	87,197	100.00 %	9.97 %
101	Charlotte	86,426	874,579	64,526	74.66 %	7.38 %
	Huntersville	86,426	61,376	5,893	6.82 %	9.60 %
102	Charlotte	86,179	874,579	86,179	100.00 %	9.85 %
103	Charlotte	87,132	874,579	23,590	27.07 %	2.70 %
	Matthews	87,132	29,435	29,435	33.78 %	100.00 %
	Midland (Mecklenburg)	87,132	0	0	0.00 %	0.00 %
	Mint Hill (Mecklenburg)	87,132	26,444	26,444	30.35 %	100.00 %
	Stallings (Mecklenburg)	87,132	384	384	0.44 %	100.00 %
	Weddington (Mecklenburg)	87,132	5	5	0.01 %	100.00 %
104	Charlotte	86,520	874,579	86,520	100.00 %	9.89 %
105	Charlotte	85,822	874,579	71,156	82.91 %	8.14 %
	Pineville	85,822	10,602	10,602	12.35 %	100.00 %
106	Charlotte	82,824	874,579	79,717	96.25 %	9.11 %
107	Charlotte	88,237	874,579	67,298	76.27 %	7.69 %
	Huntersville	88,237	61,376	16,806	19.05 %	27.38 %
108	Belmont	86,263	15,010	1,868	2.17 %	12.45 %
	Cramerton	86,263	5,296	96	0.11 %	1.81 %
	Gastonia	86,263	80,411	28,480	33.02 %	35.42 %
	Lowell	86,263	3,654	3,654	4.24 %	100.00 %
	McAdenville	86,263	890	890	1.03 %	100.00 %
	Mount Holly	86,263	17,703	17,703	20.52 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
108	Ranlo	86,263	4,511	4,500	5.22 %	99.76 %
	Spencer Mountain	86,263	0	0	0.00 %	0.00 %
	Stanley	86,263	3,963	3,963	4.59 %	100.00 %
109	Belmont	87,762	15,010	13,142	14.97 %	87.55 %
	Cramerton	87,762	5,296	5,200	5.93 %	98.19 %
	Gastonia	87,762	80,411	44,448	50.65 %	55.28 %
	Lowell	87,762	3,654	0	0.00 %	0.00 %
110	Belwood	88,397	857	857	0.97 %	100.00 %
	Bessemer City	88,397	5,428	5,428	6.14 %	100.00 %
	Casar	88,397	305	305	0.35 %	100.00 %
	Cherryville	88,397	6,078	6,078	6.88 %	100.00 %
	Dallas	88,397	5,927	5,927	6.70 %	100.00 %
	Dellview	88,397	6	6	0.01 %	100.00 %
	Fallston	88,397	627	627	0.71 %	100.00 %
	Gastonia	88,397	80,411	7,483	8.47 %	9.31 %
	High Shoals	88,397	595	595	0.67 %	100.00 %
	Kings Mountain (Cleveland)	88,397	10,032	8	0.01 %	0.08 %
	Kings Mountain (Gaston)	88,397	1,110	1,110	1.26 %	100.00 %
	Kingstown	88,397	656	656	0.74 %	100.00 %
	Lawndale	88,397	570	570	0.64 %	100.00 %
	Polkville	88,397	516	516	0.58 %	100.00 %
	Ranlo	88,397	4,511	11	0.01 %	0.24 %
	Shelby	88,397	21,918	4,409	4.99 %	20.12 %
	Waco	88,397	310	310	0.35 %	100.00 %
111	Boiling Springs	89,894	4,615	4,615	5.13 %	100.00 %
	Bostic	89,894	355	355	0.39 %	100.00 %
	Earl	89,894	198	198	0.22 %	100.00 %
	Ellenboro	89,894	723	723	0.80 %	100.00 %
	Forest City	89,894	7,377	0	0.00 %	0.00 %
	Grover	89,894	802	802	0.89 %	100.00 %
	Kings Mountain (Cleveland)	89,894	10,032	10,024	11.15 %	99.92 %
	Lattimore	89,894	406	406	0.45 %	100.00 %
	Mooresboro	89,894	293	293	0.33 %	100.00 %
	Patterson Springs	89,894	571	571	0.64 %	100.00 %
	Shelby	89,894	21,918	17,509	19.48 %	79.88 %
112	Charlotte	82,806	874,579	82,687	99.86 %	9.45 %
	Pineville	82,806	10,602	0	0.00 %	0.00 %
113	Chimney Rock Village	89,058	140	140	0.16 %	100.00 %
	Columbus	89,058	1,060	1,060	1.19 %	100.00 %
	Flat Rock	89,058	3,486	3,486	3.91 %	100.00 %
	Forest City	89,058	7,377	7,377	8.28 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
113	Hendersonville	89,058	15,137	623	0.70 %	4.12 %
	Lake Lure	89,058	1,365	1,365	1.53 %	100.00 %
	Laurel Park	89,058	2,250	0	0.00 %	0.00 %
	Ruth	89,058	347	347	0.39 %	100.00 %
	Rutherfordton	89,058	3,640	3,640	4.09 %	100.00 %
	Saluda (Henderson)	89,058	11	11	0.01 %	100.00 %
	Saluda (Polk)	89,058	620	620	0.70 %	100.00 %
	Spindale	89,058	4,225	4,225	4.74 %	100.00 %
	Tryon	89,058	1,562	1,562	1.75 %	100.00 %
114	Asheville	89,685	94,589	52,596	58.65 %	55.60 %
	Weaverville	89,685	4,567	4,567	5.09 %	100.00 %
	Woodfin	89,685	7,936	7,648	8.53 %	96.37 %
115	Asheville	90,262	94,589	29,236	32.39 %	30.91 %
	Black Mountain	90,262	8,426	8,426	9.34 %	100.00 %
	Montreat	90,262	901	901	1.00 %	100.00 %
116	Asheville	89,505	94,589	12,757	14.25 %	13.49 %
	Biltmore Forest	89,505	1,409	1,409	1.57 %	100.00 %
	Woodfin	89,505	7,936	288	0.32 %	3.63 %
117	Fletcher	91,035	7,987	7,987	8.77 %	100.00 %
	Hendersonville	91,035	15,137	14,514	15.94 %	95.88 %
	Laurel Park	91,035	2,250	2,250	2.47 %	100.00 %
	Mills River	91,035	7,078	7,078	7.78 %	100.00 %
118	Canton	83,282	4,422	4,422	5.31 %	100.00 %
	Clyde	83,282	1,368	1,368	1.64 %	100.00 %
	Hot Springs	83,282	520	520	0.62 %	100.00 %
	Maggie Valley	83,282	1,687	1,687	2.03 %	100.00 %
	Mars Hill	83,282	2,007	2,007	2.41 %	100.00 %
	Marshall	83,282	777	777	0.93 %	100.00 %
	Waynesville	83,282	10,140	10,140	12.18 %	100.00 %
119	Brevard	90,212	7,744	7,744	8.58 %	100.00 %
	Bryson City	90,212	1,558	1,558	1.73 %	100.00 %
	Dillsboro	90,212	213	213	0.24 %	100.00 %
	Forest Hills	90,212	303	303	0.34 %	100.00 %
	Highlands (Jackson)	90,212	12	12	0.01 %	100.00 %
	Rosman	90,212	701	701	0.78 %	100.00 %
	Sylva	90,212	2,578	2,578	2.86 %	100.00 %
	Webster	90,212	372	372	0.41 %	100.00 %
120	Andrews	84,907	1,667	1,667	1.96 %	100.00 %
	Fontana Dam	84,907	13	13	0.02 %	100.00 %
	Franklin	84,907	4,175	4,175	4.92 %	100.00 %
	Hayesville	84,907	461	461	0.54 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
120	Highlands (Macon)	84,907	1,060	1,060	1.25 %	100.00 %
	Lake Santeetlah	84,907	38	38	0.04 %	100.00 %
	Murphy	84,907	1,608	1,608	1.89 %	100.00 %
	Robbinsville	84,907	597	597	0.70 %	100.00 %
			Total:	**6,017,605**		

PEGDEN 5

NC General Assembly

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
1	Chowan	6	0
	Currituck	11	0
	Dare	3	1
	Perquimans	7	0
	Tyrrell	6	0
	Washington	6	0
2	Durham	8	2
	Person	11	0
3	Craven	19	1
4	Duplin	19	0
	Wayne	7	1
5	Camden	3	0
	Gates	6	0
	Hertford	13	0
	Pasquotank	9	0
6	Harnett	6	0
7	Franklin	18	0
	Granville	2	0
8	Pitt	21	0
9	Pitt	19	0
10	Wayne	20	1
11	Wake	19	0
12	Greene	10	0
	Jones	7	0
	Lenoir	22	0
13	Carteret	28	0
	Craven	1	1
14	Onslow	10	0
15	Onslow	9	0
16	Onslow	5	0
	Pender	20	0
17	Brunswick	14	0
18	New Hanover	19	0
19	Brunswick	11	0
	New Hanover	7	0
20	New Hanover	17	0
21	Wake	16	0
22	Bladen	17	0
	Sampson	23	0
23	Bertie	12	0
	Edgecombe	21	0
	Martin	13	0

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NC General Assembly

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
24	Nash	2	0
	Wilson	24	0
25	Nash	22	0
26	Johnston	12	0
27	Halifax	23	0
	Northampton	13	0
	Warren	14	0
28	Johnston	18	0
29	Durham	21	1
30	Durham	17	1
31	Durham	8	2
32	Granville	13	0
	Vance	12	0
33	Wake	19	0
34	Wake	24	0
35	Wake	14	0
36	Wake	12	0
37	Wake	12	0
38	Wake	13	0
39	Wake	14	0
40	Wake	20	0
41	Wake	11	0
42	Cumberland	13	0
43	Cumberland	28	0
44	Cumberland	19	0
45	Cumberland	16	0
46	Columbus	26	0
	Robeson	14	0
47	Robeson	25	0
48	Hoke	15	0
	Scotland	7	0
49	Wake	15	0
50	Caswell	9	0
	Orange	18	0
51	Lee	10	0
	Moore	4	0
52	Moore	10	0
	Richmond	16	0
53	Harnett	7	0
	Johnston	6	0
54	Chatham	18	0
	Randolph	2	0

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NC General Assembly

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
55	Anson	9	0
	Union	17	0
56	Orange	23	0
57	Guilford	27	0
58	Guilford	24	0
59	Guilford	24	0
60	Guilford	27	0
61	Guilford	34	0
62	Guilford	29	0
63	Alamance	19	0
64	Alamance	18	0
65	Rockingham	15	0
66	Wake	15	0
67	Montgomery	14	0
	Stanly	22	0
68	Union	16	0
69	Union	19	0
70	Randolph	12	0
71	Forsyth	20	0
72	Forsyth	32	0
73	Cabarrus	15	0
74	Forsyth	19	0
75	Forsyth	19	0
76	Rowan	25	0
77	Davie	14	0
	Rowan	5	0
	Yadkin	12	0
78	Moore	12	0
	Randolph	8	0
79	Beaufort	21	0
	Dare	12	1
	Hyde	7	0
	Pamlico	10	0
80	Davidson	22	0
81	Davidson	21	0
82	Cabarrus	20	0
83	Cabarrus	5	0
	Rowan	11	0
84	Iredell	19	0
85	Avery	19	0
	McDowell	15	0
	Mitchell	9	0
	Yancey	11	0

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NC General Assembly

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
86	Burke	33	0
87	Caldwell	20	0
	Watauga	2	0
88	Mecklenburg	18	0
89	Catawba	17	0
	Iredell	2	0
90	Surry	24	0
	Wilkes	6	0
91	Forsyth	11	0
	Stokes	18	0
92	Mecklenburg	9	0
93	Alleghany	4	0
	Ashe	17	0
	Watauga	18	0
94	Alexander	10	0
	Wilkes	21	0
95	Iredell	8	0
96	Catawba	23	0
97	Lincoln	23	0
98	Mecklenburg	10	1
99	Mecklenburg	15	0
100	Mecklenburg	21	0
101	Mecklenburg	10	0
102	Mecklenburg	19	0
103	Mecklenburg	16	0
104	Mecklenburg	26	0
105	Mecklenburg	12	0
106	Mecklenburg	10	0
107	Mecklenburg	11	1
108	Gaston	20	0
109	Gaston	14	0
110	Cleveland	10	0
	Gaston	12	0
111	Cleveland	11	0
	Rutherford	6	0
112	Mecklenburg	17	0
113	Henderson	8	0
	McDowell	2	0
	Polk	7	0
	Rutherford	11	0
114	Buncombe	29	0
115	Buncombe	32	0
116	Buncombe	18	0

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NC General Assembly

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
117	Henderson	26	0
118	Haywood	29	0
	Madison	12	0
119	Jackson	13	0
	Swain	5	0
	Transylvania	15	0
120	Cherokee	16	0
	Clay	9	0
	Graham	4	0
	Macon	15	0
	Total:	**2,659**	**7**

PEGDEN 5

NC General Assembly

Whole-Split VTD Counts by County Report

District Plan: SL 2021-175 House

County	Whole VTDs	Split VTDs
Alamance	37	0
Alexander	10	0
Alleghany	4	0
Anson	9	0
Ashe	17	0
Avery	19	0
Beaufort	21	0
Bertie	12	0
Bladen	17	0
Brunswick	25	0
Buncombe	79	0
Burke	33	0
Cabarrus	40	0
Caldwell	20	0
Camden	3	0
Carteret	28	0
Caswell	9	0
Catawba	40	0
Chatham	18	0
Cherokee	16	0
Chowan	6	0
Clay	9	0
Cleveland	21	0
Columbus	26	0
Craven	20	1
Cumberland	76	0
Currituck	11	0
Dare	15	1
Davidson	43	0
Davie	14	0
Duplin	19	0
Durham	54	3
Edgecombe	21	0
Forsyth	101	0
Franklin	18	0
Gaston	46	0
Gates	6	0
Graham	4	0
Granville	15	0
Greene	10	0
Guilford	165	0
Halifax	23	0
Harnett	13	0

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NC General Assembly

Whole-Split VTD Counts by County Report

District Plan: SL 2021-175 House

County	Whole VTDs	Split VTDs
Haywood	29	0
Henderson	34	0
Hertford	13	0
Hoke	15	0
Hyde	7	0
Iredell	29	0
Jackson	13	0
Johnston	36	0
Jones	7	0
Lee	10	0
Lenoir	22	0
Lincoln	23	0
Macon	15	0
Madison	12	0
Martin	13	0
McDowell	17	0
Mecklenburg	194	1
Mitchell	9	0
Montgomery	14	0
Moore	26	0
Nash	24	0
New Hanover	43	0
Northampton	13	0
Onslow	24	0
Orange	41	0
Pamlico	10	0
Pasquotank	9	0
Pender	20	0
Perquimans	7	0
Person	11	0
Pitt	40	0
Polk	7	0
Randolph	22	0
Richmond	16	0
Robeson	39	0
Rockingham	15	0
Rowan	41	0
Rutherford	17	0
Sampson	23	0
Scotland	7	0
Stanly	22	0
Stokes	18	0
Surry	24	0

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Based on TIGER 2020 VTDs
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PEGDEN 5

NC General Assembly

Whole-Split VTD Counts by County Report

District Plan: SL 2021-175 House

County	Whole VTDs	Split VTDs
Swain	5	0
Transylvania	15	0
Tyrrell	6	0
Union	52	0
Vance	12	0
Wake	204	0
Warren	14	0
Washington	6	0
Watauga	20	0
Wayne	27	1
Wilkes	27	0
Wilson	24	0
Yadkin	12	0
Yancey	11	0
Totals:	**2,659**	**7**

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Based on TIGER 2020 VTDs
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PEGDEN 5

NC General Assembly

Split VTD Detail Report

District Plan: SL 2021-175 House

County	VTD	District	Total VTD Population	VTD Pop in District	Percent of VTD Pop in District
Craven	002	3	18,203	6,483	35.62 %
		13	18,203	11,720	64.38 %
Dare	KDH	1	7,656	7,118	92.97 %
		79	7,656	538	7.03 %
Durham	014	29	4,535	4,232	93.32 %
		31	4,535	303	6.68 %
	023	2	10,357	1,533	14.80 %
		30	10,357	8,824	85.20 %
	30-2	2	10,654	958	8.99 %
		31	10,654	9,696	91.01 %
Mecklenburg	134	98	11,104	4,537	40.86 %
		107	11,104	6,567	59.14 %
Wayne	016	4	3,810	992	26.04 %
		10	3,810	2,818	73.96 %
			Total:	**66,319**	

Number of split VTDs: 7

PEGDEN 5

NC General Assembly

Incumbent-District Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

Last Name	First Name	Party	Current District	District in this Plan
Adams	James	Republican	96	96
Adcock	Gale	Democratic	41	41
Ager	John	Democratic	115	115
Alexander	Kelly	Democratic	107	107
Alston	Vernetta	Democratic	29	29
Arp	Larry	Republican	69	69
Autry	Johnnie	Democratic	100	100
Baker	Amber	Democratic	72	72
Baker	Kristin	Republican	82	82
Ball	Cynthia	Democratic	49	49
Belk	Mary	Democratic	88	88
Bell	John	Republican	10	10
Blackwell	Hugh	Republican	86	86
Boles	James	Republican	52	52
Bradford	John	Republican	98	98
Brisson	William	Republican	22	22
Brockman	Cecil	Democratic	60	60
Brody	Mark	Republican	55	55
Brown	Terry	Democratic	92	92
Bumgardner	Dana	Republican	109	109
Butler	Deborah	Democratic	18	18
Carney	Becky	Democratic	102	102
Clampitt	James	Republican	119	119
Clemmons	Ashton	Democratic	57	57
Cleveland	George	Republican	14	14
Cooper-Suggs	Linda	Democratic	24	24
Cunningham	Carla	Democratic	106	106
Dahle	Allison	Democratic	11	11
Davis	Robert	Republican	20	20
Dixon	James	Republican	4	4
Elmore	Jeffrey	Republican	94	94
Everitt	Terence	Democratic	35	35
Faircloth	Joseph	Republican	62	62
Farkas	Brian	Democratic	9	9
Fisher	Susan	Democratic	114	114
Gailliard	James	Democratic	25	25
Garrison	Terry	Democratic	32	32
Gill	Rosa	Democratic	33	33
Gillespie	Karl	Republican	120	120
Goodwin	Edward	Republican	1	1
Graham	Charles	Democratic	47	47
Greene	Edwin	Republican	85	85

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Row shading indicates that the district in this plan is shared by more than one incumbent.
[G20-IncDist] - Generated 11/4/2021

PEGDEN 5

Incumbent-District Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

Last Name	First Name	Party	Current District	District in this Plan
Hall	Destin	Republican	87	87
Hall	Kyle	Republican	91	91
Hanig	Robert	Republican	6	1
Hardister	Jonathan	Republican	59	59
Harris	Wesley	Democratic	105	105
Harrison	Mary	Democratic	61	61
Hastings	Kelly	Republican	110	110
Hawkins	Zack	Democratic	31	31
Howard	Julia	Republican	77	77
Humphrey	Thomas	Republican	12	12
Hunt	Rachel	Democratic	103	103
Hunter	Howard	Democratic	5	5
Hurley	Patricia	Republican	70	70
Hurtado	Ricardo	Democratic	63	63
Iler	Francis	Republican	17	17
Insko	Verla	Democratic	56	56
John	Joseph	Democratic	40	40
Johnson	Jake	Republican	113	113
Jones	Abraham	Democratic	38	38
Jones	Brenden	Republican	46	46
Kidwell	Keith	Republican	79	79
Lambeth	Donny	Republican	75	75
Lofton	Brandon	Democratic	104	104
Logan	Carolyn	Democratic	101	101
Lucas	Marvin	Democratic	42	42
Majeed	Nasif	Democratic	99	99
Martin	David	Democratic	34	34
McElraft	Patricia	Republican	13	13
McNeely	Jeffrey	Republican	84	84
McNeill	Allen	Republican	78	78
Meyer	Graig	Democratic	50	50
Miller	Charles	Republican	19	19
Mills	Paul	Republican	95	95
Moffitt	Timothy	Republican	117	117
Moore	Timothy	Republican	111	111
Morey	Marcia	Democratic	30	30
Moss	Ben	Republican	66	52
Paré	Erin	Republican	37	37
Penny	Howard	Republican	53	53
Pickett	Phillip	Republican	93	93
Pierce	Garland	Democratic	48	48
Pittman	Larry	Republican	83	82

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Row shading indicates that the district in this plan is shared by more than one incumbent.
[G20-IncDist] - Generated 11/4/2021

PEGDEN 5

NC General Assembly

Incumbent-District Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

Last Name	First Name	Party	Current District	District in this Plan
Pless	Steven	Republican	118	118
Potts	Larry	Republican	81	81
Pyrtle	Armor	Republican	65	65
Quick	Amos	Democratic	58	58
Reives	Robert	Democratic	54	54
Richardson	William	Democratic	44	44
Riddell	Dennis	Republican	64	64
Roberson	James	Democratic	39	39
Rogers	David	Republican	112	113
Saine	Jason	Republican	97	97
Sasser	Clayton	Republican	67	67
Sauls	John	Republican	51	51
Setzer	Mitchell	Republican	89	89
Shepard	Phillip	Republican	15	15
Smith	Carson	Republican	16	16
Smith	Kandie	Democratic	8	8
Smith	Raymond	Democratic	21	10
Stevens	Sarah	Republican	90	90
Strickland	Larry	Republican	28	28
Szoka	John	Republican	45	45
Terry	Evelyn	Democratic	71	71
Torbett	John	Republican	108	108
Turner	Brian	Democratic	116	116
Tyson	John	Republican	3	3
von Haefen	Julie	Democratic	36	36
Warren	Harry	Republican	76	76
Watford	Samuel	Republican	80	80
Wheatley	Diane	Republican	43	43
White	Donna	Republican	26	26
Willingham	Shelly	Democratic	23	23
Willis	David	Republican	68	68
Winslow	Matthew	Republican	7	7
Wray	Michael	Democratic	27	27
Yarborough	Lawrence	Republican	2	2
Zachary	Walter	Republican	73	77
Zenger	Jeffrey	Republican	74	74

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Row shading indicates that the district in this plan is shared by more than one incumbent.
[G20-IncDist] - Generated 11/4/2021

PEGDEN 5

NC General Assembly

District-Incumbent Report

District Plan: SL 2021-175 House

Residence Set: NC House - 10/01/2021

District in this Plan	Last Name	First Name	Party	Current District
1	Goodwin	Edward	Republican	1
	Hanig	Robert	Republican	6
2	Yarborough	Lawrence	Republican	2
3	Tyson	John	Republican	3
4	Dixon	James	Republican	4
5	Hunter	Howard	Democratic	5
6				
7	Winslow	Matthew	Republican	7
8	Smith	Kandie	Democratic	8
9	Farkas	Brian	Democratic	9
10	Bell	John	Republican	10
	Smith	Raymond	Democratic	21
11	Dahle	Allison	Democratic	11
12	Humphrey	Thomas	Republican	12
13	McElraft	Patricia	Republican	13
14	Cleveland	George	Republican	14
15	Shepard	Phillip	Republican	15
16	Smith	Carson	Republican	16
17	Iler	Francis	Republican	17
18	Butler	Deborah	Democratic	18
19	Miller	Charles	Republican	19
20	Davis	Robert	Republican	20
21				
22	Brisson	William	Republican	22
23	Willingham	Shelly	Democratic	23
24	Cooper-Suggs	Linda	Democratic	24
25	Gailliard	James	Democratic	25
26	White	Donna	Republican	26
27	Wray	Michael	Democratic	27
28	Strickland	Larry	Republican	28
29	Alston	Vernetta	Democratic	29
30	Morey	Marcia	Democratic	30
31	Hawkins	Zack	Democratic	31
32	Garrison	Terry	Democratic	32
33	Gill	Rosa	Democratic	33
34	Martin	David	Democratic	34
35	Everitt	Terence	Democratic	35
36	von Haefen	Julie	Democratic	36
37	Paré	Erin	Republican	37
38	Jones	Abraham	Democratic	38
39	Roberson	James	Democratic	39
40	John	Joseph	Democratic	40
41	Adcock	Gale	Democratic	41

PEGDEN 5

NC General Assembly

District-Incumbent Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

District in this Plan	Last Name	First Name	Party	Current District
42	Lucas	Marvin	Democratic	42
43	Wheatley	Diane	Republican	43
44	Richardson	William	Democratic	44
45	Szoka	John	Republican	45
46	Jones	Brenden	Republican	46
47	Graham	Charles	Democratic	47
48	Pierce	Garland	Democratic	48
49	Ball	Cynthia	Democratic	49
50	Meyer	Graig	Democratic	50
51	Sauls	John	Republican	51
52	Boles	James	Republican	52
	Moss	Ben	Republican	66
53	Penny	Howard	Republican	53
54	Reives	Robert	Democratic	54
55	Brody	Mark	Republican	55
56	Insko	Verla	Democratic	56
57	Clemmons	Ashton	Democratic	57
58	Quick	Amos	Democratic	58
59	Hardister	Jonathan	Republican	59
60	Brockman	Cecil	Democratic	60
61	Harrison	Mary	Democratic	61
62	Faircloth	Joseph	Republican	62
63	Hurtado	Ricardo	Democratic	63
64	Riddell	Dennis	Republican	64
65	Pyrtle	Armor	Republican	65
66				
67	Sasser	Clayton	Republican	67
68	Willis	David	Republican	68
69	Arp	Larry	Republican	69
70	Hurley	Patricia	Republican	70
71	Terry	Evelyn	Democratic	71
72	Baker	Amber	Democratic	72
73				
74	Zenger	Jeffrey	Republican	74
75	Lambeth	Donny	Republican	75
76	Warren	Harry	Republican	76
77	Howard	Julia	Republican	77
	Zachary	Walter	Republican	73
78	McNeill	Allen	Republican	78
79	Kidwell	Keith	Republican	79
80	Watford	Samuel	Republican	80
81	Potts	Larry	Republican	81

PEGDEN 5

NC General Assembly

District-Incumbent Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

District in this Plan	Last Name	First Name	Party	Current District
82	Baker	Kristin	Republican	82
	Pittman	Larry	Republican	83
83				
84	McNeely	Jeffrey	Republican	84
85	Greene	Edwin	Republican	85
86	Blackwell	Hugh	Republican	86
87	Hall	Destin	Republican	87
88	Belk	Mary	Democratic	88
89	Setzer	Mitchell	Republican	89
90	Stevens	Sarah	Republican	90
91	Hall	Kyle	Republican	91
92	Brown	Terry	Democratic	92
93	Pickett	Phillip	Republican	93
94	Elmore	Jeffrey	Republican	94
95	Mills	Paul	Republican	95
96	Adams	James	Republican	96
97	Saine	Jason	Republican	97
98	Bradford	John	Republican	98
99	Majeed	Nasif	Democratic	99
100	Autry	Johnnie	Democratic	100
101	Logan	Carolyn	Democratic	101
102	Carney	Becky	Democratic	102
103	Hunt	Rachel	Democratic	103
104	Lofton	Brandon	Democratic	104
105	Harris	Wesley	Democratic	105
106	Cunningham	Carla	Democratic	106
107	Alexander	Kelly	Democratic	107
108	Torbett	John	Republican	108
109	Bumgardner	Dana	Republican	109
110	Hastings	Kelly	Republican	110
111	Moore	Timothy	Republican	111
112				
113	Johnson	Jake	Republican	113
	Rogers	David	Republican	112
114	Fisher	Susan	Democratic	114
115	Ager	John	Democratic	115
116	Turner	Brian	Democratic	116
117	Moffitt	Timothy	Republican	117
118	Pless	Steven	Republican	118
119	Clampitt	James	Republican	119
120	Gillespie	Karl	Republican	120

2021 JOINT REDISTRICTING COMMITTEE PROPOSED CRITERIA

- Equal Population. The Committees will use the 2020 federal decennial census data as the sole basis of population for the establishment of districts in the 2021 Congressional, House and Senate plans. The number of persons in each legislative district shall be within plus or minus 5 percent of the ideal district population, as determined under the most recent federal decennial census. The number of persons in each congressional district shall be as nearly as equal as practicable, as determined under the most recent federal decennial census.

- Contiguity. Legislative and congressional districts shall be comprised of contiguous territory. Contiguity by water is sufficient.

- Counties, Groupings and Traversals. The Committees shall draw legislative districts within county groupings as required by *Stephenson v. Bartlett*, 355 N.C. 354, 562 S.E. 2d 377 (2002) (*Stephenson I*), *Stephenson v. Bartlett*, 357 N.C. 301, 582 S.E.2d 247 (2003) (*Stephenson II*), *Dickson v. Rucho*, 367 N.C. 542, 766 S.E.2d 238 (2014) (*Dickson I*) and *Dickson v. Rucho*, 368 N.C. 481, 781 S.E.2d 460 (2015) (*Dickson II*). Within county groupings, county lines shall not be traversed except as authorized by *Stephenson I*, *Stephenson II*, *Dickson I*, and *Dickson II*.

  Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking. If a county is of sufficient population size to contain an entire congressional district within the county's boundaries, the Committees shall construct a district entirely within that county.

- Racial Data. Data identifying the race of individuals or voters *shall not* be used in the construction or consideration of districts in the 2021 Congressional, House and Senate plans.

- VTDs. Voting districts ("VTDs") should be split only when necessary.

- Compactness. The Committees shall make reasonable efforts to draw legislative districts in the 2021 Congressional, House and Senate plans that are compact. In doing so, the Committee may use as a guide the minimum Reock ("dispersion") and Polsby-Popper ("perimeter") scores identified by Richard H. Pildes and Richard G. Neimi in *Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances After Shaw v. Reno*, 92 Mich. L. Rev. 483 (1993).

- Municipal Boundaries. The Committees may consider municipal boundaries when drawing districts in the 2021 Congressional, House and Senate plans.

- Election Data. Partisan considerations and election results data *shall not* be used in the drawing of districts in the 2021 Congressional, House and Senate plans.

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Exhibit #
Pegden 5
JH-12/30/2021
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PEGDEN 4

- Member Residence. Member residence may be considered in the formation of legislative and congressional districts.

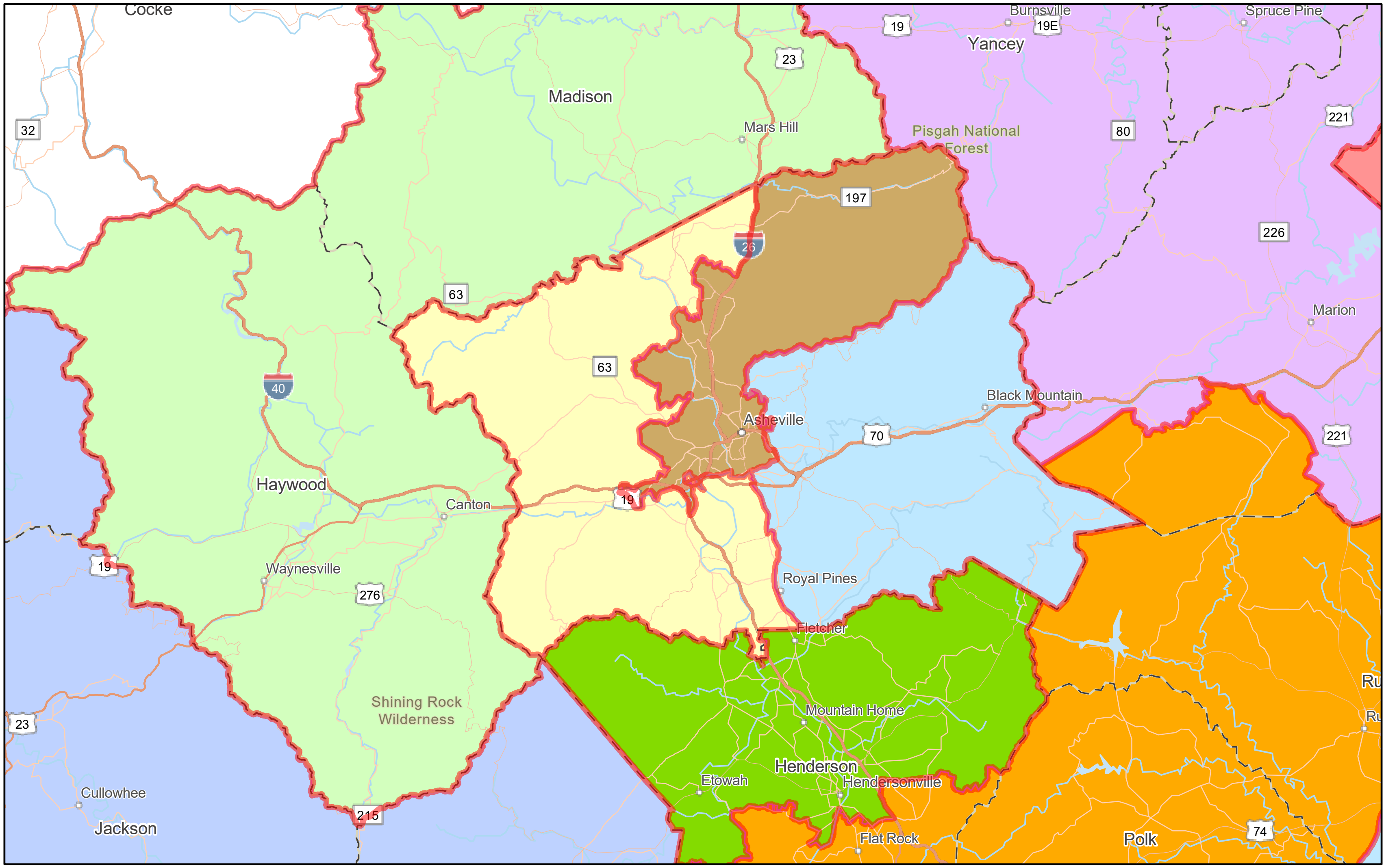
- Community Consideration. So long as a plan complies with the foregoing criteria, local knowledge of the character of communities and connections between communities may be considered in the formation of legislative and congressional districts.

S.L. 2021-174 Congress

Source: SL 2021-174 Congress

Printed by the NC General Assembly, November 4, 2021.

NC House Map - Enacted 2021



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NCLCV v. Hall
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LDTX186

Exhibit #
Pegden 7
JH-12/30/2021
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STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426
21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

REBECCA HARPER, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

LEGISLATIVE DEFENDANTS' NOTICE OF DEPOSITION OF SAM HIRSCH

PLEASE TAKE NOTICE that on December 31, 2021, beginning at 9:00 a.m., Legislative Defendants in the above-captioned matter will take the deposition of Sam Hirsch via an online videoconference, pursuant to Rules 26 and 30 of the North Carolina Rules of Civil Procedure. The testimony will be recorded by video recording and stenographic means and will be taken remotely before a Notary Public or some other person duly authorized by law to take depositions. The deponent, court reporter, and counsel will each remotely join the videoconference via phone and/or

NCLCV v. Hall
21 CVS 15426
LDTX187

Exhibit #:
Hirsch 01
12/09/21 - DLP
exhibitsticker.com

an email invitation that will be sent by the court reporter. The examination shall continue from day to day until completed. All counsel are invited to attend and cross-examine as provided by law.

This the 27th day of December, 2021.

/s/ Phillip J. Strach

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CERTIFICATE OF SERVICE

It is hereby certified that on this the 27th day of December, 2021, the foregoing was served on the individuals below by email:

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STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
FILE NO. 21 CVS 015426

NORTH CAROLINA LEAGUE, OF CONSERVATION VOTERS, INC., *et al.*,
Plaintiffs

and

COMMON CAUSE,
Plaintiff-Intervenor,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, *et al.*,
Defendants.

FILED
2021 DEC 30 PM 2:37
WAKE CO., C.S.C.
BY________

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
FILE NO. 21 CVS 500085

REBECCA HARPER, *et al.*,
Plaintiffs

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, *et al.*,
Defendants.

ORDER ON (1) NCLCV PLAINTIFFS' MOTION FOR PROTECTIVE ORDER, (2) LEGISLATIVE DEFENDANTS' MOTION FOR CLARIFICATION, AND (3) LEGISLATIVE DEFENDANTS' MOTION TO SEAL

THESE MATTERs came before the undersigned three-judge panel upon 1) NCLCV Plaintiffs' Motion for Protective Order, filed December 29, 2021, pursuant to Rule 26(c) of the North Carolina Rules of Civil Procedure; 2) Legislative Defendants' Motion for Clarification, and in the alternative, Motion to Compel, submitted provisionally under seal on December

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29, 2021, pursuant to Rules 26, 30, and 37 of the Rules of Civil Procedure; and, 3) Legislative Defendants' Motion to Seal their Motion for Clarification, and in the alternative, Motion to Compel submitted contemporaneously with the Motion on December 29, 2021, pursuant to Rule 27 of the General Rules of Practice for the Superior and District Courts.

Procedural and Factual Background

In this litigation, Plaintiffs seek a declaration that the North Carolina Congressional, North Carolina Senate, and North Carolina House of Representatives districts established by an act of the General Assembly in 2021, N.C. Sess. Laws 2021-174 (Senate Bill 750), 2021-173 (Senate Bill 739), and 2021-175 (House Bill 976) (collectively the "Enacted Plans"), violate the rights of Plaintiffs under the North Carolina Constitution. Plaintiffs seek to enjoin the future use of the 2021 congressional and state legislative districts.

On December 13, 2021, after receiving an order from the Supreme Court of North Carolina directing this Court to resolve all Plaintiffs' claims on the merits by January 11, 2022, this Court entered a Case Scheduling Order giving the parties until December 31, 2021, to complete discovery in advance of trial, which is set to commence on January 3, 2022. The parties were further ordered that expert reports produced to opposing parties "shall be accompanied by all source code, source data, input parameters, and all outputted data." On December 14, 2021, Legislative Defendants filed a Motion to Compel seeking this very information for the expert reports produced by Plaintiffs during the preliminary-injunction phase of this litigation.

Legislative Defendants' motion was granted in part by the Court on December 15, 2021[1]; however, NCLCV Plaintiffs were not required under that order to produce any documents or information that their expert Professor Moon Duchin did not consider or

[1] On December 15, 2021, the Court contemporaneously entered a Protective Order governing the exchange of confidential and highly confidential materials in these consolidated cases.

receive. On December 20, 2021, this Court entered an order clarifying that NCLCV Plaintiffs were to produce to Legislative Defendants the method and means by which the Optimized Maps were formulated and produced, including, but not limited to all source code, source data, input parameters, and all outputted data associated with the Optimized Maps, and that NCLCV Plaintiffs were to identify any and all persons who took part in drawing or participated in the computerized production of the Optimized Maps. This production was ordered to occur by the December 23, 2021, deadline in the Case Scheduling Order for initial expert reports.

After the production of this material, Legislative Defendants thereafter noticed the deposition of Sam Hirsch, an attorney in Jenner & Block LLP's Washington D.C. office and admitted *pro hac vice* by this Court as counsel of record for NCLCV Plaintiffs, on December 27, 2021. The notice of deposition states that Mr. Hirsch's deposition is scheduled to occur on December 31, 2021. Legislative Defendants likewise included Mr. Hirsch in their list of witnesses they may call to testify at trial, and this list was provided to NCLCV Plaintiffs on December 27, 2021.

On December 29, 2021, NCLCV Plaintiffs filed the present Motion for a Protective Order, seeking to quash the notice of deposition directed to Sam Hirsch and direct Legislative Defendants to strike Sam Hirsch from their witness list for trial. Legislative Defendants submitted a written response to this motion on December 29, 2021.

Also on December 29, 2021, Legislative Defendants submitted provisionally under seal the present Motion for Clarification, or in the alternative, Motion to Compel, seeking an order clarifying whether this Court's order granting *pro hac vice* status to Sam Hirsch allows Legislative Defendants to obtain deposition and trial testimony of him without a subpoena, contending that Mr. Hirsch is now a fact witness in this matter. In the alternative, Legislative Defendants seek an order compelling Mr. Hirsch to testify at the noticed deposition and at trial. Legislative Defendants also filed a Motion to Seal the Motion for Clarification due to NCLCV Plaintiffs designating the entirety of their documents produced in response to this Court's December 20, 2021, Order as Confidential per the Court's December 15, 2021, Protective Order. NCLCV Plaintiffs submitted a written response to these motions on December 29, 2021.

The parties have fully briefed their respective positions on the Motions, and the matters are now ripe for resolution by the Court.

<u>NCLCV Plaintiffs' Motion for Protective Order and Legislative Defendants' Motion for Clarification, and in the alternative, Motion to Compel</u>

After considering NCLCV Plaintiffs' motion and Legislative Defendants' motion, the parties' respective responses to the motions, and the matters contained therein, and having reviewed the record proper, the Court, in its discretion, rules upon the motions as follows:

Testimony Regarding the Optimized Maps is Relevant to the Issues in this Redistricting Litigation and Compelling the Testimony of Mr. Hirsch Satisfies the Shelton *Test*

"Parties may obtain discovery regarding any matter, not privileged, which is relevant to the subject matter involved in the pending action, whether it relates to the claim or defense of the party seeking discovery or to the claim or defense of any other party." N.C.G.S. § 1A-1, Rule 26(b)(1). "The test for relevance for discovery purposes only requires that information be 'reasonably' calculated to lead to the discovery of admissible evidence.'" *Lowd v. Reynolds*, 205 N.C. App. 208, 214, 695 S.E.2d 479, 483 (2010) (quoting N.C.G.S. § 1A-1, Rule 26(b)(1)). "[O]rders regarding discovery are within the discretion of the trial court." *Dworsky v. Travelers Ins. Co.*, 49 N.C. App. 446, 448, 271 S.E.2d 522, 523 (1980). One method of obtaining discovery is through depositions upon oral examination, which are governed by Rule 30 of the North Carolina Rules of Civil Procedure. Rule 30 provides that "[a]fter commencement of the action, any party may take the testimony of *any person*, including a party, by deposition upon oral examination." N.C.G.S. § 1A-1, Rule 30(a) (emphasis added). Furthermore, the

Rule provides that "[t]he attendance of witnesses *may* be compelled by subpoena as provided in Rule 45[.]" *Id.* (emphasis added).

Trial courts have authority over the proceedings before it, as well as the counsel in those proceedings. Indeed, the power of the court to deal with its attorneys "is an inherent one because it is an essential one for the court to possess in order for it to protect itself from fraud and impropriety and to serve the ends of the administration of justice which are, fundamentally, the *raison d'etre* for the existence and operation of the courts." *Law Offices of Peter H. Priest, PLLC v. Coch*, 2014 NCBC 54, *36 (quoting *Swenson v. Thibaut*, 39 N.C. App. 77, 109, 250 S.E.2d 279, 299 (1978)).

"The seminal case on the issue of deposing litigation counsel is *Shelton v. American Motors Corp.*, 805 F.2d 1323 (8th Cir. 1986), which limited the deposition of opposing counsel to circumstances 'where the party seeking to take the deposition has shown that (1) no other means exist to obtain the information than to depose opposing counsel; (2) the information sought is relevant and nonprivileged [sic]; and (3) the information is crucial to the preparation of the case. Courts throughout the country, including North Carolina's federal courts, have adopted the *Shelton* test." *Blue Ridge Pediatric & Adolescent Med., Inc. v. First Colony Healthcare, LLC*, 2012 NCBC 45, 58 (N.C. Super. Ct. Aug 9, 2012) (internal citation omitted).

As did the trial court in *Blue Ridge Pediatric & Adolescent Med.*, this Court agrees that "[w]hile not binding on this Court, *Shelton* and its progeny offer guidance to the Court in deciding this motion. This Court concludes that the *Shelton* test is appropriate in this case because the test closely parallels the language of Rule 26, which allows a party to limit discovery by convincing a court that information sought in discovery by deposition, upon oral examination, is (1) not 'obtainable from some other [less burdensome] source . . . ,' (2) 'not privileged . . . ,' and (3) 'importan[t to] the issues at stake in the litigation.'" *Id.* at 61 (citing N.C. R. Civ. P. 26(b)(1)) (alterations in original).

Here, NCLCV Plaintiffs are correct that the ordinary manner by which a party can compel a witness's attendance at a deposition is to issue a subpoena to that witness; however, in the extraordinary circumstances governing the timing constraints of this case to come to a full resolution of all claims by January 11, 2022, compelling Mr. Hirsch to sit for deposition—as noticed, despite the absence of a subpoena—serves the needs of this important litigation and the ends of the administration of justice in a case in which he has made an appearance. Indeed, the only means that exist to obtain the information is to depose Mr. Hirsch, the information sought is relevant and nonprivileged, and the information is crucial to the preparation of the case. Evidence before the Court demonstrates that NCLCV Plaintiffs, in complying with the Court's December 20, 2021, Order, identified Mr. Hirsch as a person who plainly and meaningfully took part in the drawing and computerized production of the Optimized Maps. *See* Leg. Def. Mot. to Clarify, Exhibit A. Mr. Hirsch's involvement, the Court observes, occurred prior to the initiation of NCLCV Plaintiffs' legal action filed against the Legislative Defendants challenging the state legislative and congressional redistricting plans at issue—and the other persons involved are not expected to be called as witnesses in this case. *Id.* Accordingly, the information sought through Mr. Hirsch's deposition is relevant and can only be obtained through him. The Court, however, acknowledges that because attorney-client privilege may protect some of the information to which Mr. Hirsch will be called to testify, nothing in this Order shall be construed as a limitation on NCLCV Plaintiffs' or Mr. Hirsch's ability to assert *bona fide* attorney-client privilege and work product doctrine assertions at his deposition.

Furthermore, as the Court explained in its Order on Legislative Defendants' Motion for Partial Reconsideration, the underlying data and persons involved in the creation of the

Optimized Maps are indeed relevant and discoverable for the following reasons: the Optimized Maps were presented, and referenced over ninety (90) times, to the Court in NCLCV Plaintiffs' Complaint; at the hearing on the Motion for Preliminary Injunction the NCLCV Plaintiffs mentioned the Optimized Maps on numerous occasions and provided the Court with copies of the same; and, NCLCV Plaintiffs, in both their Complaint and at the hearing on the Motion for Preliminary Injunction, requested that in the event Legislative Defendants are required to draw remedial maps and fail to do so to the satisfaction of the Court, that the Court require the use of the Optimized Maps for the 2022 Elections. Simply put, NCLCV Plaintiffs have put the issue of the Optimized Maps before the Court, and this includes the testimony of a person who directed the creation of the Optimized Maps. Accordingly, this Court will deny NCLCV Plaintiffs' Motion for a Protective Order and grant Legislative Defendants' Motion seeking to compel Mr. Hirsch's appearance at the noticed deposition and, if called, at trial.

Mr. Hirsch Carries the Responsibility for Complying with the Ethical Rules Governing When an Attorney May Be Called Upon as Both an Advocate and Necessary Witness at Trial

As an additional matter, when seeking to be admitted *pro hac vice*, an attorney must certify "that with reference to all matters incident to the proceeding, the attorney agrees to be subject to the orders and . . . the civil jurisdiction of the General Court of Justice." N.C.G.S. § 84-4.1(3).

It is incumbent upon attorneys admitted *pro hac vice* to comply with our state's rules of professional conduct. At issue here, Rule 3.7 of the North Carolina Rules of Professional Conduct provides that "[a] lawyer shall not act as advocate at a trial in which the lawyer is likely to be a necessary witness unless: (1) the testimony relates to an uncontested issue; (2) the testimony relates to the nature and value of legal services rendered in the case; or (3) disqualification of the lawyer would work substantial hardship on the client." N.C. Rules of

Prof'l Conduct R. 3.7(a). In a Formal Ethics Opinion issued by the N.C. State Bar on April 22, 2011, entitled "Lawyer as Advocate and Witness," the State Bar explained that this Rule requires the attorney to evaluate whether he or she may become a necessary witness in a case. 2011 Formal Ethics Opinion 1 ("A lawyer who is named as a witness by an opposing party must evaluate his knowledge of the facts in controversy and make a good faith determination as to whether his testimony will be relevant, material, and unobtainable elsewhere. This evaluation must be ongoing as the case moves toward trial, contested issues are identified, and discovery discloses additional witnesses and information about the case. However, to avoid prejudicing a client due to a last-minute change of trial counsel, a lawyer should withdraw from representation in the trial if the lawyer knows or reasonably should know that he is a necessary witness."). The Formal Ethics Opinion also clarified that the "underlying reason for the prohibition—confusion of the trier of fact relative to the lawyer's role—does not apply when the lawyer's advocacy is limited to activities outside the courtroom. Although a lawyer may continue to provide representation outside the courtroom, the lawyer should not use this as an excuse to delay withdrawal from representation in the litigation if the lawyer knows or reasonably should know that he is a necessary witness." *Id.* (internal citations omitted).

Although Mr. Hirsch's representation of NCLCV Plaintiffs outside of the courtroom does not implicate Rule 3.7, NCLCV Plaintiffs have indicated that Mr. Hirsch is set to examine certain witnesses at the trial of these consolidated cases. As such, it is incumbent upon Mr. Hirsch to determine whether he is a necessary witness such that he would need to withdraw as counsel at the trial of this matter.

<u>Legislative Defendants' Motion to Seal</u>

As the Court reminded the parties in the December 13, 2021, Case Scheduling Order, if a party intends to submit any materials under seal, they are to comply with Rule 27 of the

General Rules of Practice. Rule 27 of the General Rules of Practice governs the process for when a party submits a document under seal, and further provides that the court "may rule on the motion with or without a hearing. In the absence of a motion or brief that justifies sealing the document, the court may order that the document (or part of the document) be made public." N.C. R. Super. & Dist. Cts. 27(b)(6).

NCLCV Plaintiffs have designated as Confidential the document included with Legislative Defendants' Motion to Clarify as Exhibit A. In their written response to the Motion to Seal, NCLCV Plaintiffs state that they agree that the Motion for Clarification may enter the public record, including its discussion of Mr. Hirsch related to the Optimized Maps, but maintain that the Cover Letter attached to that motion is confidential and should be sealed. NCLCV Plaintiffs have proposed to provide a public version of the document disclosing general information described in Legislative Defendants' Motion while redacting other, specific portions and maintaining the full unredacted version under seal indefinitely.

The Court disagrees with Legislative Defendants that the document marked as Exhibit A to Legislative Defendants' Motion to Clarify was not properly designated as Confidential by NCLCV Plaintiffs at the time of disclosure. The Court also appreciates that NCLCV Plaintiffs have proposed a reasonable alternative to balance public access to the record in this case with the need for certain information, if properly designated, to remain confidential. The Court, however, finds that the nature of the information disclosed—for the reasons explained above—and the compelling public interest in the nature of this litigation requires that Exhibit A be made a part of the public record in full. Accordingly, this Court will order that Legislative Defendants' Motion to Seal be Denied and that the Motion and attached Exhibit A be filed as part of the public record.

Conclusion

WHEREFORE, the Court, for the reasons stated herein and in the exercise of its discretion, hereby ORDERS the following:

1. NCLCV Plaintiffs' Motion for a Protective Order is DENIED.

2. Legislative Defendants' Motion to Clarify is GRANTED and Mr. Sam Hirsch is hereby commanded to appear at the duly noticed deposition on December 31, 2021, or at another time and place agreed upon by the parties, and, if called, testify at trial set to commence January 3, 2022.

3. Legislative Defendants' Motion to Seal is DENIED and the Motion and attached Exhibit A shall be filed as part of the public record.

SO ORDERED, this the 30 day of December, 2021.

A. Graham Shirley, Superior Court Judge

/s/ Nathaniel J. Poovey

Nathaniel J. Poovey, Superior Court Judge

/s/ Dawn M. Layton

Dawn M. Layton, Superior Court Judge

CERTIFICATE OF SERVICE

I hereby certify that a copy of the foregoing document was served on the persons indicated below via e-mail transmission addressed as follows:

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Service is made upon local counsel for all attorneys who have been granted pro hac vice admission, with the same effect as if personally made on a foreign attorney within this state.

This the 30th day of December 2021.

/s/ Kellie Z. Myers
Kellie Z. Myers
Trial Court Administrator
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December 23, 2021

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Exhibit #:
Hirsch 03
12/09/21 - DLP
exhibitsticker.com

Re: Production of Documents and Information Pursuant to December 20 Court Order

Dear Counsel:

Pursuant to the December 20, 2021 Order of the Superior Court in case number 21-CVS-015426, enclosed is a production on behalf of Plaintiffs the North Carolina League of Conservation Voters, Inc. et al. ("the NCLCV Plaintiffs"). These files are being produced via electronic file transfer, and a password will be provided under separate cover.

Please note that this letter and all files produced as part of this production are designated as "CONFIDENTIAL" within the meaning of, and subject to, the Protective Order entered by the Superior Court dated December 15, 2021. These materials comprise competitively sensitive or proprietary information, research and analysis, development and/or commercial information, and are otherwise protected from disclosure. Counsel are advised that under the Protective Order, this letter and all produced materials "shall be used by the Parties solely in connection with this litigation" and may not be used for any "political, business, commercial, competitive, personal, governmental, or other purpose or function whatsoever, and such information shall not be disclosed to anyone" except as provided by the Protective Order. For avoidance of doubt, all information produced as part of this production shall be considered "CONFIDENTIAL" even if not individually labeled or otherwise designated as such.

The Court's December 20 Order requires the NCLCV Plaintiffs to "produce to the Legislative Defendants the method and means by which the Optimized Maps were formulated and produced,

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CONFIDENTIAL PURSUANT TO DECEMBER 15, 2021 PROTECTIVE ORDER

including, but not limited to all source code, source data, input parameters, and all outputted data associated with the Optimized Maps," and to "further identify any and all persons who took part in drawing or participated in the computerized production of the Optimized Maps."

The NCLCV Plaintiffs do not intend to offer evidence at trial about how these maps were created. Instead, the NCLCV Plaintiffs intend to rely on them to demonstrate the error in your clients' argument that the Enacted Plans' extreme partisan bias was inevitable. We therefore refer to them below as "the NCLCV Plaintiffs' demonstrative maps."

The NCLCV Plaintiffs' demonstrative maps were formulated and produced through the following method and means:

1. The process began with the compilation of source data relevant to congressional, senate, and house redistricting for the state of North Carolina. The data sources were public demographic data from the United States Census Bureau's decennial census and American Community Survey, public historical electoral data from the North Carolina State Board of Elections, and shapefiles reflecting geographic and political-subdivision boundaries that form the base layers for districting and provide the means to translate data from one geographic unit (*e.g.*, Census blocks or 2012 precincts) to another (*e.g.*, 2020 VTDs).

2. The demographic, electoral, and geographic data was then organized into data sets. This involved the creation of computer scripts to compile source data and to analyze source data for use in map-optimization. For example, North Carolina State Board of Elections electoral data and demographic data were analyzed using ecological-inference tools to determine which candidates were preferred by voters from various demographic groups. Also, electoral and American Community Survey data was pro-rated onto blocks and VTDs using such scripts.

3. After the data sets were compiled, for each of the congressional, senate, and house maps, a script was used to generate a random "seed" map that complied with certain basic criteria—such as contiguous districts—as a starting place for further analysis.

4. The random seed map was only a starting point for a long chain of maps in a multi-objective "short burst" process. In general, the computer script many times a minute randomly identified two adjoining districts, erased the boundary between those two districts to temporarily create a double-size district, and then randomly re-split that double-size district into two contiguous and roughly equally populated new districts. The chain took a series (a "short burst") of random steps, evaluated all the plans it encountered, and then chose from among the best plans so far to start its next short burst. Over the course of many steps, the maps thus changed dramatically. The source code that evaluated the plans to determine the "best" starting point for the next short burst used input parameters that incorporated key legal requirements that apply to North Carolina redistricting such as population balance, contiguity, respect for counties, geographic compactness, minority electoral opportunity, and partisan fairness. Over time, the chain tended to find maps that performed increasingly better on these various criteria. Chains were also run with different

parameters simultaneously, to identify the best available map. For congressional districts, the chains ran statewide. For senate and house districts, chains were confined to a particular "county cluster," given the North Carolina Supreme Court's interpretation of the North Carolina State Constitution's Whole County Provisions.

5. To allow the computer to robustly explore alternative possibilities, the chains just described tolerated maps with population deviations that somewhat exceeded the limits under the "one person, one vote" doctrine. So once high-performing maps were identified by these short-burst chains, they were analyzed and slightly revised with QGIS (quantum geographic information system) software to ensure, among other things, that districts' populations satisfied mandatory equal-population rules. The map was then further analyzed, and districts were numbered to facilitate comparison with the enacted districting plans.

All computer scripts, source code, source data, input parameters, and outputted data referenced in this letter are included in the produced material. NCLCV Plaintiffs hereby produce to Legislative Defendants NCLCVP_LD_01000–NCLCVP_LD_01903. To facilitate your review, we have organized these documents into six categories:

1. **Documents Related to Data Gathering (NCLCVP_LD_01000–NCLCVP_LD_01552):** These documents include raw and processed data drawn from public sources, such as the United States Census Bureau and the North Carolina State Board of Elections, typically in the form of .csv or .txt data files. Several files, for instance, reflects data from elections by voting tabulation district, or VTD. This also includes certain files that reflect geographic data. For example, several files reflect the geography of North Carolina voting tabulation districts, or VTDs. These documents also contain computer scripts that were used in data analysis to pull and initially arrange data from publicly available sources.

2. **Documents Related to Data Organization (NCLCVP_LD_01553–NCLCVP_LD_01673):** These documents include additional shapefiles and scripts used to organize and calibrate data beyond initial data gathering and preparation. They also include scripts used to analyze North Carolina State Board of Elections electoral data and demographic data, using ecological-inference tools, to determine which candidates were preferred by voters from various demographic groups. See, for example, NCLCVP_LD_1586–NCLCVP_LD_1673.

3. **Documents Related to Initial Map Generation (NCLCVP_LD_01674–NCLCVP_LD_01690):** These documents include the script, as well as associated data and shapefiles, created to find initial random "seed" maps that complied with certain basic criteria, such as contiguous districts.

4. **Documents Related to the Multi-Objective Optimization Process (NCLCVP_LD_01691–NCLCVP_LD_01764):** These files pertain to the process of conducting the randomized map-generating process. NCLCVP_LD_1699 is the central

script that was used to generate the randomized process. Other scripts in this Bates range support this process, and the remaining files include input files that provide input parameters encompassing key legal requirements that apply to North Carolina redistricting.

5. **Documents Related to Population Balancing (NCLCVP_LD_01765–NCLCVP_LD_01812):** These files are related to the process of balancing population and making other corrections using the maps generated from the multi-objective optimization process. These include QGIS files associated with the population-balancing process. See NCLCVP_LD_1787–NCLCVP_LD_1812.

6. **Documents Related to Outputted Maps (NCLCVP_LD_01813–NCLCVP_LD_01903):** An automated process generated analyses for the final outputted maps. The results of these analyses are reflected in these files. These include the block-assignment files for the NCLCV Plaintiffs' demonstrative maps, which allow anyone with redistricting software (including both commercial software and software that is available for free on the Internet) to upload and analyze the maps. We have previously provided these block-assignment files to you.

Sam Hirsch, a partner in Jenner & Block LLP's Washington office, directed the drawing and computerized production of the NCLCV Plaintiffs' demonstrative maps. Mr. Hirsch was assisted solely by two consulting experts, Amariah Becker of A Becker Consulting LLC and Dara Gold of Dara Gold LLC, who were retained or specifically employed to assist counsel in providing legal advice to the NCLCV Plaintiffs in anticipation of litigation or to prepare for trial and who are not expected to be called as witnesses during trial. These are all of the individuals who took part in drawing or participated in the computerized production of the NCLCV Plaintiffs' demonstrative maps.

With respect to this information, NCLCV Plaintiffs reserve all rights under, and do not waive any protections of, the Court's December 15, 2015 Protective Order, nor do they waive the protections of any and all other applicable privileges and protections. NCLCV Plaintiffs note that pursuant to that Order, any non-party witness must agree by affidavit, declaration, or sworn statement before the Court, that he or she has agreed to be bound by the Court's Protective Order. Pursuant to Paragraph 10(c) of the Protective Order, if you disclose, summarize, or otherwise make available this Confidential Information in whole or in part to any consulting or testifying expert retained by you for purposes of this litigation, we will require that you first provide the NCLCV Plaintiffs with copies of the executed "Exhibit A" to the Protective Order.

Best regards,

/s/ Zachary Schauf

Zachary Schauf

Enclosures

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Computational Redistricting and the Voting Rights Act

Amariah Becker, Moon Duchin, Dara Gold, and Sam Hirsch

ABSTRACT

In recent years, computers have been used to generate *ensembles* of districting plans: collections of large numbers of electoral maps that are used to assess a proposed map in the context of valid alternatives. Ensemble-based outlier analysis has played a central role in recent redistricting disputes, especially regarding partisan gerrymandering. Until now, methods for generating these ensembles have enforced districting rules that are relatively simple to assess, such as population equality, but have not contended with more complex ones, such as the prohibitions against racial gerrymandering and minority vote dilution that flow from the Constitution and the Voting Rights Act (VRA). We take up the task of building ensembles of plans that respect those legal constraints. Rather than relying on demographic data alone, our method uses precinct-level returns from a large collection of recent primary and general elections. With this electoral history, we build *effectiveness scores* that identify districts where members of minority groups have had realistic opportunities to nominate and elect their preferred candidates. In a case study of Texas congressional districts, we find that detailed election data is indispensable to assessing a map's effectiveness for minority voters. Purely demographic targets, such as demanding some specific number of majority-minority districts, not only raise constitutional concerns but also are inadequate proxies for empirical effectiveness. Beyond the primary task of building VRA-conscious ensembles for comparison, we also repurpose the same algorithmic search methods to find plans that dramatically increase minority electoral opportunities. In Texas, for example, the current enacted 36-district congressional plan has perhaps 11 to 13 districts that are effective for Latino voters, Black voters, or both. We find that better mapmaking could raise that number to at least 16 without sacrificing traditional principles such as contiguity and compactness. This would nearly eliminate the historic underrepresentation of both groups throughout the state.

Keywords: redistricting, gerrymandering, Voting Rights Act, algorithmic ensembles

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Amariah Becker conducted this study as a Data Scientist at the MGGG Redistricting Lab at Tisch College of Tufts University in Medford, Massachusetts, USA. Moon Duchin is a Professor of Mathematics and Director of the MGGG Redistricting Lab at Tufts University in Medford, Massachusetts, USA. Dara Gold conducted this study as a Data Scientist at the MGGG Redistricting Lab at Tisch College of Tufts University in Medford, Massachusetts, USA. Sam Hirsch is a Partner at Jenner & Block LLP in Washington, DC, USA.
The authors thank Jessie Amunson, Ash Bharatkumar, Charlotte Hirsch, Justin Levitt, J.N. Matthews, James Murphy, Heather Rosenfeld, Parker Rule, Gabe Schoenbach, Doug Spencer, Adam Unikowsky, and Thomas Zeitzoff for extremely helpful and stimulating conversations and in some cases for invaluable technical support of this project. Many members and student interns affiliated with the MGGG Redistricting Lab and the Voting Rights Data Institute have been involved in long-term data preparation, and we are warmly grateful for their collaboration.
Racial identification of candidates was made possible by a dataset purchased from Carl Klarner (klarnerpolitics.org).
This article is dedicated to the memory of Rice University sociology professor Chandler Davidson (1936–2021), who fought successfully for a half century to protect Latino and Black voting rights and to expand minority electoral opportunities in Texas and throughout the United States.

1. INTRODUCTION

TODAY, ONLY 107 REPRESENTATIVES in congress—fewer than a quarter of all House members—belong to a racial or language minority group.[1] If those groups were represented in proportion to their share of the nation's adult citizen population, that number would increase to 144 Representatives.[2] And this sub-proportional representation is not confined to Congress, but is replicated today in 47 of the 50 state legislatures.[3] There are two strands of conventional wisdom on the causes of this shortfall in minority representation. Either districters simply are not trying hard enough, or entrenched patterns of racial polarization in housing and voting make proportionality impossible to attain.

This article explores a third option: perhaps better tools can bring better results. Our algorithmically generated *ensembles*—collections of thousands or millions of alternative maps—show that better-designed redistricting plans could close much (though not all) of that gap and ensure that the House of Representatives and state legislatures "look more like America" than at any time in our history.

The tools to study this issue comprehensively did not exist as recently as a decade ago, when the 50 states last redistricted. Since then, algorithmic innovation and steadily improving computational power have revolutionized our ability to understand the variety of redistricting plans that could plausibly be enacted. It is now possible to generate a multitude of diverse, valid plans on a laptop overnight—and to describe how they are distributed in the universe of all possibilities. That in turn allows any plan, including one proposed for adoption, to be compared meaningfully to the available alternatives.

Not surprisingly, work in this direction has come to dominate some types of redistricting litigation in the last few years, especially lawsuits claiming that a districting plan is excessively partisan. But until now, ensemble methods have not seriously grappled with issues of race in redistricting. And these tend to be the most heavily litigated issues in the field, due to the demands imposed by the Voting Rights Act (VRA) and the Constitution's Equal Protection Clause. The legal rules addressing race in redistricting are much more complex than, say, the "one person, one vote" doctrine in federal constitutional law, or the contiguity requirements in state constitutional law. Modeling the racial rules is far from straightforward.

This article takes up that task. First, we develop methods that incorporate the legal rules involving the consideration of race in redistricting into the algorithms that generate redistricting ensembles. The main applications of these VRA-conscious ensembles would be to study the normal range of attributes of lawful plans, for instance to assess claims of partisan gerrymandering. Second, we show that the methods used to accomplish that task can also be used to draw maps that increase opportunities for minority groups to elect candidates of their choice. As it turns out, there is the potential to provide much more opportunity, at least in some states, than was previously recognized. In short, the algorithmic creation of redistricting ensembles holds the promise of not only sharpening our understanding of redistricting choices and tradeoffs, but also better fostering the aims of the Voting Rights Act, "a statute meant to hasten the waning of racism in American politics" (*Johnson* v. *De Grandy* 1994, 1020).

To that end, one of our strongest findings deserves particular emphasis. In the past, the dominant method of looking for effective minority electoral opportunity has been to use district demographics as a proxy, such as by seeking majority-Black districts to secure effective electoral opportunities for Black voters. But in our case studies, demographic share alone is a poor proxy for effectiveness; relying too heavily on demographics could inadvertently disempower minority citizens by packing them into too few districts.

Our methods will be most helpful for proactive legislatures and commissions that wish to draw legally defensible maps that will prove effective for racial and language minority groups while upholding other criteria simultaneously. The tools described here will generate examples of maps with valuable properties and will help elucidate the cost in minority electoral opportunity, if any, that results from strict application of lower-ranked criteria. Although these tools also may be helpful to

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[1]Bialik (2019). This figure refers to the 116th Congress (2019–2021).

[2]This number is based on 2019 one-year American Community Survey (ACS) data, U.S. Bureau of the Census (2019a), figured as the share of citizen voting-age population comprising those who are either Hispanic/Latino or from a non-white racial group.

[3]*See* U.S. Bureau of the Census (2019b); National Conference of State Legislatures (2020). Putting those sources together, the three exceptions are Arizona (34.4% minority citizen voting-age population vs. 38% minority legislators), Hawaii (73.2% vs. 76%), and Ohio (16.7% vs. 18%).

plaintiffs who wish to challenge existing maps under the VRA, that use is not our main focus.

We will use three main elements: a Markov chain procedure that proposes successive modifications to districting plans, an ecological-inference procedure that identifies minority-preferred candidates based on precinct-level historical election data matched to demographics, and a benchmark plan from which we can establish a presumptively acceptable number of effective districts.

Below, for our proof of concept, we will use a spanning-tree recombination procedure for the first element, a hierarchical Bayesian model for the second, and an enacted plan that has survived VRA scrutiny for the third[4]—but we emphasize that the main contribution of the current article is the overarching protocol, which is designed to be *modular*, letting users substitute in other alternatives to play these three roles. Combining these elements, our protocol defines *effective* districts for minority groups at any given threshold of confidence.

Article Outline. We begin in section 2 with a review of the burgeoning science of redistricting ensembles. Section 3 summarizes the legal rules governing the consideration of race and racial data in redistricting. Section 4 sets forth our VRA-conscious ensemble protocol, relying on recent election data to generate effectiveness scores that rate each district's likelihood of nominating and electing minority-preferred candidates. Section 5 applies this protocol to congressional redistricting in Texas, where both Latino and Black residents are numerous enough to require VRA attention. Section 6 applies techniques from statistics and machine learning to the Texas results to show the importance of using detailed electoral data. And section 7 concludes with a clear proof of concept showing that the long-standing underrepresentation of minority voters in Texas, far from being an immutable fact, can be addressed through proactive mapmaking.

Finally, we have made the corresponding software tools available for public use in our GitHub (MGGG Redistricting Lab 2020a) and through a user-friendly portal at districtr.org/VRA.

2. ENSEMBLE METHODS: ALGORITHMS FOR CREATING DISTRICTING PLANS

As Justice Kagan explained in her dissent in *Rucho v. Common Cause* (2019, 2517–23), a computer equipped with an algorithm that generates a huge number of redistricting plans could potentially create a baseline to help answer questions like:

- What is an extreme, or unfair, number of Republican (or Democratic) districts, given the partisan composition and political geography of the state's voters? or,
- What would be a typical number of competitive districts, given those same parameters? or,
- Given the new census data, can a plan comply with the "one person, one vote" principle without pairing two incumbents' homes in the same district?

And as we will soon demonstrate, an ensemble approach also can help us address questions like:

- What is a fair map for Latino and Black voters?

2.1. Illustrative example: Iowa

To see the power of redistricting ensembles, let's consider the case of Iowa. According to the 2010 census, Iowa's 99 counties contained 216,007 census blocks and 3,046,355 residents—enough for four congressional districts. Iowa's constitution simplifies the redistricting problem by mandating that "no county shall be divided in forming a congressional district," so drawing our four districts requires assigning only the 99 counties (Iowa Const. art. III, § 37). We might hope to approach the task of finding fair plans by first building all possible plans, and comparing a particular plan to the full set.

But even this modest problem of dividing 99 counties into four connected parts (four contiguous districts) is currently out of reach: no one has yet been able to find a precise answer for this problem by computer, even with a clever enumeration algorithm and a month of computing time.[5]

This problem is only compounded in most states, which build their districts from census blocks

[4]As described below, we use an implementation called GerryChain for plan generation, we use eiPack for ecological inference, and we use the current enacted Texas congressional map as our Voting Rights Act (VRA) benchmark.

[5]Indeed, even the simpler problem of partitioning a 9×9 grid into nine districts of nine units each has 706,152,947,468,301 solutions.

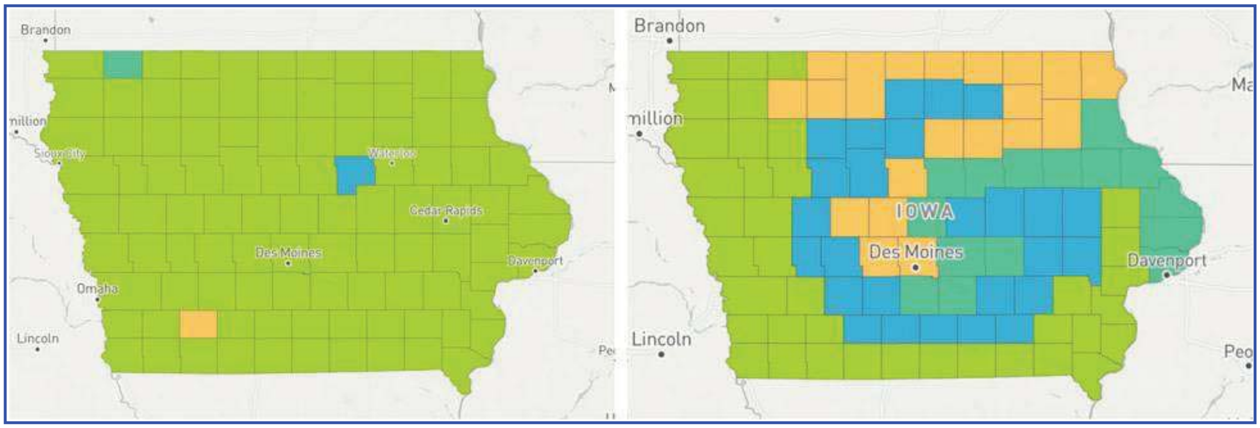

FIG. 1. These two partitions of Iowa into four connected pieces are not plausible for adoption as districting plans. The first has nearly all the state's population in a single large (*green*) district. The second more closely balances each district's population, but would likely violate Iowa law's compactness requirement.

(on average, there are more than 2,000 blocks per county). The full enumeration is subject to what is called *combinatorial explosion*, and the associated counting problem has forbidding complexity. This means not only that we lack the computing power to enumerate all plans today, but that computers likely will never be able to do so.

A second issue is that most plans in a complete enumeration would be irrelevant to the practical problem of redistricting because they would be blatantly unlawful. This is illustrated in Figure 1. The plan on the left, in which the biggest district has more than 750 times the population of the smallest one, would patently violate the federal Constitution's "one person, one vote" doctrine.[6] This means that districting plans with large population inequalities are of no practical interest, so a useful ensemble should exclude them.

The map on the right has much better population balance, but it also falls outside the plausible zone for plans. Its blue G-shaped district ("G" for gerrymandering) flaunts the mapmaker's disrespect for the traditional districting principle of compactness, which Iowa law explicitly safeguards (Iowa Code § 42.4.4).

Good ensemble methods allow us to draw a *representative sample* of compact, contiguous, population-balanced plans from the full space of possibilities—that is, a sample distributed in a known way that is suited to the law. By appealing to this sample, we can hope to address questions of partisan fairness, competitiveness, racial fairness, and all the other concerns and values we bring to bear on redistricting. To illustrate this methodology, we generated a sample of 100,000 valid Iowa congressional maps by the recombination method explained below in section 4.2, without taking partisan data into account.[7] This lets us compare the enacted plan against these alternatives in terms of votes cast for president in the November 2016 election, say. In our ensemble of compact, contiguous, population-balanced plans, nearly 75% have one safe Republican seat and three competitive seats (using a 55% majority as the line between competitive and safe). The current enacted plan has one heavily Trump-favoring district and three competitive ones, putting it in the largest category. This does not tell us by any stretch that the current plan is ideal or fair, but it does tell us that this plan is not an outlier by this way of measuring partisanship. This illustrates an elementary use of ensembles to benchmark partisan lean and competitiveness.

Similarly, ensembles can help us study how plans made without regard to race might tend to distribute a state's minority populations across districts, merely as a function of human geography. This

[6]A district-to-district population difference greater than 10% of the ideal district size is presumptively unconstitutional under the Fourteenth Amendment; for congressional districts, the standard is far stricter, under Article I of the Constitution (*Brown* v. *Thomson* 1983, 842–48; *Karcher* v. *Daggett* 1983, 730–44). The malapportioned plan in Figure 1 has top-to-bottom deviation nearly as large as the whole state, or close to 400% of ideal district size.

[7]ReCom always produces contiguous, balanced districts, and favors compact districts for reasons explained below in section 4.2.

racial baseline has been studied in a range of reports and papers, including MGGG Redistricting Lab (2018d, 2018a, 2019b, 2019a); DeFord and Duchin (2019); Duchin and Spencer (2021). But exploring the distribution of racial-group members in an ensemble is a different task from building an ensemble that takes VRA compliance into account. We will turn to that task shortly.

2.2. *Building ensembles*

Ensemble methods backed by powerful computers have proliferated in the last decade. Large ensembles of alternative plans proved critically important in federal-court cases invalidating extreme partisan gerrymanders in Ohio and Michigan (before the Supreme Court in *Rucho* held these claims nonjusticiable in federal courts) and more recently in similar state-court cases in Pennsylvania and North Carolina (*Rucho* v. *Common Cause* 2019, 2493–508; *League of Women Voters of Mich.* v. *Benson* 2019, 893–908; *Ohio A. Philip Randolph Institute* v. *Householder* 2019, 1025–62, 1082–85; *League of Women Voters* v. *Commonwealth* 2018, 770–81; *Common Cause* v. *Lewis* 2019, 17–43, 80–96).

Past ensemble methods used in litigation have focused on generating plans while controlling population balance, contiguity, compactness, and sometimes county and municipality integrity. Generating large ensembles while accounting in some way for these legitimate districting criteria helped judges decide whether one political party's disproportionate successes were due to the state's geographic features and the distribution of its voters—or to partisan manipulation of district lines. But in building their ensembles, the experts who testified in these cases did not seriously grapple with the legal requirements involving the consideration of race in redistricting.

In the Wisconsin case, for example, Democratic plaintiffs brought partisan-gerrymandering claims against a state Assembly plan that had resulted in Republicans winning 60 or more of the 99 seats, even in elections where Democratic candidates collectively received more votes than their Republican counterparts. In work prepared for the litigation and described in a subsequent article (Chen 2017), political scientist Jowei Chen built an ensemble of alternative Assembly plans to help evaluate the enacted plan and to demonstrate that the heavy advantage that Republicans enjoyed under that plan did not result inevitably from the political geography of the state's voters. Chen generated an ensemble of plans that altered boundaries for 92 of the 99 districts, while "freezing" seven heavily minority districts in and around Milwaukee, one of which had been ordered into effect to remedy a VRA violation.

Likewise, in the North Carolina cases, the experts' ensembles relied on proxies for districts' effectiveness for minority voters. For example, consider the work of one plaintiffs' expert, mathematician Jonathan Mattingly, as described in a subsequent article by his research group (Herschlag et al. 2020). Mattingly's work in North Carolina used demographic targets of 44.48% and 36.20% Black population for two congressional districts—the precise levels found in the enacted plan that the plaintiffs were challenging. He then built an ensemble by iterating a random step biased to favor plans that hit those demographic targets.[8] In addition to the effects of this tilted search, he discarded plans that fell short of those targets from the final ensemble presented in court, so that the prescribed population levels served as a minimum for all included plans.

In the context of these mid-decade partisan-gerrymandering cases, the experts' decisions to de-emphasize VRA complexities were understandable. The litigation, after all, focused on party, not race, and lawful VRA-compliant districts were already in place. But at the beginning of a new decade, with fresh census results available, that option will be foreclosed, as the minority districts from the previous map will have become either over- or under-populated due to population shifts and will thus violate "one person, one vote." So the minority districts (like all other districts) will have to be redrawn to accommodate the new census data. When generating alternative plans to create a baseline for comparison, redistricters will need to account for the delicate legal requirements imposed by the VRA and the Constitution.

For techniques that have been implemented to build VRA requirements into redistricting ensembles,

[8]Mattingly's method used a search procedure weighted to favor plans with better scores, based on a combination of population balance, compactness, county integrity, and nearness to his demographic targets for Black population.

the literature review is brief. In a new *Yale Law Journal* article called "The Race-Blind Future of Voting Rights" (Chen and Stephanopoulos 2021), Jowei Chen and legal scholar Nick Stephanopoulos take the problem of identifying suitable VRA districts head-on, defining a minority opportunity district by using a combination of partisan data (returns from the 2012 presidential general election) and demographic data (voting-age population from the 2010 census). In particular, they define a minority opportunity district to be one in which (1) the candidate of choice (typically Obama) carried the district in the general election and (2) most of the candidate's support is estimated to have come from minority voters. This is somewhat closer in spirit to the method proposed here, though this article draws dramatically different conclusions from theirs.[9]

Our method for measuring district effectiveness, described in section 4 below, will draw on a much larger collection of recent elections, pairing a primary with each general. The outcomes from these elections are the essential components of our effectiveness scores. And in section 6 we will show that the scores we develop cannot be well approximated by considering only a district's partisan lean and demographics.

2.3. *Using ensembles*

As we develop techniques for building VRA-conscious ensembles, there are two important general caveats about how and how not to use these ensembles.

Comparison, not selection. Our protocol is not designed to simulate the nuanced judgment of a seasoned voting-rights attorney. Rather, as we generate a chain of thousands of maps, we need a fast and reliable rough cut for VRA compliance. Our protocol uses a random iterative process in which districting plans are proposed, weighed, and potentially accepted into our ensemble of plans. We will be designing an in-or-out criterion that can be assessed in a fraction of a second. It is too much to expect perfection in excluding all unlawful maps and including all lawful ones, partly because the law itself is hardly a bright-line field. For example, even what seems like a rule with a clear threshold, such as the constitutional prohibition against state-legislative plans with population deviations greater than 10%, has exceptions in case law (*Cox* v. *Larios* 2004; *Unger* v. *Manchin* 2002). Nonetheless, an ensemble that includes most of the lawful maps that are proposed in the chain and rejects most of the unlawful ones will suffice for our goals of comparison and benchmarking. Ensembles should not be regarded as supplies of plans ready for immediate adoption; they are not likely to be good plans without extensive human vetting and adaptation.

Normal range, not ideal. We advocate using redistricting ensembles to learn a normal range for metrics and measures under the constraints of a set of stated redistricting rules and priorities. Ensembles allow us to justify statements such as *Plan X is an outlier in its partisan lean, taking all relevant rules into account*. While talking about normal ranges and outliers, we should avoid the temptation to valorize the top of the bell curve (or its center of mass, or any other value) as an ideal. By analogy, we can talk about people who are unusually tall or short without believing that any height is most desirable or ideal. If the 50th percentile height for American women is 5'4" and the 99th percentile height is 5'10," we can conclude that a woman who is six feet tall is unusual, and we can look for reasons (family history, diet, and so on) to explain her height. But it would be quite strange to decide that a woman who is 5'4" is a "better" height than one who is 5'5."

Justice Kagan's *Rucho* dissent skirted the edge of this temptation. She mostly reasoned from ensembles just as we will recommend here, envisioning a bell curve (in that case, of partisan advantage) and describing plans far from the bulk of the curve as presumptively impermissible: "The further out on the tail, the more extreme the partisan distortion and the more significant the vote dilution" (*Rucho* v. *Common Cause* 2019, 2518). But in the course of describing the outlier logic, she implied that plans "at or near the median" are the best of all. An outcome "smack dab in the center" (in Justice Kagan's words) may not be in any sense the most fair, however. For instance, turning to the November 2012 Obama-Romney election as a touchpoint, Obama received nearly 53% of the major-party vote in Iowa. Even if just over half

[9]For their method's details, see the full description in Chen and Stephanopoulos (2021). For a critique of their definition of minority opportunity districts and its application, see Duchin and Spencer (2021).

the congressional plans in our ensemble have three Obama-favoring districts out of four (making that the median outcome), we might still reasonably consider a map with two Obama-favoring and two Romney-favoring districts to have at least as strong a claim on fairness, given the nearly even vote split.

Likewise, there would be no reason to prefer a map that preserves intact a *median* number of whole counties or municipalities. Indeed, some states' redistricting laws expressly demand keeping the greatest practicable number of counties or municipalities intact.

The same warning, to be wary of the magnetic attraction to the middle of a bell curve, surely applies as well to racial fairness. If a state's Latino, Black, Asian American, and Native American residents have historically been (and currently remain) underrepresented, we should gravitate toward solutions that fix the shortfall rather than perpetuate it. Fortunately, federal law pushes redistricters in the right direction.

3. THE LAW OF RACE AND REDISTRICTING

The rules regarding the consideration of race in redistricting flow primarily from two sources of federal law: the Fourteenth Amendment's Equal Protection Clause and Section 2 of the Voting Rights Act, which Congress, exercising its power to enforce the Fifteenth Amendment, enacted in 1965 and significantly revised in 1982.

3.1. The Voting Rights Act prohibits minority vote dilution

Section 2 of the VRA prohibits a redistricting plan that abridges any citizen's right to vote "on account of race or color [or membership in a language-minority group]" (VRA §§ 10301(a), 10301(f)(2)). Minority plaintiffs can establish a violation of amended Section 2 by showing, "based on the totality of circumstances," that members of their racial or language-minority group "have less opportunity than other members of the electorate" to "nominat[e]" and "elect representatives of their choice" (VRA § 10301(b)).

In assessing whether a redistricting plan provides equal electoral opportunity under amended Section 2, Congress expressly permitted state redistricters and federal judges alike to consider recent election outcomes, namely "[t]he extent to which members of a protected class have been elected to office" (VRA § 10301(b)). Nothing in Section 2, however, "establishes a right to have members of a protected class elected in numbers equal to their proportion in the population." While electoral success for minority candidates is important, even more important under Section 2 is that the candidate be the "chosen representative" of a particular racial or language-minority group, regardless of the candidate's race or ethnicity (*Thornburg* v. *Gingles* 1986, 68 (plurality opinion)). And Section 2's lodestar is "equality of opportunity, not a guarantee of electoral success for minority-preferred candidates of whatever race" (*Johnson* v. *De Grandy* 1994, 1014 n.11). As the Supreme Court has explained, "minority citizens are not immune from the obligation to pull, haul, and trade to find common political ground, the virtue of which is not to be slighted in applying a statute meant to hasten the waning of racism in American politics" (*Johnson* v. *De Grandy* 1994, 1020).

In redistricting cases "the ultimate question [under Section 2] is whether a districting decision dilutes the votes of minority voters" (*Abbott* v. *Perez* 2018, 2332). District lines can dilute the voting strength of politically cohesive minority-group members either by "cracking," or dispersing, them among multiple districts where they are routinely outvoted by a bloc-voting majority, or by "packing," or concentrating, them into too few districts, wasting votes that could have mattered in neighboring districts (*Johnson* v. *De Grandy* 1994, 1007). Section 2 prohibits both cracking and packing whenever district lines combine with social and historical conditions to impair the minority group's ability to elect its preferred candidates "on an equal basis with other voters" (*Voinovich* v. *Quilter* 1993, 153).

In jurisdictions where all sizable demographic groups (majority and minority alike) consistently favor the same candidates, a redistricting plan cannot dilute minority citizens' voting strength, so Section 2 plays no role (*Thornburg* v. *Gingles* 1986, 51). But in most states, where voting is in varying degrees racially polarized, Section 2 can require replacing one or more districts that elect candidates preferred by the majority (usually, a white majority) with districts that would elect candidates preferred by one or more minority groups (*Johnson* v. *De Grandy* 1994, 1008). To prevail, Section 2 plaintiffs must prove that, under the challenged plan, a bloc-voting majority usually will defeat "candidates supported by a politically cohesive, geographically insular minority group" (*Thornburg* v. *Gingles* 1986, 49). But even with such proof, plaintiffs' challenge to a state districting plan ordinarily will fail if the plan provides effective opportunities to nominate and elect minority-preferred candidates in a number of districts *roughly proportional* to the minority group's share of the state's citizen voting-age population, or CVAP (*LULAC* v. *Perry* 2006, 436–38; *Johnson* v. *De Grandy* 1994, 1000).

One particularly useful—and simple—method for assessing minority electoral opportunities under a districting plan is to add up the votes cast for each candidate in recent *statewide* primary and general elections by district, to learn which districts gave more votes to the minority-preferred candidate than to any other candidate (*LULAC v. Perry* 2006, 428 (majority opinion), 493–94, 499–501 (Roberts, C.J., dissenting in part); *Session v. Perry* 2004, 499–501). This approach is particularly straightforward if each precinct is kept intact within a single district: simply adding up the votes for each candidate in all of a district's precincts shows, for each election, which candidate carried the district. The most difficult part of these analyses, especially in primaries, is identifying the candidate who was minority-preferred in each election, which is typically performed by a statistical-inference procedure comparing demographic patterns to voting patterns (King 1997; King, Rosen, and Tanner 1999; Elmendorf, Quinn, and Abrajano 2016). But we will take care to place actual electoral history at the center of our assessment of district effectiveness, keeping the role of statistical inference to a minimum.

3.2. The Equal Protection Clause prohibits excessive attention to race

Regardless of what techniques are used to assess minority electoral opportunities, compliance with Section 2 necessarily requires detailed consideration of race and racial data. But a state's consideration of race is constrained by the Fourteenth Amendment mandate that "[n]o State shall … deny to any person within its jurisdiction the equal protection of the laws" (U.S. Const. amend. XIV; see *Bethune-Hill* v. *Virginia State Bd. of Elections* 2017, 802). Starting in the 1990s in its *Shaw* line of cases, the Supreme Court has identified at least two ways that the excessive use of race can give rise to a presumptively unconstitutional *racial gerrymander* under the Equal Protection Clause (*Miller* v. *Johnson* 1995, 904–05, 910–17; *Shaw* v. *Reno* 1993).

First, a bizarrely noncompact district is subject to strict scrutiny under that Clause if the district's boundary is "so irrational on its face that it can be understood only as an effort to segregate voters into separate voting districts because of their race" (*Shaw* v. *Reno* 1993, 658). This type of racial predominance most often arises where a district's perimeter is defined not by the boundaries of intact precincts, for which electoral data exists, but by the boundaries of (much smaller) census blocks that have been conspicuously sorted into or out of districts according to their racial composition (Hebert et al. 2010, 66–68 & n.21; *Alabama Legislative Black Caucus* v. *Alabama* 2015, 274).

Second, although only a minority of justices have stated that the intentional creation of a majority-minority district should always be presumptively unconstitutional, a majority of the Court has held that districts violated the Equal Protection Clause because they were drawn to "maintain a particular numerical minority percentage" or to meet arbitrary or "mechanical racial targets." The Court has thus rejected a bald mandate that certain districts must have at least a 50% or a 55% Black voting-age population regardless of whether that percentage was actually shown to be necessary for the district to nominate and elect minority-preferred candidates (*Cooper* v. *Harris* 2017, 1469; *Bethune-Hill* v. *Virginia State Bd. of Elections* 2017, 799, 801–02; *Alabama Legislative Black Caucus* v. *Alabama* 2015, 267, 275; *Bush* v. *Vera* 1996, 969–72).

3.3. Implications for redistricting ensembles

These legal points have major implications for an ensemble-creation protocol keyed to compliance with the VRA and the Constitution. As an initial matter, recalling the earlier point about ensembles being far more useful for comparison than for selection, the focus here is on drawing a collection of maps that would be relatively safe from challenges under VRA Section 2, rather than on crafting a map for plaintiffs to propose when suing the state.

As a gatekeeping function before ultimately assessing the "totality of circumstances," courts generally require Section 2 plaintiffs to present an illustrative map showing that the minority group in question could constitute a literal arithmetic majority of the voting-age population (VAP) in a proposed district.[10] The Supreme Court has noted, however, that a district that falls short of the 50% threshold yet can still nominate and elect minority-preferred candidates "can … [and] should" count as a minority-effective district when assessing a state's compliance with Section 2 (*Bartlett* v. *Strickland* 2009, 24 (plurality opinion); see also *Cooper* v. *Harris* 2017, 1470). So actual electoral opportunity for minority groups—a track record of effectiveness in elections—is what matters when defending a map against a VRA challenge. Taken together, the legal points elucidated above in sections 3.1 and 3.2 suggest three crucial design principles for a VRA-conscious ensemble protocol.

(1) *Ensure effectiveness in both primaries and generals.* Aiming to weed out of an ensemble plans that violate Section 2, while retaining plans that comply, a protocol must assess whether particular districts will or will not be effective for minority-preferred candidates seeking both nomination (in primaries) and election (in generals). This assessment requires attention to both demographic data and actual election results, including precinct-level returns from primary and general elections.
(2) A*void* a priori *demographic targets.* Threshold decisions about the composition of districts should not be based on purely demographic targets—for example, requiring a certain number of districts that are at least, say, 55% Latino or 50% Black. That approach not only could lead to false positives or false negatives for district effectiveness, but could leave the methodology vulnerable to constitutional attack for excessive race-consciousness.
(3) *Maintain reasonable compactness.* To further reduce constitutional exposure, the ensemble-generating technique should admit few or no plans with bizarre district shapes.

We note that both the first and the third principles recommend the use of precincts, rather than the much smaller census blocks, when assembling districts. Precinct-based plans promote compactness and facilitate more accurate assessment of electoral history, which is fundamental to evaluating district effectiveness. And though they may not achieve perfect population equality, that fact usually should not present significant constitutional concerns.[11]

4. DESIGN OF A VRA-CONSCIOUS ENSEMBLE PROTOCOL

In this section, we will describe the design of a protocol for generating redistricting plans that comply with not only the criteria of population equality, contiguity, and reasonable compactness, but also the race-related rules mandated by the VRA and the Equal Protection Clause. The protocol begins with data preparation and culminates in the use of a constrained recombination algorithm for generating plans that meet VRA-related requirements. We propose this as a sound and detailed *VRA-conscious algorithm*, but not as *the authoritative VRA algorithm*. There may well be other ways to incorporate the legal requirements around race, and to do it well. But the methods laid out in this section come closer to the big-picture goal—building a representative sample of lawful maps—than any previous work we know. We believe that this elaborated example of one concrete, reasonable way to take account of race and the law helps illuminate some key decisions.

We recall from above that the protocol is modular with respect to three ingredients: a procedure for iteratively modifying districting plans (here, spanning-tree recombination), a procedure

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[10] *See Bartlett* v. *Strickland* (2009, 6, 9–11, 20, 24–25, 26 (plurality opinion)). *Bartlett* also may be satisfied with a majority of the proposed district's *citizen* voting-age population (CVAP). And *Bartlett*'s 50% rule may not apply if the defendant drew the challenged districts with discriminatory intent, as might well be the case when a state dismantles an existing minority-effective district.

[11] Using whole precincts will rarely raise "one person, one vote" concerns for state-legislative maps. However, the Constitution imposes stricter population-equality standards for congressional maps (*Karcher* v. *Daggett* 1983, 740-41). Although the most common current practice is to draw congressional plans so that the largest and smallest districts differ by only one person, the Supreme Court has upheld plans with significantly larger deviations (*Tennant* v. *Jefferson County Comm'n* 2012, 762, 764–65; *Abrams* v. *Johnson* 1997, 99–100). In any event, a map built from whole precincts can usually be readily modified into a map with a minimal deviation by swapping a limited number of census blocks between adjacent districts.

for identifying minority-preferred candidates (here, a Bayesian hierarchical model of ecological inference), and a benchmark that prescribes a threshold number of effective districts for each minority group (here, an enacted plan that has evaded or withstood VRA scrutiny). Our choices can be swapped out for others as new methods or special circumstances warrant, leaving the overall structure intact.

4.1. Preparing data

4.1.1. Electoral and demographic data. We will require a cleaned precinct *shapefile* for the state, with election returns and demographic data joined to those precincts.[12] This can be difficult to obtain because precincts change from year to year and a longitudinal precinct shapefile is needed for the span of years covered by the election dataset. Furthermore, we may need to clean the precinct shapes to get suitable topology: to be usable as building blocks for plans, precincts must tile the state, with every resident located in one and only one precinct.[13]

The shapefile allows us to match reported vote totals to geographic units and to record which pairs of precincts are adjacent, which will be needed to ensure that districts are contiguous. For each precinct, we have joined data on total population from the 2010 decennial census, adult citizen population by race and ethnicity from the American Community Survey (ACS) five-year rolling estimates ending in each election year, and counts of votes received by each candidate for statewide election in a large set of primary and general elections.

Although our modeling concern is with districted elections for Congress and state legislatures, our analysis is based primarily on statewide (exogenous) contests. This is because the choices facing voters in districted elections vary across the state: in any given election year, some districts are uncontested, some have strong incumbents or other idiosyncrasies. When district boundaries are moved to create alternative plans, the newly proposed districts will be composed of voters who faced completely different candidate choices. It is not clear how votes for one candidate would translate to votes for a different candidate. By contrast, statewide elections allow us to make apples-to-apples comparisons across different parts of the state, since the same set of candidates competed everywhere. Ideally, we would include all statewide contests for the last ten years, but this is not always possible because of data availability and precinct instability. As we will discuss further below, this protocol is not intended for use with fewer than five general elections, grouped with the primaries (and, where applicable, primary runoffs) that preceded them.

Because our main concern here is whether minority-preferred candidates are ultimately elected to office, we *link* the primary (and primary runoff) for a given office in a given year to the general election for that same office that same year, and define success by whether the candidate who was minority-preferred in the primary succeeded at all stages of the electoral process.

We use a simplified set of racial groups: every person who identified as Hispanic/Latino on the census or ACS is classified as *Latino*. We use the term *Black* for non-Hispanic respondents who selected Black as their single racial category, and we use *White* similarly. All other respondents (those non-Hispanic persons selecting two or more races, Asian American, Native American, and so on) are grouped together and designated as *Other*. In a state with only one sizable minority group, all other minority groups may be merged into the Other category for purposes of this VRA protocol. Citizen voting-age population is denoted by CVAP, and we use HCVAP, BCVAP, WCVAP, and OCVAP to denote Hispanic/Latino, Black, White, and Other CVAP. We focus on Latino and Black voters as minority groups because our main case study involves congressional redistricting in Texas. In other states, like California, Hawaii, or Alaska, or in certain local districting projects, we might specify different racial groups for analysis.

Importantly, we make no prior assumptions about whether the voting behavior of Latino, Black, White, or Other groups will align. This is a case-by-case empirical question addressed with statistical inference.

4.1.2. Candidates of choice. As explained above, the linchpin of a vote-dilution claim under

[12]Shapefiles store data about the position and attributes of a geographic unit, such as a precinct.

[13]Cleaned and vetted shapefiles that are suitable for longitudinal data are easier to create in some states than others. For instance, the Louisiana shapefile used in this study required hundreds of person-hours of data preparation from members of the MGGG Redistricting Lab. It would be extremely difficult to obtain an analogous data product in Mississippi, for example.

the VRA is the right to replace districts where minority-preferred candidates usually lose with districts where they have a realistic opportunity to win (*Johnson* v. *De Grandy* 1994, 1020). To assess whether a district falls into the former category or the latter requires determining which candidates are preferred by members of each sizable minority group.

Because vote totals are not reported by racial group, we cannot directly determine which candidates are minority-preferred. Instead, this effort falls under the umbrella of *ecological inference* (EI). Voting preferences are never monolithic, but techniques for measuring racial polarization have been refined for decades, and they can help us estimate the degree of bloc voting. The techniques in the ecological-inference family, like all statistical-inference methods in the presence of missing data, give imperfect and uncertain answers (Elmendorf, Quinn, and Abrajano 2016). It is fundamentally important to estimate the error that is produced by techniques and keep track of how it compounds or cancels out in our high-level conclusions. As much as possible, we will opt to make gradated and not bright-line determinations from the outputs of EI.

Our VRA-conscious ensemble protocol requires identifying the candidate who was preferred by each sizable minority group in each election, together with confidence measures that these preferred candidates are correctly identified. To perform the check for minority control of a district, as well as to identify district-wide candidates of choice for newly proposed districts, we make use of not only statewide but also precinct-level vote estimates by race for each candidate (with variance estimates). Users can employ various methods to generate these estimates (e.g., using King's EI, Ecological Regression, exit polls, or voter files). Notably, this allows our protocol to immediately incorporate any future advances in inference techniques.

In the implementation described here, we generate estimates using a version of King's EI, specifically the ei.MD.bayes function from eiPack (Lau, Moore, and Kellermann 2020) which is based on the Bayesian hierarchical Multinomial Dirichlet model for $R \times C$ tables proposed in King, Rosen, and Tanner (1999).[14] For each election we run EI at the statewide level, using precinct-level input tables. The inputs for each precinct are the row and column *sums* for the $R \times C$ table of vote counts. The row sums correspond to the precinct's estimated number of adult citizens in each racial group (HCVAP, BCVAP, WCVAP, and OCVAP). The column sums are the precinct's vote totals for each candidate as well as a *None* count, which is the sum of the four CVAP figures minus the sum of the recorded vote totals for all candidates, estimating the number of nonvoters. EI then infers values for the internal cells of these tables, i.e., estimated vote counts by racial group and candidate. Inclusion of the *None* column allows the underlying model to estimate differential turnout by race; without this, EI would rely on the unrealistic assumption that adult citizens from all demographic groups were equally likely to have cast a ballot.

Each EI run generates a large random sample of estimated precinct vote counts; we can sum these across the entire state to get statewide estimates. For each racial group, the candidate with the highest average estimated vote total for a given election is identified as the group's "candidate of choice." For a measure of confidence that Candidate X was the candidate of choice for a racial group in a given election, we first take repeated draws from the EI distribution and record the frequency with which X receives the most votes from that group. We then transform this to a confidence score.[15]

[14] Here, $R \times C$ stands for the number of rows (or racial groups) R and columns (or candidates) C.

[15] Let p be the frequency in a batch of trials with which X is observed to be the preferred candidate. We logistically transform this to a confidence score using $C(p) = 1/(1 + \exp(18 - 26p))$ to weight the election in the compound score of district effectiveness (see Table 1 below). The parameters 18 and 26 were chosen so that an election in which the draws have Candidate X ahead only 50% of the time should receive almost no weight (because it is a toss-up); but if Candidate X comes out ahead in, say, 85% of trials, the confidence should be nearly 100%. It is certainly possible to use other parameters, to skip this step and just use $C(p) = p$ as a measure of confidence, or even to forgo confidence altogether. Without some factor of this kind, however, the resulting score will have more noise due to cases where the candidate of choice is uncertain. If we do not strongly down-weight the uncertain elections, we risk a situation in which just rerunning the EI with identical settings could produce a significantly different answer. We discuss this and other robustness checks in footnote 31.

4.2. Building new plans by recombination

The science of representative sampling has advanced greatly in the past few years as ensemble methods for redistricting have matured. Using a technique known as *Markov chain Monte Carlo* (MCMC), it is now possible to efficiently create an ensemble of thousands or millions, even billions, of plausible maps. We can even sample while keeping control of the weighting that makes some kinds of plans appear more often than others. For example, we can be sure that a preference for more compact plans is designed to depend *only* on a prescribed score of compactness and on no hidden factors.[16]

The engine of our district-generation process is a Markov chain known as recombination, abbreviated ReCom, whose central idea of using spanning trees to split districts is fast becoming the standard in the field (DeFord, Duchin, and Solomon 2021; Autrey et al. 2021; McCartan and Imai 2021). We will apply it to plans built from whole precincts, the smallest geographic units for which we have accurate, detailed electoral data. Earlier MCMC methods for redistricting reassigned a single geographic unit (such as a precinct) from District A into adjacent District B at each step, creating a new plan that agreed with its predecessor on the assignment of every unit except one. (If Texas, for example, had 9,000 precincts, 8,999 would stay in their districts at each step.) By contrast, ReCom typically proposes a much larger change: at each step, two entire (adjacent) districts are merged and then re-split in a new way that is completely independent of the division in the previous plan. This means that a single ReCom step can reassign hundreds of precincts at a time. (Each of Texas's 36 congressional districts, for instance, has roughly 9,000/36, or 250, precincts, so each recombination step performs a random division of roughly 500 precincts into two new districts.) By iterating this transformation hundreds of times per minute, the map soon loses any resemblance to its starting configuration.

A ReCom step merges a random pair of adjacent districts and splits the region in a new way. Under the hood, each ReCom step uses a *spanning tree*, which is a kind of "skeleton" of the double-district created by the random merger, and then searches for a place to cut that tree to leave behind two population-balanced, connected pieces. So, by construction, all plans proposed by recombination are contiguous and maintain the desired population balance. What is less obvious is that ReCom's use of spanning trees also places an automatic priority on districts that have more internal adjacencies: so *compactness*, or a preference for plump, regular forms over thin necks or stringy appendages, is also a structural feature of the algorithm (see Figure 2) and does not have to be set as a manual choice by the programmer (DeFord, Duchin, and Solomon 2021). In fact, when the district boundaries of a plan generated by ReCom look ragged to the eye, it is often because the building-block units themselves (such as precincts) have jagged edges.[17]

Over thousands or millions of iterations, this simple method can undertake far-reaching exploration of the universe of possible plans subject to population balance, contiguity, and reasonable compactness. We will call a set of plans collected in a recombination chain an *ensemble* of plans.

Additional features and constraints can be incorporated into ReCom either with hard thresholds (i.e., validity checks) or by using probabilistic acceptance. To illustrate this, consider the traditional districting principle that counties should be kept intact when practicable. We could enforce a maximum allowable number of county splits by adding an instruction to automatically reject as invalid any proposed plan that exceeds some level of county-splitting, creating a *constrained* ensemble. A different option would be to impose a bias to the probability of acceptance, essentially flipping a weighted coin each time a proposal is generated that makes it rare but not impossible to accept plans with a large number of county splits. This would create a *biased* (or *tilted*) ensemble favoring fewer county splits.

When a proposed plan is rejected, a new plan is proposed by merging and re-splitting a freshly

[16]To be precise, the recombination algorithm used here approximately targets a known distribution called the *spanning-tree distribution*, where the probability of selecting a particular plan is proportional to a certain measure of compactness. A modified algorithm called *reversible recombination* exactly targets that steady state. See DeFord, Duchin, and Solomon 2021; Duchin and Tenner 2018; Sarah Cannon, Moon Duchin, Dana Randall, and Parker Rule 2020. "A Reversible Recombination Chain for Redistricting." On file with authors.

[17]The reasons spanning-tree partition methods produce compact districts are explored in Duchin and Tenner (2018) and DeFord, Duchin and Solomon (2021).

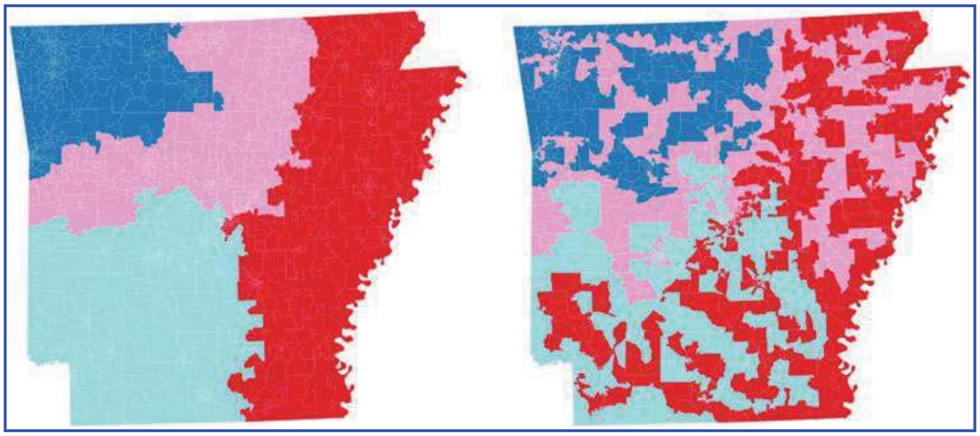

FIG. 2. If all contiguous, population-balanced plans were made equally likely, the compact plans (*left*) would be enormously outnumbered by bizarrely noncompact ones (*right*). The ReCom algorithm prefers the compact one, with a relative weight dictated *only* by its compactness score.

chosen pair of adjacent districts. This continues until some proposed plan passes the necessary tests to be accepted, at which point it is added to our ensemble. The next step proceeds from this newly accepted map, and so on until the Markov chain reaches its stopping condition (such as by collecting a prescribed number of plans). Our ensembles contain every valid plan rather than *sub-sampling*, or thinning out by accepting only every 1,000th or 10,000th plan as previous authors have done (Herschlag et al. 2020; Fifield et al. 2020). The long-range statistical properties are the same whether we use continuous sampling or sub-sampling, and we employ standard convergence heuristics from the scientific computing literature to provide evidence that our chains are run long enough for the statistics we collect to approach stationarity.[18] For more information about spanning-tree recombination and for comparisons to other methods, see DeFord, Duchin, and Solomon (2021); Becker and Solomon (2021); DeFord and Duchin (2020); McCartan and Imai (2021); and Autrey et al. (2021).[19]

Below, we will refer to district-level as well as statewide EI estimates as we build scores of district effectiveness. The district-level procedure requires some thought because of the computational cost of any calculation that occurs while the algorithm runs, rather than being performed in advance. It is not feasible to rerun EI to determine district-level candidate preferences with each newly proposed plan in a ReCom chain. We need a highly efficient calculation to retrieve both a point estimate and an estimated confidence level when a new district is formed. To handle this, we make use of the hierarchical structure of EI. The EI algorithm generates large random samples for each precinct from the distribution of possibilities produced by the underlying Bayesian model. This means that we can store outputs for each precinct in the state. Ideally, we would save the full *detailed histogram* describing the frequency with which various vote counts were estimated for each candidate and racial group in that precinct. Because this is too much information to store, we instead record the point estimate for each group's support of each candidate in addition to a simplified coarse histogram of vote counts, compressed down to just nine values, which turns out to be enough to recover the shape of the detailed histogram with remarkable fidelity, as shown in Supplementary Appendix A. During the run of the ReCom Markov chain, we can redraw samples from these coarse distributions and aggregate to the district level for each newly generated plan to determine the confidence that we have correctly identified candidates of choice.

4.3. Building raw scores of district effectiveness

We next lay out three ways to use prior election results in assigning a minority-effectiveness score

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[18]Markov chains that take large steps, like ReCom, require many fewer steps to achieve approximate independence than methods that iterate very small changes.

[19]See also Sarah Cannon, Moon Duchin, Dana Randall, and Parker Rule 2020. "A Reversible Recombination Chain for Redistricting." On file with authors.

to a proposed district: an unweighted score, a score that weights elections based on statewide voting patterns, and a score that weights elections based on voting patterns restricted to the proposed district itself. We will denote these scores by s^{unw}, s^{state}, and s^{dist}, respectively. Although election-weighting schemes differ across the three effectiveness scores, each score captures the same underlying idea: the effectiveness of a district for a minority group is keyed to the district's history of voting for minority-preferred candidates running for statewide offices. Importantly, because our districts are built from whole precincts and we have prior election results matched to those precincts, no statistical inference is required to determine which candidate prevailed in each district. We simply total up the votes cast in the district for each candidate and note which candidate got the most support.

First, we need to settle on the meaning of a successful outcome for the voters of a minority group in a particular election and district. If the candidate of choice from the primary does not advance to the runoff or general, then the outcome of the general is less informative with respect to the group's preferences. Therefore, we group elections by pairing primary and general (or grouping primary–runoff–general if applicable) as Table 3 illustrates for our Texas case study. A successful election is one in which the minority-preferred candidate in the primary prevailed in both elections in the grouping (or all three, if there was a primary runoff).[20]

Our weighting scheme is keyed to the *probative* value of each statewide election in determining minority effectiveness—its value as evidence. The unweighted score treats each election equally; no election is considered more probative than any other in determining a district's effectiveness. By contrast, the statewide weighted score s^{state} and the district weighted score s^{dist} treat some statewide elections as more probative than others and weight them accordingly. These *election weighting factors* each fall on a scale from zero to one. Their product is the final weight for an election. In keeping with case law, we up-weight elections if they have certain features:

- *Recent.* More recent elections provide stronger evidence of future electoral opportunity.
- *Clear candidate of choice.* As described above in section 4.1.2, our ecological-inference outputs come with estimates of the probability that the minority-preferred candidate in the primary election has been correctly identified. Translating this to a *confidence* that EI has identified the correct candidate gives greater weight to elections in which the minority group has a clearly preferred candidate.
- *Group member preferred.* An outcome gives stronger evidence of electoral opportunity when the minority-preferred candidate is a member of the particular minority group.

The weighting factors are summarized in Table 1. We discount elections for each year of age by a multiplicative factor of $2^{-1/4} \approx .841$, so that if any one election is four years older than another, it weighs half as much. The confidence that we have correctly identified the minority-preferred candidate is the same confidence score $C(p)$ described above (see footnote 15), using draws at the state level for s^{state} and drawing from the district-level coarse histogram for s^{dist}. When gauging Latino effectiveness, we place twice as much weight on elections in which the Latino-preferred candidate is Latino; and the analogous statement holds for other minority groups. Of course, these detailed weights are choices made by the modeler. We will introduce a calibration step for our effectiveness scores in the next section that makes our outputs more robust to these parameters, and we tested this by re-running the protocol several times with slightly different choices (see footnote 31).

These weighting factors are important for the legal interpretation we intend. More recent elections are up-weighted because the predictive value of election results tends to erode over time, as older voters pass away, younger citizens reach voting age, immigrants are naturalized, people move into or out of the district, and voters change their

[20]To be precise, suppose the primary candidate of choice is Candidate X and the runoff candidate of choice is Candidate Y (who might or might not be the same person as Candidate X). Then there are three cases we count as primary success. Case one: X won the primary (in the district) and there was no runoff. Case two: X received over 50% of the vote in the primary (in the district), whether or not there was a runoff. Case three: X ranked first or second in the primary (in the district) and Y won the runoff (in the district). An election set that meets one of these primary-success conditions and in which the minority-preferred nominee wins the general election in the district is counted as a successful election in the scores below.

Table 1. Weighting Factors for Effectiveness Scores

Score/Factor	*Recent*	*Clear candidate of choice*	*Group member preferred*
Unweighted (s^{unw})	1	1	1
Weighted/Statewide (s^{state})	1 Most recent .841 1 year prev. .707 2 years .595 3 years .500 4 years .421 5 years, etc.	Confidence from statewide EI	1 X belongs to group, .5 otherwise
Weighted/District (s^{dist})		Confidence from district-level EI	

The weighting factors for the unweighted, statewide, and district-based effectiveness scores (s^{unw}, s^{state}, and s^{dist}, respectively). All of these are computed with respect to the primary election in an election set, because the runoff and general may not contain the most-preferred candidate for the minority group. Here, Candidate X is the minority group's candidate of choice. These factors will be combined into an election-weighting term w for all elections in the dataset.

political preferences and behaviors. Confidence in correctly identifying candidates of choice is clearly pertinent, because a wrongly identified candidate of choice undermines all subsequent conclusions we will draw. Elections where the minority-preferred candidate belongs to the minority group in question are up-weighted because they are more probative: in the words of the late Judge Richard Arnold, the VRA's guarantee of equal opportunity is not met when "[c]andidates favored by [a minority group] can win, but only if the candidates are white" (*Smith* v. *Clinton* 1988, 1318).

We now have all the ingredients for the raw effectiveness score for a given district and racial group, multiplying the three factors above to get a weight $w = w(E, D)$ for each election and district. For instance, if we have 20 elections, then each w will be .05 for the s^{unw} score, no matter the election. For the statewide score s^{state}, the elections will not all count equally, so that, for example, a recent election with an in-group candidate will weigh four times as heavily as a four-year-old election with only white candidates.

Each effectiveness score is computed similarly:

$$\text{score of district } D = s(D) = \sum_{E\in\mathscr{E}} w \cdot \delta$$
$$= \text{weighted share of elections won by candidate of choice,}$$

where δ is 1 if the minority-preferred candidate carried the district and 0 otherwise. This expression applies to all three kinds of effectiveness scores $s = s^{unw}$, s^{state}, s^{dist}. For example, suppose there are two election groupings separated by four years, both have equal confidence weights and feature group members, and the candidate of choice is successful in one of those two election sets. Then the statewide and district raw scores of effectiveness would be 1/3 if the success was in the earlier election and 2/3 if the success was in the later election, while the unweighted score would be 1/2. The strength of using an approach that centers on electoral effectiveness rather than demographics is that we do not make evidence-free assumptions about how large a Latino population is needed to nominate and elect Latino-preferred candidates, or similarly for other minority groups. Rather, we directly and empirically answer that question by totaling up votes, district by district. Our direct, empirical approach is better keyed to actual minority electoral opportunities, and so also comports better with federal law. The VRA's plain text does not equate a minority-effective district with a majority-minority district; rather, it demands an assessment of whether minority citizens have an equal opportunity to "nominat[e]" and "elect representatives of their choice." And our empirical approach also respects the Equal Protection Clause's prohibition against relying on racial-percentage targets when drawing districts.

4.4. *Calibrating effectiveness scores*

The raw effectiveness scores described above combine election results in three different, reasonable ways. Each score ranges from zero (never electing minority-preferred candidates) to one (always electing them). We next convert these to calibrated scores that we will use when deciding whether to accept plans into the ensemble.

At this stage, we take a *group-control factor* into account, combining it with the raw effectiveness score because it is relevant to predicting future performance and to ensuring an emphasis on electoral success for larger numbers of minority voters. It is clear from redistricting case law that majority-minority districts are not required for VRA compliance, and indeed that setting out to draw districts with a demographic target is sometimes prohibited. At the same time, a district that has only 5% Black CVAP would not be reasonably viewed as an effective opportunity district for Black voters, on par with a district with more significant Black population. We have chosen to address this issue with a factor based on the minority group's share of district CVAP.[21] Group control of the district is relevant for two reasons. First, Section 2 of the VRA focuses on a minority group's ability to play a controlling or "decisive … role in the electoral process" and not merely one of "influence" (*LULAC* v. *Perry* 2006, 446 (plurality opinion) (citation and quotation marks omitted)). Second, because Section 2 protects the voting rights of a minority group's individual members, the effectiveness of a district should in part depend on the number of those members represented by their candidate of choice.

The goal of the calibration step is to bolster the *probabilistic* interpretation of the scores, so that, for example, a district with $s = .5$ can be described as having a 50/50 chance to perform for the minority group under consideration. To lend justification to this probabilistic interpretation, we apply a standard logistic regression to normalize the raw scores based on observed success data from actual enacted districts (specifically, all congressional, state Senate, and state House elections in the last decade).[22]

By design, the calibration step helps ensure that although the elections that are used in constructing the raw effectiveness scores are statewide contests, they still reflect election outcomes in *local* (districted) elections. We think of the logistic transformation as producing a score that best captures the observed performance of congressional, state Senate, and state House districts in the last decade. Each input (raw) score falls between zero and one; after applying the logit function we obtain an output (calibrated) effectiveness score that still falls between zero and one, but is now easier to interpret. We will reuse the same notation s^{unw}, s^{state}, s^{dist} for the outputs, taking care to refer to the scores as raw or calibrated when there is a possibility of confusion.

4.5. *Counting effective districts*

To assess whether a proposed plan complies with the VRA, we will need to count effective districts, and not just report scores. We elect to define a *Latino-effective* (or *Black-effective*) district as one whose calibrated effectiveness score estimates at least a certain threshold chance of both nominating and electing a Latino-preferred (or Black-preferred) candidate.

This threshold is a parameter to be set by the modeler, and it may involve considerable discretion. One consideration may be the mapmaker's level of risk aversion, since setting a lower threshold may result in a higher number of qualifying districts that can be simultaneously drawn, but some or all of those districts will be less certain to nominate and elect minority-preferred candidates. A second consideration may be how particular districts in the current enacted map have been characterized by judges and victorious litigants in prior redistricting litigation, or how they have actually performed in prior elections. A third consideration may be the number of statewide elections in the dataset: we may choose a higher effectiveness threshold if we have a smaller set of available elections, to account for the possibility that the signal from any single election is misleading.

In our Texas case study below, we have adopted the threshold condition $s > .6$—that is, to be deemed an *effective district*, we require a greater than 60% estimated chance of nominating and electing a minority-preferred candidate. We chose this figure in view of the above considerations, and because we found that districts with $s > .6$ in any one of our three scores were quite likely to have $s > .5$ in the other two versions, increasing our confidence

[21]Namely, our group-control factor for a district is $c = \min(2k, 1)$ where k is the group's share of CVAP. Alternatively, the modeler could set an election-specific group-control factor in several reasonable ways: as the minority group's estimated share of votes for the candidate of choice; the group's estimated share of the district's Democratic primary electorate; or the estimated group votes for the minority-preferred candidate divided by the total votes for all candidates, for example.

[22]We tune logit curves $f(x) = 1/(1 + \exp(-(ax + b)))$ so that $f(0) \geq 0$, $f(1) \leq 1$, and $f(c \cdot s_i) \approx \delta_i$ where s_i are the raw effectiveness scores of enacted districts, c is group control, and $\delta_i \in \{0, 1\}$ are the ground-truth outcomes (with 1 for success) for the corresponding candidates of choice. The aim is to input a raw effectiveness score s and a group-control factor c and update s to a probability of effectiveness $f(cs)$. For details and examples, see Supplementary Appendix B.

that the districts selected in this way are likely to perform more often than not.[23]

4.6. Assembling the ingredients to build a VRA-conscious ensemble

Running on a standard laptop, ReCom generates new plans at a pace of hundreds of plans per minute in the Python implementation in (MGGG Redistricting Lab 2018b), and runs about 40 times faster in the Julia implementation in (MGGG Redistricting Lab 2020b), depending on the size of the districting problem and the tightness of the constraints.[24] The VRA-conscious protocol implemented here in Python (MGGG Redistricting Lab 2020a) reassesses district effectiveness scores at each step, which slows the process somewhat, so that our runs take about 35 steps per minute for the unweighted and statewide scores and about 15 steps per minute for the district-level score on a state the size of Texas. For a smaller state like Louisiana, the speed more than doubles.

The last question to specify our protocol is how to set the numbers of effective districts that a proposed map must contain for each minority group, to be presumptively valid under the VRA and the Constitution, and thus to be included in our ensemble. Our first guide in answering this question is the state's most recent districting plan, which may have been in effect for up to a decade and either has gone unchallenged in court or has withstood legal challenges, including VRA claims.[25] The second guide, discussed above, is *rough proportionality*, within the meaning of the Supreme Court's important VRA decisions in *Gingles* and *De Grandy*: plans are frequently judged by whether the share of effective districts is similar to each group's share of statewide CVAP.

Considering these guides, we will reject proposed plans that have fewer minority-effective districts than the benchmark plan; in other words, we will treat this threshold level of effectiveness as a *validity check* in the district-generation algorithm. For instance, if we are considering a single minority group and the benchmark plan has three districts that are effective for that group, then each plan included in the ensemble must have at least three effective districts as well. On the other hand, we would reject a proposed plan if it had so many effective districts for one minority group that it would relegate another sizable demographic group to substantially sub-proportional representation.

Surveying the protocol described in this section, the key to our approach is its close reliance on detailed, precinct-level election results from both primary and general elections. We do not assume that some *a priori* demographic threshold will cleave districts that provide minority voters with realistic electoral opportunities from districts that will not. The approach is deeply empirical, focusing on whether a specific district, regardless of its precise demographic percentages, has a recent history of consistently supporting minority-preferred candidates in both primary and general elections. To quote Justice Kagan, our protocol is "evidence-based, data-based, statistics-based. Knowledge-based, one might say" (*Rucho* v. *Common Cause* 2019, 2519 (Kagan, J., dissenting)).

5. CASE STUDY: CONGRESSIONAL DISTRICTING IN TEXAS

We applied the VRA-conscious protocol described in section 4 of this article to build 36-district Texas congressional plans.

5.1. Data

We downloaded the 2018 Texas precinct shapefile and statewide election returns from the Texas Legislative Council's website (Texas Legislative Council 2020). Table 2 shows summaries of the demographic data obtained from the 2010 decennial census and the ACS rolling average for the five-year span

[23]Case law does not dictate how certain we must be of district effectiveness. When analyzing Texas districts, we found that rejection sampling for effectiveness ran as efficiently at the $s > .7$ threshold as it did at $s > .6$, suggesting that a modeler could exercise considerable discretion in setting the effectiveness threshold.

[24]To be more precise, we conducted non-VRA trial runs on Texas, Virginia, and Pennsylvania congressional plans built out of precincts using identical machines (Intel(R) Xeon(R) CPU E5-2660 v2 @ 2.20GHz [Ivy Bridge, late 2013]), allowing districts to deviate from ideal population by only 1%. Over runs of various lengths and with various seeds, the Python implementation generated three to eight valid plans per second, while the Julia implementation generated 120 to 320 valid plans per second.

[25]Numbers derived from this benchmark may need to be adjusted if the state's political geography or demographics or the number of districts in a state's plan has changed (for example, due to reapportionment of congressional seats). Our protocol can be run using a different map as a benchmark if there is reason to believe the current plan violates the VRA or the Constitution.

Table 2. Texas Demographics

Racial group	Share of total population	Share of VAP	Share of CVAP
Latino	37.62%	33.61%	29.36%
Black	11.48%	11.36%	13.08%
White	45.33%	49.64%	52.28%
Other	5.57%	5.39%	5.28%
Total count	*25,145,561*	*18,279,737*	*17,858,066*

Latino, Black, White, and Other shares of Texas residents by total population, voting-age population (VAP), and citizen voting-age population (CVAP). Total population and VAP data are taken from the 2010 decennial census, while CVAP data comes from the American Community Survey (ACS) five-year rolling average ending in 2018.

ending in 2018. (We used CVAP from ACS five-year spans ending 2016, 2014, and 2012 when assessing elections from those years.) While election data could be directly joined to the shapefile, we used the maup package to disaggregate ACS data from block groups (the smallest unit for which CVAP is available) down to census blocks and then aggregated the block-level data up to precincts (MGGG Redistricting Lab 2018c). Total population and VAP were collected from the 2010 decennial census; and because these data are available at the block level, they required no proration and could be directly aggregated up to the precinct level.

We then analyzed 21 statewide Texas elections conducted from 2012 to 2018, which are recorded in Table 3. These were all the statewide elections conducted since the last round of redistricting almost a decade ago—for federal and state offices, both executive and legislative, omitting only state judicial elections.

Ultimately, we eliminated from consideration seven of those 21 elections (struck through in the table) because there was no contest in the Democratic primary, which in Texas is a critically important stage of the electoral process for determining which candidates are minority-preferred. We were left with 14 contests: nine primary/general sets and five primary/runoff/general sets, where the runoff was conducted because no candidate garnered an outright majority of the vote in the Democratic primary.

Table 3. The 14 Election Sets in the Texas Data

	2012	*2014*	*2016*	*2018*
President	P/G		P/G	
U.S. Senator	P/R/G	P/R/G		P/G
Governor		P/G		P/R/G
Lieutenant Governor		~~G~~		P/G
Attorney General		~~G~~		~~G~~
Comptroller		~~G~~		P/G
Land Commissioner		~~G~~		P/G
Ag. Commissioner		P/R/G		~~G~~
RR Commissioner	~~G~~	P/G	P/R/G	P/G

The 14 election sets in our Texas data (5 of which included a primary runoff), and the 7 general elections that we omitted because the Democratic nominee lacked any primary opposition. P means Democratic primary; R means Democratic primary runoff; and G means general election.

We also compiled district-level data for the 36 U.S. House, 31 Texas Senate, and 150 Texas House of Representatives seats, including the race and party of the winning candidates in all elections from 2012 to 2018, as well as demographic data for the districts, for use in the score calibration described in section 4.4 and carried out in section 5.3 (History, Art, and Archives, U.S. House of Representatives, Office of the Historian, 2020a, 2020b).[26]

5.2. *Racial polarization and candidates of choice*

The statewide results for general elections in Texas show a stark pattern of racial polarization. Across 14 separate contests in four election cycles, all three minority groups consistently voted Democratic, and white voters consistently voted Republican, as shown in Figure 3. In Texas, it is commonplace for more than three-quarters of white voters to vote Republican and more than three-quarters of minority voters to vote Democratic in the same election. Furthermore, this basic pattern appears to hold, to a greater or lesser degree, in every region of the state.

It therefore is not surprising that the great majority of Texas's non-white officeholders are Democrats. From 2012 through 2018, there were only two exceptions for Representatives in Congress (out of 15 Latino or Black members) and eight exceptions for Texas state Senators or Representatives (out of 83 Latino or Black state legislators).

No Democratic candidate has won a statewide general election in Texas since 1994. So none of the Latino- or Black-preferred candidates in our 14 recent contests prevailed statewide. But the vote patterns show that each of them carried a significant number of *districts* in general elections under the current Texas congressional plan and under every plan in our ensembles.

Just as the Latino-preferred and Black-preferred candidates in all 14 statewide elections were Democrats (see Figure 3), the same has held true in

[26]See also Carl Klarner. 2019. "Racial Identification of State Legislators 2001–2019." Unpublished data set. Purchased from <http://klarnerpolitics.org/>.

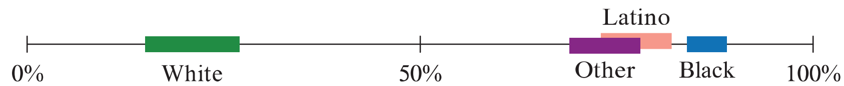

FIG. 3. The highest and lowest EI point estimates for each racial group's support of the 14 Democratic nominees in statewide general elections: White (15–27%), Other (69–78%), Latino (73–82%), and Black (84–89%).

congressional elections. The success of Latino- and Black-preferred congressional candidates in Texas therefore has hinged on their ability to win Democratic primaries (and, where applicable, primary runoffs) and then win general elections. A large majority of white voters in Texas primary elections participate in the Republican primary, while most people of color who participate in Texas primaries vote in the Democratic primary. So, for VRA purposes, we can currently forgo analysis of voting patterns in Republican primaries or Republican primary runoffs in Texas.

In Democratic primaries and primary runoffs, we found a high degree of cohesion across demographic groups. Because all 14 contests were for single-member offices (like governor), we focused on the one candidate in each Democratic primary who was preferred by each of the four demographic groups. In nine of the 14 Democratic primaries and in four of the five Democratic primary runoffs, the three minority groups (Latino, Black, Other) preferred the same candidate, as shown in Supplementary Appendix Table 7.

Given this cohesion in Democratic primaries and runoffs and especially in general elections, it might well be possible to treat Latino and Black voters, or Latino/Black/Other, as a single coalition group for VRA purposes (*Campos* v. *City of Baytown*, 1988, 1244–45). Our main analysis will treat Latino and Black voters as separate minority groups, but the same method could be adapted (and indeed simplified) for coalitional analysis.

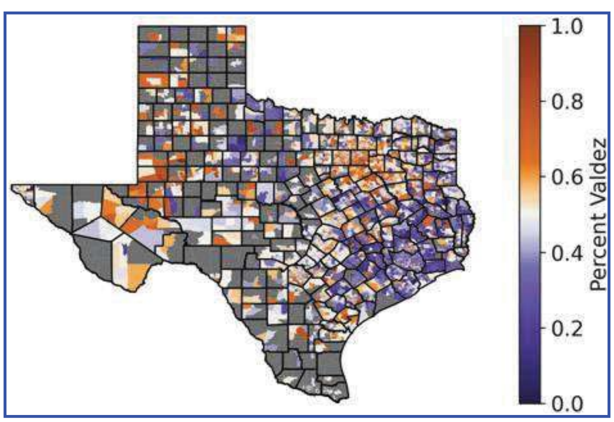

FIG. 4. The distribution of EI-estimated Black support for former Dallas County Sheriff Lupe Valdez in the 2018 gubernatorial runoff. The Dallas-Fort Worth area, in northeastern Texas, is mostly *orange* in this map, while the Houston area, in southeastern Texas, is mostly *purple*. (The map's *gray areas* contain few, if any, Black voters.) This map shows that even statewide EI can find significant regional variation in a group's voter preferences.

As a final and important point relating to our EI setup, we note that we do not need to run EI on small geographies to detect regional difference.

For example, in the 2018 gubernatorial runoff, former Dallas County Sheriff Lupe Valdez and Houston's Andrew White are identified as the statewide candidates of choice for Latino voters and Black voters, respectively. But in the Dallas-Fort Worth Metroplex, Valdez carried both minority groups. As Figure 4 shows, that effect is visible in our EI outputs from a statewide run, because the hierarchical model works by computing distributions of support on each precinct. This lets us identify Valdez as the Black-preferred candidate in the Dallas-Fort Worth Metroplex while White is seen to have carried the Black vote in the Houston area.

5.3. *Effectiveness scores and inclusion criteria*

In Texas, we have the benefit of seeing results from 33 separate contests (14 primaries, 5 primary runoffs, and 14 generals), so that 14 potential successes make up the raw effectiveness score.[27]

According to recent CVAP data (shown in Table 2 above), rough proportionality would require 10.6 districts and 4.7 districts that are effective for Latino voters and Black voters, respectively, given Texas's current congressional apportionment of 36 seats. We will round these to 11 and 5 districts, respectively. If Latino, Black, and Other voters were treated as a coalition, that coalition's proportional share would exceed 17 districts.

Using any of our three calibrated scores, Texas currently has 11 effective districts for minority groups at the 60% threshold: seven Latino-effective districts,

[27]To perform the logit calibration step described in section 4.4, we used all congressional and state-legislative winners from 2012 to 2018. This includes 145 congressional contests (36 districts), 600 state House contests (150 districts), and 77 state Senate contests (31 districts), for a total of 822 data points. This includes one special election for Congress.

TABLE 4. STATISTICS FOR EFFECTIVE DISTRICTS IN CURRENT TEXAS CONGRESSIONAL PLAN

CD	Location	HCVAP %	Latino effective s^{unw}	Latino effective s^{state}	Latino effective s^{dist}	BCVAP %	Black effective s^{unw}	Black effective s^{state}	Black effective s^{dist}	WCVAP %	Representative	Race
9	Houston	24.7	44	38	43	46.7	96	96	94	16.1	Al Green	Black
15	South Texas	73.7	95	97	97	2.5	8	9	7	22.1	Vicente Gonzalez	Latino
16	El Paso	76.0	99	99	97	4.2	11	12	10	17.5	Veronica Escobar	Latino
18	Houston	26.9	51	44	51	44.9	95	95	95	22.8	Sheila Jackson Lee	Black
20	San Antonio	65.0	97	97	97	5.6	12	12	12	25.8	Joaquin Castro	Latino
28	South Texas	69.2	86	93	96	5.5	10	12	8	23.2	Henry Cuellar	Latino
29	Houston	64.0	98	97	97	16.2	49	48	46	16.7	Sylvia R. Garcia	Latino
30	DFW	22.7	44	38	39	52.1	99+	99+	99	21.7	Eddie Bernice Johnson	Black
33	DFW	46.5	98	98	95	24.1	78	75	64	25.6	Marc A. Veasey	Black
34	South Texas	78.5	98	99	93	1.6	8	9	6	19.1	Filemon B. Vela	Latino
35	Austin/San Antonio	52.2	97	97	97	10.3	22	20	24	34.4	Lloyd Doggett	White

The population shares and calibrated effectiveness scores for the 11 districts in the current Texas congressional map that are labeled effective for Latino and/or Black voters. Scores over 60% have darker shading, and scores in the 50–60% range have lighter shading. Mark Veasey's District 33 is the only one that registers as effective for both Latino and Black voters, though Sheila Jackson Lee's District 18 and Sylvia Garcia's District 29 are close. All 11 Representatives are Democrats.

three Black-effective districts, and one district that is effective for both groups (see Table 4). If our protocol focused solely on the most recent elections (e.g., 2018), however, two additional districts—District 7, currently represented by Lizzie Fletcher, a white Democrat, and District 32, currently represented by Colin Allred, a Black Democrat—might meet the effectiveness thresholds for Latino voters or Black voters under some or all of our three calibrated scores. But in the early years of the decade (e.g., 2012 and 2014) both districts were still reliably voting for Republicans in statewide and congressional elections.

Since the current map has withstood judicial scrutiny under both the VRA and the Equal Protection Clause (*Abbott* v. *Perez* 2018, 2324–34), we require plans in our VRA-conscious ensemble to meet or exceed that map's level of effectiveness: so we require at least eight Latino-effective districts, at least four Black-effective districts, and a total of at least 11 districts that are effective for at least one of the groups. So, for example, a plan whose (Latino, Black, Both, Neither) effective-district count was (4, 0, 4, 28) would not qualify for the ensemble because it falls short of 11 minority-effective districts. In effect, this approach allows plans whose effective-district counts are (7, 3, 1, 25) or (8, 4, 0, 24), as well as plans that dominate one of those outcomes from the minority perspective by shifting districts from Neither to any of the other categories.[28]

5.4. *Basic results*

In this section we first present evidence to support the claim that our chains of districting plans have produced VRA-conscious ensembles whose statistics have stabilized after 100,000 steps. We then look at how the statistics from these ensembles compare to an ensemble built with no consideration of race and to an ensemble generated with demographic thresholds as a potential stand-in for VRA compliance. Put differently, we compare ensembles generated by our VRA-conscious protocol, which uses both racial and electoral data, with an ensemble built with racial but not electoral data and an ensemble built with neither racial nor electoral data.

We built five ReCom ensembles, by running each of the following kinds of chain until 100,000 maps are accepted.

(non-VRA) *No VRA consideration.* Only population equality is an explicit validity check, since contiguity is required and compactness is weighted into ReCom ensembles by construction, so the algorithm does not have to be manipulated to produce reasonably compact districts.

(unw) *Constrained by s^{unw} effectiveness.* Ensemble inclusion additionally requires at least eight districts over 60% Latino-effective, at least four districts over 60% Black-effective, and at least 11 total districts effective for one or both groups, using unweighted effectiveness scores.

(state) *Constrained by s^{state} effectiveness.* Same as above, but using statewide weighted scores.

[28]Although a map with fewer than 18 Neither districts could potentially give rise to a Section 2 claim by white plaintiffs and thus merit exclusion from an ensemble, our chain runs did not generate any such plan.

(dist) *Constrained by s^{dist} effectiveness.* Same as above, but using district weighted scores.

(CVAP) *Constrained by CVAP shares.* A plan must have at least eight districts over 45% HCVAP and at least four districts over 25% BCVAP to pass the validity check.[29]

5.4.1. Convergence heuristics and robustness checks. Neither ReCom nor any other MCMC method will work properly if it is not allowed to run long enough, or if designed in a way that thwarts convergence. In this article we have used ensembles built by including every plan that passes the validity checks and continuing until 500,000 maps are collected. We used two kinds of evidence to arrive at the conclusion that 500,000 plans are probably sufficient: first, we have confirmed that chains of that length have aggregate statistical properties that are approximately independent of their starting points, or "seeds," even when the seeds are quite different. This test is sometimes called the *multistart heuristic*. Second, for selected instances we have confirmed that an ensemble ten times as large has similar aggregate statistics. Passing these tests is not a rigorous proof of approximately representative sampling, but these are standard convergence heuristics used across applied statistics. If any ensemble method fails these tests, we can be sure that either the setup violates the conditions for a unique steady state, or we have not run the chain long enough to approach it.

For the multistart heuristic to have high value, we should choose plans that are initially very different and check to see that the ensembles converge to find the same summary statistics nevertheless. The first seed plan used for the multistart test for this Texas case study is the enacted congressional plan that is currently in effect, which came out of the court proceedings challenging the early-decade plan of the Republican legislature. To find two other seeds with exaggerated differences from the enacted plan, we turned to the Atlas of Redistricting project conducted by the politics team at FiveThirtyEight (Bycoffe et al. 2018). Seed 2 is their Texas plan drawn to favor Democrats, which is visibly quite different from the enacted plan and of course has very different partisan properties as well. Seed 3 is based on the plan FiveThirtyEight drew with an eye to compactness scores and county integrity.[30]

For the ensemble using the statewide effectiveness score, Figure 5 shows that a simple partisan statistic—the Clinton share of the major-party presidential vote from November 2016 across the 36 districts—gives roughly the same answers after 100,000 steps, whether the chain commences with the enacted plan or with either of the two other seed plans. Similar charts for s^{unw} and s^{dist} are found in Supplementary Appendix Figure 17. These are boxplots (or "box-and-whiskers plots") where for each plan the districts have been sorted from 1 (the district with the lowest Clinton share) to 36 (highest Clinton share). The boxes show the values at the 25th to 75th percentiles, with the median marked, and the whiskers are set at the 1st and 99th percentiles. Colored circles show the initial values for the enacted congressional plan (red) and the two additional seed plans (blue and green). The aggregate data collected from the three differently initialized runs is broadly consonant: across the districts, the three ensembles have medians, quartiles, and overall ranges within one or two percentage points of each other, even when the seeds began over 15 points apart. By contrast, Figure 6 focuses on the 18 districts with the highest Clinton share to show that our VRA-conscious ensembles, by any of the three scores, do perform differently than if a user either ignored the VRA entirely or used the CVAP demographic constraint as a VRA proxy.

We can also compare spatialized statistics such as the one shown in Figure 7, a record of the number of times that each precinct appeared in a district with $s^{state} > .6$. Just 1,000 steps from the starting point, the heatmaps are visibly different, showing that the chain has not run long enough for this statistic to converge. Much nearer visual correspondence is achieved after 10,000 steps, and the heatmaps are nearly indistinguishable after 100,000 steps.

Beyond the multistart trials, we also checked the same statistics (Clinton vote distribution and cut-edges score) after 1 million steps. We found

[29]To build a demographic-target ensemble, we searched for maps with at least eight majority-Latino districts and at least four majority-Black districts by CVAP. Initial attempts did not produce any such maps. We then lowered the thresholds to 45% for Latino CVAP and 25% for Black CVAP. While those thresholds are somewhat arbitrary, they roughly track Table 4, as well as the results of section 6 shown in Figure 9.

[30]The FiveThirtyEight compact plan did not initially meet our VRA effectiveness requirements, so we used a heuristic-optimization run as in Supplementary Appendix H to get it past the thresholds. Both FiveThirtyEight plans had to be transferred onto our precinct units with the maup package (MGGG Redistricting Lab, 2018c).

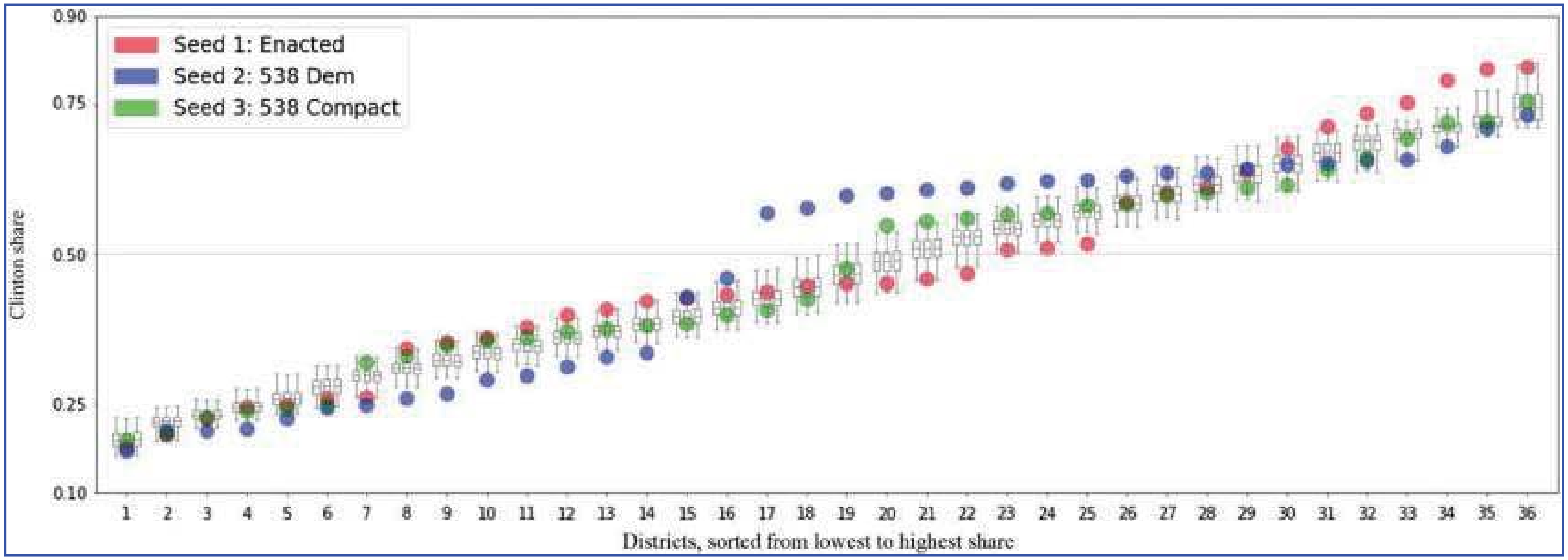

FIG. 5. In this multistart heuristic convergence test, the VRA-conscious chain for the statewide weighted effectiveness score s^{state} is run for 500,000 steps from three very different starting points. The colored dots show the Clinton share of the major-party vote from the 2016 presidential general election, district by district, in the three seed plans described in the text (with the districts sorted from lowest Clinton share to highest). The *boxes and whiskers* show Clinton share by district for each of the three ensembles—they have converged to within one or two percentage points in each district, even though the seed plans sometimes differ by 15 points or more.

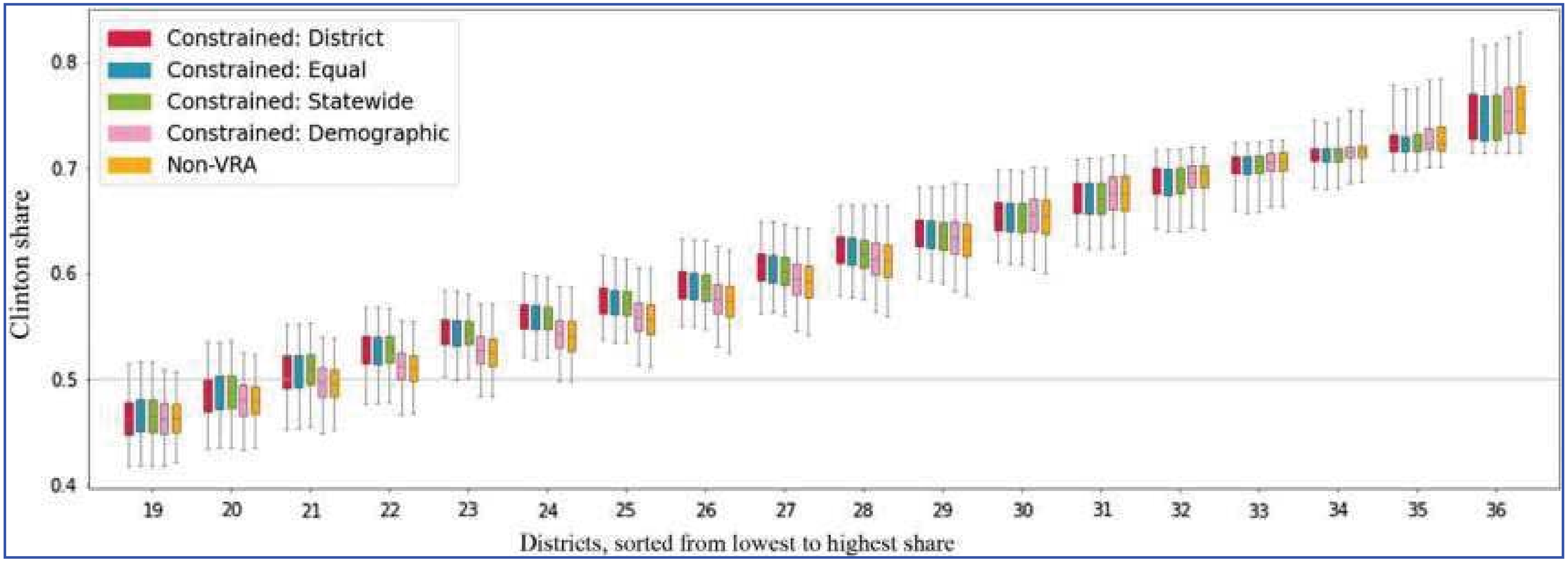

FIG. 6. Comparing the three kinds of VRA-conscious ensembles, constrained by the s^{dist}, s^{unw}, s^{state} scores, respectively, to the alternatives described in the text. Here, the Clinton share is plotted across 500,000 steps and displayed for the 18 most Democratic districts. There is a small but discernible difference that separates the partisan statistics of the VRA-conscious ensembles from those of the control ensembles, which are interestingly similar.

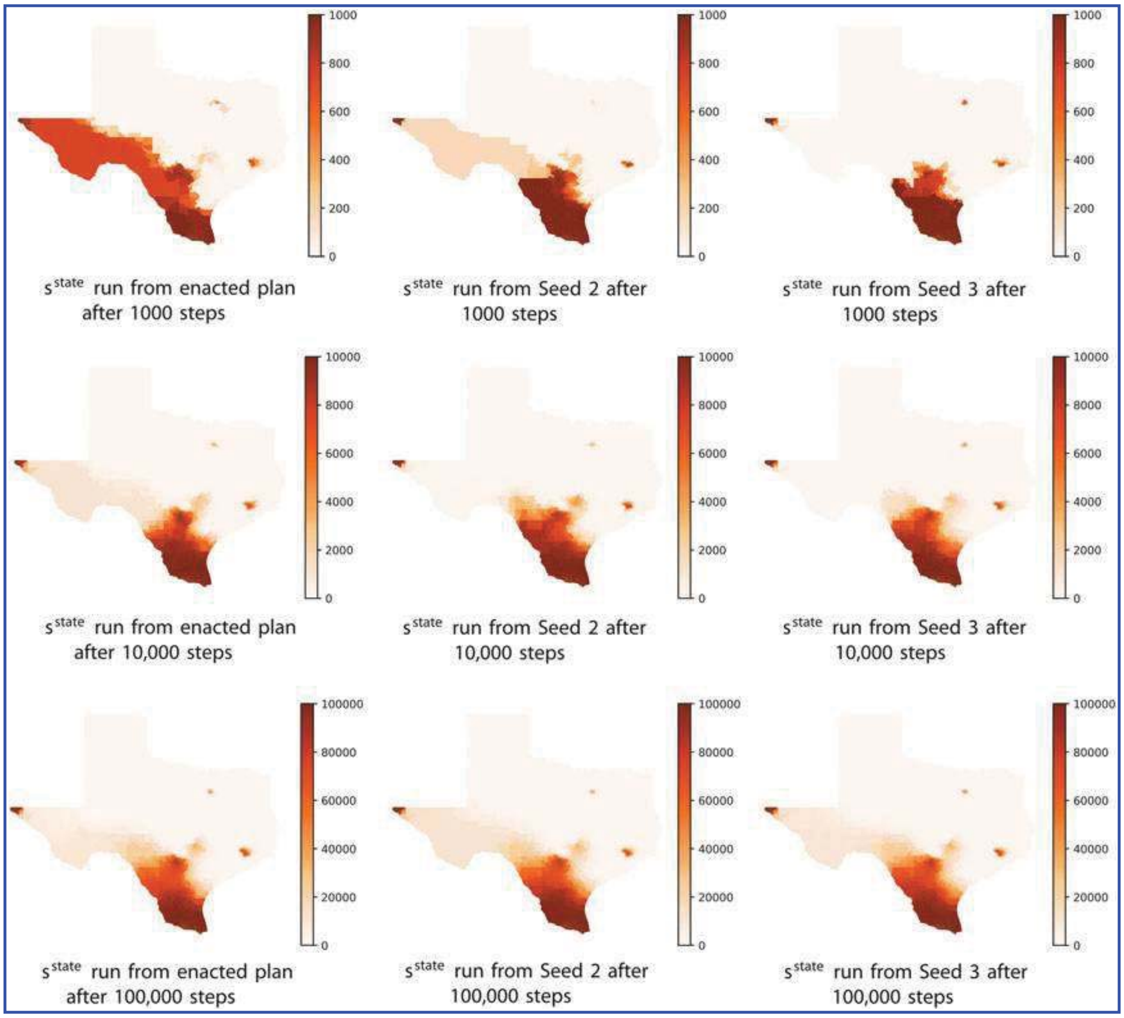

FIG. 7. The *color* of each precinct shows how many times it had appeared in a Latino-effective district after 1,000, 10,000, and 100,000 steps. These VRA-conscious ensembles are drawn with respect to the s^{state} score from the same three seed maps described in the text. There are initially significant differences across the three seeds (*top row*), but the plots converge over the course of the run (*bottom row*).

minimal difference in partisan or district-shape metrics when comparing the initial 100,000 steps, a sub-sampled 100,000-plan ensemble containing every tenth map from the set of 1 million, or the full million-plan ensemble. This raises our confidence both that the size of the sample is adequate to this level of statistical detail and that a run length in the hundreds of thousands is sufficient for convergence. Finally, we conducted slightly altered runs to confirm whether the general findings are robust to reasonable perturbations in the methodology laid out in sections 4.3, 4.4, and 4.5.[31]

[31]We conducted the following tests: using estimated share of candidate support rather than CVAP share of the district as the group-control factor *c*; replacing the confidence term for correctly identifying candidates of choice $C(p)$ with the simpler term *p*; and dropping both the group-control factor and the calibration entirely. For the alternative group-control measure, the changes to scores on Texas congressional plans were minor for both the enacted plan and generated plans. Changes also were typically small with the simplified confidence factor, but the scores became more unstable because outcomes with high EI-based uncertainty had more weight relative to clear outcomes, producing an illusion of greater electoral success on some reruns of EI. The logit calibration was valuable largely to correct for the reduction of scores by group control; we find that if we drop both of them, districts with significant shares of both Latino and Black voters are rated higher for both groups than recent electoral history warrants. Finally, we confirmed that the rate of ensemble generation is similar whether the effectiveness threshold is set at 60%, 70%, or even 75%. Taken together, these robustness runs increase our confidence that each of these parameters that requires user choice is indeed doing work in constructing a stable score that comports with electoral history, but that some of the details could be altered without breaking the protocol.

5.4.2. Comparing ensembles. In this section we compare the five ensembles defined in section 5.4 to each other, considering whether those created using our VRA-conscious protocol differ significantly from those created without electoral data or without both electoral and racial data. The answer is a definitive yes. We have already seen that the three effectiveness scores are similar to each other for the enacted plan's minority-effective districts (Table 4). Using summary statistics, we can confirm that the constrained ensembles using the three scores are similar to each other as well. But the three VRA-conscious ensembles do not resemble either the non-VRA ensemble (which uses neither electoral nor racial data) or the CVAP-shares ensemble (which uses racial, but not electoral, data as a purported stand-in for VRA compliance).

The upshot of rejecting plans with not enough effective districts is seen in Figure 8 with respect to the s^{state} score: no plan in the ensemble has fewer than eight Latino-effective or fewer than four Black-effective districts. This number of effective districts rarely happens by chance without a VRA-conscious method. Interestingly, enforcing the demographic threshold condition (bottom row) makes it somewhat more common to get at least four Black-effective districts but does not make an appreciable difference in the likelihood of creating an eighth Latino-effective district. (Supplementary Appendix F contains analogous plots for the s^{dist} and s^{unw} scores.)

Table 5 is another view of the comparison. A significant share of the plans in all the VRA-conscious ensembles pass the demographic test set forth above, but relatively few plans in the non-VRA and the

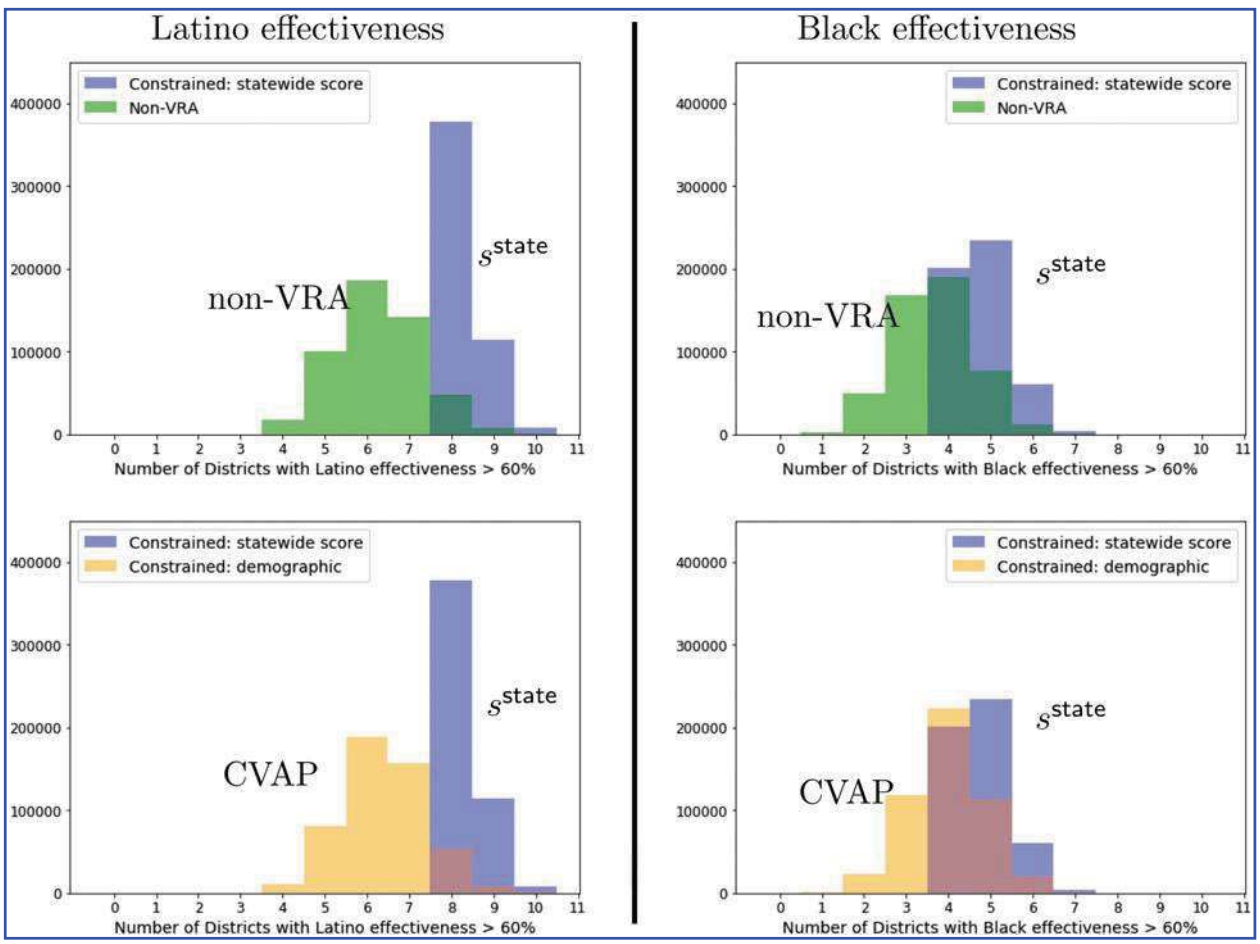

FIG. 8. The distribution of Latino- and Black-effective districts in a VRA-conscious ensemble (*purple*), compared to the non-VRA alternative (*top*, in *green*) and the CVAP-shares, demographics-based alternative (*bottom*, in *orange*). All are shown with respect to the s^{state} score. Note the very modest improvement in effectiveness for the CVAP-shares ensemble compared to the non-VRA ensemble.

TABLE 5. THE SHARE OF MAPS IN THE FIVE ENSEMBLES (COLUMNS) SATISFYING VARIOUS CRITERIA (ROWS)

		Unconstrained (non-VRA)	*Constrained* (s^{unw})	(s^{state})	(s^{dist})	*Constrained (CVAP)*
Satisfies	(s^{unw})	15%	(100%)	88%	81%	20%
effectiveness	(s^{state})	20%	98%	(100%)	94%	26%
criteria	(s^{dist})	16%	72%	78%	(100%)	22%
Satisfies demographic criteria		30%	39%	46%	51%	(100%)

For the effectiveness criteria, maps must have at least eight Latino-effective districts (effectiveness over 50% for the indicated score), at least four Black-effective districts, and at least 11 distinct districts that are effective (for one or both groups) overall. Note that each VRA-conscious variant is built to satisfy effectiveness in a chosen score at the 60% level, making it likely to pass at least 11 district effectiveness tests for the other scores at the 50% level, since the scores are similar but not identical. The demographic test in the bottom row requires a map to have at least eight districts over 45% HCVAP and at least four districts over 25% BCVAP.

CVAP-shares ensembles pass our effectiveness tests.[32] This suggests that Texas ensembles built without rich electoral data—or by imposing a racial threshold—are unlikely to reflect VRA compliance and might well contain far too many maps that violate federal law. And this problem likely cannot be cured simply by changing the threshold levels for the CVAP-shares ensemble: if the CVAP thresholds are raised, it will become harder to find plans with enough qualifying districts, and many effective districts will be missed.

Comparing the three score-based ensembles against each other shows some differences but also substantial alignment in the determinations of validity. We should not be surprised that scores that typically track each other within a few percentage points can fall on the other side of a bright-line threshold: if s^{unw} is just over .6, it can certainly happen that s^{dist} is just below that level. But most districts for which one score is over .6 have the other scores over .5, making them more likely than not to be effective for the group in question. This standard is met by more than three-quarters of the s^{state} and s^{dist} ensembles. (Again, this is part of the justification to set the effectiveness threshold for ensemble inclusion at a level buffered safely above 50%.)

Considering all the evidence so far, one might ask whether any of the three calibrated effectiveness scores is to be preferred to the other two. Our determination is that all three scores can be useful. The unweighted score has the weakest claim of the three, because on its face it omits factors that are legally and factually relevant. As for the other two scores, we think it can be valuable to consider both. The district-weighted score has more regional discernment and a more sophisticated incorporation of EI outputs; the statewide-weighted score has a simpler explanation and still takes uncertainty into account. While results for different scores are not identical, the modeling methodology is robust across three reasonable ways of weighting elections to measure district effectiveness.

6. LEARNING PATTERNS IN DISTRICT EFFECTIVENESS

We have just seen that Texas congressional ensembles using demographic data but no electoral data do not resemble ensembles generated by our VRA-conscious, heavily data-driven protocol. But what about a method that uses both demographics and electoral data but in a limited way, needing only a smaller and simpler dataset? Often, scores that seem to be complicated by taking many things into account can be closely replicated using simpler inputs. In our setting, we would like to see whether our seemingly sophisticated handling of dozens of election contests could be well approximated by pared-down district metrics. To examine this question, we now model the nonlinear relationship between effectiveness scores and lower-dimensional combinations of demographic and partisan features.

In statistics and machine learning, numerous techniques have been developed to recognize patterns in data. *Classifier* models use training data to "learn" discrete labels (like yes/no effectiveness), while *regression* models "learn" continuous-

[32]That only about half the maps in the three VRA-conscious ensembles satisfy the demographic criteria implies that it is not uncommon in Texas for Latino-effective districts to have less than 45% HCVAP or for Black-effective districts to have less than 25% BCVAP. That fact in turn suggests that, at least in some parts of the state, there is significant coalitional voting between different minority groups.

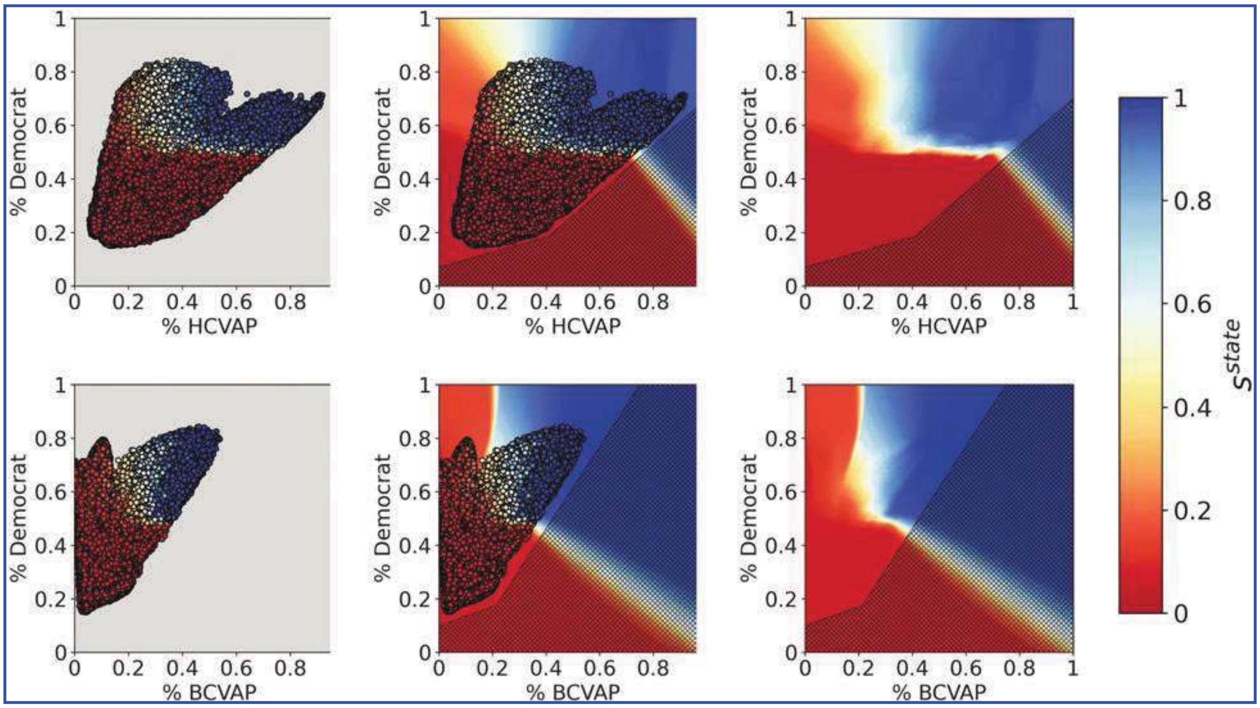

FIG. 9. The *top row* refers to effectiveness for Latino voters and to Latino CVAP; the *bottom row* to corresponding statistics for Black voters. Two-dimensional scatterplots (*left column*) show a collection of districts drawn from a non-VRA ensemble, arranged by Latino or Black CVAP share on the *x* axis and partisan lean on the *y* axis, then colored by their s^{state} score for Latino- or Black-effectiveness, respectively. The *k*-nearest-neighbors (KNN) method is "trained" on that data to infer approximate scores for all possible positions in the square (shown with the training data in the *center figures* and without it at *right*). The hatched areas in the *center and right-hand plots* contain no labeled data points, so the KNN estimates are less meaningful in those areas.

valued assignments (like effectiveness scores), on the basis of features in the data. For our examples, we are choosing to classify potential Texas congressional districts on the basis of two kinds of features:

- *Demographics*, using Latino and Black CVAP shares; and
- *Partisan lean*, obtained by averaging the Democratic shares of the 2016 and 2012 major-party presidential vote, with the more recent general election weighted twice as heavily as the older one.

We begin with a (non-VRA) ensemble of 500,000 plans, then extract the districts from each to make a large dataset, containing 997,163 districts after de-duplication. For each district, we compute its statewide weighted effectiveness score s^{state}. We randomly separate these districts into training data (80%) and data points held back for testing and validation (20%).

We attempted several kinds of models. A *k*-nearest neighbors (KNN) model assigns a value to each point based on the *k* points in the training data that are closest to its location. This can be thought of as a predicted effectiveness score for districts that may be proposed in the future. The choice of *k* is made by a validation step that attempts many different values and chooses the one that provides the highest accuracy.[33] For the regression, the learned value assigned to a point is the average value of its *k* nearest neighbors, while the yes/no classification is made by selecting the majority label among those neighbors.

The outcomes of two-dimensional KNN regression are shown in Figure 9. They show a complicated district-level relationship between effectiveness (color), Latino or Black CVAP shares (*x* axis), and partisan lean (*y* axis). If the effectiveness of districts could be captured with CVAP

[33]To be precise, we use *m*-fold cross-validation with $m=10$, then choose the *k* for KNN with the best average r^2 and mean squared error (MSE) over those ten-fold trials. Using those values of *k*, the final accuracy estimates use the full set of training data and are then corroborated against the withheld testing data.

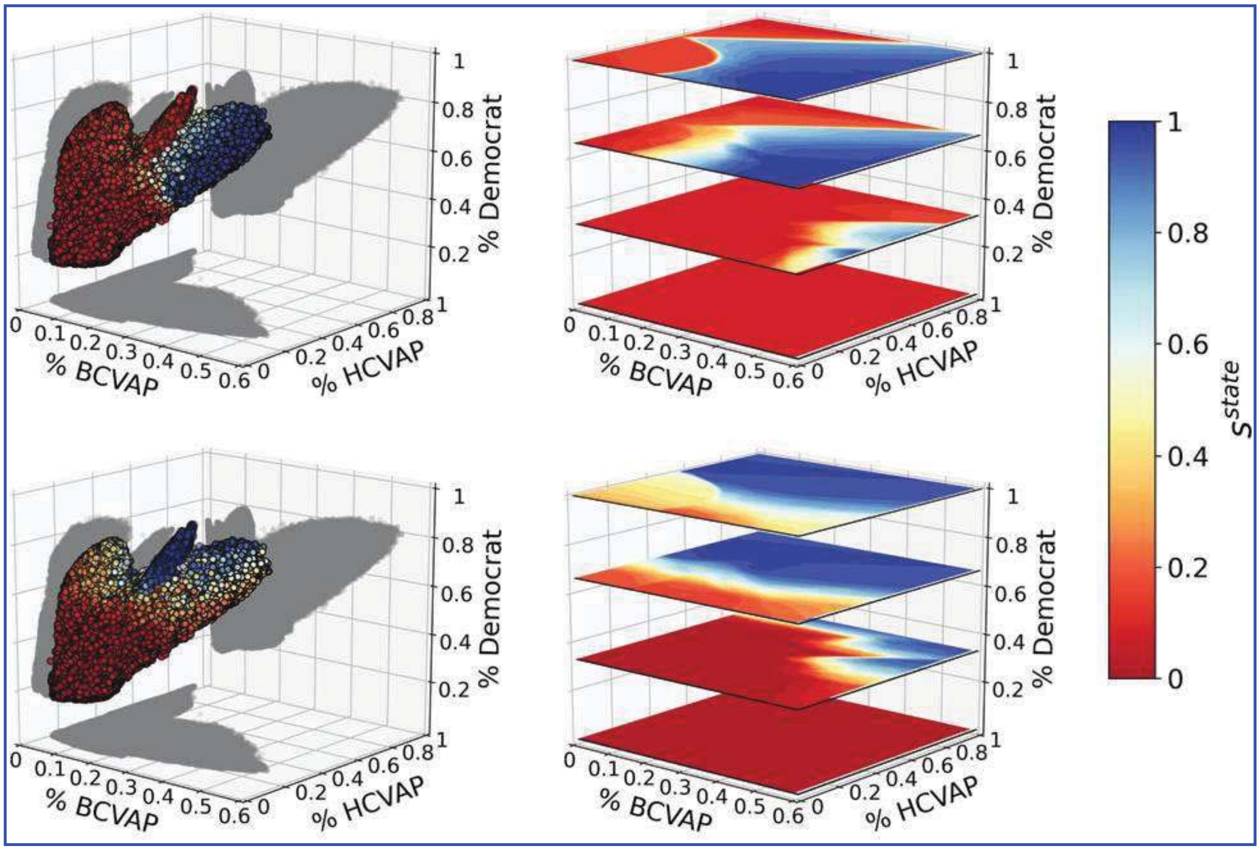

FIG. 10. KNN regression for a three-dimensional scatterplot of district effectiveness.

shares alone, we would see a vertical line dividing the effective (blue) from the ineffective (red) zones. If overall partisanship were a good predictor on its own, we might see a horizontal dividing line; this is not the case, but we note that partisanship alone is more predictive for Latino effectiveness. If effectiveness could be expressed in a simple linear relationship between partisan lean and CVAP, we would see a straight line of some slope separating the blue and red regions. Instead, we see a more complicated frontier with a large zone of ambiguity, especially in Latino effectiveness.[34]

Because Texas has two sizable minority groups, and Latino and Black voters often have overlapping electoral preferences, we might hope to do better by taking both groups' CVAP shares into account simultaneously. To this end, Figure 10 shows the same kind of regressions in three dimensions: Latino CVAP, Black CVAP, and the same measure of partisan lean. These plots still reveal complex, nonlinear frontiers and significant zones of ambiguity.

Further pattern-recognition results using various models for regression and classification are found in Supplementary Appendix G. Together, these methods indicate that scores built from our involved electoral methodology do not easily reduce to combinations of CVAP demographics and general-election partisan lean. This leads us to conclude that electoral complexity, perhaps especially the dynamics of actual primary elections, is playing an ineliminable role in our determination of district effectiveness.

7. CLOSING THE REPRESENTATION GAP

Finally, we return to where this article began: the underrepresentation of communities of color at both the federal and state level. The algorithmic techniques described in this article can be readily

[34]Grofman, Handley, and Lublin (2001) studied what amounts to effectiveness classification in a similar feature space nearly 20 years ago, positing an "elbow" or V-shaped frontier of effectiveness. For a comparison of our classification results with their framework, see Supplementary Appendix G.

reconfigured to point the way to maps that are likely to promote significant gains in minority representation.

7.1. Searching for higher effectiveness

Recall first that our VRA-conscious ensembles are made by imposing yes/no validity constraints rather than a probabilistic tilt or bias: the proposal of new plans is made without regard to race, and the validity criteria are given by a threshold test, with no preference for plans that exceed the threshold by a wider margin. It is therefore unsurprising that this procedure does not on its own favor the creation of plans that greatly surpass the status quo in minority electoral opportunities. But—so long as districts are population-balanced, contiguous, reasonably compact, and constructed largely or entirely from intact precincts, as is the case across all our ensembles—maps generating rough proportionality for all sizable minority groups might well be the ones that actually minimize legal exposure under both the VRA and the Equal Protection Clause.

By shifting to an algorithm that has a tilted acceptance function favoring increased minority electoral opportunities, we found it to be straightforward to create maps that fully meet (or even exceed) rough proportionality simultaneously for multiple minority groups. For example, in Texas we were able to create maps that are effective enough to typically meet rough proportionality simultaneously for both Latino and Black voters, while not sacrificing districts to double-counting—i.e., while achieving near-proportionality for people of color overall as well as for each group individually. A *heuristic optimization* algorithm can preferentially accept maps with higher minority effectiveness. We carried this out with the general "short bursts" strategy outlined in Cannon et al. 2020; for details, see Supplementary Appendix H.

To be clear: maps proposed for adoption should be developed through human deliberation based on significant community input and a broader range of criteria and values than our algorithm incorporates. No map plucked from an ensemble is likely to satisfy all human desiderata off the shelf. But just to demonstrate that a map with eight Latino-effective districts and four Black-effective districts can be replaced by one with (at least) ten and five such districts, respectively, we examine one demonstration plan found in a local search.

7.2. A demonstration plan

Our demonstration plan is depicted in Figure 11, and its effectiveness statistics by district are shown in Table 6.

We emphasize that this map is not intended to be an ideal map. But it does show that a carefully drawn plan could be dramatically fairer for historically underrepresented minority groups in Texas. We call it a "demonstration map" because it demonstrates that the shortfall of minority representation in the status quo map can be cured. The failure to do so can be attributed not to geography or law, but only to line-drawing.

In Table 6, we have *uncoupled* the primary and general elections, to give a more detailed view of the electoral history of these districts. In other words, this table shows the primary/runoff success independent of the general-election outcome, while our effectiveness-scoring system requires wins in both the primary (or primary and runoff) and the general, to be counted as a success. The table shows that, using any of the three scores, the demonstration plan contains at least 11, and perhaps as many as 13, effective districts for Latino voters and at least five, and perhaps as many as seven, effective districts for Black voters. Because one district in the Dallas area (District 33) and at least one in the Houston area (District 18) appear to be effective for both Black and Latino voters, the total number of minority-effective districts in the demonstration plan is 14, 15, or 16, depending on whether you rely on the unweighted, statewide, or district scores, respectively. Only one of the 16 districts is majority-white by CVAP.

Several of these 16 highlighted districts have demographics and effectiveness scores similar to those of the minority-effective districts in the current enacted plan (compare Table 4). However, in the current enacted plan, every district except Congressman Veasey's District 33 follows the rule that districts marked effective for Latino voters have HCVAP over 50% and those marked effective for Black voters have BCVAP over 40%. By contrast, the demonstration plan presented here features several effective districts with lower Latino and Black population percentages. For example, the Austin-based District 27 is a Latino-effective district with an HCVAP a shade under 40%, and the Houston-based District 9 is a Black-effective district with a BCVAP of only 28.6%. We emphasize that each

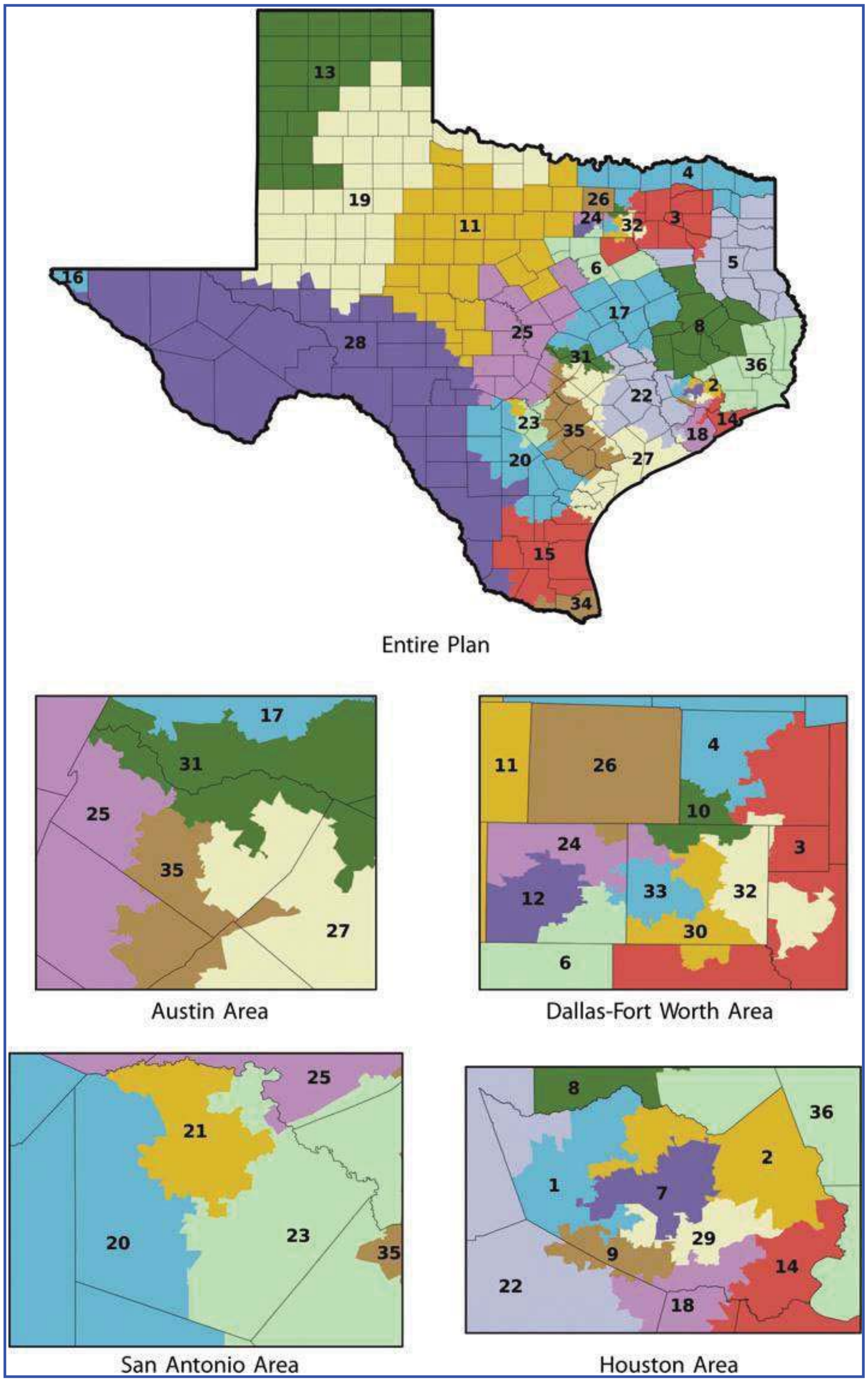

FIG. 11. An interesting demonstration plan found by heuristic optimization.

of those demonstration districts earned its effectiveness score by voting for the Latino- or Black-preferred candidates, respectively, in nearly every statewide election conducted in the last decade.

This map refutes the notion that demographics is destiny when it comes to Texas congressional districts. It contains districts that are majority-minority but not minority-effective (District 2), majority-white but Latino-effective (District 35), plurality-white but Black-effective (Districts 9, 30, and 32) or Latino-effective (Districts 27 and 29), and plurality-Latino but Black-effective

TABLE 6. STATISTICS FOR EFFECTIVE DISTRICTS IN DEMONSTRATION TEXAS CONGRESSIONAL PLAN

Demonstration Plan

			Latino effective				*Black effective*				*14 Primaries*		
CD	*Location*	*HCVAP %*	s^{unw}	s^{state}	s^{dist}	*BCVAP %*	s^{unw}	s^{state}	s^{dist}	*WCVAP %*	*Latino*	*Black*	*14 Gen (Dem.)*
7	Houston	36.5	77	65	77	25.5	70	58	31	31.4	9–13	9–10	14
9	Houston	23.3	40	30	33	28.6	78	66	75	31.5	10–12	10–12	14
15	South Texas	78.8	97	98	96	1.7	8	9	6	17.5	12–14	10–11	14
16	El Paso	76.1	99	99	97	4.2	11	12	10	17.4	13–14	11–14	14
18	Houston	32.0	66	59	63	30.7	76	77	69	30.4	10–13	10–12	14
20	San Antonio	60.6	77	82	76	5.5	10	11	9	30.9	12–14	12–13	9
21	San Antonio	47.5	35	74	79	5.6	8	8	8	42.9	12–14	10–14	7
23	San Antonio	51.1	77	82	79	10.7	14	15	14	34.7	12–14	10–12	9
27	Austin/Gulf Coast	39.8	84	85	85	8.8	17	16	18	47.7	12–13	10–14	13
28	South/West Texas	81.4	91	95	96	1.0	7	8	6	16.6	11–14	9–11	14
29	Houston	33.4	70	57	75	25.5	70	58	52	35.5	9–11	9–12	14
30	DFW	15.5	20	15	13	31.8	85	84	69	48.5	9–10	10–11	14
32	DFW	24.1	24	26	28	24.4	52	67	62	44.9	10–13	12–14	10
33	DFW	37.0	85	80	66	32.9	96	97	88	25.1	10–11	13	14
34	South Texas	86.7	97	98	97	0.4	6	7	5	12.3	11–14	9–11	14
35	Austin	30.7	62	62	67	4.8	10	10	9	60.6	11–13	9–10	14

District 27 (with statewide candidates of choice)

		Primary election		*Primary runoff election*		*General election*	
		Latino-pref.	*Winner*	*Latino-pref.*	*Winner*	*Latino-pref.*	*Winner*
President	2012	Obama	Obama ✓			Obama	Obama ✓
U.S. Senator	2012	Sadler	Sadler ✓	Sadler	Sadler ✓	Sadler	Sadler ✓
U.S. Senator	2014	Alameel	Alameel ✓	Alameel	Alameel ✓	Alameel	Cornyn ×
Governor	2014	Davis	Davis ✓			Davis	Davis ✓
Ag. Commissioner	2014	Friedman	Friedman ✓	Hogan	Hogan ✓	Hogan	Hogan ✓
RR Commissioner	2014	Brown	Brown ✓			Brown	Brown ✓
President	2016	Clinton	Clinton ✓			Clinton	Clinton ✓
RR Commissioner	2016	Yarbrough	Yarbrough ✓	Yarbrough	Yarbrough ✓	Yarbrough	Yarbrough ✓
U.S. Senator	2018	O'Rourke	O'Rourke ✓			O'Rourke	O'Rourke ✓
Governor	2018	Valdez	Valdez ✓	Valdez	Valdez ✓	Valdez	Valdez ✓
Lieutenant Governor	2018	Cooper	Collier ×			Collier	Collier ✓
Comptroller	2018	Mahoney	Chevalier ×			Chevalier	Chevalier ✓
Land Commissioner	2018	Suazo	Suazo ✓			Suazo	Suazo ✓
RR Commissioner	2018	McAllen	McAllen ✓			McAllen	McAllen ✓

The demonstration plan has up to 16 minority-effective districts, as shown in the top table, while the enacted plan has no more than 11 to 13 (compare Table 4 and accompanying text). Scores over 60% have darker shading, and scores in the 50–60% range have lighter shading. The frequency of primary and general election wins by minority-preferred candidates is shown in the last two columns. Because different candidates of choice can be identified by the statewide and district-specific method, the number of successes is given as a range. The bottom table shows that candidates preferred by Latino voters statewide prevailed in District 27 in 12 of the 14 primaries, 5 of the 5 runoffs, and 13 of the 14 general elections. (With the candidates of choice inferred from the district-specific method, there are 13 primary successes).

(the two coalition districts, 18 and 33). There are also districts that are reliably Democratic but are not effective for either Latino voters or Black voters (Districts 12 and 31).

Table 6 takes a single district and brings us back to the most basic facts about it: whether the minority-preferred candidates actually won the most votes. We use as an example the plurality-white but Latino-effective District 27, which starts in East Austin and stretches south toward the Gulf Coast. For 11 of the 14 offices, the candidate preferred by Latino voters statewide prevailed at every step in District 27: primary, runoff (when there was one), and general. In the 2014 general election, however, the Latino-preferred Democratic nominee David Alameel failed to carry District 27 against Republican incumbent U.S. Senator John Cornyn; and in the 2018 Democratic primaries for lieutenant governor and comptroller, the candidates preferred by Latino voters statewide (Michael Cooper and

Tim Mahoney, respectively) failed to carry the district. This district generated Latino-effectiveness scores of about 84 or 85%, far above our threshold for effectiveness (60%) but below the scores for the map's four most heavily Latino districts, which consistently exceeded 90%.

7.3. Aggregate effectiveness

The use of a search technique tailored to raise the number of minority-effective districts might lead us to wonder about the effect on the rest of the map. With respect to demographics alone, redistricting is a fixed-sum activity: there are only so many Latino citizens of voting age in the state, so building more districts with high HCVAP means there is less remaining HCVAP to distribute across the other districts. We might worry that we can only secure a larger number of effective districts by draining opportunities for coalitional influence from the rest of the state. But this is not the case. Because of the highly nonlinear relationship between demographics and effectiveness (see section 6), it is possible to create some plans with a greater overall effectiveness than others.

To see this, let us consider the sum of the effectiveness scores for all 36 Texas congressional districts. Because each district has a score between 0 and 1, the sum will fall between 0 and 36. To the extent that a group's effectiveness scores behave like probabilities of electoral success, the sum over the 36 districts can be regarded as the *expected value* for the group in a given election. This expected-value score takes into account the probability but not certainty of electoral success in the effective districts, and also includes contributions from other districts in which an effectiveness score could fall well below .5 yet still reflect real political influence and a chance to win.

The enacted plan has an expected-value score a bit under 12, driven by 11 highly effective districts. After a few thousand steps of a heuristic-

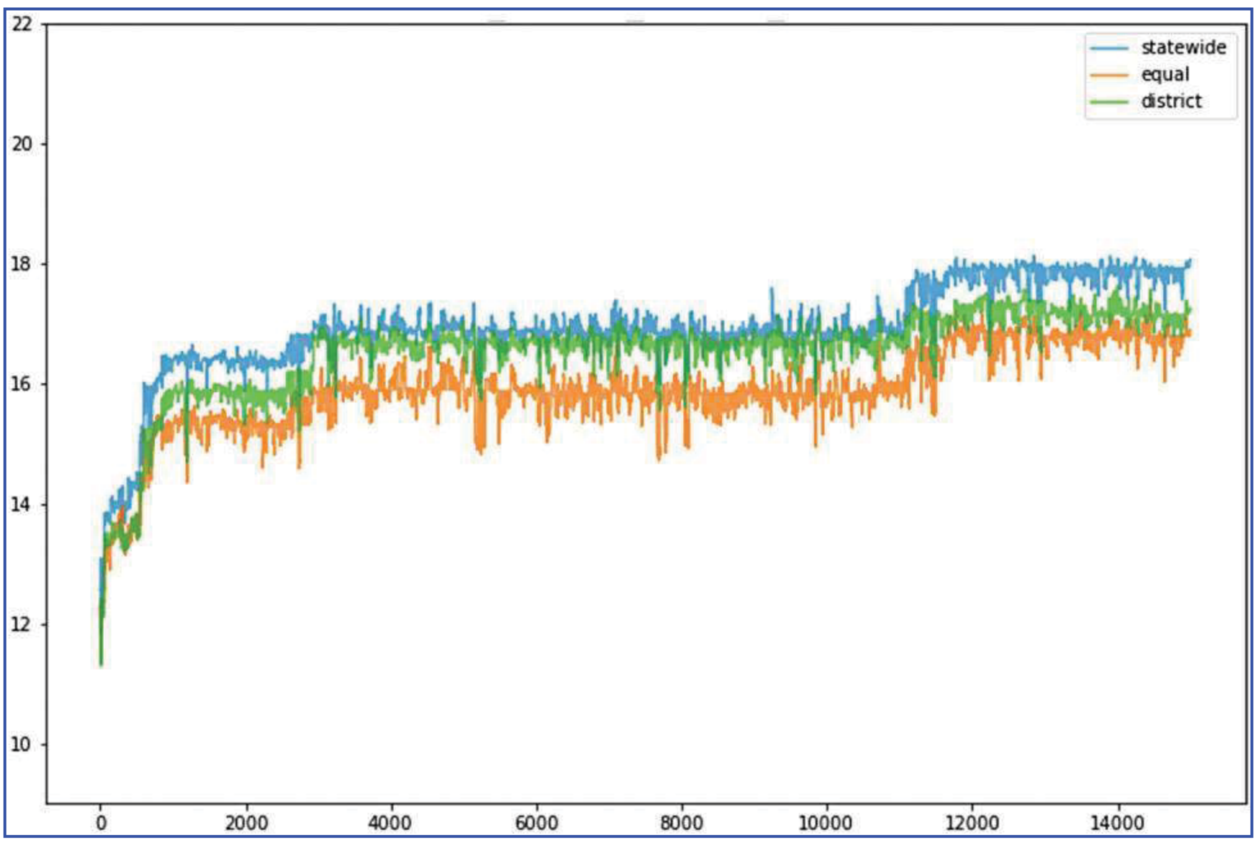

FIG. 12. This trace plot shows a kind of aggregate effectiveness for Latino and Black voters, formed by summing Latino and/or Black effectiveness scores over all 36 districts. This aggregate effectiveness trends up markedly over the course of a heuristic-optimization run that preferentially accepts plans with more districts effective for at least one minority group under the s^{state} score. This drives up the s^{state} score (in blue) most, with the other two scores following behind. (See Supplementary Appendix H for details on related optimization runs.)

optimization run (shown in Figure 12), the expected-value score is well over 15, usually over 16, and it is possible to drive the expectation up near 18 in the score being optimized. Our demonstration plan has an expectation of nearly 17, which tracks with the 16 districts highlighted in Table 6.

We find that, with respect to electoral opportunity, districting is not a fixed-sum game. We can find plans that combine Latino and Black voters with other population (including Asian American and white voters who tend to support the same candidates) in ways that lead to effective combinations. We can create safe minority districts, likely-to-elect minority districts, and some minority influence districts in a way that is especially beneficial in aggregate. This is a departure from the narrower focus on effectiveness that is directly relevant for VRA compliance, but may still point the way to a more coalitional expansion of minority opportunities beyond the demands of the law.

8. CONCLUSION

The principal goal of this project is the design and study of a protocol for building ensembles of alternative districting plans, taking closely into account the law of race and redistricting. We do this by using longitudinal electoral data, one of a choice of effectiveness scores, and a constrained district-generation algorithm.

No inclusion criterion assessed by a computer could perfectly track the conclusions of a court (not least because of variation in the judiciary itself), but ours is constructed to give us strong justification for describing it as a *representative sample* of the universe of VRA-compliant plans. We have pursued this objective in a way that also avoids overreliance on purely demographic targets that might run afoul of the Equal Protection Clause.

The structure of our protocol is described in section 4, and a detailed case study for Texas congressional districts is detailed in section 5. In section 6 we confirm that the role played by the extensive electoral data is not easily replaced by simpler proxies. And in section 7 we explore the use of similar techniques to minimize underrepresentation for minority groups—showing in particular that pushing to find plans that go the farthest to cure longstanding underrepresentation is a markedly different task from creating collections of alternatives that pass VRA muster. Studying the conditions of political and human geography that make it possible to attain near-proportionality is an interesting direction for future work.

With a detailed case study in the large, complex state of Texas, we confirm that our implementation lets us carry out the work on a time scale suitable for all stages of redistricting, from considering plans for possible adoption all the way to challenging them in litigation. We have made careful use of error estimates, performed tests of quality for ensemble generation, and confirmed robustness of the method across reasonable variations in the steps. By making our code and data public (MGGG Redistricting Lab, 2020a), we aim to make it possible for other researchers and practitioners to use this method on the ground.

This tool now makes it possible to assess proposed districting plans in racially diverse states against a baseline that takes the Voting Rights Act and the Equal Protection Clause into account. The computational tools for redistricting are continually becoming both more powerful and more refined, facilitating the creation of new maps that better meet our ideals of fairness and helping to understand maps in the context of realistic alternatives. By using novel tools in combination with renewed commitment to safeguarding minority representation, we can come closer than ever to the goal articulated by John Adams almost 250 years ago, in the midst of the American Revolution: to make our representative assemblies "in miniature an exact portrait of the people at large" (Adams, 1776, 108).

SUPPLEMENTARY MATERIAL

Supplementary Appendix

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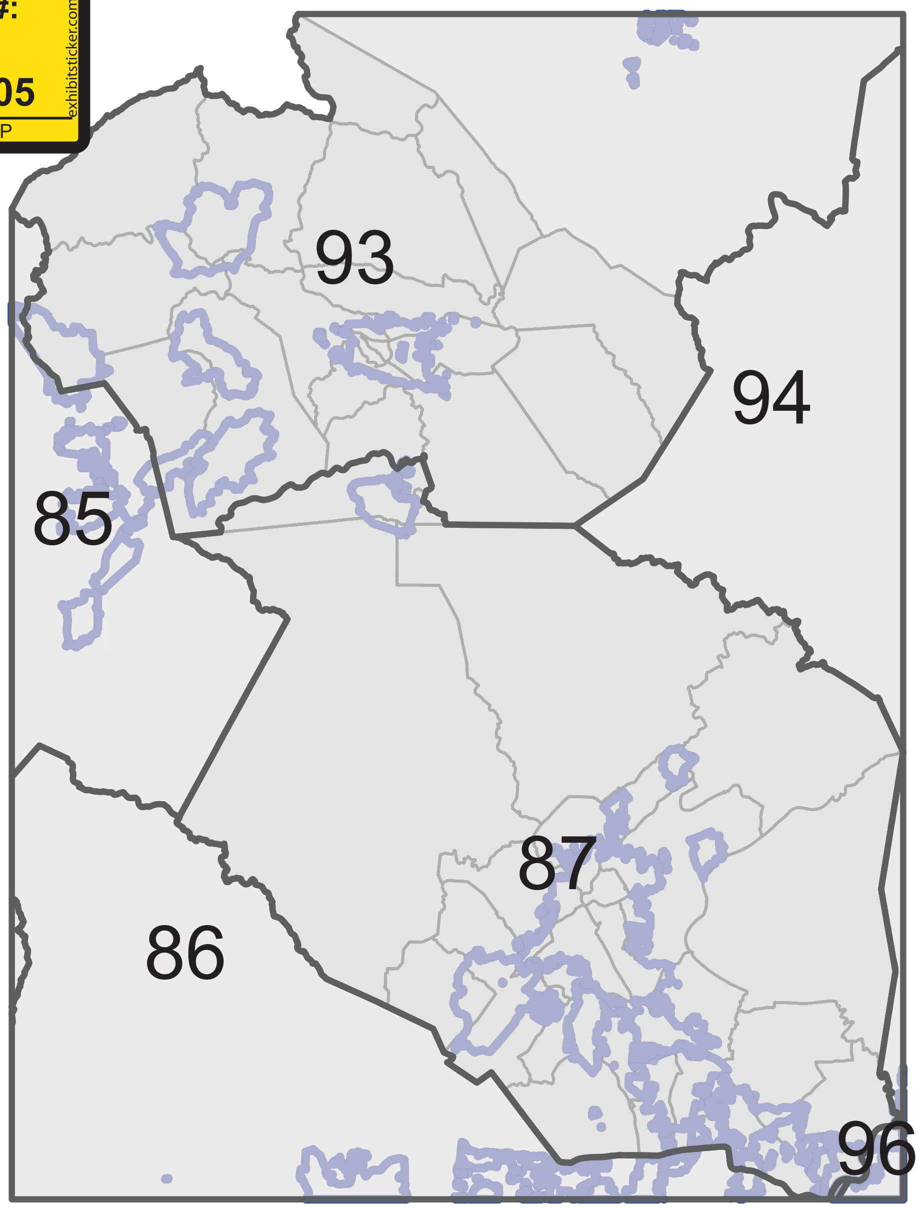
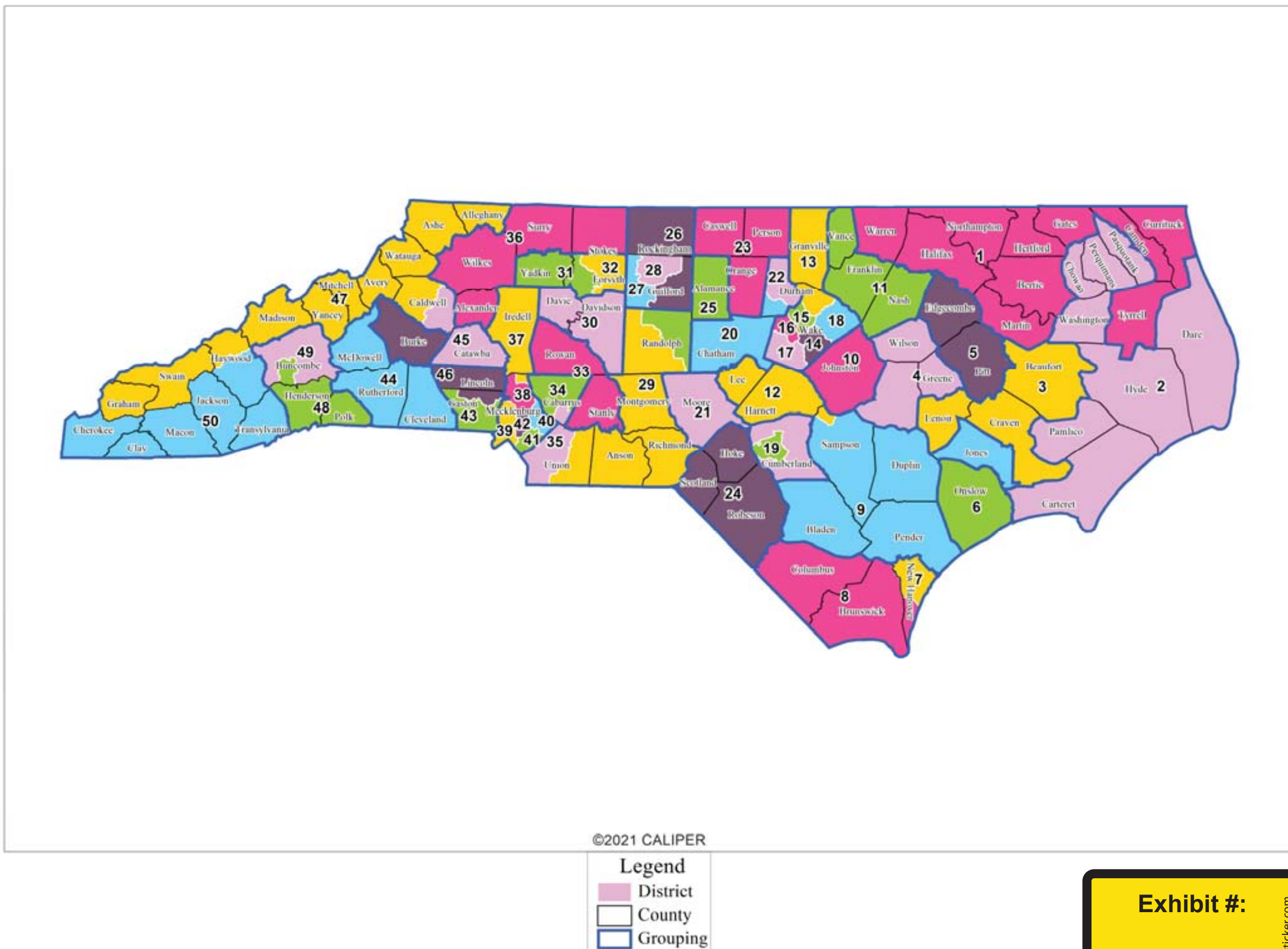
'Optimized' Map Districts in Caldwell and Watauga Counties, with Municipalities





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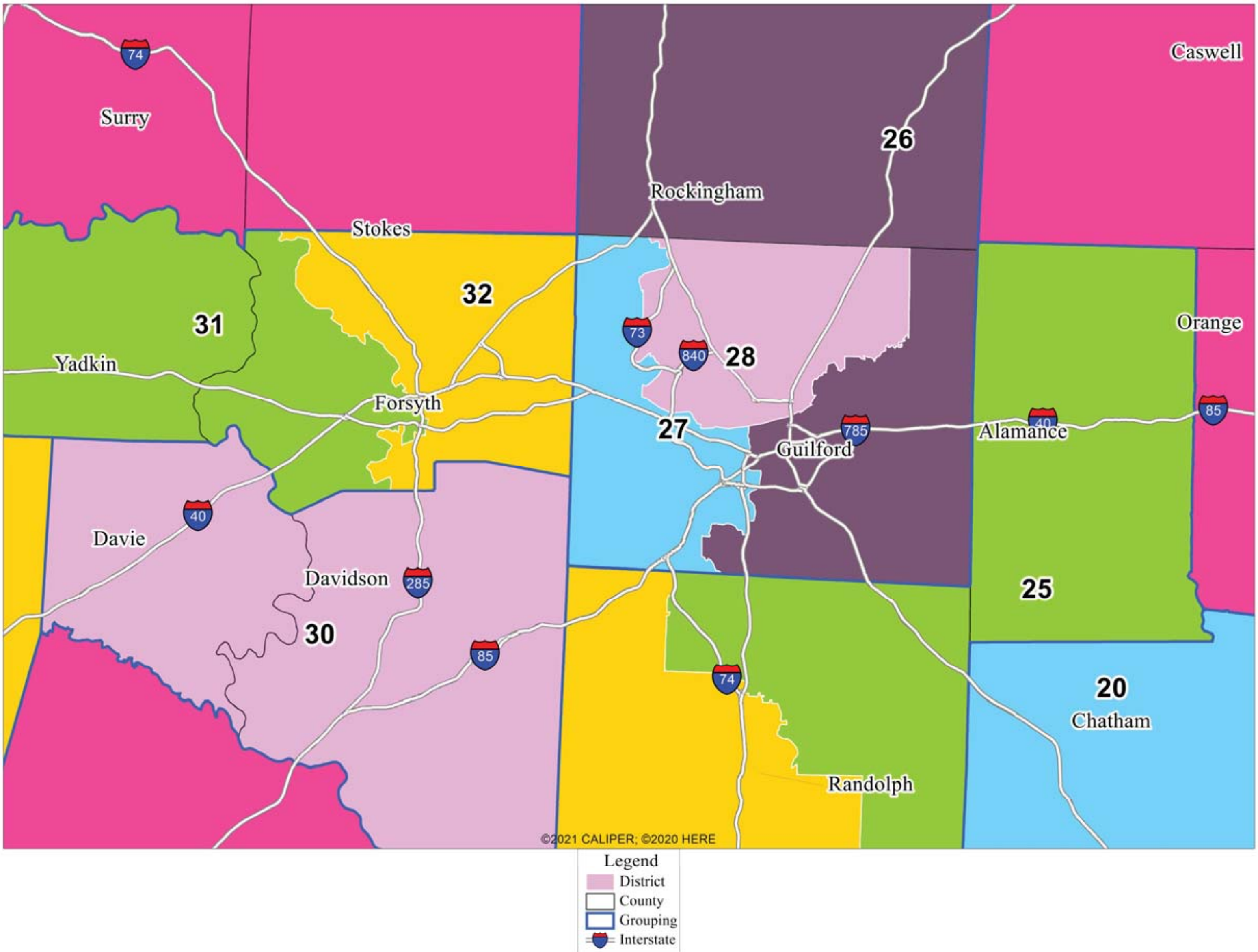

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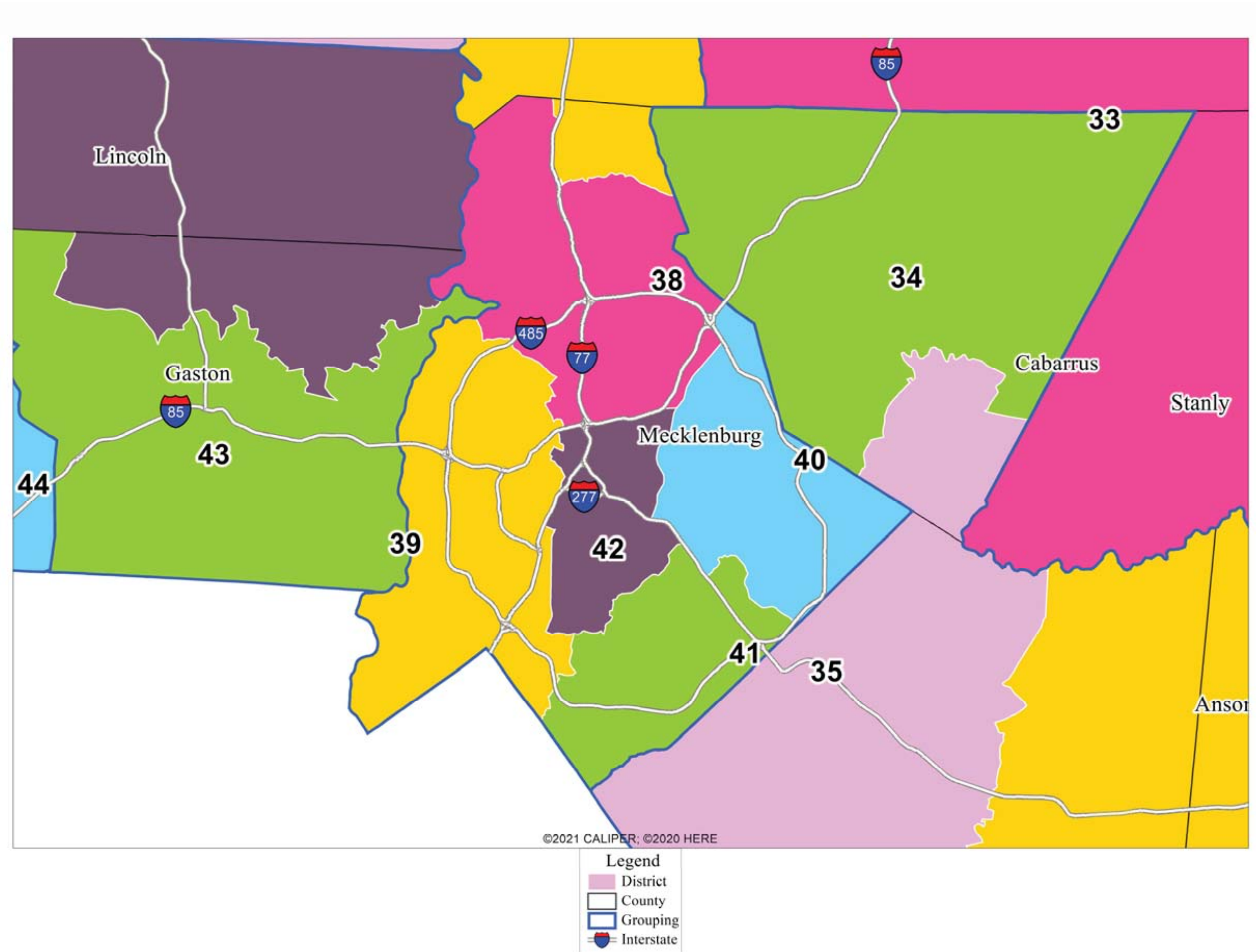
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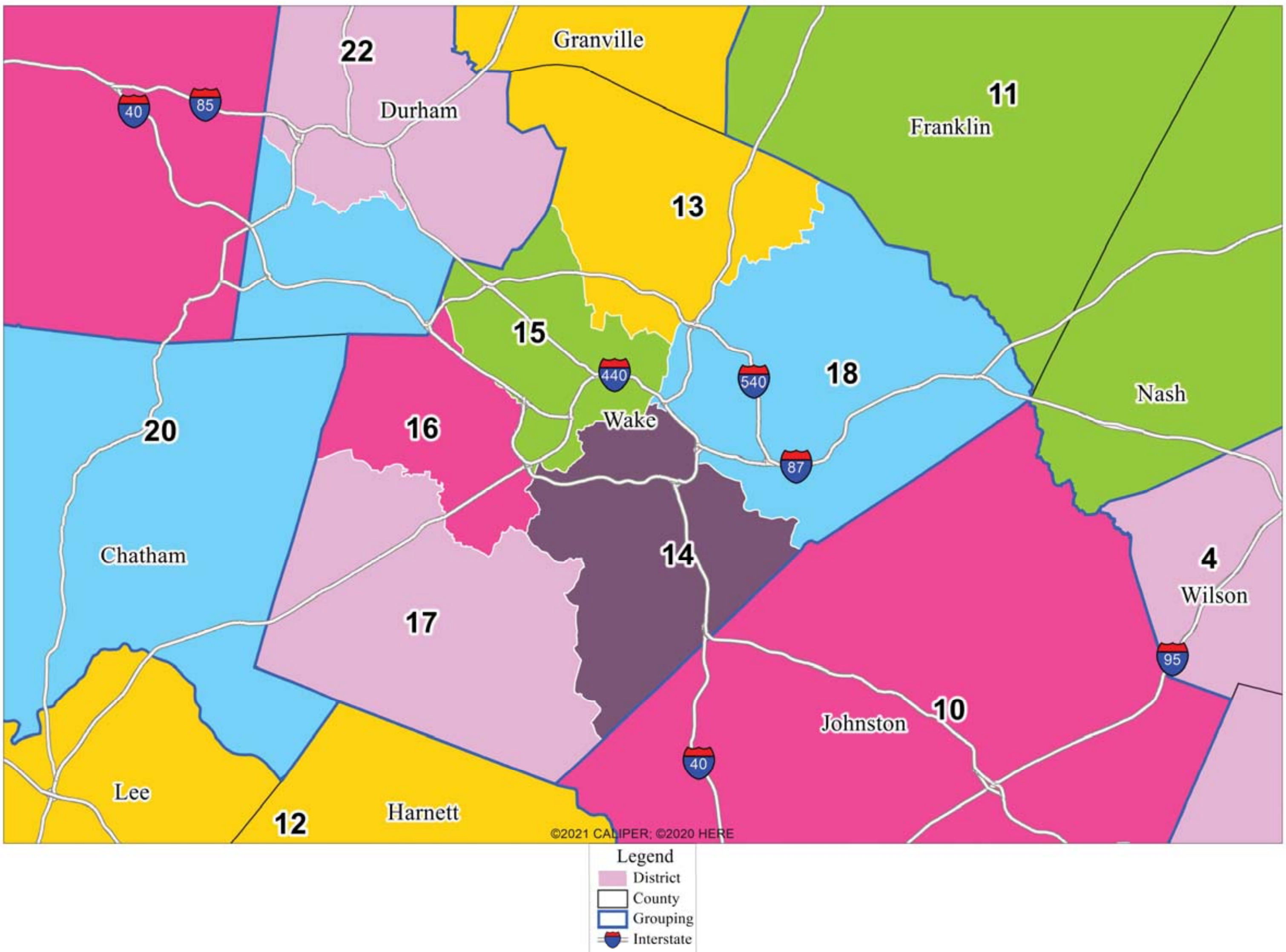
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Expert Report on the North Carolina State Legislature and Congressional Redistricting (Corrected Version)

Jonathan C. Mattingly

December 23, 2021

Contents

1 Introduction

I am a Professor of Mathematics and Statistical Science at Duke University. My degrees are from the North Carolina School of Science and Math (High School Diploma), Yale University (B.S.), and Princeton University (Ph.D.). I grew up in Charlotte, North Carolina and currently live in Durham, North Carolina.

I lead a group at Duke University which conducts non-partisan research to understand and quantify gerrymandering. This report grows out of aspects of our group's work around the current North Carolina legislative districts which are relevant to the case being filed.

I previously submitted an expert report in Common Cause v. Rucho, No. 18-CV-1026 (M.D.N.C.), Diamond v. Torres, No. 17-CV-5054 (E.D. Pa.), Common Cause v. Lewis (N.C. Sup. Ct No. 18-cvs-014001), and Harper v. Lewis (No. 19-cv-012667) and was an expert witness for the plaintiffs in Common Cause v Rucho and Common Cause v. Lewis. I am being paid at a rate of $400/per hour for the work on this case. Much of the work derives from an independent research effort, unrelated to this lawsuit, to understand gerrymandering nationally and in North Carolina specifically. Much of the core analysis described in this report was previously released publicly as part of a non-partisan effort to inform the discussion around the redistricting process.

2 General Overview

I was asked in this case to analyze whether the enacted Congressional, state House, and state Senate redistricting plans for North Carolina were drawn intentionally for partisan advantage. In summary, to conduct our analysis, we used historic voting data to compare election results under the enacted plans with elections results under a collection of non-partisan maps generated using Markov Chain Monte Carlo methods, referred to throughout this report as an "ensemble." No partisan information is used to construct this ensemble of maps; only the generally accepted districting criteria of approximately equal population per district, contiguous and relatively compact districts, reducing traversals, and keeping counties, precincts, and possibly municipalities whole. One strength of the ensemble method is that it makes no assumptions in advance about what structure an election should have such as a relation to proportional representation or some type of symmetry considerations. Rather it shows what results would naturally occur, and the structure of those results, because of political geography of the state when non-partisan maps are used. We examine both the number of seats that would have been won under these vote counts, along with the expected margins of victory.

We see that each of the enacted plans is an extreme outlier with respect to its partisan properties in comparison to the ensemble. The Congressional, House, and Senate plans each systematically favor the Republican Party to an extent which is rarely, if ever, seen in the non-partisan collection of maps. Under many historic elections considered, each of the enacted maps elects significantly fewer Democrats than the typical number of Democrats found in the collection of maps. Specifically, the enacted Congressional plan produces 10 Republican seats and 4 Democratic seats across a wide range of historic elections, spanning roughly a 6-point differential in the statewide two-party vote share. In other words, Republicans win 10 congressional seats despite large shifts in the statewide vote fraction and across a variety of election structures. Over the statewide vote Democratic partisan vote range of 46.59% to 52.32%, the enacted map only twice changes the number of Republicans elected. The outcome of the election is largely stuck at 4 Democrats. Our non-partisan ensemble plans, by contrast, are far more responsive to changes in the election structure and the statewide vote fraction.

Under the enacted Senate and House plans, at times the Democratic Party is either denied a majority of seats or denied breaking a Republican supermajority when the overwhelming majority of maps in our ensemble would have resulted in either a Democratic majority or a simple Republican majority. In the Senate, we find instances in which the Republicans would have gained a supermajority under the enacted plan, but would have lost a supermajority in nearly every map in our collection. In the House, we find instances in which the Republicans won the supermajority of seats under the enacted plan but they would have not won the supermajority in the majority of maps in our collection.

In the House and Senate plans, the extreme statewide tilt towards the Republican Party is the result of a significant number of truly independent choices at the level of the county-clusters into which the state is divided. The chance of making so many independent choices which bias the results towards the Republican Party unintentionally, without corresponding choices favoring the Democratic party, is astronomically small.

In addition to this systematic bias towards the Republican Party which when aggregated produces highly atypical results, the enacted House and Senate plans also have highly atypical results in a number of county clusters even when viewed alone. Beyond often creating atypical results in terms of the number of seats won in a given cluster, our results also show a durability in the results in certain clusters under the enacted plans. By durable, we mean that the results remain atypically unchanged over a wide range of elections. This unresponsiveness to changes in vote counts is another problematic feature revealed by our analysis of the enacted plans.

Our analysis show that each of the three enacted plans is an extreme gerrymander over a range of voter behavior seen historically in North Carolina. The effect of these extreme gerrymanders is to prevent the Democrats from winning as many seats in Congress, the House, and the Senate as they would have had the maps been drawn in a neutral way without political considerations. In many cases, the enacted maps reduce the extent to which the results of an election respond to the changing options of the electorate as expressed at the ballot box.

3 Discussion on Interpreting The Ensemble Method

3.1 The Political Geography

In redistricting conversations, there are often discussions of the urban versus rural divide and natural packing. These points demonstrate the need for a methodology that accounts for this political geography; ensemble methods precisely capture it. The distribution on redistricting plans can distinguish between typical plans and atypical plans. This determination is fundamentally informed by the geometry of the state, its political geography, and the spatial structure of the elections used to probe the redistricting plan.

The fundamental power of the ensemble method is that it begins with a clear set of redistricting criteria as an input. It then creates a representative ensemble of redistricting plans which accounts for the geometry of the state and the geography of where people live and how they vote. Any collection of voting data can then be applied to this ensemble of restricting plans to obtain a collection of election results. The election results give a benchmark against which a particular redistricting may be compared under the same set of voting data. It is only the relative difference between the ensemble and the enacted plan which matters. Our ensemble of restricting plans naturally incorporates how nonpartisan redistricting criteria interact with the political geography and geometry of the state. It naturally adapts to natural packing in urban areas and other effects. It is capable of separating these natural effects from those of partisan gerrymandering. Because of this, this mode of analysis can separate bias that natural packing might induce from other effects.

Additionally, none of these analyses rely on any forms of partisan symmetry or ideas of proportional representation. The ensemble method does not impose any idea of fairness nor does it select for a particular seats-to-votes curve. Rather it illuminates what the result would have typically been had only the stated redistricting criteria been utilized. It is quite possible, and often happens, that the results from the ensemble method do not yield proportional representation and one party has a natural advantage relative to the statewide vote fraction. One can then use this natural advantage as a benchmark to detect when a particular plan is biased beyond the neutral standard the ensemble establishes.

3.2 Different Elections have Different Voting Patterns

Elections differ both in the statewide partisan vote fraction and the spatial patterns of voting across the state. Hence, it is not at all surprising that a given map can act differently under different voting patterns; even those that share the same statewide partisan vote fractions. For instance, a map could be designed to neutralize the effectiveness of a particular set of coalitions, and hence would only be a statistical outlier in elections when those coalitions are active.

On a number of occasions, we have seen maps that particularly show the effect of the Gerrymander when there is a danger that the majority or supermajority are lost. To better understand why this is natural, consider the following example. Let us assume that a region has three varieties of people who always vote as a block and are spatially contiguous. For definiteness, let us call them red, purple, and blue people. We will assume that red always vote for the red candidate and blue for the blue candidate. Sometimes the purple vote for the red candidate and sometimes for the blue candidate. Hence, sometimes red wins two seats, and sometimes three seats, depending on how the purple people vote. Let us assume that most redistricting plans that one would naturally draw (without knowing where the red, purple, and blue people lived) would produce 2 majority red districts, 2 majority blue districts, and one majority purple district. We will call these neutral plans. Now let us consider a plan which is carefully drawn so that the purple people are never a majority but rather the purple people are split such that there are three majority blue districts and two majority red. We will call this the gerrymandered plan.

Under the gerrymandered plan the red candidates always win two of the five seats, but never more. This is typical of elections where the purple people vote with the blue people. It is typical because the majority purple district in the neutral plans would vote for the blue candidate to elect three blue candidates. On the other hand, in elections where the purple people vote with the red people, the outcome would be highly atypical as the neutral maps would have always produced three red winners but the gerrymandered plan only produces two red winners. In summary, atypical maps may lead to a typical split of elected officials under some vote counts, but not under others. It is not unusual for gerrymandered maps to sometimes produce typical results.

3.3 Collected Seat Histograms and Uniform Swing Analysis

It is a misconception that a gerrymandered map will behave atypically under all different types of elections. Gerrymandered maps can behave atypically under some types of elections and typically under other types of elections. For example, a map may only become atypical when a party is in danger of losing the majority. We demonstrate this through a type of plot we call *Collected Seat Histograms*. The election data use can either be historical elections or data generated using a uniform swing hypothesis.[1]

In both cases, we plot the histograms tabulating the fraction of the ensemble maps which produce a particular number of Democratic seats under a particular choice of statewide votes (tabulated at the precinct level). We then collect these histograms on a single plot where they are arranged on the vertical axis according to their statewide vote fractions, with the most Republican at the bottom and the most Democratic at the top. On each of the individual histograms, we also place a mark corresponding to the number of seats the enacted map would produce using those votes. Using these plots, one can identify trends and types of elections were the enacted maps products outlier results. When considering the NC State House and Senate, we also place vertical lines on each plot to mark where the supermajorities are in effect and where the simple majority in the chamber changes hand.

In addition to using historical statewide votes to produce our Collected Seat Histograms, we also create a collection of Collected Seat Histograms built from a single historical vote which is shifted using the Uniform Swing Hypothesis to produce a collection of votes which preserve the relative voting pattern across the state while seeing the effect of shifting the partisan tilt of the election.

Both kinds of Collected Seat Histograms are effective at identifying maps that are non-responsive to changing voter opinions or under-respond to those changes. A district map that results in different representation when the number of votes for a particular party changes sufficiently is a minimal requirement of a democratic process that is responsive to the changing will of the people. The Collected Seat Histograms can be used to determine the level of responsiveness to changes in the votes one should expect of the maps that were drawn without a partisan bias. The Rank Ordered Boxplots in the next section can help illuminate the structure of the map which is responsible for any systematic bias or lack of responsiveness relative to the nonpartisan benchmark embodied in the ensemble.

[1] The uniform swing hypothesis takes a single election and then uniformly increases (or decreases) the percentage for a given party across all the predicts. This creates a new set of voting data with the same spatial structure but a different statewide partisan percentage for each party.

3.4 Structure of Maps and Rank-Ordered Marginal Boxplots and Histograms

While the partisan seat count is clearly a quantity of interest, it can be less effective at illuminating the structure of a map that also explores how the elections are won. To this end, we introduce the *Rank-Ordered Marginal Boxplots and Histograms*. These are formed by considering the partisan vote fraction for one of the political parties (say the Democrats, or equally the Republicans) in each of the districts for a given redistricting plan. These marginal vote fractions are then ordered from smallest to largest, that is to say; from most Republican district to most Democratic district. These ordered numbers are then tabulated over all of the plans in the ensemble.

The Rank-Ordered Marginal Boxplots plot the typical range of the most Republican district to most Democratic district. Ranges are represented by box-plots. In these box-plots, 50% of all plans have corresponding ranked districts that lie within the box; the median is given by the line within the box; the ticks mark the 2.5%, 10%, 90% and 97.5% quartiles; the extent of the lines outside of the boxes represent the range of results observed in the ensemble. The number of boxes is the same as the number of seats. That is 120 seats for the NC House, 50 seats for the NC Senate, and 14 seats for the NC Congressional Delegation. Any box that lies above the 50% line on the vertical axis will elect (or typically elect) a Democrat; any box that lies below the 50% line will elect (or typically elect) a Republican.

We take the enacted plan with each set of votes and plot the ordered district returns over the box plots. If the districts of an enacted plan lie either far above or far below the ensemble at a particular ranking, this can indicate that the district was either packed or cracked to provide an atypical result.

4 State Legislature

Using historic voting data, we compare election results under the enacted districting plans for the North Carolina House and North Carolina Senate with election results under a collection of non-partisan maps. One strength of this method is that it makes no assumptions in advance about what structure an election should have such as a relation to proportional representation or some type of symmetry considerations. We examine both the number of seats that would have been won under these vote counts, along with the expected margins of victory.

4.1 State Legislature: Overview of Findings

4.2 State Legislature: Overview of Method

We generate a collection of alternative restricting maps using Markov Chain Monte Carlo methods, and used this collection to characterize what would be expected if only non-partisan redistricting criteria where used. We have described this method in detail in our academic work. See [7, 3, 8, 10, 1, 2]. (References in this report to numbers in brackets are to articles cited in a numbered bibliography at the end of this report). No partisan information is used to construct this ensemble of maps; only the generally accepted districting criteria of approximately equal population per district, contiguous and relatively compact districts, reducing traversals, and keeping counties, precincts, and municipalities whole.

For both the NC House and NC Senate, we generate a *Primary Ensemble* whose non-partisan properties are close to those of the enacted plan. Because of this, we sometimes label this plan as the *Matched Ensemble*. For both the NC Senate and NC House, we produce a *Secondary Ensemble* which makes different policy choices concerning the preservation of municipalities. In a third ensemble built, we also consider the pairing of incumbents.

The ensembles are generated by using the Metropolis-Hasting Markov Chain Monte Carlo Algorithm in a parallel tempering framework which employs proposal from the Multiscale Forest RECOM algorithm [2, 1] and the single-node flip algorithm [7]. Using these proposals, the Metropolis-Hasting algorithm is then used to produce samples from the desired policy-informed, non-partisan distribution on redistrictings; such algorithms are widely accepted for sampling high-dimensional distributions. The Markov Chain Monte Carlo and Metropolis-Hasting algorithms are a cornerstone of modern computational statistics, protein folding and drug discovery, and weather prediction. They date back to at least the Manhattan Project in Los Alamos are used in a huge range of mathematical and statistical applications.

The distributions we use are defined to be concentrated on districting plans that contain districts near the ideal district population based on the one-person-one-vote principle (including the 5% population deviation acceptable for legislative districts). They are also designed to produce contiguous districts that are relatively compact and to reduce the number of counties and, in some cases, the number of people split out of a municipality. For the Primary Ensemble, the distribution on redistricting plans is tuned so that these non-partisan qualities, including the number of counties, municipalities, and precincts which are split, are similar to the enacted plan. We also respect the county-clustering requirement for State Legislative maps.

We will see that the enacted NC Senate preserves municipalities to a high degree; in a way consistent with the most municipality preserving distributions we could produce. Hence, we also provide a *Secondary Ensemble* for the NC Senate which does not explicitly preserve municipalities (thought compactness and the county preservation lead to a degree of municipality preservation.) It coincides with the primary ensemble properties in other resects.

For the NC house, we will see that the enacted plan is not as stringent in its municipality preservation, and that respecting the other criteria could naturally create many plans that better preserve municipalities than the enacted plan. Since we have tuned our primary ensemble to match the level of municipality preservation in the enacted plan, which include a Secondary Ensemble for the NC house we is better at preserving municipalities.

As the guidance from the legislature at the start of the redistricting process stated that one "may consider municipality preservation" (in contrast to other directives which were not optional), all four of these ensembles meet the guidance given by the legislature. As already mentioned, we also provide a third ensemble for both the NC house and NC Senate which is derived from the primary ensemble, but considers the double-bunking of incumbents.

In all cases using the Metropolis-Hasting Markov Chain Monte Carlo Algorithm, we can produce a mathematically representative sample of the redistricting plans that comply with the criteria described.

4.3 County Clusters for State Legislature

In Stephenson v. Bartlett, 562 S.E.2d 377 (N.C. 2002), the North Carolina Supreme Court ruled that North Carolina's state legislative districts should be clustered into groups of counties and that no district should cross between two of the "county clusters." As part of our non-partisan work concerning redistricting, we implemented the algorithmic part of the Stephenson Ruling in a publicly available open-source piece of software [4]. We used this computer software to produce the county clusterings used in this report. The resulting clusterings were described in our publicly released report which can be found here [5]. We understand that the NC Legislature also used this report to determine the possible clusterings. In any case, the clusterings we found coincide with those discussed by the legislature.

There is not a unique choice of statewide clustering. Rather there are parts of the state which can only be clustered in one way, while there are two ways to cluster the counties in other regions. In the state Senate, there are 17 clusters containing 36 of the 50 districts that are fixed based on determining optimal county clusters. These are represented by the color county groupings in Figure 4.3.1. The white numbers annotating each county clustering give the number of districts that the county cluster should contain. Ten of these clusters contain one district, meaning that ten of the 50 senate districts are fixed by the county clusters. The remaining county clusters must be further subdivided into legislative districts. The remaining 14 counties, shown in gray on the map in Figure 4.3.1 are distributed among four groups, each containing two clustering options. Following the nomenclature in [5], we will label the cluster groups by the letters A, B, C, and D . Each group consists of two different possible clusterings which we will label with the numbers 1 and 2. Thus, the first choice in cluster A is labeled A1, and the second choice A2. A complete choice of county clusters then consists of one choice from the A group, the B group, the C group, and the D group.

Similarly, in the NC State House, there are 33 clusters containing 107 of the 120 districts that are fixed based on determining optimal county clusters. These are represented by the color county groupings in Figure 4.3.2. Again, the white numbers annotating each county clustering give the number of districts that the county cluster should contain. Eleven of these clusters contain one district, meaning that eleven of the 120 house districts are fixed by the clustering process. The remaining clusters (shown in gray) are separated into three groups each containing two clustering options. As before, the groups will be demoted by the letters A, B, and C with each of the two options in each group labeled with the numbers 1 or 2.

More details can be found in [5] and [4]. It should be noted that the algorithm used to produce these clusterings only implements the algorithmic portion of the Stephenson v. Bartlett. In particular, it does not address any compliance with the Voting Rights Act.

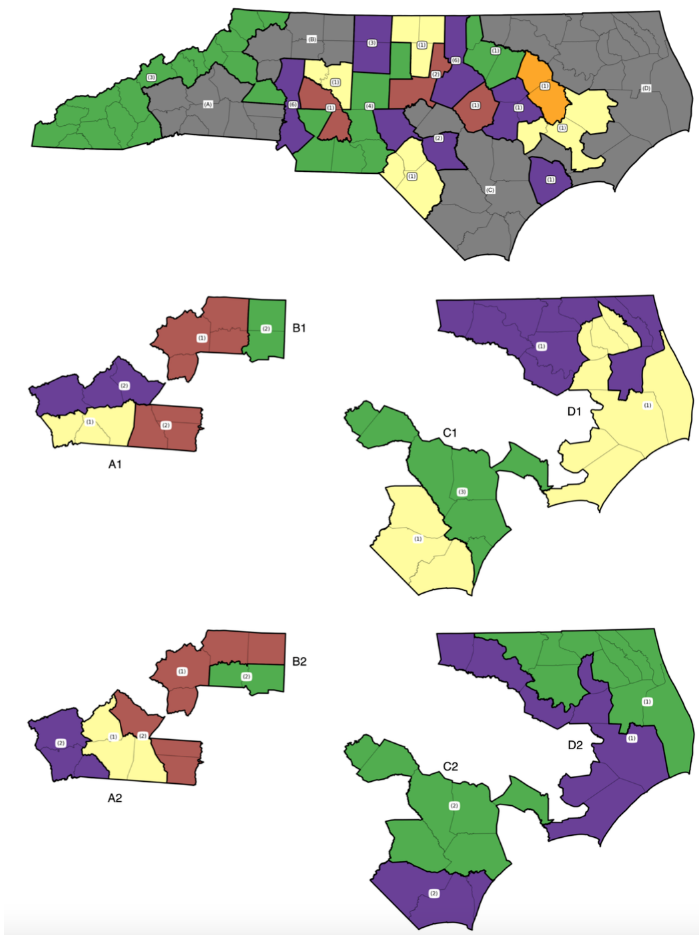


Figure 4.3.1: Senate

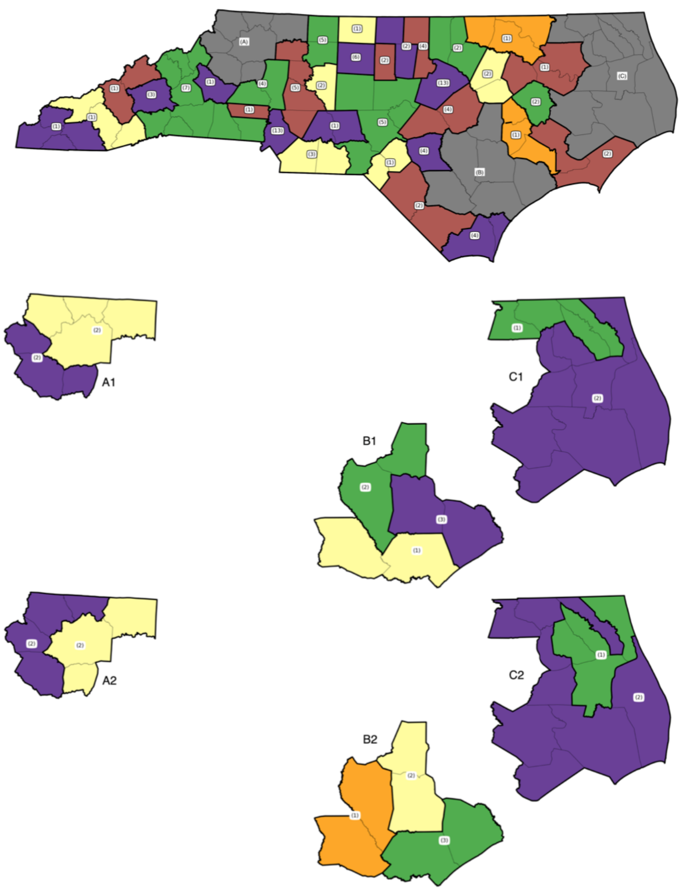


Figure 4.3.2: House

4.4 State Legislature: Ensemble Overview

We now give more details on the different distributions already sketched in Section 4.2. They represent different distributions that emphasize different policies consistent with the Legislature's guidance and historical presidents. All the distributions from which we build our ensembles respect the county clusters we derived in [6] by algorithmically implementing the ruling Stephenson v. Bartlett, 562 S.E.2d 377 (N.C. 2002). That is to say in both the State House and State Senate, the state is segmented into groups of counties referred to as *county clusters* so that the population of each county cluster can be divided into a number of districts each with a population within 5% of the ideal district population. The county clusters are different for the State House and State Senate as the number of districts, and hence the ideal district populations, are different. Each district is constrained to lay entirely within one county cluster.

Beyond the county cluster requirement all of our primary and secondary ensembles for both chambers also satisfy the following constraints:

- The maps minimize the number of split counties. The 2021 redistricting criteria state that "Within county groupings, county lines shall not be traversed except as authorized by Stephenson I, Stephenson II, Dickson I, and Dickson II."
- Districts traverse counties as few times as possible.
- All districts are required to consist of one contiguous region.
- Except for two exceptions, the deviation of the total population in any district is within 5% of the ideal district population. The two special cases are explained in Section 7.2.
- Voting tabulation districts (i.e. VTDs or precincts) are not split (see again the two exceptions with population deviation in Section 7.2)
- Compactness: The distributions on redistricting plans are constructed so that a plan with a larger total isoperimetric ratio is less likely than those with a lower total isoperimetric ratio. (See Section 7.2 and 8.1 for a definition of the isoperimetric ratio.) The total isoperimetric ratio of a redistricting plan is simply the sum of the isoperimetric ratios over each district. The isoperimetric ratio is the reciprocal of the Polsby-Poper score; hence, smaller isoperimetric ratio corresponds to larger Polsby-Poper scores. The General Assembly stated in its guidance that the plans should be compact according to the Polsby-Popper score or the Reock score [9]. We have found that while the Reock is useful when comparing two districts. However, the Polsby-Popper/isoperimetric score is a better measure when generating district computationally. In our previous work, we have seen that this choice did not qualitatively change our conclusions (see [7] and the expert report in Common Cause v. Rucho).

  We tuned our primary ensemble so that compactness scores of the ensemble were comparable to those of the enacted plan. See Section 7, for plots showing the compactness scores.

Municipality Preservation: We now come to the property which distinguishes the Primary and Secondary ensembles. In both chambers of the NC Legislature, we tune the primary ensemble to match the level of municipalities preservation to those seen in the enacted plan. Since municipality preservation is concerned with keeping the voters of a particular municipality together as a block, we concentrate on the number of *ousted voters*. Ousted voters are those who have been removed from the districts which primarily contain the other members of the municipalities. We construct the ensemble to control the total number of ousted voters across the entire state. More details are given in Section 7.2. As already mentioned, we tune the Secondary ensembles differently for the two chambers. Since the Enacted Senate plan was at the lowest end of municipality splitting we observed, we have included a secondary ensemble in the Senate which did not explicitly consider municipality reservation. In the NC House, since the enacted plan did not preserve municipalities to the level we found possible, we included a secondary ensemble which better preserved municipalities.

Incumbency: The effect of incumbency are addressed in a subsequent section of this report.

4.5 Construction of Statewide Ensembles for State Legislature

Statewide ensembles are created by drawing samples from a number of "sub-ensembles." Because of the county cluster structure, we can sample each county cluster independently of the other county clusters. In the house, we sample the Wake and Mecklenburg county cluster groups separately from the rest of the state as they have many more precincts and districts. In the Senate, we sample the Wake county cluster independently since it must split precincts to achieve the 5% population balance. There are several regions of the state that have multiple options for county clusters and we sample each of the county clustering options separately. We then sample the remainder of the state together.

We combine these sub-ensembles by first choosing which of the county clustering options will be used, treating all options equally. With these fixed, we then choose a map from each of the other sub-ensembles and combine them to produce a statewide map. We used this procedure to create an ensemble of 100,000 maps. These ensembles of statewide maps were used to generate the various figures. This number was chosen as it proved to be sufficient for the statistics of the quantities of interest to have converged. That is to say that adding additional maps to the ensemble did not change the results. See Section 7.1 for more details on the sampling method.

4.6 Election Data Used in Analysis

The historic elections we consider are from the year 2016 and 2020. We only consider statewide elections. We will use the following abbreviations: AG for Attorney General, USS for United States Senate, CI for Commissioner of Insurance, LG for Lieutenant Governor, GV for Governor, TR for State Treasure, SST for Secretary of State, AD for State Auditor, CA for Commissioner of Agriculture, and PR for United States President. We add to these abbreviations the last two digits of the year of the election. Hence CI16 is the vote data from the Commissioner of Insurance election in 2016.

5 State Legislature: Main Statewide Analysis

Our analysis shows that the enacted plan for the NC State House is an extreme gerrymander over a wide range of voter behavior seen historically in NC. The effect of this extreme gerrymander is to prevent the Democrats from winning as many seat as they would have had the maps been drawn in a neutral way without political considerations. This gerrymander is achieved by packing Democrats in a number of the most Democratic districts while depleting them from those districts which typically change hands when the public changes its expressed political opinon through the vote. The effect is particularly strong in situations where the Democrats would typically reduce a Republican supermajority to a a simple majority. The enacted map often denies this transition. Similarly the enacted map again behaves in an anomalous fashion by under electing democrats when the typical maps would almost always give the Democrats the majority in the House. This extreme outlier behavior is reflected in the behavior we see at the individual cluster level.

The effect in the Senate is less pronounced. At the cluster level there are a number of strong and extreme outliers signaling extreme partisan gerrymandering. At the statewide level, the structure of the map shows it to be an extreme outlier in the fashion in which Democrats are packed in certain districts and depleted from others. The effect at the statewide level is mostly seen when the Republicans are in danger of losing the supermajority in the Senate. Over this range the anomalous packing and cracking of Democrats leads to a number of extreme outlier behaviors which result in the Republicans maintaining the supermajority when they typically would have lost it under a non-partisan map from the ensemble.

Additionally we see that the reason that the Senate map is typical in many situations stems from the choice to highly conserve municipalities. The municipality preservation is at the extreme end of what we have observed. In contrast, the municipality preservation in the house is less extreme as we can easily create an ensemble which preserves municipalities to a higher degree. For the Senate plan, relaxing the requirement to preserve municipalities leads to an ensemble that is more favorable to the Democrats, meaning that the enacted plan would be an extreme outlier in more situations. Put differently, prioritizing municipality preservation in the Senate plan appears to enable more maps that favor Republicans. By contrast, for the House plan, where the enacted map does not prioritize preserving municipalities, my analysis finds that such a prioritization would not have favored the Republican party.

5.1 NC State House

Figure 5.1.1 shows the distribution of Democratic seats elected under a number of historical elections which capture plausible voting patterns in North Carolina elections. The elections are arranged vertically by the statewide Democratic vote share, from most Republican at the bottom to the most Democratic at the top. The Democratic seats elected under each election by the enacted plan is marked with a yellow dot.

It is important to remember that the single number of statewide vote fraction is not sufficient to categorize an election. Elections with similar statewide vote fractions can have dramatically different seat counts since the votes can be concentrated differently geographically. An example of this is shown in Figure 5.1.8 which shows the Collected Seat Histograms for an ensemble that places more weight on preserving municipalities that the enacted plan or the primary ensemble. Notice that the AG20 votes produce more democratic seats typically than either AG16 or GV16 even though the statewide vote fraction of AG20 is sandwiched between AG16 and GV16. (Recall the definitions of these abbreviations given in Section 4.6.)

Returning to Figure 5.1.1, we see that the enacted map is atypical in its favoring of the Republican party in every one of the elections considered and an outlier or extreme outlier in the vast majority of the elections. Additionally, the enacted plan is an extreme outlier when the Republicans are likely to lose either the Super-majority or control of the chamber. Observe that in the vast majority of plans in the primary ensemble (Figure 5.1.1) the votes in PR16, LG20 and CL20 produce a simple majority for the Republican party in the NC State House (and not a supermajority). Yet under the enacted plan, the Republican Party maintains the supermajority in all three cases.

Similarly, in a large number of the ensemble plans the Democrats hold the majority in the chamber under the voting patterns given by AD20, SST20, and GV20. (Under GV20 the Democrats have the majority most of the time, under AD20 roughly half the time and under SST roughly 75% of the time.) Yet, under the enacted plan the results are extreme outliers, giving the Republicans the majority with a safety margin of a few seats in all cases.

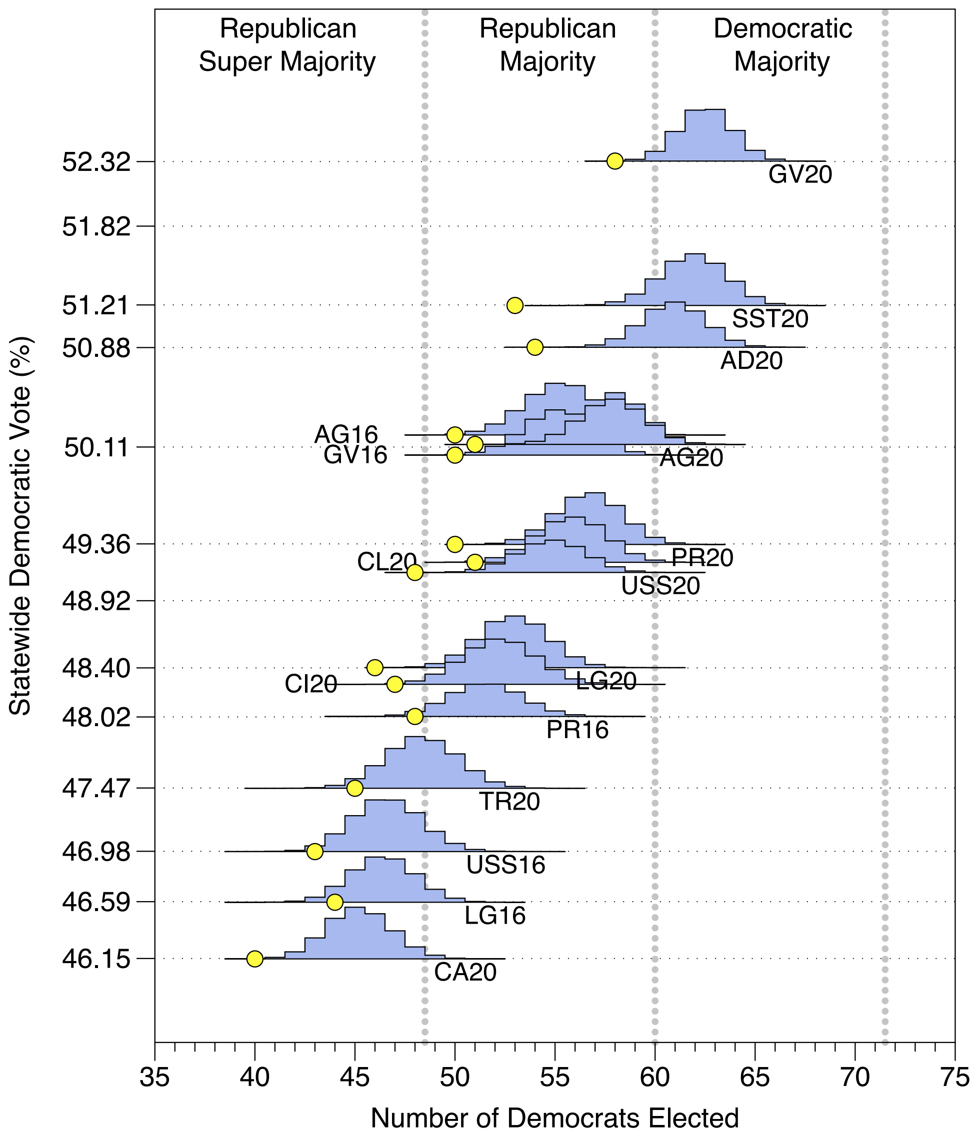


Figure 5.1.1: The Collected Seat Histogram for the Primary Ensemble on the NC House. The individual histograms give the frequency of the Democratic seat count for each of the statewide elections considered from the years 2016 and 2020. The histograms are organized vertically based on the statewide partisan vote fraction for each election. The more Republican elections are placed lower on the plot while more Democratic elections are placed higher. Three dotted lines denote the boundary between where the supermajorities and simple majorities are in force. The yellow dot represents the enacted plan.

As already observed, Figure 5.1.1 helps to identify the properties of the Enacted Map under different electoral environments. There is a clear trend as one moves to more Democratic elections, the atypical results (already tilted to toward

% Dem	Election	% Outlier	# Outlier	# Samples
52.32%	GV20	0.118%	118	100000
51.21%	SST20	0.000%	0	100000
50.88%	AD20	0.007%	7	100000
50.20%	AG16	0.451%	451	100000
50.13%	AG20	0.005%	5	100000
50.05%	GV16	0.399%	399	100000
49.36%	PR20	0.007%	7	100000
49.22%	CL20	0.759%	759	100000
49.14%	USS20	0.012%	12	100000
48.40%	LG20	0.009%	9	100000
48.27%	CI20	0.461%	461	100000
47.47%	TR20	5.569%	5569	100000
46.98%	USS16	3.066%	3066	100000
46.59%	LG16	11.778%	11778	100000
46.15%	CA20	0.094%	94	100000

Table 1: NC House Collected Seat Histogram Outlier Data. Starting from the left, the first column gives the statewide partisan makeup of the of the election under consideration whose abbreviation is given in the second column from the left. The right most column gives the total number of plans in the ensemble considered which is 100,000. The second column from the right gives the number of those 100,000 plans which elect the same or less Democrats under the given election. These are the plans which are as much or more of an outlier than the enacted map. The middle column is the percentage of plans which are more or equal of an outlier. (It is calculated by dividing the 2nd column from the right by 100,000 and multiplying by 100 to make a percentage.) The extremely low percentages in the middle column shows that the enacted plan is an extreme outlier across many different electoral settings.

the Republican party) in the more Republican elections in Figure 5.1.1 trend into extreme outliers as we shift to the more Democratic leaning elections.

To make the above table more quantitative, in Table 1 we tabulated the number of maps which produced the same or fewer seats for the Democrats in each of the elections we consider. We see that the enacted map is an extreme outlier. Across the vast majority of elections, the house map behaves as an extreme outlier in favor of the Republican party.

In the three elections where the results are not an extreme outlier (TR20, USS16, and LG16), the enacted plan is still atypically tilted to favor the Republican party. These three elections have a strong statewide Republican vote fraction. Hence, there is no need for a gerrymander as the Republicans have the needed votes to often keep a supermajority under even a typical map.

We will see in Figure 5.1.2 and 5.1.3 below that when these three elections are shifted (using the uniform swing hypothesis) to produce plausible voting fractions at a larger statewide Democratic vote fraction, then the results are also extreme outliers.

It is also worth noting that the bias in the enacted plan from what non-partisan map would produce systematically is the favor of the Republican party. Not once is the tilt even mildly in the favor of the Democrats.

To better control for other variation, we now include a number of Collected Seat Histograms built from a single election which has been shifted to create a sequence of elections with different statewide partisan vote fractions but the same spatial voting patern.

In Figures 5.1.2 and 5.1.3, we see that the same phenomena from Figure 5.1.1 is repeated again and again. As the vote share increases to the point where the primary ensemble for the NC House would typically break the Republicans supermajority, the enacted plan under elects Democrats to an extent which makes it an extreme outlier. This exceptional under-electing of Democrats persists past the point where almost all of the ensemble maps would have given the majority to the Democrats. In many cases the enacted map fails to respond to the shifting will of the electorate, leaving the control in the Republican hands. In addition to presenting these figures, we have also animated this affect with movies that have been submitted.

To better understand the structures responsible at the district level for the extreme outlier behavior seen in Table 2 and Figures5.2.1 to 5.2.2, we now turn to the rank-order-boxplots as described in Section 3.4. It is easy to see the abnormal structures of the enacted plan which are responsible for its extreme outlier behavior. The pattern revealed is one often seen in gerrymandered maps; namely *packing and cracking*. This refers to the depleting of one party from districts which typically would be competitive but often elect a representative from their party and instead place them in districts which were already overwhelmingly safe for either party. In Figures 5.1.4, 5.1.5, and 5.1.6, a version of this pattern is repeated. The number of Democrats seen in the districts which usually would be moderate in their partisan makeup has been decreased with a corresponding increase in the number of Democrats in the more Democratic districts where their presence has little effect on the election outcome. We give the specifics in the captions of each figure. We will see that this type of structure will be repeated in many of the individual clusters which are analyzed in Section 6.1. In addition to presenting these figures, we have also animated this affect with movies that have been submitted.

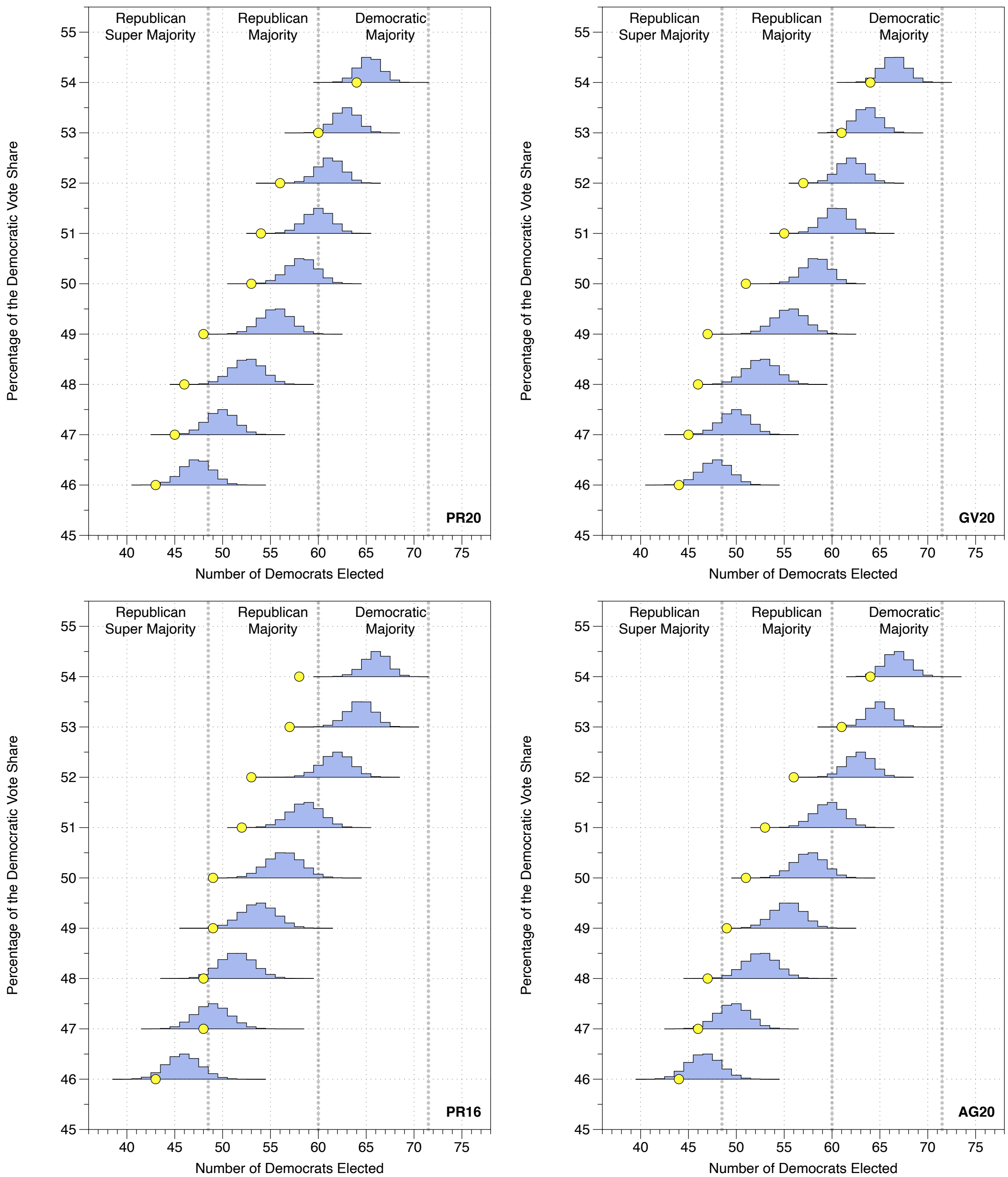


Figure 5.1.2: The individual histograms give the frequency of the Democratic seat count in the ensemble for each of the shown statewide elections, with a uniform swing. The histograms are organized vertically based on the statewide partisan vote fraction. The more Republican swings are placed lower on the plot while more Democratic swings are placed higher. Three dotted lines denote the boundary between where the supermajorities and simple majorities are in force. The yellow dot is the enacted plan.

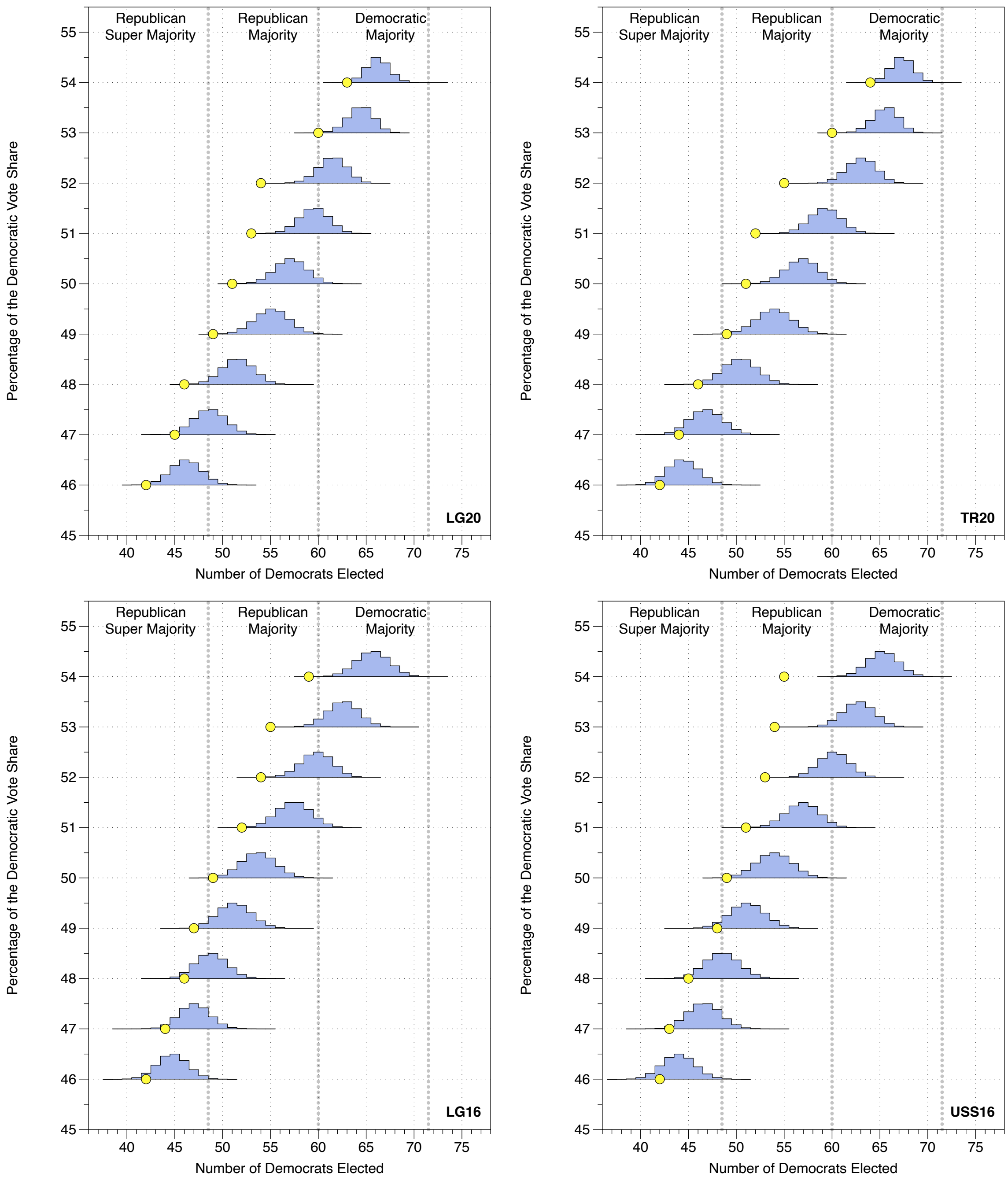


Figure 5.1.3: The individual histograms give the frequency of the Democratic seat count in the ensemble for each of the shown statewide elections, with a uniform swing. The histograms are organized vertically based on the statewide partisan vote fraction. The more Republican swings are placed lower on the plot while more Democratic swings are placed higher. Three dotted lines denote the boundary between where the supermajorities and simple majorities are in force. The yellow dot is the enacted plan.

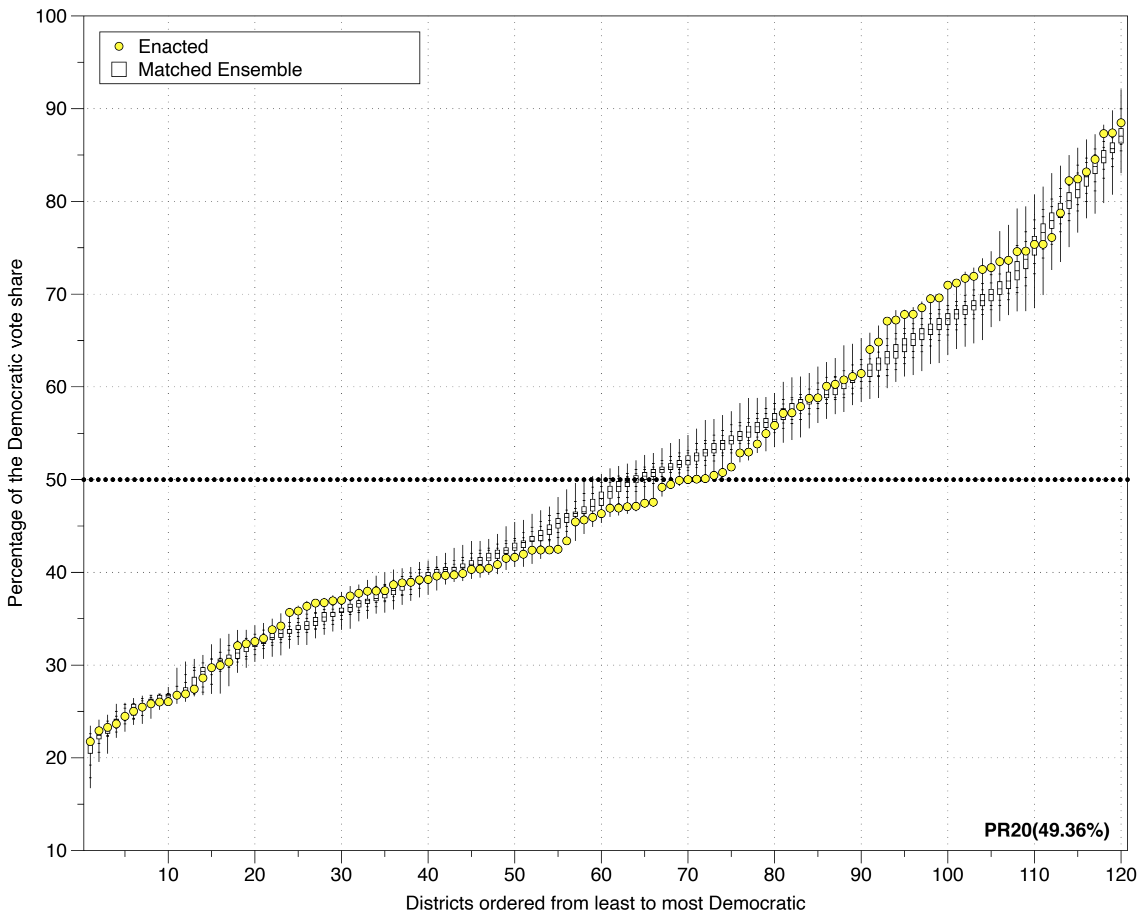


Figure 5.1.4: The yellow dots represent the democratic vote fraction of the enacted map under the PR20 vote count when the district are ordered from most Republican on the left to most Democratic in vote share on the right. The box-plots show the range of the same statistic plotted over the primary ensemble. From around the 60th to 80th district the yellow dots all well below the boxplots of the ensemble. This result is that many dots fall well below the dotted 50% line than usually would; and hence more Republicans are elected than typical. To achieve this effect, the fraction of Democrats is increased in the already strongly democratic districts ranging from the 90th to 105th most Democratic districts. This structure does not exist in the non-partisan ensemble and is responsible for the map's extreme outlier behavior.

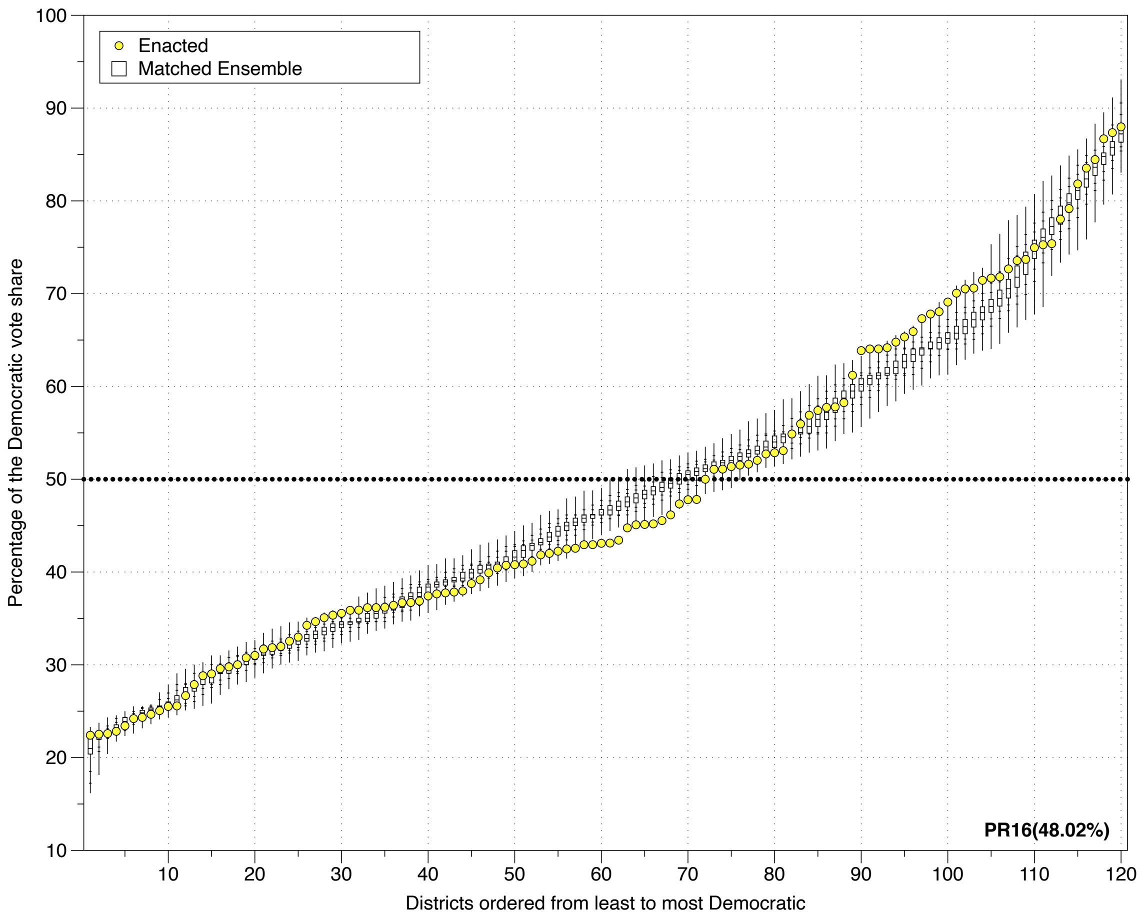


Figure 5.1.5: A similar structure to that seen in Figure 5.1.4 is repeated here. The low 50s to the high 70s have had the number of democrats depleted while the districts from the high80s to around 105 have an excess of Democrats.

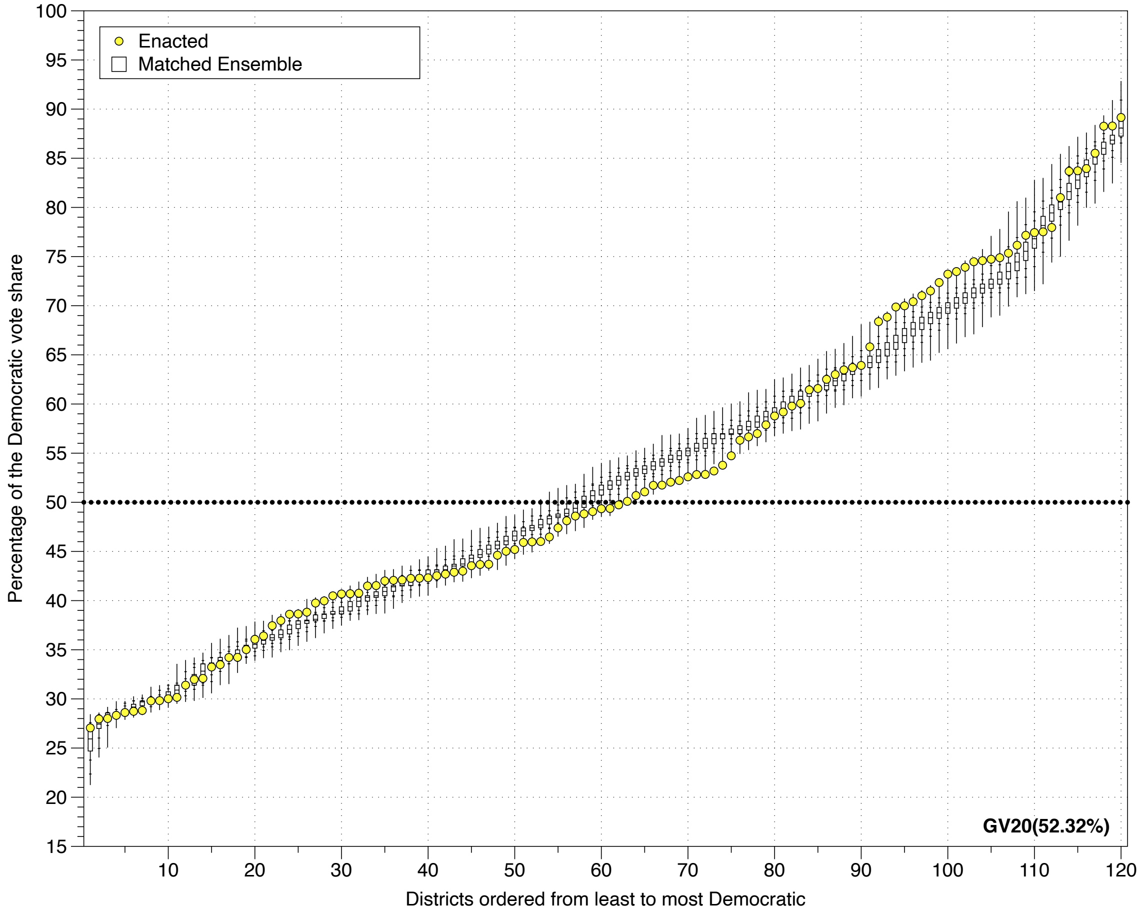


Figure 5.1.6: Mirroring what was seen in Figure 5.1.4 and Figure 5.1.5, we have abnormally few Democrats from around the 60th to the 80th most Republican and abnormally many Democrats packed in the districts in the low 90s to the just below 110.

NC House: Primary Ensemble considering Incumbency.

Figure 5.1.7 shows the Collected Seat Histogram analogous to Figure 5.1.1, but for an ensemble which pairs the same or fewer incumbents than the enacted plan. The other considerations are left unchanged from the Primary ensemble. Comparing the two figures, we see no qualitative change in the behavior of the ensemble. Hence the previous conclusions continue to hold. In particular, a desire to prevent the pairing of incumbents cannot explain the extreme outlier behavior of the enacted plan.

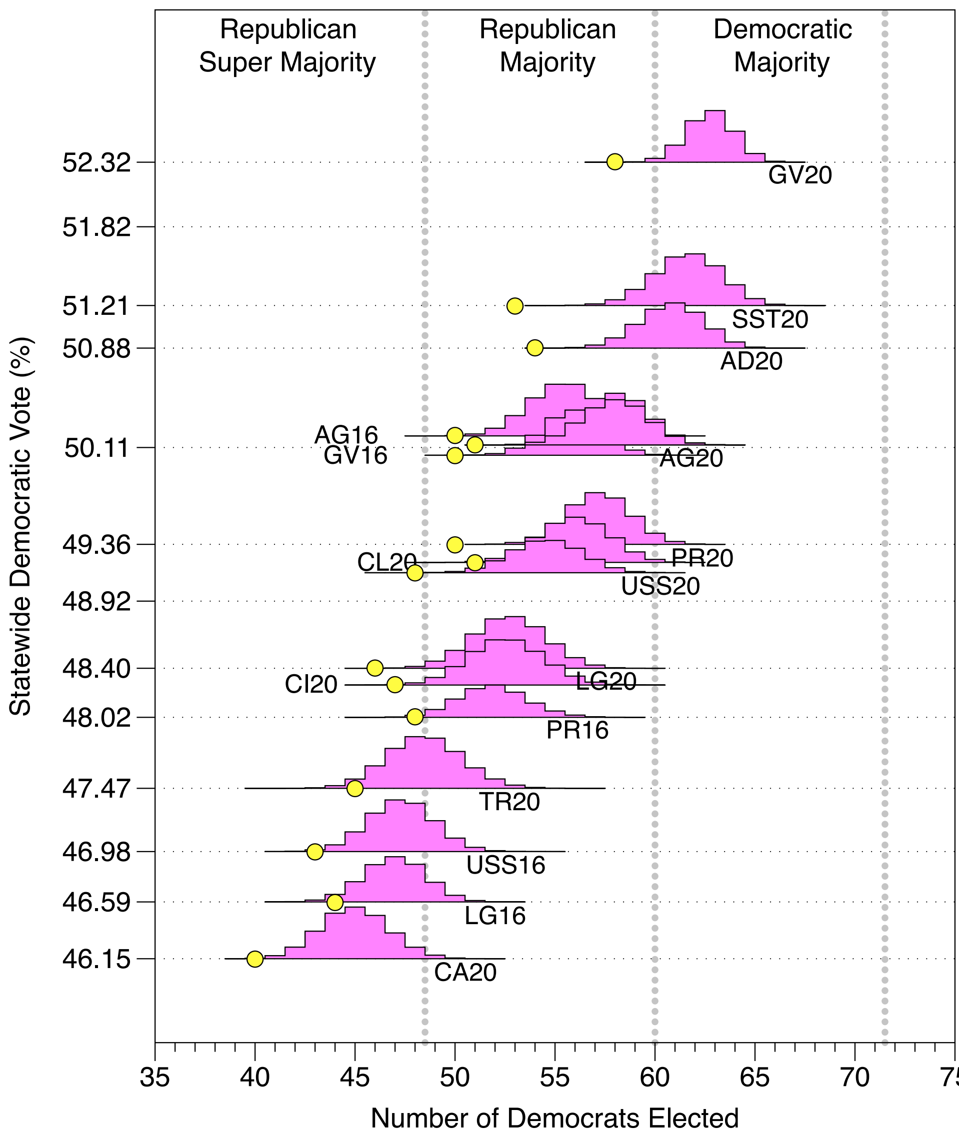


Figure 5.1.7: The Collected Seat Histogram for the Primary Ensemble on the NC House with incumbency considerations added. See Figure 5.1.1 for full description.

NC House: Secondary Distribution

The ensemble used to produce Figure 5.1.8, put more weight on preserving municipalities than either the enacted plan or the Primary Ensemble, which is tuned to match the enacted plan. This enacted plan is still an extreme outlier with respect to this secondary ensemble. We still see that the enacted map resists relinquishing the supermajority under PR16, CI20 and LG20 when this secondary ensemble almost always does. Similarly as the elections become more Democratic in AD20, SST20 and GV20 and the ensemble regularly would give the majority to the Democrats the enacted map dramatically under elects Democrats. In other words, we find that if the mapmakers had made an effort to prioritize preservation of municipalities in the House, that effort would not have led to a map that was more likely to favor Republicans.

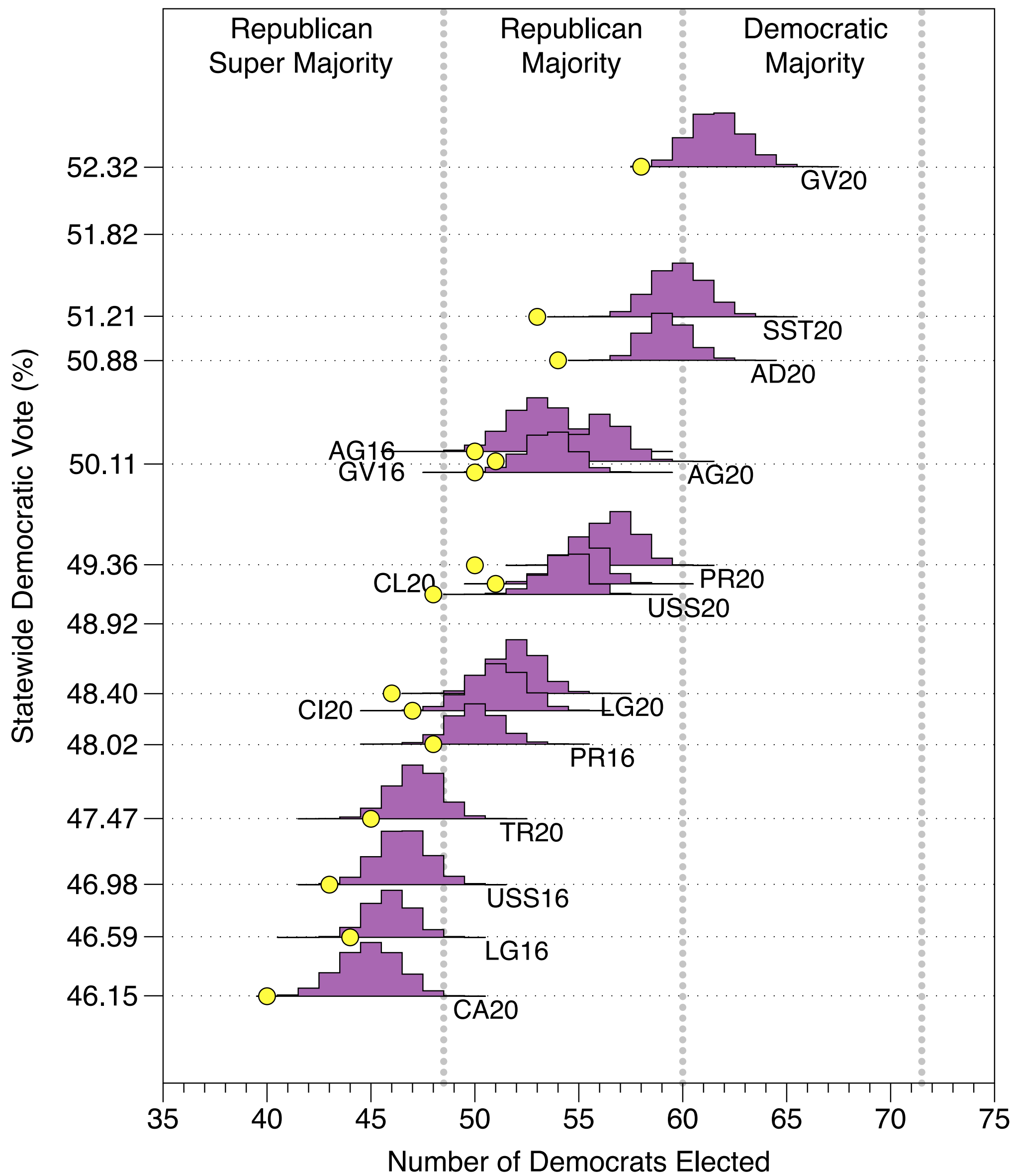


Figure 5.1.8: The Collected Seat Histogram for the Secondary Ensemble on the NC House. The Secondary Ensemble for the NC House is centered on distributions which better preserve municipalities than the enacted plan. See Figure 5.1.1 for full description.

% Dem	Election	% Outlier	# Outlier	# Samples
52.32%	GV20	16.343%	16343	100000
51.21%	SST20	35.184%	35184	100000
50.88%	AD20	42.880%	42880	100000
50.20%	AG16	12.129%	12129	100000
50.13%	AG20	4.332%	4332	100000
50.05%	GV16	0.075%	75	100000
49.36%	PR20	6.220%	6220	100000
49.22%	CL20	5.365%	5365	100000
49.14%	USS20	14.052%	14052	100000
48.40%	LG20	0.000%	0	100000
48.27%	CI20	0.322%	322	100000
47.47%	TR20	5.726%	5726	100000
46.98%	USS16	43.176%	43176	100000
46.59%	LG16	44.943%	44943	100000
46.15%	CA20	1.123%	1123	100000

Table 2: NC Senate Collected Seat Histogram Outlier Data. Starting from the left, the first column gives the statewide partisan makeup of the election under consideration whose abbreviation is given in the second column from the left. The right most column gives the total number of plans in the ensemble considered which is 100,000. The second column from the right gives the number of those 100,000 plans which elect the same or less Democrats under the given election. These are the plans which are as much or more of an outlier than the enacted map. The middle column is the percentage of plans which are more or equal of an outlier. (It is calculated by dividing the 2nd column from the right by 100,000 and multiplying by 100 to make a percentage.) The number of fairly small to extremely small percentage in the middle column between 50.13% (AG20) and 47.47% (TR20) are another signature of the anomalous behavior seen visually in Figure 5.2.1 over the same range of vote percentages.

5.2 NC State Senate

We will see in our cluster-by-cluster analysis that the NC Senate map has a number of clusters that are outliers. Their structures are systematically in favor of the Republican party. As discussed in Section 3.2, we often see maps that express their outlier status under a specific voting climate; often when one party is in danger of losing the majority or super-majority. The enacted map for the NC Senate shows this behavior.

Figure 5.2.1 is the plot for the NC Senate analogous to Figure 5.1.1, which was for the NC House. Most of the outlier behavior at the state level for the enacted NC Senate map is concentrated in the interval between 47.5% statewide Democratic vote share and around 50.5% statewide Democratic vote share. In this range, the enacted map is always an outlier and often an extreme outlier under the votes considered. This range is significant for a number of reasons. First, this is a range of statewide vote fraction where many North Carolina elections occur. Secondly, looking at Figure 5.2.1 we see that over this range the ensemble shows that one should expect the Republican super-majority (less than 21 Democratic Seats) to switch to a simple Republican majority (between 21 and 24 Democratic Seats). Yet the enacted map often resists this switch, breaking the supermajority only when the PR20 and CL20 votes are considered. In both of these elections, the ensemble places the typical number of Democratic seats well away from the supermajority line and centered between it and the simple majority line.

To make Figure 5.2.1 more quantitative, we have included Table 2 which shows the number of maps where the primary ensemble elects less democrates in that election than the enacted map.

Looking at Table 2 we see that a number of the elections in the critical partisan range of around 47.5% to 50% are extreme outliers (GV16, LG20, and CI20) while other (AG20, PR20, and TR20) show atypical behavior all favoring the Republican candidates. It is again important to notice that the enacted plan is never seen to favor the Democratic party relative to what is expected from the Primary non-partisan ensemble. The enacted map ranges between tilted to the Republican party to being an extreme partisan outlier. The importance of the range of statewide Democratic between 47.5% to 50% by looking at Figure 5.2.1. The primary ensemble shows that is within this range that one expects a Republican supermajority to become a simple majority. The effect of the enacted plan is to suppress this by under electing Democrats.

We will in the cluster-by-cluster analysis in Section 6.2 that a number of individual clusters are extreme outliers in their partisan structure.

To better control for other variation we now include a number of Collected Seat Histograms built from a single election which has been shifted to create a sequence of elections with different statewide partisan vote fractions but the same spatial voting pattern.

The large jump that we see in Figures 5.2.3 to 5.2.5 between the 33nd most Republican district and the 35th most

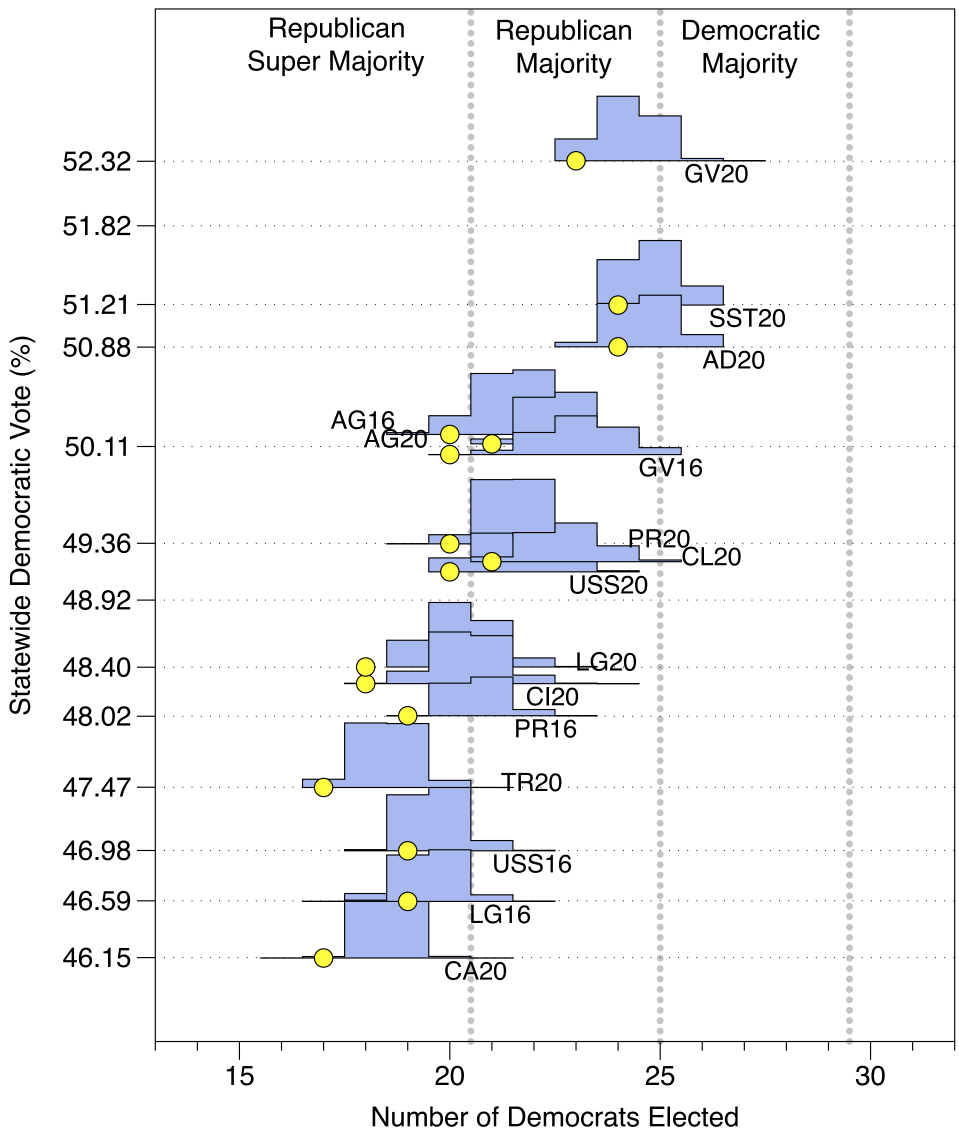


Figure 5.2.1: The Collected Seat Histogram for the Primary Ensemble on the NC Senate. The individual histograms give the frequency of the Democratic seat count for each of the statewide elections considered from the years 2016 and 2020. The histograms are organized vertically based on the statewide partisan vote fraction for each election. The more Republican elections are placed lower on the plot while more Democratic elections are placed higher. Three dotted lines denote the boundary between where the supermajorities and simple majorities are in force.

Republican district means that over a large range of swings in the partisan character of the election the outcome will change at most by one seat.

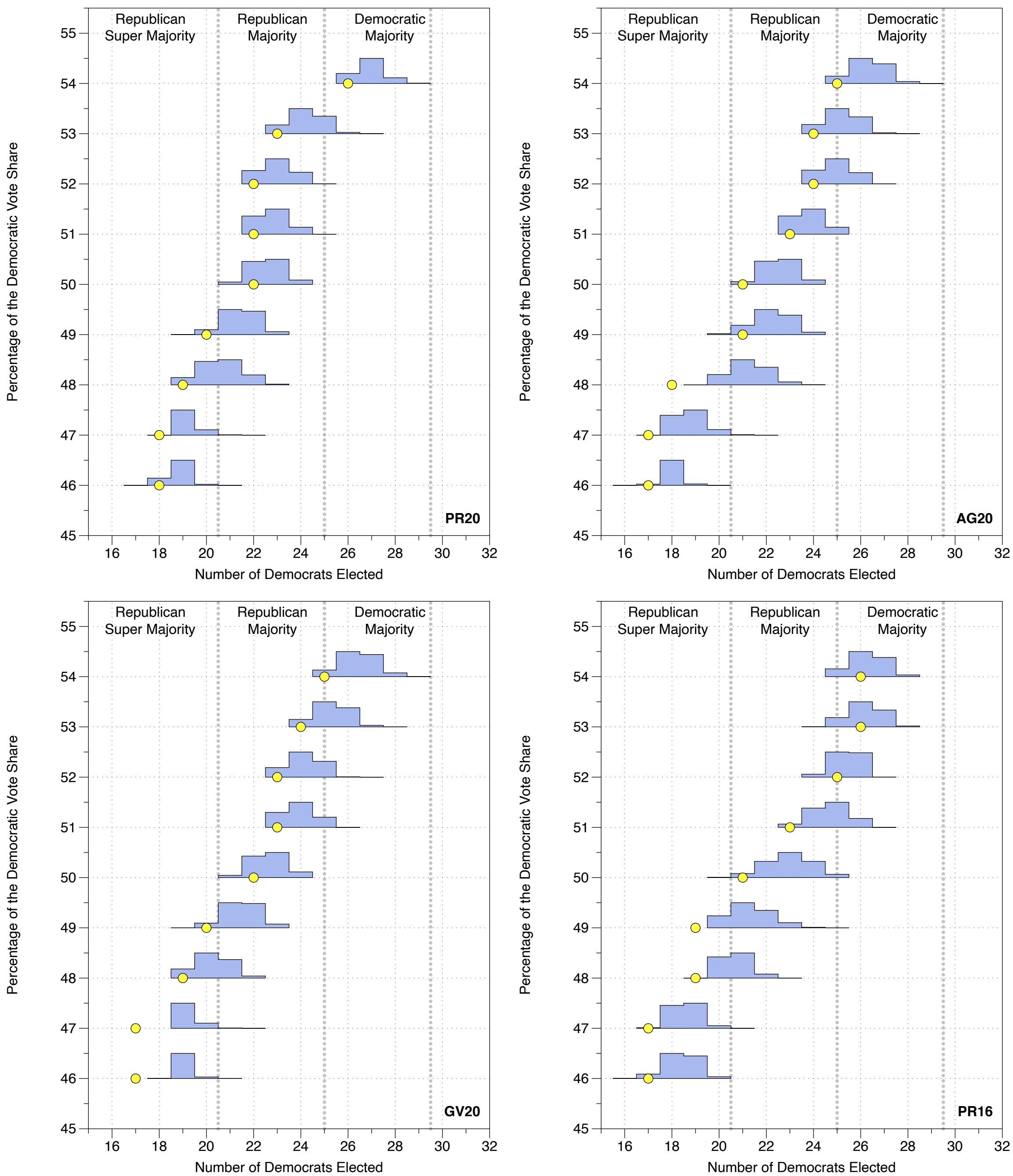


Figure 5.2.2: The Collected Seat Histograms for the Primary Ensemble on the NC House built from a collection of voting data generated via uniform swing.

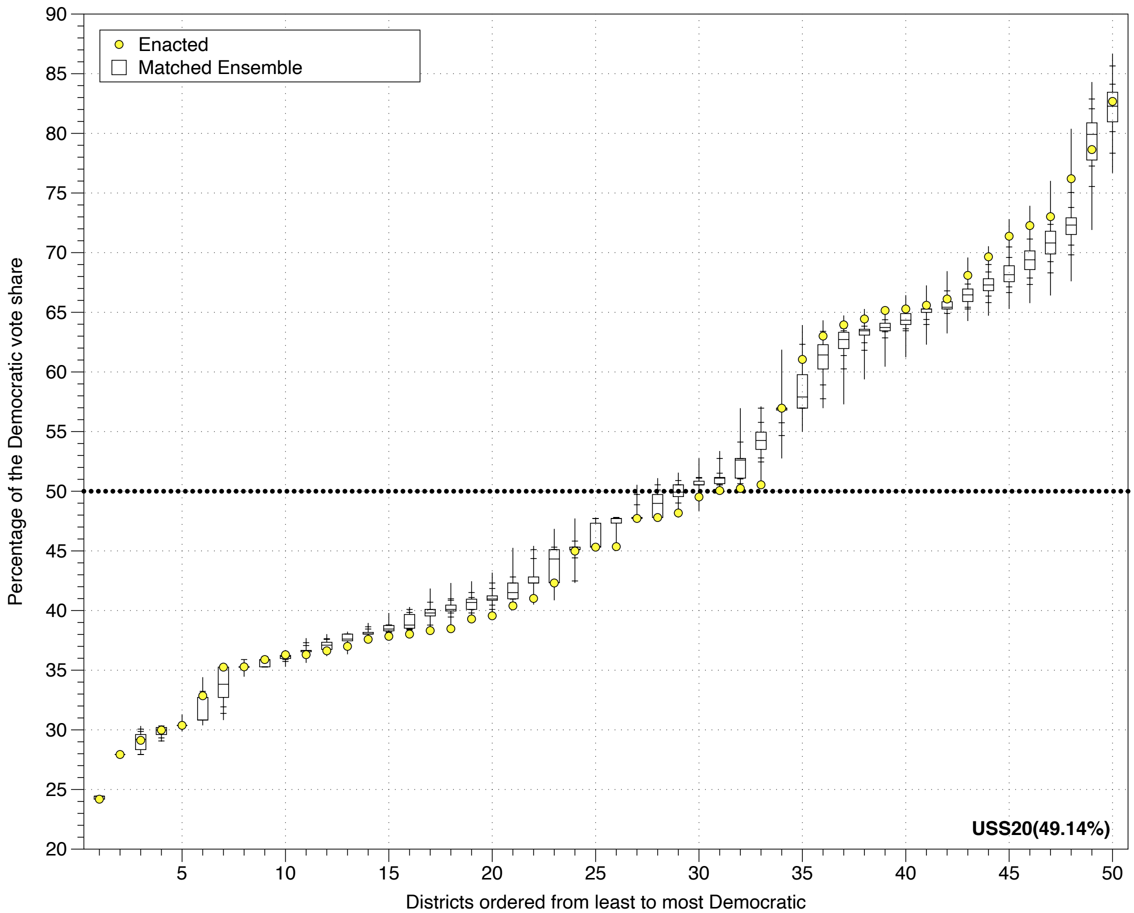


Figure 5.2.3: The yellow dots represent the democratic vote fraction of the enacted map under the USS20 vote count when the district are ordered from most Republican on the left to most Democratic in vote share on the right. The box-plots show the range of the same statistic plotted over the primary ensemble. Essentially all of the districts between the 15th most Republican and the 33rd most Republican have abnormally few Democrats. This is compensated by packing abnormally many Democrats the 35th to the 47th most Republican districts. This structure is an extreme outlier and does not occur in the ensemble.

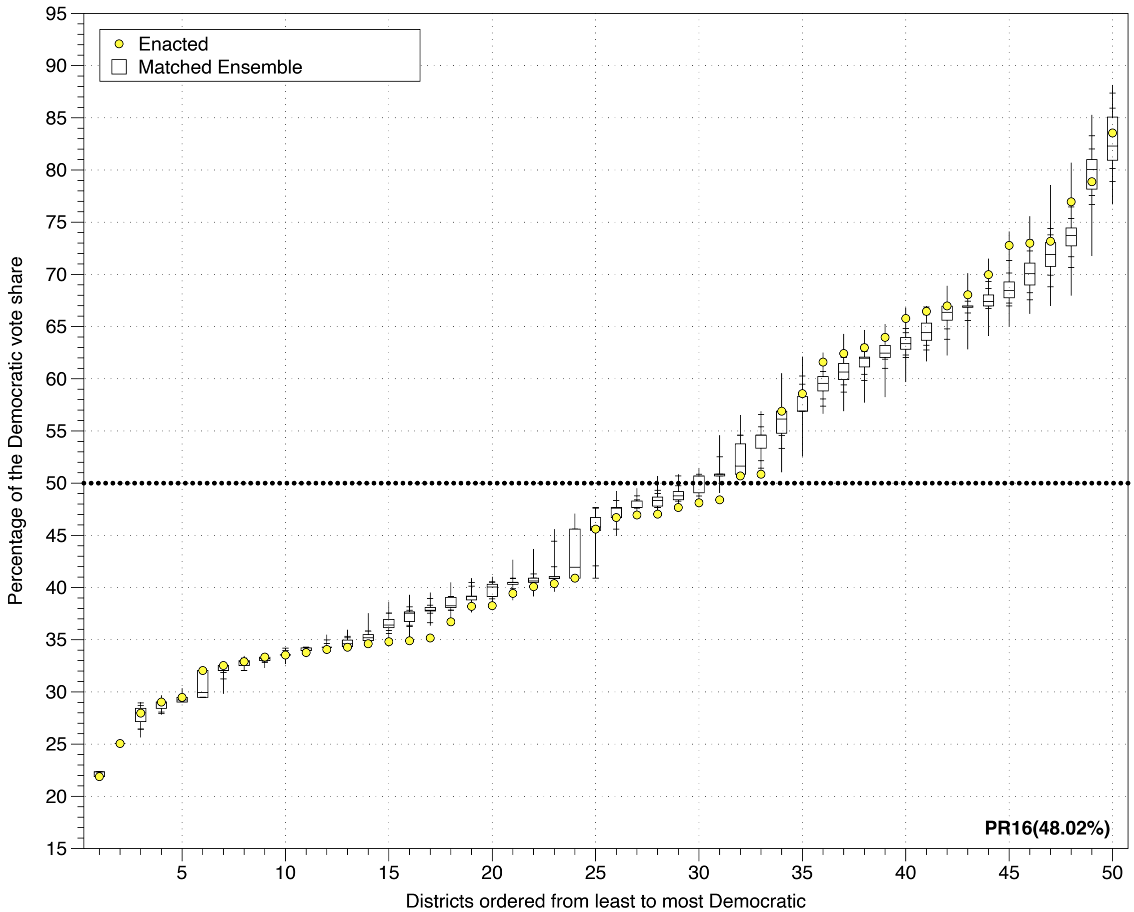


Figure 5.2.4: A similar structure to that seen in Figure 5.2.3 is repeated here over a nearly identical range of districts.

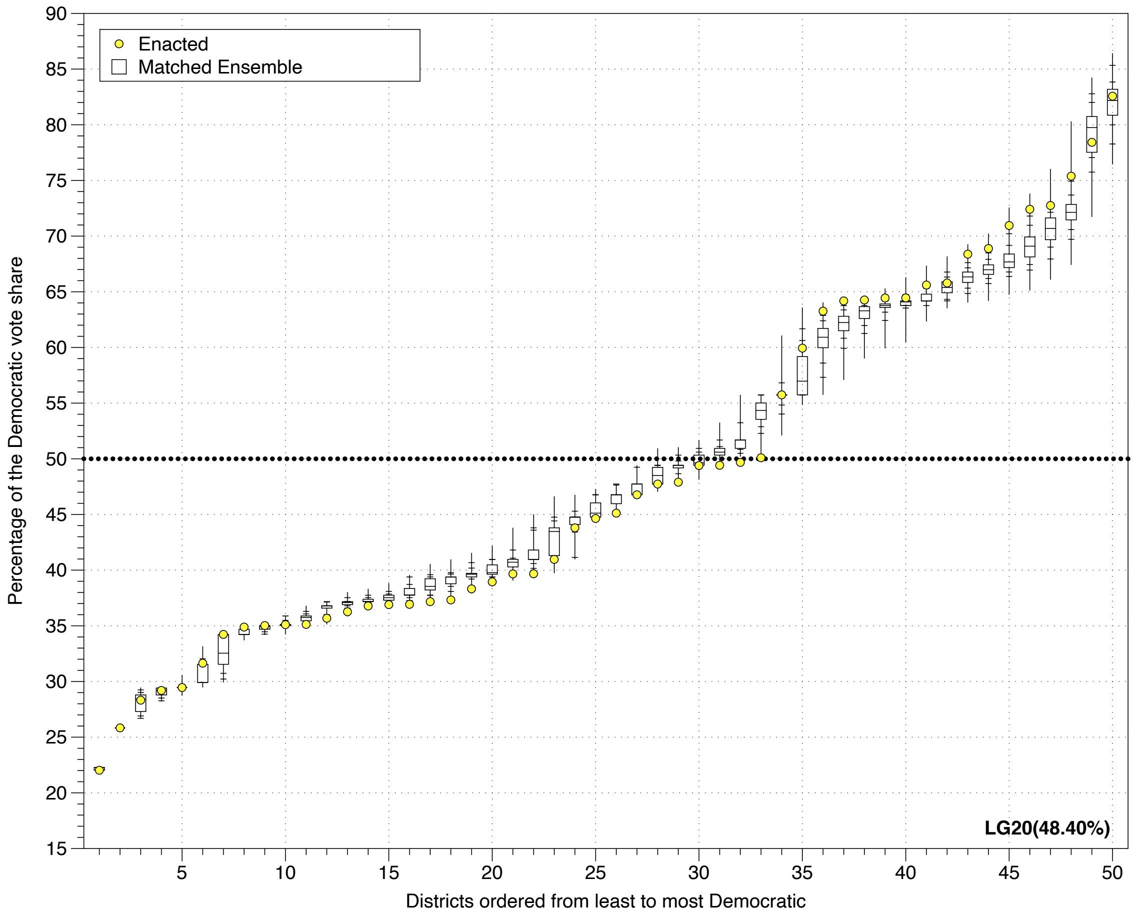


Figure 5.2.5: A similar structure to that seen in Figure 5.2.3 is repeated here.

NC Senate: Primary Ensemble considering Incumbency.

Preserving incumbency has little qualitative effect on the observations we have made. Looking at 5.2.6, we see that the election between and including GV16 and TR20 in the Figure 5.2.6 are all extreme outliers. This is in fact more extreme that the enacted map was under the Primary ensemble. It reinforces that this gerrymander seems to be most efective at the statewide level when the Republican supermajority is possible but in question.

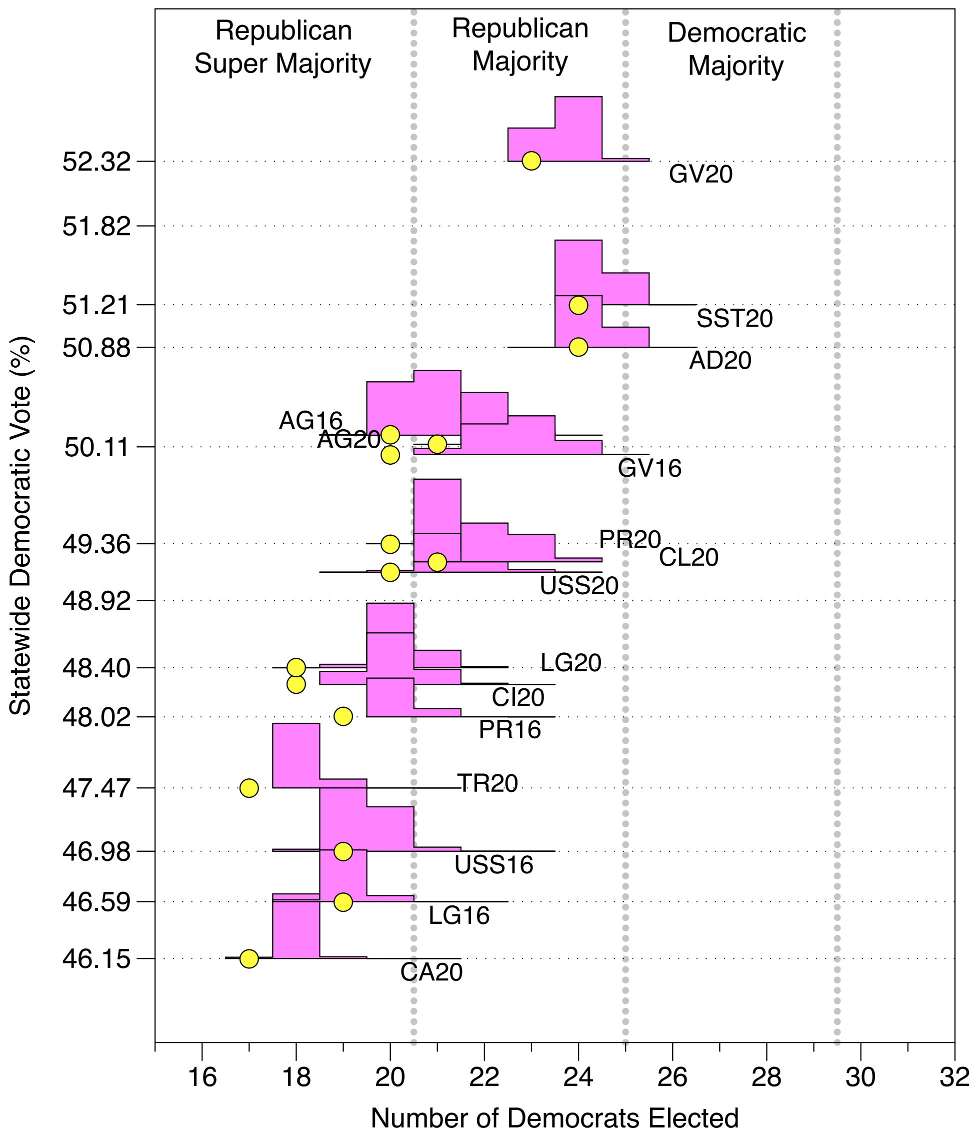


Figure 5.2.6: The Collected Seat Histogram for the Primary Ensemble on the NC Senate with incumbency considerations added. See Figure 5.1.1 for full description.

NC Senate: Secondary Distribution

When municipal preservation is not prioritized, the enacted plan becomes an outlier in all but the two most Republican elections as shown in Figure 5.2.7. Additionally, in most cases it was an extreme outlier when municipal preservation is not considered.

In other words, when municipal preservation is not prioritized, the ensemble produced is more favorable to the Democrats, meaning that the enacted plan appears as an extreme outlier in more situations than in the ensemble that matched the enacted map in prioritizing municipality. Put differently, the decision to prioritize municipality preservation in the Senate plan appears to have enabled more maps that favor Republicans.

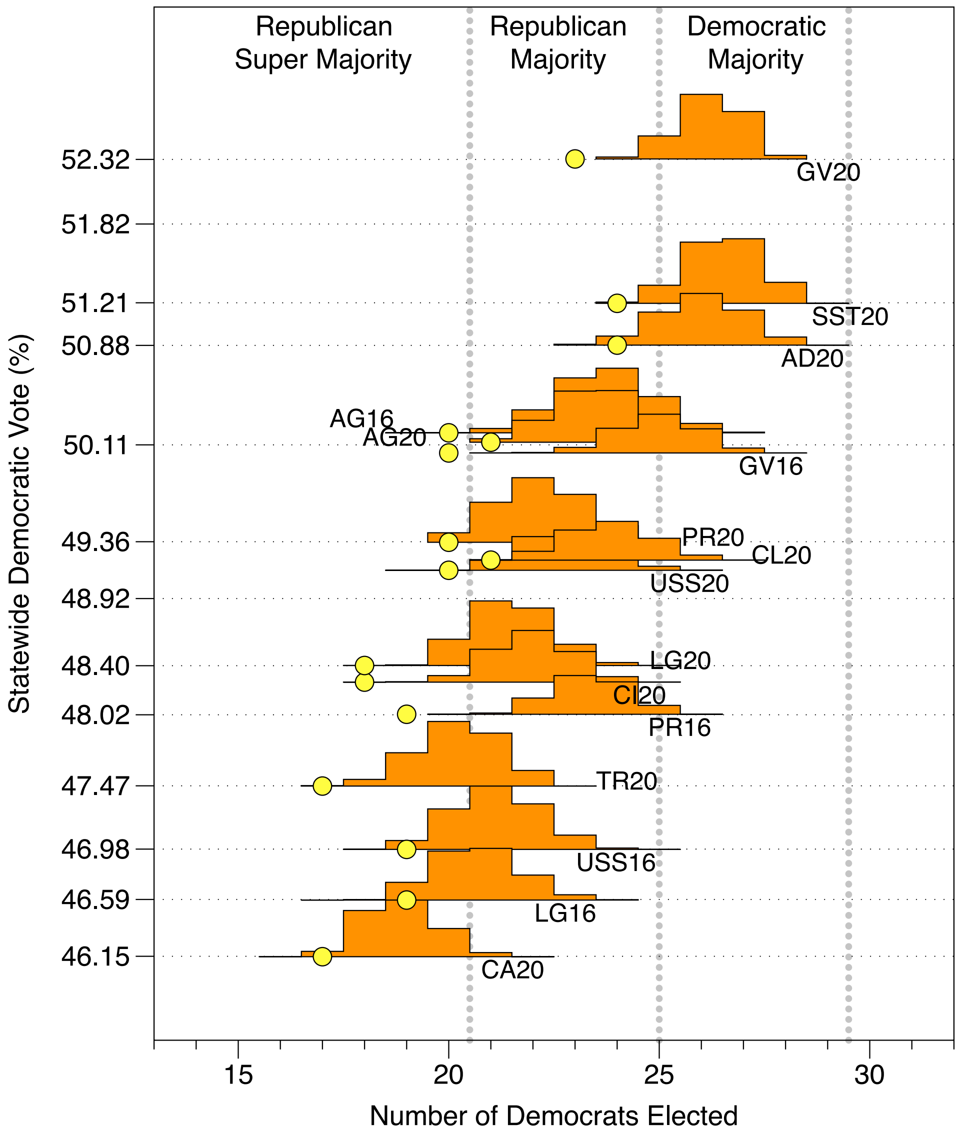


Figure 5.2.7: The Collected Seat Histogram for the Secondary Ensemble on the NC Senate. The Secondary Ensemble for the NC Senate is centered on distributions which do not explicitly consider municipality preservation. See Figure 5.1.1 for full description.

6 State Legislature: Selected Cluster by Cluster Analysis

Using the same tools, we now turn our analysis to the individual cluster. We find that a number of cluster demonstrate significate cracking and packing. In some cases this leads to changes in the partisan make of the representative typically elected from the region. In other cases, it makes the districts insensitive to changes in the voters political outlook as expressed in their votes.

6.1 NC State House

6.1.1 Mecklenburg

The ranked ordered histogram for the Mecklenburg cluster using the primary ensemble (which matches the number of people displaced from municipalities) is given in Figure 6.1.1. Across all of the voting patterns considered, we see that the two most Republican Districts (districts 98 and 103) have exceptionally few Democrats. This has the effect of making them more likely to elect a Republican when many (and often almost all) ensemble plans elect a Democrat in those districts. Specifically, that is the case under LG20, AG20, USS20, CL20, AD20 and SST20. Under GV20 and PR20, the two most Republican districts barely elect Democrats even though the majority of the ensemble plans safely elect Democrats. Under CA20 and TR20, the enacted plan safely elects two Republicans while under the ensemble the races are much closer, swinging in both directions under different plans. In these two elections, the enacted map elects a third Republican (in District 104) when the ensemble of maps typically would not. All of this is achieved by packing exceptionally many Democrats into the 6th through 9th most Democrat district, as shown in Figure 6.1.1 where the enacted plan is consistently at the extreme top of the range seen in the ensemble. All of these facts make the plan an extreme outlier in this cluster.

In fact, ranging over all of the elections considered, the Democratic fraction in the four most republican districts in the ensemble is greater than that in the enacted plan in less than 1.7% of the plans with it dipping as low as around 0.5% in a few cases. More dramatically, the percentage of plans in the ensemble where the fraction of Democrats, in the four most Democratic districts, is always less than 0.11% with it often dipping as low as 0.02% or lower.

As already discussed, it was possible to oust many less people from municipalities than the enacted plan does. Figure 6.1.2 shows the secondary ensemble which constrains municipalities much more strongly. We seen that structures highlighted above persist in this ensemble; again making the enacted map an extreme outlier.

Municipal Splits and Ousted Population: In Figure 6.1.3, we see that the enacted plan ousts people from municipalities at a number that is comparable to the primary ensemble but typically more than the Secondary House ensemble.

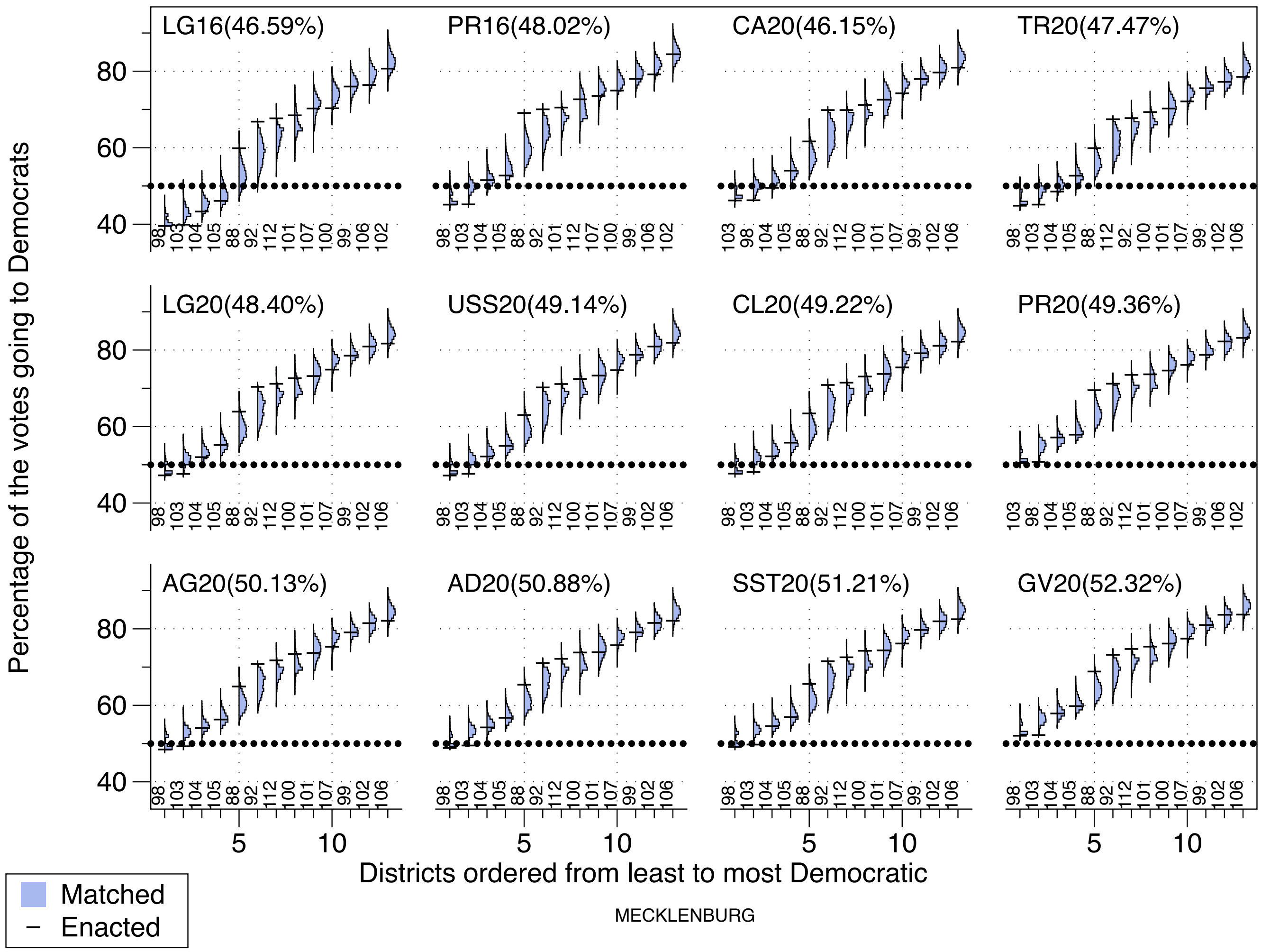


Figure 6.1.1: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

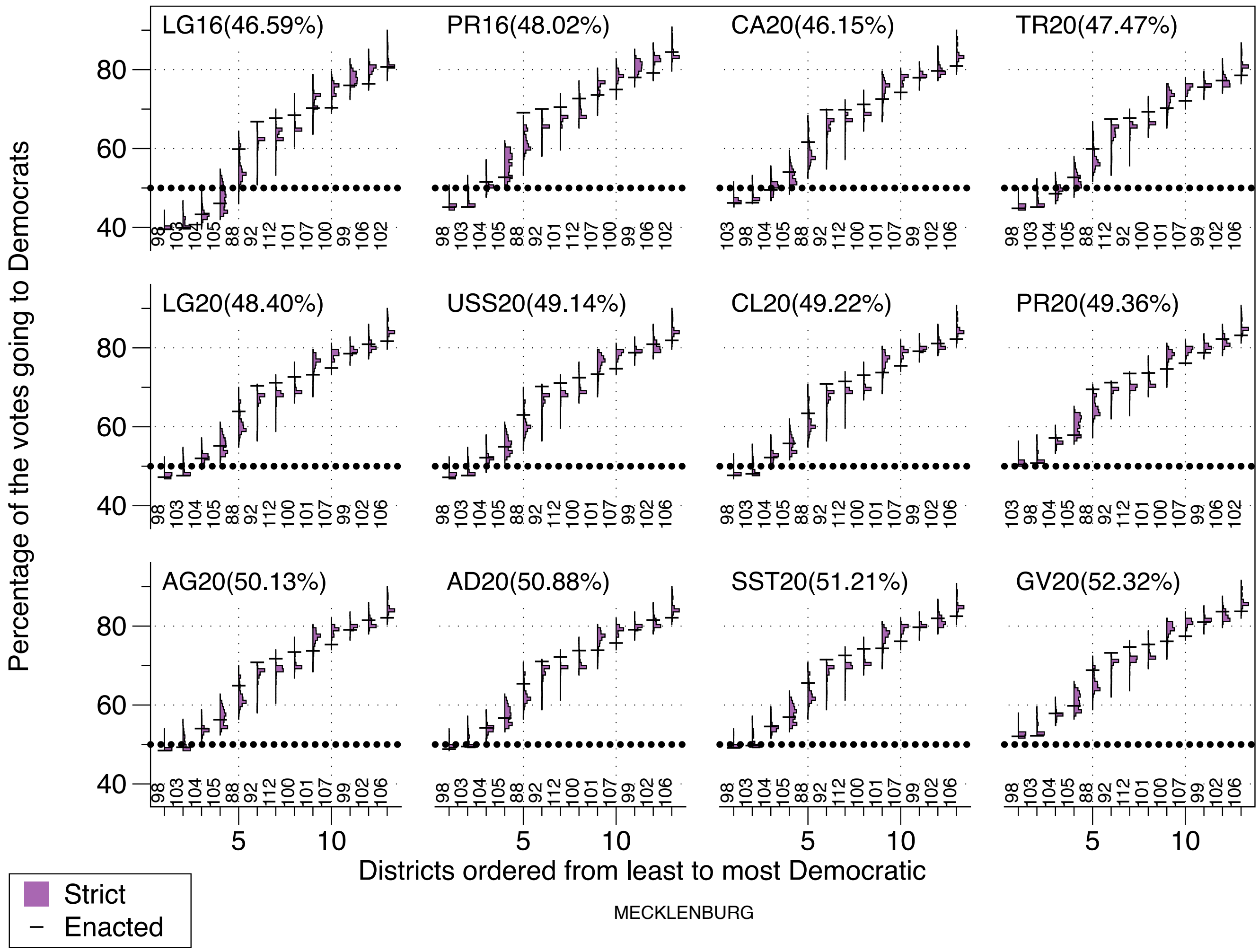


Figure 6.1.2: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

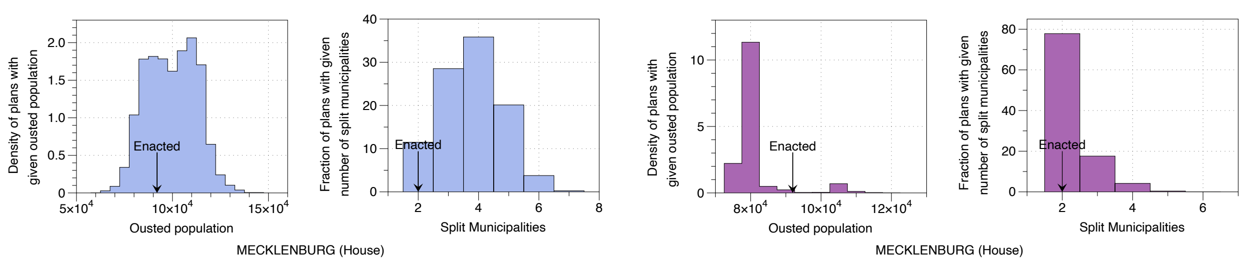


Figure 6.1.3: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.2 Wake

In the Wake cluster, we again see the depleting of Democrats from the two most Republican districts (Districts 37 and 35) while packing Democrats into the next several districts, as in the Mecklenburg cluster. The effect is to swing the two most Republican districts into play in elections where they would not be under the ensemble. Furthermore, the enacted plan makes them safer for Republicans in situations when the ensemble maps would typically have it as a toss-up.

Across all of the elections considered, the number of maps in the ensemble which have a lower Democratic vote fraction in the two most Republican districts than in the enacted plan is less than 0.42% except for the CA20 election where it is 1.2%.

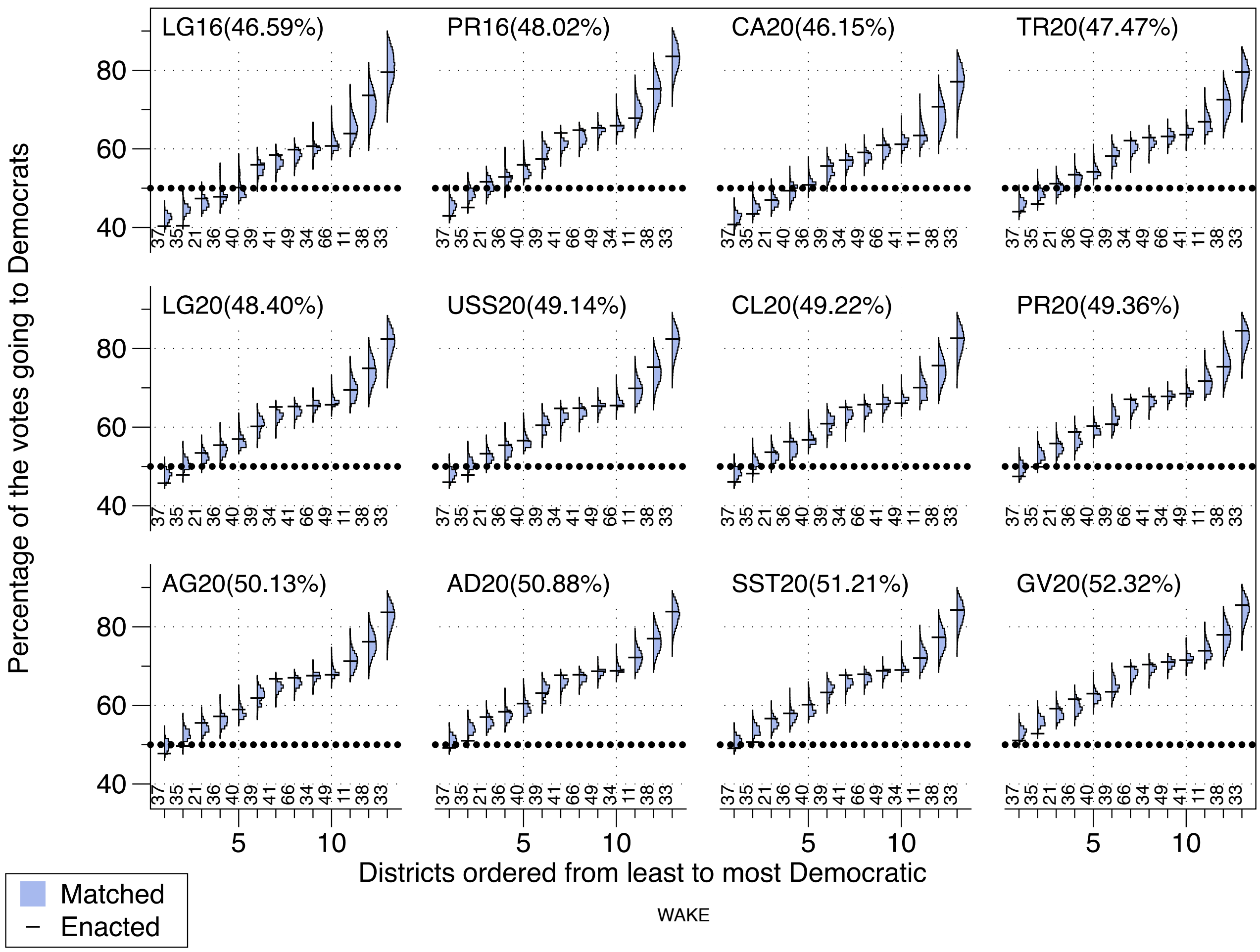


Figure 6.1.4: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

As shown in Figure 6.1.5, the trend continues under the secondary ensemble which better preserves municipalities.

Municipal Splits and Ousted Population:

In Wake we see from Figure 6.1.6 that the enacted plan consistently ousts more people than the primary ensemble and significantly more than the secondary ensemble.

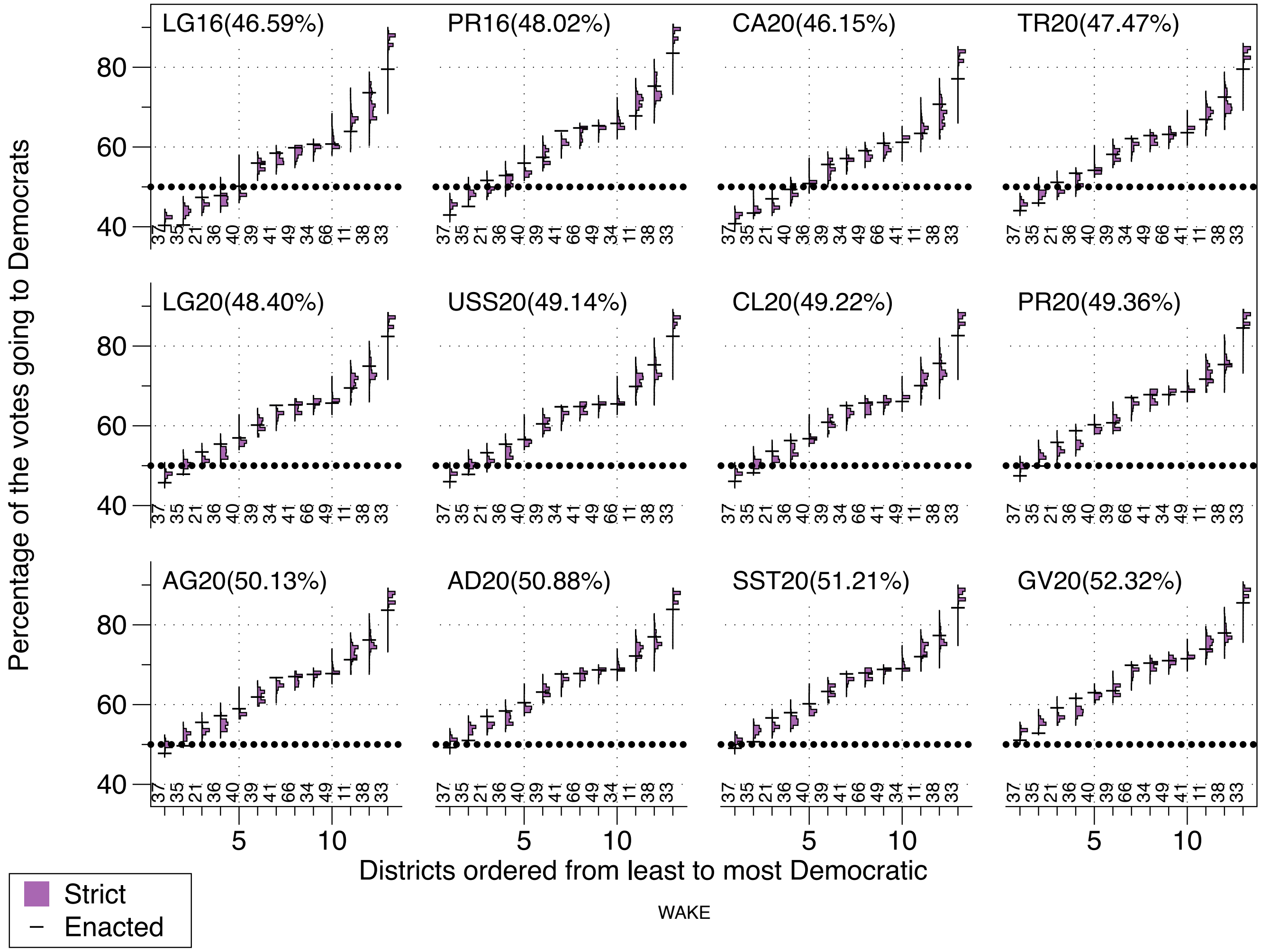


Figure 6.1.5: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

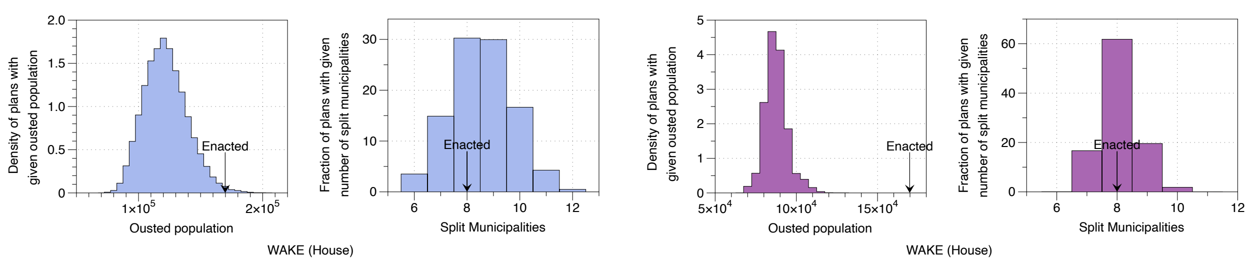


Figure 6.1.6: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.3 Forsyth-Stokes

Again in Figure 6.1.7, showing the primary ensemble in the Forsyth-Stokes cluster, we see the most Republican districts depleted of Democrats while excess Democrats are packed in safe democratic districts and in the safest Republican district are moved to competitive districts. The effect is apparent in all of the elections, but varies slightly across different voting patterns. In all cases, we see the Democratic makeup of the 3rd most Republican district pulled below the range typically seen in the ensemble often resulting in this district electing a Republican when it would not typically. In the three elections where the 3rd-most Republican district still elects a Democrat (GV20), the map's depletion of Democrats from the second most Republican district is enough to reliably elect a Republican in that district when typically the election would vary between being close and strongly favoring the Democrats.

Ranging over all of the elections considered, less than 0.02% of the plans in the ensemble have a lower Democratic fraction in the three most Republican districts than the enacted plan signaling extreme cracking. Additionally, less than 1.3% of the plans in the ensemble have a larger Democratic in the two most Democratic districts than the enacted plan.

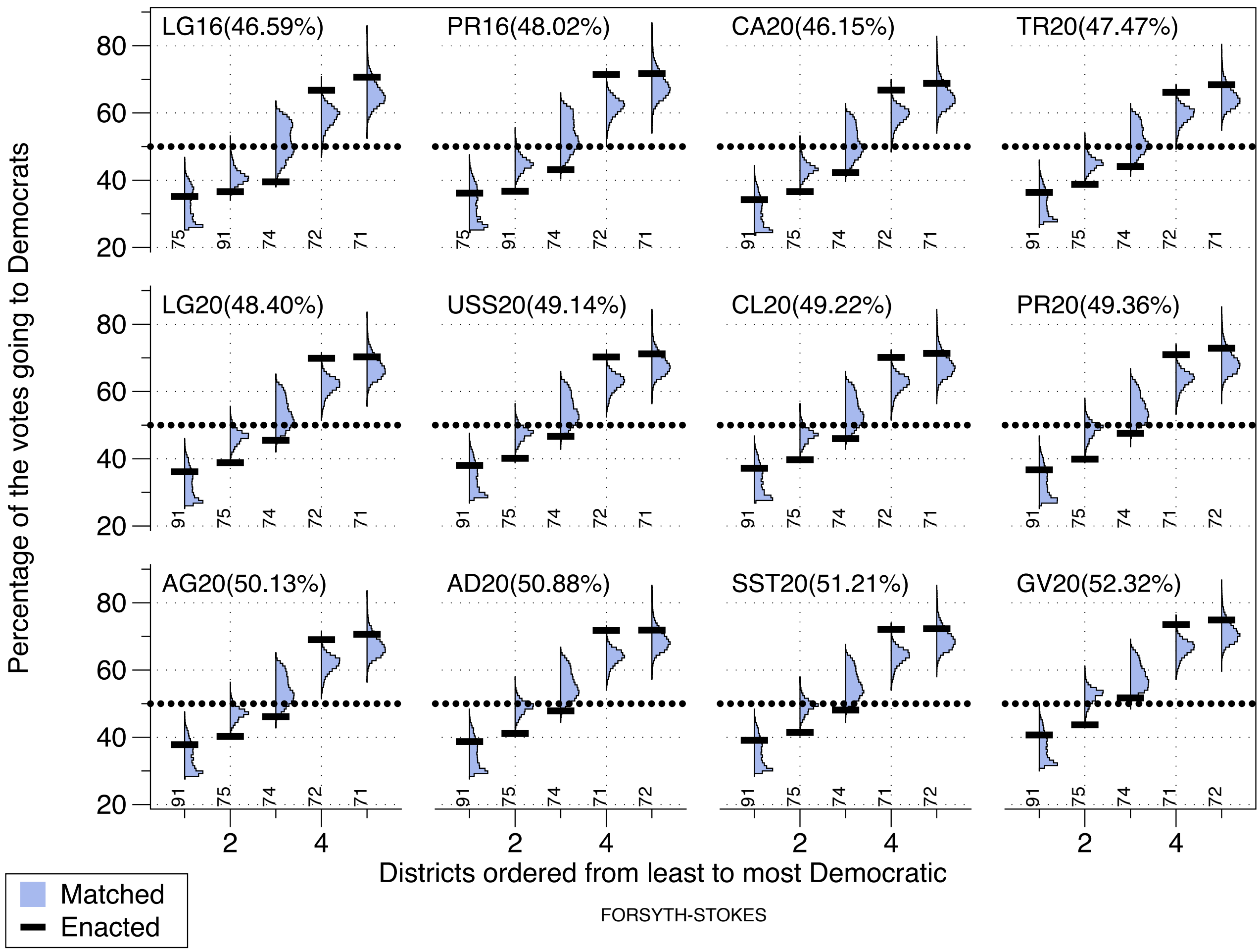


Figure 6.1.7: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

As shown in Figure 6.1.8, the trend continues under the secondary ensemble which better preserves municipalities. Some of the effects are more extreme and in this cluster, this ensemble leads to more partisan districts. Nonetheless, the enacted map still regularly elects a Republican in the third most Republican district even thought it is typically more firmly Democratic under this ensemble.

Municipal Splits and Ousted Population:

From Figure 6.1.9, we see that in Forsyth-Stokes the enacted plan ousts a number of people comparable to the primary ensemble but consistently more than the secondary ensemble.

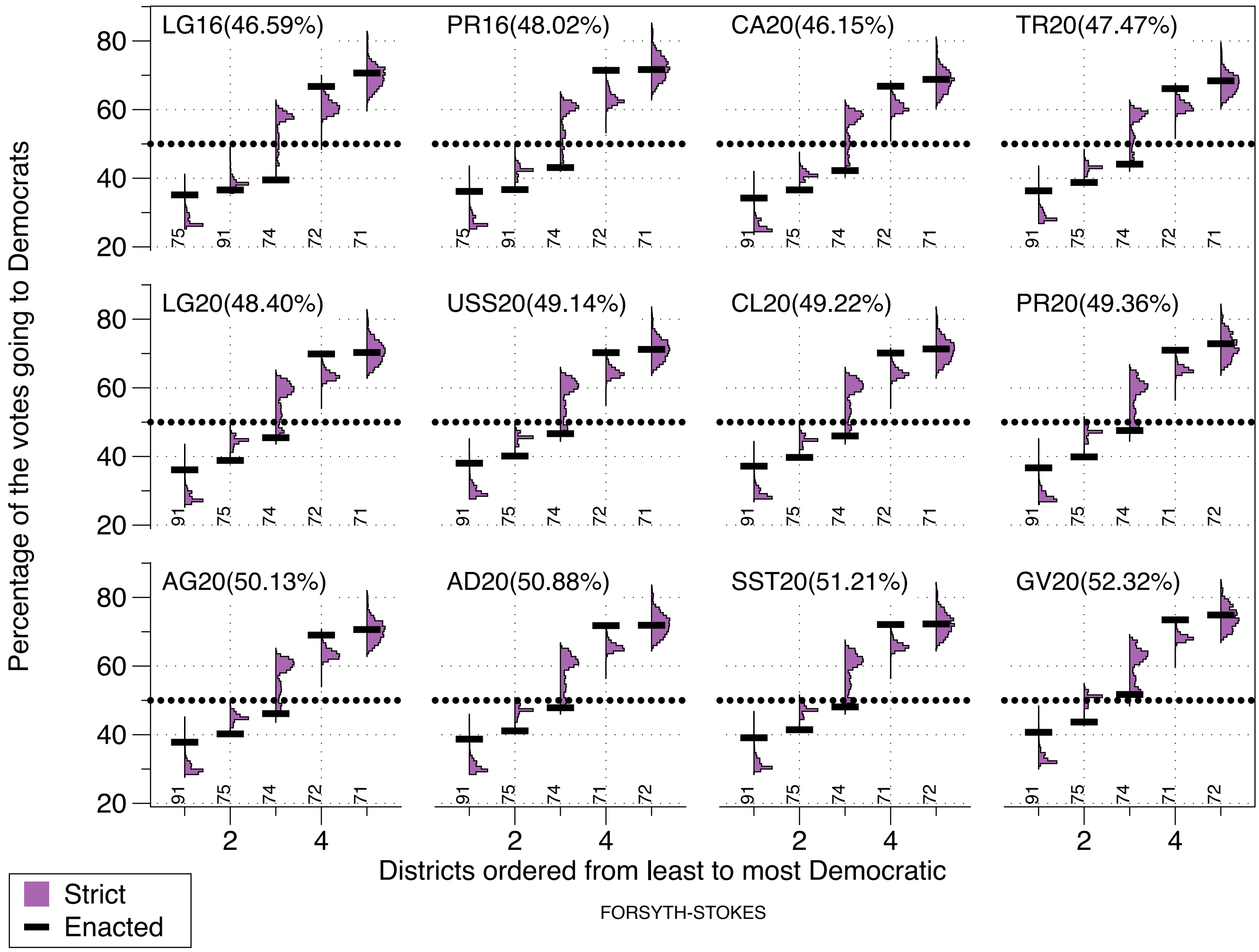


Figure 6.1.8: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

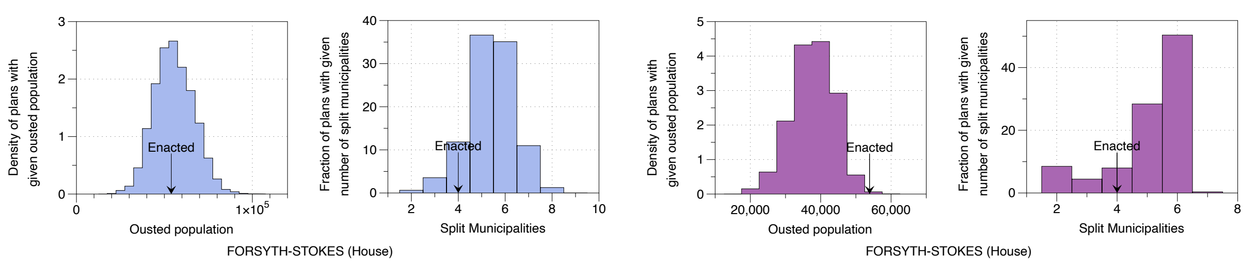


Figure 6.1.9: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.4 Guilford

The pattern seen previously is again repeated in an extreme fashion in the Guilford County. The two most Republican Districts (districts 59 and 62) have abnormally few Democrats when compared to what is seen in the primary ensemble and the more Democratic districts (numbered 57, 58, 60, and 61) have exceptionally many Democrats packed into them. The effect is that the enacted plan regularly (and often safely) elects two Republicans under election climates which would rarely or never do so.

Over all of the elections considered and all of the around 80,000 plans in the ensemble, none of the plans have a higher Democratic fraction in the four most Democratic districts or a lower Democratic fraction in the two most Republican districts, in comparison to the enacted plan. . In other words, this cluster shows more cracking and packing of Democrats than every single plan in the nonpartisan ensemble.

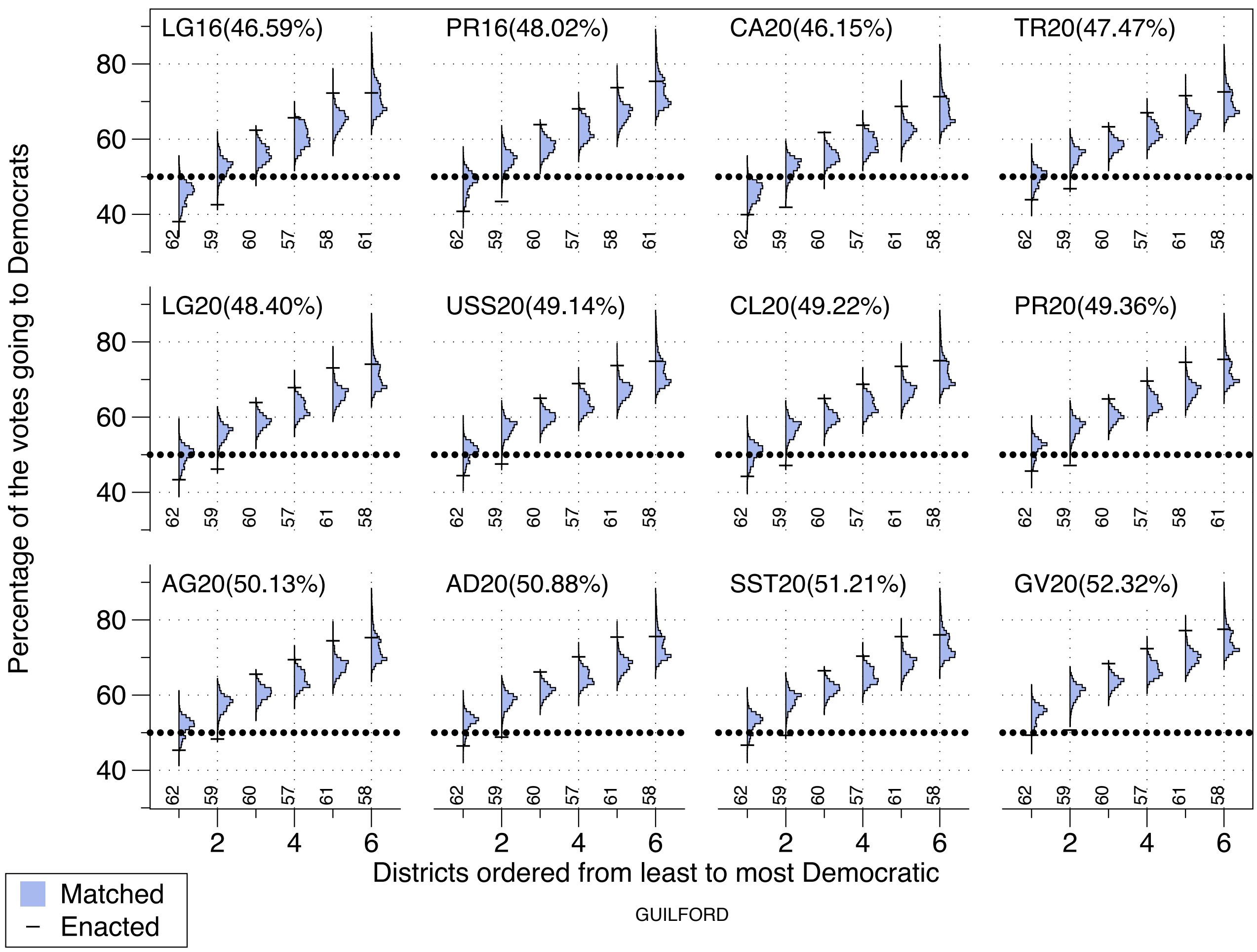


Figure 6.1.10: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

In Figure 6.1.11, we see the effect of considering the the ensemble that more strongly preserves municipalities than the enacted plan. The ensemble reliably has four democratic districts and a 5th which typically leans Republican but sometimes is competitive. Yet, the enacted plan gives one clearly Republican district and one which is often safely Republican and at times competitive.

Municipal Splits and Ousted Population: From Figure 6.1.12, we see that in Guilford the enacted plan ousts a number of people comparable to the primary ensemble but constantly more than the secondary ensemble.

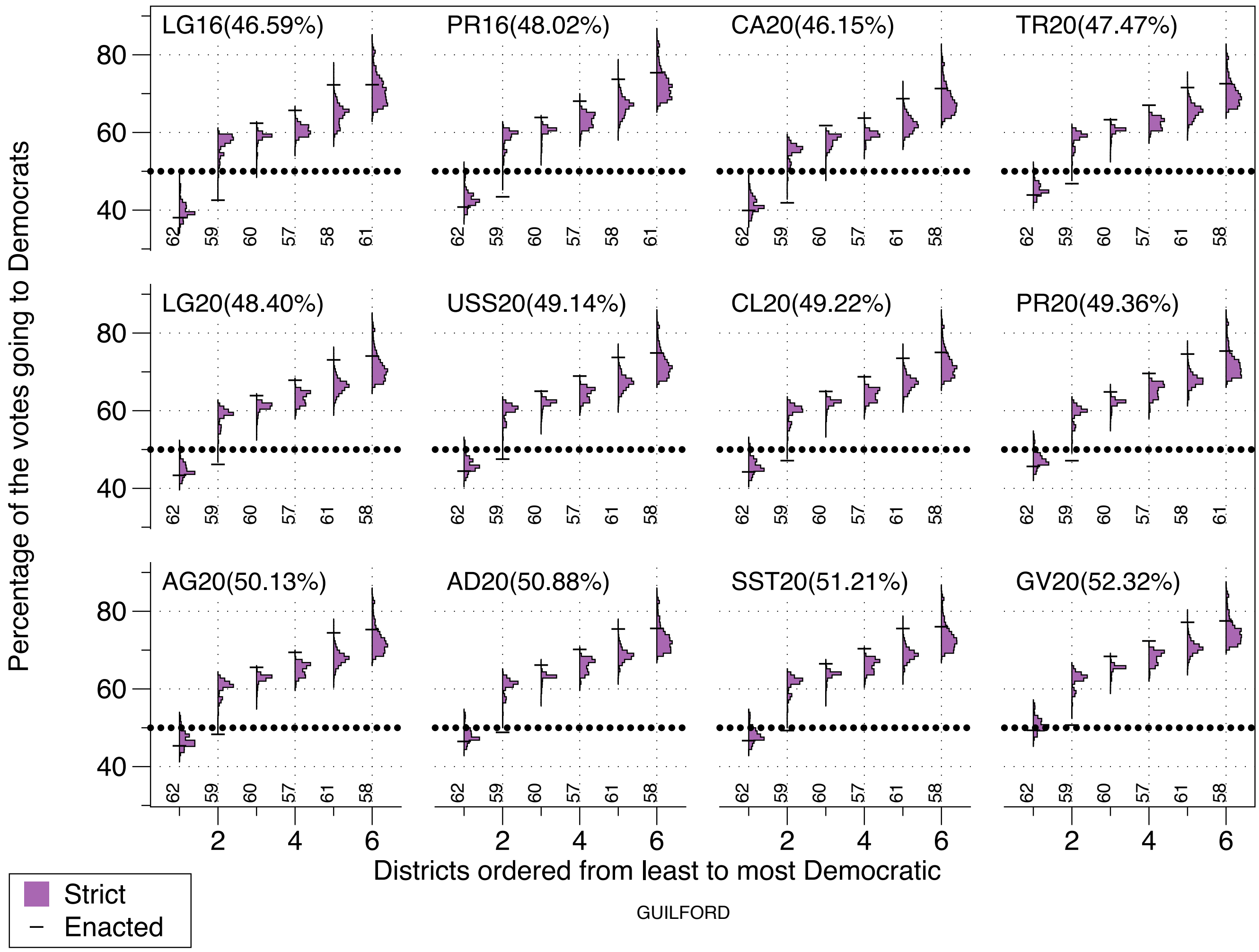


Figure 6.1.11: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The “ – ” on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the “ – ”. This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

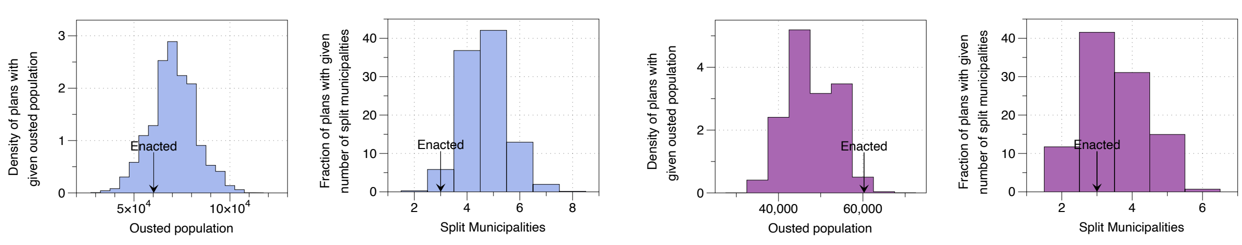


Figure 6.1.12: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.5 Buncombe

As seen in Figure 6.1.13, the primary ensemble shows two Democratic districts with a third typically leaning Democratic but sometimes in play. However, the enacted map produces one district which is typically Republican. This is achieved by packing unusually many Democratic in the most Democratic district (district 114) leaving abnormally few Democrats for the most Republican district (district 116).

Ranging over the elections considered, at most 1.2% of the plans in the ensemble have a lower democratic fraction in the most Republican district in the ensemble than the enacted plan does. The percentage of plans with a larger Democratic fraction in the most Democratic district in the ensemble fluctuates around 5%.

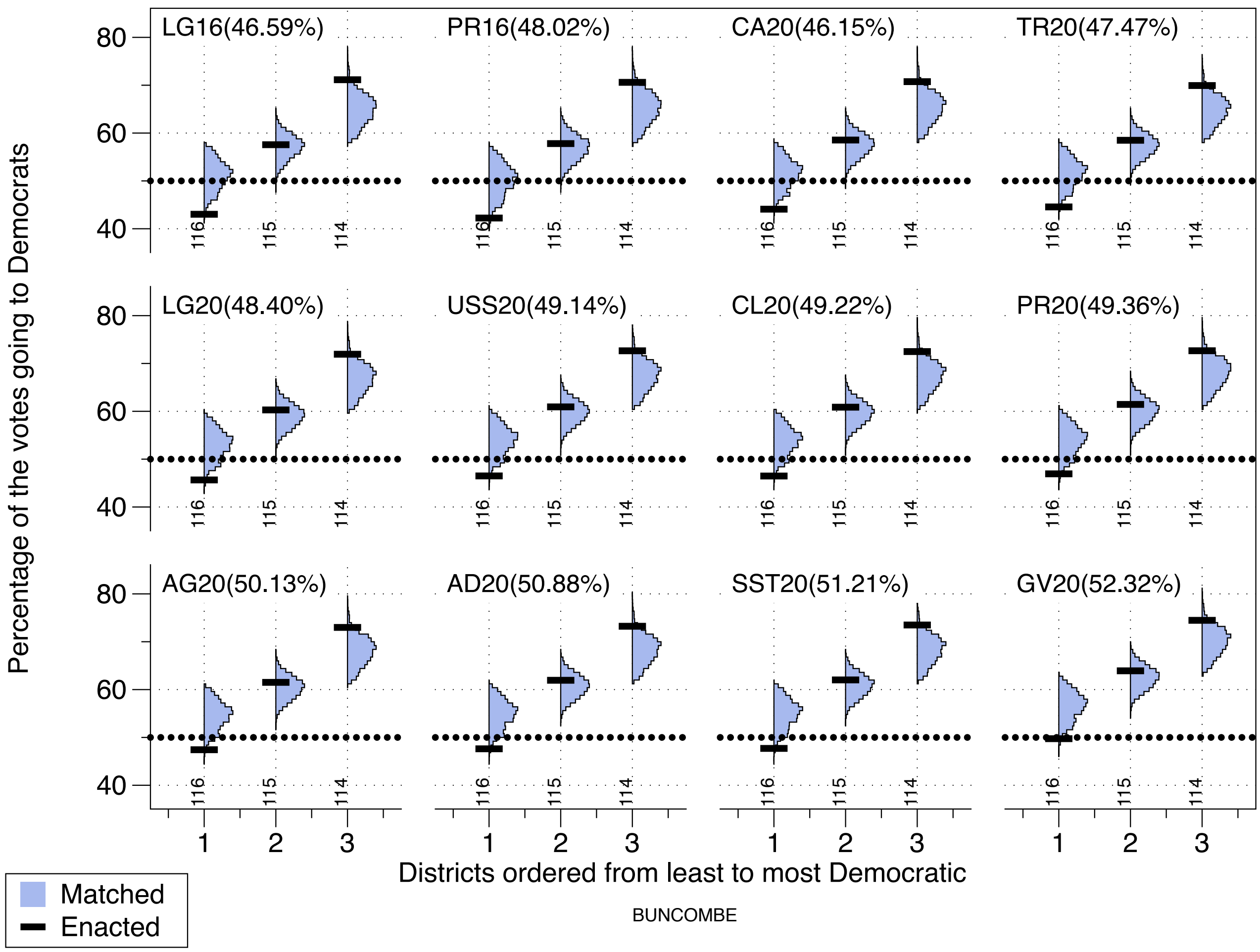


Figure 6.1.13: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

The same pattern of depleting Democrats from the most republican district so that it often elects a Republican when it typically would not under the ensemble is again seen in Figure 6.1.14 which shows the results under the secondary ensemble.

Municipal Splits and Ousted Population: From Figure 6.1.15, we see that there is not a lot of difference between the two ensembles in the number of ousted people. Both are comparable to the enacted map.

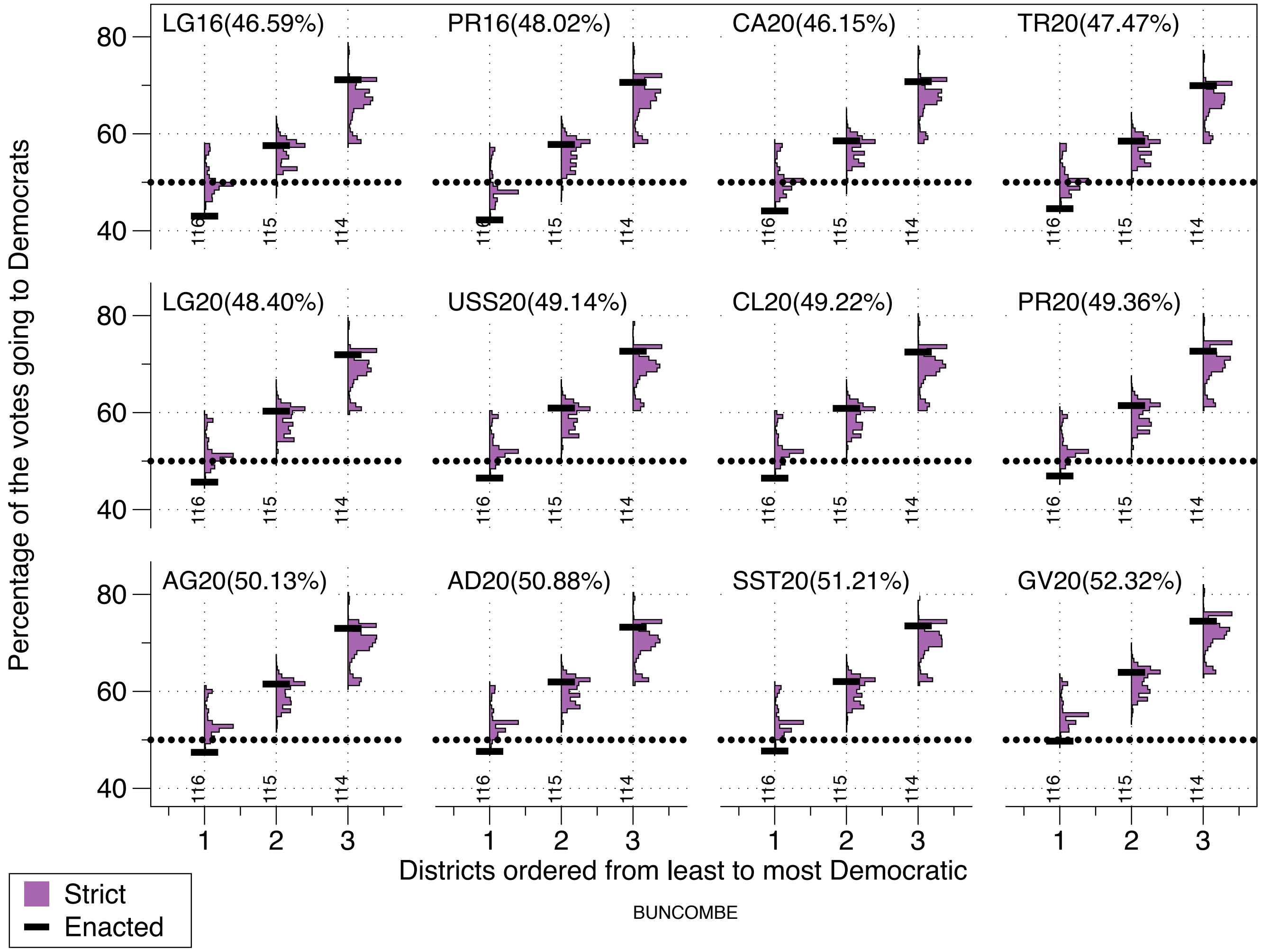


Figure 6.1.14: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

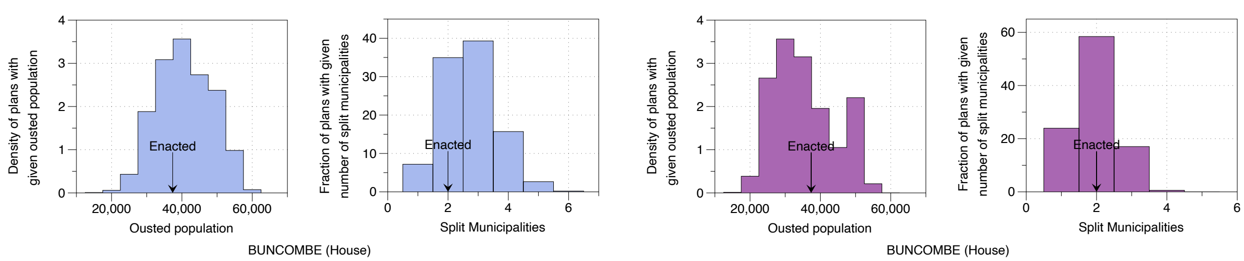


Figure 6.1.15: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.6 Pitt

Pitt County only has two districts. The enacted places atypically many Democrats in the most Democratic district (district 8) while placing atypically few in the most Republican district (district 9). This maximizes the chance that the second district will elect a republican. In many cases, it does when many of the ensemble maps would not. By maximizing the difference in the partisan makeup of the two districts, the enacted map minimized the degree to which the enacted map responds to the shifting opinions of the electorate.

Across the elections considered, the percentage of plans in the ensemble which have a higher fraction of Democrats in the most Democratic district than the enacted plan fluctuates between 1.1% and 5.3%.

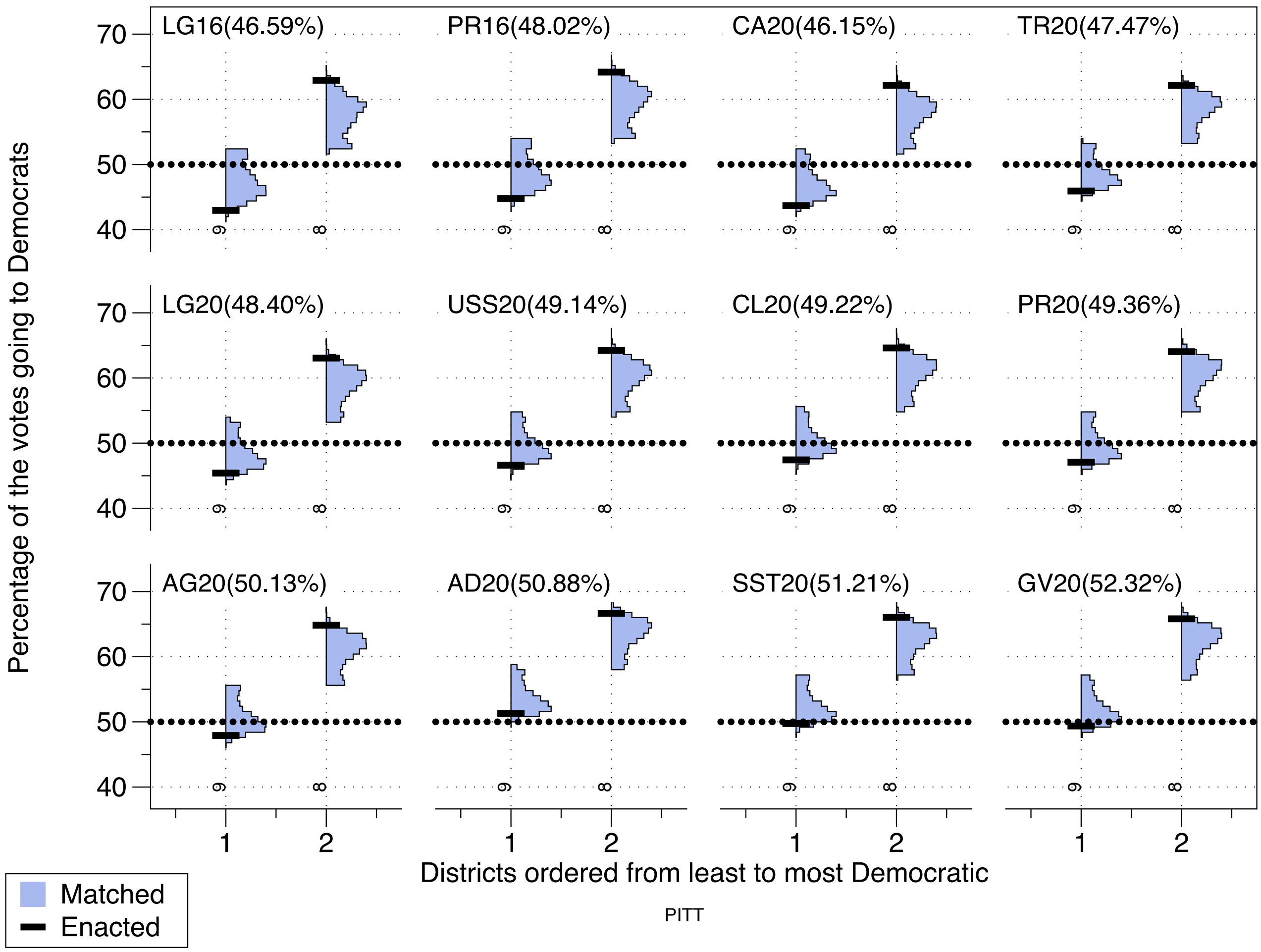


Figure 6.1.16: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

The same pattern is repeated in Figure 6.1.17 which uses the secondary ensemble which better preserves municipalities than the enacted map.

Municipal Splits and Ousted Population: From Figure 6.1.18, we the number of ousted people in the primary ensemble is comparable to the enacted plan but more than the secondary ensemble.

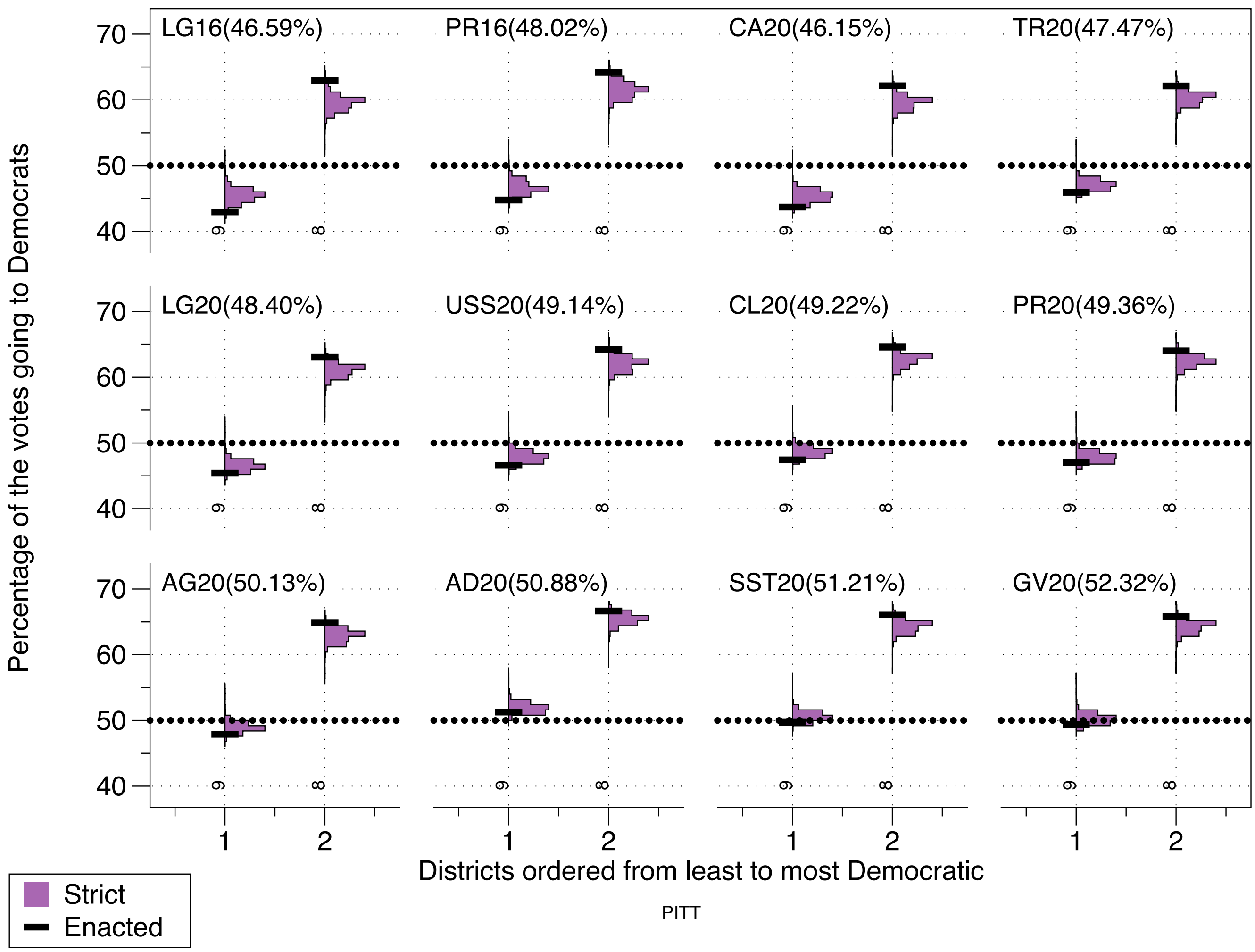


Figure 6.1.17: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

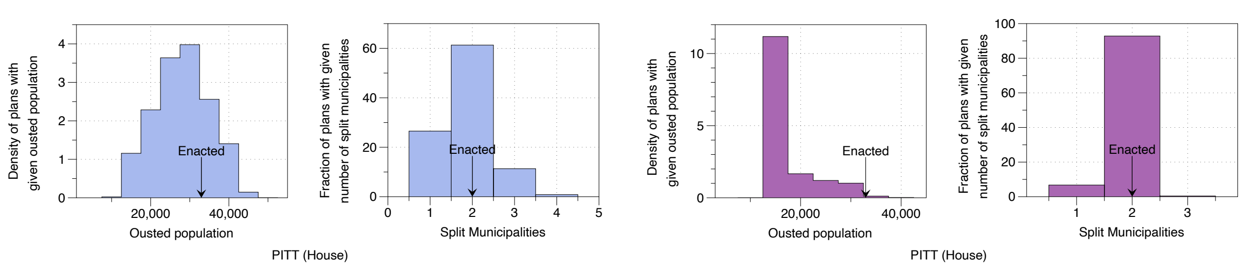


Figure 6.1.18: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.7 Duplin-Wayne

In the Duplin-Wayne county cluster the two districts are safely Republican under the elections considered. The enacted map is typical, falling in the middle of the observed democratic fraction on the Histograms.

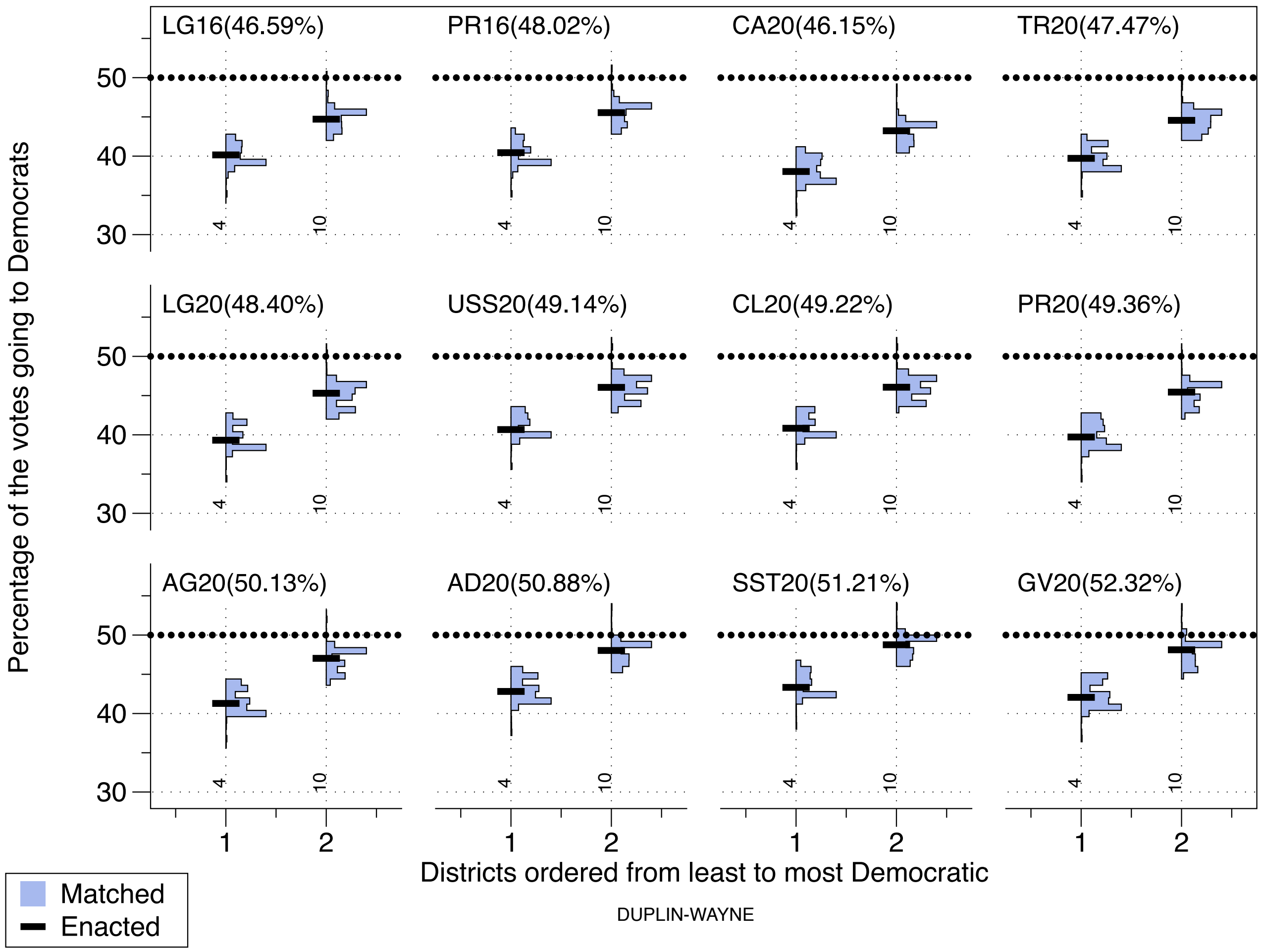


Figure 6.1.19: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

As seen in Figure 6.1.20, the distribution has extremely small variance when municipalities are better preserved. Here there seem to be a little less Democrats in the most Democratic district than typical, but this has little effect as the two districts are firmly Republican and the distribution is highly concentrated.

Municipal Splits and Ousted Population: From Figure 6.1.21, we seen that the number of people ousted by the enacted plan is at the lower end of the typical amounts seen in the Primary ensemble or the secondary ensemble.

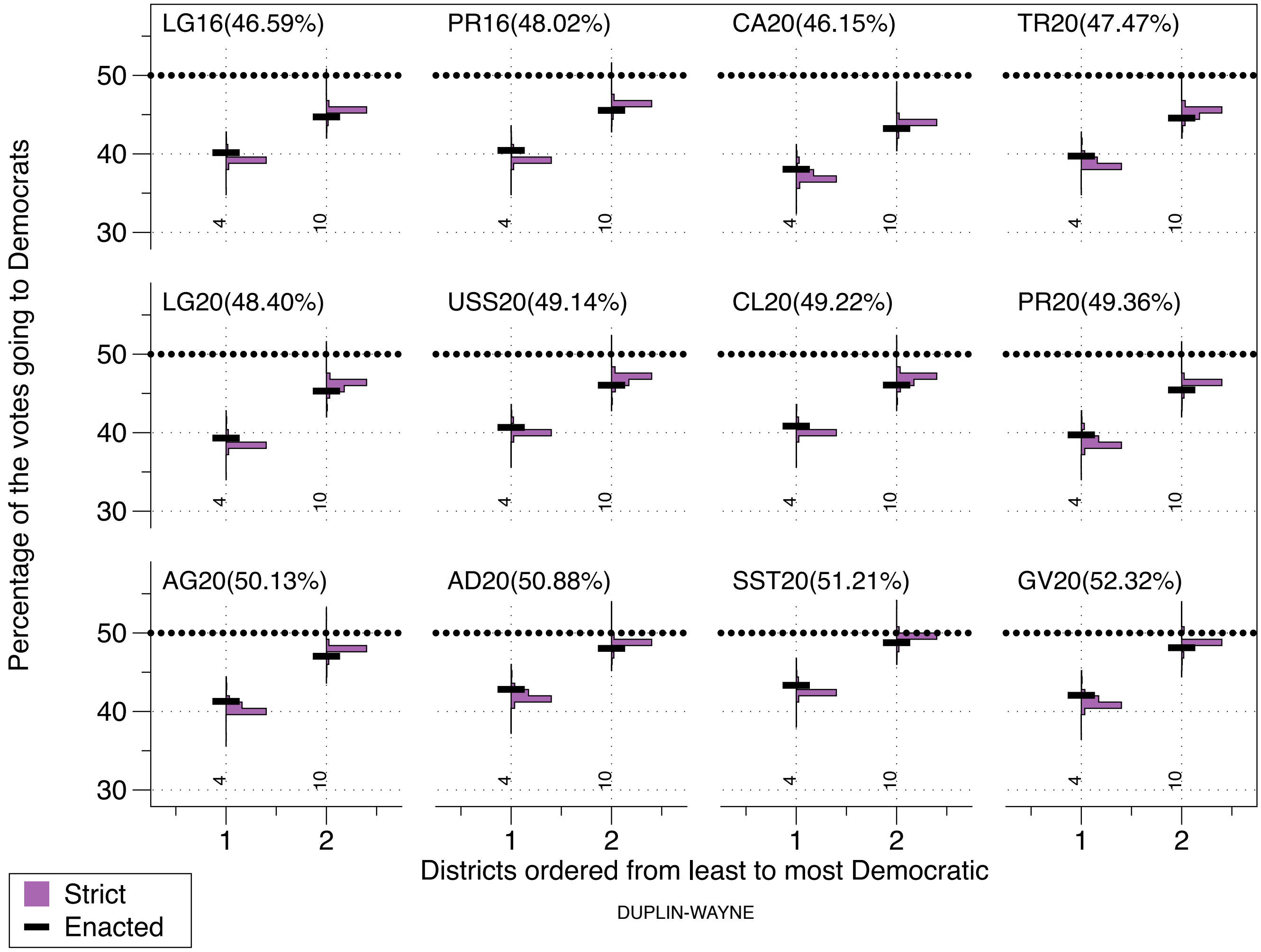


Figure 6.1.20: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

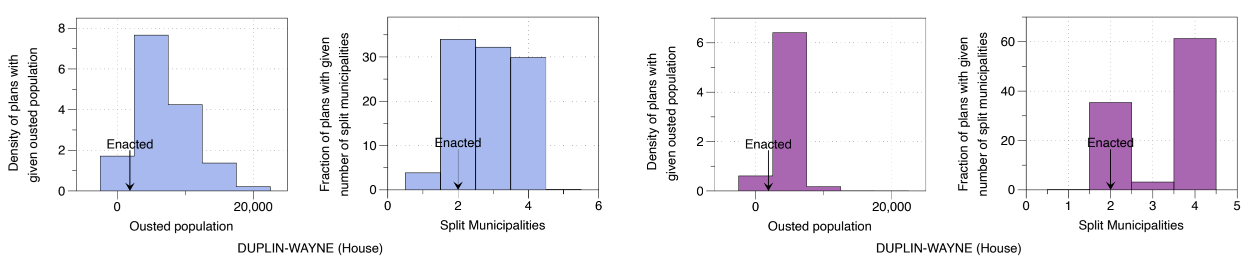


Figure 6.1.21: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.8 Durham-Person

As seen in Figure 6.1.22, under the primary ensemble Durham-Person cluster typically has three exceedingly Democratic districts and one more moderately Democratic district. The enacted plan places abnormally few Democrats in the most Republican district (district 2). This is accomplished by packing more Democrats in the most Democratic districts (districts 29 and 30). The effect is sufficient to pick up a Republican seat in a few elections where the seat typically would have remained democratic according to the non-partisan primary ensemble.

Not a single map in the non-partisan ensemble across any of the elections considered has a smaller fraction of Democrats in the most Republican district than the enacted plan does. This signals extreme cracking. In all but two elections the fraction of plans which have a higher Democratic vote fraction than the enacted plan is less than 0.62%. The two exceptions are LG16 (3.5%) and CA20 (1.2%).

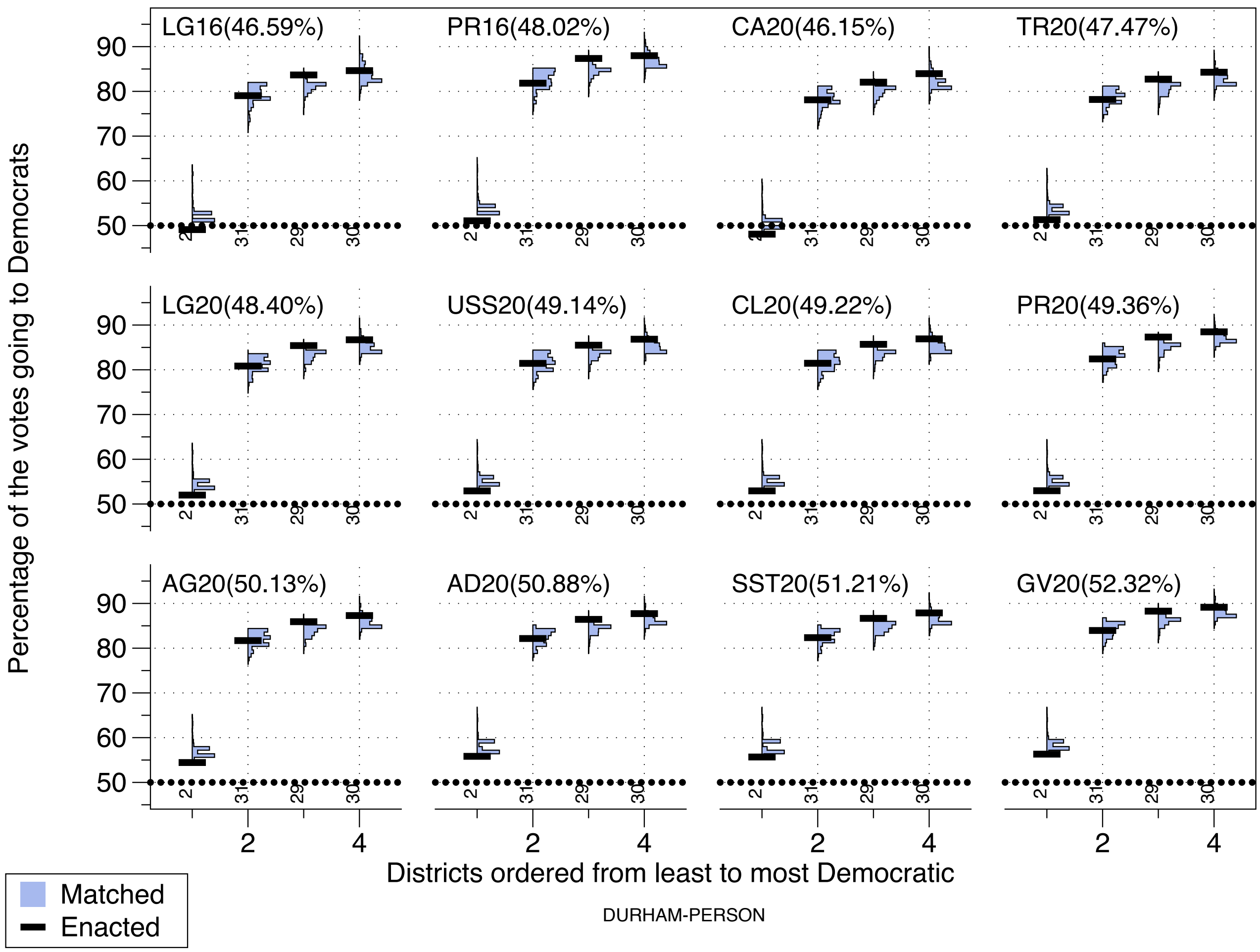


Figure 6.1.22: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

A similar effect is seen in 6.1.23, for the ensemble which better preserves municipalities.

Municipal Splits and Ousted Population:

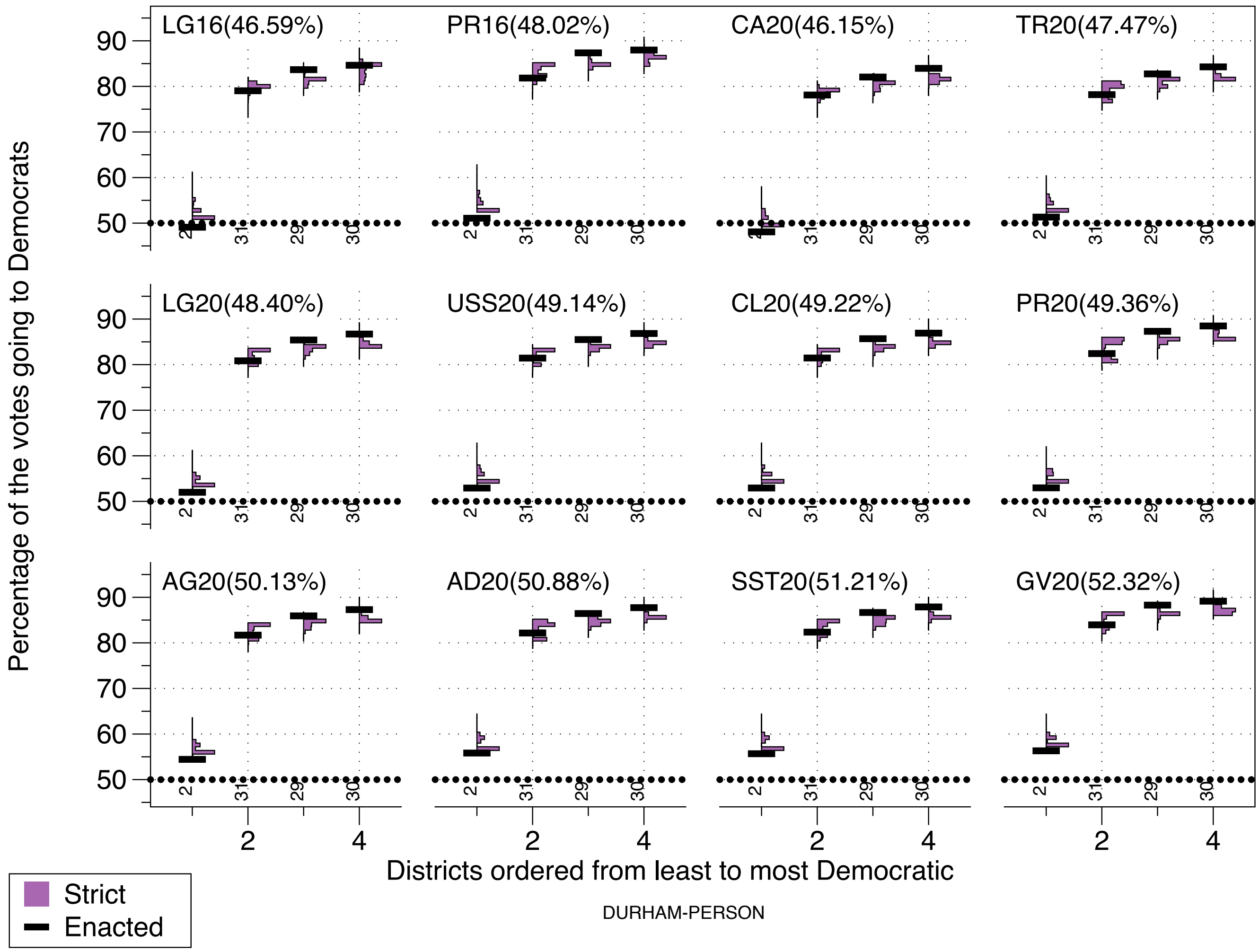


Figure 6.1.23: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

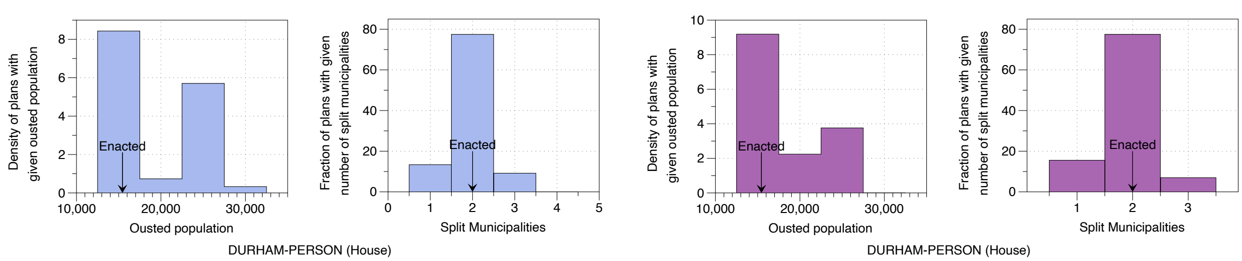


Figure 6.1.24: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.9 Alamance

From Figure 6.1.25, we see that though the enacted map tends have more Democrats in the more Democratic district and less in the less democratic district it not an outlier on its own.

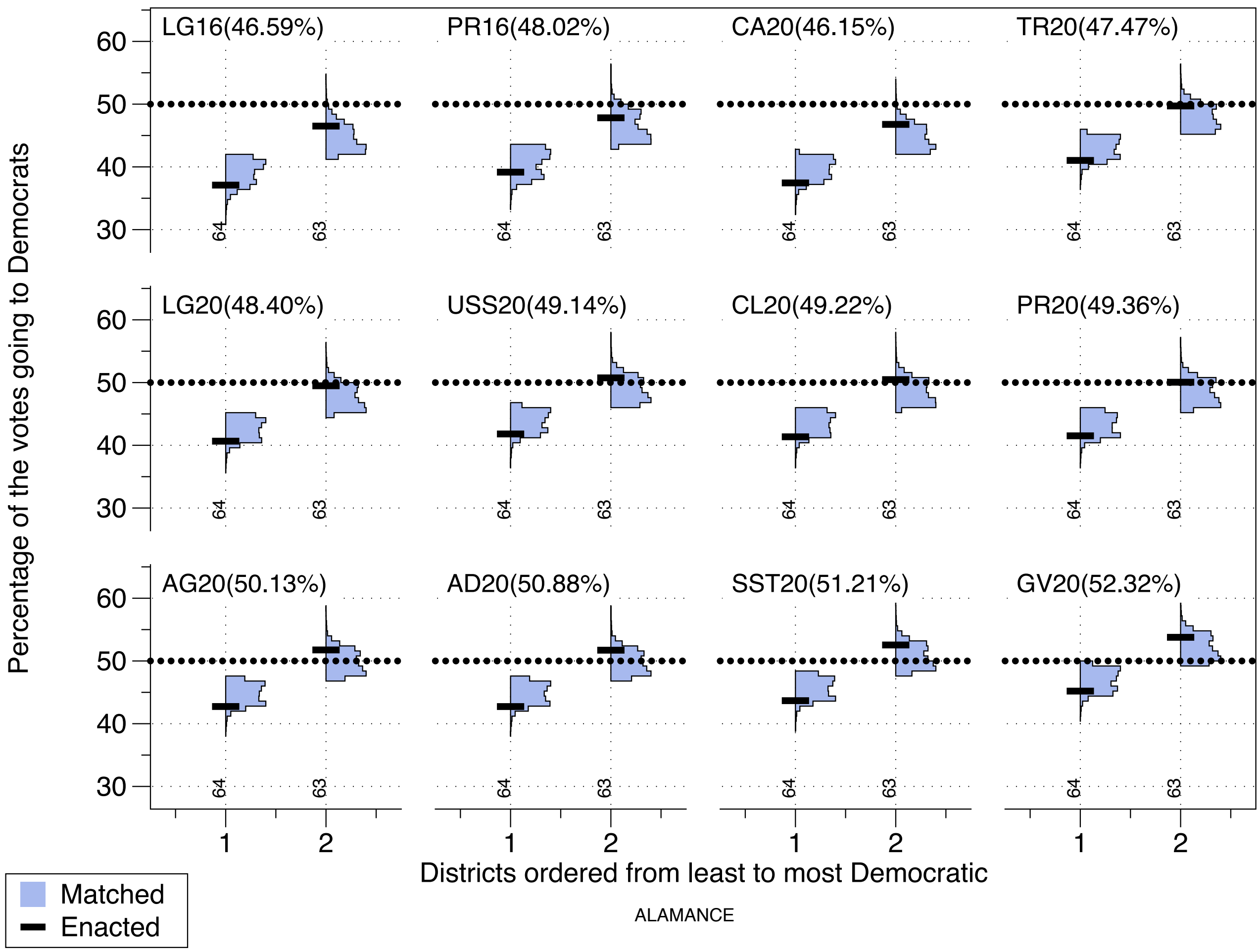


Figure 6.1.25: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

Figure 6.1.26 tells a similar story to Figure 6.1.25,

Municipal Splits and Ousted Population:

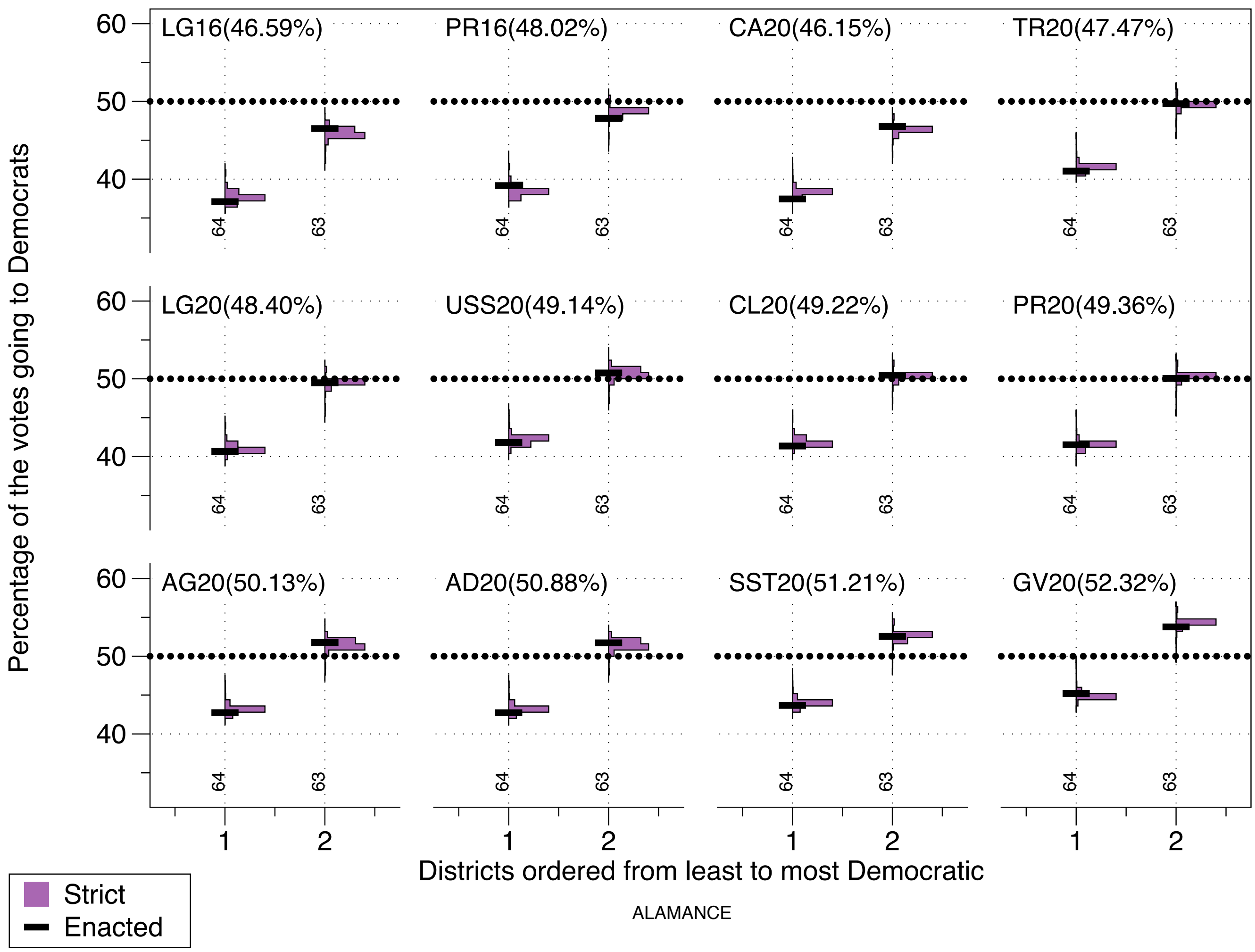


Figure 6.1.26: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

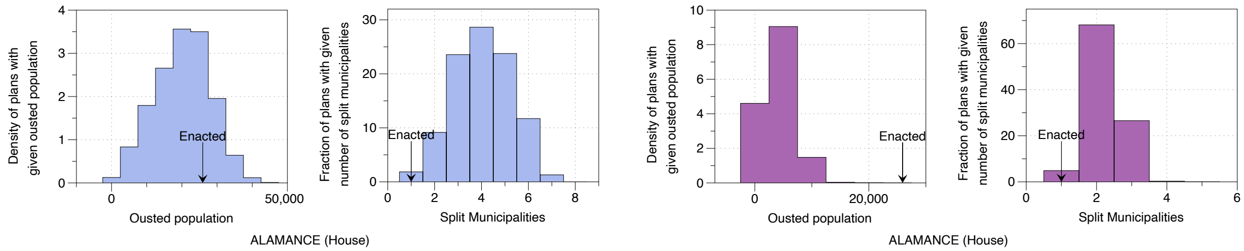


Figure 6.1.27: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.10 Cumberland

Looking at Figure 6.1.28, we again see outlier behavior in Cumberland County. We see that the districts in the enacted plan have been constructed so that the two most Republican districts (district 43 and 45) have a similar partisan makeup. Typically, one is more Democratic and one is more Republican. This is achieved by removing republicans from the most republican district and Democrats from the most democratic two districts. While the effect on the most Republican district individually is within the typical range, the combined effect creates an enacted cluster which is an strong outlier.

For each of the elections considered, the number of plans in the ensemble with smaller fraction of democrats in the second most republican district is typically around 1% with, for a few elections, the percentage reaching as high as 7% or as low as 0.4%.

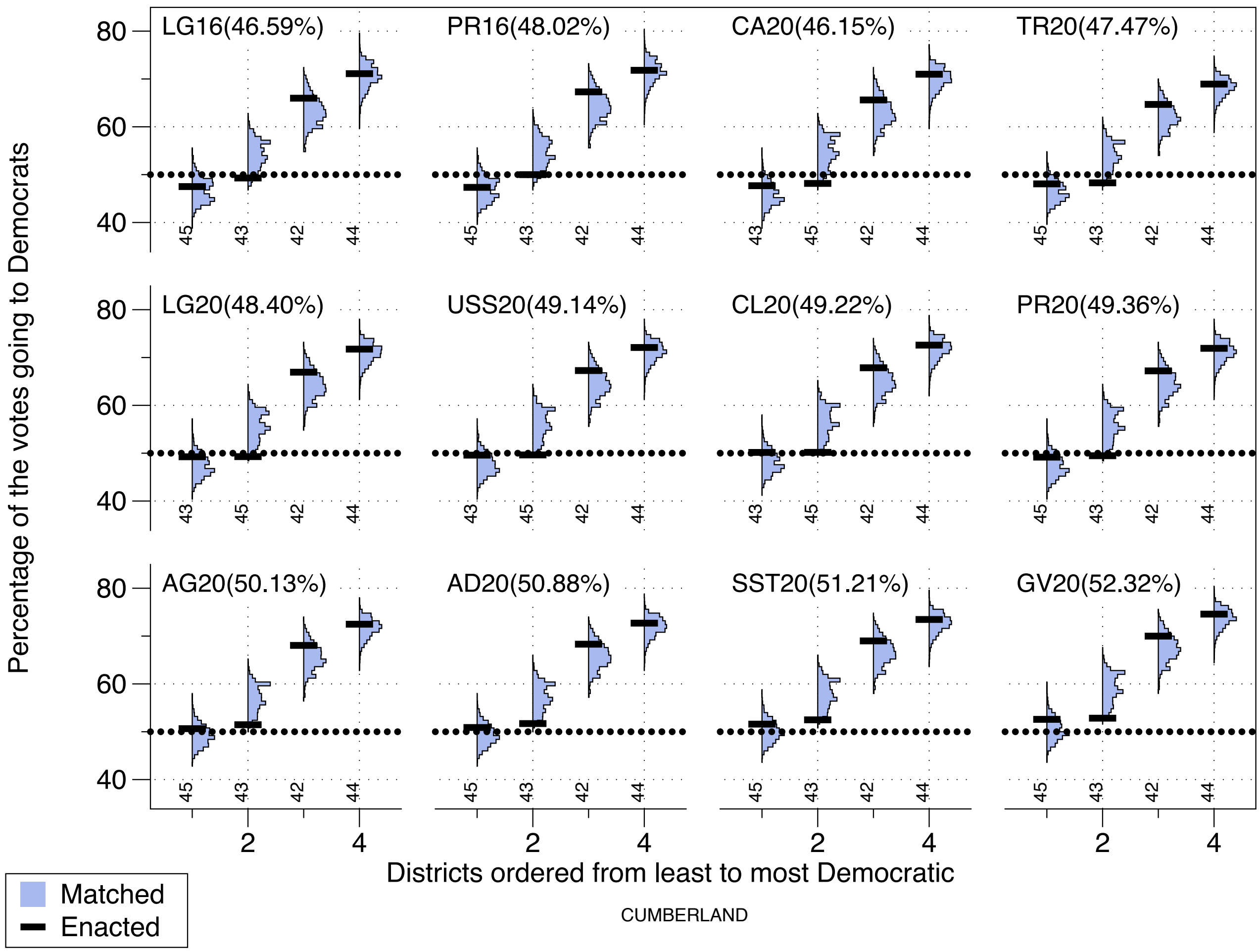


Figure 6.1.28: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

Looking at Figure 6.1.29, we see that the structure of the enacted map is a more extreme outlier for the secondary ensemble which better preserves municipalities. In an ensemble that better preserves municipalities, the most Republican district is typically more republican and the second most Republican district more Democratic. This makes the enacted plan which squeezes the two together with an large outlier.

Municipal Splits and Ousted Population:

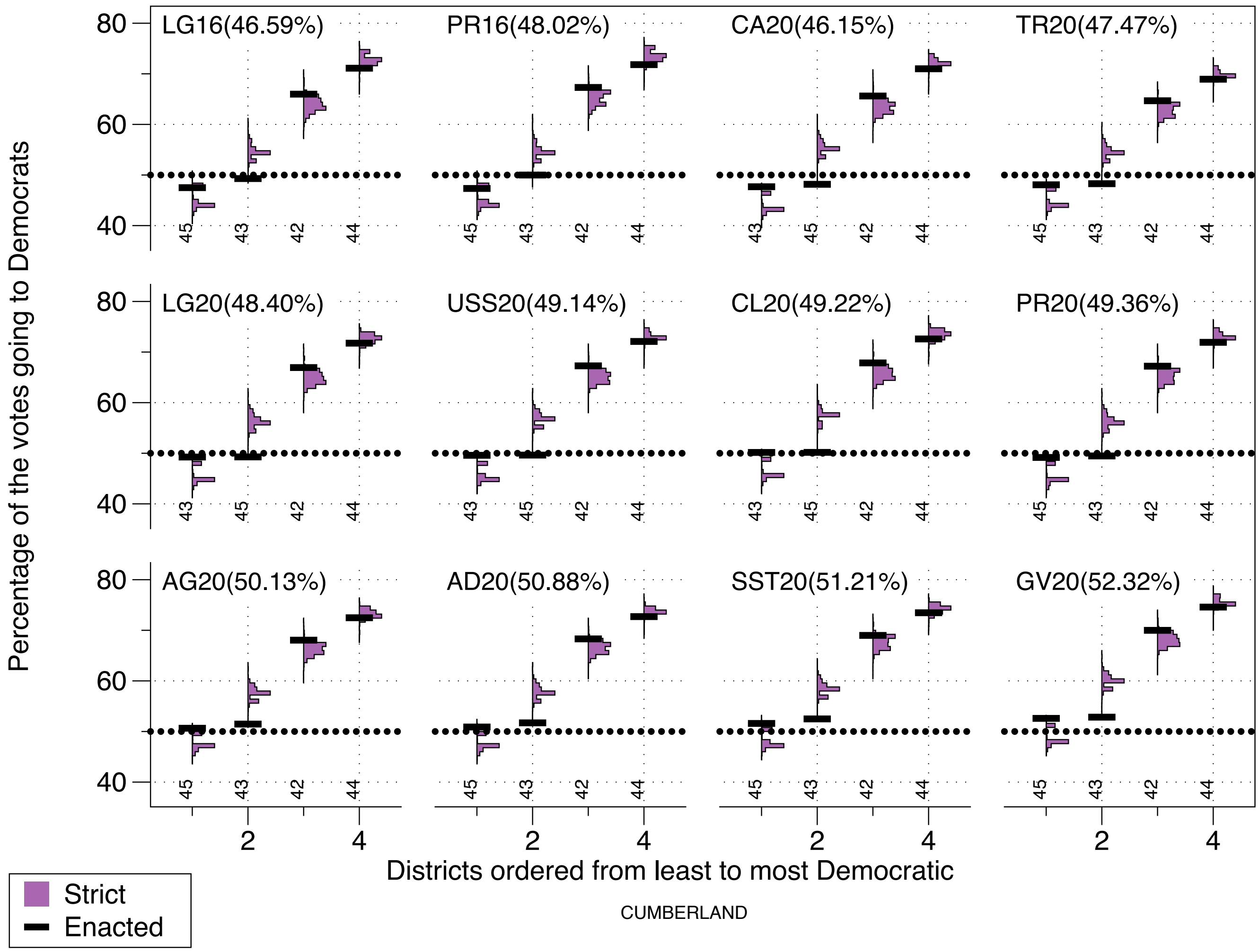


Figure 6.1.29: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

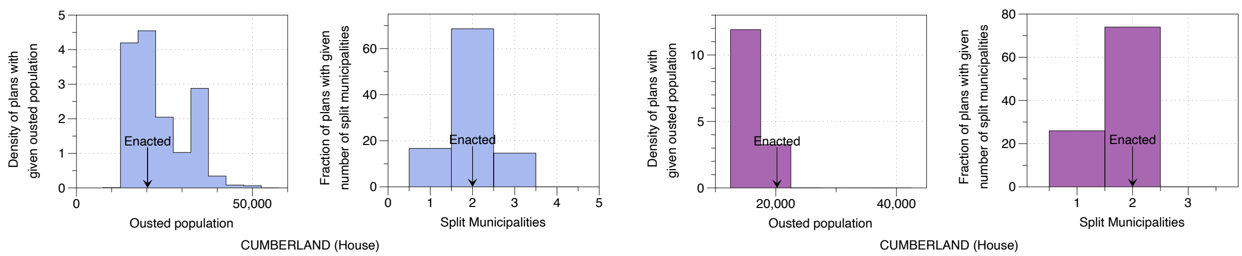


Figure 6.1.30: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.11 Cabarrus-Davie-Rowan-Yadkin

In the Cabarrus-Davie-Rowan-Yadkin county cluster, there are abnormally few Democrats in the most Democratic district (district 82). This is accomplished by placing abnormally many Democrats in the next three most democratic districts (districts 73, 76, and 83 – all of which are safe Republican districts). The effect is to make the most Democratic district a relatively reliable Republican seat (being won by the Republicans in all of the elections considered). Under the ensemble, it would switch parties in a number of the elections and regularly be a close contest.

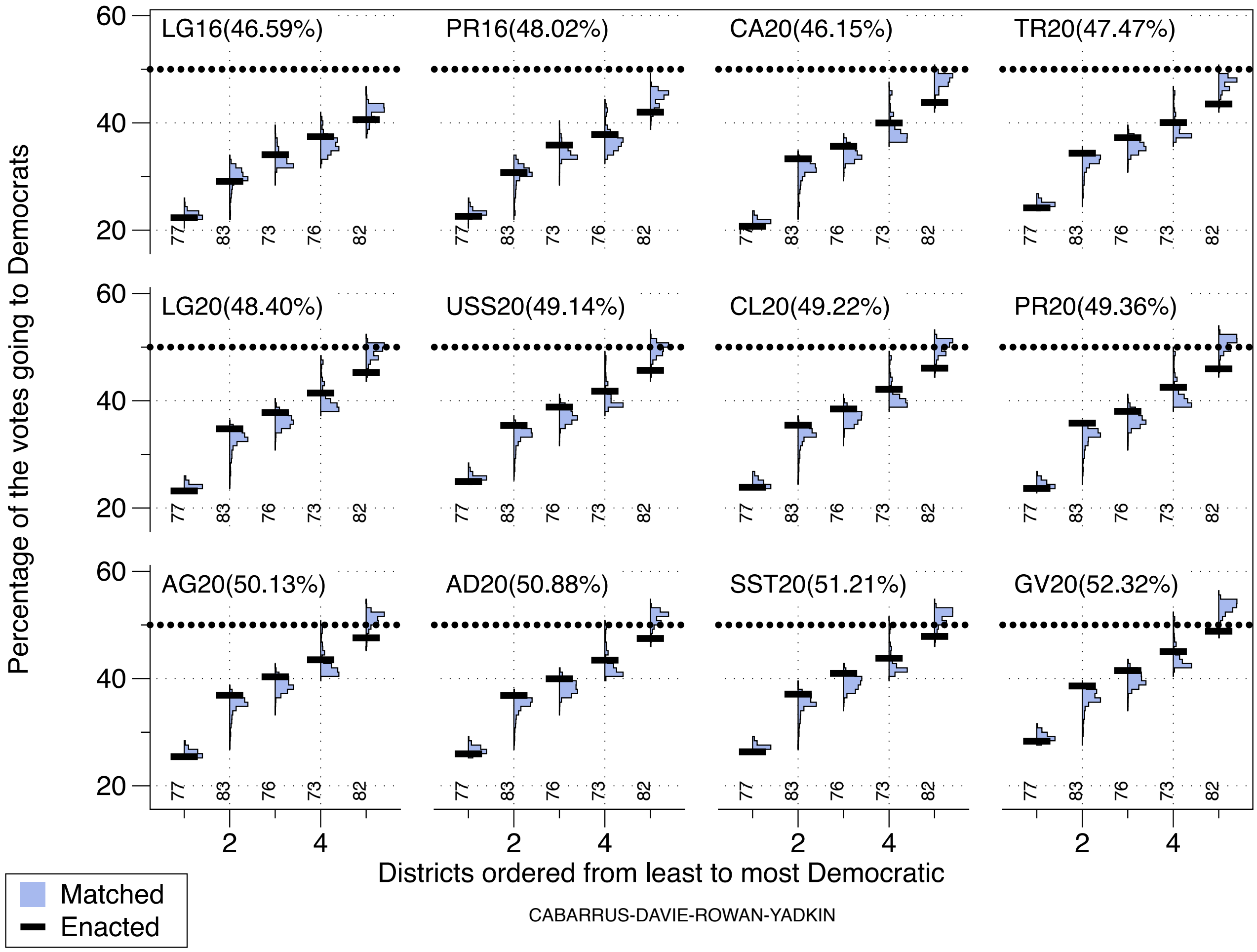


Figure 6.1.31: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

Looking at Figure 6.1.32, we see that the same pattern persists under the secondary ensemble which better preserves municipalities.

Municipal Splits and Ousted Population:

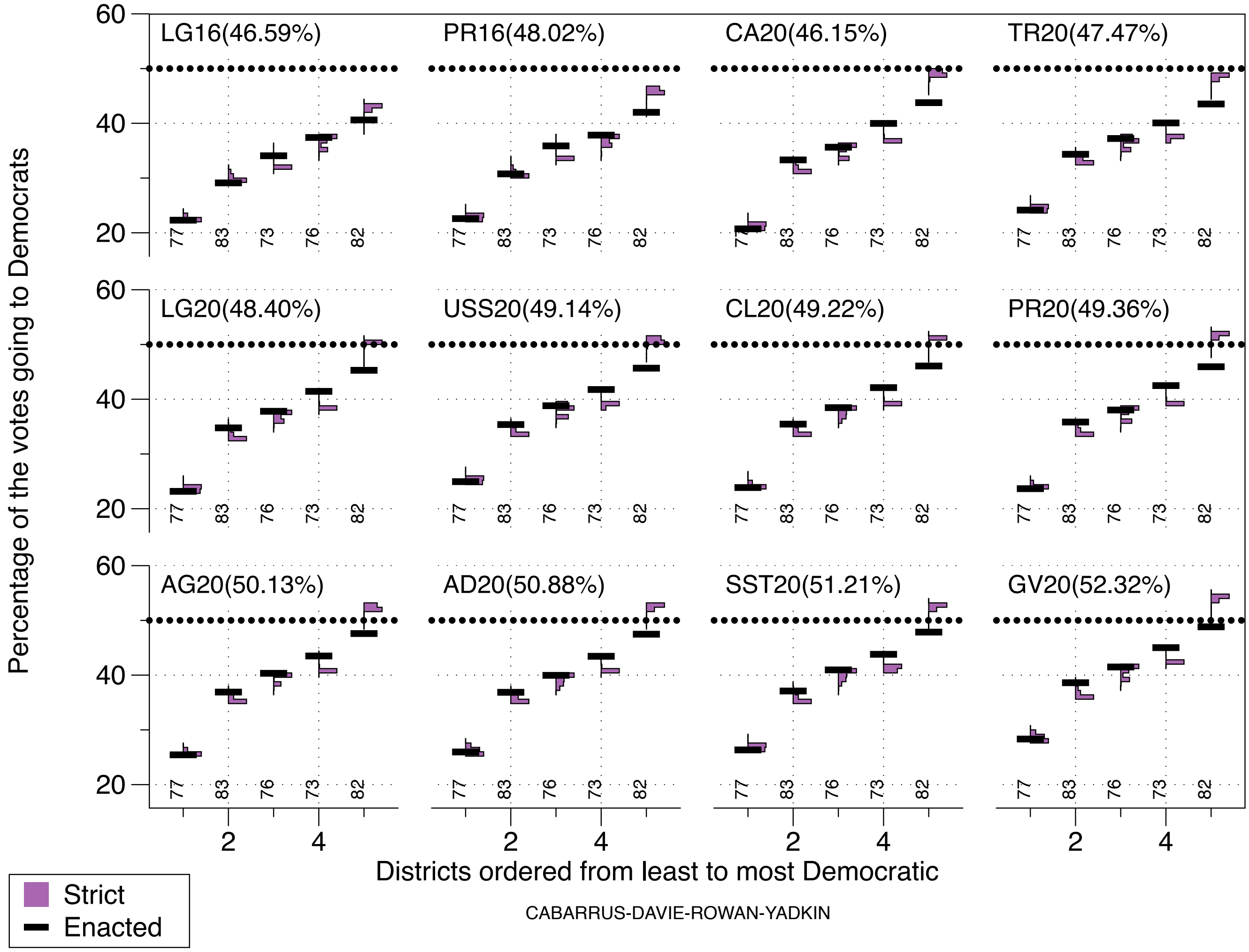


Figure 6.1.32: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

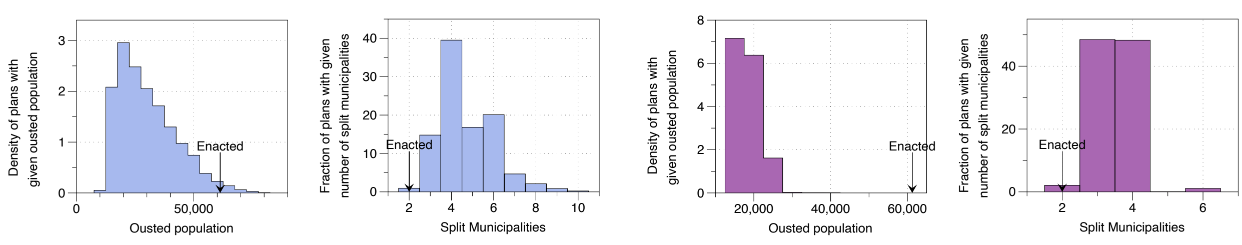


Figure 6.1.33: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.1.12 Brunswick-New Hanover

In the Brunswick-New Hanover county cluster, Figure 6.1.34 shows that the most Democratic district (district 18) has had abnormally many Democrats packed into it and the most Republican has had abnormally few Republicans placed in it, while the second-most Democratic district (district 20) has been depleted of Democrats. This makes the enacted plan much less responsive to changes in the the enacted plan preferences of the voters. The Republican party typically wins the second most democratic district in the enacted plan even though it would go to the Democrats under a number of elections when the neutral maps in the primary ensemble are used. Over each of the elections considered, the fraction of plans in the ensemble

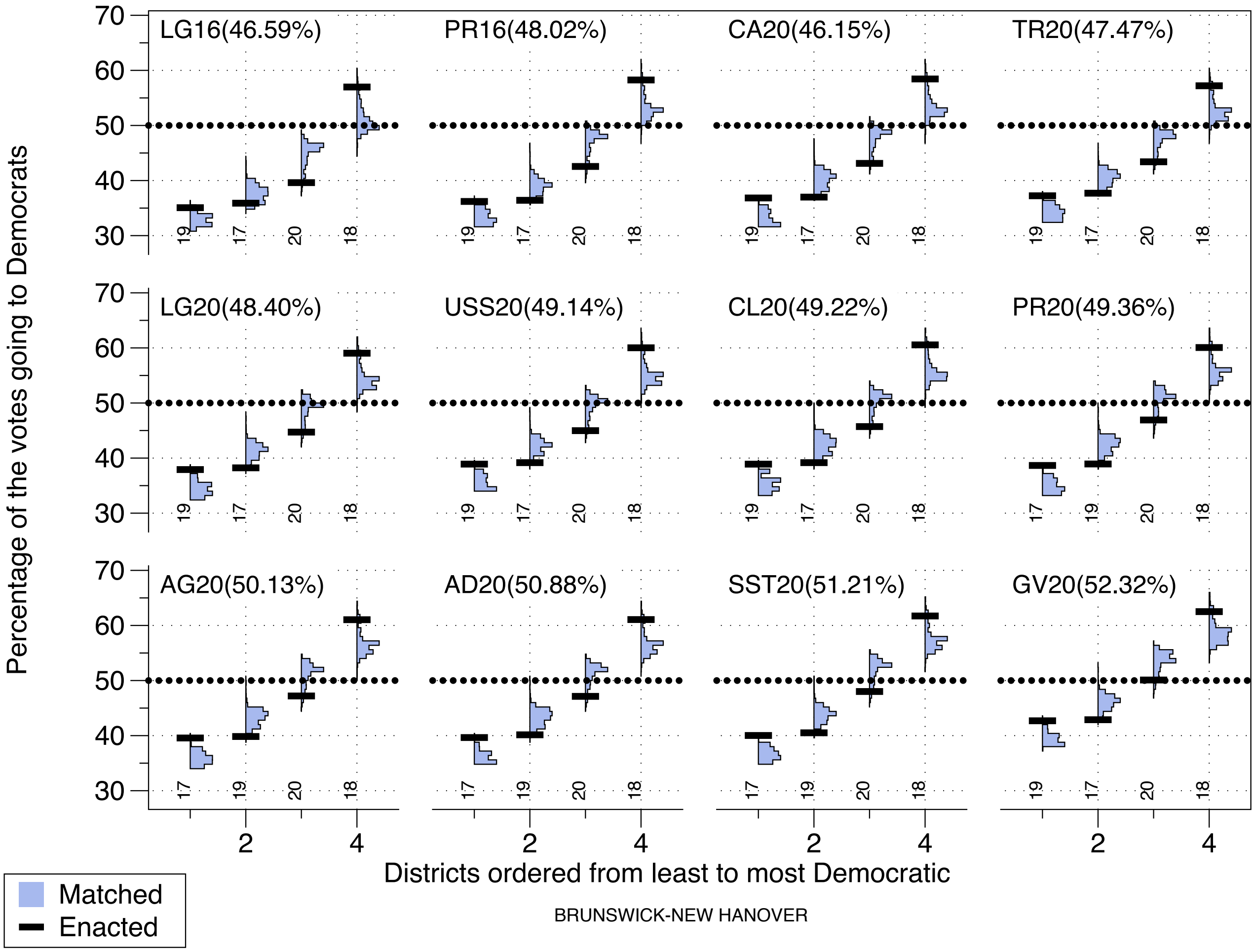


Figure 6.1.34: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

when a lower Democratic vote fraction in the second and third most Republican districts in the ensemble compared to the enacted plan map is always less than 0.5% and often much smaller.

Under the secondary ensemble which better preserves municipalities shown in Figure 6.1.35, we see that the same structure persists. The enacted map becomes a more extreme outlier since this ensemble reduced the variance of the marginals and aligns the outcome gradual progression which ensures the map is fairly responsive to changes in the voter's preference, a property not shared by the enacted map.

Municipal Splits and Ousted Population:

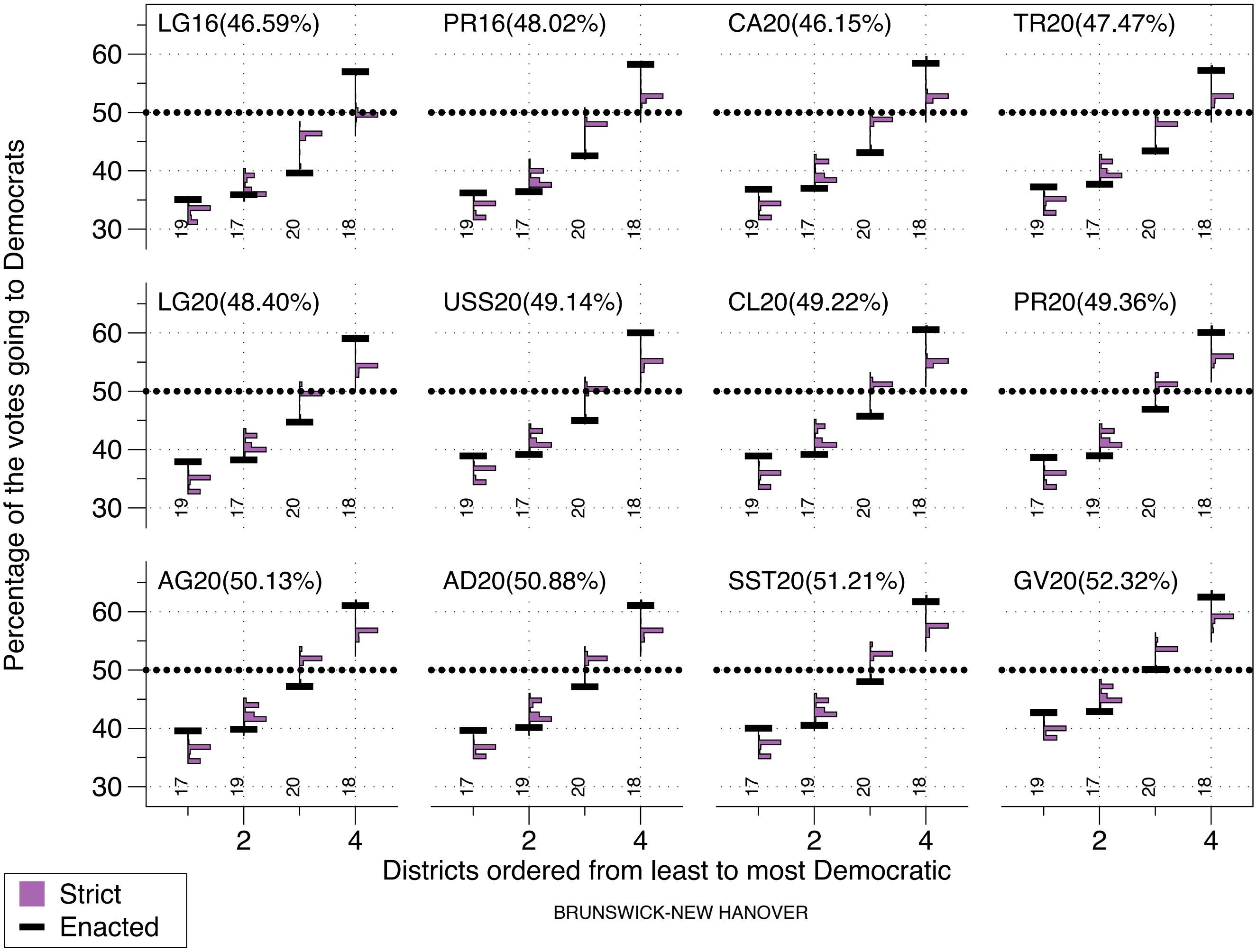


Figure 6.1.35: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The “ – ” on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the “ – ”. This plot uses the Secondary ensemble which better preserves municipalities than the enacted plan.

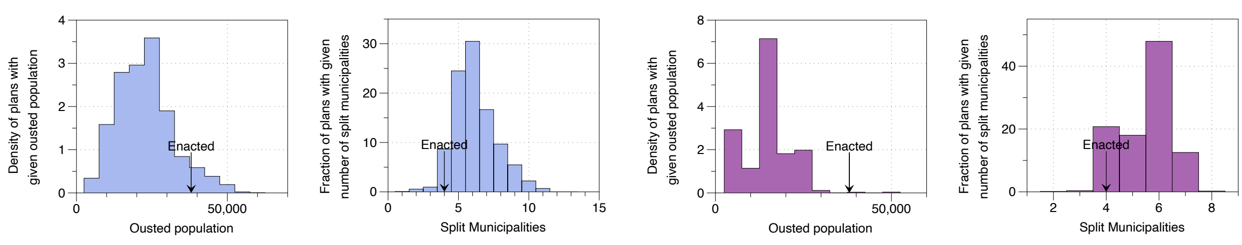


Figure 6.1.36: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.2 NC State Senate

Though the principal Senate ensemble, which prioritizes municipality preservation in line with the enacted plan, does not have as dramatic a shift towards the Republicans at the statewide level in comparison to the House, we still see a number of cases of extreme packing and cracking at the individual cluster level. Without exceptions, the effect is to minimize the effect of the Democratic votes and make the outcome of the election insensitive to a wide range of swings in the partisan vote fraction.

In the NC Senate, we again see the effect of prioritizing municipal preservation in our ensemble. When municipal preservation was not prioritized, there are two major effects. First, the enacted maps become extreme outliers, as the typical results swings are much less tilted to the Republican Party. Second, the two parties are much less separated. Requiring a high level of municipal preservation often leads the separation of the two political parties between disjoint districts. This in turn produces maps that are much less responsive to swinging public opinion. In other words, the results of the elections do not change over a wider range of statewide vote ranges.

6.2.1 Iredell-Mecklenburg

In this cluster, the second most Republican district (District 41 in the enacted plan) is the principal district whose outcome varies from election to election. In the enacted plan, unusually few democrats have been placed in this district to maximize the chance that the district elects a Republican. See Figure 6.2.1. In many elections, this means that the Republican wins this district under the enacted plan, whereas a Democrat would win the district under the a majority of ensemble plans.

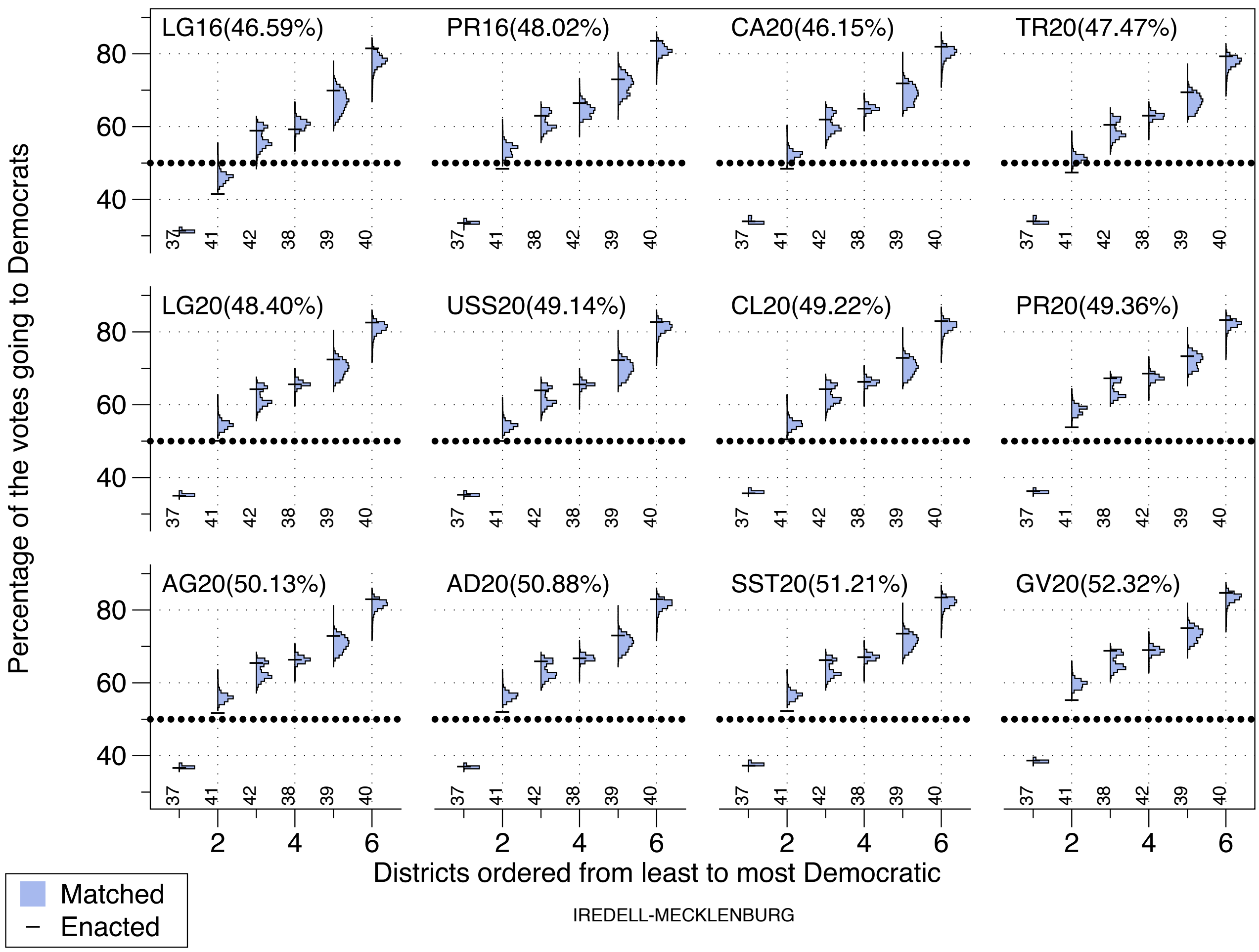


Figure 6.2.1: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

For each of the 2020 and 2016 elections we have consider, we found that none of approximately 80,000 plans in our ensemble had as low a fraction of Democrats in the two most Republican districts in the Iredell-Mecklenburg cluster as the enacted plan. Similarly, in the vast majority of the elections the ensemble had no plans with a higher fraction of democrats packed in the four most Democratic districts. In two elections 0.01% of the plans had a higher fraction of Democrats packed in the four most Democratic districts.

The effect discussed above is essentially the same when the municipality preservation is not prioritized. See Figure 6.2.2.

Municipal Splits and Ousted Population:

We see that in the Iredell-Mecklenburg cluster, the number of ousted people in the enacted plan is comparable the number of ousted people in the ensemble prioritizing municipalities. The enacted plan splits two municipalities which coincides with the most typical number split by the ensemble prioritizing municipalities. Though this ensemble sometimes splits a number more municipalities, it typically displaces a comparable number of people to the enacted plan.

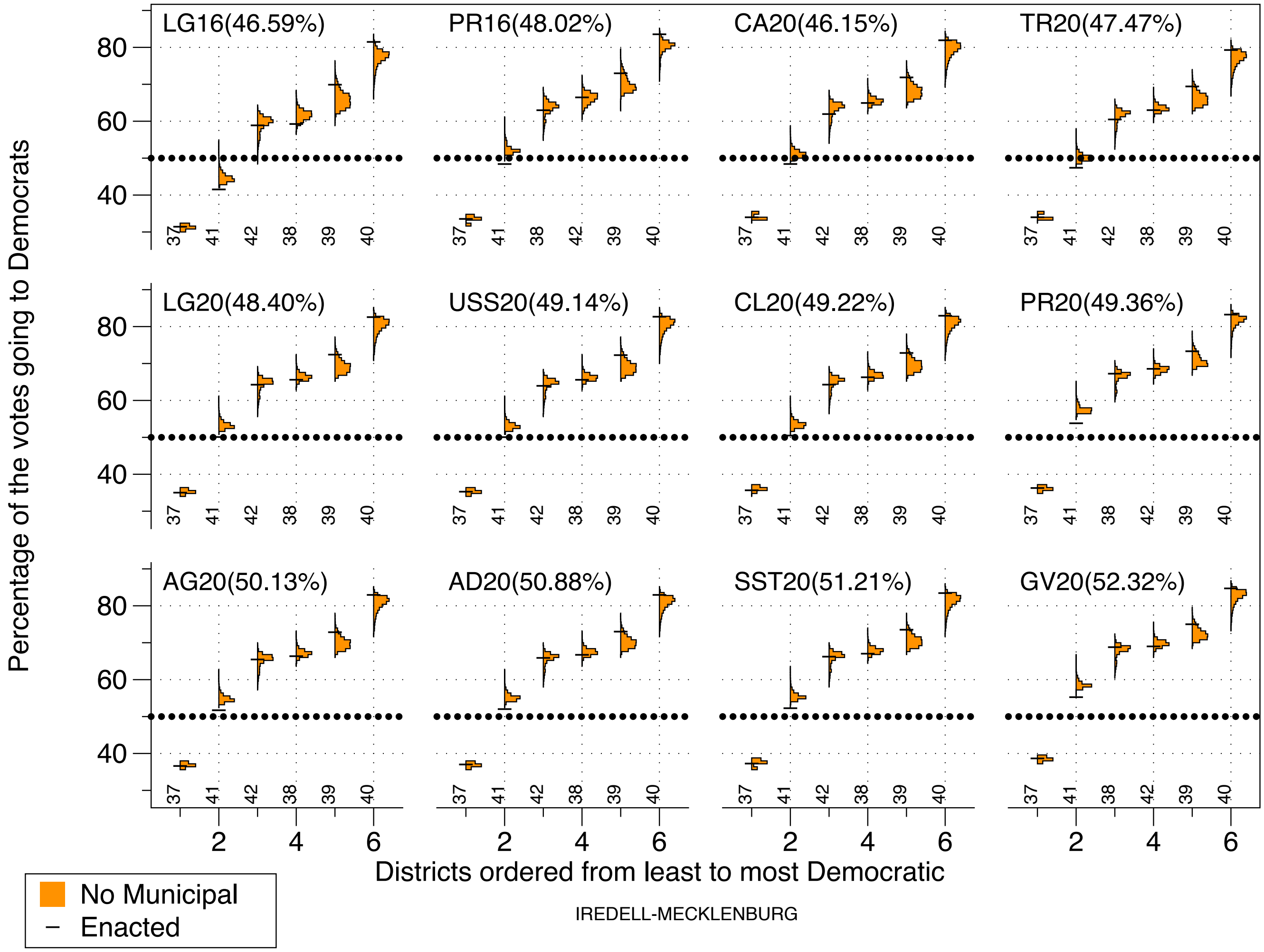


Figure 6.2.2: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the NC Senate Secondary ensemble which does not explicitly preserves municipalities.

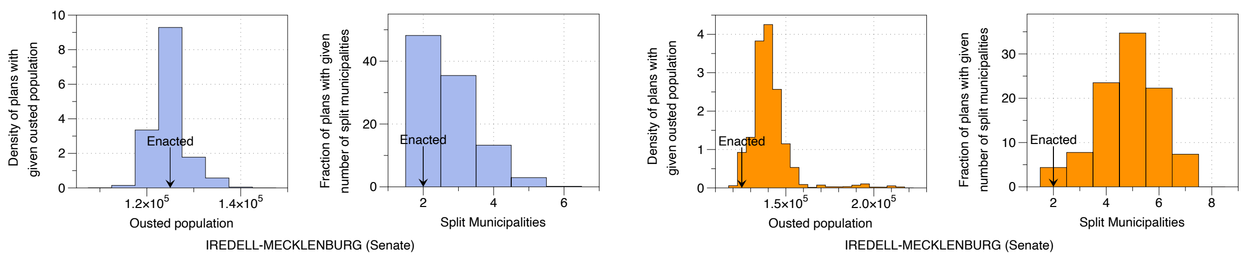


Figure 6.2.3: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.2.2 Granville-Wake

The enacted plan is chosen to be at the extreme edge of the ensemble. It maximizes the chance of the Republicans winning Districts 17 and 18 by packing a larger than typical number of Democrats in districts 14, 15, 16, and 18. The effect is shown in Figure 6.2.4 across the 12 elections. For each of the 2020 and 2016 elections we have consider, we found that none of

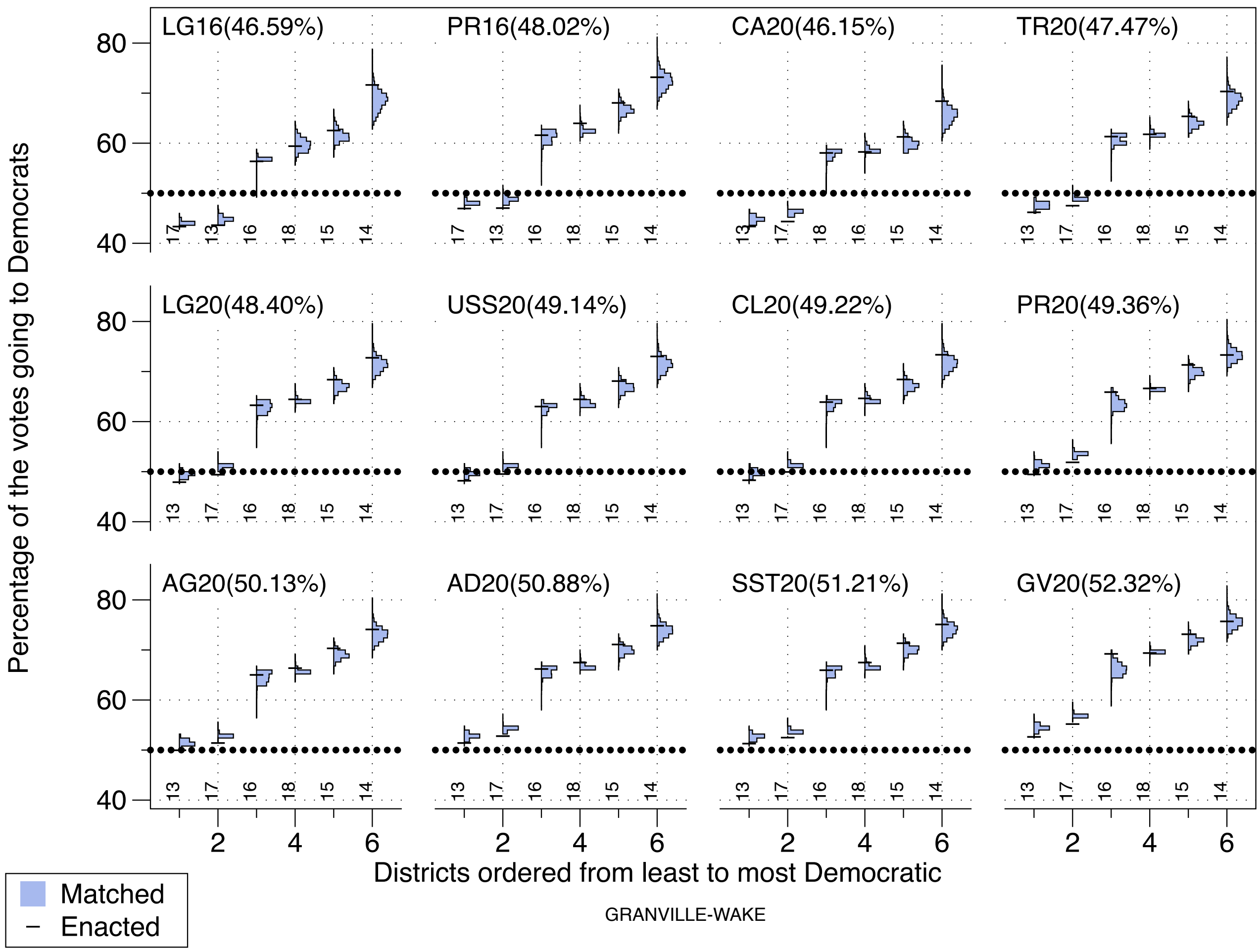


Figure 6.2.4: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

approximately 40,000 plans in our ensemble had as low a fraction of Democrats in the two most Republican districts in the Granville-Wake cluster as the enacted plan. Similarly, in six of the elections, the ensemble has no plans with more democrats packed in the four most Democratic districts. In six elections at most 0.022% of the plans had a higher fraction of Democrats packed in the four most Democratic districts than the enacted plan.

In this cluster, the prioritization of municipal preservation has a dramatic effect of packing Democrats in four districts and Republicans into two districts. The effect is show in Figure 6.2.5 across the 12 elections.

Municipal Splits and Ousted Population:

We see that in the Granville-Wake cluster, the number of ousted people in the enacted plan is significantly more than the number of ousted people in the ensemble prioritizing municipalities. The enacted plan splits three municipalities which coincides with the most typical number split by the ensemble prioritizing municipalities. Though this ensemble sometimes splits a number more municipalities, it typically displaces significantly fewer people than the enacted plan. From the perspective of the number of people ousted, the enacted plan is situated squarely between our ensemble prioritizing municipal preservation and that which does not.

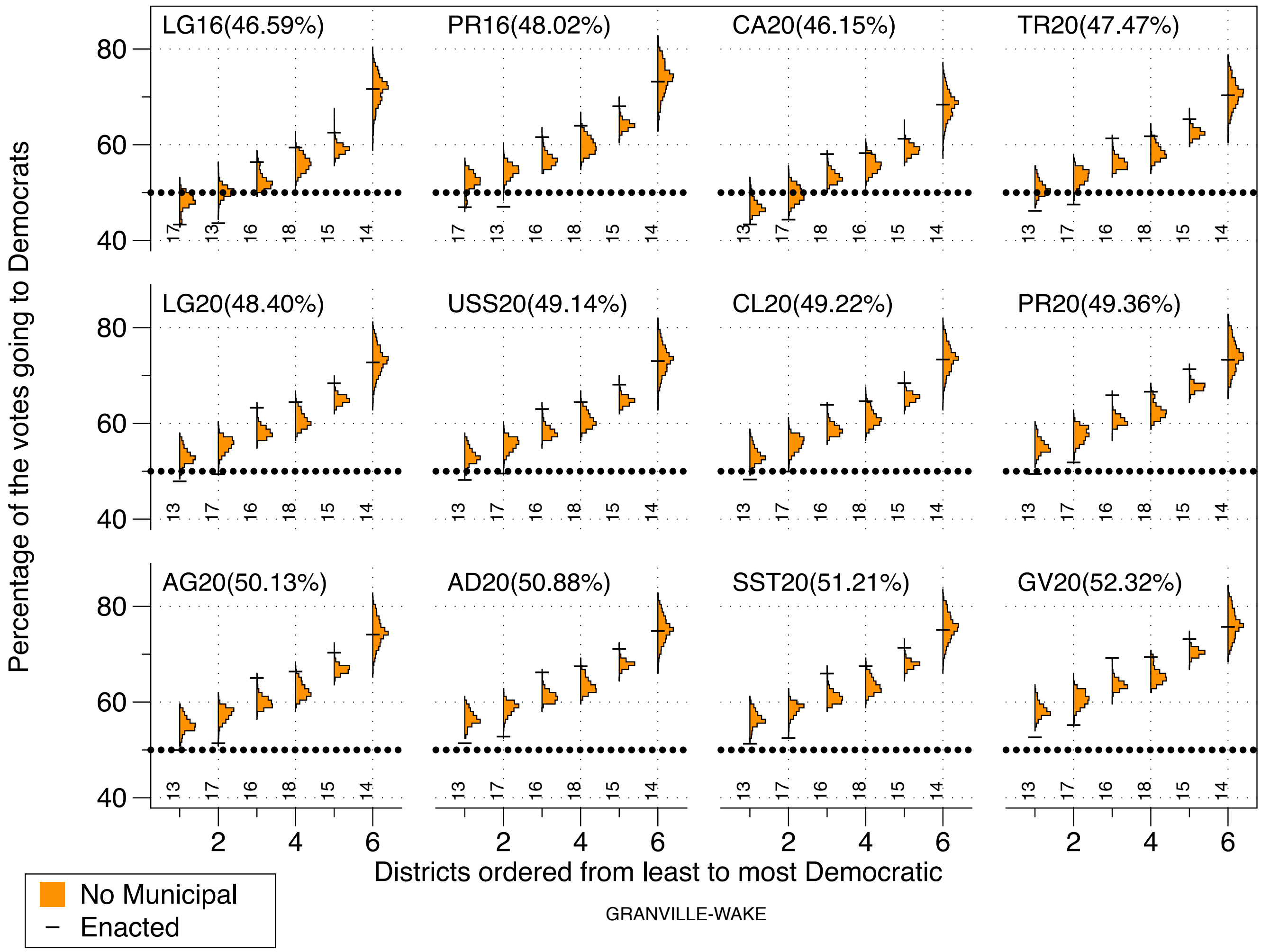


Figure 6.2.5: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the NC Senate Secondary ensemble which does not explicitly preserves municipalities.

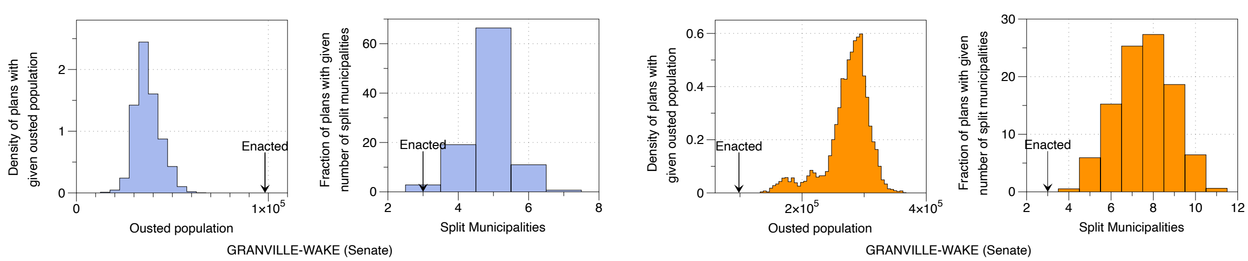


Figure 6.2.6: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.2.3 Forsyth-Stokes

There are only two districts in this cluster. The districts in the enacted plan are chosen to maximize the number of Democrats in the more democratic district and the number of republicans in the most Republican district. The map is an extreme outlier in both of these regards. The effect is a maximally non-responsive map. The effect is shown in Figure 6.2.7 across the 12 elections. Of the almost 80,000 maps in the ensemble, less than 1% had as low a fraction of Democrats in the most

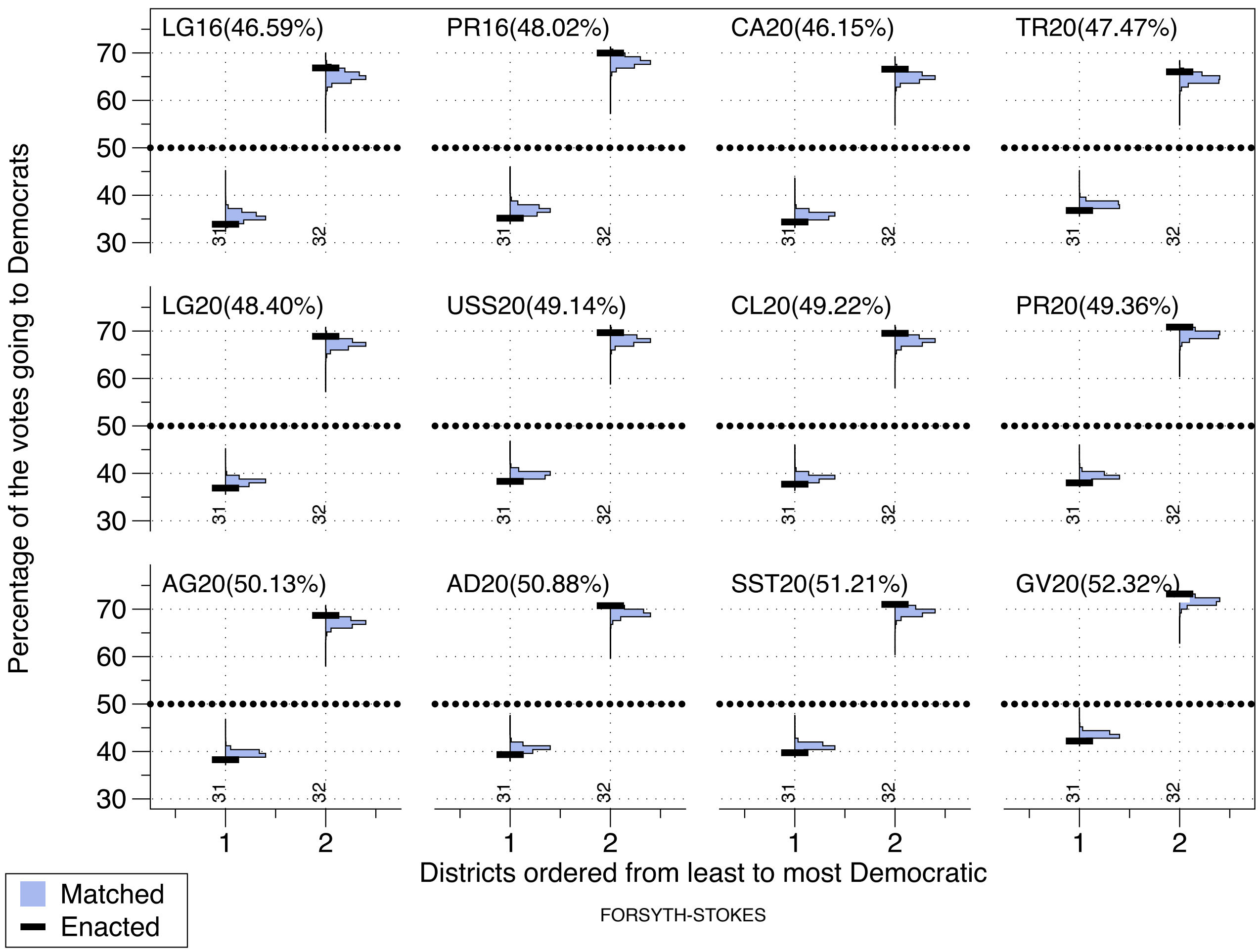


Figure 6.2.7: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

Republican district under the 2020 and 2016 elections considered. And between 1% and 5% of the plans had such a high Democratic fraction in the most Republican District.

When municipal preservation is not prioritized, the enacted map becomes an even more extreme outlier; showing an extreme level of packing of Democrats into one district and Republicans into the other. The effect is shown in Figure 6.2.8 across the 12 elections.

Municipal Splits and Ousted Population: In the Forsyth-Stokes Cluster we see that the number of people ousted from municipalities is comparable between the enacted plan and the municipality prioritizing ensemble. Additionally, the enacted plan splits one municipality which is the most common number of splits in the municipality prioritizing ensemble.

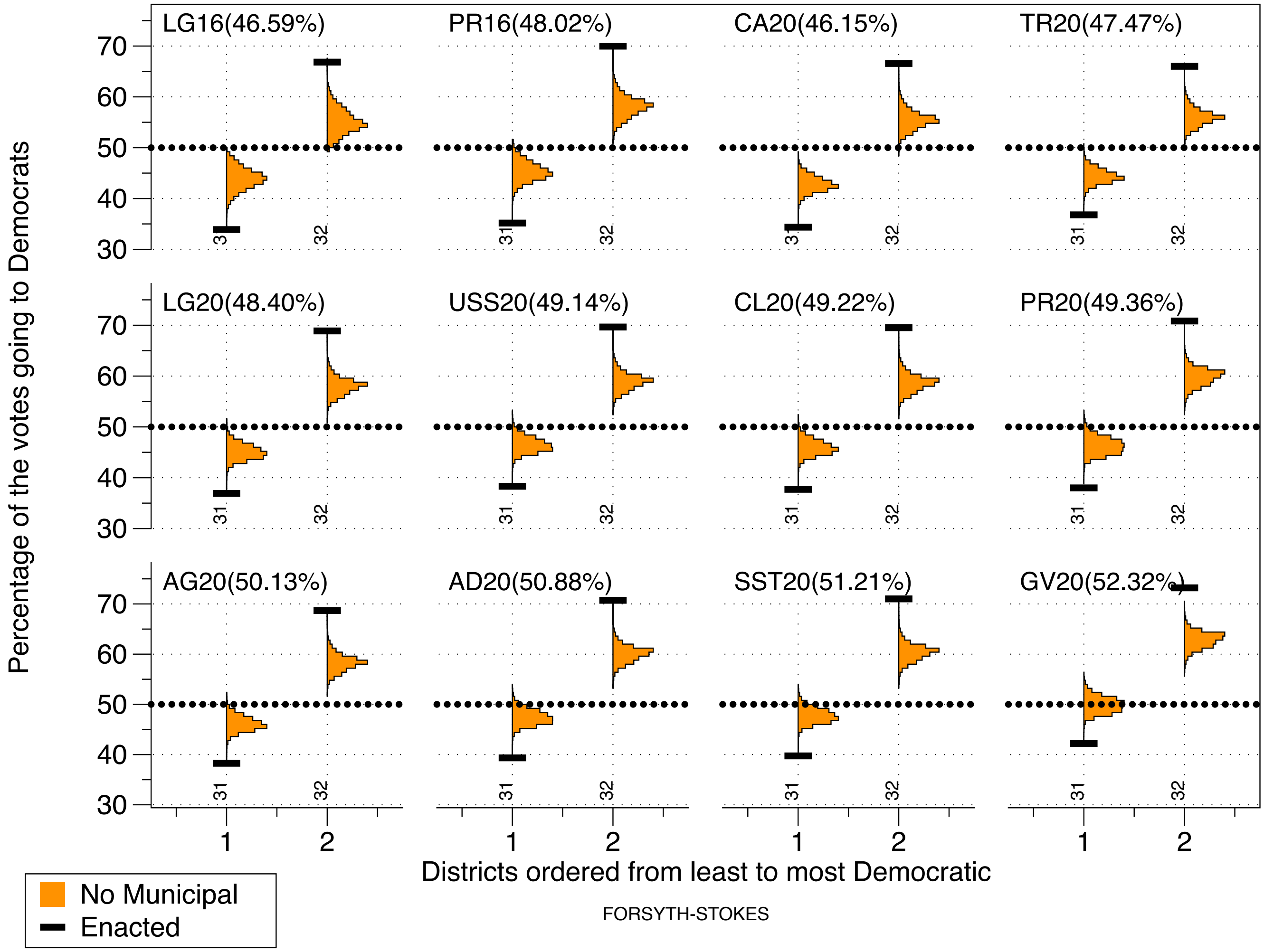


Figure 6.2.8: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the NC Senate Secondary ensemble which does not explicitly preserves municipalities.

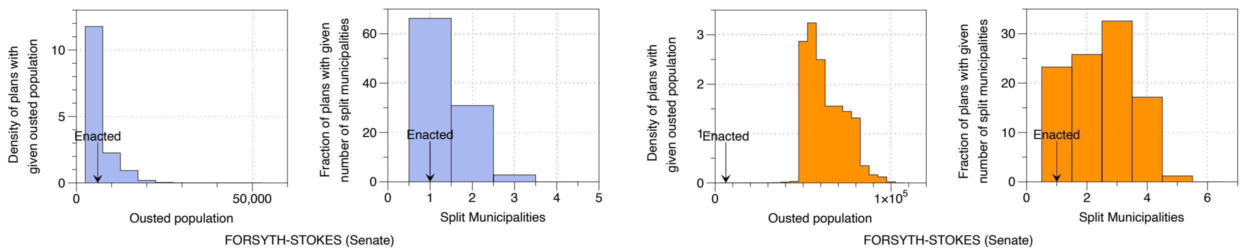


Figure 6.2.9: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.2.4 Cumberland-Moore

There are only two districts in this cluster. The districts in the enacted are chosen to maximize the number of Democrats in the more democratic district and the number of republicans in the most Republican district. The map is an extreme outlier in both of these regards. The effect is a maximally non-responsive map. The effect is shown in Figure 6.2.10 across the 12 elections. In each of the elections considered, no more than 0.06% of the ensemble plans have a lower fraction of Democrats

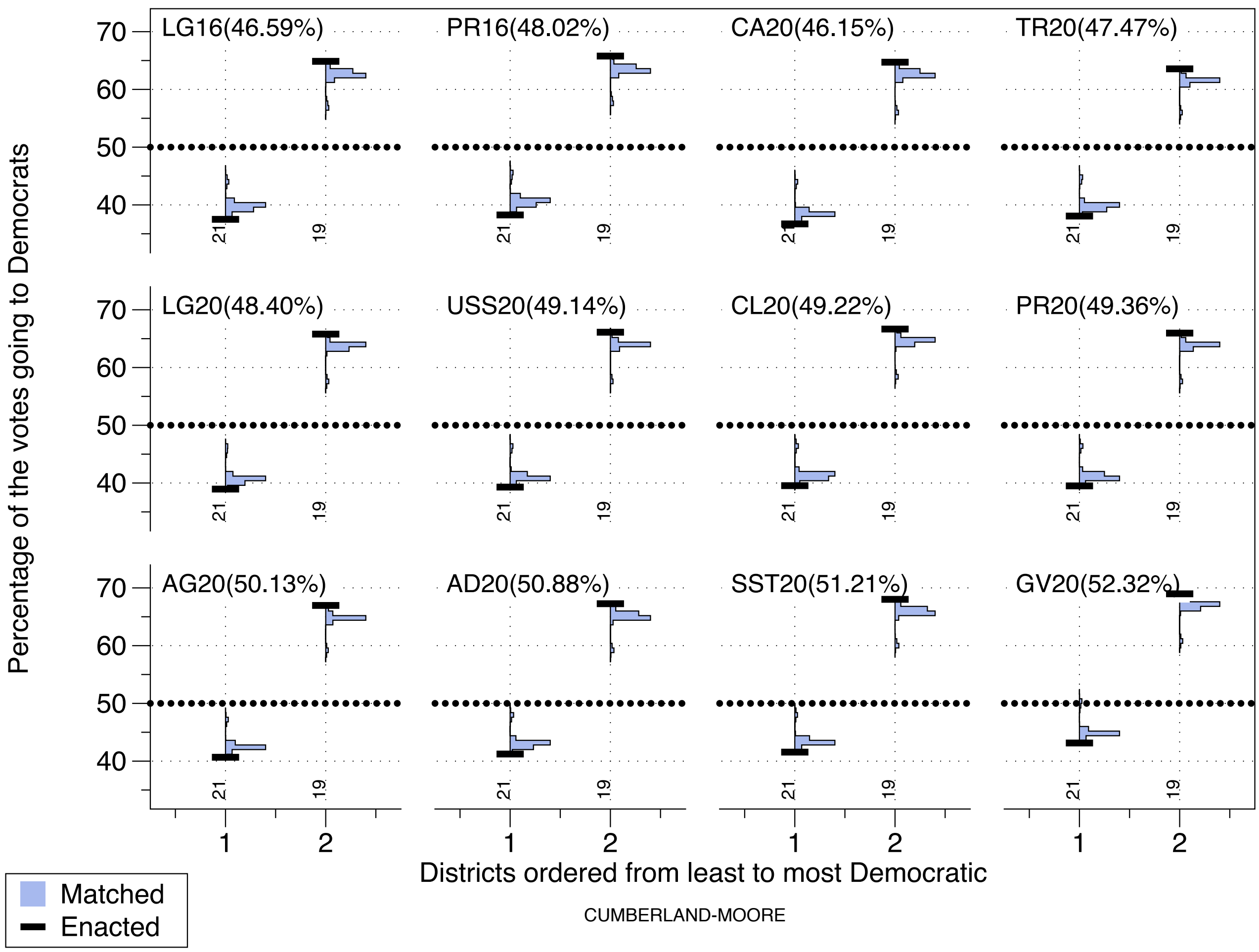


Figure 6.2.10: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

in the most Republican districts. Also no more than 0.06% of the ensemble plans have a higher fraction of Democrats in the most Democratic districts.

The prioritization of municipal preservation leads a dramatically less responsive pair of districts. When municipalities are less prioritized, both district have politically more centrist make up. Additionally, the more Republican district would regularly lean democratic without the prioritization of municipal preservation. The effect is show in Figure 6.2.11 across the 12 elections.

Municipal Splits and Ousted Population: In the Cumberland-Moore cluster, the enacted plan ousts a number of people close to the minimum number of ousted people seen in the ensemble prioritization municipal preservation. The enacted plan splits two municipalities which is the most common number of splits found in the ensemble prioritization municipal preservation.

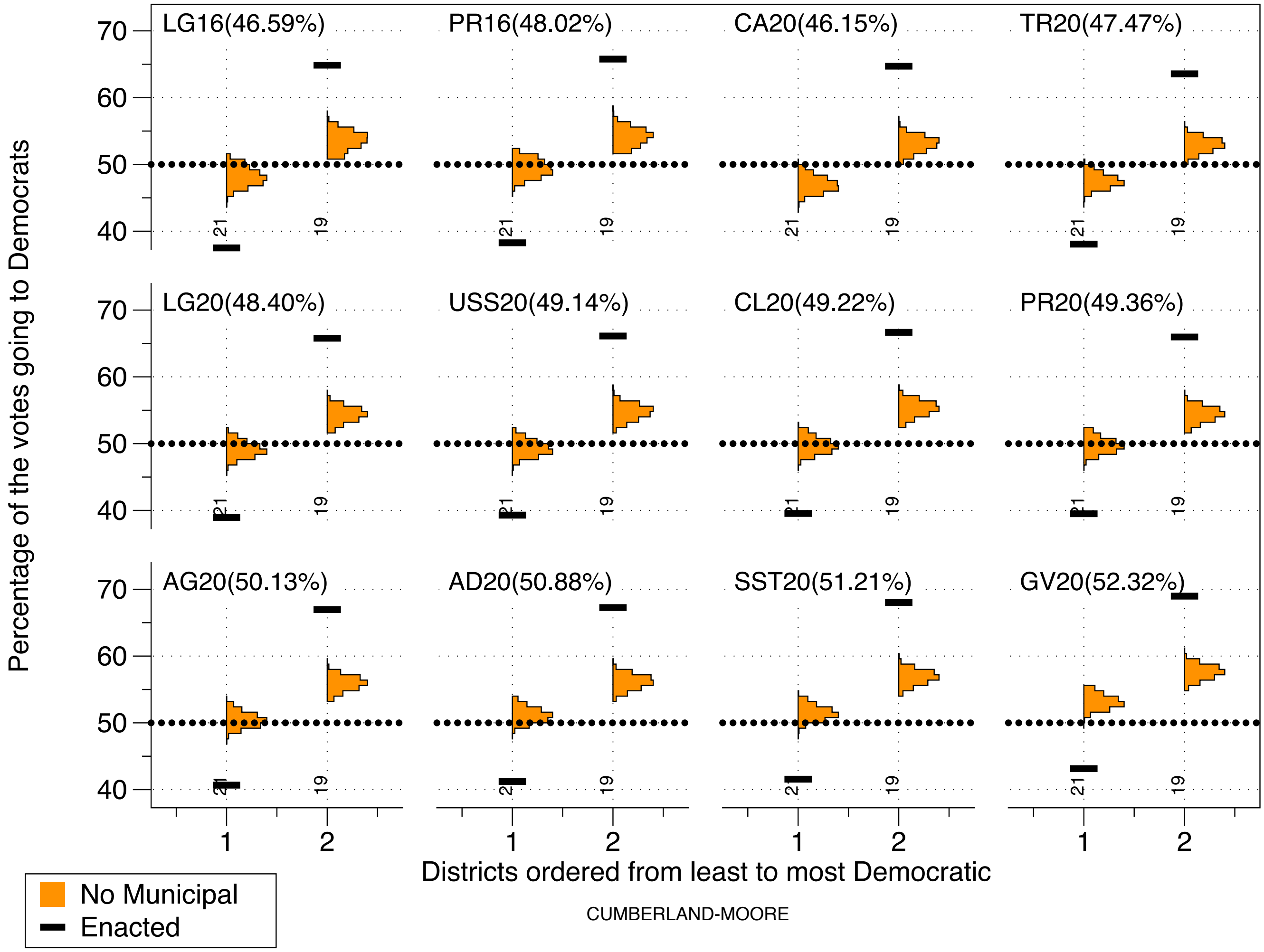


Figure 6.2.11: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the NC Senate Secondary ensemble which does not explicitly preserves municipalities.

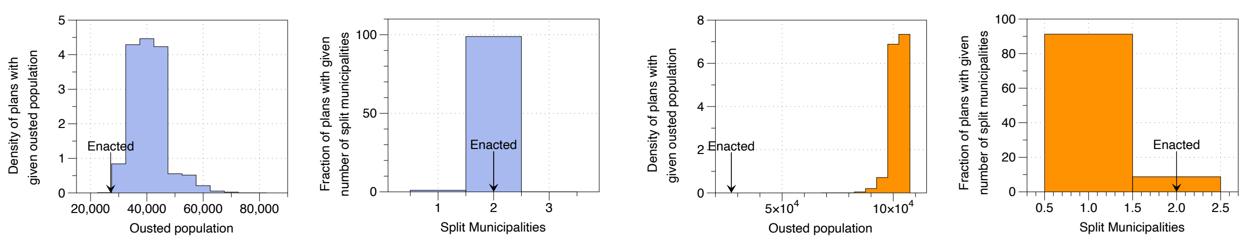


Figure 6.2.12: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.2.5 Guilford-Rockingham

The three districts in the Guilford-Rockingham cluster are constructed to pack an exceptional number of democrats in the most democratic district (district 28) and exceptionally few Democrats in the most Republican district (district 26). The effect is to ensure a Republican victory in the district 26, when in some elections the most republican district would be at risk of going to the Democratic Party. The effect is shown in Figure 6.2.13 across the 12 elections. In the Guilford-Rockingham

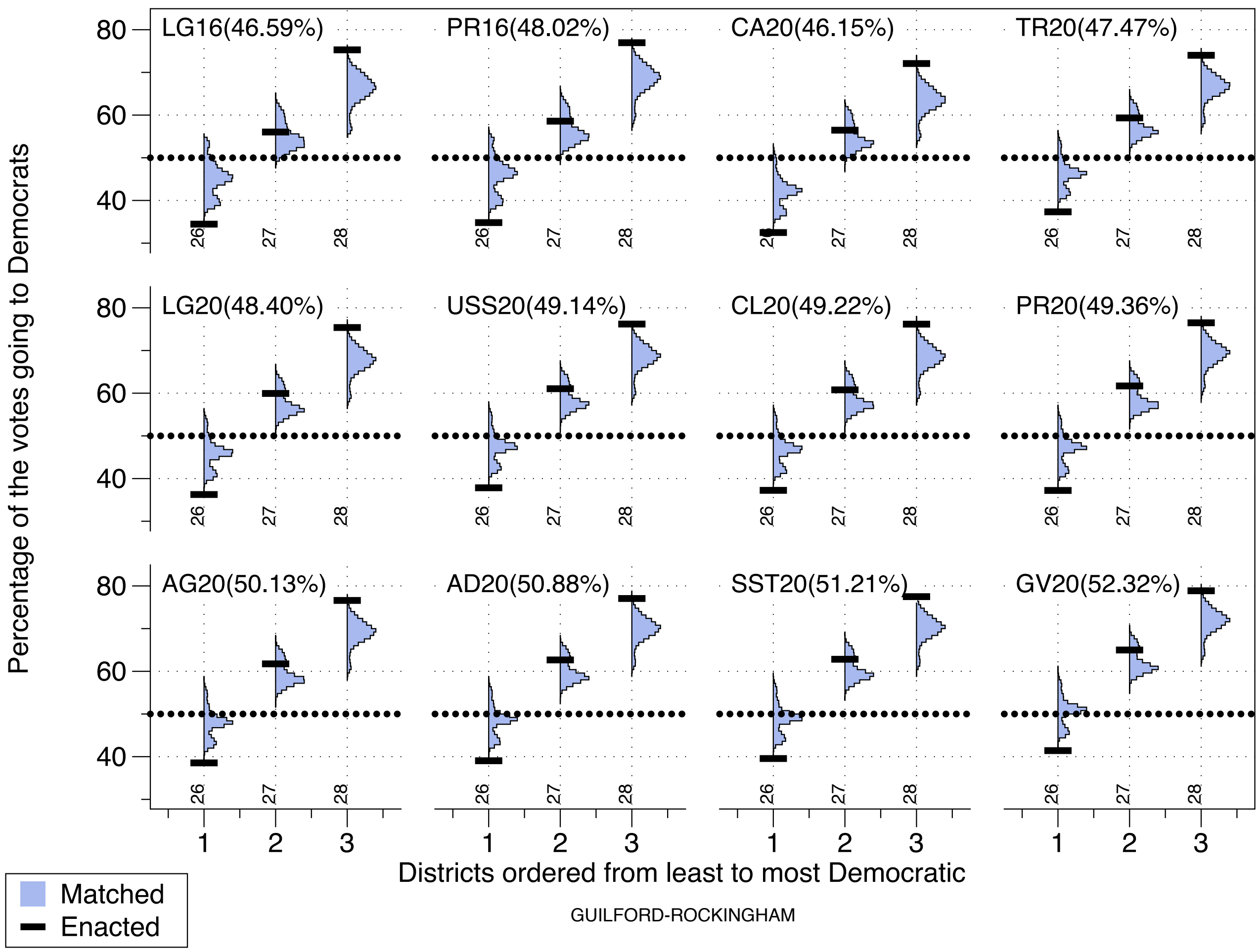


Figure 6.2.13: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The " – " on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the " – ". This plot uses the Primary ensemble which was tuned to match the municipal preservation of the enacted plan.

across all of the elections considered, none of the plans have lower fraction of Democrats in the most Republican district than the enacted plan. Conversely, in none of the elections considered do more than 0.08% of the plans have more Democrats packed in the most Democratic district than the enacted plan.

When municipalities are prioritized less, the effect is even more dramatic. In that setting, the extreme number of Democrats packed into the most democratic district and Republicans into the most Republican distinct is even more extreme. The effect is shown in Figure 6.2.14 across the 12 elections.

Municipal Splits and Ousted Population: In the Guilford-Rockingham cluster, the enacted plan splits one municipality and ousts a number of people which is typically found in the ensemble prioritizing municipality preservation which has an average ousted population which is slightly higher than the enacted plan.

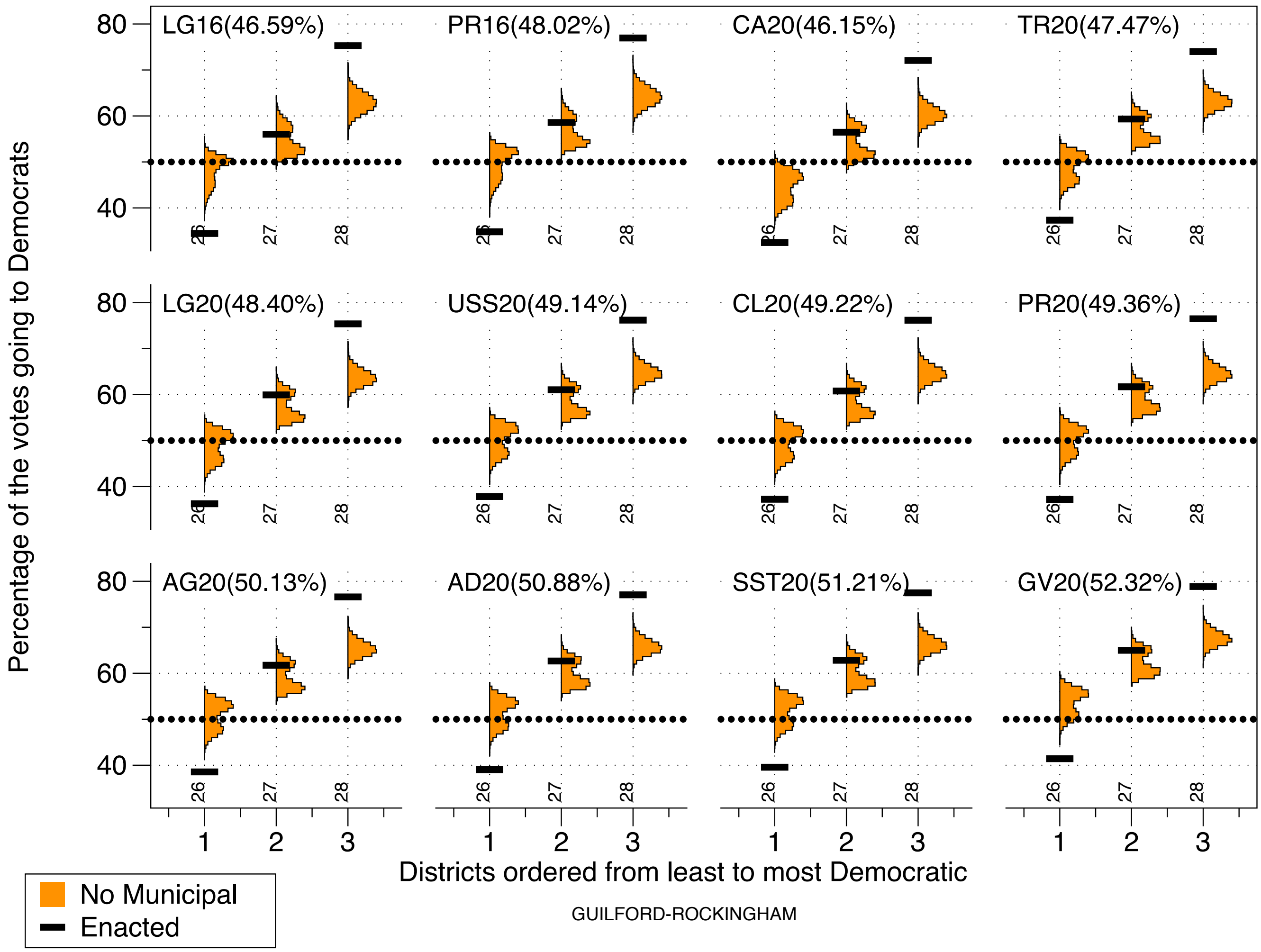


Figure 6.2.14: Shown are the distributions of the Democratic vote fraction of the districts in the plan when ordered from most Republican (on the left) to most Democrat (on the right). The “ – ” on each marginal histogram denotes the vote fraction of the corresponding district in the enacted plan. The numbers along the horizontal axis give the district numbers in the enacted plan corresponding to the “ – ”. This plot uses the NC Senate Secondary ensemble which does not explicitly preserves municipalities.

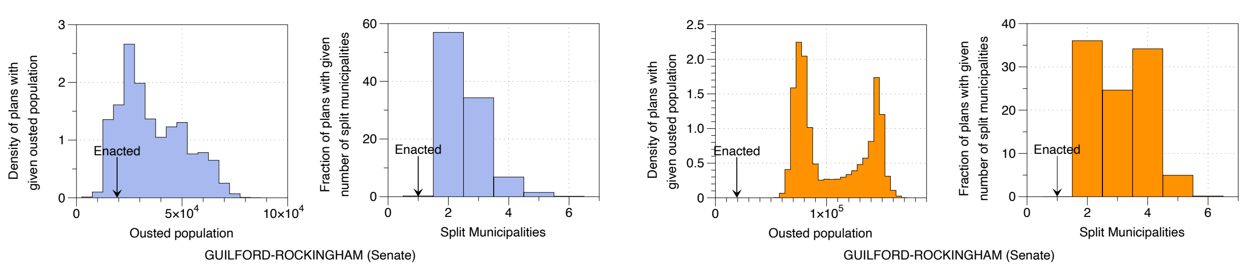


Figure 6.2.15: Plots showing the distribution of the number of people ousted from municipalities in this cluster under the primary and secondary ensemble. The amount of people ousted by the enacted map is also shown.

6.2.6 Northeastern County Cluster

In the NC Senate, there is more than one possible group of county clusters in the northeast corner of the state. As described in Figure 4.3.1 from Section 4.3, there is a choice between two different groups of county clusters. Each group consists of two different county clusters. Based on their population, each of these clusters has only one district. Thus, there is no choice on how to redistrict this region once the county grouping is set. We now explore partisan implications of choosing one county grouping over the other. As shown in the table below, under the enacted county groupings, Republicans win both districts in every election we consider. By contrast, under the alternative county grouping, each party won one of the two districts under every election we consider.

	Enacted Cluster 1	Enacted Cluster 2	Alternative Cluster 1	Alternative Cluster 2
County Clusters	Martin, Warren, Halifax, Hyde, Pamlico, Chowan, Washington, Carteret	Gates Currituck Pasquotank Dare Bertie Camden Perquimans Hertford Tyrrell Northampton	Pasquotank, Dare, Perquimans, Hyde, Pamlico, Chowan, Washington, Carteret	Gates, Currituck, Camden, Bertie, Warren, Halifax, Hertford, Tyrrell, Northampton, Martin
Democratic Vote %(LG16)	46.07%	47.74%	38.51%	55.42%
Democratic Vote % (PR16)	45.60%	46.70%	37.83%	54.59%
Democratic Vote % (CA20)	42.28%	44.47%	36.48%	50.75%
Democratic Vote % (USS20)	45.31%	45.36%	38.45%	52.75%
Democratic Vote % (TR20)	44.12%	44.58%	37.61%	51.59%
Democratic Vote % (GV20)	46.79%	47.56%	40.75%	54.12%
Democratic Vote % (AD20)	47.79%	47.72%	41.02%	54.99%
Democratic Vote % (SST20)	47.56%	47.85%	41.03%	54.89%
Democratic Vote % (AG20)	45.88%	46.11%	39.15%	53.40%
Democratic Vote % (PR20)	44.09%	45.54%	38.30%	51.84%
Democratic Vote % (LG20)	43.80%	45.12%	37.74%	51.69%
Democratic Vote % (CL20)	45.23%	46.42%	39.12%	52.00%

Table 3: Voting History for the two different choices of county grouping northeast corner in the NC Sente.

7 State Legislature: Additional Details

7.1 State Legislature: Details on the Sampling Method

To effectively generate a representative ensemble of maps from the desired non-partisan distributions, we use the well-established method of parallel tempering. It allows one to effectively sample from a possibly difficult to sample distribution by connecting it to an easy to sample distribution through a sequence of intermediate "interpolating" distributions.

We connect our desired distributions to a distribution on redistricting plans that favors plans with a larger number of spanning trees. This alternative distribution satisfies the same constraints, however, it does not consider compactness nor municipal preservation. We make this choice because it can be effectively sampled using a variation on the Metropolized Multiscale Forest RECOM sampling algorithm outlined in [1, 2] coupled with the Metropolis-Hasting algorithm. Using Parallel Tempering, we interpolate between the desired distribution on redistricting and a distribution which is chosen so that the Markov Chain Monte Carlo algorithm converges to its target distribution quickly.

In sampling the interpolating ladder of distributions between the easier-to-sample distribution and our target distribution with the needed policy considerations, we use parallel tempering with a classical Metropolis-Hasting sampling scheme to sample each level of the interpolating ladder of distributions. As proposals in the Metropolis-Hasting sampling scheme, we use a mixture of the Multiscale Forest RECOM proposals and single node flip proposals, depending on what is appropriate for the distribution associated with the given level in the interpolation. The Multiscale Forest RECOM has a number of advantages. Its multiscale nature seems to provide improvements in computational efficiency and the global moves of RECOM lead empirically to faster mixing. Additionally, it can efficiently preserve counties and other groupings. Lastly, it can be effectively combined with the Metropolis-Hasting algorithm to produce an algorithm that samples from the specified distribution.

To facilitate mixing and for computational practicality, we often split the interpolating groups of manageable size, typically between 10 and 30 interpolating levels. Each grouping is then run to produce an ensemble at the top level which approaches; which is closer to the desired ensemble. This ensemble is then used as an *independent sample reservoir* to generate independent samples for the next group of interpolating levels. This process is repeated until the desired level is reached. We typically use between 60 and 100 interpolating levels in our sampling schemes. The number of plans sampled differs from cluster to cluster. We also sometimes group clusters together for sampling. Usually the number of samples in around 80,000 but in all cases we have check various empirical measure to evaluate if the sampling has converged and is well mixed.

7.2 State Legislature: Mathematical Description of Ensemble Distribution

In designing our distributions, we have chosen to define explicit distributions and then use an implementation of the Metropolis-Hastings algorithm to generate the ensemble. We feel this choice promotes transparency because an explicit distribution can better be discussed and critiqued. It also allows us to more explicitly translate the policy considerations into the ensemble.

In order to formally define our distributions, we consider the labeling ξ of the precincts of the map of NC with the number $\{1, \dots, d\}$, where d is the total number of districts. So for the i-th precinct, $\xi(i)$ gives the district to which the precinct belongs. If we let $A_j(\xi)$ and $B_j(\xi)$ be respectively the surface area and perimeter (or length of the boundary) of the j-district then our compactness score is

$$J_{\text{compact}}(\xi) = \sum_{j=1}^{d} \frac{A_j(\xi)}{B_j^2(\xi)}.$$

Then the probability of drawing the redistricting ξ is

$$\text{Prob}(\xi) = \begin{cases} \frac{1}{Z} e^{-w_{\text{compact}} J_{\text{compact}}(\xi)} & \text{for } \xi \text{ which is allowable} \\ 0 & \text{for } \xi \text{ which is not allowable} \end{cases}$$

Here Z is a number that makes the sum of Prob(ξ) over all redistricting plans are equal to one.

The collection of allowable redistricting plans ξ is defined to be all redistricting plans which satisfy the following conditions:

1. all districts are connected
2. the populations of each district is within %5 of the ideal district population unless the district in the wake county cluster in the senate or the Craven-Carteret county cluster in the house.[2]
3. The number of split counties is minimized.
4. We minimize the occurrence of districts traversing county boundaries.

The second distribution includes a municipality score, $J_{MCD}(\xi)$. This score describes the number of people who have been displaced from a district that could have preserved the voters within their municipality, and is defined as

$$J_{MCD}(\xi) = \sum_{m \in M} \text{pop}_{oust}(\xi, m),$$

where M is the set of all MCDs, and $\text{pop}_{\text{oust}}(\xi, m)$ is the number of displaced people from the municipality m under the redistricting plan ξ. We define pop_{oust} in one way if the population of the municipality is less than the size of a district and another if it is greater.

[2] In the two exceptional clusters, it is impossible to draw districts that preserve precincts and also achieve population balance within 5%. For Wake in the senate, we sample with a deviation of 6% and generate an associated ensemble; past experience has shown that this does not create a partisan effect and we will be confirming this in follow on analyses. In Craven-Carteret, precinct 02 in Craven is the only precinct that connects the bulk of Craven with Carteret and it must be split to achieve population balance between the two districts within this cluster. We have examined the voting patterns when assigning this precinct to the district with the bulk of Craven or with all of Carteret and found minimal effects on the outcome.

If m has a population that is less than the population of a district, we consider the district that holds the most people from the municipality m as the representative district for that municipality. Any person within municipality m, but not within the representative district is considered to have been displaced.

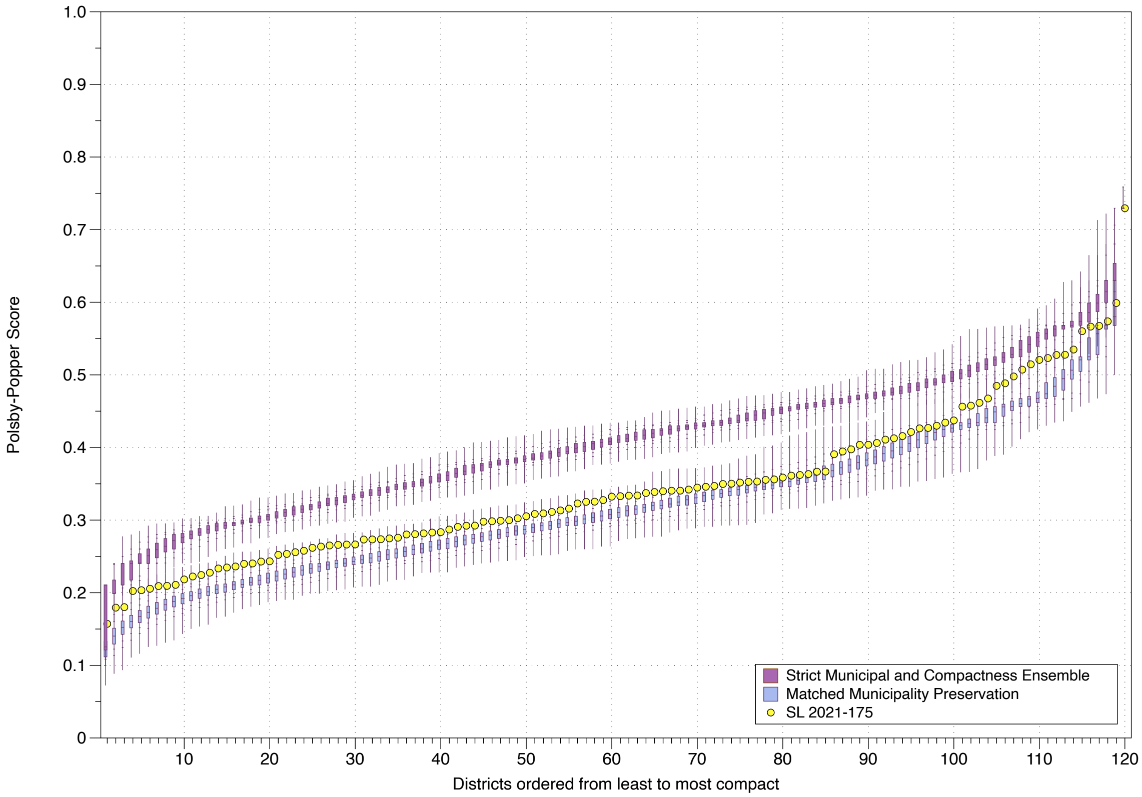
If m has a population that is greater than the population of a district, we consider the number of districts that could fit within m to be $d(m) = \lfloor \text{pop}(m)/\text{pop}_{\text{ideal}} \rfloor$, where pop$(m)$ is the population of the MCD m and $\text{pop}_{\text{ideal}}$ is the ideal district population. We also consider the remaining population in the municipality that cannot fit within a whole district to be $r(m) = \text{pop}(m) - d(m) \times \text{pop}_{\text{ideal}}$. To determine the displaced population, we look at the $d(m)$ districts that contain the largest populations from the municipality m. Hypothetically, everyone in these districts could live in the municipality m. Therefore, anyone who is in one of these districts and that does not live in the municipality m could be replaced by someone who does live in the municipality. Thus, we sum the number of people not in m in the $d(m)$ districts that contain the largest populations of m. We also note that the remaining population $r(m)$ could hypothetically be kept intact when drawing a $(d(m) + 1)$th district. We, therefore, look at the number of people in the municipality m who are living in the district with the $(d(m) + 1)$th most population of the municipality. If the number of people in m is less than $r(m)$, then we add this difference to the number of ousted people (since each of these people in the municipality could have conceivably been placed in the district).

Formally, we let the $|M| \times d$ matrix, $MCD(\xi)_{m,j}$ represent the number of people who are in the municipality m and the district ξ_j. Then

$$\text{pop}_{\text{oust}}(\xi, m) \begin{cases} \sum_j MCD(\xi)_{m,j} - \max_j(MCD(\xi)_{m,j}) & \text{pop}(m) < \text{pop}_{\text{ideal}} \\ \sum_{j \in D(m)}(\text{pop}(\xi_j) - MCD(\xi)_{m,j}(\xi)) & \text{pop}(m) \geq \text{pop}_{\text{ideal}} \\ \quad + \max(0, MCD(\xi)_{m,N(m)} - r(m)) & \end{cases},$$

where pop(ξ_j) is the population of district ξ_j, $D(m)$ is the set of district indices that represent the $d(m)$ districts with the largest populations of municipality m, and $N(m)$ represents the district index with the $d(m) + 1$ most population of municipality m.

7.3 State Legislature: Additional Ensemble Statistics



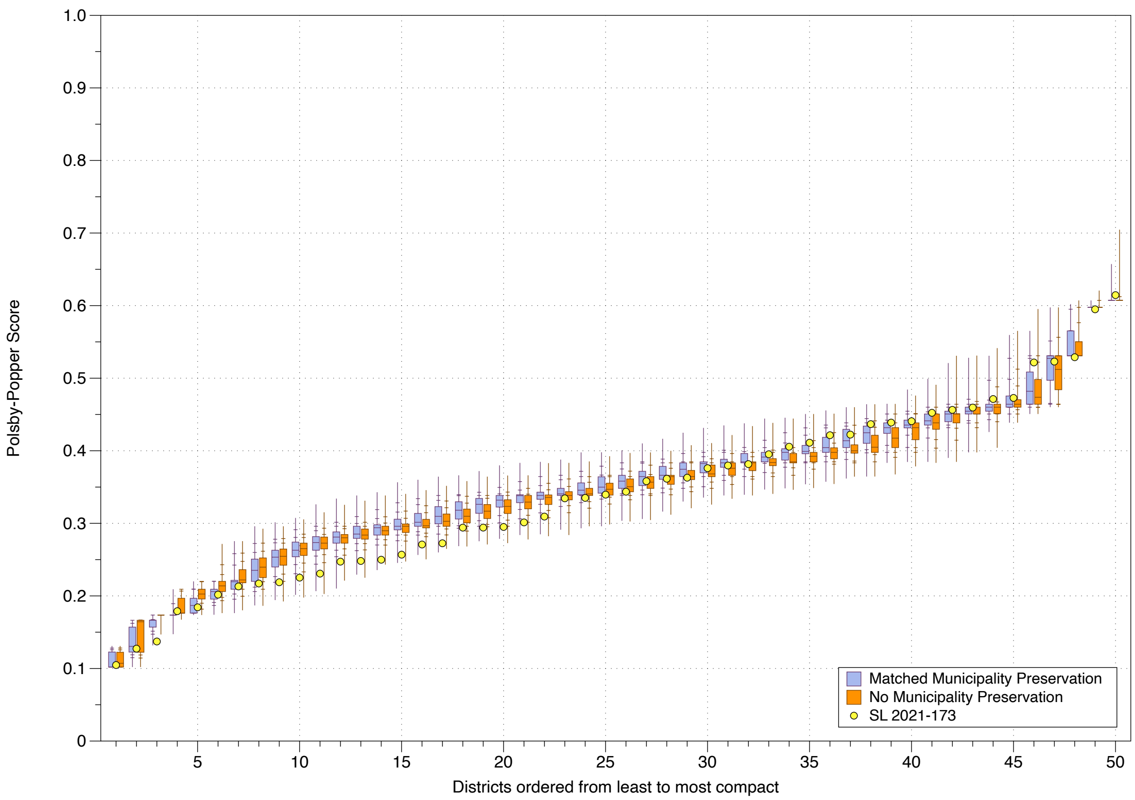


Figure 7.3.1: These plots compare the Polsby-Popper Score of the enacted maps (shown we the yellow dots) with the marginal histograms of the primary and secondary ensembles.

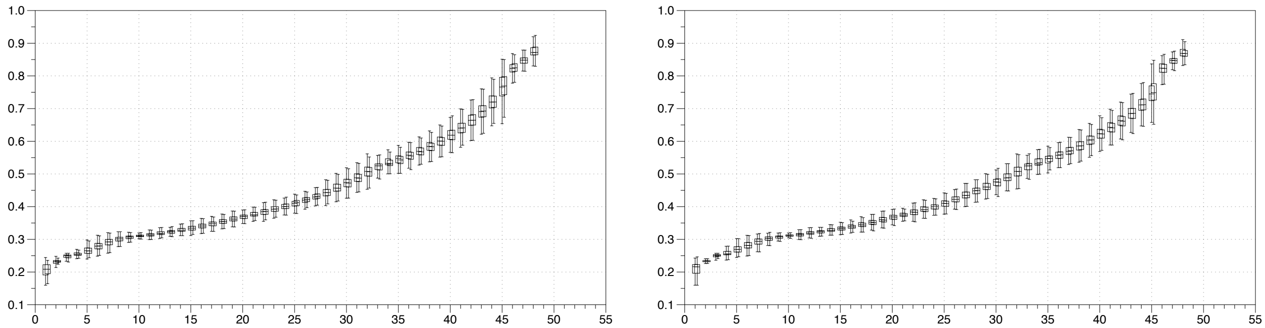


Figure 7.4.1: We compare a subset of the threads to the remaining threads. Each thread represents a different initial condition, and thus takes a different trajectory through the phase space. We compare our standard observables, such as the ranked ordered marginal distributions and confirm that they yield equivalent results. On the left we show an example of comparing one thread with all threads in a parallel tempering run; on the right we show an example of comparing half of the thread with the other half of the threads in a parallel tempering run.

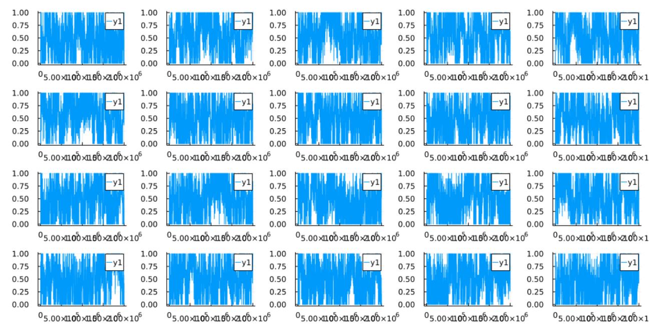


Figure 7.4.2: We examine how each of the parallel tempering threads swaps as a function of the proposal number. The vertical axis represents different measures and the horizontal axis represents the proposal in the Markov Chain. When the thread (or redistricting) is near the bottom of the vertical axis it mixes quickly when drawing from the reservoir; when it is at the top of the vertical axis it is at the desired measure which is either the desired measure we are sampling from or an intermediate measure that will act as a subsequent reservoir.

7.4 State Legislature: Convergence Tests

We performed a number of tests to assess if our sampling of the desired distribution was sufficient to provide an accurate representation of the desired distribution. Sometimes many samples are needed, yet in other cases a much smaller number is sufficient. We use a number of different methods to assess convergence.

Many of our runs were generated with an implementation of the *parallel tempering algorithm* with an *independent sample reservoir*. The use of parallel tempering provides a number of different threads that can be grouped and then compared against each other. As each thread starts from a different initial condition, if the distributions look similar then there is evidence that the system is mixing. Similarly, if a subset of the threads has a similar distribution to all of the threads, then there is evidence that enough samples were used.

The following plots show representative ranked ordered histograms for some NC House and NC Senate runs where different threads in a parallel tempering run are compared.

Each time a thread exchanges its state with the independent sample reservoir, it receives a new configuration that is independent of the previous state of the system. Additionally, if the thread then progresses up to the parameter level of interest, then we have strong evidence that we are producing decorated samples. The following plots show the current level of each for the different threads in a parallel tempering run. Switching regularly from the highest level (the desired sample distribution) to the lowest level (the level with the independent sample reservoir) is a strong indication that the system will be well mixed and converged.

In some cases, we run two or more complete sampling runs for the same target distribution. If the ensembles generated are close then we have strong evidence that the ensembles are converged as each run started from different initial conditions and used different randomness.

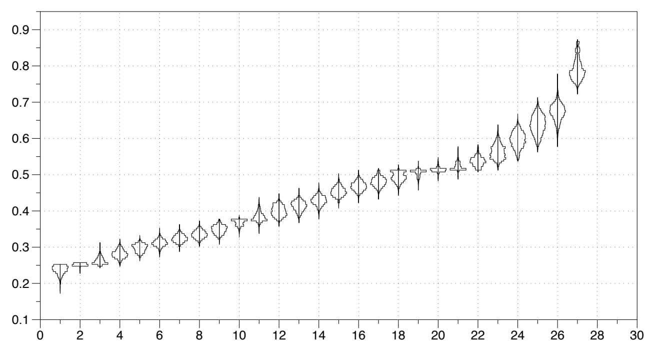


Figure 7.4.3: We compare the ranked ordered marginals on two independent parallel tempering runs.

8 Congressional Plan

As with the NC House and NC Senate plans, we place a probability distribution on Congressional plans for North Carolina. The distributions embody different policy choices. With each distribution, we produce representative ensembles of maps to serve as benchmarks against which to compare specific maps. The ensembles are generated by using the Metropolis-Hasting Markov Chain Monte Carlo Algorithm in a parallel tempering framework which employs the proposal from the Multiscale Forest RECOM algorithm [2, 1].

This analysis parallels the analysis already presented for the NC House and NC Senate with the simplification that we no longer need to consider County Clusters and that some of the criteria are modified. The details are given in Sections 8.1 and 7.2.

8.1 Congressional: Ensemble Overview

Similarly to the distribution placed on the NC Legislative redistricting plans in Section 4.4, we consider a distribution (and hence an ensemble) satisfying the following constraints:

- The maps split no more than 14 counties.
- The maps split no county into more than two districts.
- Districts traverse counties as few times as possible.
- All districts are required to consist of one contiguous region.
- The deviation of the total population in any district is within 1% of the ideal district population. We have verified in previous work in related settings that the small changes needed to make the districting plan have perfectly balanced populations do not change the results. (See [7] and the expert report in Common Cause v. Rucho).
- **Compactness**: The distributions on redistricting plans are constructed so that a plan with a larger total isoperimetric ratio is less likely than those with a lower total isoperimetric ratio. The total isoperimetric ratio of a redistricting plan is simply the sum of the isoperimetric ratios over each district. The isoperimetric ratio is the reciprocal of the Polsby-Poper score; hence, smaller isoperimetric ratio corresponds to larger Polsby-Poper scores. As the General Assembly stated in its guidance that the plans should be compact according to the Polsby-Popper score [9], we tuned the distribution so that it yields plans of a similar compactness to those of the legislature. (See Figure 10.2.1 in Section 10.2.) We further limited our distribution only to include those with an Isoparametric score less than 80.

  The legislature also listed the Reock score as another measure of compactness which one could consider. However, we have found Polsby-Popper/isoperimetric score to be a better measure when generating districts computationally. In our previous work, we have seen that this choice did not qualitatively change our conclusions (see [7] and the expert report in Common Cause v. Rucho).

8.2 Congressional Plan: Sampling Method

We have chosen the distribution from which to draw our ensemble to comply with the desired policy and legal considerations. It is well accepted that not all distributions on possible redistricting plans are equally easy to sample from.

As discussed in Section 7.1 to effectively generate a representative ensemble of maps from these distributions, we use the well-established method of parallel tempering. It allows one to effectively sample from a possibly difficult to sample distribution by connecting it to an easy to sample distribution through a sequence of intermediate "interpolating" distributions.

We connect our desired distributions, which includes a compactness score, to a measure on redistricting plans which is uniform on spanning forests which satisfy the population and county constants. Furthermore, the enacted plan can be effectively sampled using a variation on the Metropolized Multiscale Forest RECOM sampling algorithm outlined in [1, 2].

In sampling the interpolating ladder of distributions between the easier-to-sample measure and our target measure which includes a compactness score, we use parallel tempering with a classical Metropolis-Hasting sampling scheme to sample each level of the interpolating ladder of distributions. As proposals in the Metropolis-Hasting sampling scheme, we use Multiscale Forest RECOM proposals. We sample around 80,000 plans have confirmed that the distribution seems well mixed and than it has been sufficiently sampled to provide stable statistics.

8.3 Election Data Used in Analysis

The same historic elections and abbreviations were use to analyze the congressional plan and ensemble as were used for the NC legislative maps and ensemble. See Section 4.6.

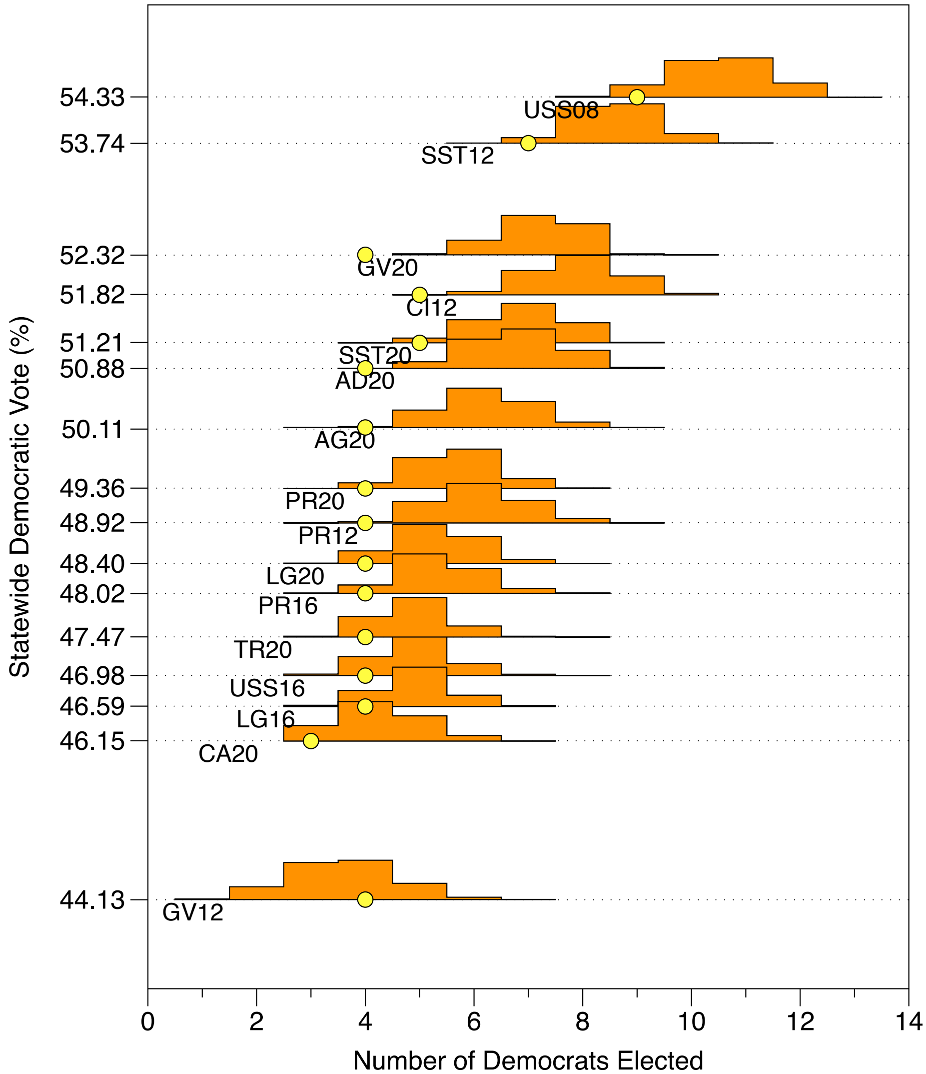


Figure 9.0.1: Each histogram represents the range and distribution of possible Democratic seats won in the ensemble of plans; the height is the relative probability of observing the result. The yellow dots represent the results from the enacted congressional plan under the various historic votes.

9 Congressional Plan: Main Analysis

Figure 9.0.1 gives the *Collected Seat Histograms* for the ensemble sampled from the distribution. This figure also shows how many Democrats the enacted congressional plan would have elected under the votes from a variety of historic elections.

Without reference to a particular ensemble, a primary message of this plot is that the enacted congressional plan is largely stuck electing 4 of 14 Democrats despite large shifts in the statewide vote fraction and across a variety of election structures. Over the statewide vote Democratic partisan vote range of 46.59% to 52.32%, the enacted map only twice changes the number of Republicans elected. The outcome of the election is largely stuck at 4 Democrats. This shows the enacted map to be highly non-responsive to the changing opinion of the electorate. Without holding the election one largely knows that the result will be 10 Republicans and 4 Democrats.

This non-responsiveness is not observed in the ensemble. The ensemle shows that a typical map drawn without political considerations gradually shift from 4-5 Democrats typically being elected at one end of this regime to 7-8 being elected at the other end. Hence, under historic elections in which Democrats win 46% to 53% of the statewide vote, a typical map would gradually shift from around 4 Democrats in the NC congressional delegation to around 8 Democrats as the electorate changed is vote. This does not happen under the enacted plan with the elections considered. Instead, as described above, the enacted map sticks at only 4 Democrats in North Carolina's congressional delegation under nearly all of these elections.

To better illuminate the structure responsible for making the enacted map an extreme outlier, we turn to the Rank Ordered Box plots already discussed in general in Section 3.4 and in the context of the state legislative maps in the previous sections. The plots show extreme packing of Democrats in the three most Democratic districts and depletion of Democrats from the

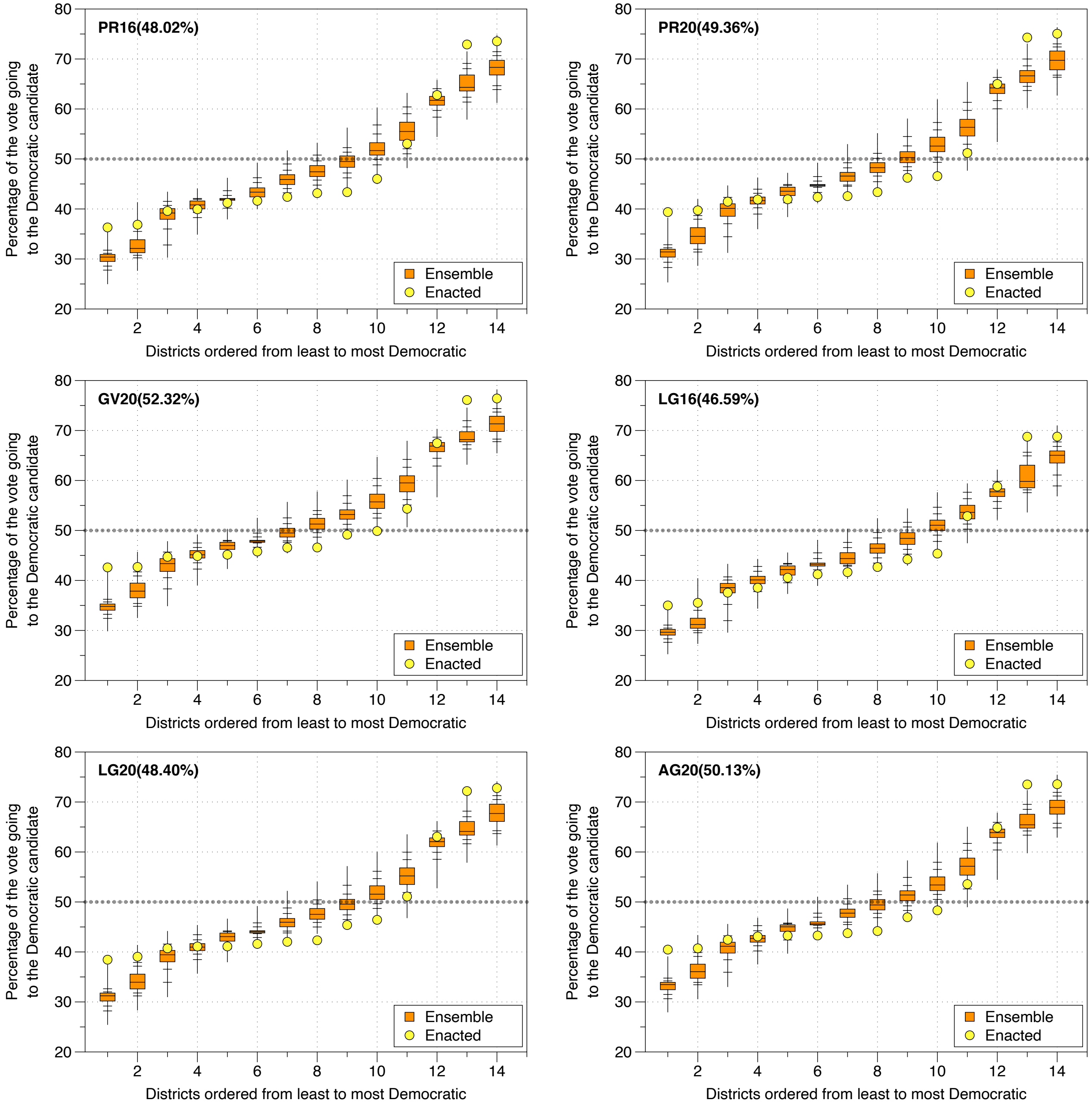


Figure 9.0.2: The Ranked Marginal Box-plots for the NC Congressional Plan. The ranked ordered marginals for the enacted map are shown in yellow. 50% of the ensemble is contained within the box. Inside the first pair of tick marks is 80% of the data and inside the second set is 95% of the points.

next 7 to 9 most Democratic districts. The effect of this cracking and packing is the non-responsiveness seen in Figure 9.0.1.

Motivated by the cracking and packing of Democrats shown in Figure 9.0.1, we ask how common is such a highly polarized districts in our non-partisan ensemble of maps. The results are summarized in Table 4. They show that the Congressional map is not only non-responsive to the changing preferences of the electorate but it is also an extreme partisan gerrymander. Maps which lock in such an extreme partisan outcome do not occur in our ensemble.

Election	Plans with the same or more Dem (1-2)	Plans with the same or more Rep (5-11)	Plans with the same or more Dem (12-14)	Total Plans
LG16	18	0	0	79997
PR16	0	0	0	79997
CA20	0	0	0	79997
TR20	0	0	0	79997
LG20	0	0	0	79997
USS20	0	0	0	79997
CL20	0	0	0	79997
PR20	0	0	0	79997
AG20	0	0	0	79997
AD20	0	0	0	79997
SST20	0	0	0	79997
GV20	0	0	0	79997
CI20	0	0	0	79997
USS16	0	0	0	79997
GV16	1	0	0	79997
AG16	15	0	0	79997

Table 4: Over the approximately 80,000 plans in our ensemble, we ask how many plans have (1) as high Democratic fraction in the two most Republican districts, (2) as small a fraction of Democrats in the 5th through 11th most Republican districts, and (3) have as high a Democratic fraction in the 12th through 14th most Republican districts. The answer is given in this table along with the total number of plans in our ensemble.

10 Congressional: Additional Details

10.1 Congressional Plan: Mathematical Description of Ensemble Distribution

In specifying our distribution, we have chosen to define explicit distributions and then use an implementation of the Metropolis-Hastings algorithm to generate the ensemble. We feel this choice promotes transparency because an explicit distribution can better be discussed and critiqued. It also allows us to more explicitly translate the policy considerations into the ensemble.

In order to formally define our distributions, the partition of the precinct adjacency graph into a spanning forest $\mathcal{T}$ with 14 district trees $\{\mathcal{T}_1, \cdots, \mathcal{T}_{14}\}$ corresponding to each district. Hence $\mathcal{T} = \{\mathcal{T}_1, \cdots, \mathcal{T}_{14}\}$ completely specifies the redistricting.

If we let $A_j(\mathcal{T})$ and $B_j(\mathcal{T})$ be respectively the surface area and perimeter (or length of the boundary) of the j-district then our compactness score is

$$J_{\text{compact}}(\mathcal{T}) = \sum_{j=1}^{14} \frac{A_j(\mathcal{T})}{B_j^2(\mathcal{T})}.$$

Then the probability of drawing the spanning forest $\mathcal{T}$ is

$$\text{Prob}(\mathcal{T}) = \begin{cases} \frac{1}{Z} e^{-w_{\text{compact}} J_{\text{compact}}(\mathcal{T})} & \text{for } \mathcal{T} \text{ which is allowable} \\ 0 & \text{for } \mathcal{T} \text{ which is not allowable} \end{cases}$$

Here Z is a number which makes the sum of Prob($\mathcal{T}$) over all spanning forests with 14 trees equal to one.

The collection of allowable spanning forests $\mathcal{T}$ is defined as those which produce redistricting plans which satisfy the following conditions:

1. all districts are connected
2. the populations of each district is within %1 of the ideal district population.
3. No more than 14 counties are split with no county split more once.
4. We minimize the occurrence of districts traversing county boundaries.

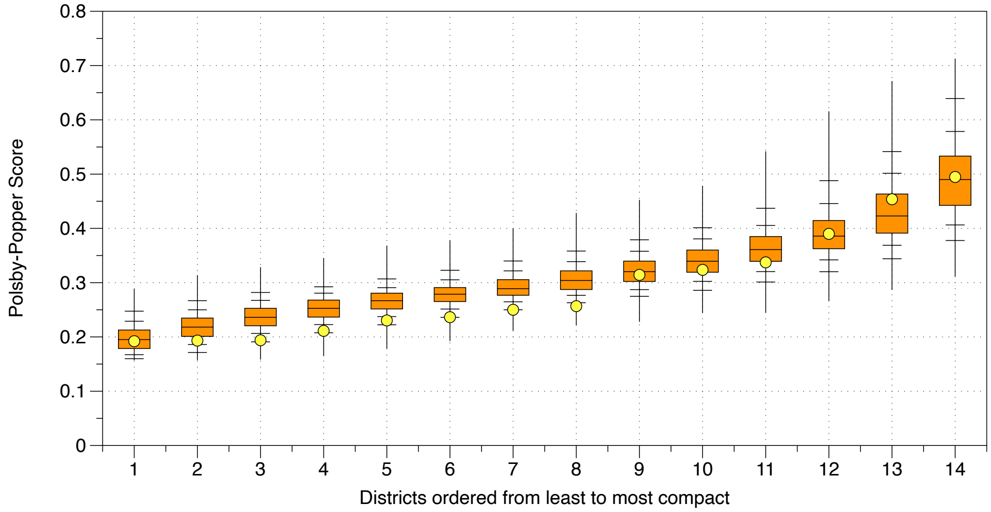


Figure 10.2.1: The yellow dots display the ordered Polsby-Popper score of the 14 districts in the enacted plan.

10.2 Congressional Plan: Additional Ensemble Statistics

In Figure 10.2.1, we give the box-plots for the ranked ordered marginal distribution for the compactness score, namely the Polsby-Popper score (see companion methods document). We compare the ensemble of plans with the enacted plan.

10.3 Congressional Plan: Convergence Tests

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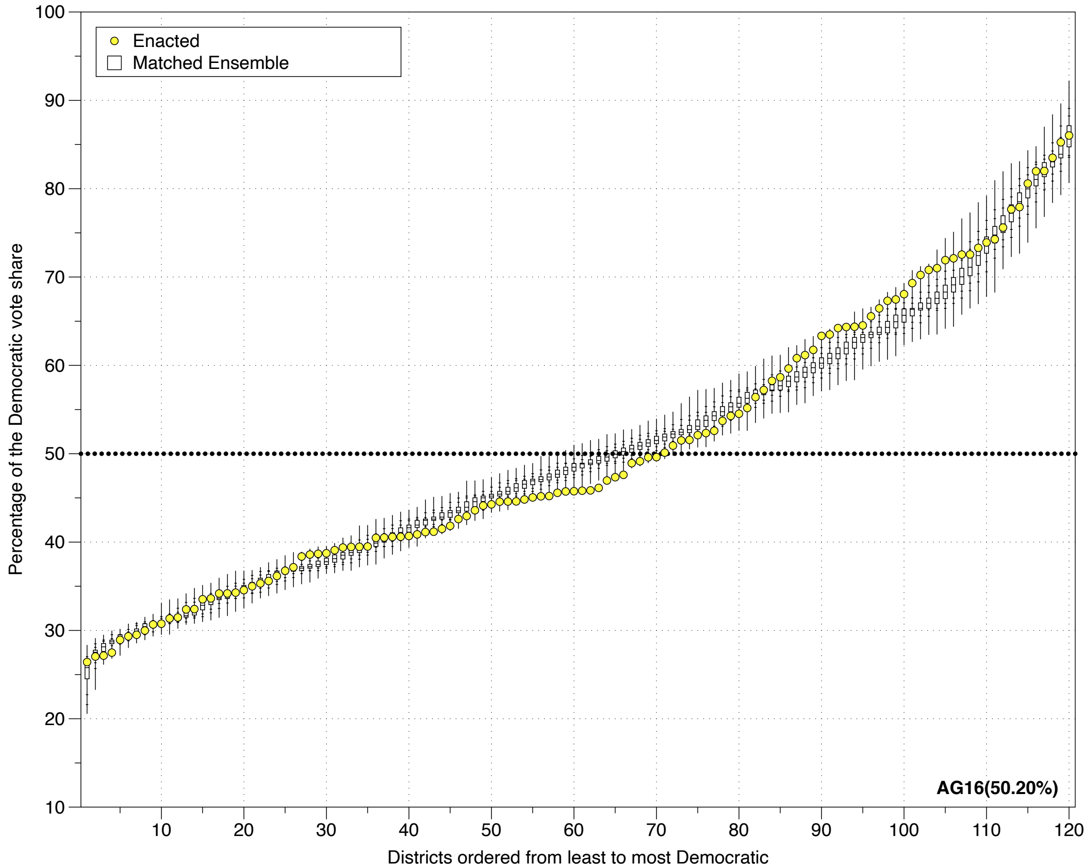
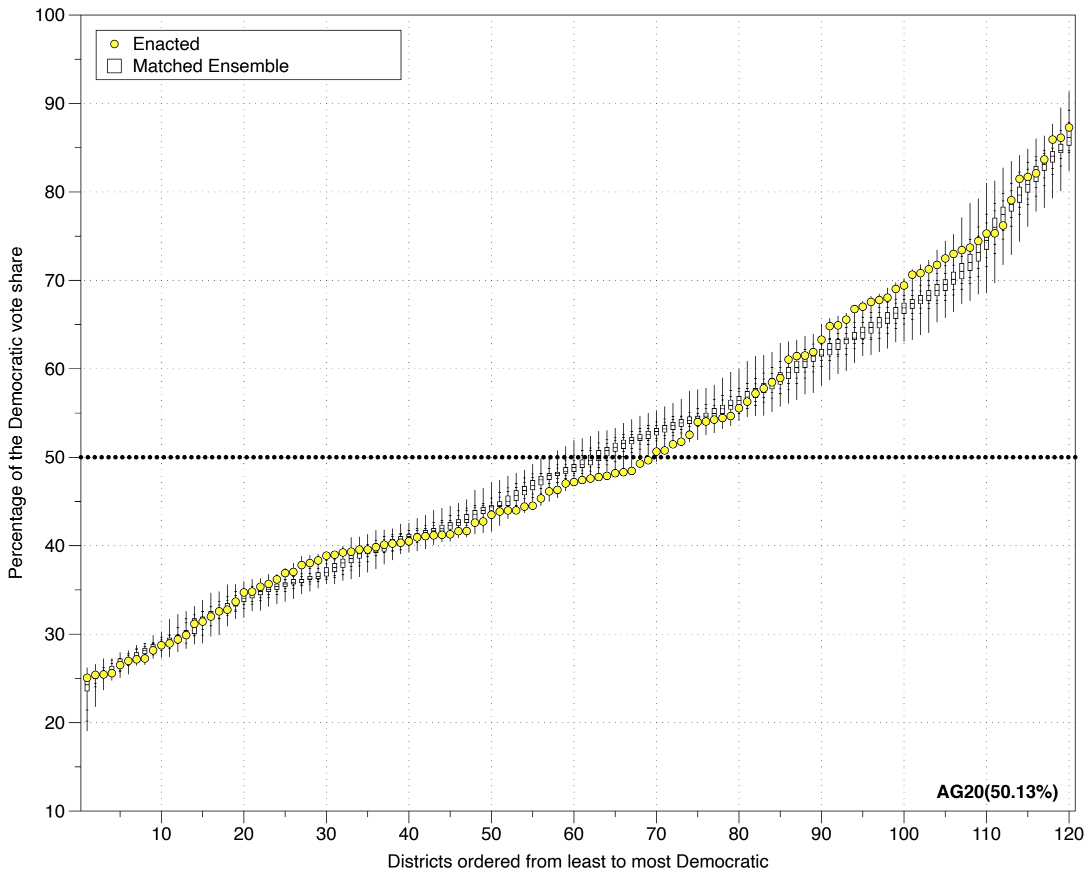
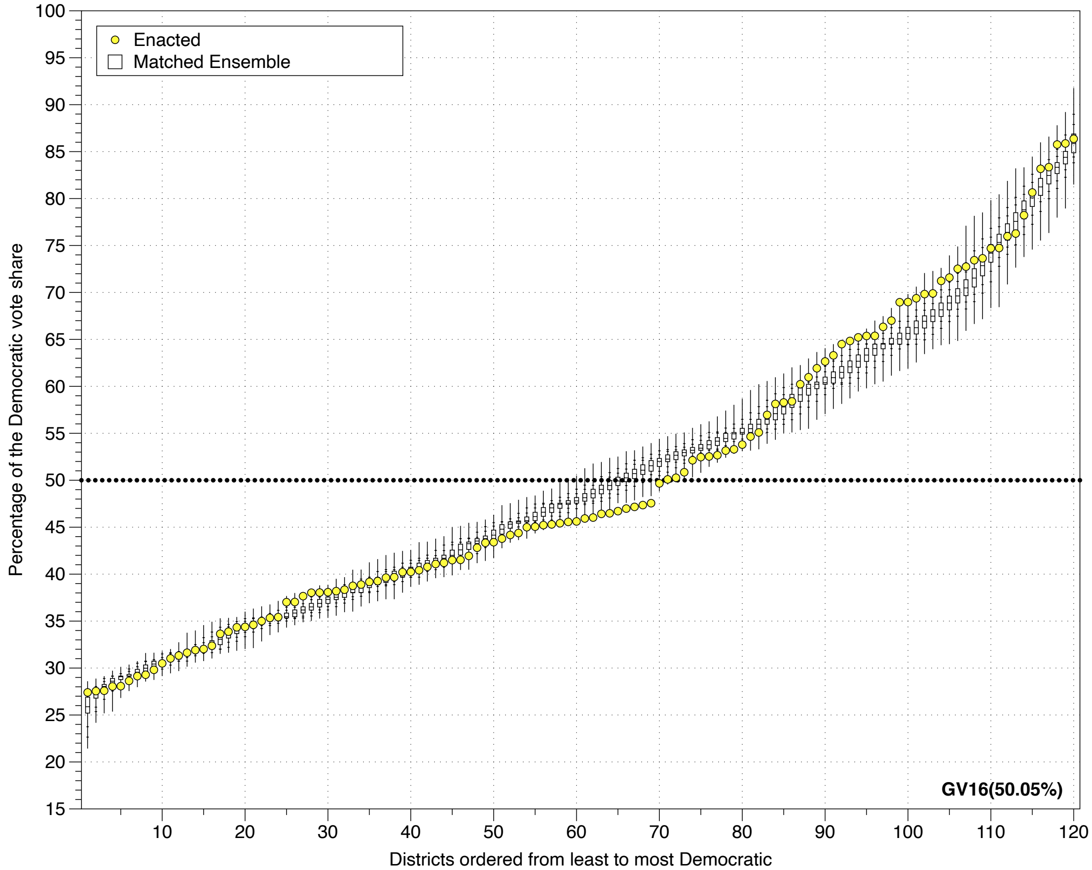
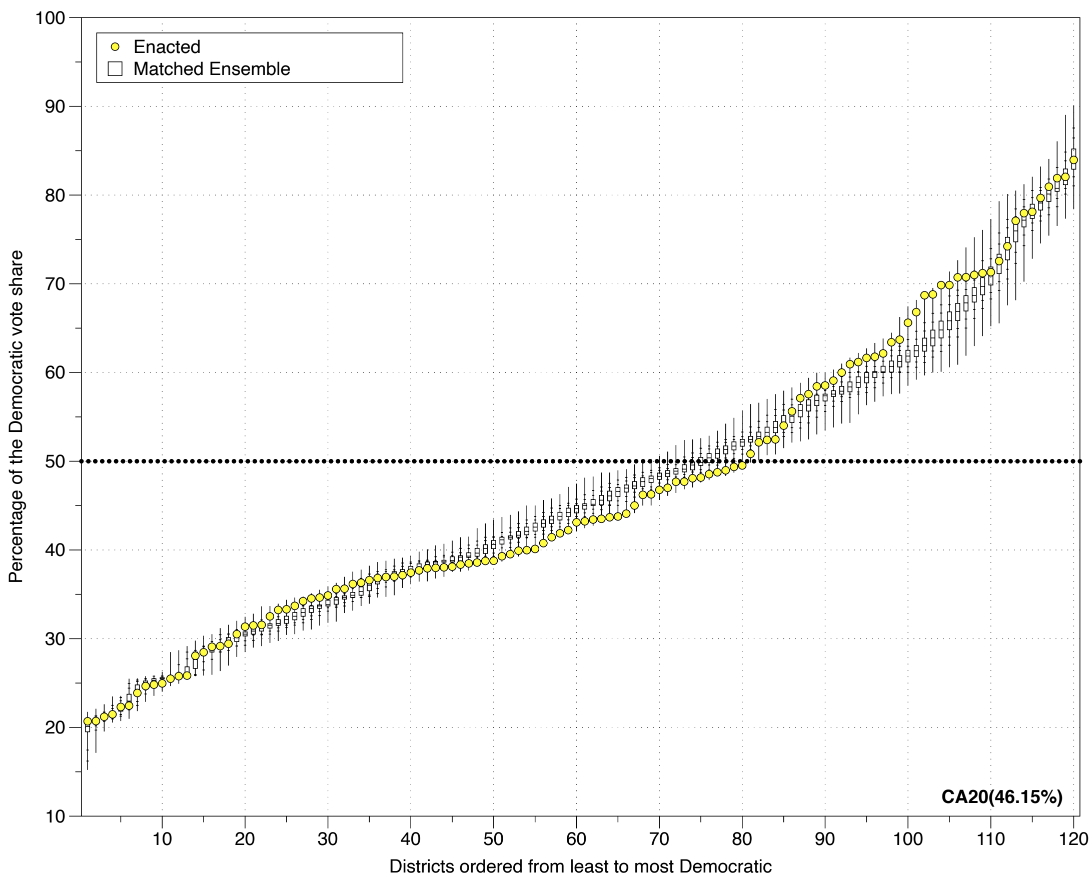
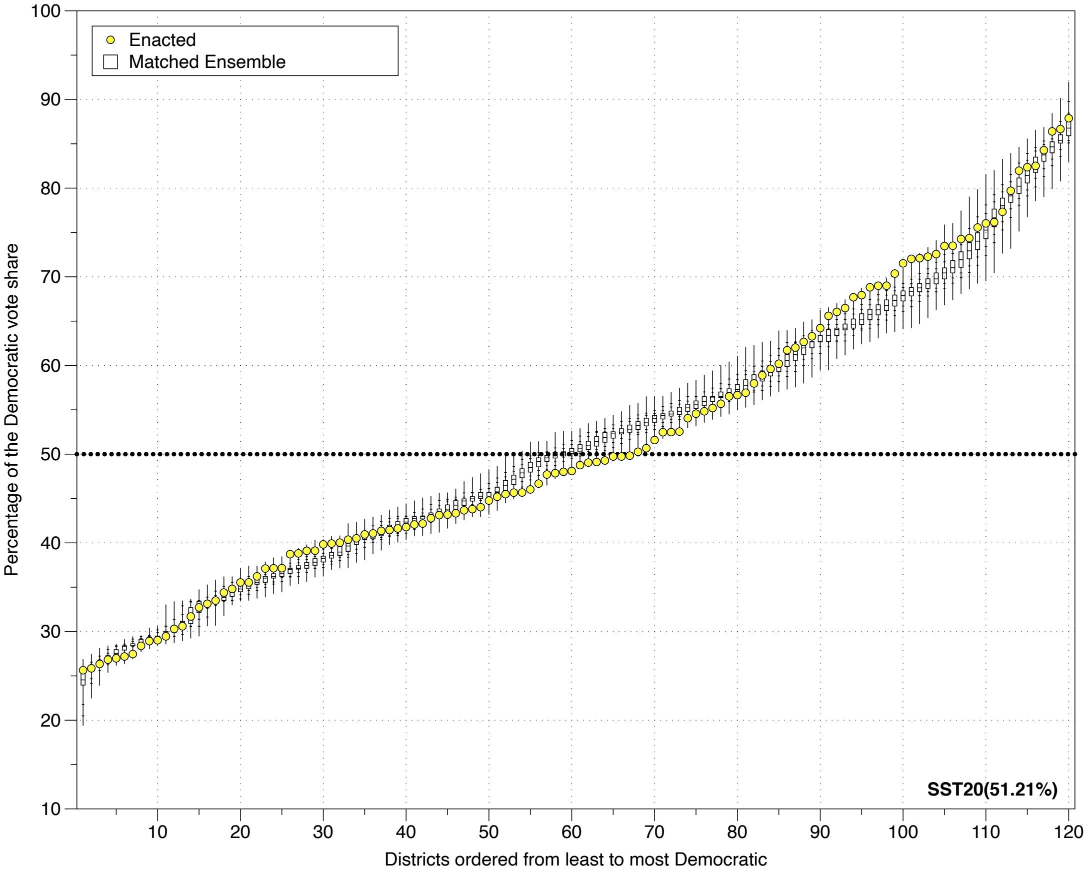
A NC House: Ranked-Ordered Marginal Boxplots

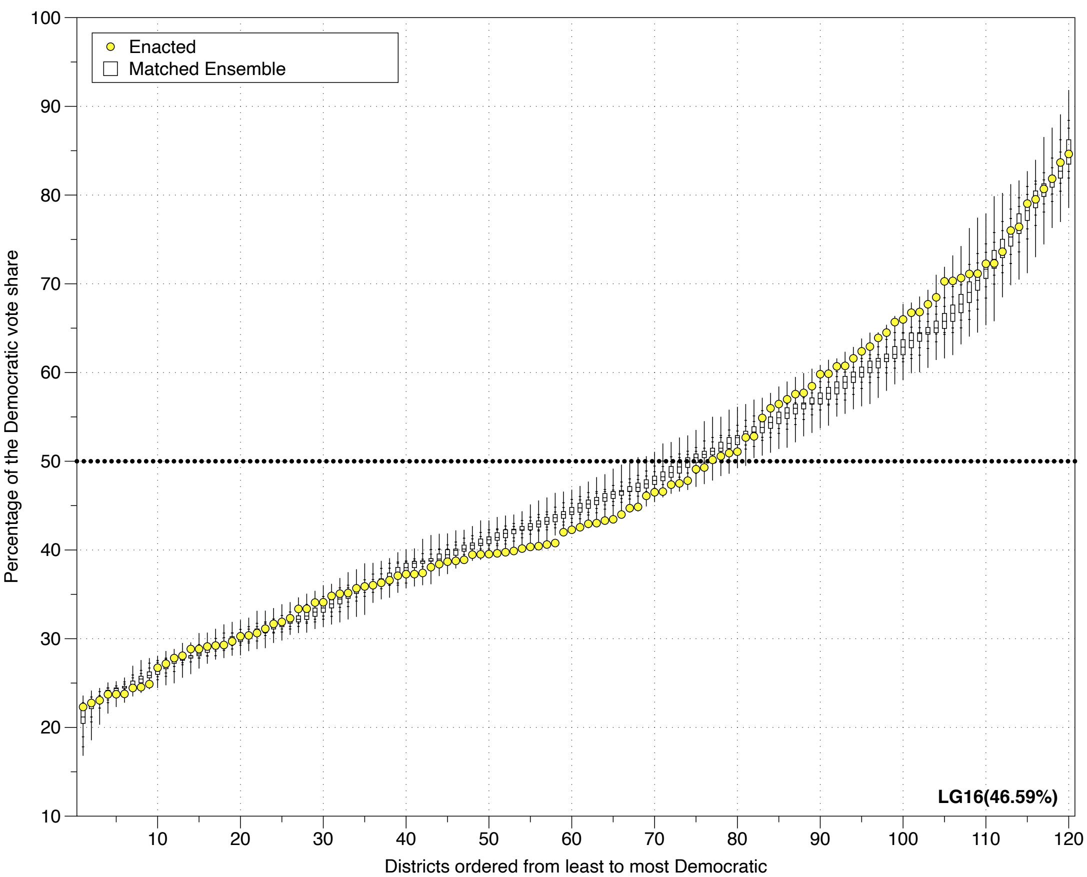


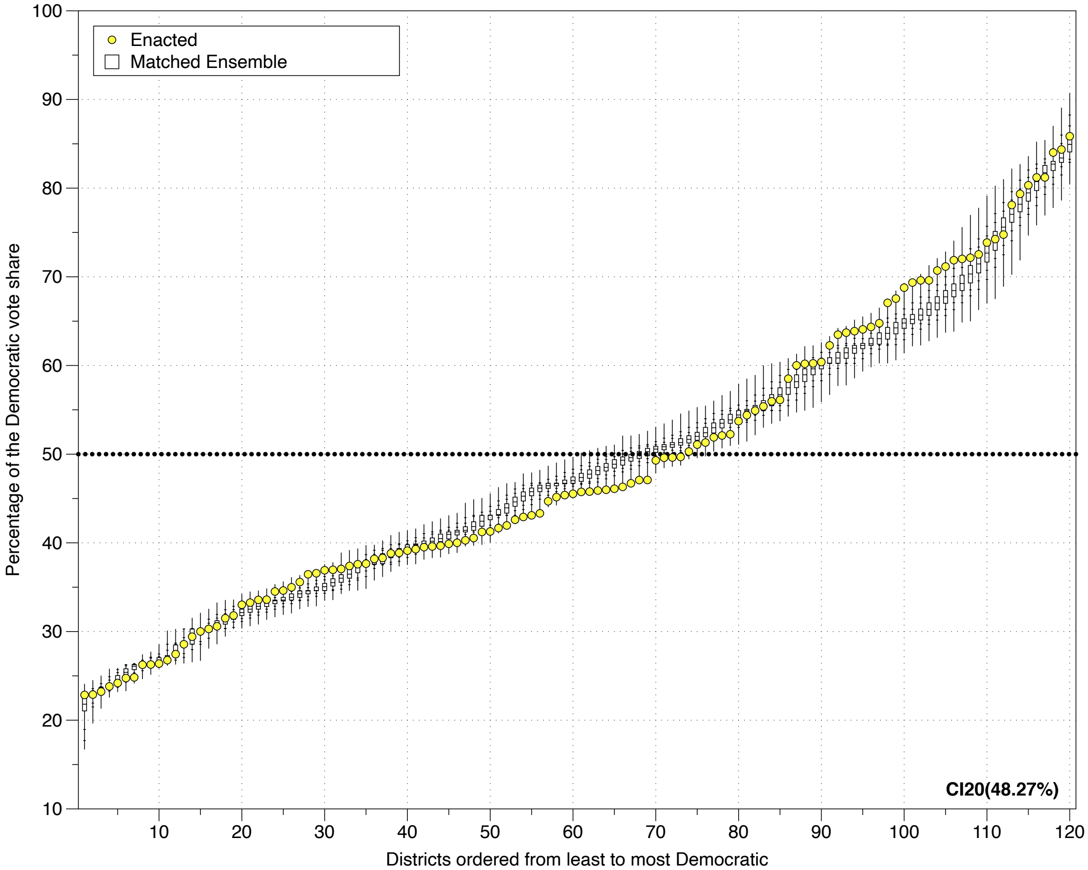


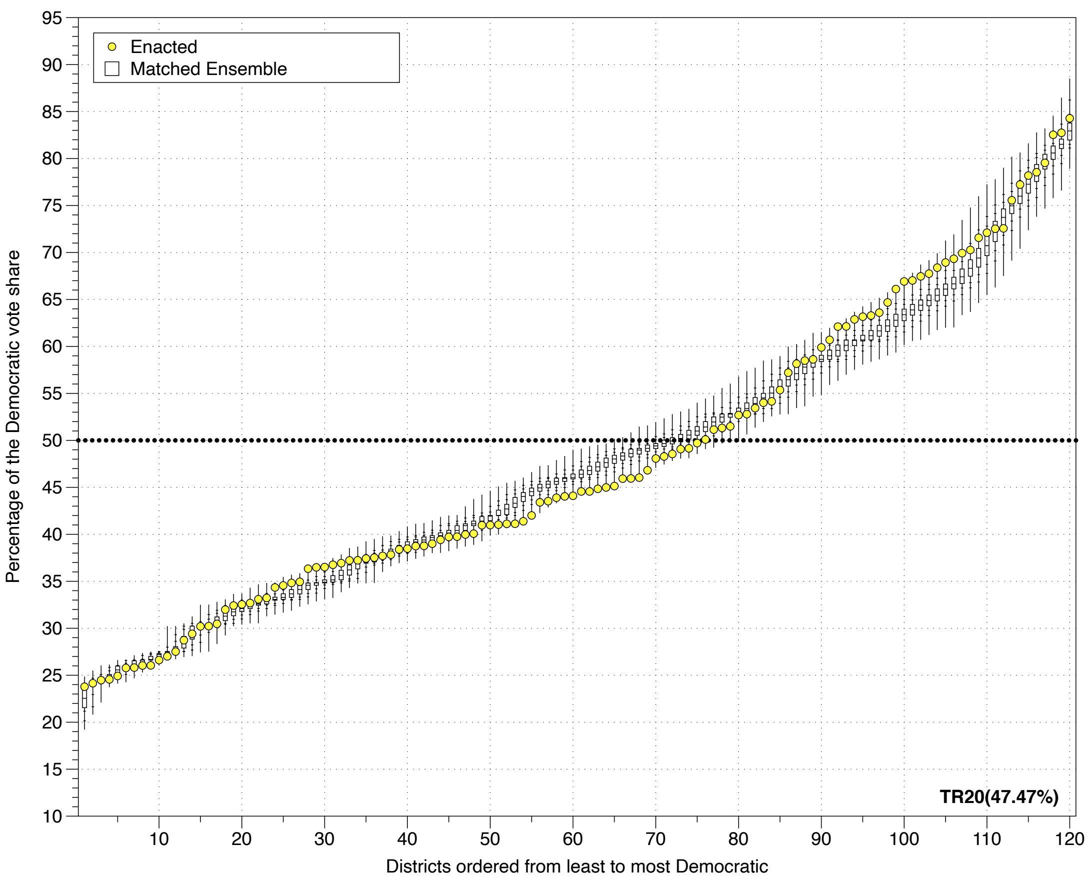

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
GV16(50.05%)

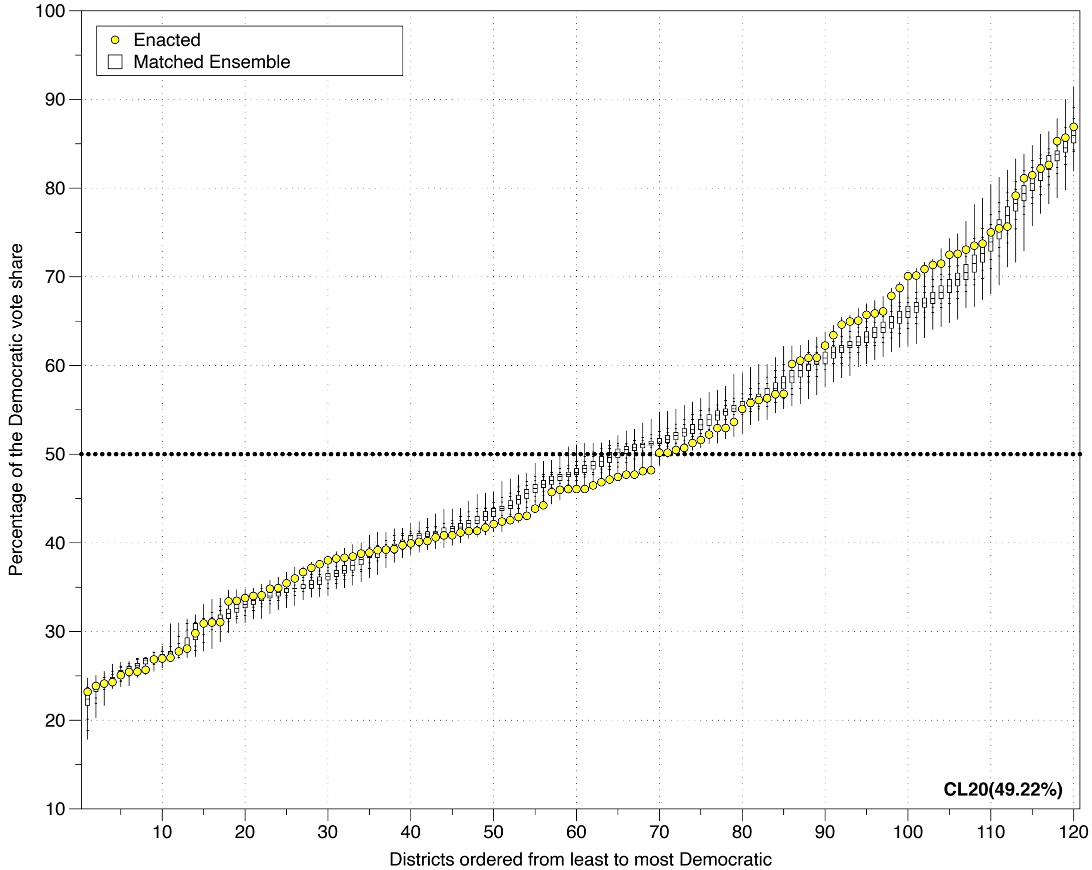

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
CA20(46.15%)

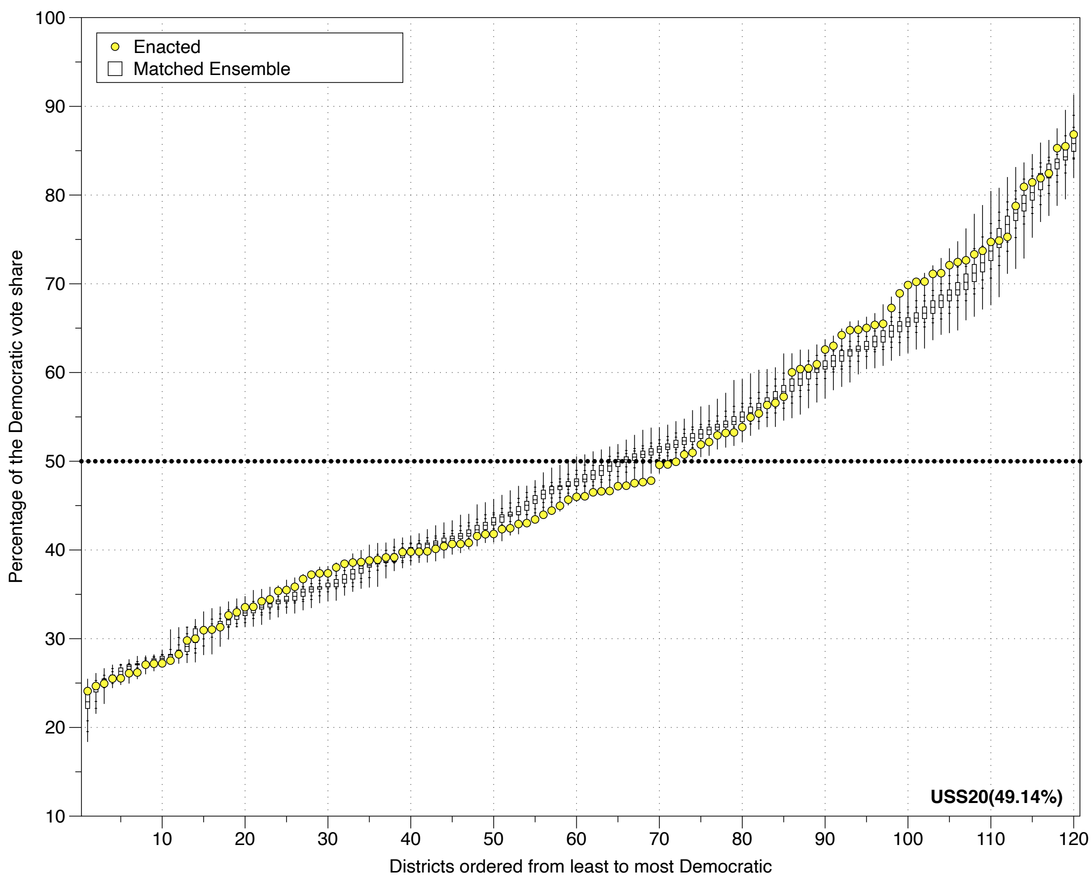

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
SST20(51.21%)
100
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
110
120

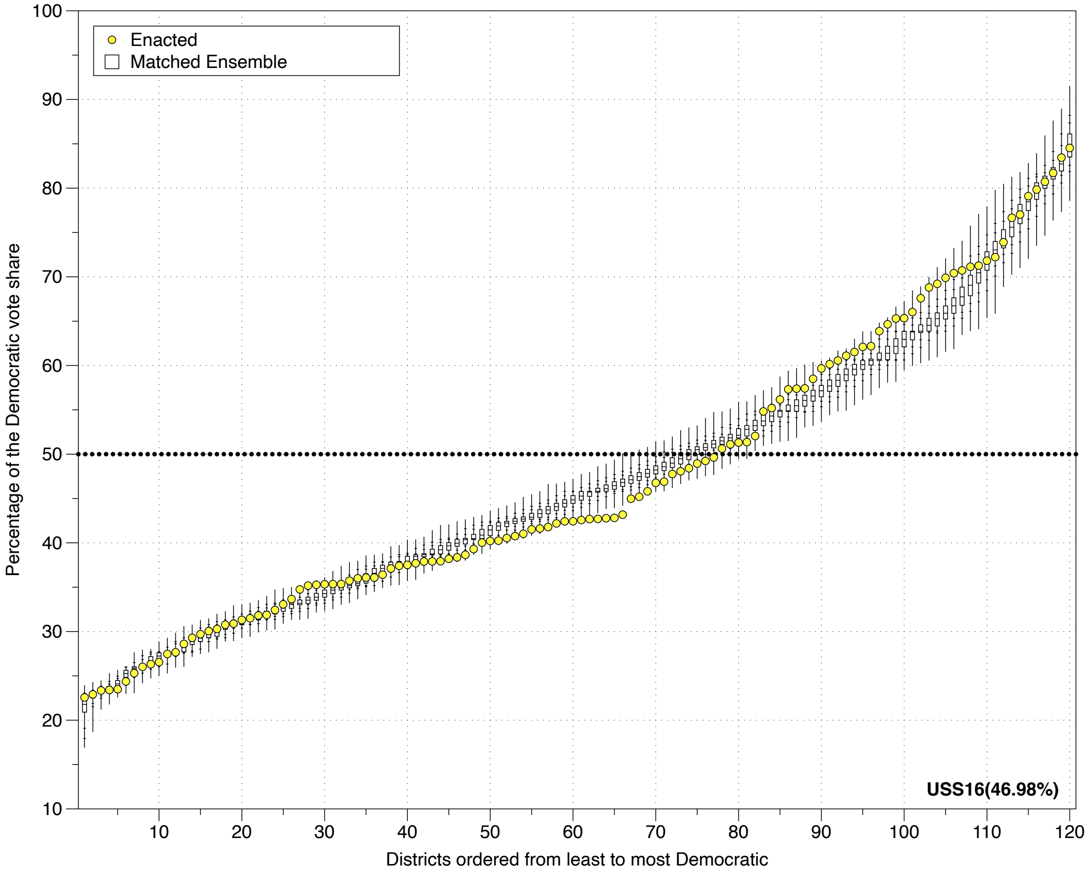

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
LG16(46.59%)
100
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
110
120

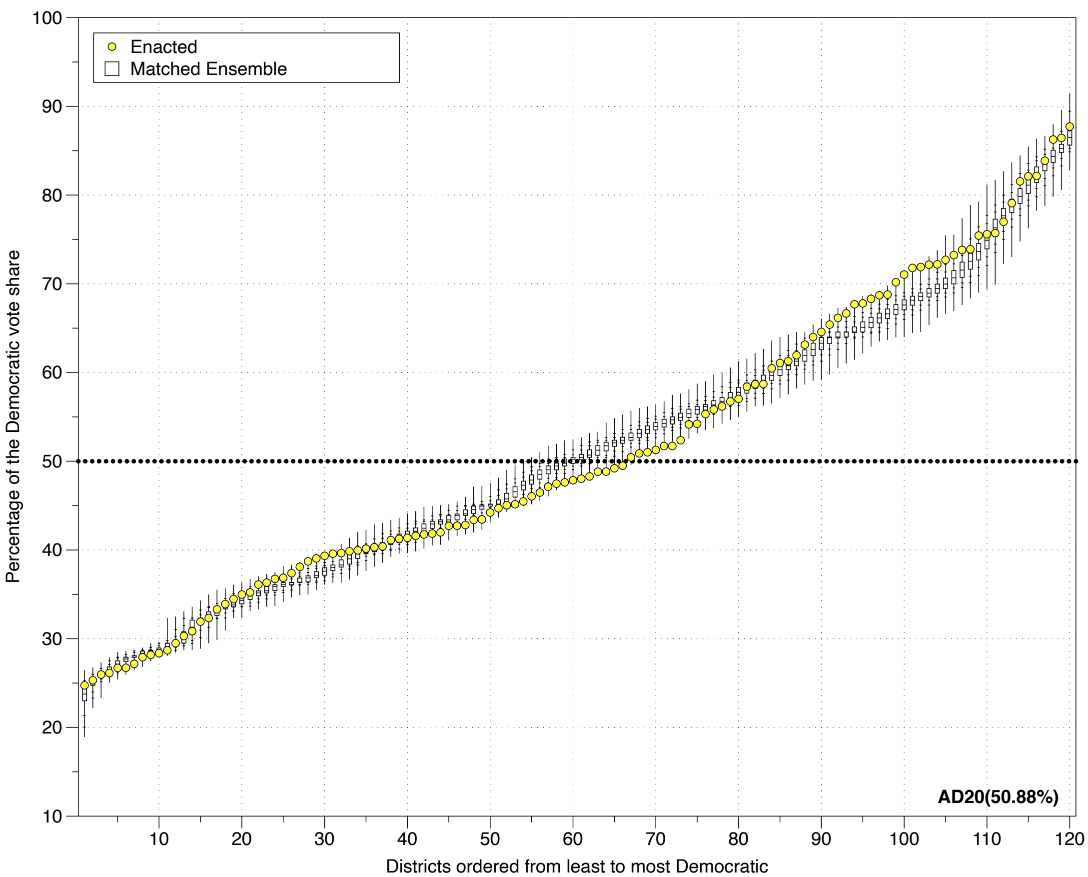

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
CI20(48.27%)
100
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
110
120

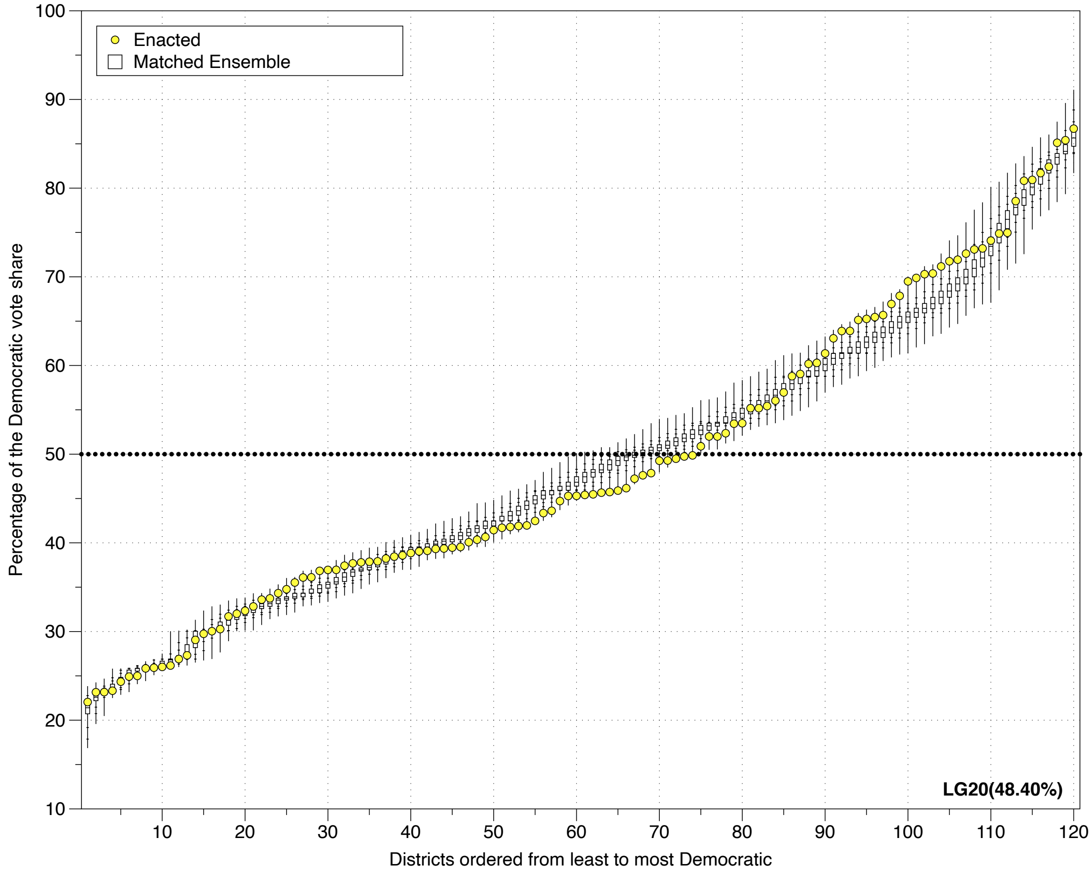

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
TR20(47.47%)
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
10
20
30
40
50
60
70
80
90
100
110
120


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
CL20(49.22%)

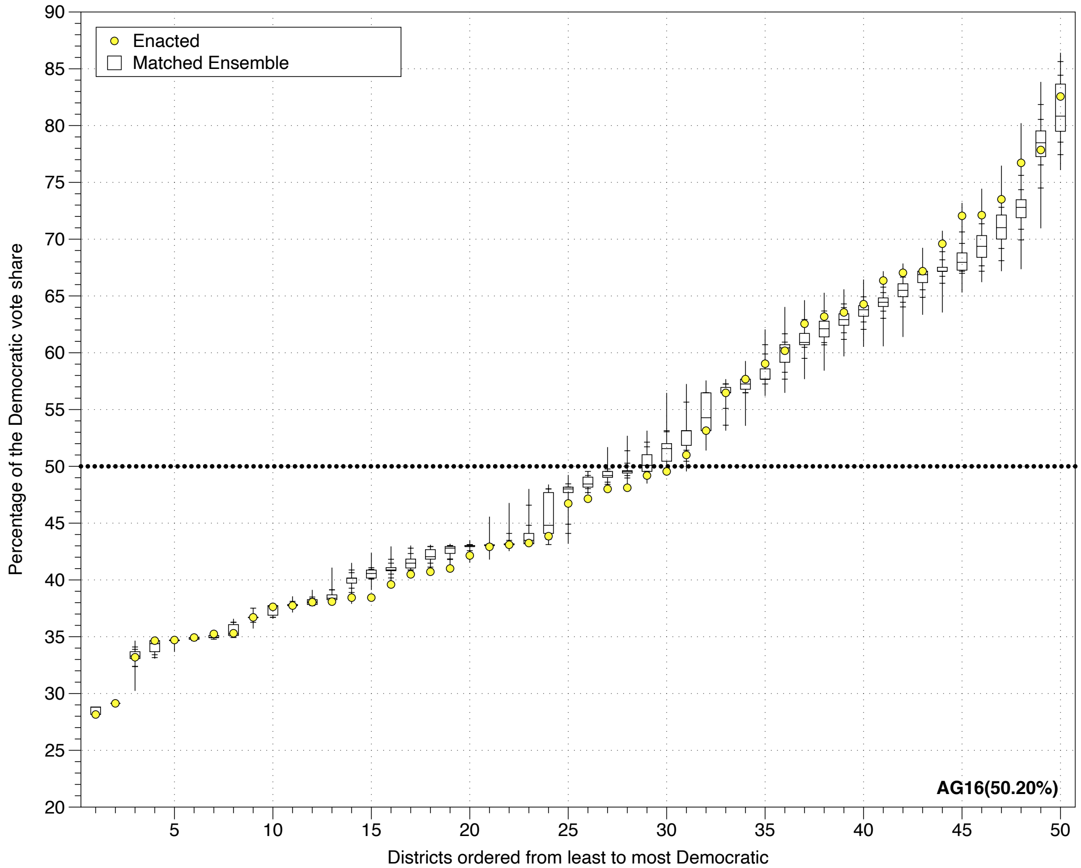

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
USS20(49.14%)

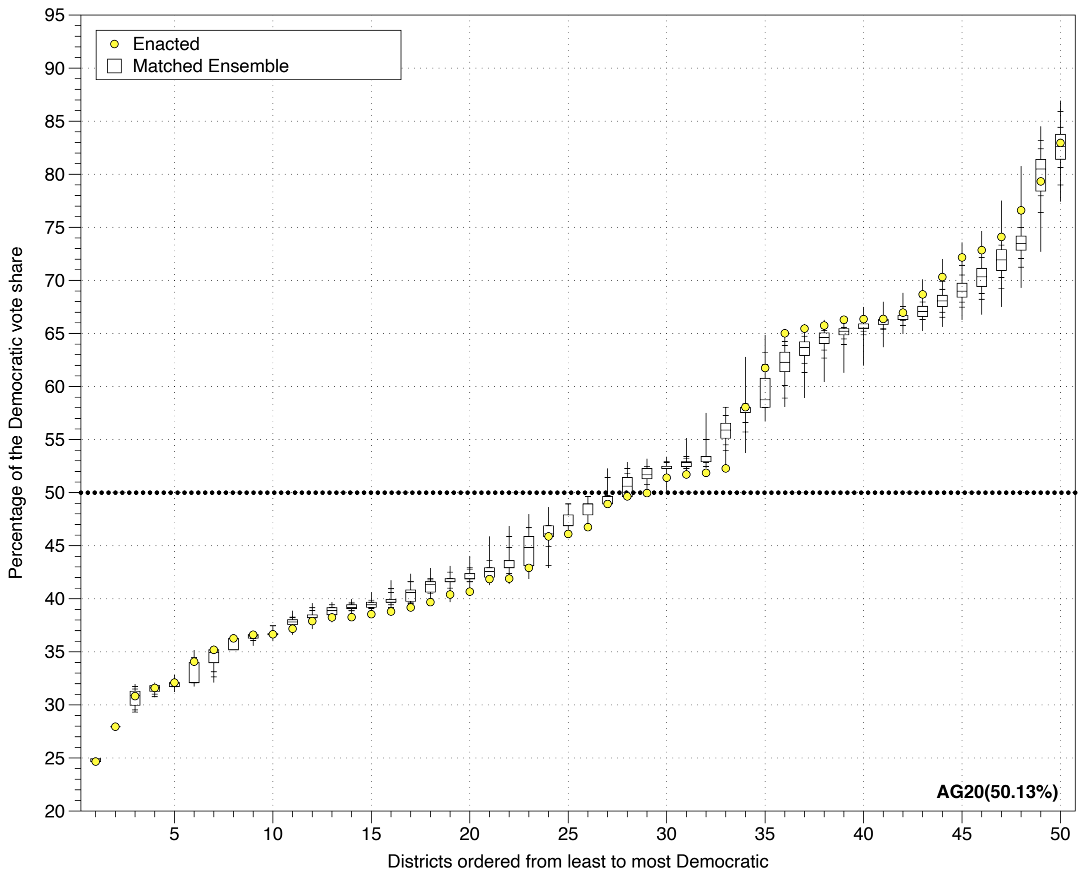

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
USS16(46.98%)
100
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
110
120

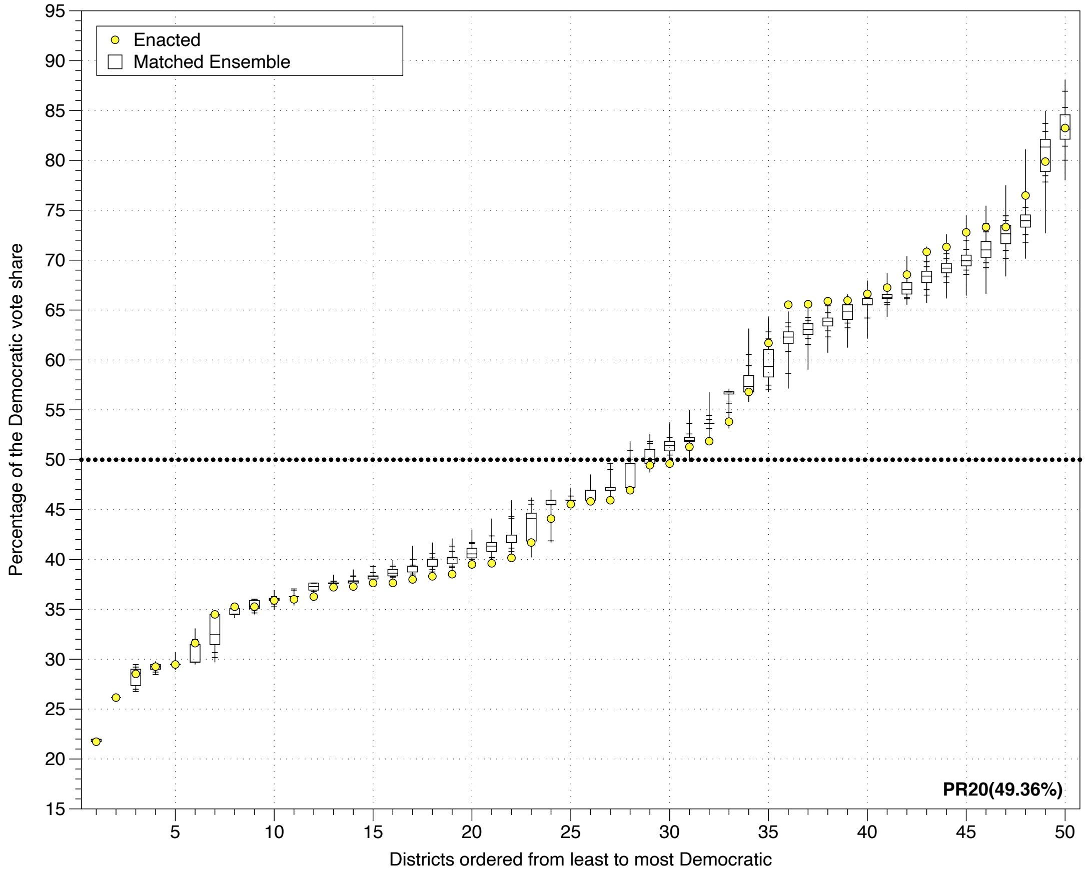

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
AD20(50.88%)
100
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
110
120

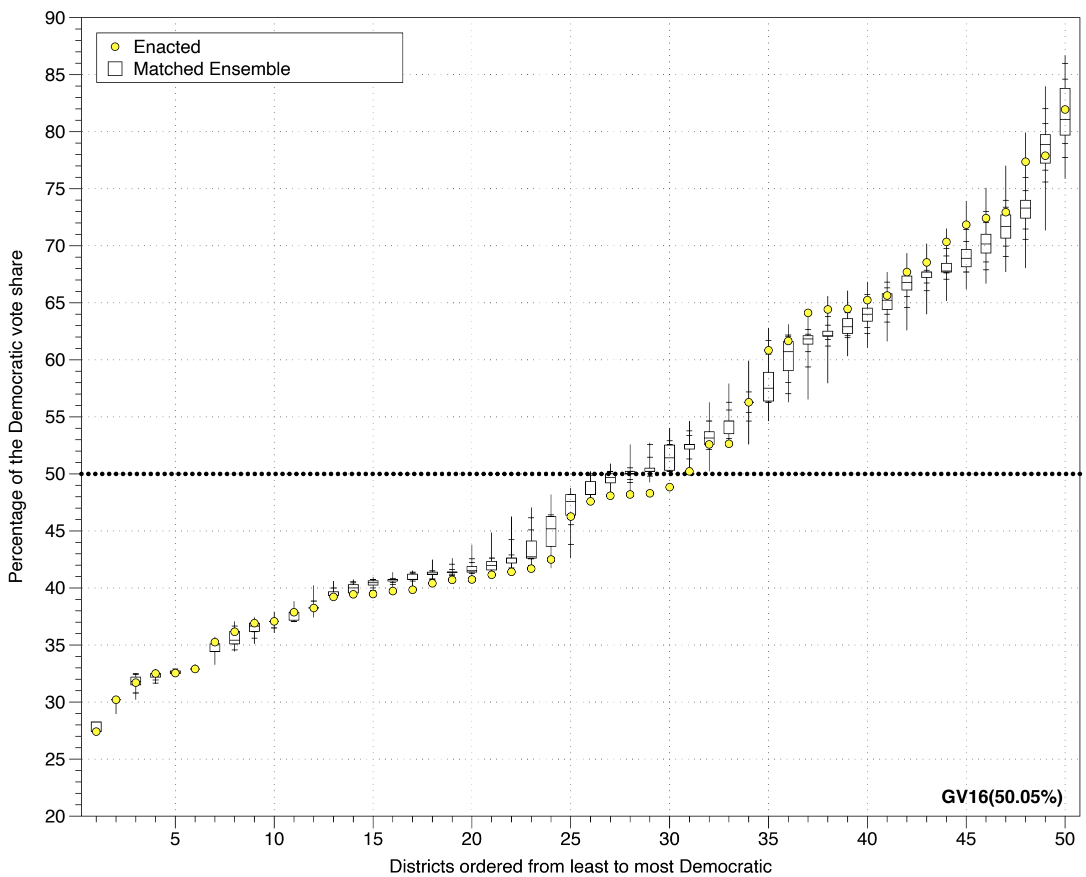

Enacted
Matched Ensemble
LG20(48.40%)
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
100
90
80
70
60
50
40
30
20
10
10
20
30
40
50
60
70
80
90
100
110
120

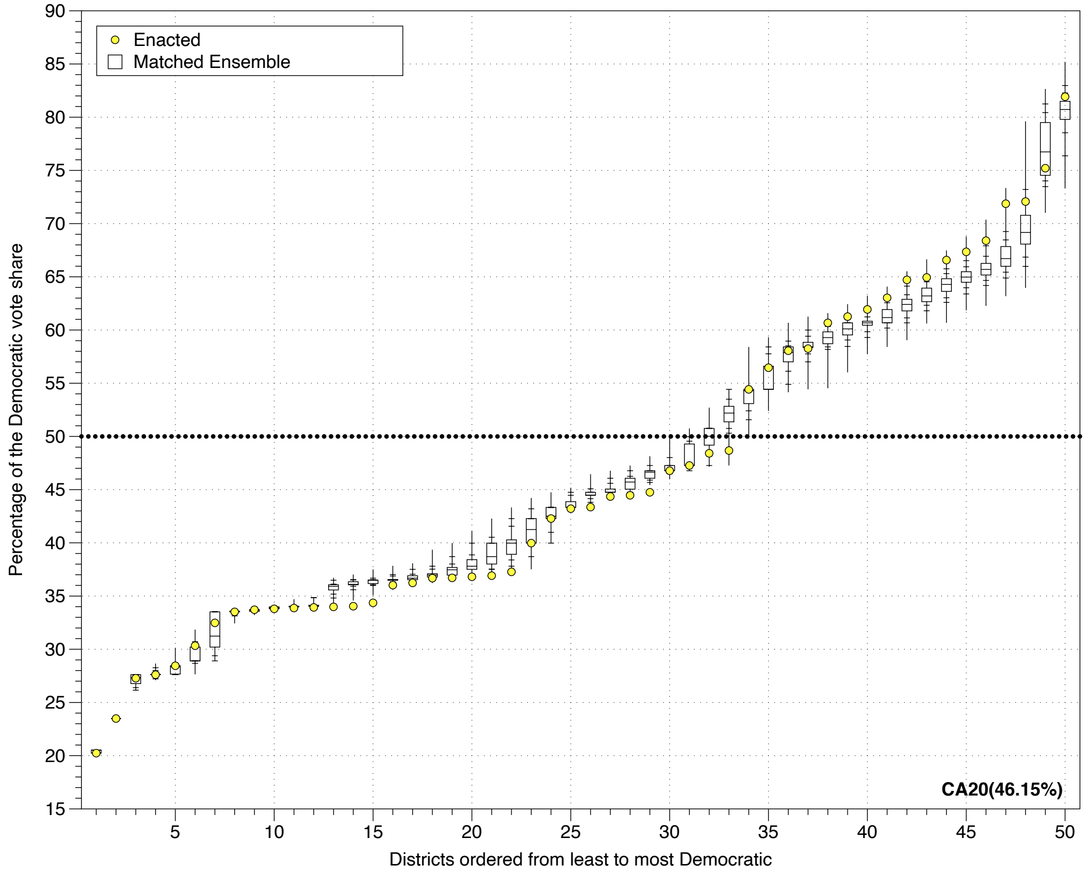
B NC Senate: Ranked-Ordered Marginal Boxplots

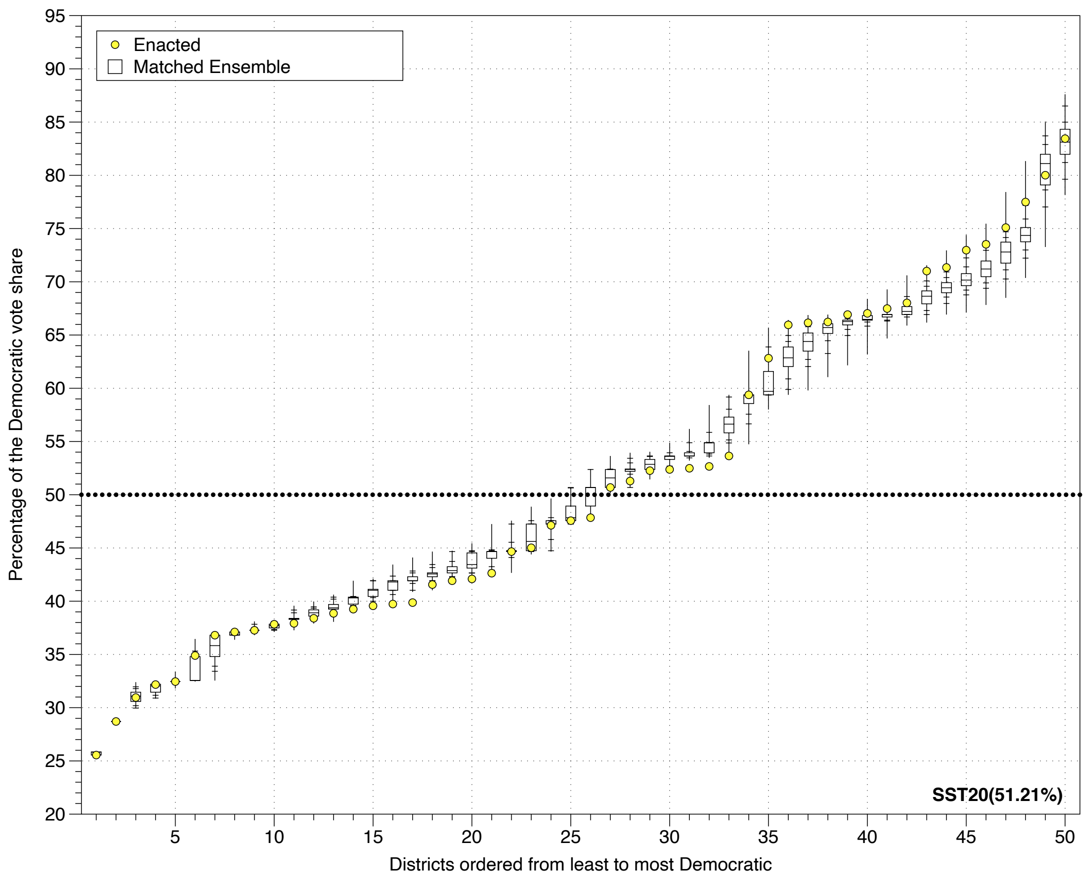


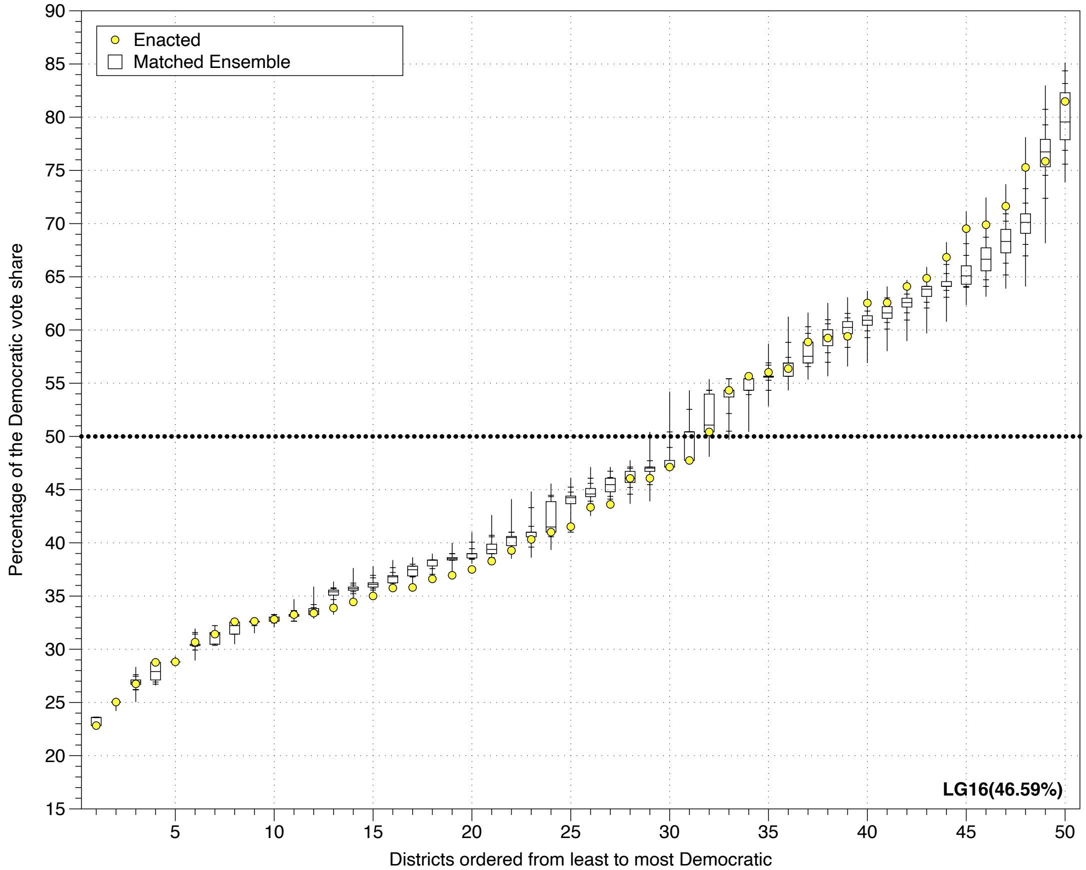


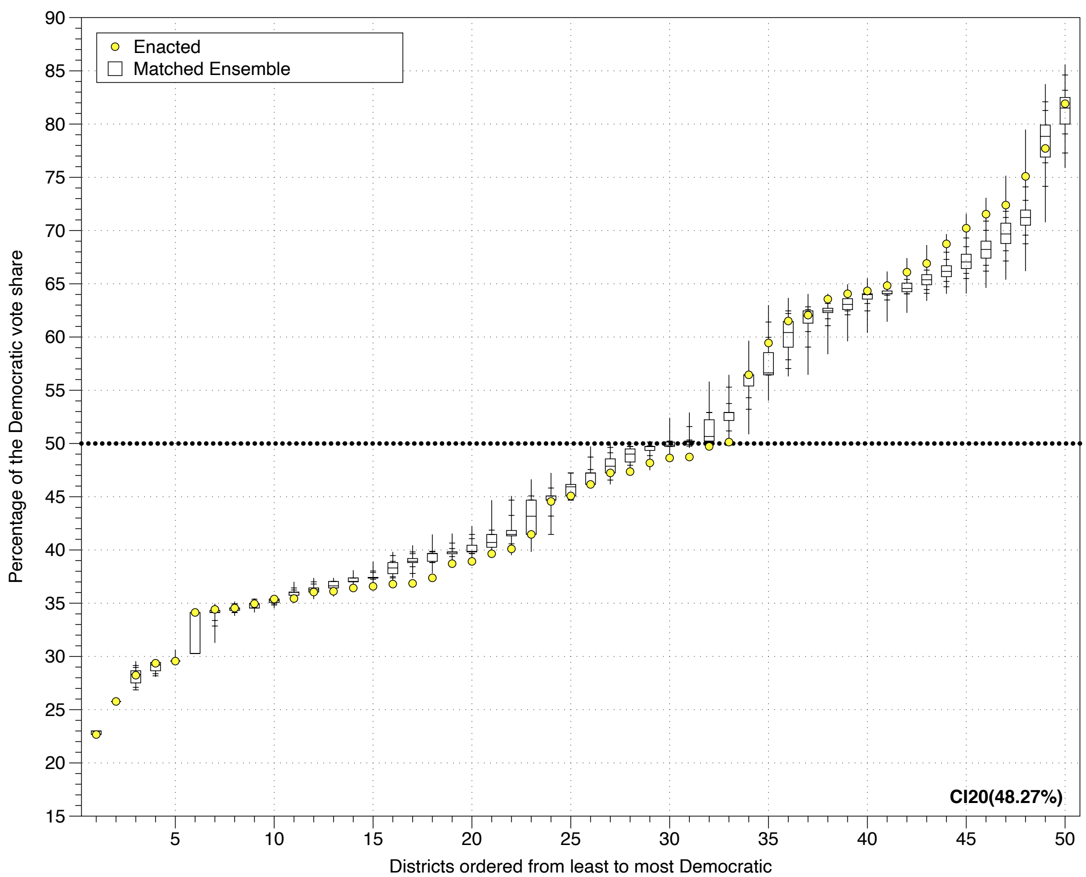

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
PR20(49.36%)
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
5
10
15
20
25
30
35
40
45
50

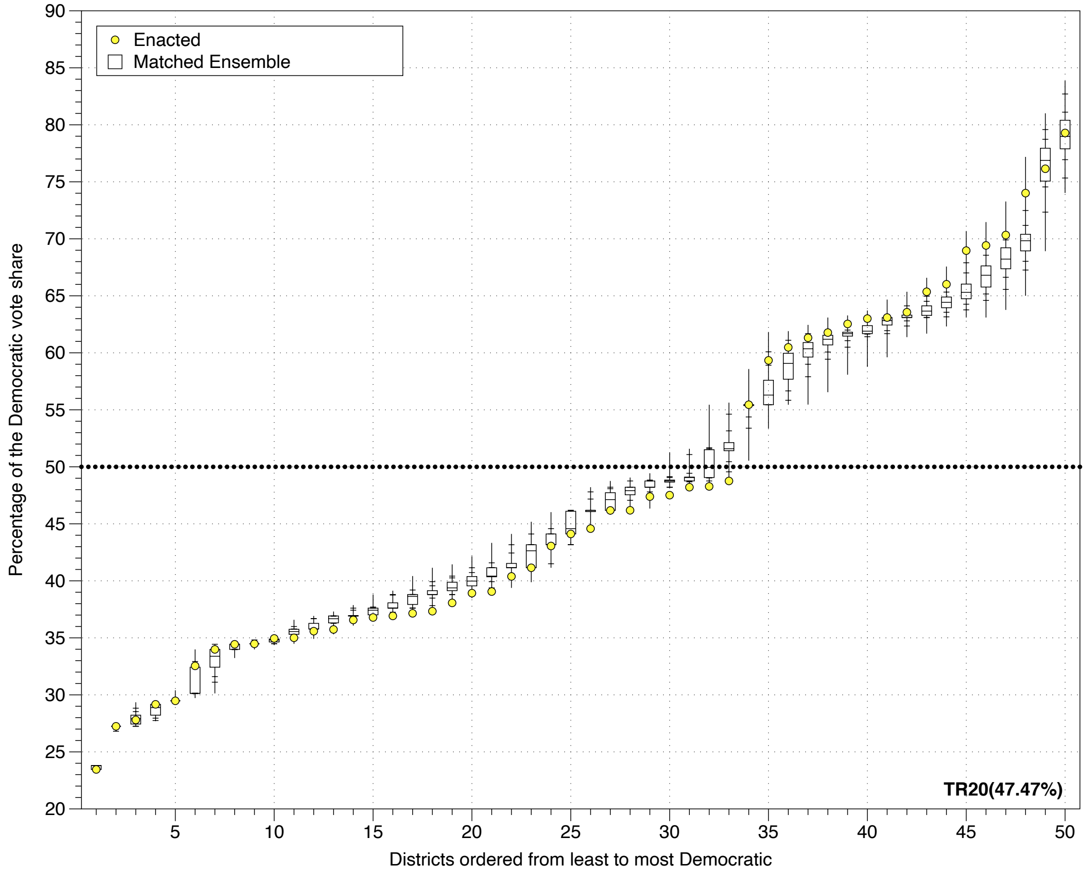

Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
GV16(50.05%)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
5
10
15
20
25
30
35
40
45
50


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
CA20(46.15%)


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
SST20(51.21%)


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
LG16(46.59%)


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
CI20(48.27%)


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
TR20(47.47%)
90
85
80
75
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60
55
50
45
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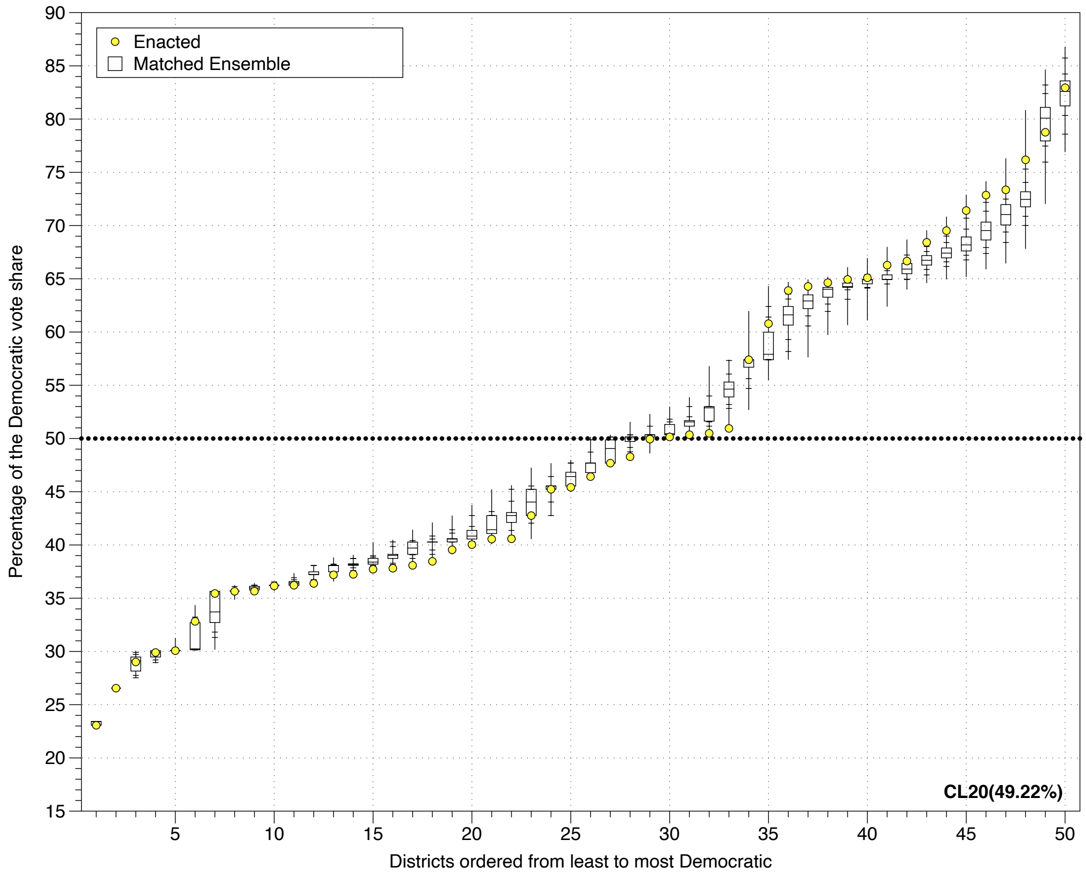
Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
CL20(49.22%)
90
85
80
75
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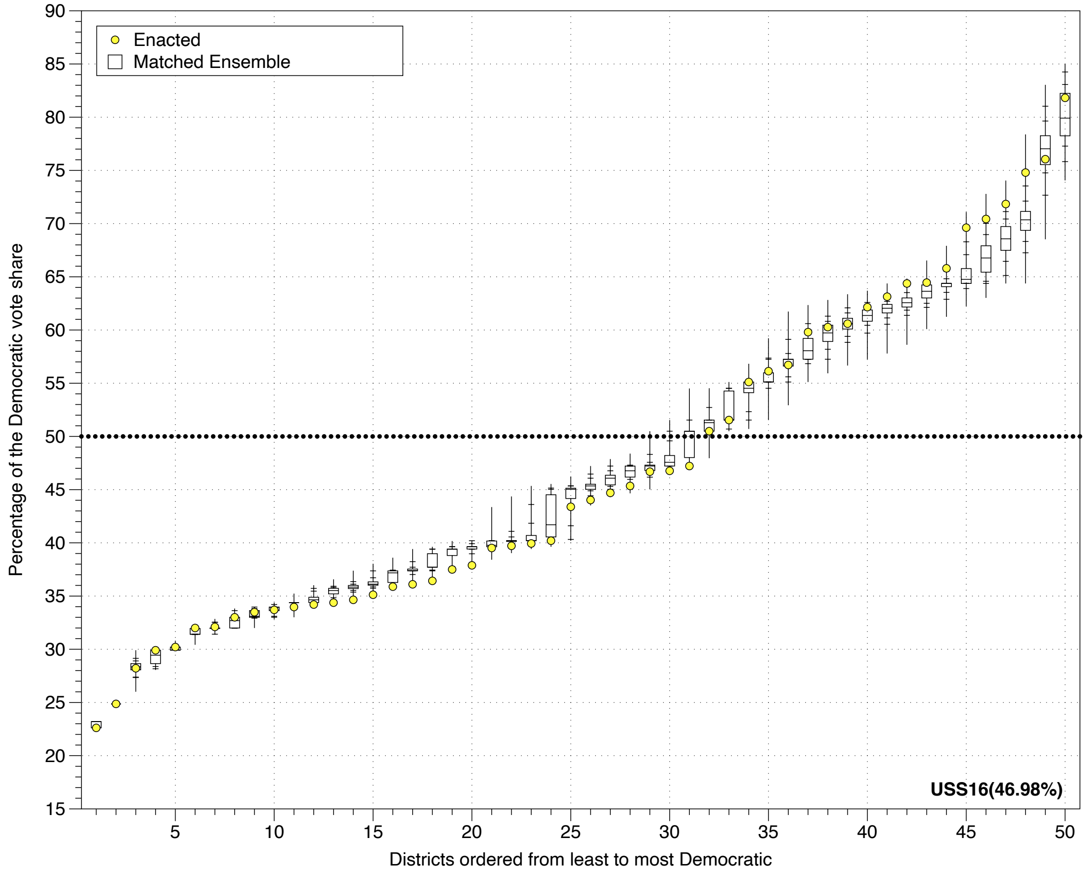
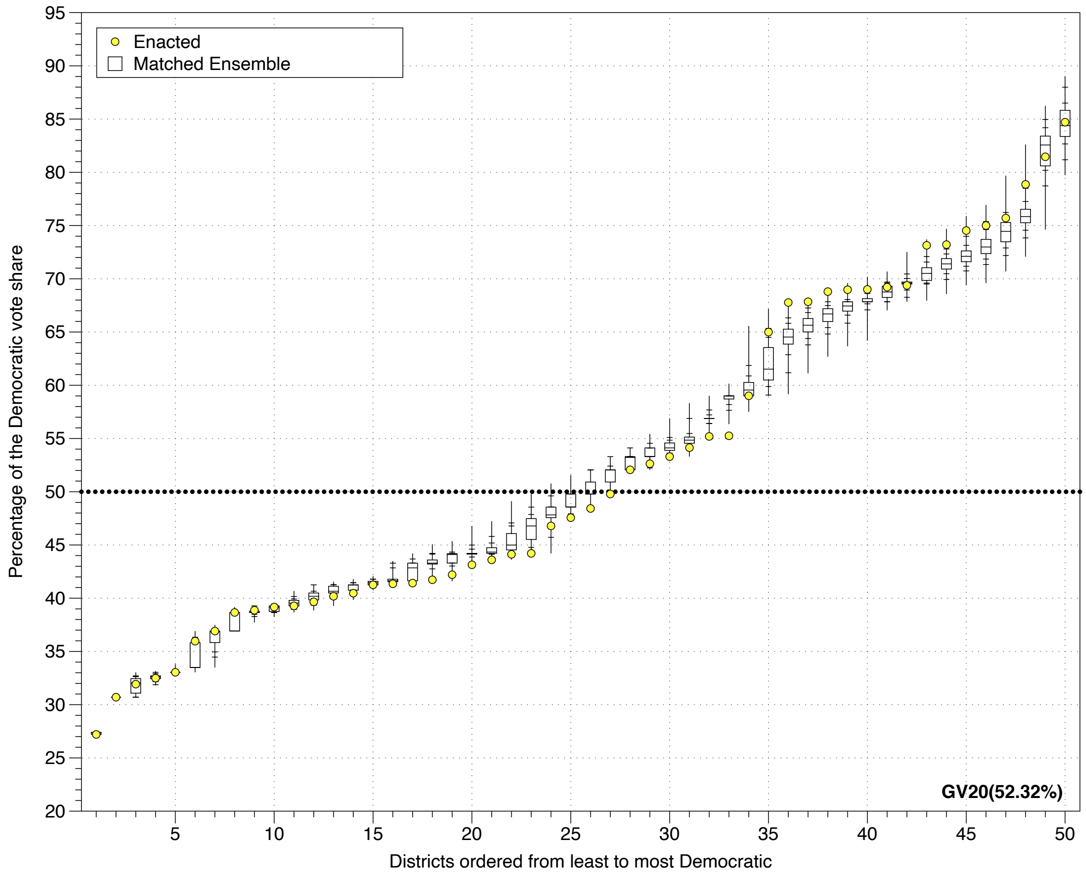
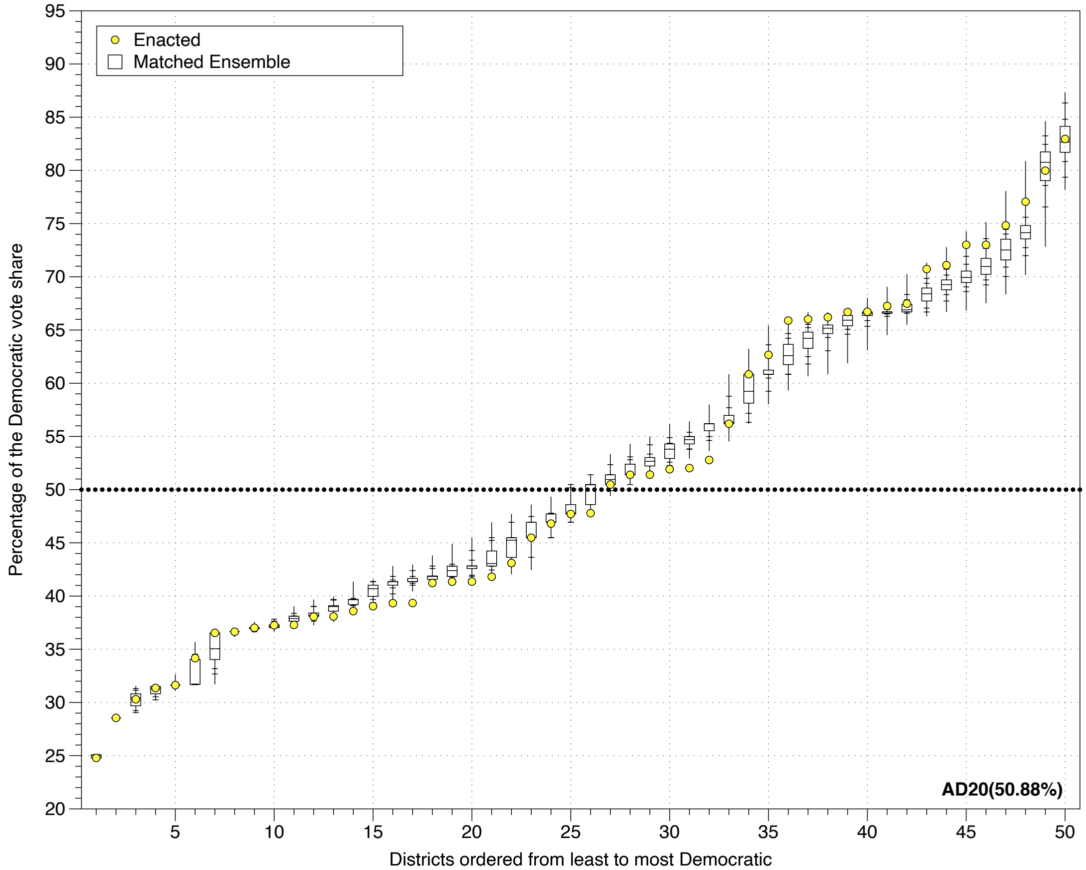
45
50


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
USS16(46.98%)


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
GV20(52.32%)


Enacted
Matched Ensemble
Percentage of the Democratic vote share
Districts ordered from least to most Democratic
AD20(50.88%)
95
90
85
80
75
70
65
60
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50

C NC House: Additional Plots

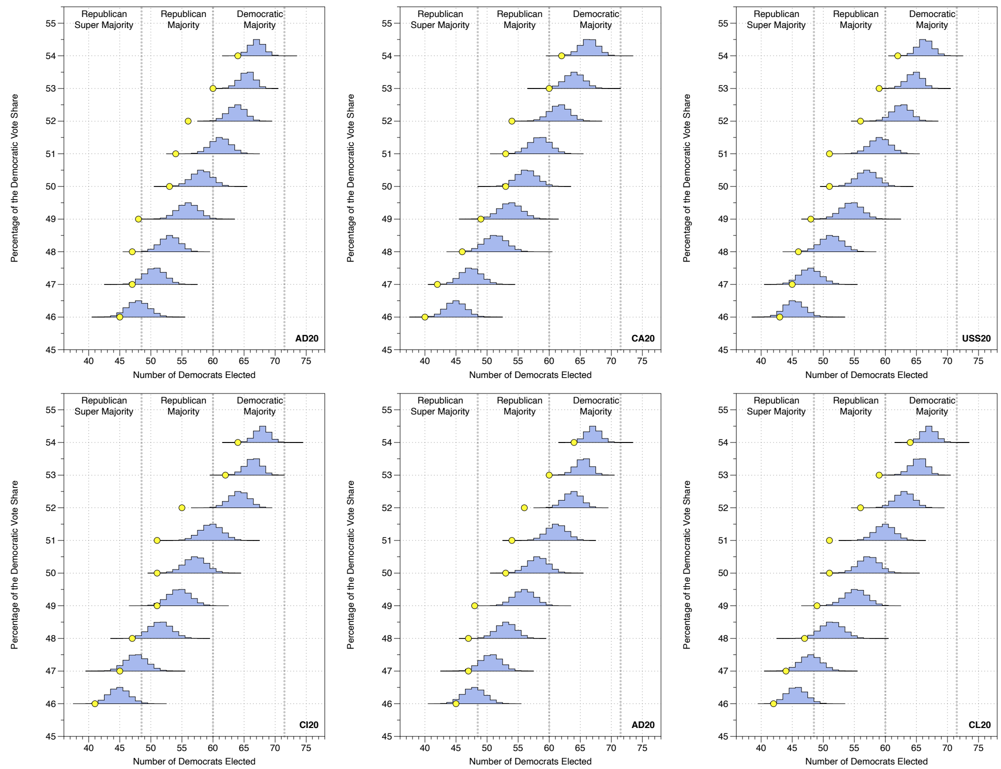

Figure C.0.1: The Collected Seat Histograms for the Primary Ensemble on the NC House built from a collection of voting data generated via uniform swing.

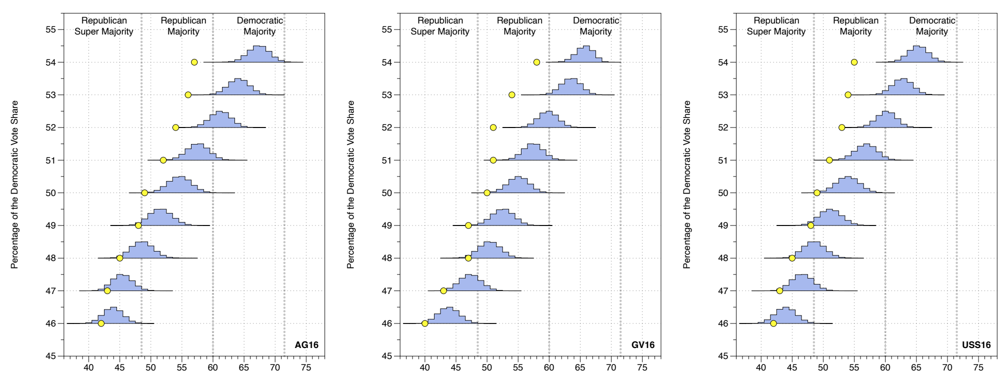

Figure C.0.2: The Collected Seat Histograms for the Primary Ensemble on the NC House built from a collection of voting data generated via uniform swing.

D NC Senate: Additional Plots

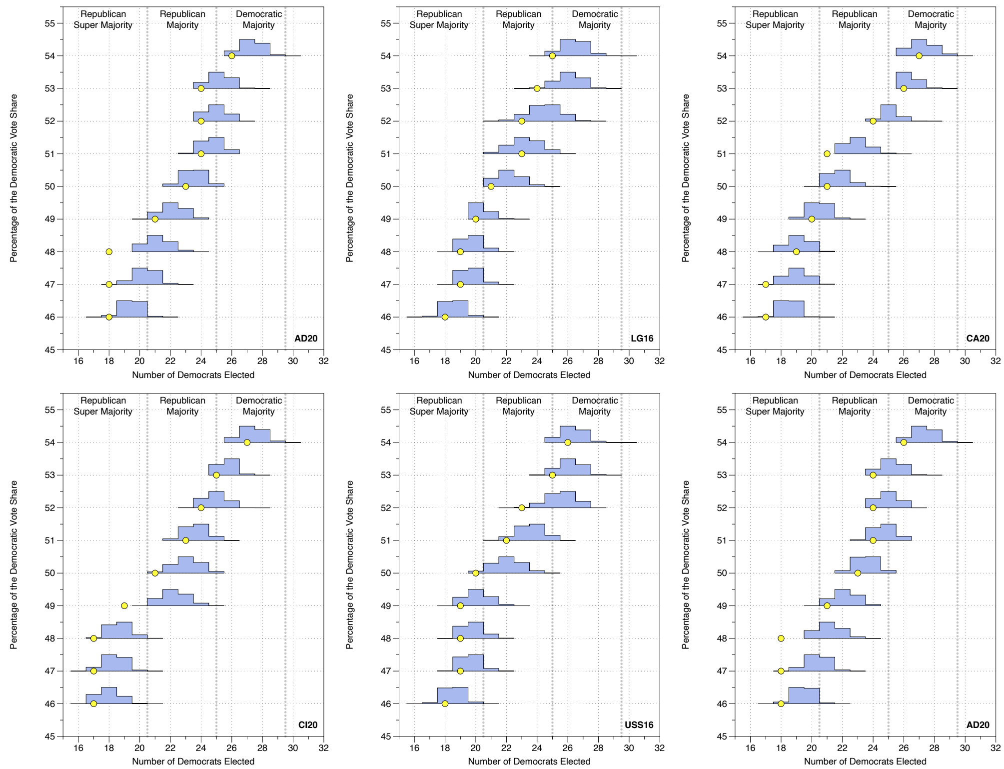

Figure D.0.1: The Collected Seat Histograms for the Primary Ensemble on the NC Senate built from a collection of voting data generated via uniform swing.

E NC Congressional: Ranked-Ordered Marginal Boxplots

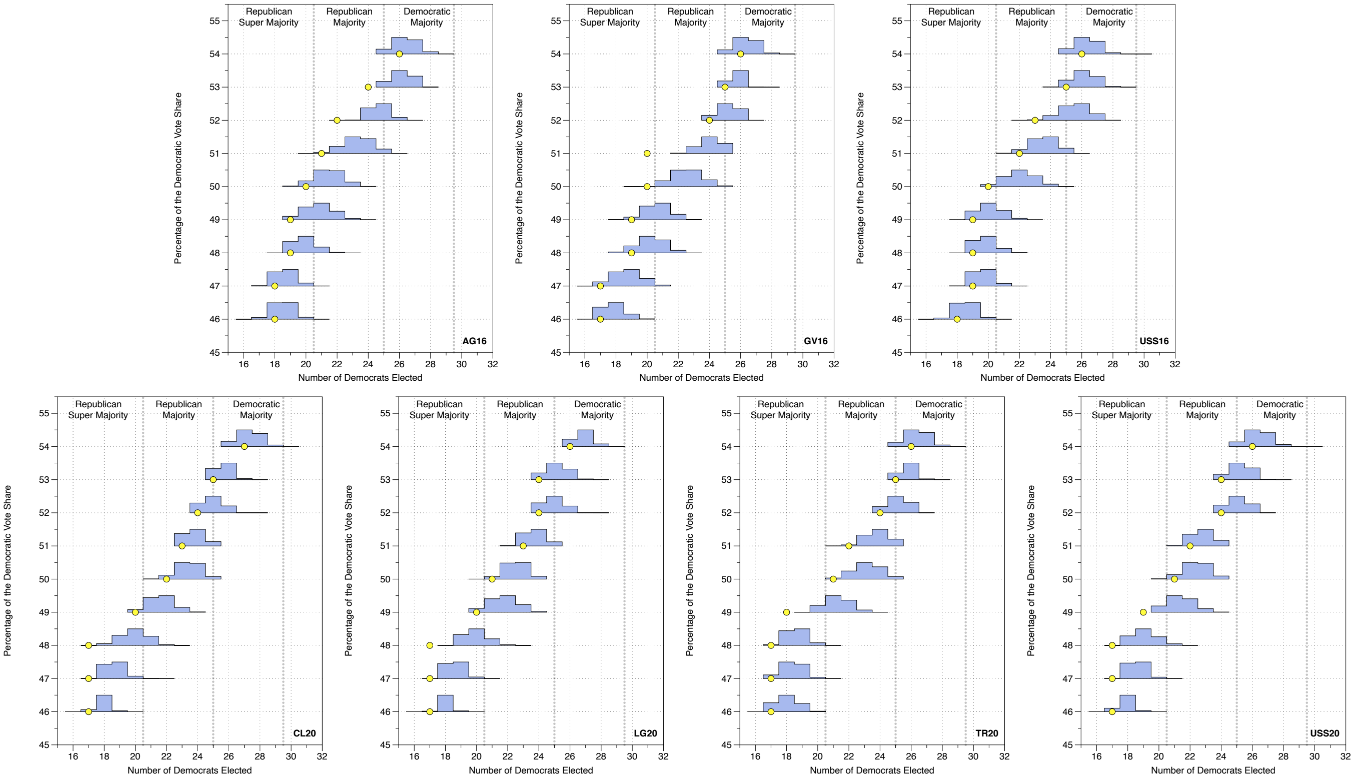

Figure D.0.2: The Collected Seat Histograms for the Primary Ensemble on the NC Senate built from a collection of voting data generated via uniform swing.

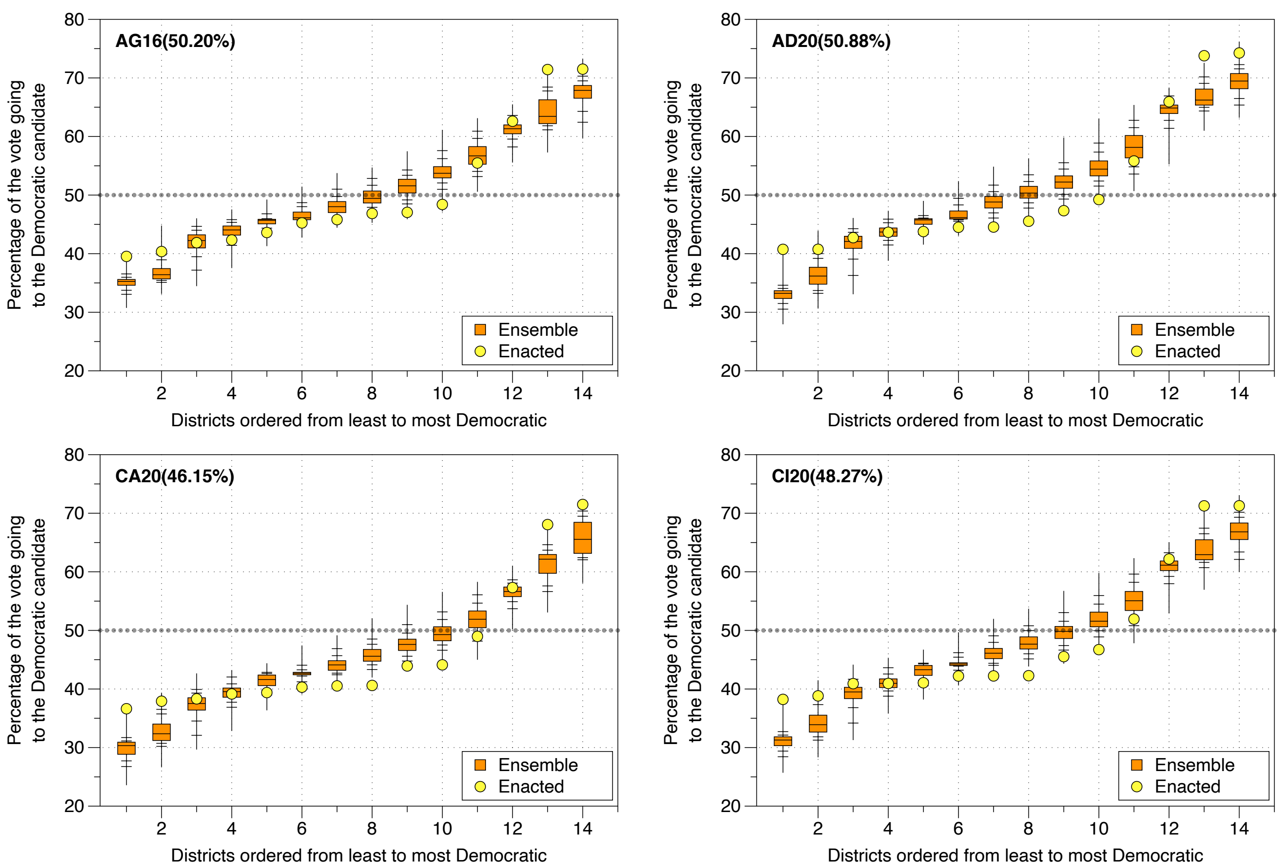

Figure E.0.1: something

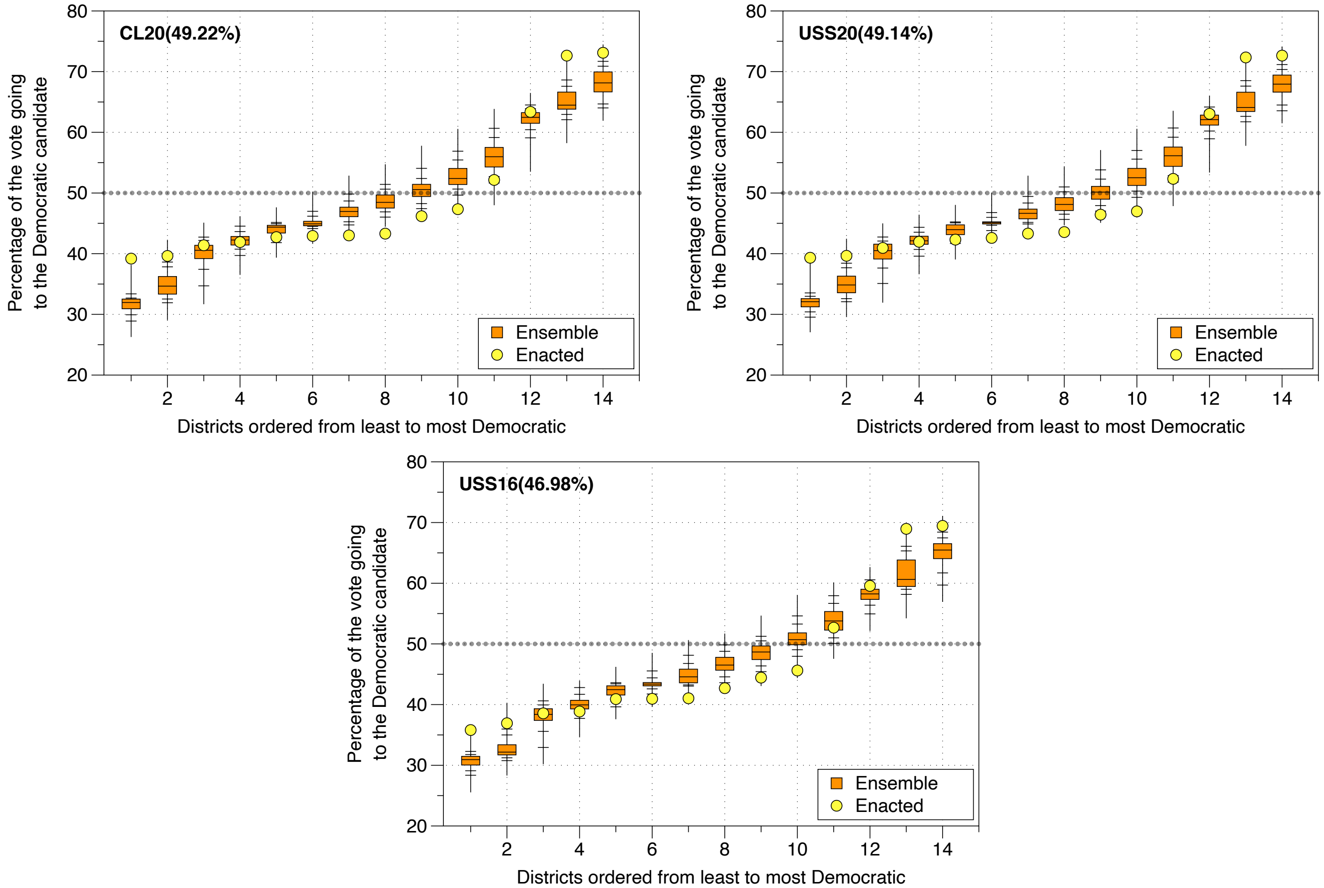

Figure E.0.2: something

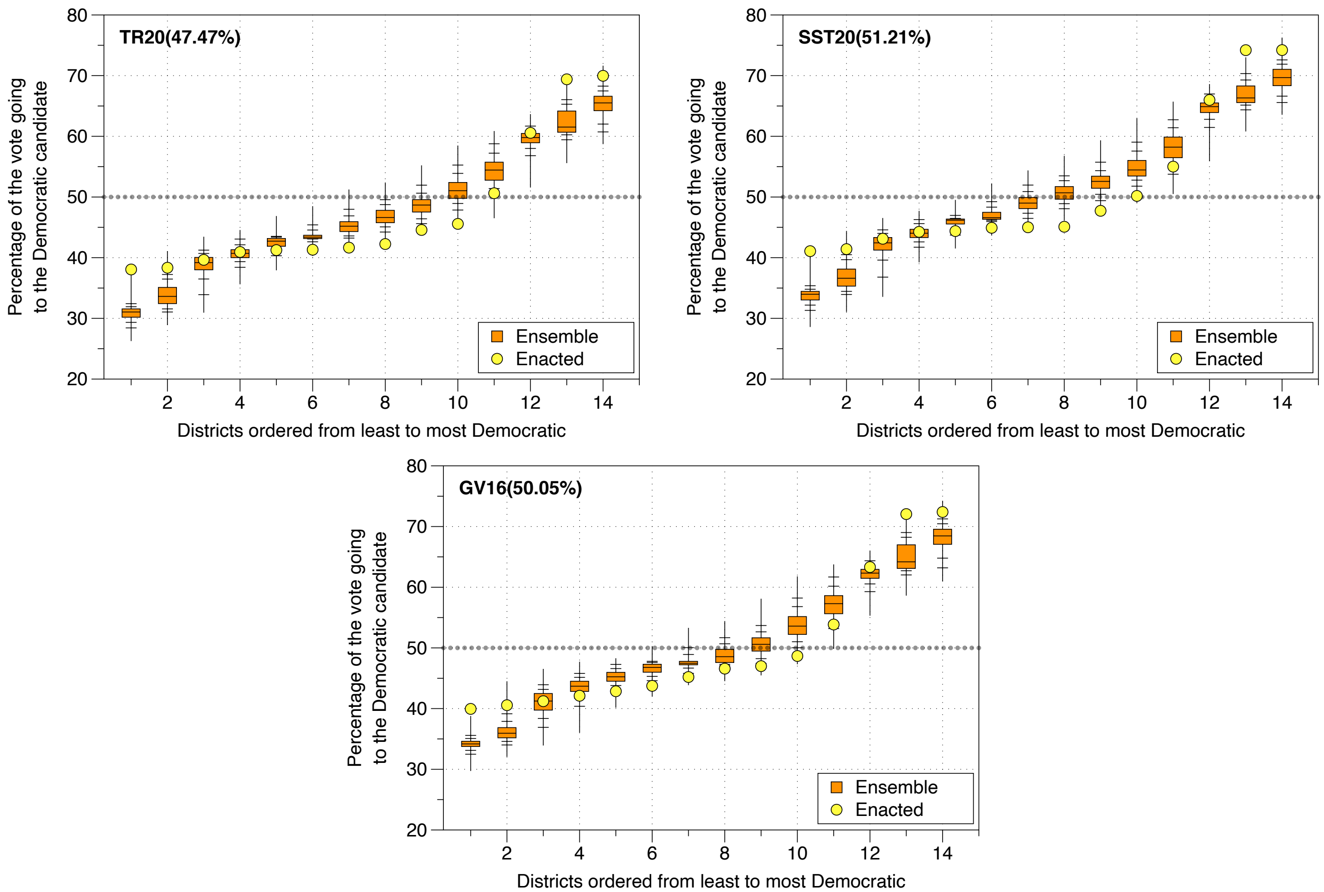

Figure E.0.3: something

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	13507	16.9	16380	20.5	79997	1	2
PR16	23688	29.6	25268	31.6	79997	1	2
AD20	7579	9.47	13561	17.0	79997	1	2
AG20	8831	11.0	14968	18.7	79997	1	2
CA20	7818	9.77	12779	16.0	79997	1	2
CL20	8308	10.4	14272	17.8	79997	1	2
GV20	14684	18.4	19730	24.7	79997	1	2
LG20	10040	12.6	15902	19.9	79997	1	2
PR20	15099	18.9	19674	24.6	79997	1	2
SST20	9265	11.6	15681	19.6	79997	1	2
TR20	10164	12.7	16049	20.1	79997	1	2
USS20	11197	14.0	16428	20.5	79997	1	2

Table 5: Alamance; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	384	0.48	2281	2.85	79997	2 3	4
PR16	288	0.36	4743	5.93	79997	2 3	4
AD20	72	0.09	5122	6.4	79997	2 3	4
AG20	64	0.08	5154	6.44	79997	2 3	4
CA20	48	0.06	4227	5.28	79997	2 3	4
CL20	56	0.07	4995	6.24	79997	2 3	4
GV20	200	0.25	6254	7.82	79997	2 3	4
LG20	80	0.1	5107	6.38	79997	2 3	4
PR20	128	0.16	5842	7.3	79997	2 3	4
SST20	72	0.09	5418	6.77	79997	2 3	4
TR20	80	0.1	4755	5.94	79997	2 3	4
USS20	56	0.07	4334	5.42	79997	2 3	4

Table 6: Brunswick-New Hanover; house

F Cluster-by-cluster outlier analysis

We quantify the visual trends seen in the cluster-by-cluster ordered marginal vote distributions. Similar to the analysis in Table 4, we group ranked districts and inquire how many plans in the ensemble have an average Democratic vote fraction that is more toward the extremes than the enacted plan. In general, lower numbers in the tables below signify more atypical clusters.

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	288	0.36	2406	3.01	79997	1	3
PR16	848	1.06	3910	4.89	79997	1	3
AD20	578	0.723	3738	4.67	79997	1	3
AG20	657	0.821	3711	4.64	79997	1	3
CA20	506	0.633	3072	3.84	79997	1	3
CL20	573	0.716	3578	4.47	79997	1	3
GV20	892	1.12	4803	6.0	79997	1	3
LG20	642	0.803	3699	4.62	79997	1	3
PR20	960	1.2	4790	5.99	79997	1	3
SST20	546	0.683	3305	4.13	79997	1	3
TR20	555	0.694	3295	4.12	79997	1	3
USS20	541	0.676	3404	4.26	79997	1	3

Table 7: Buncombe; house

Election	No. plans w/ ≥ Dems (First Cluster)	% of plans w/ ≥ Dems (First Cluster)	No. plans w/ ≤ Dems (Second Cluster)	% of plans w/ ≤ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	12935	16.2	12183	15.2	79997	3 4	5
PR16	13057	16.3	5371	6.71	79997	3 4	5
AD20	12585	15.7	1657	2.07	79997	3 4	5
AG20	12230	15.3	2081	2.6	79997	3 4	5
CA20	12445	15.6	1573	1.97	79997	3 4	5
CL20	12411	15.5	1785	2.23	79997	3 4	5
GV20	12167	15.2	1489	1.86	79997	3 4	5
LG20	12312	15.4	1789	2.24	79997	3 4	5
PR20	12320	15.4	921	1.15	79997	3 4	5
SST20	12059	15.1	1709	2.14	79997	3 4	5
TR20	12102	15.1	1537	1.92	79997	3 4	5
USS20	11901	14.9	1669	2.09	79997	3 4	5

Table 8: Cabarrus-Davie-Rowan-Yadkin; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	3767	4.71	13593	17.0	79997	2	3 4
PR16	5414	6.77	13064	16.3	79997	2	3 4
AD20	970	1.21	11880	14.9	79997	2	3 4
AG20	899	1.12	11149	13.9	79997	2	3 4
CA20	833	1.04	11167	14.0	79997	2	3 4
CL20	341	0.426	10790	13.5	79997	2	3 4
GV20	517	0.646	11339	14.2	79997	2	3 4
LG20	346	0.433	10829	13.5	79997	2	3 4
PR20	579	0.724	11315	14.1	79997	2	3 4
SST20	1206	1.51	12333	15.4	79997	2	3 4
TR20	587	0.734	10981	13.7	79997	2	3 4
USS20	360	0.45	10674	13.3	79997	2	3 4

Table 9: Cumberland; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	46063	57.6	46238	57.8	79997	1	2
PR16	43010	53.8	43894	54.9	79997	1	2
AD20	41097	51.4	41193	51.5	79997	1	2
AG20	38601	48.3	38516	48.1	79997	1	2
CA20	39051	48.8	39158	48.9	79997	1	2
CL20	38891	48.6	39038	48.8	79997	1	2
GV20	38179	47.7	38073	47.6	79997	1	2
LG20	38313	47.9	38392	48.0	79997	1	2
PR20	38660	48.3	38492	48.1	79997	1	2
SST20	41059	51.3	40686	50.9	79997	1	2
TR20	38891	48.6	39342	49.2	79997	1	2
USS20	38430	48.0	38734	48.4	79997	1	2

Table 10: Duplin-Wayne; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	0	0.0	2768	3.46	79997	1	3 4
PR16	0	0.0	409	0.511	79997	1	3 4
AD20	0	0.0	274	0.343	79997	1	3 4
AG20	0	0.0	312	0.39	79997	1	3 4
CA20	0	0.0	929	1.16	79997	1	3 4
CL20	0	0.0	417	0.521	79997	1	3 4
GV20	0	0.0	232	0.29	79997	1	3 4
LG20	0	0.0	328	0.41	79997	1	3 4
PR20	0	0.0	96	0.12	79997	1	3 4
SST20	0	0.0	296	0.37	79997	1	3 4
TR20	0	0.0	280	0.35	79997	1	3 4
USS20	0	0.0	497	0.621	79997	1	3 4

Table 11: Durham-Person; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	1	0.00125	659	0.824	79997	1 2 3	4 5
PR16	0	0.0	543	0.679	79997	1 2 3	4 5
AD20	8	0.01	952	1.19	79997	1 2 3	4 5
AG20	11	0.0138	1025	1.28	79997	1 2 3	4 5
CA20	11	0.0138	1032	1.29	79997	1 2 3	4 5
CL20	9	0.0113	995	1.24	79997	1 2 3	4 5
GV20	8	0.01	982	1.23	79997	1 2 3	4 5
LG20	8	0.01	980	1.23	79997	1 2 3	4 5
PR20	8	0.01	893	1.12	79997	1 2 3	4 5
SST20	0	0.0	912	1.14	79997	1 2 3	4 5
TR20	9	0.0113	944	1.18	79997	1 2 3	4 5
USS20	16	0.02	1106	1.38	79997	1 2 3	4 5

Table 12: Forsyth-Stokes; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	0	0.0	0	0.0	79997	1 2	3 4 5 6
PR16	0	0.0	0	0.0	79997	1 2	3 4 5 6
AD20	0	0.0	0	0.0	79997	1 2	3 4 5 6
AG20	0	0.0	0	0.0	79997	1 2	3 4 5 6
CA20	0	0.0	0	0.0	79997	1 2	3 4 5 6
CL20	0	0.0	0	0.0	79997	1 2	3 4 5 6
GV20	0	0.0	0	0.0	79997	1 2	3 4 5 6
LG20	0	0.0	0	0.0	79997	1 2	3 4 5 6
PR20	0	0.0	0	0.0	79997	1 2	3 4 5 6
SST20	0	0.0	0	0.0	79997	1 2	3 4 5 6
TR20	0	0.0	0	0.0	79997	1 2	3 4 5 6
USS20	0	0.0	0	0.0	79997	1 2	3 4 5 6

Table 13: Guilford; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	661	0.826	2	0.0025	79997	1 2 3 4	5 6 7 8
PR16	168	0.21	6	0.0075	79997	1 2 3 4	5 6 7 8
AD20	569	0.711	32	0.04	79997	1 2 3 4	5 6 7 8
AG20	763	0.954	35	0.0438	79997	1 2 3 4	5 6 7 8
CA20	1363	1.7	84	0.105	79997	1 2 3 4	5 6 7 8
CL20	1146	1.43	72	0.09	79997	1 2 3 4	5 6 7 8
GV20	396	0.495	40	0.05	79997	1 2 3 4	5 6 7 8
LG20	700	0.875	36	0.045	79997	1 2 3 4	5 6 7 8
PR20	202	0.253	19	0.0238	79997	1 2 3 4	5 6 7 8
SST20	496	0.62	29	0.0363	79997	1 2 3 4	5 6 7 8
TR20	975	1.22	88	0.11	79997	1 2 3 4	5 6 7 8
USS20	1082	1.35	69	0.0863	79997	1 2 3 4	5 6 7 8

Table 14: Mecklenburg; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	1194	1.49	899	1.12	79997	1	2
PR16	2115	2.64	1829	2.29	79997	1	2
AD20	8230	10.3	4317	5.4	79997	1	2
AG20	4434	5.54	2326	2.91	79997	1	2
CA20	2295	2.87	1334	1.67	79997	1	2
CL20	4069	5.09	2163	2.7	79997	1	2
GV20	6311	7.89	3379	4.22	79997	1	2
LG20	4123	5.15	2222	2.78	79997	1	2
PR20	6573	8.22	3564	4.46	79997	1	2
SST20	5386	6.73	2656	3.32	79997	1	2
TR20	4243	5.3	2177	2.72	79997	1	2
USS20	3799	4.75	2074	2.59	79997	1	2

Table 15: Pitt; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	209	0.261	6107	7.63	79997	1 2	3 4 5 6 7 8 9
PR16	160	0.2	4317	5.4	79997	1 2	3 4 5 6 7 8 9
AD20	240	0.3	4968	6.21	79997	1 2	3 4 5 6 7 8 9
AG20	230	0.288	4728	5.91	79997	1 2	3 4 5 6 7 8 9
CA20	1151	1.44	15113	18.9	79997	1 2	3 4 5 6 7 8 9
CL20	337	0.421	6643	8.3	79997	1 2	3 4 5 6 7 8 9
GV20	225	0.281	3777	4.72	79997	1 2	3 4 5 6 7 8 9
LG20	298	0.373	5552	6.94	79997	1 2	3 4 5 6 7 8 9
PR20	241	0.301	4462	5.58	79997	1 2	3 4 5 6 7 8 9
SST20	291	0.364	4572	5.72	79997	1 2	3 4 5 6 7 8 9
TR20	377	0.471	7229	9.04	79997	1 2	3 4 5 6 7 8 9
USS20	354	0.443	6912	8.64	79997	1 2	3 4 5 6 7 8 9

Table 16: Wake; house

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	48	0.06	0	0.0	79997	1	2
PR16	48	0.06	48	0.06	79997	1	2
AD20	48	0.06	48	0.06	79997	1	2
AG20	48	0.06	48	0.06	79997	1	2
CA20	48	0.06	48	0.06	79997	1	2
CL20	48	0.06	48	0.06	79997	1	2
GV20	48	0.06	48	0.06	79997	1	2
LG20	48	0.06	48	0.06	79997	1	2
PR20	48	0.06	48	0.06	79997	1	2
SST20	48	0.06	48	0.06	79997	1	2
TR20	48	0.06	48	0.06	79997	1	2
USS20	48	0.06	48	0.06	79997	1	2

Table 17: Cumberland-Moore; senate

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	855	1.07	3472	4.34	79997	1	2
PR16	600	0.75	1822	2.28	79997	1	2
AD20	506	0.633	1745	2.18	79997	1	2
AG20	595	0.744	2455	3.07	79997	1	2
CA20	570	0.713	2521	3.15	79997	1	2
CL20	550	0.688	2191	2.74	79997	1	2
GV20	471	0.589	1496	1.87	79997	1	2
LG20	485	0.606	1967	2.46	79997	1	2
PR20	447	0.559	1392	1.74	79997	1	2
SST20	515	0.644	1827	2.28	79997	1	2
TR20	646	0.808	2696	3.37	79997	1	2
USS20	498	0.623	2174	2.72	79997	1	2

Table 18: Forsyth-Stokes; senate

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	0	0.0	6	0.015	39991	1 2	3 4 5 6
PR16	0	0.0	3	0.0075	39991	1 2	3 4 5 6
AD20	0	0.0	0	0.0	39991	1 2	3 4 5 6
AG20	0	0.0	0	0.0	39991	1 2	3 4 5 6
CA20	0	0.0	9	0.0225	39991	1 2	3 4 5 6
CL20	0	0.0	4	0.01	39991	1 2	3 4 5 6
GV20	0	0.0	0	0.0	39991	1 2	3 4 5 6
LG20	0	0.0	0	0.0	39991	1 2	3 4 5 6
PR20	0	0.0	0	0.0	39991	1 2	3 4 5 6
SST20	0	0.0	0	0.0	39991	1 2	3 4 5 6
TR20	0	0.0	5	0.0125	39991	1 2	3 4 5 6
USS20	0	0.0	4	0.01	39991	1 2	3 4 5 6

Table 19: Granville-Wake; senate

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	0	0.0	13	0.0163	79997	1	3
PR16	0	0.0	13	0.0163	79997	1	3
AD20	0	0.0	54	0.0675	79997	1	3
AG20	0	0.0	33	0.0413	79997	1	3
CA20	0	0.0	15	0.0188	79997	1	3
CL20	0	0.0	23	0.0288	79997	1	3
GV20	0	0.0	56	0.07	79997	1	3
LG20	0	0.0	22	0.0275	79997	1	3
PR20	0	0.0	59	0.0738	79997	1	3
SST20	0	0.0	32	0.04	79997	1	3
TR20	0	0.0	20	0.025	79997	1	3
USS20	0	0.0	23	0.0288	79997	1	3

Table 20: Guilford-Rockingham; senate

Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
LG16	0	0.0	0	0.0	79997	1 2	3 4 5 6
PR16	0	0.0	0	0.0	79997	1 2	3 4 5 6
AD20	0	0.0	0	0.0	79997	1 2	3 4 5 6
AG20	0	0.0	0	0.0	79997	1 2	3 4 5 6
CA20	0	0.0	8	0.01	79997	1 2	3 4 5 6
CL20	0	0.0	0	0.0	79997	1 2	3 4 5 6
GV20	0	0.0	0	0.0	79997	1 2	3 4 5 6
LG20	0	0.0	0	0.0	79997	1 2	3 4 5 6
PR20	0	0.0	0	0.0	79997	1 2	3 4 5 6
SST20	0	0.0	0	0.0	79997	1 2	3 4 5 6
TR20	0	0.0	8	0.01	79997	1 2	3 4 5 6
USS20	0	0.0	0	0.0	79997	1 2	3 4 5 6

Table 21: Iredell-Mecklenburg; senate

References

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I declare under penalty of perjury under the laws of the state of North Carolina that the foregoing is true and correct to the best of my knowledge.

Jonathan Mattingly, 12/23/2021

NCLCV v. Hall
21 CVS 15426
LDTX196

Exhibit #
Mattingly 3
12/31/21 - MS

Joint Meeting of Committees

August 12, 2021

House Committee on Redistricting
Senate Committee on Redistricting and Elections

Criteria Adopted by the Committees

- **Equal Population.** The Committees will use the 2020 federal decennial census data as the sole basis of population for the establishment of districts in the 2021 Congressional, House, and Senate plans. The number of persons in each legislative district shall be within plus or minus 5% of the ideal district population, as determined under the most recent federal decennial census. The number of persons in each congressional district shall be as nearly as equal as practicable, as determined under the most recent federal decennial census.

- **Contiguity.** No point contiguity shall be permitted in any 2021 Congressional, House, and Senate plan. Congressional, House, and Senate districts shall be compromised of contiguous territory. Contiguity by water is sufficient.

- **Counties, Groupings, and Traversals.** The Committees shall draw legislative districts within county groupings as required by *Stephenson v. Bartlett*, 355 N.C. 354, 562 S.E.2d 377 (2002) (*Stephenson I*), *Stephenson v. Bartlett*, 357 N.C. 301, 582 S.E.2d 247 (2003) (*Stephenson II*), *Dickson v. Rucho*, 367 N.C. 542, 766 S.E.2d 238 (2014) (*Dickson I*) and *Dickson v. Rucho*, 368 N.C. 481, 781 S.E. 2d 460 (2015) (*Dickson II*). Within county groupings, county lines shall not be traversed except as authorized by *Stephenson I*, *Stephenson II*, *Dickson I*, and *Dickson II*.

  Division of counties in the 2021 Congressional plan shall only be made for reasons of equalizing population and consideration of double bunking. If a county is of sufficient population size to contain an entire congressional district within the county's boundaries, the Committees shall construct a district entirely within that county.

- **Racial Data.** Data identifying the race of individuals or voters *shall not* be used in the construction or consideration of districts in the 2021 Congressional, House, and Senate plans. The Committees will draw districts that comply with the Voting Rights Act.

- **VTDs.** Voting districts ("VTDs") should be split only when necessary.

- **Compactness.** The Committees shall make reasonable efforts to draw legislative districts in the 2021 Congressional, House and Senate plans that are compact. In doing so, the Committee may use as a guide the minimum Reock ("dispersion") and Polsby-Popper ("permiter") scores identified by Richard H. Pildes and Richard G. Neimi in *Expressive Harms, "Bizarre Districts," and Voting Rights: Evaluating Election-District Appearances After Shaw v. Reno*, 92 Mich. L. Rev. 483 (1993).

- **Municipal Boundaries.** The Committees may consider municipal boundaries when drawing districts in the 2021 Congressional, House, and Senate plans.

- **Election Data.** Partisan considerations and election results data *shall not* be used in the drawing of districts in the 2021 Congressional, House, and Senate plans.

- **Member Residence.** Member residence may be considered in the formation of legislative and congressional districts.

- **Community Consideration.** So long as a plan complies with the foregoing criteria, local knowledge of the character of communities and connections between communities may be considered in the formation of legislative and congressional districts.

Exhibit #
Mattingly 4
12/31/21 - MS

NC General Assembly

Population Deviation Report

District Plan: SL 2021-175 House

District	Seats	Ideal Pop	Actual Pop	Deviation	Deviation %
1	1	86,995	84,330	-2,665	-3.06%
2	1	86,995	90,793	3,798	4.37%
3	1	86,995	85,099	-1,896	-2.18%
4	1	86,995	83,095	-3,900	-4.48%
5	1	86,995	82,953	-4,042	-4.65%
6	1	86,995	87,332	337	0.39%
7	1	86,995	83,510	-3,485	-4.01%
8	1	86,995	85,793	-1,202	-1.38%
9	1	86,995	84,450	-2,545	-2.93%
10	1	86,995	82,953	-4,042	-4.65%
11	1	86,995	86,298	-697	-0.80%
12	1	86,995	84,745	-2,250	-2.59%
13	1	86,995	83,307	-3,688	-4.24%
14	1	86,995	86,538	-457	-0.53%
15	1	86,995	87,578	583	0.67%
16	1	86,995	90,663	3,668	4.22%
17	1	86,995	89,763	2,768	3.18%
18	1	86,995	91,245	4,250	4.89%
19	1	86,995	91,041	4,046	4.65%
20	1	86,995	90,346	3,351	3.85%
21	1	86,995	86,179	-816	-0.94%
22	1	86,995	88,642	1,647	1.89%
23	1	86,995	88,865	1,870	2.15%
24	1	86,995	87,220	225	0.26%
25	1	86,995	86,534	-461	-0.53%
26	1	86,995	89,947	2,952	3.39%
27	1	86,995	84,735	-2,260	-2.60%
28	1	86,995	85,389	-1,606	-1.85%
29	1	86,995	91,212	4,217	4.85%
30	1	86,995	91,165	4,170	4.79%
31	1	86,995	90,760	3,765	4.33%
32	1	86,995	88,633	1,638	1.88%
33	1	86,995	83,049	-3,946	-4.54%
34	1	86,995	83,679	-3,316	-3.81%
35	1	86,995	88,374	1,379	1.59%
36	1	86,995	90,166	3,171	3.65%
37	1	86,995	90,867	3,872	4.45%
38	1	86,995	88,226	1,231	1.42%
39	1	86,995	90,164	3,169	3.64%
40	1	86,995	83,175	-3,820	-4.39%
41	1	86,995	89,887	2,892	3.32%
42	1	86,995	85,537	-1,458	-1.68%
43	1	86,995	82,956	-4,039	-4.64%
44	1	86,995	83,297	-3,698	-4.25%

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Data Source: 2020 Census Redistricting Data (Public Law 94-171) Summary File.

[PL20-Po

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Population Deviation Report

District Plan: SL 2021-175 House

District	Seats	Ideal Pop	Actual Pop	Deviation	Deviation %
45	1	86,995	82,938	-4,057	-4.66%
46	1	86,995	83,445	-3,550	-4.08%
47	1	86,995	83,708	-3,287	-3.78%
48	1	86,995	86,256	-739	-0.85%
49	1	86,995	86,157	-838	-0.96%
50	1	86,995	85,345	-1,650	-1.90%
51	1	86,995	83,073	-3,922	-4.51%
52	1	86,995	84,383	-2,612	-3.00%
53	1	86,995	86,899	-96	-0.11%
54	1	86,995	83,475	-3,520	-4.05%
55	1	86,995	87,005	10	0.01%
56	1	86,995	86,087	-908	-1.04%
57	1	86,995	90,615	3,620	4.16%
58	1	86,995	90,808	3,813	4.38%
59	1	86,995	90,361	3,366	3.87%
60	1	86,995	89,735	2,740	3.15%
61	1	86,995	90,201	3,206	3.69%
62	1	86,995	89,579	2,584	2.97%
63	1	86,995	86,399	-596	-0.69%
64	1	86,995	85,016	-1,979	-2.27%
65	1	86,995	91,096	4,101	4.71%
66	1	86,995	83,189	-3,806	-4.37%
67	1	86,995	88,255	1,260	1.45%
68	1	86,995	88,138	1,143	1.31%
69	1	86,995	85,179	-1,816	-2.09%
70	1	86,995	89,118	2,123	2.44%
71	1	86,995	84,874	-2,121	-2.44%
72	1	86,995	86,949	-46	-0.05%
73	1	86,995	90,649	3,654	4.20%
74	1	86,995	84,857	-2,138	-2.46%
75	1	86,995	84,220	-2,775	-3.19%
76	1	86,995	89,815	2,820	3.24%
77	1	86,995	90,628	3,633	4.18%
78	1	86,995	86,365	-630	-0.72%
79	1	86,995	83,163	-3,832	-4.40%
80	1	86,995	84,864	-2,131	-2.45%
81	1	86,995	84,066	-2,929	-3.37%
82	1	86,995	90,771	3,776	4.34%
83	1	86,995	90,742	3,747	4.31%
84	1	86,995	86,773	-222	-0.26%
85	1	86,995	90,863	3,868	4.45%
86	1	86,995	87,570	575	0.66%
87	1	86,995	85,758	-1,237	-1.42%
88	1	86,995	82,834	-4,161	-4.78%

Population Deviation Report

District Plan: SL 2021-175 House

District	Seats	Ideal Pop	Actual Pop	Deviation	Deviation %
89	1	86,995	85,577	-1,418	-1.63%
90	1	86,995	82,937	-4,058	-4.66%
91	1	86,995	86,210	-785	-0.90%
92	1	86,995	85,031	-1,964	-2.26%
93	1	86,995	86,445	-550	-0.63%
94	1	86,995	90,835	3,840	4.41%
95	1	86,995	85,366	-1,629	-1.87%
96	1	86,995	89,587	2,592	2.98%
97	1	86,995	86,810	-185	-0.21%
98	1	86,995	86,827	-168	-0.19%
99	1	86,995	87,647	652	0.75%
100	1	86,995	87,197	202	0.23%
101	1	86,995	86,426	-569	-0.65%
102	1	86,995	86,179	-816	-0.94%
103	1	86,995	87,132	137	0.16%
104	1	86,995	86,520	-475	-0.55%
105	1	86,995	85,822	-1,173	-1.35%
106	1	86,995	82,824	-4,171	-4.79%
107	1	86,995	88,237	1,242	1.43%
108	1	86,995	86,263	-732	-0.84%
109	1	86,995	87,762	767	0.88%
110	1	86,995	88,397	1,402	1.61%
111	1	86,995	89,894	2,899	3.33%
112	1	86,995	82,806	-4,189	-4.82%
113	1	86,995	89,058	2,063	2.37%
114	1	86,995	89,685	2,690	3.09%
115	1	86,995	90,262	3,267	3.76%
116	1	86,995	89,505	2,510	2.89%
117	1	86,995	91,035	4,040	4.64%
118	1	86,995	83,282	-3,713	-4.27%
119	1	86,995	90,212	3,217	3.70%
120	1	86,995	84,907	-2,088	-2.40%
Totals:	**120**		**10,439,388**		

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Alamance	63	171,415	86,399	86,399	50.40 %	100.00 %
	64	171,415	85,016	85,016	49.60 %	100.00 %
Alexander	94	36,444	90,835	36,444	100.00 %	40.12 %
Alleghany	93	10,888	86,445	10,888	100.00 %	12.60 %
Anson	55	22,055	87,005	22,055	100.00 %	25.35 %
Ashe	93	26,577	86,445	26,577	100.00 %	30.74 %
Avery	85	17,806	90,863	17,806	100.00 %	19.60 %
Beaufort	79	44,652	83,163	44,652	100.00 %	53.69 %
Bertie	23	17,934	88,865	17,934	100.00 %	20.18 %
Bladen	22	29,606	88,642	29,606	100.00 %	33.40 %
Brunswick	17	136,693	89,763	89,763	65.67 %	100.00 %
	19	136,693	91,041	46,930	34.33 %	51.55 %
Buncombe	114	269,452	89,685	89,685	33.28 %	100.00 %
	115	269,452	90,262	90,262	33.50 %	100.00 %
	116	269,452	89,505	89,505	33.22 %	100.00 %
Burke	86	87,570	87,570	87,570	100.00 %	100.00 %
Cabarrus	73	225,804	90,649	90,649	40.14 %	100.00 %
	82	225,804	90,771	90,771	40.20 %	100.00 %
	83	225,804	90,742	44,384	19.66 %	48.91 %
Caldwell	87	80,652	85,758	80,652	100.00 %	94.05 %
Camden	5	10,355	82,953	10,355	100.00 %	12.48 %
Carteret	13	67,686	83,307	67,686	100.00 %	81.25 %
Caswell	50	22,736	85,345	22,736	100.00 %	26.64 %
Catawba	89	160,610	85,577	71,023	44.22 %	82.99 %
	96	160,610	89,587	89,587	55.78 %	100.00 %
Chatham	54	76,285	83,475	76,285	100.00 %	91.39 %
Cherokee	120	28,774	84,907	28,774	100.00 %	33.89 %
Chowan	1	13,708	84,330	13,708	100.00 %	16.26 %
Clay	120	11,089	84,907	11,089	100.00 %	13.06 %
Cleveland	110	99,519	88,397	34,479	34.65 %	39.00 %
	111	99,519	89,894	65,040	65.35 %	72.35 %
Columbus	46	50,623	83,445	50,623	100.00 %	60.67 %
Craven	3	100,720	85,099	85,099	84.49 %	100.00 %
	13	100,720	83,307	15,621	15.51 %	18.75 %
Cumberland	42	334,728	85,537	85,537	25.55 %	100.00 %
	43	334,728	82,956	82,956	24.78 %	100.00 %
	44	334,728	83,297	83,297	24.88 %	100.00 %
	45	334,728	82,938	82,938	24.78 %	100.00 %
Currituck	1	28,100	84,330	28,100	100.00 %	33.32 %
Dare	1	36,915	84,330	15,269	41.36 %	18.11 %
	79	36,915	83,163	21,646	58.64 %	26.03 %

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Davidson	80	168,930	84,864	84,864	50.24 %	100.00 %
	81	168,930	84,066	84,066	49.76 %	100.00 %
Davie	77	42,712	90,628	42,712	100.00 %	47.13 %
Duplin	4	48,715	83,095	48,715	100.00 %	58.63 %
Durham	2	324,833	90,793	51,696	15.91 %	56.94 %
	29	324,833	91,212	91,212	28.08 %	100.00 %
	30	324,833	91,165	91,165	28.07 %	100.00 %
	31	324,833	90,760	90,760	27.94 %	100.00 %
Edgecombe	23	48,900	88,865	48,900	100.00 %	55.03 %
Forsyth	71	382,590	84,874	84,874	22.18 %	100.00 %
	72	382,590	86,949	86,949	22.73 %	100.00 %
	74	382,590	84,857	84,857	22.18 %	100.00 %
	75	382,590	84,220	84,220	22.01 %	100.00 %
	91	382,590	86,210	41,690	10.90 %	48.36 %
Franklin	7	68,573	83,510	68,573	100.00 %	82.11 %
Gaston	108	227,943	86,263	86,263	37.84 %	100.00 %
	109	227,943	87,762	87,762	38.50 %	100.00 %
	110	227,943	88,397	53,918	23.65 %	61.00 %
Gates	5	10,478	82,953	10,478	100.00 %	12.63 %
Graham	120	8,030	84,907	8,030	100.00 %	9.46 %
Granville	7	60,992	83,510	14,937	24.49 %	17.89 %
	32	60,992	88,633	46,055	75.51 %	51.96 %
Greene	12	20,451	84,745	20,451	100.00 %	24.13 %
Guilford	57	541,299	90,615	90,615	16.74 %	100.00 %
	58	541,299	90,808	90,808	16.78 %	100.00 %
	59	541,299	90,361	90,361	16.69 %	100.00 %
	60	541,299	89,735	89,735	16.58 %	100.00 %
	61	541,299	90,201	90,201	16.66 %	100.00 %
	62	541,299	89,579	89,579	16.55 %	100.00 %
Halifax	27	48,622	84,735	48,622	100.00 %	57.38 %
Harnett	6	133,568	87,332	87,332	65.38 %	100.00 %
	53	133,568	86,899	46,236	34.62 %	53.21 %
Haywood	118	62,089	83,282	62,089	100.00 %	74.55 %
Henderson	113	116,281	89,058	25,246	21.71 %	28.35 %
	117	116,281	91,035	91,035	78.29 %	100.00 %
Hertford	5	21,552	82,953	21,552	100.00 %	25.98 %
Hoke	48	52,082	86,256	52,082	100.00 %	60.38 %
Hyde	79	4,589	83,163	4,589	100.00 %	5.52 %
Iredell	84	186,693	86,773	86,773	46.48 %	100.00 %
	89	186,693	85,577	14,554	7.80 %	17.01 %
	95	186,693	85,366	85,366	45.73 %	100.00 %
Jackson	119	43,109	90,212	43,109	100.00 %	47.79 %

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Johnston	26	215,999	89,947	89,947	41.64 %	100.00 %
	28	215,999	85,389	85,389	39.53 %	100.00 %
	53	215,999	86,899	40,663	18.83 %	46.79 %
Jones	12	9,172	84,745	9,172	100.00 %	10.82 %
Lee	51	63,285	83,073	63,285	100.00 %	76.18 %
Lenoir	12	55,122	84,745	55,122	100.00 %	65.04 %
Lincoln	97	86,810	86,810	86,810	100.00 %	100.00 %
Macon	120	37,014	84,907	37,014	100.00 %	43.59 %
Madison	118	21,193	83,282	21,193	100.00 %	25.45 %
Martin	23	22,031	88,865	22,031	100.00 %	24.79 %
McDowell	85	44,578	90,863	39,684	89.02 %	43.67 %
	113	44,578	89,058	4,894	10.98 %	5.50 %
Mecklenburg	88	1,115,482	82,834	82,834	7.43 %	100.00 %
	92	1,115,482	85,031	85,031	7.62 %	100.00 %
	98	1,115,482	86,827	86,827	7.78 %	100.00 %
	99	1,115,482	87,647	87,647	7.86 %	100.00 %
	100	1,115,482	87,197	87,197	7.82 %	100.00 %
	101	1,115,482	86,426	86,426	7.75 %	100.00 %
	102	1,115,482	86,179	86,179	7.73 %	100.00 %
	103	1,115,482	87,132	87,132	7.81 %	100.00 %
	104	1,115,482	86,520	86,520	7.76 %	100.00 %
	105	1,115,482	85,822	85,822	7.69 %	100.00 %
	106	1,115,482	82,824	82,824	7.42 %	100.00 %
	107	1,115,482	88,237	88,237	7.91 %	100.00 %
	112	1,115,482	82,806	82,806	7.42 %	100.00 %
Mitchell	85	14,903	90,863	14,903	100.00 %	16.40 %
Montgomery	67	25,751	88,255	25,751	100.00 %	29.18 %
Moore	51	99,727	83,073	19,788	19.84 %	23.82 %
	52	99,727	84,383	41,437	41.55 %	49.11 %
	78	99,727	86,365	38,502	38.61 %	44.58 %
Nash	24	94,970	87,220	8,436	8.88 %	9.67 %
	25	94,970	86,534	86,534	91.12 %	100.00 %
New Hanover	18	225,702	91,245	91,245	40.43 %	100.00 %
	19	225,702	91,041	44,111	19.54 %	48.45 %
	20	225,702	90,346	90,346	40.03 %	100.00 %
Northampton	27	17,471	84,735	17,471	100.00 %	20.62 %
Onslow	14	204,576	86,538	86,538	42.30 %	100.00 %
	15	204,576	87,578	87,578	42.81 %	100.00 %
	16	204,576	90,663	30,460	14.89 %	33.60 %
Orange	50	148,696	85,345	62,609	42.11 %	73.36 %
	56	148,696	86,087	86,087	57.89 %	100.00 %
Pamlico	79	12,276	83,163	12,276	100.00 %	14.76 %

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Pasquotank	5	40,568	82,953	40,568	100.00 %	48.90 %
Pender	16	60,203	90,663	60,203	100.00 %	66.40 %
Perquimans	1	13,005	84,330	13,005	100.00 %	15.42 %
Person	2	39,097	90,793	39,097	100.00 %	43.06 %
Pitt	8	170,243	85,793	85,793	50.39 %	100.00 %
	9	170,243	84,450	84,450	49.61 %	100.00 %
Polk	113	19,328	89,058	19,328	100.00 %	21.70 %
Randolph	54	144,171	83,475	7,190	4.99 %	8.61 %
	70	144,171	89,118	89,118	61.81 %	100.00 %
	78	144,171	86,365	47,863	33.20 %	55.42 %
Richmond	52	42,946	84,383	42,946	100.00 %	50.89 %
Robeson	46	116,530	83,445	32,822	28.17 %	39.33 %
	47	116,530	83,708	83,708	71.83 %	100.00 %
Rockingham	65	91,096	91,096	91,096	100.00 %	100.00 %
Rowan	76	146,875	89,815	89,815	61.15 %	100.00 %
	77	146,875	90,628	10,702	7.29 %	11.81 %
	83	146,875	90,742	46,358	31.56 %	51.09 %
Rutherford	111	64,444	89,894	24,854	38.57 %	27.65 %
	113	64,444	89,058	39,590	61.43 %	44.45 %
Sampson	22	59,036	88,642	59,036	100.00 %	66.60 %
Scotland	48	34,174	86,256	34,174	100.00 %	39.62 %
Stanly	67	62,504	88,255	62,504	100.00 %	70.82 %
Stokes	91	44,520	86,210	44,520	100.00 %	51.64 %
Surry	90	71,359	82,937	71,359	100.00 %	86.04 %
Swain	119	14,117	90,212	14,117	100.00 %	15.65 %
Transylvania	119	32,986	90,212	32,986	100.00 %	36.56 %
Tyrrell	1	3,245	84,330	3,245	100.00 %	3.85 %
Union	55	238,267	87,005	64,950	27.26 %	74.65 %
	68	238,267	88,138	88,138	36.99 %	100.00 %
	69	238,267	85,179	85,179	35.75 %	100.00 %
Vance	32	42,578	88,633	42,578	100.00 %	48.04 %

County - District Report

District Plan: SL 2021-175 House

County	District	Total County Population	Total District Population	County Pop in District	Percent of County Pop in District	Percent of District Pop in County
Wake	11	1,129,410	86,298	86,298	7.64 %	100.00 %
	21	1,129,410	86,179	86,179	7.63 %	100.00 %
	33	1,129,410	83,049	83,049	7.35 %	100.00 %
	34	1,129,410	83,679	83,679	7.41 %	100.00 %
	35	1,129,410	88,374	88,374	7.82 %	100.00 %
	36	1,129,410	90,166	90,166	7.98 %	100.00 %
	37	1,129,410	90,867	90,867	8.05 %	100.00 %
	38	1,129,410	88,226	88,226	7.81 %	100.00 %
	39	1,129,410	90,164	90,164	7.98 %	100.00 %
	40	1,129,410	83,175	83,175	7.36 %	100.00 %
	41	1,129,410	89,887	89,887	7.96 %	100.00 %
	49	1,129,410	86,157	86,157	7.63 %	100.00 %
	66	1,129,410	83,189	83,189	7.37 %	100.00 %
Warren	27	18,642	84,735	18,642	100.00 %	22.00 %
Washington	1	11,003	84,330	11,003	100.00 %	13.05 %
Watauga	87	54,086	85,758	5,106	9.44 %	5.95 %
	93	54,086	86,445	48,980	90.56 %	56.66 %
Wayne	4	117,333	83,095	34,380	29.30 %	41.37 %
	10	117,333	82,953	82,953	70.70 %	100.00 %
Wilkes	90	65,969	82,937	11,578	17.55 %	13.96 %
	94	65,969	90,835	54,391	82.45 %	59.88 %
Wilson	24	78,784	87,220	78,784	100.00 %	90.33 %
Yadkin	77	37,214	90,628	37,214	100.00 %	41.06 %
Yancey	85	18,470	90,863	18,470	100.00 %	20.33 %
			Total:	**10,439,388**		

Number of split counties: 36
Display: all counties

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
1	Chowan	84,330	13,708	13,708	16.26 %	100.00 %
	Currituck	84,330	28,100	28,100	33.32 %	100.00 %
	Dare	84,330	36,915	15,269	18.11 %	41.36 %
	Perquimans	84,330	13,005	13,005	15.42 %	100.00 %
	Tyrrell	84,330	3,245	3,245	3.85 %	100.00 %
	Washington	84,330	11,003	11,003	13.05 %	100.00 %
2	Durham	90,793	324,833	51,696	56.94 %	15.91 %
	Person	90,793	39,097	39,097	43.06 %	100.00 %
3	Craven	85,099	100,720	85,099	100.00 %	84.49 %
4	Duplin	83,095	48,715	48,715	58.63 %	100.00 %
	Wayne	83,095	117,333	34,380	41.37 %	29.30 %
5	Camden	82,953	10,355	10,355	12.48 %	100.00 %
	Gates	82,953	10,478	10,478	12.63 %	100.00 %
	Hertford	82,953	21,552	21,552	25.98 %	100.00 %
	Pasquotank	82,953	40,568	40,568	48.90 %	100.00 %
6	Harnett	87,332	133,568	87,332	100.00 %	65.38 %
7	Franklin	83,510	68,573	68,573	82.11 %	100.00 %
	Granville	83,510	60,992	14,937	17.89 %	24.49 %
8	Pitt	85,793	170,243	85,793	100.00 %	50.39 %
9	Pitt	84,450	170,243	84,450	100.00 %	49.61 %
10	Wayne	82,953	117,333	82,953	100.00 %	70.70 %
11	Wake	86,298	1,129,410	86,298	100.00 %	7.64 %
12	Greene	84,745	20,451	20,451	24.13 %	100.00 %
	Jones	84,745	9,172	9,172	10.82 %	100.00 %
	Lenoir	84,745	55,122	55,122	65.04 %	100.00 %
13	Carteret	83,307	67,686	67,686	81.25 %	100.00 %
	Craven	83,307	100,720	15,621	18.75 %	15.51 %
14	Onslow	86,538	204,576	86,538	100.00 %	42.30 %
15	Onslow	87,578	204,576	87,578	100.00 %	42.81 %
16	Onslow	90,663	204,576	30,460	33.60 %	14.89 %
	Pender	90,663	60,203	60,203	66.40 %	100.00 %
17	Brunswick	89,763	136,693	89,763	100.00 %	65.67 %
18	New Hanover	91,245	225,702	91,245	100.00 %	40.43 %
19	Brunswick	91,041	136,693	46,930	51.55 %	34.33 %
	New Hanover	91,041	225,702	44,111	48.45 %	19.54 %
20	New Hanover	90,346	225,702	90,346	100.00 %	40.03 %
21	Wake	86,179	1,129,410	86,179	100.00 %	7.63 %
22	Bladen	88,642	29,606	29,606	33.40 %	100.00 %
	Sampson	88,642	59,036	59,036	66.60 %	100.00 %
23	Bertie	88,865	17,934	17,934	20.18 %	100.00 %
	Edgecombe	88,865	48,900	48,900	55.03 %	100.00 %
	Martin	88,865	22,031	22,031	24.79 %	100.00 %

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
24	Nash	87,220	94,970	8,436	9.67 %	8.88 %
	Wilson	87,220	78,784	78,784	90.33 %	100.00 %
25	Nash	86,534	94,970	86,534	100.00 %	91.12 %
26	Johnston	89,947	215,999	89,947	100.00 %	41.64 %
27	Halifax	84,735	48,622	48,622	57.38 %	100.00 %
	Northampton	84,735	17,471	17,471	20.62 %	100.00 %
	Warren	84,735	18,642	18,642	22.00 %	100.00 %
28	Johnston	85,389	215,999	85,389	100.00 %	39.53 %
29	Durham	91,212	324,833	91,212	100.00 %	28.08 %
30	Durham	91,165	324,833	91,165	100.00 %	28.07 %
31	Durham	90,760	324,833	90,760	100.00 %	27.94 %
32	Granville	88,633	60,992	46,055	51.96 %	75.51 %
	Vance	88,633	42,578	42,578	48.04 %	100.00 %
33	Wake	83,049	1,129,410	83,049	100.00 %	7.35 %
34	Wake	83,679	1,129,410	83,679	100.00 %	7.41 %
35	Wake	88,374	1,129,410	88,374	100.00 %	7.82 %
36	Wake	90,166	1,129,410	90,166	100.00 %	7.98 %
37	Wake	90,867	1,129,410	90,867	100.00 %	8.05 %
38	Wake	88,226	1,129,410	88,226	100.00 %	7.81 %
39	Wake	90,164	1,129,410	90,164	100.00 %	7.98 %
40	Wake	83,175	1,129,410	83,175	100.00 %	7.36 %
41	Wake	89,887	1,129,410	89,887	100.00 %	7.96 %
42	Cumberland	85,537	334,728	85,537	100.00 %	25.55 %
43	Cumberland	82,956	334,728	82,956	100.00 %	24.78 %
44	Cumberland	83,297	334,728	83,297	100.00 %	24.88 %
45	Cumberland	82,938	334,728	82,938	100.00 %	24.78 %
46	Columbus	83,445	50,623	50,623	60.67 %	100.00 %
	Robeson	83,445	116,530	32,822	39.33 %	28.17 %
47	Robeson	83,708	116,530	83,708	100.00 %	71.83 %
48	Hoke	86,256	52,082	52,082	60.38 %	100.00 %
	Scotland	86,256	34,174	34,174	39.62 %	100.00 %
49	Wake	86,157	1,129,410	86,157	100.00 %	7.63 %
50	Caswell	85,345	22,736	22,736	26.64 %	100.00 %
	Orange	85,345	148,696	62,609	73.36 %	42.11 %
51	Lee	83,073	63,285	63,285	76.18 %	100.00 %
	Moore	83,073	99,727	19,788	23.82 %	19.84 %
52	Moore	84,383	99,727	41,437	49.11 %	41.55 %
	Richmond	84,383	42,946	42,946	50.89 %	100.00 %
53	Harnett	86,899	133,568	46,236	53.21 %	34.62 %
	Johnston	86,899	215,999	40,663	46.79 %	18.83 %
54	Chatham	83,475	76,285	76,285	91.39 %	100.00 %
	Randolph	83,475	144,171	7,190	8.61 %	4.99 %

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
55	Anson	87,005	22,055	22,055	25.35 %	100.00 %
	Union	87,005	238,267	64,950	74.65 %	27.26 %
56	Orange	86,087	148,696	86,087	100.00 %	57.89 %
57	Guilford	90,615	541,299	90,615	100.00 %	16.74 %
58	Guilford	90,808	541,299	90,808	100.00 %	16.78 %
59	Guilford	90,361	541,299	90,361	100.00 %	16.69 %
60	Guilford	89,735	541,299	89,735	100.00 %	16.58 %
61	Guilford	90,201	541,299	90,201	100.00 %	16.66 %
62	Guilford	89,579	541,299	89,579	100.00 %	16.55 %
63	Alamance	86,399	171,415	86,399	100.00 %	50.40 %
64	Alamance	85,016	171,415	85,016	100.00 %	49.60 %
65	Rockingham	91,096	91,096	91,096	100.00 %	100.00 %
66	Wake	83,189	1,129,410	83,189	100.00 %	7.37 %
67	Montgomery	88,255	25,751	25,751	29.18 %	100.00 %
	Stanly	88,255	62,504	62,504	70.82 %	100.00 %
68	Union	88,138	238,267	88,138	100.00 %	36.99 %
69	Union	85,179	238,267	85,179	100.00 %	35.75 %
70	Randolph	89,118	144,171	89,118	100.00 %	61.81 %
71	Forsyth	84,874	382,590	84,874	100.00 %	22.18 %
72	Forsyth	86,949	382,590	86,949	100.00 %	22.73 %
73	Cabarrus	90,649	225,804	90,649	100.00 %	40.14 %
74	Forsyth	84,857	382,590	84,857	100.00 %	22.18 %
75	Forsyth	84,220	382,590	84,220	100.00 %	22.01 %
76	Rowan	89,815	146,875	89,815	100.00 %	61.15 %
77	Davie	90,628	42,712	42,712	47.13 %	100.00 %
	Rowan	90,628	146,875	10,702	11.81 %	7.29 %
	Yadkin	90,628	37,214	37,214	41.06 %	100.00 %
78	Moore	86,365	99,727	38,502	44.58 %	38.61 %
	Randolph	86,365	144,171	47,863	55.42 %	33.20 %
79	Beaufort	83,163	44,652	44,652	53.69 %	100.00 %
	Dare	83,163	36,915	21,646	26.03 %	58.64 %
	Hyde	83,163	4,589	4,589	5.52 %	100.00 %
	Pamlico	83,163	12,276	12,276	14.76 %	100.00 %
80	Davidson	84,864	168,930	84,864	100.00 %	50.24 %
81	Davidson	84,066	168,930	84,066	100.00 %	49.76 %
82	Cabarrus	90,771	225,804	90,771	100.00 %	40.20 %
83	Cabarrus	90,742	225,804	44,384	48.91 %	19.66 %
	Rowan	90,742	146,875	46,358	51.09 %	31.56 %
84	Iredell	86,773	186,693	86,773	100.00 %	46.48 %

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
85	Avery	90,863	17,806	17,806	19.60 %	100.00 %
	McDowell	90,863	44,578	39,684	43.67 %	89.02 %
	Mitchell	90,863	14,903	14,903	16.40 %	100.00 %
	Yancey	90,863	18,470	18,470	20.33 %	100.00 %
86	Burke	87,570	87,570	87,570	100.00 %	100.00 %
87	Caldwell	85,758	80,652	80,652	94.05 %	100.00 %
	Watauga	85,758	54,086	5,106	5.95 %	9.44 %
88	Mecklenburg	82,834	1,115,482	82,834	100.00 %	7.43 %
89	Catawba	85,577	160,610	71,023	82.99 %	44.22 %
	Iredell	85,577	186,693	14,554	17.01 %	7.80 %
90	Surry	82,937	71,359	71,359	86.04 %	100.00 %
	Wilkes	82,937	65,969	11,578	13.96 %	17.55 %
91	Forsyth	86,210	382,590	41,690	48.36 %	10.90 %
	Stokes	86,210	44,520	44,520	51.64 %	100.00 %
92	Mecklenburg	85,031	1,115,482	85,031	100.00 %	7.62 %
93	Alleghany	86,445	10,888	10,888	12.60 %	100.00 %
	Ashe	86,445	26,577	26,577	30.74 %	100.00 %
	Watauga	86,445	54,086	48,980	56.66 %	90.56 %
94	Alexander	90,835	36,444	36,444	40.12 %	100.00 %
	Wilkes	90,835	65,969	54,391	59.88 %	82.45 %
95	Iredell	85,366	186,693	85,366	100.00 %	45.73 %
96	Catawba	89,587	160,610	89,587	100.00 %	55.78 %
97	Lincoln	86,810	86,810	86,810	100.00 %	100.00 %
98	Mecklenburg	86,827	1,115,482	86,827	100.00 %	7.78 %
99	Mecklenburg	87,647	1,115,482	87,647	100.00 %	7.86 %
100	Mecklenburg	87,197	1,115,482	87,197	100.00 %	7.82 %
101	Mecklenburg	86,426	1,115,482	86,426	100.00 %	7.75 %
102	Mecklenburg	86,179	1,115,482	86,179	100.00 %	7.73 %
103	Mecklenburg	87,132	1,115,482	87,132	100.00 %	7.81 %
104	Mecklenburg	86,520	1,115,482	86,520	100.00 %	7.76 %
105	Mecklenburg	85,822	1,115,482	85,822	100.00 %	7.69 %
106	Mecklenburg	82,824	1,115,482	82,824	100.00 %	7.42 %
107	Mecklenburg	88,237	1,115,482	88,237	100.00 %	7.91 %
108	Gaston	86,263	227,943	86,263	100.00 %	37.84 %
109	Gaston	87,762	227,943	87,762	100.00 %	38.50 %
110	Cleveland	88,397	99,519	34,479	39.00 %	34.65 %
	Gaston	88,397	227,943	53,918	61.00 %	23.65 %
111	Cleveland	89,894	99,519	65,040	72.35 %	65.35 %
	Rutherford	89,894	64,444	24,854	27.65 %	38.57 %
112	Mecklenburg	82,806	1,115,482	82,806	100.00 %	7.42 %

District - County Report

District Plan: SL 2021-175 House

District	County	Total District Population	Total County Population	District Pop in County	Percent of District Pop in County	Percent of County Pop in District
113	Henderson	89,058	116,281	25,246	28.35 %	21.71 %
	McDowell	89,058	44,578	4,894	5.50 %	10.98 %
	Polk	89,058	19,328	19,328	21.70 %	100.00 %
	Rutherford	89,058	64,444	39,590	44.45 %	61.43 %
114	Buncombe	89,685	269,452	89,685	100.00 %	33.28 %
115	Buncombe	90,262	269,452	90,262	100.00 %	33.50 %
116	Buncombe	89,505	269,452	89,505	100.00 %	33.22 %
117	Henderson	91,035	116,281	91,035	100.00 %	78.29 %
118	Haywood	83,282	62,089	62,089	74.55 %	100.00 %
	Madison	83,282	21,193	21,193	25.45 %	100.00 %
119	Jackson	90,212	43,109	43,109	47.79 %	100.00 %
	Swain	90,212	14,117	14,117	15.65 %	100.00 %
	Transylvania	90,212	32,986	32,986	36.56 %	100.00 %
120	Cherokee	84,907	28,774	28,774	33.89 %	100.00 %
	Clay	84,907	11,089	11,089	13.06 %	100.00 %
	Graham	84,907	8,030	8,030	9.46 %	100.00 %
	Macon	84,907	37,014	37,014	43.59 %	100.00 %
			Total:	**10,439,388**		

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Aberdeen	52	8,516	84,383	8,516	100.00 %	10.09 %
	78	8,516	86,365	0	0.00 %	0.00 %
Ahoskie	5	4,891	82,953	4,891	100.00 %	5.90 %
Alamance	64	988	85,016	988	100.00 %	1.16 %
Albemarle	67	16,432	88,255	16,432	100.00 %	18.62 %
Alliance	79	733	83,163	733	100.00 %	0.88 %
Andrews	120	1,667	84,907	1,667	100.00 %	1.96 %
Angier	6	5,265	87,332	4,709	89.44 %	5.39 %
	37	5,265	90,867	556	10.56 %	0.61 %
Ansonville	55	440	87,005	440	100.00 %	0.51 %
Apex	11	58,780	86,298	0	0.00 %	0.00 %
	21	58,780	86,179	556	0.95 %	0.65 %
	36	58,780	90,166	57,843	98.41 %	64.15 %
	41	58,780	89,887	381	0.65 %	0.42 %
Arapahoe	79	416	83,163	416	100.00 %	0.50 %
Archdale	60	11,907	89,735	380	3.19 %	0.42 %
	70	11,907	89,118	11,527	96.81 %	12.93 %
Archer Lodge	26	4,797	89,947	4,797	100.00 %	5.33 %
Asheboro	70	27,156	89,118	25,890	95.34 %	29.05 %
	78	27,156	86,365	1,266	4.66 %	1.47 %
Asheville	114	94,589	89,685	52,596	55.60 %	58.65 %
	115	94,589	90,262	29,236	30.91 %	32.39 %
	116	94,589	89,505	12,757	13.49 %	14.25 %
Askewville	23	184	88,865	184	100.00 %	0.21 %
Atkinson	16	296	90,663	296	100.00 %	0.33 %
Atlantic Beach	13	1,364	83,307	1,364	100.00 %	1.64 %
Aulander	23	763	88,865	763	100.00 %	0.86 %
Aurora	79	455	83,163	455	100.00 %	0.55 %
Autryville	22	167	88,642	167	100.00 %	0.19 %
Ayden	9	4,977	84,450	4,977	100.00 %	5.89 %
Badin	67	2,024	88,255	2,024	100.00 %	2.29 %
Bailey	24	568	87,220	568	100.00 %	0.65 %
Bakersville	85	450	90,863	450	100.00 %	0.50 %
Bald Head Island	19	268	91,041	268	100.00 %	0.29 %
Banner Elk	85	1,049	90,863	1,049	100.00 %	1.15 %
Bath	79	245	83,163	245	100.00 %	0.29 %
Bayboro	79	1,161	83,163	1,161	100.00 %	1.40 %
Bear Grass	23	89	88,865	89	100.00 %	0.10 %
Beaufort	13	4,464	83,307	4,464	100.00 %	5.36 %
Beech Mountain	85	675	90,863	62	9.19 %	0.07 %
	93	675	86,445	613	90.81 %	0.71 %
Belhaven	79	1,410	83,163	1,410	100.00 %	1.70 %

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Belmont	108	15,010	86,263	1,868	12.45 %	2.17 %
	109	15,010	87,762	13,142	87.55 %	14.97 %
Belville	17	2,406	89,763	2,406	100.00 %	2.68 %
Belwood	110	857	88,397	857	100.00 %	0.97 %
Benson	28	3,967	85,389	3,967	100.00 %	4.65 %
	53	3,967	86,899	0	0.00 %	0.00 %
Bermuda Run	77	3,120	90,628	3,120	100.00 %	3.44 %
Bessemer City	110	5,428	88,397	5,428	100.00 %	6.14 %
Bethania	74	344	84,857	0	0.00 %	0.00 %
	91	344	86,210	344	100.00 %	0.40 %
Bethel	8	1,373	85,793	1,373	100.00 %	1.60 %
Beulaville	4	1,116	83,095	1,116	100.00 %	1.34 %
Biltmore Forest	116	1,409	89,505	1,409	100.00 %	1.57 %
Biscoe	67	1,848	88,255	1,848	100.00 %	2.09 %
Black Creek	24	692	87,220	692	100.00 %	0.79 %
Black Mountain	115	8,426	90,262	8,426	100.00 %	9.34 %
Bladenboro	22	1,648	88,642	1,648	100.00 %	1.86 %
Blowing Rock	87	1,376	85,758	96	6.98 %	0.11 %
	93	1,376	86,445	1,280	93.02 %	1.48 %
Boardman	46	166	83,445	166	100.00 %	0.20 %
Bogue	13	695	83,307	695	100.00 %	0.83 %
Boiling Spring Lakes	19	5,943	91,041	5,943	100.00 %	6.53 %
Boiling Springs	111	4,615	89,894	4,615	100.00 %	5.13 %
Bolivia	19	149	91,041	149	100.00 %	0.16 %
Bolton	46	519	83,445	519	100.00 %	0.62 %
Boone	87	19,092	85,758	595	3.12 %	0.69 %
	93	19,092	86,445	18,497	96.88 %	21.40 %
Boonville	77	1,185	90,628	1,185	100.00 %	1.31 %
Bostic	111	355	89,894	355	100.00 %	0.39 %
Brevard	119	7,744	90,212	7,744	100.00 %	8.58 %
Bridgeton	3	349	85,099	349	100.00 %	0.41 %
Broadway	6	1,267	87,332	0	0.00 %	0.00 %
	51	1,267	83,073	1,267	100.00 %	1.53 %
Brookford	96	442	89,587	442	100.00 %	0.49 %
Brunswick	46	973	83,445	973	100.00 %	1.17 %
Bryson City	119	1,558	90,212	1,558	100.00 %	1.73 %
Bunn	7	327	83,510	327	100.00 %	0.39 %
Burgaw	16	3,088	90,663	3,088	100.00 %	3.41 %
Burlington	59	57,303	90,361	1,822	3.18 %	2.02 %
	63	57,303	86,399	25,917	45.23 %	30.00 %
	64	57,303	85,016	29,564	51.59 %	34.77 %
Burnsville	85	1,614	90,863	1,614	100.00 %	1.78 %

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Butner	32	8,397	88,633	8,397	100.00 %	9.47 %
Cajah's Mountain	87	2,722	85,758	2,722	100.00 %	3.17 %
Calabash	17	2,011	89,763	2,011	100.00 %	2.24 %
Calypso	4	327	83,095	327	100.00 %	0.39 %
Cameron	51	244	83,073	244	100.00 %	0.29 %
Candor	67	813	88,255	813	100.00 %	0.92 %
	78	813	86,365	0	0.00 %	0.00 %
Canton	118	4,422	83,282	4,422	100.00 %	5.31 %
Cape Carteret	13	2,224	83,307	2,224	100.00 %	2.67 %
Carolina Beach	19	6,564	91,041	6,564	100.00 %	7.21 %
Carolina Shores	17	4,588	89,763	4,588	100.00 %	5.11 %
Carrboro	50	21,295	85,345	174	0.82 %	0.20 %
	56	21,295	86,087	21,121	99.18 %	24.53 %
Carthage	51	2,775	83,073	2,747	98.99 %	3.31 %
	52	2,775	84,383	28	1.01 %	0.03 %
Cary	11	174,721	86,298	43,537	24.92 %	50.45 %
	21	174,721	86,179	30,622	17.53 %	35.53 %
	36	174,721	90,166	0	0.00 %	0.00 %
	37	174,721	90,867	2,012	1.15 %	2.21 %
	41	174,721	89,887	74,074	42.40 %	82.41 %
	49	174,721	86,157	20,767	11.89 %	24.10 %
	54	174,721	83,475	3,709	2.12 %	4.44 %
Casar	110	305	88,397	305	100.00 %	0.35 %
Castalia	25	264	86,534	264	100.00 %	0.31 %
Caswell Beach	19	395	91,041	395	100.00 %	0.43 %
Catawba	89	702	85,577	702	100.00 %	0.82 %
Cedar Point	13	1,764	83,307	1,764	100.00 %	2.12 %
Cedar Rock	87	301	85,758	301	100.00 %	0.35 %
Cerro Gordo	46	131	83,445	131	100.00 %	0.16 %
Chadbourn	46	1,574	83,445	1,574	100.00 %	1.89 %
Chapel Hill	29	61,960	91,212	2,906	4.69 %	3.19 %
	56	61,960	86,087	59,054	95.31 %	68.60 %

Municipality - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Charlotte	88	874,579	82,834	82,834	9.47 %	100.00 %
	92	874,579	85,031	63,762	7.29 %	74.99 %
	99	874,579	87,647	79,113	9.05 %	90.26 %
	100	874,579	87,197	87,197	9.97 %	100.00 %
	101	874,579	86,426	64,526	7.38 %	74.66 %
	102	874,579	86,179	86,179	9.85 %	100.00 %
	103	874,579	87,132	23,590	2.70 %	27.07 %
	104	874,579	86,520	86,520	9.89 %	100.00 %
	105	874,579	85,822	71,156	8.14 %	82.91 %
	106	874,579	82,824	79,717	9.11 %	96.25 %
	107	874,579	88,237	67,298	7.69 %	76.27 %
	112	874,579	82,806	82,687	9.45 %	99.86 %
Cherryville	110	6,078	88,397	6,078	100.00 %	6.88 %
Chimney Rock Village	113	140	89,058	140	100.00 %	0.16 %
China Grove	83	4,434	90,742	4,434	100.00 %	4.89 %
Chocowinity	79	722	83,163	722	100.00 %	0.87 %
Claremont	89	1,692	85,577	1,692	100.00 %	1.98 %
Clarkton	22	614	88,642	614	100.00 %	0.69 %
Clayton	26	26,307	89,947	26,307	100.00 %	29.25 %
	38	26,307	88,226	0	0.00 %	0.00 %
	39	26,307	90,164	0	0.00 %	0.00 %
Clemmons	74	21,163	84,857	21,163	100.00 %	24.94 %
Cleveland	77	846	90,628	846	100.00 %	0.93 %
Clinton	22	8,383	88,642	8,383	100.00 %	9.46 %
Clyde	118	1,368	83,282	1,368	100.00 %	1.64 %
Coats	53	2,155	86,899	2,155	100.00 %	2.48 %
Cofield	5	267	82,953	267	100.00 %	0.32 %
Colerain	23	217	88,865	217	100.00 %	0.24 %
Columbia	1	610	84,330	610	100.00 %	0.72 %
Columbus	113	1,060	89,058	1,060	100.00 %	1.19 %
Como	5	67	82,953	67	100.00 %	0.08 %
Concord	73	105,240	90,649	32,447	30.83 %	35.79 %
	82	105,240	90,771	48,723	46.30 %	53.68 %
	83	105,240	90,742	24,070	22.87 %	26.53 %
Conetoe	23	198	88,865	198	100.00 %	0.22 %
Connelly Springs	86	1,529	87,570	1,529	100.00 %	1.75 %
Conover	89	8,421	85,577	424	5.04 %	0.50 %
	96	8,421	89,587	7,997	94.96 %	8.93 %
Conway	27	752	84,735	752	100.00 %	0.89 %
Cooleemee	77	940	90,628	940	100.00 %	1.04 %
Cornelius	98	31,412	86,827	31,412	100.00 %	36.18 %
Cove City	3	378	85,099	378	100.00 %	0.44 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Cramerton	108	5,296	86,263	96	1.81 %	0.11 %
	109	5,296	87,762	5,200	98.19 %	5.93 %
Creedmoor	7	4,866	83,510	2,065	42.44 %	2.47 %
	32	4,866	88,633	2,801	57.56 %	3.16 %
Creswell	1	207	84,330	207	100.00 %	0.25 %
Crossnore	85	143	90,863	143	100.00 %	0.16 %
Dallas	110	5,927	88,397	5,927	100.00 %	6.70 %
Danbury	91	189	86,210	189	100.00 %	0.22 %
Davidson	95	15,106	85,366	378	2.50 %	0.44 %
	98	15,106	86,827	14,728	97.50 %	16.96 %
Dellview	110	6	88,397	6	100.00 %	0.01 %
Denton	80	1,494	84,864	1,494	100.00 %	1.76 %
Dillsboro	119	213	90,212	213	100.00 %	0.24 %
Dobbins Heights	52	687	84,383	687	100.00 %	0.81 %
Dobson	90	1,462	82,937	1,462	100.00 %	1.76 %
Dortches	25	1,082	86,534	1,082	100.00 %	1.25 %
Dover	3	349	85,099	349	100.00 %	0.41 %
Drexel	86	1,760	87,570	1,760	100.00 %	2.01 %
Dublin	22	267	88,642	267	100.00 %	0.30 %
Duck	1	742	84,330	742	100.00 %	0.88 %
Dunn	53	8,446	86,899	8,446	100.00 %	9.72 %
Durham	2	283,506	90,793	25,167	8.88 %	27.72 %
	29	283,506	91,212	87,035	30.70 %	95.42 %
	30	283,506	91,165	89,671	31.63 %	98.36 %
	31	283,506	90,760	81,220	28.65 %	89.49 %
	40	283,506	83,175	269	0.09 %	0.32 %
	49	283,506	86,157	0	0.00 %	0.00 %
	50	283,506	85,345	144	0.05 %	0.17 %
Earl	111	198	89,894	198	100.00 %	0.22 %
East Arcadia	22	418	88,642	418	100.00 %	0.47 %
East Bend	77	634	90,628	634	100.00 %	0.70 %
East Laurinburg	48	234	86,256	234	100.00 %	0.27 %
Eastover	43	3,656	82,956	3,656	100.00 %	4.41 %
East Spencer	76	1,567	89,815	1,567	100.00 %	1.74 %
Eden	65	15,421	91,096	15,421	100.00 %	16.93 %
Edenton	1	4,460	84,330	4,460	100.00 %	5.29 %
Elizabeth City	5	18,631	82,953	18,631	100.00 %	22.46 %
Elizabethtown	22	3,296	88,642	3,296	100.00 %	3.72 %
Elkin	90	4,122	82,937	4,122	100.00 %	4.97 %
Elk Park	85	542	90,863	542	100.00 %	0.60 %
Ellenboro	111	723	89,894	723	100.00 %	0.80 %
Ellerbe	52	864	84,383	864	100.00 %	1.02 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Elm City	24	1,218	87,220	1,218	100.00 %	1.40 %
	25	1,218	86,534	0	0.00 %	0.00 %
Elon	64	11,336	85,016	11,336	100.00 %	13.33 %
Emerald Isle	13	3,847	83,307	3,847	100.00 %	4.62 %
Enfield	27	1,865	84,735	1,865	100.00 %	2.20 %
Erwin	53	4,542	86,899	4,542	100.00 %	5.23 %
Eureka	10	214	82,953	214	100.00 %	0.26 %
Everetts	23	150	88,865	150	100.00 %	0.17 %
Fair Bluff	46	709	83,445	709	100.00 %	0.85 %
Fairmont	46	2,191	83,445	2,191	100.00 %	2.63 %
	47	2,191	83,708	0	0.00 %	0.00 %
Fairview	69	3,456	85,179	3,456	100.00 %	4.06 %
Faison	4	784	83,095	784	100.00 %	0.94 %
	22	784	88,642	0	0.00 %	0.00 %
Faith	76	819	89,815	819	100.00 %	0.91 %
Falcon	22	324	88,642	0	0.00 %	0.00 %
	43	324	82,956	324	100.00 %	0.39 %
Falkland	8	47	85,793	47	100.00 %	0.05 %
Fallston	110	627	88,397	627	100.00 %	0.71 %
Farmville	8	4,461	85,793	4,461	100.00 %	5.20 %
Fayetteville	42	208,501	85,537	65,401	31.37 %	76.46 %
	43	208,501	82,956	44,532	21.36 %	53.68 %
	44	208,501	83,297	83,293	39.95 %	100.00 %
	45	208,501	82,938	15,275	7.33 %	18.42 %
Flat Rock	113	3,486	89,058	3,486	100.00 %	3.91 %
Fletcher	117	7,987	91,035	7,987	100.00 %	8.77 %
Fontana Dam	120	13	84,907	13	100.00 %	0.02 %
Forest City	111	7,377	89,894	0	0.00 %	0.00 %
	113	7,377	89,058	7,377	100.00 %	8.28 %
Forest Hills	119	303	90,212	303	100.00 %	0.34 %
Fountain	8	385	85,793	385	100.00 %	0.45 %
Four Oaks	28	2,158	85,389	2,158	100.00 %	2.53 %
Foxfire	52	1,288	84,383	0	0.00 %	0.00 %
	78	1,288	86,365	1,288	100.00 %	1.49 %
Franklin	120	4,175	84,907	4,175	100.00 %	4.92 %
Franklinton	7	2,456	83,510	2,456	100.00 %	2.94 %
Franklinville	78	1,197	86,365	1,197	100.00 %	1.39 %
Fremont	10	1,196	82,953	1,196	100.00 %	1.44 %
Fuquay-Varina	6	34,152	87,332	0	0.00 %	0.00 %
	21	34,152	86,179	30	0.09 %	0.03 %
	36	34,152	90,166	16	0.05 %	0.02 %
	37	34,152	90,867	34,106	99.87 %	37.53 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Gamewell	87	3,702	85,758	3,702	100.00 %	4.32 %
Garland	22	595	88,642	595	100.00 %	0.67 %
Garner	21	31,159	86,179	11,789	37.83 %	13.68 %
	33	31,159	83,049	14	0.04 %	0.02 %
	37	31,159	90,867	0	0.00 %	0.00 %
	38	31,159	88,226	19,356	62.12 %	21.94 %
Garysburg	27	904	84,735	904	100.00 %	1.07 %
Gaston	27	1,008	84,735	1,008	100.00 %	1.19 %
Gastonia	108	80,411	86,263	28,480	35.42 %	33.02 %
	109	80,411	87,762	44,448	55.28 %	50.65 %
	110	80,411	88,397	7,483	9.31 %	8.47 %
Gatesville	5	267	82,953	267	100.00 %	0.32 %
Gibson	48	449	86,256	449	100.00 %	0.52 %
Gibsonville	59	8,920	90,361	4,642	52.04 %	5.14 %
	64	8,920	85,016	4,278	47.96 %	5.03 %
Glen Alpine	86	1,529	87,570	1,529	100.00 %	1.75 %
Godwin	43	128	82,956	128	100.00 %	0.15 %
Goldsboro	4	33,657	83,095	5	0.01 %	0.01 %
	10	33,657	82,953	33,652	99.99 %	40.57 %
Goldston	54	234	83,475	234	100.00 %	0.28 %
Graham	63	17,157	86,399	17,157	100.00 %	19.86 %
Grandfather Village	85	95	90,863	95	100.00 %	0.10 %
Granite Falls	87	4,965	85,758	4,965	100.00 %	5.79 %
Granite Quarry	76	2,984	89,815	2,984	100.00 %	3.32 %
Grantsboro	79	692	83,163	692	100.00 %	0.83 %
Greenevers	4	567	83,095	567	100.00 %	0.68 %
Green Level	63	3,152	86,399	3,152	100.00 %	3.65 %
Greensboro	57	299,035	90,615	83,540	27.94 %	92.19 %
	58	299,035	90,808	84,725	28.33 %	93.30 %
	59	299,035	90,361	13,852	4.63 %	15.33 %
	60	299,035	89,735	8,829	2.95 %	9.84 %
	61	299,035	90,201	90,201	30.16 %	100.00 %
	62	299,035	89,579	17,888	5.98 %	19.97 %
Greenville	8	87,521	85,793	52,881	60.42 %	61.64 %
	9	87,521	84,450	34,640	39.58 %	41.02 %
Grifton	9	2,448	84,450	2,301	94.00 %	2.72 %
	12	2,448	84,745	147	6.00 %	0.17 %
Grimesland	9	386	84,450	386	100.00 %	0.46 %
Grover	111	802	89,894	802	100.00 %	0.89 %
Halifax	27	170	84,735	170	100.00 %	0.20 %
Hamilton	23	306	88,865	306	100.00 %	0.34 %
Hamlet	52	6,025	84,383	6,025	100.00 %	7.14 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Harmony	84	543	86,773	543	100.00 %	0.63 %
Harrells	4	160	83,095	0	0.00 %	0.00 %
	22	160	88,642	160	100.00 %	0.18 %
Harrellsville	5	85	82,953	85	100.00 %	0.10 %
Harrisburg	73	18,967	90,649	18,967	100.00 %	20.92 %
Hassell	23	49	88,865	49	100.00 %	0.06 %
Havelock	3	16,621	85,099	5,986	36.01 %	7.03 %
	13	16,621	83,307	10,635	63.99 %	12.77 %
Haw River	63	2,252	86,399	2,252	100.00 %	2.61 %
Hayesville	120	461	84,907	461	100.00 %	0.54 %
Hemby Bridge	69	1,614	85,179	1,614	100.00 %	1.89 %
Henderson	32	15,060	88,633	15,060	100.00 %	16.99 %
Hendersonville	113	15,137	89,058	623	4.12 %	0.70 %
	117	15,137	91,035	14,514	95.88 %	15.94 %
Hertford	1	1,934	84,330	1,934	100.00 %	2.29 %
Hickory	86	43,490	87,570	79	0.18 %	0.09 %
	87	43,490	85,758	32	0.07 %	0.04 %
	89	43,490	85,577	0	0.00 %	0.00 %
	96	43,490	89,587	43,379	99.74 %	48.42 %
Highlands	119	1,072	90,212	12	1.12 %	0.01 %
	120	1,072	84,907	1,060	98.88 %	1.25 %
High Point	60	114,059	89,735	66,033	57.89 %	73.59 %
	62	114,059	89,579	41,288	36.20 %	46.09 %
	70	114,059	89,118	8	0.01 %	0.01 %
	75	114,059	84,220	84	0.07 %	0.10 %
	80	114,059	84,864	6,646	5.83 %	7.83 %
High Shoals	110	595	88,397	595	100.00 %	0.67 %
Hildebran	86	1,679	87,570	1,679	100.00 %	1.92 %
Hillsborough	50	9,660	85,345	9,660	100.00 %	11.32 %
Hobgood	27	268	84,735	268	100.00 %	0.32 %
Hoffman	52	418	84,383	418	100.00 %	0.50 %
Holden Beach	17	921	89,763	0	0.00 %	0.00 %
	19	921	91,041	921	100.00 %	1.01 %
Holly Ridge	15	4,171	87,578	4,171	100.00 %	4.76 %
Holly Springs	21	41,239	86,179	11,892	28.84 %	13.80 %
	36	41,239	90,166	17,734	43.00 %	19.67 %
	37	41,239	90,867	11,613	28.16 %	12.78 %
Hookerton	12	413	84,745	413	100.00 %	0.49 %
Hope Mills	43	17,808	82,956	64	0.36 %	0.08 %
	45	17,808	82,938	17,744	99.64 %	21.39 %
Hot Springs	118	520	83,282	520	100.00 %	0.62 %
Hudson	87	3,780	85,758	3,780	100.00 %	4.41 %

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Huntersville	98	61,376	86,827	38,677	63.02 %	44.54 %
	101	61,376	86,426	5,893	9.60 %	6.82 %
	107	61,376	88,237	16,806	27.38 %	19.05 %
Indian Beach	13	223	83,307	223	100.00 %	0.27 %
Indian Trail	55	39,997	87,005	2,376	5.94 %	2.73 %
	68	39,997	88,138	15,036	37.59 %	17.06 %
	69	39,997	85,179	22,585	56.47 %	26.51 %
Jackson	27	430	84,735	430	100.00 %	0.51 %
Jacksonville	14	72,723	86,538	28,456	39.13 %	32.88 %
	15	72,723	87,578	44,267	60.87 %	50.55 %
Jamestown	60	3,668	89,735	3,668	100.00 %	4.09 %
Jamesville	23	424	88,865	424	100.00 %	0.48 %
Jefferson	93	1,622	86,445	1,622	100.00 %	1.88 %
Jonesville	77	2,308	90,628	2,308	100.00 %	2.55 %
Kannapolis	82	53,114	90,771	33,907	63.84 %	37.35 %
	83	53,114	90,742	19,207	36.16 %	21.17 %
Kelford	23	203	88,865	203	100.00 %	0.23 %
Kenansville	4	770	83,095	770	100.00 %	0.93 %
Kenly	24	1,491	87,220	198	13.28 %	0.23 %
	28	1,491	85,389	1,293	86.72 %	1.51 %
Kernersville	62	26,449	89,579	502	1.90 %	0.56 %
	71	26,449	84,874	0	0.00 %	0.00 %
	75	26,449	84,220	25,947	98.10 %	30.81 %
Kill Devil Hills	1	7,656	84,330	7,118	92.97 %	8.44 %
	79	7,656	83,163	538	7.03 %	0.65 %
King	91	7,197	86,210	7,197	100.00 %	8.35 %
Kings Mountain	110	11,142	88,397	1,118	10.03 %	1.26 %
	111	11,142	89,894	10,024	89.97 %	11.15 %
Kingstown	110	656	88,397	656	100.00 %	0.74 %
Kinston	12	19,900	84,745	19,900	100.00 %	23.48 %
Kittrell	32	132	88,633	132	100.00 %	0.15 %
Kitty Hawk	1	3,689	84,330	3,689	100.00 %	4.37 %
Knightdale	38	19,435	88,226	0	0.00 %	0.00 %
	39	19,435	90,164	19,435	100.00 %	21.56 %
Kure Beach	19	2,191	91,041	2,191	100.00 %	2.41 %
La Grange	12	2,595	84,745	2,595	100.00 %	3.06 %
Lake Lure	113	1,365	89,058	1,365	100.00 %	1.53 %
Lake Park	69	3,269	85,179	3,269	100.00 %	3.84 %
Lake Santeetlah	120	38	84,907	38	100.00 %	0.04 %
Lake Waccamaw	46	1,296	83,445	1,296	100.00 %	1.55 %
Landis	83	3,690	90,742	3,690	100.00 %	4.07 %
Lansing	93	126	86,445	126	100.00 %	0.15 %

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Lasker	27	64	84,735	64	100.00 %	0.08 %
Lattimore	111	406	89,894	406	100.00 %	0.45 %
Laurel Park	113	2,250	89,058	0	0.00 %	0.00 %
	117	2,250	91,035	2,250	100.00 %	2.47 %
Laurinburg	48	14,978	86,256	14,978	100.00 %	17.36 %
Lawndale	110	570	88,397	570	100.00 %	0.64 %
Leggett	23	37	88,865	37	100.00 %	0.04 %
Leland	17	22,908	89,763	22,908	100.00 %	25.52 %
Lenoir	87	18,352	85,758	18,352	100.00 %	21.40 %
Lewiston Woodville	23	426	88,865	426	100.00 %	0.48 %
Lewisville	74	13,381	84,857	13,381	100.00 %	15.77 %
Lexington	80	19,632	84,864	0	0.00 %	0.00 %
	81	19,632	84,066	19,632	100.00 %	23.35 %
Liberty	54	2,655	83,475	2,655	100.00 %	3.18 %
Lilesville	55	395	87,005	395	100.00 %	0.45 %
Lillington	6	4,735	87,332	882	18.63 %	1.01 %
	53	4,735	86,899	3,853	81.37 %	4.43 %
Lincolnton	97	11,091	86,810	11,091	100.00 %	12.78 %
Linden	43	136	82,956	136	100.00 %	0.16 %
Littleton	27	559	84,735	559	100.00 %	0.66 %
Locust	67	4,537	88,255	3,996	88.08 %	4.53 %
	73	4,537	90,649	541	11.92 %	0.60 %
Long View	86	5,088	87,570	735	14.45 %	0.84 %
	96	5,088	89,587	4,353	85.55 %	4.86 %
Louisburg	7	3,064	83,510	3,064	100.00 %	3.67 %
Love Valley	84	154	86,773	154	100.00 %	0.18 %
Lowell	108	3,654	86,263	3,654	100.00 %	4.24 %
	109	3,654	87,762	0	0.00 %	0.00 %
Lucama	24	1,036	87,220	1,036	100.00 %	1.19 %
Lumber Bridge	47	82	83,708	82	100.00 %	0.10 %
Lumberton	46	19,025	83,445	350	1.84 %	0.42 %
	47	19,025	83,708	18,675	98.16 %	22.31 %
McAdenville	108	890	86,263	890	100.00 %	1.03 %
Macclesfield	23	413	88,865	413	100.00 %	0.46 %
McDonald	46	94	83,445	94	100.00 %	0.11 %
McFarlan	55	94	87,005	94	100.00 %	0.11 %
Macon	27	110	84,735	110	100.00 %	0.13 %
Madison	65	2,129	91,096	2,129	100.00 %	2.34 %
Maggie Valley	118	1,687	83,282	1,687	100.00 %	2.03 %
Magnolia	4	831	83,095	831	100.00 %	1.00 %
Maiden	89	3,736	85,577	3,736	100.00 %	4.37 %
	97	3,736	86,810	0	0.00 %	0.00 %

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Manteo	79	1,600	83,163	1,600	100.00 %	1.92 %
Marietta	46	111	83,445	111	100.00 %	0.13 %
Marion	85	7,717	90,863	7,717	100.00 %	8.49 %
Marshall	118	777	83,282	777	100.00 %	0.93 %
Mars Hill	118	2,007	83,282	2,007	100.00 %	2.41 %
Marshville	55	2,522	87,005	2,522	100.00 %	2.90 %
Marvin	68	6,358	88,138	6,358	100.00 %	7.21 %
Matthews	103	29,435	87,132	29,435	100.00 %	33.78 %
Maxton	46	2,110	83,445	1,902	90.14 %	2.28 %
	48	2,110	86,256	208	9.86 %	0.24 %
Mayodan	65	2,418	91,096	2,418	100.00 %	2.65 %
Maysville	12	818	84,745	818	100.00 %	0.97 %
Mebane	50	17,797	85,345	3,171	17.82 %	3.72 %
	63	17,797	86,399	14,626	82.18 %	16.93 %
Mesic	79	144	83,163	144	100.00 %	0.17 %
Micro	28	458	85,389	458	100.00 %	0.54 %
Middleburg	32	101	88,633	101	100.00 %	0.11 %
Middlesex	24	912	87,220	912	100.00 %	1.05 %
Midland	73	4,684	90,649	4,684	100.00 %	5.17 %
	103	4,684	87,132	0	0.00 %	0.00 %
Midway	80	4,742	84,864	3,469	73.15 %	4.09 %
	81	4,742	84,066	1,273	26.85 %	1.51 %
Mills River	117	7,078	91,035	7,078	100.00 %	7.78 %
Milton	50	155	85,345	155	100.00 %	0.18 %
Mineral Springs	55	3,159	87,005	2,293	72.59 %	2.64 %
	68	3,159	88,138	866	27.41 %	0.98 %
Minnesott Beach	79	530	83,163	530	100.00 %	0.64 %
Mint Hill	69	26,450	85,179	6	0.02 %	0.01 %
	99	26,450	87,647	0	0.00 %	0.00 %
	103	26,450	87,132	26,444	99.98 %	30.35 %
Misenheimer	67	650	88,255	650	100.00 %	0.74 %
Mocksville	77	5,900	90,628	5,900	100.00 %	6.51 %
Momeyer	25	277	86,534	277	100.00 %	0.32 %
Monroe	55	34,562	87,005	12,650	36.60 %	14.54 %
	69	34,562	85,179	21,912	63.40 %	25.72 %
Montreat	115	901	90,262	901	100.00 %	1.00 %
Mooresboro	111	293	89,894	293	100.00 %	0.33 %
Mooresville	84	50,193	86,773	205	0.41 %	0.24 %
	95	50,193	85,366	49,988	99.59 %	58.56 %
Morehead City	13	9,556	83,307	9,556	100.00 %	11.47 %
Morganton	86	17,474	87,570	17,474	100.00 %	19.95 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Morrisville	11	29,630	86,298	0	0.00 %	0.00 %
	31	29,630	90,760	207	0.70 %	0.23 %
	41	29,630	89,887	14,239	48.06 %	15.84 %
	49	29,630	86,157	15,184	51.25 %	17.62 %
Morven	55	329	87,005	329	100.00 %	0.38 %
Mount Airy	90	10,676	82,937	10,676	100.00 %	12.87 %
Mount Gilead	67	1,171	88,255	1,171	100.00 %	1.33 %
Mount Holly	108	17,703	86,263	17,703	100.00 %	20.52 %
Mount Olive	4	4,198	83,095	4,198	100.00 %	5.05 %
Mount Pleasant	73	1,671	90,649	1,671	100.00 %	1.84 %
Murfreesboro	5	2,619	82,953	2,619	100.00 %	3.16 %
Murphy	120	1,608	84,907	1,608	100.00 %	1.89 %
Nags Head	79	3,168	83,163	3,168	100.00 %	3.81 %
Nashville	25	5,632	86,534	5,632	100.00 %	6.51 %
Navassa	17	1,367	89,763	1,367	100.00 %	1.52 %
New Bern	3	31,291	85,099	31,291	100.00 %	36.77 %
Newland	85	715	90,863	715	100.00 %	0.79 %
New London	67	607	88,255	607	100.00 %	0.69 %
Newport	13	4,364	83,307	4,364	100.00 %	5.24 %
Newton	89	13,148	85,577	13,148	100.00 %	15.36 %
	96	13,148	89,587	0	0.00 %	0.00 %
Newton Grove	22	585	88,642	585	100.00 %	0.66 %
Norlina	27	920	84,735	920	100.00 %	1.09 %
Norman	52	100	84,383	100	100.00 %	0.12 %
North Topsail Beach	15	1,005	87,578	1,005	100.00 %	1.15 %
Northwest	17	703	89,763	703	100.00 %	0.78 %
North Wilkesboro	94	4,382	90,835	4,382	100.00 %	4.82 %
Norwood	67	2,367	88,255	2,367	100.00 %	2.68 %
Oakboro	67	2,128	88,255	2,128	100.00 %	2.41 %
Oak City	23	266	88,865	266	100.00 %	0.30 %
Oak Island	19	8,396	91,041	8,396	100.00 %	9.22 %
Oak Ridge	62	7,474	89,579	7,474	100.00 %	8.34 %
Ocean Isle Beach	17	867	89,763	867	100.00 %	0.97 %
Old Fort	85	811	90,863	811	100.00 %	0.89 %
Oriental	79	880	83,163	880	100.00 %	1.06 %
Orrum	46	59	83,445	59	100.00 %	0.07 %
Ossipee	64	536	85,016	536	100.00 %	0.63 %
Oxford	32	8,628	88,633	8,628	100.00 %	9.73 %
Pantego	79	164	83,163	164	100.00 %	0.20 %
Parkton	47	504	83,708	504	100.00 %	0.60 %
Parmele	23	243	88,865	243	100.00 %	0.27 %
Patterson Springs	111	571	89,894	571	100.00 %	0.64 %

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Peachland	55	390	87,005	390	100.00 %	0.45 %
Peletier	13	769	83,307	769	100.00 %	0.92 %
Pembroke	47	2,823	83,708	2,823	100.00 %	3.37 %
Pikeville	10	712	82,953	712	100.00 %	0.86 %
Pilot Mountain	90	1,440	82,937	1,440	100.00 %	1.74 %
Pinebluff	52	1,473	84,383	1,473	100.00 %	1.75 %
Pinehurst	52	17,581	84,383	8	0.05 %	0.01 %
	78	17,581	86,365	17,573	99.95 %	20.35 %
Pine Knoll Shores	13	1,388	83,307	1,388	100.00 %	1.67 %
Pine Level	28	2,046	85,389	2,046	100.00 %	2.40 %
Pinetops	23	1,200	88,865	1,200	100.00 %	1.35 %
Pineville	105	10,602	85,822	10,602	100.00 %	12.35 %
	112	10,602	82,806	0	0.00 %	0.00 %
Pink Hill	12	451	84,745	451	100.00 %	0.53 %
Pittsboro	54	4,537	83,475	4,537	100.00 %	5.44 %
Pleasant Garden	59	5,000	90,361	5,000	100.00 %	5.53 %
Plymouth	1	3,320	84,330	3,320	100.00 %	3.94 %
Polkton	55	2,250	87,005	2,250	100.00 %	2.59 %
Polkville	110	516	88,397	516	100.00 %	0.58 %
Pollocksville	12	268	84,745	268	100.00 %	0.32 %
Powellsville	23	189	88,865	189	100.00 %	0.21 %
Princeton	28	1,315	85,389	1,315	100.00 %	1.54 %
Princeville	23	1,254	88,865	1,254	100.00 %	1.41 %
Proctorville	46	121	83,445	121	100.00 %	0.15 %
Raeford	48	4,559	86,256	4,559	100.00 %	5.29 %
Raleigh	2	467,665	90,793	1,326	0.28 %	1.46 %
	11	467,665	86,298	40,792	8.72 %	47.27 %
	21	467,665	86,179	13	0.00 %	0.02 %
	31	467,665	90,760	233	0.05 %	0.26 %
	33	467,665	83,049	82,480	17.64 %	99.31 %
	34	467,665	83,679	83,503	17.86 %	99.79 %
	35	467,665	88,374	6,171	1.32 %	6.98 %
	38	467,665	88,226	56,840	12.15 %	64.43 %
	39	467,665	90,164	13,011	2.78 %	14.43 %
	40	467,665	83,175	57,345	12.26 %	68.94 %
	49	467,665	86,157	47,783	10.22 %	55.46 %
	66	467,665	83,189	78,168	16.71 %	93.96 %
Ramseur	78	1,774	86,365	1,774	100.00 %	2.05 %
Randleman	70	4,595	89,118	4,595	100.00 %	5.16 %
Ranlo	108	4,511	86,263	4,500	99.76 %	5.22 %
	110	4,511	88,397	11	0.24 %	0.01 %
Raynham	46	60	83,445	60	100.00 %	0.07 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Red Cross	67	762	88,255	762	100.00 %	0.86 %
Red Oak	25	3,342	86,534	3,342	100.00 %	3.86 %
Red Springs	47	3,087	83,708	3,087	100.00 %	3.69 %
	48	3,087	86,256	0	0.00 %	0.00 %
Reidsville	65	14,583	91,096	14,583	100.00 %	16.01 %
Rennert	47	275	83,708	275	100.00 %	0.33 %
Rhodhiss	86	997	87,570	639	64.09 %	0.73 %
	87	997	85,758	358	35.91 %	0.42 %
Richfield	67	582	88,255	582	100.00 %	0.66 %
Richlands	16	2,287	90,663	2,287	100.00 %	2.52 %
Rich Square	27	894	84,735	894	100.00 %	1.06 %
River Bend	3	2,902	85,099	2,902	100.00 %	3.41 %
Roanoke Rapids	27	15,229	84,735	15,229	100.00 %	17.97 %
Robbins	78	1,168	86,365	1,168	100.00 %	1.35 %
Robbinsville	120	597	84,907	597	100.00 %	0.70 %
Robersonville	23	1,269	88,865	1,269	100.00 %	1.43 %
Rockingham	52	9,243	84,383	9,243	100.00 %	10.95 %
Rockwell	76	2,302	89,815	2,302	100.00 %	2.56 %
Rocky Mount	23	54,341	88,865	15,414	28.37 %	17.35 %
	25	54,341	86,534	38,927	71.63 %	44.98 %
Rolesville	35	9,475	88,374	9,467	99.92 %	10.71 %
	39	9,475	90,164	8	0.08 %	0.01 %
Ronda	90	438	82,937	438	100.00 %	0.53 %
Roper	1	485	84,330	485	100.00 %	0.58 %
Roseboro	22	1,163	88,642	1,163	100.00 %	1.31 %
Rose Hill	4	1,371	83,095	1,371	100.00 %	1.65 %
Rosman	119	701	90,212	701	100.00 %	0.78 %
Rowland	46	885	83,445	885	100.00 %	1.06 %
Roxboro	2	8,134	90,793	8,134	100.00 %	8.96 %
Roxobel	23	187	88,865	187	100.00 %	0.21 %
Rural Hall	91	3,351	86,210	3,351	100.00 %	3.89 %
Ruth	113	347	89,058	347	100.00 %	0.39 %
Rutherford College	86	1,226	87,570	1,226	100.00 %	1.40 %
	87	1,226	85,758	0	0.00 %	0.00 %
Rutherfordton	113	3,640	89,058	3,640	100.00 %	4.09 %
St. Helena	16	417	90,663	417	100.00 %	0.46 %
St. James	19	6,529	91,041	6,529	100.00 %	7.17 %
St. Pauls	47	2,045	83,708	2,045	100.00 %	2.44 %
Salemburg	22	457	88,642	457	100.00 %	0.52 %
Salisbury	76	35,540	89,815	35,540	100.00 %	39.57 %
Saluda	113	631	89,058	631	100.00 %	0.71 %
Sandy Creek	17	248	89,763	248	100.00 %	0.28 %

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Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Sandyfield	46	430	83,445	430	100.00 %	0.52 %
Sanford	51	30,261	83,073	30,261	100.00 %	36.43 %
Saratoga	24	353	87,220	353	100.00 %	0.40 %
Sawmills	87	5,020	85,758	5,020	100.00 %	5.85 %
Scotland Neck	27	1,640	84,735	1,640	100.00 %	1.94 %
Seaboard	27	542	84,735	542	100.00 %	0.64 %
Seagrove	78	235	86,365	235	100.00 %	0.27 %
Sedalia	59	676	90,361	676	100.00 %	0.75 %
Selma	28	6,317	85,389	6,317	100.00 %	7.40 %
Seven Devils	85	313	90,863	38	12.14 %	0.04 %
	93	313	86,445	275	87.86 %	0.32 %
Seven Springs	4	55	83,095	55	100.00 %	0.07 %
Severn	27	191	84,735	191	100.00 %	0.23 %
Shallotte	17	4,185	89,763	4,185	100.00 %	4.66 %
Sharpsburg	23	1,697	88,865	215	12.67 %	0.24 %
	24	1,697	87,220	421	24.81 %	0.48 %
	25	1,697	86,534	1,061	62.52 %	1.23 %
Shelby	110	21,918	88,397	4,409	20.12 %	4.99 %
	111	21,918	89,894	17,509	79.88 %	19.48 %
Siler City	54	7,702	83,475	7,702	100.00 %	9.23 %
Simpson	9	390	84,450	390	100.00 %	0.46 %
Sims	24	275	87,220	275	100.00 %	0.32 %
Smithfield	28	11,292	85,389	11,292	100.00 %	13.22 %
Snow Hill	12	1,481	84,745	1,481	100.00 %	1.75 %
Southern Pines	52	15,545	84,383	15,545	100.00 %	18.42 %
	78	15,545	86,365	0	0.00 %	0.00 %
Southern Shores	1	3,090	84,330	3,090	100.00 %	3.66 %
Southport	19	3,971	91,041	3,971	100.00 %	4.36 %
Sparta	93	1,834	86,445	1,834	100.00 %	2.12 %
Speed	23	63	88,865	63	100.00 %	0.07 %
Spencer	76	3,308	89,815	3,308	100.00 %	3.68 %
Spencer Mountain	108	0	86,263	0	0.00 %	0.00 %
Spindale	113	4,225	89,058	4,225	100.00 %	4.74 %
Spring Hope	25	1,309	86,534	1,309	100.00 %	1.51 %
Spring Lake	42	11,660	85,537	11,660	100.00 %	13.63 %
Spruce Pine	85	2,194	90,863	2,194	100.00 %	2.41 %
Staley	54	397	83,475	397	100.00 %	0.48 %
Stallings	68	16,112	88,138	0	0.00 %	0.00 %
	69	16,112	85,179	15,728	97.62 %	18.46 %
	103	16,112	87,132	384	2.38 %	0.44 %
Stanfield	67	1,585	88,255	1,585	100.00 %	1.80 %
Stanley	108	3,963	86,263	3,963	100.00 %	4.59 %

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Stantonsburg	24	762	87,220	762	100.00 %	0.87 %
Star	67	806	88,255	806	100.00 %	0.91 %
Statesville	84	28,419	86,773	28,415	99.99 %	32.75 %
	89	28,419	85,577	4	0.01 %	0.00 %
Stedman	43	1,277	82,956	1,277	100.00 %	1.54 %
Stem	32	960	88,633	960	100.00 %	1.08 %
Stokesdale	62	5,924	89,579	5,924	100.00 %	6.61 %
Stoneville	65	1,308	91,096	1,308	100.00 %	1.44 %
Stonewall	79	214	83,163	214	100.00 %	0.26 %
Stovall	32	324	88,633	324	100.00 %	0.37 %
Sugar Mountain	85	371	90,863	371	100.00 %	0.41 %
Summerfield	57	10,951	90,615	746	6.81 %	0.82 %
	59	10,951	90,361	2,509	22.91 %	2.78 %
	62	10,951	89,579	7,696	70.28 %	8.59 %
Sunset Beach	17	4,175	89,763	4,175	100.00 %	4.65 %
Surf City	15	3,867	87,578	334	8.64 %	0.38 %
	16	3,867	90,663	3,533	91.36 %	3.90 %
Swansboro	14	3,744	86,538	3,744	100.00 %	4.33 %
Swepsonville	63	2,445	86,399	2,445	100.00 %	2.83 %
Sylva	119	2,578	90,212	2,578	100.00 %	2.86 %
Tabor City	46	3,781	83,445	3,781	100.00 %	4.53 %
Tarboro	23	10,721	88,865	10,721	100.00 %	12.06 %
Tar Heel	22	90	88,642	90	100.00 %	0.10 %
Taylorsville	94	2,320	90,835	2,320	100.00 %	2.55 %
Taylortown	52	634	84,383	4	0.63 %	0.00 %
	78	634	86,365	630	99.37 %	0.73 %
Teachey	4	448	83,095	448	100.00 %	0.54 %
Thomasville	70	27,183	89,118	521	1.92 %	0.58 %
	80	27,183	84,864	26,662	98.08 %	31.42 %
Tobaccoville	74	2,578	84,857	824	31.96 %	0.97 %
	91	2,578	86,210	1,754	68.04 %	2.03 %
Topsail Beach	16	461	90,663	461	100.00 %	0.51 %
Trenton	12	238	84,745	238	100.00 %	0.28 %
Trent Woods	3	4,074	85,099	4,074	100.00 %	4.79 %
Trinity	70	7,006	89,118	7,006	100.00 %	7.86 %
Troutman	84	3,698	86,773	885	23.93 %	1.02 %
	89	3,698	85,577	2,813	76.07 %	3.29 %
Troy	67	2,850	88,255	2,850	100.00 %	3.23 %
Tryon	113	1,562	89,058	1,562	100.00 %	1.75 %
Turkey	22	213	88,642	213	100.00 %	0.24 %
Unionville	69	6,643	85,179	6,643	100.00 %	7.80 %
Valdese	86	4,689	87,570	4,689	100.00 %	5.35 %

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Vanceboro	3	869	85,099	869	100.00 %	1.02 %
Vandemere	79	246	83,163	246	100.00 %	0.30 %
Varnamtown	19	525	91,041	525	100.00 %	0.58 %
Vass	51	952	83,073	952	100.00 %	1.15 %
Waco	110	310	88,397	310	100.00 %	0.35 %
Wade	43	638	82,956	638	100.00 %	0.77 %
Wadesboro	55	5,008	87,005	5,008	100.00 %	5.76 %
Wagram	48	615	86,256	615	100.00 %	0.71 %
Wake Forest	7	47,601	83,510	1,504	3.16 %	1.80 %
	35	47,601	88,374	46,097	96.84 %	52.16 %
	66	47,601	83,189	0	0.00 %	0.00 %
Walkertown	71	5,692	84,874	3,176	55.80 %	3.74 %
	75	5,692	84,220	2,516	44.20 %	2.99 %
Wallace	4	3,413	83,095	3,413	100.00 %	4.11 %
	16	3,413	90,663	0	0.00 %	0.00 %
Wallburg	80	3,051	84,864	3,051	100.00 %	3.60 %
Walnut Cove	91	1,586	86,210	1,586	100.00 %	1.84 %
Walnut Creek	4	1,084	83,095	1,084	100.00 %	1.30 %
Walstonburg	12	193	84,745	193	100.00 %	0.23 %
Warrenton	27	851	84,735	851	100.00 %	1.00 %
Warsaw	4	2,733	83,095	2,733	100.00 %	3.29 %
Washington	79	9,875	83,163	9,875	100.00 %	11.87 %
Washington Park	79	392	83,163	392	100.00 %	0.47 %
Watha	16	181	90,663	181	100.00 %	0.20 %
Waxhaw	55	20,534	87,005	0	0.00 %	0.00 %
	68	20,534	88,138	20,534	100.00 %	23.30 %
Waynesville	118	10,140	83,282	10,140	100.00 %	12.18 %
Weaverville	114	4,567	89,685	4,567	100.00 %	5.09 %
Webster	119	372	90,212	372	100.00 %	0.41 %
Weddington	68	13,181	88,138	13,172	99.93 %	14.94 %
	69	13,181	85,179	4	0.03 %	0.00 %
	103	13,181	87,132	5	0.04 %	0.01 %
Weldon	27	1,444	84,735	1,444	100.00 %	1.70 %
Wendell	39	9,793	90,164	9,793	100.00 %	10.86 %
Wentworth	65	2,662	91,096	2,662	100.00 %	2.92 %
Wesley Chapel	55	8,681	87,005	3,868	44.56 %	4.45 %
	68	8,681	88,138	4,813	55.44 %	5.46 %
West Jefferson	93	1,279	86,445	1,279	100.00 %	1.48 %
Whispering Pines	52	4,987	84,383	4,987	100.00 %	5.91 %
Whitakers	23	627	88,865	290	46.25 %	0.33 %
	25	627	86,534	337	53.75 %	0.39 %
White Lake	22	843	88,642	843	100.00 %	0.95 %

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Whiteville	46	4,766	83,445	4,766	100.00 %	5.71 %
Whitsett	59	584	90,361	584	100.00 %	0.65 %
Wilkesboro	94	3,687	90,835	3,687	100.00 %	4.06 %
Williamston	23	5,248	88,865	5,248	100.00 %	5.91 %
Wilmington	18	115,451	91,245	48,680	42.17 %	53.35 %
	19	115,451	91,041	8,207	7.11 %	9.01 %
	20	115,451	90,346	58,564	50.73 %	64.82 %
Wilson	24	47,851	87,220	47,851	100.00 %	54.86 %
Wilson's Mills	26	2,534	89,947	0	0.00 %	0.00 %
	28	2,534	85,389	2,534	100.00 %	2.97 %
Windsor	23	3,582	88,865	3,582	100.00 %	4.03 %
Winfall	1	555	84,330	555	100.00 %	0.66 %
Wingate	55	4,055	87,005	4,055	100.00 %	4.66 %
Winston-Salem	71	249,545	84,874	77,631	31.11 %	91.47 %
	72	249,545	86,949	86,867	34.81 %	99.91 %
	74	249,545	84,857	32,409	12.99 %	38.19 %
	75	249,545	84,220	22,818	9.14 %	27.09 %
	91	249,545	86,210	29,820	11.95 %	34.59 %
Winterville	8	10,462	85,793	44	0.42 %	0.05 %
	9	10,462	84,450	10,418	99.58 %	12.34 %
Winton	5	629	82,953	629	100.00 %	0.76 %
Woodfin	114	7,936	89,685	7,648	96.37 %	8.53 %
	116	7,936	89,505	288	3.63 %	0.32 %
Woodland	27	557	84,735	557	100.00 %	0.66 %
Wrightsville Beach	20	2,473	90,346	2,473	100.00 %	2.74 %
Yadkinville	77	2,995	90,628	2,995	100.00 %	3.30 %
Yanceyville	50	1,937	85,345	1,937	100.00 %	2.27 %
Youngsville	7	2,016	83,510	2,016	100.00 %	2.41 %
Zebulon	26	6,903	89,947	0	0.00 %	0.00 %
	39	6,903	90,164	6,903	100.00 %	7.66 %
			Total:	**6,017,605**		

Number of split municipalities: 112
Display: all municipalities

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Aberdeen	52	8,516	84,383	8,516	100.00 %	10.09 %
	78	8,516	86,365	0	0.00 %	0.00 %
Ahoskie	5	4,891	82,953	4,891	100.00 %	5.90 %
Alamance	64	988	85,016	988	100.00 %	1.16 %
Albemarle	67	16,432	88,255	16,432	100.00 %	18.62 %
Alliance	79	733	83,163	733	100.00 %	0.88 %
Andrews	120	1,667	84,907	1,667	100.00 %	1.96 %
Angier (Harnett)	6	4,709	87,332	4,709	100.00 %	5.39 %
Angier (Wake)	37	556	90,867	556	100.00 %	0.61 %
Ansonville	55	440	87,005	440	100.00 %	0.51 %
Apex	11	58,780	86,298	0	0.00 %	0.00 %
	21	58,780	86,179	556	0.95 %	0.65 %
	36	58,780	90,166	57,843	98.41 %	64.15 %
	41	58,780	89,887	381	0.65 %	0.42 %
Arapahoe	79	416	83,163	416	100.00 %	0.50 %
Archdale (Guilford)	60	380	89,735	380	100.00 %	0.42 %
Archdale (Randolph)	70	11,527	89,118	11,527	100.00 %	12.93 %
Archer Lodge	26	4,797	89,947	4,797	100.00 %	5.33 %
Asheboro	70	27,156	89,118	25,890	95.34 %	29.05 %
	78	27,156	86,365	1,266	4.66 %	1.47 %
Asheville	114	94,589	89,685	52,596	55.60 %	58.65 %
	115	94,589	90,262	29,236	30.91 %	32.39 %
	116	94,589	89,505	12,757	13.49 %	14.25 %
Askewville	23	184	88,865	184	100.00 %	0.21 %
Atkinson	16	296	90,663	296	100.00 %	0.33 %
Atlantic Beach	13	1,364	83,307	1,364	100.00 %	1.64 %
Aulander	23	763	88,865	763	100.00 %	0.86 %
Aurora	79	455	83,163	455	100.00 %	0.55 %
Autryville	22	167	88,642	167	100.00 %	0.19 %
Ayden	9	4,977	84,450	4,977	100.00 %	5.89 %
Badin	67	2,024	88,255	2,024	100.00 %	2.29 %
Bailey	24	568	87,220	568	100.00 %	0.65 %
Bakersville	85	450	90,863	450	100.00 %	0.50 %
Bald Head Island	19	268	91,041	268	100.00 %	0.29 %
Banner Elk	85	1,049	90,863	1,049	100.00 %	1.15 %
Bath	79	245	83,163	245	100.00 %	0.29 %
Bayboro	79	1,161	83,163	1,161	100.00 %	1.40 %
Bear Grass	23	89	88,865	89	100.00 %	0.10 %
Beaufort	13	4,464	83,307	4,464	100.00 %	5.36 %
Beech Mountain (Avery)	85	62	90,863	62	100.00 %	0.07 %
Beech Mountain (Watauga)	93	613	86,445	613	100.00 %	0.71 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Belhaven	79	1,410	83,163	1,410	100.00 %	1.70 %
Belmont	108	15,010	86,263	1,868	12.45 %	2.17 %
	109	15,010	87,762	13,142	87.55 %	14.97 %
Belville	17	2,406	89,763	2,406	100.00 %	2.68 %
Belwood	110	857	88,397	857	100.00 %	0.97 %
Benson (Harnett)	53	0	86,899	0	0.00 %	0.00 %
Benson (Johnston)	28	3,967	85,389	3,967	100.00 %	4.65 %
Bermuda Run	77	3,120	90,628	3,120	100.00 %	3.44 %
Bessemer City	110	5,428	88,397	5,428	100.00 %	6.14 %
Bethania	74	344	84,857	0	0.00 %	0.00 %
	91	344	86,210	344	100.00 %	0.40 %
Bethel	8	1,373	85,793	1,373	100.00 %	1.60 %
Beulaville	4	1,116	83,095	1,116	100.00 %	1.34 %
Biltmore Forest	116	1,409	89,505	1,409	100.00 %	1.57 %
Biscoe	67	1,848	88,255	1,848	100.00 %	2.09 %
Black Creek	24	692	87,220	692	100.00 %	0.79 %
Black Mountain	115	8,426	90,262	8,426	100.00 %	9.34 %
Bladenboro	22	1,648	88,642	1,648	100.00 %	1.86 %
Blowing Rock (Caldwell)	87	91	85,758	91	100.00 %	0.11 %
Blowing Rock (Watauga)	87	1,285	85,758	5	0.39 %	0.01 %
	93	1,285	86,445	1,280	99.61 %	1.48 %
Boardman	46	166	83,445	166	100.00 %	0.20 %
Bogue	13	695	83,307	695	100.00 %	0.83 %
Boiling Spring Lakes	19	5,943	91,041	5,943	100.00 %	6.53 %
Boiling Springs	111	4,615	89,894	4,615	100.00 %	5.13 %
Bolivia	19	149	91,041	149	100.00 %	0.16 %
Bolton	46	519	83,445	519	100.00 %	0.62 %
Boone	87	19,092	85,758	595	3.12 %	0.69 %
	93	19,092	86,445	18,497	96.88 %	21.40 %
Boonville	77	1,185	90,628	1,185	100.00 %	1.31 %
Bostic	111	355	89,894	355	100.00 %	0.39 %
Brevard	119	7,744	90,212	7,744	100.00 %	8.58 %
Bridgeton	3	349	85,099	349	100.00 %	0.41 %
Broadway (Harnett)	6	0	87,332	0	0.00 %	0.00 %
Broadway (Lee)	51	1,267	83,073	1,267	100.00 %	1.53 %
Brookford	96	442	89,587	442	100.00 %	0.49 %
Brunswick	46	973	83,445	973	100.00 %	1.17 %
Bryson City	119	1,558	90,212	1,558	100.00 %	1.73 %
Bunn	7	327	83,510	327	100.00 %	0.39 %
Burgaw	16	3,088	90,663	3,088	100.00 %	3.41 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Burlington (Alamance)	63	55,481	86,399	25,917	46.71 %	30.00 %
	64	55,481	85,016	29,564	53.29 %	34.77 %
Burlington (Guilford)	59	1,822	90,361	1,822	100.00 %	2.02 %
Burnsville	85	1,614	90,863	1,614	100.00 %	1.78 %
Butner	32	8,397	88,633	8,397	100.00 %	9.47 %
Cajah's Mountain	87	2,722	85,758	2,722	100.00 %	3.17 %
Calabash	17	2,011	89,763	2,011	100.00 %	2.24 %
Calypso	4	327	83,095	327	100.00 %	0.39 %
Cameron	51	244	83,073	244	100.00 %	0.29 %
Candor (Montgomery)	67	813	88,255	813	100.00 %	0.92 %
Candor (Moore)	78	0	86,365	0	0.00 %	0.00 %
Canton	118	4,422	83,282	4,422	100.00 %	5.31 %
Cape Carteret	13	2,224	83,307	2,224	100.00 %	2.67 %
Carolina Beach	19	6,564	91,041	6,564	100.00 %	7.21 %
Carolina Shores	17	4,588	89,763	4,588	100.00 %	5.11 %
Carrboro	50	21,295	85,345	174	0.82 %	0.20 %
	56	21,295	86,087	21,121	99.18 %	24.53 %
Carthage	51	2,775	83,073	2,747	98.99 %	3.31 %
	52	2,775	84,383	28	1.01 %	0.03 %
Cary (Chatham)	54	3,709	83,475	3,709	100.00 %	4.44 %
Cary (Wake)	11	171,012	86,298	43,537	25.46 %	50.45 %
	21	171,012	86,179	30,622	17.91 %	35.53 %
	36	171,012	90,166	0	0.00 %	0.00 %
	37	171,012	90,867	2,012	1.18 %	2.21 %
	41	171,012	89,887	74,074	43.32 %	82.41 %
	49	171,012	86,157	20,767	12.14 %	24.10 %
Casar	110	305	88,397	305	100.00 %	0.35 %
Castalia	25	264	86,534	264	100.00 %	0.31 %
Caswell Beach	19	395	91,041	395	100.00 %	0.43 %
Catawba	89	702	85,577	702	100.00 %	0.82 %
Cedar Point	13	1,764	83,307	1,764	100.00 %	2.12 %
Cedar Rock	87	301	85,758	301	100.00 %	0.35 %
Cerro Gordo	46	131	83,445	131	100.00 %	0.16 %
Chadbourn	46	1,574	83,445	1,574	100.00 %	1.89 %
Chapel Hill (Durham)	29	2,906	91,212	2,906	100.00 %	3.19 %
Chapel Hill (Orange)	56	59,054	86,087	59,054	100.00 %	68.60 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Charlotte	88	874,579	82,834	82,834	9.47 %	100.00 %
	92	874,579	85,031	63,762	7.29 %	74.99 %
	99	874,579	87,647	79,113	9.05 %	90.26 %
	100	874,579	87,197	87,197	9.97 %	100.00 %
	101	874,579	86,426	64,526	7.38 %	74.66 %
	102	874,579	86,179	86,179	9.85 %	100.00 %
	103	874,579	87,132	23,590	2.70 %	27.07 %
	104	874,579	86,520	86,520	9.89 %	100.00 %
	105	874,579	85,822	71,156	8.14 %	82.91 %
	106	874,579	82,824	79,717	9.11 %	96.25 %
	107	874,579	88,237	67,298	7.69 %	76.27 %
	112	874,579	82,806	82,687	9.45 %	99.86 %
Cherryville	110	6,078	88,397	6,078	100.00 %	6.88 %
Chimney Rock Village	113	140	89,058	140	100.00 %	0.16 %
China Grove	83	4,434	90,742	4,434	100.00 %	4.89 %
Chocowinity	79	722	83,163	722	100.00 %	0.87 %
Claremont	89	1,692	85,577	1,692	100.00 %	1.98 %
Clarkton	22	614	88,642	614	100.00 %	0.69 %
Clayton (Johnston)	26	26,307	89,947	26,307	100.00 %	29.25 %
Clayton (Wake)	38	0	88,226	0	0.00 %	0.00 %
	39	0	90,164	0	0.00 %	0.00 %
Clemmons	74	21,163	84,857	21,163	100.00 %	24.94 %
Cleveland	77	846	90,628	846	100.00 %	0.93 %
Clinton	22	8,383	88,642	8,383	100.00 %	9.46 %
Clyde	118	1,368	83,282	1,368	100.00 %	1.64 %
Coats	53	2,155	86,899	2,155	100.00 %	2.48 %
Cofield	5	267	82,953	267	100.00 %	0.32 %
Colerain	23	217	88,865	217	100.00 %	0.24 %
Columbia	1	610	84,330	610	100.00 %	0.72 %
Columbus	113	1,060	89,058	1,060	100.00 %	1.19 %
Como	5	67	82,953	67	100.00 %	0.08 %
Concord	73	105,240	90,649	32,447	30.83 %	35.79 %
	82	105,240	90,771	48,723	46.30 %	53.68 %
	83	105,240	90,742	24,070	22.87 %	26.53 %
Conetoe	23	198	88,865	198	100.00 %	0.22 %
Connelly Springs	86	1,529	87,570	1,529	100.00 %	1.75 %
Conover	89	8,421	85,577	424	5.04 %	0.50 %
	96	8,421	89,587	7,997	94.96 %	8.93 %
Conway	27	752	84,735	752	100.00 %	0.89 %
Cooleemee	77	940	90,628	940	100.00 %	1.04 %
Cornelius	98	31,412	86,827	31,412	100.00 %	36.18 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Cove City	3	378	85,099	378	100.00 %	0.44 %
Cramerton	108	5,296	86,263	96	1.81 %	0.11 %
	109	5,296	87,762	5,200	98.19 %	5.93 %
Creedmoor	7	4,866	83,510	2,065	42.44 %	2.47 %
	32	4,866	88,633	2,801	57.56 %	3.16 %
Creswell	1	207	84,330	207	100.00 %	0.25 %
Crossnore	85	143	90,863	143	100.00 %	0.16 %
Dallas	110	5,927	88,397	5,927	100.00 %	6.70 %
Danbury	91	189	86,210	189	100.00 %	0.22 %
Davidson (Iredell)	95	378	85,366	378	100.00 %	0.44 %
Davidson (Mecklenburg)	98	14,728	86,827	14,728	100.00 %	16.96 %
Dellview	110	6	88,397	6	100.00 %	0.01 %
Denton	80	1,494	84,864	1,494	100.00 %	1.76 %
Dillsboro	119	213	90,212	213	100.00 %	0.24 %
Dobbins Heights	52	687	84,383	687	100.00 %	0.81 %
Dobson	90	1,462	82,937	1,462	100.00 %	1.76 %
Dortches	25	1,082	86,534	1,082	100.00 %	1.25 %
Dover	3	349	85,099	349	100.00 %	0.41 %
Drexel	86	1,760	87,570	1,760	100.00 %	2.01 %
Dublin	22	267	88,642	267	100.00 %	0.30 %
Duck	1	742	84,330	742	100.00 %	0.88 %
Dunn	53	8,446	86,899	8,446	100.00 %	9.72 %
Durham (Durham)	2	283,093	90,793	25,167	8.89 %	27.72 %
	29	283,093	91,212	87,035	30.74 %	95.42 %
	30	283,093	91,165	89,671	31.68 %	98.36 %
	31	283,093	90,760	81,220	28.69 %	89.49 %
Durham (Orange)	50	144	85,345	144	100.00 %	0.17 %
Durham (Wake)	40	269	83,175	269	100.00 %	0.32 %
	49	269	86,157	0	0.00 %	0.00 %
Earl	111	198	89,894	198	100.00 %	0.22 %
East Arcadia	22	418	88,642	418	100.00 %	0.47 %
East Bend	77	634	90,628	634	100.00 %	0.70 %
East Laurinburg	48	234	86,256	234	100.00 %	0.27 %
East Spencer	76	1,567	89,815	1,567	100.00 %	1.74 %
Eastover	43	3,656	82,956	3,656	100.00 %	4.41 %
Eden	65	15,421	91,096	15,421	100.00 %	16.93 %
Edenton	1	4,460	84,330	4,460	100.00 %	5.29 %
Elizabeth City (Camden)	5	38	82,953	38	100.00 %	0.05 %
Elizabeth City (Pasquotank)	5	18,593	82,953	18,593	100.00 %	22.41 %
Elizabethtown	22	3,296	88,642	3,296	100.00 %	3.72 %
Elk Park	85	542	90,863	542	100.00 %	0.60 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Elkin (Surry)	90	4,049	82,937	4,049	100.00 %	4.88 %
Elkin (Wilkes)	90	73	82,937	73	100.00 %	0.09 %
Ellenboro	111	723	89,894	723	100.00 %	0.80 %
Ellerbe	52	864	84,383	864	100.00 %	1.02 %
Elm City (Nash)	25	0	86,534	0	0.00 %	0.00 %
Elm City (Wilson)	24	1,218	87,220	1,218	100.00 %	1.40 %
Elon	64	11,336	85,016	11,336	100.00 %	13.33 %
Emerald Isle	13	3,847	83,307	3,847	100.00 %	4.62 %
Enfield	27	1,865	84,735	1,865	100.00 %	2.20 %
Erwin	53	4,542	86,899	4,542	100.00 %	5.23 %
Eureka	10	214	82,953	214	100.00 %	0.26 %
Everetts	23	150	88,865	150	100.00 %	0.17 %
Fair Bluff	46	709	83,445	709	100.00 %	0.85 %
Fairmont	46	2,191	83,445	2,191	100.00 %	2.63 %
	47	2,191	83,708	0	0.00 %	0.00 %
Fairview	69	3,456	85,179	3,456	100.00 %	4.06 %
Faison (Duplin)	4	784	83,095	784	100.00 %	0.94 %
Faison (Sampson)	22	0	88,642	0	0.00 %	0.00 %
Faith	76	819	89,815	819	100.00 %	0.91 %
Falcon (Cumberland)	43	324	82,956	324	100.00 %	0.39 %
Falcon (Sampson)	22	0	88,642	0	0.00 %	0.00 %
Falkland	8	47	85,793	47	100.00 %	0.05 %
Fallston	110	627	88,397	627	100.00 %	0.71 %
Farmville	8	4,461	85,793	4,461	100.00 %	5.20 %
Fayetteville	42	208,501	85,537	65,401	31.37 %	76.46 %
	43	208,501	82,956	44,532	21.36 %	53.68 %
	44	208,501	83,297	83,293	39.95 %	100.00 %
	45	208,501	82,938	15,275	7.33 %	18.42 %
Flat Rock	113	3,486	89,058	3,486	100.00 %	3.91 %
Fletcher	117	7,987	91,035	7,987	100.00 %	8.77 %
Fontana Dam	120	13	84,907	13	100.00 %	0.02 %
Forest City	111	7,377	89,894	0	0.00 %	0.00 %
	113	7,377	89,058	7,377	100.00 %	8.28 %
Forest Hills	119	303	90,212	303	100.00 %	0.34 %
Fountain	8	385	85,793	385	100.00 %	0.45 %
Four Oaks	28	2,158	85,389	2,158	100.00 %	2.53 %
Foxfire	52	1,288	84,383	0	0.00 %	0.00 %
	78	1,288	86,365	1,288	100.00 %	1.49 %
Franklin	120	4,175	84,907	4,175	100.00 %	4.92 %
Franklinton	7	2,456	83,510	2,456	100.00 %	2.94 %
Franklinville	78	1,197	86,365	1,197	100.00 %	1.39 %

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Municipality by County - District Report

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Fremont	10	1,196	82,953	1,196	100.00 %	1.44 %
Fuquay-Varina (Harnett)	6	0	87,332	0	0.00 %	0.00 %
Fuquay-Varina (Wake)	21	34,152	86,179	30	0.09 %	0.03 %
	36	34,152	90,166	16	0.05 %	0.02 %
	37	34,152	90,867	34,106	99.87 %	37.53 %
Gamewell	87	3,702	85,758	3,702	100.00 %	4.32 %
Garland	22	595	88,642	595	100.00 %	0.67 %
Garner	21	31,159	86,179	11,789	37.83 %	13.68 %
	33	31,159	83,049	14	0.04 %	0.02 %
	37	31,159	90,867	0	0.00 %	0.00 %
	38	31,159	88,226	19,356	62.12 %	21.94 %
Garysburg	27	904	84,735	904	100.00 %	1.07 %
Gaston	27	1,008	84,735	1,008	100.00 %	1.19 %
Gastonia	108	80,411	86,263	28,480	35.42 %	33.02 %
	109	80,411	87,762	44,448	55.28 %	50.65 %
	110	80,411	88,397	7,483	9.31 %	8.47 %
Gatesville	5	267	82,953	267	100.00 %	0.32 %
Gibson	48	449	86,256	449	100.00 %	0.52 %
Gibsonville (Alamance)	64	4,278	85,016	4,278	100.00 %	5.03 %
Gibsonville (Guilford)	59	4,642	90,361	4,642	100.00 %	5.14 %
Glen Alpine	86	1,529	87,570	1,529	100.00 %	1.75 %
Godwin	43	128	82,956	128	100.00 %	0.15 %
Goldsboro	4	33,657	83,095	5	0.01 %	0.01 %
	10	33,657	82,953	33,652	99.99 %	40.57 %
Goldston	54	234	83,475	234	100.00 %	0.28 %
Graham	63	17,157	86,399	17,157	100.00 %	19.86 %
Grandfather Village	85	95	90,863	95	100.00 %	0.10 %
Granite Falls	87	4,965	85,758	4,965	100.00 %	5.79 %
Granite Quarry	76	2,984	89,815	2,984	100.00 %	3.32 %
Grantsboro	79	692	83,163	692	100.00 %	0.83 %
Green Level	63	3,152	86,399	3,152	100.00 %	3.65 %
Greenevers	4	567	83,095	567	100.00 %	0.68 %
Greensboro	57	299,035	90,615	83,540	27.94 %	92.19 %
	58	299,035	90,808	84,725	28.33 %	93.30 %
	59	299,035	90,361	13,852	4.63 %	15.33 %
	60	299,035	89,735	8,829	2.95 %	9.84 %
	61	299,035	90,201	90,201	30.16 %	100.00 %
	62	299,035	89,579	17,888	5.98 %	19.97 %
Greenville	8	87,521	85,793	52,881	60.42 %	61.64 %
	9	87,521	84,450	34,640	39.58 %	41.02 %
Grifton (Lenoir)	12	147	84,745	147	100.00 %	0.17 %

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[G20-MbCD] - Generated 11/4/2021

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Grifton (Pitt)	9	2,301	84,450	2,301	100.00 %	2.72 %
Grimesland	9	386	84,450	386	100.00 %	0.46 %
Grover	111	802	89,894	802	100.00 %	0.89 %
Halifax	27	170	84,735	170	100.00 %	0.20 %
Hamilton	23	306	88,865	306	100.00 %	0.34 %
Hamlet	52	6,025	84,383	6,025	100.00 %	7.14 %
Harmony	84	543	86,773	543	100.00 %	0.63 %
Harrells (Duplin)	4	0	83,095	0	0.00 %	0.00 %
Harrells (Sampson)	22	160	88,642	160	100.00 %	0.18 %
Harrellsville	5	85	82,953	85	100.00 %	0.10 %
Harrisburg	73	18,967	90,649	18,967	100.00 %	20.92 %
Hassell	23	49	88,865	49	100.00 %	0.06 %
Havelock	3	16,621	85,099	5,986	36.01 %	7.03 %
	13	16,621	83,307	10,635	63.99 %	12.77 %
Haw River	63	2,252	86,399	2,252	100.00 %	2.61 %
Hayesville	120	461	84,907	461	100.00 %	0.54 %
Hemby Bridge	69	1,614	85,179	1,614	100.00 %	1.89 %
Henderson	32	15,060	88,633	15,060	100.00 %	16.99 %
Hendersonville	113	15,137	89,058	623	4.12 %	0.70 %
	117	15,137	91,035	14,514	95.88 %	15.94 %
Hertford	1	1,934	84,330	1,934	100.00 %	2.29 %
Hickory (Burke)	86	79	87,570	79	100.00 %	0.09 %
Hickory (Caldwell)	87	32	85,758	32	100.00 %	0.04 %
Hickory (Catawba)	89	43,379	85,577	0	0.00 %	0.00 %
	96	43,379	89,587	43,379	100.00 %	48.42 %
High Point (Davidson)	80	6,646	84,864	6,646	100.00 %	7.83 %
High Point (Forsyth)	75	84	84,220	84	100.00 %	0.10 %
High Point (Guilford)	60	107,321	89,735	66,033	61.53 %	73.59 %
	62	107,321	89,579	41,288	38.47 %	46.09 %
High Point (Randolph)	70	8	89,118	8	100.00 %	0.01 %
High Shoals	110	595	88,397	595	100.00 %	0.67 %
Highlands (Jackson)	119	12	90,212	12	100.00 %	0.01 %
Highlands (Macon)	120	1,060	84,907	1,060	100.00 %	1.25 %
Hildebran	86	1,679	87,570	1,679	100.00 %	1.92 %
Hillsborough	50	9,660	85,345	9,660	100.00 %	11.32 %
Hobgood	27	268	84,735	268	100.00 %	0.32 %
Hoffman	52	418	84,383	418	100.00 %	0.50 %
Holden Beach	17	921	89,763	0	0.00 %	0.00 %
	19	921	91,041	921	100.00 %	1.01 %
Holly Ridge	15	4,171	87,578	4,171	100.00 %	4.76 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

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Holly Springs	21	41,239	86,179	11,892	28.84 %	13.80 %
	36	41,239	90,166	17,734	43.00 %	19.67 %
	37	41,239	90,867	11,613	28.16 %	12.78 %
Hookerton	12	413	84,745	413	100.00 %	0.49 %
Hope Mills	43	17,808	82,956	64	0.36 %	0.08 %
	45	17,808	82,938	17,744	99.64 %	21.39 %
Hot Springs	118	520	83,282	520	100.00 %	0.62 %
Hudson	87	3,780	85,758	3,780	100.00 %	4.41 %
Huntersville	98	61,376	86,827	38,677	63.02 %	44.54 %
	101	61,376	86,426	5,893	9.60 %	6.82 %
	107	61,376	88,237	16,806	27.38 %	19.05 %
Indian Beach	13	223	83,307	223	100.00 %	0.27 %
Indian Trail	55	39,997	87,005	2,376	5.94 %	2.73 %
	68	39,997	88,138	15,036	37.59 %	17.06 %
	69	39,997	85,179	22,585	56.47 %	26.51 %
Jackson	27	430	84,735	430	100.00 %	0.51 %
Jacksonville	14	72,723	86,538	28,456	39.13 %	32.88 %
	15	72,723	87,578	44,267	60.87 %	50.55 %
Jamestown	60	3,668	89,735	3,668	100.00 %	4.09 %
Jamesville	23	424	88,865	424	100.00 %	0.48 %
Jefferson	93	1,622	86,445	1,622	100.00 %	1.88 %
Jonesville	77	2,308	90,628	2,308	100.00 %	2.55 %
Kannapolis (Cabarrus)	82	42,846	90,771	33,907	79.14 %	37.35 %
	83	42,846	90,742	8,939	20.86 %	9.85 %
Kannapolis (Rowan)	83	10,268	90,742	10,268	100.00 %	11.32 %
Kelford	23	203	88,865	203	100.00 %	0.23 %
Kenansville	4	770	83,095	770	100.00 %	0.93 %
Kenly (Johnston)	28	1,293	85,389	1,293	100.00 %	1.51 %
Kenly (Wilson)	24	198	87,220	198	100.00 %	0.23 %
Kernersville (Forsyth)	71	25,947	84,874	0	0.00 %	0.00 %
	75	25,947	84,220	25,947	100.00 %	30.81 %
Kernersville (Guilford)	62	502	89,579	502	100.00 %	0.56 %
Kill Devil Hills	1	7,656	84,330	7,118	92.97 %	8.44 %
	79	7,656	83,163	538	7.03 %	0.65 %
King (Forsyth)	91	591	86,210	591	100.00 %	0.69 %
King (Stokes)	91	6,606	86,210	6,606	100.00 %	7.66 %
Kings Mountain (Cleveland)	110	10,032	88,397	8	0.08 %	0.01 %
	111	10,032	89,894	10,024	99.92 %	11.15 %
Kings Mountain (Gaston)	110	1,110	88,397	1,110	100.00 %	1.26 %
Kingstown	110	656	88,397	656	100.00 %	0.74 %
Kinston	12	19,900	84,745	19,900	100.00 %	23.48 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Kittrell	32	132	88,633	132	100.00 %	0.15 %
Kitty Hawk	1	3,689	84,330	3,689	100.00 %	4.37 %
Knightdale	38	19,435	88,226	0	0.00 %	0.00 %
	39	19,435	90,164	19,435	100.00 %	21.56 %
Kure Beach	19	2,191	91,041	2,191	100.00 %	2.41 %
La Grange	12	2,595	84,745	2,595	100.00 %	3.06 %
Lake Lure	113	1,365	89,058	1,365	100.00 %	1.53 %
Lake Park	69	3,269	85,179	3,269	100.00 %	3.84 %
Lake Santeetlah	120	38	84,907	38	100.00 %	0.04 %
Lake Waccamaw	46	1,296	83,445	1,296	100.00 %	1.55 %
Landis	83	3,690	90,742	3,690	100.00 %	4.07 %
Lansing	93	126	86,445	126	100.00 %	0.15 %
Lasker	27	64	84,735	64	100.00 %	0.08 %
Lattimore	111	406	89,894	406	100.00 %	0.45 %
Laurel Park	113	2,250	89,058	0	0.00 %	0.00 %
	117	2,250	91,035	2,250	100.00 %	2.47 %
Laurinburg	48	14,978	86,256	14,978	100.00 %	17.36 %
Lawndale	110	570	88,397	570	100.00 %	0.64 %
Leggett	23	37	88,865	37	100.00 %	0.04 %
Leland	17	22,908	89,763	22,908	100.00 %	25.52 %
Lenoir	87	18,352	85,758	18,352	100.00 %	21.40 %
Lewiston Woodville	23	426	88,865	426	100.00 %	0.48 %
Lewisville	74	13,381	84,857	13,381	100.00 %	15.77 %
Lexington	80	19,632	84,864	0	0.00 %	0.00 %
	81	19,632	84,066	19,632	100.00 %	23.35 %
Liberty	54	2,655	83,475	2,655	100.00 %	3.18 %
Lilesville	55	395	87,005	395	100.00 %	0.45 %
Lillington	6	4,735	87,332	882	18.63 %	1.01 %
	53	4,735	86,899	3,853	81.37 %	4.43 %
Lincolnton	97	11,091	86,810	11,091	100.00 %	12.78 %
Linden	43	136	82,956	136	100.00 %	0.16 %
Littleton	27	559	84,735	559	100.00 %	0.66 %
Locust (Cabarrus)	73	541	90,649	541	100.00 %	0.60 %
Locust (Stanly)	67	3,996	88,255	3,996	100.00 %	4.53 %
Long View (Burke)	86	735	87,570	735	100.00 %	0.84 %
Long View (Catawba)	96	4,353	89,587	4,353	100.00 %	4.86 %
Louisburg	7	3,064	83,510	3,064	100.00 %	3.67 %
Love Valley	84	154	86,773	154	100.00 %	0.18 %
Lowell	108	3,654	86,263	3,654	100.00 %	4.24 %
	109	3,654	87,762	0	0.00 %	0.00 %
Lucama	24	1,036	87,220	1,036	100.00 %	1.19 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

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Lumber Bridge	47	82	83,708	82	100.00 %	0.10 %
Lumberton	46	19,025	83,445	350	1.84 %	0.42 %
	47	19,025	83,708	18,675	98.16 %	22.31 %
Macclesfield	23	413	88,865	413	100.00 %	0.46 %
Macon	27	110	84,735	110	100.00 %	0.13 %
Madison	65	2,129	91,096	2,129	100.00 %	2.34 %
Maggie Valley	118	1,687	83,282	1,687	100.00 %	2.03 %
Magnolia	4	831	83,095	831	100.00 %	1.00 %
Maiden (Catawba)	89	3,736	85,577	3,736	100.00 %	4.37 %
Maiden (Lincoln)	97	0	86,810	0	0.00 %	0.00 %
Manteo	79	1,600	83,163	1,600	100.00 %	1.92 %
Marietta	46	111	83,445	111	100.00 %	0.13 %
Marion	85	7,717	90,863	7,717	100.00 %	8.49 %
Mars Hill	118	2,007	83,282	2,007	100.00 %	2.41 %
Marshall	118	777	83,282	777	100.00 %	0.93 %
Marshville	55	2,522	87,005	2,522	100.00 %	2.90 %
Marvin	68	6,358	88,138	6,358	100.00 %	7.21 %
Matthews	103	29,435	87,132	29,435	100.00 %	33.78 %
Maxton (Robeson)	46	1,902	83,445	1,902	100.00 %	2.28 %
Maxton (Scotland)	48	208	86,256	208	100.00 %	0.24 %
Mayodan	65	2,418	91,096	2,418	100.00 %	2.65 %
Maysville	12	818	84,745	818	100.00 %	0.97 %
McAdenville	108	890	86,263	890	100.00 %	1.03 %
McDonald	46	94	83,445	94	100.00 %	0.11 %
McFarlan	55	94	87,005	94	100.00 %	0.11 %
Mebane (Alamance)	63	14,626	86,399	14,626	100.00 %	16.93 %
Mebane (Orange)	50	3,171	85,345	3,171	100.00 %	3.72 %
Mesic	79	144	83,163	144	100.00 %	0.17 %
Micro	28	458	85,389	458	100.00 %	0.54 %
Middleburg	32	101	88,633	101	100.00 %	0.11 %
Middlesex	24	912	87,220	912	100.00 %	1.05 %
Midland (Cabarrus)	73	4,684	90,649	4,684	100.00 %	5.17 %
Midland (Mecklenburg)	103	0	87,132	0	0.00 %	0.00 %
Midway	80	4,742	84,864	3,469	73.15 %	4.09 %
	81	4,742	84,066	1,273	26.85 %	1.51 %
Mills River	117	7,078	91,035	7,078	100.00 %	7.78 %
Milton	50	155	85,345	155	100.00 %	0.18 %
Mineral Springs	55	3,159	87,005	2,293	72.59 %	2.64 %
	68	3,159	88,138	866	27.41 %	0.98 %
Minnesott Beach	79	530	83,163	530	100.00 %	0.64 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

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Mint Hill (Mecklenburg)	99	26,444	87,647	0	0.00 %	0.00 %
	103	26,444	87,132	26,444	100.00 %	30.35 %
Mint Hill (Union)	69	6	85,179	6	100.00 %	0.01 %
Misenheimer	67	650	88,255	650	100.00 %	0.74 %
Mocksville	77	5,900	90,628	5,900	100.00 %	6.51 %
Momeyer	25	277	86,534	277	100.00 %	0.32 %
Monroe	55	34,562	87,005	12,650	36.60 %	14.54 %
	69	34,562	85,179	21,912	63.40 %	25.72 %
Montreat	115	901	90,262	901	100.00 %	1.00 %
Mooresboro	111	293	89,894	293	100.00 %	0.33 %
Mooresville	84	50,193	86,773	205	0.41 %	0.24 %
	95	50,193	85,366	49,988	99.59 %	58.56 %
Morehead City	13	9,556	83,307	9,556	100.00 %	11.47 %
Morganton	86	17,474	87,570	17,474	100.00 %	19.95 %
Morrisville (Durham)	31	207	90,760	207	100.00 %	0.23 %
Morrisville (Wake)	11	29,423	86,298	0	0.00 %	0.00 %
	41	29,423	89,887	14,239	48.39 %	15.84 %
	49	29,423	86,157	15,184	51.61 %	17.62 %
Morven	55	329	87,005	329	100.00 %	0.38 %
Mount Airy	90	10,676	82,937	10,676	100.00 %	12.87 %
Mount Gilead	67	1,171	88,255	1,171	100.00 %	1.33 %
Mount Holly	108	17,703	86,263	17,703	100.00 %	20.52 %
Mount Olive (Duplin)	4	5	83,095	5	100.00 %	0.01 %
Mount Olive (Wayne)	4	4,193	83,095	4,193	100.00 %	5.05 %
Mount Pleasant	73	1,671	90,649	1,671	100.00 %	1.84 %
Murfreesboro	5	2,619	82,953	2,619	100.00 %	3.16 %
Murphy	120	1,608	84,907	1,608	100.00 %	1.89 %
Nags Head	79	3,168	83,163	3,168	100.00 %	3.81 %
Nashville	25	5,632	86,534	5,632	100.00 %	6.51 %
Navassa	17	1,367	89,763	1,367	100.00 %	1.52 %
New Bern	3	31,291	85,099	31,291	100.00 %	36.77 %
New London	67	607	88,255	607	100.00 %	0.69 %
Newland	85	715	90,863	715	100.00 %	0.79 %
Newport	13	4,364	83,307	4,364	100.00 %	5.24 %
Newton	89	13,148	85,577	13,148	100.00 %	15.36 %
	96	13,148	89,587	0	0.00 %	0.00 %
Newton Grove	22	585	88,642	585	100.00 %	0.66 %
Norlina	27	920	84,735	920	100.00 %	1.09 %
Norman	52	100	84,383	100	100.00 %	0.12 %
North Topsail Beach	15	1,005	87,578	1,005	100.00 %	1.15 %
North Wilkesboro	94	4,382	90,835	4,382	100.00 %	4.82 %

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Municipality by County - District Report

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Northwest	17	703	89,763	703	100.00 %	0.78 %
Norwood	67	2,367	88,255	2,367	100.00 %	2.68 %
Oak City	23	266	88,865	266	100.00 %	0.30 %
Oak Island	19	8,396	91,041	8,396	100.00 %	9.22 %
Oak Ridge	62	7,474	89,579	7,474	100.00 %	8.34 %
Oakboro	67	2,128	88,255	2,128	100.00 %	2.41 %
Ocean Isle Beach	17	867	89,763	867	100.00 %	0.97 %
Old Fort	85	811	90,863	811	100.00 %	0.89 %
Oriental	79	880	83,163	880	100.00 %	1.06 %
Orrum	46	59	83,445	59	100.00 %	0.07 %
Ossipee	64	536	85,016	536	100.00 %	0.63 %
Oxford	32	8,628	88,633	8,628	100.00 %	9.73 %
Pantego	79	164	83,163	164	100.00 %	0.20 %
Parkton	47	504	83,708	504	100.00 %	0.60 %
Parmele	23	243	88,865	243	100.00 %	0.27 %
Patterson Springs	111	571	89,894	571	100.00 %	0.64 %
Peachland	55	390	87,005	390	100.00 %	0.45 %
Peletier	13	769	83,307	769	100.00 %	0.92 %
Pembroke	47	2,823	83,708	2,823	100.00 %	3.37 %
Pikeville	10	712	82,953	712	100.00 %	0.86 %
Pilot Mountain	90	1,440	82,937	1,440	100.00 %	1.74 %
Pine Knoll Shores	13	1,388	83,307	1,388	100.00 %	1.67 %
Pine Level	28	2,046	85,389	2,046	100.00 %	2.40 %
Pinebluff	52	1,473	84,383	1,473	100.00 %	1.75 %
Pinehurst	52	17,581	84,383	8	0.05 %	0.01 %
	78	17,581	86,365	17,573	99.95 %	20.35 %
Pinetops	23	1,200	88,865	1,200	100.00 %	1.35 %
Pineville	105	10,602	85,822	10,602	100.00 %	12.35 %
	112	10,602	82,806	0	0.00 %	0.00 %
Pink Hill	12	451	84,745	451	100.00 %	0.53 %
Pittsboro	54	4,537	83,475	4,537	100.00 %	5.44 %
Pleasant Garden	59	5,000	90,361	5,000	100.00 %	5.53 %
Plymouth	1	3,320	84,330	3,320	100.00 %	3.94 %
Polkton	55	2,250	87,005	2,250	100.00 %	2.59 %
Polkville	110	516	88,397	516	100.00 %	0.58 %
Pollocksville	12	268	84,745	268	100.00 %	0.32 %
Powellsville	23	189	88,865	189	100.00 %	0.21 %
Princeton	28	1,315	85,389	1,315	100.00 %	1.54 %
Princeville	23	1,254	88,865	1,254	100.00 %	1.41 %
Proctorville	46	121	83,445	121	100.00 %	0.15 %
Raeford	48	4,559	86,256	4,559	100.00 %	5.29 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Raleigh (Durham)	2	1,559	90,793	1,326	85.05 %	1.46 %
	31	1,559	90,760	233	14.95 %	0.26 %
Raleigh (Wake)	11	466,106	86,298	40,792	8.75 %	47.27 %
	21	466,106	86,179	13	0.00 %	0.02 %
	33	466,106	83,049	82,480	17.70 %	99.31 %
	34	466,106	83,679	83,503	17.92 %	99.79 %
	35	466,106	88,374	6,171	1.32 %	6.98 %
	38	466,106	88,226	56,840	12.19 %	64.43 %
	39	466,106	90,164	13,011	2.79 %	14.43 %
	40	466,106	83,175	57,345	12.30 %	68.94 %
	49	466,106	86,157	47,783	10.25 %	55.46 %
	66	466,106	83,189	78,168	16.77 %	93.96 %
Ramseur	78	1,774	86,365	1,774	100.00 %	2.05 %
Randleman	70	4,595	89,118	4,595	100.00 %	5.16 %
Ranlo	108	4,511	86,263	4,500	99.76 %	5.22 %
	110	4,511	88,397	11	0.24 %	0.01 %
Raynham	46	60	83,445	60	100.00 %	0.07 %
Red Cross	67	762	88,255	762	100.00 %	0.86 %
Red Oak	25	3,342	86,534	3,342	100.00 %	3.86 %
Red Springs (Hoke)	48	0	86,256	0	0.00 %	0.00 %
Red Springs (Robeson)	47	3,087	83,708	3,087	100.00 %	3.69 %
Reidsville	65	14,583	91,096	14,583	100.00 %	16.01 %
Rennert	47	275	83,708	275	100.00 %	0.33 %
Rhodhiss (Burke)	86	639	87,570	639	100.00 %	0.73 %
Rhodhiss (Caldwell)	87	358	85,758	358	100.00 %	0.42 %
Rich Square	27	894	84,735	894	100.00 %	1.06 %
Richfield	67	582	88,255	582	100.00 %	0.66 %
Richlands	16	2,287	90,663	2,287	100.00 %	2.52 %
River Bend	3	2,902	85,099	2,902	100.00 %	3.41 %
Roanoke Rapids	27	15,229	84,735	15,229	100.00 %	17.97 %
Robbins	78	1,168	86,365	1,168	100.00 %	1.35 %
Robbinsville	120	597	84,907	597	100.00 %	0.70 %
Robersonville	23	1,269	88,865	1,269	100.00 %	1.43 %
Rockingham	52	9,243	84,383	9,243	100.00 %	10.95 %
Rockwell	76	2,302	89,815	2,302	100.00 %	2.56 %
Rocky Mount (Edgecombe)	23	15,414	88,865	15,414	100.00 %	17.35 %
Rocky Mount (Nash)	25	38,927	86,534	38,927	100.00 %	44.98 %
Rolesville	35	9,475	88,374	9,467	99.92 %	10.71 %
	39	9,475	90,164	8	0.08 %	0.01 %
Ronda	90	438	82,937	438	100.00 %	0.53 %
Roper	1	485	84,330	485	100.00 %	0.58 %

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Rose Hill	4	1,371	83,095	1,371	100.00 %	1.65 %
Roseboro	22	1,163	88,642	1,163	100.00 %	1.31 %
Rosman	119	701	90,212	701	100.00 %	0.78 %
Rowland	46	885	83,445	885	100.00 %	1.06 %
Roxboro	2	8,134	90,793	8,134	100.00 %	8.96 %
Roxobel	23	187	88,865	187	100.00 %	0.21 %
Rural Hall	91	3,351	86,210	3,351	100.00 %	3.89 %
Ruth	113	347	89,058	347	100.00 %	0.39 %
Rutherford College (Burke)	86	1,226	87,570	1,226	100.00 %	1.40 %
Rutherford College (Caldwell)	87	0	85,758	0	0.00 %	0.00 %
Rutherfordton	113	3,640	89,058	3,640	100.00 %	4.09 %
Salemburg	22	457	88,642	457	100.00 %	0.52 %
Salisbury	76	35,540	89,815	35,540	100.00 %	39.57 %
Saluda (Henderson)	113	11	89,058	11	100.00 %	0.01 %
Saluda (Polk)	113	620	89,058	620	100.00 %	0.70 %
Sandy Creek	17	248	89,763	248	100.00 %	0.28 %
Sandyfield	46	430	83,445	430	100.00 %	0.52 %
Sanford	51	30,261	83,073	30,261	100.00 %	36.43 %
Saratoga	24	353	87,220	353	100.00 %	0.40 %
Sawmills	87	5,020	85,758	5,020	100.00 %	5.85 %
Scotland Neck	27	1,640	84,735	1,640	100.00 %	1.94 %
Seaboard	27	542	84,735	542	100.00 %	0.64 %
Seagrove	78	235	86,365	235	100.00 %	0.27 %
Sedalia	59	676	90,361	676	100.00 %	0.75 %
Selma	28	6,317	85,389	6,317	100.00 %	7.40 %
Seven Devils (Avery)	85	38	90,863	38	100.00 %	0.04 %
Seven Devils (Watauga)	93	275	86,445	275	100.00 %	0.32 %
Seven Springs	4	55	83,095	55	100.00 %	0.07 %
Severn	27	191	84,735	191	100.00 %	0.23 %
Shallotte	17	4,185	89,763	4,185	100.00 %	4.66 %
Sharpsburg (Edgecombe)	23	215	88,865	215	100.00 %	0.24 %
Sharpsburg (Nash)	25	1,061	86,534	1,061	100.00 %	1.23 %
Sharpsburg (Wilson)	24	421	87,220	421	100.00 %	0.48 %
Shelby	110	21,918	88,397	4,409	20.12 %	4.99 %
	111	21,918	89,894	17,509	79.88 %	19.48 %
Siler City	54	7,702	83,475	7,702	100.00 %	9.23 %
Simpson	9	390	84,450	390	100.00 %	0.46 %
Sims	24	275	87,220	275	100.00 %	0.32 %
Smithfield	28	11,292	85,389	11,292	100.00 %	13.22 %
Snow Hill	12	1,481	84,745	1,481	100.00 %	1.75 %

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[G20-MbCD] - Generated 11/4/2021

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Southern Pines	52	15,545	84,383	15,545	100.00 %	18.42 %
	78	15,545	86,365	0	0.00 %	0.00 %
Southern Shores	1	3,090	84,330	3,090	100.00 %	3.66 %
Southport	19	3,971	91,041	3,971	100.00 %	4.36 %
Sparta	93	1,834	86,445	1,834	100.00 %	2.12 %
Speed	23	63	88,865	63	100.00 %	0.07 %
Spencer	76	3,308	89,815	3,308	100.00 %	3.68 %
Spencer Mountain	108	0	86,263	0	0.00 %	0.00 %
Spindale	113	4,225	89,058	4,225	100.00 %	4.74 %
Spring Hope	25	1,309	86,534	1,309	100.00 %	1.51 %
Spring Lake	42	11,660	85,537	11,660	100.00 %	13.63 %
Spruce Pine	85	2,194	90,863	2,194	100.00 %	2.41 %
St. Helena	16	417	90,663	417	100.00 %	0.46 %
St. James	19	6,529	91,041	6,529	100.00 %	7.17 %
St. Pauls	47	2,045	83,708	2,045	100.00 %	2.44 %
Staley	54	397	83,475	397	100.00 %	0.48 %
Stallings (Mecklenburg)	103	384	87,132	384	100.00 %	0.44 %
Stallings (Union)	68	15,728	88,138	0	0.00 %	0.00 %
	69	15,728	85,179	15,728	100.00 %	18.46 %
Stanfield	67	1,585	88,255	1,585	100.00 %	1.80 %
Stanley	108	3,963	86,263	3,963	100.00 %	4.59 %
Stantonsburg	24	762	87,220	762	100.00 %	0.87 %
Star	67	806	88,255	806	100.00 %	0.91 %
Statesville	84	28,419	86,773	28,415	99.99 %	32.75 %
	89	28,419	85,577	4	0.01 %	0.00 %
Stedman	43	1,277	82,956	1,277	100.00 %	1.54 %
Stem	32	960	88,633	960	100.00 %	1.08 %
Stokesdale	62	5,924	89,579	5,924	100.00 %	6.61 %
Stoneville	65	1,308	91,096	1,308	100.00 %	1.44 %
Stonewall	79	214	83,163	214	100.00 %	0.26 %
Stovall	32	324	88,633	324	100.00 %	0.37 %
Sugar Mountain	85	371	90,863	371	100.00 %	0.41 %
Summerfield	57	10,951	90,615	746	6.81 %	0.82 %
	59	10,951	90,361	2,509	22.91 %	2.78 %
	62	10,951	89,579	7,696	70.28 %	8.59 %
Sunset Beach	17	4,175	89,763	4,175	100.00 %	4.65 %
Surf City (Onslow)	15	334	87,578	334	100.00 %	0.38 %
Surf City (Pender)	16	3,533	90,663	3,533	100.00 %	3.90 %
Swansboro	14	3,744	86,538	3,744	100.00 %	4.33 %
Swepsonville	63	2,445	86,399	2,445	100.00 %	2.83 %
Sylva	119	2,578	90,212	2,578	100.00 %	2.86 %

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Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Tabor City	46	3,781	83,445	3,781	100.00 %	4.53 %
Tar Heel	22	90	88,642	90	100.00 %	0.10 %
Tarboro	23	10,721	88,865	10,721	100.00 %	12.06 %
Taylorsville	94	2,320	90,835	2,320	100.00 %	2.55 %
Taylortown	52	634	84,383	4	0.63 %	0.00 %
	78	634	86,365	630	99.37 %	0.73 %
Teachey	4	448	83,095	448	100.00 %	0.54 %
Thomasville (Davidson)	80	26,662	84,864	26,662	100.00 %	31.42 %
Thomasville (Randolph)	70	521	89,118	521	100.00 %	0.58 %
Tobaccoville (Forsyth)	74	2,578	84,857	824	31.96 %	0.97 %
	91	2,578	86,210	1,754	68.04 %	2.03 %
Tobaccoville (Stokes)	91	0	86,210	0	0.00 %	0.00 %
Topsail Beach	16	461	90,663	461	100.00 %	0.51 %
Trent Woods	3	4,074	85,099	4,074	100.00 %	4.79 %
Trenton	12	238	84,745	238	100.00 %	0.28 %
Trinity	70	7,006	89,118	7,006	100.00 %	7.86 %
Troutman	84	3,698	86,773	885	23.93 %	1.02 %
	89	3,698	85,577	2,813	76.07 %	3.29 %
Troy	67	2,850	88,255	2,850	100.00 %	3.23 %
Tryon	113	1,562	89,058	1,562	100.00 %	1.75 %
Turkey	22	213	88,642	213	100.00 %	0.24 %
Unionville	69	6,643	85,179	6,643	100.00 %	7.80 %
Valdese	86	4,689	87,570	4,689	100.00 %	5.35 %
Vanceboro	3	869	85,099	869	100.00 %	1.02 %
Vandemere	79	246	83,163	246	100.00 %	0.30 %
Varnamtown	19	525	91,041	525	100.00 %	0.58 %
Vass	51	952	83,073	952	100.00 %	1.15 %
Waco	110	310	88,397	310	100.00 %	0.35 %
Wade	43	638	82,956	638	100.00 %	0.77 %
Wadesboro	55	5,008	87,005	5,008	100.00 %	5.76 %
Wagram	48	615	86,256	615	100.00 %	0.71 %
Wake Forest (Franklin)	7	1,504	83,510	1,504	100.00 %	1.80 %
Wake Forest (Wake)	35	46,097	88,374	46,097	100.00 %	52.16 %
	66	46,097	83,189	0	0.00 %	0.00 %
Walkertown	71	5,692	84,874	3,176	55.80 %	3.74 %
	75	5,692	84,220	2,516	44.20 %	2.99 %
Wallace (Duplin)	4	3,413	83,095	3,413	100.00 %	4.11 %
Wallace (Pender)	16	0	90,663	0	0.00 %	0.00 %
Wallburg	80	3,051	84,864	3,051	100.00 %	3.60 %
Walnut Cove	91	1,586	86,210	1,586	100.00 %	1.84 %
Walnut Creek	4	1,084	83,095	1,084	100.00 %	1.30 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Walstonburg	12	193	84,745	193	100.00 %	0.23 %
Warrenton	27	851	84,735	851	100.00 %	1.00 %
Warsaw	4	2,733	83,095	2,733	100.00 %	3.29 %
Washington	79	9,875	83,163	9,875	100.00 %	11.87 %
Washington Park	79	392	83,163	392	100.00 %	0.47 %
Watha	16	181	90,663	181	100.00 %	0.20 %
Waxhaw	55	20,534	87,005	0	0.00 %	0.00 %
	68	20,534	88,138	20,534	100.00 %	23.30 %
Waynesville	118	10,140	83,282	10,140	100.00 %	12.18 %
Weaverville	114	4,567	89,685	4,567	100.00 %	5.09 %
Webster	119	372	90,212	372	100.00 %	0.41 %
Weddington (Mecklenburg)	103	5	87,132	5	100.00 %	0.01 %
Weddington (Union)	68	13,176	88,138	13,172	99.97 %	14.94 %
	69	13,176	85,179	4	0.03 %	0.00 %
Weldon	27	1,444	84,735	1,444	100.00 %	1.70 %
Wendell	39	9,793	90,164	9,793	100.00 %	10.86 %
Wentworth	65	2,662	91,096	2,662	100.00 %	2.92 %
Wesley Chapel	55	8,681	87,005	3,868	44.56 %	4.45 %
	68	8,681	88,138	4,813	55.44 %	5.46 %
West Jefferson	93	1,279	86,445	1,279	100.00 %	1.48 %
Whispering Pines	52	4,987	84,383	4,987	100.00 %	5.91 %
Whitakers (Edgecombe)	23	290	88,865	290	100.00 %	0.33 %
Whitakers (Nash)	25	337	86,534	337	100.00 %	0.39 %
White Lake	22	843	88,642	843	100.00 %	0.95 %
Whiteville	46	4,766	83,445	4,766	100.00 %	5.71 %
Whitsett	59	584	90,361	584	100.00 %	0.65 %
Wilkesboro	94	3,687	90,835	3,687	100.00 %	4.06 %
Williamston	23	5,248	88,865	5,248	100.00 %	5.91 %
Wilmington	18	115,451	91,245	48,680	42.17 %	53.35 %
	19	115,451	91,041	8,207	7.11 %	9.01 %
	20	115,451	90,346	58,564	50.73 %	64.82 %
Wilson	24	47,851	87,220	47,851	100.00 %	54.86 %
Wilson's Mills	26	2,534	89,947	0	0.00 %	0.00 %
	28	2,534	85,389	2,534	100.00 %	2.97 %
Windsor	23	3,582	88,865	3,582	100.00 %	4.03 %
Winfall	1	555	84,330	555	100.00 %	0.66 %
Wingate	55	4,055	87,005	4,055	100.00 %	4.66 %

Municipality by County - District Report

District Plan: SL 2021-175 House

Municipality	District	Total Muni Population	Total District Population	Muni Pop in District	Percent of Muni Pop in District	Percent of District Pop in Muni
Winston-Salem	71	249,545	84,874	77,631	31.11 %	91.47 %
	72	249,545	86,949	86,867	34.81 %	99.91 %
	74	249,545	84,857	32,409	12.99 %	38.19 %
	75	249,545	84,220	22,818	9.14 %	27.09 %
	91	249,545	86,210	29,820	11.95 %	34.59 %
Winterville	8	10,462	85,793	44	0.42 %	0.05 %
	9	10,462	84,450	10,418	99.58 %	12.34 %
Winton	5	629	82,953	629	100.00 %	0.76 %
Woodfin	114	7,936	89,685	7,648	96.37 %	8.53 %
	116	7,936	89,505	288	3.63 %	0.32 %
Woodland	27	557	84,735	557	100.00 %	0.66 %
Wrightsville Beach	20	2,473	90,346	2,473	100.00 %	2.74 %
Yadkinville	77	2,995	90,628	2,995	100.00 %	3.30 %
Yanceyville	50	1,937	85,345	1,937	100.00 %	2.27 %
Youngsville	7	2,016	83,510	2,016	100.00 %	2.41 %
Zebulon (Johnston)	26	0	89,947	0	0.00 %	0.00 %
Zebulon (Wake)	39	6,903	90,164	6,903	100.00 %	7.66 %
			Total:	**6,017,605**		

Number of municipalities split within counties: 81

Display: all municipalities

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM

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District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
1	Columbia	84,330	610	610	0.72 %	100.00 %
	Creswell	84,330	207	207	0.25 %	100.00 %
	Duck	84,330	742	742	0.88 %	100.00 %
	Edenton	84,330	4,460	4,460	5.29 %	100.00 %
	Hertford	84,330	1,934	1,934	2.29 %	100.00 %
	Kill Devil Hills	84,330	7,656	7,118	8.44 %	92.97 %
	Kitty Hawk	84,330	3,689	3,689	4.37 %	100.00 %
	Plymouth	84,330	3,320	3,320	3.94 %	100.00 %
	Roper	84,330	485	485	0.58 %	100.00 %
	Southern Shores	84,330	3,090	3,090	3.66 %	100.00 %
	Winfall	84,330	555	555	0.66 %	100.00 %
2	Durham (Durham)	90,793	283,093	25,167	27.72 %	8.89 %
	Raleigh (Durham)	90,793	1,559	1,326	1.46 %	85.05 %
	Roxboro	90,793	8,134	8,134	8.96 %	100.00 %
3	Bridgeton	85,099	349	349	0.41 %	100.00 %
	Cove City	85,099	378	378	0.44 %	100.00 %
	Dover	85,099	349	349	0.41 %	100.00 %
	Havelock	85,099	16,621	5,986	7.03 %	36.01 %
	New Bern	85,099	31,291	31,291	36.77 %	100.00 %
	River Bend	85,099	2,902	2,902	3.41 %	100.00 %
	Trent Woods	85,099	4,074	4,074	4.79 %	100.00 %
	Vanceboro	85,099	869	869	1.02 %	100.00 %
4	Beulaville	83,095	1,116	1,116	1.34 %	100.00 %
	Calypso	83,095	327	327	0.39 %	100.00 %
	Faison (Duplin)	83,095	784	784	0.94 %	100.00 %
	Goldsboro	83,095	33,657	5	0.01 %	0.01 %
	Greenevers	83,095	567	567	0.68 %	100.00 %
	Harrells (Duplin)	83,095	0	0	0.00 %	0.00 %
	Kenansville	83,095	770	770	0.93 %	100.00 %
	Magnolia	83,095	831	831	1.00 %	100.00 %
	Mount Olive (Duplin)	83,095	5	5	0.01 %	100.00 %
	Mount Olive (Wayne)	83,095	4,193	4,193	5.05 %	100.00 %
	Rose Hill	83,095	1,371	1,371	1.65 %	100.00 %
	Seven Springs	83,095	55	55	0.07 %	100.00 %
	Teachey	83,095	448	448	0.54 %	100.00 %
	Wallace (Duplin)	83,095	3,413	3,413	4.11 %	100.00 %
	Walnut Creek	83,095	1,084	1,084	1.30 %	100.00 %
	Warsaw	83,095	2,733	2,733	3.29 %	100.00 %
5	Ahoskie	82,953	4,891	4,891	5.90 %	100.00 %
	Cofield	82,953	267	267	0.32 %	100.00 %
	Como	82,953	67	67	0.08 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
5	Elizabeth City (Camden)	82,953	38	38	0.05 %	100.00 %
	Elizabeth City (Pasquotank)	82,953	18,593	18,593	22.41 %	100.00 %
	Gatesville	82,953	267	267	0.32 %	100.00 %
	Harrellsville	82,953	85	85	0.10 %	100.00 %
	Murfreesboro	82,953	2,619	2,619	3.16 %	100.00 %
	Winton	82,953	629	629	0.76 %	100.00 %
6	Angier (Harnett)	87,332	4,709	4,709	5.39 %	100.00 %
	Broadway (Harnett)	87,332	0	0	0.00 %	0.00 %
	Fuquay-Varina (Harnett)	87,332	0	0	0.00 %	0.00 %
	Lillington	87,332	4,735	882	1.01 %	18.63 %
7	Bunn	83,510	327	327	0.39 %	100.00 %
	Creedmoor	83,510	4,866	2,065	2.47 %	42.44 %
	Franklinton	83,510	2,456	2,456	2.94 %	100.00 %
	Louisburg	83,510	3,064	3,064	3.67 %	100.00 %
	Wake Forest (Franklin)	83,510	1,504	1,504	1.80 %	100.00 %
	Youngsville	83,510	2,016	2,016	2.41 %	100.00 %
8	Bethel	85,793	1,373	1,373	1.60 %	100.00 %
	Falkland	85,793	47	47	0.05 %	100.00 %
	Farmville	85,793	4,461	4,461	5.20 %	100.00 %
	Fountain	85,793	385	385	0.45 %	100.00 %
	Greenville	85,793	87,521	52,881	61.64 %	60.42 %
	Winterville	85,793	10,462	44	0.05 %	0.42 %
9	Ayden	84,450	4,977	4,977	5.89 %	100.00 %
	Greenville	84,450	87,521	34,640	41.02 %	39.58 %
	Grifton (Pitt)	84,450	2,301	2,301	2.72 %	100.00 %
	Grimesland	84,450	386	386	0.46 %	100.00 %
	Simpson	84,450	390	390	0.46 %	100.00 %
	Winterville	84,450	10,462	10,418	12.34 %	99.58 %
10	Eureka	82,953	214	214	0.26 %	100.00 %
	Fremont	82,953	1,196	1,196	1.44 %	100.00 %
	Goldsboro	82,953	33,657	33,652	40.57 %	99.99 %
	Pikeville	82,953	712	712	0.86 %	100.00 %
11	Apex	86,298	58,780	0	0.00 %	0.00 %
	Cary (Wake)	86,298	171,012	43,537	50.45 %	25.46 %
	Morrisville (Wake)	86,298	29,423	0	0.00 %	0.00 %
	Raleigh (Wake)	86,298	466,106	40,792	47.27 %	8.75 %
12	Grifton (Lenoir)	84,745	147	147	0.17 %	100.00 %
	Hookerton	84,745	413	413	0.49 %	100.00 %
	Kinston	84,745	19,900	19,900	23.48 %	100.00 %
	La Grange	84,745	2,595	2,595	3.06 %	100.00 %
	Maysville	84,745	818	818	0.97 %	100.00 %

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12	Pink Hill	84,745	451	451	0.53 %	100.00 %
	Pollocksville	84,745	268	268	0.32 %	100.00 %
	Snow Hill	84,745	1,481	1,481	1.75 %	100.00 %
	Trenton	84,745	238	238	0.28 %	100.00 %
	Walstonburg	84,745	193	193	0.23 %	100.00 %
13	Atlantic Beach	83,307	1,364	1,364	1.64 %	100.00 %
	Beaufort	83,307	4,464	4,464	5.36 %	100.00 %
	Bogue	83,307	695	695	0.83 %	100.00 %
	Cape Carteret	83,307	2,224	2,224	2.67 %	100.00 %
	Cedar Point	83,307	1,764	1,764	2.12 %	100.00 %
	Emerald Isle	83,307	3,847	3,847	4.62 %	100.00 %
	Havelock	83,307	16,621	10,635	12.77 %	63.99 %
	Indian Beach	83,307	223	223	0.27 %	100.00 %
	Morehead City	83,307	9,556	9,556	11.47 %	100.00 %
	Newport	83,307	4,364	4,364	5.24 %	100.00 %
	Peletier	83,307	769	769	0.92 %	100.00 %
	Pine Knoll Shores	83,307	1,388	1,388	1.67 %	100.00 %
14	Jacksonville	86,538	72,723	28,456	32.88 %	39.13 %
	Swansboro	86,538	3,744	3,744	4.33 %	100.00 %
15	Holly Ridge	87,578	4,171	4,171	4.76 %	100.00 %
	Jacksonville	87,578	72,723	44,267	50.55 %	60.87 %
	North Topsail Beach	87,578	1,005	1,005	1.15 %	100.00 %
	Surf City (Onslow)	87,578	334	334	0.38 %	100.00 %
16	Atkinson	90,663	296	296	0.33 %	100.00 %
	Burgaw	90,663	3,088	3,088	3.41 %	100.00 %
	Richlands	90,663	2,287	2,287	2.52 %	100.00 %
	St. Helena	90,663	417	417	0.46 %	100.00 %
	Surf City (Pender)	90,663	3,533	3,533	3.90 %	100.00 %
	Topsail Beach	90,663	461	461	0.51 %	100.00 %
	Wallace (Pender)	90,663	0	0	0.00 %	0.00 %
	Watha	90,663	181	181	0.20 %	100.00 %
17	Belville	89,763	2,406	2,406	2.68 %	100.00 %
	Calabash	89,763	2,011	2,011	2.24 %	100.00 %
	Carolina Shores	89,763	4,588	4,588	5.11 %	100.00 %
	Holden Beach	89,763	921	0	0.00 %	0.00 %
	Leland	89,763	22,908	22,908	25.52 %	100.00 %
	Navassa	89,763	1,367	1,367	1.52 %	100.00 %
	Northwest	89,763	703	703	0.78 %	100.00 %
	Ocean Isle Beach	89,763	867	867	0.97 %	100.00 %
	Sandy Creek	89,763	248	248	0.28 %	100.00 %
	Shallotte	89,763	4,185	4,185	4.66 %	100.00 %

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17	Sunset Beach	89,763	4,175	4,175	4.65 %	100.00 %
18	Wilmington	91,245	115,451	48,680	53.35 %	42.17 %
19	Bald Head Island	91,041	268	268	0.29 %	100.00 %
	Boiling Spring Lakes	91,041	5,943	5,943	6.53 %	100.00 %
	Bolivia	91,041	149	149	0.16 %	100.00 %
	Carolina Beach	91,041	6,564	6,564	7.21 %	100.00 %
	Caswell Beach	91,041	395	395	0.43 %	100.00 %
	Holden Beach	91,041	921	921	1.01 %	100.00 %
	Kure Beach	91,041	2,191	2,191	2.41 %	100.00 %
	Oak Island	91,041	8,396	8,396	9.22 %	100.00 %
	Southport	91,041	3,971	3,971	4.36 %	100.00 %
	St. James	91,041	6,529	6,529	7.17 %	100.00 %
	Varnamtown	91,041	525	525	0.58 %	100.00 %
	Wilmington	91,041	115,451	8,207	9.01 %	7.11 %
20	Wilmington	90,346	115,451	58,564	64.82 %	50.73 %
	Wrightsville Beach	90,346	2,473	2,473	2.74 %	100.00 %
21	Apex	86,179	58,780	556	0.65 %	0.95 %
	Cary (Wake)	86,179	171,012	30,622	35.53 %	17.91 %
	Fuquay-Varina (Wake)	86,179	34,152	30	0.03 %	0.09 %
	Garner	86,179	31,159	11,789	13.68 %	37.83 %
	Holly Springs	86,179	41,239	11,892	13.80 %	28.84 %
	Raleigh (Wake)	86,179	466,106	13	0.02 %	0.00 %
22	Autryville	88,642	167	167	0.19 %	100.00 %
	Bladenboro	88,642	1,648	1,648	1.86 %	100.00 %
	Clarkton	88,642	614	614	0.69 %	100.00 %
	Clinton	88,642	8,383	8,383	9.46 %	100.00 %
	Dublin	88,642	267	267	0.30 %	100.00 %
	East Arcadia	88,642	418	418	0.47 %	100.00 %
	Elizabethtown	88,642	3,296	3,296	3.72 %	100.00 %
	Faison (Sampson)	88,642	0	0	0.00 %	0.00 %
	Falcon (Sampson)	88,642	0	0	0.00 %	0.00 %
	Garland	88,642	595	595	0.67 %	100.00 %
	Harrells (Sampson)	88,642	160	160	0.18 %	100.00 %
	Newton Grove	88,642	585	585	0.66 %	100.00 %
	Roseboro	88,642	1,163	1,163	1.31 %	100.00 %
	Salemburg	88,642	457	457	0.52 %	100.00 %
	Tar Heel	88,642	90	90	0.10 %	100.00 %
	Turkey	88,642	213	213	0.24 %	100.00 %
	White Lake	88,642	843	843	0.95 %	100.00 %
23	Askewville	88,865	184	184	0.21 %	100.00 %
	Aulander	88,865	763	763	0.86 %	100.00 %

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23	Bear Grass	88,865	89	89	0.10 %	100.00 %
	Colerain	88,865	217	217	0.24 %	100.00 %
	Conetoe	88,865	198	198	0.22 %	100.00 %
	Everetts	88,865	150	150	0.17 %	100.00 %
	Hamilton	88,865	306	306	0.34 %	100.00 %
	Hassell	88,865	49	49	0.06 %	100.00 %
	Jamesville	88,865	424	424	0.48 %	100.00 %
	Kelford	88,865	203	203	0.23 %	100.00 %
	Leggett	88,865	37	37	0.04 %	100.00 %
	Lewiston Woodville	88,865	426	426	0.48 %	100.00 %
	Macclesfield	88,865	413	413	0.46 %	100.00 %
	Oak City	88,865	266	266	0.30 %	100.00 %
	Parmele	88,865	243	243	0.27 %	100.00 %
	Pinetops	88,865	1,200	1,200	1.35 %	100.00 %
	Powellsville	88,865	189	189	0.21 %	100.00 %
	Princeville	88,865	1,254	1,254	1.41 %	100.00 %
	Robersonville	88,865	1,269	1,269	1.43 %	100.00 %
	Rocky Mount (Edgecombe)	88,865	15,414	15,414	17.35 %	100.00 %
	Roxobel	88,865	187	187	0.21 %	100.00 %
	Sharpsburg (Edgecombe)	88,865	215	215	0.24 %	100.00 %
	Speed	88,865	63	63	0.07 %	100.00 %
	Tarboro	88,865	10,721	10,721	12.06 %	100.00 %
	Whitakers (Edgecombe)	88,865	290	290	0.33 %	100.00 %
	Williamston	88,865	5,248	5,248	5.91 %	100.00 %
	Windsor	88,865	3,582	3,582	4.03 %	100.00 %
24	Bailey	87,220	568	568	0.65 %	100.00 %
	Black Creek	87,220	692	692	0.79 %	100.00 %
	Elm City (Wilson)	87,220	1,218	1,218	1.40 %	100.00 %
	Kenly (Wilson)	87,220	198	198	0.23 %	100.00 %
	Lucama	87,220	1,036	1,036	1.19 %	100.00 %
	Middlesex	87,220	912	912	1.05 %	100.00 %
	Saratoga	87,220	353	353	0.40 %	100.00 %
	Sharpsburg (Wilson)	87,220	421	421	0.48 %	100.00 %
	Sims	87,220	275	275	0.32 %	100.00 %
	Stantonsburg	87,220	762	762	0.87 %	100.00 %
	Wilson	87,220	47,851	47,851	54.86 %	100.00 %
25	Castalia	86,534	264	264	0.31 %	100.00 %
	Dortches	86,534	1,082	1,082	1.25 %	100.00 %
	Elm City (Nash)	86,534	0	0	0.00 %	0.00 %
	Momeyer	86,534	277	277	0.32 %	100.00 %
	Nashville	86,534	5,632	5,632	6.51 %	100.00 %

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25	Red Oak	86,534	3,342	3,342	3.86 %	100.00 %
	Rocky Mount (Nash)	86,534	38,927	38,927	44.98 %	100.00 %
	Sharpsburg (Nash)	86,534	1,061	1,061	1.23 %	100.00 %
	Spring Hope	86,534	1,309	1,309	1.51 %	100.00 %
	Whitakers (Nash)	86,534	337	337	0.39 %	100.00 %
26	Archer Lodge	89,947	4,797	4,797	5.33 %	100.00 %
	Clayton (Johnston)	89,947	26,307	26,307	29.25 %	100.00 %
	Wilson's Mills	89,947	2,534	0	0.00 %	0.00 %
	Zebulon (Johnston)	89,947	0	0	0.00 %	0.00 %
27	Conway	84,735	752	752	0.89 %	100.00 %
	Enfield	84,735	1,865	1,865	2.20 %	100.00 %
	Garysburg	84,735	904	904	1.07 %	100.00 %
	Gaston	84,735	1,008	1,008	1.19 %	100.00 %
	Halifax	84,735	170	170	0.20 %	100.00 %
	Hobgood	84,735	268	268	0.32 %	100.00 %
	Jackson	84,735	430	430	0.51 %	100.00 %
	Lasker	84,735	64	64	0.08 %	100.00 %
	Littleton	84,735	559	559	0.66 %	100.00 %
	Macon	84,735	110	110	0.13 %	100.00 %
	Norlina	84,735	920	920	1.09 %	100.00 %
	Rich Square	84,735	894	894	1.06 %	100.00 %
	Roanoke Rapids	84,735	15,229	15,229	17.97 %	100.00 %
	Scotland Neck	84,735	1,640	1,640	1.94 %	100.00 %
	Seaboard	84,735	542	542	0.64 %	100.00 %
	Severn	84,735	191	191	0.23 %	100.00 %
	Warrenton	84,735	851	851	1.00 %	100.00 %
	Weldon	84,735	1,444	1,444	1.70 %	100.00 %
	Woodland	84,735	557	557	0.66 %	100.00 %
28	Benson (Johnston)	85,389	3,967	3,967	4.65 %	100.00 %
	Four Oaks	85,389	2,158	2,158	2.53 %	100.00 %
	Kenly (Johnston)	85,389	1,293	1,293	1.51 %	100.00 %
	Micro	85,389	458	458	0.54 %	100.00 %
	Pine Level	85,389	2,046	2,046	2.40 %	100.00 %
	Princeton	85,389	1,315	1,315	1.54 %	100.00 %
	Selma	85,389	6,317	6,317	7.40 %	100.00 %
	Smithfield	85,389	11,292	11,292	13.22 %	100.00 %
	Wilson's Mills	85,389	2,534	2,534	2.97 %	100.00 %
29	Chapel Hill (Durham)	91,212	2,906	2,906	3.19 %	100.00 %
	Durham (Durham)	91,212	283,093	87,035	95.42 %	30.74 %
30	Durham (Durham)	91,165	283,093	89,671	98.36 %	31.68 %
31	Durham (Durham)	90,760	283,093	81,220	89.49 %	28.69 %

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31	Morrisville (Durham)	90,760	207	207	0.23 %	100.00 %
	Raleigh (Durham)	90,760	1,559	233	0.26 %	14.95 %
32	Butner	88,633	8,397	8,397	9.47 %	100.00 %
	Creedmoor	88,633	4,866	2,801	3.16 %	57.56 %
	Henderson	88,633	15,060	15,060	16.99 %	100.00 %
	Kittrell	88,633	132	132	0.15 %	100.00 %
	Middleburg	88,633	101	101	0.11 %	100.00 %
	Oxford	88,633	8,628	8,628	9.73 %	100.00 %
	Stem	88,633	960	960	1.08 %	100.00 %
	Stovall	88,633	324	324	0.37 %	100.00 %
33	Garner	83,049	31,159	14	0.02 %	0.04 %
	Raleigh (Wake)	83,049	466,106	82,480	99.31 %	17.70 %
34	Raleigh (Wake)	83,679	466,106	83,503	99.79 %	17.92 %
35	Raleigh (Wake)	88,374	466,106	6,171	6.98 %	1.32 %
	Rolesville	88,374	9,475	9,467	10.71 %	99.92 %
	Wake Forest (Wake)	88,374	46,097	46,097	52.16 %	100.00 %
36	Apex	90,166	58,780	57,843	64.15 %	98.41 %
	Cary (Wake)	90,166	171,012	0	0.00 %	0.00 %
	Fuquay-Varina (Wake)	90,166	34,152	16	0.02 %	0.05 %
	Holly Springs	90,166	41,239	17,734	19.67 %	43.00 %
37	Angier (Wake)	90,867	556	556	0.61 %	100.00 %
	Cary (Wake)	90,867	171,012	2,012	2.21 %	1.18 %
	Fuquay-Varina (Wake)	90,867	34,152	34,106	37.53 %	99.87 %
	Garner	90,867	31,159	0	0.00 %	0.00 %
	Holly Springs	90,867	41,239	11,613	12.78 %	28.16 %
38	Clayton (Wake)	88,226	0	0	0.00 %	0.00 %
	Garner	88,226	31,159	19,356	21.94 %	62.12 %
	Knightdale	88,226	19,435	0	0.00 %	0.00 %
	Raleigh (Wake)	88,226	466,106	56,840	64.43 %	12.19 %
39	Clayton (Wake)	90,164	0	0	0.00 %	0.00 %
	Knightdale	90,164	19,435	19,435	21.56 %	100.00 %
	Raleigh (Wake)	90,164	466,106	13,011	14.43 %	2.79 %
	Rolesville	90,164	9,475	8	0.01 %	0.08 %
	Wendell	90,164	9,793	9,793	10.86 %	100.00 %
	Zebulon (Wake)	90,164	6,903	6,903	7.66 %	100.00 %
40	Durham (Wake)	83,175	269	269	0.32 %	100.00 %
	Raleigh (Wake)	83,175	466,106	57,345	68.94 %	12.30 %
41	Apex	89,887	58,780	381	0.42 %	0.65 %
	Cary (Wake)	89,887	171,012	74,074	82.41 %	43.32 %
	Morrisville (Wake)	89,887	29,423	14,239	15.84 %	48.39 %
42	Fayetteville	85,537	208,501	65,401	76.46 %	31.37 %

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42	Spring Lake	85,537	11,660	11,660	13.63 %	100.00 %
43	Eastover	82,956	3,656	3,656	4.41 %	100.00 %
	Falcon (Cumberland)	82,956	324	324	0.39 %	100.00 %
	Fayetteville	82,956	208,501	44,532	53.68 %	21.36 %
	Godwin	82,956	128	128	0.15 %	100.00 %
	Hope Mills	82,956	17,808	64	0.08 %	0.36 %
	Linden	82,956	136	136	0.16 %	100.00 %
	Stedman	82,956	1,277	1,277	1.54 %	100.00 %
	Wade	82,956	638	638	0.77 %	100.00 %
44	Fayetteville	83,297	208,501	83,293	100.00 %	39.95 %
45	Fayetteville	82,938	208,501	15,275	18.42 %	7.33 %
	Hope Mills	82,938	17,808	17,744	21.39 %	99.64 %
46	Boardman	83,445	166	166	0.20 %	100.00 %
	Bolton	83,445	519	519	0.62 %	100.00 %
	Brunswick	83,445	973	973	1.17 %	100.00 %
	Cerro Gordo	83,445	131	131	0.16 %	100.00 %
	Chadbourn	83,445	1,574	1,574	1.89 %	100.00 %
	Fair Bluff	83,445	709	709	0.85 %	100.00 %
	Fairmont	83,445	2,191	2,191	2.63 %	100.00 %
	Lake Waccamaw	83,445	1,296	1,296	1.55 %	100.00 %
	Lumberton	83,445	19,025	350	0.42 %	1.84 %
	Marietta	83,445	111	111	0.13 %	100.00 %
	Maxton (Robeson)	83,445	1,902	1,902	2.28 %	100.00 %
	McDonald	83,445	94	94	0.11 %	100.00 %
	Orrum	83,445	59	59	0.07 %	100.00 %
	Proctorville	83,445	121	121	0.15 %	100.00 %
	Raynham	83,445	60	60	0.07 %	100.00 %
	Rowland	83,445	885	885	1.06 %	100.00 %
	Sandyfield	83,445	430	430	0.52 %	100.00 %
	Tabor City	83,445	3,781	3,781	4.53 %	100.00 %
	Whiteville	83,445	4,766	4,766	5.71 %	100.00 %
47	Fairmont	83,708	2,191	0	0.00 %	0.00 %
	Lumber Bridge	83,708	82	82	0.10 %	100.00 %
	Lumberton	83,708	19,025	18,675	22.31 %	98.16 %
	Parkton	83,708	504	504	0.60 %	100.00 %
	Pembroke	83,708	2,823	2,823	3.37 %	100.00 %
	Red Springs (Robeson)	83,708	3,087	3,087	3.69 %	100.00 %
	Rennert	83,708	275	275	0.33 %	100.00 %
	St. Pauls	83,708	2,045	2,045	2.44 %	100.00 %
48	East Laurinburg	86,256	234	234	0.27 %	100.00 %
	Gibson	86,256	449	449	0.52 %	100.00 %

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48	Laurinburg	86,256	14,978	14,978	17.36 %	100.00 %
	Maxton (Scotland)	86,256	208	208	0.24 %	100.00 %
	Raeford	86,256	4,559	4,559	5.29 %	100.00 %
	Red Springs (Hoke)	86,256	0	0	0.00 %	0.00 %
	Wagram	86,256	615	615	0.71 %	100.00 %
49	Cary (Wake)	86,157	171,012	20,767	24.10 %	12.14 %
	Durham (Wake)	86,157	269	0	0.00 %	0.00 %
	Morrisville (Wake)	86,157	29,423	15,184	17.62 %	51.61 %
	Raleigh (Wake)	86,157	466,106	47,783	55.46 %	10.25 %
50	Carrboro	85,345	21,295	174	0.20 %	0.82 %
	Durham (Orange)	85,345	144	144	0.17 %	100.00 %
	Hillsborough	85,345	9,660	9,660	11.32 %	100.00 %
	Mebane (Orange)	85,345	3,171	3,171	3.72 %	100.00 %
	Milton	85,345	155	155	0.18 %	100.00 %
	Yanceyville	85,345	1,937	1,937	2.27 %	100.00 %
51	Broadway (Lee)	83,073	1,267	1,267	1.53 %	100.00 %
	Cameron	83,073	244	244	0.29 %	100.00 %
	Carthage	83,073	2,775	2,747	3.31 %	98.99 %
	Sanford	83,073	30,261	30,261	36.43 %	100.00 %
	Vass	83,073	952	952	1.15 %	100.00 %
52	Aberdeen	84,383	8,516	8,516	10.09 %	100.00 %
	Carthage	84,383	2,775	28	0.03 %	1.01 %
	Dobbins Heights	84,383	687	687	0.81 %	100.00 %
	Ellerbe	84,383	864	864	1.02 %	100.00 %
	Foxfire	84,383	1,288	0	0.00 %	0.00 %
	Hamlet	84,383	6,025	6,025	7.14 %	100.00 %
	Hoffman	84,383	418	418	0.50 %	100.00 %
	Norman	84,383	100	100	0.12 %	100.00 %
	Pinebluff	84,383	1,473	1,473	1.75 %	100.00 %
	Pinehurst	84,383	17,581	8	0.01 %	0.05 %
	Rockingham	84,383	9,243	9,243	10.95 %	100.00 %
	Southern Pines	84,383	15,545	15,545	18.42 %	100.00 %
	Taylortown	84,383	634	4	0.00 %	0.63 %
	Whispering Pines	84,383	4,987	4,987	5.91 %	100.00 %
53	Benson (Harnett)	86,899	0	0	0.00 %	0.00 %
	Coats	86,899	2,155	2,155	2.48 %	100.00 %
	Dunn	86,899	8,446	8,446	9.72 %	100.00 %
	Erwin	86,899	4,542	4,542	5.23 %	100.00 %
	Lillington	86,899	4,735	3,853	4.43 %	81.37 %
54	Cary (Chatham)	83,475	3,709	3,709	4.44 %	100.00 %
	Goldston	83,475	234	234	0.28 %	100.00 %

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54	Liberty	83,475	2,655	2,655	3.18 %	100.00 %
	Pittsboro	83,475	4,537	4,537	5.44 %	100.00 %
	Siler City	83,475	7,702	7,702	9.23 %	100.00 %
	Staley	83,475	397	397	0.48 %	100.00 %
55	Ansonville	87,005	440	440	0.51 %	100.00 %
	Indian Trail	87,005	39,997	2,376	2.73 %	5.94 %
	Lilesville	87,005	395	395	0.45 %	100.00 %
	Marshville	87,005	2,522	2,522	2.90 %	100.00 %
	McFarlan	87,005	94	94	0.11 %	100.00 %
	Mineral Springs	87,005	3,159	2,293	2.64 %	72.59 %
	Monroe	87,005	34,562	12,650	14.54 %	36.60 %
	Morven	87,005	329	329	0.38 %	100.00 %
	Peachland	87,005	390	390	0.45 %	100.00 %
	Polkton	87,005	2,250	2,250	2.59 %	100.00 %
	Wadesboro	87,005	5,008	5,008	5.76 %	100.00 %
	Waxhaw	87,005	20,534	0	0.00 %	0.00 %
	Wesley Chapel	87,005	8,681	3,868	4.45 %	44.56 %
	Wingate	87,005	4,055	4,055	4.66 %	100.00 %
56	Carrboro	86,087	21,295	21,121	24.53 %	99.18 %
	Chapel Hill (Orange)	86,087	59,054	59,054	68.60 %	100.00 %
57	Greensboro	90,615	299,035	83,540	92.19 %	27.94 %
	Summerfield	90,615	10,951	746	0.82 %	6.81 %
58	Greensboro	90,808	299,035	84,725	93.30 %	28.33 %
59	Burlington (Guilford)	90,361	1,822	1,822	2.02 %	100.00 %
	Gibsonville (Guilford)	90,361	4,642	4,642	5.14 %	100.00 %
	Greensboro	90,361	299,035	13,852	15.33 %	4.63 %
	Pleasant Garden	90,361	5,000	5,000	5.53 %	100.00 %
	Sedalia	90,361	676	676	0.75 %	100.00 %
	Summerfield	90,361	10,951	2,509	2.78 %	22.91 %
	Whitsett	90,361	584	584	0.65 %	100.00 %
60	Archdale (Guilford)	89,735	380	380	0.42 %	100.00 %
	Greensboro	89,735	299,035	8,829	9.84 %	2.95 %
	High Point (Guilford)	89,735	107,321	66,033	73.59 %	61.53 %
	Jamestown	89,735	3,668	3,668	4.09 %	100.00 %
61	Greensboro	90,201	299,035	90,201	100.00 %	30.16 %
62	Greensboro	89,579	299,035	17,888	19.97 %	5.98 %
	High Point (Guilford)	89,579	107,321	41,288	46.09 %	38.47 %
	Kernersville (Guilford)	89,579	502	502	0.56 %	100.00 %
	Oak Ridge	89,579	7,474	7,474	8.34 %	100.00 %
	Stokesdale	89,579	5,924	5,924	6.61 %	100.00 %
	Summerfield	89,579	10,951	7,696	8.59 %	70.28 %

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63	Burlington (Alamance)	86,399	55,481	25,917	30.00 %	46.71 %
	Graham	86,399	17,157	17,157	19.86 %	100.00 %
	Green Level	86,399	3,152	3,152	3.65 %	100.00 %
	Haw River	86,399	2,252	2,252	2.61 %	100.00 %
	Mebane (Alamance)	86,399	14,626	14,626	16.93 %	100.00 %
	Swepsonville	86,399	2,445	2,445	2.83 %	100.00 %
64	Alamance	85,016	988	988	1.16 %	100.00 %
	Burlington (Alamance)	85,016	55,481	29,564	34.77 %	53.29 %
	Elon	85,016	11,336	11,336	13.33 %	100.00 %
	Gibsonville (Alamance)	85,016	4,278	4,278	5.03 %	100.00 %
	Ossipee	85,016	536	536	0.63 %	100.00 %
65	Eden	91,096	15,421	15,421	16.93 %	100.00 %
	Madison	91,096	2,129	2,129	2.34 %	100.00 %
	Mayodan	91,096	2,418	2,418	2.65 %	100.00 %
	Reidsville	91,096	14,583	14,583	16.01 %	100.00 %
	Stoneville	91,096	1,308	1,308	1.44 %	100.00 %
	Wentworth	91,096	2,662	2,662	2.92 %	100.00 %
66	Raleigh (Wake)	83,189	466,106	78,168	93.96 %	16.77 %
	Wake Forest (Wake)	83,189	46,097	0	0.00 %	0.00 %
67	Albemarle	88,255	16,432	16,432	18.62 %	100.00 %
	Badin	88,255	2,024	2,024	2.29 %	100.00 %
	Biscoe	88,255	1,848	1,848	2.09 %	100.00 %
	Candor (Montgomery)	88,255	813	813	0.92 %	100.00 %
	Locust (Stanly)	88,255	3,996	3,996	4.53 %	100.00 %
	Misenheimer	88,255	650	650	0.74 %	100.00 %
	Mount Gilead	88,255	1,171	1,171	1.33 %	100.00 %
	New London	88,255	607	607	0.69 %	100.00 %
	Norwood	88,255	2,367	2,367	2.68 %	100.00 %
	Oakboro	88,255	2,128	2,128	2.41 %	100.00 %
	Red Cross	88,255	762	762	0.86 %	100.00 %
	Richfield	88,255	582	582	0.66 %	100.00 %
	Stanfield	88,255	1,585	1,585	1.80 %	100.00 %
	Star	88,255	806	806	0.91 %	100.00 %
	Troy	88,255	2,850	2,850	3.23 %	100.00 %
68	Indian Trail	88,138	39,997	15,036	17.06 %	37.59 %
	Marvin	88,138	6,358	6,358	7.21 %	100.00 %
	Mineral Springs	88,138	3,159	866	0.98 %	27.41 %
	Stallings (Union)	88,138	15,728	0	0.00 %	0.00 %
	Waxhaw	88,138	20,534	20,534	23.30 %	100.00 %
	Weddington (Union)	88,138	13,176	13,172	14.94 %	99.97 %
	Wesley Chapel	88,138	8,681	4,813	5.46 %	55.44 %

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69	Fairview	85,179	3,456	3,456	4.06 %	100.00 %
	Hemby Bridge	85,179	1,614	1,614	1.89 %	100.00 %
	Indian Trail	85,179	39,997	22,585	26.51 %	56.47 %
	Lake Park	85,179	3,269	3,269	3.84 %	100.00 %
	Mint Hill (Union)	85,179	6	6	0.01 %	100.00 %
	Monroe	85,179	34,562	21,912	25.72 %	63.40 %
	Stallings (Union)	85,179	15,728	15,728	18.46 %	100.00 %
	Unionville	85,179	6,643	6,643	7.80 %	100.00 %
	Weddington (Union)	85,179	13,176	4	0.00 %	0.03 %
70	Archdale (Randolph)	89,118	11,527	11,527	12.93 %	100.00 %
	Asheboro	89,118	27,156	25,890	29.05 %	95.34 %
	High Point (Randolph)	89,118	8	8	0.01 %	100.00 %
	Randleman	89,118	4,595	4,595	5.16 %	100.00 %
	Thomasville (Randolph)	89,118	521	521	0.58 %	100.00 %
	Trinity	89,118	7,006	7,006	7.86 %	100.00 %
71	Kernersville (Forsyth)	84,874	25,947	0	0.00 %	0.00 %
	Walkertown	84,874	5,692	3,176	3.74 %	55.80 %
	Winston-Salem	84,874	249,545	77,631	91.47 %	31.11 %
72	Winston-Salem	86,949	249,545	86,867	99.91 %	34.81 %
73	Concord	90,649	105,240	32,447	35.79 %	30.83 %
	Harrisburg	90,649	18,967	18,967	20.92 %	100.00 %
	Locust (Cabarrus)	90,649	541	541	0.60 %	100.00 %
	Midland (Cabarrus)	90,649	4,684	4,684	5.17 %	100.00 %
	Mount Pleasant	90,649	1,671	1,671	1.84 %	100.00 %
74	Bethania	84,857	344	0	0.00 %	0.00 %
	Clemmons	84,857	21,163	21,163	24.94 %	100.00 %
	Lewisville	84,857	13,381	13,381	15.77 %	100.00 %
	Tobaccoville (Forsyth)	84,857	2,578	824	0.97 %	31.96 %
	Winston-Salem	84,857	249,545	32,409	38.19 %	12.99 %
75	High Point (Forsyth)	84,220	84	84	0.10 %	100.00 %
	Kernersville (Forsyth)	84,220	25,947	25,947	30.81 %	100.00 %
	Walkertown	84,220	5,692	2,516	2.99 %	44.20 %
	Winston-Salem	84,220	249,545	22,818	27.09 %	9.14 %
76	East Spencer	89,815	1,567	1,567	1.74 %	100.00 %
	Faith	89,815	819	819	0.91 %	100.00 %
	Granite Quarry	89,815	2,984	2,984	3.32 %	100.00 %
	Rockwell	89,815	2,302	2,302	2.56 %	100.00 %
	Salisbury	89,815	35,540	35,540	39.57 %	100.00 %
	Spencer	89,815	3,308	3,308	3.68 %	100.00 %
77	Bermuda Run	90,628	3,120	3,120	3.44 %	100.00 %
	Boonville	90,628	1,185	1,185	1.31 %	100.00 %

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77	Cleveland	90,628	846	846	0.93 %	100.00 %
	Cooleemee	90,628	940	940	1.04 %	100.00 %
	East Bend	90,628	634	634	0.70 %	100.00 %
	Jonesville	90,628	2,308	2,308	2.55 %	100.00 %
	Mocksville	90,628	5,900	5,900	6.51 %	100.00 %
	Yadkinville	90,628	2,995	2,995	3.30 %	100.00 %
78	Aberdeen	86,365	8,516	0	0.00 %	0.00 %
	Asheboro	86,365	27,156	1,266	1.47 %	4.66 %
	Candor (Moore)	86,365	0	0	0.00 %	0.00 %
	Foxfire	86,365	1,288	1,288	1.49 %	100.00 %
	Franklinville	86,365	1,197	1,197	1.39 %	100.00 %
	Pinehurst	86,365	17,581	17,573	20.35 %	99.95 %
	Ramseur	86,365	1,774	1,774	2.05 %	100.00 %
	Robbins	86,365	1,168	1,168	1.35 %	100.00 %
	Seagrove	86,365	235	235	0.27 %	100.00 %
	Southern Pines	86,365	15,545	0	0.00 %	0.00 %
	Taylortown	86,365	634	630	0.73 %	99.37 %
79	Alliance	83,163	733	733	0.88 %	100.00 %
	Arapahoe	83,163	416	416	0.50 %	100.00 %
	Aurora	83,163	455	455	0.55 %	100.00 %
	Bath	83,163	245	245	0.29 %	100.00 %
	Bayboro	83,163	1,161	1,161	1.40 %	100.00 %
	Belhaven	83,163	1,410	1,410	1.70 %	100.00 %
	Chocowinity	83,163	722	722	0.87 %	100.00 %
	Grantsboro	83,163	692	692	0.83 %	100.00 %
	Kill Devil Hills	83,163	7,656	538	0.65 %	7.03 %
	Manteo	83,163	1,600	1,600	1.92 %	100.00 %
	Mesic	83,163	144	144	0.17 %	100.00 %
	Minnesott Beach	83,163	530	530	0.64 %	100.00 %
	Nags Head	83,163	3,168	3,168	3.81 %	100.00 %
	Oriental	83,163	880	880	1.06 %	100.00 %
	Pantego	83,163	164	164	0.20 %	100.00 %
	Stonewall	83,163	214	214	0.26 %	100.00 %
	Vandemere	83,163	246	246	0.30 %	100.00 %
	Washington	83,163	9,875	9,875	11.87 %	100.00 %
	Washington Park	83,163	392	392	0.47 %	100.00 %
80	Denton	84,864	1,494	1,494	1.76 %	100.00 %
	High Point (Davidson)	84,864	6,646	6,646	7.83 %	100.00 %
	Lexington	84,864	19,632	0	0.00 %	0.00 %
	Midway	84,864	4,742	3,469	4.09 %	73.15 %
	Thomasville (Davidson)	84,864	26,662	26,662	31.42 %	100.00 %

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80	Wallburg	84,864	3,051	3,051	3.60 %	100.00 %
81	Lexington	84,066	19,632	19,632	23.35 %	100.00 %
	Midway	84,066	4,742	1,273	1.51 %	26.85 %
82	Concord	90,771	105,240	48,723	53.68 %	46.30 %
	Kannapolis (Cabarrus)	90,771	42,846	33,907	37.35 %	79.14 %
83	China Grove	90,742	4,434	4,434	4.89 %	100.00 %
	Concord	90,742	105,240	24,070	26.53 %	22.87 %
	Kannapolis (Cabarrus)	90,742	42,846	8,939	9.85 %	20.86 %
	Kannapolis (Rowan)	90,742	10,268	10,268	11.32 %	100.00 %
	Landis	90,742	3,690	3,690	4.07 %	100.00 %
84	Harmony	86,773	543	543	0.63 %	100.00 %
	Love Valley	86,773	154	154	0.18 %	100.00 %
	Mooresville	86,773	50,193	205	0.24 %	0.41 %
	Statesville	86,773	28,419	28,415	32.75 %	99.99 %
	Troutman	86,773	3,698	885	1.02 %	23.93 %
85	Bakersville	90,863	450	450	0.50 %	100.00 %
	Banner Elk	90,863	1,049	1,049	1.15 %	100.00 %
	Beech Mountain (Avery)	90,863	62	62	0.07 %	100.00 %
	Burnsville	90,863	1,614	1,614	1.78 %	100.00 %
	Crossnore	90,863	143	143	0.16 %	100.00 %
	Elk Park	90,863	542	542	0.60 %	100.00 %
	Grandfather Village	90,863	95	95	0.10 %	100.00 %
	Marion	90,863	7,717	7,717	8.49 %	100.00 %
	Newland	90,863	715	715	0.79 %	100.00 %
	Old Fort	90,863	811	811	0.89 %	100.00 %
	Seven Devils (Avery)	90,863	38	38	0.04 %	100.00 %
	Spruce Pine	90,863	2,194	2,194	2.41 %	100.00 %
	Sugar Mountain	90,863	371	371	0.41 %	100.00 %
86	Connelly Springs	87,570	1,529	1,529	1.75 %	100.00 %
	Drexel	87,570	1,760	1,760	2.01 %	100.00 %
	Glen Alpine	87,570	1,529	1,529	1.75 %	100.00 %
	Hickory (Burke)	87,570	79	79	0.09 %	100.00 %
	Hildebran	87,570	1,679	1,679	1.92 %	100.00 %
	Long View (Burke)	87,570	735	735	0.84 %	100.00 %
	Morganton	87,570	17,474	17,474	19.95 %	100.00 %
	Rhodhiss (Burke)	87,570	639	639	0.73 %	100.00 %
	Rutherford College (Burke)	87,570	1,226	1,226	1.40 %	100.00 %
	Valdese	87,570	4,689	4,689	5.35 %	100.00 %
87	Blowing Rock (Caldwell)	85,758	91	91	0.11 %	100.00 %
	Blowing Rock (Watauga)	85,758	1,285	5	0.01 %	0.39 %
	Boone	85,758	19,092	595	0.69 %	3.12 %

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87	Cajah's Mountain	85,758	2,722	2,722	3.17 %	100.00 %
	Cedar Rock	85,758	301	301	0.35 %	100.00 %
	Gamewell	85,758	3,702	3,702	4.32 %	100.00 %
	Granite Falls	85,758	4,965	4,965	5.79 %	100.00 %
	Hickory (Caldwell)	85,758	32	32	0.04 %	100.00 %
	Hudson	85,758	3,780	3,780	4.41 %	100.00 %
	Lenoir	85,758	18,352	18,352	21.40 %	100.00 %
	Rhodhiss (Caldwell)	85,758	358	358	0.42 %	100.00 %
	Rutherford College (Caldwell)	85,758	0	0	0.00 %	0.00 %
	Sawmills	85,758	5,020	5,020	5.85 %	100.00 %
88	Charlotte	82,834	874,579	82,834	100.00 %	9.47 %
89	Catawba	85,577	702	702	0.82 %	100.00 %
	Claremont	85,577	1,692	1,692	1.98 %	100.00 %
	Conover	85,577	8,421	424	0.50 %	5.04 %
	Hickory (Catawba)	85,577	43,379	0	0.00 %	0.00 %
	Maiden (Catawba)	85,577	3,736	3,736	4.37 %	100.00 %
	Newton	85,577	13,148	13,148	15.36 %	100.00 %
	Statesville	85,577	28,419	4	0.00 %	0.01 %
	Troutman	85,577	3,698	2,813	3.29 %	76.07 %
90	Dobson	82,937	1,462	1,462	1.76 %	100.00 %
	Elkin (Surry)	82,937	4,049	4,049	4.88 %	100.00 %
	Elkin (Wilkes)	82,937	73	73	0.09 %	100.00 %
	Mount Airy	82,937	10,676	10,676	12.87 %	100.00 %
	Pilot Mountain	82,937	1,440	1,440	1.74 %	100.00 %
	Ronda	82,937	438	438	0.53 %	100.00 %
91	Bethania	86,210	344	344	0.40 %	100.00 %
	Danbury	86,210	189	189	0.22 %	100.00 %
	King (Forsyth)	86,210	591	591	0.69 %	100.00 %
	King (Stokes)	86,210	6,606	6,606	7.66 %	100.00 %
	Rural Hall	86,210	3,351	3,351	3.89 %	100.00 %
	Tobaccoville (Forsyth)	86,210	2,578	1,754	2.03 %	68.04 %
	Tobaccoville (Stokes)	86,210	0	0	0.00 %	0.00 %
	Walnut Cove	86,210	1,586	1,586	1.84 %	100.00 %
	Winston-Salem	86,210	249,545	29,820	34.59 %	11.95 %
92	Charlotte	85,031	874,579	63,762	74.99 %	7.29 %
93	Beech Mountain (Watauga)	86,445	613	613	0.71 %	100.00 %
	Blowing Rock (Watauga)	86,445	1,285	1,280	1.48 %	99.61 %
	Boone	86,445	19,092	18,497	21.40 %	96.88 %
	Jefferson	86,445	1,622	1,622	1.88 %	100.00 %
	Lansing	86,445	126	126	0.15 %	100.00 %
	Seven Devils (Watauga)	86,445	275	275	0.32 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
93	Sparta	86,445	1,834	1,834	2.12 %	100.00 %
	West Jefferson	86,445	1,279	1,279	1.48 %	100.00 %
94	North Wilkesboro	90,835	4,382	4,382	4.82 %	100.00 %
	Taylorsville	90,835	2,320	2,320	2.55 %	100.00 %
	Wilkesboro	90,835	3,687	3,687	4.06 %	100.00 %
95	Davidson (Iredell)	85,366	378	378	0.44 %	100.00 %
	Mooresville	85,366	50,193	49,988	58.56 %	99.59 %
96	Brookford	89,587	442	442	0.49 %	100.00 %
	Conover	89,587	8,421	7,997	8.93 %	94.96 %
	Hickory (Catawba)	89,587	43,379	43,379	48.42 %	100.00 %
	Long View (Catawba)	89,587	4,353	4,353	4.86 %	100.00 %
	Newton	89,587	13,148	0	0.00 %	0.00 %
97	Lincolnton	86,810	11,091	11,091	12.78 %	100.00 %
	Maiden (Lincoln)	86,810	0	0	0.00 %	0.00 %
98	Cornelius	86,827	31,412	31,412	36.18 %	100.00 %
	Davidson (Mecklenburg)	86,827	14,728	14,728	16.96 %	100.00 %
	Huntersville	86,827	61,376	38,677	44.54 %	63.02 %
99	Charlotte	87,647	874,579	79,113	90.26 %	9.05 %
	Mint Hill (Mecklenburg)	87,647	26,444	0	0.00 %	0.00 %
100	Charlotte	87,197	874,579	87,197	100.00 %	9.97 %
101	Charlotte	86,426	874,579	64,526	74.66 %	7.38 %
	Huntersville	86,426	61,376	5,893	6.82 %	9.60 %
102	Charlotte	86,179	874,579	86,179	100.00 %	9.85 %
103	Charlotte	87,132	874,579	23,590	27.07 %	2.70 %
	Matthews	87,132	29,435	29,435	33.78 %	100.00 %
	Midland (Mecklenburg)	87,132	0	0	0.00 %	0.00 %
	Mint Hill (Mecklenburg)	87,132	26,444	26,444	30.35 %	100.00 %
	Stallings (Mecklenburg)	87,132	384	384	0.44 %	100.00 %
	Weddington (Mecklenburg)	87,132	5	5	0.01 %	100.00 %
104	Charlotte	86,520	874,579	86,520	100.00 %	9.89 %
105	Charlotte	85,822	874,579	71,156	82.91 %	8.14 %
	Pineville	85,822	10,602	10,602	12.35 %	100.00 %
106	Charlotte	82,824	874,579	79,717	96.25 %	9.11 %
107	Charlotte	88,237	874,579	67,298	76.27 %	7.69 %
	Huntersville	88,237	61,376	16,806	19.05 %	27.38 %
108	Belmont	86,263	15,010	1,868	2.17 %	12.45 %
	Cramerton	86,263	5,296	96	0.11 %	1.81 %
	Gastonia	86,263	80,411	28,480	33.02 %	35.42 %
	Lowell	86,263	3,654	3,654	4.24 %	100.00 %
	McAdenville	86,263	890	890	1.03 %	100.00 %
	Mount Holly	86,263	17,703	17,703	20.52 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
108	Ranlo	86,263	4,511	4,500	5.22 %	99.76 %
	Spencer Mountain	86,263	0	0	0.00 %	0.00 %
	Stanley	86,263	3,963	3,963	4.59 %	100.00 %
109	Belmont	87,762	15,010	13,142	14.97 %	87.55 %
	Cramerton	87,762	5,296	5,200	5.93 %	98.19 %
	Gastonia	87,762	80,411	44,448	50.65 %	55.28 %
	Lowell	87,762	3,654	0	0.00 %	0.00 %
110	Belwood	88,397	857	857	0.97 %	100.00 %
	Bessemer City	88,397	5,428	5,428	6.14 %	100.00 %
	Casar	88,397	305	305	0.35 %	100.00 %
	Cherryville	88,397	6,078	6,078	6.88 %	100.00 %
	Dallas	88,397	5,927	5,927	6.70 %	100.00 %
	Dellview	88,397	6	6	0.01 %	100.00 %
	Fallston	88,397	627	627	0.71 %	100.00 %
	Gastonia	88,397	80,411	7,483	8.47 %	9.31 %
	High Shoals	88,397	595	595	0.67 %	100.00 %
	Kings Mountain (Cleveland)	88,397	10,032	8	0.01 %	0.08 %
	Kings Mountain (Gaston)	88,397	1,110	1,110	1.26 %	100.00 %
	Kingstown	88,397	656	656	0.74 %	100.00 %
	Lawndale	88,397	570	570	0.64 %	100.00 %
	Polkville	88,397	516	516	0.58 %	100.00 %
	Ranlo	88,397	4,511	11	0.01 %	0.24 %
	Shelby	88,397	21,918	4,409	4.99 %	20.12 %
	Waco	88,397	310	310	0.35 %	100.00 %
111	Boiling Springs	89,894	4,615	4,615	5.13 %	100.00 %
	Bostic	89,894	355	355	0.39 %	100.00 %
	Earl	89,894	198	198	0.22 %	100.00 %
	Ellenboro	89,894	723	723	0.80 %	100.00 %
	Forest City	89,894	7,377	0	0.00 %	0.00 %
	Grover	89,894	802	802	0.89 %	100.00 %
	Kings Mountain (Cleveland)	89,894	10,032	10,024	11.15 %	99.92 %
	Lattimore	89,894	406	406	0.45 %	100.00 %
	Mooresboro	89,894	293	293	0.33 %	100.00 %
	Patterson Springs	89,894	571	571	0.64 %	100.00 %
	Shelby	89,894	21,918	17,509	19.48 %	79.88 %
112	Charlotte	82,806	874,579	82,687	99.86 %	9.45 %
	Pineville	82,806	10,602	0	0.00 %	0.00 %
113	Chimney Rock Village	89,058	140	140	0.16 %	100.00 %
	Columbus	89,058	1,060	1,060	1.19 %	100.00 %
	Flat Rock	89,058	3,486	3,486	3.91 %	100.00 %
	Forest City	89,058	7,377	7,377	8.28 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
113	Hendersonville	89,058	15,137	623	0.70 %	4.12 %
	Lake Lure	89,058	1,365	1,365	1.53 %	100.00 %
	Laurel Park	89,058	2,250	0	0.00 %	0.00 %
	Ruth	89,058	347	347	0.39 %	100.00 %
	Rutherfordton	89,058	3,640	3,640	4.09 %	100.00 %
	Saluda (Henderson)	89,058	11	11	0.01 %	100.00 %
	Saluda (Polk)	89,058	620	620	0.70 %	100.00 %
	Spindale	89,058	4,225	4,225	4.74 %	100.00 %
	Tryon	89,058	1,562	1,562	1.75 %	100.00 %
114	Asheville	89,685	94,589	52,596	58.65 %	55.60 %
	Weaverville	89,685	4,567	4,567	5.09 %	100.00 %
	Woodfin	89,685	7,936	7,648	8.53 %	96.37 %
115	Asheville	90,262	94,589	29,236	32.39 %	30.91 %
	Black Mountain	90,262	8,426	8,426	9.34 %	100.00 %
	Montreat	90,262	901	901	1.00 %	100.00 %
116	Asheville	89,505	94,589	12,757	14.25 %	13.49 %
	Biltmore Forest	89,505	1,409	1,409	1.57 %	100.00 %
	Woodfin	89,505	7,936	288	0.32 %	3.63 %
117	Fletcher	91,035	7,987	7,987	8.77 %	100.00 %
	Hendersonville	91,035	15,137	14,514	15.94 %	95.88 %
	Laurel Park	91,035	2,250	2,250	2.47 %	100.00 %
	Mills River	91,035	7,078	7,078	7.78 %	100.00 %
118	Canton	83,282	4,422	4,422	5.31 %	100.00 %
	Clyde	83,282	1,368	1,368	1.64 %	100.00 %
	Hot Springs	83,282	520	520	0.62 %	100.00 %
	Maggie Valley	83,282	1,687	1,687	2.03 %	100.00 %
	Mars Hill	83,282	2,007	2,007	2.41 %	100.00 %
	Marshall	83,282	777	777	0.93 %	100.00 %
	Waynesville	83,282	10,140	10,140	12.18 %	100.00 %
119	Brevard	90,212	7,744	7,744	8.58 %	100.00 %
	Bryson City	90,212	1,558	1,558	1.73 %	100.00 %
	Dillsboro	90,212	213	213	0.24 %	100.00 %
	Forest Hills	90,212	303	303	0.34 %	100.00 %
	Highlands (Jackson)	90,212	12	12	0.01 %	100.00 %
	Rosman	90,212	701	701	0.78 %	100.00 %
	Sylva	90,212	2,578	2,578	2.86 %	100.00 %
	Webster	90,212	372	372	0.41 %	100.00 %
120	Andrews	84,907	1,667	1,667	1.96 %	100.00 %
	Fontana Dam	84,907	13	13	0.02 %	100.00 %
	Franklin	84,907	4,175	4,175	4.92 %	100.00 %
	Hayesville	84,907	461	461	0.54 %	100.00 %

District - Municipality by County Report

District Plan: SL 2021-175 House

District	Municipality	Total District Population	Total Muni Population	District Pop in Muni	Percent of District Pop in Muni	Percent of Muni Pop in District
120	Highlands (Macon)	84,907	1,060	1,060	1.25 %	100.00 %
	Lake Santeetlah	84,907	38	38	0.04 %	100.00 %
	Murphy	84,907	1,608	1,608	1.89 %	100.00 %
	Robbinsville	84,907	597	597	0.70 %	100.00 %
			Total:	**6,017,605**		

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
1	Chowan	6	0
	Currituck	11	0
	Dare	3	1
	Perquimans	7	0
	Tyrrell	6	0
	Washington	6	0
2	Durham	8	2
	Person	11	0
3	Craven	19	1
4	Duplin	19	0
	Wayne	7	1
5	Camden	3	0
	Gates	6	0
	Hertford	13	0
	Pasquotank	9	0
6	Harnett	6	0
7	Franklin	18	0
	Granville	2	0
8	Pitt	21	0
9	Pitt	19	0
10	Wayne	20	1
11	Wake	19	0
12	Greene	10	0
	Jones	7	0
	Lenoir	22	0
13	Carteret	28	0
	Craven	1	1
14	Onslow	10	0
15	Onslow	9	0
16	Onslow	5	0
	Pender	20	0
17	Brunswick	14	0
18	New Hanover	19	0
19	Brunswick	11	0
	New Hanover	7	0
20	New Hanover	17	0
21	Wake	16	0
22	Bladen	17	0
	Sampson	23	0
23	Bertie	12	0
	Edgecombe	21	0
	Martin	13	0

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
24	Nash	2	0
	Wilson	24	0
25	Nash	22	0
26	Johnston	12	0
27	Halifax	23	0
	Northampton	13	0
	Warren	14	0
28	Johnston	18	0
29	Durham	21	1
30	Durham	17	1
31	Durham	8	2
32	Granville	13	0
	Vance	12	0
33	Wake	19	0
34	Wake	24	0
35	Wake	14	0
36	Wake	12	0
37	Wake	12	0
38	Wake	13	0
39	Wake	14	0
40	Wake	20	0
41	Wake	11	0
42	Cumberland	13	0
43	Cumberland	28	0
44	Cumberland	19	0
45	Cumberland	16	0
46	Columbus	26	0
	Robeson	14	0
47	Robeson	25	0
48	Hoke	15	0
	Scotland	7	0
49	Wake	15	0
50	Caswell	9	0
	Orange	18	0
51	Lee	10	0
	Moore	4	0
52	Moore	10	0
	Richmond	16	0
53	Harnett	7	0
	Johnston	6	0
54	Chatham	18	0
	Randolph	2	0

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
55	Anson	9	0
	Union	17	0
56	Orange	23	0
57	Guilford	27	0
58	Guilford	24	0
59	Guilford	24	0
60	Guilford	27	0
61	Guilford	34	0
62	Guilford	29	0
63	Alamance	19	0
64	Alamance	18	0
65	Rockingham	15	0
66	Wake	15	0
67	Montgomery	14	0
	Stanly	22	0
68	Union	16	0
69	Union	19	0
70	Randolph	12	0
71	Forsyth	20	0
72	Forsyth	32	0
73	Cabarrus	15	0
74	Forsyth	19	0
75	Forsyth	19	0
76	Rowan	25	0
77	Davie	14	0
	Rowan	5	0
	Yadkin	12	0
78	Moore	12	0
	Randolph	8	0
79	Beaufort	21	0
	Dare	12	1
	Hyde	7	0
	Pamlico	10	0
80	Davidson	22	0
81	Davidson	21	0
82	Cabarrus	20	0
83	Cabarrus	5	0
	Rowan	11	0
84	Iredell	19	0
85	Avery	19	0
	McDowell	15	0
	Mitchell	9	0
	Yancey	11	0

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
86	Burke	33	0
87	Caldwell	20	0
	Watauga	2	0
88	Mecklenburg	18	0
89	Catawba	17	0
	Iredell	2	0
90	Surry	24	0
	Wilkes	6	0
91	Forsyth	11	0
	Stokes	18	0
92	Mecklenburg	9	0
93	Alleghany	4	0
	Ashe	17	0
	Watauga	18	0
94	Alexander	10	0
	Wilkes	21	0
95	Iredell	8	0
96	Catawba	23	0
97	Lincoln	23	0
98	Mecklenburg	10	1
99	Mecklenburg	15	0
100	Mecklenburg	21	0
101	Mecklenburg	10	0
102	Mecklenburg	19	0
103	Mecklenburg	16	0
104	Mecklenburg	26	0
105	Mecklenburg	12	0
106	Mecklenburg	10	0
107	Mecklenburg	11	1
108	Gaston	20	0
109	Gaston	14	0
110	Cleveland	10	0
	Gaston	12	0
111	Cleveland	11	0
	Rutherford	6	0
112	Mecklenburg	17	0
113	Henderson	8	0
	McDowell	2	0
	Polk	7	0
	Rutherford	11	0
114	Buncombe	29	0
115	Buncombe	32	0
116	Buncombe	18	0

Whole-Split VTD Counts by District Report

District Plan: SL 2021-175 House

District	County	Whole VTDs	Split VTDs
117	Henderson	26	0
118	Haywood	29	0
	Madison	12	0
119	Jackson	13	0
	Swain	5	0
	Transylvania	15	0
120	Cherokee	16	0
	Clay	9	0
	Graham	4	0
	Macon	15	0
	Total:	**2,659**	**7**

Whole-Split VTD Counts by County Report

District Plan: SL 2021-175 House

County	Whole VTDs	Split VTDs
Alamance	37	0
Alexander	10	0
Alleghany	4	0
Anson	9	0
Ashe	17	0
Avery	19	0
Beaufort	21	0
Bertie	12	0
Bladen	17	0
Brunswick	25	0
Buncombe	79	0
Burke	33	0
Cabarrus	40	0
Caldwell	20	0
Camden	3	0
Carteret	28	0
Caswell	9	0
Catawba	40	0
Chatham	18	0
Cherokee	16	0
Chowan	6	0
Clay	9	0
Cleveland	21	0
Columbus	26	0
Craven	20	1
Cumberland	76	0
Currituck	11	0
Dare	15	1
Davidson	43	0
Davie	14	0
Duplin	19	0
Durham	54	3
Edgecombe	21	0
Forsyth	101	0
Franklin	18	0
Gaston	46	0
Gates	6	0
Graham	4	0
Granville	15	0
Greene	10	0
Guilford	165	0
Halifax	23	0
Harnett	13	0

Whole-Split VTD Counts by County Report

District Plan: SL 2021-175 House

County	Whole VTDs	Split VTDs
Haywood	29	0
Henderson	34	0
Hertford	13	0
Hoke	15	0
Hyde	7	0
Iredell	29	0
Jackson	13	0
Johnston	36	0
Jones	7	0
Lee	10	0
Lenoir	22	0
Lincoln	23	0
Macon	15	0
Madison	12	0
Martin	13	0
McDowell	17	0
Mecklenburg	194	1
Mitchell	9	0
Montgomery	14	0
Moore	26	0
Nash	24	0
New Hanover	43	0
Northampton	13	0
Onslow	24	0
Orange	41	0
Pamlico	10	0
Pasquotank	9	0
Pender	20	0
Perquimans	7	0
Person	11	0
Pitt	40	0
Polk	7	0
Randolph	22	0
Richmond	16	0
Robeson	39	0
Rockingham	15	0
Rowan	41	0
Rutherford	17	0
Sampson	23	0
Scotland	7	0
Stanly	22	0
Stokes	18	0
Surry	24	0

Whole-Split VTD Counts by County Report

District Plan: SL 2021-175 House

County	Whole VTDs	Split VTDs
Swain	5	0
Transylvania	15	0
Tyrrell	6	0
Union	52	0
Vance	12	0
Wake	204	0
Warren	14	0
Washington	6	0
Watauga	20	0
Wayne	27	1
Wilkes	27	0
Wilson	24	0
Yadkin	12	0
Yancey	11	0
Totals:	**2,659**	**7**

Split VTD Detail Report

District Plan: SL 2021-175 House

County	VTD	District	Total VTD Population	VTD Pop in District	Percent of VTD Pop in District
Craven	002	3	18,203	6,483	35.62 %
		13	18,203	11,720	64.38 %
Dare	KDH	1	7,656	7,118	92.97 %
		79	7,656	538	7.03 %
Durham	014	29	4,535	4,232	93.32 %
		31	4,535	303	6.68 %
	023	2	10,357	1,533	14.80 %
		30	10,357	8,824	85.20 %
	30-2	2	10,654	958	8.99 %
		31	10,654	9,696	91.01 %
Mecklenburg	134	98	11,104	4,537	40.86 %
		107	11,104	6,567	59.14 %
Wayne	016	4	3,810	992	26.04 %
		10	3,810	2,818	73.96 %
			Total:	**66,319**	

Number of split VTDs: 7

Incumbent-District Report

District Plan: SL 2021-175 House

Residence Set: NC House - 10/01/2021

Last Name	First Name	Party	Current District	District in this Plan
Adams	James	Republican	96	96
Adcock	Gale	Democratic	41	41
Ager	John	Democratic	115	115
Alexander	Kelly	Democratic	107	107
Alston	Vernetta	Democratic	29	29
Arp	Larry	Republican	69	69
Autry	Johnnie	Democratic	100	100
Baker	Amber	Democratic	72	72
Baker	Kristin	Republican	82	82
Ball	Cynthia	Democratic	49	49
Belk	Mary	Democratic	88	88
Bell	John	Republican	10	10
Blackwell	Hugh	Republican	86	86
Boles	James	Republican	52	52
Bradford	John	Republican	98	98
Brisson	William	Republican	22	22
Brockman	Cecil	Democratic	60	60
Brody	Mark	Republican	55	55
Brown	Terry	Democratic	92	92
Bumgardner	Dana	Republican	109	109
Butler	Deborah	Democratic	18	18
Carney	Becky	Democratic	102	102
Clampitt	James	Republican	119	119
Clemmons	Ashton	Democratic	57	57
Cleveland	George	Republican	14	14
Cooper-Suggs	Linda	Democratic	24	24
Cunningham	Carla	Democratic	106	106
Dahle	Allison	Democratic	11	11
Davis	Robert	Republican	20	20
Dixon	James	Republican	4	4
Elmore	Jeffrey	Republican	94	94
Everitt	Terence	Democratic	35	35
Faircloth	Joseph	Republican	62	62
Farkas	Brian	Democratic	9	9
Fisher	Susan	Democratic	114	114
Gailliard	James	Democratic	25	25
Garrison	Terry	Democratic	32	32
Gill	Rosa	Democratic	33	33
Gillespie	Karl	Republican	120	120
Goodwin	Edward	Republican	1	1
Graham	Charles	Democratic	47	47
Greene	Edwin	Republican	85	85

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Row shading indicates that the district in this plan is shared by more than one incumbent.
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Incumbent-District Report

District Plan: SL 2021-175 House

Residence Set: NC House - 10/01/2021

Last Name	First Name	Party	Current District	District in this Plan
Hall	Destin	Republican	87	87
Hall	Kyle	Republican	91	91
Hanig	Robert	Republican	6	1
Hardister	Jonathan	Republican	59	59
Harris	Wesley	Democratic	105	105
Harrison	Mary	Democratic	61	61
Hastings	Kelly	Republican	110	110
Hawkins	Zack	Democratic	31	31
Howard	Julia	Republican	77	77
Humphrey	Thomas	Republican	12	12
Hunt	Rachel	Democratic	103	103
Hunter	Howard	Democratic	5	5
Hurley	Patricia	Republican	70	70
Hurtado	Ricardo	Democratic	63	63
Iler	Francis	Republican	17	17
Insko	Verla	Democratic	56	56
John	Joseph	Democratic	40	40
Johnson	Jake	Republican	113	113
Jones	Abraham	Democratic	38	38
Jones	Brenden	Republican	46	46
Kidwell	Keith	Republican	79	79
Lambeth	Donny	Republican	75	75
Lofton	Brandon	Democratic	104	104
Logan	Carolyn	Democratic	101	101
Lucas	Marvin	Democratic	42	42
Majeed	Nasif	Democratic	99	99
Martin	David	Democratic	34	34
McElraft	Patricia	Republican	13	13
McNeely	Jeffrey	Republican	84	84
McNeill	Allen	Republican	78	78
Meyer	Graig	Democratic	50	50
Miller	Charles	Republican	19	19
Mills	Paul	Republican	95	95
Moffitt	Timothy	Republican	117	117
Moore	Timothy	Republican	111	111
Morey	Marcia	Democratic	30	30
Moss	Ben	Republican	66	52
Paré	Erin	Republican	37	37
Penny	Howard	Republican	53	53
Pickett	Phillip	Republican	93	93
Pierce	Garland	Democratic	48	48
Pittman	Larry	Republican	83	82

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Row shading indicates that the district in this plan is shared by more than one incumbent.
[G20-IncDist] - Generated 11/4/2021

Incumbent-District Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

Last Name	First Name	Party	Current District	District in this Plan
Pless	Steven	Republican	118	118
Potts	Larry	Republican	81	81
Pyrtle	Armor	Republican	65	65
Quick	Amos	Democratic	58	58
Reives	Robert	Democratic	54	54
Richardson	William	Democratic	44	44
Riddell	Dennis	Republican	64	64
Roberson	James	Democratic	39	39
Rogers	David	Republican	112	113
Saine	Jason	Republican	97	97
Sasser	Clayton	Republican	67	67
Sauls	John	Republican	51	51
Setzer	Mitchell	Republican	89	89
Shepard	Phillip	Republican	15	15
Smith	Carson	Republican	16	16
Smith	Kandie	Democratic	8	8
Smith	Raymond	Democratic	21	10
Stevens	Sarah	Republican	90	90
Strickland	Larry	Republican	28	28
Szoka	John	Republican	45	45
Terry	Evelyn	Democratic	71	71
Torbett	John	Republican	108	108
Turner	Brian	Democratic	116	116
Tyson	John	Republican	3	3
von Haefen	Julie	Democratic	36	36
Warren	Harry	Republican	76	76
Watford	Samuel	Republican	80	80
Wheatley	Diane	Republican	43	43
White	Donna	Republican	26	26
Willingham	Shelly	Democratic	23	23
Willis	David	Republican	68	68
Winslow	Matthew	Republican	7	7
Wray	Michael	Democratic	27	27
Yarborough	Lawrence	Republican	2	2
Zachary	Walter	Republican	73	77
Zenger	Jeffrey	Republican	74	74

District plan definition file: 'SL 2021-175 House.csv', modified 11/4/2021 3:01 PM
Row shading indicates that the district in this plan is shared by more than one incumbent.
[G20-IncDist] - Generated 11/4/2021

District-Incumbent Report

District Plan: SL 2021-175 House

Residence Set: NC House - 10/01/2021

District in this Plan	Last Name	First Name	Party	Current District
1	Goodwin	Edward	Republican	1
	Hanig	Robert	Republican	6
2	Yarborough	Lawrence	Republican	2
3	Tyson	John	Republican	3
4	Dixon	James	Republican	4
5	Hunter	Howard	Democratic	5
6				
7	Winslow	Matthew	Republican	7
8	Smith	Kandie	Democratic	8
9	Farkas	Brian	Democratic	9
10	Bell	John	Republican	10
	Smith	Raymond	Democratic	21
11	Dahle	Allison	Democratic	11
12	Humphrey	Thomas	Republican	12
13	McElraft	Patricia	Republican	13
14	Cleveland	George	Republican	14
15	Shepard	Phillip	Republican	15
16	Smith	Carson	Republican	16
17	Iler	Francis	Republican	17
18	Butler	Deborah	Democratic	18
19	Miller	Charles	Republican	19
20	Davis	Robert	Republican	20
21				
22	Brisson	William	Republican	22
23	Willingham	Shelly	Democratic	23
24	Cooper-Suggs	Linda	Democratic	24
25	Gailliard	James	Democratic	25
26	White	Donna	Republican	26
27	Wray	Michael	Democratic	27
28	Strickland	Larry	Republican	28
29	Alston	Vernetta	Democratic	29
30	Morey	Marcia	Democratic	30
31	Hawkins	Zack	Democratic	31
32	Garrison	Terry	Democratic	32
33	Gill	Rosa	Democratic	33
34	Martin	David	Democratic	34
35	Everitt	Terence	Democratic	35
36	von Haefen	Julie	Democratic	36
37	Paré	Erin	Republican	37
38	Jones	Abraham	Democratic	38
39	Roberson	James	Democratic	39
40	John	Joseph	Democratic	40
41	Adcock	Gale	Democratic	41

District-Incumbent Report

District Plan: SL 2021-175 House
Residence Set: NC House - 10/01/2021

District in this Plan	Last Name	First Name	Party	Current District
42	Lucas	Marvin	Democratic	42
43	Wheatley	Diane	Republican	43
44	Richardson	William	Democratic	44
45	Szoka	John	Republican	45
46	Jones	Brenden	Republican	46
47	Graham	Charles	Democratic	47
48	Pierce	Garland	Democratic	48
49	Ball	Cynthia	Democratic	49
50	Meyer	Graig	Democratic	50
51	Sauls	John	Republican	51
52	Boles	James	Republican	52
	Moss	Ben	Republican	66
53	Penny	Howard	Republican	53
54	Reives	Robert	Democratic	54
55	Brody	Mark	Republican	55
56	Insko	Verla	Democratic	56
57	Clemmons	Ashton	Democratic	57
58	Quick	Amos	Democratic	58
59	Hardister	Jonathan	Republican	59
60	Brockman	Cecil	Democratic	60
61	Harrison	Mary	Democratic	61
62	Faircloth	Joseph	Republican	62
63	Hurtado	Ricardo	Democratic	63
64	Riddell	Dennis	Republican	64
65	Pyrtle	Armor	Republican	65
66				
67	Sasser	Clayton	Republican	67
68	Willis	David	Republican	68
69	Arp	Larry	Republican	69
70	Hurley	Patricia	Republican	70
71	Terry	Evelyn	Democratic	71
72	Baker	Amber	Democratic	72
73				
74	Zenger	Jeffrey	Republican	74
75	Lambeth	Donny	Republican	75
76	Warren	Harry	Republican	76
77	Howard	Julia	Republican	77
	Zachary	Walter	Republican	73
78	McNeill	Allen	Republican	78
79	Kidwell	Keith	Republican	79
80	Watford	Samuel	Republican	80
81	Potts	Larry	Republican	81

District-Incumbent Report

District Plan: SL 2021-175 House

Residence Set: NC House - 10/01/2021

District in this Plan	Last Name	First Name	Party	Current District
82	Baker	Kristin	Republican	82
	Pittman	Larry	Republican	83
83				
84	McNeely	Jeffrey	Republican	84
85	Greene	Edwin	Republican	85
86	Blackwell	Hugh	Republican	86
87	Hall	Destin	Republican	87
88	Belk	Mary	Democratic	88
89	Setzer	Mitchell	Republican	89
90	Stevens	Sarah	Republican	90
91	Hall	Kyle	Republican	91
92	Brown	Terry	Democratic	92
93	Pickett	Phillip	Republican	93
94	Elmore	Jeffrey	Republican	94
95	Mills	Paul	Republican	95
96	Adams	James	Republican	96
97	Saine	Jason	Republican	97
98	Bradford	John	Republican	98
99	Majeed	Nasif	Democratic	99
100	Autry	Johnnie	Democratic	100
101	Logan	Carolyn	Democratic	101
102	Carney	Becky	Democratic	102
103	Hunt	Rachel	Democratic	103
104	Lofton	Brandon	Democratic	104
105	Harris	Wesley	Democratic	105
106	Cunningham	Carla	Democratic	106
107	Alexander	Kelly	Democratic	107
108	Torbett	John	Republican	108
109	Bumgardner	Dana	Republican	109
110	Hastings	Kelly	Republican	110
111	Moore	Timothy	Republican	111
112				
113	Johnson	Jake	Republican	113
	Rogers	David	Republican	112
114	Fisher	Susan	Democratic	114
115	Ager	John	Democratic	115
116	Turner	Brian	Democratic	116
117	Moffitt	Timothy	Republican	117
118	Pless	Steven	Republican	118
119	Clampitt	James	Republican	119
120	Gillespie	Karl	Republican	120

Addendum to Primary Expert Report of Jonathan C. Mattingly, Ph.D.

I am a Professor of Mathematics and Statistical Science at Duke University. My degrees are from the North Carolina School of Science and Math (High School Diploma), Yale University (B.S.), and Princeton University (Ph.D.). I grew up in Charlotte, North Carolina and currently live in Durham, North Carolina.

I lead a group at Duke University which conducts non-partisan research to understand and quantify gerrymandering. This report grows out of aspects of our group's work around the current North Carolina legislative districts which are relevant to the case being filed.

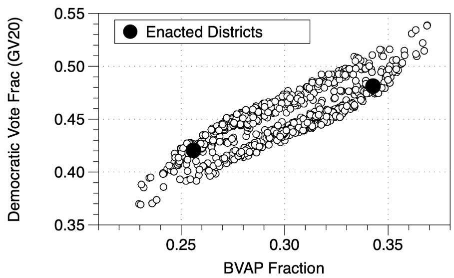
I previously submitted an expert report in Common Cause v. Rucho, No. 18-CV-1026 (M.D.N.C.), Diamond v. Torres, No. 17-CV-5054 (E.D. Pa.), Common Cause v. Lewis (N.C. Sup. Ct No. 18-cvs-014001), and Harper v. Lewis (No. 19-cv-012667) and was an expert witness for the plaintiffs in Common Cause v. Rucho and Common Cause v. Lewis. I am being paid at a rate of $400/per hour for the work on this case. This note is a companion to the main expert report. It has been requested by a subset of plaintiffs' counsel.

Addendum Analysis

We examine the correlation between the fraction of the black voting age population and the partisan make up of (i) the North Eastern cluster choices in the North Carolina State Senate, and (ii) the districts within the Duplin-Wayne county cluster in the North Carolina State House.

North Eastern Cluster Options

	Enacted Clusters		Alternative Option	
County Clusters (1 district per cluster)	**MARTIN WARREN HALIFAX HYDE PAMLICO CHOWAN WASHINGTON CARTERET**	**GATES CURRITUCK PASQUOTANK DARE BERTIE CAMDEN PERQUIMANS HERTFORD TYRRELL NORTHAMPTON**	**PASQUOTANK DARE PERQUIMANS HYDE PAMLICO CHOWAN WASHINGTON CARTERET**	**GATES CURRITUCK CAMDEN BERTIE WARREN HALIFAX HERTFORD TYRRELL NORTHAMPTON MARTIN**
BVAP(%)	30.0%	29.49%	17.47%	42.33%
Dem Vote % (LG16)	46.07%	47.74%	38.51%	55.42%
Dem Vote %(PR16)	45.60%	46.70%	37.83%	54.59%
Dem Vote %(CA20)	42.28%	44.47%	36.48%	50.75%
Dem Vote %(USS20)	45.31%	45.36%	38.45%	52.75%
Dem Vote %(TR20)	44.12%	44.58%	37.61%	51.59%
Dem Vote %(GV20)	46.79%	47.56%	40.75%	54.12%
Dem Vote %(AD20)	47.79%	47.72%	41.02%	54.99%
Dem Vote %(SST20)	47.56%	47.85%	41.03%	54.89%
Dem Vote %(AG20)	45.88%	46.11%	39.15%	53.40%
Dem Vote %(PR20)	44.09%	45.54%	38.30%	51.84%
Dem Vote %(LG20)	43.80%	45.12%	37.74%	51.69%
Dem Vote %(CL20)	45.23%	46.42%	39.12%	52.00%



The Northeastern corner of the North Carolina State Senate has two possible county clusterings; each clustering is made of two clusters each with one district. We compare the enacted plan with the other possible districting option. We find that the enacted plan splits the Black voters roughly in half, whereas the other potential clustering would have concentrated Black voters in one of the two resulting districts. Furthermore, we find that the enacted plan leads to two stable Republican districts when measured across a range of historic voting patterns. In contrast, the alternative clustering would have allowed the district with the larger BVAP (42.33% BVAP) to reliably elect a Democratic candidate. Thus, the chosen cluster is the choice that favors the Republican party andsignificantly fractures Black voters in the area.

Next, we examine the correlation between BVAP fraction and Democratic vote fraction in the Duplin-Wayne cluster. We elect to use the 2020 Governor votes and plot the relationship between the BVAP and the vote fraction in (i) our ensemble and (ii) the enacted plan. We demonstrate that (i) it is possible to draw districts with significantly higher BVAPs and that (ii) according to the examined historic votes, raising the BVAP would likely raise the Democratic vote fraction.

I declare under penalty of perjury under the laws of the state of North Carolina that the foregoing is true and correct to the best of my Knowledge.

Jonathan C Mattingly
Dec 23, 2021.

Response to Expert Report by Dr. Barber on the North Carolina State Legislature Redistricting Plans

Jonathan C. Mattingly

December 28, 2021

Contents

1 Introduction

The report by Dr. Michael Barber begins with a discussion of the political geography of the state of North Carolina. He emphasizes the heterogeneity of the state. While he points out the strengths of ensemble methods to separate the effect of natural clustering of votes and other effects due to political geography, Dr. Barber limits its use to analysis of the individual county clusters. Similarly, though he uses a collection of election data at the cluster level, he does not consider a diverse collection of election analyses both at the cluster level and when performing his statewide analysis. Rather, he restricts himself to a single summary statistic, namely, counting the number of Democratic-leaning districts at the individual cluster level based primarily on a composite election obtained through averaging several past statewide elections.

We complete the missing parts of Dr. Barber's analysis using data directly from his report when possible. When needed, we augment this data with an ensemble of maps obtained by running Dr. Barber's code. From this completed analysis, we see that Dr. Barber's ensemble shows both the Enacted NC House and the Enacted NC Senate to be extreme partisan outliers with a clear and systematic tilt in favor of electing Republicans.

When we focus on the structure of the enacted maps in the county clusters under Dr. Barber's analysis, we again see the same structures we observed using the Primary Ensembles from our initial report. These structures showed the enacted map to be an extreme outlier. Due to time constraints, we did not complete cluster level analysis on all clusters using Dr. Barber's simulations; we have, however, performed a cluster level analysis on a diverse collection of clusters in the NC House. Our cluster level analysis considers not only seat counts, but also the margins of victory within those seats. By examining the margins, we identify extreme partisan behavior at the cluster level using the very sampling code that Dr. Barber created.

We conclude that Dr. Barber's ensembles provide another independent verification that the enacted plans for the NC House and NC Senate are extreme gerrymanders.

2 Comment on Political Geography of State

In Section 3 of Dr. Barber's report, he discusses the political geography of the state. He made a number of statewide evaluations of the partisan structure using a single average of 11 statewide elections from 2014-2020. As his analysis in later sections makes clear, the political climate varies significantly from year to year and election to election. The average of these elections creates a new set of voting data, possibly quite district from those averaged to create it. I see no reason to elevate the behavior and properties of a map under the one particular political environment signified by this vote over other elections. It is important that the map used to translate our election votes into elected officials act in a non-biased way across a number of elections which represent different political climates seen in North Carolina, not just one.

In the rest of the report, Dr. Barber does switch to considering a number of distinct elections. However, he does not return to any aggregate statewide discussion using these individual elections and the diversity of election environments they represent. He does firmly endorse the use of a computer drawn ensemble of maps to create a base line against which the enacted map can be compared. He correctly represents that this method has the advantage of taking into account all of the political geography of the state, such as the concentrating of particular voters in some regions of the state or the preservation of counties and the like. Hence, when a map is an outlier compared to a computer drawn ensemble, these natural clustering or political geography considerations cannot be the explanation.

Dr. Barber never conducts any statewide analysis under his ensemble using different election results. However, all of the components necessary to perform such analysis are present in his report. Utilizing Dr. Barber's cluster-by-cluster ensembles, we complete the absent statewide analysis to examine the number of Democratic leaning seats under various elections. This analysis demonstrates that the enacted map *is* an extreme outlier when compared to Dr. Barber's ensemble.

3 Nonpartisan Ensemble Generated by Dr. Barber

In analyzing the North Carolina State House and Senate maps, Dr. Michael Barber generates an ensemble of non-partisan redistricting maps via the Sequential Monte Carlo (SMC) procedure in the *redist* R-package developed and maintained by a research group at Harvard University. When used to sample from a known distribution in a moderate sized problem, this method has been shown to faithfully sample the target distribution. This was validated on moderate sized examples using an enumeration algorithm developed by the same group that developed the *redist* R-package at Harvard. The method we used has similarly been validated using this and other methods. Dr. Barber used the ensemble method only at the cluster level and does not use it to perform a statewide analysis based on a statewide ensemble. Rather he just summarizes the cluster by cluster results in a few tables (Table 2 and Table 32) instead of performing any analysis which would show the cumulative effect at the statewide level. The coin flipping analogy we offer below shows why this is so inadequate. In utilizing Dr. Barber's ensemble, we demonstrate that he would have concluded the enacted map was an extreme outlier at the statewide level. This is not an endorsement of any of the particular algorithm choices he has made, but rather to demonstrate that this conclusion is available from his findings.

By taking the percentages in the cluster-by-cluster tables in Dr. Barber's report, we were able to perform the statewide analysis he neglected using his data. We were also able to perform this for the collection of different statewide elections Dr. Barber used in his analysis. This allowed us to see the behavior of the maps under different types of elections. Both of these considerations are important and we briefly discuss them individually before turning to the statewide analysis using Dr. Barber's data.

- **Importance of statewide analysis:** Dr. Barber analyzes each cluster one-by-one and concludes that the majority of them are not extreme outliers so under his election composite the map is not an outlier. However, in almost every case, he finds that the more Republican of the non-outlying options is selected. Consider the following analogy. Someone flips a coin that they claim is fair but is in fact biased to produce heads more often. They flip the coin and produce 40 heads and zero tails. On each flip, the chance of getting a head from a fair coin is 50%. Hence the outcome on each flip is not that surprising. Dr. Barber's analysis is analogous to looking at each flip alone and then claiming that the coin is fair because the outcome was a head and the chance of a fair coin producing a head was reasonable. However, taking a more global view one can an easily see that the chance of getting 40 heads in a row is astronomically small. And thus, one can conclude the coin is biased. This would even be true if there were only 35 heads and 5 tails.

  Analogously, each cluster taken individually might not be an extreme outlier, but it is extremely unlikely that all of these clusters woud exist together in a statewide map drawn without partisan intent.

  We will also see that some of the local clusters are extreme outliers in their own right using Dr. Barber's data and extending his analysis to look at the margins of victory (or the extent of the partisan lean) rather than only focusing on the number of seats won by either party (or the direction of the partisan lean). This extended analysis agrees with the finding in our initial report.

- **Often extreme behavior is apparent in only some elections:** If one wanted to rig a card game by colluding with some of the other players, the group would only need to act when none of the group was going to win. The group need only act when cards were aligned against them. Hence, the behavior of a gerrymandered map might appear typical in settings where the gerrymandering party is content with the outcome that one would typically expect without gerrymandering. Furthermore, it is possible that whatever system the card players are using is not sufficient to counteract some hands. In other words, even a card player that is cheating might not be able to win when their opponent draws a royal flush. Hence, it is not to be expected that in all cases a gerrymandered map is effective in supporting the gerrymandering party.

  In particular, one can not simply declare that a map is not gerrymandered because it is fair in some fraction (even a relatively large fraction) of the election environments. If it is clearly gerrymandered in some reasonable and pertinent election environments, then the map should be seen as gerrymandered. To do otherwise would be to argue that a casino would be happy with card players who only cheated 30% of the time and in particular did not cheat when they were already winning or had an unsalvageable hand.

In addition to generating a statewide analysis using the actual data from Dr. Barber's report, we also employ ensembles generated from the *redist* code base, set up according to Dr. Barber's analysis scripts.[1] We then show that well-established methods of probing for gerrymandering reveal that many of the individual clusters are indeed extreme gerrymanders. In doing so, we consider the partisan seat counts of each party and also extend the analysis to consider *how* the seats are won. The latter is important as it shows the degree that a given district is politically safe as well as determines how future political swings, unseen at present, might affect political outcomes. For example, atypically polarized districts can lead to maps which do not respond to the shifts in the electorate's preferences, and effectively lock in a particular outcome. Additionally, when a map has an extremely partisan structure, this can speak to the intent of the map makers even if the structure would be unlikely to affect some collection of elections such as wave elections in favor of the gerrymandering party.

[1]Dr. Barber did include a R Data file which might have included the maps he generated in his run. However, since our version of R was slightly different than his, it would not load. Hence we were forced to re-run his code.

4 Statewide Analysis of Dr. Barber's Ensemble of NC House Plans

Within each cluster, Dr. Barber presents the fraction of plans in his ensembles that would lead to a certain number of Democratic districts under each set of historic and averaged vote counts. These tables can be used to construct the probability of drawing a non-partisan plan at the statewide level that would yield a certain number of Democratic leaning districts under various elections.

Beginning with his averaged statewide vote counts, we construct the statewide probabilities of electing various numbers of representatives and present them in Figure 1 in terms of the number of Democrats elected. Only 0.177% of all of the plans in Dr. Barber's ensemble elect the same or more Republicans than the enacted plan.

Note that our count of Democrats elected includes the Democrats elected in single-district clusters, which are omitted from Dr. Barber's Table 2. So our Figure 1 reports that the enacted plan elects 49 Democrats under Dr. Barber's composite of elections, which is the four Democrats elected in single-district clusters that Dr. Barber reports in his Table 1 plus the 45 Democrats elected in multi-district clusters that Dr. Barber reports in his Table 2.

We repeat the above analysis with the 2016 and 2020 election data used by Dr. Barber. The only supplemental data we introduce is the number of single district Democratic clusters in each election which we have taken from our previous analysis. We summarize the 10 elections in Figure 2 and Table 1.

As in our previous analysis, we find that the outlier status of the ensemble has a significant impact on the amount of power the Republicans can amass in the House. For example, under the votes of the 2020 Lt. Governor race, 2016 Presidential race, and 2020 US Senate race, the ensemble breaks a Republican supermajority in 99.3937%, 98.976, and 99.992% of the plans in Dr. Barber's ensemble, respectively. However, the enacted plan would elect a Republican supermajority under each of these votes. Similarly, under the 2020 Governor race, the Republican majority would have been broken in 96.42% of the plans in Dr Barber's ensemble, yet they would have maintained the majority using the enacted map under these votes.

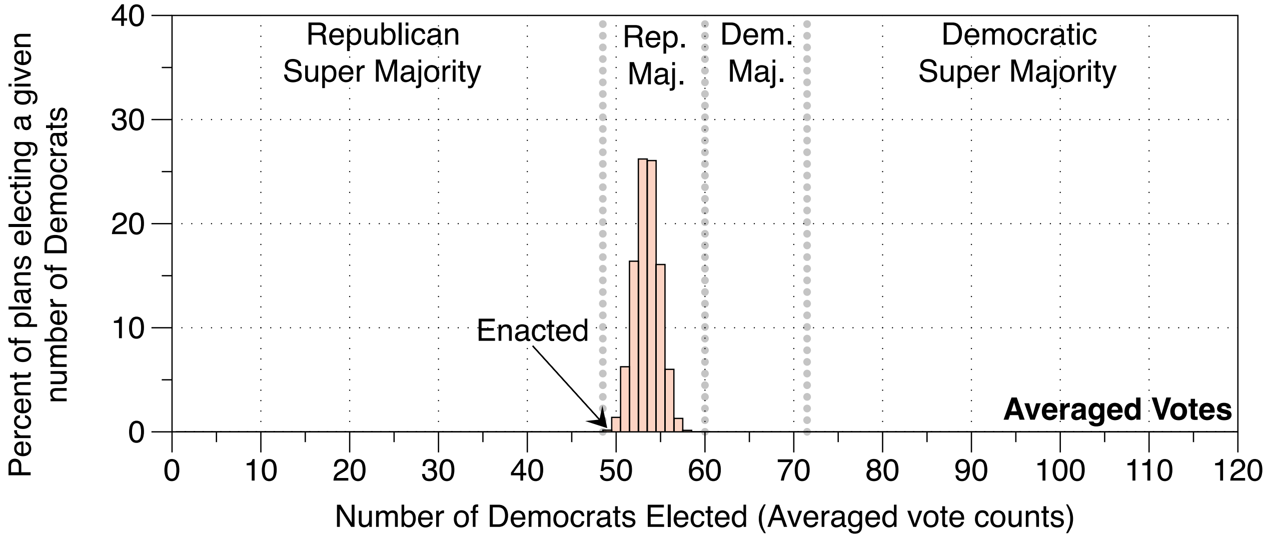


Figure 1: We compare Dr. Barber's statewide ensemble with the enacted plan under the Averaged election results used in his report. We find that only 0.177% of all of the plans in his ensemble would elect the same or more Republicans.

Election	Statewide Dem. Vote	% of Dr. Barber's Plans electing the same or more Republicans than the enacted plan
Barber's Average Vote	-	0.177%
2020 Governor	52.32%	0.204%
2016 Attorney General	50.20%	1.34%
2020 Attorney General	50.13%	0.00684%
2016 Governor	50.047%	0.215%
2020 President	49.36%	0.000146%
2020 Senate	49.14%	0.00804%
2020 Lt. Governor	48.40%	0.000377%
2016 President	48.024%	1.02%
2016 Senate	46.98%	0.223%
2016 Lt. Governor	46.59%	0.518%

Table 1: When considered at the statewide level, the ensembles produced by Dr. Barber are all extreme outliers. The chance that a plan drawn from the ensemble would elect the same or more Republicans as the enacted plan is, at most, 1.34%; in all but three of the elections it is less than 0.25%. We have ordered the elections with the election with the largest Democratic statewide vote fraction at the top and the election with largest Republican statewide vote fraction at the bottom. It is worth noting that many of the most extreme outliers happen for those between 50% and 48%. Looking at Figure 2, we see that this is the range where the Republicans would typically lose the super majority according to Dr. Barber's analysis. Though "Barber's Average Vote" which he used as a partisan index might or might not represent an actual plausible voting pattern, we have included it for comparison.

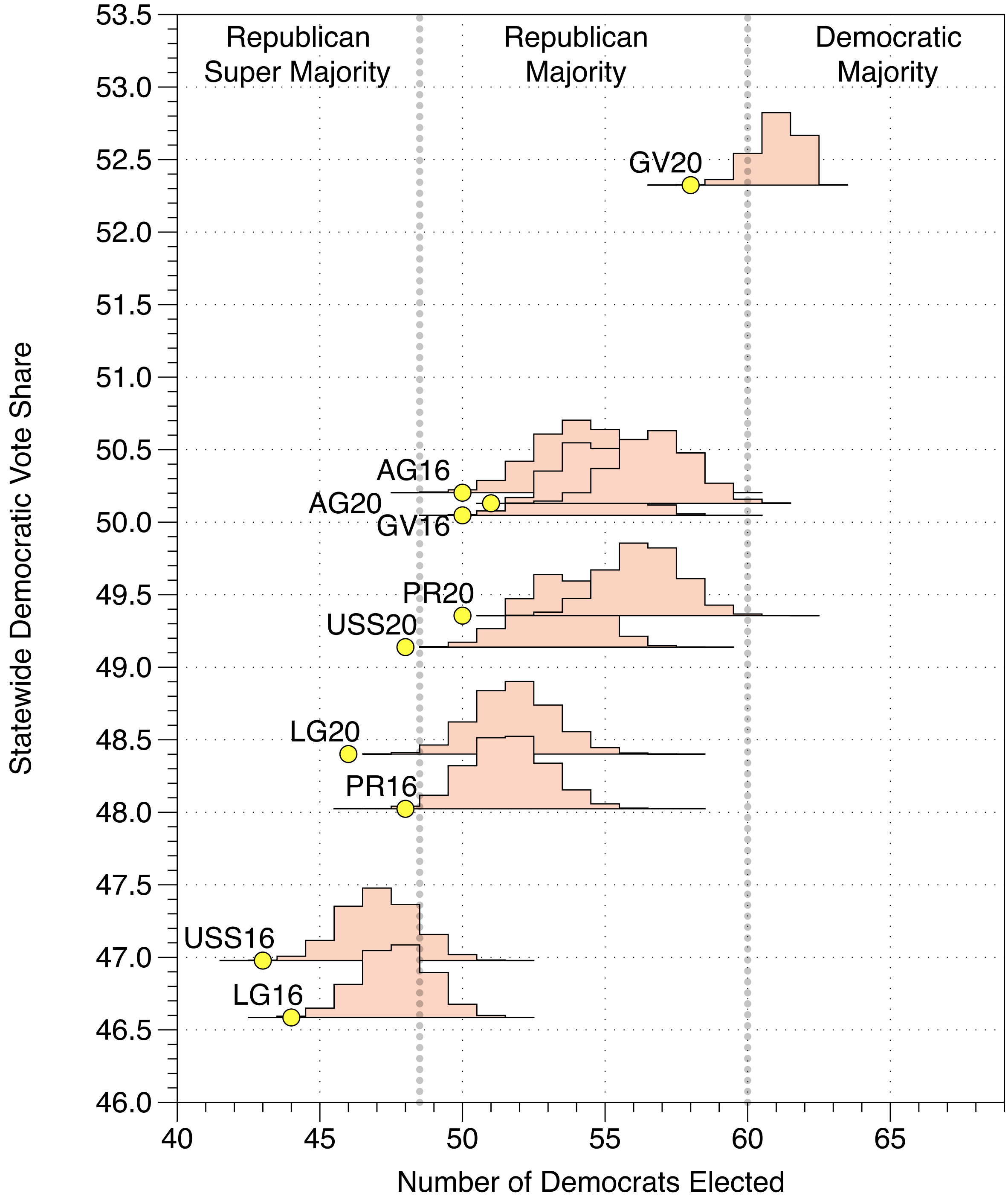


Figure 2: We compare Dr. Barber's statewide ensemble with the enacted plan under the ten 2016 and 2020 elections used in his report. Yellow dots show the result of the enacted plan. The enacted plan is an extreme outlier when considering the same data under a statewide lens. We summarize the numerical extent of the outliers in Table 1. The elections are abbreviated with the last two digits signifying the year, and the first letters representing Lt. Governor (LG), Governor (GV), President (PR), and US Senate (USS).

5 Statewide Analysis of Dr. Barber's Ensemble of NC Senate Plans

Repeating the above analysis for Dr. Barber's ensemble of Senate plans, we begin with the averaged statewide vote counts. We construct the statewide probabilities of electing various numbers of Senators and present them in Figure 3. Once again, our count of Democrats elected includes the Democrats elected in single-district Senate clusters, which are omitted from Dr. Barbers Table 32. So our Figure 3 reports that the enacted plan elects 20 Democrats under Dr. Barbers composite of elections, which is the four Democrats elected in single-district clusters that Dr. Barber reports in his Table 31 plus the 16 Democrats elected in multi-district clusters that Dr. Barber reports in his Table 32. Only 0.00385% of all of the plans in Dr. Barber's ensemble elect the same or more Republicans. Furthermore, this is the percentage of plans that lead to a Republican supermajority under these votes (which the enacted plan would produce as well). In other words, while the enacted plan always produces a Republican supermajority under Dr. Barber's analysis, only .00385% of the non-partisan plans that Dr. Barber simulates would produce a Republican supermajority.

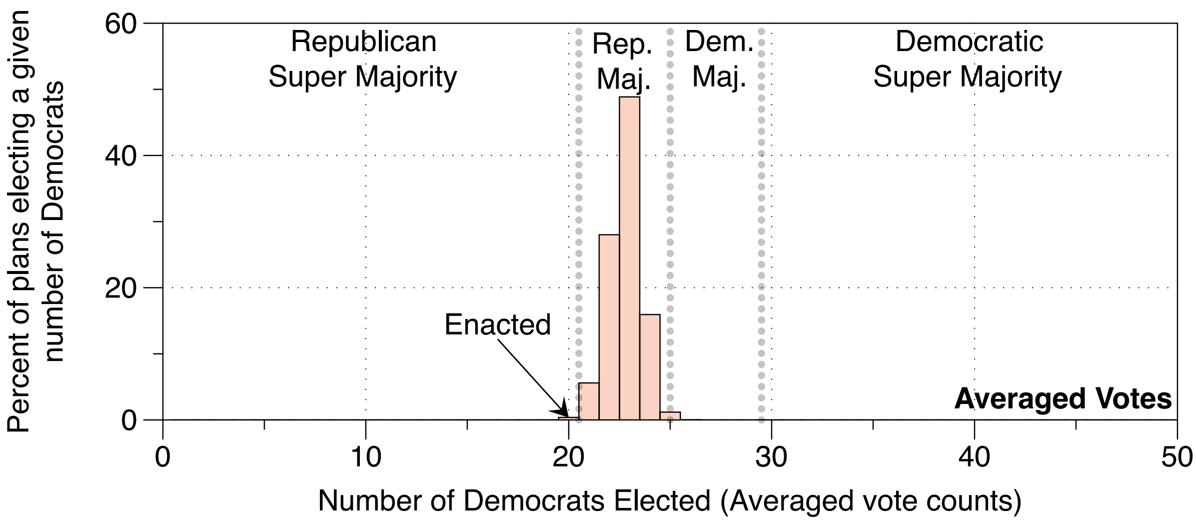


Figure 3: We compare Dr. Barber's statewide ensemble with the enacted plan under the Averaged election results used in his report. We find that only 0.00385% of all of the plans in his ensemble would elect the same or more Republicans than the enacted plan.

We repeat the above analysis with the 2016 and 2020 election data used by Dr. Barber. The only supplemental data we introduce is the number of single district Democratic clusters in each election which we have taken from our previous analysis. We summarize the 10 elections in Figure 4 and Table 2.

Again, we find that the outlier status of the ensemble has a significant impact on the amount of power the Republicans can amass in the Senate. Under the votes of the 2016 Governor race and 2016 Attorney General races, the Republicans lose their supermajority in 99.9544% and 98.9501% of the plans in Dr. Barber's ensemble, respectively. However, the enacted plan would elect a Republican supermajority under each of these voting patterns.

Election	Statewide Dem. Vote	% of Dr. Barber's Plans electing the same or more Republicans than the enacted plan
Averaged	-	0.00385%
2020 Governor	52.32%	1.92%
2016 Attorney General	50.20%	1.05%
2016 Governor	50.047%	0.047%
2020 Attorney General	50.13%	3.74%
2020 President	49.36%	9.92%
2020 Senate	49.14%	5.76%
2020 Lt. Governor	48.40%	0.250%
2016 President	48.024%	0.16%
2016 Senate	46.98%	1.22%
2016 Lt. Governor	46.59%	10.9%

Table 2: When considered at the statewide level, many of the ensembles produced by Dr. Barber are extreme outliers. In six of the ten elections, there is less than a 2% chance that a plan drawn from the ensemble would elect the same or more Republicans as the enacted plan; in three of the ten elections, there is less than a 0.251% chance that a plan drawn from the ensemble would elect the same or more Republicans than the enacted plan. As we have remarked in both our original report and in the analysis below, this *does not* mean that the enacted plan is not an extreme partisan gerrymander under the other four elections; it only indicates that the plan is not as extreme of an outlier in these elections under the particular lens of seat counts.

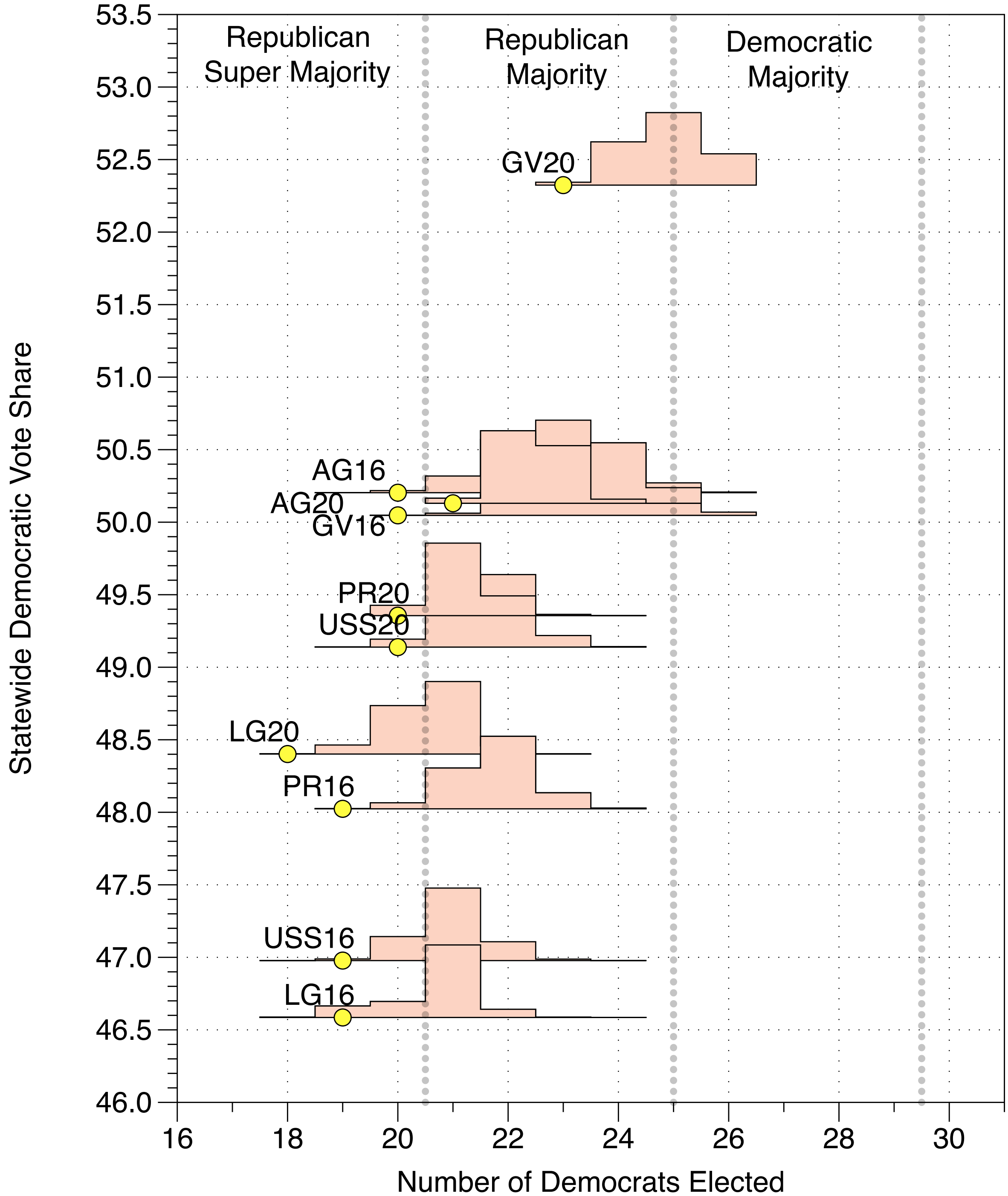


Figure 4: We compare Dr. Barber's statewide ensemble with the enacted plan under the ten 2016 and 2020 elections used in his report. Yellow dots show the result of the enacted plan. The enacted plan is an extreme outlier when considering the same data under a statewide lens. We summarize the numerical extent of the outliers in Table 1. The elections are abbreviated with the last two digits signifying the year, and the first letters representing Lt. Governor (LG), Governor (GV), President (PR), and US Senate (USS).

6 Cluster by Cluster Analysis

We now turn to examining certain clusters presented in Dr. Barber's work. We do not exhaustively examine all of the clusters. Rather, we select certain clusters to demonstrate how the lens that Dr. Barber chooses to use (namely only looking at the number of Democratic districts) yields an incomplete picture of the partisan make up of the districts even with respect to the individual districts.

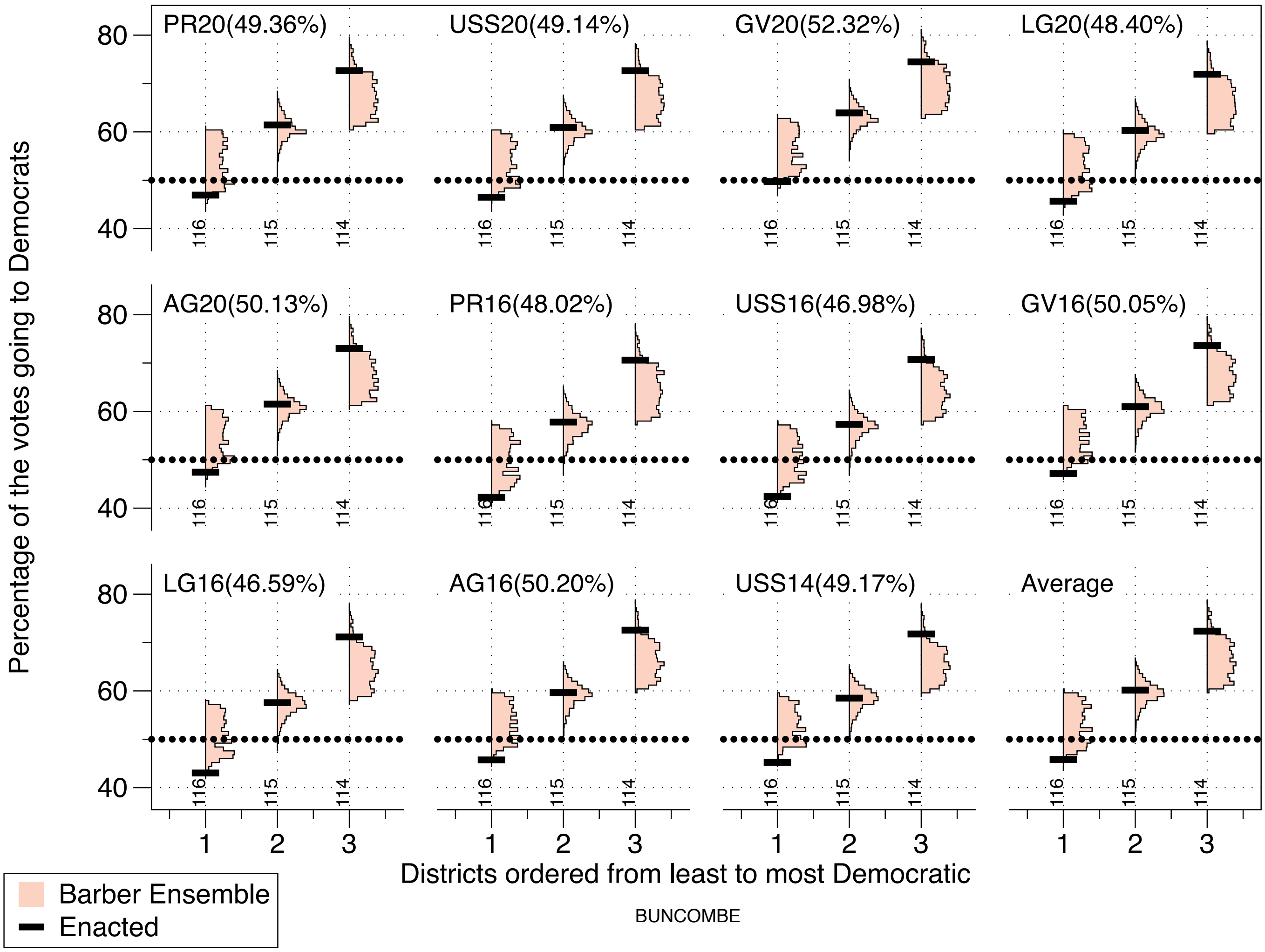
For a more complete picture, one would need to look at the actual partisan make-up of each district within a cluster. In fact, Dr. Barber reported on these values for the enacted plan, but did not compare these values to those found in his ensemble. One way of comparing these numbers is to examine the rank ordered marginal distributions of the vote fraction in each district. To do this, we order the districts from least to most Democratic (what Dr. Barber calls the Partisan Lean of Districts), and then look at the distribution of the most Republican, second most Republican, etc..., all the way until we reach the most Democratic district.

This type of analysis reveals not only how many Democratic leaning districts are within Dr. Barber's ensemble, but also *how much* they lean Democratic (or Republican). As we have demonstrated in our report, this is also relevant at a statewide level.

Note that all of our previous statewide analysis of seat counts simply relied on the numbers presented in Dr. Barber's report, i.e., the exact same ensemble that he relies on. The analysis below uses an ensemble of plans derived from running Dr. Barbers code (we were unable to extract his ensembles he used from the data he provided).[2] However, re-running his same code with his exact same input parameters should produce a comparable ensemble to the one he generated from the report, assuming that his code performs in the way he represents.

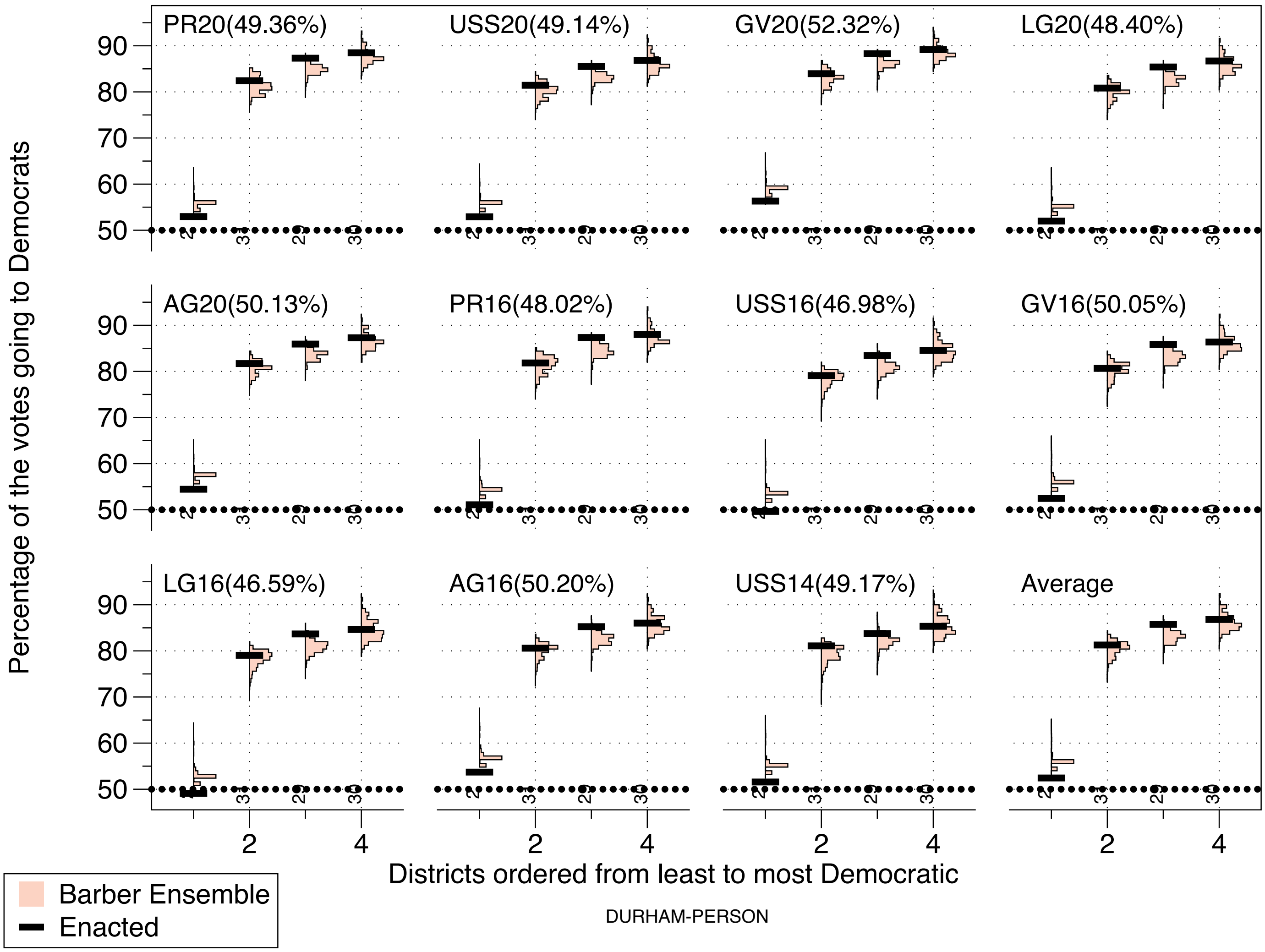
The main conclusion is that when comparing the cluster-by-cluster results from Dr. Barber's ensemble to those in our report, we find the qualitative structure to be the same. We again conclude that the enacted map is an extreme outlier when using Dr. Barber's ensemble with this additional analysis. We include a number of county clusters from the NC House. We make a number of comments in the caption of each figure. We refer the reader to our initial report to the court for a description of these Ranked-Ordered-Marginal-Histograms.

[2] We obtained the ensemble data from runs of Dr. Barber's code from Wes Pegden (CMU) who ran the code on his R installation as we did not have a computing environment able to run the code conveniently during the window when the rebuttal reports were due.



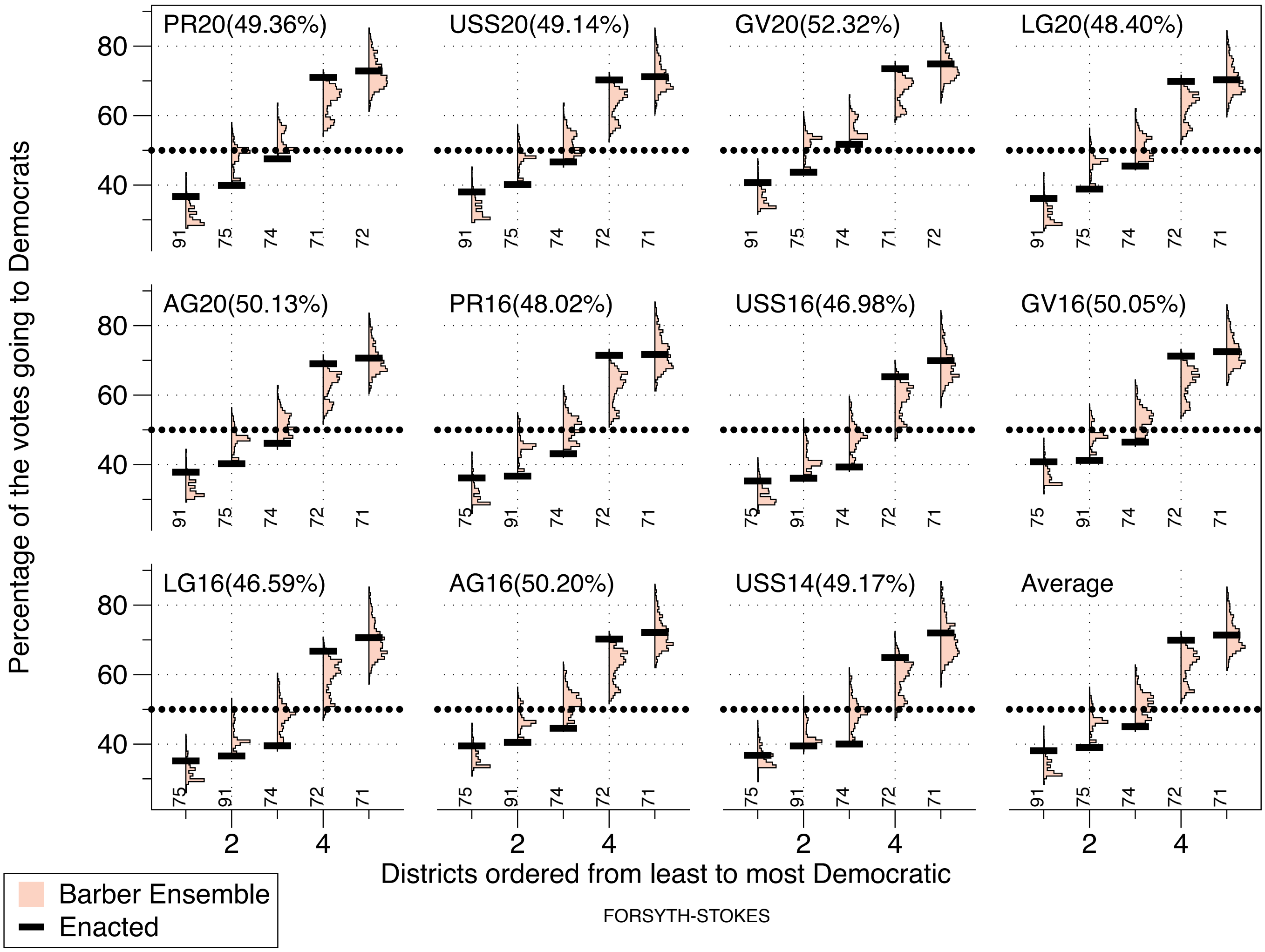
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	107	0.277	2409	6.23	38664	1	3
PR20	756	1.96	3095	8.0	38664	1	3
USS20	409	1.06	2529	6.54	38664	1	3
GV20	662	1.71	3200	8.28	38664	1	3
LG20	424	1.1	2624	6.79	38664	1	3
AG20	534	1.38	2655	6.87	38664	1	3
PR16	321	0.83	2701	6.99	38664	1	3
USS16	17	0.044	2062	5.33	38664	1	3
GV16	18	0.0466	2067	5.35	38664	1	3
LG16	18	0.0466	1998	5.17	38664	1	3
AG16	17	0.044	1992	5.15	38664	1	3
USS14	3	0.00776	1807	4.67	38664	1	3

Figure 5: In Buncombe County, the Enacted maps is an extreme outlier under Dr. Barber's ensemble. We see the same structure as we saw when compared with the probability ensemble our initial report. The most Republican district in the enacted plan has exceptionally few Democrats while the most Democratic district has exceptionally many Democrats. The result is that the Democrats never win three seats in the enacted plan under any of the elections considered, including Dr. Barber's composite "Averaged Election", even though they would typically do so under a number of elections under Dr. Barber's ensemble.



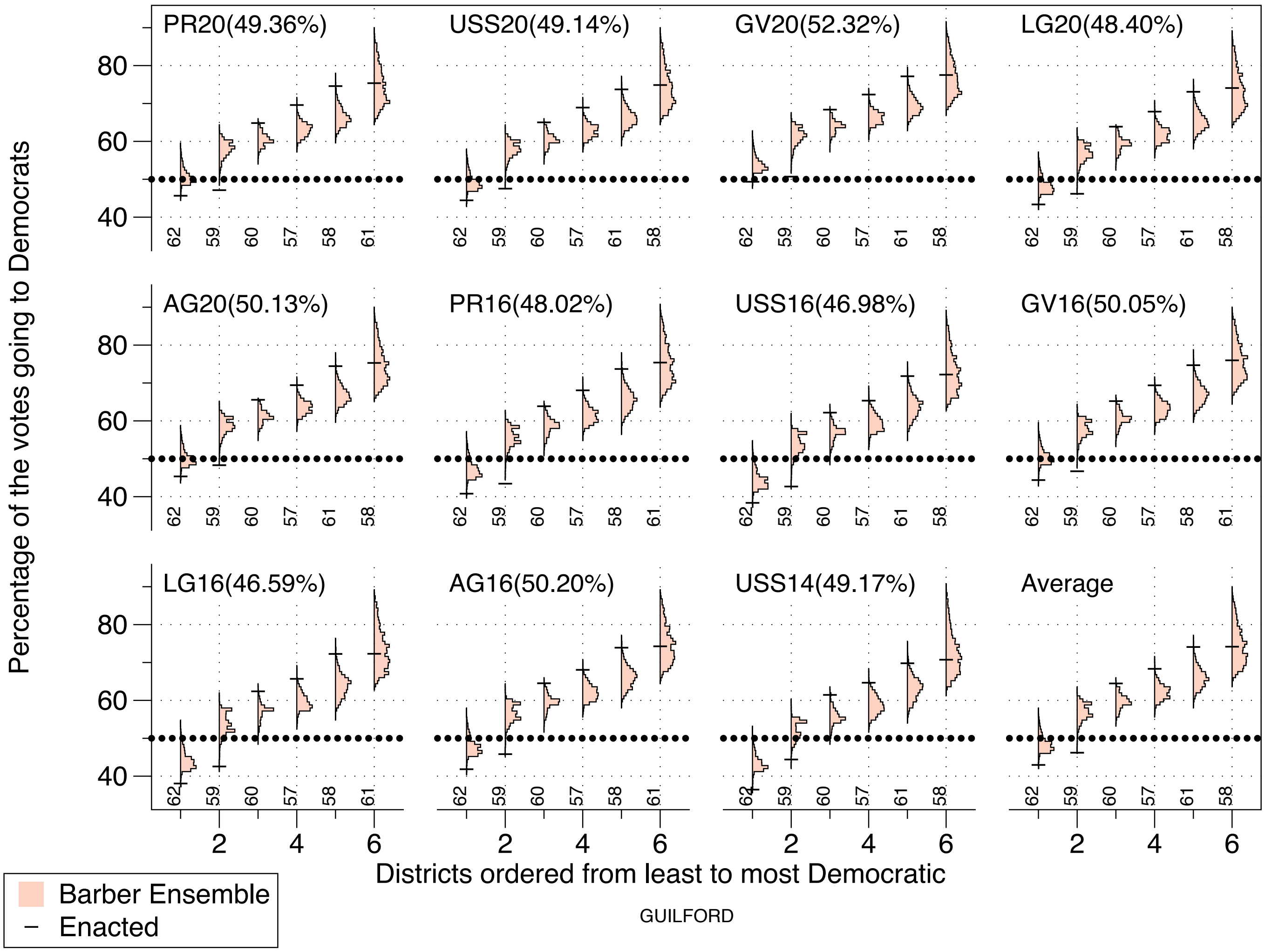
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	0	0.0	1396	3.69	37800	1	3 4
PR20	0	0.0	790	2.09	37800	1	3 4
USS20	0	0.0	1326	3.51	37800	1	3 4
GV20	0	0.0	1123	2.97	37800	1	3 4
LG20	0	0.0	1199	3.17	37800	1	3 4
AG20	0	0.0	1205	3.19	37800	1	3 4
PR16	0	0.0	1184	3.13	37800	1	3 4
USS16	0	0.0	2932	7.76	37800	1	3 4
GV16	0	0.0	1382	3.66	37800	1	3 4
LG16	0	0.0	2675	7.08	37800	1	3 4
AG16	0	0.0	1931	5.11	37800	1	3 4
USS14	0	0.0	10357	27.4	37800	1	3 4

Figure 6: In the Durham-Person cluster, we the same outlier structure in the enacted map when compared to Dr. Barber's ensemble as when compared to the primary ensemble in our orignal report. We see that the most Republican district has been depleted of Democrates. This makes the district much more competitive than it typically would be under a non-partisan redistricting plan.



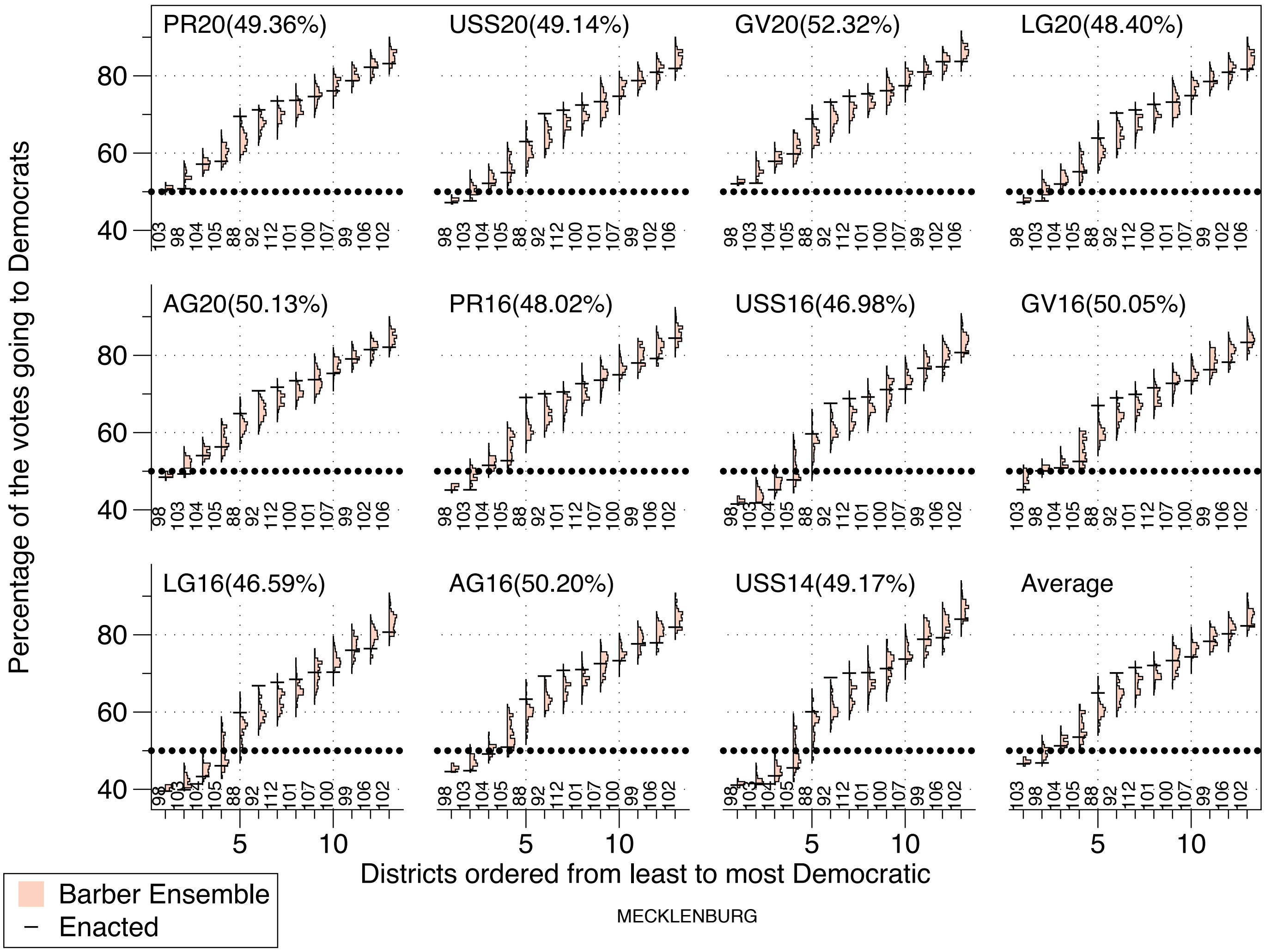
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	17	0.456	317	8.51	3726	1 2 3	4 5
PR20	4	0.107	349	9.37	3726	1 2 3	4 5
USS20	60	1.61	429	11.5	3726	1 2 3	4 5
GV20	2	0.0537	357	9.58	3726	1 2 3	4 5
LG20	21	0.564	376	10.1	3726	1 2 3	4 5
AG20	47	1.26	395	10.6	3726	1 2 3	4 5
PR16	7	0.188	284	7.62	3726	1 2 3	4 5
USS16	44	1.18	280	7.51	3726	1 2 3	4 5
GV16	11	0.295	292	7.84	3726	1 2 3	4 5
LG16	30	0.805	269	7.22	3726	1 2 3	4 5
AG16	25	0.671	263	7.06	3726	1 2 3	4 5
USS14	13	0.349	351	9.42	3726	1 2 3	4 5

Figure 7: In the Forsyth-Stokes cluster, We again see the same structure in Dr. Barber's ensemble as in the primary ensemble from our initial report. We see abnormally few Democrats in the second and third most Republican districts while we see abnormally many Democrats in the most Republican district and in the two most Democratic districts. The effect is to regularly flip the 3rd most Republican district to the republicans under the enacted map even under elections where many to almost all of the plans in Dr. Barber's ensemble would have awarded the seat to the Democrats.



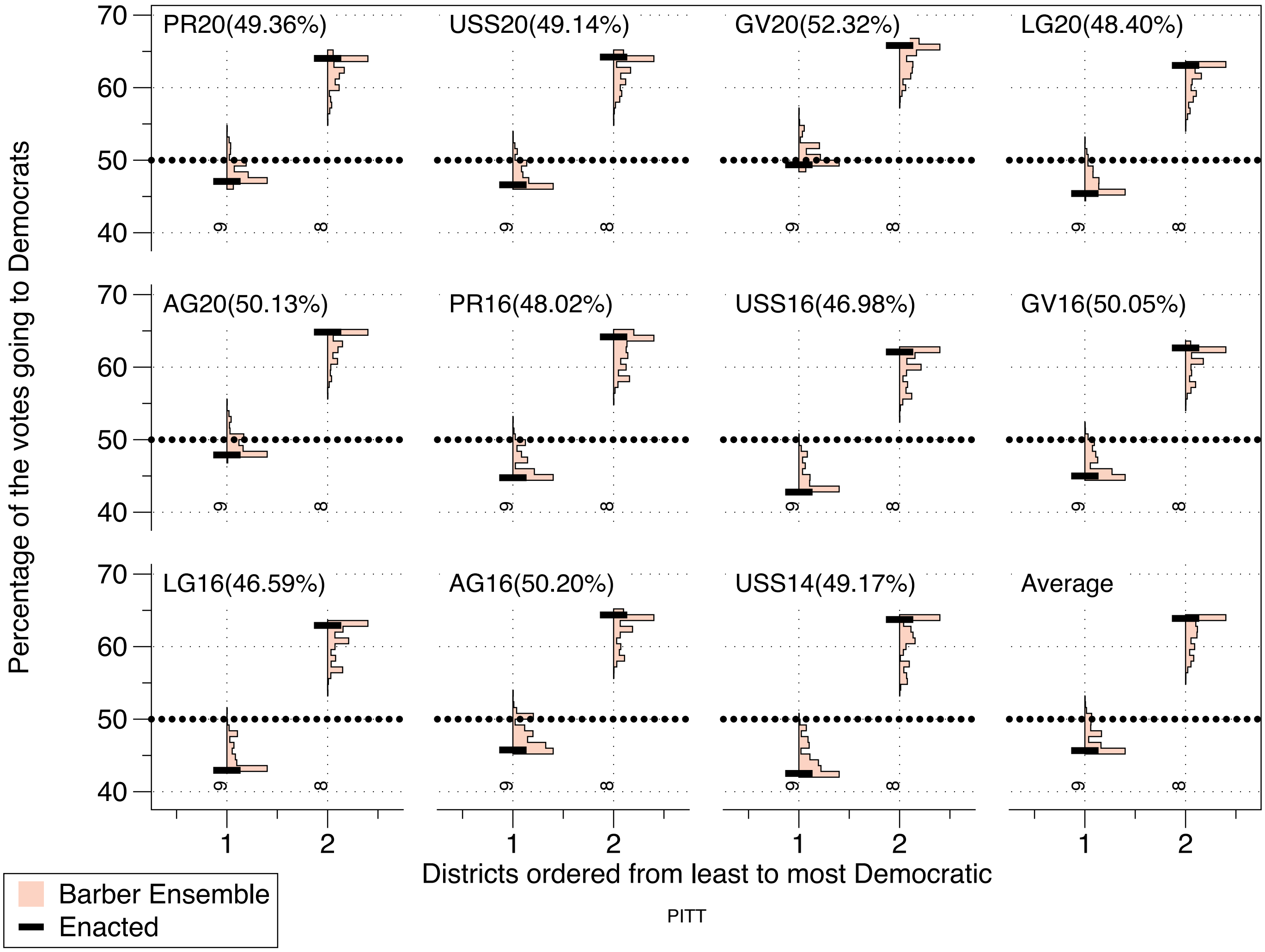
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	0	0.0	0	0.0	15489	1 2	3 4 5 6
PR20	0	0.0	0	0.0	15489	1 2	3 4 5 6
USS20	0	0.0	0	0.0	15489	1 2	3 4 5 6
GV20	0	0.0	0	0.0	15489	1 2	3 4 5 6
LG20	0	0.0	0	0.0	15489	1 2	3 4 5 6
AG20	0	0.0	0	0.0	15489	1 2	3 4 5 6
PR16	0	0.0	0	0.0	15489	1 2	3 4 5 6
USS16	0	0.0	0	0.0	15489	1 2	3 4 5 6
GV16	0	0.0	0	0.0	15489	1 2	3 4 5 6
LG16	0	0.0	0	0.0	15489	1 2	3 4 5 6
AG16	0	0.0	0	0.0	15489	1 2	3 4 5 6
USS14	0	0.0	0	0.0	15489	1 2	3 4 5 6

Figure 8: Dr. Barber did identify Guilford county as a Republican Gerrymander in the enacted map. The structure which produces this result is clear when compared with this plot of Dr. Barber's ensemble. We see that the two most Republican districts have abnormally few Democrats and the next three Republican districts have abnormally many Democrats. The effect is that the second most Republican seat reliably goes to the Republican party even though in some elections almost all of the maps in Dr. Barber's ensemble would award the seat to the Democrats. This was the same structure seen in the plots of our primary ensemble from our initial report.



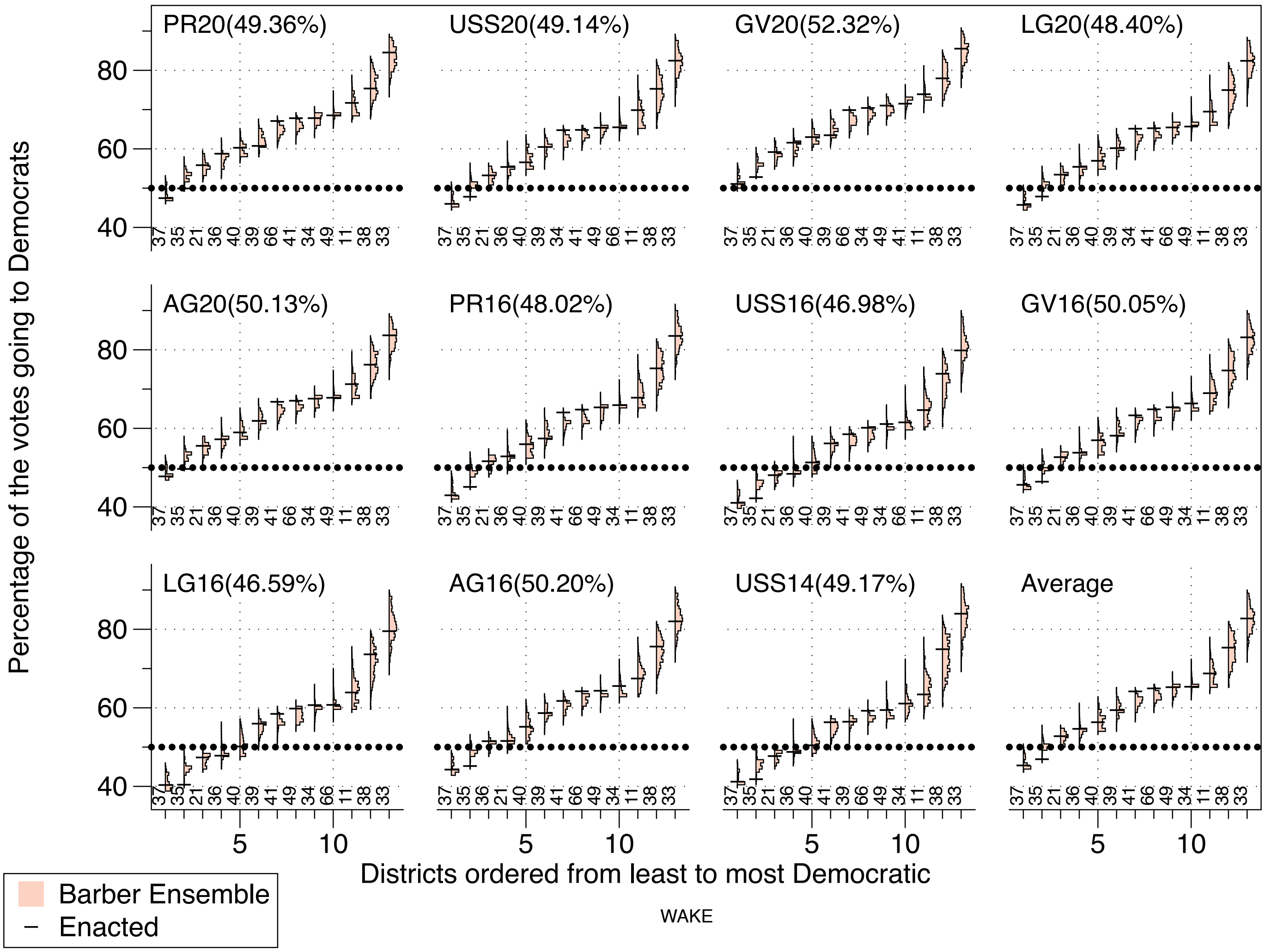
Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	139	4.4	14	0.443	3161	1 2 3 4	5 6 7 8
PR20	105	3.32	18	0.569	3161	1 2 3 4	5 6 7 8
USS20	145	4.59	29	0.917	3161	1 2 3 4	5 6 7 8
GV20	114	3.61	17	0.538	3161	1 2 3 4	5 6 7 8
LG20	117	3.7	17	0.538	3161	1 2 3 4	5 6 7 8
AG20	119	3.76	17	0.538	3161	1 2 3 4	5 6 7 8
PR16	23	0.728	18	0.569	3161	1 2 3 4	5 6 7 8
USS16	74	2.34	15	0.475	3161	1 2 3 4	5 6 7 8
GV16	56	1.77	23	0.728	3161	1 2 3 4	5 6 7 8
LG16	68	2.15	18	0.569	3161	1 2 3 4	5 6 7 8
AG16	52	1.65	15	0.475	3161	1 2 3 4	5 6 7 8
USS14	153	4.84	16	0.506	3161	1 2 3 4	5 6 7 8

Figure 9: In Mecklenburg county, we again have that the four most Republican districts have abnormally few Democrats in them while the next four most Republican districts have abnormally many Democrats. This is the same structure as we saw under our primary ensemble in our initial report. The effect is that in a number of elections the Republican party wins one to two more seats than the typical plan from Dr. Barber's ensemble would award.



Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	314	6.05	1929	37.2	5189	1	2
PR20	1539	29.7	1974	38.0	5189	1	2
USS20	1525	29.4	1929	37.2	5189	1	2
GV20	1556	30.0	1974	38.0	5189	1	2
LG20	1537	29.6	1974	38.0	5189	1	2
AG20	1537	29.6	1974	38.0	5189	1	2
PR16	483	9.31	1929	37.2	5189	1	2
USS16	0	0.0	1660	32.0	5189	1	2
GV16	483	9.31	1929	37.2	5189	1	2
LG16	0	0.0	1660	32.0	5189	1	2
AG16	169	3.26	1660	32.0	5189	1	2
USS14	0	0.0	1660	32.0	5189	1	2

Figure 10: In Pitt county we see that same structure we found in our Primary ensemble repeated in Dr. Barber's ensemble. In particular, we see the districts pulled to the extremes of what is seen in Dr. Barber's ensemble. The depletion of Democrats from the more Republican district protects it from electing a Democrat in the enacted plan even though it would elect a Democrat in many of the plans in Dr. Barber's ensemble in a few of the elections we considered.



Election	No. plans w/ ≤ Dems (First Cluster)	% of plans w/ ≤ Dems (First Cluster)	No. plans w/ ≥ Dems (Second Cluster)	% of plans w/ ≥ Dems (Second Cluster)	Total Plans	First Cluster	Second Cluster
Average	159	1.11	2649	18.5	14305	1 2	3 4 5 6 7 8
PR20	140	0.979	1872	13.1	14305	1 2	3 4 5 6 7 8
USS20	209	1.46	2961	20.7	14305	1 2	3 4 5 6 7 8
GV20	145	1.01	1772	12.4	14305	1 2	3 4 5 6 7 8
LG20	159	1.11	2240	15.7	14305	1 2	3 4 5 6 7 8
AG20	165	1.15	2260	15.8	14305	1 2	3 4 5 6 7 8
PR16	137	0.958	2264	15.8	14305	1 2	3 4 5 6 7 8
USS16	196	1.37	3774	26.4	14305	1 2	3 4 5 6 7 8
GV16	220	1.54	3504	24.5	14305	1 2	3 4 5 6 7 8
LG16	196	1.37	2707	18.9	14305	1 2	3 4 5 6 7 8
AG16	205	1.43	3076	21.5	14305	1 2	3 4 5 6 7 8
USS14	287	2.01	3632	25.4	14305	1 2	3 4 5 6 7 8

Figure 11: In Wake county, we see that the number of Democrats in the first two districts is exceptionally low. Looking across the different Ranked Ordered Marginal Histograms, we see that this increases the electoral environments (as captured in different elections) in which the Republican party wins one of these two districts. In particular, Dr. Barber's ensemble would lead to the Democrats typically winning one of these two districts in cases where the enacted plan does not.

7 Comments on Sampling Methods

We now give some additional details to clarify some of the terms we used and the procedures we followed in sampling of the legislative maps in our original report in light of the discussion in Dr. Barber's report.

We recall that in the Legislative case we used parallel tempering to interpolate between a base measure equal to the uniform measure on spanning forests given the county and population constraints and a measure centered on the districts with a compactness similar to the enacted plan. The Primary ensemble for the legislative ensemble reported in the report was the latter of these two ensembles. The first of these ensembles would be the target distribution of the SMC algorithms from the *rdist* package when it is properly configured with resampling included. We took 4 million steps (proposals the Metropolis-Hastings algorithm) at the spanning tree level and 2 million steps on the other levels. We output maps every 25 steps for a total of 160,000 maps in the 4 million step case and 80,000 map in the 2 million step cases. We interpolated between the different ensembles using between 60 and 100 parallel tempering levels. We proposed switching between the parallel tempering levels every 100 steps. In some cases, we ran a number of clusters together in one sampling run and sometimes we ran them separately or is smaller subgroups in a single run. Generally we ran the larger, more compacted clusters such as Wake or Mecklenburg, in this way.[3] As described in the original report, *independent sample reservoirs* were used to split the 60 to 100 levels into computationally feasible chunks. This also improved the mixing and decorrelation properties of our algorithm. The congressional ensemble was drawn from a measure with a compactness weight against the same tree measure that the resampled rdist algorithm would sample. We used 12 parallel temping levels to move between the distribution without a compactness measure and the finial target distribution with the sampling weight. The number of steps was as specified above. The weights and other parameters used in the different run are specified in the header files of the datasets.

[3]For one run in the Senate, we only ran Granville-Wake for 1 million steps as we had strong evidence that this was sufficient for the parameter values being considered.

I declare under penalty of perjury under the laws of the state of North Carolina that the foregoing is true and correct to the best of my knowledge.

Jonathan Mattingly, 12/28/2021

EXHIBIT F

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426
21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

REBECCA HARPER, et al.,

Plaintiffs,

vs.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

EXPERT REPORT OF DR. JEFFREY B. LEWIS

Pursuant to the North Carolina Rules of Civil Procedure and the Case Management Orders of the Court in the above-captioned matter, I, Jeffrey B. Lewis, provide the following written report:

1. I am a Professor of Political Science at the University of California, Los Angeles (UCLA). I am also the past department chair of UCLA's political science department and past president of the Society for Political Methodology. I have been a member of the UCLA faculty since 2001. Prior to that, I was an Assistant Professor of Politics and Public Affairs at Princeton University from 1998 to 2001. I earned my B.A. in Political

NCLCV v. Hall
21 CVS 15426
LDTX200

Witness:
Jeffrey Lewis, Ph.D.
Ex 1
12/31/21 D. Myers Byrd

Science and Economics from Wesleyan University in 1990 and my Ph.D. in Political Science from the Massachusetts Institute of Technology (MIT) in 1998. My main area of specialization is quantitative political methodology with a focus on making inferences about preferences and behavior from the analysis of voting patterns in the mass public and in legislatures. I have published on the topic of ecological inference – the challenge that arises when one wants to know how individuals of different types voted in an election, but one can only observe electoral data aggregated to the precinct, county or other summary level. A true, accurate, and complete copy of my curriculum vitae is attached as Exhibit A.

2. I have previously been retained as an expert in relation to nine court cases: one involving allegations of voting machine failure in Florida (Jennings v. Elections Can-vassing Commission of State of Florida), four involving claims of minority vote dilution in California (Avitia v. Tulare Local Healthcare District; Satorre et al. v. San Mateo County Board of Supervisors et al.; Ladonna Yumori-Kaku v. City of Santa Clara); and Pico Neighborhood Association and Maria Loya v. City of Santa Monica), one involving claims of minority vote dilution in Texas (Perez, et al. v. Abbott, et al.), one involving claims of minority vote dilution in North Carolina (Common Cause, et al. v. Lewis), one involving claims of minority vote dilution in Washington (Aguilar v. Yakima County), and one involving the compactness of legislative districts in Illinois (Radogno et al v. Illinois State Board of Elections, et al.). I testified as an expert in the cases of Ladonna Yumori-Kaku v. City of Santa Clara and Pico Neighborhood Association and Maria Loya v. City of Santa Monica.
3. I am being compensated at a rate of $550/hour.
4. In the attached tables and spreadsheet, at Exhibit B, I present summaries of the results of North Carolina general and Democratic primary election contests held in 2014, 2016, 2018, and 2020. In particular, I consider how each contest would have turned out if only the votes of those residing in each current and in each enacted State House, State Senate, and Congressional district had been counted.
5. This exercise allows us to consider the voting strength of the Black voters in each existing and proposed legislative district.

6. For each of these "reconstituted" election contest in each district, I used weighted ecological regression (ER) to estimate the degree of Black voter cohesion and non-Black voter crossover (hereafter "white crossover"). In some cases, the number of voting precincts available for the analysis was too small or Black share of voters was too small to meaningfully apply ER. I omit such contest-district combinations.
7. I further narrow the set of contests to partisan races for executive and legislative offices. And, I only "reconstitute" a given contest within a given district if the data indicate that at least 80 percent of the voters in the given election who resided the district, voted in the given contest.
8. I identify the "Black-preferred" candidate in each contest as the candidate estimated by ER to have received the largest share of Black votes in the given contest or, in the case of single-candidate elections, that candidate if they are a Democrat (single-candidate elections without a Democrat are considered not to have a Black-preferred candidate).
9. I also note whether each candidate is Black and whether each contest includes at least one Black candidate.
10. The tabulations and estimates are based on datasets that I downloaded from the North Carolina Board of Elections (SBOE) website with the exception of a crosswalk between the current and enacted legislative districts and voting precincts used in the 2014, 2016, 2018, and 2020 elections and estimates of Black Voting-Age population (VAP) by district that were provided by Clark Bensen of POLIDATA.
11. The race of each candidate was determined by looking up each candidate listed in the SBOE's candidate list datasets on the North Carolina voter list (also from the SBOE). In some cases, a candidate's race could not be determined because: their legal name matched no voter on the voter list, no race was indicated on the voter list, or they were matched to several voters of different races on the voter list. In total, over 1,800 Black candidates were identified (including many competing in contests not subsequently analyzed for the reasons described above).
12. The demographic composition of voters from each precinct needed to perform ER was derived by merging vote history records from the SBOE to the precinct election returns. Because some counties do not allocate "One Stop" and absentee votes back to precincts (and for other reasons), not all voters can be matched to a voting precinct and not all

precincts can be placed in legislative districts. Where One Stop and absentee ballots were allocated to regular voting precincts, the voting and demography within each precinct was broken down by voting method when performing ER. This is possible because the vote history records (which are used to estimate the fraction of voters in each precinct who were Black) are broken down by voting method (as sometimes are the election returns within each precinct). When a county reported One Stop or absentee votes without allocating them to precincts and where feasible, I aggregated the One Stop and absentee votes in the election returns and the One Stop and absentee voters into a single One Stop and a single absentee precinct. Given the need to break down the votes by legislative district, this was only feasible in counties that fall entirely within a single State House, State Senate, or Congressional district.

13. The attached tables summarize the reconstituted elections analysis. For each district, the tables show averages of many of the quantities described above as well as: the Black-preferred candidate "win rate" (the fraction of Black-preferred candidates who would have won if the contest had only been held in the given district); the percent of Black-preferred candidates who were Democrats; the average number of major-party candidates in the reconstituted contests; the average fraction of voters who were Black; and, an estimate of the average minimum fraction of those voting in the district that would have had to be Black in order for the Black-preferred candidate to expect to get at least 50 percent of the vote (based on the ER estimates and only applied in contests involving two major-party candidates).
14. The tables present separate results for primary and general elections. Separate tallies are also presented that include only those contests that included at least one Black candidate.
15. The attached spreadsheet *minority_preferred_candidates.csv* identifies the minority-preferred candidate in each of the reconstituted contests considered. It includes the following fields:
    a. *district*, an identifier of the district including its chamber, plan, and number in which the contest is reconstituted.
    b. *election_date*, the date of the election
    c. *election_type,* primary or general
    d. *contest,* the electoral contest being reconstituted.

e. *minority_preferred_candidate,* the name of the minority preferred candidate (as identified by ER).

f. *minority_preferred_party,* the party of the minority-preferred candidate.

g. *cand_is_black,* whether the Black-preferred candidate is Black.

h. *has_minority_candidate,* whether the contest included a Black candidate.

i. *wonlost,* identifies the Black-preferred candidate as a "winner" or "loser" of the reconstituted election (highest-vote getter).

j. *pct_vote,* percent of vote won by the Black-preferred candidate in the reconstituted contest.

k. *ER.pct_black,* average share of voters in the ER analyses who were Black.

l. *ER.black_cohesion,* weighted Ecological Regression (ER) estimates of support for Black-preferred candidate among Black voters in the reconstituted election.

m. *ER.white_crossover,* weighted Ecological Regression (ER) estimates of support for the Black-preferred candidate among white (non-Black) voters in the reconstituted election.

n. *ER.black_pct_needed_for_majority,* Uses the ER estimates to infer the minimum share of the voters in the reconstituted election that would generate majority support for the minority-preferred candidate in the reconstituted election. Note that this is the estimated average percentage of Black voters in the contest needed for a majority, not the percentage of Black VAP existing in the district.

o. *Coverage,* the ratio of the total votes cast in the reconstituted election to the most votes cast in any reconstituted contest in the same district and election expressed as a percentage. In many cases, eligibility to participate in a particular contest will only partially overlap with the district in which the reconstituted election is considered. Because the area of overlap may encompass a set of voters who are not representative of the voters a district as whole when the overlap is small, I consider only contests for which this overlap or "coverage" exceeds 80 percent (for example, this include contests for statewide offices).

p. *number_of_candidates,* The number of major-party candidates in the contest.

16. This analysis goes beyond Professor Dunchin's analysis to consider not just 4 primary and 4 general election contests, but over 420 individual contests including over 190 that

include a Black candidate. These contests include both endogenous and exogenous contests for legislative and executive offices ranging from a Recorder of Deeds to the US President. The analysis also expands on Professor Duchin's analysis by estimating the rate of support of each candidate in each contest within each district to capture variation in Black voter cohesion and white cross-over voting across the districts (whereas Professor Duchin estimates a single rate of cohesion and of cross-over voting statewide for the 8 contests that she considers).

17. Using (without endorsing) Professor Duchin's definition of "effective" Black districts (greater than 75 percent Black preferred win rate in races with minority candidates combined with greater than 25 percent Black voting-age population), an analysis of this larger set of election contests identifies as "effective" the enacted districts that Professor Duchin enumerates (with the exceptions of State Senate District 12 and State House District Districts 066 which do not exhibit a 75 percent win rate in the larger dataset and House District 039 for which too few data precinct points were available to apply ER to identify the Black-preferred candidates). It also identifies as "effective" by Duchin's definition as many as seven additional State House districts and four additional State Senate districts. *See* Table 1.
18. Relaxing Professor Duchin's requirement that an "effective" district must have more than 25 percent Black voting-age population, my more expansive analysis suggests the existence of one additional "effective" Congressional district, four additional "effective" State House districts, and two additional "effective" State Senate districts.
19. Further relaxing the definition of "effective" to those districts in which the Black preferred win rate exceeds 66 percent suggests the existence of seven more "effective" State Senate districts and 16 additional "effective" State House districts. *See* Table 1.
20. Increasing the set of contests considered to include contests without Black candidates further lifts the number of apparently "effective" districts under Duchin's definition.
21. Only two of the "effective" districts (by any of the above definitions) are majority Black VAP. Districts with Black-preferred win rates of over 75 percent in the reconstituted elections include two districts with Black voting-age populations below 7 percent and five districts with Black voting-age populations below 20 percent.

Table 1 – Duchin "Effective" Black Districts in Enacted Plans

	House	Senate	Congress
Number of "Effective" Black Districts in enacted plans using Duchin definition	29	12	2
Number of "Effective" Black Districts in enacted plans using Duchin definition but relaxing 25% BVAP and applying win rate of 66%	49	21	5
Number of "Effective" Black Districts in enacted plans using Duchin definition but relaxing 25% BVAP and applying win rate of 50%	88	40	11

22. In no district, enacted or in 2020, does it appear that a majority Black VAP is needed for that district to regularly generate majority support for minority-preferred candidates in the reconstituted elections.
23. Black voters constitute a powerful political force in North Carolina electoral politics because of their numerical size and highly cohesive voting as well as the sizeable white (non-Black) cross-over vote for Black-preferred candidates that exists particularly in areas of the state in which Black voters are concentrated. As Professor Duchin documents, contemporary Black voting power in North Carolina is such that it is now even possible to draw a set of districts in which Black voters would have effective control (by her definition) of a share of the state's legislative districts that meaningfully exceeds the size of the Black population.
24. I reviewed the "Addendum to Primary Expert Report of Jonathan C. Mattingly, Ph.D." Dr. Mattingly appears to have reconstituted election results in different county cluster options and identified Black VAP in those same clusters. Dr. Mattingly's Addendum is not a racially polarized voting analysis.

CERTIFICATION

I certify that the statements and opinions provided in this report are true and accurate to the best of my knowledge, information, and belief.

____________________________________ _____December 28, 2021_________
Jeffrey B. Lewis, Ph.D. Date

Exhibit A

Jeffrey B. Lewis

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Education

Massachusetts Institute of Technology — Cambridge, MA
Ph.D., Department of Political Science, February 1998.

Wesleyan University — Middletown, CT
B.A., Political Science and Economics with Honors in General Scholarship. June 1990.

Academic Experience

University of California Los Angeles — Los Angeles, CA
Professor of Political Science. July 2012–present.

University of California Los Angeles — Los Angeles, CA
Director, Center for American Politics and Public Policy. July 2017–July 2018.

University of California Los Angeles — Los Angeles, CA
Chair, Department of Political Science. July 2011–June 2017.

University of California Los Angeles — Los Angeles, CA
Associate Professor of Political Science. July 2007–June 2012.

University of California Los Angeles — Los Angeles, CA
Assistant Professor of Political Science. July 2001–June 2007.

Dartmouth College,
Rockefeller Center for the Social Sciences — Hanover, NH
Research Fellow. July 2000–June 2001.

Princeton University — Princeton, NJ
Assistant Professor of Politics and Public Affairs. July 1997–July 2001.

Teaching Interests

Quantitative methods
Elections & Direct democracy
California politics

Grants & Awards

Fellow, Society for Political Methodology, Elected 2019.

Research grant, "For Modernizing the VoteView Website And Software." Madison Initiative. William and Flora Hewlett Foundation (Grant #2016-3870). January 2016. $200k.

Conference/training grant, "Support for Conferences and Mentoring of Women and Underrepresented Groups in Political Methodology," National Science Foundation (NSF-SBE-1628102 with Kosuke Imai), $308k.

Research grant. "Collaborative Research on Dynamic Models of Roll Call Voting." National Science Foundation (NSF-SBS-0611974, with Keith Poole and Howard Rosenthal). July 2006. $394k total ($182k UCLA).

Brian P. Copenhaver Award for Innovation in Teaching with Technology, College of Letters and Sciences, University of California Los Angeles. 2007.

Warren Miller Prize for best article in volume 11 of *Political Analysis*. 2003 (article co-authored with Ken Schultz).

Research grant. "Empirical Testing of Crisis Bargaining Models." National Science Foundation (NSF-SBS-0241647, with Ken Schultz). February 2003. $200k.

Research grant, "Term limits in California." John Randolf and Dora Haynes Foundation, May 2000. $27k.

Research grant, Princeton University Committee on Research in the Humanities and Social Sciences, May 1998.

Harvard/MIT Research Training Group for Positive Political Economy Dissertation Fellowship, 1995-1996.

Sigma Xi Honorary Society, Wesleyan University, 1990.

White Prize for excellence in economics, Wesleyan University, 1990.

Ford Foundation Summer Research Fellowship, Wesleyan University, 1988.

Publications

"The new Voteview.com: preserving and continuing Keith Poole?s infrastructure for scholars, students and observers of Congress," *Public Choice*. 2018, 176:17–32 (with Adam Boche, Aaron Rudkin, and Luke Sonnet).

"Recovering a Basic Space from Issue Scales in R." *Journal of Statistical Software*. 2016, 69(7) (Keith T. Poole, Howard Rosenthal, James Lo, Royce Carroll).

"The Structure of Utility in Spatial Models of Voting," *American Journal of Political Science*. 2013, 56(4):1008–1028 (with Royce Carroll, James Lo, Keith T. Poole, and Howard Rosenthal).

"Economic Crisis, Iraq, and Race: A Study of the 2008 Presidential Election." (*Election Law Journal*. 2010, 9(1): 41–62 (with Michael Herron and Seth Hill).

"Comparing NOMINATE and IDEAL: Points of difference and Monte Carlo tests." *Legislative Studies Quarterly*. 2009, 34:555–592 (with Royce Carroll, James Lo, Keith T. Poole, and Howard Rosenthal).

"Measuring Bias and Uncertainty in DW-NOMINATE Ideal Point Estimates via the Parametric Bootstrap", *Political Analysis.* 2009, 17(3):261–275 (with Royce Carrol, James Lo, Keith T. Poole, and Howard Rosenthal).

"poLCA: An R Package for Polytomous Variable Latent Class Analysis." *Journal of Statistical Software.* 2011, 42(10) (with Drew A. Linzer).

"Scaling Roll Call Votes with Wnominate in R." *Journal of Statistical Software.* 2011, 42(14) (with Keith Poole, James Lo, and Royce Carroll).

"Ballot Formats, Touchscreens, and Undervotes: A Study of the 2006 Midterm Elections in Florida." *Election Law Journal.* 2008. 7(1):25–47 (with Laurin Frisana, Michael C. Herron, and James Honaker).

"An Estimate of Risk Aversion in the U.S. Electorate." *Quarterly Journal of Political Science.* 2007, 2(2):139–154. (with Adam J. Berinsky).

"Ideological Adaptation? The Survival Instinct of Threatened Legislators." *Journal of Politics.* 2007, 69(3):823–843 (with Thad Kousser and Seth Masket).

"Did Ralph Nader Spoil a Gore Presidency? A Ballot-Level Study of Green and Reform Party Voters in the 2000 Presidential Election." *Quarterly Journal of Political Science.* 2007, 2(3):205–226 (with Michael Herron).

"A Return to Normalcy? Revisiting the Effects of Term Limits on Competitiveness and Spending in California Assembly Elections" *State Politics and Policy Quarterly.* 2007, 7(1):20–38 (with Seth Masket).

"Learning about Learning: A Response to Wand." *Political Analysis.* 2006, 14: 121-129 (with Kenneth Schultz).

"Estimating Regression Models in Which the Dependent Variable Is Based on Estimates" *Political Analysis.* 2005, 13(4) (with Drew A. Linzer)

"Beyond the Median: Voter Preferences, District Heterogeneity, and Representation." *Journal of Political Economy.* 2004, 106(6):1364–1383 (with Liz Gerber).

"Measuring Bias and Uncertainty in Ideal Point Estimates via the Parametric Bootstrap." *Political Analysis.* Spring 2004. 12:105–127 (with Keith Poole)

"Extending King's Ecological Inference Model to Multiple Elections using Markov Chain Monte Carlo," Chapter in Gary King, Ori Rosen, and Martin Tanner, Eds. *Ecological Inference: New Methodological Strategies.* Cambridge: Cambridge University Press. 2004.

"Revealing Preferences: Empirical Estimation of a Crisis Bargaining Game with Incomplete Information." *Political Analysis.* 2003, 11(4):345–365 (with Kenneth A. Schultz).

"Understanding King's Ecological Inference Model: A Method-of-moments Approach," *Historical Methods.* 2001, 34(4):170–188.

"Estimating Voter Preference Distributions from Individual-Level Voting Data," *Political Analysis.* 2001, 9(3):275-297.

"No Evidence on Directional vs. Proximity Voting," *Political Analysis.* 1999, 8(1):21-33 (with Gary King).

"Reevaluating the Effect of N-Ach (Need for Achievement) on Economic Growth," *World Development.* 1991, 19(9):1269–1274.

Other Publications

Comment on "McCue, K. F. (2001), 'The Statistical Foundations of the EI method, *The American Statistician.* 2002, 55(3):250.

"Veteran's Adjustment." Chapter in *After the Cold War: Living with Lower Defense Spending*, Congress of the United States, Office of Technology Assessment, OTA-ITE-524. 1992.

Working Papers

Has Joint Scaling Solved the Achen Objection to Miller and Stokes? (with Christopher Tausanovitch, under revision).

Residual Votes in the 2008 Minnesota Senate Race (with Jonathan W. Chipman and Michael C. Herron)

From Punchcards to Touchscreens: Some Evidence from Pasco County, Florida on the Effects of Changing Voting Technology (with Michael C. Herron)

Voting in Low Information Elections: Bundling and Non-Independence of Voter Choice (with Liz Gerber, April 2002)

Dangers of Measurement Error in Non-linear Models: The Case of Directional versus Proximity Voting (April 2002)

A Reply to McCue's Reply to My Comment on "The Statistical Foundations of the EI method"

PhD Students

Committees Chaired or Co-chaired: Ryan Enos (Harvard), Seth Hill (UCSD), James Lo (USC), stonegarden grindlife.
Currently charing or co-chairing five committees.
Committee member on over 35 PhD students (including as an outsider member in Economics and Statistics).

Conference Presentations

American Political Science Association, Philadelphia, September 2016.
Annual Meetings of the Midwest Political Science Association, Chicago, April 2014.
Annual Meetings of the Midwest Political Science Association, Chicago, April 2011.
Summer Meetings of the Political Methodology Society, New Haven, 2009

Annual Meetings of the Midwest Political Science Association, Chicago, April 2006.
American Political Science Association, Chicago, September 2004.
American Political Science Association, Philadelphia, September 2003.
Annual Meetings of the Midwest Political Science Association, Chicago, April 2003.
Summer Meeting of the Political Methodology Society, Seattle, 2002
Annual Meetings of the Public Choice Society, Houston, San Diego, 2002.
Annual Meetings of the Midwest Political Science Association, Chicago, April 2002.
Annual Meetings of the Midwest Political Science Association, Chicago, April 2001.
Annual Meetings of the Midwest Political Science Association, Chicago, April 2000.
Summer Meeting of the Political Methodology Society, College Station Texas, 1999.
Annual Meetings of the Social Science History Association, Chicago, November 1998.
American Political Science Association, Boston, September 1998.
Annual Meetings of the Midwest Political Science Association, Chicago, April 1997.
Annual Meetings of the American Political Science Association, San Francisco,August 1996.
Annual Meetings of the Public Choice Society, Houston, April 1996.
American Political Science Association, Atlanta, August 1989.

Software

Voteview: US Roll call votes and legislator ideologies, 1789–2021: Provides interactive search and visualization of every roll call vote ever taken in the United States Congress. See `https://voteview.com`.

WNominate (v1.2): R package implementing Poole and Rosenthal's W-Nominate estimator co-authored with Keith Poole and James Lo. (`http://cran.r-project.org/web/packages/wnominate/index.html`)

PoLCA (v1.4.1): R package for Polytomous Variable Latent Class Analysis. Co-authored with Drew Linzer. (`http://dlinzer.github.io/poLCA/`)

Data collections

US Congressional roll call voting and related data, 1789–2021: Provides data on every roll call vote ever taken in the United States Congress. See `https://voteview.com`.

US Congressional District Boundaries, 1789–2017. Detailed GIS descriptions of every district in US history (with Brandon DeVine (UCLA), Lincoln Pritcher (UCLA), and Ken Martis (UWV)). See `http://cdmaps.polisci.ucla.edu/`.

109th – 114th Congress Data Project. UCLA. Webpage allows download of up to the hour roll call voting matrices for the current US Congress [Now included in the Voteview project].

California Roll Call Project. UCLA. Collection of roll call voting data from the California Assembly from 1850 to the present. Ongoing (with Seth Masket).

Crisis Bargaining Data Base. UCLA. Codings of post-World War I international crises outcomes in terms of a simple game theoretic model of coercive diplomacy (supported by NSF-SBS-0241647) (with Ken Schultz).

Record of American Democracy Project Harvard University. One of several project leaders. Summer 1995.

University Service

Chair: Executive Committee, Faculty of Letters and Science, UCLA (September 2019–Present)

Vice Chair: Executive Committee, Faculty of Letters and Science, UCLA (2018–2019)

Member: Executive Committee, Faculty of Letters and Science, UCLA (2017–2018); Council on Academic Planning and Budget, UCLA (2019–Present); Classroom Advisory Committee, UCLA (2018–2020); Pathways to Commencement Task Force, UCLA (2013–2014).

Professional Experience

President: Society for Political Methodology (2015–2017).

Vice President/President elect: Society for Political Methodology (2013–2015).

Co-editor: *The American Political Science Review* July 2008–July 2011; *The Political Methodologist*, the APSA Methodology section newsletter. 2004–2007 (with Adam Berinsky and Michael Herron).

Editorial Board Member: *Journal of Politics*, 2005–2008; *Political Analysis* 2005–present.

Panelist: National Science Foundation ad hoc peer review panels (June 2004, February 2008, October 2010); National Science Foundation Political Science Panel (2009–2010).

Departmental review visiting committee member: University of Colorado, 2013; London School of Economics, 2015; University of Michigan, 2015.

Nominations committee member: American Political Science Association, 2011–12, 2012–13.

Program committee member: American Political Science Association Annual Meetings 2003, Political Methodology division head.

Anonymous Referee: *American Political Science Review*, *American Journal of Political Science*, *Journal of Law and Economics*, *World Politics*, *Political Analysis*, *Legislative Studies Quarterly*, *Sociological Methods Review*, *Journal of Politics*, *Journal of Theoretical Politics*, and *Political Behavior*, *Perspectives on Politics*, *Public Opinion Quarterly*, *Journal of Political Economy*.

Discussant/Panel Chair Political Methodology Conference (1997, 2004, 2005, 2015), Midwest Political Science Association meetings (1998, 2005, 2006). American Political Science Association meetings (1998, 2002, 2003, 2006, 2010, 2016). Public Choice Society (1996, 2002)

Work Experience

Polimetrix — Palo Alto, CA
Director of Statistics, 2003–2007.

Office of Technology Assessment, U.S. Congress — Washington, DC
Research Analyst, Industry Technology and Employment program. October 1990 – August 1992.

Selected Invited Lectures

American Politics Seminar, Political Science Department, Columbia University, 1998

Political Economy Seminar, Political Science Department, Michigan University, 1999

Political Economy Seminar, Graduate School of Business, Stanford University, 1999

Political Economy Seminar, Politics & Economics Departments, Princeton University, 1998

Southern California Methods Program, UC Riverside, November 2001.

Ideal-Point Estimation Conference, Washington University St. Louis, September 2002.

American Politics Seminar, Political Science Department, Yale University, 2003.

Political Economy Seminar, Politics & Economics Departments, Princeton University, Spring 2004.

Political Economy Seminar, Politics Department, Massachusetts Institute of Technology, Spring 2004.

Empirical Implications of Theoretical Models Program, Washington University, St. Louis, June 2004.

Multilevel Methods Conference, Center for the Study of Democratic Politics, Woodrow Wilson School of Public and International Affairs, Princeton University, October 2004.

Empirical Implications of Theoretical Models Program, University of California Berkeley (one week module co-taught with Kenneth A. Schultz). June 2005.

Roll Call Voting Conference, Department of Political Science, University of California, San Diego. May 2006.

Measures of Legislators' Policy Preferences and the Dimensionality of Policy Spaces Conference Department of Political Science, Washington University, St. Louis. November 2007.

Causal Inference. Business School. University of Southern California. June 2010.

How to Scrape Web Pages. Summer Methods Program. Department of Sociology. Stanford University, July 2010, 2011, 2012, 2013, 2014, 2015.

Lectures on Ecological Inference. Summer Methods Training Program, Academia Senica, Taipei, Taiwan. July 2010.

Applied Statistics Workshop. Department of Government. Harvard University, April 2011.

Methods Workshop. Department of Political Science, Stanford University. June 2011.

Conference on "Political Representation: Fifty Years After Miller & Stokes." Vanderbilt University, March 2013

Center for the Study of Democratic Politics (CSDP) Workshop, Princeton University, April 2015.

Ideal Point Models in Political Science Workshop, MIT, April 2015.

Interdisciplinary Seminar in Quantitative Methods (ISQM) Workshop, University of Michigan, September 2015.

Political Economy Seminar, Graduate School of Business, Stanford University, April 2019,

Exhibit B

Table 1: General Elections

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
CD20-001	41.9	17	100	2.0	100	56	39	100	24	35
CD20-002	18.2	35	100	2.0	43	49	14	100	41	15
CD20-003	18.7	18	100	2.0	0	38	18	99	24	35
CD20-004	24.4	17	100	2.0	100	68	22	94	40	19
CD20-005	10.7	16	100	2.0	0	34	10	100	25	33
CD20-006	32.0	17	100	2.0	100	60	30	100	42	14
CD20-007	15.4	17	100	2.0	0	42	13	93	33	29
CD20-008	25.9	19	100	2.0	11	48	29	100	27	32
CD20-009	17.4	18	100	2.0	0	44	15	100	32	27
CD20-010	10.1	17	100	2.0	0	32	11	100	26	33
CD20-012	34.1	22	100	1.9	100	72	39	100	54	6
CD20-013	13.9	17	100	2.0	0	33	12	100	23	35
CD21-001	22.4	19	100	2.0	0	39	19	97	25	35
CD21-002	39.1	16	100	2.0	94	55	35	100	25	33
CD21-003	15.7	17	100	2.0	0	43	14	95	33	27
CD21-004	27.5	16	100	2.0	38	49	34	100	27	31
CD21-005	23.2	35	100	2.0	46	50	18	100	39	17
CD21-006	20.4	17	100	2.0	100	66	17	100	42	13
CD21-007	15.3	17	100	2.0	0	39	13	100	27	31
CD21-008	16.5	17	100	2.0	0	40	14	100	29	30
CD21-009	36.3	22	100	1.9	100	75	42	100	58	2
CD21-010	16.2	16	100	2.0	0	35	12	100	24	34
CD21-011	19.2	16	100	2.0	0	37	16	100	27	31
CD21-012	17.1	16	100	2.0	0	43	18	100	33	25
CD21-013	14.8	16	100	2.0	0	38	14	100	29	30
LD20-001	36.6	19	100	2.0	21	48	28	100	20	37
LD20-002	25.7	20	100	2.0	5	43	25	100	25	33
LD20-003	19.2	24	100	2.0	4	41	19	98	28	31
LD20-004	20.6	20	100	2.0	0	38	17	100	17	39

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-005	41.0	20	100	2.0	100	56	34	100	20	37
LD20-006	7.1	21	100	2.0	0	36	7	84	28	43
LD20-007	22.4	27	100	2.0	15	46	24	100	29	29
LD20-008	42.5	23	100	2.0	65	54	35	100	30	31
LD20-009	27.9	23	100	2.0	9	45	21	100	31	31
LD20-010	22.0	20	100	2.0	0	37	21	100	17	40
LD20-011	15.4	37	100	2.0	89	57	13	100	50	5
LD20-012	36.9	23	100	2.0	39	49	38	100	18	39
LD20-013	7.9	11	100	2.0	0	30	9	95	22	39
LD20-014	17.8	14	100	2.0	0	40	19	100	26	33
LD20-015	10.7	14	100	2.0	0	32	12	100	22	36
LD20-016	18.3	22	100	2.0	0	37	17	95	25	36
LD20-017	10.1	33	100	2.0	0	37	10	88	31	33
LD20-018	21.1	24	100	1.9	100	66	21	100	56	5
LD20-019	6.3	8	100	2.0	0	39	6	100	35	22
LD20-020	5.5	1	100	1.0	100	100	3	.	.	.
LD20-021	37.4	22	100	2.0	36	47	32	99	23	36
LD20-022	29.3	19	100	2.0	11	45	29	100	19	38
LD20-023	50.6	19	100	2.0	100	62	37	100	18	39
LD20-024	38.2	21	100	2.0	95	55	36	100	26	32
LD20-025	42.6	13	100	2.0	15	43	34	100	18	39
LD20-026	16.5	25	100	2.0	0	32	11	100	24	34
LD20-027	51.6	23	100	1.9	100	67	45	100	29	35
LD20-028	15.8	23	100	2.0	0	29	10	100	21	37
LD20-029	37.2	26	100	1.8	100	82	40	100	70	0
LD20-030	28.2	19	100	1.9	100	60	25	100	47	12
LD20-031	39.8	24	100	1.8	100	80	48	100	62	1
LD20-032	48.1	25	100	1.9	100	67	50	100	35	29
LD20-033	39.9	36	100	2.0	100	64	37	100	43	12

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-034	11.5	36	100	2.0	19	43	6	100	39	16
LD20-035	18.0	37	57	2.0	43	45	11	66	43	31
LD20-036	7.5	14	50	2.0	50	52	6	65	52	16
LD20-037	11.3	36	100	2.0	0	36	9	100	30	28
LD20-038	39.4	43	100	1.9	100	77	42	98	62	2
LD20-040	11.3	38	100	2.0	8	40	7	100	35	22
LD20-041	7.1	13	92	2.0	46	50	6	88	47	8
LD20-042	38.1	25	100	1.9	100	71	49	100	40	24
LD20-043	33.9	23	100	2.0	30	50	29	100	30	32
LD20-044	48.1	26	100	1.9	100	75	54	100	45	19
LD20-045	31.4	26	100	2.0	65	52	32	99	30	32
LD20-046	25.0	21	100	2.0	29	45	27	98	25	33
LD20-047	23.8	30	100	1.9	47	55	24	98	42	25
LD20-048	35.5	19	100	2.0	100	56	40	100	28	30
LD20-049	12.3	36	100	2.0	61	52	7	100	49	7
LD20-050	17.5	17	100	2.0	12	43	23	89	28	34
LD20-052	11.0	26	100	2.0	0	29	10	99	22	36
LD20-054	12.9	30	53	2.0	3	44	9	91	39	21
LD20-055	26.2	20	100	2.0	0	43	23	100	23	35
LD20-056	10.2	36	100	1.7	100	79	10	100	76	0
LD20-057	39.7	30	100	1.9	100	66	39	99	45	17
LD20-058	43.1	29	100	1.9	100	73	44	98	54	6
LD20-059	28.6	26	100	2.0	0	39	23	100	21	36
LD20-060	34.6	26	100	2.0	96	60	36	100	36	21
LD20-061	40.0	30	100	1.9	100	70	32	100	55	6
LD20-062	13.7	28	100	2.0	0	36	11	100	28	30
LD20-063	24.8	28	100	2.0	39	49	24	100	33	25
LD20-064	15.1	27	100	2.0	0	40	14	100	30	29
LD20-065	19.6	26	100	2.0	0	36	19	99	22	37

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-066	24.0	18	100	2.0	11	44	20	100	25	33
LD20-067	7.9	23	100	2.0	0	23	6	100	17	39
LD20-068	8.4	24	100	2.0	0	35	8	100	30	28
LD20-069	11.6	25	100	2.0	0	35	11	100	27	32
LD20-070	7.2	30	100	2.0	0	24	6	100	19	38
LD20-071	40.3	25	100	2.0	100	73	46	99	50	4
LD20-072	34.4	25	100	2.0	100	71	34	100	56	1
LD20-073	14.6	21	100	2.0	0	36	19	100	28	31
LD20-074	11.4	26	100	2.0	0	45	11	100	38	19
LD20-075	15.3	26	100	2.0	0	38	15	100	27	31
LD20-076	21.6	23	100	2.0	0	41	20	100	26	32
LD20-077	7.3	20	100	2.0	0	26	6	100	19	38
LD20-078	6.1	1	100	2.0	0	24	7	100	19	38
LD20-079	22.3	23	100	2.2	4	37	16	98	19	39
LD20-080	9.5	24	100	2.0	0	23	8	100	16	40
LD20-081	9.6	25	100	2.0	0	26	8	100	20	38
LD20-082	20.2	13	100	1.9	8	45	18	100	34	30
LD20-083	19.5	24	100	2.0	46	48	12	100	26	32
LD20-084	14.1	26	100	2.0	0	32	13	100	22	36
LD20-086	6.0	28	100	2.0	4	36	6	100	31	27
LD20-088	16.0	19	100	1.9	100	59	18	100	51	4
LD20-089	7.9	24	100	2.0	0	28	7	100	22	36
LD20-091	4.8	12	100	2.0	0	23	6	100	17	40
LD20-092	40.2	24	100	1.8	100	76	46	100	55	7
LD20-095	9.6	24	100	2.0	0	33	8	100	28	31
LD20-096	8.9	24	100	2.0	0	36	7	100	30	28
LD20-098	9.2	27	100	2.0	7	43	9	100	38	20
LD20-099	36.0	20	100	2.0	100	64	42	100	38	19
LD20-100	30.5	24	100	1.8	100	76	35	100	63	0

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-101	48.0	27	100	1.9	100	78	55	100	51	13
LD20-102	33.8	25	100	1.8	100	82	39	99	71	0
LD20-103	14.2	21	100	2.0	19	48	13	100	40	17
LD20-104	12.0	25	100	2.0	20	46	10	100	41	16
LD20-105	12.9	20	100	2.0	50	50	13	100	42	14
LD20-106	46.3	30	100	1.7	100	87	59	99	71	1
LD20-107	53.6	26	100	1.8	100	82	57	100	60	3
LD20-108	19.5	31	100	2.0	6	40	17	100	28	32
LD20-109	15.3	30	100	2.0	7	39	12	100	31	30
LD20-110	14.6	19	100	2.0	0	28	13	100	18	39
LD20-111	22.8	29	100	2.0	3	41	23	100	24	35
LD20-112	9.2	36	100	2.0	0	31	8	99	25	34
LD20-115	6.9	12	100	2.0	100	61	6	100	49	6
LD20-116	7.2	10	100	2.0	60	53	7	100	49	5
LD21-001	17.7	21	100	2.0	0	38	15	93	25	37
LD21-002	23.7	22	100	2.0	9	43	23	99	26	32
LD21-003	19.4	22	100	2.0	5	41	17	99	29	30
LD21-004	24.9	17	100	2.0	0	35	20	100	19	38
LD21-005	37.5	20	100	2.0	85	53	32	100	19	38
LD21-007	22.2	27	100	2.0	15	46	23	100	30	29
LD21-008	44.2	23	100	2.0	87	57	37	100	32	29
LD21-009	24.6	24	100	2.0	4	41	19	97	28	36
LD21-010	33.1	23	100	2.0	4	41	28	99	19	38
LD21-011	14.2	36	100	2.0	81	55	11	100	49	5
LD21-012	37.7	18	100	2.0	11	47	34	100	19	38
LD21-013	8.3	21	100	2.0	0	30	7	96	24	36
LD21-014	17.8	14	100	2.0	0	40	19	100	26	33
LD21-015	10.6	14	100	2.0	0	32	13	100	22	36
LD21-016	13.2	25	100	2.0	0	34	14	93	24	38

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-017	10.3	33	100	2.0	0	38	10	88	32	32
LD21-018	21.6	24	100	1.9	100	66	22	100	57	5
LD21-019	5.1	8	100	2.0	0	37	5	100	33	25
LD21-020	5.3	1	100	1.0	100	100	3	.	.	.
LD21-021	10.8	35	100	2.0	0	38	7	92	34	28
LD21-022	27.7	20	100	2.0	0	41	26	100	19	38
LD21-023	52.5	19	100	2.0	100	62	39	100	17	39
LD21-024	36.6	21	100	2.0	86	54	36	100	26	32
LD21-025	40.0	21	100	2.0	33	46	29	100	18	39
LD21-027	50.8	21	100	2.0	100	64	48	100	27	31
LD21-028	16.2	22	100	2.0	0	28	11	100	19	38
LD21-029	38.3	24	100	1.8	100	80	44	100	65	0
LD21-030	33.0	23	100	1.8	100	81	35	100	71	0
LD21-031	38.1	5	100	1.0	100	100	45	.	.	.
LD21-032	42.4	19	100	1.9	100	63	43	100	35	31
LD21-033	29.8	43	100	1.9	100	77	30	100	67	0
LD21-034	18.2	36	100	2.0	56	51	13	100	44	11
LD21-036	8.0	9	100	2.0	0	36	7	100	31	28
LD21-038	43.6	2	100	1.0	100	100	47	.	.	.
LD21-040	10.7	23	100	2.0	9	44	6	100	41	15
LD21-042	38.1	25	100	1.9	100	71	49	100	40	24
LD21-043	34.8	23	100	2.0	43	51	30	100	31	31
LD21-044	48.1	26	100	1.9	100	75	54	100	45	19
LD21-045	30.3	25	100	2.0	32	49	31	99	26	33
LD21-046	28.5	21	100	2.0	14	44	27	100	22	36
LD21-047	21.5	29	100	1.9	48	57	23	96	45	22
LD21-048	35.5	19	100	2.0	100	56	40	100	28	30
LD21-049	13.0	36	100	2.0	47	50	8	100	46	9
LD21-050	17.9	17	100	2.0	12	44	25	90	28	34

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-052	22.3	20	100	2.0	20	46	22	99	24	34
LD21-054	11.1	31	58	2.0	6	44	10	86	39	23
LD21-055	24.0	20	100	2.0	0	42	21	100	24	34
LD21-056	10.1	36	100	1.7	100	79	10	100	76	0
LD21-057	39.7	30	100	1.9	100	66	39	99	45	17
LD21-058	42.8	29	100	1.9	100	72	44	99	52	8
LD21-059	26.6	26	100	2.0	0	37	20	100	21	36
LD21-060	34.9	26	100	2.0	100	61	37	100	37	20
LD21-061	40.8	30	100	1.9	100	70	34	100	55	6
LD21-062	13.3	28	100	2.0	0	35	10	100	28	30
LD21-063	24.3	29	100	2.0	24	48	22	100	34	25
LD21-064	15.5	28	100	2.0	0	40	14	100	30	29
LD21-065	18.9	26	100	2.0	0	36	19	99	22	36
LD21-066	27.2	35	100	2.0	66	53	22	100	39	17
LD21-067	13.0	21	100	2.0	0	31	13	100	21	36
LD21-068	8.1	24	100	2.0	0	35	7	100	30	28
LD21-069	11.6	21	100	2.0	0	33	10	100	26	33
LD21-070	7.0	30	100	2.0	0	24	6	100	19	38
LD21-071	39.5	24	100	2.0	100	71	45	98	49	4
LD21-072	33.7	24	100	2.0	100	69	32	100	54	1
LD21-073	17.0	13	100	2.0	0	40	12	100	26	33
LD21-074	11.3	26	100	2.0	0	43	10	100	36	22
LD21-075	15.3	26	100	2.0	0	38	15	100	27	31
LD21-076	20.4	24	100	2.0	0	39	19	100	25	33
LD21-077	5.5	19	100	2.0	0	26	6	100	19	38
LD21-078	5.5	1	100	2.0	0	26	5	92	23	39
LD21-079	16.9	21	100	2.0	0	38	12	90	27	37
LD21-080	9.4	24	100	2.0	0	24	9	100	17	40
LD21-081	9.6	25	100	2.0	0	26	9	100	20	38

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-082	21.0	25	100	2.0	4	39	16	100	28	34
LD21-083	11.9	18	100	2.0	0	28	8	100	22	36
LD21-084	16.0	26	100	2.0	0	34	15	100	23	35
LD21-086	6.1	28	100	2.0	4	35	6	100	31	28
LD21-088	23.3	19	100	1.9	100	64	23	100	53	5
LD21-089	6.7	24	100	2.0	0	26	6	100	21	36
LD21-091	14.1	19	100	2.0	0	37	19	100	31	28
LD21-092	39.1	24	100	1.8	100	74	44	100	54	10
LD21-095	7.6	24	100	2.0	0	32	5	100	28	30
LD21-096	9.9	25	100	2.0	0	36	9	100	30	28
LD21-098	7.5	27	100	2.0	0	41	7	100	37	20
LD21-099	46.8	28	100	1.8	100	82	57	100	59	2
LD21-100	31.0	24	100	1.8	100	76	35	100	63	0
LD21-101	46.8	26	100	1.8	100	76	52	100	51	13
LD21-102	37.6	26	100	1.8	100	84	44	99	73	0
LD21-103	11.8	22	100	2.0	0	43	12	99	35	23
LD21-104	8.5	26	100	2.0	0	45	7	100	41	15
LD21-105	12.2	24	100	2.0	42	49	13	100	42	13
LD21-106	43.4	27	100	1.8	100	83	54	99	64	1
LD21-107	47.4	23	100	1.8	100	77	49	100	55	9
LD21-108	19.3	30	100	2.0	3	38	16	100	26	32
LD21-109	16.8	17	100	1.9	6	42	14	100	33	31
LD21-110	15.7	19	100	2.0	0	34	19	100	19	38
LD21-111	16.4	19	100	2.0	0	31	14	100	20	38
LD21-112	27.8	22	100	1.9	100	74	37	100	59	1
LD21-113	6.8	18	100	2.0	0	33	6	96	27	33
LD21-114	7.6	13	100	1.9	100	67	7	100	66	0
LD21-115	6.3	7	100	2.0	29	49	5	100	46	7
SD20-001	24.6	20	100	2.0	0	45	19	96	25	34

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Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD20-002	14.1	21	100	2.0	0	35	15	99	25	34
SD20-003	42.2	18	100	2.0	100	55	42	100	23	35
SD20-004	46.5	19	100	2.0	100	60	40	100	24	35
SD20-005	34.8	20	100	2.0	100	54	29	100	26	32
SD20-006	14.5	22	100	2.0	0	34	16	98	21	38
SD20-007	33.6	19	100	2.0	5	47	36	100	20	38
SD20-008	12.6	18	100	2.0	0	38	11	86	31	34
SD20-009	12.0	22	100	1.9	64	57	10	100	52	8
SD20-010	20.1	20	100	2.0	0	39	20	100	18	39
SD20-011	27.5	20	100	2.0	25	48	22	100	22	35
SD20-012	18.8	22	100	2.0	0	42	16	100	24	34
SD20-013	25.1	20	100	2.0	40	47	25	99	27	31
SD20-014	32.1	37	100	2.0	100	65	31	100	49	6
SD20-015	18.1	35	100	2.0	37	45	12	100	38	19
SD20-016	12.9	37	100	2.0	46	50	9	100	45	10
SD20-017	8.8	36	100	2.0	0	39	7	90	35	27
SD20-018	24.4	20	100	2.0	5	44	22	100	28	30
SD20-019	33.6	22	100	2.0	77	53	32	100	32	30
SD20-020	35.4	24	100	1.8	100	78	40	100	64	1
SD20-021	41.2	20	100	2.0	100	67	50	100	34	24
SD20-022	30.0	16	100	2.0	38	49	27	100	29	29
SD20-023	11.1	25	56	1.9	56	56	10	82	52	14
SD20-024	22.0	22	100	2.0	0	44	20	100	31	28
SD20-025	23.4	19	100	2.0	5	43	24	100	23	35
SD20-026	12.6	25	100	2.0	0	26	8	100	19	38
SD20-027	24.0	26	100	2.0	23	44	20	100	30	28
SD20-028	43.9	28	100	1.9	100	72	42	100	53	8
SD20-029	10.5	22	100	2.0	0	28	9	100	19	39
SD20-030	14.7	19	100	2.0	0	33	17	99	21	37

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD20-031	22.0	19	100	2.0	5	45	23	100	30	29
SD20-032	23.9	23	100	2.0	96	57	23	100	45	10
SD20-033	14.4	18	100	2.0	0	31	12	100	22	36
SD20-034	10.1	21	100	2.0	0	31	10	100	25	33
SD20-035	12.2	22	100	2.0	0	36	12	100	28	31
SD20-036	17.9	24	100	2.0	0	41	12	100	24	34
SD20-037	13.8	17	100	2.0	65	50	12	100	43	11
SD20-038	42.8	26	100	1.8	100	82	50	99	65	0
SD20-039	21.3	18	100	2.0	100	57	24	100	44	11
SD20-040	38.7	24	100	1.8	100	77	48	100	56	6
SD20-041	29.1	21	100	2.0	100	58	30	100	40	16
SD20-042	7.9	18	100	2.0	0	31	6	100	26	33
SD20-043	17.4	29	100	2.0	7	38	15	100	28	33
SD20-044	13.1	22	100	2.0	0	32	16	100	21	37
SD20-046	5.5	1	100	2.0	0	28	5	100	26	32
SD20-049	6.4	11	100	2.0	100	61	6	100	53	2
SD21-001	28.8	18	100	2.0	22	47	20	96	24	35
SD21-002	29.3	16	100	2.0	12	46	23	100	26	32
SD21-003	25.9	18	100	2.0	0	43	26	100	23	35
SD21-004	34.1	17	100	2.0	35	49	33	100	23	35
SD21-005	39.3	19	100	2.0	100	57	31	100	26	33
SD21-006	13.8	22	100	2.0	0	32	15	99	20	38
SD21-007	11.5	22	100	1.9	64	57	10	100	52	8
SD21-008	13.9	17	100	2.0	0	38	11	85	31	35
SD21-009	23.1	16	100	2.0	0	38	20	99	23	36
SD21-010	15.9	22	100	2.0	0	38	10	100	21	36
SD21-011	35.7	17	100	2.0	71	52	32	100	27	31
SD21-012	19.6	22	100	2.0	0	42	16	100	24	34
SD21-013	20.5	18	100	2.0	0	43	22	99	28	31

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-014	41.5	35	100	2.0	100	63	39	100	39	17
SD21-015	13.9	36	100	2.0	67	54	9	100	50	6
SD21-016	8.1	36	100	2.0	33	46	6	100	43	12
SD21-017	10.1	36	100	2.0	0	36	8	99	31	28
SD21-018	21.5	36	100	2.0	53	51	16	100	41	14
SD21-019	45.0	24	100	1.9	100	70	46	100	44	23
SD21-020	26.2	21	81	2.0	81	55	16	88	48	8
SD21-021	18.3	18	100	2.0	0	39	21	99	23	35
SD21-022	33.2	18	100	2.0	100	62	30	100	46	9
SD21-023	16.0	16	100	2.0	100	65	24	84	35	26
SD21-024	28.4	17	100	2.0	59	53	31	98	30	29
SD21-025	17.1	22	100	2.0	5	40	16	100	29	30
SD21-026	16.8	22	100	2.0	0	34	16	100	22	36
SD21-027	26.2	25	100	2.0	68	52	22	99	39	18
SD21-028	49.5	26	100	1.9	100	74	50	99	50	11
SD21-029	17.3	16	100	2.0	0	35	13	100	21	37
SD21-030	8.8	18	100	2.0	0	25	7	100	19	38
SD21-031	11.5	20	100	2.0	0	37	12	100	29	29
SD21-032	33.8	24	100	2.0	100	68	35	99	51	2
SD21-033	14.4	18	100	2.0	0	32	13	100	22	36
SD21-034	18.9	24	100	2.0	21	45	13	100	25	33
SD21-035	11.1	22	100	2.0	0	35	10	100	28	31
SD21-037	10.7	22	100	2.0	0	33	10	100	26	32
SD21-038	33.4	19	100	2.0	100	62	35	100	42	13
SD21-039	39.0	23	100	1.8	100	76	48	100	55	8
SD21-040	47.5	25	100	1.8	100	86	59	97	69	0
SD21-041	10.0	20	100	2.0	0	44	9	100	38	19
SD21-042	20.3	18	100	1.9	100	62	20	100	53	2
SD21-043	17.9	29	100	2.0	7	39	15	100	28	32

Table 1: General Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-044	12.7	22	100	2.0	0	33	15	100	20	37
SD21-045	7.1	21	100	2.0	0	31	7	100	26	32
SD21-049	6.9	12	100	1.9	100	65	6	100	54	1

Table 2: Primary Elections

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
CD20-001	41.9	17	100	4.0	100	61	62	69	47	10
CD20-002	18.2	22	100	3.6	68	56	25	69	52	16
CD20-003	18.7	18	100	3.9	78	55	40	66	48	19
CD20-004	24.4	20	100	3.8	80	61	33	67	57	9
CD20-005	10.7	19	100	3.8	58	52	22	64	48	14
CD20-006	32.0	18	100	4.1	72	53	47	60	46	19
CD20-007	15.4	20	100	3.8	80	53	29	63	50	4
CD20-008	25.9	17	100	4.0	76	54	52	60	48	17
CD20-009	17.4	20	100	4.3	60	50	32	64	45	10
CD20-010	10.1	18	100	3.9	72	52	25	62	49	24
CD20-011	3.7	2	100	3.5	50	50	5	82	46	26
CD20-012	34.1	23	100	3.6	87	61	54	69	51	17
CD20-013	13.9	18	100	3.9	78	56	33	61	53	11
CD21-001	22.4	18	100	3.9	78	55	42	66	48	16
CD21-002	39.1	17	100	4.0	100	61	60	70	47	11
CD21-003	15.7	22	100	3.7	68	53	27	66	46	11
CD21-004	27.5	17	100	4.0	71	54	55	61	47	17
CD21-005	23.2	21	100	3.6	71	58	32	69	54	16
CD21-006	20.4	18	100	4.3	61	50	24	74	45	19
CD21-007	15.3	18	100	3.9	67	52	31	62	48	22
CD21-008	16.5	18	100	3.9	72	52	35	63	46	22
CD21-009	36.3	23	100	3.6	83	61	55	69	51	17
CD21-010	16.2	18	100	3.9	78	53	35	62	48	22
CD21-011	19.2	17	100	4.0	71	53	35	64	47	20
CD21-012	17.1	19	100	3.8	74	53	36	63	48	18
CD21-013	14.8	20	100	3.9	80	54	31	65	49	10
CD21-014	3.6	2	100	3.5	50	50	5	82	46	26
LD20-001	36.6	18	100	3.9	89	57	57	73	38	17
LD20-002	25.7	18	100	3.9	89	58	46	71	47	10

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Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-003	19.2	22	100	3.6	64	54	41	66	44	22
LD20-004	20.6	18	100	3.9	89	58	52	70	45	10
LD20-005	41.0	20	100	3.7	95	61	61	69	47	15
LD20-006	7.1	16	100	4.1	75	52	15	64	51	6
LD20-007	22.4	23	100	3.5	96	66	49	81	52	2
LD20-008	42.5	19	100	3.8	95	60	59	67	49	12
LD20-009	27.9	19	100	3.8	79	58	38	67	52	8
LD20-010	22.0	17	100	4.0	76	54	44	72	36	15
LD20-011	15.4	22	100	3.6	50	47	15	70	42	25
LD20-012	36.9	18	100	3.9	89	60	61	67	48	5
LD20-013	7.9	17	100	4.0	65	52	22	66	47	9
LD20-014	17.8	16	100	4.1	94	56	47	62	51	11
LD20-015	10.7	16	100	4.1	75	52	38	62	46	8
LD20-016	18.3	19	100	3.8	79	52	39	61	46	4
LD20-017	10.1	22	100	3.6	73	55	25	64	51	12
LD20-018	21.1	19	100	3.8	79	56	35	62	53	11
LD20-019	6.3	20	100	3.8	55	51	10	64	49	10
LD20-020	5.5	15	100	4.1	60	54	8	77	52	5
LD20-021	37.4	23	100	3.6	87	56	63	62	45	15
LD20-022	29.3	23	100	3.7	91	58	56	70	43	7
LD20-023	50.6	21	100	3.8	86	61	66	67	46	11
LD20-024	38.2	19	100	3.8	95	63	63	68	52	10
LD20-025	42.6	12	100	4.2	92	57	69	63	46	10
LD20-026	16.5	19	100	3.8	63	53	35	66	46	24
LD20-027	51.6	23	100	3.6	78	57	59	71	37	30
LD20-028	15.8	19	100	3.8	95	56	35	65	51	7
LD20-029	37.2	24	100	3.6	67	61	37	78	50	12
LD20-030	28.2	23	100	3.6	70	59	32	73	52	13
LD20-031	39.8	24	100	3.6	92	63	57	73	49	14

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-032	48.1	20	100	3.7	100	68	65	78	51	8
LD20-033	39.9	23	100	3.6	83	62	58	74	48	16
LD20-034	11.5	22	100	3.6	32	42	12	73	38	39
LD20-035	18.0	24	100	3.5	71	58	31	67	55	18
LD20-036	7.5	24	100	3.5	58	52	13	62	50	13
LD20-037	11.3	23	100	3.6	57	52	23	63	49	13
LD20-038	39.4	22	100	3.5	77	60	52	68	53	22
LD20-040	11.3	21	100	3.6	43	47	17	70	42	25
LD20-041	7.1	22	100	3.6	41	46	11	73	43	23
LD20-042	38.1	10	100	3.0	90	61	76	67	42	12
LD20-043	33.9	19	100	3.9	79	52	51	59	46	26
LD20-044	48.1	19	100	3.9	84	56	76	60	44	32
LD20-045	31.4	20	100	3.9	75	54	60	62	43	25
LD20-046	25.0	18	100	4.0	89	52	41	61	46	11
LD20-047	23.8	24	100	3.7	75	51	23	68	46	8
LD20-048	35.5	22	100	3.7	91	58	63	67	44	16
LD20-049	12.3	22	100	3.6	32	42	10	68	39	37
LD20-050	17.5	20	100	3.8	60	51	28	61	48	13
LD20-052	11.0	18	100	3.9	72	56	26	62	54	9
LD20-054	12.9	18	100	3.9	67	55	18	63	54	0
LD20-055	26.2	20	100	4.1	75	52	51	74	35	21
LD20-056	10.2	22	100	3.8	36	42	8	77	40	29
LD20-057	39.7	20	100	3.9	80	56	56	63	46	18
LD20-058	43.1	21	100	3.8	76	55	60	62	46	25
LD20-059	28.6	21	100	3.9	76	55	60	64	41	19
LD20-060	34.6	20	100	3.9	85	58	60	64	48	12
LD20-061	40.0	20	100	3.9	70	54	35	63	49	17
LD20-062	13.7	21	100	3.8	67	51	27	64	46	9
LD20-063	24.8	20	100	3.8	80	55	43	62	49	13

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-064	15.1	20	100	3.9	65	52	30	60	48	24
LD20-065	19.6	18	100	3.9	89	56	44	66	49	16
LD20-066	24.0	18	100	4.1	78	52	42	63	43	10
LD20-067	7.9	18	100	3.9	61	50	22	70	44	13
LD20-068	8.4	19	100	4.1	84	57	25	65	54	4
LD20-069	11.6	19	100	3.9	79	54	31	64	49	5
LD20-070	7.2	18	100	3.9	83	56	19	67	53	16
LD20-071	40.3	23	100	3.7	87	58	62	63	50	14
LD20-072	34.4	23	100	3.7	70	54	40	65	46	20
LD20-073	14.6	18	100	4.0	72	51	36	64	44	21
LD20-074	11.4	19	100	3.9	63	50	23	64	46	8
LD20-075	15.3	20	100	3.8	75	52	37	65	44	24
LD20-076	21.6	19	100	3.8	95	56	42	61	53	19
LD20-077	7.3	19	100	3.9	79	54	23	62	51	8
LD20-078	6.1	18	100	3.9	67	53	19	62	51	12
LD20-079	22.3	19	100	4.1	84	55	41	68	46	13
LD20-080	9.5	18	100	3.9	83	56	26	63	53	16
LD20-081	9.6	18	100	3.9	78	56	24	62	54	9
LD20-082	20.2	10	100	2.8	100	61	42	70	55	7
LD20-083	19.5	18	100	3.9	78	53	37	64	46	25
LD20-084	14.1	18	100	3.9	89	52	31	64	47	9
LD20-086	6.0	20	100	3.7	65	54	14	66	52	16
LD20-087	5.1	19	100	3.8	74	52	13	66	49	11
LD20-088	16.0	14	100	4.3	64	55	24	67	51	13
LD20-089	7.9	17	100	4.0	88	55	23	61	54	1
LD20-090	3.3	17	100	3.9	53	47	8	70	45	19
LD20-091	4.8	19	100	3.8	63	53	13	65	50	29
LD20-092	40.2	21	100	3.6	81	60	64	67	48	12
LD20-094	5.7	23	100	3.8	52	46	12	58	44	14

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-095	9.6	18	100	3.9	67	51	22	61	48	11
LD20-096	8.9	17	100	4.0	71	50	17	59	48	16
LD20-097	5.5	18	100	3.9	61	55	15	67	52	8
LD20-098	9.2	18	100	3.9	56	54	18	63	52	21
LD20-099	36.0	23	100	3.6	87	62	65	70	47	15
LD20-100	30.5	20	100	3.7	80	57	41	66	51	19
LD20-101	48.0	21	100	3.6	90	62	72	69	44	19
LD20-102	33.8	19	100	4.2	84	59	46	68	52	15
LD20-103	14.2	18	100	3.9	67	53	24	64	49	21
LD20-104	12.0	17	100	3.9	53	46	15	66	43	33
LD20-105	12.9	18	100	4.1	78	55	24	65	52	9
LD20-106	46.3	26	100	3.7	100	64	72	72	44	12
LD20-107	53.6	24	100	3.6	96	64	72	72	44	12
LD20-108	19.5	19	100	3.8	74	53	41	69	43	14
LD20-109	15.3	20	100	3.7	75	53	30	62	49	8
LD20-110	14.6	19	100	3.8	84	53	37	64	47	12
LD20-111	22.8	21	100	3.8	90	57	46	71	45	9
LD20-112	9.2	20	100	3.8	70	51	19	66	47	11
LD20-115	6.9	17	100	4.2	59	54	7	66	54	13
LD20-116	7.2	20	100	4.0	65	56	8	63	55	18
LD20-117	3.6	22	100	3.7	59	51	5	67	50	4
LD21-001	17.7	17	100	4.0	100	56	35	70	49	9
LD21-002	23.7	18	100	3.9	72	56	37	63	52	22
LD21-003	19.4	21	100	3.7	62	52	35	68	43	22
LD21-004	24.9	18	100	4.0	83	56	53	66	45	7
LD21-005	37.5	19	100	3.8	95	59	60	68	45	20
LD21-007	22.2	23	100	3.5	96	66	48	81	52	3
LD21-008	44.2	19	100	3.8	95	60	59	67	48	10
LD21-009	24.6	17	100	4.0	71	56	39	61	52	16

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-010	33.1	18	100	3.9	94	57	58	65	47	16
LD21-011	14.2	22	100	3.6	45	46	14	71	42	31
LD21-012	37.7	17	100	4.0	94	59	60	68	46	6
LD21-013	8.3	18	100	3.9	72	54	19	66	50	14
LD21-014	17.8	16	100	4.1	94	56	47	62	51	11
LD21-015	10.6	17	100	4.1	71	51	39	60	45	6
LD21-016	13.2	17	100	4.0	71	52	38	61	47	6
LD21-017	10.3	23	100	3.6	70	53	25	62	49	12
LD21-018	21.6	20	100	3.9	70	54	35	60	50	11
LD21-019	5.1	20	100	3.8	70	53	10	64	51	11
LD21-020	5.3	14	100	4.1	64	56	8	77	54	5
LD21-021	10.8	22	100	3.6	59	51	16	63	49	15
LD21-022	27.7	21	100	3.8	90	56	55	69	45	10
LD21-023	52.5	19	100	3.8	89	63	67	70	46	11
LD21-024	36.6	18	100	3.9	94	61	61	66	51	11
LD21-025	40.0	19	100	3.8	100	62	63	74	45	13
LD21-026	16.8	10	100	2.8	80	60	37	75	52	30
LD21-027	50.8	22	100	3.7	86	60	62	73	49	14
LD21-028	16.2	20	100	3.8	90	55	36	64	50	7
LD21-029	38.3	24	100	3.6	79	62	43	77	51	12
LD21-030	33.0	23	100	3.6	74	60	30	74	54	13
LD21-032	42.4	18	100	3.9	94	62	60	80	34	15
LD21-033	29.8	22	100	3.6	73	61	34	74	55	8
LD21-034	18.2	22	100	3.6	50	50	18	67	46	28
LD21-036	8.0	8	100	5.2	50	42	13	53	40	0
LD21-040	10.7	22	100	3.6	41	45	14	76	41	28
LD21-042	38.1	10	100	3.0	90	61	76	67	42	12
LD21-043	34.8	19	100	3.9	79	52	52	59	46	26
LD21-044	48.1	19	100	3.9	84	56	76	60	44	32

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-045	30.3	18	100	4.0	78	54	60	63	41	22
LD21-046	28.5	20	100	3.9	80	51	42	64	42	8
LD21-047	21.5	25	100	3.7	80	51	26	66	47	5
LD21-048	35.5	22	100	3.7	91	58	63	67	44	16
LD21-049	13.0	22	100	3.6	27	40	14	77	34	28
LD21-050	17.9	19	100	3.8	63	52	30	61	48	13
LD21-052	22.3	18	100	4.0	78	56	38	62	51	12
LD21-053	18.8	10	100	2.9	90	64	40	68	60	12
LD21-054	11.1	26	100	3.4	38	45	17	58	42	25
LD21-055	24.0	20	100	4.1	75	51	49	74	36	21
LD21-056	10.1	22	100	3.8	36	42	8	77	40	29
LD21-057	39.7	20	100	3.9	80	56	56	63	46	18
LD21-058	42.8	21	100	3.8	76	55	60	63	45	25
LD21-059	26.6	20	100	3.9	75	55	58	65	41	18
LD21-060	34.9	20	100	3.9	85	58	60	64	48	12
LD21-061	40.8	20	100	3.9	70	54	37	63	49	17
LD21-062	13.3	21	100	3.8	67	51	26	64	46	9
LD21-063	24.3	18	100	3.9	78	53	40	63	46	19
LD21-064	15.5	19	100	3.8	68	53	30	61	50	24
LD21-065	18.9	18	100	3.9	89	56	42	66	49	16
LD21-066	27.2	21	100	3.6	76	58	40	66	54	12
LD21-067	13.0	17	100	4.0	76	51	35	68	41	21
LD21-068	8.1	17	100	4.9	82	59	24	66	56	4
LD21-069	11.6	18	100	4.0	78	52	30	63	47	6
LD21-070	7.0	19	100	3.9	79	53	18	67	50	17
LD21-071	39.5	23	100	3.7	87	58	60	63	50	15
LD21-072	33.7	22	100	3.7	68	55	39	65	47	16
LD21-073	17.0	10	100	2.8	90	57	35	72	49	20
LD21-074	11.3	19	100	3.9	68	52	23	64	48	8

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-075	15.3	20	100	3.8	75	52	37	65	44	24
LD21-076	20.4	20	100	3.7	95	57	41	61	54	7
LD21-077	5.5	20	100	3.9	75	52	20	60	50	8
LD21-078	5.5	18	100	3.9	72	53	17	59	51	8
LD21-079	16.9	18	100	3.9	83	57	30	66	53	3
LD21-080	9.4	19	100	3.9	84	54	27	62	51	16
LD21-081	9.6	19	100	3.8	79	55	24	61	54	10
LD21-082	21.0	18	100	3.9	89	56	37	63	52	12
LD21-083	11.9	17	100	4.0	82	53	31	69	45	20
LD21-084	16.0	18	100	3.9	83	52	35	63	46	10
LD21-086	6.1	20	100	3.7	65	54	13	67	51	18
LD21-087	4.9	19	100	3.8	58	51	11	63	49	31
LD21-088	23.3	14	100	4.3	71	55	28	64	52	13
LD21-089	6.7	17	100	4.0	76	52	19	64	49	2
LD21-090	3.5	19	100	3.8	58	49	8	69	47	13
LD21-091	14.1	18	100	3.9	72	51	33	65	46	20
LD21-092	39.1	20	100	3.7	80	59	62	66	48	10
LD21-094	5.3	20	100	3.8	65	51	11	62	50	12
LD21-095	7.6	16	100	4.2	69	50	14	62	48	17
LD21-096	9.9	17	100	4.0	76	53	21	59	51	16
LD21-097	5.5	18	100	3.9	61	54	15	67	52	8
LD21-098	7.5	18	100	3.9	50	50	14	66	48	28
LD21-099	46.8	27	100	3.7	96	62	74	69	44	15
LD21-100	31.0	20	100	3.7	80	57	41	65	51	19
LD21-101	46.8	21	100	3.8	90	60	70	67	43	16
LD21-102	37.6	22	100	3.9	86	59	51	68	50	19
LD21-103	11.8	20	100	3.8	70	53	25	66	49	22
LD21-104	8.5	17	100	3.9	35	40	12	67	37	47
LD21-105	12.2	18	100	4.1	78	55	24	63	52	9

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-106	43.4	27	100	3.7	100	63	68	73	45	13
LD21-107	47.4	23	100	3.6	96	65	68	72	47	14
LD21-108	19.3	19	100	3.8	74	53	38	67	44	15
LD21-110	15.7	19	100	4.0	95	56	46	68	46	11
LD21-111	16.4	19	100	4.0	74	52	33	65	47	10
LD21-112	27.8	20	100	3.7	75	58	48	67	49	18
LD21-113	6.8	19	100	4.0	63	49	13	59	47	3
LD21-114	7.6	19	100	4.4	63	53	7	61	52	9
LD21-115	6.3	17	100	4.2	53	50	6	62	49	13
LD21-117	3.5	10	100	2.8	70	58	5	65	57	4
SD20-001	24.6	17	100	4.0	94	56	41	66	48	10
SD20-002	14.1	20	100	3.9	60	50	32	67	46	23
SD20-003	42.2	18	100	3.9	94	64	61	77	45	7
SD20-004	46.5	18	100	4.1	94	59	65	68	49	12
SD20-005	34.8	17	100	4.0	82	56	49	64	49	21
SD20-006	14.5	17	100	4.0	82	55	45	64	47	10
SD20-007	33.6	20	100	3.8	95	57	62	64	48	7
SD20-008	12.6	21	100	3.7	62	51	27	64	44	20
SD20-009	12.0	18	100	3.9	72	54	20	62	53	13
SD20-010	20.1	19	100	3.9	89	57	47	65	49	14
SD20-011	27.5	18	100	3.9	89	60	52	69	48	14
SD20-012	18.8	21	100	3.7	67	54	41	62	47	5
SD20-013	25.1	25	100	3.9	72	52	32	64	47	4
SD20-014	32.1	22	100	3.6	82	61	44	73	52	8
SD20-015	18.1	22	100	3.5	64	55	23	64	53	12
SD20-016	12.9	22	100	3.6	41	45	15	75	40	24
SD20-017	8.8	22	100	3.6	55	49	15	63	47	21
SD20-018	24.4	20	100	3.8	90	63	46	74	53	11
SD20-019	33.6	18	100	4.0	78	53	56	59	45	16

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD20-020	35.4	24	100	3.6	71	61	42	74	52	13
SD20-021	41.2	21	100	3.8	76	57	73	61	46	16
SD20-022	30.0	21	100	3.9	76	59	41	66	55	0
SD20-023	11.1	23	100	3.9	48	48	13	58	47	6
SD20-024	22.0	18	100	3.9	83	55	43	63	49	18
SD20-025	23.4	18	100	4.0	67	53	44	62	46	20
SD20-026	12.6	17	100	4.0	82	55	29	63	51	5
SD20-027	24.0	21	100	3.8	76	54	45	62	48	5
SD20-028	43.9	20	100	3.9	70	55	50	64	46	17
SD20-029	10.5	18	100	3.9	78	56	28	63	53	10
SD20-030	14.7	18	100	3.9	78	51	38	60	47	22
SD20-031	22.0	19	100	3.8	79	54	49	64	45	24
SD20-032	23.9	21	100	3.7	62	51	35	65	44	25
SD20-033	14.4	19	100	3.8	95	55	35	63	52	8
SD20-034	10.1	19	100	4.0	74	51	24	60	48	10
SD20-035	12.2	19	100	3.9	84	55	32	62	51	6
SD20-036	17.9	18	100	3.9	83	53	37	65	46	17
SD20-037	13.8	16	100	4.2	56	46	18	62	43	29
SD20-038	42.8	25	100	3.7	92	62	63	69	50	17
SD20-039	21.3	20	100	3.8	80	55	40	66	48	15
SD20-040	38.7	24	100	3.8	88	62	65	69	47	16
SD20-041	29.1	23	100	3.6	83	60	50	69	51	17
SD20-042	7.9	17	100	4.0	82	52	18	60	51	2
SD20-043	17.4	19	100	3.8	79	54	36	65	47	8
SD20-044	13.1	18	100	3.9	72	54	35	66	48	10
SD20-045	3.3	1	100	2.0	0	38	6	72	33	44
SD20-046	5.5	20	100	3.7	65	54	12	63	52	7
SD20-047	5.1	18	100	3.9	39	45	9	65	42	23
SD20-049	6.4	19	100	4.2	68	56	6	63	55	11

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-001	28.8	17	100	4.0	88	57	46	67	47	7
SD21-002	29.3	17	100	4.0	94	60	48	70	49	9
SD21-003	25.9	21	100	4.0	90	57	46	70	46	10
SD21-004	34.1	17	100	4.0	88	59	59	66	48	12
SD21-005	39.3	17	100	4.0	94	59	56	65	50	12
SD21-006	13.8	18	100	4.1	83	55	44	63	48	9
SD21-007	11.5	17	100	4.1	71	54	19	62	53	14
SD21-008	13.9	20	100	3.8	65	51	25	64	46	15
SD21-009	23.1	17	100	4.0	94	56	50	66	46	5
SD21-010	15.9	20	100	3.8	80	54	35	65	48	13
SD21-011	35.7	19	100	4.0	84	61	59	74	45	12
SD21-012	19.6	20	100	3.8	65	53	42	62	46	18
SD21-013	20.5	18	100	3.9	78	60	37	66	56	0
SD21-014	41.5	22	100	3.6	86	62	61	75	43	21
SD21-015	13.9	22	100	3.6	36	43	12	72	39	32
SD21-016	8.1	22	100	3.6	45	45	11	76	42	21
SD21-017	10.1	22	100	3.6	64	54	20	62	52	6
SD21-018	21.5	22	100	3.5	64	56	27	64	53	12
SD21-019	45.0	19	100	3.9	74	54	69	58	45	17
SD21-020	26.2	21	100	3.8	67	55	33	76	47	14
SD21-021	18.3	18	100	3.9	61	50	41	59	44	5
SD21-022	33.2	23	100	3.6	74	60	37	73	52	14
SD21-023	16.0	24	100	3.6	58	51	21	60	50	18
SD21-024	28.4	23	100	3.8	78	53	42	69	44	6
SD21-025	17.1	19	100	3.8	84	56	34	62	53	15
SD21-026	16.8	18	100	3.9	78	54	39	62	50	25
SD21-027	26.2	21	100	3.9	67	53	36	62	47	12
SD21-028	49.5	20	100	3.9	85	57	65	63	46	17
SD21-029	17.3	17	100	4.0	76	50	39	67	41	21

Table 2: Primary Elections *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-030	8.8	18	100	3.9	83	56	24	62	54	10
SD21-031	11.5	19	100	3.9	68	49	30	64	42	23
SD21-032	33.8	22	100	3.7	68	54	46	63	45	24
SD21-033	14.4	20	100	3.8	95	56	34	62	53	7
SD21-034	18.9	20	100	3.7	85	55	38	63	50	4
SD21-035	11.1	18	100	4.0	83	54	30	62	50	7
SD21-036	4.2	18	100	3.9	56	48	10	65	46	14
SD21-037	10.7	17	100	4.0	71	52	23	62	49	11
SD21-038	33.4	23	100	3.6	91	61	55	71	49	15
SD21-039	39.0	24	100	3.5	92	63	65	70	47	14
SD21-040	47.5	24	100	3.8	100	64	71	70	49	16
SD21-041	10.0	17	100	3.9	65	51	20	66	47	20
SD21-042	20.3	18	100	4.1	72	56	26	64	53	10
SD21-043	17.9	19	100	3.8	79	54	37	65	47	9
SD21-044	12.7	19	100	4.0	74	53	35	67	45	11
SD21-045	7.1	17	100	4.0	82	55	18	61	53	1
SD21-046	4.6	17	100	4.0	59	52	7	72	50	7
SD21-048	5.2	20	100	3.9	55	47	9	60	45	3
SD21-049	6.9	19	100	4.2	68	56	7	62	55	11

Table 3: General Elections (contests with Black candidate)

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
CD20-001	41.9	4	100	2.0	100	54	38	100	21	37
CD20-002	18.2	6	100	2.0	17	47	14	99	38	19
CD20-003	18.7	5	100	2.0	0	36	18	98	22	37
CD20-004	24.4	3	100	2.0	100	68	21	93	39	21
CD20-005	10.7	3	100	2.0	0	33	10	100	24	34
CD20-006	32.0	3	100	2.0	100	60	30	100	41	15
CD20-007	15.4	3	100	2.0	0	41	13	91	32	30
CD20-008	25.9	4	100	2.0	0	48	30	100	26	32
CD20-009	17.4	4	100	2.0	0	43	16	100	31	28
CD20-010	10.1	3	100	2.0	0	31	11	100	25	33
CD20-012	34.1	7	100	1.7	100	76	39	99	62	7
CD20-013	13.9	3	100	2.0	0	32	12	100	22	36
CD21-001	22.4	5	100	2.0	0	38	19	98	22	37
CD21-002	39.1	3	100	2.0	100	53	34	100	23	35
CD21-003	15.7	3	100	2.0	0	42	14	93	32	29
CD21-004	27.5	3	100	2.0	0	48	34	100	26	32
CD21-005	23.2	6	100	2.0	33	47	18	99	36	22
CD21-006	20.4	3	100	2.0	100	65	17	100	40	17
CD21-007	15.3	3	100	2.0	0	38	12	100	27	32
CD21-008	16.5	4	100	2.0	0	40	14	100	28	30
CD21-009	36.3	7	100	1.7	100	79	43	99	64	3
CD21-010	16.2	3	100	2.0	0	34	11	100	23	35
CD21-011	19.2	3	100	2.0	0	34	15	100	25	33
CD21-012	17.1	3	100	2.0	0	42	18	100	32	26
CD21-013	14.8	3	100	2.0	0	37	14	100	27	32
LD20-001	36.6	4	100	2.0	0	47	28	100	18	39
LD20-002	25.7	5	100	2.0	0	43	25	100	24	34
LD20-003	19.2	7	100	2.0	0	39	19	100	25	33
LD20-004	20.6	4	100	2.0	0	36	15	100	16	41

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-005	41.0	3	100	2.0	100	55	33	100	18	39
LD20-006	7.1	5	100	2.0	0	34	7	84	25	49
LD20-007	22.4	4	100	2.0	0	43	23	100	26	32
LD20-008	42.5	6	100	2.0	33	51	33	100	26	32
LD20-009	27.9	4	100	2.0	0	43	21	100	27	31
LD20-010	22.0	5	100	2.0	0	35	23	100	15	41
LD20-011	15.4	6	100	2.0	83	54	13	100	48	6
LD20-012	36.9	7	100	2.0	14	47	38	100	15	41
LD20-013	7.9	2	100	2.0	0	27	9	94	18	42
LD20-014	17.8	5	100	2.0	0	40	20	100	25	33
LD20-015	10.7	5	100	2.0	0	31	12	100	22	36
LD20-016	18.3	5	100	2.0	0	36	17	95	24	37
LD20-017	10.1	11	100	2.0	0	37	11	90	30	34
LD20-018	21.1	3	100	2.0	100	62	21	100	51	5
LD20-019	6.3	1	100	2.0	0	37	6	100	33	25
LD20-021	37.4	5	100	2.0	20	44	29	100	21	37
LD20-022	29.3	4	100	2.0	0	43	28	100	18	39
LD20-023	50.6	6	100	2.0	100	60	38	100	16	41
LD20-024	38.2	8	100	2.0	100	56	37	100	28	29
LD20-025	42.6	4	100	2.0	0	40	34	99	14	42
LD20-026	16.5	5	100	2.0	0	31	11	100	22	36
LD20-027	51.6	6	100	2.0	100	63	44	100	20	37
LD20-028	15.8	5	100	2.0	0	27	10	100	19	38
LD20-029	37.2	10	100	1.6	100	87	40	100	78	0
LD20-030	28.2	4	100	2.0	100	59	25	100	45	11
LD20-031	39.8	8	100	1.6	100	84	48	100	71	0
LD20-032	48.1	10	100	2.0	100	63	50	100	28	31
LD20-033	39.9	6	100	2.0	100	61	38	99	38	19

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-034	11.5	6	100	2.0	0	40	6	100	36	22
LD20-035	18.0	6	67	2.0	33	46	12	64	44	39
LD20-036	7.5	3	33	2.0	67	56	6	59	56	15
LD20-037	11.3	6	100	2.0	0	34	10	100	27	31
LD20-038	39.4	10	100	1.6	100	83	42	98	72	2
LD20-040	11.3	6	100	2.0	0	38	7	100	33	25
LD20-041	7.1	3	100	2.0	0	43	6	94	40	16
LD20-042	38.1	6	100	2.0	100	66	48	100	36	22
LD20-043	33.9	6	100	2.0	0	47	29	100	26	32
LD20-044	48.1	5	100	2.0	100	71	52	100	40	16
LD20-045	31.4	7	100	2.0	57	50	32	100	27	32
LD20-046	25.0	5	100	2.0	20	42	27	99	21	37
LD20-047	23.8	6	100	2.0	17	43	24	98	26	32
LD20-048	35.5	6	100	2.0	100	56	40	100	29	30
LD20-049	12.3	6	100	2.0	50	49	7	100	45	10
LD20-050	17.5	3	100	2.0	0	41	24	92	25	37
LD20-052	11.0	4	100	2.0	0	26	10	100	18	38
LD20-054	12.9	8	50	2.0	0	43	9	91	38	22
LD20-055	26.2	5	100	2.0	0	42	25	100	22	36
LD20-056	10.2	7	100	2.0	100	71	10	100	66	0
LD20-057	39.7	5	100	2.0	100	58	38	98	33	25
LD20-058	43.1	8	100	2.0	100	69	45	96	47	8
LD20-059	28.6	5	100	2.0	0	37	24	100	17	40
LD20-060	34.6	8	100	2.0	88	59	38	100	34	24
LD20-061	40.0	8	100	2.0	100	64	31	100	48	8
LD20-062	13.7	5	100	2.0	0	32	11	100	24	34
LD20-063	24.8	4	100	2.0	0	48	24	100	32	27
LD20-064	15.1	4	100	2.0	0	39	14	100	29	30

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-065	19.6	5	100	2.0	0	33	19	94	19	43
LD20-066	24.0	4	100	2.0	0	42	21	100	22	36
LD20-067	7.9	7	100	2.0	0	21	6	100	16	40
LD20-068	8.4	5	100	2.0	0	36	7	100	31	27
LD20-069	11.6	5	100	2.0	0	34	11	100	26	32
LD20-070	7.2	4	100	2.0	0	24	6	100	19	38
LD20-071	40.3	7	100	1.9	100	76	46	99	56	4
LD20-072	34.4	8	100	2.0	100	71	34	100	56	1
LD20-073	14.6	3	100	2.0	0	35	19	100	28	31
LD20-074	11.4	6	100	2.0	0	45	11	100	38	19
LD20-075	15.3	5	100	2.0	0	38	15	100	27	32
LD20-076	21.6	7	100	2.0	0	41	20	100	26	32
LD20-077	7.3	4	100	2.0	0	26	7	100	19	38
LD20-079	22.3	7	100	2.6	14	34	16	98	15	41
LD20-080	9.5	7	100	2.0	0	23	8	100	16	40
LD20-081	9.6	5	100	2.0	0	26	8	100	19	38
LD20-082	20.2	1	100	2.0	0	40	18	100	27	32
LD20-083	19.5	5	100	2.0	60	48	12	100	24	34
LD20-084	14.1	6	100	2.0	0	31	13	100	21	37
LD20-086	6.0	4	100	2.0	0	32	6	100	28	31
LD20-088	16.0	4	100	2.0	100	56	18	99	47	6
LD20-089	7.9	4	100	2.0	0	27	7	100	22	36
LD20-091	4.8	2	100	2.0	0	23	6	100	16	40
LD20-092	40.2	9	100	1.7	100	80	47	100	63	9
LD20-095	9.6	6	100	2.0	0	32	8	100	26	32
LD20-096	8.9	4	100	2.0	0	35	7	100	30	30
LD20-098	9.2	6	100	2.0	0	41	8	100	36	22
LD20-099	36.0	6	100	2.0	100	63	42	99	38	20

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-100	30.5	8	100	1.6	100	82	36	100	71	0
LD20-101	48.0	10	100	1.7	100	82	55	99	60	12
LD20-102	33.8	9	100	1.6	100	87	40	98	79	0
LD20-103	14.2	4	100	2.0	0	47	14	100	38	19
LD20-104	12.0	6	100	2.0	0	47	10	100	41	16
LD20-105	12.9	6	100	2.0	50	49	13	100	41	14
LD20-106	46.3	15	100	1.5	100	91	60	99	79	2
LD20-107	53.6	10	100	1.6	100	87	58	99	70	4
LD20-108	19.5	8	100	2.0	0	38	17	100	25	33
LD20-109	15.3	8	100	2.0	0	35	12	100	27	32
LD20-110	14.6	3	100	2.0	0	28	13	100	17	39
LD20-111	22.8	6	100	2.0	0	38	22	100	20	37
LD20-112	9.2	4	100	2.0	0	28	8	100	22	36
LD20-115	6.9	1	100	2.0	100	59	6	100	44	11
LD20-116	7.2	1	100	2.0	0	49	7	100	46	7
LD21-001	17.7	5	100	2.0	0	35	15	91	22	42
LD21-002	23.7	5	100	2.0	20	43	23	99	26	32
LD21-003	19.4	6	100	2.0	0	38	18	100	25	34
LD21-004	24.9	3	100	2.0	0	33	19	100	17	40
LD21-005	37.5	3	100	2.0	67	51	30	100	17	40
LD21-007	22.2	4	100	2.0	0	43	22	100	27	32
LD21-008	44.2	6	100	2.0	83	54	36	100	28	30
LD21-009	24.6	5	100	2.0	0	37	19	98	23	37
LD21-010	33.1	5	100	2.0	0	38	26	100	17	40
LD21-011	14.2	6	100	2.0	83	52	11	100	46	8
LD21-012	37.7	5	100	2.0	0	45	34	100	16	41
LD21-013	8.3	6	100	2.0	0	28	7	97	22	37
LD21-014	17.8	5	100	2.0	0	40	20	100	25	33

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-015	10.6	5	100	2.0	0	32	13	100	22	36
LD21-016	13.2	5	100	2.0	0	34	14	95	23	38
LD21-017	10.3	11	100	2.0	0	37	11	90	31	32
LD21-018	21.6	3	100	2.0	100	62	21	100	52	4
LD21-019	5.1	1	100	2.0	0	34	5	100	31	28
LD21-021	10.8	6	100	2.0	0	35	7	87	31	37
LD21-022	27.7	4	100	2.0	0	39	26	100	17	40
LD21-023	52.5	6	100	2.0	100	61	39	100	15	41
LD21-024	36.6	8	100	2.0	100	55	37	100	28	29
LD21-025	40.0	5	100	2.0	20	42	30	99	14	42
LD21-027	50.8	8	100	2.0	100	64	48	100	26	32
LD21-028	16.2	5	100	2.0	0	26	10	100	17	40
LD21-029	38.3	8	100	1.6	100	85	44	100	74	0
LD21-030	33.0	7	100	1.6	100	87	34	100	80	0
LD21-031	38.1	3	100	1.0	100	100	44	.	.	.
LD21-032	42.4	4	100	2.0	100	57	43	100	26	32
LD21-033	29.8	10	100	1.6	100	83	31	99	76	0
LD21-034	18.2	6	100	2.0	33	48	13	100	41	15
LD21-036	8.0	2	100	2.0	0	36	7	100	30	28
LD21-038	43.6	2	100	1.0	100	100	47	.	.	.
LD21-040	10.7	4	100	2.0	0	39	6	100	35	23
LD21-042	38.1	6	100	2.0	100	66	48	100	36	22
LD21-043	34.8	6	100	2.0	17	49	30	100	27	31
LD21-044	48.1	5	100	2.0	100	71	52	100	40	16
LD21-045	30.3	7	100	2.0	29	49	31	100	26	33
LD21-046	28.5	4	100	2.0	0	40	28	100	17	39
LD21-047	21.5	6	100	2.0	17	46	23	97	30	28
LD21-048	35.5	6	100	2.0	100	56	40	100	29	30

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-049	13.0	6	100	2.0	33	47	8	100	42	13
LD21-050	17.9	3	100	2.0	0	42	26	93	25	37
LD21-052	22.3	4	100	2.0	0	44	22	100	21	36
LD21-054	11.1	8	50	2.0	0	45	10	84	40	22
LD21-055	24.0	5	100	2.0	0	41	22	100	23	35
LD21-056	10.1	7	100	2.0	100	71	10	100	66	0
LD21-057	39.7	5	100	2.0	100	58	38	98	33	25
LD21-058	42.8	8	100	2.0	100	68	44	98	45	11
LD21-059	26.6	5	100	2.0	0	35	22	100	17	40
LD21-060	34.9	8	100	2.0	100	59	38	100	34	23
LD21-061	40.8	8	100	2.0	100	64	32	100	48	8
LD21-062	13.3	5	100	2.0	0	31	10	100	23	34
LD21-063	24.3	4	100	2.0	0	47	22	100	32	26
LD21-064	15.5	4	100	2.0	0	39	14	100	29	30
LD21-065	18.9	5	100	2.0	0	33	19	94	19	43
LD21-066	27.2	6	100	2.0	50	51	23	100	36	22
LD21-067	13.0	5	100	2.0	0	29	13	100	19	38
LD21-068	8.1	5	100	2.0	0	36	7	100	31	27
LD21-069	11.6	4	100	2.0	0	34	10	100	26	32
LD21-070	7.0	4	100	2.0	0	23	6	100	18	39
LD21-071	39.5	6	100	2.0	100	71	46	98	49	4
LD21-072	33.7	7	100	2.0	100	68	32	100	53	2
LD21-073	17.0	2	100	2.0	0	36	13	100	22	36
LD21-074	11.3	6	100	2.0	0	43	11	100	36	22
LD21-075	15.3	5	100	2.0	0	38	15	100	27	32
LD21-076	20.4	7	100	2.0	0	40	20	100	26	33
LD21-077	5.5	3	100	2.0	0	24	6	100	18	39
LD21-079	16.9	5	100	2.0	0	36	12	92	23	40

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-080	9.4	7	100	2.0	0	24	9	100	17	40
LD21-081	9.6	5	100	2.0	0	26	9	100	19	38
LD21-082	21.0	5	100	2.0	0	34	15	100	23	35
LD21-083	11.9	3	100	2.0	0	27	7	100	21	37
LD21-084	16.0	6	100	2.0	0	33	15	100	22	36
LD21-086	6.1	4	100	2.0	0	31	6	100	27	32
LD21-088	23.3	5	100	1.8	100	67	23	100	57	6
LD21-089	6.7	4	100	2.0	0	25	6	100	20	38
LD21-091	14.1	3	100	2.0	0	36	19	100	30	28
LD21-092	39.1	9	100	1.7	100	79	44	100	62	12
LD21-095	7.6	6	100	2.0	0	31	5	100	27	32
LD21-096	9.9	4	100	2.0	0	36	9	100	30	30
LD21-098	7.5	6	100	2.0	0	39	7	100	35	23
LD21-099	46.8	13	100	1.7	100	85	58	99	65	3
LD21-100	31.0	8	100	1.6	100	82	36	99	71	0
LD21-101	46.8	9	100	1.7	100	81	52	99	62	13
LD21-102	37.6	9	100	1.6	100	89	45	98	81	0
LD21-103	11.8	4	100	2.0	0	42	12	100	34	24
LD21-104	8.5	6	100	2.0	0	45	7	100	41	16
LD21-105	12.2	7	100	2.0	43	48	13	100	41	15
LD21-106	43.4	11	100	1.6	100	86	55	99	71	2
LD21-107	47.4	8	100	1.6	100	82	50	99	65	10
LD21-108	19.3	8	100	2.0	0	37	16	100	25	34
LD21-109	16.8	4	100	2.0	0	39	14	100	28	30
LD21-110	15.7	3	100	2.0	0	33	18	100	18	39
LD21-111	16.4	3	100	2.0	0	30	13	100	19	38
LD21-112	27.8	7	100	1.7	100	78	38	99	65	2
LD21-113	6.8	3	100	2.0	0	32	6	97	25	34

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-114	7.6	1	100	2.0	100	60	7	100	58	0
LD21-115	6.3	1	100	2.0	0	46	5	100	43	12
SD20-001	24.6	4	100	2.0	0	42	18	98	21	38
SD20-002	14.1	6	100	2.0	0	33	15	99	23	35
SD20-003	42.2	5	100	2.0	100	53	42	100	21	37
SD20-004	46.5	6	100	2.0	100	59	40	100	22	36
SD20-005	34.8	4	100	2.0	100	54	29	100	25	33
SD20-006	14.5	6	100	2.0	0	34	16	100	20	38
SD20-007	33.6	3	100	2.0	0	46	35	100	18	39
SD20-008	12.6	3	100	2.0	0	37	10	86	31	35
SD20-009	12.0	3	100	2.0	67	55	10	100	49	6
SD20-010	20.1	5	100	2.0	0	37	20	100	16	40
SD20-011	27.5	4	100	2.0	0	48	23	100	20	38
SD20-012	18.8	3	100	2.0	0	40	15	100	22	36
SD20-013	25.1	4	100	2.0	25	43	26	100	22	35
SD20-014	32.1	7	100	1.9	100	67	32	99	53	10
SD20-015	18.1	6	100	2.0	17	43	12	100	34	23
SD20-016	12.9	6	100	2.0	33	47	9	100	42	13
SD20-017	8.8	6	100	2.0	0	37	7	88	33	32
SD20-018	24.4	3	100	2.0	0	43	21	100	27	32
SD20-019	33.6	5	100	2.0	100	51	31	100	29	30
SD20-020	35.4	8	100	1.6	100	83	40	100	72	0
SD20-021	41.2	4	100	2.0	100	67	49	100	35	23
SD20-022	30.0	3	100	2.0	33	47	27	100	27	32
SD20-023	11.1	7	57	2.0	57	54	10	79	49	13
SD20-024	22.0	3	100	2.0	0	44	19	100	31	27
SD20-025	23.4	4	100	2.0	0	43	26	100	21	37
SD20-026	12.6	4	100	2.0	0	24	7	100	18	39

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD20-027	24.0	5	100	2.0	0	41	21	100	25	33
SD20-028	43.9	7	100	2.0	100	67	41	99	45	11
SD20-029	10.5	5	100	2.0	0	27	9	100	18	39
SD20-030	14.7	3	100	2.0	0	32	18	100	19	38
SD20-031	22.0	3	100	2.0	0	45	23	100	29	30
SD20-032	23.9	6	100	2.0	100	57	23	100	44	10
SD20-033	14.4	4	100	2.0	0	30	12	100	20	38
SD20-034	10.1	5	100	2.0	0	30	10	100	23	35
SD20-035	12.2	4	100	2.0	0	36	11	100	28	31
SD20-036	17.9	5	100	2.0	0	40	12	100	23	35
SD20-037	13.8	4	100	2.0	50	49	12	100	42	14
SD20-038	42.8	10	100	1.6	100	87	53	99	73	0
SD20-039	21.3	5	100	2.0	100	57	24	100	43	12
SD20-040	38.7	9	100	1.7	100	81	49	99	65	6
SD20-041	29.1	5	100	2.0	100	58	30	100	39	17
SD20-042	7.9	4	100	2.0	0	29	6	100	24	34
SD20-043	17.4	8	100	2.0	0	35	15	100	24	34
SD20-044	13.1	5	100	2.0	0	31	16	99	19	39
SD20-049	6.4	1	100	2.0	100	58	6	100	48	4
SD21-001	28.8	3	100	2.0	0	46	20	97	21	38
SD21-002	29.3	3	100	2.0	0	45	22	100	24	34
SD21-003	25.9	5	100	2.0	0	41	26	99	20	38
SD21-004	34.1	4	100	2.0	0	48	34	100	21	37
SD21-005	39.3	4	100	2.0	100	56	30	100	25	34
SD21-006	13.8	6	100	2.0	0	32	15	100	20	38
SD21-007	11.5	3	100	2.0	67	55	10	100	50	6
SD21-008	13.9	3	100	2.0	0	38	11	84	31	36
SD21-009	23.1	3	100	2.0	0	37	20	99	22	37

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-010	15.9	5	100	2.0	0	37	10	100	19	38
SD21-011	35.7	3	100	2.0	67	51	32	100	25	33
SD21-012	19.6	3	100	2.0	0	40	16	100	22	36
SD21-013	20.5	3	100	2.0	0	42	22	100	26	32
SD21-014	41.5	6	100	2.0	100	61	40	100	34	22
SD21-015	13.9	6	100	2.0	50	52	10	100	47	8
SD21-016	8.1	6	100	2.0	17	44	6	100	40	16
SD21-017	10.1	6	100	2.0	0	33	8	99	28	31
SD21-018	21.5	6	100	2.0	50	48	16	100	38	19
SD21-019	45.0	5	100	2.0	100	65	45	100	37	21
SD21-020	26.2	5	60	2.0	60	51	14	85	45	13
SD21-021	18.3	3	100	2.0	0	38	22	100	22	36
SD21-022	33.2	4	100	2.0	100	64	30	100	48	9
SD21-023	16.0	3	100	2.0	100	65	24	87	31	32
SD21-024	28.4	4	100	2.0	50	51	31	98	28	31
SD21-025	17.1	3	100	2.0	0	38	15	100	28	31
SD21-026	16.8	3	100	2.0	0	33	16	100	20	37
SD21-027	26.2	6	100	2.0	50	50	23	99	35	23
SD21-028	49.5	5	100	2.0	100	68	49	98	39	18
SD21-029	17.3	3	100	2.0	0	33	13	100	19	38
SD21-030	8.8	4	100	2.0	0	24	8	100	18	39
SD21-031	11.5	4	100	2.0	0	37	12	100	29	30
SD21-032	33.8	6	100	2.0	100	69	36	99	51	3
SD21-033	14.4	4	100	2.0	0	31	12	100	21	37
SD21-034	18.9	5	100	2.0	20	45	13	100	23	35
SD21-035	11.1	4	100	2.0	0	35	10	100	28	30
SD21-037	10.7	6	100	2.0	0	32	10	100	24	34
SD21-038	33.4	5	100	2.0	100	62	35	100	42	14

Table 3: General Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-039	39.0	8	100	1.6	100	82	48	100	66	9
SD21-040	47.5	10	100	1.6	100	89	60	97	76	0
SD21-041	10.0	5	100	2.0	0	44	9	100	38	19
SD21-042	20.3	4	100	2.0	100	59	20	100	49	3
SD21-043	17.9	8	100	2.0	0	36	15	100	24	34
SD21-044	12.7	5	100	2.0	0	31	15	99	19	39
SD21-045	7.1	4	100	2.0	0	30	7	100	25	33
SD21-049	6.9	1	100	2.0	100	59	6	100	50	0

Table 4: Primary Elections (contests with Black candidate)

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
CD20-001	41.9	14	100	4.1	100	61	62	69	48	12
CD20-002	18.2	15	100	4.1	67	55	26	71	50	14
CD20-003	18.7	15	100	4.0	73	54	40	66	47	22
CD20-004	24.4	16	100	3.9	75	59	34	68	55	12
CD20-005	10.7	16	100	3.9	56	51	21	62	48	15
CD20-006	32.0	15	100	4.2	67	51	47	59	44	23
CD20-007	15.4	15	100	4.0	73	52	30	62	47	5
CD20-008	25.9	14	100	4.1	79	54	52	60	48	20
CD20-009	17.4	16	100	4.6	56	46	33	63	42	13
CD20-010	10.1	15	100	4.0	73	52	25	62	48	27
CD20-011	3.7	1	100	5.0	100	54	5	100	47	.
CD20-012	34.1	20	100	3.6	85	60	54	68	50	18
CD20-013	13.9	14	100	4.1	71	54	33	59	52	14
CD21-001	22.4	15	100	4.0	73	55	41	66	47	18
CD21-002	39.1	14	100	4.1	100	61	60	70	47	13
CD21-003	15.7	16	100	4.1	56	48	28	65	40	17
CD21-004	27.5	14	100	4.1	71	54	55	60	48	20
CD21-005	23.2	14	100	4.1	71	59	32	71	54	12
CD21-006	20.4	15	100	4.5	60	52	25	76	47	10
CD21-007	15.3	14	100	4.1	57	49	32	61	44	30
CD21-008	16.5	14	100	4.1	64	48	36	62	41	29
CD21-009	36.3	20	100	3.6	80	60	56	68	50	19
CD21-010	16.2	14	100	4.1	86	54	35	63	50	15
CD21-011	19.2	14	100	4.1	64	51	35	63	46	24
CD21-012	17.1	16	100	3.9	75	53	36	63	47	21
CD21-013	14.8	17	100	3.9	76	53	31	64	48	11
CD21-014	3.6	1	100	5.0	100	54	5	100	47	.
LD20-001	36.6	14	100	4.1	93	58	58	73	40	19
LD20-002	25.7	15	100	4.1	87	57	45	70	47	12

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-003	19.2	19	100	3.7	63	53	41	66	43	24
LD20-004	20.6	15	100	4.0	93	58	52	69	46	12
LD20-005	41.0	17	100	3.8	94	60	61	68	47	16
LD20-006	7.1	13	100	4.3	69	51	15	63	49	8
LD20-007	22.4	15	100	4.1	93	63	49	78	49	4
LD20-008	42.5	15	100	4.1	93	58	59	66	47	16
LD20-009	27.9	14	100	4.1	71	56	38	64	50	13
LD20-010	22.0	14	100	4.1	79	54	44	72	36	18
LD20-011	15.4	15	100	4.1	47	45	16	67	40	29
LD20-012	36.9	15	100	4.1	87	59	61	67	46	6
LD20-013	7.9	14	100	4.1	57	50	22	65	45	10
LD20-014	17.8	13	100	4.2	92	56	47	61	51	12
LD20-015	10.7	13	100	4.2	77	52	38	62	45	9
LD20-016	18.3	15	100	4.0	73	50	39	60	44	4
LD20-017	10.1	16	100	3.9	69	53	26	64	49	6
LD20-018	21.1	14	100	4.1	71	55	35	61	51	14
LD20-019	6.3	15	100	4.0	53	49	10	66	47	13
LD20-020	5.5	12	100	4.4	58	50	8	79	47	7
LD20-021	37.4	17	100	3.9	88	56	62	63	46	15
LD20-022	29.3	18	100	3.9	94	58	55	72	42	9
LD20-023	50.6	16	100	4.0	100	64	66	70	50	12
LD20-024	38.2	16	100	3.9	94	63	63	68	52	11
LD20-025	42.6	8	100	5.2	100	58	68	68	40	24
LD20-026	16.5	15	100	4.0	60	53	35	67	46	27
LD20-027	51.6	18	100	3.8	78	57	59	72	36	36
LD20-028	15.8	15	100	4.0	93	57	35	66	51	8
LD20-029	37.2	20	100	3.7	65	61	38	79	50	7
LD20-030	28.2	19	100	3.7	68	59	33	73	52	8

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-031	39.8	20	100	3.7	95	64	58	74	49	7
LD20-032	48.1	16	100	3.9	100	68	66	78	52	6
LD20-033	39.9	16	100	4.0	88	65	58	75	52	0
LD20-034	11.5	15	100	4.1	33	42	12	71	38	39
LD20-035	18.0	15	100	4.0	67	57	31	68	52	13
LD20-036	7.5	16	100	4.0	50	49	13	62	47	18
LD20-037	11.3	16	100	4.0	62	52	24	62	50	6
LD20-038	39.4	15	100	4.0	73	61	53	69	54	21
LD20-040	11.3	14	100	4.1	43	46	17	69	41	31
LD20-041	7.1	15	100	4.1	40	44	11	70	41	28
LD20-042	38.1	9	100	2.8	89	60	76	66	44	12
LD20-043	33.9	16	100	4.0	75	51	51	58	44	30
LD20-044	48.1	16	100	4.0	81	56	76	60	44	36
LD20-045	31.4	17	100	3.9	71	54	60	62	42	29
LD20-046	25.0	15	100	4.1	93	52	41	60	47	13
LD20-047	23.8	18	100	4.1	67	47	24	66	41	10
LD20-048	35.5	18	100	3.8	94	58	63	67	43	18
LD20-049	12.3	15	100	4.1	33	41	10	68	38	38
LD20-050	17.5	16	100	3.9	56	50	28	60	47	16
LD20-052	11.0	15	100	4.1	67	55	26	62	52	10
LD20-054	12.9	14	100	4.1	57	52	18	62	50	0
LD20-055	26.2	17	100	4.2	71	49	51	72	34	24
LD20-056	10.2	14	100	4.5	43	45	8	76	42	21
LD20-057	39.7	16	100	4.1	75	54	56	62	43	24
LD20-058	43.1	17	100	4.0	71	54	60	61	43	32
LD20-059	28.6	17	100	4.1	71	53	60	62	39	24
LD20-060	34.6	16	100	4.1	81	56	60	63	44	16
LD20-061	40.0	16	100	4.1	62	52	35	62	46	23

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-062	13.7	17	100	4.0	65	50	27	65	44	11
LD20-063	24.8	15	100	4.1	73	52	43	60	45	20
LD20-064	15.1	16	100	4.1	62	51	30	59	48	31
LD20-065	19.6	15	100	4.0	87	55	43	66	48	18
LD20-066	24.0	15	100	4.3	80	50	42	61	42	12
LD20-067	7.9	14	100	4.1	64	47	22	70	41	18
LD20-068	8.4	15	100	4.3	80	54	24	63	51	5
LD20-069	11.6	15	100	4.1	73	51	31	61	47	6
LD20-070	7.2	15	100	4.1	80	56	19	65	53	19
LD20-071	40.3	19	100	3.8	84	58	63	62	50	17
LD20-072	34.4	19	100	3.8	68	53	41	65	44	24
LD20-073	14.6	15	100	4.1	73	50	36	64	43	24
LD20-074	11.4	16	100	4.0	62	50	23	65	45	9
LD20-075	15.3	17	100	3.9	76	52	37	65	44	27
LD20-076	21.6	15	100	4.0	93	55	42	60	51	25
LD20-077	7.3	15	100	4.1	73	52	24	61	49	11
LD20-078	6.1	15	100	4.1	60	52	19	62	50	14
LD20-079	22.3	16	100	4.2	81	54	41	68	44	15
LD20-080	9.5	14	100	4.1	79	55	26	62	52	21
LD20-081	9.6	14	100	4.1	71	54	24	61	52	12
LD20-082	20.2	8	100	2.6	100	61	42	69	56	8
LD20-083	19.5	14	100	4.1	71	51	37	64	44	33
LD20-084	14.1	14	100	4.1	93	52	32	63	47	11
LD20-086	6.0	15	100	4.0	67	54	14	65	52	12
LD20-087	5.1	15	100	4.0	80	52	13	66	50	2
LD20-088	16.0	11	100	4.5	55	52	24	65	49	16
LD20-089	7.9	14	100	4.1	86	54	23	60	52	1
LD20-090	3.3	14	100	4.1	50	46	8	69	44	21

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD20-091	4.8	16	100	3.9	56	52	13	64	50	33
LD20-092	40.2	18	100	3.7	78	60	65	65	49	14
LD20-094	5.7	19	100	3.9	47	45	12	57	43	15
LD20-095	9.6	14	100	4.1	64	51	22	61	49	13
LD20-096	8.9	14	100	4.1	64	48	17	57	47	18
LD20-097	5.5	14	100	4.1	57	54	14	65	51	11
LD20-098	9.2	14	100	4.2	50	51	18	62	49	29
LD20-099	36.0	20	100	3.6	85	61	65	69	46	17
LD20-100	30.5	17	100	3.8	76	56	42	65	49	21
LD20-101	48.0	18	100	3.7	89	61	72	67	44	21
LD20-102	33.8	16	100	4.3	81	58	47	66	51	18
LD20-103	14.2	14	100	4.2	57	49	24	63	44	30
LD20-104	12.0	12	100	4.4	50	44	16	61	42	37
LD20-105	12.9	15	100	4.2	73	54	24	64	50	10
LD20-106	46.3	23	100	3.7	100	64	73	71	45	13
LD20-107	53.6	21	100	3.7	95	64	72	71	44	14
LD20-108	19.5	16	100	3.9	69	52	41	67	42	16
LD20-109	15.3	17	100	3.8	71	52	30	62	48	9
LD20-110	14.6	15	100	4.0	87	53	37	64	47	14
LD20-111	22.8	16	100	4.1	94	54	46	67	42	13
LD20-112	9.2	14	100	4.1	79	50	19	64	48	10
LD20-115	6.9	12	100	4.5	58	57	7	68	56	20
LD20-116	7.2	12	100	4.8	58	55	8	67	54	16
LD20-117	3.6	17	100	3.8	59	52	5	68	51	5
LD21-001	17.7	14	100	4.1	100	55	35	69	47	11
LD21-002	23.7	15	100	4.0	67	55	37	62	51	25
LD21-003	19.4	18	100	3.8	61	51	35	68	41	25
LD21-004	24.9	15	100	4.1	87	56	54	65	45	9

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-005	37.5	16	100	3.9	94	59	60	67	46	22
LD21-007	22.2	15	100	4.1	93	63	48	78	49	4
LD21-008	44.2	15	100	4.1	93	58	59	66	46	13
LD21-009	24.6	14	100	4.1	64	55	38	61	52	19
LD21-010	33.1	14	100	4.1	100	58	58	64	49	12
LD21-011	14.2	15	100	4.1	40	44	15	67	40	39
LD21-012	37.7	14	100	4.1	100	59	60	68	46	7
LD21-013	8.3	15	100	4.1	67	53	19	64	49	16
LD21-014	17.8	13	100	4.2	92	56	47	61	51	12
LD21-015	10.6	14	100	4.3	71	50	40	60	44	7
LD21-016	13.2	14	100	4.1	64	51	38	59	46	7
LD21-017	10.3	17	100	3.9	65	51	26	62	47	7
LD21-018	21.6	15	100	4.1	67	52	35	60	48	14
LD21-019	5.1	15	100	4.0	60	50	10	64	48	15
LD21-020	5.3	11	100	4.4	64	52	8	80	50	7
LD21-021	10.8	15	100	4.1	60	50	16	63	47	22
LD21-022	27.7	17	100	3.9	94	57	54	70	46	12
LD21-023	52.5	15	100	4.0	100	65	67	71	50	13
LD21-024	36.6	15	100	4.0	93	61	61	67	50	13
LD21-025	40.0	15	100	4.0	100	63	62	77	43	17
LD21-026	16.8	9	100	2.6	78	61	37	75	54	30
LD21-027	50.8	18	100	3.9	89	60	62	75	49	17
LD21-028	16.2	15	100	4.0	93	57	35	67	51	8
LD21-029	38.3	20	100	3.7	80	63	44	78	51	7
LD21-030	33.0	19	100	3.7	74	61	30	74	55	8
LD21-032	42.4	14	100	4.1	93	61	61	78	35	12
LD21-033	29.8	15	100	4.1	73	62	34	75	57	0
LD21-034	18.2	15	100	4.1	53	49	18	69	45	29

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-036	8.0	6	100	6.2	50	39	13	52	37	0
LD21-040	10.7	14	100	4.1	36	43	14	75	39	33
LD21-042	38.1	9	100	2.8	89	60	76	66	44	12
LD21-043	34.8	16	100	4.0	75	51	52	58	44	30
LD21-044	48.1	16	100	4.0	81	56	76	60	44	36
LD21-045	30.3	15	100	4.1	73	54	60	63	41	25
LD21-046	28.5	16	100	4.0	81	50	41	64	40	9
LD21-047	21.5	19	100	4.1	84	50	27	63	45	2
LD21-048	35.5	18	100	3.8	94	58	63	67	43	18
LD21-049	13.0	15	100	4.1	27	38	14	75	32	28
LD21-050	17.9	15	100	4.1	60	51	30	61	47	18
LD21-052	22.3	15	100	4.1	80	55	38	61	50	14
LD21-053	18.8	9	100	2.7	89	65	40	67	63	12
LD21-054	11.1	19	100	3.7	37	42	18	57	39	23
LD21-055	24.0	17	100	4.2	71	49	49	72	34	25
LD21-056	10.1	14	100	4.5	43	45	8	76	42	21
LD21-057	39.7	16	100	4.1	75	54	56	62	43	24
LD21-058	42.8	17	100	4.0	71	54	61	62	43	32
LD21-059	26.6	16	100	4.1	69	53	58	64	38	22
LD21-060	34.9	16	100	4.1	81	56	60	63	45	16
LD21-061	40.8	16	100	4.1	62	52	37	62	46	23
LD21-062	13.3	17	100	4.0	65	50	26	64	44	12
LD21-063	24.3	14	100	4.1	71	51	40	62	43	25
LD21-064	15.5	15	100	4.0	67	52	30	60	49	31
LD21-065	18.9	15	100	4.0	87	55	42	66	48	18
LD21-066	27.2	14	100	4.1	79	59	41	65	55	8
LD21-067	13.0	14	100	4.1	79	49	35	68	40	25
LD21-068	8.1	13	100	5.5	77	57	24	64	54	6

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-069	11.6	15	100	4.1	73	51	30	61	47	6
LD21-070	7.0	16	100	4.0	75	53	18	64	50	20
LD21-071	39.5	19	100	3.8	84	58	61	62	50	18
LD21-072	33.7	18	100	3.9	67	53	40	65	45	19
LD21-073	17.0	8	100	2.6	88	58	35	73	49	25
LD21-074	11.3	16	100	4.0	69	51	23	64	47	10
LD21-075	15.3	17	100	3.9	76	52	37	65	44	27
LD21-076	20.4	16	100	3.9	94	55	41	60	52	9
LD21-077	5.5	16	100	4.1	75	49	20	57	48	11
LD21-078	5.5	15	100	4.1	67	51	17	59	50	9
LD21-079	16.9	14	100	4.1	79	55	30	64	50	4
LD21-080	9.4	15	100	4.2	80	53	27	61	50	22
LD21-081	9.6	15	100	4.1	73	54	24	60	52	14
LD21-082	21.0	14	100	4.1	86	55	38	62	52	16
LD21-083	11.9	14	100	4.1	79	52	31	68	45	23
LD21-084	16.0	14	100	4.1	93	52	36	63	46	11
LD21-086	6.1	15	100	4.0	67	54	13	66	52	13
LD21-087	4.9	15	100	4.0	67	51	11	64	49	27
LD21-088	23.3	11	100	4.5	64	53	28	61	50	17
LD21-089	6.7	14	100	4.1	71	50	19	63	47	2
LD21-090	3.5	16	100	3.9	56	48	8	69	47	15
LD21-091	14.1	15	100	4.0	73	51	33	65	45	23
LD21-092	39.1	17	100	3.8	76	58	63	64	49	11
LD21-094	5.3	17	100	3.9	65	51	11	61	50	14
LD21-095	7.6	12	100	4.5	58	48	14	62	46	22
LD21-096	9.9	14	100	4.1	71	52	21	58	50	18
LD21-097	5.5	14	100	4.1	57	53	15	64	51	11
LD21-098	7.5	14	100	4.2	43	47	14	64	44	40

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
LD21-099	46.8	24	100	3.8	96	61	75	67	44	17
LD21-100	31.0	17	100	3.8	76	56	42	64	49	21
LD21-101	46.8	18	100	3.9	89	59	70	66	43	18
LD21-102	37.6	19	100	3.9	84	58	52	66	50	21
LD21-103	11.8	15	100	4.1	60	49	25	64	44	30
LD21-104	8.5	12	100	4.4	33	38	12	64	35	58
LD21-105	12.2	15	100	4.2	73	54	25	64	50	10
LD21-106	43.4	24	100	3.7	100	63	68	72	46	14
LD21-107	47.4	20	100	3.6	95	64	68	71	47	16
LD21-108	19.3	16	100	3.9	69	52	38	66	44	17
LD21-110	15.7	16	100	4.1	100	55	46	66	46	12
LD21-111	16.4	16	100	4.1	75	51	32	62	47	11
LD21-112	27.8	17	100	3.8	71	57	49	66	48	20
LD21-113	6.8	14	100	4.1	57	49	12	57	48	4
LD21-114	7.6	12	100	5.1	67	56	6	62	56	22
LD21-115	6.3	12	100	4.5	42	49	6	64	48	20
LD21-117	3.5	8	100	2.6	75	60	5	64	60	4
SD20-001	24.6	14	100	4.1	100	55	40	66	48	12
SD20-002	14.1	17	100	3.9	53	48	32	66	44	26
SD20-003	42.2	15	100	4.0	93	64	61	77	46	8
SD20-004	46.5	15	100	4.3	93	59	64	69	50	14
SD20-005	34.8	14	100	4.1	79	55	49	64	48	24
SD20-006	14.5	14	100	4.1	86	54	45	64	46	11
SD20-007	33.6	15	100	4.0	100	59	61	67	48	9
SD20-008	12.6	15	100	4.0	60	49	28	64	41	17
SD20-009	12.0	13	100	4.3	69	53	20	61	51	18
SD20-010	20.1	16	100	4.1	88	57	47	64	49	16
SD20-011	27.5	14	100	4.1	93	62	52	71	49	4

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD20-012	18.8	17	100	3.9	65	52	41	60	47	7
SD20-013	25.1	20	100	4.2	65	48	33	62	43	5
SD20-014	32.1	15	100	4.1	80	62	45	74	53	0
SD20-015	18.1	15	100	4.0	67	56	23	64	53	7
SD20-016	12.9	15	100	4.1	40	43	15	73	38	29
SD20-017	8.8	15	100	4.1	47	46	16	62	43	34
SD20-018	24.4	15	100	4.1	87	62	47	73	51	16
SD20-019	33.6	15	100	4.1	80	53	56	59	45	18
SD20-020	35.4	20	100	3.7	70	62	43	75	52	7
SD20-021	41.2	17	100	3.9	71	56	74	60	46	19
SD20-022	30.0	17	100	4.1	71	56	41	66	52	0
SD20-023	11.1	16	100	4.3	44	44	14	61	44	11
SD20-024	22.0	14	100	4.1	79	53	43	62	47	24
SD20-025	23.4	15	100	4.1	67	51	44	60	46	23
SD20-026	12.6	14	100	4.1	79	54	29	62	50	6
SD20-027	24.0	17	100	4.0	71	53	45	61	45	6
SD20-028	43.9	16	100	4.1	62	53	51	62	43	23
SD20-029	10.5	14	100	4.1	71	54	28	62	51	14
SD20-030	14.7	15	100	4.0	73	50	37	60	45	25
SD20-031	22.0	16	100	3.9	81	54	50	64	44	28
SD20-032	23.9	17	100	3.8	59	50	36	65	41	31
SD20-033	14.4	15	100	4.0	100	55	35	62	52	10
SD20-034	10.1	15	100	4.2	73	50	25	60	47	12
SD20-035	12.2	15	100	4.1	80	53	32	59	50	8
SD20-036	17.9	14	100	4.1	79	51	37	64	44	22
SD20-037	13.8	13	100	4.5	46	43	18	61	39	37
SD20-038	42.8	22	100	3.8	91	61	64	68	49	19
SD20-039	21.3	17	100	3.8	76	54	40	66	46	17

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD20-040	38.7	21	100	3.8	86	61	65	68	46	18
SD20-041	29.1	20	100	3.6	80	59	50	68	50	18
SD20-042	7.9	14	100	4.1	79	51	18	59	49	3
SD20-043	17.4	16	100	3.9	75	53	36	64	47	10
SD20-044	13.1	14	100	4.1	71	52	35	63	46	14
SD20-045	3.3	1	100	2.0	0	38	6	72	33	44
SD20-046	5.5	15	100	4.0	67	54	12	64	53	10
SD20-047	5.1	13	100	4.2	38	43	8	63	41	25
SD20-049	6.4	12	100	4.8	67	56	6	66	55	15
SD21-001	28.8	14	100	4.1	93	57	45	67	48	8
SD21-002	29.3	14	100	4.1	93	60	48	71	49	10
SD21-003	25.9	18	100	4.1	89	56	46	71	44	11
SD21-004	34.1	14	100	4.1	93	59	59	66	48	14
SD21-005	39.3	14	100	4.1	93	58	56	65	49	14
SD21-006	13.8	15	100	4.2	87	54	44	62	48	11
SD21-007	11.5	12	100	4.5	67	53	19	62	51	22
SD21-008	13.9	15	100	4.0	53	47	26	63	41	20
SD21-009	23.1	14	100	4.1	93	55	50	66	45	6
SD21-010	15.9	16	100	3.9	81	54	35	66	49	15
SD21-011	35.7	16	100	4.1	81	60	58	74	43	14
SD21-012	19.6	16	100	4.0	62	51	42	61	44	24
SD21-013	20.5	14	100	4.1	79	59	37	66	55	0
SD21-014	41.5	15	100	4.1	87	64	62	76	46	7
SD21-015	13.9	15	100	4.1	33	42	12	71	38	33
SD21-016	8.1	15	100	4.1	40	43	11	73	40	25
SD21-017	10.1	15	100	4.1	67	53	20	61	52	6
SD21-018	21.5	15	100	4.0	67	56	27	64	53	7
SD21-019	45.0	16	100	4.1	75	54	69	58	45	20

Table 4: Primary Elections (contests with Black candidate) *(continued)*

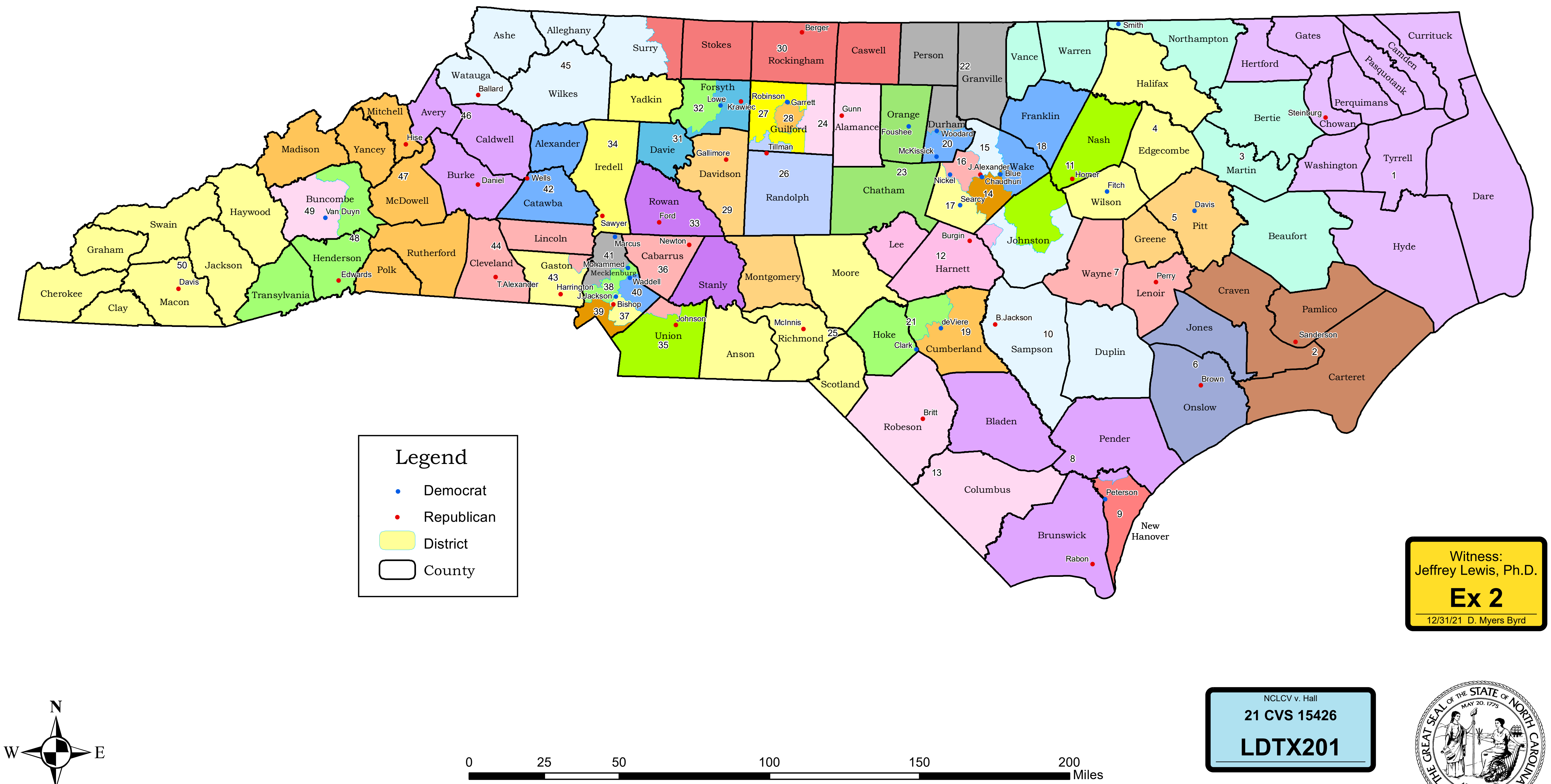
District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-020	26.2	17	100	4.0	65	55	34	77	47	8
SD21-021	18.3	15	100	4.1	60	49	41	60	43	6
SD21-022	33.2	19	100	3.7	74	61	38	74	52	8
SD21-023	16.0	17	100	4.1	47	46	23	58	44	30
SD21-024	28.4	18	100	4.1	78	51	43	70	41	9
SD21-025	17.1	14	100	4.1	79	53	34	60	50	22
SD21-026	16.8	15	100	4.0	73	54	39	61	49	29
SD21-027	26.2	16	100	4.1	62	52	36	63	45	16
SD21-028	49.5	16	100	4.1	81	55	65	62	42	23
SD21-029	17.3	14	100	4.1	79	49	39	64	40	25
SD21-030	8.8	14	100	4.1	79	55	24	61	53	13
SD21-031	11.5	16	100	4.0	69	48	30	64	41	26
SD21-032	33.8	18	100	3.9	67	52	47	63	43	30
SD21-033	14.4	15	100	4.0	100	55	35	62	52	9
SD21-034	18.9	16	100	3.9	81	54	38	62	49	4
SD21-035	11.1	15	100	4.1	80	53	30	60	50	8
SD21-036	4.2	15	100	4.0	53	48	10	64	45	16
SD21-037	10.7	14	100	4.1	64	51	24	60	48	13
SD21-038	33.4	20	100	3.6	90	61	56	70	49	16
SD21-039	39.0	21	100	3.6	90	62	66	69	47	15
SD21-040	47.5	21	100	3.8	100	63	72	68	48	18
SD21-041	10.0	12	100	4.4	50	44	20	63	40	32
SD21-042	20.3	15	100	4.2	67	55	27	64	52	12
SD21-043	17.9	16	100	3.9	75	53	37	64	47	10
SD21-044	12.7	15	100	4.3	73	51	35	64	43	14
SD21-045	7.1	14	100	4.1	79	54	18	59	52	2
SD21-046	4.6	14	100	4.1	57	51	7	69	49	8
SD21-048	5.2	15	100	4.0	53	46	9	58	45	3

Table 4: Primary Elections (contests with Black candidate) *(continued)*

District	Percent Black Voting Age Population	Number of Contests	Percent of Black-preferred candidates Democratic	Average Number of Candidates	Black-preferred win rate	Average Black-preferred candidate vote share	Avg. Pct. Voters Black	Avg. ER Black cohesion (pct.)	Avg. ER White crossover support (pct.)	Pct. Black needed for majority
SD21-049	6.9	12	100	4.8	67	56	7	65	55	15

EXHIBIT E

2019 Senate Consensus Nonpartisan Map



Senate Consensus Nonpartisan Map v3

Printed by the NC General Assembly, September 13, 2019

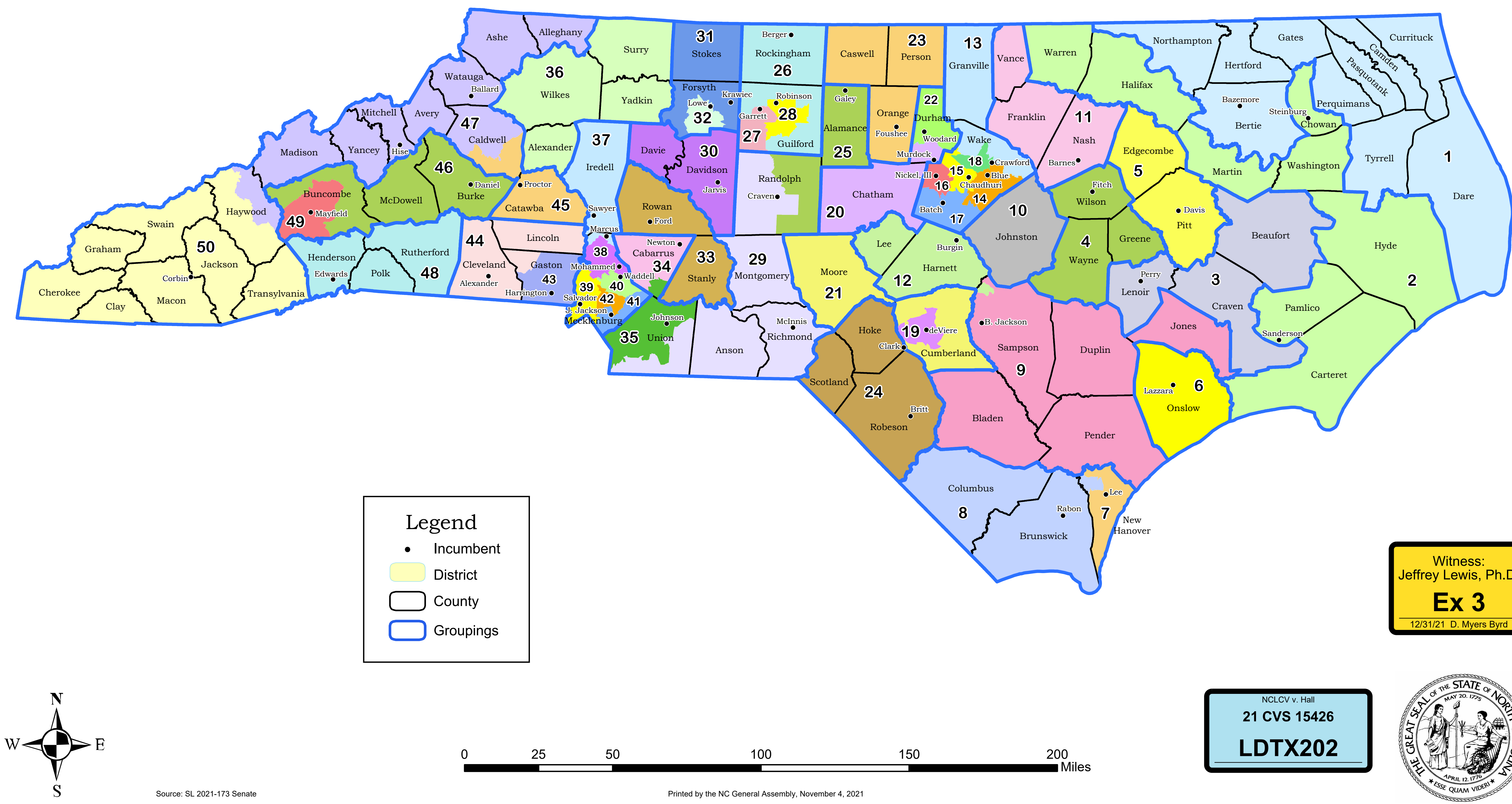
Witness:
Jeffrey Lewis, Ph.D.
Ex 2
12/31/21 D. Myers Byrd

NCLCV v. Hall
21 CVS 15426
LDTX201

THE GREAT SEAL OF THE STATE OF NORTH CAROLINA
MAY 20, 1775
APRIL 12, 1776
ESSE QUAM VIDERI

EXHIBIT D

S.L. 2021-173 Senate



Source: SL 2021-173 Senate

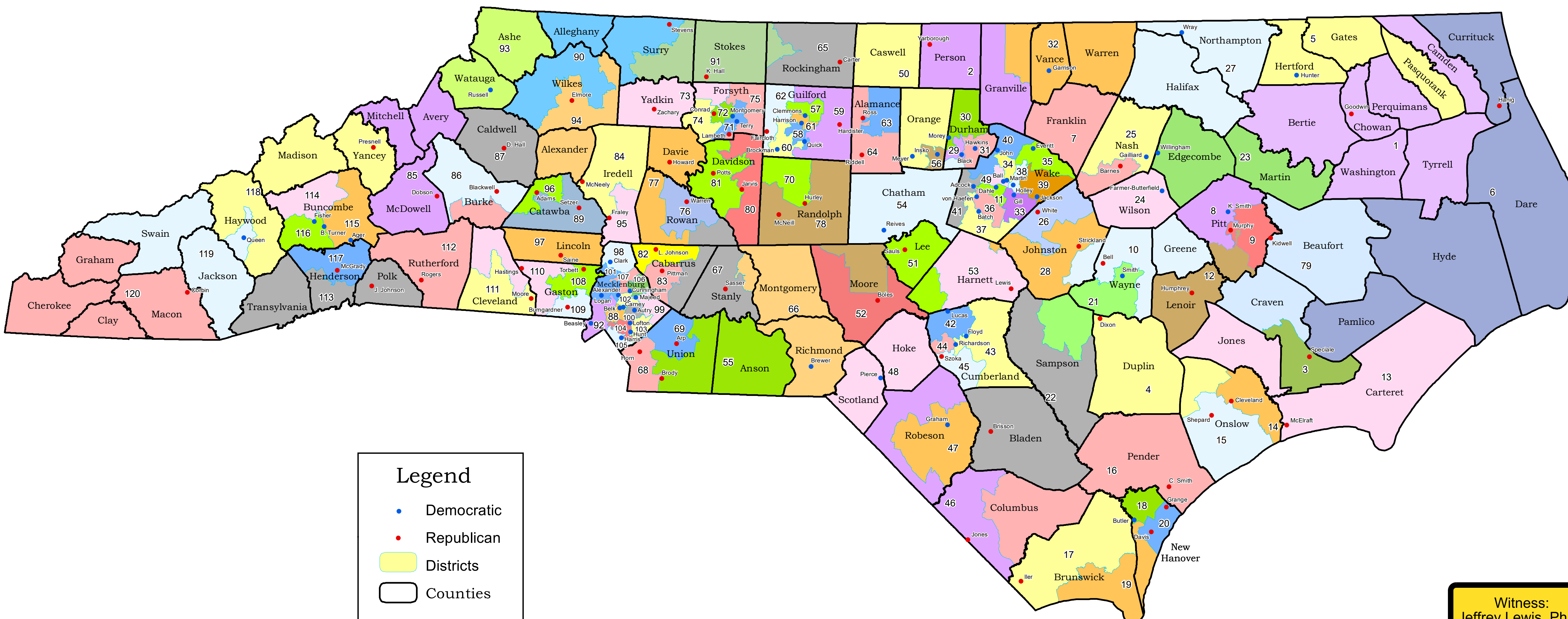
Printed by the NC General Assembly, November 4, 2021

NCLCV v. Hall
21 CVS 15426
LDTX202

Witness:
Jeffrey Lewis, Ph.D.
Ex 3
12/31/21 D. Myers Byrd

EXIBIT C

HB 1020, 2nd Edition – 2019 House Remedial Map



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HB 1020 H Red Comm CSBK-25

Printed by the NC General Assembly, September 13, 2019

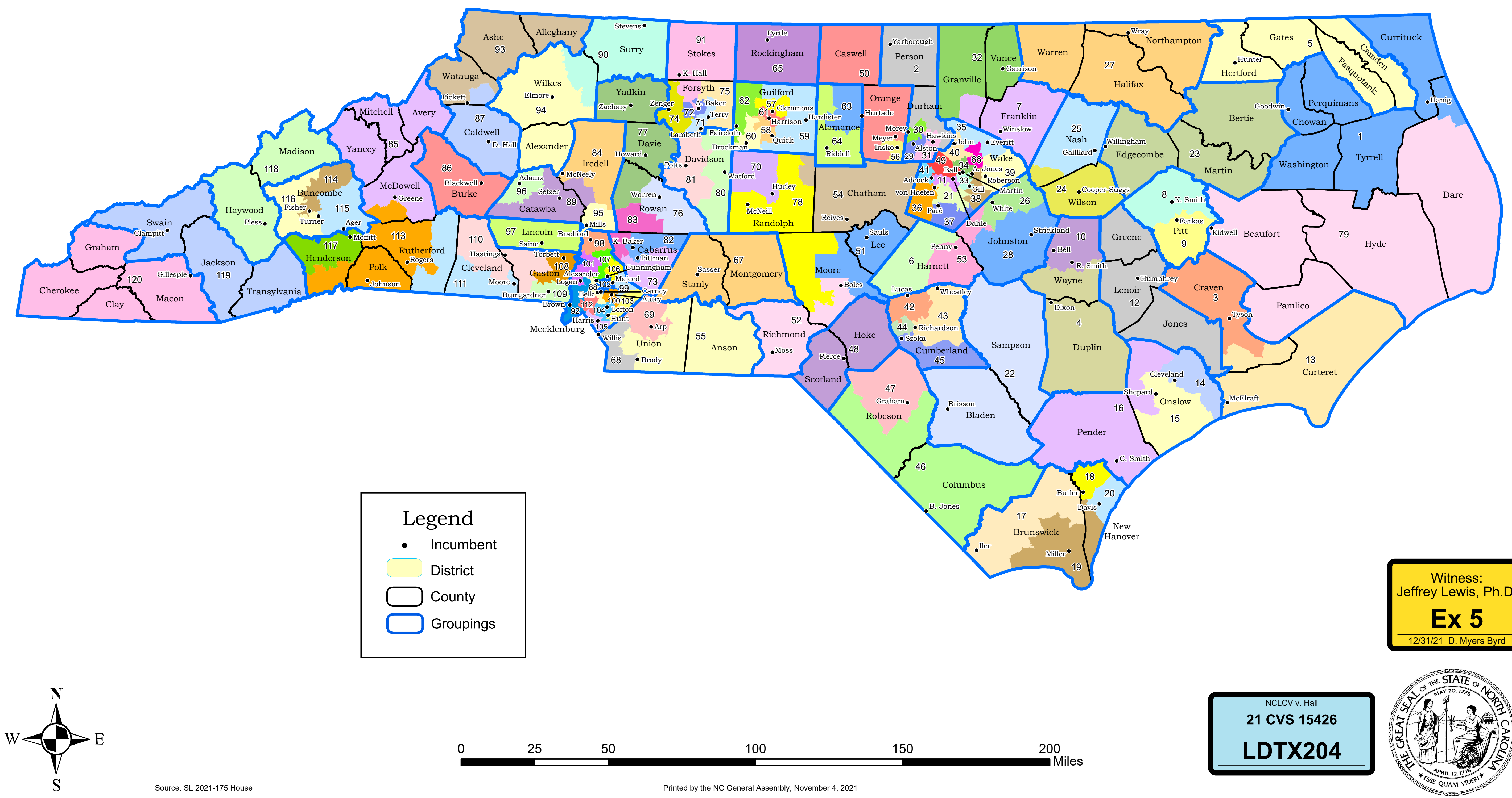
Witness:
Jeffrey Lewis, Ph.D.
Ex 4
12/31/21 D. Myers Byrd

NCLCV v. Hall
21 CVS 15426
LDTX203

THE GREAT SEAL OF THE STATE OF NORTH CAROLINA
MAY 20, 1775
APRIL 12, 1776
ESSE QUAM VIDERI

EXIBIT B

S.L. 2021-175 House



Witness:
Jeffrey Lewis, Ph.D.
Ex 5
12/31/21 D. Myers Byrd

NCLCV v. Hall
21 CVS 15426
LDTX204

THE GREAT SEAL OF THE STATE OF NORTH CAROLINA
MAY 20, 1775
APRIL 12, 1776
ESSE QUAM VIDERI

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC., et al.,

REBECCA HARPER, et al.,

COMMON CAUSE,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.

Defendants.

AFFIDAVIT OF ROBERT PHILLIPS
EXECUTIVE DIRECTOR OF COMMON CAUSE NORTH CAROLINA

I, Robert "Bob" Phillips, swear under penalty of perjury that the following information is true to the best of my knowledge and state as follows:

1. I am a resident of Wake County, where I have lived since 1981. I am a native of Charlotte, North Carolina and have lived in the Triangle area for the past 45 years.

2. Since 2001, I have served as Executive Director of Common Cause North Carolina ("CCNC"), a state chapter of National Common Cause ("Common Cause"), which is a 501(c)(4) registered nonpartisan, nonprofit grassroots organization dedicated to upholding the core values of American democracy. Before becoming Executive Director of CCNC, I was hired as a full-time consultant to manage CCNC's 501(c)(3) grant awarded for nonpartisan public outreach and education on pro-democracy reforms. Prior to joining Common Cause, I worked as a local television journalist and Communications Director for the Office of Lieutenant Governor.

NCLCV v. Hall
21 CVS 15426
LDTX205

Witness:
Jeffrey Lewis, Ph.D.
Ex 6
12/31/21 D. Myers Byrd

3. As Executive Director of CCNC, I manage a diverse staff of eight people who work in the Triangle, Triad and Charlotte regions. I help design and implement policy and program priorities for Common Cause NC. I represent CCNC before the public, the media, decision-makers, and donors. I am also a registered lobbyist for Common Cause at the North Carolina General Assembly, and have worked with lawmakers on both sides of the aisle on matters related to redistricting reform.

4. I am authorized to speak for Common Cause in this case.

Common Cause Background

5. Since its founding in 1970, Common Cause has been dedicated to fair elections and making government at all levels more representative, open, and responsive to the interests of ordinary people. Common Cause regularly assists voters in understanding and navigating the election process, provides resources to help voters determine their districts and polling locations, and mobilizes voters to engage in political advocacy.

6. Common Cause has been one of the leading proponents of redistricting reform, conducting public education, advocacy, legislative lobbying, and participating in litigation in order to secure fair maps for all North Carolinians. Common Cause has been particularly active in efforts to curb partisan gerrymandering, working on legislative advocacy with both Democrats and Republicans in North Carolina for the past 20 years. Common Cause has also served as the lead plaintiff in multiple partisan gerrymandering lawsuits, including *Common Cause v. Rucho* in federal court and *Common Cause v. Lewis* in state court.

7. Partisan gerrymandering frustrates Common Cause's organizational mission of increasing democratic engagement and voter participation by insulating elected officials from the democratic process. When election results are preordained by partisan gerrymanders, voters are much less likely to contact their representatives, vote in elections, or engage in the democratic process. All of these effects directly impede Common Cause's organizational purpose.

Common Cause North Carolina Membership

8. As part of my Executive Director responsibilities, I oversee the maintenance of CCNC's statewide membership, supporter, and staff lists, records and information. Common Cause currently has over 25,000 members, staff, and supporters in North Carolina.

9. Based on my review and comparison of the Common Cause member database and with publicly available information in the North Carolina voter registration database, I am personally aware that Common Cause has members in the following counties as of October 2021 in the numbers indicated below, and do not have reason to believe these figures have changed appreciably since then:

    a. 310 members in Alamance County;

    b. 441 members in Brunswick County;

c. 2,005 members in Buncombe County;

d. 411 members in Cumberland County;

e. 136 members in Davidson County;

f. 1,717 members in Durham County;

g. 972 members in Forsyth County;

h. 1,540 members in Guilford County;

i. 198 members in Johnston County;

j. 2,441 members in Mecklenburg County;

k. 109 members in Nash County;

l. 743 members in New Hanover County;

m. 162 members in Onslow County;

n. 62 members in Robeson County;

o. 259 members in Union County;

p. 4,166 members in Wake County;

q. 79 members in Wayne County;

10. Common Cause members include voters who self-identify as Black throughout North Carolina. Based on my review of the Common Cause member database and of publicly available information in the North Carolina voter registration database, I am personally aware that we have members who have self-identified as Black in at least the following areas:

a. Bertie County;

b. Gates County;

c. Hertford County;

d. Hoke County;

e. Nash County;

f. Northampton County;

g. Pasquotank County;

   h. Scotland County;

   i. Wake County;

   j. Wayne County; and

   k. Wilson County.

11. CCNC's strength as an organization comes from our members and supporters. All across North Carolina, our members drive our efforts to hold those in power accountable, and to create public mechanisms and institutions that ensure that the people are the ones in charge. Our members staff our volunteer campaigns, call other North Carolinians and legislators alike to advocate for democracy-enabling policies, and power our movement forward. Nothing we do would be possible without our members.

12. Our members also help drive our efforts to assist voters in North Carolina to increase civic engagement. For example, the mission of CCNC's HBCU Student Action Alliance, launched in 2006, is to raise civic engagement among students of color at each of North Carolina's ten Historically Black Colleges and Universities (HBCUs). Additionally, we identify and nurture student leadership by selecting campus ambassadors whom we identify as our Democracy Fellows. Each Fellow receives a semester stipend for being our civic leader on their campus. Much of the HBCU campus work revolves around encouraging civic engagement, which includes registering to vote and voting in every election. Moreover, we strive to help every student understand that participating in democracy is more than just voting. We engage students to help us with our public education efforts and civic outreach activities, along with holding local elected officials accountable through contacts with their representatives.

The 2021 Redistricting Process

13. As part of my role as Executive Director of CCNC, I closely monitored the 2021 North Carolina redistricting process. My monitoring activities included physically attending meetings of the House Redistricting Committee and the Senate Redistricting and Elections Committee, attending public hearings, and watching livestreamed legislative meetings, as specified below, from August 2021 until the final maps were enacted in November 2021. This work was part of CCNC's initiative to amplify the transparency and accessibility of the redistricting process by educating our members and the public about the process and notifying them of opportunities to engage and provide input, such as the time(s) and location(s) of scheduled public hearings, the topics to be discussed at those hearings and the availability of draft maps for their review.

14. I am aware that the Legislative Defendants in this matter have insisted, both in public statements during the redistricting process and in litigation about this process, that the 2021 redistricting process was the most open and transparent process in North Carolina's history. Having worked in an advocacy role through three prior redistricting cycles and the remedial redistrictings this past decade, this assertion does not accurately reflect the process I personally experienced this year, both as a member of the public and as a nonpartisan advocate for voters.

15. From the beginning of this redistricting process, Common Cause advocated for a fair, transparent, timely, and inclusive redistricting process that would allow for meaningful public input. We understood that the delay in decennial census data (which is usually issued in the spring but was delayed until August this year) might require accommodations to the redistricting process, but given our experience in past redistricting cycles, we were confident that with adequate planning, it was still feasible to provide the public with a fulsome opportunity to provide input both before and after draft maps were publicly available. This would have enabled legislators to hear from the public on what types of maps would best serve their communities, as well as to hear feedback on proposed maps and, based on that feedback, make any changes necessary to ensure that communities across the state were adequately represented. Unfortunately, this is not the process that occurred.

16. The 2021 redistricting process was so riddled with obstacles to monitoring and engagement that I found myself – an experienced advocate who has followed many past iterations of redistricting – struggling to follow the process. These obstacles included late, inaccurate, and conflicting notices of scheduled public hearings from the House and Senate Committees on Redistricting, fewer public hearings than were provided in the 2011 redistricting process, and uncertainty as to whether/when the public would be given an opportunity to review and provide feedback on draft maps. Overall, it felt extremely chaotic and left advocates like those of us at Common Cause rushing last-minute to notify members of the public of when, where, and how they could provide input.

17. When public hearings were first proposed on August 18, 2021, legislative leaders announced that there would only be 10 public hearings before any draft maps were released.[1] This is in stark contrast to the dozens of public hearings held during the 2011 cycle.[2] After public pushback, the legislature announced a slightly expanded schedule of 13 public hearings on September 1, 2021, to be held from September 8 – 30.[3] This gave advocates and members of the public less than a week to prepare for the first hearing, with no indication of whether remote participation would be possible in light of COVID considerations. There was also no public information as to whether or not there would be any draft maps available during these hearings.

18. These obstacles caused unnecessary confusion and presented burdens to advocates like myself, as well as voters and other members of the public, many of whom expressed their eagerness to participate in these hearings to me directly. For example, the hearing location for the first public hearing on September 8, 2021, in Caldwell County was announced as the Caldwell Community College and Technical Institute.[4] But the actual location was at the J.E. Broyhill Civic Center Auditorium, which is in downtown Lenoir County and two miles from the college campus. I observed that this created great confusion amongst the

1 *See* https://ncleg.gov/documentsites/committees/House2021-182/2021/08-18-21/Chairs%20Potential%20Sites%20Handout%20v1.pdf

2 *See* https://www.ncleg.gov/Legislation/SupplementalDocs/2011/publichearings/redistricting

3 *See* https://www.ncleg.gov/documentsites/committees/House2021-182/2021/Public%20Hearing%20Schedule.pdf

4 *See* https://www.ncleg.gov/documentsites/committees/House2021-182/2021/Public%20Hearing%20Schedule.pdf

public who planned to attend. I showed up at the wrong location at Caldwell Community College, where I could not identify anyone who knew where the hearing would be. Signage directing people to the new site was so sparse that it took me 15 minutes of searching for information before I finally found it. In fact, I arrived to the community college campus at the same time Mecklenburg County House Representative Becky Carney did who was planning on being one of the lawmakers presiding over the hearing. She too had no idea at the time where the meeting was. After I finally made it to the J.E. Broyhill Civic Center Auditorium, I observed that a number of people who were called out to provide public comment did not appear to be present when their names were called to provide public comment. In fact, the first four people called upon were no shows, and I became the first speaker at number five. I could not help but wonder how many of the no shows were folks who, like me, did not have the correct location for the hearing.

19. This was not the only issue with the public hearing notices in September. The public hearing in Forsyth County on September 14 was also noticed with the wrong location. The legislature's schedule advertised this hearing's location as the Strickland Auditorium when in fact the hearing took place at the Dewitt Rhoades Conference Center in Winston Salem.

20. On another occasion, there was conflicting information about the same hearing posted by the House and Senate Committees. The legislature posted conflicting schedules on the House Redistricting Committee and Senate Redistricting Committee websites in mid-September 2021. These different schedules indicated different times for the same Robeson County hearing scheduled for September 28, 2021. It was only after community follow up that the correct time for the Robeson hearing was clarified.

21. The public hearing process concluded on September 28, 2021 with no indication of what would come next. Two days later, on September 30, 2021, the legislature noticed meetings of the House and Senate Redistricting Committees for the following week without a specific agenda. These are just a few examples of the obstacles that advocates and other members of the public were confronted with in their efforts to provide public comment before maps were drawn.

22. During the public comment period before there were any draft maps, I observed firsthand the passion many people expressed as they pleaded with lawmakers to draw fair maps, often making specific suggestions based on local knowledge of their community in these public hearings. But since the Chairs chose to limit public hearings to the period before there were any draft maps that citizens could examine and review, they were unable to provide any such comments specifically in response to actual proposed maps and how those maps would impact their communities. I believe this process significantly undermined citizens' ability to access their right to participate in the redistricting process. I also question whether the location and time choices deliberately excluded three of the largest metropolitan areas - including Raleigh, Greensboro, and Asheville - which I understand were directly impacted by the lines struck down as unlawful last cycle. Finally, these meetings were held in September, at a time when the Delta COVID-19 variant was rampant in North Carolina, and I knew many of the North Carolinians we engage in our work were eager to engage in the redistricting process without deviating from the CDC's advisory regarding the increased health risk associated with attending public gatherings in indoor

spaces. Yet lawmakers made no provisions to livestream a single public hearing in this series of meetings. There was no way for a citizen to watch or participate in real time from the safety of their home - yet "virtual participation" was provided at public meetings on the maps in late October.

Map-Drawing Process

23. On October 5, 2021, the House and Senate Redistricting Committees met separately, and I watched these on livestream. In both meetings, the respective Chairs announced the process legislators would have to use in drawing proposed state Legislative and Congressional maps. This included leaving specific committee rooms with four map-drawing computer stations open during business hours and allowing members to come in and, with the assistance of staff, draw maps at the stations. The Chairs did not indicate how long these stations would be available or how long the map-drawing process would extend, and did not provide lawmakers with any set deadline for when they had to draw and propose maps.

24. CCNC devoted multiple staff members to monitor the map drawing process in the General Assembly. This was part of our effort to provide some substantive transparency out of the surface-level transparency that the Chairs' redistricting process offered. However, the way in which the map-drawing was set up, with 10 live-stream cameras running more than 40 hours per week with no public information as to when legislators would be drawing maps, was daunting for our organization. We had to dedicate staff to monitoring these cameras at the expense of other use of this staff time and resources. Despite our best efforts and the increased resources we had to dedicate to this issue, we fell far short of being able to fully monitor and educate the public on the map-drawing process while it was happening.

25. These efforts were made all the more difficult by the various obstacles to in-person observation. Citizens were relegated to sitting in the back of the room in both committee meeting rooms where map-drawing occurred, where they had no ability to actually hear lawmakers or other individuals involved in the map drawing at work, or see what information they had brought with them to the map drawing computer stations. There was also no indication of who was seated at the work stations. I did not see anyone - lawmakers, nonpartisan staff, or partisan staff - make any effort to identify who they were or who was participating in the map-drawing. Additionally, watching the screens of each work station was also more confusing than it was informative, as maps would randomly appear, with lines shifting and various visual filters all changing rapidly without any context or explanation. In short, it felt like a waste of time to attend these sessions in person, and the times that I did go (early on in the process) I saw few if any members of the public in the room.

26. For these reasons, I strongly disagree that this process was transparent, given that members of the public did not know who was involved in drawing the maps, what information was being taken into the room or used while in the room, or the reasons certain lines were being drawn or altered at any particular time. Finally, while I was on-site during the map-drawing process, I observed lawmakers and others participating in the map-drawing process freely entering and exiting the committee rooms with papers and communications devices, including cell phones, and I saw nothing that would have hindered them from viewing

partisan or other data outside the committee room between map-drawing session, or from bringing in draft maps and materials with them from outside the room to the computer work station.

Limited public hearings on draft maps

25. Late on Wednesday, October 20, 2021, the General Assembly noticed two hearings for public comment: one on Monday, October 25, 2021 for the Congressional maps and one on Tuesday, October 26, 2021 for the Senate and House maps. The hearing notices did not specify which maps specifically would be discussed. This last-minute timing and lack of specifics gave members of the public very little opportunity to review, analyze, and prepare their public comment on the draft maps that had been publicly released, and made it very difficult for us at CCNC to notify the public about their ability to weigh in on map proposals. It also left exceedingly little time for that public comment to be incorporated into the maps that were passed shortly thereafter in the first week of November.

26. As in September, I observed that the North Carolinians attending the October public hearings were well-informed and passionate about conveying to lawmakers their desire to have fair maps, but I also observed confusion and frustration for members of the public who were unable to clearly identify which maps lawmakers were actually considering and would be voting on so they could provide comment on them. The sign-up process was also unnecessarily limited to less than 300 public speaking slots total across the two hearings - in a state of more than 10 million - to comment on legislative and Congressional maps that will be in place for the next decade. There was also no opportunity for citizens to sign up in the room of the in-person hearings. I believe this process failed to provide a meaningful opportunity for members of the public who wanted to speak to be able to do so.

RPV Analysis and NC NAACP v. Berger suit

27. During the process, my colleagues at CCNC and I grew increasingly concerned about the criteria prohibiting any use of racial data during redistricting, particularly as it prevented legislators from formally using data needed to protect voters of color in redistricting. This was especially concerning given the state’s long history of targeting and discriminating against these voters in past redistricting cycles. When we saw the draft member-submitted map “SST-4” posted online, and particularly two of the proposed Senate Districts (marked Districts 1 and 9 on that map) we became concerned that Black voters in these areas would be deprived of the chance to re-elect their candidates of choice. We obtained a preliminary racially polarized voting analysis showing that Black voters would likely be unable to elect their candidates of choice as the result of racially polarized voting in these areas, and I sent this analysis via email to the legislative leaders, as well as the House and Senate Redistricting Committee members.

28. My hope was that the legislators would use this information to remedy these issues in the map, and to undertake additional analysis of racially polarized voting in North Carolina before enacting final maps. I sent this in part because the Chairs had indicated they would be open to viewing this type of information in committee meetings. This email is appended to this affidavit as **Exhibit A**. My understanding is that the legislators did not follow-up on

these issues even after receiving my email, or conduct any other analysis of racial data to mitigate the destruction of districts that perform for Black voters in the House and Senate maps.

29. We had serious concerns about this process, and therefore filed a complaint on October 29, 2021, asking for judicial review of this process and alleging that it would harm voters of color and specifically Black voters, including our own members and the voters we served. *See N.C. NAACP v. Berger*, No. 21 CVS 014776 (N.C. Super. Ct., Wake Cty.). We voluntarily withdrew our appeal of the dismissal of that complaint before asking to intervene in this matter after the maps were passed.

Vote on Final Maps

30. As the redistricting process wound toward a vote on final maps, the legislature's process continued to be wrought with obstacles to transparency. For example, the version of the state House bill filed on October 28, 2021 was just a placeholder that did not include any specific district lines. The proposed state House map was not posted on the General Assembly's website under "member-submitted maps" as would have been expected. In the November 1, 2021 House Redistricting Committee meeting, Chair Hall spoke at length about the transparency of the legislature's redistricting process. While he was making those comments, the proposed House map was not publicly available anywhere, including on the "Member Submitted Maps" page designated for posting the maps under consideration.

31. The final maps were passed very quickly over just a few days in early November. Overall, I found the entire process confusing and frustrating for its lack of context and transparency. My observation as an advocate who works with members of the public on civic engagement is that the average North Carolinian could not meaningfully have a voice in this process.

I declare under penalty of perjury under the laws of the United States that the foregoing is true and correct to the best of my knowledge.

Executed on December 23, 2021.

Bob Phillips

Bob Phillips

Sworn and subscribed before me this 23rd day of December, 2021.

Talia Ray

Notary Public

Name: Talia Ray

My commission expires: 11-6-2024

TALIA RAY
My Commission Expires
November 6, 2024
NOTARY PUBLIC
MOORE COUNTY, NC

PHILLIPS AFFIDAVIT EXHIBIT A

From: Bob Phillips <bphillips@commoncause.org>
Subject: RPV Analysis for proposed SD9 and SD1 in member submitted map "SST-4"
Date: October 26, 2021 at 11:54:06 AM EDT
To: "Tim.Moore@ncleg.gov" <Tim.Moore@ncleg.gov>, "Grace.Irvin@ncleg.gov" <Grace.Irvin@ncleg.gov>, "Phil.Berger@ncleg.gov'" <Phil.Berger@ncleg.gov>, "Robin.Braswell@ncleg.gov" <Robin.Braswell@ncleg.gov>, "Warren.Daniel@ncleg.gov" <Warren.Daniel@ncleg.gov>, "Andy.Perrigo@ncleg.gov" <Andy.Perrigo@ncleg.gov>, "Ralph.Hise@ncleg.gov" <Ralph.Hise@ncleg.gov>, "Susan.Fanning@ncleg.gov" <Susan.Fanning@ncleg.gov>, "Paul.Newton@ncleg.gov" <Paul.Newton@ncleg.gov>, "Andrew.Stiffel@ncleg.gov" <Andrew.Stiffel@ncleg.gov>, "Destin.Hall@ncleg.gov" <Destin.Hall@ncleg.gov>, "Lucy.Harrill@ncleg.gov" <Lucy.Harrill@ncleg.gov>, "Dan.Blue@ncleg.gov" <Dan.Blue@ncleg.gov>, "Bonnie.McNeil@ncleg.gov" <Bonnie.McNeil@ncleg.gov>, "Robert.Reives@ncleg.gov" <Robert.Reives@ncleg.gov>, "Veronica.Green@ncleg.gov" <Veronica.Green@ncleg.gov>, "Ben.Clark@ncleg.gov" <Ben.Clark@ncleg.gov>, "Michael.Johnson@ncleg.gov" <Michael.Johnson@ncleg.gov>, "Don.Davis@ncleg.gov" <Don.Davis@ncleg.gov>, "Edwin.Woodard@ncleg.gov" <Edwin.Woodard@ncleg.gov>, "Chuck.Edwards@ncleg.gov" <Chuck.Edwards@ncleg.gov>, "Heather.Millett@ncleg.gov" <Heather.Millett@ncleg.gov>, "Carl.Ford@ncleg.gov" <Carl.Ford@ncleg.gov>, "Angela.Ford@ncleg.gov" <Angela.Ford@ncleg.gov>, "Kathy.Harrington@ncleg.gov" <Kathy.Harrington@ncleg.gov>, "Lorie.Byrd@ncleg.gov" <Lorie.Byrd@ncleg.gov>, "Brent.Jackson@ncleg.gov" <Brent.Jackson@ncleg.gov>, "William.Kirkley@ncleg.gov" <William.Kirkley@ncleg.gov>, "Joyce.Krawiec@ncleg.gov" <Joyce.Krawiec@ncleg.gov>, "Debbie.Lown@ncleg.gov" <Debbie.Lown@ncleg.gov>, "Paul.Lowe@ncleg.gov" <Paul.Lowe@ncleg.gov>, "Corneisha.Mitchell@ncleg.gov" <Corneisha.Mitchell@ncleg.gov>, "Natasha.Marcus@ncleg.gov" <Natasha.Marcus@ncleg.gov>, "Jessica.Bolin@ncleg.gov" <Jessica.Bolin@ncleg.gov>, "Wiley.Nickel@ncleg.gov" <Wiley.Nickel@ncleg.gov>, "Michael.Cullen@ncleg.gov" <Michael.Cullen@ncleg.gov>, "Jim.Perry@ncleg.gov" <Jim.Perry@ncleg.gov>, "LeighAnn.Biddix@ncleg.gov" <LeighAnn.Biddix@ncleg.gov>, "Bill.Rabon@ncleg.gov" <Bill.Rabon@ncleg.gov>, "Paula.Fields@ncleg.gov" <Paula.Fields@ncleg.gov>, "William.Richardson@ncleg.gov" <William.Richardson@ncleg.gov>, "Leigh.Lawrence@ncleg.gov" <Leigh.Lawrence@ncleg.gov>, "Jason.Saine@ncleg.gov" <Jason.Saine@ncleg.gov>, "MaryStuart.Sloan@ncleg.gov" <MaryStuart.Sloan@ncleg.gov>, "John.Torbett@ncleg.gov" <John.Torbett@ncleg.gov>, "Viddia.Torbett@ncleg.gov" <Viddia.Torbett@ncleg.gov>, "Cecil.Brockman@ncleg.gov" <Cecil.Brockman@ncleg.gov>, "Matthew.Barley@ncleg.gov" <Matthew.Barley@ncleg.gov>, "Becky.Carney@ncleg.gov" <Becky.Carney@ncleg.gov>, "Beth.LeGrande@ncleg.gov" <Beth.LeGrande@ncleg.gov>, "Linda.Cooper-Suggs@ncleg.gov" <Linda.Cooper-Suggs@ncleg.gov>, "Caroline.Enloe@ncleg.gov" <Caroline.Enloe@ncleg.gov>, "Jimmy.Dixon@ncleg.gov" <Jimmy.Dixon@ncleg.gov>, "Michael.Wiggins@ncleg.gov" <Michael.Wiggins@ncleg.gov>, "Jon.Hardister@ncleg.gov" <Jon.Hardister@ncleg.gov>, "Jayne.Nelson@ncleg.gov" <Jayne.Nelson@ncleg.gov>, "Pricey.Harrison@ncleg.gov" <Pricey.Harrison@ncleg.gov>, "Mary.Lee@ncleg.gov" <Mary.Lee@ncleg.gov>, "Kelly.Hastings@ncleg.gov" <Kelly.Hastings@ncleg.gov>, "Sophia.Hastings@ncleg.gov" <Sophia.Hastings@ncleg.gov>, "Zack.Hawkins@ncleg.gov" <Zack.Hawkins@ncleg.gov>, "Anita.Wilder@ncleg.gov" <Anita.Wilder@ncleg.gov>, "Brenden.Jones@ncleg.gov" <Brenden.Jones@ncleg.gov>, "Jeff.Hauser@ncleg.gov" <Jeff.Hauser@ncleg.gov>, "Grey.Mills@ncleg.gov" <Grey.Mills@ncleg.gov>, "Mason.Barefoot@ncleg.gov" <Mason.Barefoot@ncleg.gov>, "David.Rogers@ncleg.gov" <David.Rogers@ncleg.gov>, "Misty.Rogers@ncleg.gov" <Misty.Rogers@ncleg.gov>, "John.Szoka@ncleg.gov" <John.Szoka@ncleg.gov>, "Beverly.Slagle@ncleg.gov" <Beverly.Slagle@ncleg.gov>, "Harry.Warren@ncleg.gov" <Harry.Warren@ncleg.gov>, "Cristy.Yates@ncleg.gov" <Cristy.Yates@ncleg.gov>, "Lee.Zachary@ncleg.gov" <Lee.Zachary@ncleg.gov>, "Martha.Jenkins@ncleg.gov" <Martha.Jenkins@ncleg.gov>

Subject: RPV Analysis for proposed SD9 and SD1 in member submitted map "SST-4"

Dear Senators and Representatives,

Attached are analyses of recent state-wide election results in the proposed SD9 and SD1 as drawn in the member submitted map "SST-4" that we believe are indicative of racially polarized voting in these jurisdictions. We strongly urge the House and Senate Redistricting Committees to consider this information, and to take care this redistricting cycle to ensure that House and Senate maps do not dilute the voting power of voters of color, particularly for voters in Northeast North Carolina.

RPV in SD1 in SST4 Bertie-Camden-Currituck-Dare-Gates-Hertford-Northampton-Pasquotank-Perquimans-Tyrrell (Ernestine Bazemore)

	Beasley vs. Newby - NC Supreme Court 2020GEN								
	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (0)	≥ 90% White Precincts (18)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Beasley		34.58%	90.74%	27.00%	98.71%	21.02%	95.80%	23.69%	46.55%
Newby		65.42%	9.26%	73.00%	1.86%	78.94%	4.20%	76.31%	53.45%

	Holmes vs. Dobson - NC Commissioner of Labor 2020GEN								
	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (0)	≥ 90% White Precincts (18)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Holmes		33.59%	91.96%	26.15%	98.61%	20.31%	96.41%	22.50%	46.40%
Dobson		66.41%	8.04%	73.85%	0.98%	79.73%	3.59%	77.50%	53.60%

	Blue vs. Folwell - NC Treasurer 2016GEN								
	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (25)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Blue	93.86%	34.11%	93.41%	26.70%	98.79%	24.05%	97.19%	25.73%	48.07%
Folwell	6.14%	65.89%	6.59%	73.31%	0.79%	75.90%	2.81%	74.27%	51.93%

	Coleman vs. Forest vs. Cole - Lt. Governor 2016GEN								
	Homogeneous Precinct Analysis		Bivariate Ecological Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (25)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Coleman	93.69%	33.83%	91.15%	25.49%	98.16%	22.79%	90.05%	27.98%	46.58%
Forest	5.74%	62.71%	8.85%	74.51%	1.16%	74.73%	9.13%	70.36%	50.98%
Cole	0.56%	3.47%			0.57%	3.42%	0.82%	1.66%	2.44%

RPV in SD9 in SST-4 Greene-Wayne-Wilson (Milton "Toby" Fitch Jr.)

	Beasley vs. Newby - NC Supreme Court 2020GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (0)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Beasley	94.90%		99.31%	18.74%	98.69%	8.57%	97.28%	10.60%	48.28%
Newby	5.10%		0.69%	81.26%	1.13%	91.40%	2.72%	89.40%	51.72%

	Holmes vs. Dobson - NC Commissioner of Labor 2020GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (1)	≥ 90% White Precincts (0)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Holmes	95.87%		100.00%	16.96%	99.11%	7.29%	97.89%	8.67%	47.68%
Dobson	4.13%		0.00%	83.04%	0.02%	92.70%	2.11%	91.33%	52.32%

	Blue vs. Folwell - NC Treasurer 2016GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (2)	≥ 90% White Precincts (1)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Blue	96.55%	15.82%	100.00%	17.62%	99.02%	13.55%	97.40%	15.83%	48.71%
Folwell	3.45%	84.18%	0.00%	82.38%	0.84%	86.28%	2.60%	84.17%	51.29%

	Coleman vs. Forest vs. Cole - Lt. Governor 2016GEN								
	Homogeneous Precinct Analysis		Bivariate Regression		King's Iterative EI		RxC EI		Percent Vote
	≥ 90% Black Precincts (2)	≥ 90% White Precincts (1)	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	Support from Black Voters	Support from White Voters	
Coleman	96.76%	13.79%	99.86%	14.28%	99.19%	9.91%	83.13%	22.97%	46.32%
Forest	2.19%	84.90%	0.14%	85.72%	0.90%	87.47%	16.19%	76.55%	51.96%
Cole	1.05%	1.31%			1.68%	1.80%	0.67%	0.48%	1.72%

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
21 CVS 015426, 21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC.; HENRY M. MICHAUX, JR., et al.,

Plaintiffs,

REBECCA HARPER, et al.,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, in his official capacity as Chair of the House Standing Committee on Redistricting, et al.,

Defendants.

AFFIDAVIT OF PROFESSOR MOON DUCHIN

NCLCV v. Hall
21 CVS 15426
LDTX206

Witness:
Jeffrey Lewis, Ph.D.
Ex 7
12/31/21 D. Myers Byrd

I, Dr. Moon, Duchin, having been duly sworn by an officer authorized to administer oaths, depose and state as follows:

1. I am over 18 years of age, legally competent to give this Affidavit, and have personal knowledge of the facts set forth in this Affidavit.
2. All of the quantitative work described in this Affidavit was performed by myself with the support of research assistants working under my direct supervision.

Background and qualifications

3. I hold a Ph.D. and an M.S in Mathematics from the University of Chicago as well as an A.B. in Mathematics and Women's Studies from Harvard University.
4. I am a Professor of Mathematics and a Senior Fellow in the Jonathan M. Tisch College of Civic Life at Tufts University.
5. My general research areas are geometry, topology, dynamics, and applications of mathematics and computing to the study of elections and voting. My redistricting-related work has been published in venues such as the Election Law Journal, Political Analysis, Foundations of Data Science, the Notices of the American Mathematical Society, Statistics and Public Policy, the Virginia Policy Review, the Harvard Data Science Review, Foundations of Responsible Computing, and the Yale Law Journal Forum.
6. My research has had continuous grant support from the National Science Foundation since 2009, including a CAREER grant from 2013–2018. I am currently on the editorial board of the journals Advances in Mathematics and the Harvard Data Science Review. I was elected a Fellow of the American Mathematical Society in 2017 and was named a Radcliffe Fellow and a Guggenheim Fellow in 2018.
7. A current copy of my full CV is attached to this report.
8. I am compensated at the rate of $400 per hour.

Analysis of 2021 enacted redistricting plans in North Carolina

Moon Duchin
Professor of Mathematics, Tufts University
Senior Fellow, Tisch College of Civic Life

December 23, 2021

1 Introduction

On November 4, 2021, the North Carolina General Assembly enacted three districting plans: maps of 14 U.S. Congressional districts, 50 state Senate districts, and 120 state House districts. This affidavit contains a brief summary of my evaluation of the properties of these plans. My focus will be on the egregious partisan imbalance and racial vote dilution in the enacted plans, following a brief review of the traditional districting principles.

Because redistricting inevitably involves complex interactions of rules, which can create intricate tradeoffs, it will be useful to employ a direct comparison to an alternative set of plans. These demonstrative plans illustrate that it is possible to *simultaneously maintain or improve* metrics for all of the most important redistricting principles that are operative in North Carolina's constitution and state and federal law. Crucially, this shows that nothing about the state's political geography compels us to draw a plan with a massive and entrenched partisan skew or a significant dilutive effect on Black voters.

To this end, I will be comparing the following plans: the enacted plans SL-174, SL-173, and SL-175 and a corresponding set of alternative plans labeled NCLCV-Cong, NCLCV-Sen, and NCLCV-House (proposed by plaintiffs who include the North Carolina League of Conservation Voters). The accompanying block assignment files are Appendices A1, A2, A3 to this affidavit, and I understand that they will be provided to the court in native format.

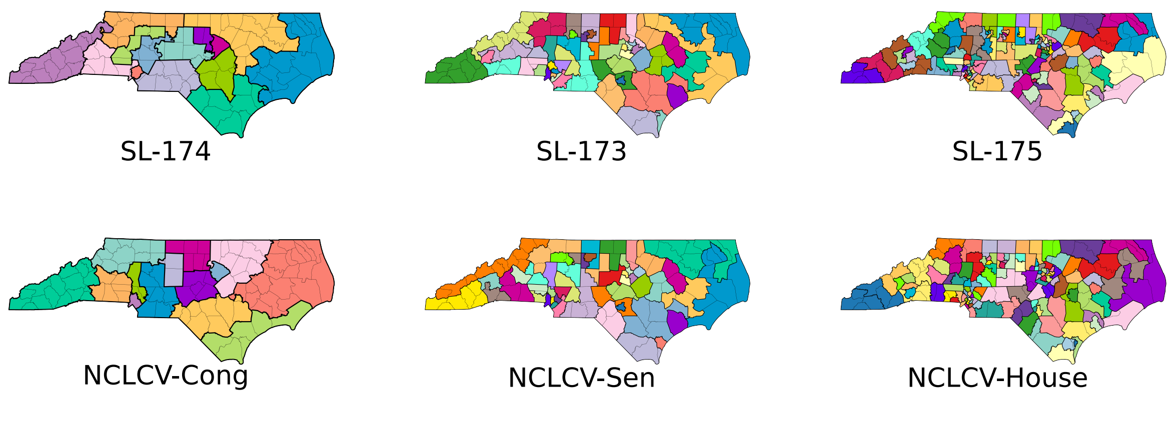


Figure 1: The six plans under discussion in this affidavit.

2 Partisan gerrymandering

2.1 Abstract partisan fairness

There are many notions of partisan fairness that can be found in the scholarly literature and in redistricting practitioner guides and software. Most of them are numerical, in the sense that they address *how a certain quantitative share of the vote should be translated to a quantitative share of the seats* in a state legislature or Congressional delegation.

The numerical notions of partisan fairness all tend to agree on one central point: an electoral climate with a roughly 50-50 split in partisan preference should produce a roughly 50-50 representational split. I will call this the *Close-Votes-Close-Seats* principle. North Carolina voting has displayed a partisan split staying consistently close to even between the two major parties over the last ten years, but the plans released by the General Assembly after the 2010 census were very far from realizing the ideal of converting even voting to even representation. This time, with a 14th seat added to North Carolina's apportionment, an exactly even seat outcome is possible. But the new enacted plans, like the plans from ten years ago, are decidedly not conducive to even representation.

Importantly, Close-Votes-Close-Seats is not tantamount to a requirement for proportionality. Rather, it is closely related to the principle of *Majority Rule*: a party or group with more than half of the votes should be able to secure more than half of the seats. In fact, Close-Votes-Close-Seats is essentially a corollary (or byproduct) of Majority Rule. It is not practicable to design a map that *always* attains these properties, but by contrast a map that *consistently thwarts* them should be closely scrutinized and usually rejected.

Unlike proportionality, neither Close-Votes-Close-Seats nor Majority Rule has any bearing on the preferred representational outcome when one party has a significant voting advantage: these principles are silent about whether 70% vote share should secure 70% of the seats, as proportionality would dictate, or 90% of the seats, as supporters of the efficiency gap would prefer. The size of the "winner's bonus" is not at all prescribed by a Close-Votes-Close-Seats norm.

2.2 Geography and fairness

Some scholars have argued that all numerical ideals, including Close-Votes-Close-Seats, ignore the crucial *political geography*—this school of thought reminds us that the location of votes for each party, and not just the aggregate preferences, has a major impact on redistricting outcomes. In [5], my co-authors and I gave a vivid demonstration of the impacts of political geography in Massachusetts: we showed that for a ten-year span of observed voting patterns, even though Republicans tended to get over one-third of the statewide vote, it was impossible to draw a single Congressional district with a Republican majority. That is, the geography of Massachusetts Republicans locked them out of Congressional representation. It is therefore not reasonable to charge the Massachusetts legislature with gerrymandering for having produced maps which yielded all-Democratic delegations; they could not have done otherwise.

In North Carolina, this is not the case. The alternative plans demonstrate that it is possible to produce maps that give the two major parties a roughly equal opportunity to elect their candidates. These plans are just examples among many thousands of plausible maps that convert voter preferences to far more even representation by party. In Congressional redistricting, present-day North Carolina geography is easily conducive to a seat share squarely in line with the vote share. In Senate and House plans, even following the strict detail of the Whole County Provisions, there are likewise many alternatives converting nearly even voting patterns to nearly even representation, across a large set of recent elections.

The clear conclusion is that the political geography of North Carolina today does not obstruct the selection of a map that treats Democratic and Republican voters fairly and even-handedly.

2.3 Overlaying elections and plans

The enacted plans behave as though they are built to resiliently safeguard electoral advantage for Republican candidates. We can examine this effect without invoking any predictions or assumptions about future voting behavior by using a standard technique in election analysis: pairing proposed plans with actual recent elections. This method works by overlaying (or superimposing) the districting plans on a series of observed voting patterns from the recent past; this lets us take advantage of the rich dataset of real electoral outcomes in North Carolina in the last ten years to avoid speculative or predictive modeling about voting trends in the future.[1]

The overlay method works best when there is a large set of statewide elections to apply, which is certainly true in North Carolina. Of the 52 statewide party-ID general elections from the last cycle, 29 are elections for Council of State (ten offices elected three times, with the Attorney General race uncontested in 2012), three are presidential races, three are for U.S. Senate, and 17 are judicial races since mid-decade, when those became partisan contests. See Table 1 for more detail on the election dataset.

2.4 Partisanship outcomes

North Carolina is a very "purple" state. In 38 out of the 52 contests in our dataset, the statewide partisan outcome is within a 6-point margin: 47-53 or closer.

To understand how the enacted plans create major shortfalls for Democratic representation, we will overlay the plans with voting patterns from individual elections in the past Census cycle. We can make a striking observation by laying our six plans over the vote patterns, shown in Table 1. This reveals that the enacted Congressional plan (SL-174) shows a remarkable lack of responsiveness, giving 10–4 partisan outcomes across a wide range of recent electoral conditions, meaning that 10 Republicans and only 4 Democrats would represent North Carolina in Congress. The alternative plan (NCLCV-Cong) is far more faithful to the vote share, far more responsive, and tends to award more seats to the party with more votes—usually upholding both basic small-d-democratic principles of Majority Rules and Close-Votes-Close-Seats, which are violated by the enacted plan.

The same patterns are visible at the Senate and House level. Overall, the three enacted plans combine with those 38 relatively even vote patterns to produce 114 outcomes. Every single pairing of an enacted plan with a close statewide contest—a complete sweep of 114 opportunities—gives an *outright Republican majority* of seats. All three enacted plans will lock in an extreme, resilient, and unnecessary advantage for one party.

By every measure considered above that corresponds to a clear legal or good-government redistricting goal or value, the alternative plans meet or exceed the performance of the enacted plans. This demonstrates that it is possible, without any cost to the redistricting principles in play, to select maps that are far fairer to the voters of North Carolina.

Below, the outcomes of overlaying the plans on the elections will be presented in a series of tables and figures. First, Table 1 overviews the overlays with numbers.[2] Then, Figure 2 offers a visualization to depict the same big picture of entrenched partisan advantage in the enacted plans with the full 52-election dataset. The diagonals show various lines of *responsiveness* that pivot around the central point of fairness: half of the votes securing half of the seats.

Finally, we will restrict to a smaller set of the 14 "up-ballot" races and consider the comparison for one office at a time in Figures 3-5.

[1] Many authors have used this technique of overlaying "exogenous" statewide elections rather than using statistical regressions and other modeling to manipulate "endogenous" districted elections. For instance this can be found in peer-reviewed work and expert reports of scholar-practitioners such as Bernard Grofman and Steven Ansolabehere.

[2] The backup data supporting Table 1 is attached to this report as Appendix C and I understand that it will be provided to the court in native format.

Do close votes translate to close seats?

The table records the number of districts in each plan with a Democratic win. This shows that the enacted maps systematically violate the principles of Close-Votes-Close-Seats and Majority Rule.

	D Vote Share	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
GOV12	0.4418	4	4	16	18	41	44
AGC16	0.4444	4	4	17	17	40	42
LAC16	0.4475	4	5	18	20	42	45
JHU16	0.4563	4	5	18	19	42	49
AGC20	0.4615	3	4	17	19	40	51
JZA16	0.4619	4	5	19	21	43	50
JDI16	0.4653	4	6	19	21	44	53
LTG16	0.4665	4	6	19	21	44	54
LAC12	0.4674	4	5	20	20	44	51
AGC12	0.4678	4	5	18	18	43	50
SEN16	0.4705	4	6	19	21	43	55
TRS16	0.4730	4	6	19	21	45	53
TRS20	0.4743	4	6	17	20	45	51
JA620	0.4806	4	7	17	21	46	55
PRS16	0.4809	4	7	19	22	48	56
JA420	0.4822	4	7	17	22	47	56
INC20	0.4823	4	7	18	23	47	56
LTG20	0.4836	4	7	18	21	46	55
JA720	0.4842	4	7	17	22	48	56
SUP20	0.4862	4	7	19	23	49	56
JA520	0.4874	4	7	18	22	49	57
JA218	0.4876	4	7	18	22	45	55
JS420	0.4879	4	7	19	24	49	56
J1320	0.4885	4	7	19	23	49	56
PRS12	0.4897	4	6	20	21	46	55
SEN20	0.4910	4	7	20	24	48	56
LAC20	0.4918	4	8	21	25	51	58
SEN14	0.4919	4	6	20	22	46	52
PRS20	0.4932	4	8	20	25	50	60
JS220	0.4934	4	8	21	24	51	59
SUP16	0.4941	4	6	22	23	49	57
JS118	0.4955	4	7	20	25	50	58
INC16	0.4960	4	6	22	22	50	57
JST16	0.4976	4	7	21	23	50	58
LTG12	0.4992	5	7	22	22	50	58
JS120	0.5000	4	8	22	27	52	60
AUD16	0.5007	5	8	22	23	51	56
GOV16	0.5011	4	7	20	27	50	58
ATG20	0.5013	4	8	21	25	51	58
ATG16	0.5027	4	7	20	23	50	57
JA118	0.5078	4	8	22	26	51	58
AUD20	0.5088	4	8	24	28	54	61
JA318	0.5091	4	8	21	26	52	59
SOS20	0.5116	5	8	24	28	53	62
JGE16	0.5131	5	8	22	25	52	59
INC12	0.5186	5	8	22	22	55	61
SOS16	0.5226	5	9	24	24	57	62
GOV20	0.5229	4	8	23	27	58	63
AUD12	0.5371	8	9	27	28	61	65
SOS12	0.5379	7	9	26	26	59	63
TRS12	0.5383	7	9	25	24	59	65
SUP12	0.5424	8	9	28	28	61	66

53 — 47 or closer (rows SEN16 through GOV20)

AGC = Agriculture Commissioner; ATG = Attorney General; AUD = Auditor; GOV = Governor; INC = Insurance Commissioner; LAC = Labor Commissioner; LTG = Lieutenant Governor; PRS = President; SEN = Senator; SOS = Secretary of State; SUP = Superintendent of Public Instruction; TRS = Treasurer. The prefix JA* refers to judicial elections to the Court of Appeals (so that, for instance, JA118 is the election to the Seat 1 on the Court of Appeals in 2018), JS* are elections to the state Supreme Court. All other J* prefixes refer to an election to replace a specific judge on the Court of Appeals. Where there was more than one judicial candidate from a given party on the ballot, they were combined for this analysis. The two-digit suffix designates the election year.

Table 1: 52 general elections, sorted from lowest to highest Democratic share.

Seats vs. Votes

Majority Rule says that outcomes should tend to fall in the Northeast and Southwest quadrants, avoiding the Southeast and Northwest. Close-Votes-Close-Seats says that points should not miss the bulls-eye near the center by systematically deviating to the North or the South. These principles are clearly upheld by the alternative plans (**green**) and violated by the enacted plans (**maroon**).

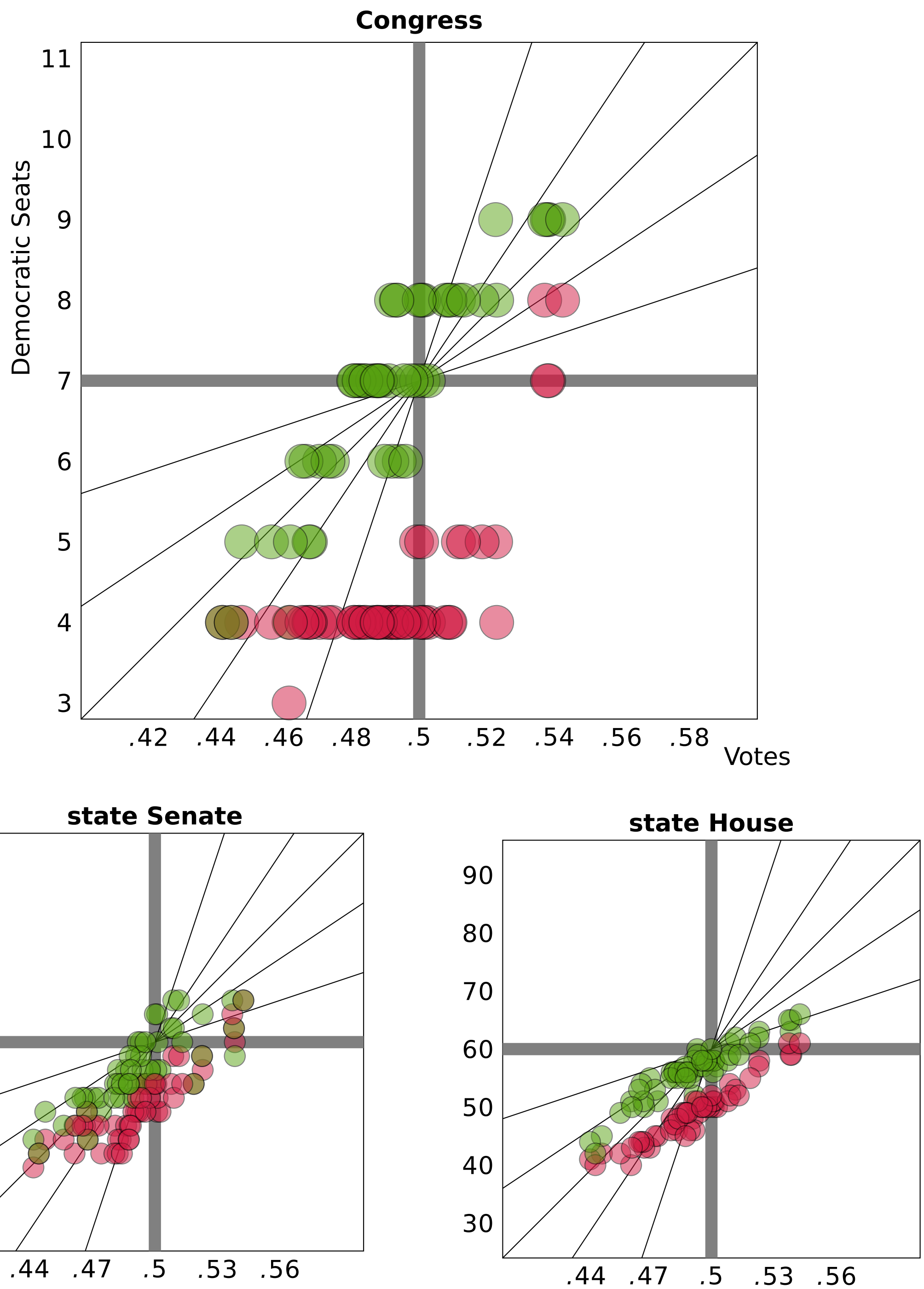


Figure 2: On these seats-vs.-votes plots, we see the election results when overlaying the six maps on the 52 general election contests in the last decade; each colored dot is plotted as the coordinate pair (vote share, seat share).

2.5 Up-ballot races

The same patterns are apparent if we narrow our focus to the smaller set of better-known "up-ballot" races: in order, the first five to appear on the ballot are the contests for President, U.S. Senator, Governor, Lieutenant Governor, and Attorney General. Together these occurred 14 times in the last Census cycle.

	Up-ballot generals (14)		All generals (52)	
	D vote share	D seat share	D vote share	D seat share
SL-174	.4883	.2908	.4911	.3118
NCLCV-Cong		.4796		.4931
SL-173	.4883	.3957	.4911	.4065
NCLCV-Sen		.4557		.4592
SL-175	.4883	.3994	.4911	.4080
NCLCV-House		.4649		.4684

Table 2: Comparing overall fidelity of representation to the voting preferences of the electorate. Vote shares are computed with respect to the major-party vote total.

Figure 3 shows the performance of the Congressional maps in the three Presidential contests in the last Census cycle, where the Democratic vote share (pink box) was between 48% and 50% of the major-party total each time. For a contest that is so evenly divided, we would expect a fair map to have 6, 7, or 8 out of 14 districts favoring each party. The alternative Congressional map NCLCV-Cong does just that, while the enacted plan SL-174 has just 4 out of 14 Democratic-majority districts each time (green and maroon circles). The alternative plan is far more successful at reflecting the even split of voter preferences.

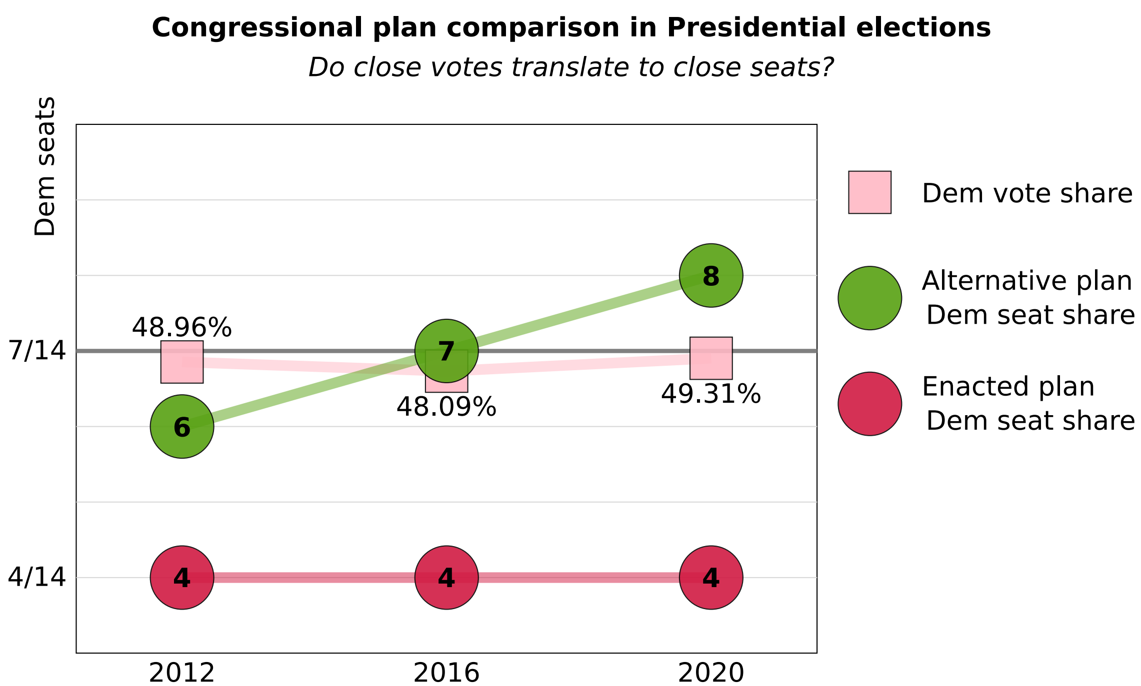


Figure 3: When Presidential voting is overlaid on the plans, we can compare the Democratic seat share in the enacted Congressional plan SL-174 (**maroon**) and the alternative Congressional plan NCLCV-Cong (**green**) to the vote share (**pink**) for Democratic candidates. The 50% line is marked.

Next, simplified versions of the same type of graphic are presented for all five up-ballot offices. Figure 4 compares Congressional maps, and Figure 5 compares legislative maps in the same fashion.

In these figures, we can view whether the plans display a tendency to uphold the Close-Votes-Close-Seats norm, for one office at a time. The pink squares are the vote share. If they are close to the 50-50 mark, then a fair map would also produce seat shares that are close to that mark. This is consistently true for the alternative plans and consistently false for the enacted plans.

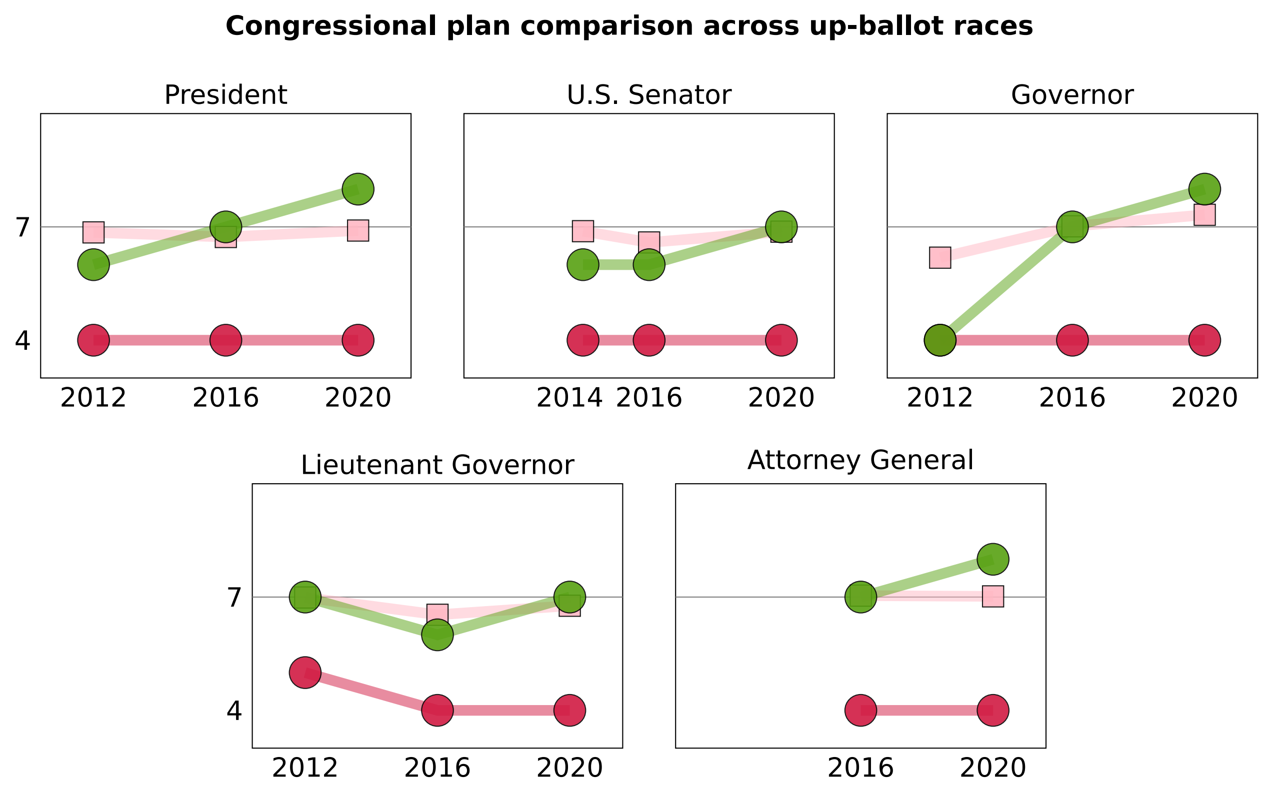


Figure 4: For up-ballot general election contests across the previous Census cycle, we can compare the seat share under the enacted Congressional plan SL-174 (**maroon**) and the seat share under the alternative Congressional plan NCLCV-Cong (**green**) to the vote share (**pink**) for Democratic candidates. The presidential comparison from the previous figure is repeated here, alongside the other four up-ballot offices. The 50% line is marked each time.

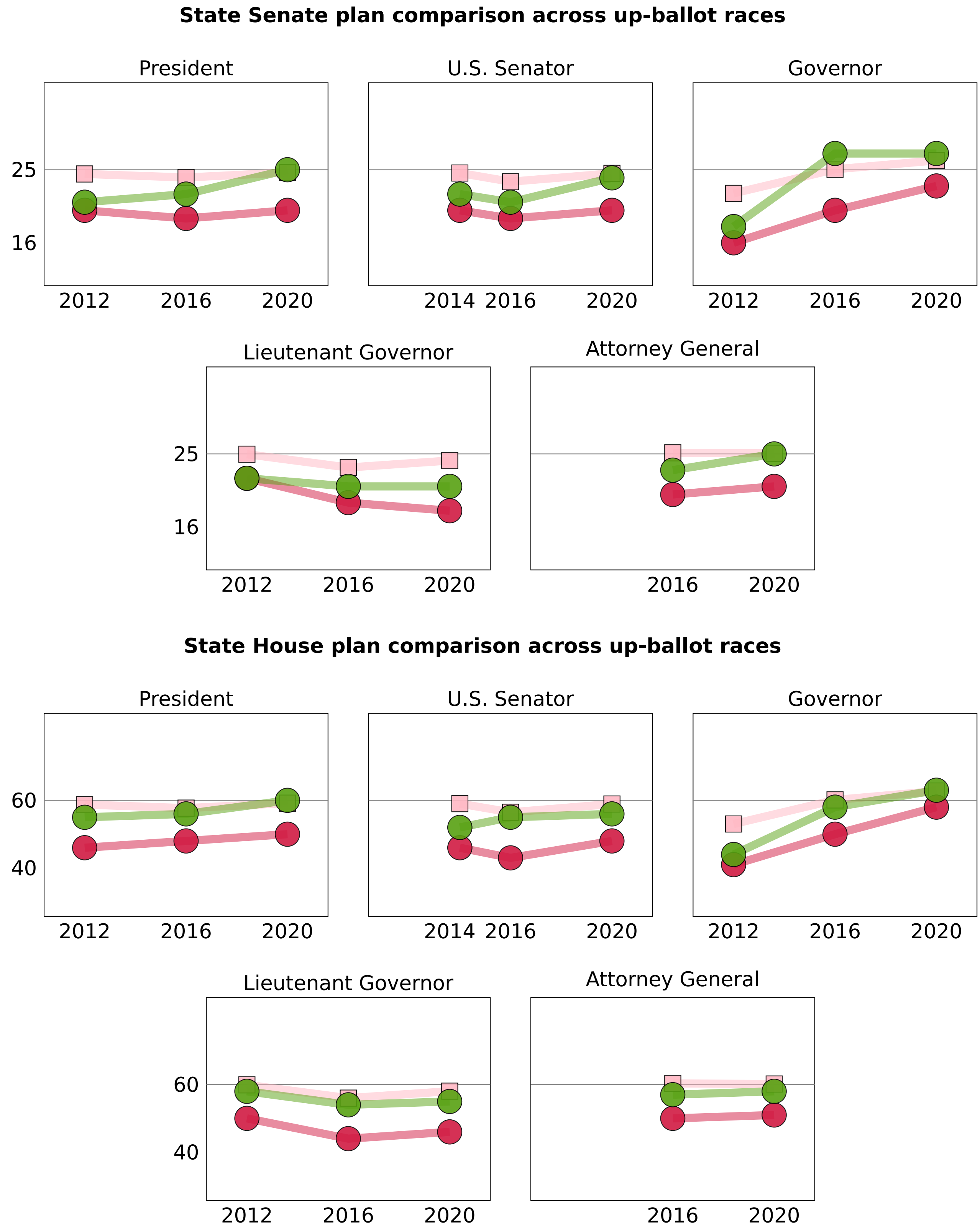


Figure 5: Legislative plans overlaid with voting patterns from up-ballot elections. The enacted plans SL-173 and SL-175 are shown in **maroon**. The alternative plans NCLCV-Sen and NCLCV-House, in **green**, have seat shares tracking much closer to the nearly even voting preferences.

3 Racial vote dilution

North Carolina has a large minority of Black-identified residents. Over two million North Carolinians—2,107,526 out of 10,439,388 to be precise, or about 20.2%—were identified as non-Hispanic Black-alone on the Census. Within the voting-age population, the numbers shift to 1,620,569 out of 8,155,099, or about 19.9%. Increasing numbers of Americans identify as Black in combination with other races and/or Hispanic ethnicity. Passing to this more expansive definition of Black voting age population raises the numbers to 1,743,052 out of 8,155,099, or 21.4%.

Minority groups' opportunity to elect candidates of choice is protected by both state and federal law. A detailed assessment of opportunity must not primarily hinge on the demographics of the districts, but must also rely on electoral history and an assessment of polarization patterns.[3]

I have used industry-leading techniques to study the racial polarization patterns in North Carolina general and primary elections from the last decade. They indicate a consistent pattern of polarization in statewide general elections, such that White voters are estimated to support the Republican candidate at a rate of over 61% in every general election, and Black voters are estimated to support the Democratic candidate at a rate of over 94% each time. Polarization is present in many Democratic primary elections as well, particularly in elections in which there is a Black Democratic candidate. I have designated a selection of eight elections—four generals and four primaries—chosen to be particularly informative in determining whether Black voters have an opportunity to elect their candidates of choice.

Democratic Primaries

- Sutton preferred over Mangrum in the 2020 Superintendent primary;
- Smith preferred over Wadsworth in the 2020 Ag. Commissioner primary;
- Williams preferred over Stein in the 2016 Attorney General primary;
- Coleman preferred over the field in the 2016 Lieutenant Governor primary.

General Elections

- Holley preferred over Robinson in the 2020 Lieutenant Governor election;
- Cunningham preferred over Tillis in the 2020 U.S. Senate election;
- Coleman preferred over Forest in the 2016 Lieutenant Governor election;
- Blue preferred over Folwell in the 2016 Treasurer election.

These eight contests were chosen by a combination of factors that combine to make an election particularly informative with respect to the preferences of Black voters. Namely: I prioritized elections that are more recent, that have a Black candidate on the ballot, that are clearly polarized, and that are close enough to produce variation at the district level.[4]

The electoral alignment score derived from these elections is a value from 0 to 8. I consider a district in which the Black candidate of choice prevails in at least 6 of these 8 contests to be aligned with Black voting preferences in the state.[5] If, in addition, at least 25% of the voting age population is Black, then I label the district to be effective for Black voters.

I note that the use of electoral history is not just cosmetic: there are House-sized districts with 35-39% BVAP that are nonetheless not labeled effective in these lists because they fall short of the standard of inclining to the Black candidate of choice in at least six out of the eight chosen elections.

[3] A detailed discussion of the inadequacy of using demographics alone as a proxy can be found in [3].

[4] Of the candidates above, Sutton, Williams, Coleman, Colley, and Blue are themselves Black-identified.

[5] I have used statewide ecological inference ("EI") runs to determine the candidate of choice for Black voters. I note that it is also possible to run EI on smaller geographies (such as counties or county clusters) to detect regional candidates of choice rather than statewide candidates of choice; in most cases, these will be the same, but in some cases, regional effects may be meaningful and could affect these results at the margin.

At all three levels, the NCLCV alternative maps provide more effective opportunity-to-elect districts for Black voters than the corresponding enacted plans.

Effective districts for Black voters
Out of 14 Congressional districts, SL-174 has 2 effective districts, while NCLCV-Cong has 4.
Out of 50 Senate districts, SL-173 has 8 effective districts, while NCLCV-Sen has 12.
Out of 120 House districts, SL-175 has 24 effective districts, while NCLCV-House has 36.

effective districts in state plan	effective districts in alternative plan
CD2, 9	CD2, 4, 9, 11
SD5, 11, 14, 19, 28, 38, 39, 40	SD1, 5, 11, 14, 18, 19, 26, 27, 32, 38, 39, 40
HD8, 23, 24, 25, 27, 32, 38, 39, 42, 44, 48, 57, 58, 60, 66, 71, 92, 99, 100, 101, 102, 106, 107, 112	HD2, 8, 9, 10, 23, 24, 25, 27, 31, 32, 33, 38, 39, 40, 42, 43, 44, 45, 48, 57, 58, 59, 60, 61, 63, 66, 71, 88, 92, 99, 100, 101, 102, 106, 107, 112

4 Detailed plan comparison

Detailed maps showing how the district lines cut through the patterns of Democratic and Republican support, and how they cut through the demographic location of Black voting age population, can be found in Appendix B.

4.1 Traditional districting principles

Principles that are relevant to North Carolina redistricting include the following.

- **Population balance.** The standard interpretation of *One Person, One Vote* for Congressional districts is that districts should be fine-tuned so that their total Census population deviates by no more than one person from any district to any other.

  There is more latitude with legislative districts; they typically vary top-to-bottom by no more than 10% of ideal district size. In North Carolina, the Whole County Provisions make it very explicit that 5% deviation must be tolerated if it means preserving more counties intact.

  All six plans have acceptable population balance.

Population deviation

	Max Positive Deviation	District	Max Negative Deviation	District
SL-174	0	(eight districts)	−1	(six districts)
NCLCV-Cong	0	(eight districts)	−1	(six districts)
SL-173	10,355 (4.960%)	5	−10,434 (4.997%)	13,18
NCLCV-Sen	10,355 (4.960%)	5	−10,427 (4.994%)	15
SL-175	4250 (4.885%)	18	−4189 (4.815%)	112
NCLCV-House	4341 (4.990%)	82	−4323 (4.969%)	87

Table 3: Deviations are calculated with respect to the rounded ideal district populations of 745,671 for Congress, 208,788 for Senate, and 86,995 for House.

- **Contiguity.** All six plans are contiguous; for each district, it is possible to transit from any part of the district to any other part through a sequence of census blocks that share boundary segments of positive length. As is traditional in North Carolina, contiguity through water is accepted.

- **Compactness.** The two compactness metrics most commonly appearing in litigation are the *Polsby-Popper score* and the *Reock score*. Polsby-Popper is the name given in redistricting to a metric from ancient mathematics: the isoperimetric ratio comparing a region's area to its perimeter via the formula $4\pi A/P^2$. Higher scores are considered more compact, with circles uniquely achieving the optimum score of 1. Reock is a different measurement of how much a shape differs from a circle: it is computed as the ratio of a region's area to that of its circumcircle, defined as the smallest circle in which the region can be circumscribed. From this definition, it is clear that it too is optimized at a value of 1, which is achieved only by circles.

  These scores depend on the contours of a district and have been criticized as being too dependent on map projections or on cartographic resolution [1, 2]. Recently, some mathematicians have argued for using discrete compactness scores, taking into account the units of Census geography from which the district is built. The most commonly cited discrete score for districts is the *cut edges score*, which counts how many adjacent pairs of geographical units receive different district assignments. In other words, cut edges measures the "scissors complexity" of the districting plan: how much work would have to be done to separate the districts from each other? Plans with a very intricate boundary would require many separations. This score improves on the contour-based scores by better controlling for factors like coastline and other natural boundaries, and by focusing on the units actually available to redistricters rather than treating districts like free-form Rorschach blots.

  The alternative plans are significantly more compact than the enacted plans in all three compactness metrics.

Compactness

	block cut edges (lower is better)	average Polsby-Popper (higher is better)	average Reock (higher is better)
SL-174	5194	0.303	0.417
NCLCV-Cong	4124	0.383	0.470
SL-173	9702	0.342	0.416
NCLCV-Sen	9249	0.369	0.428
SL-175	16,182	0.351	0.437
NCLCV-House	13,963	0.414	0.465

Table 4: Comparing compactness scores via one discrete and two contour-based metrics. These scores were computed using dissolved districts based on the census blocks that were assigned in the plans under discussion.

District-by-district compactness scores for the contour-based metrics are shown in Tables 5-7.

	Reock		Polsby-Popper	
CD	SL-174	NCLCV-Cong	SL-174	NCLCV-Cong
1	0.517	0.534	0.324	0.403
2	0.303	0.47	0.278	0.323
3	0.484	0.212	0.331	0.228
4	0.487	0.412	0.39	0.304
5	0.468	0.582	0.347	0.514
6	0.418	0.472	0.231	0.483
7	0.424	0.664	0.199	0.434
8	0.472	0.523	0.532	0.398
9	0.678	0.579	0.469	0.43
10	0.41	0.285	0.197	0.254
11	0.282	0.553	0.207	0.532
12	0.247	0.388	0.243	0.368
13	0.41	0.558	0.266	0.379
14	0.232	0.354	0.221	0.313

Table 5: Compactness scores by district for the Congressional plans.

	Reock		Polsby-Popper	
SD	SL-173	NCLCV-Sen	SL-173	NCLCV-Sen
1	0.263	0.297	0.213	0.174
2	0.231	0.397	0.105	0.178
3	0.409	0.409	0.179	0.179
4	0.564	0.564	0.406	0.406
5	0.403	0.403	0.335	0.335
6	0.616	0.616	0.595	0.595
7	0.213	0.553	0.219	0.411
8	0.446	0.457	0.439	0.478
9	0.443	0.441	0.217	0.226
10	0.618	0.618	0.614	0.614
11	0.464	0.464	0.376	0.376
12	0.42	0.388	0.395	0.404
13	0.284	0.357	0.257	0.4
14	0.399	0.523	0.247	0.45
15	0.397	0.52	0.231	0.398
16	0.619	0.51	0.473	0.388
17	0.488	0.54	0.361	0.505
18	0.376	0.644	0.309	0.514
19	0.53	0.53	0.34	0.34
20	0.384	0.387	0.363	0.344
21	0.218	0.218	0.137	0.137
22	0.473	0.459	0.471	0.517
23	0.498	0.498	0.529	0.529
24	0.52	0.52	0.452	0.452
25	0.283	0.325	0.271	0.276
26	0.451	0.397	0.301	0.331
27	0.541	0.364	0.437	0.321
28	0.444	0.544	0.248	0.457
29	0.317	0.378	0.202	0.252
30	0.4	0.4	0.456	0.456
31	0.482	0.429	0.344	0.355
32	0.62	0.455	0.422	0.354
33	0.322	0.322	0.294	0.294
34	0.49	0.477	0.523	0.489
35	0.375	0.342	0.225	0.348
36	0.463	0.314	0.411	0.294
37	0.401	0.397	0.421	0.437
38	0.523	0.566	0.334	0.444
39	0.356	0.391	0.295	0.368
40	0.381	0.453	0.382	0.538
41	0.287	0.519	0.294	0.531
42	0.429	0.397	0.273	0.469
43	0.533	0.341	0.522	0.274
44	0.386	0.425	0.46	0.357
45	0.343	0.391	0.25	0.3
46	0.229	0.249	0.184	0.213
47	0.186	0.116	0.127	0.113
48	0.404	0.373	0.38	0.264
49	0.479	0.424	0.358	0.22
50	0.422	0.312	0.441	0.335

Table 6: Compactness scores by district for the Senate plans.

	Reock		Polsby-Popper	
HD	SL-175	NCLCV-House	SL-175	NCLCV-House
1	0.413	0.393	0.213	0.168
2	0.316	0.404	0.326	0.468
3	0.377	0.448	0.298	0.329
4	0.482	0.337	0.448	0.237
5	0.28	0.28	0.3	0.3
6	0.389	0.539	0.479	0.549
7	0.476	0.442	0.44	0.403
8	0.394	0.437	0.327	0.314
9	0.587	0.698	0.411	0.425
10	0.589	0.606	0.567	0.398
11	0.359	0.654	0.246	0.473
12	0.312	0.312	0.291	0.291
13	0.379	0.367	0.425	0.488
14	0.384	0.305	0.291	0.204
15	0.546	0.468	0.371	0.395
16	0.404	0.483	0.242	0.388
17	0.416	0.668	0.227	0.473
18	0.589	0.336	0.37	0.374
19	0.462	0.482	0.285	0.359
20	0.463	0.172	0.557	0.173
21	0.45	0.591	0.206	0.469
22	0.528	0.528	0.361	0.361
23	0.453	0.453	0.359	0.359
24	0.463	0.554	0.538	0.638
25	0.463	0.402	0.511	0.455
26	0.45	0.474	0.4	0.412
27	0.433	0.433	0.353	0.353
28	0.573	0.411	0.498	0.43
29	0.36	0.519	0.333	0.645
30	0.381	0.306	0.356	0.389
31	0.415	0.476	0.323	0.533
32	0.534	0.528	0.587	0.543
33	0.491	0.254	0.289	0.252
34	0.414	0.383	0.289	0.349
35	0.28	0.528	0.292	0.464
36	0.586	0.396	0.532	0.443
37	0.417	0.372	0.369	0.379
38	0.377	0.522	0.247	0.383
39	0.649	0.399	0.519	0.245
40	0.413	0.342	0.336	0.242
41	0.521	0.581	0.423	0.498
42	0.537	0.402	0.395	0.258
43	0.52	0.415	0.281	0.372
44	0.587	0.564	0.419	0.564
45	0.248	0.555	0.274	0.495
46	0.316	0.432	0.239	0.275
47	0.604	0.535	0.498	0.453
48	0.479	0.479	0.442	0.442
49	0.447	0.555	0.358	0.604
50	0.375	0.384	0.343	0.388
51	0.48	0.427	0.283	0.262
52	0.352	0.468	0.214	0.28
53	0.322	0.597	0.256	0.449
54	0.459	0.486	0.376	0.442
55	0.458	0.534	0.312	0.399
56	0.502	0.652	0.37	0.691
57	0.436	0.589	0.368	0.475
58	0.397	0.521	0.257	0.432
59	0.455	0.463	0.334	0.56
60	0.383	0.361	0.261	0.407

	Reock		Polsby-Popper	
HD	SL-175	NCLCV-House	SL-175	NCLCV-House
61	0.388	0.356	0.294	0.346
62	0.318	0.651	0.312	0.589
63	0.56	0.596	0.353	0.533
64	0.329	0.48	0.257	0.459
65	0.594	0.594	0.764	0.764
66	0.457	0.46	0.264	0.293
67	0.444	0.444	0.486	0.486
68	0.45	0.577	0.305	0.502
69	0.539	0.49	0.346	0.364
70	0.542	0.638	0.535	0.65
71	0.267	0.488	0.275	0.509
72	0.521	0.495	0.27	0.398
73	0.487	0.46	0.421	0.612
74	0.367	0.548	0.299	0.425
75	0.388	0.468	0.266	0.53
76	0.43	0.43	0.497	0.497
77	0.408	0.408	0.297	0.297
78	0.341	0.479	0.204	0.447
79	0.523	0.353	0.36	0.2
80	0.285	0.413	0.319	0.359
81	0.481	0.434	0.312	0.359
82	0.311	0.444	0.32	0.477
83	0.474	0.473	0.328	0.342
84	0.498	0.57	0.515	0.645
85	0.501	0.493	0.315	0.299
86	0.49	0.49	0.437	0.437
87	0.538	0.512	0.437	0.526
88	0.233	0.367	0.211	0.364
89	0.304	0.462	0.291	0.338
90	0.508	0.431	0.349	0.381
91	0.541	0.563	0.522	0.583
92	0.28	0.399	0.244	0.455
93	0.317	0.33	0.288	0.319
94	0.507	0.496	0.348	0.371
95	0.616	0.49	0.596	0.516
96	0.358	0.316	0.351	0.33
97	0.321	0.321	0.515	0.515
98	0.593	0.574	0.576	0.589
99	0.469	0.471	0.322	0.443
100	0.537	0.359	0.333	0.312
101	0.488	0.518	0.31	0.515
102	0.392	0.621	0.23	0.36
103	0.278	0.546	0.349	0.479
104	0.573	0.432	0.32	0.313
105	0.395	0.437	0.419	0.391
106	0.599	0.485	0.419	0.503
107	0.304	0.529	0.183	0.556
108	0.374	0.402	0.24	0.288
109	0.466	0.485	0.421	0.522
110	0.355	0.514	0.277	0.39
111	0.348	0.641	0.24	0.436
112	0.58	0.266	0.397	0.229
113	0.392	0.368	0.224	0.186
114	0.307	0.549	0.182	0.46
115	0.559	0.308	0.349	0.289
116	0.401	0.532	0.159	0.332
117	0.422	0.581	0.271	0.393
118	0.412	0.412	0.247	0.247
119	0.276	0.276	0.22	0.22
120	0.4	0.4	0.367	0.367

Table 7: Compactness scores by district for the House plans.

- **Respect for political subdivisions.** For legislative redistricting, North Carolina has one of the strongest requirements for county consideration of any state in the nation. In my understanding, courts have interpreted the Whole County Provisions as follows.[6]
  - First, if any county is divisible into a whole number of districts that will be within ±5% of ideal population, then it must be subdivided accordingly without districts crossing into other counties.
  - Next, seek any contiguous grouping of two counties that is similarly divisible into a whole number of districts.
  - Repeat for groupings of three, and so on, until all counties are accounted for.

  Once clusters have been formed, there are more rules about respecting county lines within clusters. The legal language is again explicit: "[T]he resulting interior county lines created by any such groupings may be crossed or traversed in the creation of districts within said multi-county grouping but only to the extent necessary" to meet the ±5% population standard for districts. To address this, I have counted the *county traversals* in each plan, i.e., the number of times a district crosses between adjacent counties within a grouping.

  Table 8 reflects the county integrity metric that is most relevant at each level: the enacted congressional plan splits 11 counties into 25 pieces while the alternative plan splits 13, but splits no county three ways. (The enacted plans unnecessarily split three counties into three pieces.) In the legislative plans, the law specifies traversals as the fundamental integrity statistic.

County and municipality preservation

	# county pieces
SL-174	25
NCLCV-Cong	26

	# traversals
SL-173	97
NCLCV-Sen	89
SL-175	69
NCLCV-House	66

	# municipal pieces (considering all blocks)	# municipal pieces (considering populated blocks)
SL-174	90	50
NCLCV-Cong	58	41
SL-173	152	91
NCLCV-Sen	125	100
SL-175	292	222
NCLCV-House	201	173

Table 8: Comparing the plans' conformance to political boundaries.

[6] A complete set of solutions is described in detail in the white paper of Mattingly et al.—though with the important caveat that the work "does not reflect... compliance with the Voting Rights Act" [4]. Absent a VRA conflict, the 2020 Decennial Census population data dictates that the North Carolina Senate plan must be decomposed into ten single-district fixed clusters and seven multi-district fixed clusters (comprising 2, 2, 3, 3, 4, 6, and 6 districts, respectively). It has four more areas in which there is a choice of groupings. In all, there are sixteen different possible clusterings for Senate, each comprising 26 county clusters. The House likewise has 11 single-district fixed clusters and 22 multi-district fixed clusters (with two to thirteen districts per cluster), together with three more areas with a choice of groupings. In all, the House has only eight acceptable clusterings, each comprising 40 county clusters. Again, it is important to note that VRA compliance may present a compelling reason to select some clusterings and reject others.

The alternative plans are comparable to the enacted plans, and often superior, in each of these key metrics regarding preservation of political boundaries. This remains true whether splits of municipalities are counted by the division of any of their census blocks, or only by the division of populated census blocks.

I will briefly mention several additional redistricting principles.

- **Communities of interest.** In North Carolina, there was no sustained effort by the state or by community groups to formally collect community of interest (COI) maps, to my knowledge. Without this, it is difficult to produce a suitable metric.
- **Cores of prior districts.** In some states, there is statutory guidance to seek districting plans that preserve the cores of prior districts. In North Carolina, this is not a factor in the constitution, in statute, or in case law. In addition, attention to core preservation would be prohibitively difficult in the Senate and House because of the primacy of the Whole County Provisions, which forces major changes to the districts simply as a consequence of fresh population numbers.
- **Incumbent pairing.** In 2017, the North Carolina legislative redistricting committee listed "incumbency protection" as a goal in their itemization of principles. In 2021, this was softened to the statement that "Member residence may be considered" in the drawing of districts. I have counted the districts in each plan that contain more than one incumbent address; these are sometimes colorfully called "double-bunked" districts. For this statistic, it is not entirely clear whether a high or low number is preferable. When a plan remediates a gerrymandered predecessor, we should not be surprised if it ends up pairing numerous incumbents.

Double-bunking

	# districts pairing incumbents
SL-174	3
NCLCV-Cong	1
SL-173	5
NCLCV-Sen	9
SL-175	6
NCLCV-House	16

Table 9: For Congress and Senate, the enacted and alternative plans are comparable; at the House level, the alternative plan has more double-bunking. *Note: These numbers were calculated using incumbent addresses that I understand were provided by the Legislative Defendants.*

4.2 Swing districts and competitive contests

Another way to understand the electoral properties of districting plans is to investigate how many districts always give the same partisan result over a suite of observed electoral conditions, and how many districts can "swing" between the parties. Figure 6 compares the six plans across the up-ballot elections. The enacted plans lock in large numbers of always-Republican seats. In the Senate and House, nearly half the seats are locked down for Republicans. In the Congressional plan, it's well *over* half. This provides another view from which the NCLCV plans provide attractive alternatives.

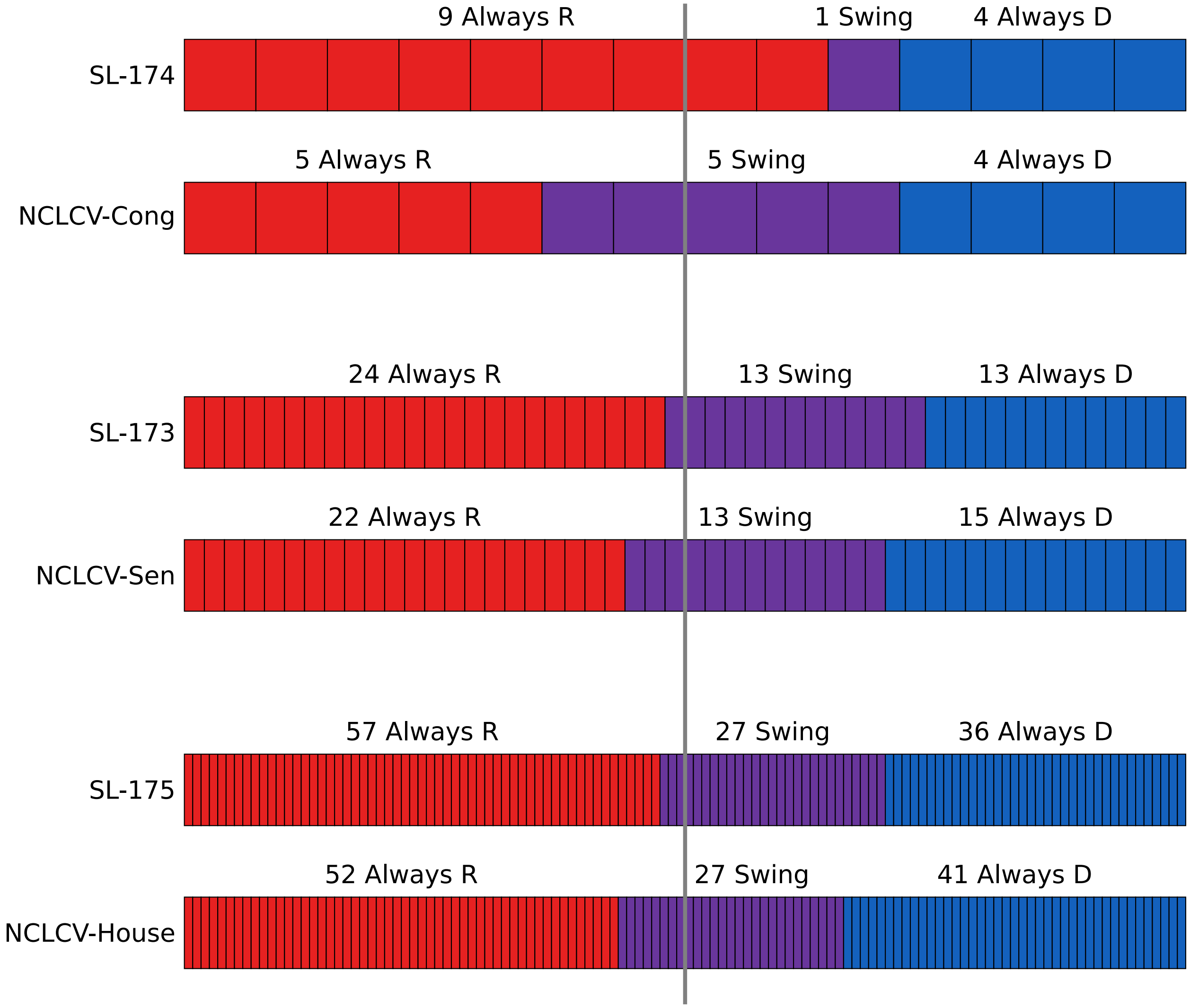


Figure 6: These visuals show the breakdown of seats that always have a Republican winner, always have a Democratic winner, or are sometimes led by each party across the 14 up-ballot elections over the previous Census cycle. The 50-50 split is marked.

In interpreting this visualization, note that this is consistent with the discussion elsewhere of entrenched Republican majorities in the enacted maps. These Always-Republican districts provide a *floor* for Republican performance from the viewpoint of these up-ballot contests.

One more measure of partisan fairness, frequently referenced in the public discourse, is the tendency of a districting plan to promote close or competitive contests. We close with a comparison of the enacted and alternative plans that displays the number of times across the full dataset of 52 elections that a contest had a partisan margin of closer than 10 points, 6 points, or 2 points, respectively. This can occur up to $14 \cdot 52 = 728$ times in Congressional maps, $50 \cdot 52 = 2600$ times in state Senate maps, and $120 \cdot 52 = 6240$ times in state House maps. The figures below show horizontal rules at every 10% interval of the total number of possible competitive contests; we can see, for instance, that the alternative Congressional plan has contests within a 10-point margin more than 40% of the time.

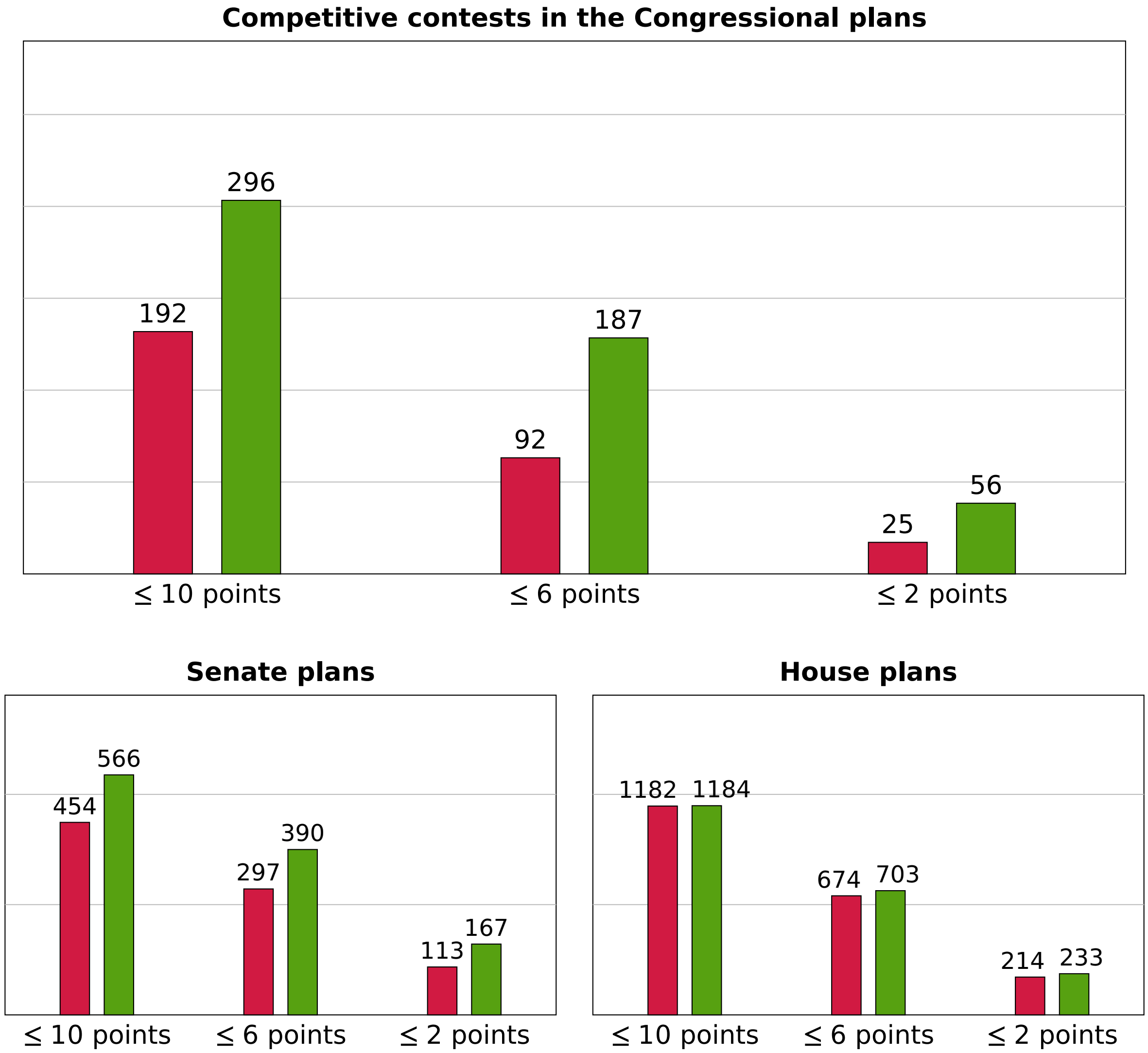


Figure 7: These bar graphs show the number of competitive contests for the enacted plans (**maroon**) and the alternative plans (**green**). In each plot, we consider increasingly restrictive definitions of "competitive" from left to right, counting districts in which the major-party vote split is closer than 45-55, 47-53, and 49-51, respectively.

5 Location-specific comparison of electoral opportunity

I received information reflecting the residential locations of 147 individuals, who come from either of two groups:

- plaintiffs in the NCLCV v. Hall case; or
- registered voters belonging to the NCLCV membership who are Black and/or are registered as Democrats.

In Table 10 below, I summarize the impact on the identified individuals in terms of electoral opportunity if the enacted maps are compared to the alternative maps.

Subsequently, Figures 8 and 9 provide a visualization that pinpoints the geographical sites where the alternative plans improve electoral opportunities for plaintiffs and NCLCV members—that is, places where the identified individuals (as Democrats and/or Black voters) have measurably greater ability to elect their candidates of choice under the alternative plans than under the existing plans.

This is backed up by the data in Tables 11-13 below, which identify the district numbers in the six enacted and alternative plans for each of these identified individuals. The district numbers were computed using census block information to specify the locations, but the table reports the locations by larger units (VTDs) in order to protect privacy.

Lost opportunity for Democratic and Black voters

	greater Democratic opportunity in alternative plan than enacted plan
Congress	51 individuals
Senate	37 individuals
House	39 individuals

	resides in effective district in alternative plan but not enacted plan
Congress	28 Black voters
Senate	21 Black voters
House	21 Black voters

Table 10: Of the 147 identified individuals, how many saw a change in their opportunity for Democratic representation? How many Black voters saw a change in their opportunity to elect Black candidates of choice?

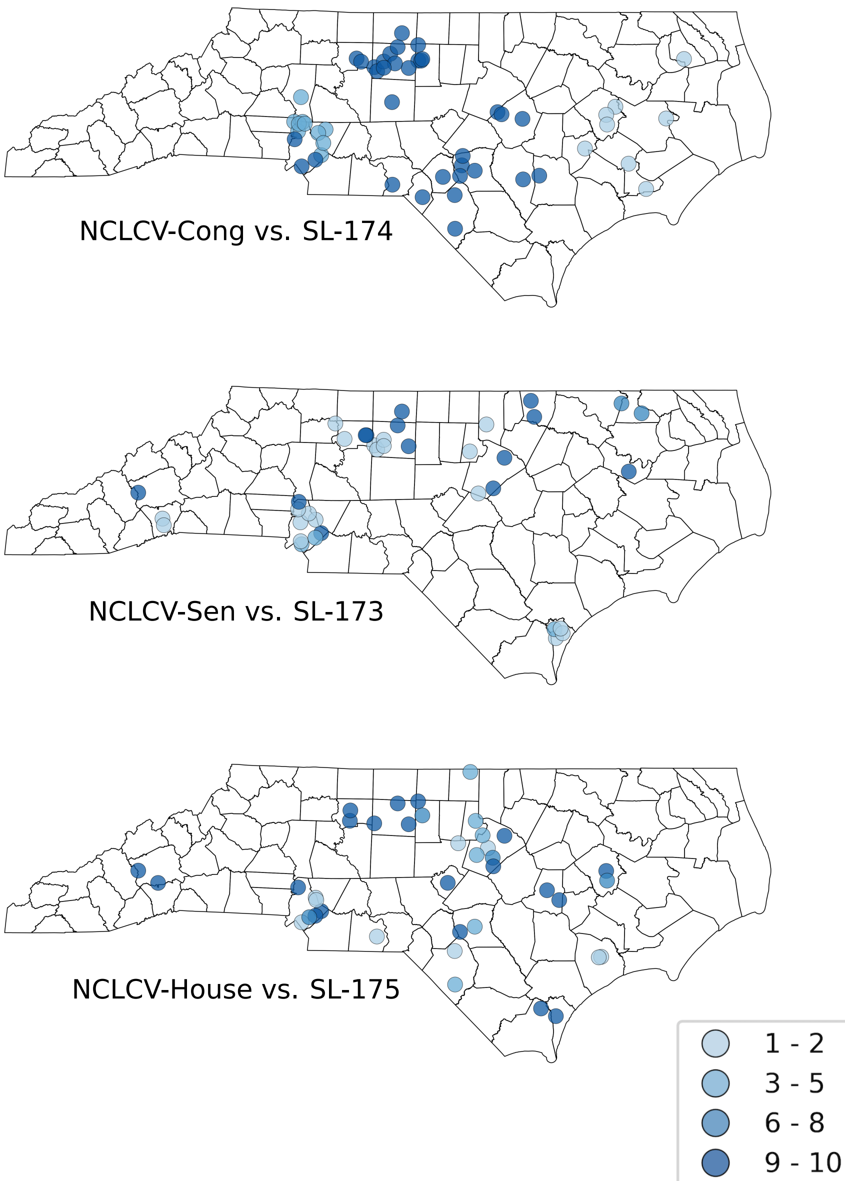


Figure 8: Locations where identified individuals have less opportunity to be represented by a Democrat in Congress, state Senate, and state House under the enacted plans. The shading indicates the drop in Democratic wins across the 14 up-ballot races in the enacted map relative to the alternative map. There are 51 such individuals in the Congressional maps, 37 in the Senate maps, and 31 in the House maps.

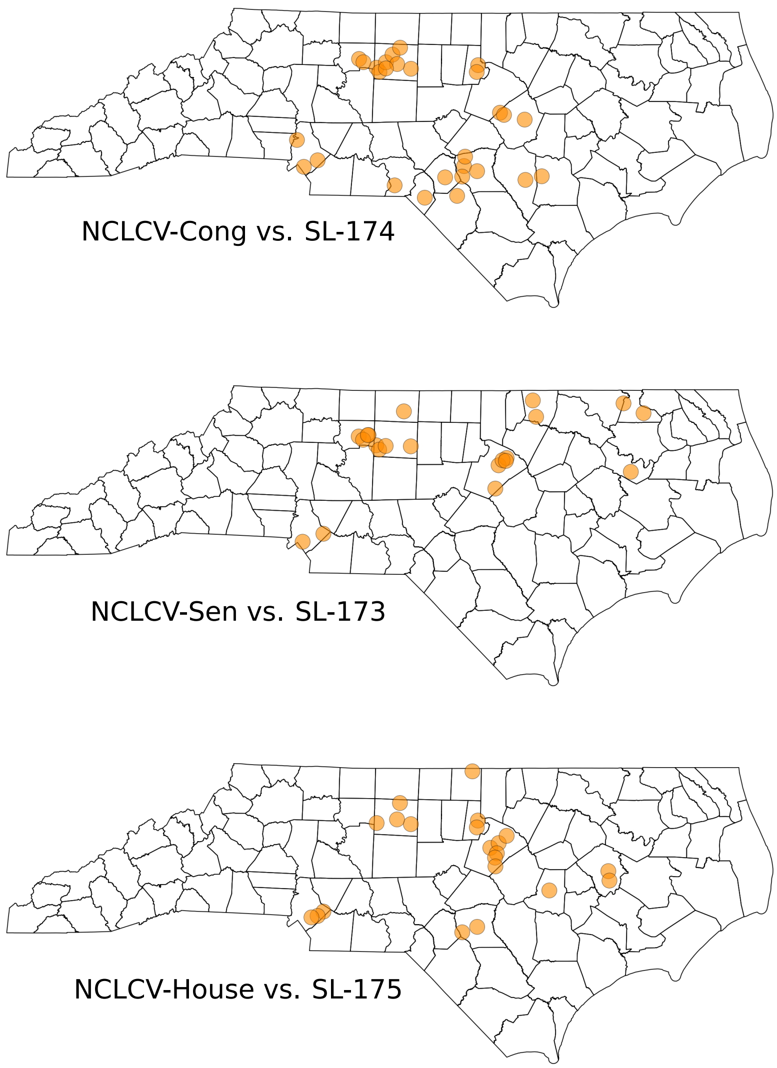


Figure 9: Locations where Black voters from the identified individuals list would be in a district that provides effective electoral opportunity under the alternative plan, but not under the enacted plan. There are 28 such voters at the Congressional level and 21 at each of the Senate and House level.

VTD Census ID	VTD/Precinct Name	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
37025001-07	01-07	10	10	34	34	73	73
37025012-03	12-03	10	10	34	34	82	82
37025002-07	02-07	10	10	34	34	83	73
37009000002	CLIFTON	11	12	47	47	93	93
37063000029	GLENN ELEMENTARY	6	2	22	22	2	2
37063000043	FOREST VIEW ELEMENTARY	6	6	22	20	30	30
37063000052	EVANGEL ASSEMBLY OF GOD	6	2	22	22	31	31
37063055-11	055-11	6	6	20	22	29	29
37071000012	FLINT GROVES	13	13	43	43	108	108
37071000004	FOREST HEIGHTS	13	13	43	43	109	109
37057000076	THOMASVILLE 10 76	7	8	30	30	80	80
371350000EF	EFLAND	6	6	23	23	50	50
371050000A2	A2	7	7	12	12	51	54
37131NEWTOW	NEWTOWN	2	2	1	1	27	27
371350000CF	CEDAR FALLS	6	6	23	23	56	56
37081000H25	H25	10	11	27	27	62	60
37093000061	RAEFORD 1	8	4	24	24	48	48
37081000RC2	RC2	7	11	26	26	59	59
3712700P15A	OAK LEVEL	2	2	11	11	25	25
3707700TYHO	00TYHO	2	2	13	13	32	32
370910000CO	COFIELD	2	1	1	1	5	5
37057000038	EASTSIDE 38	7	8	30	30	81	81
370210021.1	HAW CREEK ELEMENTARY SCHOOL	14	14	49	49	115	114
37019000015	GRISSETTOWN	3	3	8	8	17	19
37047000P15	TATUM	3	3	8	8	46	46
37019000002	LELAND	3	3	8	8	17	17
370450CASAR	CASAR	13	13	44	44	110	111
370210007.1	KENILWORTH PRESBYTERIAN CHURCH	14	14	49	49	114	115
370210053.1	LEICESTER 2 - COMMUNITY CENTER	14	14	46	49	116	116
370210054.2	LUTHERAN CHURCH OF THE NATIVITY	14	14	49	49	116	115
37193000108	FAIRPLAINS	11	12	36	36	94	94
37173000BC2	BC2	14	14	50	47	119	119
37119000054	54	9	9	40	42	102	112
37119000108	108	9	9	40	40	100	100
37119000208	208	13	10	37	38	98	98
371190204.1	204.1	9	10	40	40	99	106
37119000097	97	9	9	42	39	112	105
37119000222	222	9	9	38	39	101	101
37097000ST6	STATESVILLE 6	12	10	37	37	84	84
370970DV1-B	DAVIDSON 1-B	10	10	37	37	95	95
37119000048	48	9	9	42	42	88	104
37119000216	216	8	9	41	41	103	99
37081000G27	G27	11	11	28	28	57	57
37081000G43	G43	11	11	27	28	58	62
37153000006	WOLF PIT 3	8	4	29	29	52	52
371570000MS	MOSS STREET	11	6	26	26	65	65
3716300ROWA	ROWAN	4	4	9	9	22	22
3719500PRWI	WILSON I	2	2	4	4	24	24
37119000206	206	13	10	37	37	98	98
37119000236	236	8	10	41	40	103	99

Table 11: Locations of identified individuals, Part 1 of 3. For each location, the district numbers are given for the six plans discussed here. VTDs are listed rather than the more precise census block in order to protect privacy. Rows highlighted **blue** indicate individuals who lose Democratic opportunity in at least one of the enacted plans, relative to the alternative plans. Rows highlighted **orange** indicate Black voters who lose the opportunity to be in an effective district for Black candidates of choice in at least one level. (As it turns out, every instance of lost opportunity for Black voters is also an instance of lost Democratic opportunity.)

VTD Census ID	VTD/Precinct Name	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
37119000142	142	13	10	38	38	98	112
37081000G65	G65	11	11	27	27	58	58
37081000G70	G70	11	11	28	26	61	61
3708100H19A	H19A	10	11	27	27	60	60
3708100MON3	MON3	11	11	26	28	59	57
37183015-01	15-01	5	7	17	14	37	38
37183019-17	19-17	5	5	18	18	39	66
37183001-31	01-31	5	5	15	15	11	33
37183012-02	12-02	7	7	17	17	37	37
37119000087	87	8	9	41	41	105	105
37119000068	68	9	9	42	41	104	100
371190223.1	223.1	13	9	39	39	101	101
37119000081	81	9	9	39	39	92	101
37119000237	237	9	10	38	40	106	106
37119000127	127	13	10	37	37	98	98
37191000014	14	2	1	4	4	4	10
37183005-01	05-01	6	7	16	16	41	41
37183020-09	20-09	6	7	16	17	36	36
37183004-18	04-18	6	7	16	16	49	11
37191000010	10	2	1	4	4	10	10
37183019-21	19-21	5	5	13	18	35	66
37183001-46	01-46	5	5	18	18	34	40
37183001-50	01-50	5	5	14	14	33	38
37183016-05	16-05	5	5	14	14	21	38
37119000145	145	9	10	38	38	107	107
37183008-03	08-03	5	5	15	15	40	49
37183017-05	17-05	5	5	14	18	38	40
37183013-09	13-09	5	5	18	18	66	66
370490000N2	FORT TOTTEN	1	1	3	3	3	3
37049000002	HAVELOCK	1	1	3	3	13	13
37001000004	MORTON	7	6	25	25	64	63
37001000126	BURLINGTON 6	7	6	25	25	63	64
3700100003N	NORTH BOONE	7	6	25	25	64	64
37001000124	BURLINGTON 4	7	6	25	25	63	63
37165001-16	01-16/01	8	4	24	24	48	48
37067000063	CASH ELEMENTARY SCHOOL	12	12	31	32	75	75
37067000074	MEADOWLARK MIDDLE SCHOOL	12	12	31	31	74	74
37067000709	WARD ELEMENTARY SCHOOL	12	12	32	31	74	71
37067000065	KERNERSVILLE 7TH DAY ADVENTIST CHURCH	12	12	31	32	75	75
37067000507	SEDGE GARDEN REC CTR	12	11	32	32	71	75
371510000AE	ASHEBORO EAST	7	11	29	29	70	70
37067000905	BETHABARA MORAVIAN CH	12	12	32	31	91	72
37067000402	FOURTEENTH STREET REC	12	11	32	32	72	72
370890000FR	FLAT ROCK	14	14	48	48	113	117
3708900HV-1	HENDERSONVILLE-1	14	14	48	48	117	117
37023000039	MORGANTON 09	13	13	46	46	86	86
3710900LB34	LABORATORY	12	13	44	46	97	97
3706100WARS	WARSAW	3	4	9	9	4	4
3712900CF01	CF01	3	3	8	7	18	17
370130BELHV	BELHAVEN	1	1	3	3	79	1

Table 12: Locations of identified individuals, Part 2 of 3. For each location, the district numbers are given for the six plans discussed here. VTDs are listed rather than the more precise census block in order to protect privacy. Rows highlighted **blue** indicate individuals who lose Democratic opportunity in at least one of the enacted plans, relative to the alternative plans. Rows highlighted **orange** indicate Black voters who lose the opportunity to be in an effective district for Black candidates of choice in at least one level. (As it turns out, every instance of lost opportunity for Black voters is also an instance of lost Democratic opportunity.)

VTD Census ID	VTD/Precinct Name	SL-174	NCLCV-Cong	SL-173	NCLCV-Sen	SL-175	NCLCV-House
37037NWM117	NORTH WILLIAMS	7	7	20	20	54	54
3714100CL05	COLUMBIA	3	3	9	9	16	16
3713300BM08	BRYNN MARR	1	3	6	6	14	15
3713300NR02	NEW RIVER	1	3	6	6	15	15
37051SL78-3	Spring Lake 3	4	4	21	21	42	44
3705100G10A	STONEY POINT 2-G10	4	4	19	19	45	45
37051000G1A	CROSS CREEK 02-G1	4	4	19	19	43	42
37035000035	SWEETWATER	12	13	45	45	96	96
37035000032	SOUTH NEWTON	12	13	45	45	89	89
3705100CC32	CROSS CREEK 32	4	4	19	19	44	44
37059000007	JERUSALEM	10	8	30	30	77	77
3708500PR01	ANDERSON CREEK	4	7	12	12	6	6
3708500PR07	BARBECUE	4	7	12	12	6	6
371070000K8	KINSTON-8	1	1	3	3	12	12
37189000009	ELK	14	12	47	47	87	93
371170000BG	BEAR GRASS	2	1	2	1	23	23
371010PR12B	NORTH CLEVELAND 2	4	2	10	10	26	26
371010PR31B	SOUTHWEST CLEVELAND	4	2	10	10	53	53
3710100PR24	EAST SELMA	4	2	10	10	28	28
3714701102A	SIMPSON A	1	1	5	5	9	8
37167000003	ALBEMARLE NUMBER 3	8	8	33	33	67	67
3700700LILE	LILESVILLE	8	8	29	29	55	55
3704500KM-N	KM N	13	13	44	44	111	110
37143BETHEL	BETHEL	1	1	1	2	1	1
37147000601	CHICOD	1	1	5	5	9	9
37147001201	PACTOLUS	1	1	5	5	8	8
37159000040	NORTH WARD	10	8	33	33	76	76
3712900FP04	FP04	3	3	7	8	19	20
37129000W16	W16	3	3	7	7	20	18
37129000H11	H11	3	3	7	7	18	20
37129000H02	H02	3	3	7	7	20	20
37159000036	SOUTH WARD	10	8	33	33	76	76
37125000DHR	DEEP RIVER/HIGH FALLS/RITTER	8	7	21	21	78	51
37069000015	EAST FRANKLINTON	2	2	11	11	7	7
3719908-CRA	CRABTREE	14	14	47	47	85	85
3719700EBND	EAST BEND	12	12	36	31	77	77
37171000018	MT AIRY 8	11	12	36	36	90	90
3708700WS-2	WAYNESVILLE SOUTH 2	14	14	50	50	118	118
3715500005A	FAIRMONT	3	4	24	24	46	47
37155000028	RENNERT	3	4	24	24	47	47
37113000011	SMITHBRIDGE	14	14	50	50	120	120
3714500WDSD	WOODSDALE	2	6	23	23	2	2
3717900029A	SHILOH ELEMENTARY SCHOOL	8	8	35	35	68	69
3717900037A	NEXT LEVEL CHURCH	8	8	35	35	69	69
37169000017	WEST WALNUT COVE	11	12	31	36	91	91
37185000007	SHOCCO	2	2	2	1	27	27
37185000013	NORLINA	2	2	2	1	27	27

Table 13: Locations of identified individuals, Part 3 of 3. For each location, the district numbers are given for the six plans discussed here. VTDs are listed rather than the more precise census block in order to protect privacy. Rows highlighted **blue** indicate individuals who lose Democratic opportunity in at least one of the enacted plans, relative to the alternative plans. Rows highlighted **orange** indicate Black voters who lose the opportunity to be in an effective district for Black candidates of choice in at least one level. (As it turns out, every instance of lost opportunity for Black voters is also an instance of lost Democratic opportunity.)

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I declare under penalty of perjury that the foregoing is true and correct.

Executed this 23 day of December, 2021.

Professor Moon Duchin

Sworn and subscribed before me
this the 23rd of December, 2021

SHANNON C PETERSON
Notary Public
State of Colorado
Notary ID # 20214018369
My Commission Expires 05-10-2025

Notary Public

Name: Shannon C Peterson

My commission expires: 05/10/2025

Moon Duchin

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Mathematics · STS · Tisch College of Civic Life | Tufts University

Education

University of Chicago MS 1999, PhD 2005
Mathematics
Advisor: Alex Eskin Dissertation: *Geodesics track random walks in Teichmüller space*

Harvard University BA 1998
Mathematics and Women's Studies

Appointments

Tufts University
Professor of Mathematics 2021—
Assistant Professor, Associate Professor 2011–2021

Director | Program in Science, Technology, & Society 2015–2021
(on leave 2018–2019)

Principal Investigator | MGGG Redistricting Lab 2017—

Senior Fellow | Tisch College of Civic Life 2017—

University of Michigan
Assistant Professor (postdoctoral) 2008–2011

University of California, Davis
NSF VIGRE Postdoctoral Fellow 2005–2008

Research Interests

Data science for civil rights, computation and governance, elections, geometry and redistricting.
Science, technology, and society, science policy, technology and law.
Random walks and Markov chains, random groups, random constructions in geometry.
Large-scale geometry, metric geometry, isoperimetric inequalities.
Geometric group theory, growth of groups, nilpotent groups, dynamics of group actions.
Geometric topology, hyperbolicity, Teichmüller theory.

Awards & Distinctions

Research Professor - MSRI Program in Analysis and Geometry of Random Spaces Spring 2022
Guggenheim Fellow 2018
Radcliffe Fellow - Evelyn Green Davis Fellowship 2018–2019
Fellow of the American Mathematical Society elected 2017
NSF C-ACCEL (PI) - Harnessing the Data Revolution: Network science of Census data 2019–2020
NSF grants (PI) - CAREER grant and three standard Topology grants 2009–2022
Professor of the Year, Tufts Math Society 2012–2013
AAUW Dissertation Fellowship 2004–2005
NSF Graduate Fellowship 1998–2002
Lawrence and Josephine Graves Prize for Excellence in Teaching (U Chicago) 2002
Robert Fletcher Rogers Prize (Harvard Mathematics) 1995–1996

Mathematics Publications & Preprints

The (homological) persistence of gerrymandering
Foundations of Data Science, online first. (with Thomas Needham and Thomas Weighill)

You can hear the shape of a billiard table: Symbolic dynamics and rigidity for flat surfaces
Commentarii Mathematici Helvetici, to appear. arXiv:1804.05690
(with Viveka Erlandsson, Christopher Leininger, and Chandrika Sadanand)

Conjugation curvature for Cayley graphs
Journal of Topology and Analysis, online first. (with Assaf Bar-Natan and Robert Kropholler)

A reversible recombination chain for graph partitions
Preprint. (with Sarah Cannon, Dana Randall, and Parker Rule)

Recombination: A family of Markov chains for redistricting
Harvard Data Science Review. Issue 3.1, Winter 2021. online. (with Daryl DeFord and Justin Solomon)

Census TopDown: The impact of differential privacy on redistricting
2nd Symposium on Foundations of Responsible Computing (FORC 2021), 5:1–5:22. online.
(with Aloni Cohen, JN Matthews, and Bhushan Suwal)

Stars at infinity in Teichmüller space
Geometriae Dedicata, Volume 213, 531–545 (2021). (with Nate Fisher) arXiv:2004.04321

Random walks and redistricting: New applications of Markov chain Monte Carlo
(with Daryl DeFord) For edited volume, Political Geometry. Under contract with Birkhäuser.

Mathematics of nested districts: The case of Alaska
Statistics and Public Policy. Vol 7, No 1 (2020), 39–51. (w/ Sophia Caldera, Daryl DeFord, Sam Gutekunst, & Cara Nix)

A computational approach to measuring vote elasticity and competitiveness
Statistics and Public Policy. Vol 7, No 1 (2020), 69–86. (with Daryl DeFord and Justin Solomon)

The Heisenberg group is pan-rational
Advances in Mathematics **346** (2019), 219–263. (with Michael Shapiro)

Random nilpotent groups I
IMRN, Vol 2018, Issue 7 (2018), 1921–1953. (with Matthew Cordes, Yen Duong, Meng-Che Ho, and Ayla Sánchez)

Hyperbolic groups
chapter in *Office Hours with a Geometric Group Theorist*, eds. M.Clay,D.Margalit, Princeton U Press (2017), 177–203.

Counting in groups: Fine asymptotic geometry
Notices of the American Mathematical Society **63**, No. 8 (2016), 871–874.

A sharper threshold for random groups at density one-half
Groups, Geometry, and Dynamics **10**, No. 3 (2016), 985–1005.
(with Katarzyna Jankiewicz, Shelby Kilmer, Samuel Lelièvre, John M. Mackay, and Ayla Sánchez)

Equations in nilpotent groups
Proceedings of the American Mathematical Society **143** (2015), 4723–4731. (with Hao Liang and Michael Shapiro)

Statistical hyperbolicity in Teichmüller space
Geometric and Functional Analysis, Volume 24, Issue 3 (2014), 748–795. (with Howard Masur and Spencer Dowdall)

Fine asymptotic geometry of the Heisenberg group
Indiana University Mathematics Journal 63 No. 3 (2014), 885–916. (with Christopher Mooney)

Pushing fillings in right-angled Artin groups
Journal of the LMS, Vol 87, Issue 3 (2013), 663–688. (with Aaron Abrams, Noel Brady, Pallavi Dani, and Robert Young)

Spheres in the curve complex
In the Tradition of Ahlfors and Bers VI, Contemp. Math. **590** (2013), 1–8. (with Howard Masur and Spencer Dowdall)

The sprawl conjecture for convex bodies
Experimental Mathematics, Volume 22, Issue 2 (2013), 113–122. (with Samuel Lelièvre and Christopher Mooney)

Filling loops at infinity in the mapping class group
Michigan Math. J., Vol 61, Issue 4 (2012), 867–874. (with Aaron Abrams, Noel Brady, Pallavi Dani, and Robert Young)

The geometry of spheres in free abelian groups
Geometriae Dedicata, Volume 161, Issue 1 (2012), 169–187. (with Samuel Lelièvre and Christopher Mooney)

Statistical hyperbolicity in groups
Algebraic and Geometric Topology **12** (2012) 1–18. (with Samuel Lelièvre and Christopher Mooney)

Length spectra and degeneration of flat metrics
Inventiones Mathematicae, Volume 182, Issue 2 (2010), 231–277. (with Christopher Leininger and Kasra Rafi)

Divergence of geodesics in Teichmüller space and the mapping class group
Geometric and Functional Analysis, Volume 19, Issue 3 (2009), 722–742. (with Kasra Rafi)

Curvature, stretchiness, and dynamics
In the Tradition of Ahlfors and Bers IV, Contemp. Math. **432** (2007), 19–30.

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Science, Technology, Law, and Policy Publications & Preprints

Models, Race, and the Law
Yale Law Journal Forum, Vol. 130 (March 2021). Available online. (with Doug Spencer)

Computational Redistricting and the Voting Rights Act
Election Law Journal, Available online. (with Amariah Becker, Dara Gold, and Sam Hirsch)

Discrete geometry for electoral geography
Preprint. (with Bridget Eileen Tenner) arXiv:1808.05860

Implementing partisan symmetry: Problems and paradoxes
Political Analysis, to appear. (with Daryl DeFord, Natasha Dhamankar, Mackenzie McPike, Gabe Schoenbach, and Ki-Wan Sim) arXiv:2008:06930

Clustering propensity: A mathematical framework for measuring segregation
Preprint. (with Emilia Alvarez, Everett Meike, and Marshall Mueller; appendix by Tyler Piazza)

Locating the representational baseline: Republicans in Massachusetts
Election Law Journal, Volume 18, Number 4, 2019, 388–401.
(with Taissa Gladkova, Eugene Henninger-Voss, Ben Klingensmith, Heather Newman, and Hannah Wheelen)

Redistricting reform in Virginia: Districting criteria in context
Virginia Policy Review, Volume XII, Issue II, Spring 2019, 120–146. (with Daryl DeFord)

Geometry v. Gerrymandering
The Best Writing on Mathematics 2019, ed. Mircea Pitici. Princeton University Press.
reprinted from Scientific American, November 2018, 48–53.

Gerrymandering metrics: How to measure? What's the baseline?
Bulletin of the American Academy for Arts and Sciences, Vol. LXII, No. 2 (Winter 2018), 54–58.

Rebooting the mathematics of gerrymandering: How can geometry track with our political values?
The Conversation (online magazine), October 2017. (with Peter Levine)

A formula goes to court: Partisan gerrymandering and the efficiency gap
Notices of the American Mathematical Society **64** No. 9 (2017), 1020–1024. (with Mira Bernstein)

International mobility and U.S. mathematics
Notices of the American Mathematical Society **64**, No. 7 (2017), 682–683.

Graduate Advising in Mathematics

Nate Fisher (PhD 2021), Sunrose Shrestha (PhD 2020), Ayla Sánchez (PhD 2017), Kevin Buckles (PhD 2015), Mai Mansouri (MS 2014)

Outside committee member for Chris Coscia (PhD 2020), Dartmouth College

Postdoctoral Advising in Mathematics

Principal supervisor Thomas Weighill (2019–2020)

Co-supervisor Daryl DeFord (MIT 2018–2020), Rob Kropholler (2017–2020), Hao Liang (2013–2016)

Teaching

Courses Developed or Customized

Mathematics of Social Choice | sites.tufts.edu/socialchoice
Voting theory, impossibility theorems, redistricting, theory of representative democracy, metrics of fairness.

History of Mathematics | sites.tufts.edu/histmath
Social history of mathematics, organized around episodes from antiquity to present. Themes include materials and technologies of creation and dissemination, axioms, authority, credibility, and professionalization. In-depth treatment of mathematical content from numeration to cardinal arithmetic to Galois theory.

Reading Lab: Mathematical Models in Social Context | sites.tufts.edu/models
One hr/wk discussion seminar of short but close reading on topics in mathematical modeling, including history of psychometrics; algorithmic bias; philosophy of statistics; problems of model explanation and interpretation.

Geometric Literacy
Module-based graduate topics course. Modules have included: p-adic numbers, hyperbolic geometry, nilpotent geometry, Lie groups, convex geometry and analysis, the complex of curves, ergodic theory, the Gauss circle problem.

Markov Chains (graduate topics course)
Teichmüller Theory (graduate topics course)
Fuchsian Groups (graduate topics course)
Continued Fractions and Geometric Coding (undergraduate topics course)
Mathematics for Elementary School Teachers

Standard Courses

Discrete Mathematics, Calculus I-II-III, Intro to Proofs, Linear Algebra, Complex Analysis, Differential Geometry, Abstract Algebra, Graduate Real Analysis, Mathematical Modeling and Computation

Weekly Seminars Organized

- Geometric Group Theory and Topology
- Science, Technology, and Society Lunch Seminar

Selected Talks and Lectures

Distinguished Plenary Lecture — June 2021
75th Anniversary Meeting of Canadian Mathematical Society, Ottawa, Ontario — *online (COVID)*

BMC/BAMC Public Lecture — April 2021
Joint British Mathematics/Applied Mathematics Colloquium, Glasgow, Scotland — *online (COVID)*

AMS Einstein Public Lecture in Mathematics — [March 2020]
Southeastern Sectional Meeting of the AMS, Charlottesville, VA — *postponed*

Gerald and Judith Porter Public Lecture
AMS-MAA-SIAM, Joint Mathematics Meetings, San Diego, CA — January 2018

Mathematical Association of America Distinguished Lecture
MAA Carriage House, Washington, DC — October 2016

American Mathematical Society Invited Address
AMS Eastern Sectional Meeting, Brunswick, ME — September 2016

Named University Lectures

- Parsons Lecture | UNC Asheville — October 2020
- Loeb Lectures in Mathematics | Washington University in St. Louis — [March 2020]
- Math, Stats, CS, and Society | Macalester College — October 2019
- MRC Public Lecture | Stanford University — May 2019
- Freedman Memorial Colloquium | Boston University — March 2019
- Julian Clancy Frazier Colloquium Lecture | U.S. Naval Academy — January 2019
- Barnett Lecture | University of Cincinnati — October 2018
- School of Science Colloquium Series | The College of New Jersey — March 2018
- Kieval Lecture | Cornell University — February 2018
- G. Milton Wing Lectures | University of Rochester — October 2017
- Norman Johnson Lecture | Wheaton College — September 2017
- Dan E. Christie Lecture | Bowdoin College — September 2017

Math/Computer Science Department Colloquia

- Reed College — Dec 2020
- Georgetown (CS) — Sept 2020
- Santa Fe Institute — July 2020
- UC Berkeley — Sept 2018
- Brandeis-Harvard-MIT-NEU — Mar 2018
- Northwestern University — Oct 2017
- University of Illinois — Sept 2017
- University of Utah — Aug 2017
- Wesleyan — Dec 2016
- Worcester Polytechnic Inst. — Dec 2016
- Université de Neuchâtel — Jun 2016
- Brandeis University — Mar 2016
- Swarthmore College — Oct 2015
- Bowling Green — May 2015
- City College of New York — Feb 2015
- Indiana University — Nov 2014
- the Technion — Oct 2014
- Wisconsin–Madison — Sept 2014
- Stony Brook — March 2013

Minicourses

- Integer programming and combinatorial optimization (two talks) | Georgia Tech — May 2021
- Workshop in geometric topology (main speaker, three talks) | Provo, UT — June 2017
- Growth in groups (two talks) | MSRI, Berkeley, CA — August 2016
- Hyperbolicity in Teichmüller space (three talks) | Université de Grenoble — May 2016
- Counting and growth (four talks) | IAS Women's Program, Princeton — May 2016
- Nilpotent groups (three talks) | Seoul National University — October 2014
- Sub-Finsler geometry of nilpotent groups (five talks) | Galatasaray Univ., Istanbul — April 2014

Science, Technology, and Society

- The Mathematics of Accountability | Sawyer Seminar, Anthropology, Johns Hopkins — February 2020
- STS Circle | Harvard Kennedy School of Government — September 2019
- Data, Classification, and Everyday Life Symposium | Rutgers Center for Cultural Analysis — January 2019
- Science Studies Colloquium | UC San Diego — January 2019
- Arthur Miller Lecture on Science and Ethics | MIT Program in Science, Tech, and Society — November 2018

Data Science, Computer Science, Quantitative Social Science

- Data Science for Social Good Workshop (DS4SG) | Georgia Tech (virtual) — November 2020
- Privacy Tools Project Retreat | Harvard (virtual) — May 2020
- Women in Data Science Conference | Microsoft Research New England — March 2020
- Quantitative Research Methods Workshop | Yale Center for the Study of American Politics — February 2020
- Societal Concerns in Algorithms and Data Analysis | Weizmann Institute — December 2018
- Quantitative Collaborative | University of Virginia — March 2018
- Quantitative Social Science | Dartmouth College — September 2017
- Data for Black Lives Conference | MIT — November 2017

Political Science, Geography, Law, Democracy, Fairness

- The Long 19th Amendment: Women, Voting, and American Democracy | Radcliffe Institute — Nov–Dec 2020
- "The New Math" for Civil Rights | Social Justice Speaker Series, Davidson College — November 2020
- Math, Law, and Racial Fairness | Justice Speaker Series, University of South Carolina — November 2020
- Voting Rights Conference | Northeastern Public Interest Law Program — September 2020
- Political Analysis Workshop | Indiana University — November 2019
- Program in Public Law Panel | Duke Law School — October 2019
- Redistricting 2021 Seminar | University of Chicago Institute of Politics — May 2019
- Geography of Redistricting Conference Keynote | Harvard Center for Geographic Analysis — May 2019
- Political Analytics Conference | Harvard University — November 2018
- Cyber Security, Law, and Society Alliance | Boston University — September 2018
- Clough Center for the Study of Constitutional Democracy | Boston College — November 2017
- Tech/Law Colloquium Series | Cornell Tech — November 2017
- Constitution Day Lecture | Rockefeller Center for Public Policy, Dartmouth College — September 2017

Editorial Boards

Harvard Data Science Review
Associate Editor — since 2019

Advances in Mathematics
Member, Editorial Board — since 2018

Selected Professional and Public Service

Amicus Brief of Mathematicians, Law Professors, and Students 2019
principal co-authors: Guy-Uriel Charles and Moon Duchin
Supreme Court of the United States, in Rucho v. Common Cause - cited in dissent

Committee on Science Policy 2020–2023
American Mathematical Society

Program Committee 2020–2021
Symposium on Foundations of Responsible Computing

Presenter on Public Mapping, Statistical Modeling 2019, 2020
National Conference of State Legislatures

Committee on the Human Rights of Mathematicians 2016–2019
American Mathematical Society

Committee on The Future of Voting: Accessible, Reliable, Verifiable Technology 2017–2018
National Academies of Science, Engineering, and Medicine

Visiting Positions and Residential Fellowships

Visiting Professor Department of Mathematics Fall 2021
Boston College | Chestnut Hill, MA

Fellow Radcliffe Institute for Advanced Study 2018–19
Harvard University | Cambridge, MA

Member Center of Mathematical Sciences and Applications 2018–19
Harvard University | Cambridge, MA

Visitor Microsoft Research Lab 2018–19
MSR New England | Cambridge, MA

Research Member Geometric Group Theory program Fall 2016
Mathematical Sciences Research Institute | Berkeley, CA

Research Member Random Walks and Asymptotic Geometry of Groups program Spring 2014
Institut Henri Poincaré | Paris, France

Research Member Low-dimensional Topology, Geometry, and Dynamics program Fall 2013
Institute for Computational and Experimental Research in Mathematics | Providence, RI

Research Member Geometric and Analytic Aspects of Group Theory program May 2012
Institut Mittag-Leffler | Stockholm, Sweden

Research Member Quantitative Geometry program Fall 2011
Mathematical Sciences Research Institute | Berkeley, CA

Postdoctoral Fellow Teichmüller "project blanc" Spring 2009
Agence Nationale de la Recherche (Collège de France) | Paris, France

STATE OF NORTH CAROLINA

COUNTY OF WAKE

IN THE GENERAL COURT OF JUSTICE
SUPERIOR COURT DIVISION
No. 21 CVS 015426
No. 21 CVS 500085

NORTH CAROLINA LEAGUE OF CONSERVATION VOTERS, INC., *et al.*,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS SENIOR CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING, *et al.*,

Defendants.

REBECCA HARPER, *et al.*,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS SENIOR CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING, *et al.*,

Defendants.

COMMON CAUSE, *et al.*,

Plaintiffs,

v.

REPRESENTATIVE DESTIN HALL, IN HIS OFFICIAL CAPACITY AS SENIOR CHAIR OF THE HOUSE STANDING COMMITTEE ON REDISTRICTING, *et al.*,

Defendants.

PROPOSED JOINT STIPULATIONS OF FACT

Pursuant to the Court's December 13, 2021 Case Scheduling Order, the parties hereby stipulate to the following facts:

THE PARTIES

1. The plaintiffs in this action are:

a. North Carolina League of Conservation Voters, Inc.; Henry M. Michaux, Jr.; Dandrielle Lewis; Timothy Chartier; Talia Fernos; Katherine Newhall; R. Jason Parsley; Edna Scott; Roberta Scott; Yvette Roberts; Jereann King Johnson; Reverend Reginald Wells; Yarbrough Williams, Jr.; Reverend Deloris L. Jerman; Viola Ryals Figueroa; and Cosmos George (collectively the "NCLCV Plaintiffs").

b. Rebecca Harper; Amy Clare Oseroff; Donald Rumph; John Anthony Balla; Richard R. Crews; Lily Nicole Quick; Gettys Cohen Jr.; Shawn Rush; Mark S. Peters; Kathleen Barnes; Virginia Walters Brien; Eileen Stephens; Barbara Proffitt; Mary Elizabeth Voss; Chenita Barber Johnson; Sarah Taber; Joshua Perry Brown; Laureen Floor; Donald M. MacKinnon; Ron Osborne; Ann Butzner; Sondra Stein; Bobby Jones; Kristiann Herring; and David Dwight Brown (collectively the "Harper Plaintiffs").

c. Common Cause.

2. The defendants in this action are as follows:

a. Destin Hall, in his official capacity as Chairman of the House Standing Committee on Redistricting; Ralph E. Hise, Jr., Warren Daniel, Paul Newton, in their official capacities as Co-Chairmen of the Senate Committee on Redistricting and Elections; Philip E. Berger, in his official capacity as President Pro Tempore of the North Carolina Senate; Timothy

K. Moore, in his official capacity as Speaker of the North Carolina House of Representatives (collectively "Legislative Defendants");

b. The State of North Carolina; The North Carolina State Board of Elections; Damon Circosta, in his official capacity as Chair of the State Board of Elections; Stella Anderson, in her official capacity as Secretary of the State Board of Elections; Stacy Eggers IV, in his official capacity as Member of the State Board of Elections; Jeff Carmon III, in his official capacity as Member of the State Board of Elections; Tommy Tucker, in his official capacity as Member of the State Board of Elections; Karen Brinson Bell, in her official capacity as Executive Director of the State Board of Elections (collectively "State Defendants")

3. The NCLCV Plaintiffs' Complaint, filed November 16, 2021, alleges that the 2021 districting plans for Congress, the North Carolina Senate, and the North Carolina House of Representatives violate the North Carolina Constitution by establishing severe partisan gerrymanders in violation of the Free Elections Clause, Art. I, § 10, the Equal Protection Clause, Art. I, § 19, and the Freedom of Speech and Assembly Clauses, Art. I, §§ 12, 14; by engaging in racial vote dilution in violation of the Free Elections Clause, Art. I, § 10, and the Equal Protection Clause, Art. I, § 19; and by violating the Whole County Provisions, Art. II, §§ 3(3), 5(3).

4. Harper Plaintiffs' Amended Complaint, filed December 12, 2021, alleges that the 2021 districting plans for Congress, the North Carolina Senate, and the North Carolina House of Representatives violate the North Carolina Constitution—namely its Free Elections Clause, Art. I, § 10; its Equal Protection Clause, Art. I, § 19; and its Freedom of Speech and Freedom of Assembly Clauses, Art. I, §§ 12, 14.

5. Plaintiff Common Cause's Complaint, filed December 16, 2021, alleges that the 2021 districting plans for Congress, the North Carolina Senate, and the North Carolina House of Representatives violate the North Carolina Constitution—namely its Equal Protection Clause, Art. I, § 19; its Free Elections Clause, Art. I, § 10; and its Freedom of Speech and Freedom of Assembly Clauses, Art. I, §§ 12, 14—and seeks, among other relief, a declaratory ruling under the Declaratory Judgment Act.

6. Defendant Ralph E. Hise, Jr. is a Republican member of the North Carolina Senate, representing Senate District 47, and the Chairman of the Senate Standing Committee on Redistricting and Elections. Defendant Hise is sued in his official capacity only. Defendant Hise resides in Senate District 47 in the 2021 districting plan.

7. Defendant Warren Daniel is a Republican member of the North Carolina Senate, representing Senate District 46, and the Chairman of the Senate Standing Committee on Redistricting and Elections. Defendant Daniel is sued in his official capacity only. Defendant Daniel resides in Senate District 46 in the 2021 districting plan.

8. Defendant Paul Newton is a Republican member of the North Carolina Senate, representing Senate District 36, and the Chairman of the Senate Standing Committee on Redistricting and Elections. Defendant Newton is sued in his official capacity only. Defendant Newton resides in Senate District 34 in the 2021 districting plan.

9. Representative Destin Hall is Republican member of the North Carolina House of Representatives, representing House District 87, and the Chairman of the House Standing Committee on Redistricting. Defendant Hall is sued in his official capacity only. Defendant Hall resides in House District 87 in the 2021 districting plan.

10. Defendant Timothy K. Moore is a Republican member and the Speaker of the North Carolina House of Representatives, representing House District 111. Defendant Moore is sued in his official capacity only. Defendant Moore resides in House District 111 in the 2021 districting plan.

11. Defendant Philip E. Berger is a Republican member and the President Pro Tempore of the North Carolina Senate, representing Senate District 30. Defendant Berger is sued in his official capacity only. Defendant Berger resides in Senate District 26 in the 2021 districting plan.

BACKGROUND

12. Following each decennial census, the North Carolina General Assembly must redraw the districts for the North Carolina House of Representatives, the North Carolina Senate, and the North Carolina Congressional map.

13. In North Carolina, legislative redistricting is performed exclusively by the General Assembly. The Governor of North Carolina has no power to veto redistricting bills.

14. The State Constitution specifically enumerates four limitations upon the redistricting and reapportionment authority of the General Assembly, including that:

a. Each Senator and Representative shall represent, as nearly as possible, an equal number of inhabitants;

b. Each senate and representative district shall at all times consist of contiguous territory;

c. No county shall be divided in the formation of senator or representative districts (the "Whole County Provision"); and

d. Once established, the senate and representative districts and the apportionment of Senators and Representatives shall remain unaltered until the next decennial census of population taken by order of Congress.

15. Between 1870 and 2010, Democrats at all times controlled one or both houses of the General Assembly.

16. After the 2010 election, for the first time since 1870, Republicans constituted a majority of both the North Carolina House of Representatives and the North Carolina Senate.

17. Republicans have constituted a majority in both the North Carolina House of Representatives and the North Carolina Senate from 2010 to present day and have therefore controlled each of the last two cycles of redistricting in North Carolina.

THE 2021 REDISTRICTING PROCESS

Census Data

18. On February 12, 2021, the U.S. Census Bureau announced that its release of P.L. 94-171 redistricting data would be delayed by the COVID-19 pandemic, and would not be released until the fall of 2021, and specifically that it would deliver the Public Law 94.171 redistricting data to all states by September 30, 2021.[1]

19. On February 24, 2021, the North Carolina State Board of Elections Executive Director Karen Brinson Bell presented recommendations to the House Elections Law and Campaign Finance Reform Committee to move the 2022 primary to a May 3 primary, July 12 second primary, and November 8 general election.[2]

[1] Press Release, U.S. Census Bureau, Census Bureau Statement on Redistricting Data Timeline (Feb. 12, 2021), https://www.census.gov/newsroom/press-releases/2021/statement-redistricting-data-timeline.html.

[2] North Carolina State Board of Elections, *A Look Back at North Carolina's Historic 2020 Election & Looking Ahead at 2021*, *Presentation to House Election Law & Campaign Finance Reform Committee* at p. 14, Feb. 24, 2021, 2021–2022 Session (N.C. 2021),

20. On March 15, 2021, the United States Census Bureau announced that it would release a "legacy" format summary redistricting data file to all states by mid-to-late August 2021, in addition to the "tabulated" P.L. 94-171 block-level data released before September 30, 2021, "[i]n recognition of the difficulties this timeline creates for states with redistricting and election deadlines prior to Sept. 30."[3]

21. On April 26, 2021, the United States Census Bureau released data indicating that North Carolina's population increased from 9,535,483 residents in 2010[4] to 10,439,388 residents in 2020.[5] This 9.5 percent population increase resulted in North Carolina being given an additional Congressional seat following the 2020 Census, resulting in North Carolina's congressional delegation growing from 13 to 14 members.[6]

22. On August 12, 2021, the U.S. Census Bureau released the 2020 Census Redistricting Data (Public Law 94-171) Summary File for all states, including North Carolina, in "legacy" format.[7]

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https://www.ncleg.gov/documentsites/committees/House2021-21/02-24-21/House%20Elections%20Committee%20Presentation%202-24-2021%20FINALv2.pdf.

[3] U.S. Census Bureau, *U.S. Census Bureau Statement on Release of Legacy Format Summary Redistricting Data File* (Mar. 15, 2021), https://www.census.gov/newsroom/press-releases/2021/statement-legacy-format-redistricting.html.

[4] U.S. Census Bureau, *North Carolina: 2010: Population and Housing Unit Census* (2021), https://www.census.gov/prod/cen2010/cph-2-35.pdf.

[5] *See* U.S. Census Bureau, *2020 Census Apportionment Results Delivered to the President* (Apr. 27, 2021); https://www.census.gov/newsroom/press-releases/2021/2020-census-apportionment-results.html; *North Carolina: 2020 Census*, U.S. CENSUS BUREAU (Aug. 25, 2021), https://www.census.gov/library/stories/state-by-state/north-carolina-population-change-between-census-decade.html.

[6] *2020 Census: Apportionment of the U.S. House of Representatives*, U.S. CENSUS BUREAU (Apr. 26, 2021), https://www.census.gov/library/visualizations/2021/dec/2020-apportionment-map.html.

[7] *See* U.S. Census Bureau, *U.S. Census Bureau Delivers Data for States to Begin Redistricting Efforts* (Aug. 12, 2021), https://www.census.gov/newsroom/press-releases/2021/population-changes-nations-diversity.html.

The Redistricting Committee Criteria & Map Drawing Process

23. On Thursday, August 5, 2021 at 2:00 PM, the Senate Committee on Redistricting and Elections convened a Joint Meeting of the Senate Redistricting and Elections Committee and the House Redistricting Committee to begin discussion on the redistricting process.[8]

24. Following this meeting, staff member Erika Churchill distributed to the joint committee members the legislative redistricting criteria ordered by the North Carolina Superior Court for Wake County in its September 3, 2019 Judgment in the matter *Common Cause v. Lewis*, No. 18 CVS 014001, 2019 N.C. Super. LEXIS 56 (the "2019 Criteria").

25. On Monday, August 9, 2021 the redistricting chairs of the joint committees released the "2021 Joint Redistricting Committee Proposed Criteria," a copy of which appears at https://ncleg.gov/documentsites/committees/Senate2021-154/2021/08-09-2021/2021%20Joint%20Redistricting%20Committee%20Plan%20Proposed%20Criteria.pdf.

26. The Joint Redistricting Committees received in-person public comment on the Proposed Criteria on Tuesday, August 10, 2021 beginning at 8:30 AM.

27. On Thursday, August 12, 2021, the Joint Redistricting Committees convened to debate and vote on the 2021 Joint Redistricting Committee Proposed Criteria.

28. That same day, the Joint Redistricting Committees adopted the final redistricting criteria, a copy of which appears at: https://ncleg.gov/documentsites/committees/Senate2021-154/2021/08-12-2021/Criteria.adopted.8.12.pdf.

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[8] *Joint Meeting of the Senate Redistricting and Elections Committee and the House Redistricting Committee to Begin Discussion on the Redistricting Process*, Aug. 5, 2021, 2021–2022 Session (N.C. 2021), https://ncleg.gov/documentsites/committees/Senate2021-154/2021/08-05-2021/6683.pdf.

29. On Wednesday, September 1, 2021, the Joint Redistricting Committees announced a Joint Public Hearing Schedule, that would consist of 13 public hearings held from September 8, 2021 through September 30, 2021.[9]

30. On Tuesday, October 5, 2021, the Senate Committee on Redistricting and Elections and the House Committee on Redistricting each convened separately. In both meetings, the Redistricting Chairs announced utilization of county groupings described in the academic paper *N.C. General Assembly County Clusterings from the 2020 Census* (the "Duke Academic Paper"), published on the Duke University website "Quantifying Gerrymandering."[10]

31. In the meeting of the Senate Committee on Redistricting and Elections, Defendant Hise provided the set of sixteen possible Senate cluster options, based upon the Duke Academic Paper, that constituted the set of options eligible for adoption (the "Duke Senate Clusters"). *See* "Duke Senate Groupings Maps 11x17."[11]

32. In the meeting of the House Committee on Redistricting, Defendant Hall provided the set of eight possible House cluster options, based upon the Duke Academic Paper, that

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[9] 9.1.21 released Hearing schedule: https://www.ncleg.gov/documentsites/committees/House2021-182/2021/Public%20Hearing%20Schedule.pdf

9.13.21 released Hearing schedule with addresses:
https://www.ncleg.gov/documentsites/committees/House2021-182/2021/Public%20Hearing%20Schedule%20with%20addresses.pdf

[10] Christopher Cooper et al., *NC General Assembly County Clusterings from the 2020 Census*, QUANTIFYING GERRYMANDERING (Aug. 17, 2021), https://sites.duke.edu/quantifyinggerrymandering/files/2021/08/countyClusters2020.pdf.

[11] *Duke Senate Groupings Maps 11x17*, North Carolina Senate Redistricting and Elections Committee, Oct. 5, 2021, 2021–2022 Session (N.C. 2021), https://ncleg.gov/documentsites/committees/Senate2021-154/2021/10-05-2021/Duke%20Senate%20Groupings%20Maps%2011x17.pdf.

constituted the set of options eligible for adoption (the "Duke House Clusters"). *See* "Duke House Groupings Maps 11x17.pdf."[12]

33. On Friday, October 8, 2021, Legislative Defendants received a letter from Allison J. Riggs, current counsel for Plaintiff Common Cause, concerning the county clustering option maps introduced on Tuesday, October 5, 2021.[13]

34. On Monday, October 25, 2021, Legislative Defendants received a second letter from Allison J. Riggs, current counsel for Plaintiff Common Cause, concerning draft Senate map, "SST-4".[14]

35. A placeholder version of the state House Map was filed on Thursday, October 28, 2021 as House Bill 976 ("HB976") where it passed its first reading. A committee substitute ("HBK-14") received a favorable review and, after one amendment, passed its second and third readings on the House and its first reading in the Senate on November 2, 2021. It received a favorable report from the Senate Redistricting Committee on November 3, 2021 without alteration and passed its second and third readings on November 4, 2021.

36. HB976 was ratified into law on November 4, 2021 as S.L. 2021-175.

37. A proposed version of the state Senate map ("SST-13") was filed on Friday, October 29, 2021 as Senate Bill 739 ("SB739") and received its first reading in the Senate that day. It was then referred to the Senate Redistricting Committee on November 1 where the Redistricting Committee adopted a substitute along party lines ("SBK-7"). On November 2,

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[12] *Duke House Groupings Maps 11x17*, North Carolina House Redistricting Committee, Oct. 5, 2021, 2021–2022 Session (N.C. 2021), https://ncleg.gov/documentsites/committees/House2021-182/2021/October%205,%202021/Duke%20House%20Groupings%20Maps%2011x17.pdf.

[13] Letter from SCSJ Attorneys to Legislative Defendants, Oct. 8, 2021, https://southerncoalition.org/wp-content/uploads/2021/10/SCSJ-correspondence_NCGA-redistricting_2021.10.082.pdf.

[14] Letter from SCSJ Attorneys to Legislative Defendants, Oct. 25, 2021, https://southerncoalition.org/wp-content/uploads/2021/10/SCSJ-Letter-Senate-Map-10-25-21-FINAL.pdf.

Senator Marcus offered an amendment entitled "SBVAmend-2" to the Senate Redistricting Committee.[15] Senator Clark also offered an amendment entitled "SCGAmend-3" to the Senate Redistricting Committee.[16] Both amendments were adopted and included in the final version of SB739. The bill then passed its second and third readings in the Senate by November 3 along party lines, and passed all three readings and the House Redistricting Committee without any alteration on November 3 – 4, 2021.

38. SB739 was ratified into law on November 4, 2021 as S.L. 2021-173.

39. A proposed Congressional map ("CST-13") was filed on October 29, 2021 as Senate Bill 740 ("SB740") and passed its first reading and received a favorable report from the Senate Redistricting Committee on November 1, 2021. It proceeded unaltered through its second and third readings in the Senate and its first reading in the House on November 2, received a favorable report from the House Redistricting Committee on November 3, and proceeded unaltered through its second and third readings in the House on November 4, 2021.

40. SB740 was ratified into law on November 4, 2021 as S.L. 2021-174.

41. The State House, State Senate and Congressional Maps all passed along party lines.

42. The State House map, HB976, passed the House on a strict party line vote, with 67 Republican Representatives in favor and 49 Democratic Representatives opposed. HB976 also passed the Senate on a strict party line vote, with 25 Republican Senators in favor and 21 Democratic Senators opposed.

[15] https://www.ncleg.gov/documentsites/committees/Senate2021-154/2021/11-02-2021/Adopted%20Amendments/S739-ATU-40.printing.pdf

[16] https://www.ncleg.gov/documentsites/committees/Senate2021-154/2021/11-02-2021/Adopted%20Amendments/S739-ABA-40.printing.pdf

43. The State Senate map, SB739, passed the Senate on a strict party line vote, with 26 Republican Senators in favor and 19 Democratic Senators opposed. SB739 also passed the House on a strict party line vote, with 65 Republican Representatives in favor and 49 Democratic Representatives opposed.

44. The Congressional map, SB740, passed the Senate on a strict party line vote, with 27 Republican Senators in favor and 22 Democratic Senators opposed. SB740 also passed the House on a strict party line vote, with 65 Republican Representatives in favor and 49 Democratic Representatives opposed.

GENERAL REDISTRICTING PROCESS STIPULATIONS

45. All parties stipulate and agree that any party may cite, discuss, and otherwise rely on as admitted evidence, publicly available legislative records from the website of the North Carolina General Assembly concerning SB 739,[17] SB 740,[18] HB 976,[19] and Legislative and Congressional Redistricting,[20] including all materials from the House Standing Committee on Redistricting,[21] the Senate Standing Committee on Redistricting and Elections,[22] and the Joint Redistricting Committee concerning the aforementioned redistricting plans and the 2021 redistricting cycle.

46. All parties stipulate and agree that any party may cite, discuss, and otherwise rely on as admitted evidence, all transcriptions, audio and/or video recordings of: (1) the committee

[17] https://www.ncleg.gov/BillLookUp/2021/S739

[18] https://www.ncleg.gov/BillLookUp/2021/S740

[19] https://www.ncleg.gov/BillLookUp/2021/H976

[20] https://www.ncleg.gov/Redistricting

[21] https://www.ncleg.gov/Committees/CommitteeInfo/HouseStanding/182

[22] https://www.ncleg.gov/Committees/CommitteeInfo/SenateStanding/154

meetings of the House Standing Committee on Redistricting, the Senate Standing Committee on Redistricting and Elections, and the Joint Redistricting Committee, including public hearings hosted by any of those committees concerning the 2021 redistricting process, (2) the House and Senate floor votes concerning SB 739, SB 740, and HB 976, and (3) the publicly available House and Senate map drawing sessions related to SB 739, SB 740, and HB 976.

HISTORICAL ELECTION RESULTS & CENSUS DATA STIPULATIONS

47. All parties stipulate and agree to the accuracy and admissibility of historical election results publicly available on the website of the North Carolina State Board of Elections, including all election results from 2000 to 2020, sorted by precinct, available on the North Carolina State Board of Elections website.[23]

48. All parties stipulate and agree to the accuracy and admissibility of the publicly available Public Law 94-171 redistricting data released by the United States Census Bureau in 2021, including data from the United States Census Bureau's 2020 Census (Public Law 94-171) "Redistricting Data Summary Files" and "TIGER/Line Shapefiles."[24]

[23] https://www.ncsbe.gov/results-data/election-results/historical-election-results-data; https://dl.ncsbe.gov.

[24] https://www.census.gov/data/datasets/2020/dec/2020-census-redistricting-summary-file-dataset.html; https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html; https://www2.census.gov/programs-surveys/decennial/2020/data/01-Redistricting_File--PL_94-171/North_Carolina/

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