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 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
LDTX107

DocuSigned by:
Michael Barber
82F8BEB03413425...

Executed on 22 December, 2021

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.

NOTARY PUBLIC
STATE OF TEXAS

**MARY S. LEE**
Notary ID
11405696
My Commission Expires
11/4/2022

DocuSigned by:
Mary S. Lee
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Notary Public

# Exhibit A:
# Expert Report of Michael Barber, PhD

Dr. Michael Barber
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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

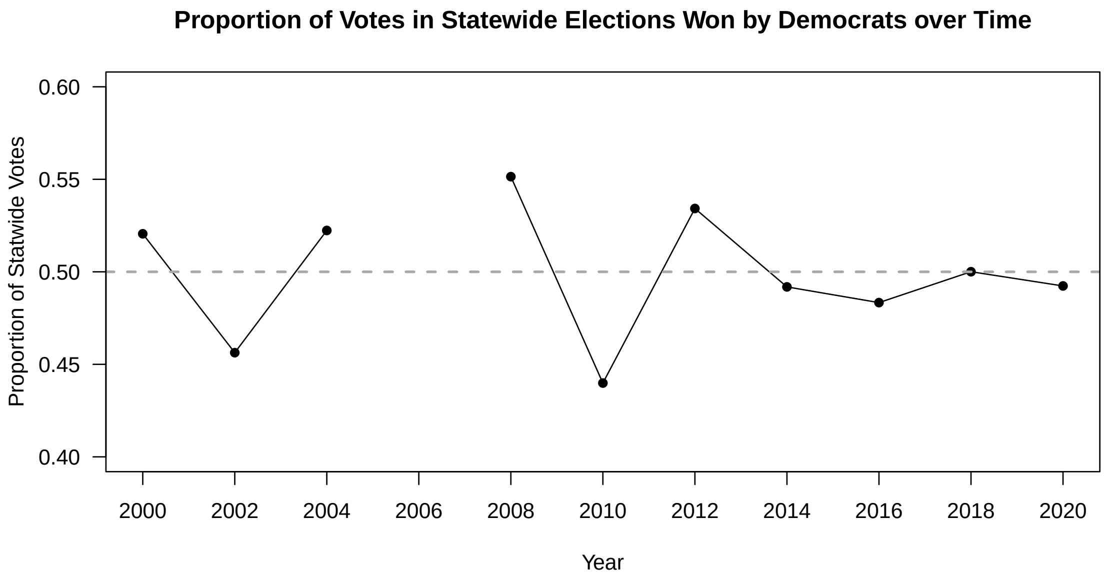



Figure 1: **Democratic Proportion of Statewide Election Contests, 2000-2020**

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.

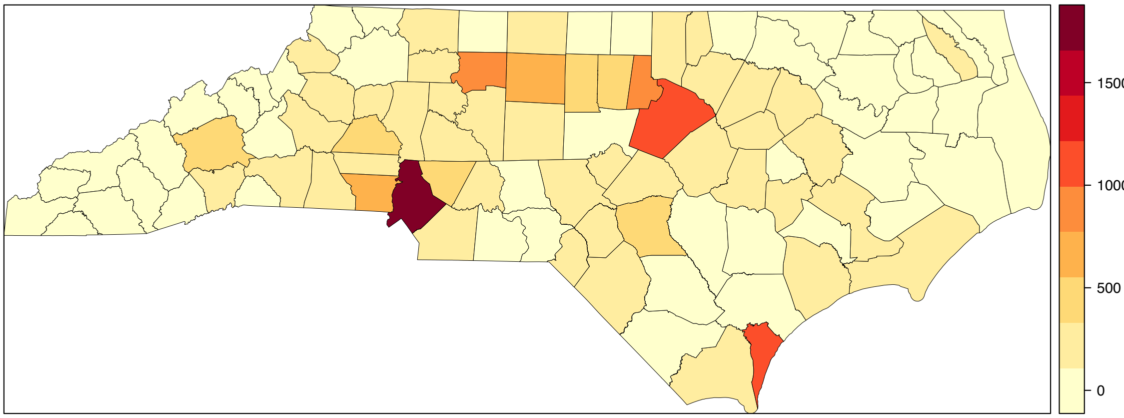
Figure 2 shows two maps of North Carolina. The top map shows the population density across counties. The bottom map shows the distribution of partisan preference across the state. Comparing the two shows that the most dense and urban counties (Wake, Mecklenburg, Durham, Guilford, Forsyth, New Hanover) 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.

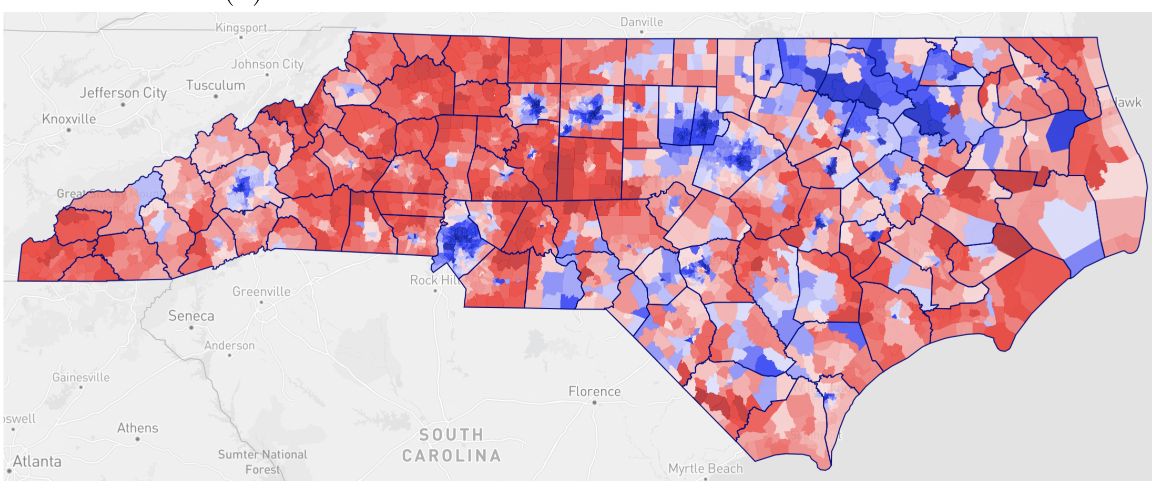
[6]This would include Vance, Warren, Halifax, Northampton, Hertford, Bertie, and Edgecomb counties.

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.

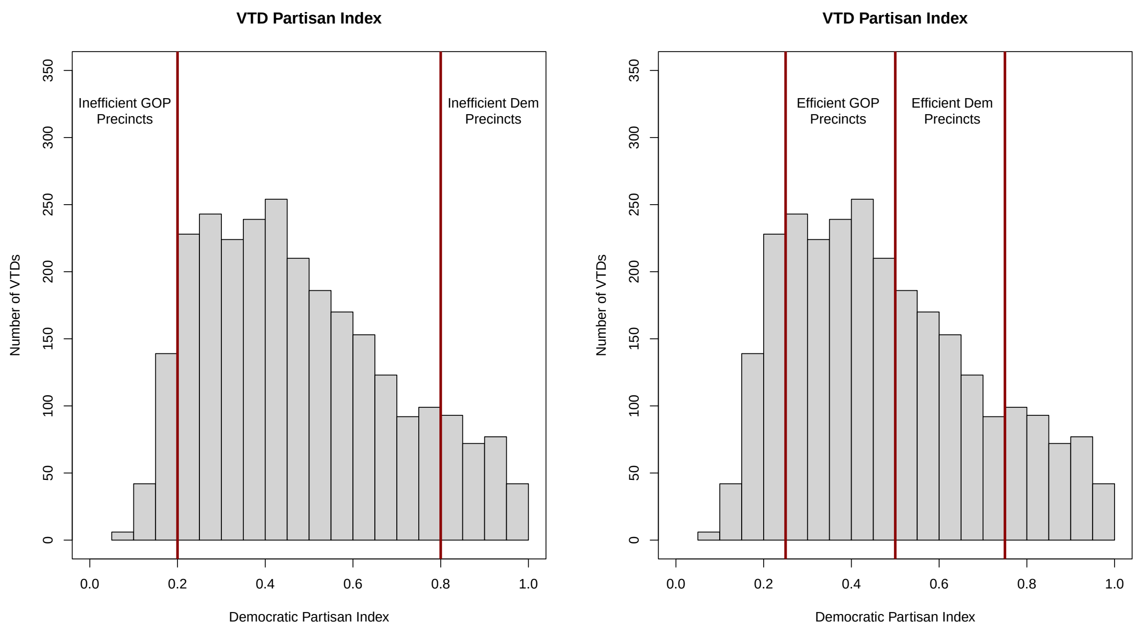
This inefficient distribution of votes would not be a problem for Democrats if districts were able to amble about the state so as to create districts that had less overwhelming Democratic support. Rodden (2019) notes this by saying: "Democrats would need a redistricting process that intentionally carved 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

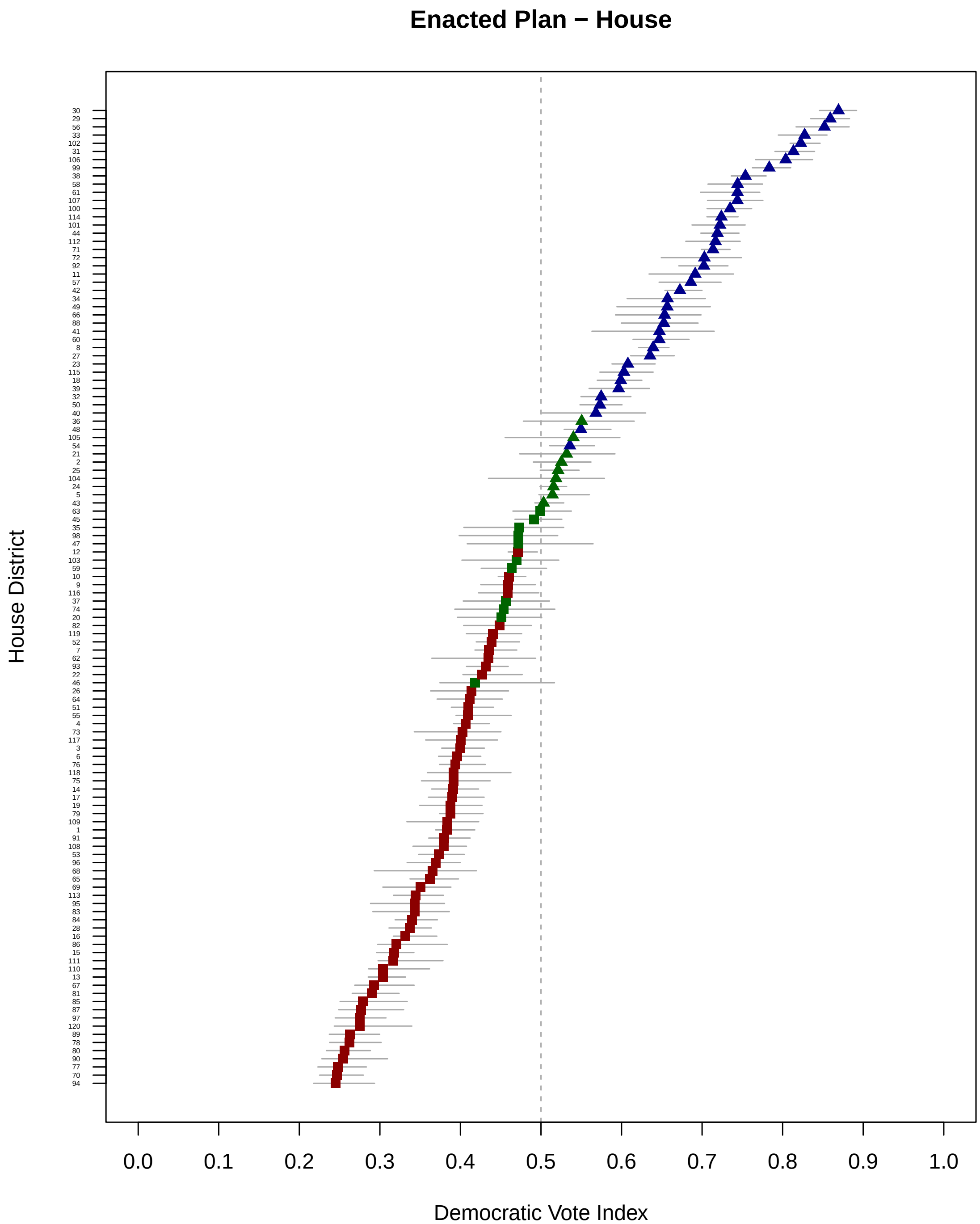
across multiple cities) and are much more constrained to remain within the county clusters, unlike the congressional district maps.

[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.

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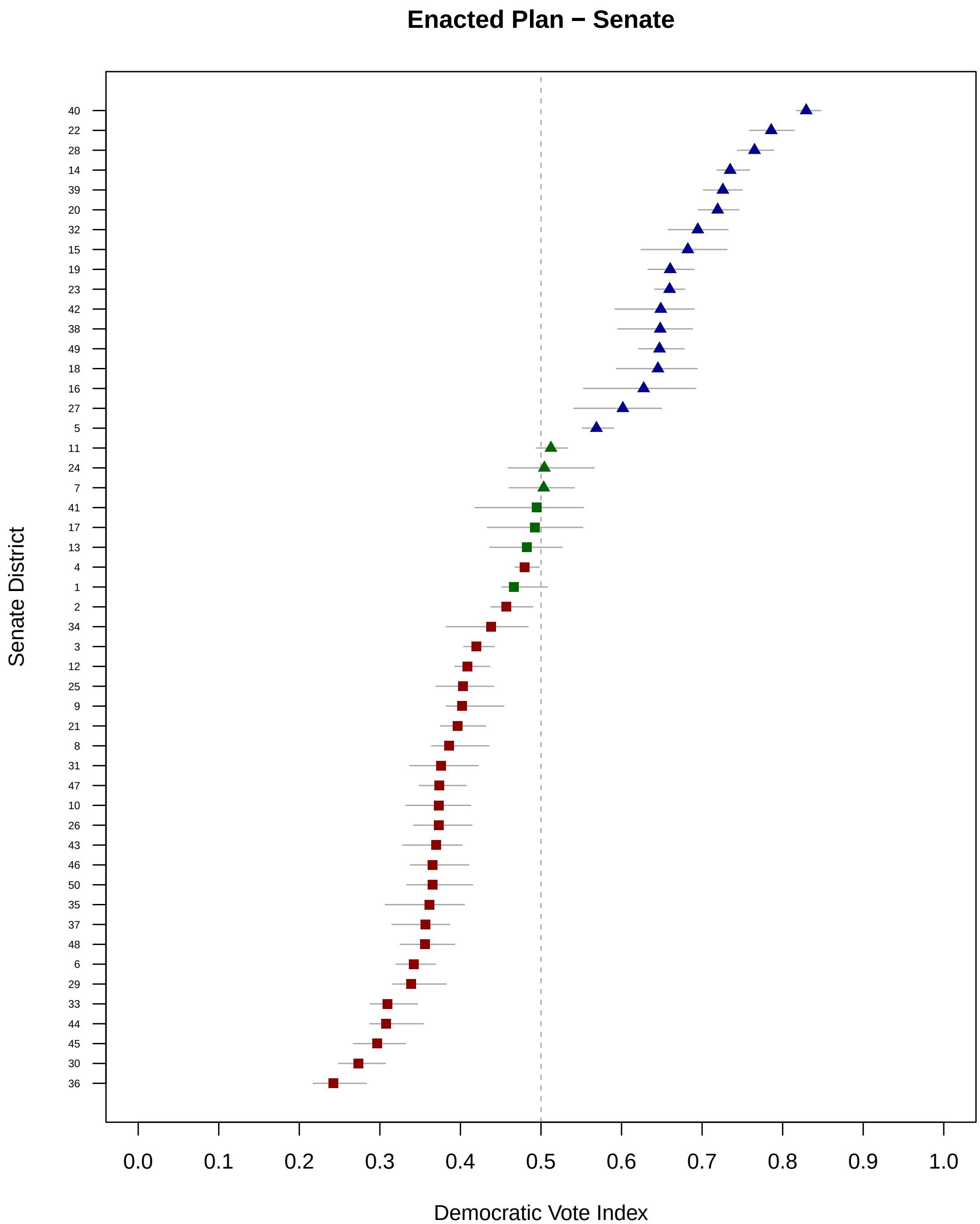


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# 4 Introduction to Simulations Analysis

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**

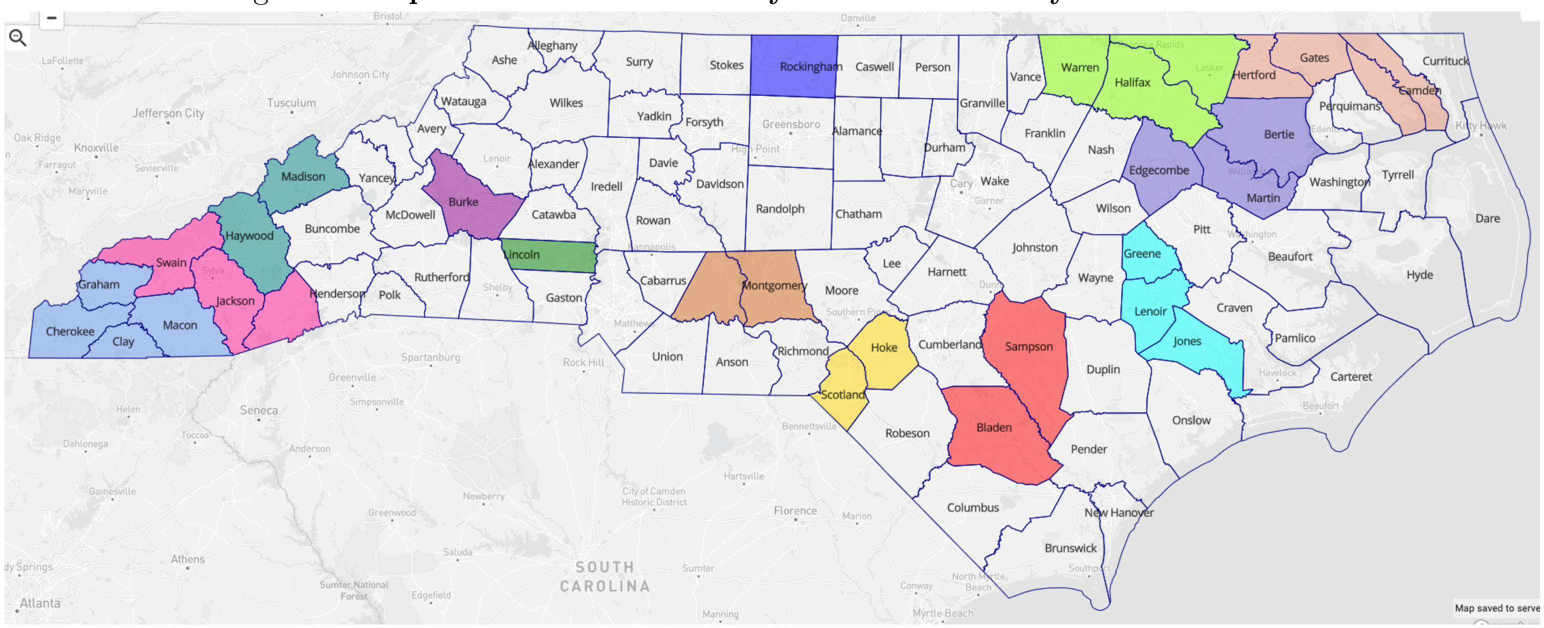


Table 1: County Grouping Containing 1 House District

| 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

| | | | # of Districts that are Democratic Leaning | | |
|---|---|---|---|---|---|
| **County Cluster** | **Cluster Democratic Partisan Index** | **# Districts** | **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**

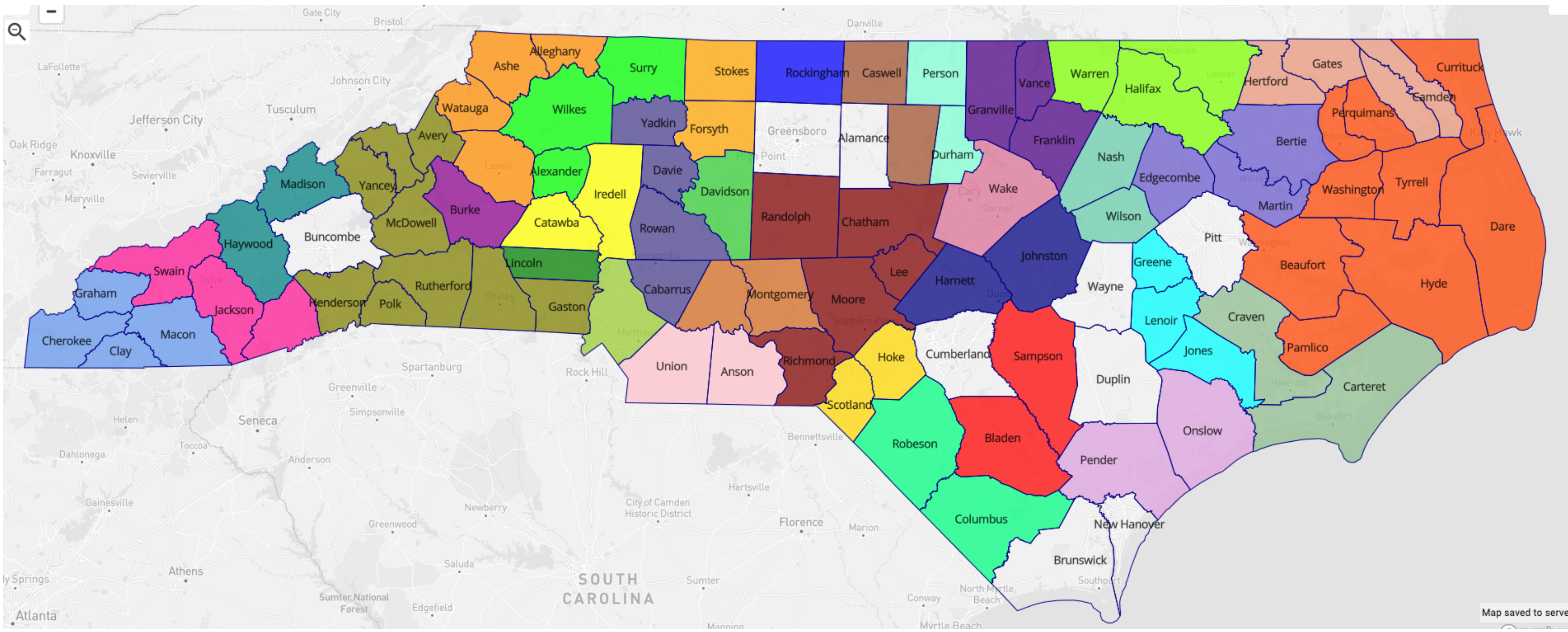
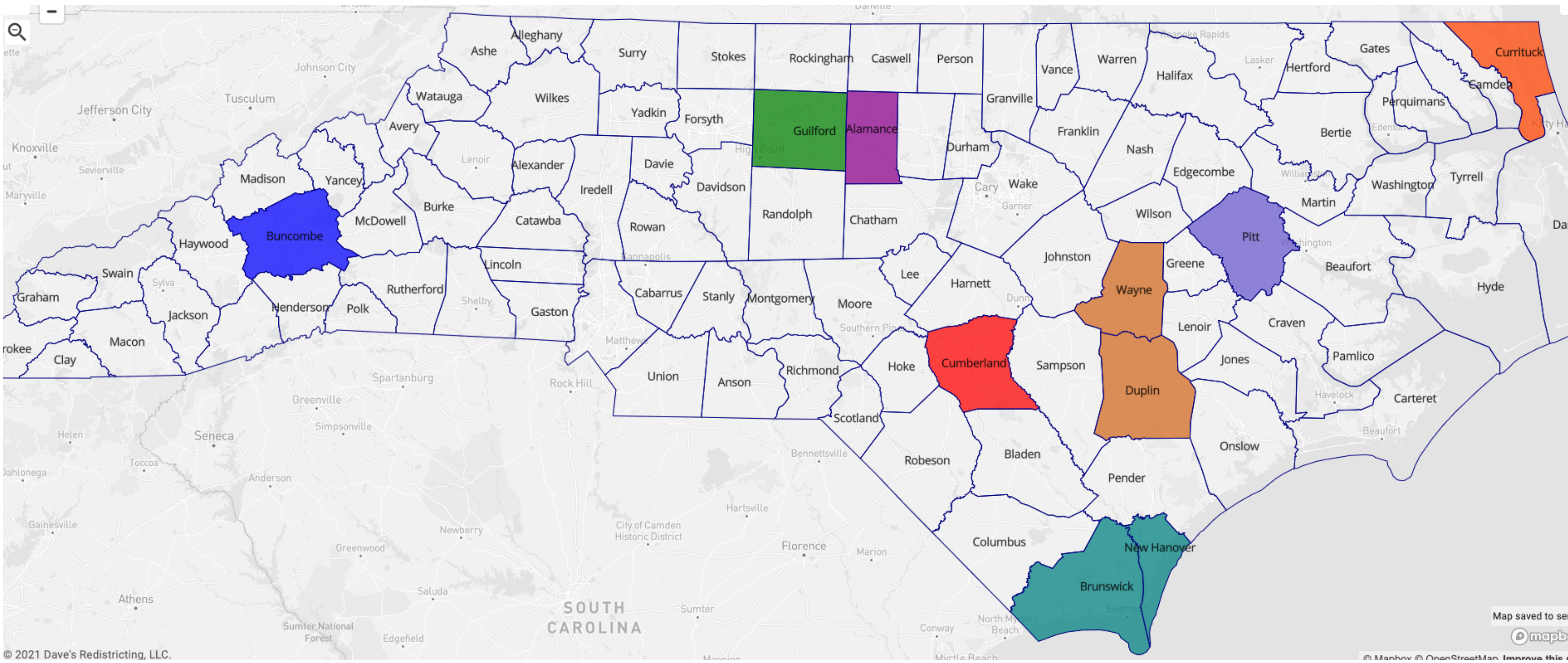


Figure 8: **Map of House County Clusters Where Enacted and Duchin Plans Disagree on Partisan Lean of Districts**



## 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**

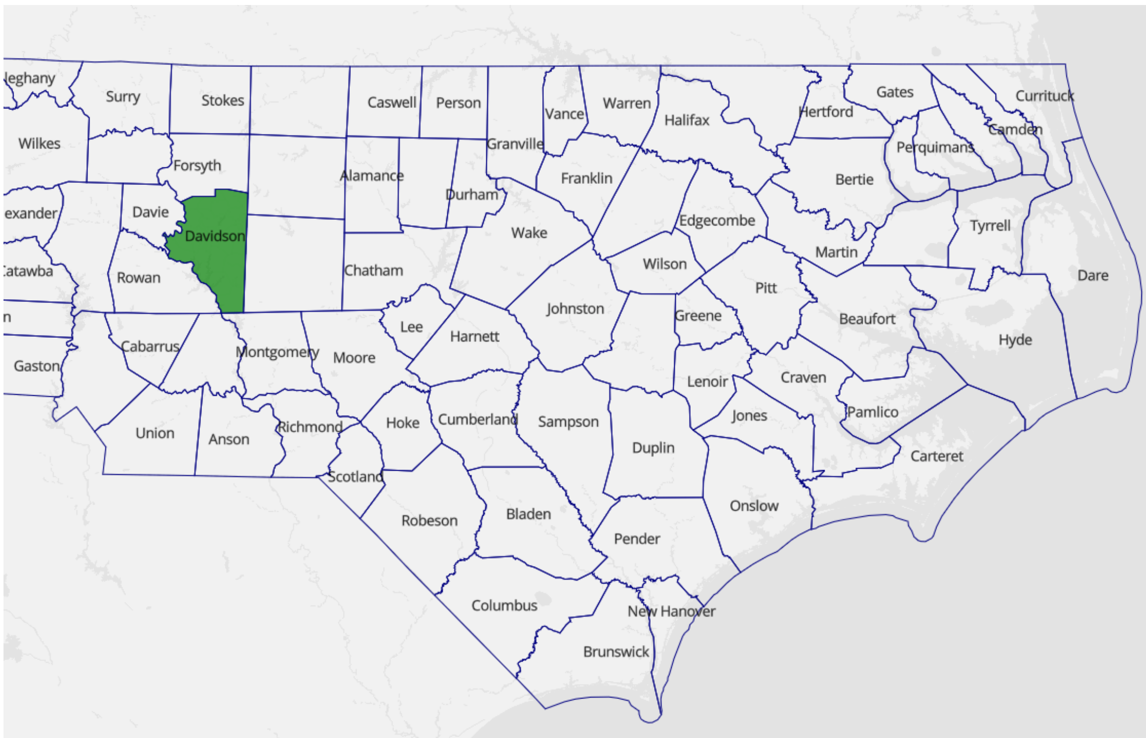
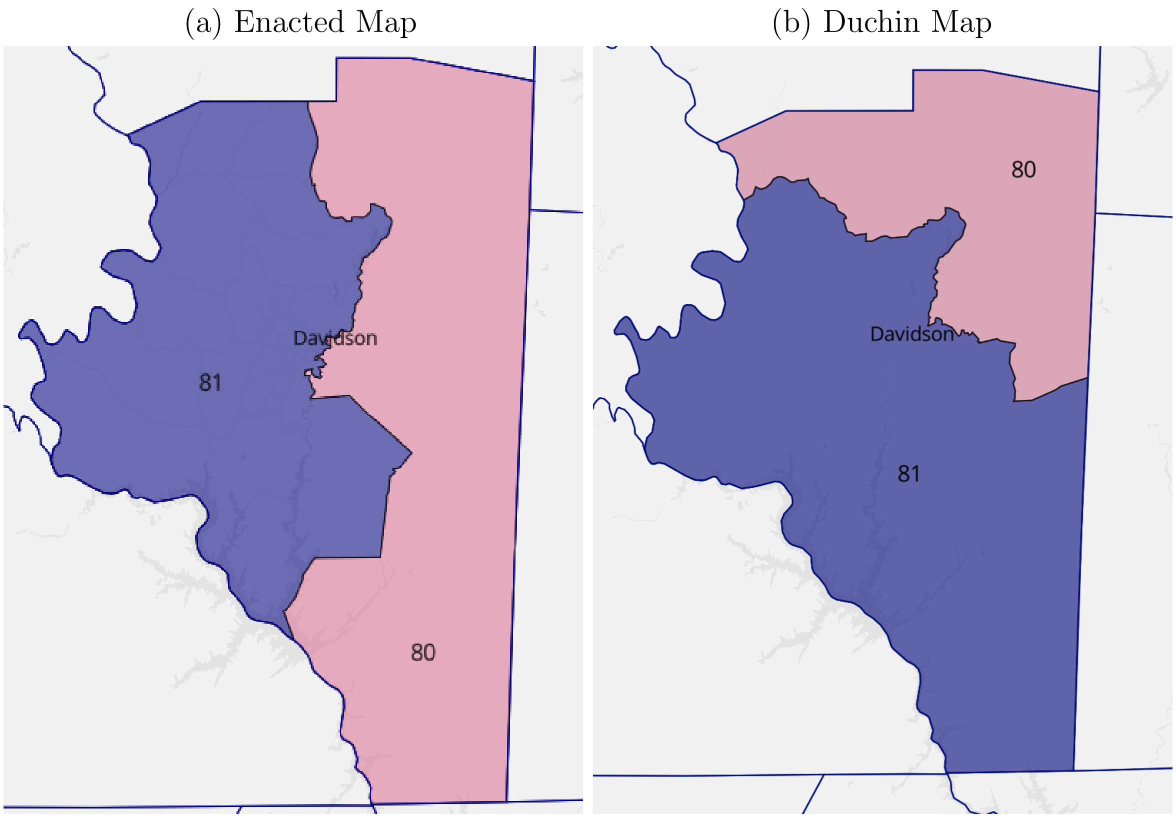


Figure 10: **Map of House Enacted Plan in Davidson County Cluster**



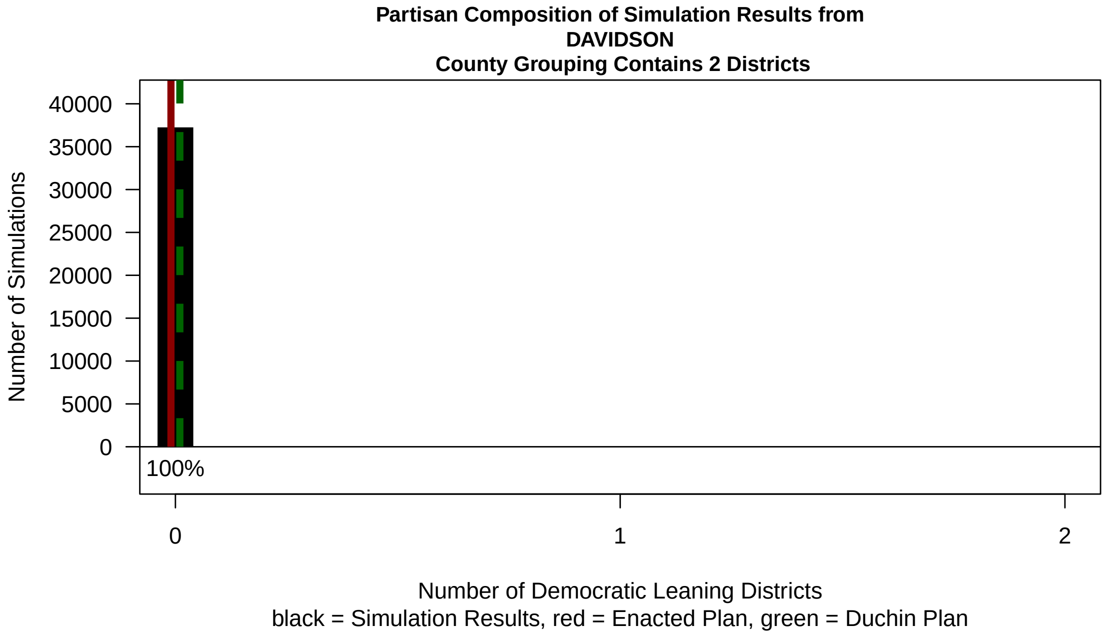

Note: The left map shows the district lines for the Enacted Map and the right map shows the district lines for the Duchin Map.

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**

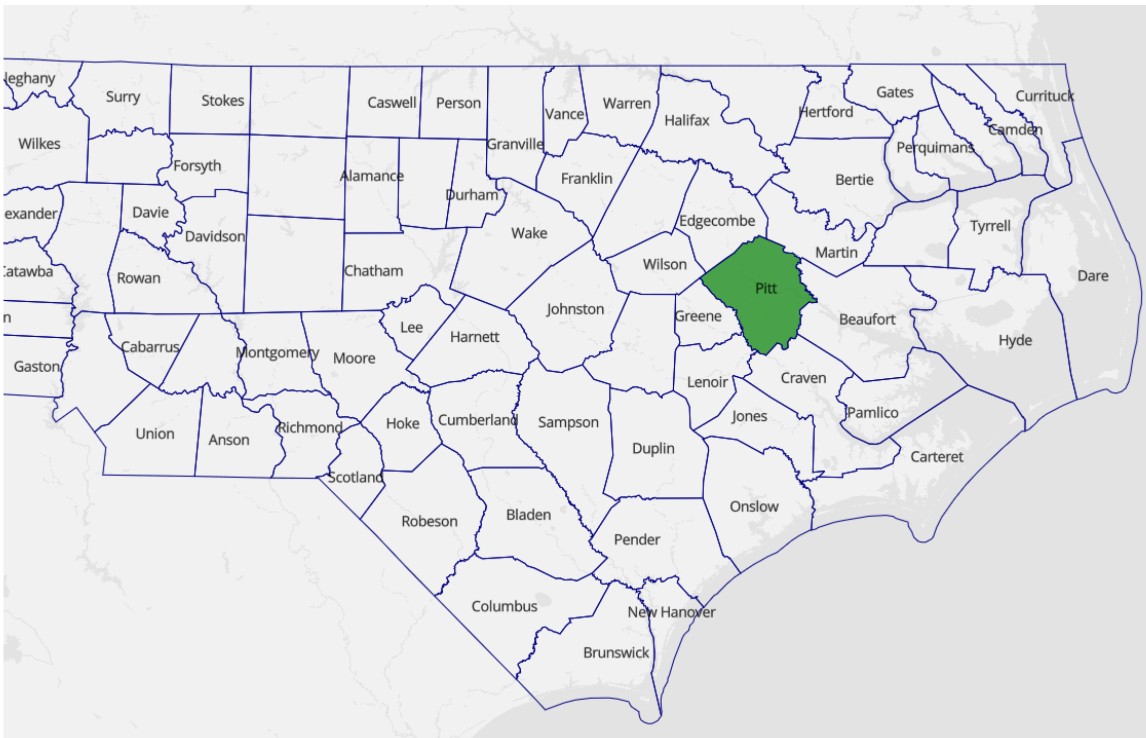
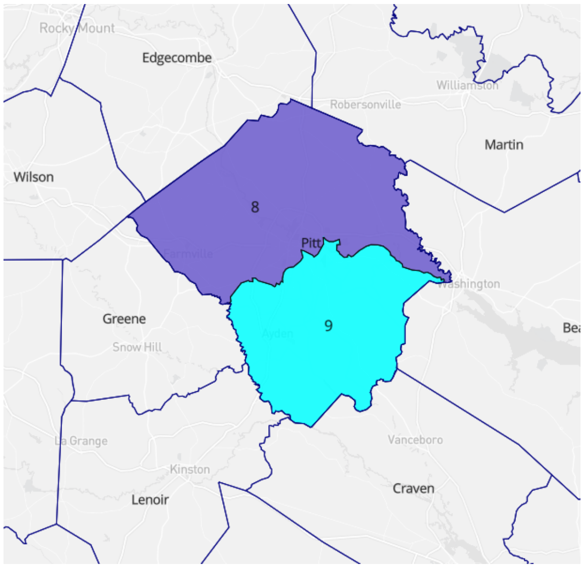
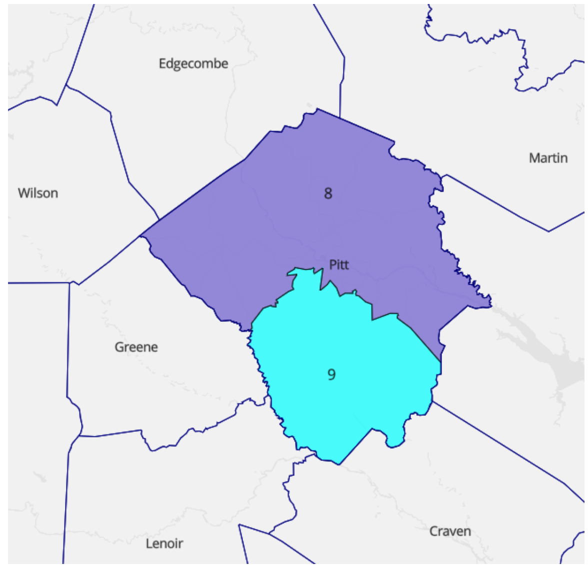


Figure 13: **Enacted Map and Duchin Map in Pitt House County Cluster**

(a) Enacted Map




(b) Duchin Map

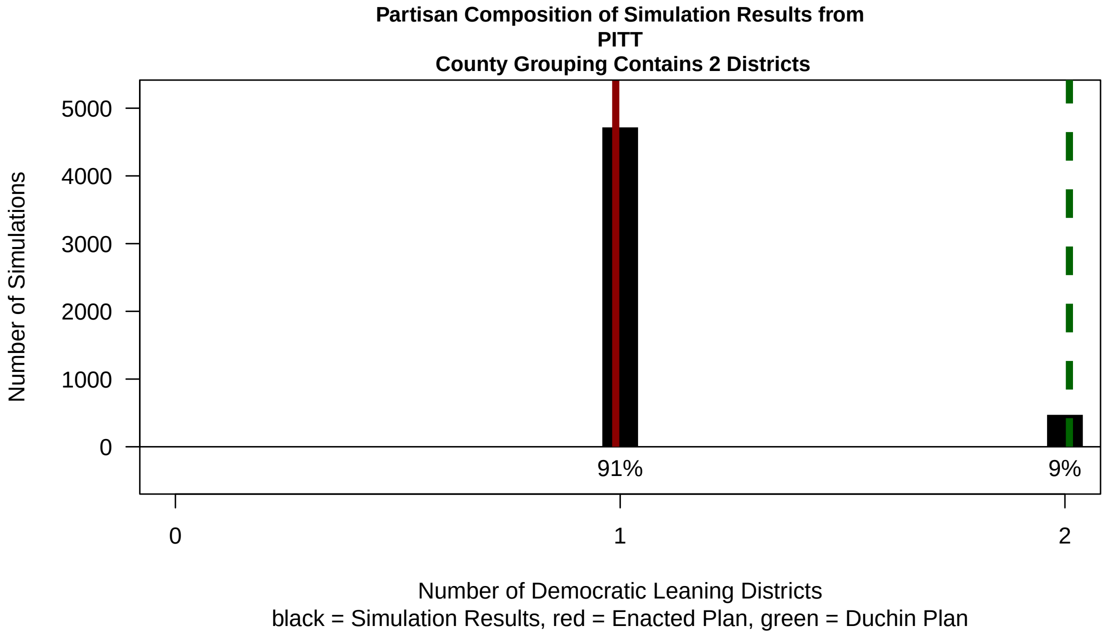



Partisan Lean of Districts

| 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**

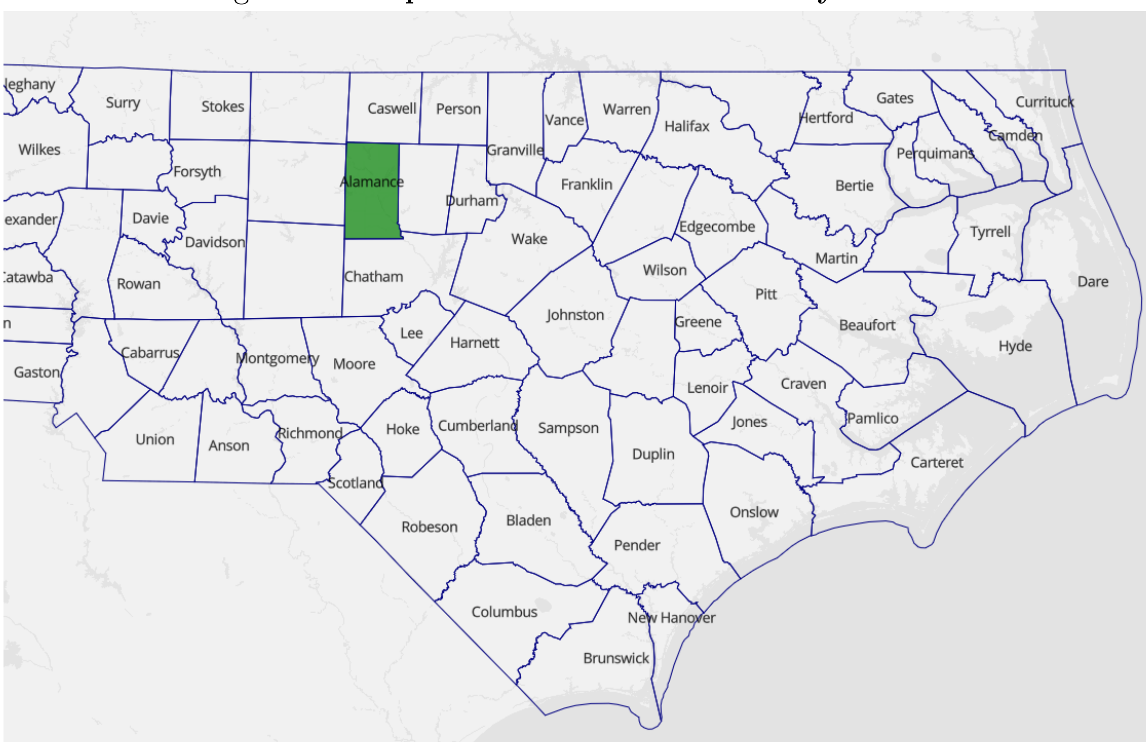
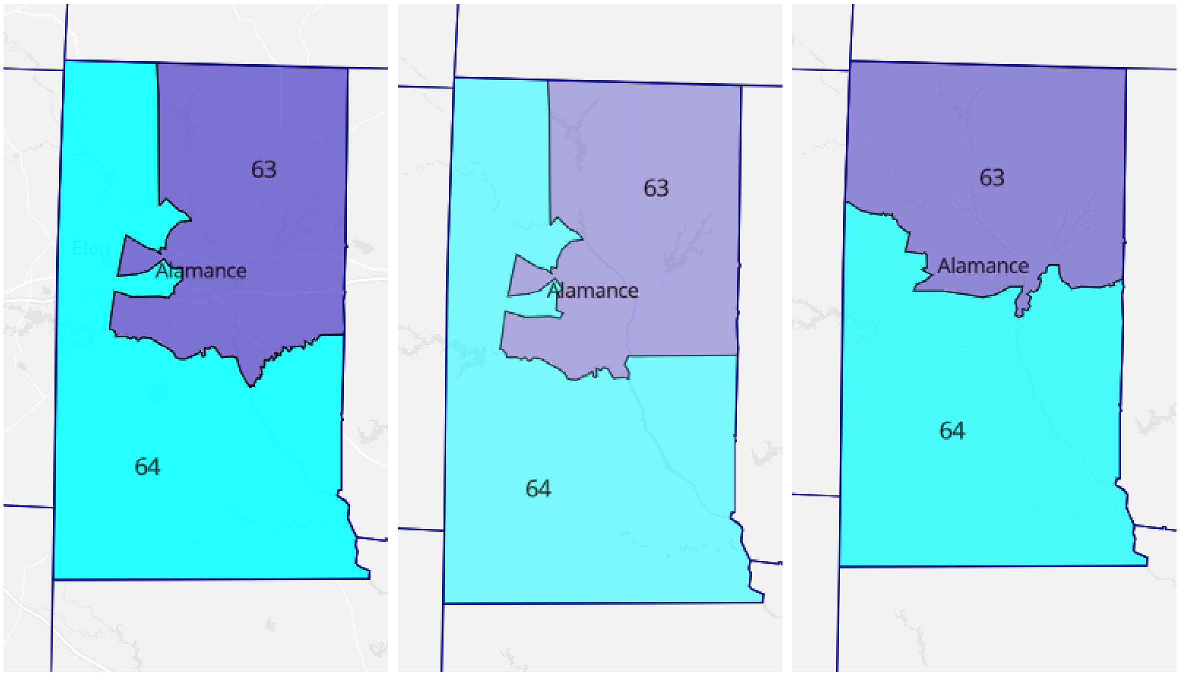


Figure 16: **Enacted Map, 2020 Map, and Duchin Map in Pitt House County Cluster**

(a) Enacted Map (b) 2020 Map (c) Duchin Map

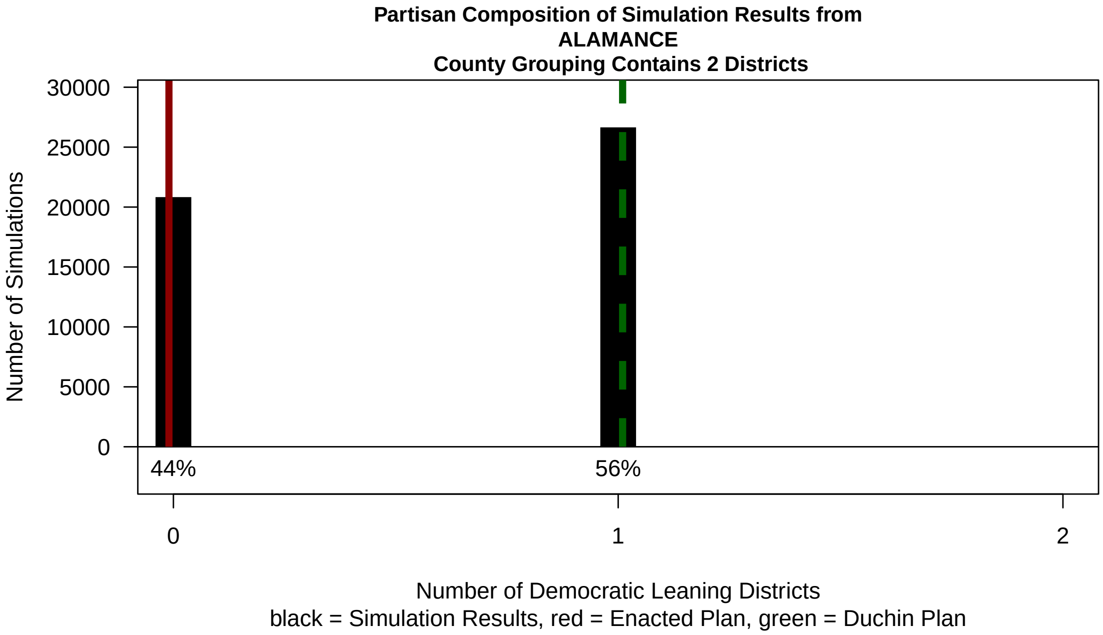



Partisan Lean of Districts

| 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**

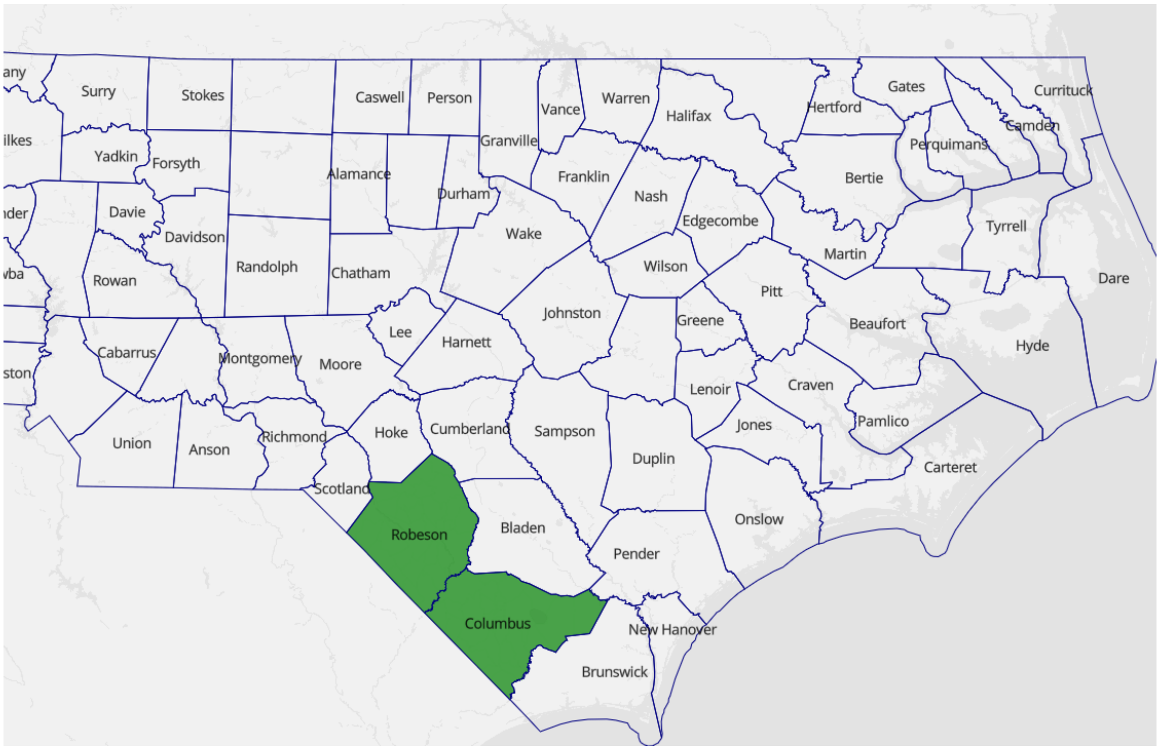
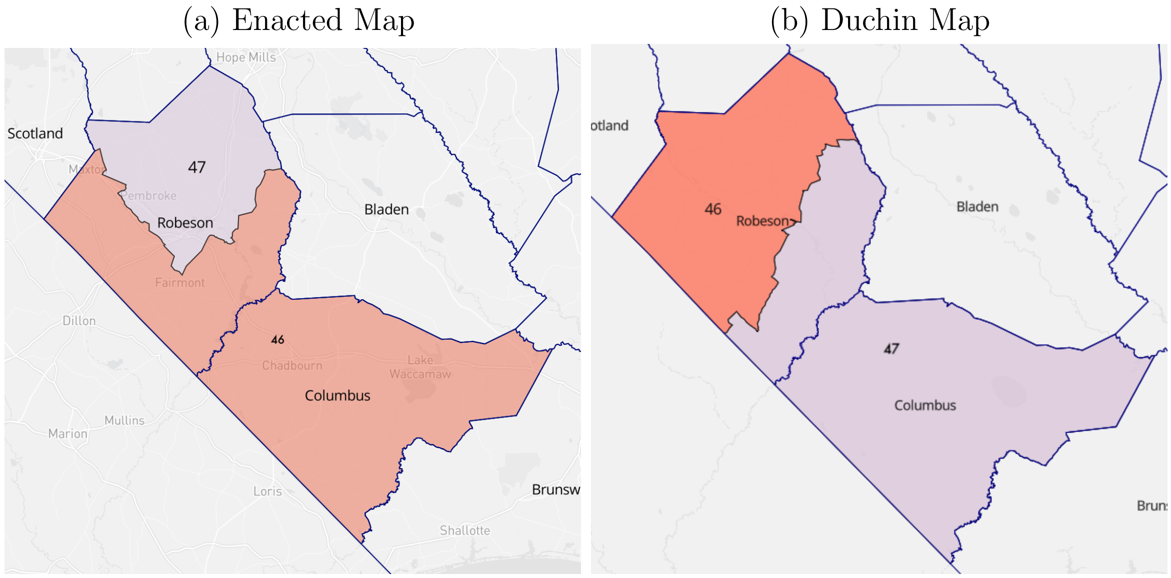


Figure 19: **Map of House Enacted Plan and Duchin Plan in Columbus and Robeson County Cluster**

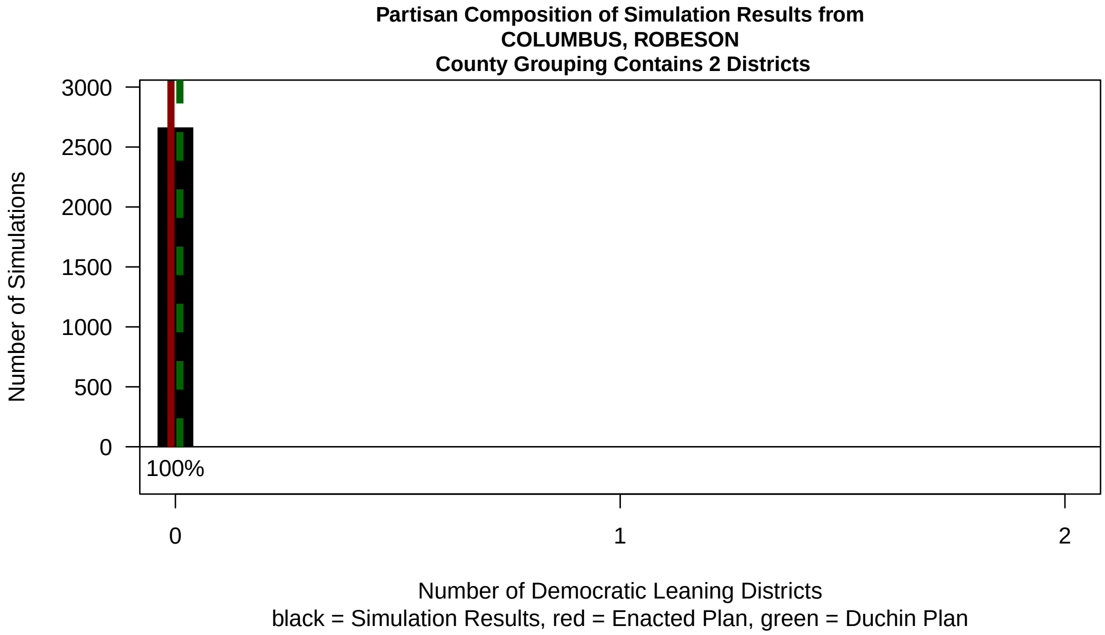



Partisan Lean of Districts

| 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**

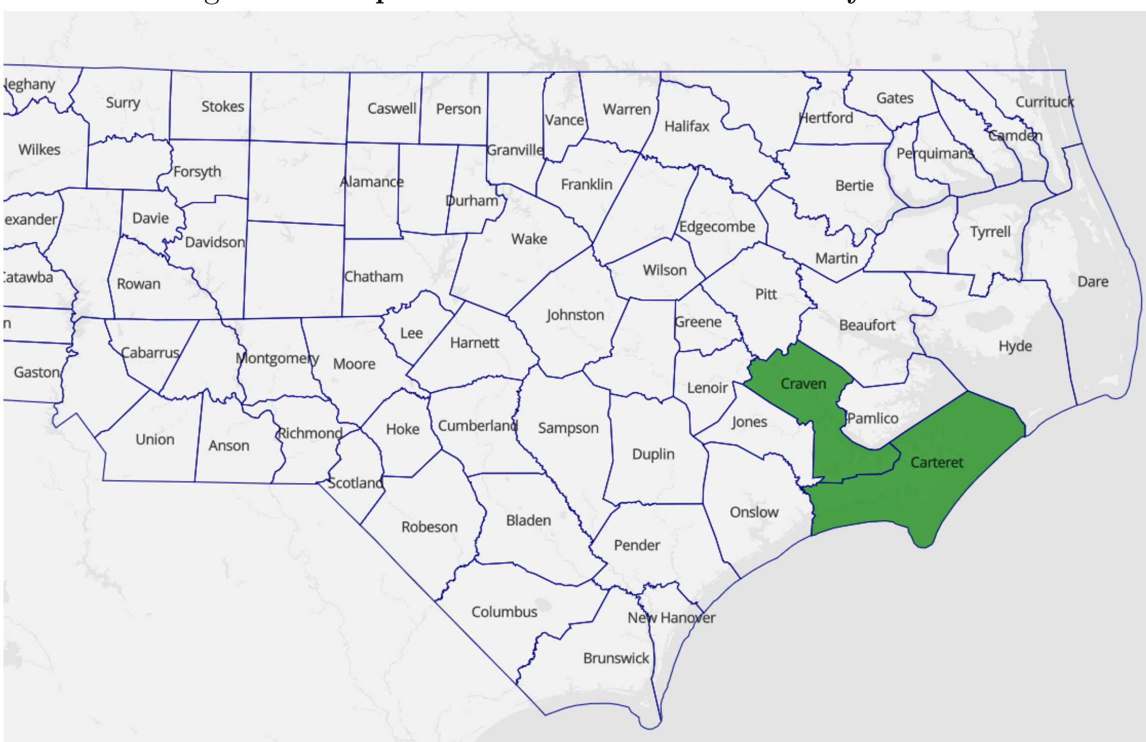
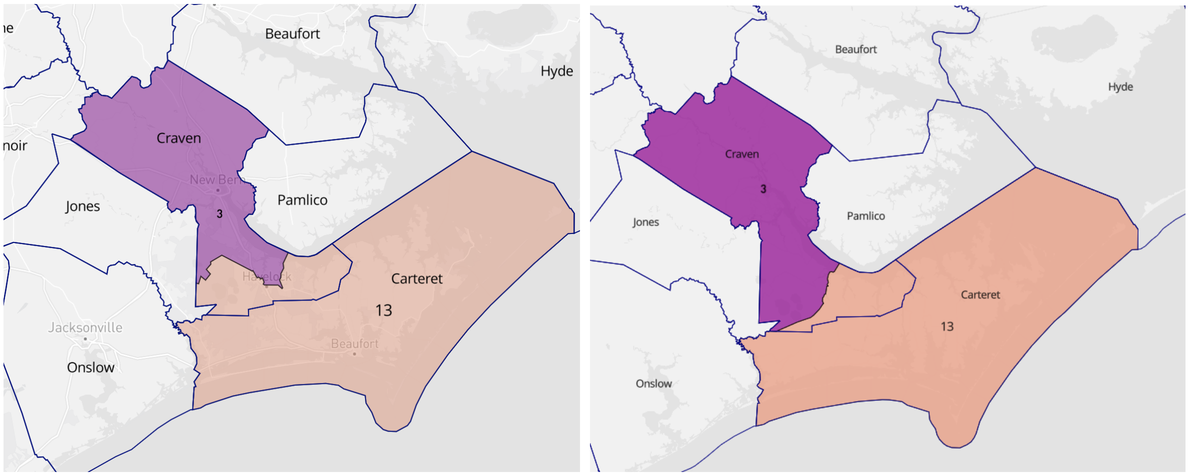


Figure 22: **Map of House Enacted Plan in Carteret and Craven County Cluster**

(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**

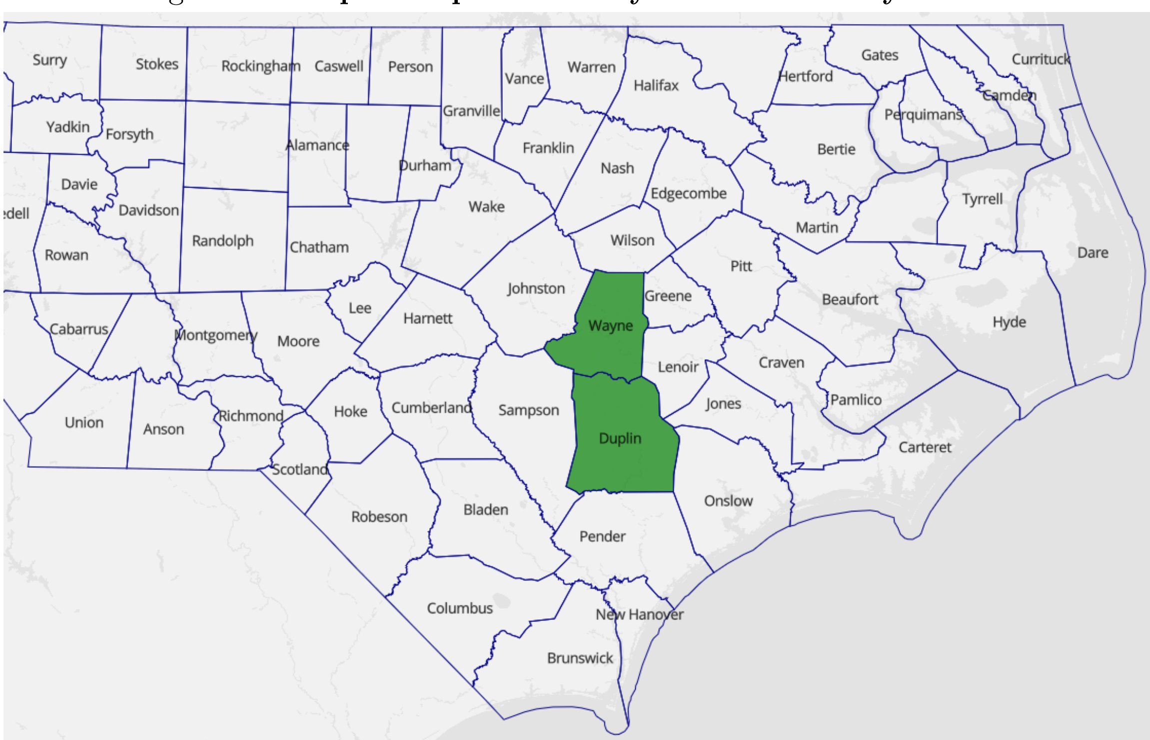
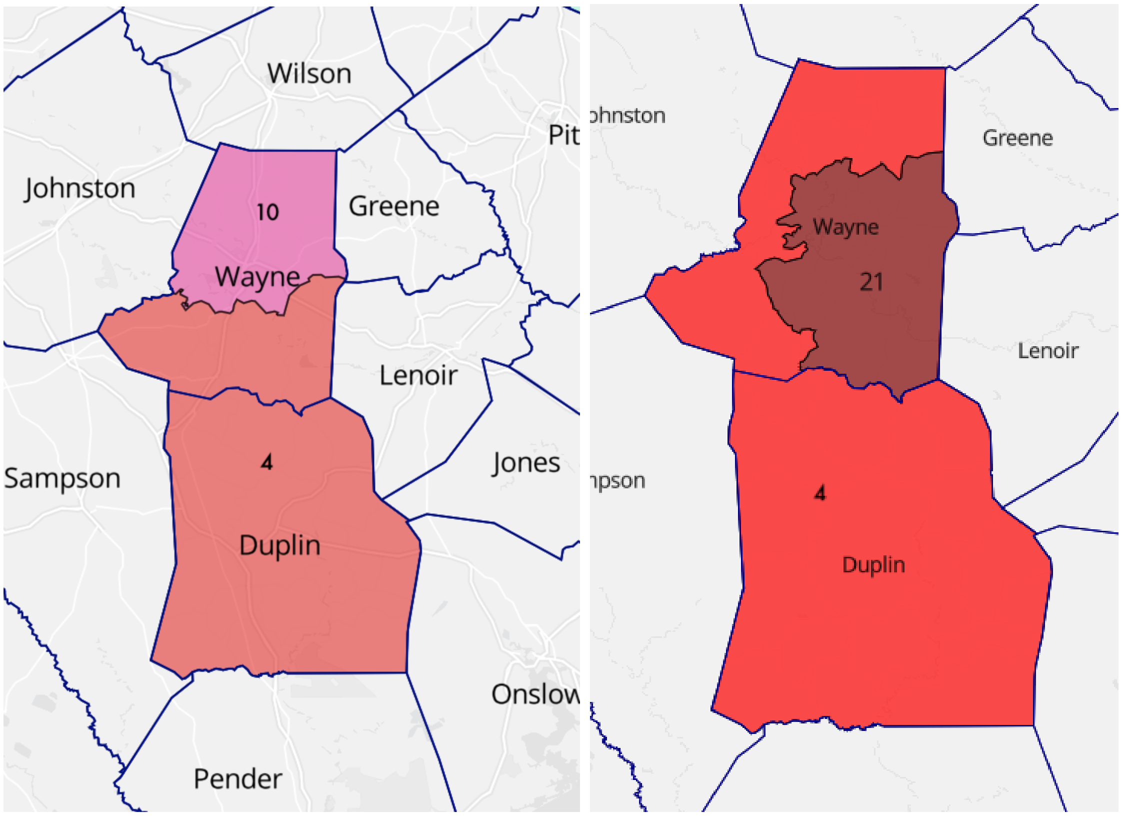


Figure 24: **Map of House Enacted Plan in Duplin and Wayne County Cluster**

(a) Enacted Map (b) Duchin Map

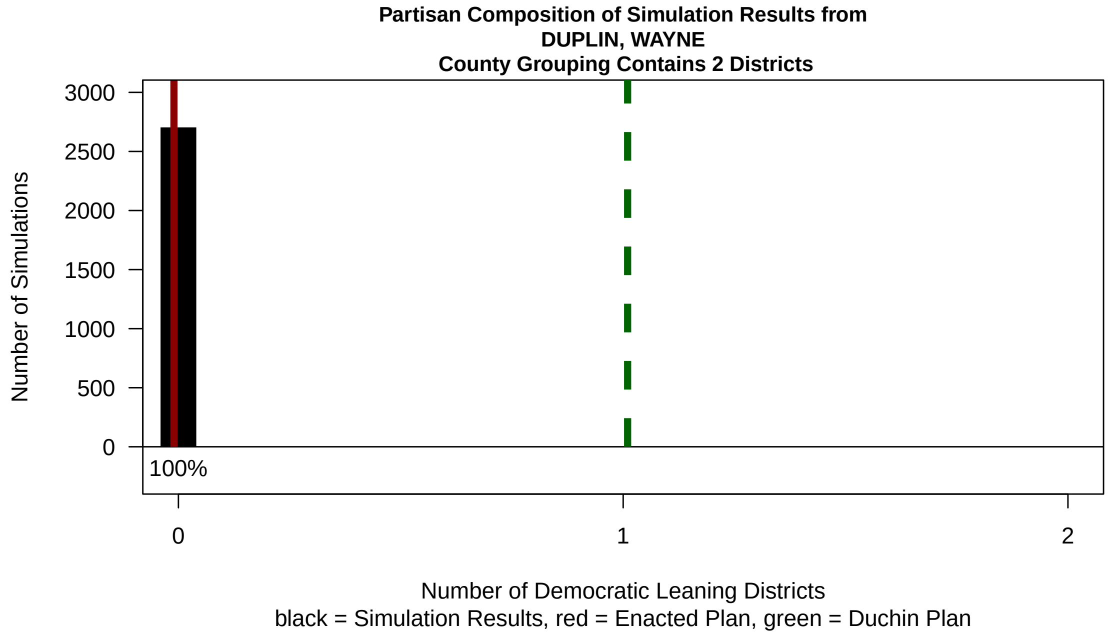



Partisan Lean of Districts

| 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**

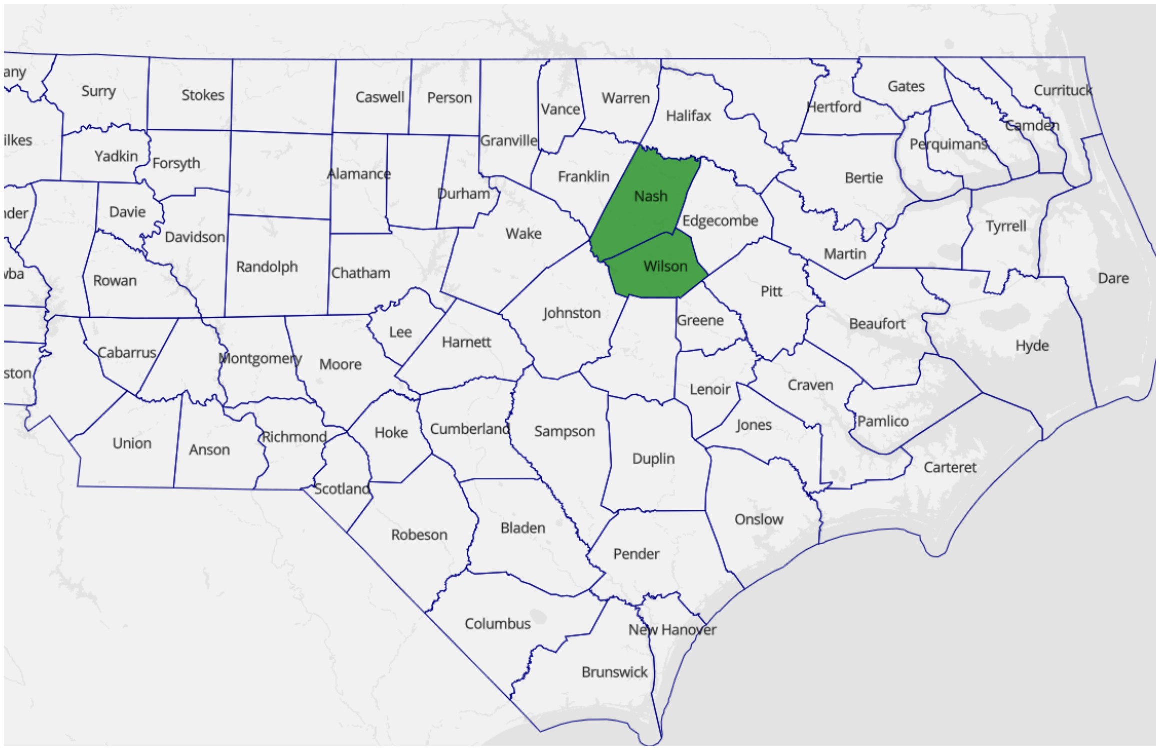
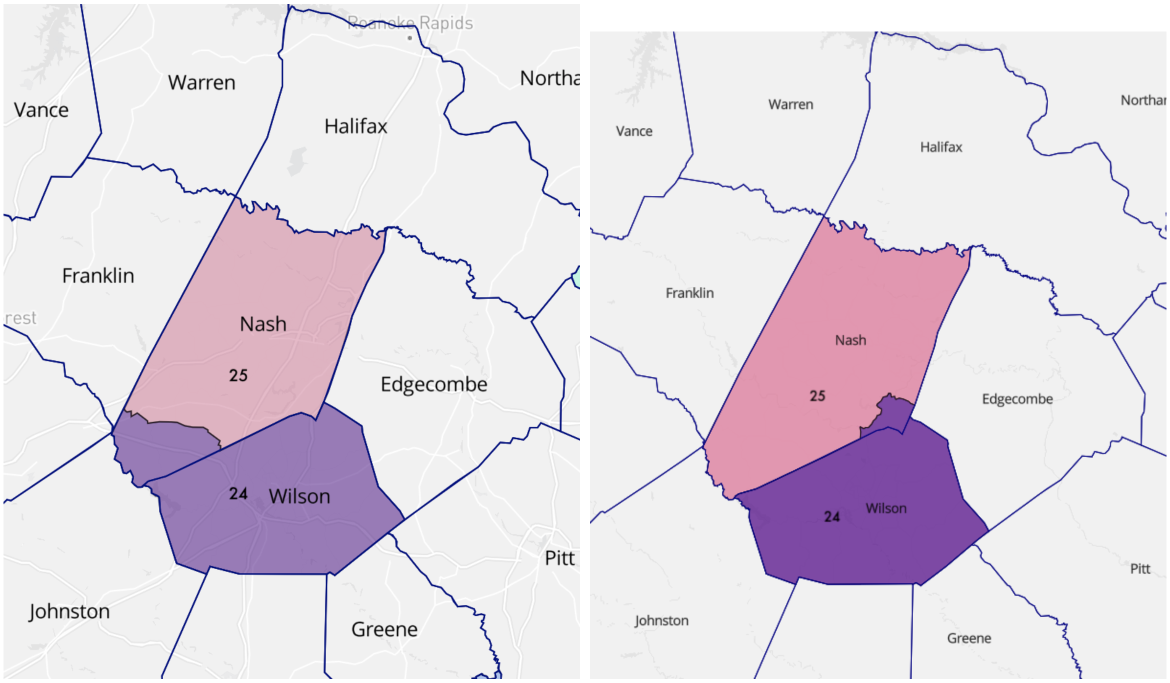


Figure 27: **Map of House Enacted Plan in Nash and Wilson County Cluster**

(a) Enacted Map (b) Duchin Map

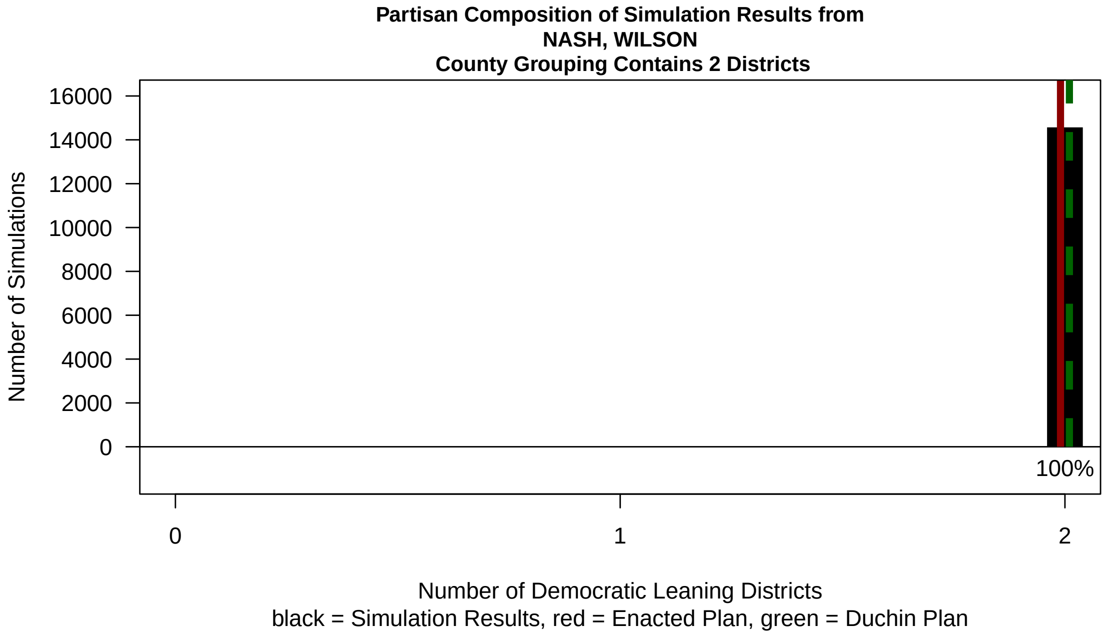



Partisan Lean of Districts

| 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.

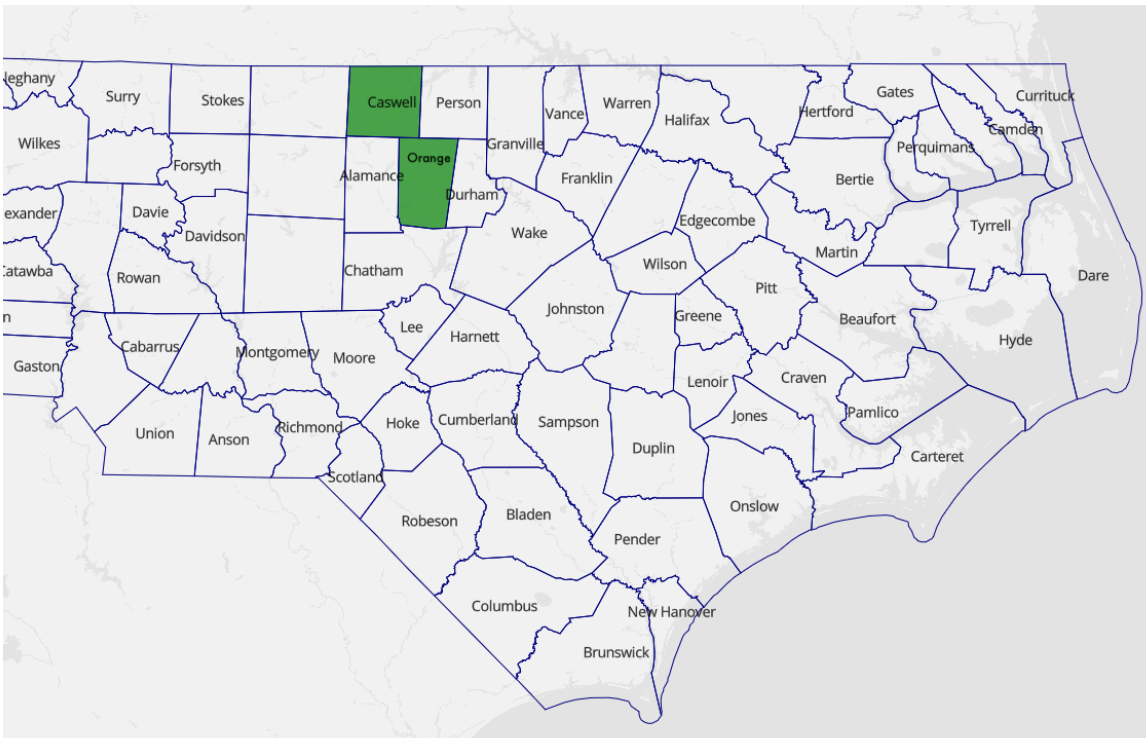
A map of the location of this county cluster in relation to the rest of the state is shown in Figure 29. A map of the Enacted Map's district boundaries and the Duchin Map's district boundaries within this county grouping are shown in Figure 30.

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

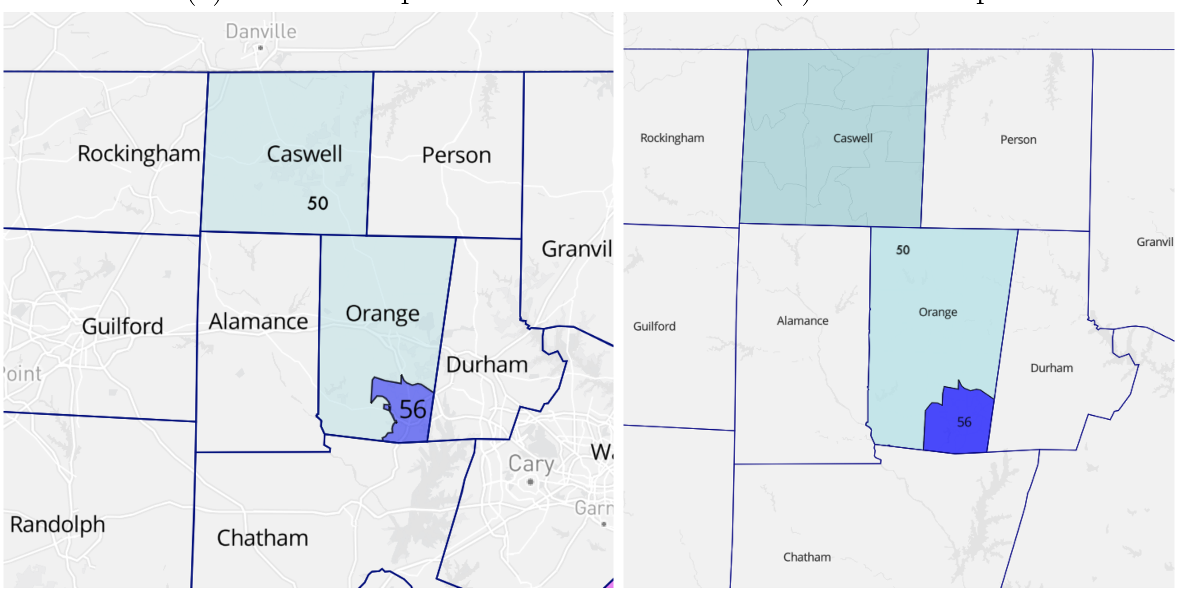
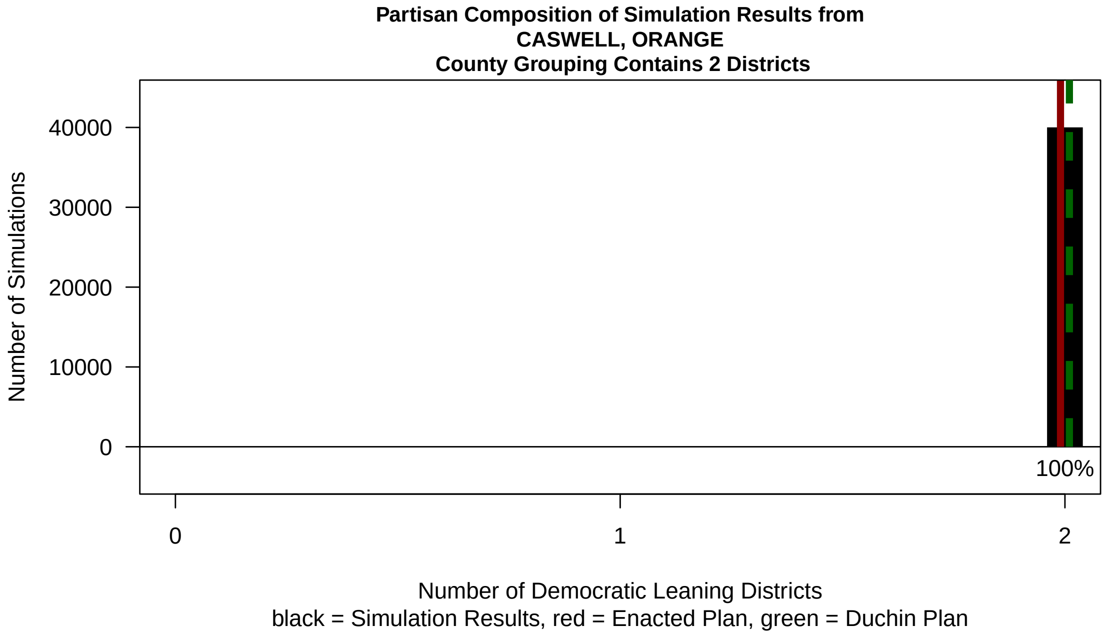


Figure 31: **Distribution of Partisan Districts from Simulations in Caswell and Orange House County Cluster**




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**

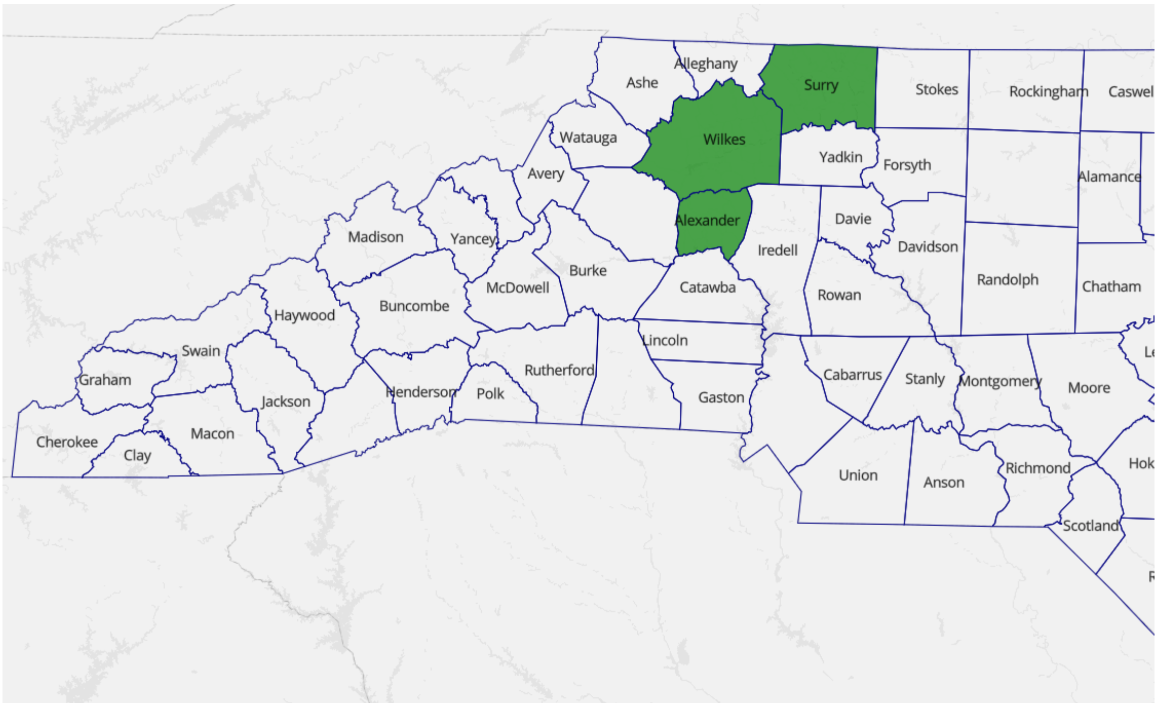
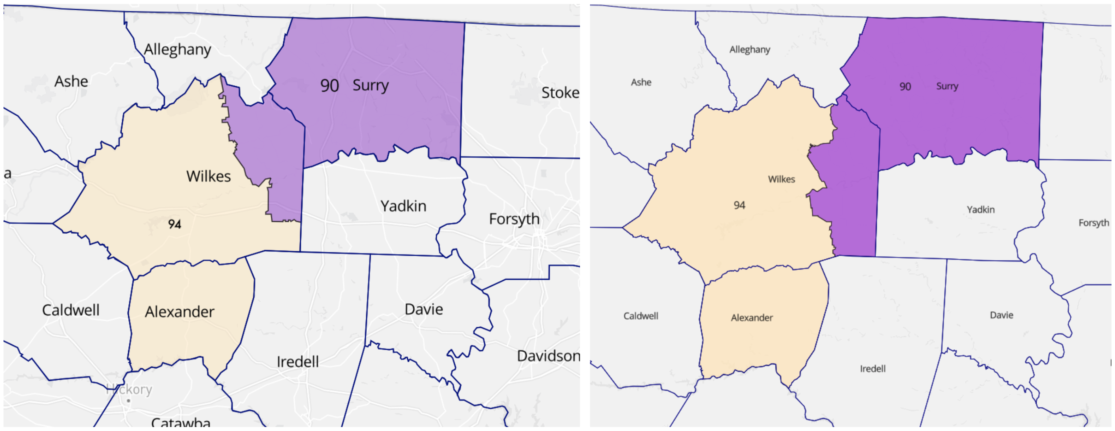


Figure 33: **Map of House Enacted Plan in Alexander, Surry, and Wilkes County Cluster**

(a) Enacted Map (b) Duchin Map

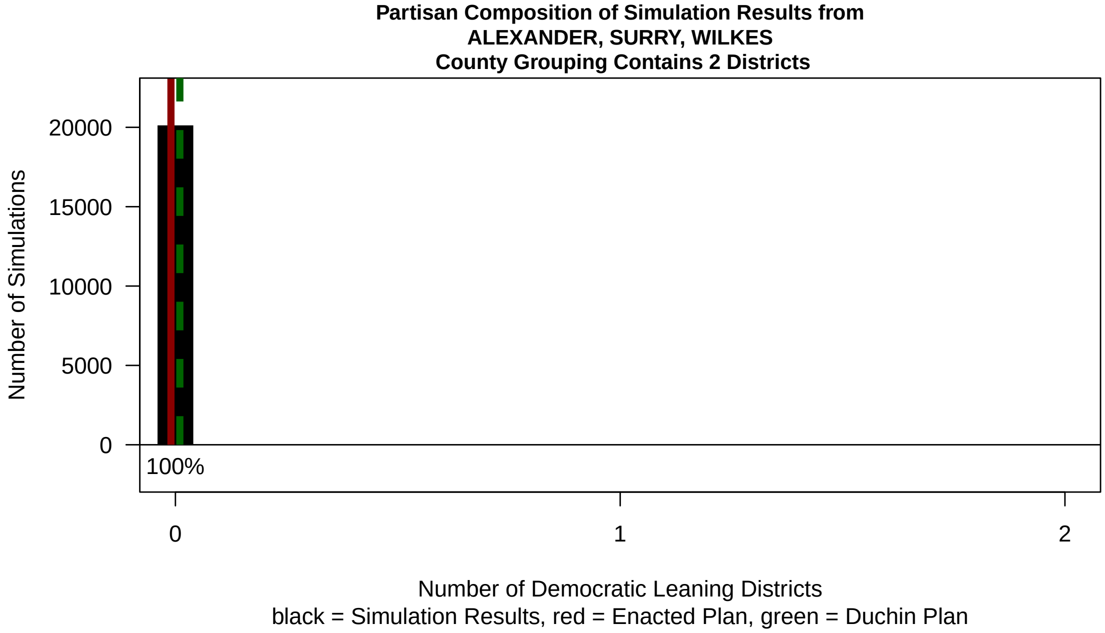



Partisan Lean of Districts

| 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**

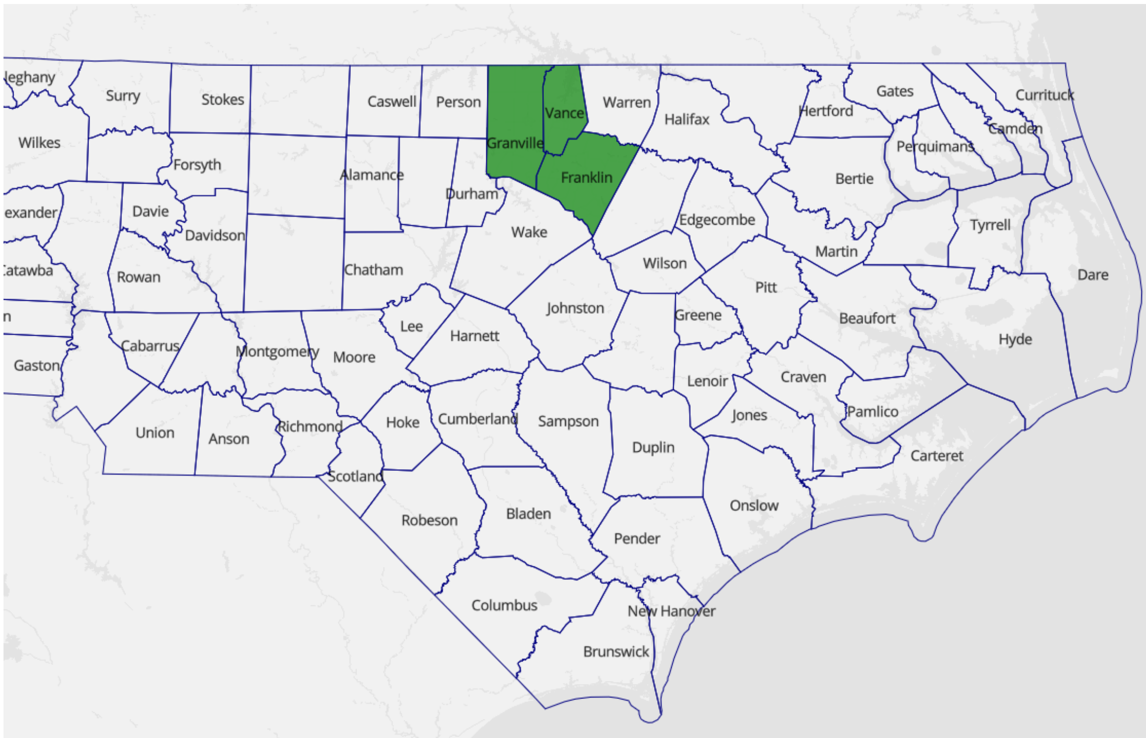
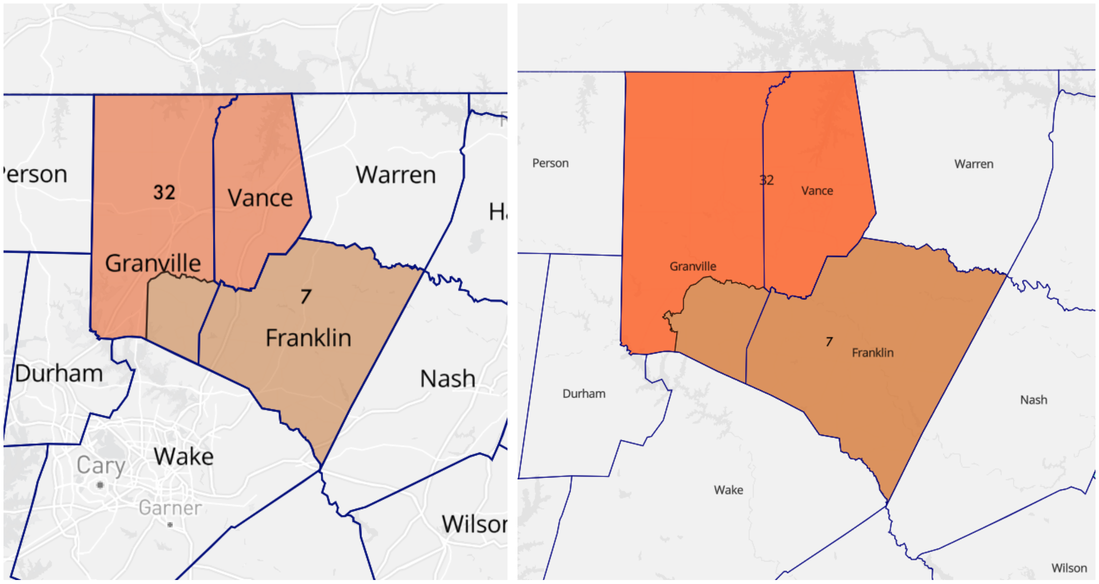


Figure 36: **Map of House Enacted Plan in Franklin, Granville, and Vance County Cluster**

(a) Enacted Map (b) Duchin Map

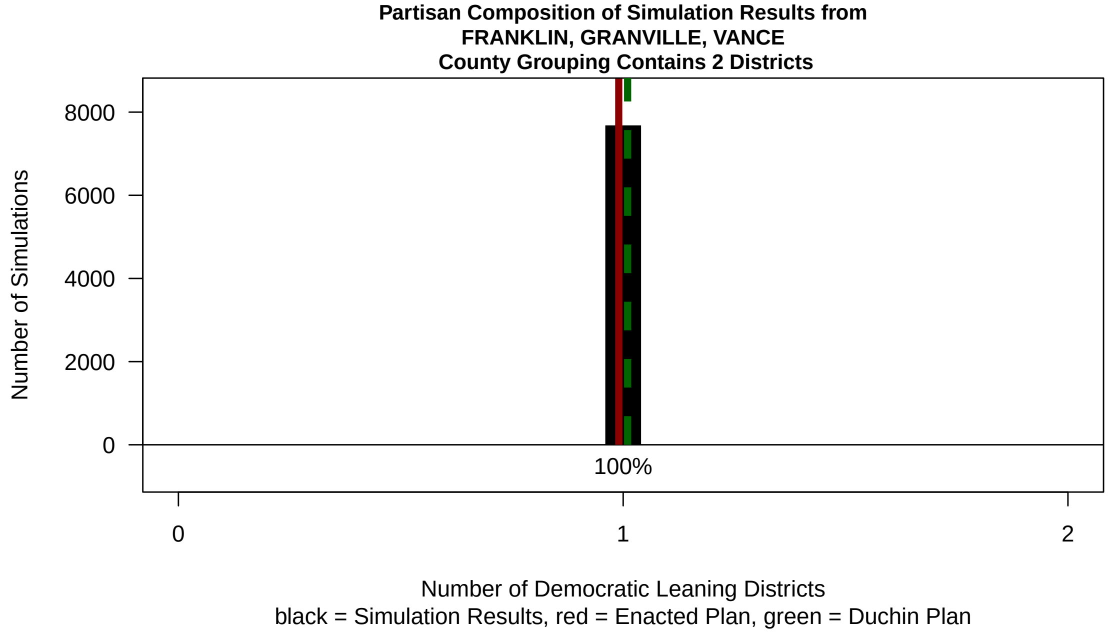



Partisan Lean of Districts

| 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**

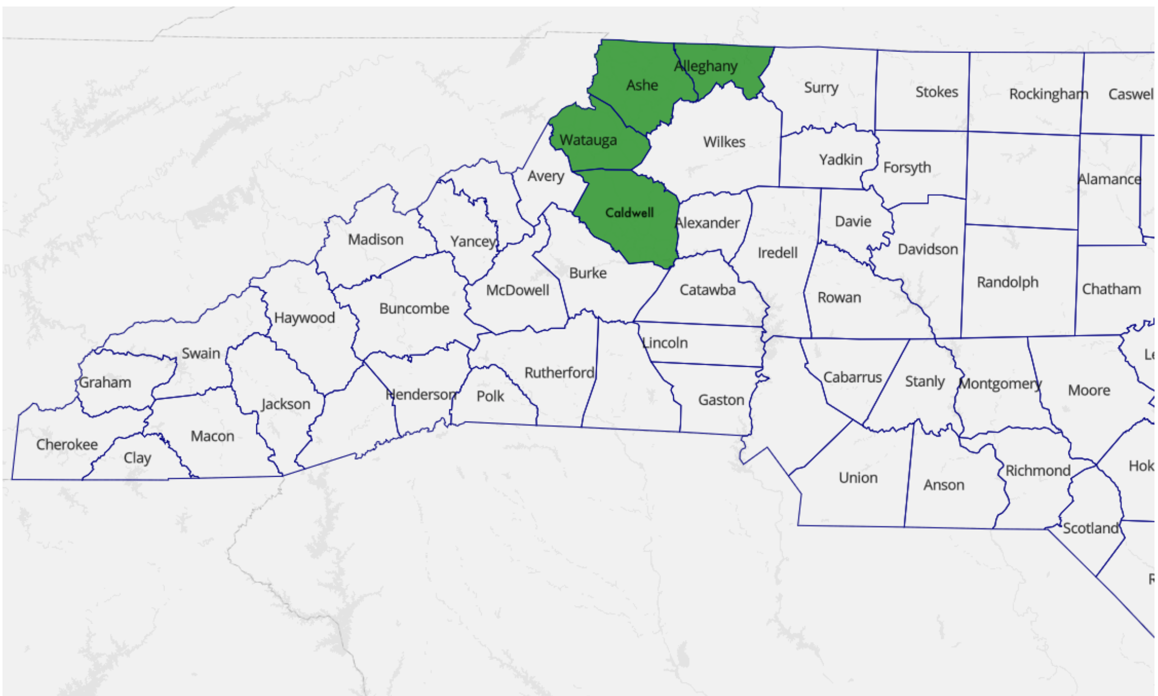
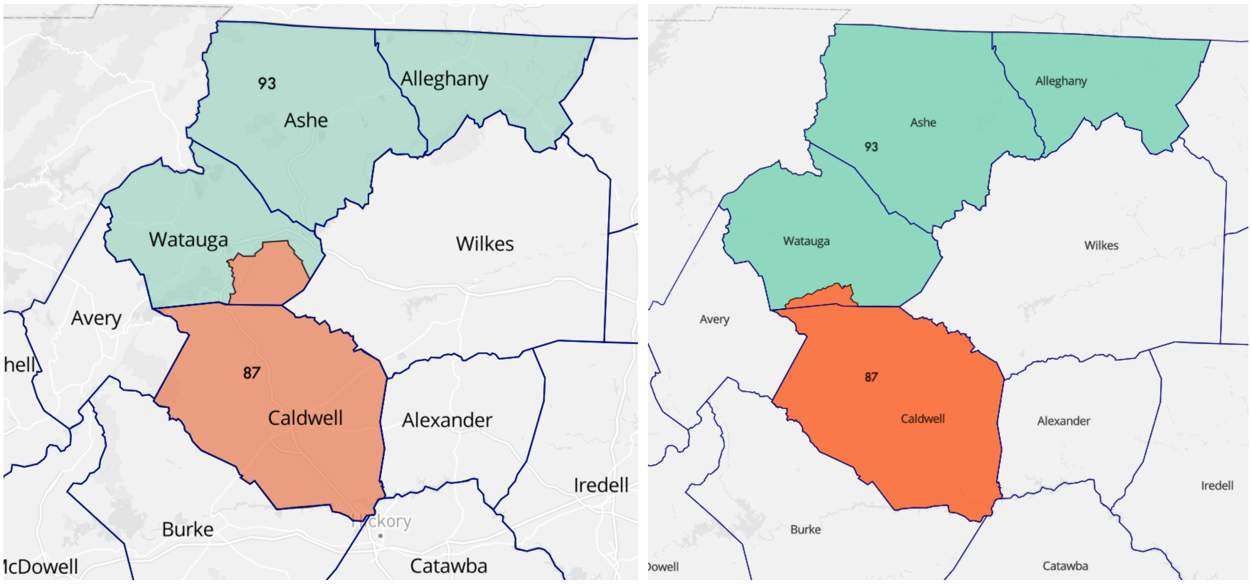


Figure 39: **Map of House Enacted Plan inAlleghany, Ashe, Caldwell, and Watauga County Cluster**

(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**

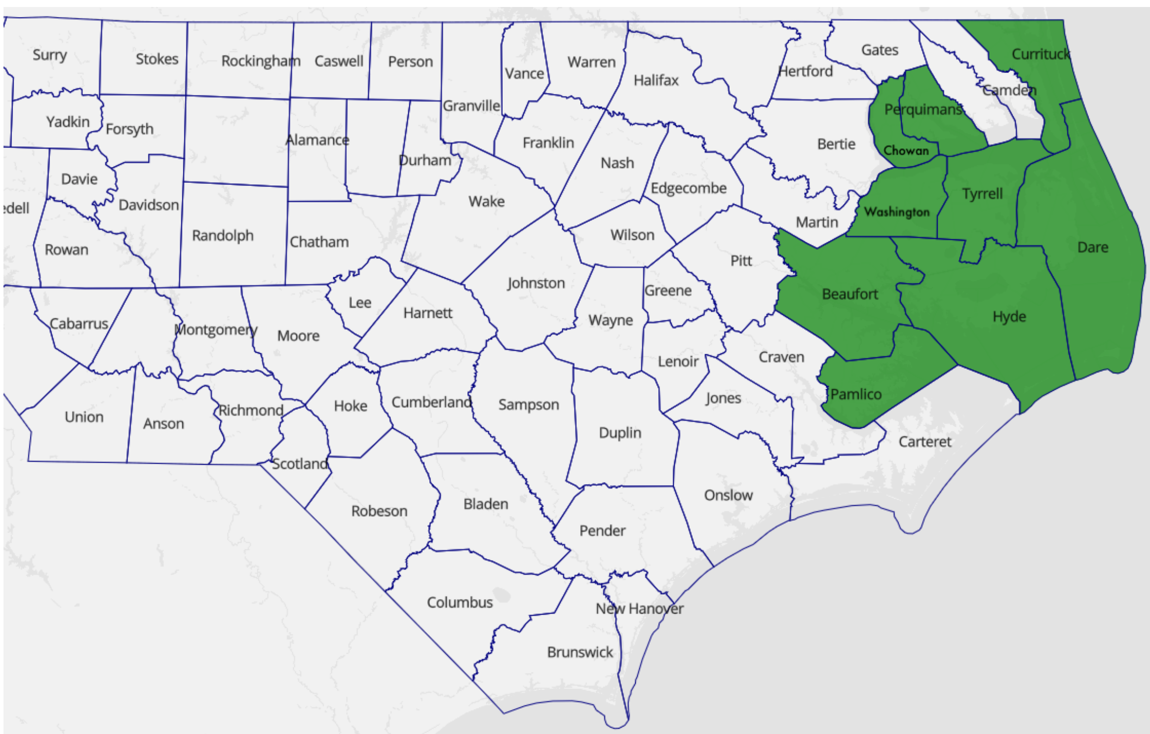
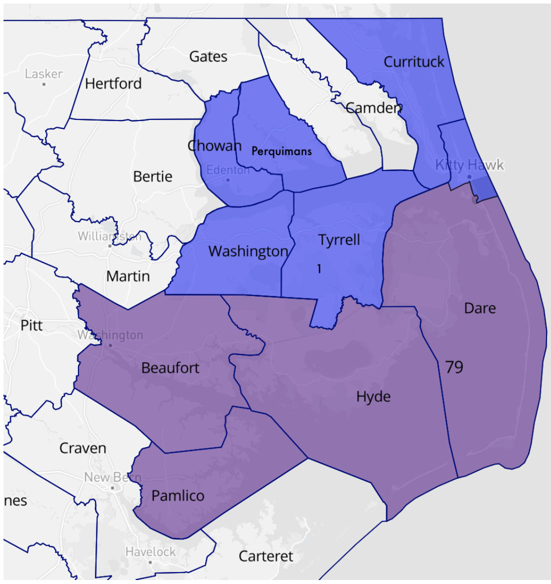
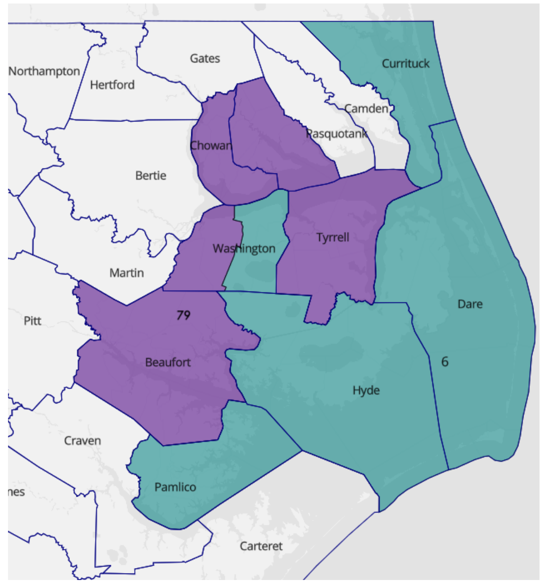


Figure 41: **Map of House Enacted Plan in Beaufort, Chowan, Currituck, Dare, Hyde, Pamlico, Perquimans, Tyrrell, and Washington County Cluster**

(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**

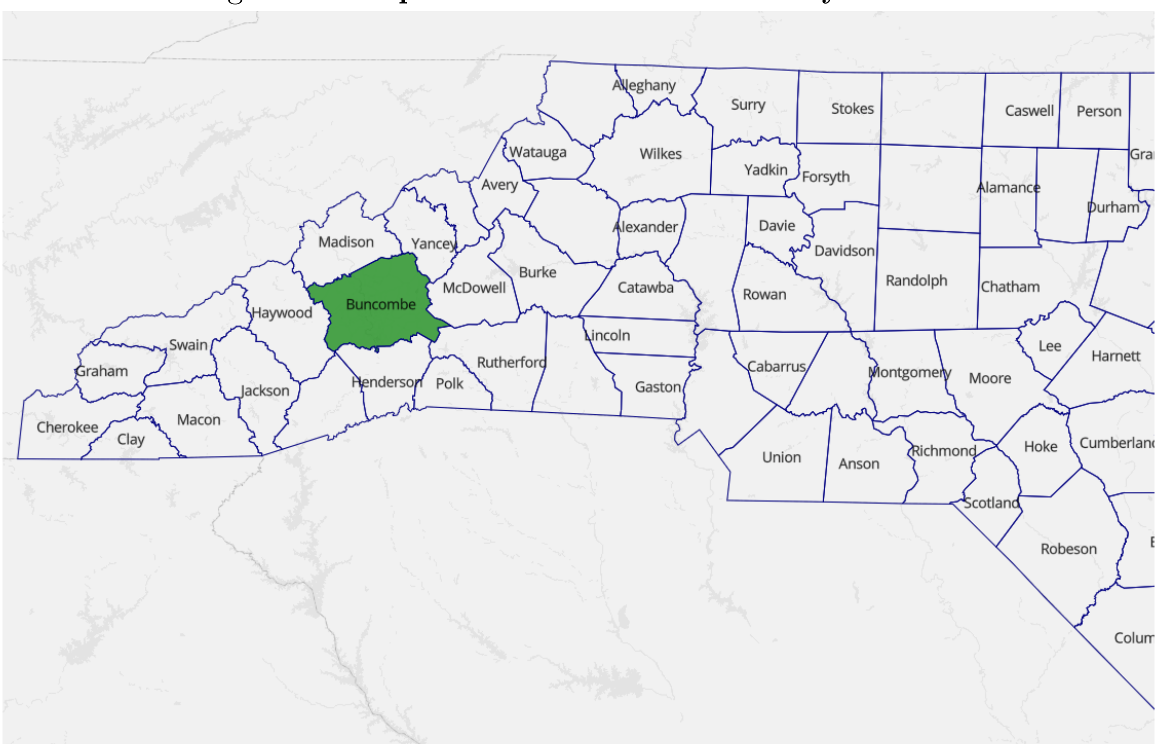
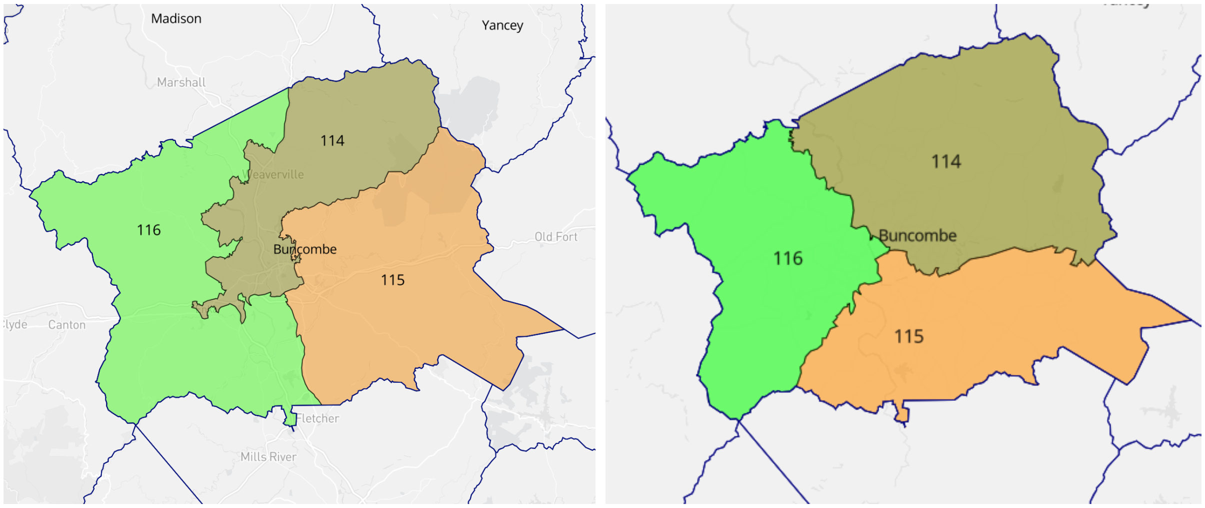


Figure 43: **Map of House Enacted Plan and Duchin Plan in Buncombe County Cluster**

(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

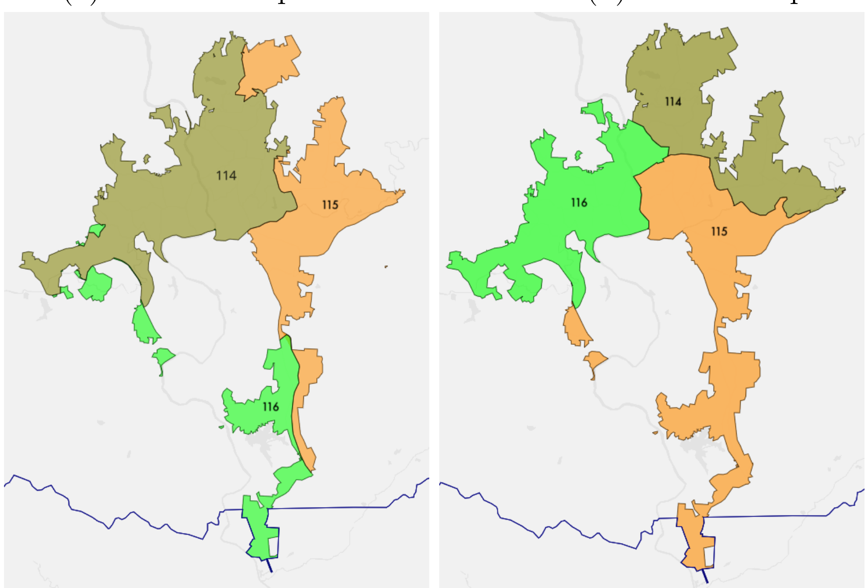
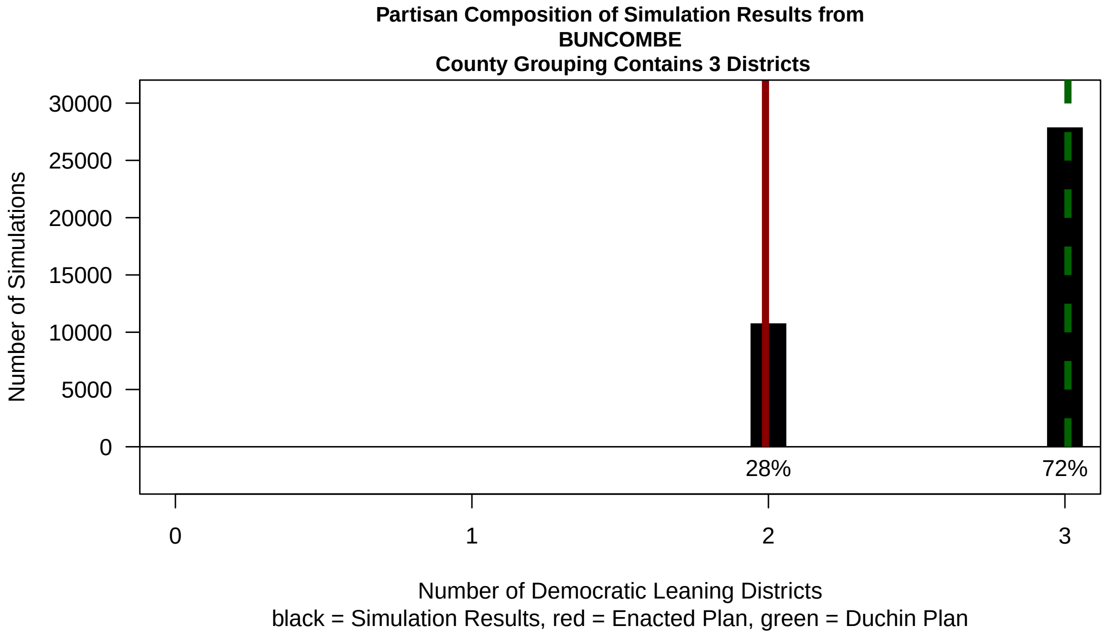


Figure 45: **Distribution of Partisan Districts from Simulations in Buncombe House County Cluster**




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**

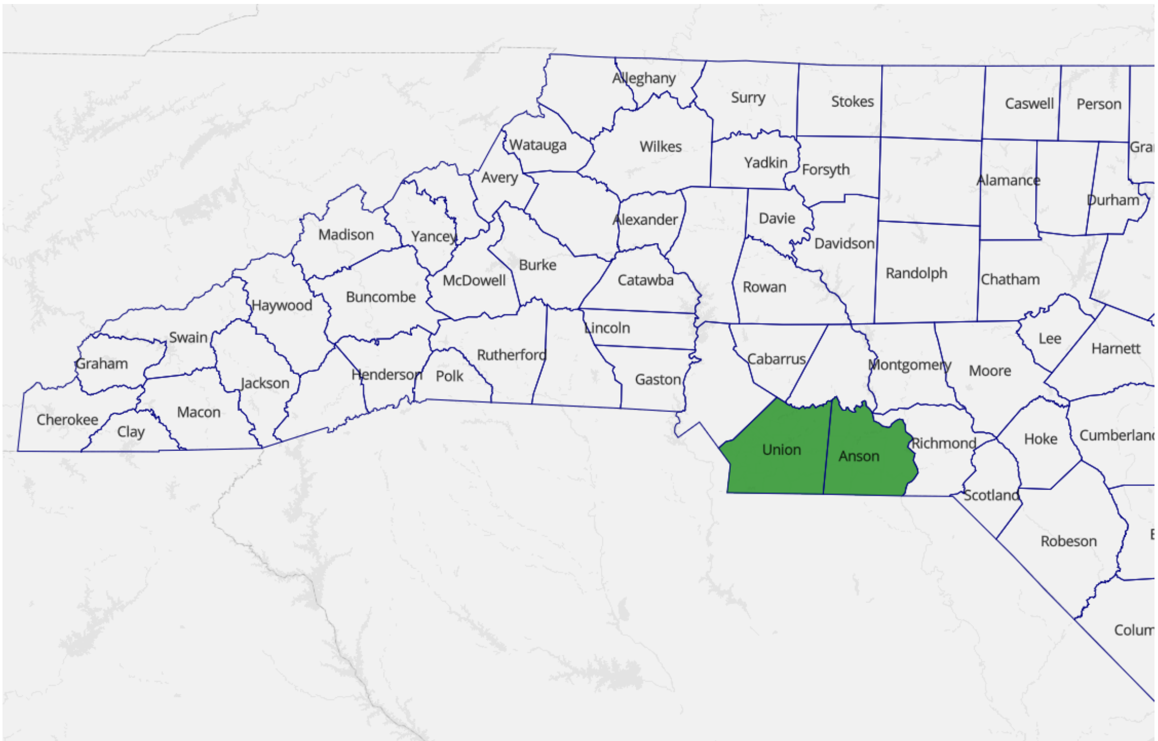
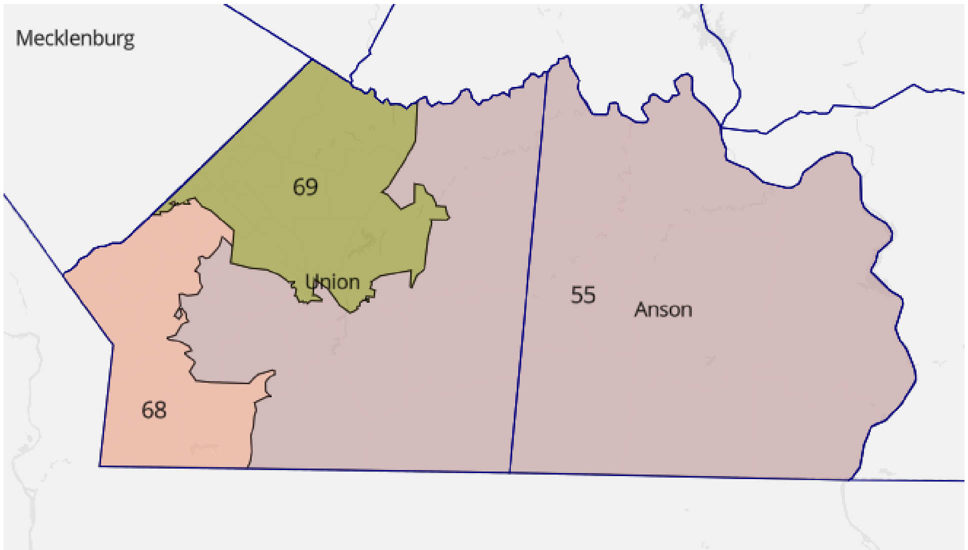
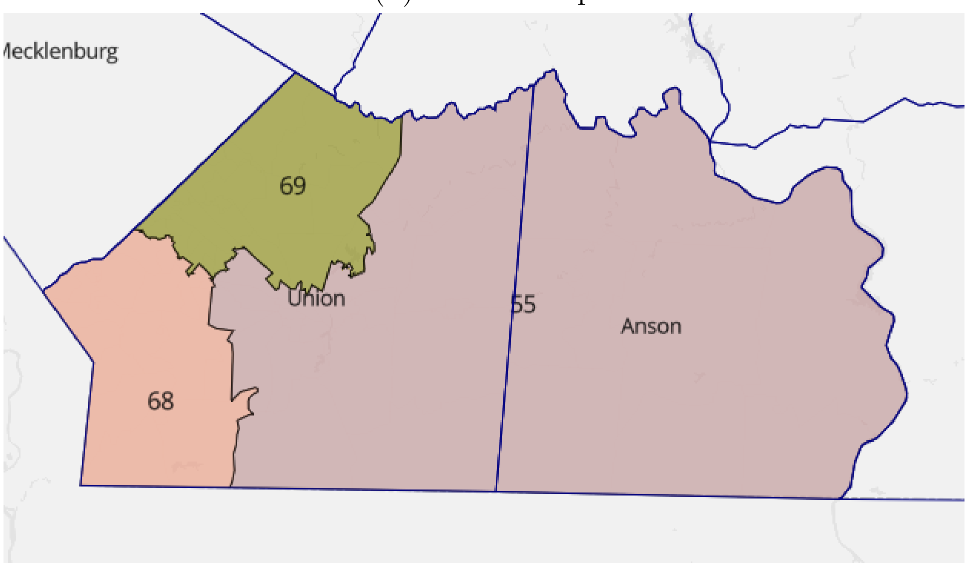


Figure 47: **Map of House Enacted Plan in Anson and Union House County Cluster**

(a) Enacted Map




(b) Duchin Map

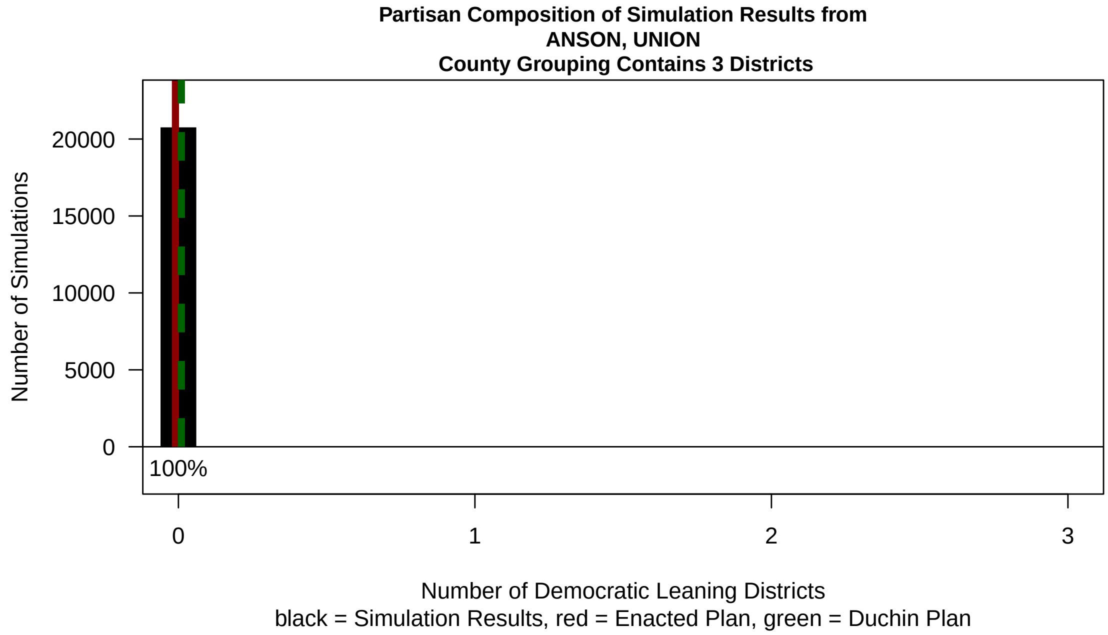


Partisan Lean of Districts

| 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**

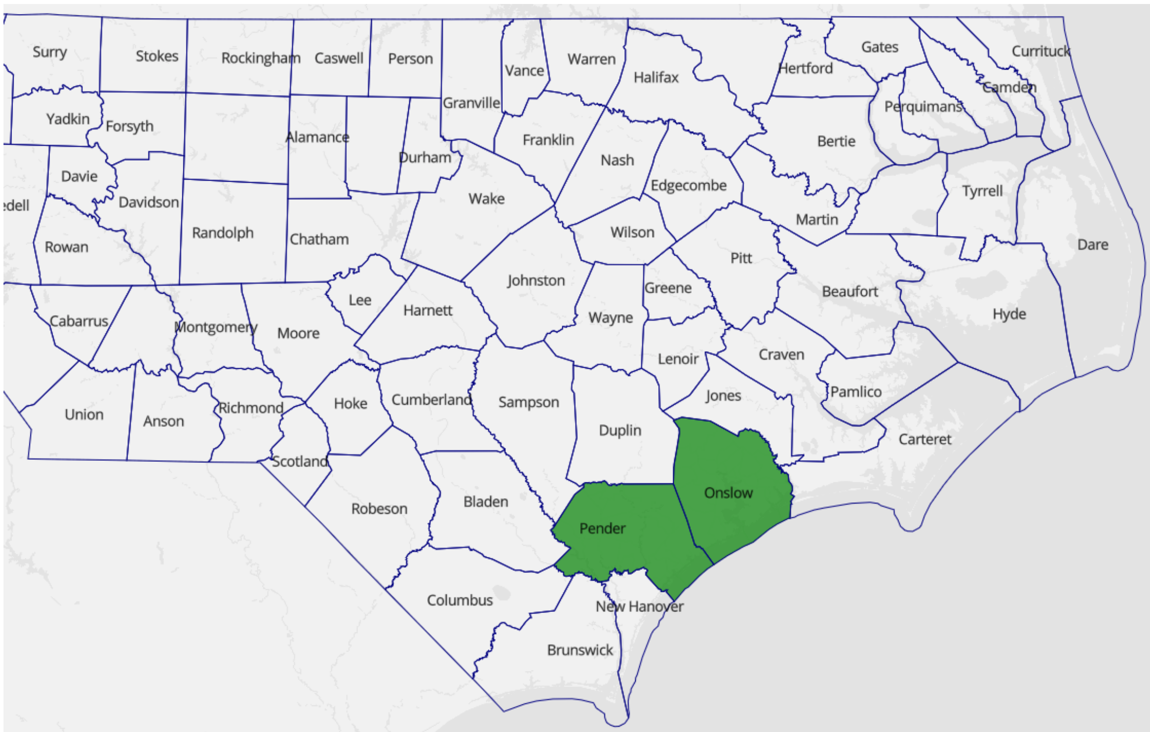
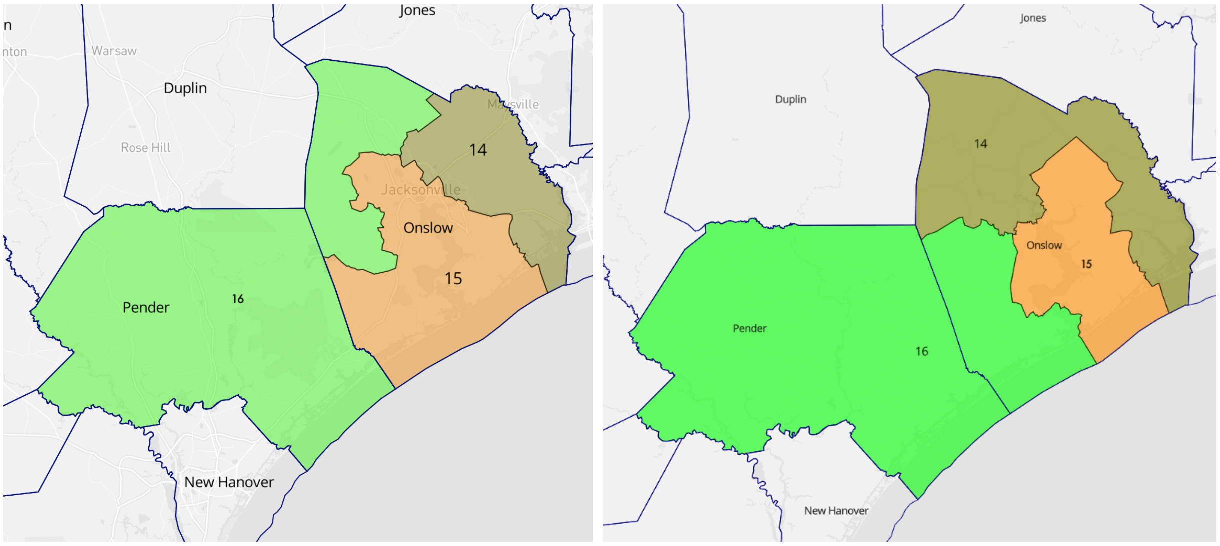


Figure 50: **Map of House Enacted Plan in Onslow and Pender County Cluster**

(a) Enacted Map (b) Duchin Map

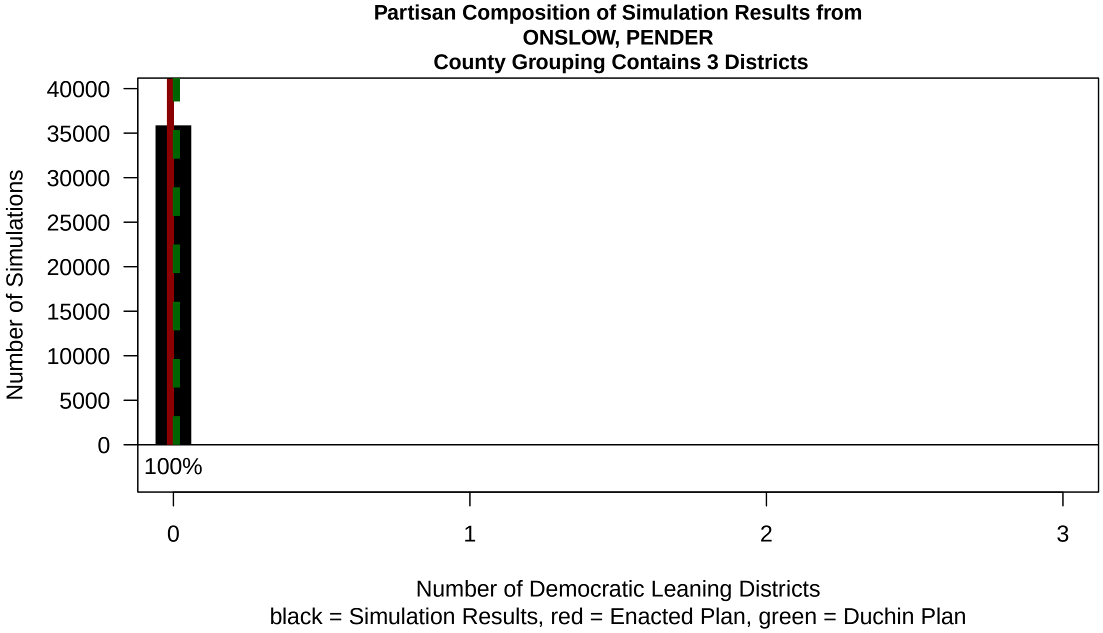



Partisan Lean of Districts

| 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**

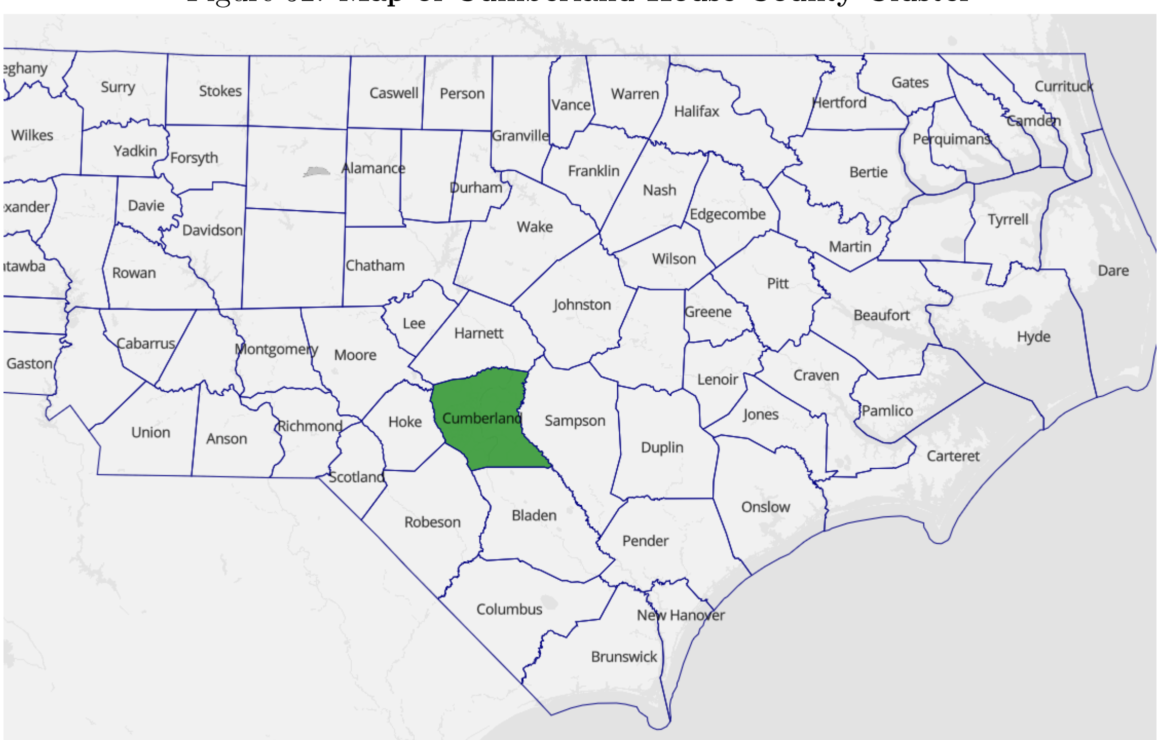
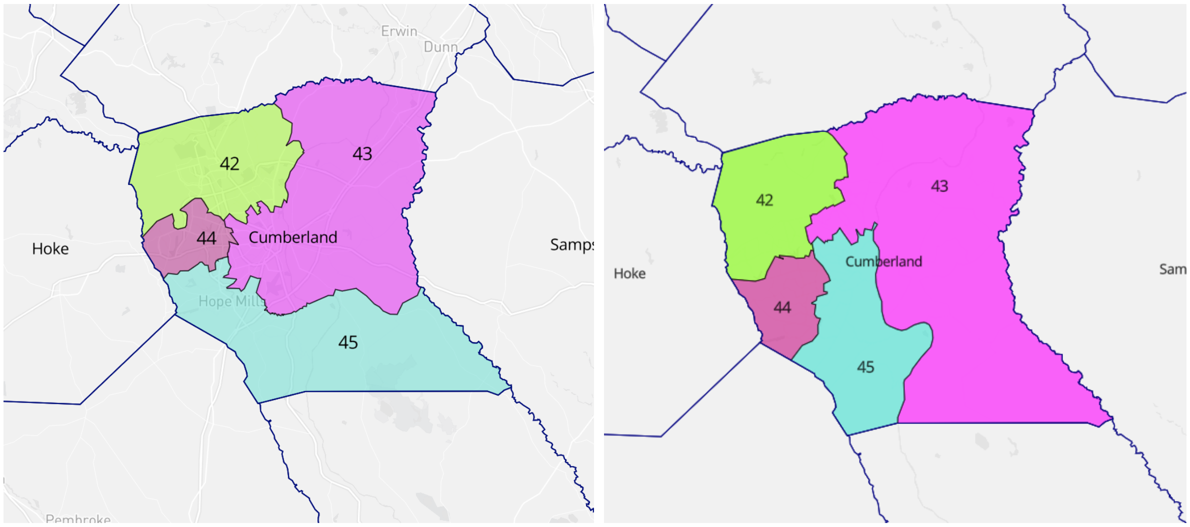


Figure 53: **Map of House Enacted Plan in Cumberland County Cluster**

(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

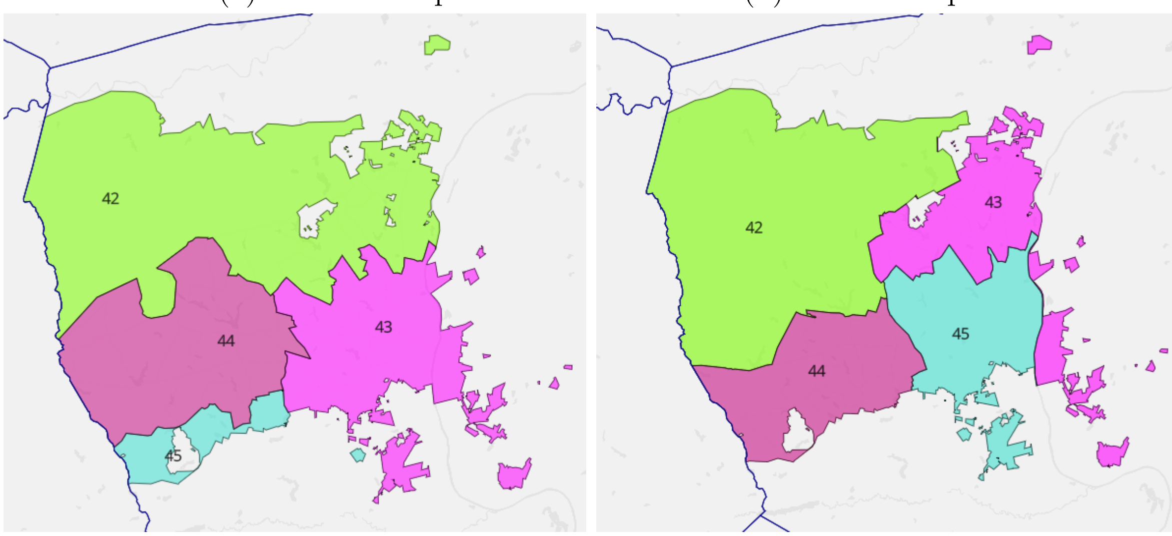
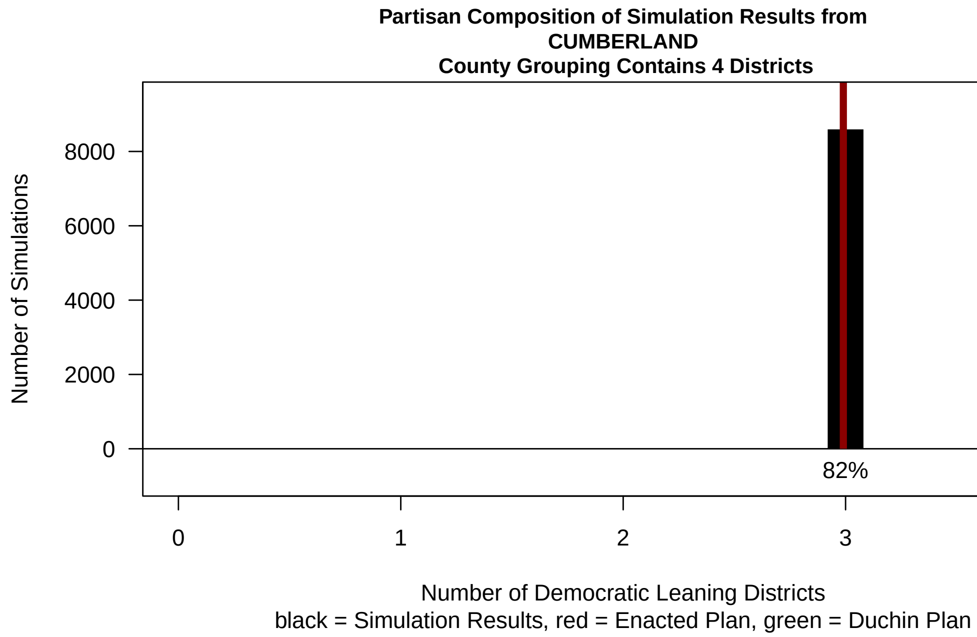


Figure 55: **Distribution of Partisan Districts from Simulations in Cumberland House County Cluster**




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**

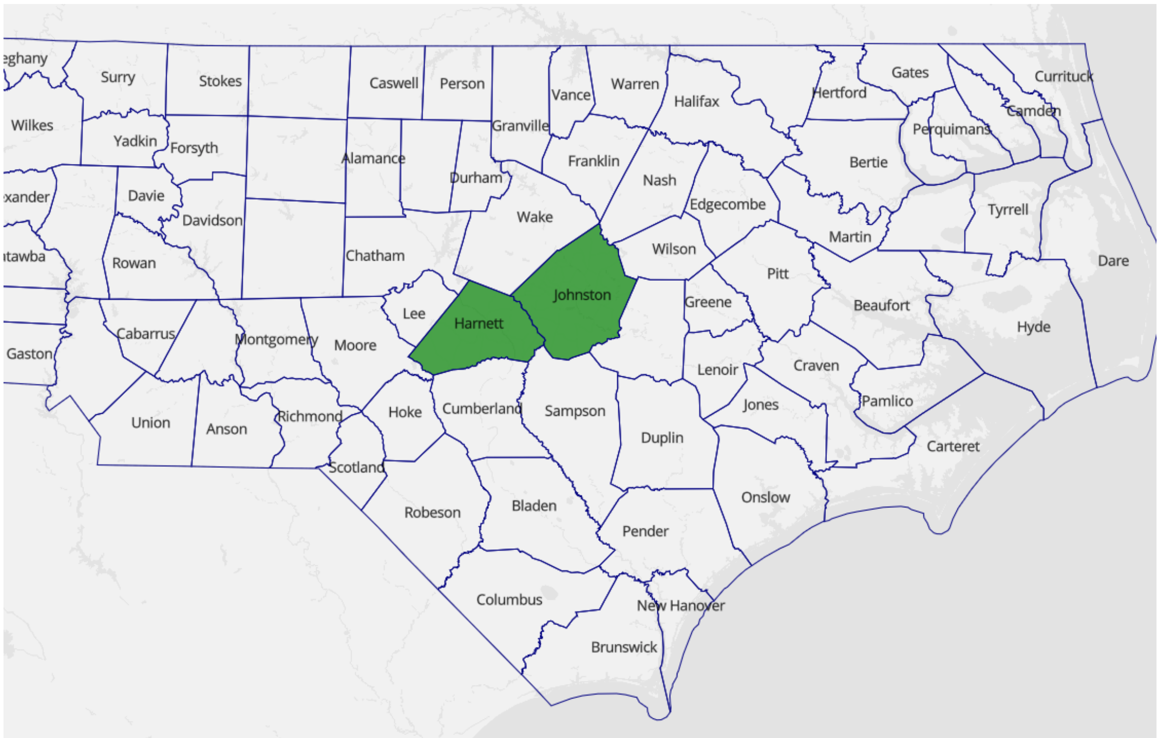
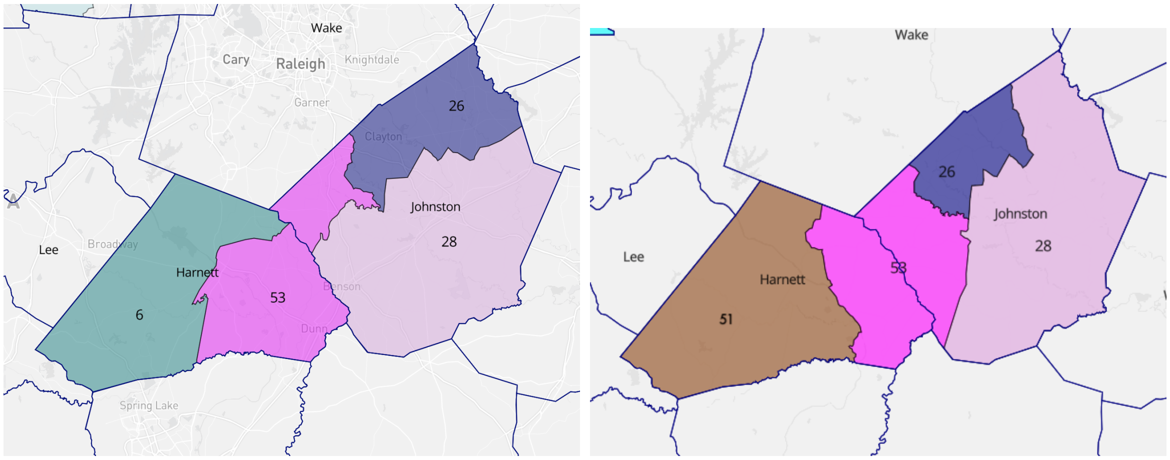


Figure 57: **Map of House Enacted Plan in Harnett and Johnston County Cluster**

(a) Enacted Map (b) Duchin Map

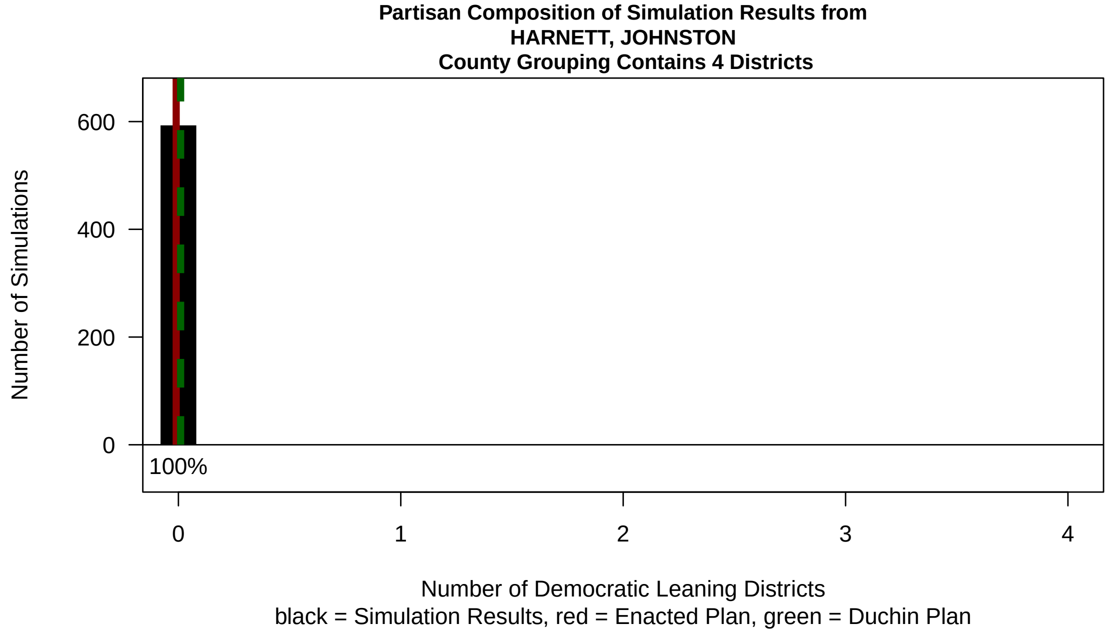



Partisan Lean of Districts

| 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**

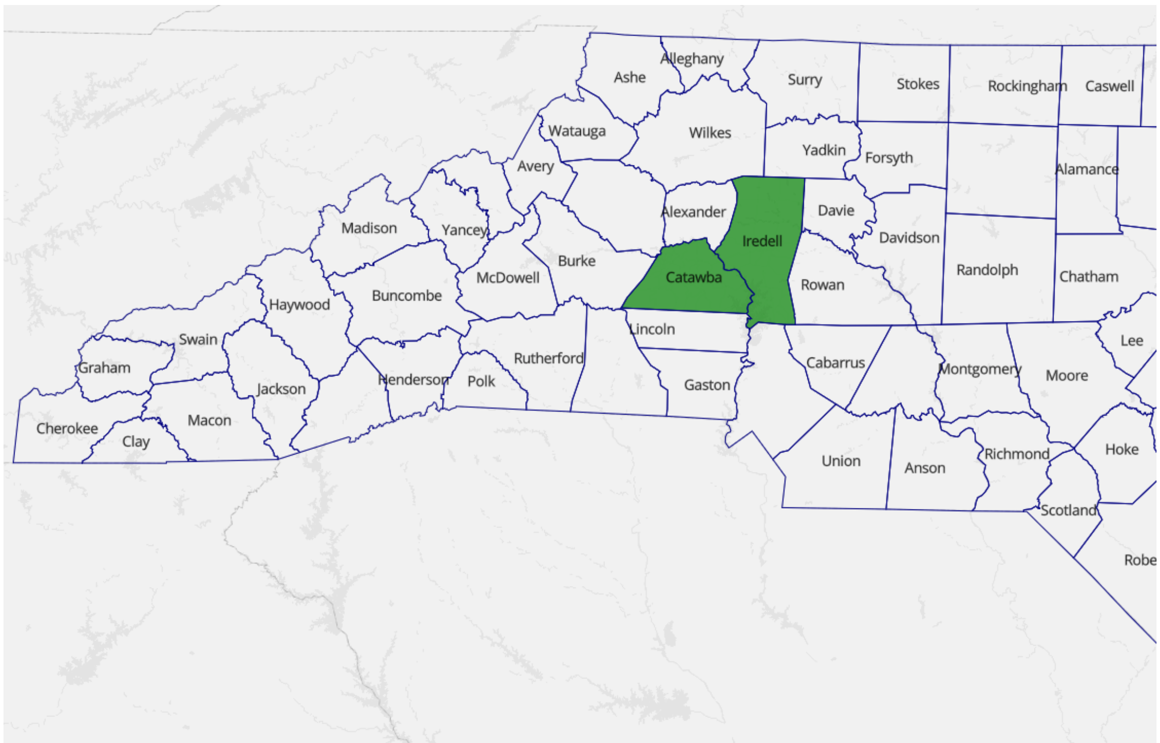
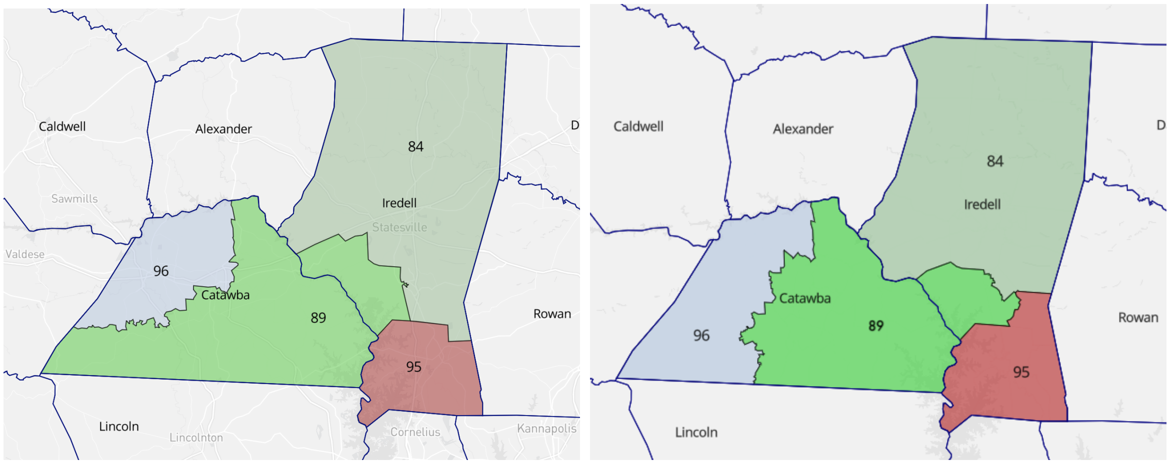


Figure 60: **Map of House Enacted Plan in Catawba and Iredell County Cluster**

(a) Enacted Map (b) Duchin Map

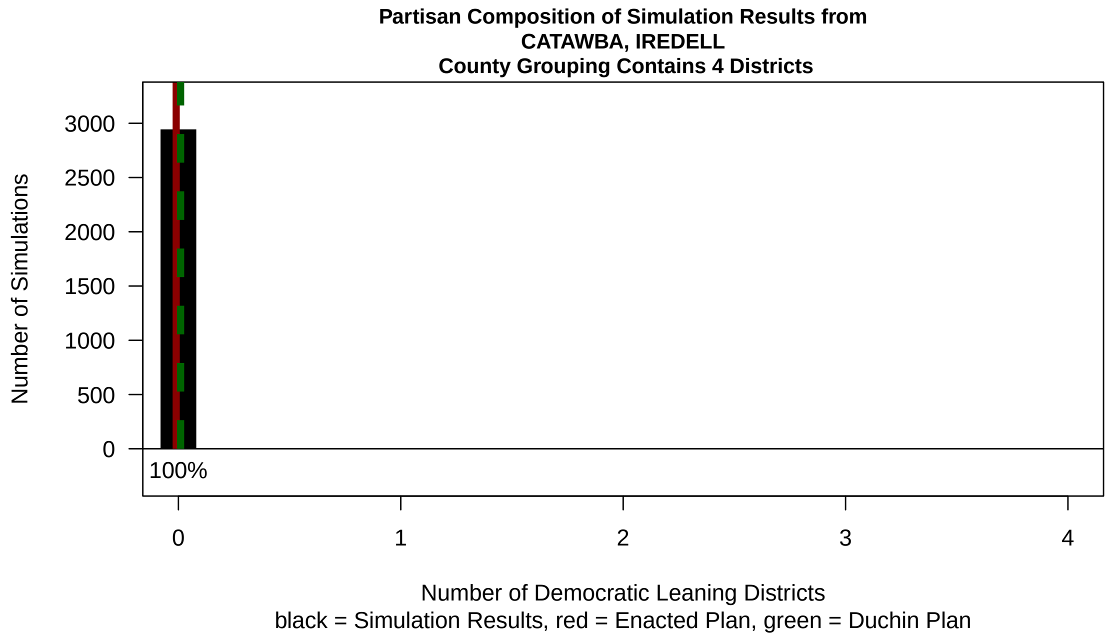



Partisan Lean of Districts

| 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**

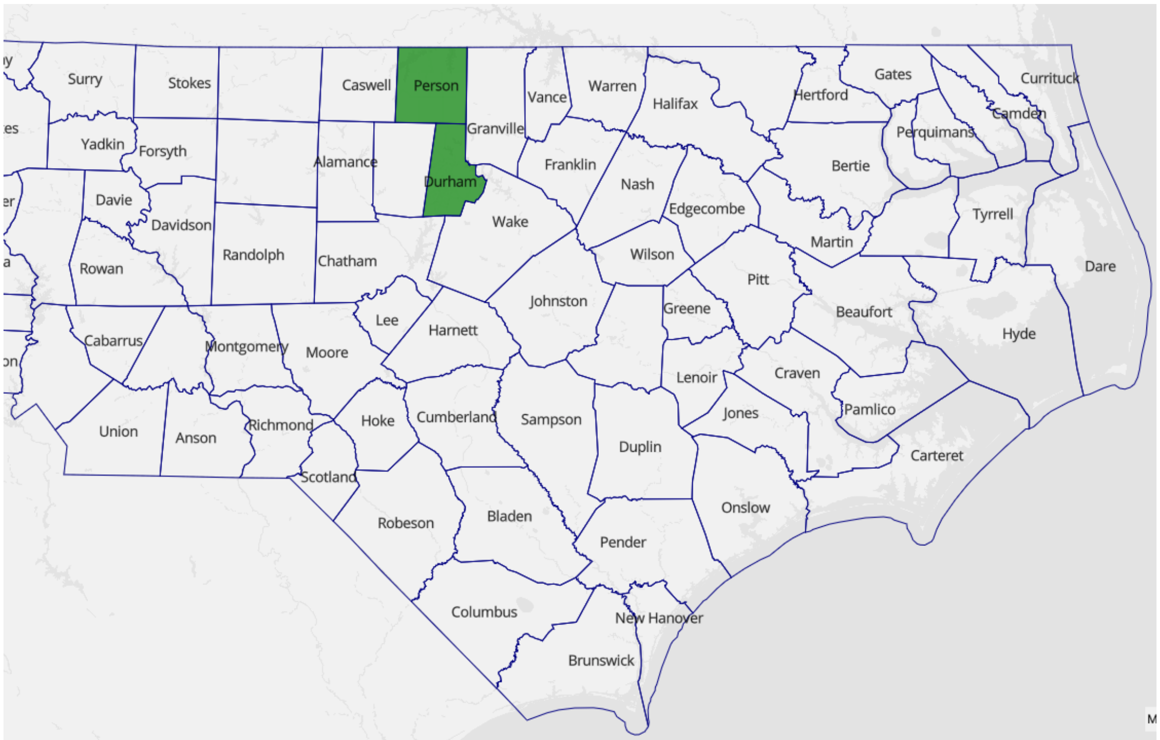
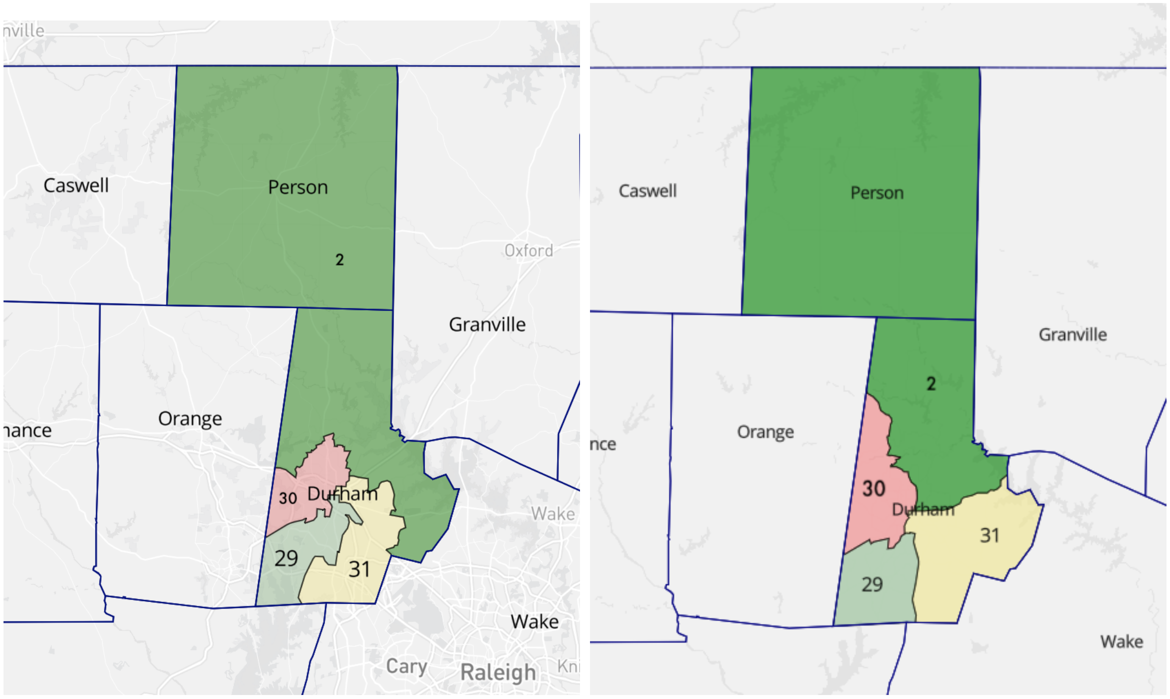


Figure 63: **Map of House Enacted Plan in Durham and Person House County Cluster**

(a) Enacted Map (b) Duchin Map

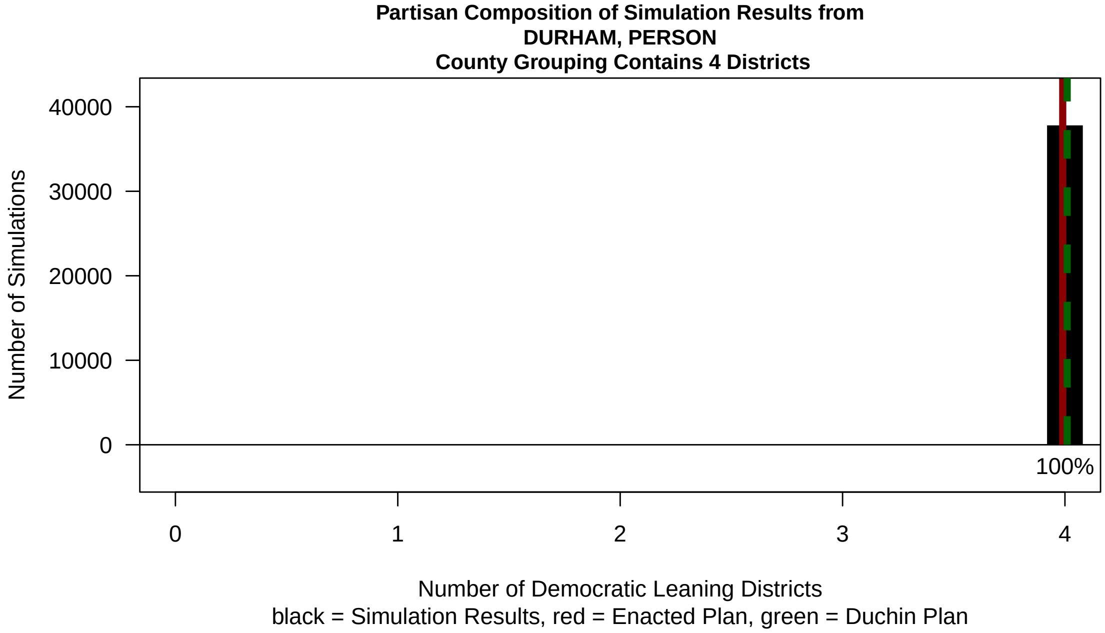



Partisan Lean of Districts

| 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**

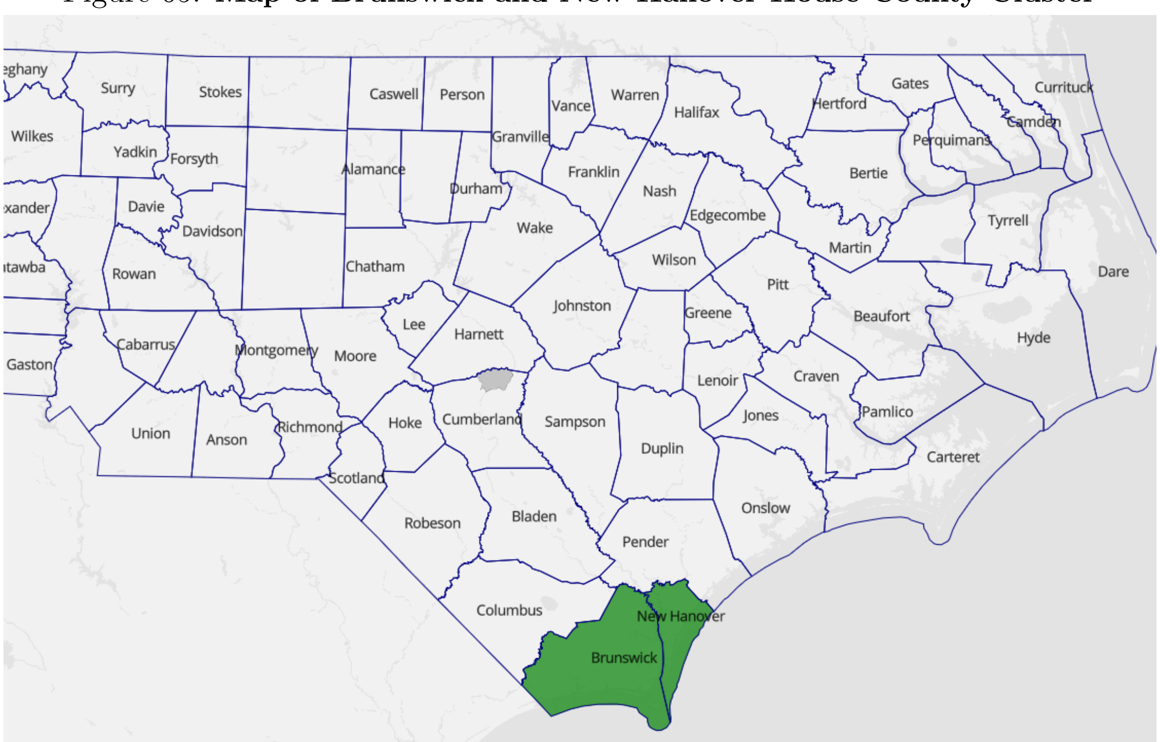
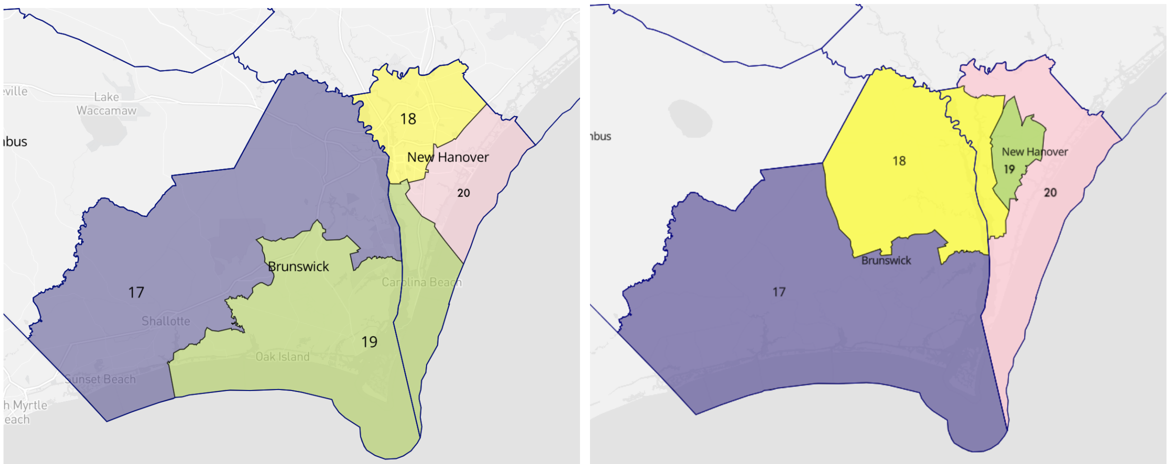


Figure 66: **Map of House Enacted Plan in Brunswick and New Hanover County Cluster**

(a) Enacted Map (b) Duchin Map

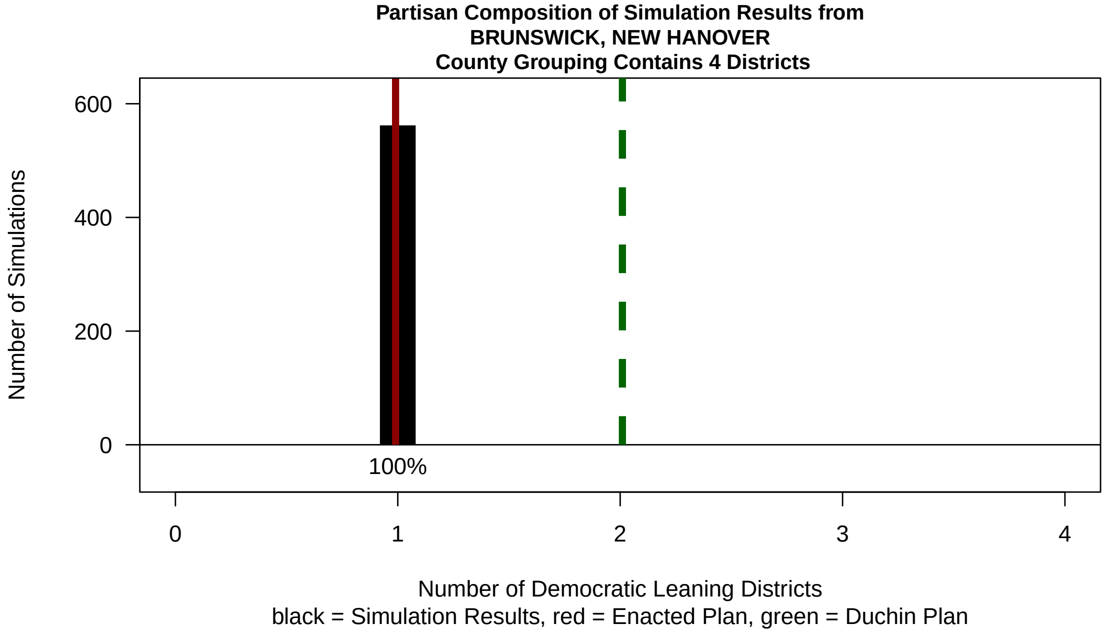



Partisan Lean of Districts

| 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**

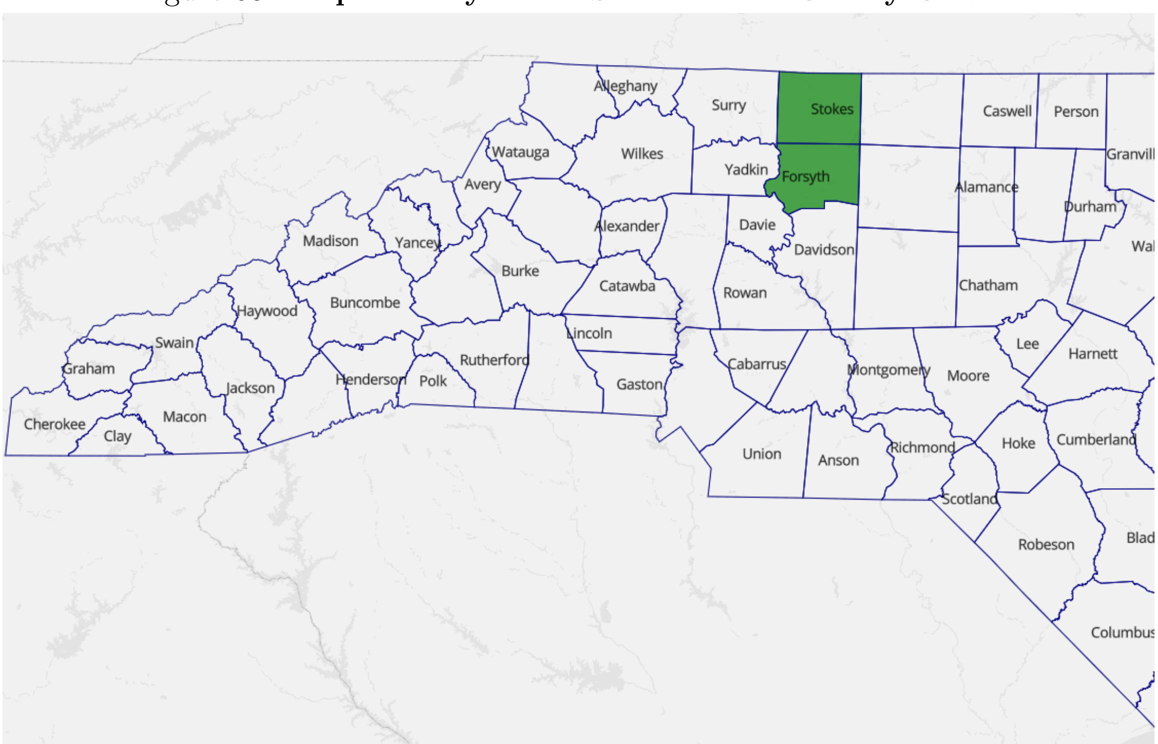
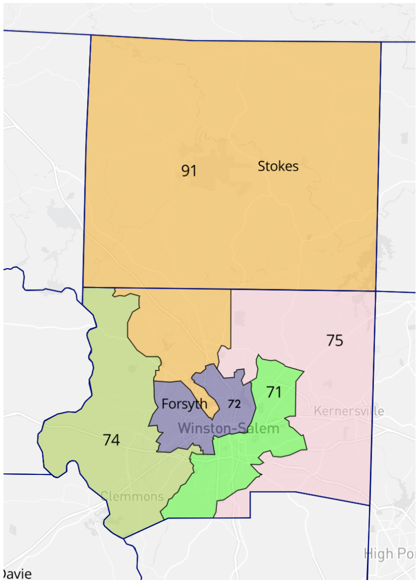
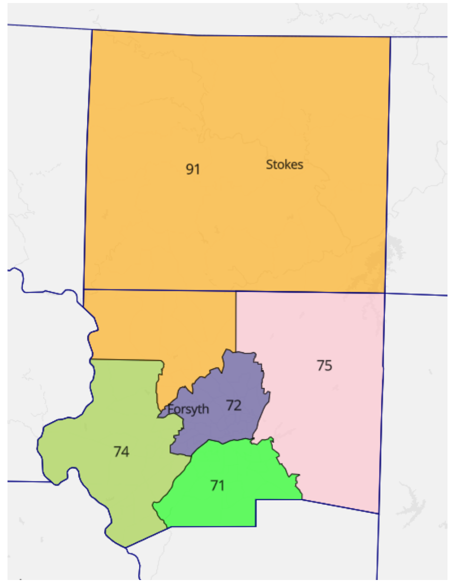


Figure 69: **Map of House Enacted Plan in Forsyth and Stokes County Cluster**

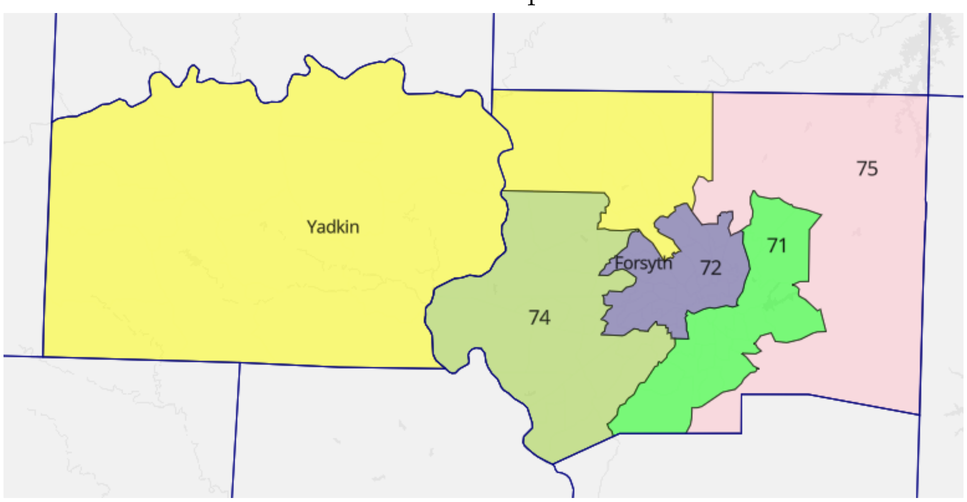
(a) Enacted Map




(b) Duchin Map




2020 Maps

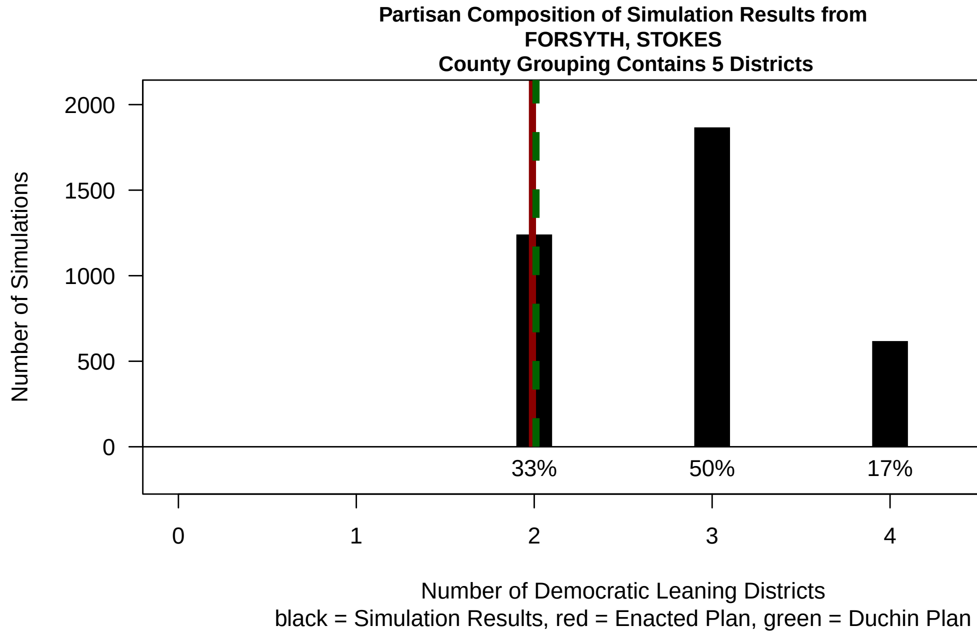


Partisan Lean of Districts

| 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**

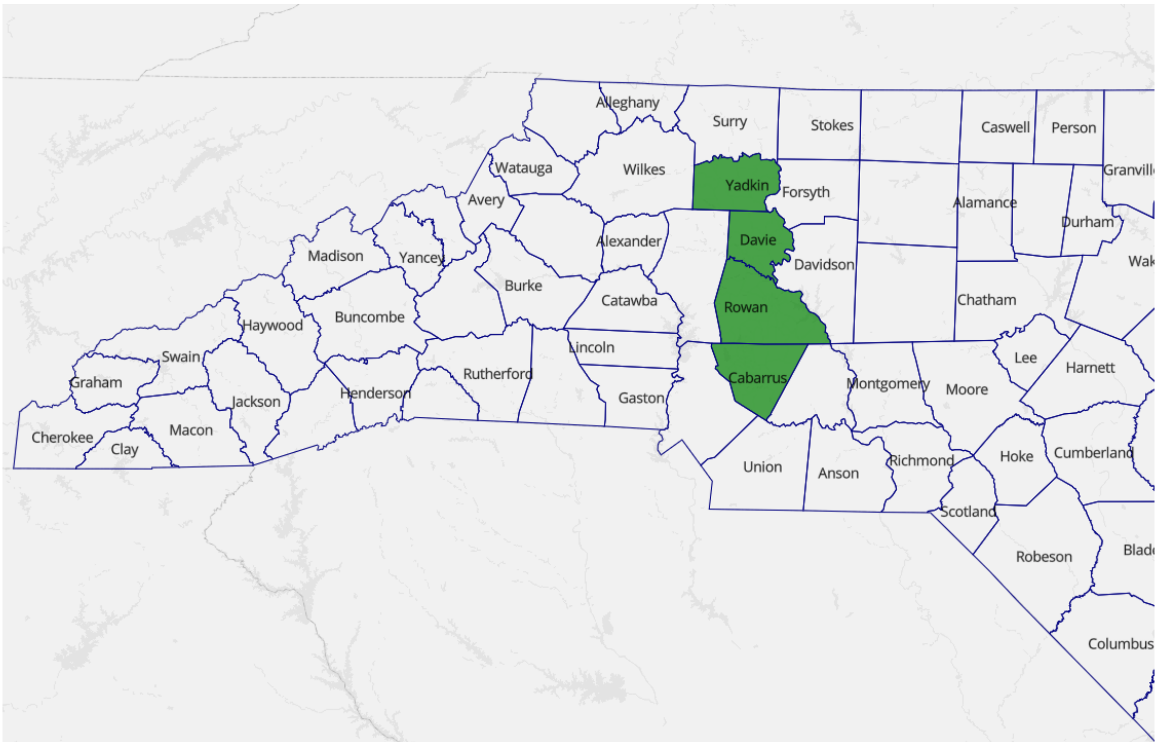
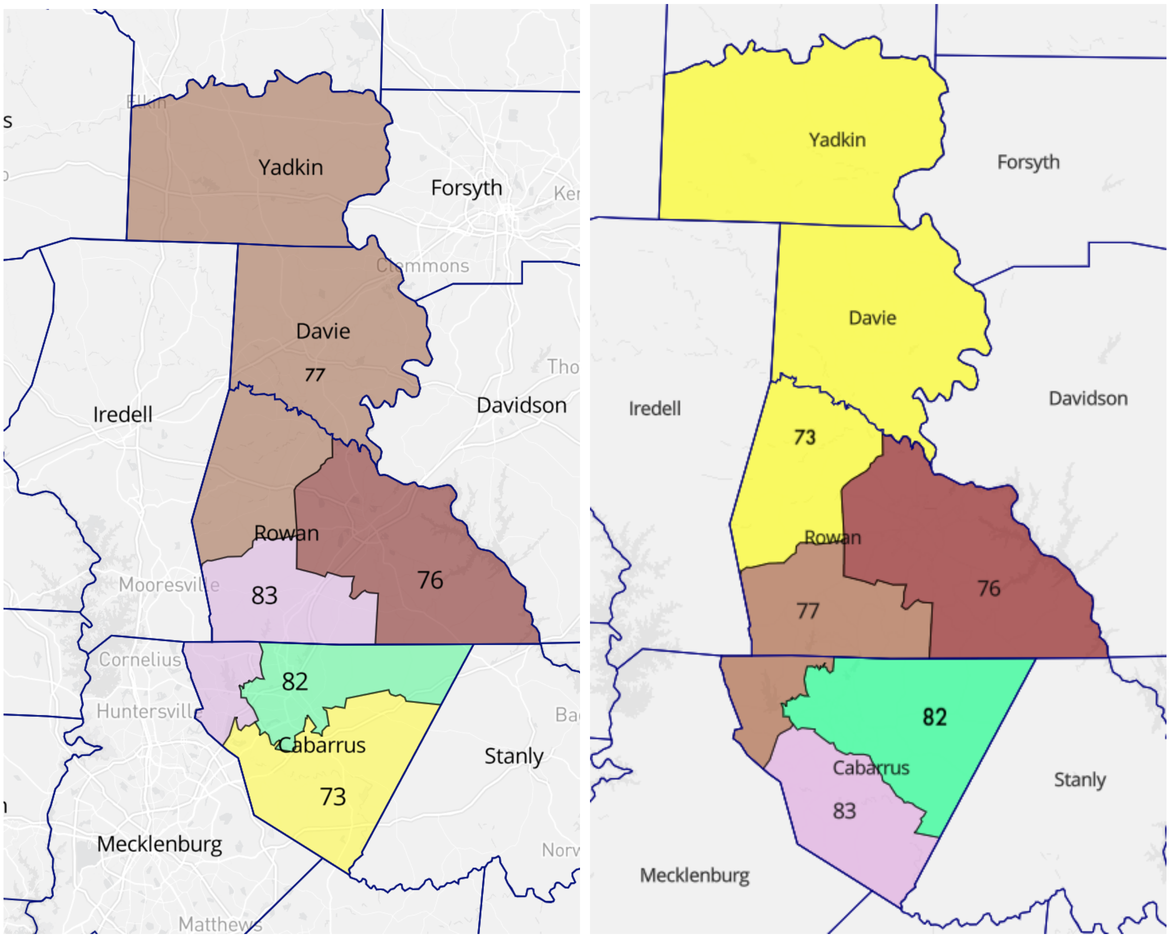


Figure 72: **Map of House Enacted Plan in Cabarrus, Davie, Rowan, and Yadkin County Cluster**

(a) Enacted Map (b) Duchin Map

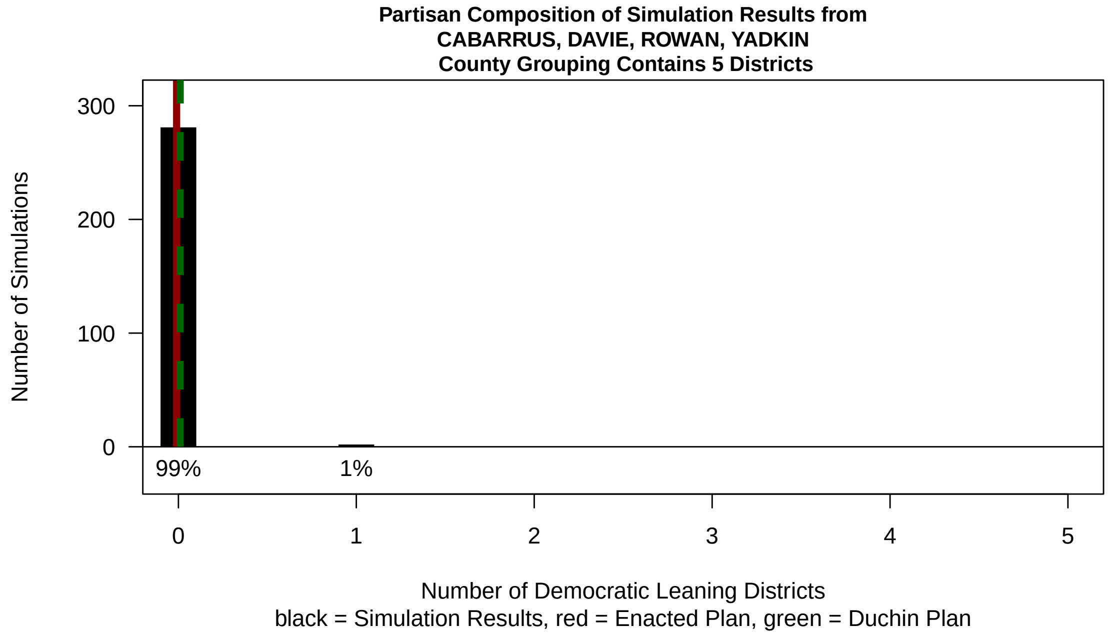



Partisan Lean of Districts

| 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**

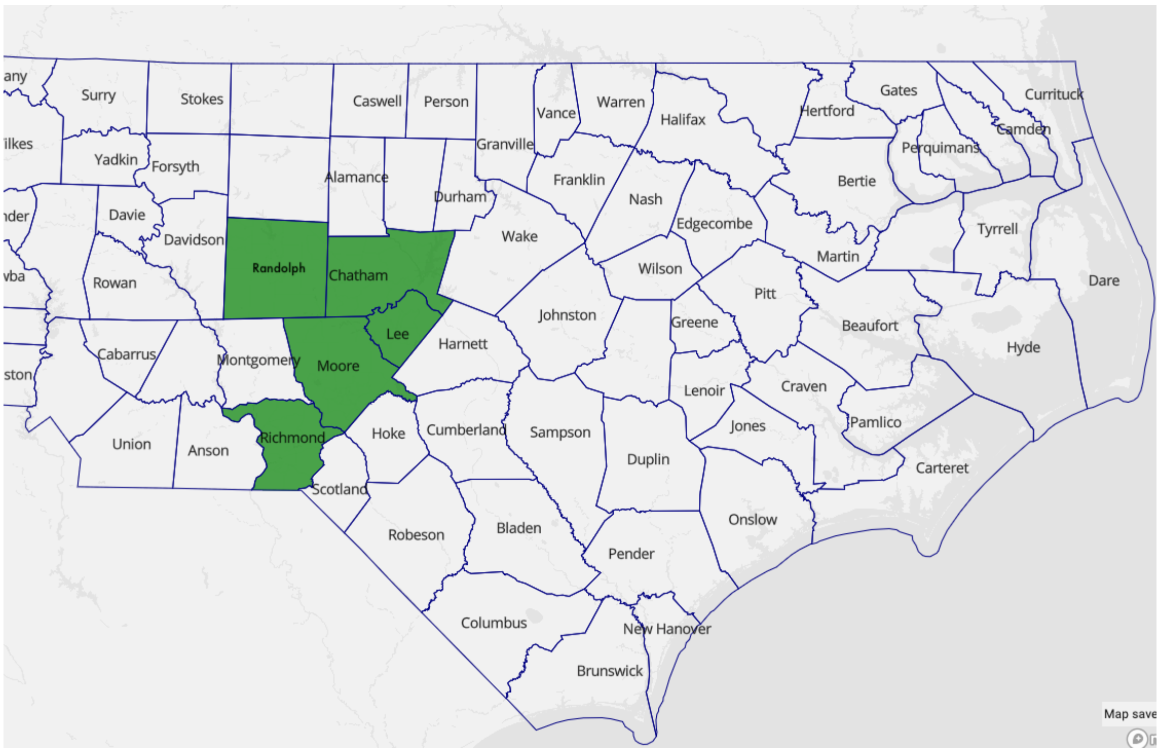
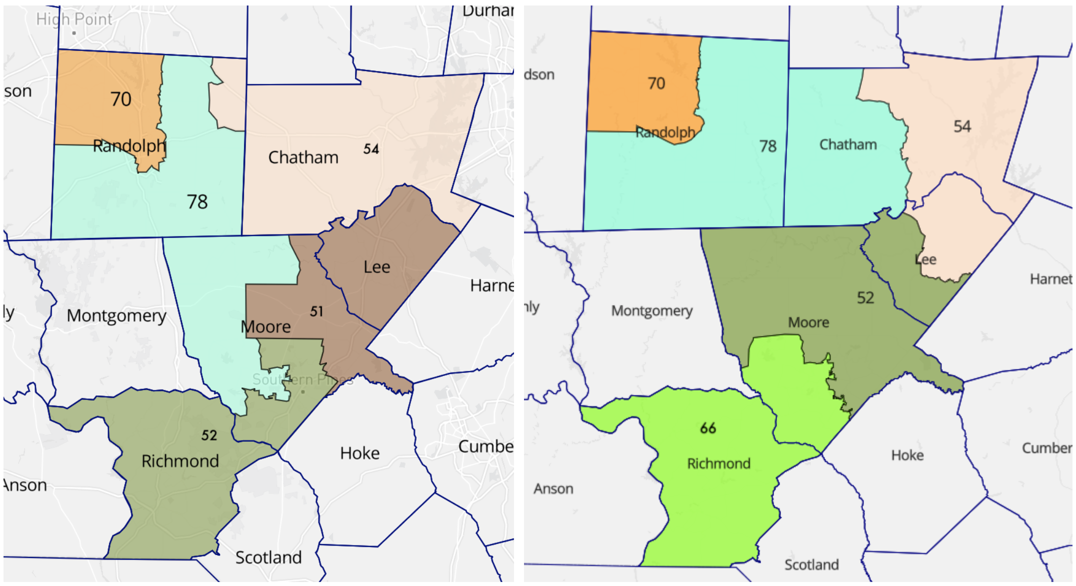


Figure 75: **Map of House Enacted Plan in Chatham, Lee, Moore, Randolph, and Richmond County Cluster**

(a) Enacted Map (b) Duchin Map

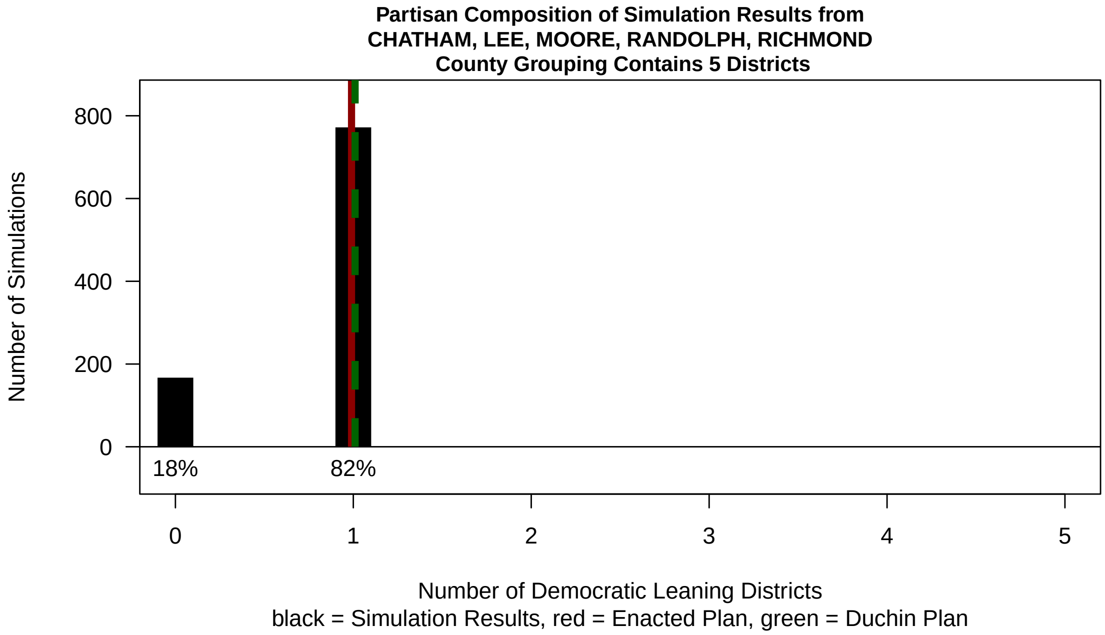



Partisan Lean of Districts

| 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**

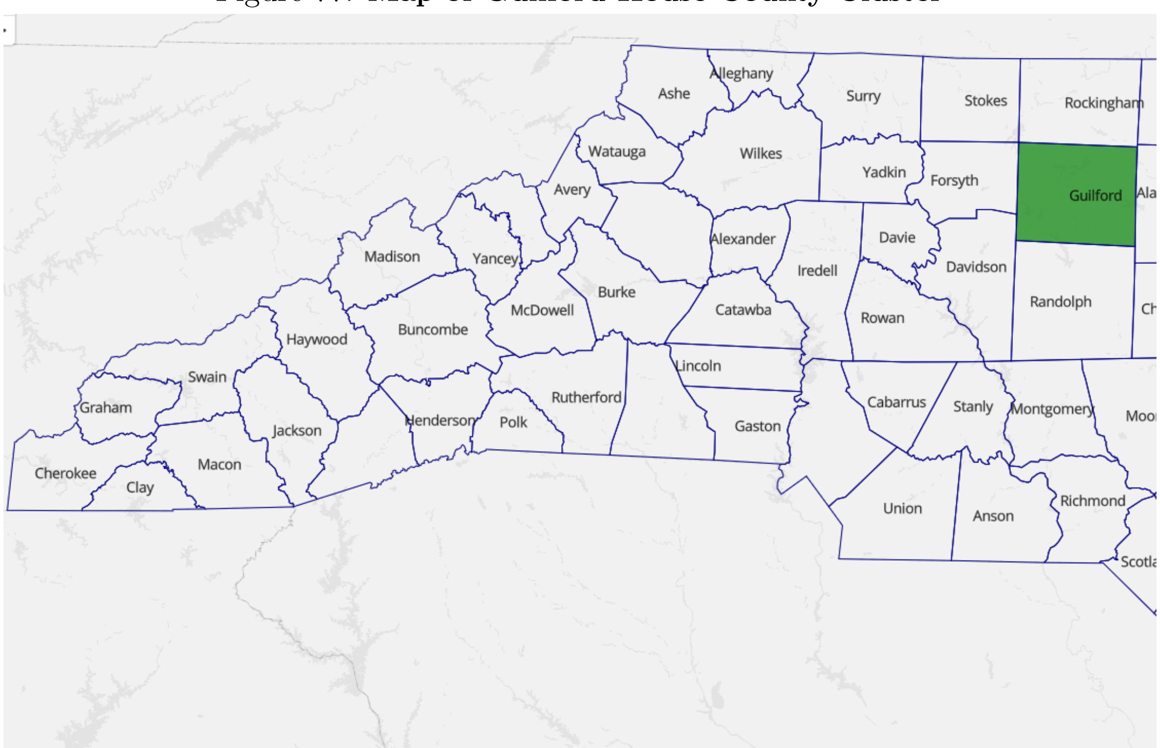
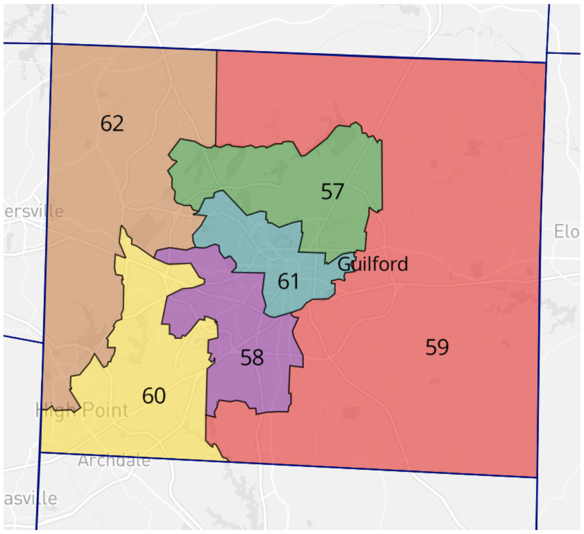
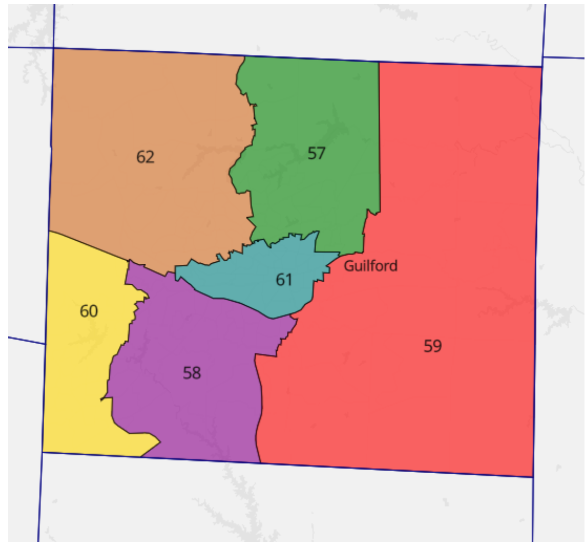


Figure 78: **Map of House Enacted Plan in Guilford County Cluster**

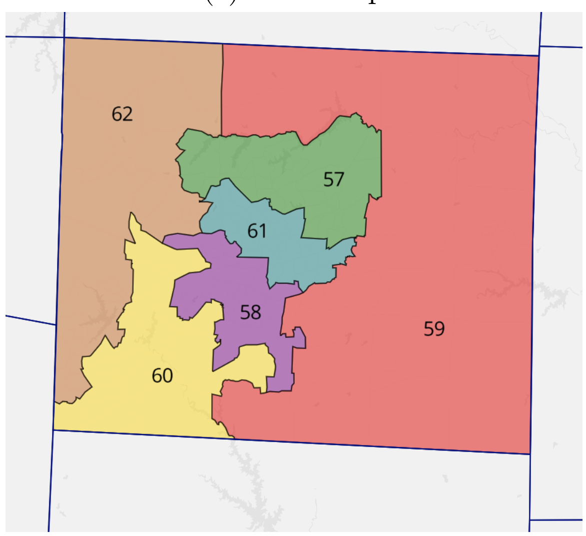
(a) Enacted Map




(b) Duchin Map




(c) 2020 Map

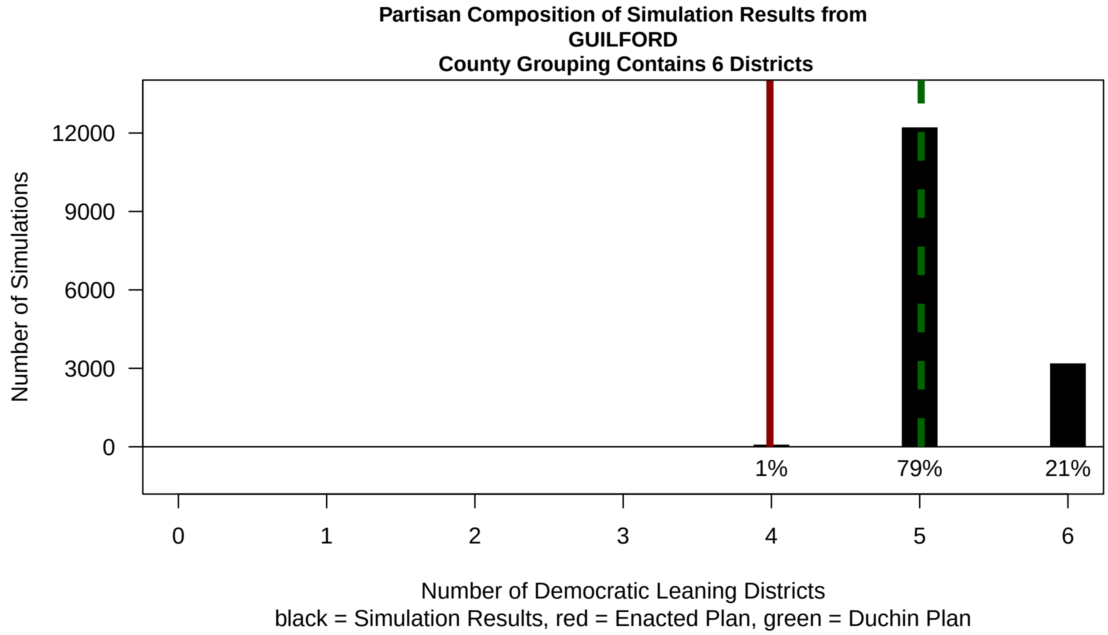


Partisan Lean of Districts

| 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**

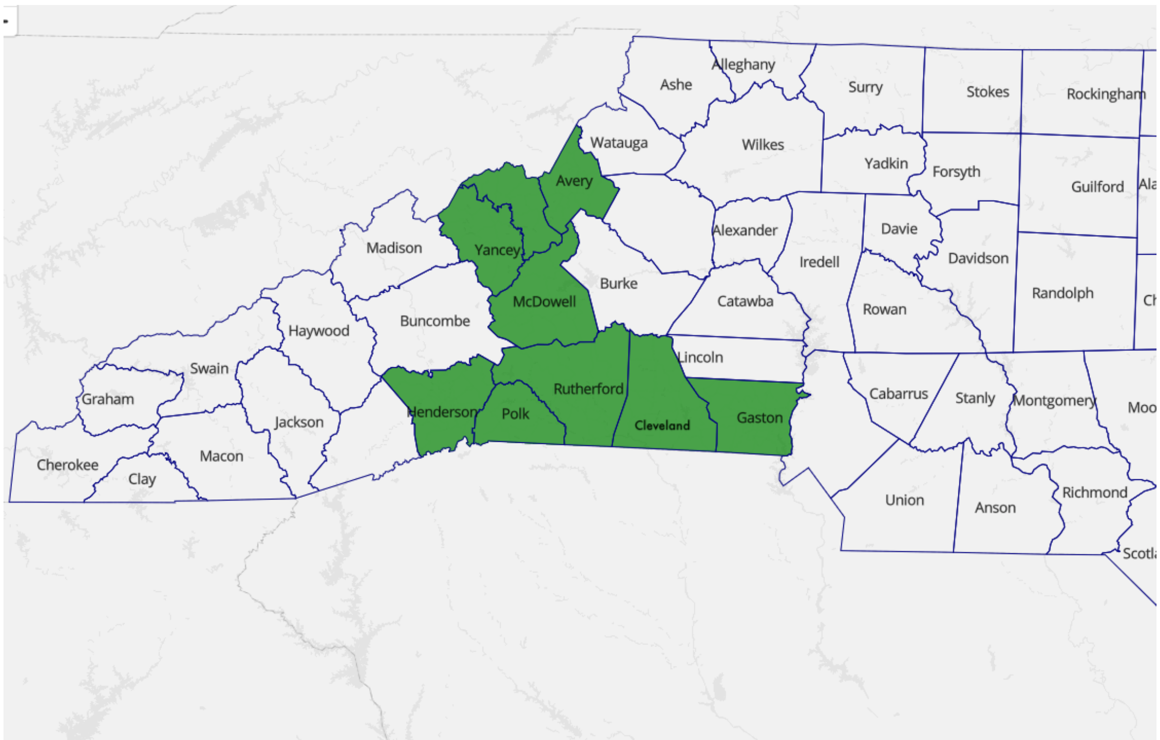
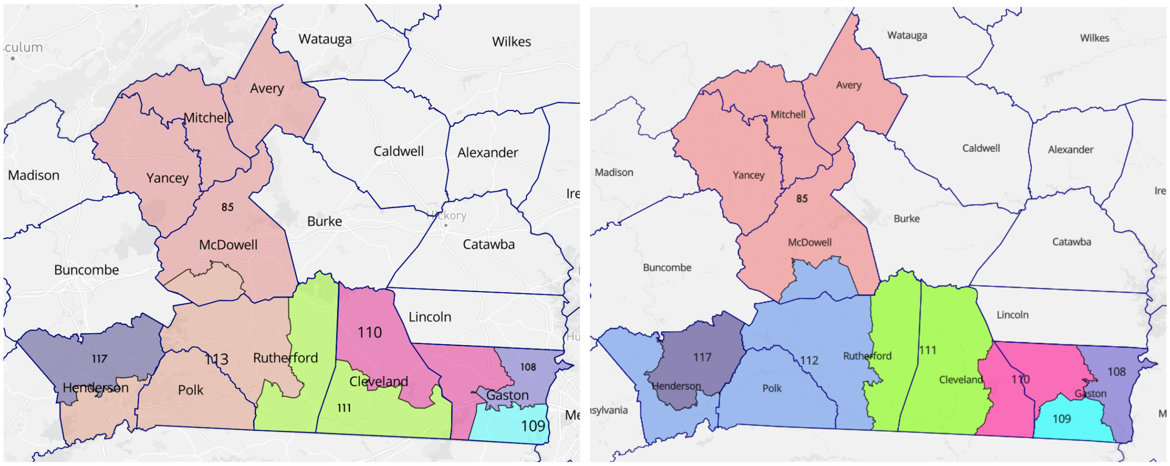


Figure 81: **Map of House Enacted Plan in Avery, Cleveland, Gaston, Henderson, McDowell, Mitchell, Polk, Rutherford, and Yancey County Cluster**

(a) Enacted Map (b) Duchin Map

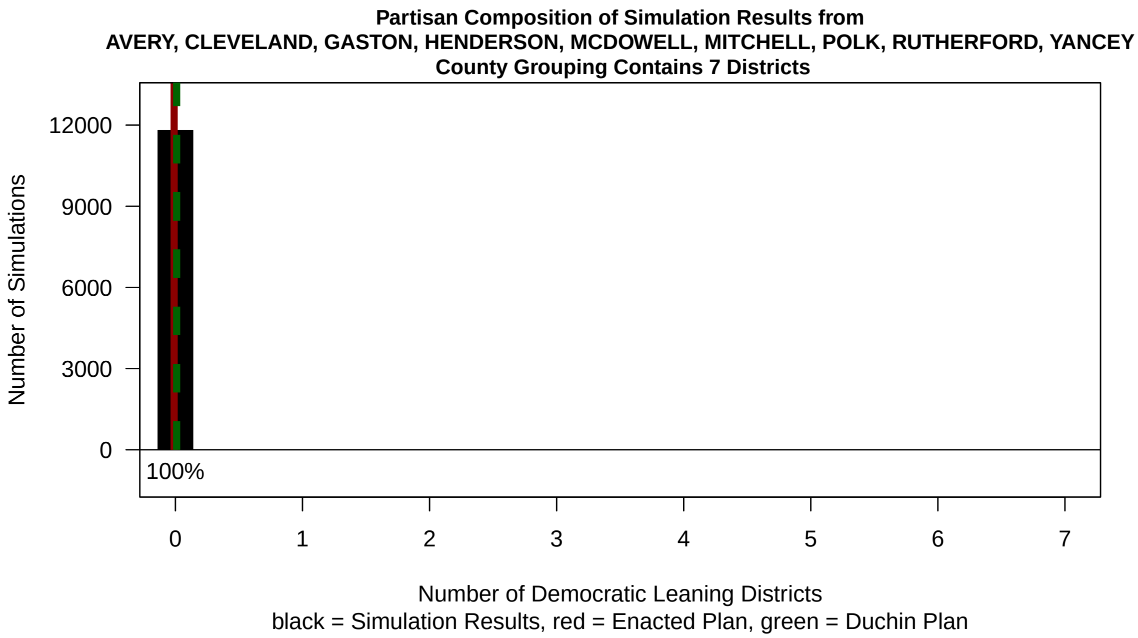



Partisan Lean of Districts

| 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**

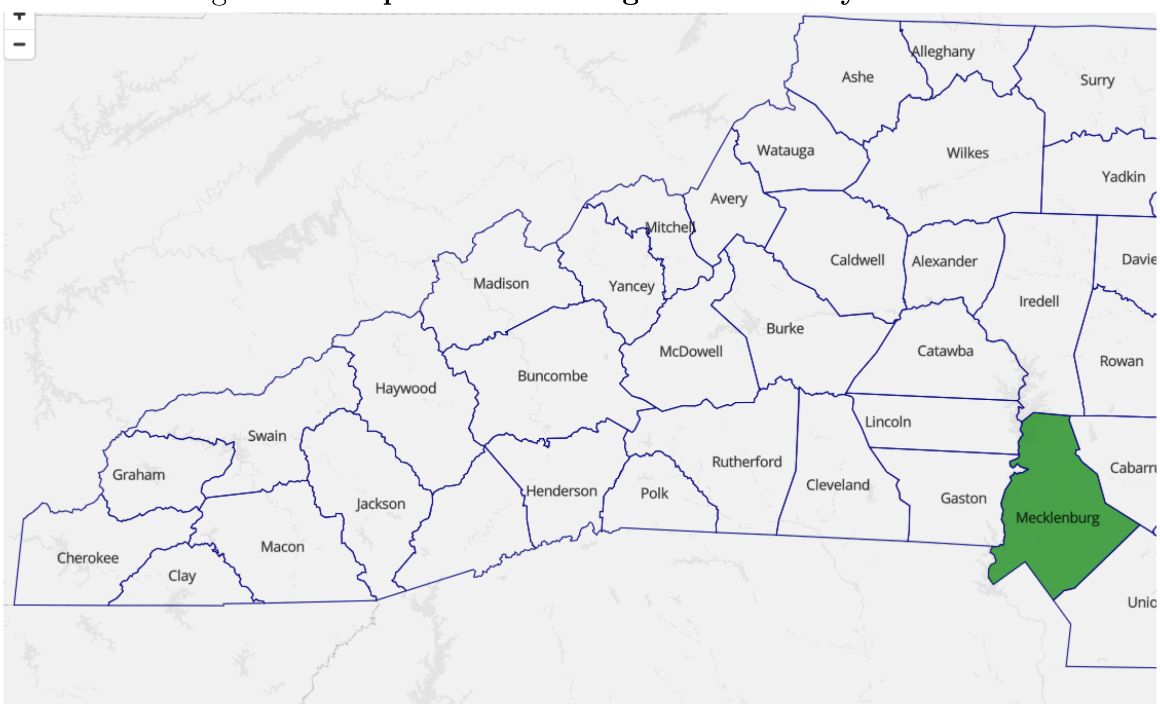
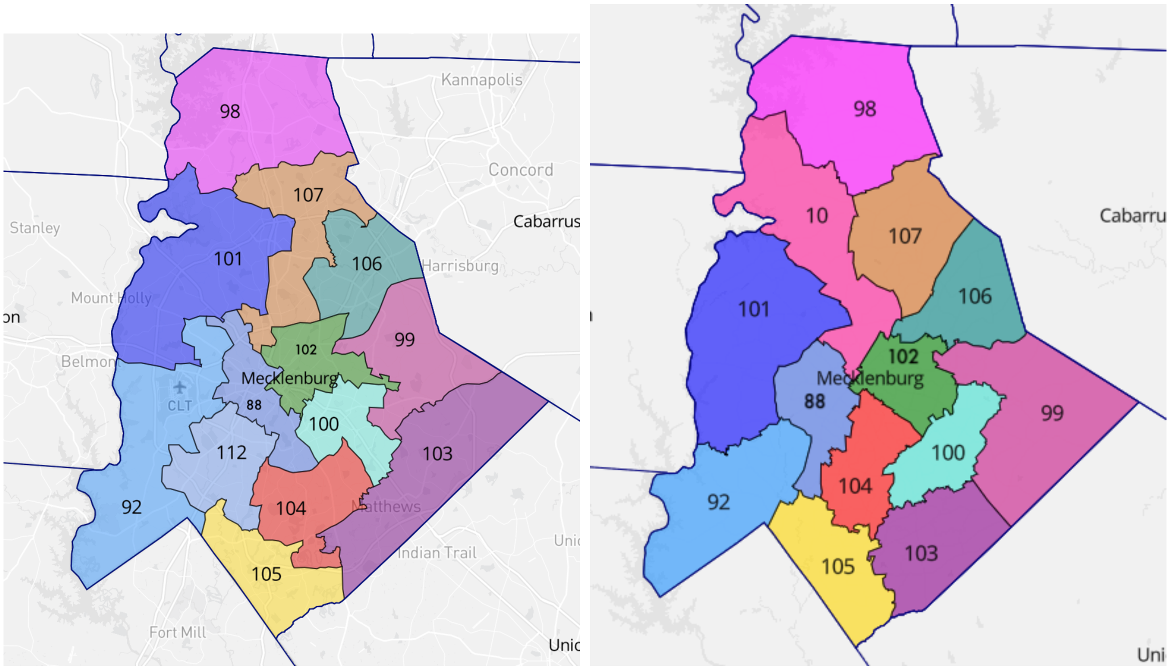


Figure 84: **Map of House Enacted Plan in Mecklenburg County Cluster**

(a) Enacted Map (b) Duchin Map

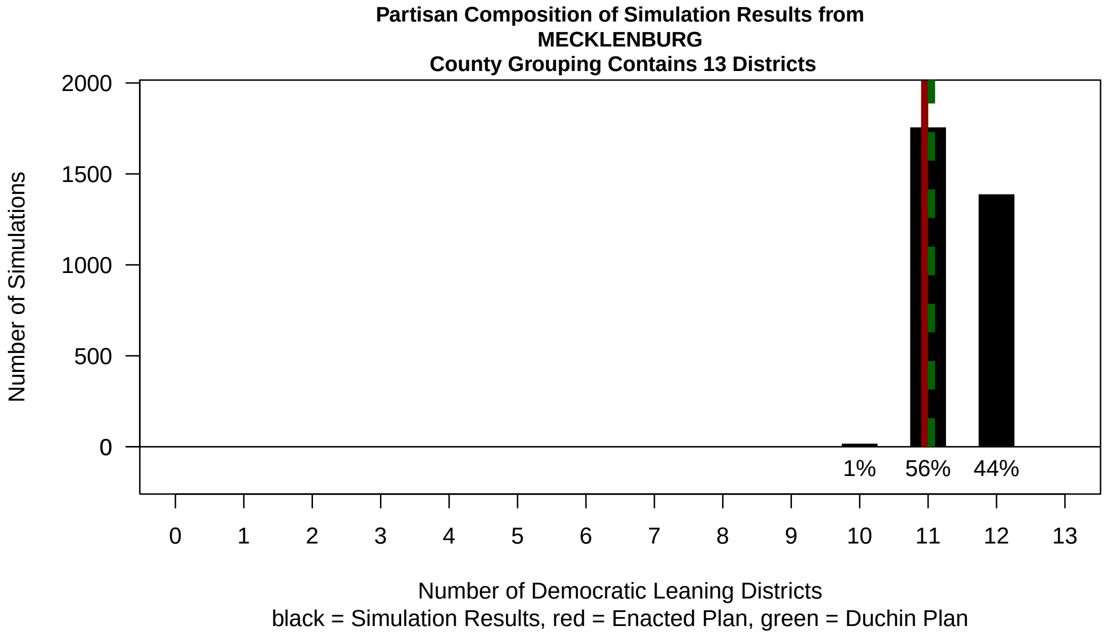



Partisan Lean of Districts

| 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**

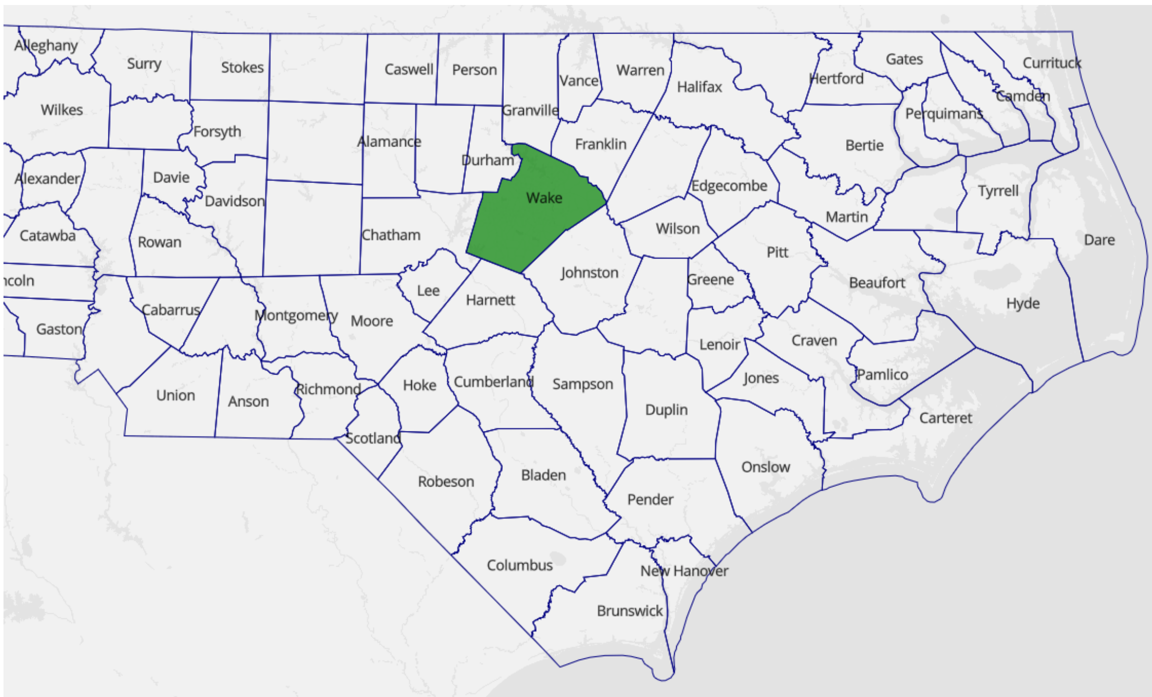
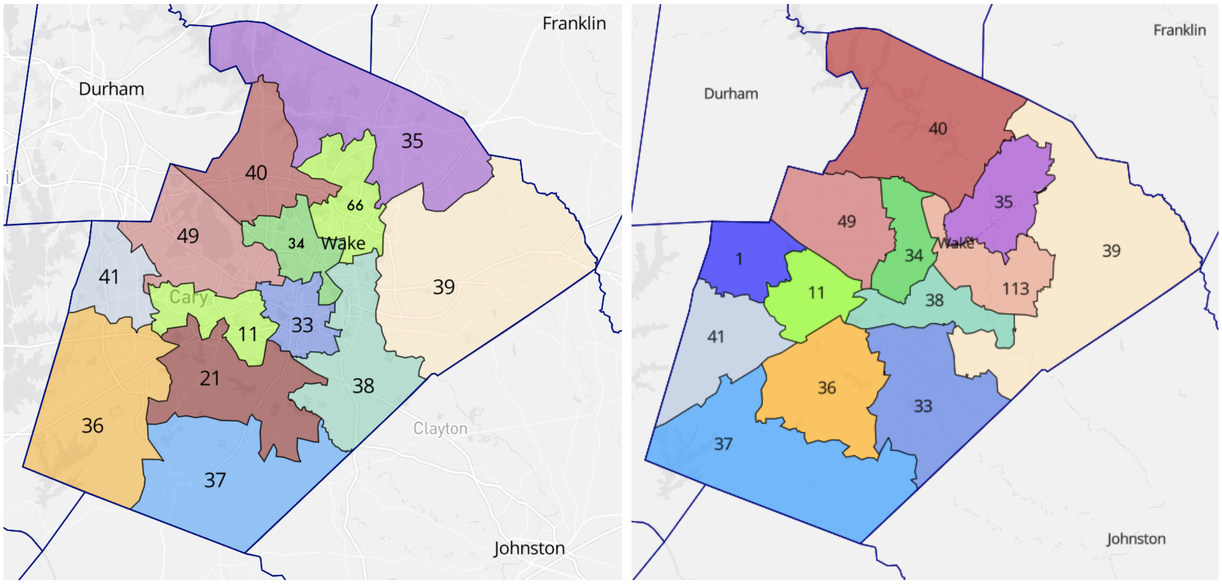


Figure 87: **Map of House Enacted Plan in Wake County Cluster**

(a) Enacted Map (b) Duchin Map

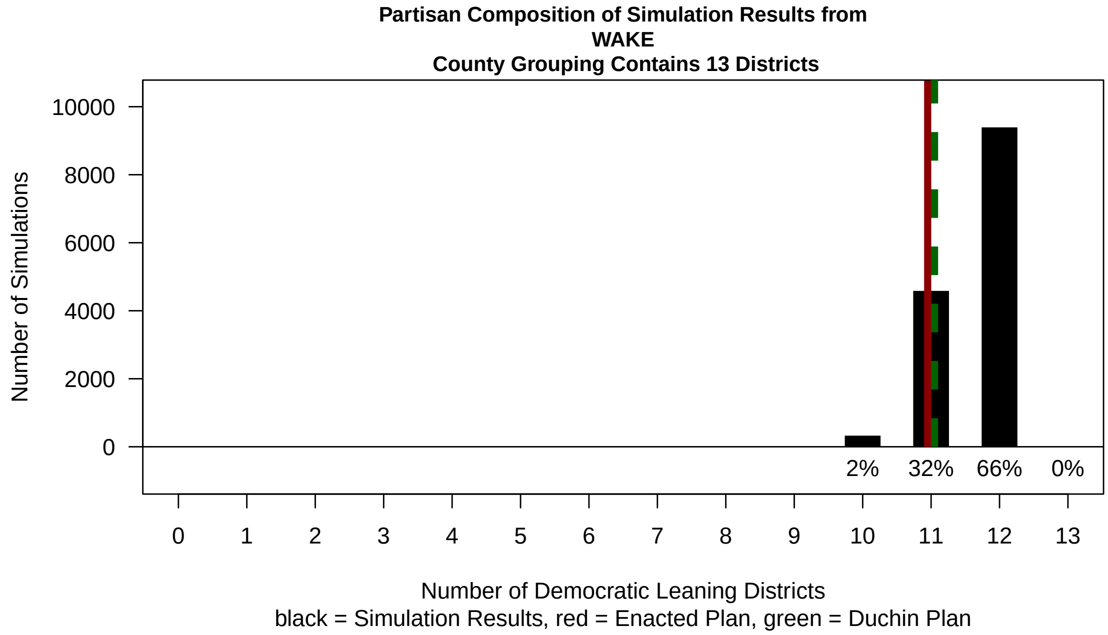



Partisan Lean of Districts

| 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**

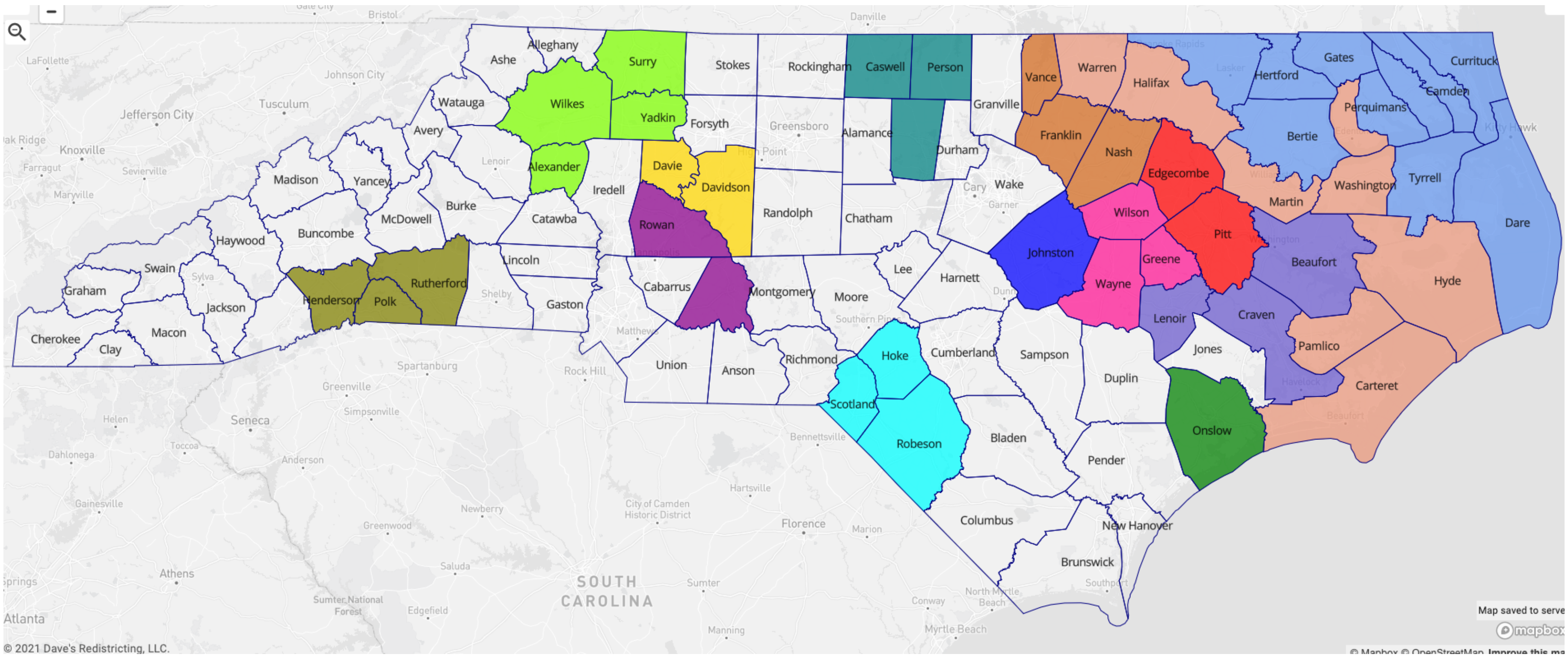
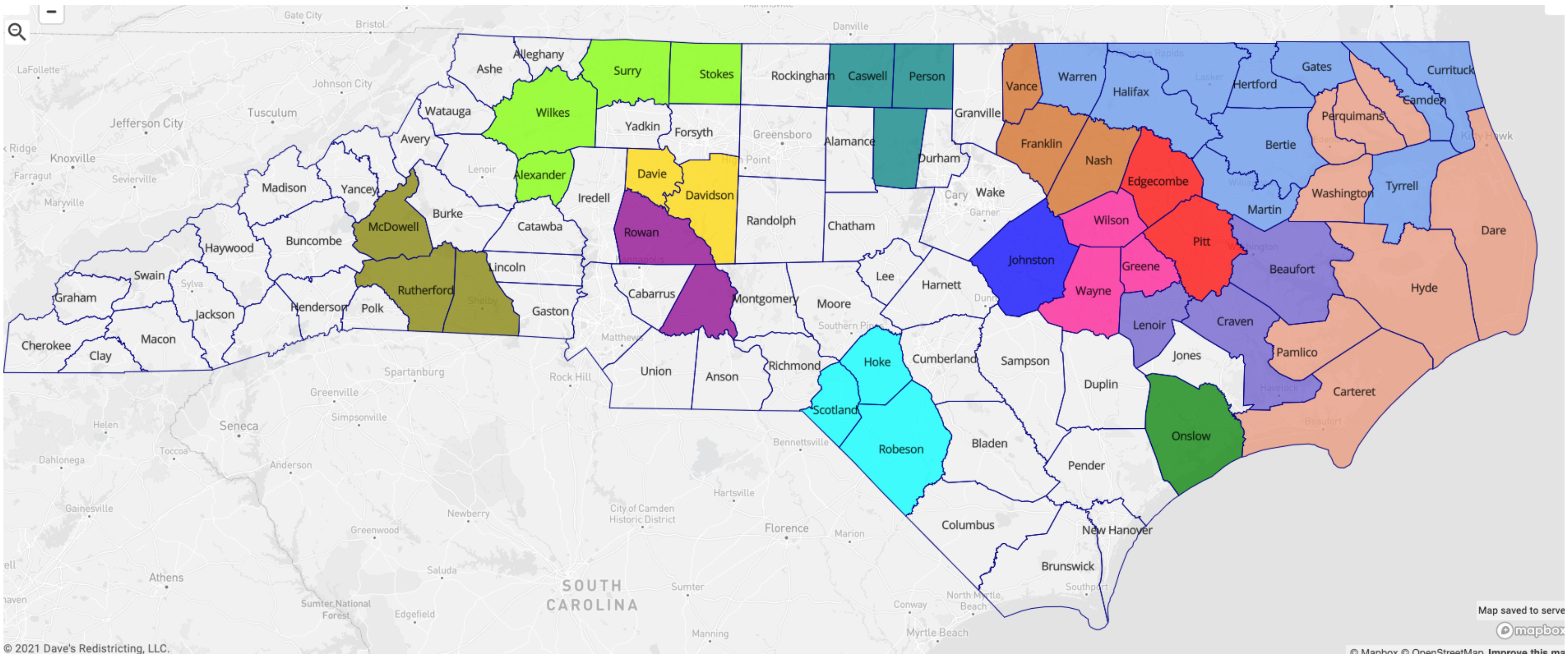


Figure 90: **Map of Counties and County Clusters with only 1 Senate District in Duchin Plan**



# 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**

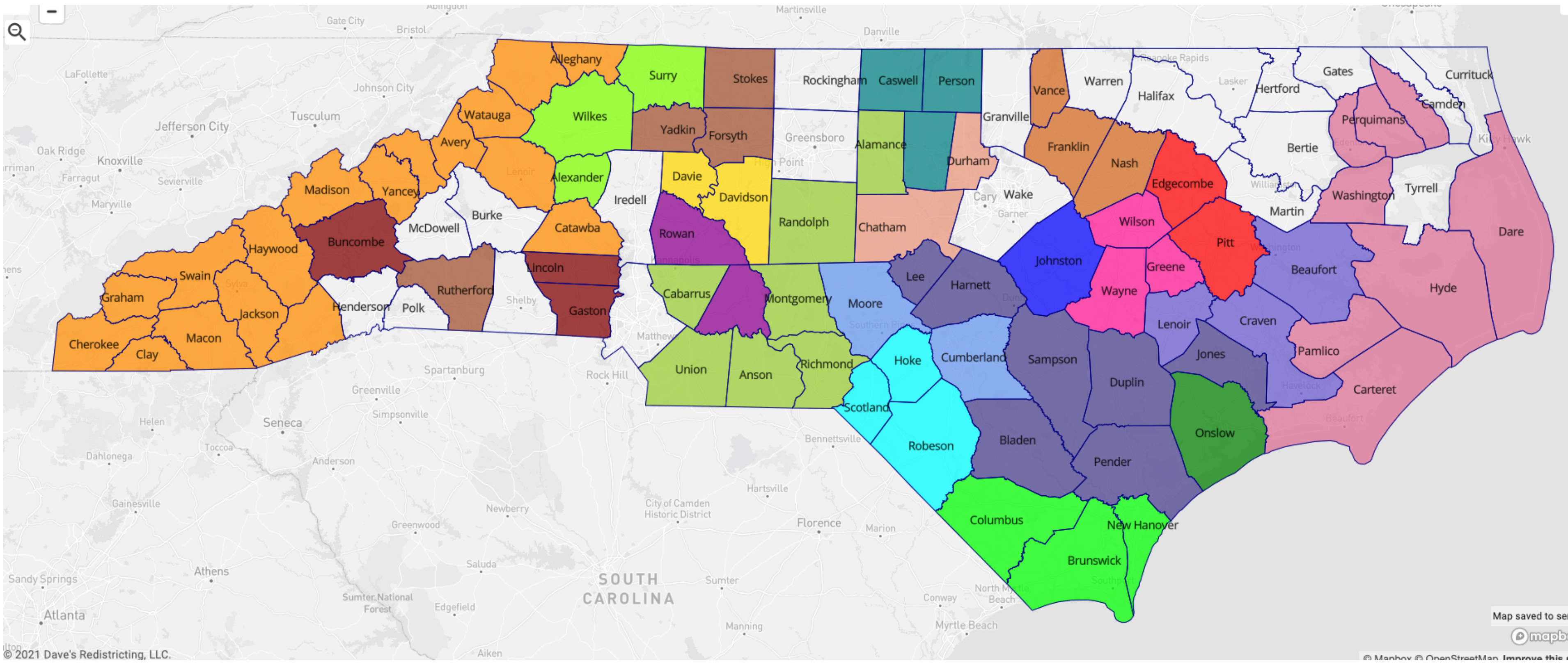
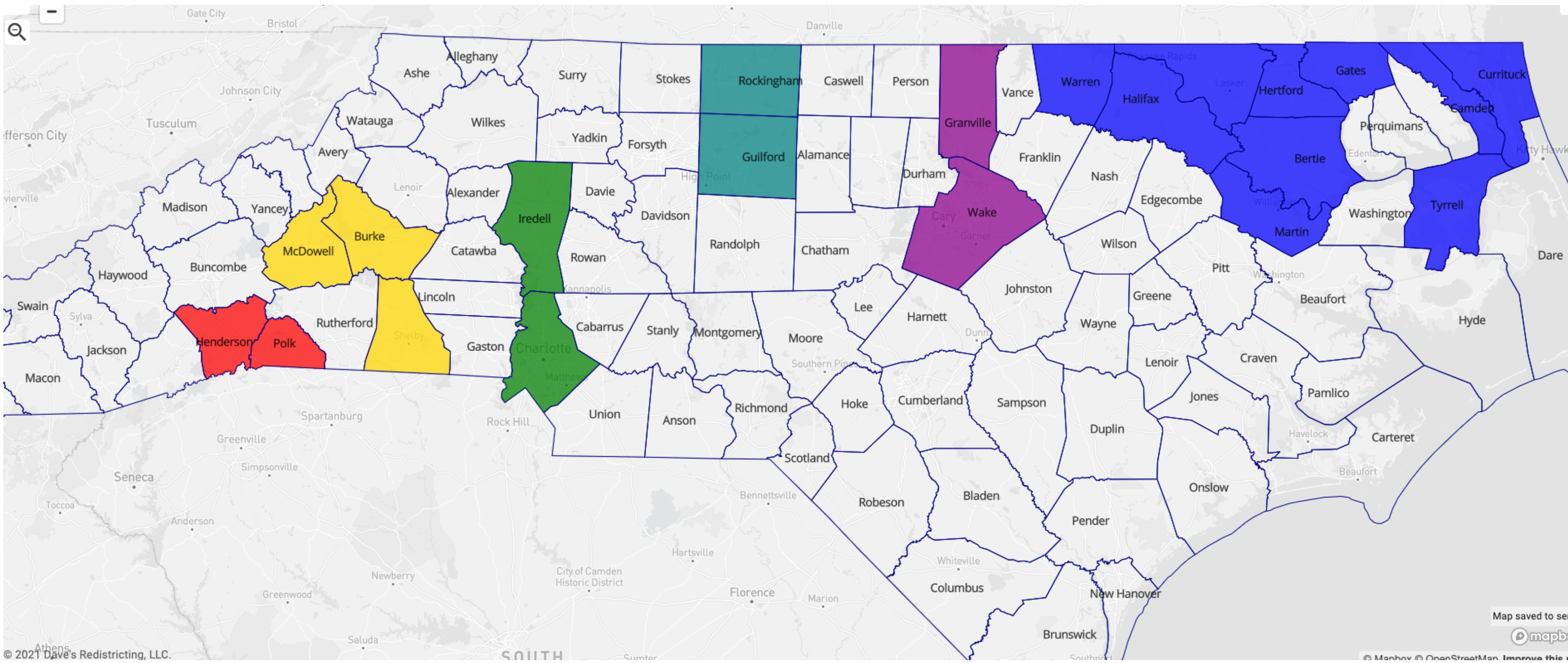


Figure 92: **Map of Senate Counties Where Enacted and Duchin Plans Disagree on Partisan Lean of Districts**



## 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**

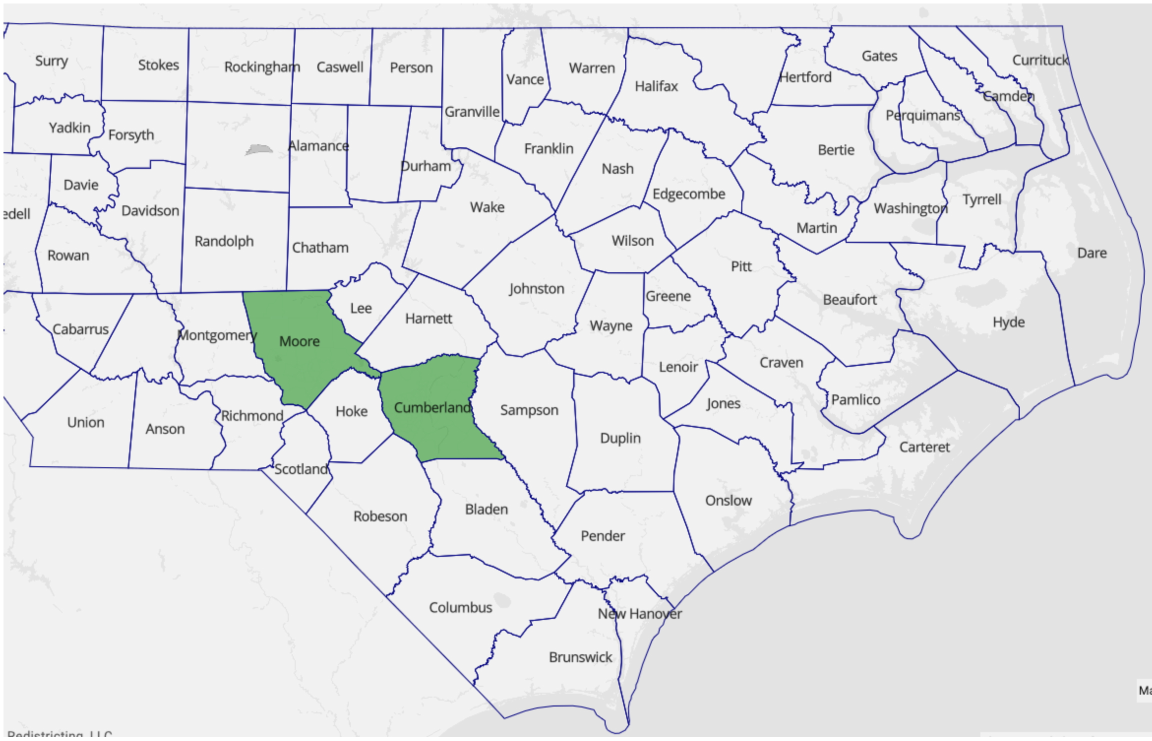
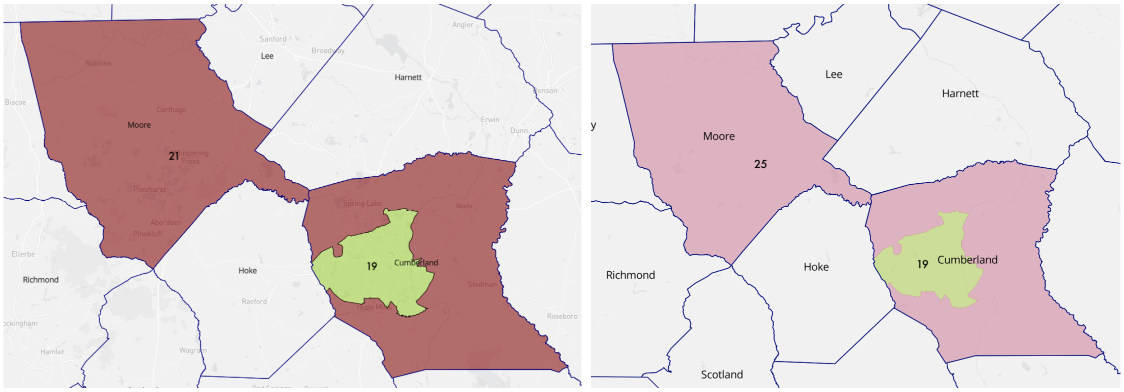


Figure 94: **Map of Enacted Plan in Cumberland and Moore Senate County Cluster**

(a) Enacted Map (b) Duchin Map

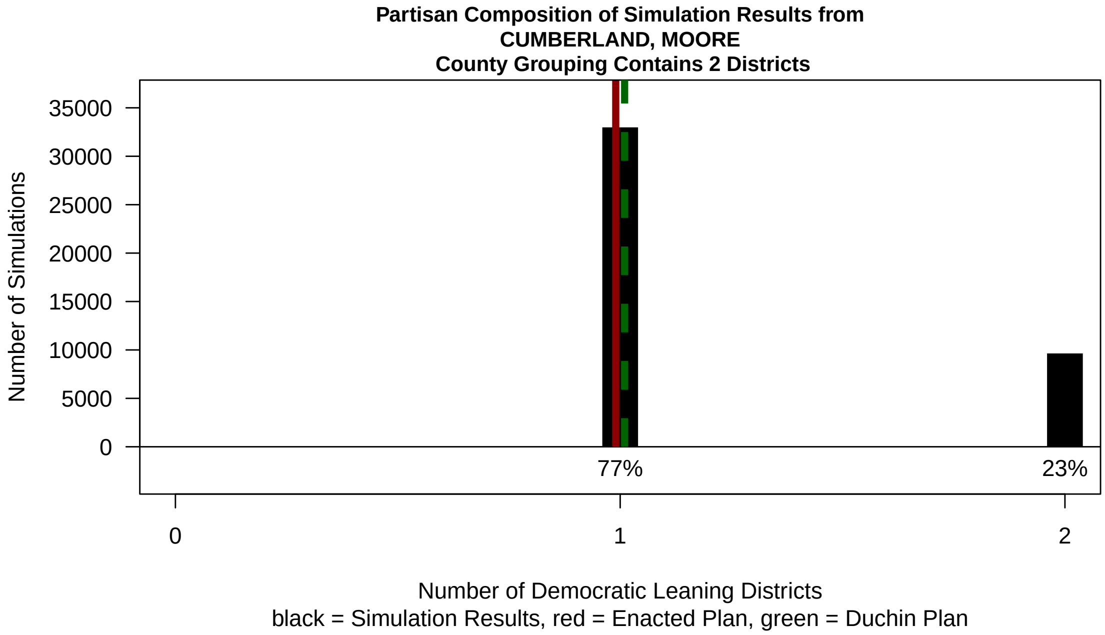



Partisan Lean of Districts

| 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**

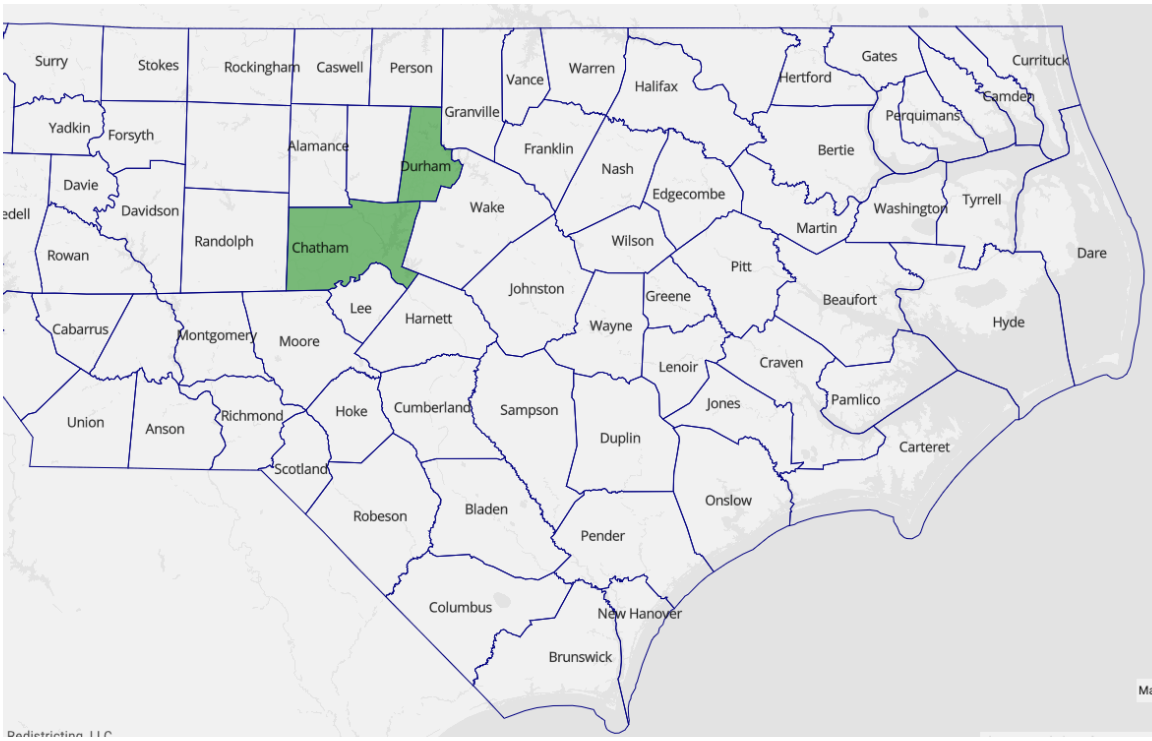
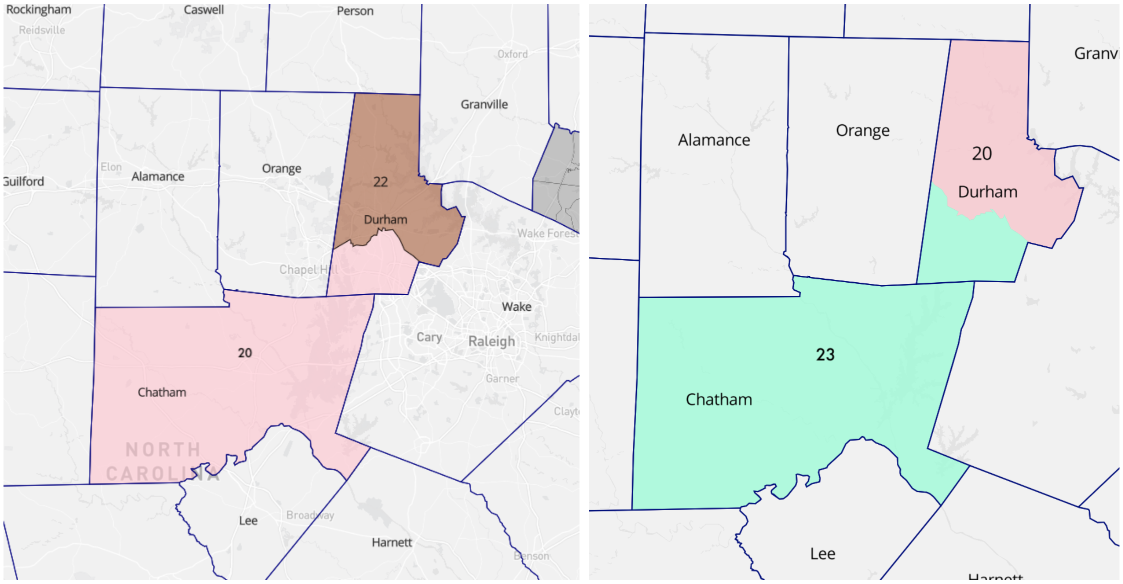


Figure 97: **Map of Enacted Plan in Chatham and Durham Senate County Cluster**

(a) Enacted Map (b) Duchin Map

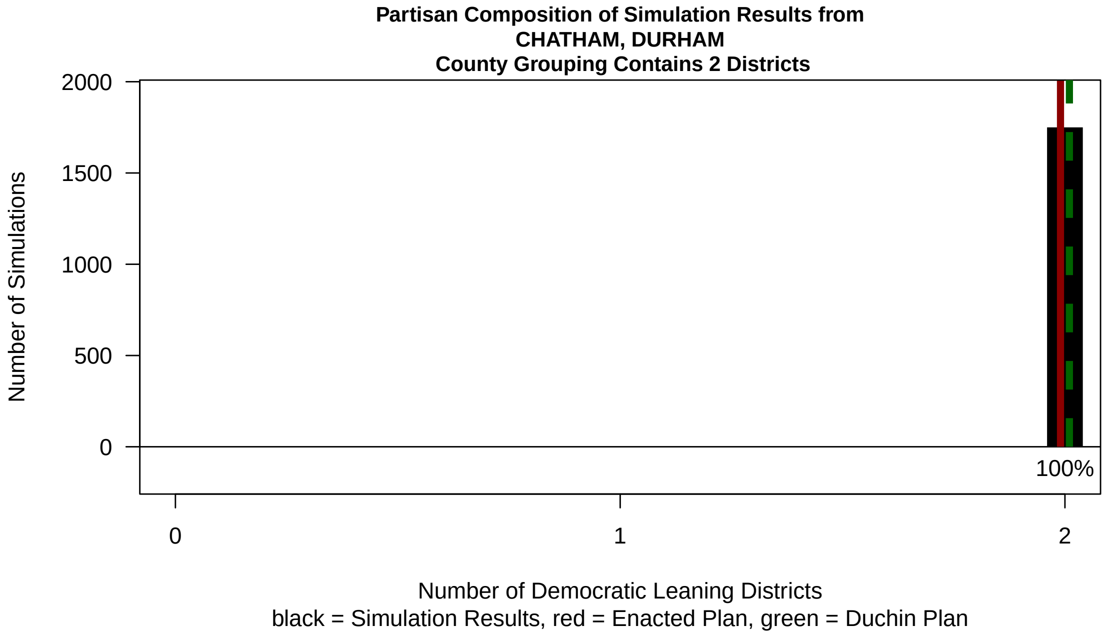



Partisan Lean of Districts

| 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**

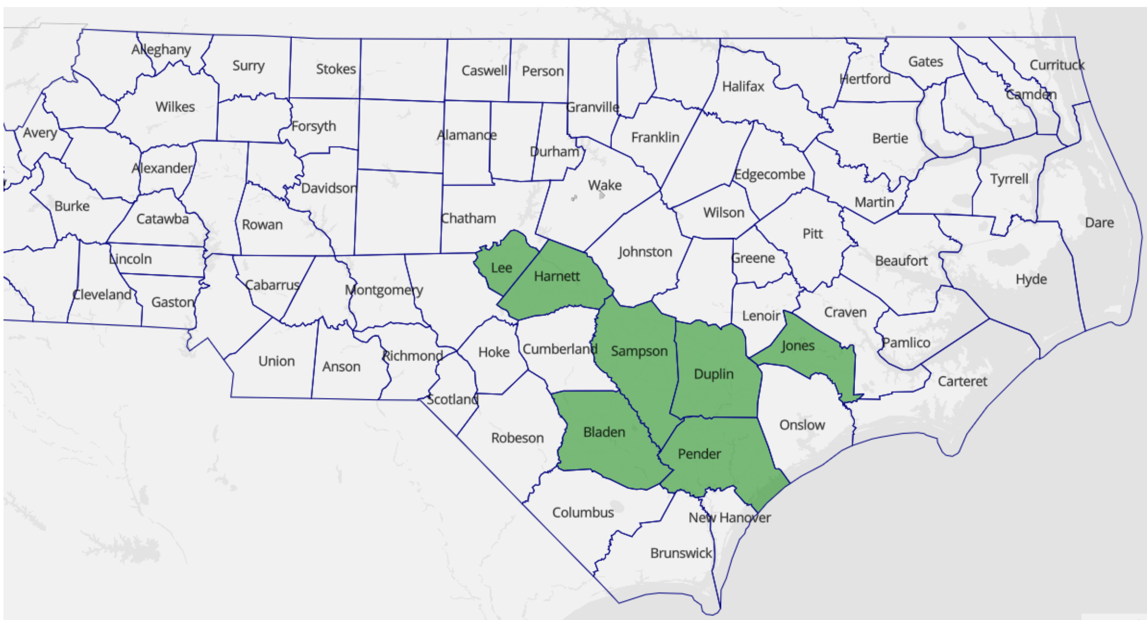
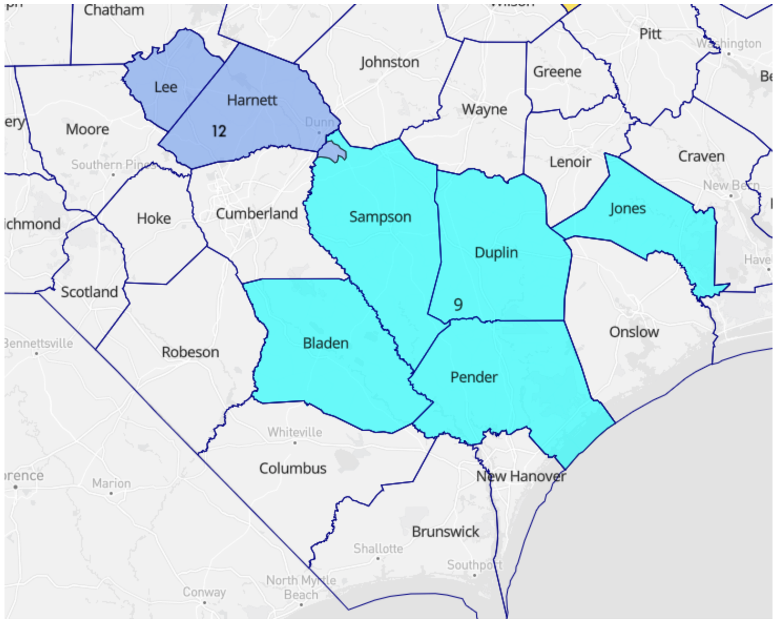
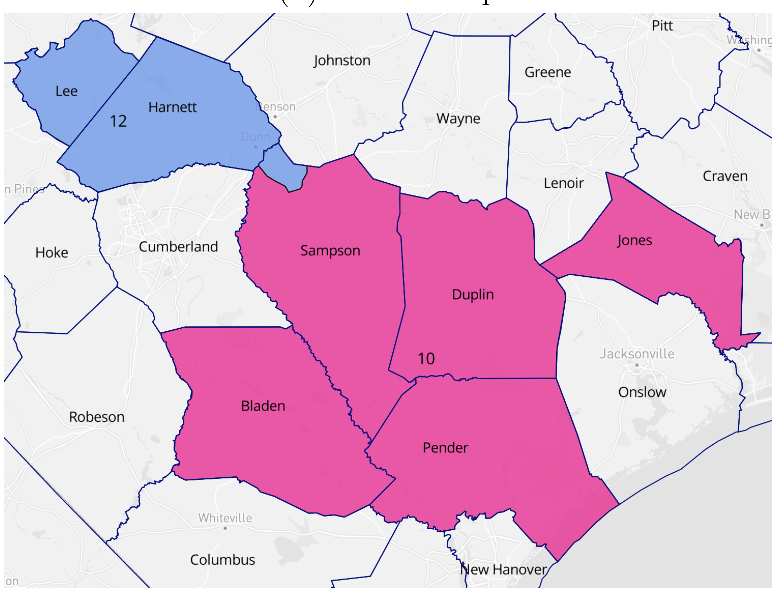


Figure 100: **Map of Enacted Plan in Bladen, Duplin, Harnett, Jones, Lee, Pender, and Sampson Senate County Cluster**

(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**

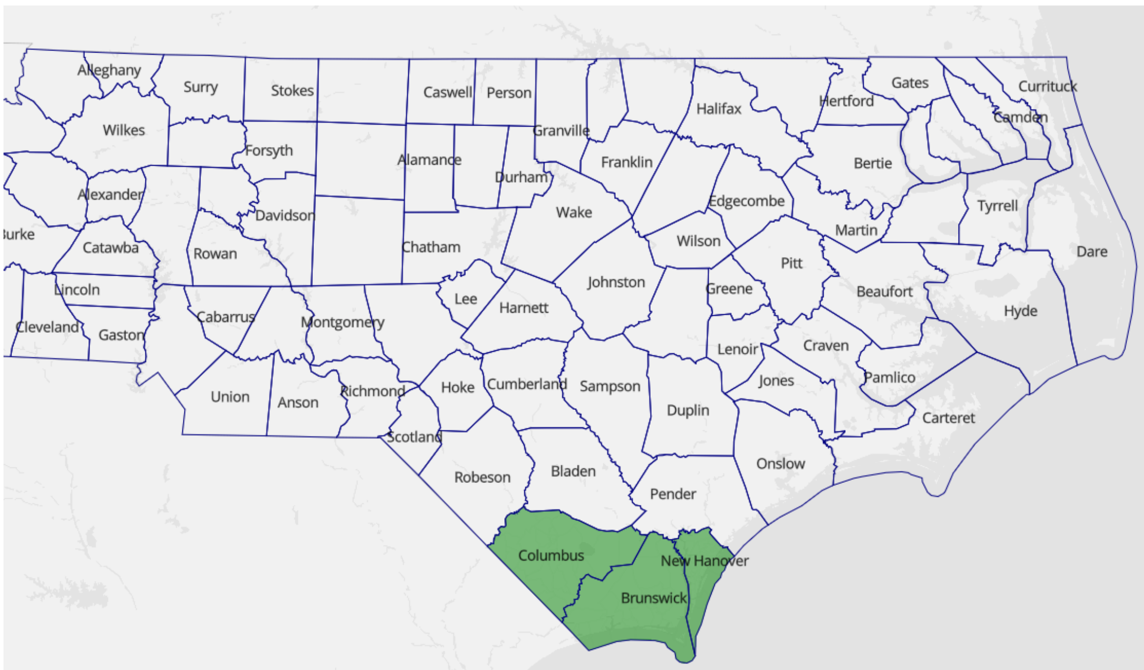
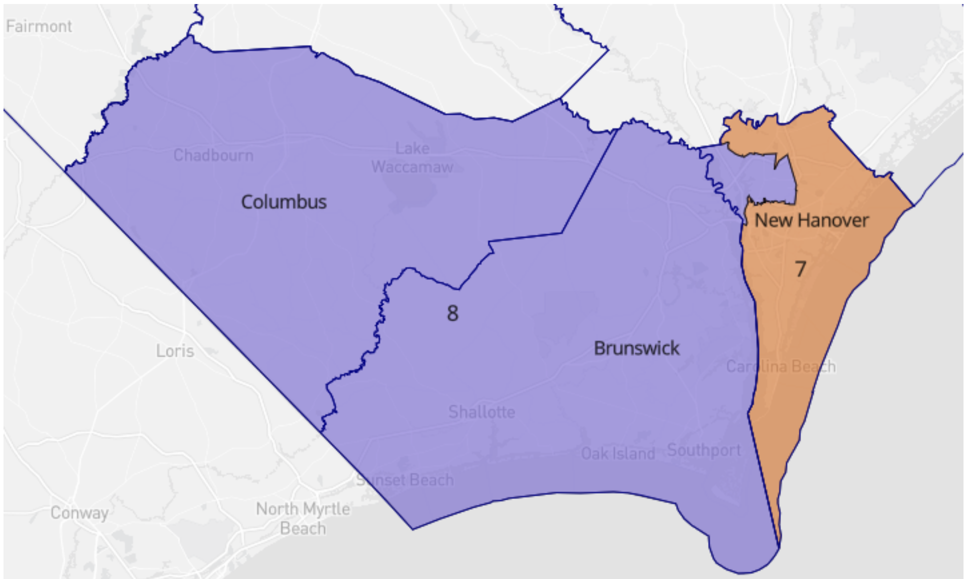
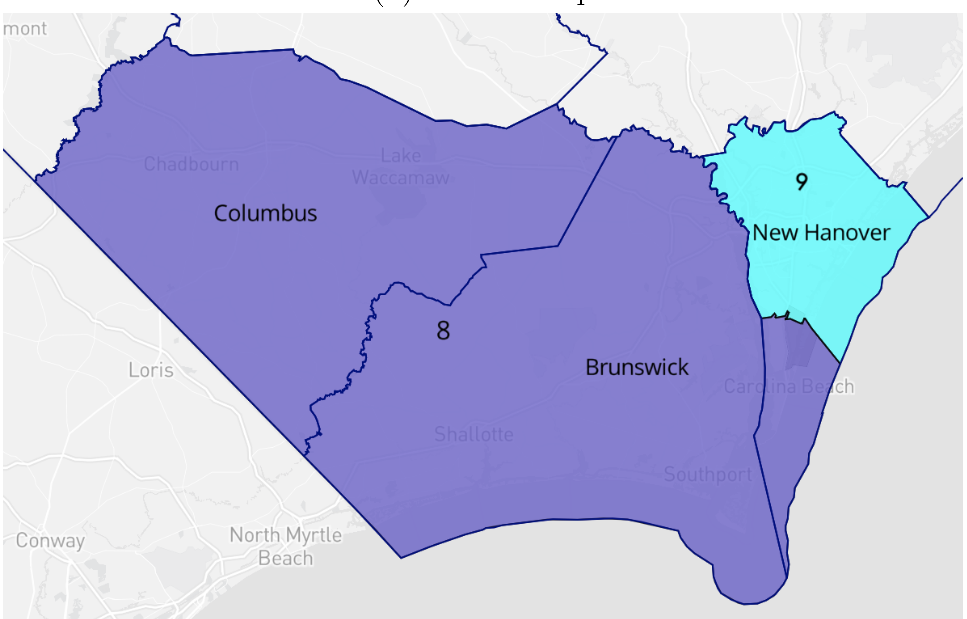


Figure 102: **Map of Enacted Plan in Brunswick, Columbus, and New Hanover Senate County Cluster**

(a) Enacted Map




(b) Duchin Map

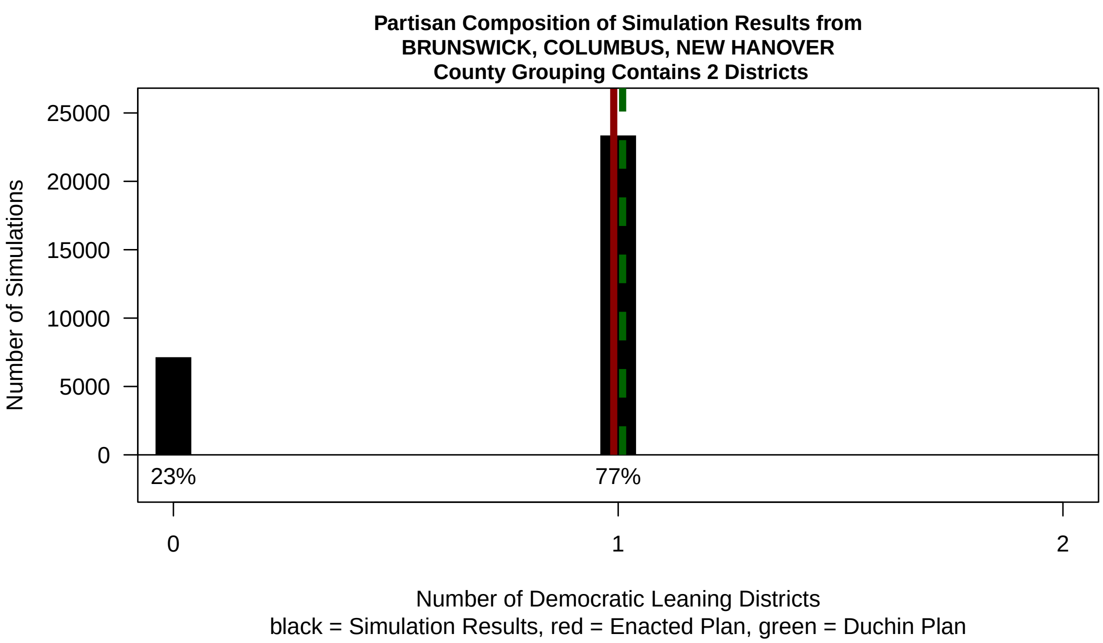


Partisan Lean of Districts

| 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**

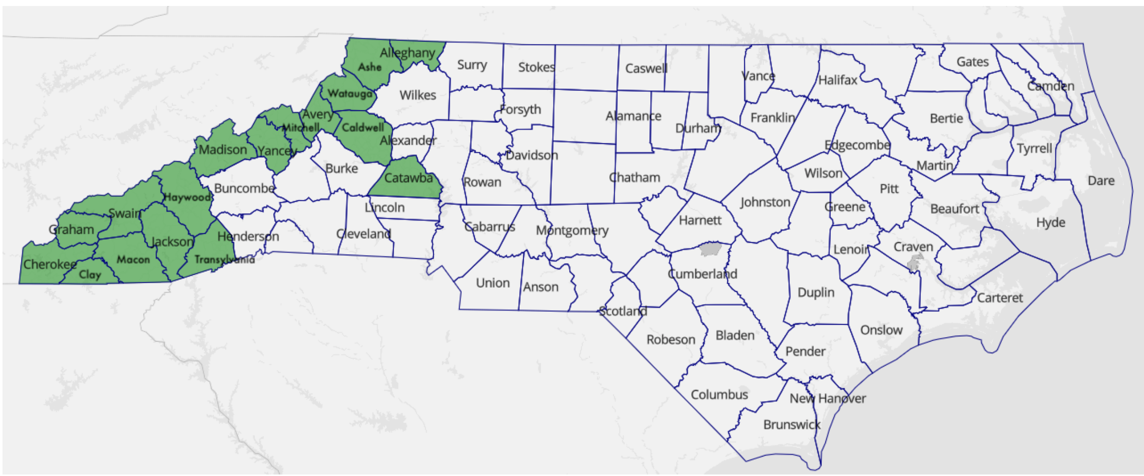
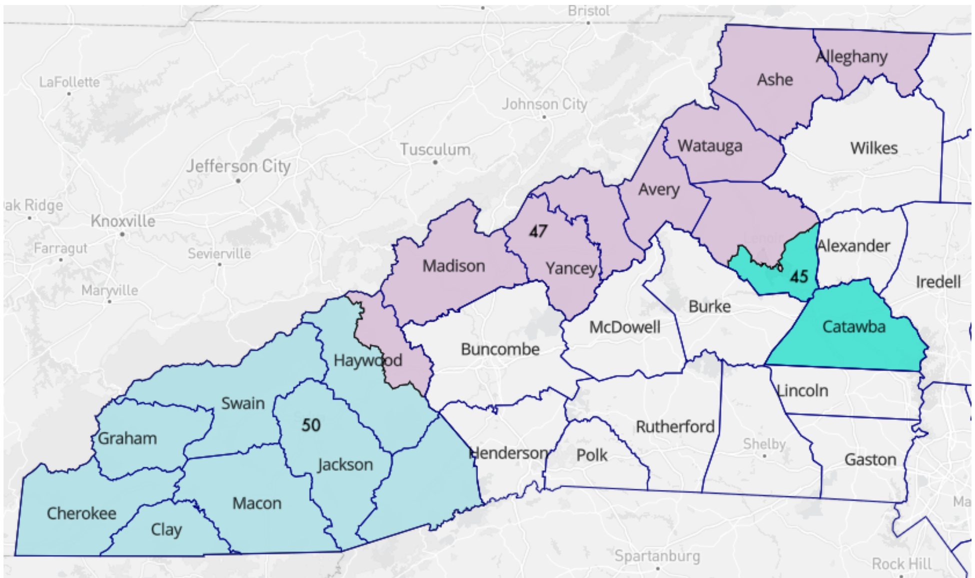
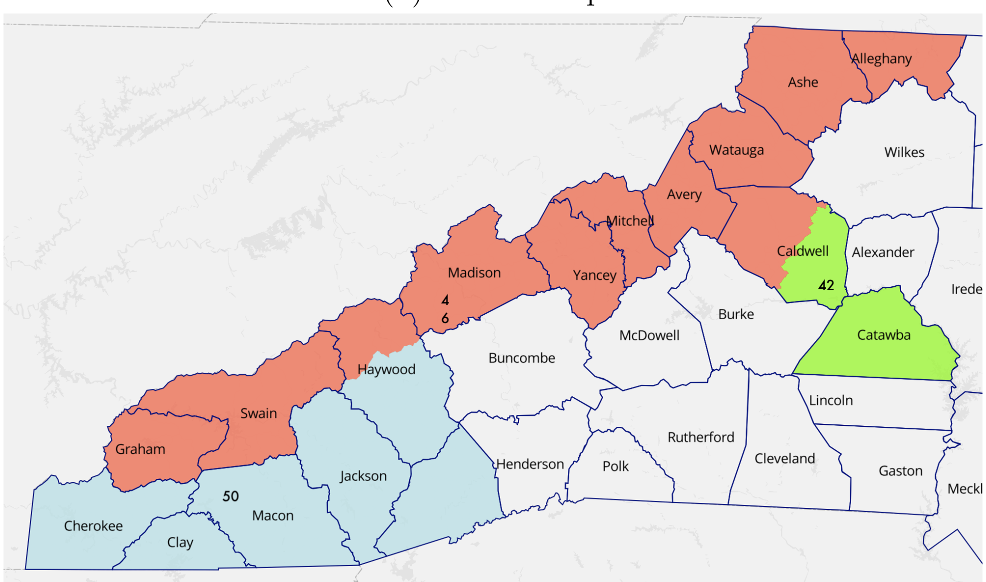


Figure 105: **Map of Enacted Plan in Alleghany, Ashe, Avery, Caldwell, Catawba, Cherokee, Clay, Graham, Haywood, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, and Yancey Senate County Cluster**

(a) Enacted Map




(b) Duchin Map

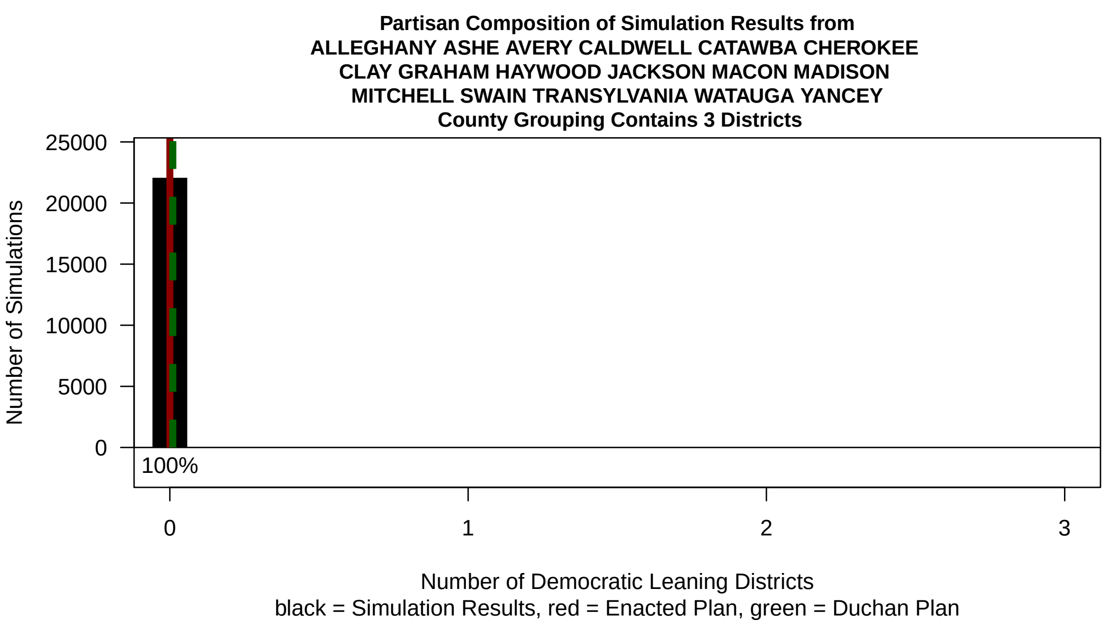


Partisan Lean of Districts

| 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

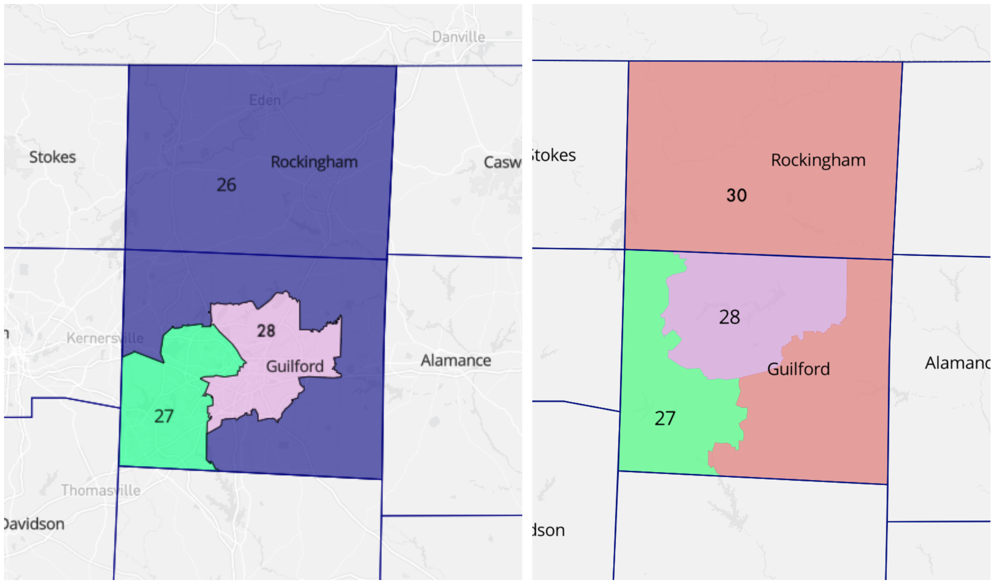
| | Percent of Greensboro in district | |
|---|---|---|
| District: | Enacted Plan | Duchin Plan |
| 26 (30 in Duchin) | 4.3 | 19.6 |
| 27 | 30.8 | 20.4 |
| 28 | 64.9 | 60.0 |
| Total: | 100% | 100% |

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

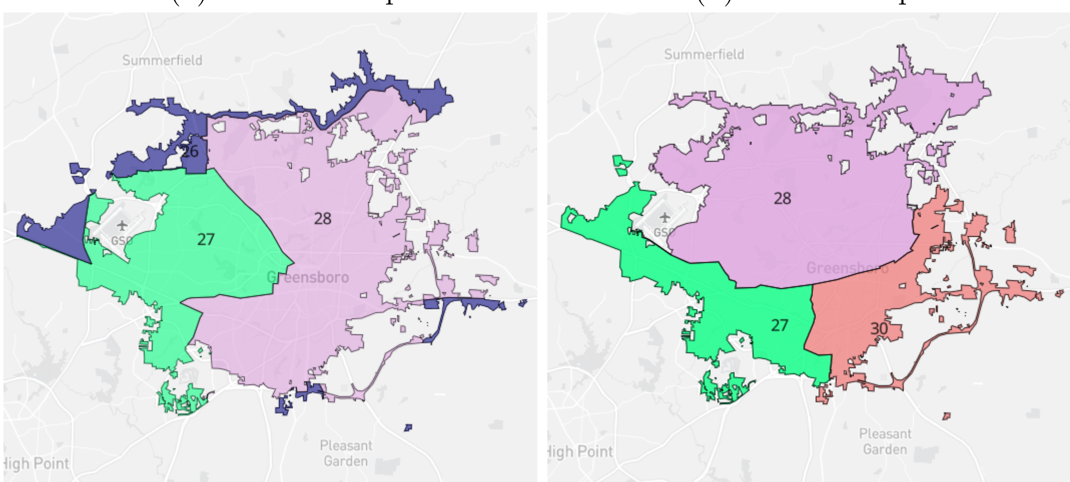
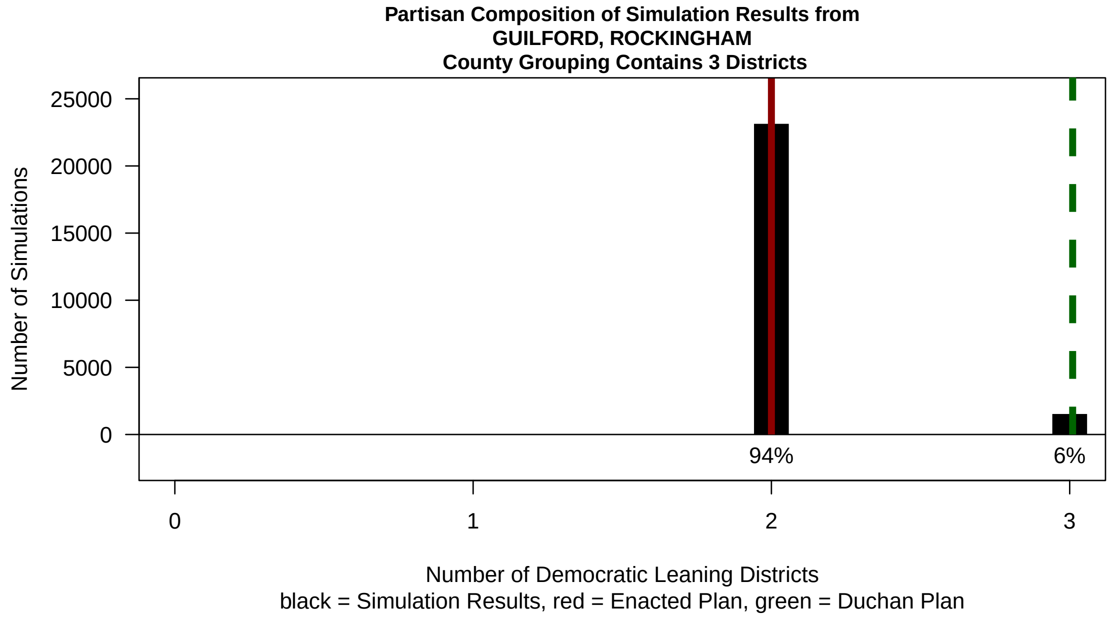


Figure 110: **Distribution of Partisan Districts from Simulations in Guilford and Rockingham Senate County Cluster**




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**

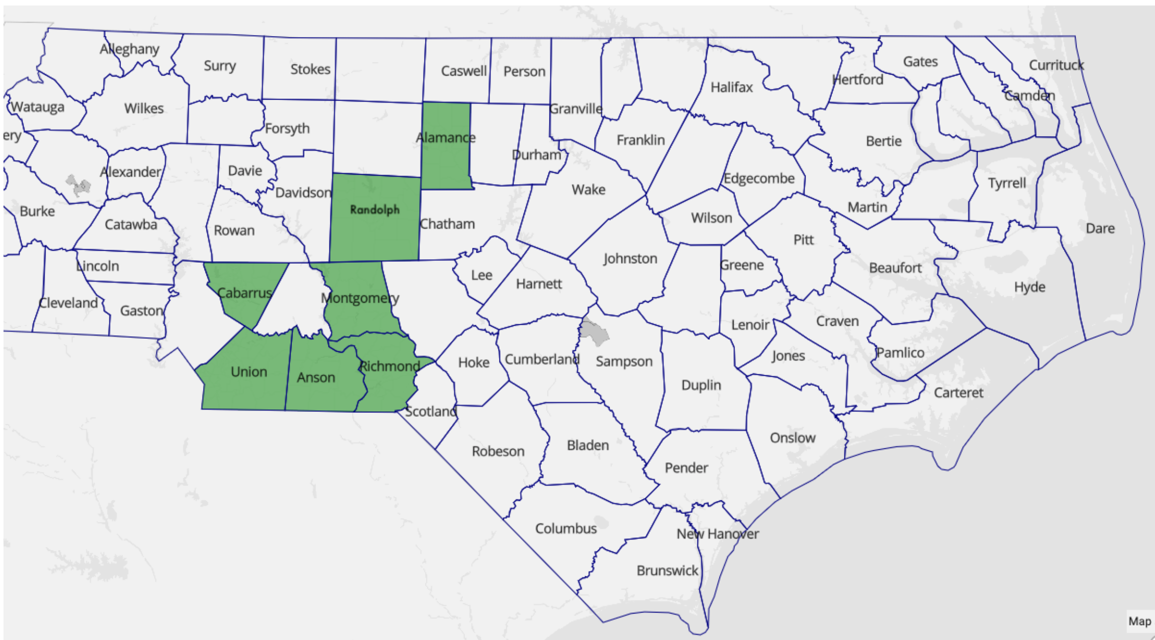
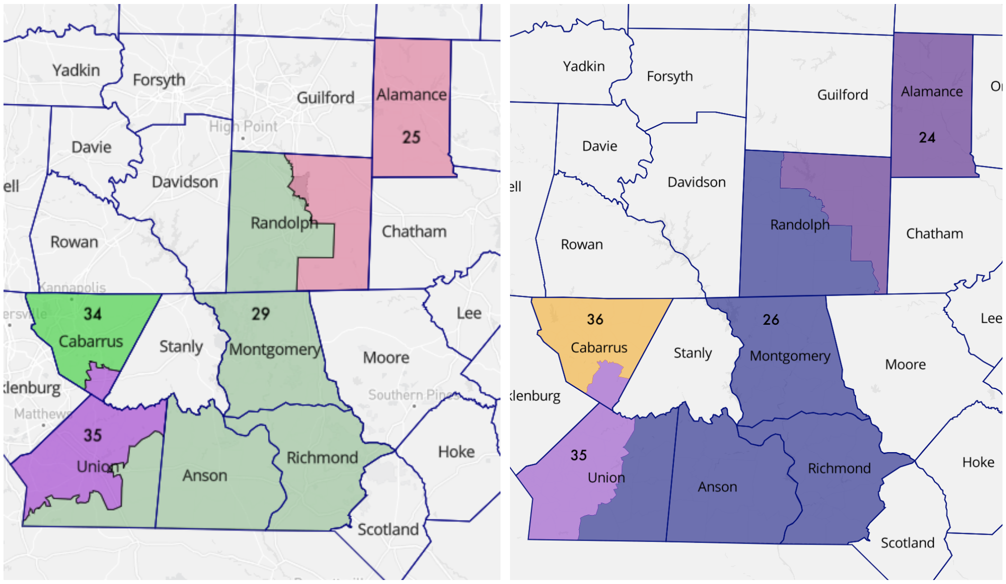


Figure 112: **Map of Enacted Plan in Alamance, Anson, Cabarrus, Montgomery, Randolph, Richmond, and Union Senate County Cluster**

(a) Enacted Map (b) Duchin Map

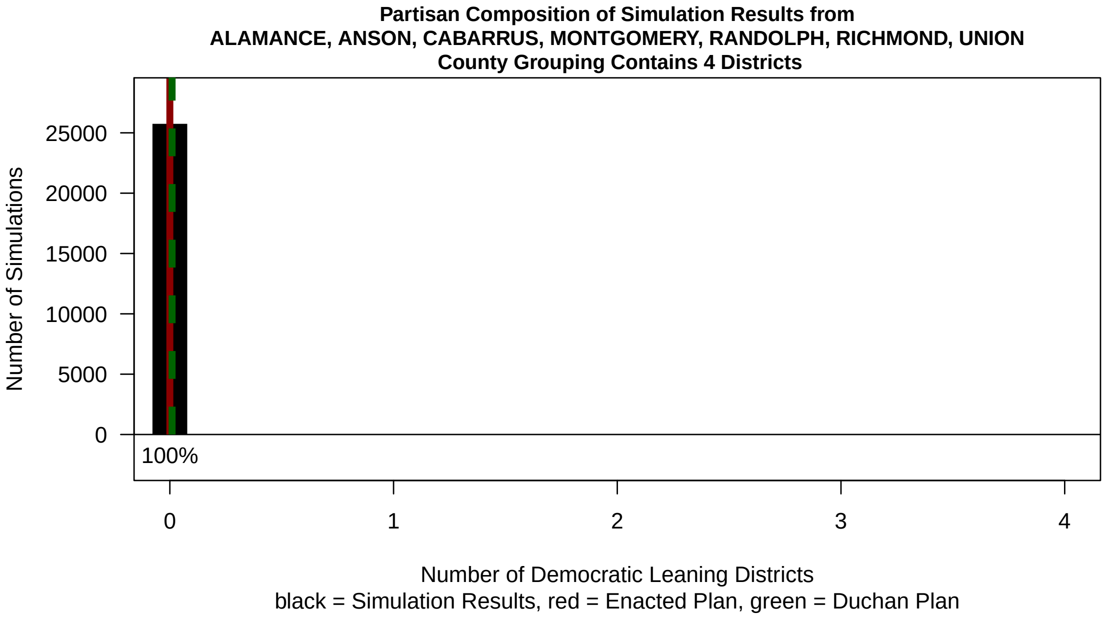



Partisan Lean of Districts

| 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**

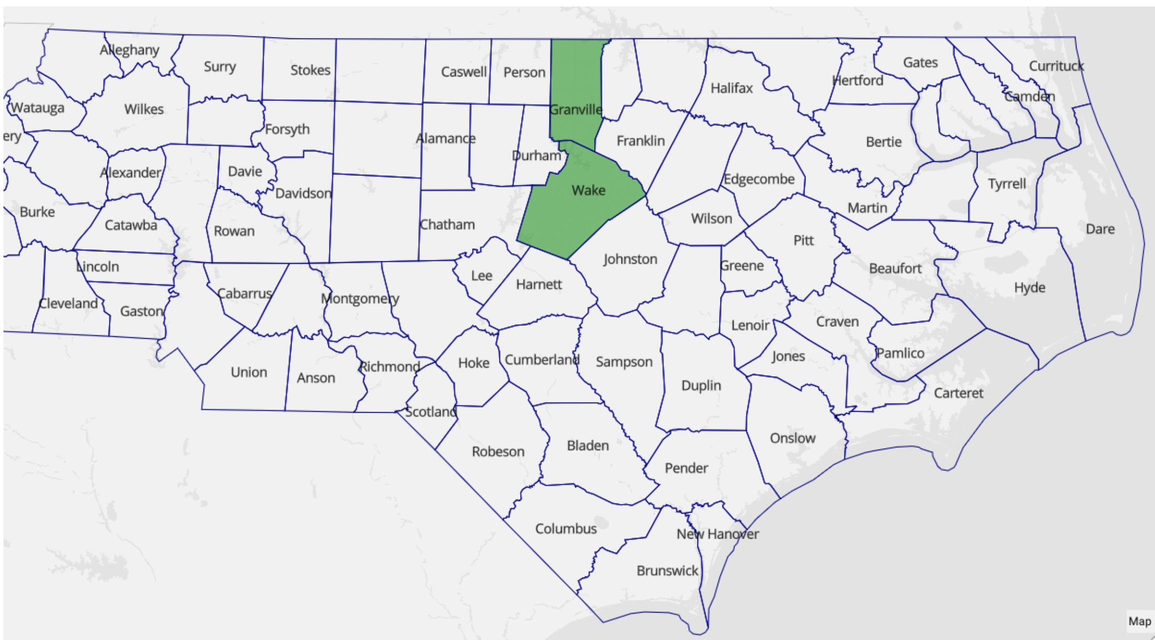
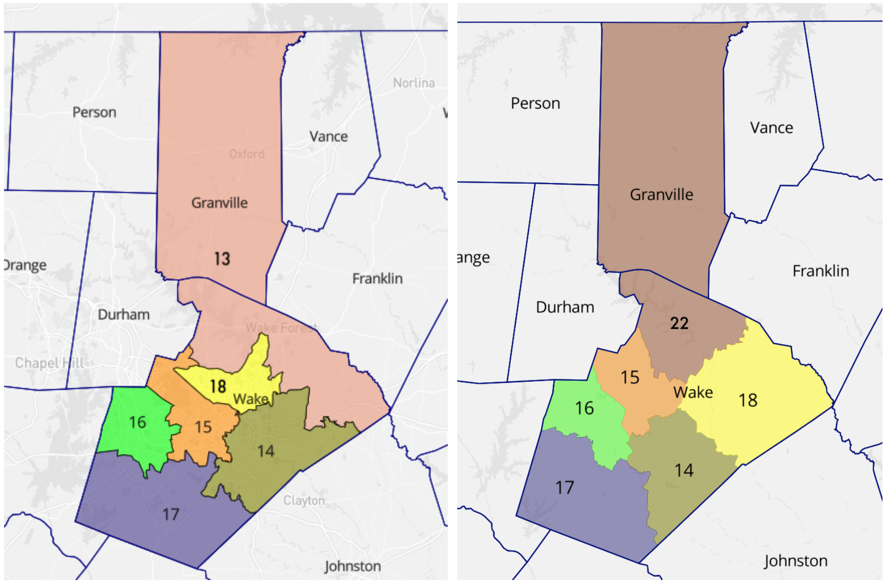


Figure 115: **Map of Enacted Plan in Granville and Wake Senate County Cluster**

(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

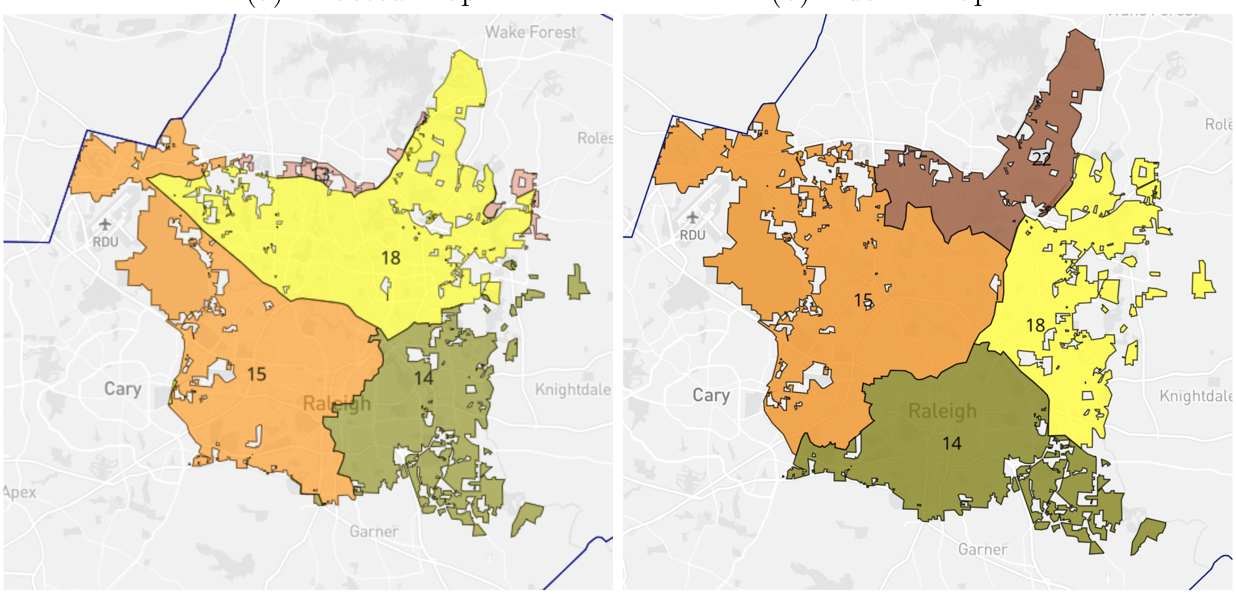
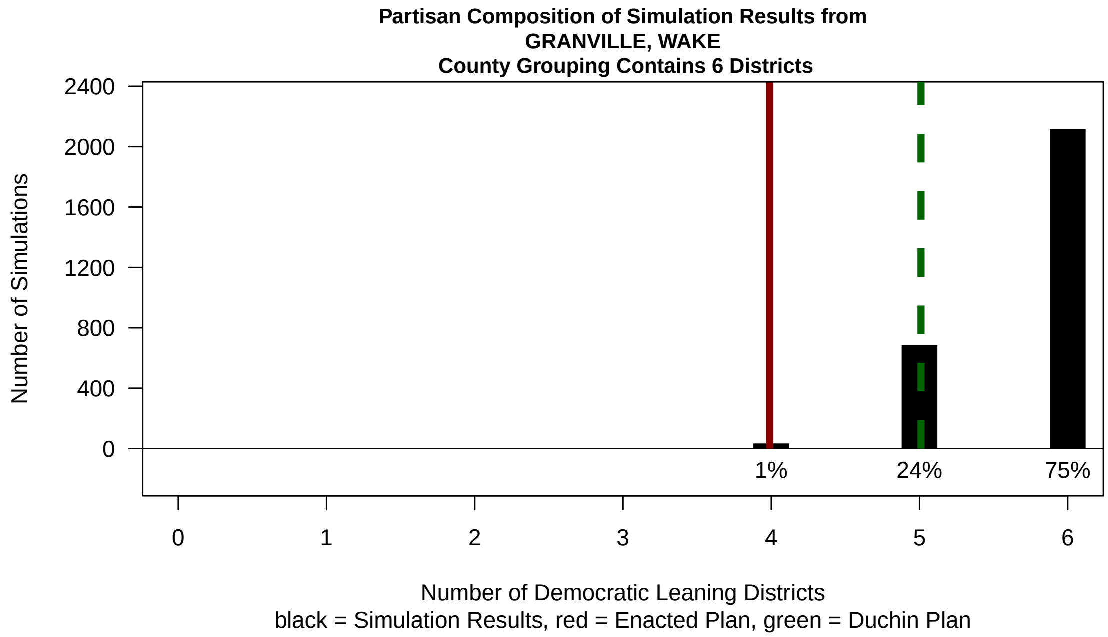


Figure 117: **Distribution of Partisan Districts from Simulations in Granville and Wake Senate County Cluster**




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.

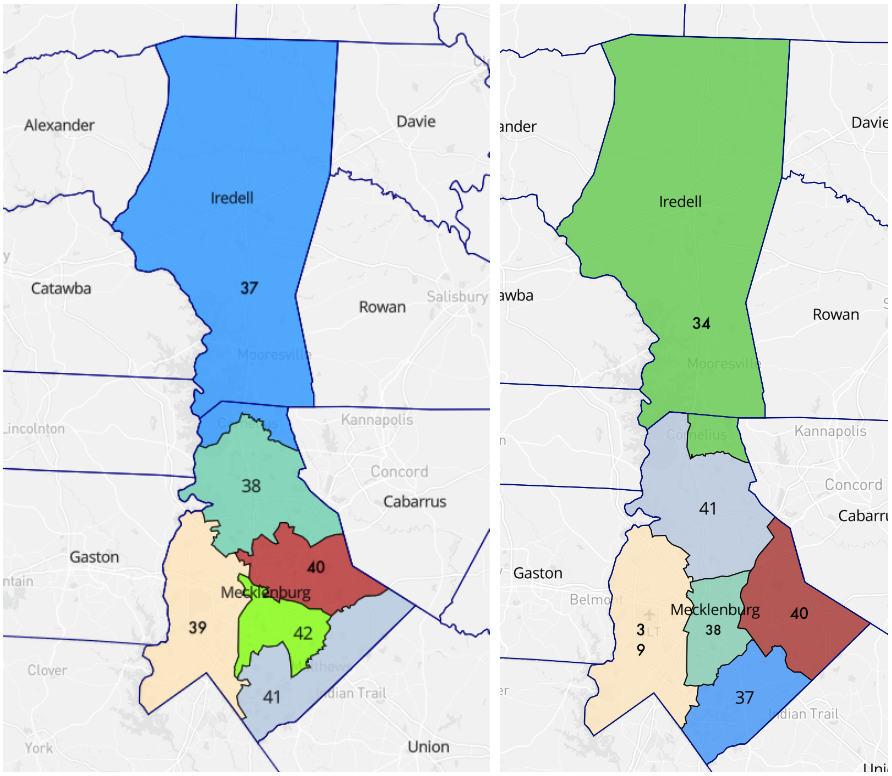
Why is the Enacted Plan an outlier in this county grouping? There are two factors to consider in explaining this divergence. First, while the Enacted Plan generates 4 solidly Democratic leaning districts, the remaining two districts are not solidly Republican. Instead, one is solidly Republican. District 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

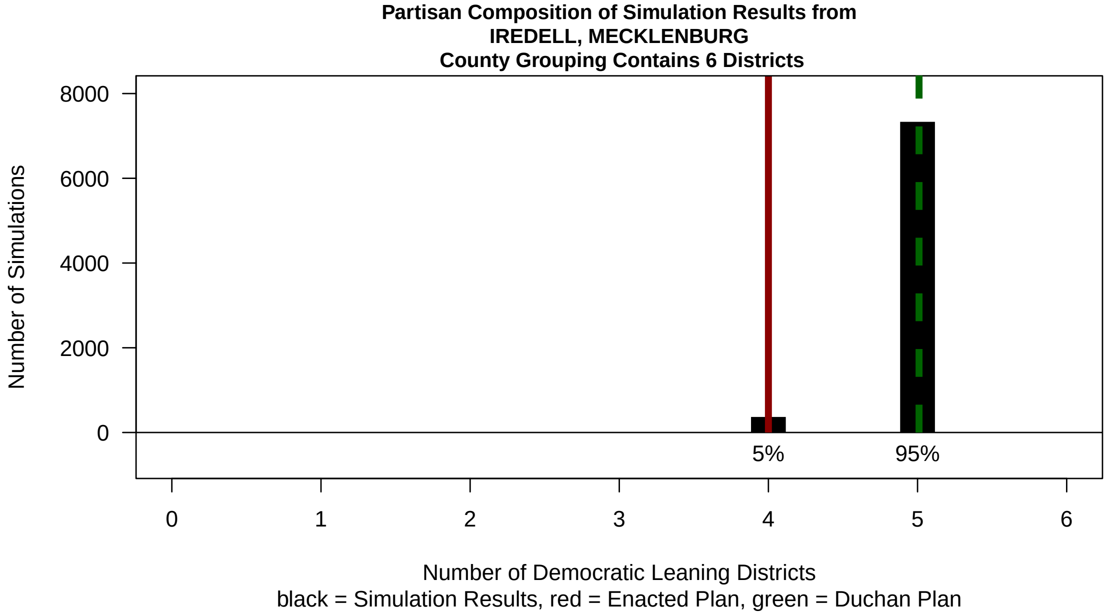



Partisan Lean of Districts

| 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**

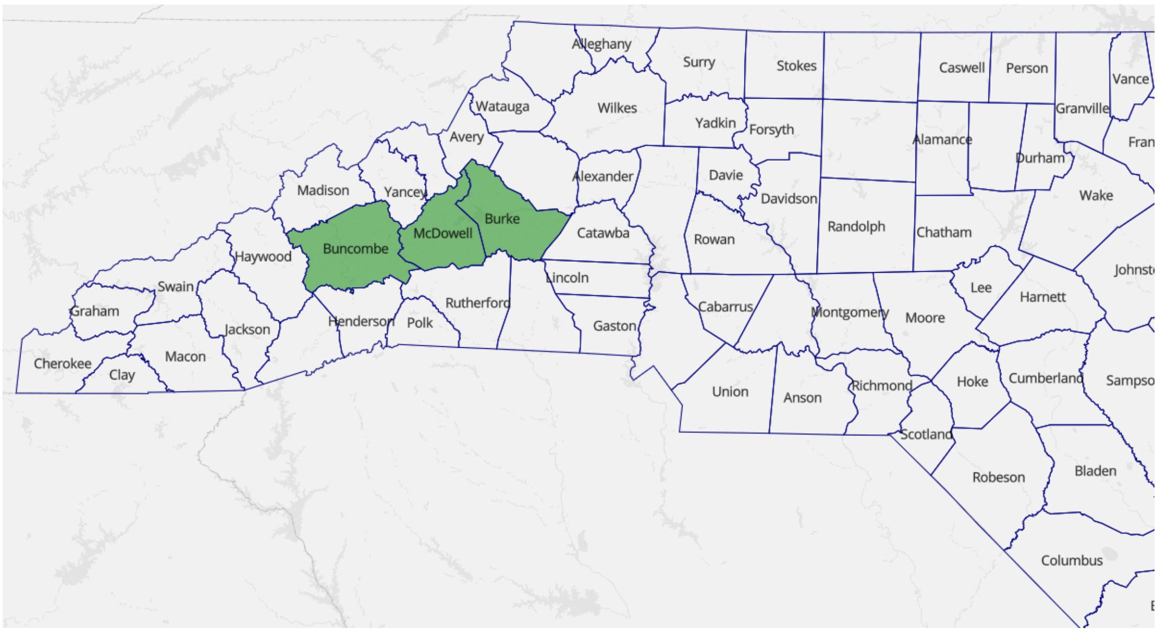
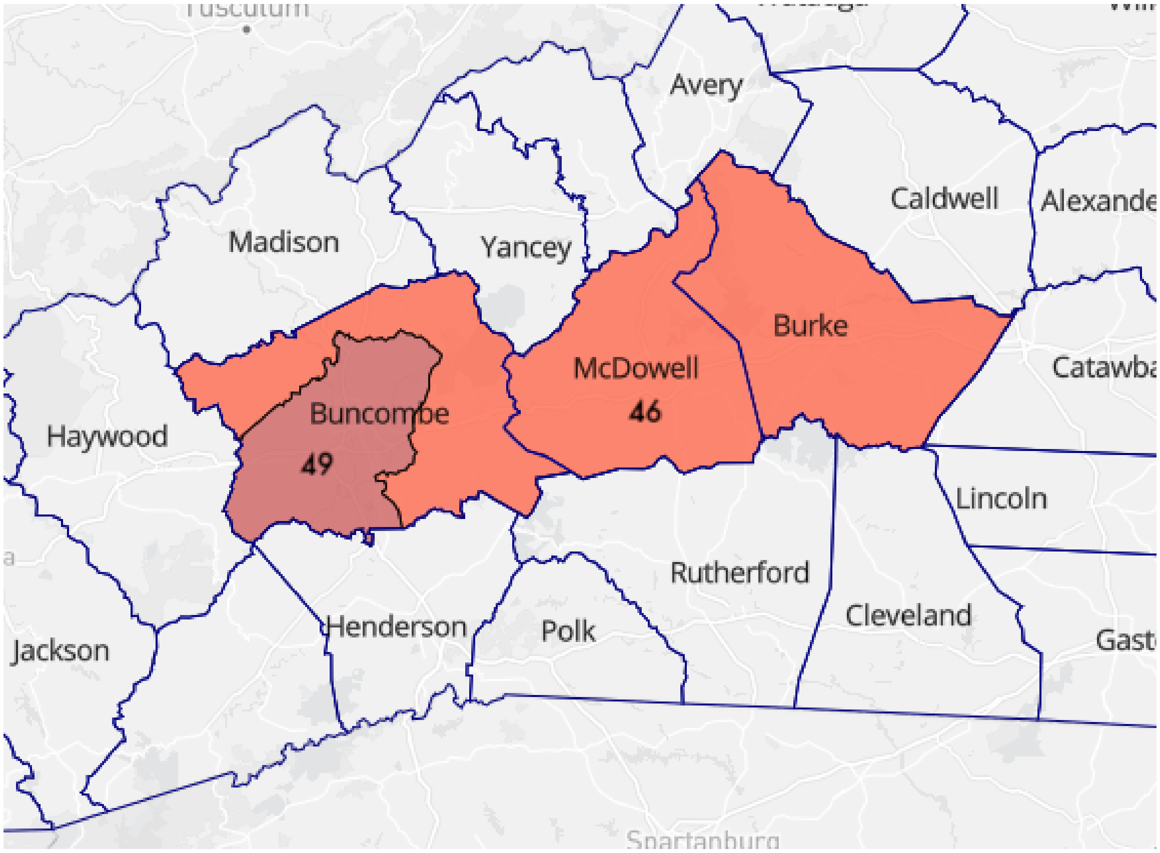


Figure 122: **Map of Enacted Plan in Buncombe, Burke, and McDowell Senate County Cluster**

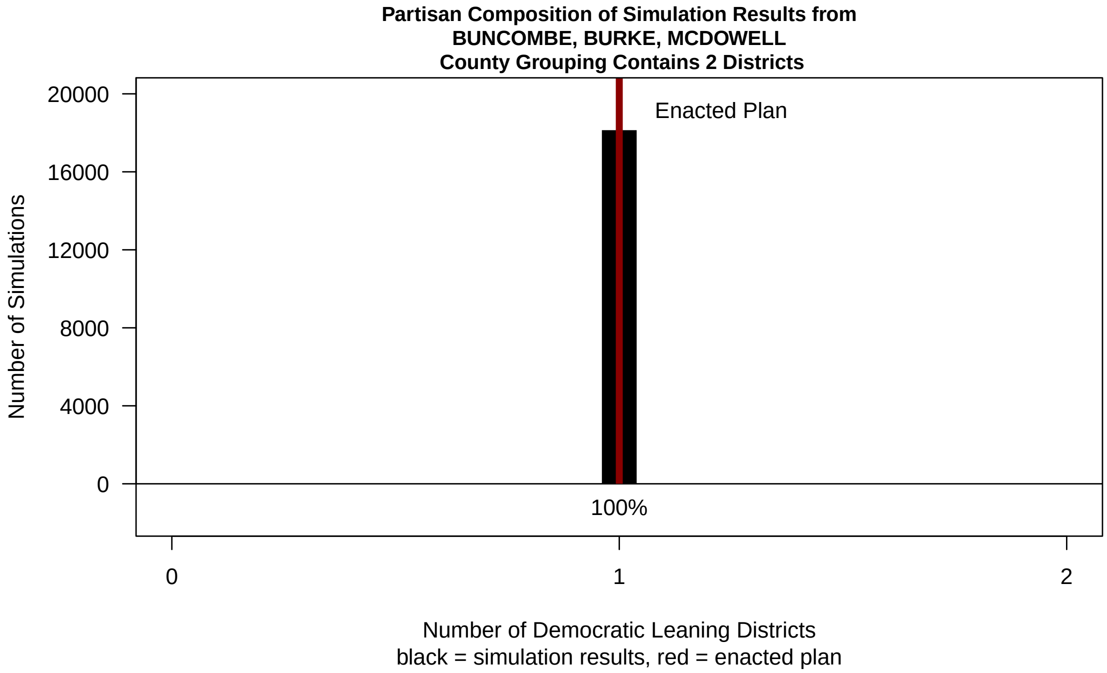



Partisan Lean of Districts

| 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**

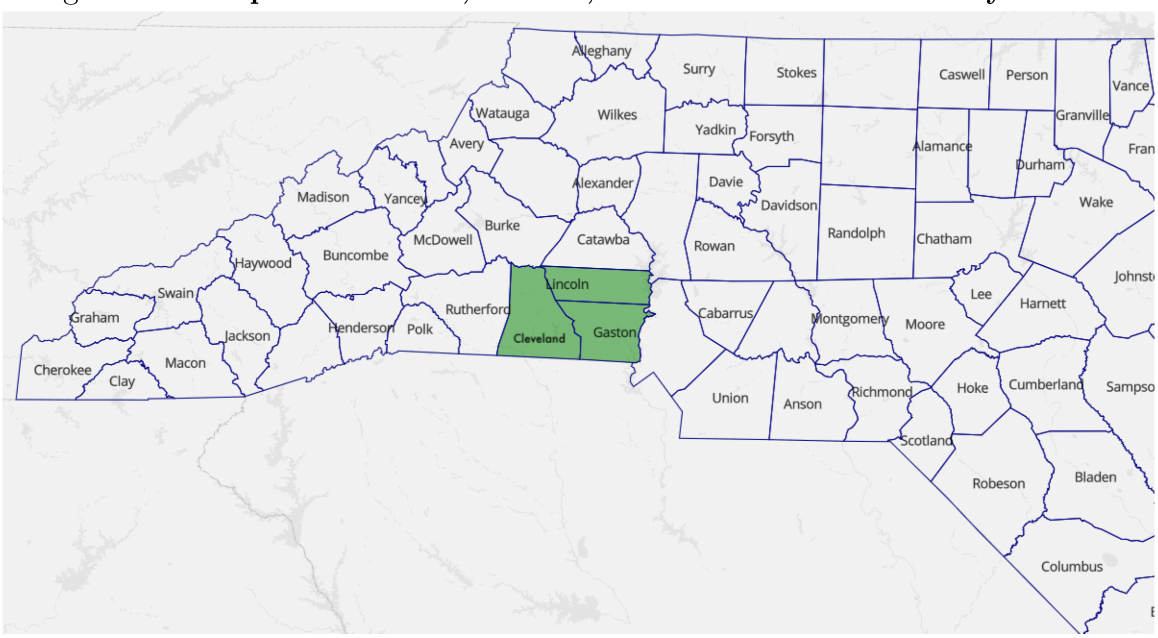
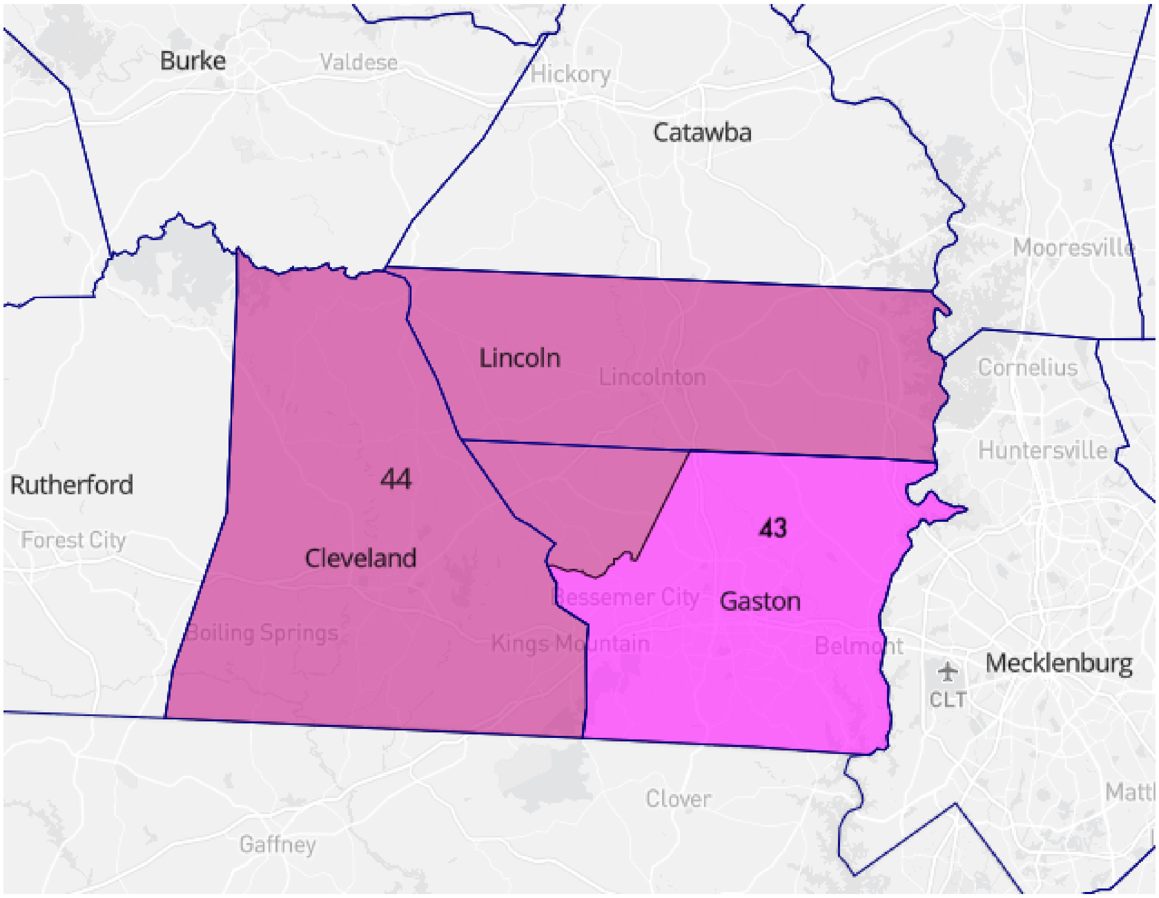


Figure 125: **Map of Enacted Plan in Cleveland, Gaston, and Lincoln Senate County Cluster**




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.

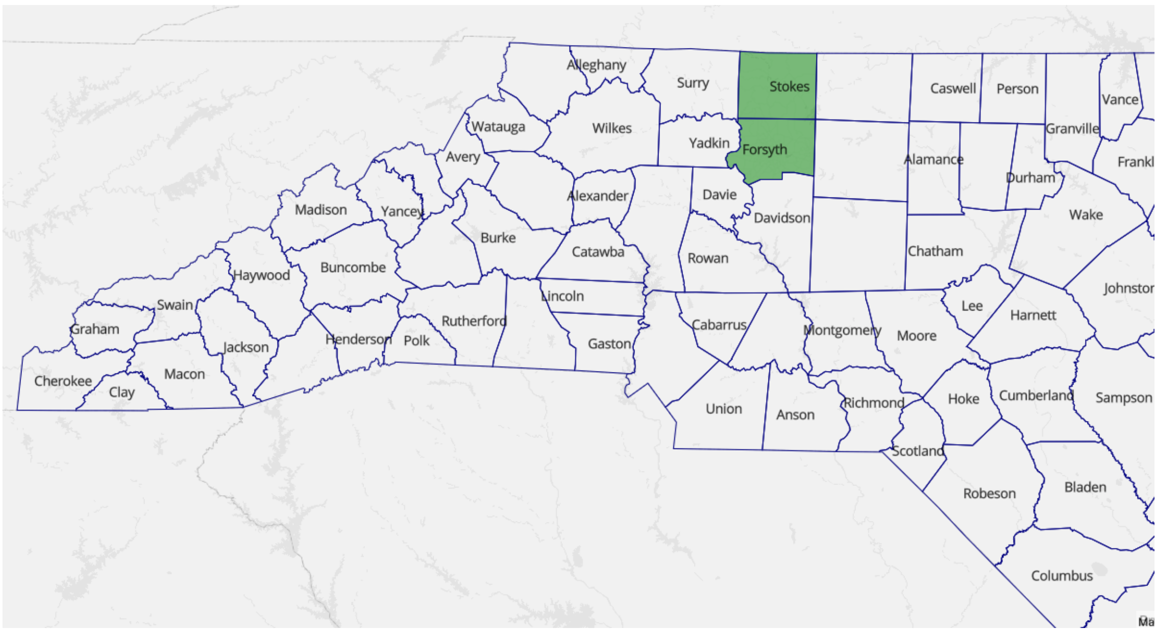
A map of the location of this county cluster in relation to the rest of the state is shown in Figure 126. A map of the Enacted Map's district boundaries is shown in Figure 127. The Duchin Plan uses an alternative county grouping and is therefore not comparable to this cluster in the Enacted Plan. I analyze 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**

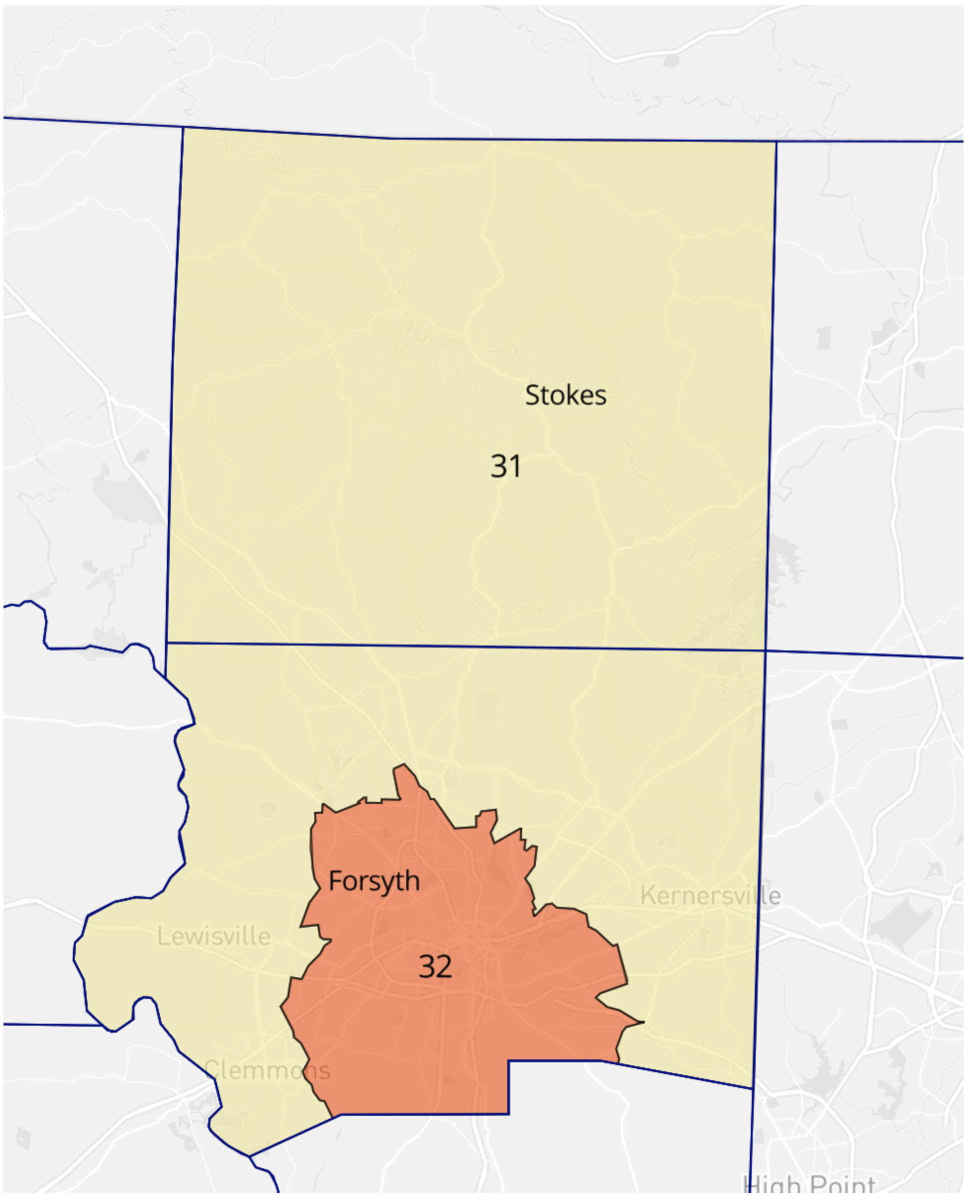
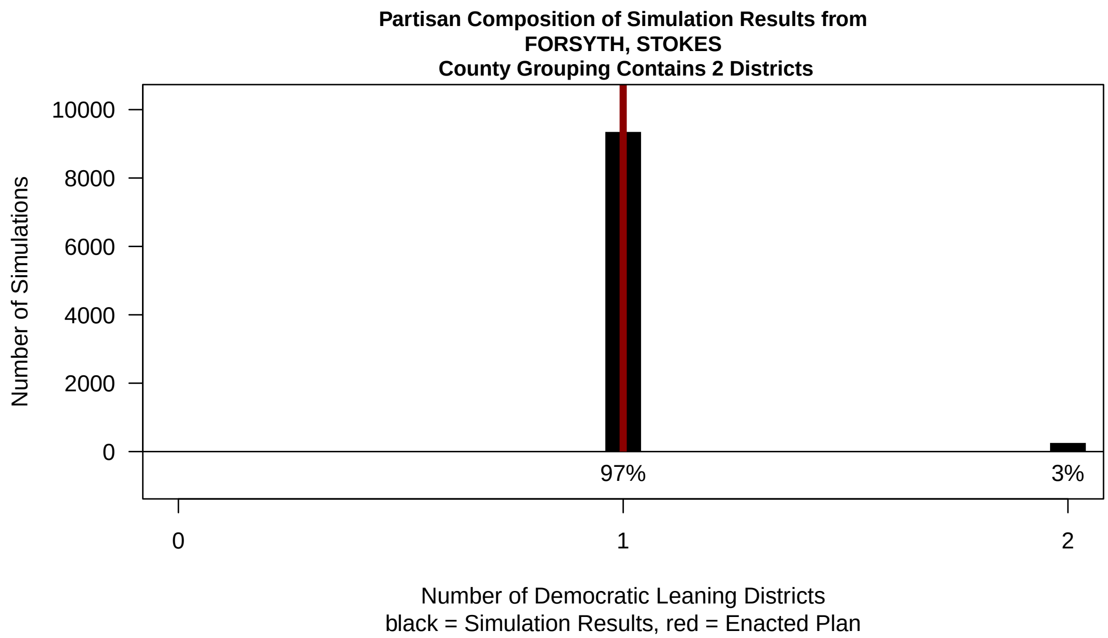


Figure 128: **Distribution of Partisan Districts from Simulations in Forsyth and Stokes Senate County Cluster**




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**

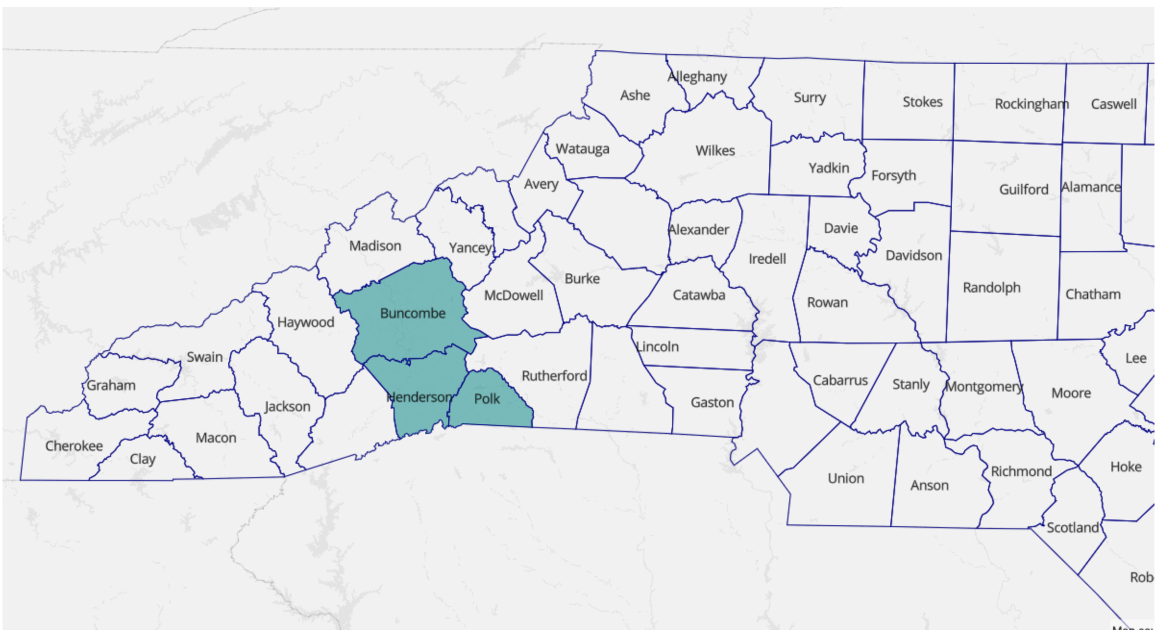
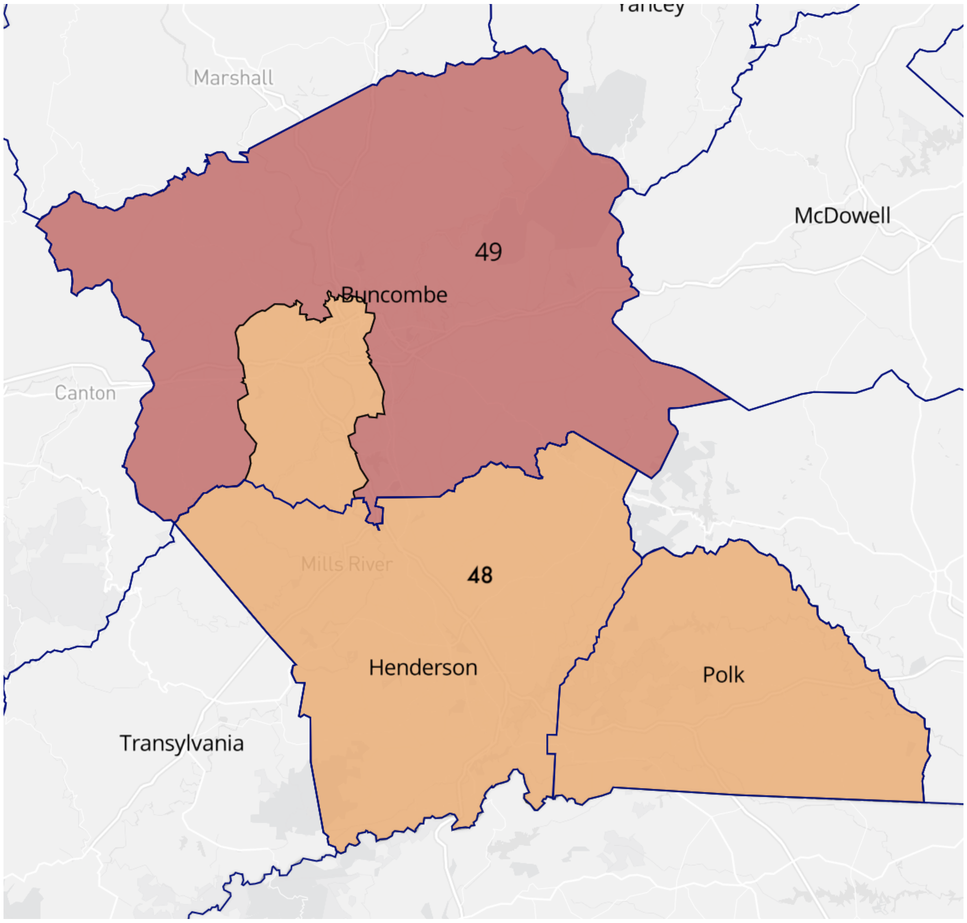


Figure 130: **Map of Duchin Plan in Buncombe, Henderson, and Polk Alternative Senate County Cluster**




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

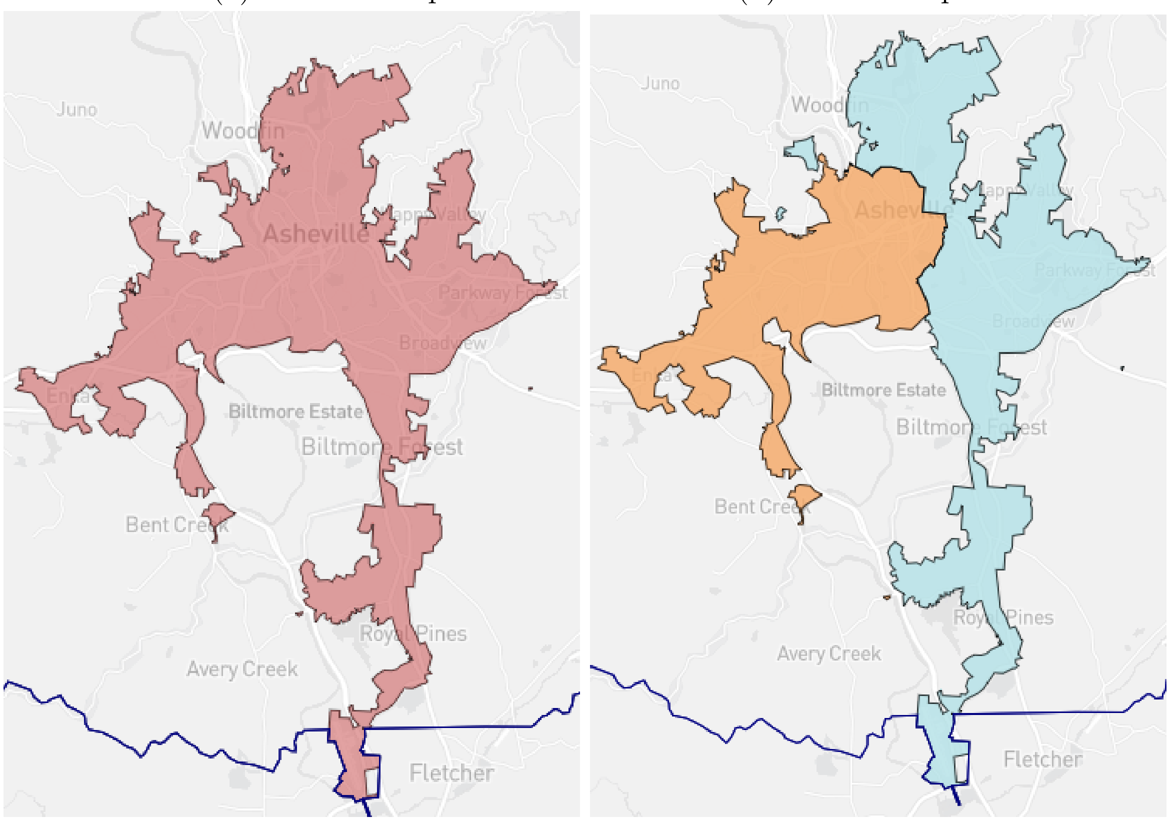
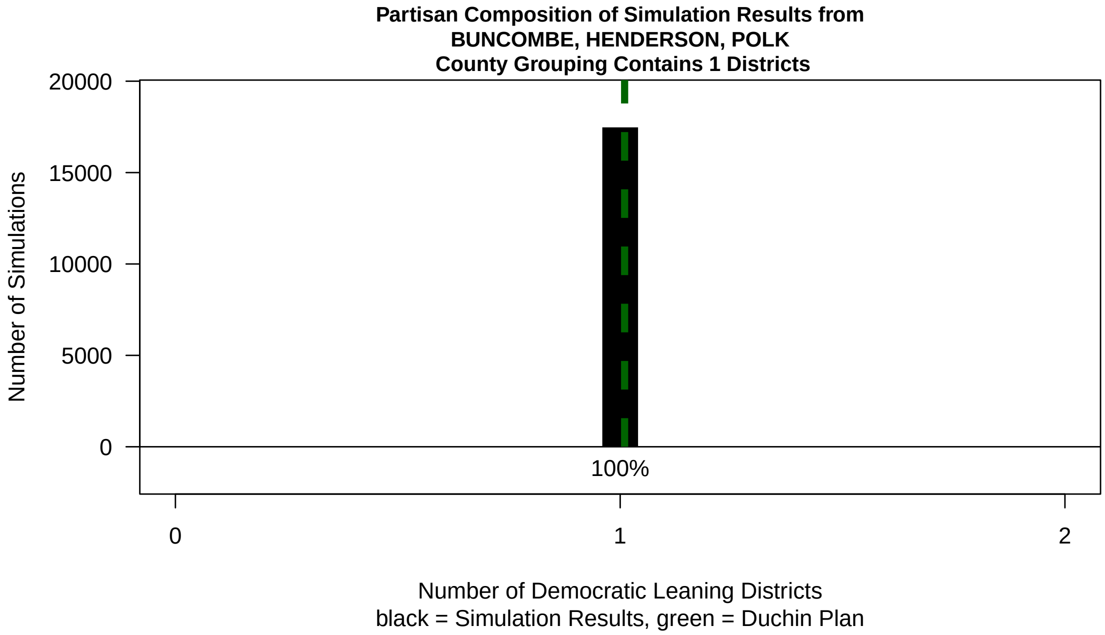


Figure 132: **Distribution of Partisan Districts from Simulations in Buncombe, Henderson, and Polk Alternative Senate County Cluster**




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**

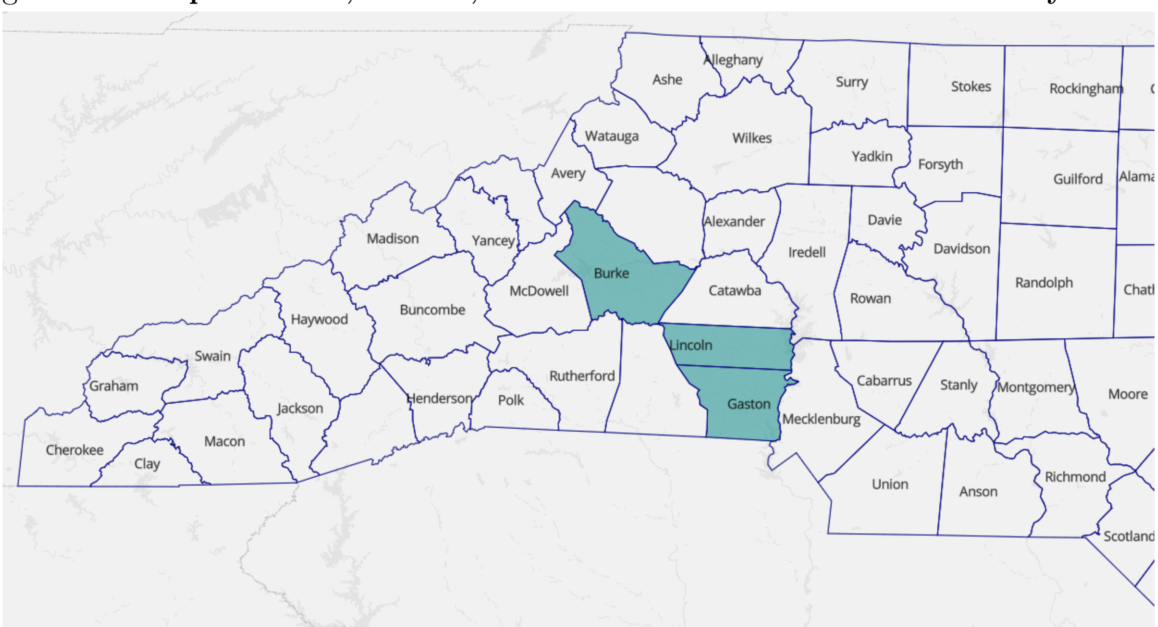
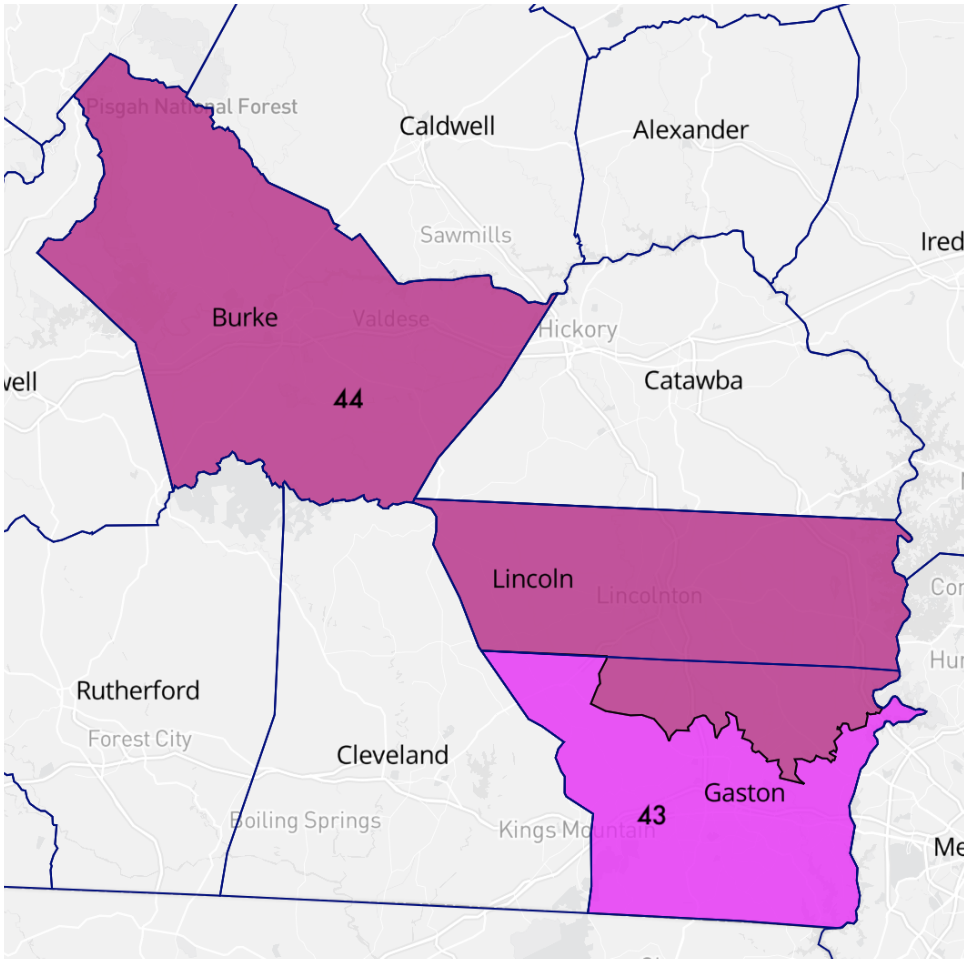


Figure 134: **Map of Duchin Plan in Burke, Gaston, and Lincoln Alternative Senate County Cluster**

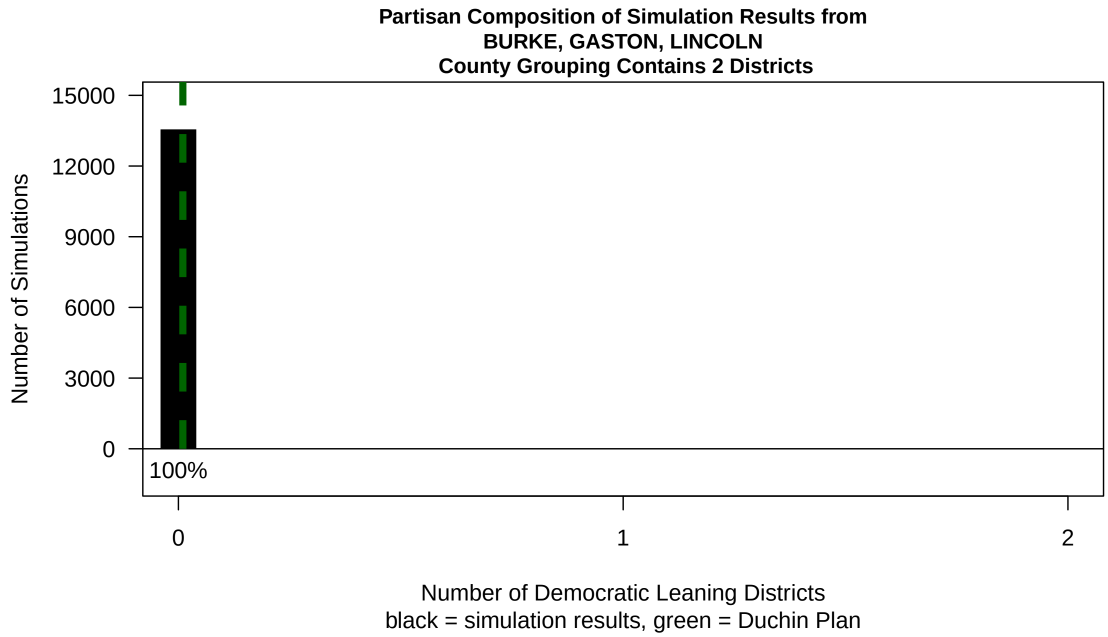



Partisan Lean of Districts

| 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**

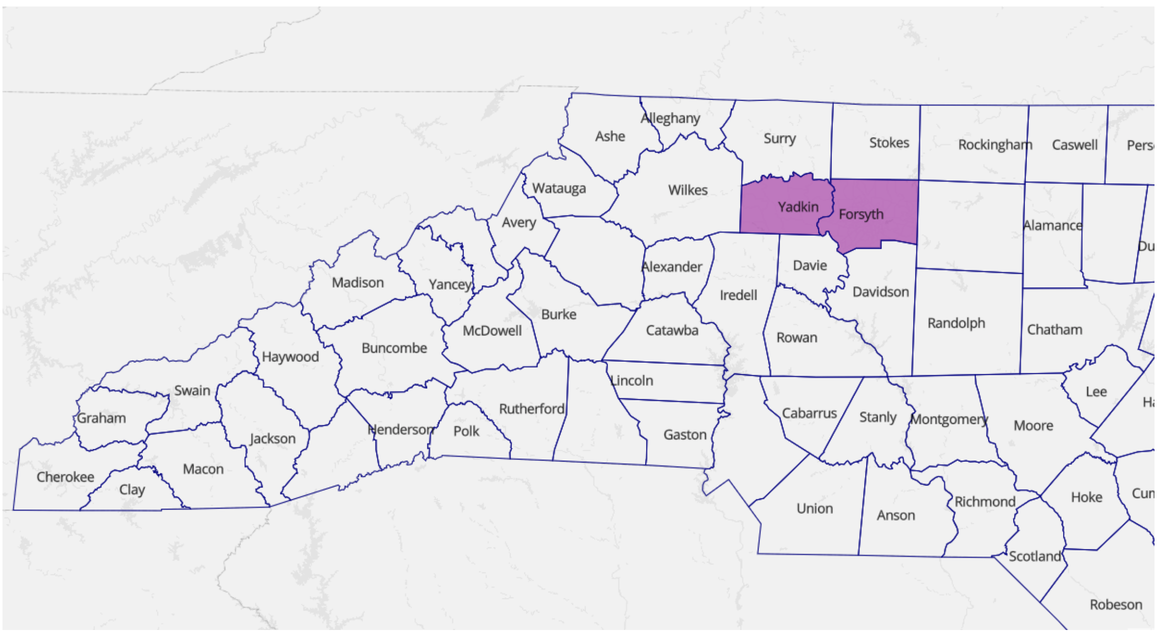


Figure 137: **Map of Duchin Plan in Forsyth and Yadkin Alternative Senate County Cluster**

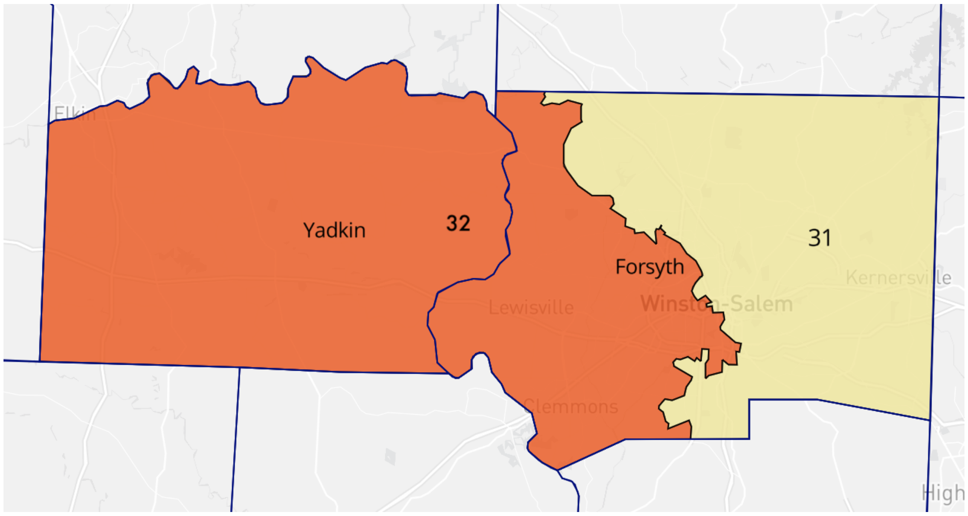
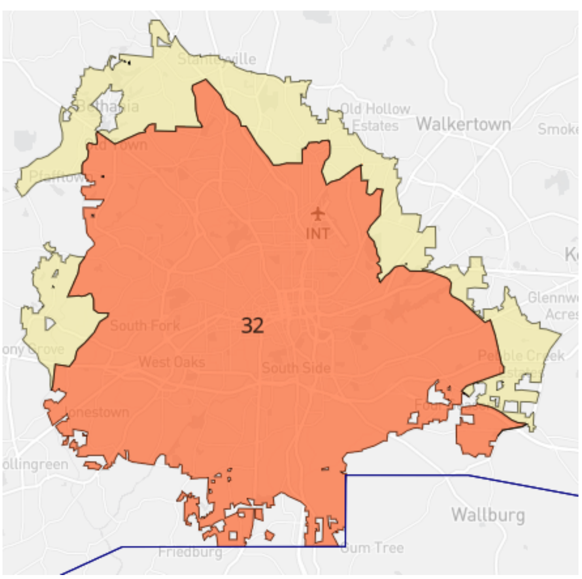
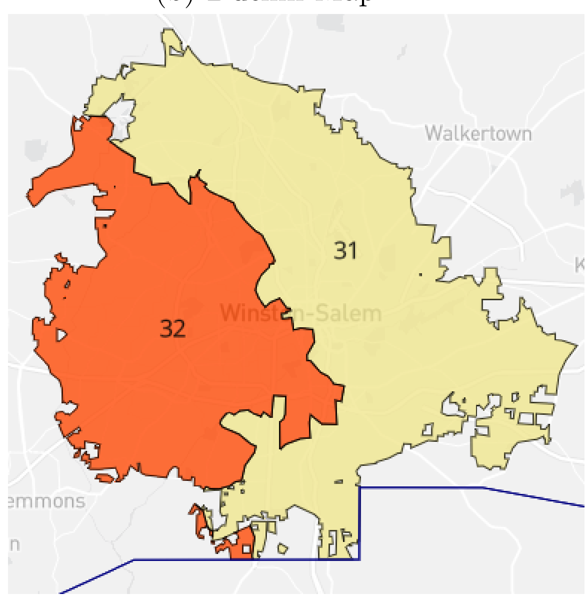



Figure 138: **Map of Division of Winston-Salem in Enacted and Duchin Senate Plans**

(a) Enacted Map




(b) Duchin Map

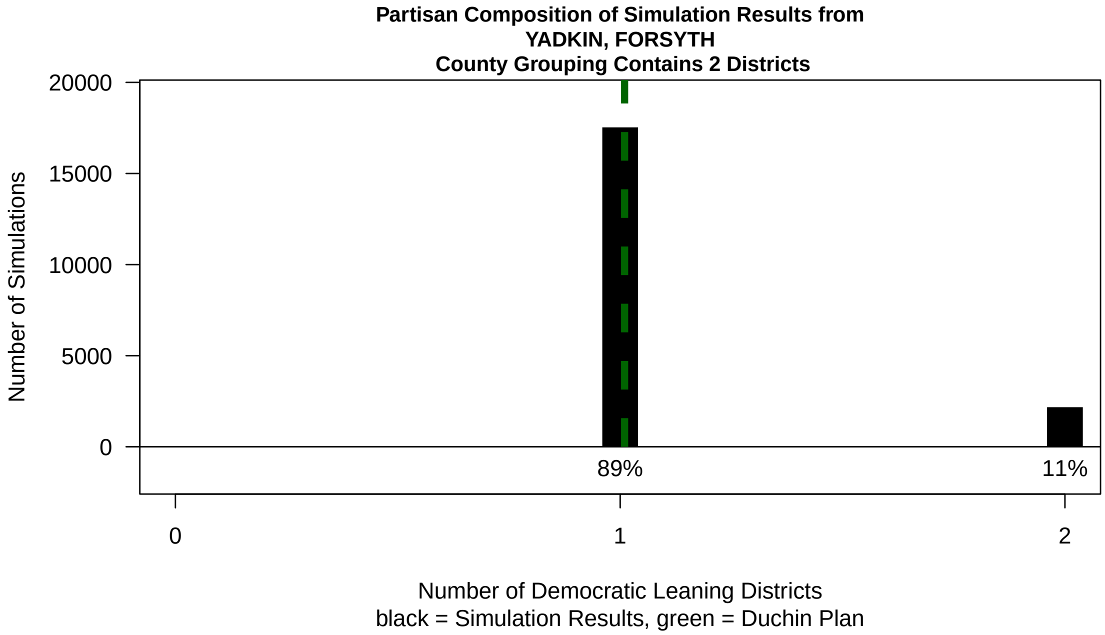


Partisan Lean of Districts

| 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.

# Michael Jay Barber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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