

**STATE OF NEW MEXICO
COUNTY OF LEA
FIFTH JUDICIAL DISTRICT**

**REPUBLICAN PARTY OF NEW MEXICO,
DAVID GALLEGOS, TIMOTHY JENNINGS,
DINAH VARGAS, MANUEL GONZALES, JR.
BOBBY AND DEE ANN KIMBRO, and
PEARL GARCIA,**

Plaintiffs,

v.

Cause No. D-506-Cv-2022-00041

**MAGGIE TOLOUSE OLIVER, in her official capacity as
New Mexico Secretary of State, MICHELLE LUJAN
GRISHAM, in her official capacity as Governor of New
Mexico, HOWIE MORALES, in his official capacity as
New Mexico Lieutenant Governor and President of the
New Mexico Senate, MIMI STEWART, in her official
capacity as President Pro Tempore of the New Mexico
Senate, and JAVIER MARTINEZ, in his official capacity as
Speaker of the New Mexico House of Representatives,**

Defendants.

EXPERT REPORT OF JOWEI CHEN, Ph.D.

1. I am an Associate Professor in the Department of Political Science at the University of Michigan, Ann Arbor. I am also a Research Associate Professor at the Center for Political Studies of the Institute for Social Research at the University of Michigan and a Research Associate at the Spatial Social Science Laboratory at Stanford University. In 2004, I received a B.A. in Ethics, Politics, and Economics from Yale University. In 2007, I received a M.S. in Statistics from Stanford University, and in 2009, I received a Ph.D. in Political Science from Stanford University.

2. I have published academic papers on legislative districting and political geography in several academic journals, including *Yale Law Journal*, *Stanford Law Review*, *The American Journal of Political Science*, *The American Political Science Review*, and *Election Law Journal*. My academic areas of expertise include legislative elections, spatial statistics, geographic information systems (GIS) data, redistricting, racial politics, legislatures, and political geography. I have expertise in the use of computer simulations of legislative districting and in analyzing political geography, elections, and redistricting. In 2019, Common Cause honored me as a “Defender of Democracy” for developing the use of random computer-simulated districting maps in partisan gerrymandering court challenges around the country.¹

3. I have authored expert reports in the following redistricting court cases: *The League of Women Voters of Florida v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2012); *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *Brown v. Detzner* (N.D. Fla. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho*

¹ <https://www.commoncause.org/press-release/common-cause-honors-four-defenders-of-democracy/>

(M.D.N.C 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Harper v. Lewis* (N.C. Super. 2019); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021); *Adams v. DeWine* (Ohio 2021); *Harper v. Hall* (N.C. Super. 2021); *Rivera v. Schwab and Abbott* (Wyandotte County D. Ct. 2022); *Norelli v. David Scanlan* (Hillsborough County Super. Ct. 2022). I have testified at deposition or at trial in the following cases: *Romo v. Detzner* (Fla. 2d Judicial Cir. Leon Cnty. 2013); *Missouri National Association for the Advancement of Colored People v. Ferguson-Florissant School District & St. Louis County Board of Election Commissioners* (E.D. Mo. 2014); *Raleigh Wake Citizens Association v. Wake County Board of Elections* (E.D.N.C. 2015); *City of Greensboro v. Guilford County Board of Elections* (M.D.N.C. 2015); *Common Cause v. Rucho* (M.D.N.C. 2016); *The League of Women Voters of Pennsylvania v. Commonwealth of Pennsylvania* (No. 261 M.D. 2017); *Georgia State Conference of the NAACP v. The State of Georgia* (N.D. Ga. 2017); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Whitford v. Gill* (W.D. Wis. 2018); *Common Cause v. Lewis* (N.C. Super. 2018); *Baroody v. City of Quincy, Florida* (N.D. Fla. 2020); *McConchie v. Illinois State Board of Elections* (N.D. Ill. 2021); *Harper v. Hall* (N.C. Super. 2021); *Rivera v. Schwab and Abbott* (Wyandotte County D. Ct. 2022).

4. **Research Question:** Defendants’ counsel asked me to evaluate the partisanship of New Mexico’s Congressional districting plan, as enacted in December 2021 by the State Legislature in Senate Bill 1 (hereinafter: “The SB 1 plan”). Specifically, Defendants’ counsel asked me to determine whether the partisan characteristics of the SB 1 plan could have plausibly

emerged from a partisan-neutral map-drawing process adhering to certain non-partisan districting criteria. The non-partisan districting criteria that I was asked to incorporate into my analysis include population equality, district contiguity, precinct preservation, municipal boundary considerations, Indian (Native American) reservation considerations, avoiding county splits, oil industry considerations, and district compactness. These districting criteria are described in detail later in this report in Paragraph 9. Defendants counsel asked me to determine how likely a map-drawing process following these criteria could have produced a map with the partisan characteristics of the SB 1 plan.

5. ***Summary of Findings:*** I programmed a partisan-blind computer algorithm to generate a large number of random districting plans while strictly adhering to the aforementioned districting criteria. The partisan characteristics of the SB 1 plan are well within the normal range of these computer-generated districting plans drawn with the partisan-blind algorithm. Thus, the SB 1 plan is neither extreme nor a statistical outlier in terms of its partisanship. The partisan characteristics of the SB 1 plan could reasonably have emerged from a partisan-neutral map-drawing process adhering to all of the aforementioned districting criteria.

6. ***The Use of Computer-Simulated Districting Plans:*** In conducting my academic research on legislative districting, partisan and racial gerrymandering, and electoral bias, I have developed various computer simulation programming techniques that allow me to produce a large number of partisan-blind districting plans that adhere to any set of specified districting criteria using US Census geographies, such as precincts, as building blocks. This simulation process ignores all partisan and racial considerations when drawing districts. Instead, the computer simulations are programmed to draw districting plans following any set of specified districting considerations, such as population equality, avoiding county splits, protecting

municipal boundaries, and pursuing geographic compactness. By randomly generating a large number of districting plans that adhere to a specified set of districting criteria, I am able to assess an enacted plan drawn by a state legislature and determine whether its partisanship is similar to or different from the sorts of plans that would naturally emerge from the specified set of districting criteria. More specifically, by holding constant the application of these districting criteria through the computer simulations, I am able to determine whether the enacted plan could have naturally emerged from these specified districting criteria, without any intentional partisan manipulation by the map-drawer.

7. Defendants' counsel asked me to use this approach to analyze the partisanship of the SB 1 plan. Defendants' counsel gave me a list of partisan-neutral districting considerations and asked me to determine the partisan distribution of districting maps that naturally emerge from a map-drawing process adhering strictly to these considerations. I programmed a computer algorithm adhering only to these specified districting considerations, and the algorithm produced a set of 1,000 random computer-simulated maps for New Mexico's congressional districts. I analyzed the partisanship of these computer-simulated maps, and I found that the SB 1 plan is well within the normal distribution of the computer-simulated plans in terms of its partisanship. In other words, the partisan characteristics of the SB 1 plan are typical of partisan characteristics exhibited by the random computer-simulated plans. Hence, the SB 1 plan does not exhibit extreme partisan characteristics when accounting for the various non-partisan districting criteria that I incorporated into the computer algorithm.

8. These computer simulation methods are widely used by academic scholars to analyze districting maps. For over a decade, political scientists have used such computer-simulated districting techniques to analyze the racial and partisan characteristics of legislative

and congressional districting maps.² Several courts have also relied upon computer simulations to assess claims of partisan bias in enacted districting plans.³

9. ***Redistricting Criteria:*** I programmed the computer algorithm to create 1,000 independent simulated plans adhering to the following eight districting criteria:

a) **Population Equality:** Because New Mexico’s 2020 Census population was 2,117,522, districts in every three-member congressional plan have an ideal population of 705,840.7. In the SB 1 plan, the most-populated district (CD-2) and the least-populated district (CD-1) have a difference in population of only 14 people. Defendants’ counsel instructed me to follow this same degree of population equality by requiring that all computer-simulated districts deviate from perfect equality by no more than seven people. Therefore, every computer-simulated district that my algorithm produced is required to have a population of between 705,834 and 705,847, resulting in a total difference between the highest-populated district and the lowest-populated district of no more than 14 people.

b) **Precinct Boundaries:** New Mexico is divided into 2,163 precincts. These precincts are the lowest geographic unit at which elections are administered in New Mexico. Defendants’ counsel informed me that precincts serve as the primary building block for congressional districting plans in New Mexico, and the SB 1 plan was intentionally drawn to avoid splitting any of New Mexico’s 2,163 precincts. Therefore,

² *E.g.*, Carmen Cirincione, Thomas A. Darling, Timothy G. O’Rourke. “Assessing South Carolina’s 1990s Congressional Districting,” *Political Geography* 19 (2000) 189–211; Jowei Chen, “The Impact of Political Geography on Wisconsin Redistricting: An Analysis of Wisconsin’s Act 43 Assembly Districting Plan.” *Election Law Journal*.

³ *See, e.g.*, *League of Women Voters of Pa. v. Commonwealth*, 178 A. 3d 737, 818-21 (Pa. 2018); *Raleigh Wake Citizens Association v. Wake County Board of Elections*, 827 F.3d 333, 344-45 (4th Cir. 2016); *City of Greensboro v. Guilford County Board of Elections*, No. 1:15-CV-599, 2017 WL 1229736 (M.D.N.C. Apr 3, 2017); *Common Cause v. Rucho*, No. 1:16-CV-1164 (M.D.N.C. Jan 11, 2018); *The League of Women Voters of Michigan v. Johnson* (E.D. Mich. 2017); *Common Cause v. David Lewis* (N.C. Super. 2018); *Harper v. Hall* (N.C. Feb 14, 2022).

Defendants' counsel instructed me to similarly avoid splitting any precincts in the construction of the computer-simulated plans. Every computer-simulated district is composed entirely of whole precincts, with no precinct split across two or more districts.

c) Contiguity: The simulation algorithm required all congressional districts to be geographically contiguous.

d) Municipality Considerations: Defendants' counsel instructed me to program the computer algorithm to consider municipal boundaries in the following ways: First, Albuquerque, Las Cruces, and the Santa Fe metro area were each primarily assigned to their own respective districts. Las Cruces and the Santa Fe metro area were always kept intact and not split across two or more districts. Due to the large size of the Albuquerque metro area, Albuquerque could be partially split across districts, but at least 60% or more of Albuquerque's population was required to be assigned to a single district. Finally, the South Valley and the Rio Grande River Valley were required to be kept together in the same district. Collectively, these municipality considerations resulted in computer-simulated plans in which one district contains the entire Santa Fe metro area, a second district contains all of Las Cruces, and a third district contains most of Albuquerque.

e) Indian Reservation Considerations: Defendants' counsel instructed me to program the simulation algorithm to treat Indian (Native American) reservations as follows: First, the Mescalero Apache Reservation was always split apart, such that Precinct 11 was always placed in a different district than Precinct 56 in Otero County. Next, the Zuni Indian Reservation (The Pueblo of Zuni) was always split apart, such that Precincts 27, 29, 30, 64 and 66 in McKinley County were always placed in a different

district than Precinct 28 in McKinley County. Finally, in order to keep the Navajo Nation together, San Juan County and most of McKinley County were always kept together in the same district, with the exception of the aforementioned Zuni Pueblo portion of McKinley County.

f) Oil Industry Considerations: Defendants' counsel informed me that due to the economic importance of the oil production industry in New Mexico, a policy consideration in the state's congressional districting process was to spread out the state's oil wells across multiple districts. Therefore, Defendants' counsel instructed me to require that no single congressional district in any computer-simulated plan contains more than 60% of the state's active oil wells. I was instructed to use geospatial data from New Mexico's Oil Conservation Division to identify the locations of all active oil wells in the state.⁴

g) Minimizing County Splits: Following instructions from Defendants' counsel, I programmed the simulation algorithm to avoid splitting New Mexico's 33 counties, except when doing so was necessary to avoid violating one of the aforementioned criteria. Most commonly, splitting counties was necessary for the purpose of achieving population equality across districts, as well as satisfying the Indian Reservation considerations described earlier.

h) Geographic Compactness: The simulation algorithm favored the drawing of more compact district boundaries whenever doing so does not violate any of the aforementioned criteria.

10. On the following three pages of this report, Map 1, Map 2, and Map 3 display three examples of computer-simulated plans produced by the computer algorithm. The upper

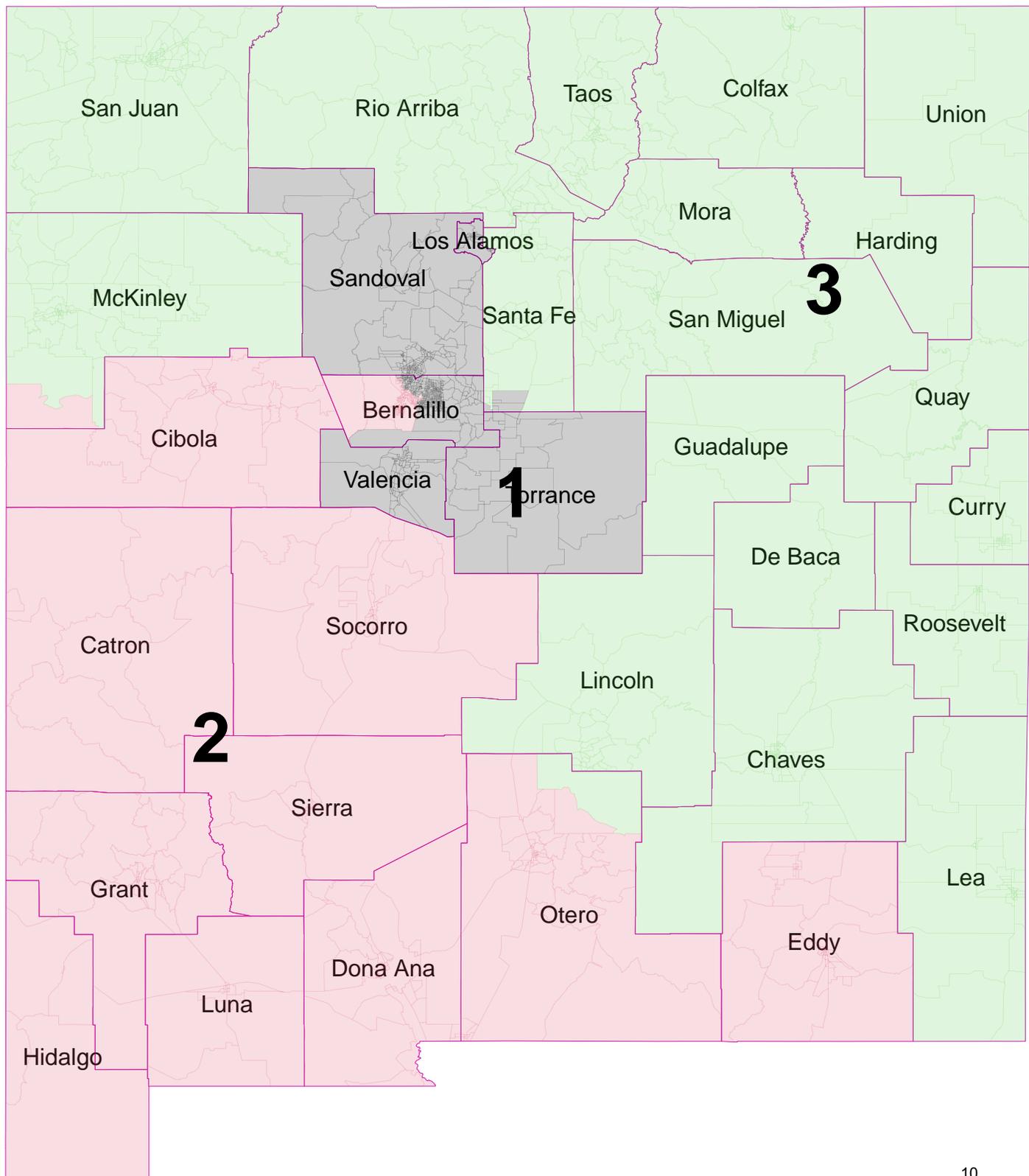
⁴ <https://ocd-hub-nm-emnrd.hub.arcgis.com/>

portion of each Map also reports the total population and the Republican partisanship of each of the three districts in the computer-simulated plan. Specifically, the partisanship of each district is measured using both the district's Republican Performance Index and the district's Republican two-party share of registered voters ("Republican Registered Voters %"). Both of these two measures of district partisanship are explained in more detail in the following section of this report.

Map 1 : Example of a Computer-Simulated Congressional Plan

District:	Population:	Republican Performance Index:	Republican Registered Voters %:
1	705,841	46.7%	42.6%
2	705,836	45%	39.3%
3	705,845	45.4%	40.3%

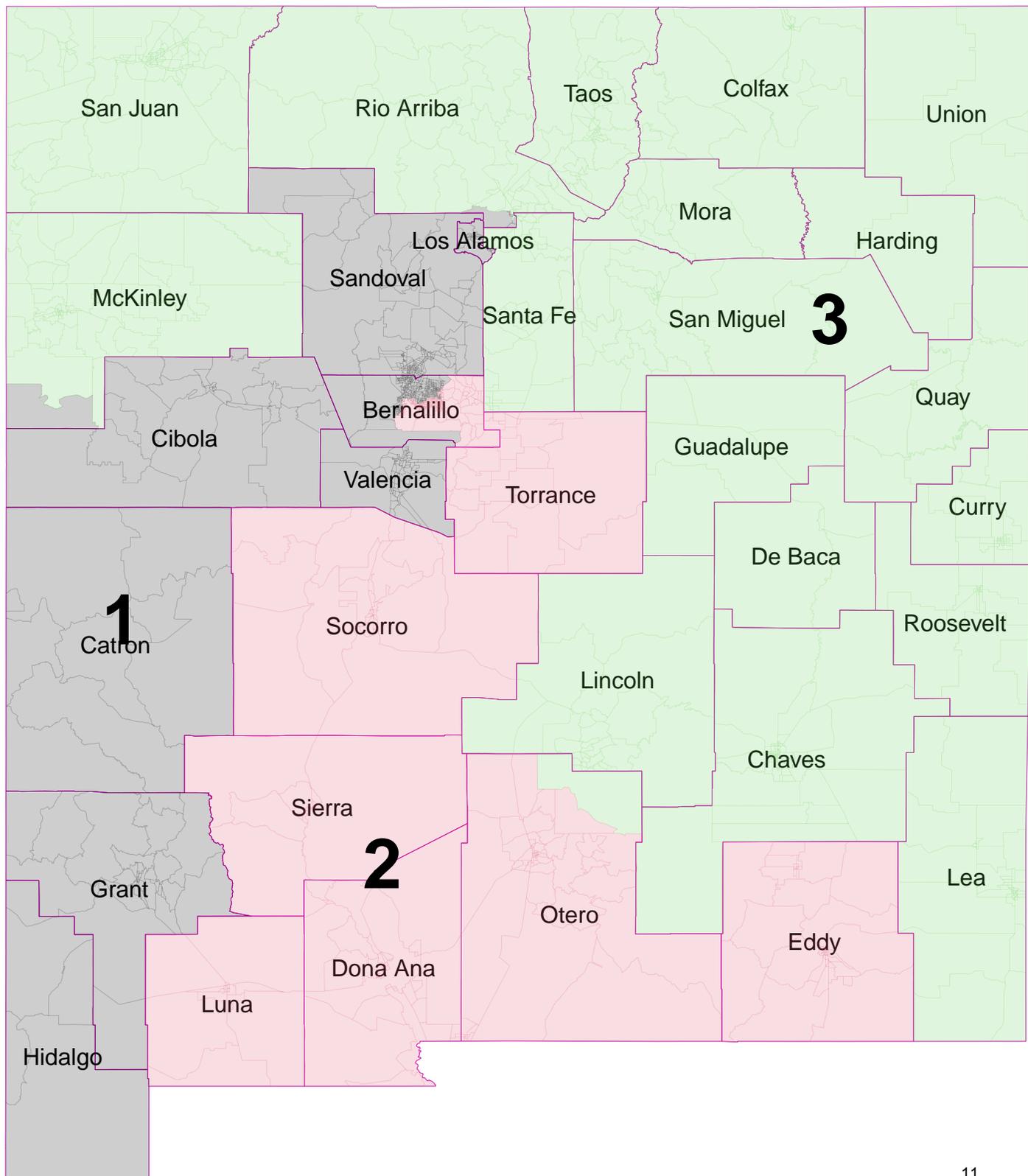
Plan Average: 705,840.7



Map 2 : Example of a Computer-Simulated Congressional Plan

District:	Population:	Republican Performance Index:	Republican Registered Voters %:
1	705,840	45.7%	40.6%
2	705,842	46%	41.3%
3	705,840	45.7%	40.7%

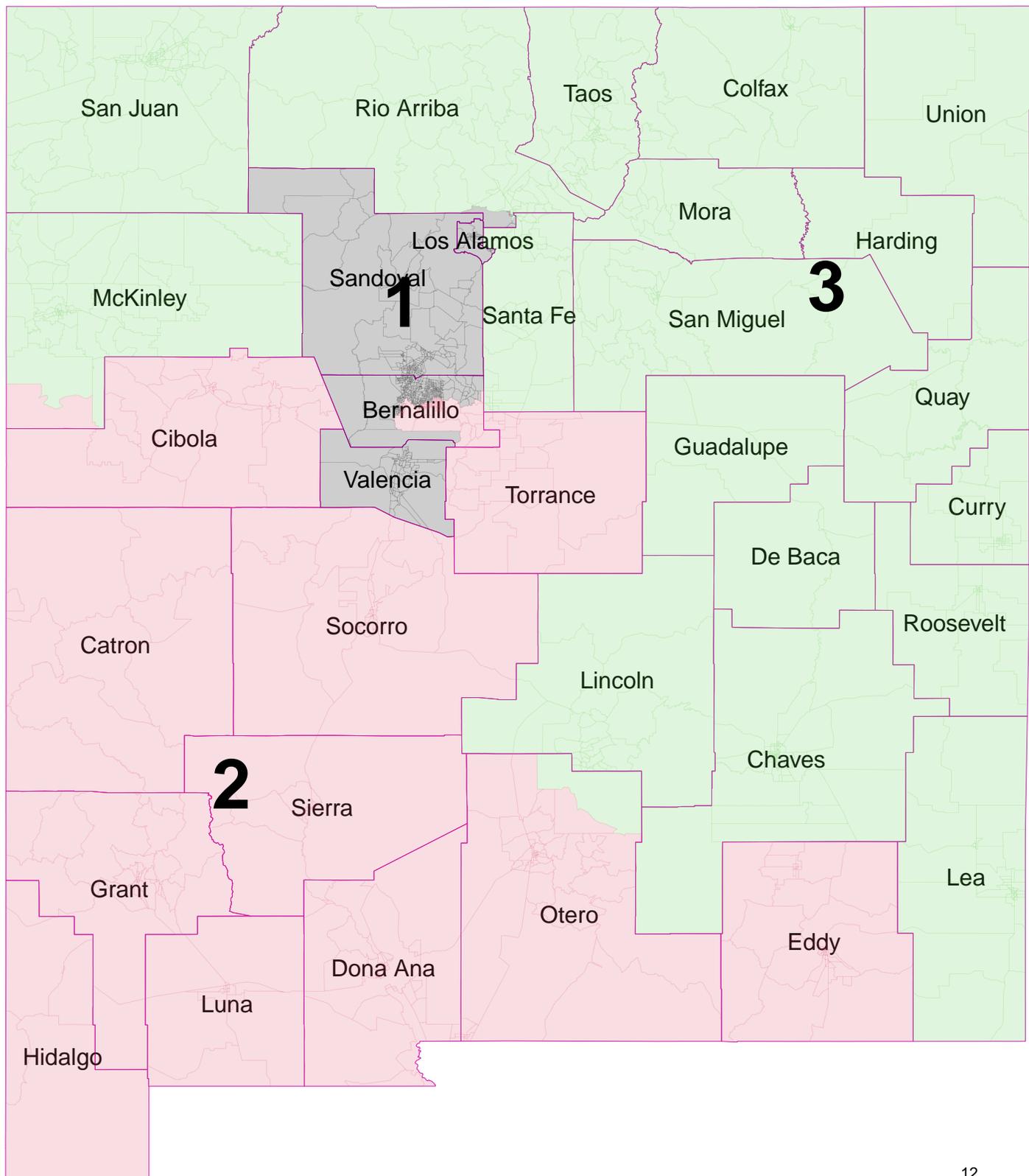
Plan Average: 705,840.7



Map 3 : Example of a Computer-Simulated Congressional Plan

District:	Population:	Republican Performance Index:	Republican Registered Voters %:
1	705,844	45.1%	40.6%
2	705,838	46.8%	41.3%
3	705,840	45.7%	40.7%

Plan Average: 705,840.7



Measuring the Partisanship of Districting Plans

11. In this report, I measure the partisanship of districts in the SB 1 plan and compare them to the partisanship of districts in the computer-simulated congressional plans. By using the same measure of partisanship for both the SB 1 plan and for the computer-simulated plans, I am able to assess whether or not the partisanship of SB 1 plan districts are typical of and within the normal distribution of the computer-simulated plans' districts. As explained below, I use past results from New Mexico's statewide election contests as well as voter registration numbers for each political party to measure and compare the partisanship of districts in the SB 1 plan and the computer-simulated plans.

12. In most states, redistricting map-drawers commonly measure the partisanship of congressional and legislative districting plans by using election results from several recent, statewide election results. It is common practice to aggregate together election results from several recent elections because in general, the most reliable method of comparing the partisanship of different districts within a state is to consider whether these districts have tended to favor Republican or Democratic candidates in recent, competitive statewide elections.

13. ***The Republican Performance Index:*** In New Mexico, the most commonly recognized formula for measuring the partisanship of districts using recent statewide elections is the "Performance Index" developed by Research & Polling, Inc. The Performance Index used during the 2021 redistricting cycle is simply an aggregation of results of all competitive statewide general elections from 2012, 2014, 2016, 2018, and 2020. Non-competitive elections, defined as those contests in which the victor won by more than 20 percentage points, were

⁶ The 2018 US Senate, the 2018 Secretary of State, and the 2018 Attorney General elections were excluded because the victor won by more than 20 percentage points.

excluded from the Performance Index.⁶ There were a total of 26 competitive statewide election contests held during these years, and the election results for these contests are available at the level of New Mexico’s 2,163 precincts.⁷ For any given geographic area, such as a congressional district, the Republican Performance Index is calculated as the Republican share of two-party votes (Republican and Democratic candidates’ votes) cast across all 26 election contests. In other words, one would first sum the total number of votes cast in favor of the Republican candidates in these 26 contests and the total number of votes cast in favor of the Democratic candidates in these same contests. The Republican candidates’ total share of the two-party votes across all 26 contests is referred to as the Republican Performance Index.

14. The election data necessary for calculating the Republican Performance Index were reported in the Legislature’s 2021 precinct-level geographic files, which the Legislature made publicly available as part of its 2021 congressional redistricting process.⁸ Across the entire state of New Mexico, there were a total of 10,194,444 votes cast in favor of the Republican candidates in these 26 contests and 12,064,492 votes cast in favor of the Democratic candidates. Therefore, the Republican Performance Index for the entire state is 45.8%. For the three individual districts in the SB 1 plan, the Republican Performance Index is as follows:

SB 1 Plan Districts:	Votes for Republican Candidates in the 26 Contests:	Votes for Democratic Candidates in the 26 Contests:	Republican Performance Index:
CD-1	4,038,053	4,643,322	46.5%
CD-2	2,918,452	3,294,911	47.0%
CD-3	3,237,939	4,126,259	44.0%

⁷ These 26 competitive statewide election contests were: The 2012 US Presidential, 2012 US Senate, the 2012 Supreme Court, the 2012 Court of Appeals, the 2014 US Senate, the 2014 Governor, the 2014 Secretary of State, the 2014 Attorney General, the 2014 Auditor, the 2014 Treasurer, the 2014 State Land Commissioner, the 2014 Court of Appeals, the 2016 US Presidential, 2016 Secretary of State, the 2016 Supreme Court, the 2016 Court of Appeals, the 2018 Governor, the 2018 Auditor, the 2018 Treasurer, the 2018 State Land Commissioner, the 2018 Court of Appeals, the 2018 Supreme Court, the 2020 US President, the 2020 US Senate, the 2020 Supreme Court, and the 2020 Court of Appeals elections.

⁸ https://www.nmlegis.gov/sessions/diy_redistricting/2021/

15. **Partisan Affiliation of Registered Voters:** In addition to measuring the partisanship of districts according to their Republican Performance Index, Defendants’ counsel also instructed me to measure the partisanship of each district using the Republican Party’s two-party share of registered voters. In other words, for each district, I count the number of registered Republican voters residing within the district as a share of all registered Republicans and Democrats in the district. These registered voter counts were calculated and reported in the Legislature’s 2021 precinct-level geographic files, which the Legislature made publicly available as part of its 2021 congressional redistricting process.⁹

16. Across the entire state, there were a total of 414,327 registered Republicans and 600,720 registered Democrats as of 2021. Therefore, the Republican two-party share of registered voters for the entire state was 40.8%. This percentage does not count anyone who was neither a Republican nor a Democrat. For the three individual districts in the SB 1 plan, the Republican share of registered voters was as follows:

SB 1 Plan Districts:	Registered Republicans:	Registered Democrats:	Republican Share of Registered Voters:
CD-1	157,461	211,916	42.6%
CD-2	123,390	177,183	41.1%
CD-3	133,476	211,621	38.7%

17. In the following section of this report, I use both the Republican Performance Index as well as the Republican share of registered voters to measure the partisanship of districts. I compare the SB 1 plan districts to the districts in the computer-simulated plans in order to assess whether the SB 1 plan exhibits partisan characteristics which could reasonably have arisen from a map-drawing process based on the districting criteria that were programmed into the simulation algorithm.

⁹ https://www.nmlegis.gov/sessions/diy_redistricting/2021/

District-Level and Plan-Wide Partisan Comparisons of the SB 1 Plan and Simulated Plans:

18. In this section, I present partisan comparisons of the SB 1 plan to the computer-simulated plans at both a district-by-district level as well as a plan-wide level, with partisanship measured using both the Republican Partisan Index as well as the Republican share of registered voters. First, I compare the district-level Republican partisanship of the SB 1 plan's districts to the partisanship of the districts in the computer-simulated plans. Additionally, I compare the partisanship of the SB 1 plan containing Las Cruces (CD-2) to the partisanship of the district in each simulated plan containing Las Cruces. Finally, I compare the total number of districts in the SB 1 Plan and in each of the computer-simulated plans with a Republican Performance Index between 46-54%.

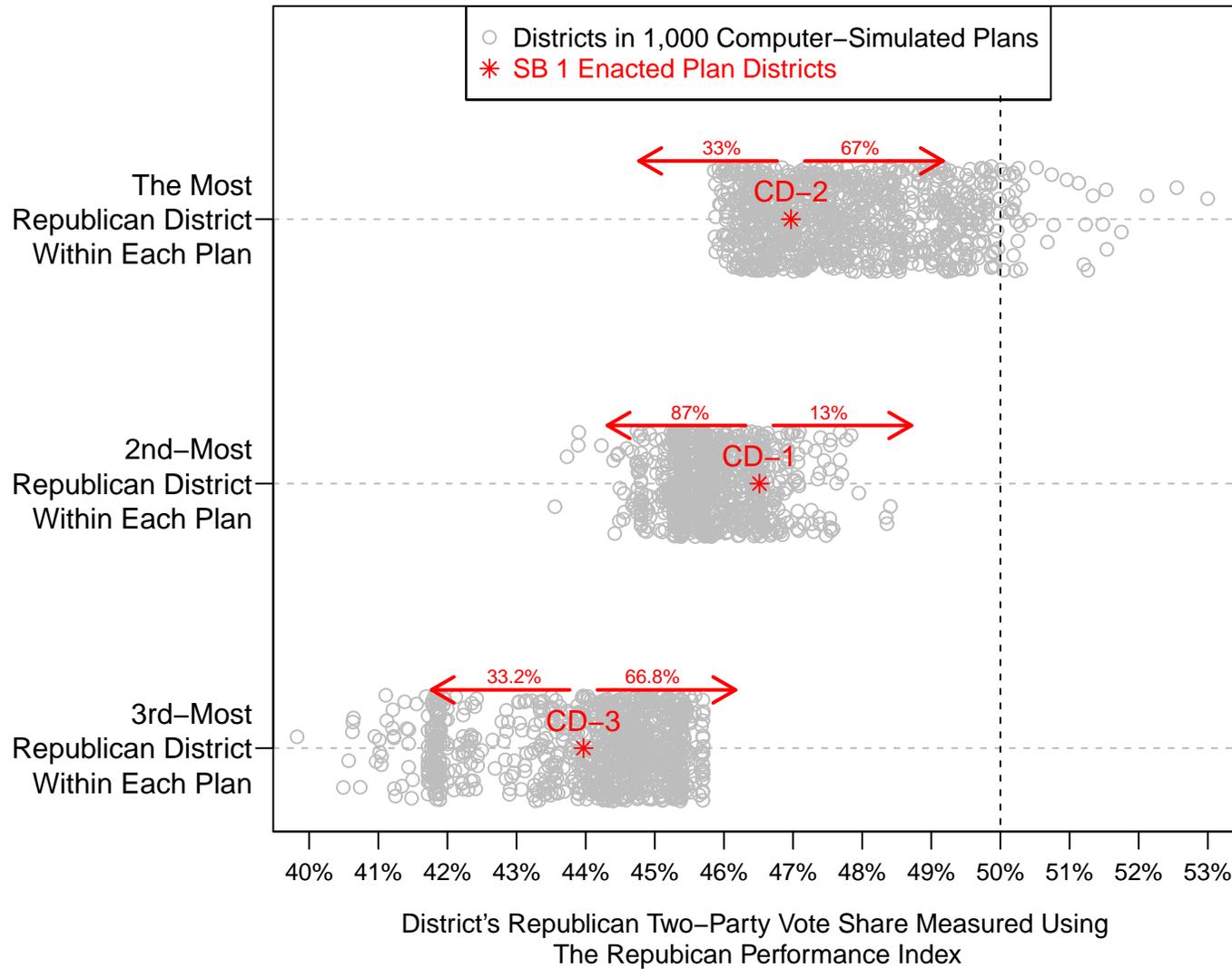
19. Overall, I find that all three of the districts in the SB 1 plan exhibit partisan characteristics that are typical of and could have reasonably emerged from the partisan-neutral computer-simulated districting process adhering to non-partisan districting criteria. In particular, the partisan composition of CD-2, which is the most Republican-favorable district in the SB 1 plan, is well within the normal range of the simulated plans' most-Republican districts. None of the three districts in the SB 1 plan are statistical outliers when compared to the computer-simulated plans' districts. Additionally, CD-2 in the SB 1 plan exhibits a partisan composition that is quite typical among the Las Cruces-based districts in the computer-simulated plans. Finally, the total number of districts with a Republican Performance Index between 46-54% is greater in the SB 1 plan than in most of the computer-simulated plans. I describe each of these findings in detail below:

20. *District-By-District Comparisons Using the Partisan Index:* In Figure 1, I directly compare the partisan distribution of districts in the SB 1 plan to the partisan distribution of districts in the 1,000 computer-simulated plans. I first order the SB 1 plan's districts from most-Republican to least-Republican, as measured by Republican vote share using the Performance Index. The most-Republican district appears on the top row, the second-most-Republican district appears on the second row, and the least-Republican district appears on the bottom row. Next, I analyze each of the 1,000 computer-simulated plans and similarly order each simulated plan's districts from the most- to the least-Republican district

21. I then directly compare the most-Republican SB 1 plan district (CD-2) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In other words, I compare one district from the SB 1 plan to 1,000 computer-simulated districts, and I compare these districts based on their Republican Performance Index. I then directly compare the second-most-Republican district in the Enacted Plan (CD-1) to the second-most Republican district from each of the 1,000 simulated plans. And finally, the third row compares the least-Republican district in the SB 1 plan (CD-3) to the least-Republican district from each of the 1,000 simulated plans. In each row of this Figure, the SB 1 plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row.

Figure 1:

Comparisons of SB 1 Enacted Plan Districts to 1,000 Computer-Simulated Plans' Districts



Note: Percentages in red above arrows indicate the percent of simulated districts in each row with a lower/higher Republican vote share than each Enacted Plan district.

22. In the top row of Figure 1, I directly compare the most-Republican SB 1 plan district (CD-2) to the most-Republican simulated district from each of the 1,000 computer-simulated plans. In other words, I compare one district from the SB 1 plan to 1,000 computer-simulated districts, and I compare these districts based on their Republican Performance Index. In the second row of Figure 1, I then directly compare the second-most-Republican district in the Enacted Plan (CD-1) to the second-most Republican district from each of the 1,000 simulated plans. And finally, the third row compares the least-Republican district in the SB 1 plan (CD-3) to the least-Republican district from each of the 1,000 simulated plans. In each row of this Figure, the SB 1 plan's district is depicted with a red star and labeled in red with its district number; meanwhile, the 1,000 computer-simulated districts are depicted with 1,000 gray circles on each row

23. The top row of Figure 1 illustrates that the most-Republican district in the SB 1 plan (CD-2) has a Republican Performance Index of 47.0%, which is well within the normal partisan distribution of the most-Republican district in the 1,000 simulated plans. The red percentages above the two arrows in the top row of this Figure report that in 33% of the simulated plans, the most-Republican district has a lower Republican Performance Index than CD-2, while in 67% of the simulated plans, the most-Republican district has a higher Republican Performance Index than CD-2.

24. In other words, CD-2 in the SB 1 plan is less favorable to Republicans than 67% of the simulated plans' most-Republican districts, and CD-2 is more favorable to Republicans than 33% of the simulated plans' most-Republican districts. Hence, CD-2 is squarely within the normal partisan distribution when compared to the most-Republican districts created by the 1,000 computer-simulated plans. It is clearly not a statistical outlier in terms of its partisanship.

The partisan composition of CD-2 is quite typical among the most-Republican districts in the computer-simulated plans.

25. The second row of Figure 1 illustrates a similar finding regarding CD-1, the second-most-Republican district in the SB 1 plan. CD-1 has a Republican Performance Index of 46.5%, which is higher than 87% of the simulated districts' second-most-Republican districts. In other words, CD-1 is more favorable to Republicans than most of the simulated plans' second-most-Republican districts, but CD-1 is still within the normal partisan distribution of these simulated districts. Hence, it is clear that CD-1 is not a statistical outlier in terms of its partisanship.

26. Finally, the bottom row of Figure 1 illustrates a similar finding regarding CD-3, the least-Republican district in the SB 1 plan. CD-3 has a Republican Performance Index of 44.0%, which is higher than 33.2% and lower than 66.8% of the simulated districts' least-Republican districts. In other words, CD-3 is more favorable to Republicans than one-third of the simulated plans' second-most-Republican districts and less favorable to Republicans than two-thirds of the simulated districts. Hence, CD-1 is very much within the normal partisan distribution of the simulated plans' second-most Republican districts. It is therefore clear that CD-1 is not a statistical outlier in terms of its partisanship.

27. Overall, I conclude that a non-partisan map-drawing process adhering to the non-partisan districting criteria outlined in Paragraph 9 could reasonably have resulted in a congressional plan with the SB 1 plan's district-level partisan characteristics. The partisan characteristics of all three districts are clearly quite typical of districts produced by the partisan-blind computer-simulation process. None of the three districts are partisan outliers, nor are they extreme when compared to the partisanship of the simulated plans' districts.

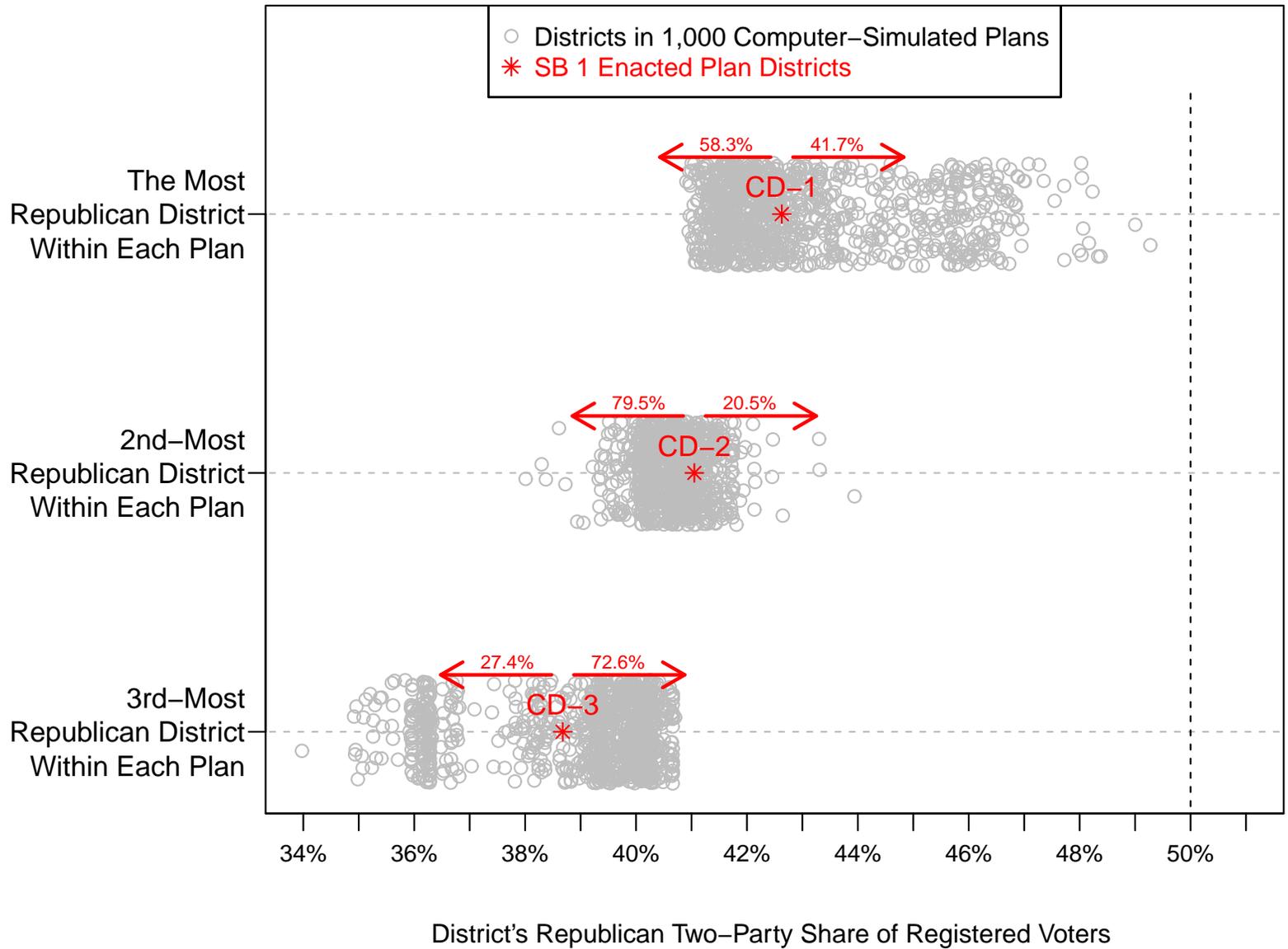
28. *District-By-District Comparisons Using Voters' Party Registration:* Figure 2 presents a similar partisan comparison of the SB 1 plan's districts to the districts in the 1,000 computer-simulated plans, but in this Figure, partisanship is measured using each district's Republican share of registered voters. When the partisanship of districts is measured using registered voters, the most-Republican district in the SB 1 plan is CD-1, which has a 42.6% Republican two-party share of registered voters. The second-most-Republican district in the SB 1 plan is CD-2, which has a 41.1% Republican two-party share of registered voters. And finally, the least-Republican district in the SB 1 plan is CD-3, which has a 38.7% Republican two-party share of registered voters.

29. The top row of Figure 2 illustrates that the most-Republican district in the SB 1 plan (CD-1) is well within the normal partisan distribution of the most-Republican district in the 1,000 simulated plans. The red percentages above the two arrows in the top row of this Figure report that in 58.3% of the simulated plans, the most-Republican district has a lower Republican share than CD-1, while in 41.7% of the simulated plans, the most-Republican district has a higher Republican Performance Index than CD-1.

30. In other words, CD-1 in the SB 1 plan is less favorable to Republicans than 41.7% of the simulated plans' most-Republican districts, and CD-1 is more favorable to Republicans than 58.3% of the simulated plans' most-Republican districts. Hence, CD-1 is very close to the median of the distribution when compared to the most-Republican districts created by the 1,000 computer-simulated plans. It is clearly not a statistical outlier in terms of its partisanship. The partisan composition of CD-1 is quite typical among the most-Republican districts in the computer-simulated plans.

Figure 2:

Comparisons of 2021 Enacted Plan Districts to 1,000 Computer-Simulated Plans' Districts



Note: Percentages in red above arrows indicate the percent of simulated districts in each row with a lower/higher Republican share of registered voters than each Enacted Plan district.

31. The second row of Figure 2 illustrates a similar finding regarding CD-2, the second-most-Republican district in the SB 1 plan. The Republican share of registered voters in CD-2 is higher than 79.5% of the simulated districts' second-most-Republican districts. In other words, CD-2 is more favorable to Republicans than most of the simulated plans' second-most-Republican districts, but CD-2 is still within the normal partisan distribution of these simulated districts. Hence, it is clear that CD-2 is not a statistical outlier in terms of its partisanship when measured using party registration.

32. Finally, the bottom row of Figure 2 illustrates a similar finding regarding CD-3, the least-Republican district in the SB 1 plan. The Republican share of registered voters in CD-3 is higher than 27.4% and lower than 72.6% of the simulated districts' least-Republican districts. Hence, CD-3 is very much within the normal partisan distribution of the simulated plans' second-most Republican districts, when partisanship is measured using voters' party registration. It is thus clear that CD-3 is not a statistical outlier in terms of its partisanship.

33. Overall, Figure 2 illustrates that even when partisanship is measured using voters' party registration, my earlier conclusions do not change: A non-partisan map-drawing process adhering to the non-partisan districting criteria outlined in Paragraph 9 could reasonably have resulted in a congressional plan with the SB 1 plan's district-level partisan characteristics. The Republican share of registered voters within each of the SB 1 plan's districts are typical of districts produced by the partisan-blind computer-simulation process. None of the three districts are partisan outliers, nor are they extreme when compared to the partisanship of the simulated plans' districts.

34. ***Partisanship of the District Containing Las Cruces:*** In the SB 1 Plan, Las Cruces is assigned to CD-2, which has a 47.0% Republican Performance Index and a 41.1%

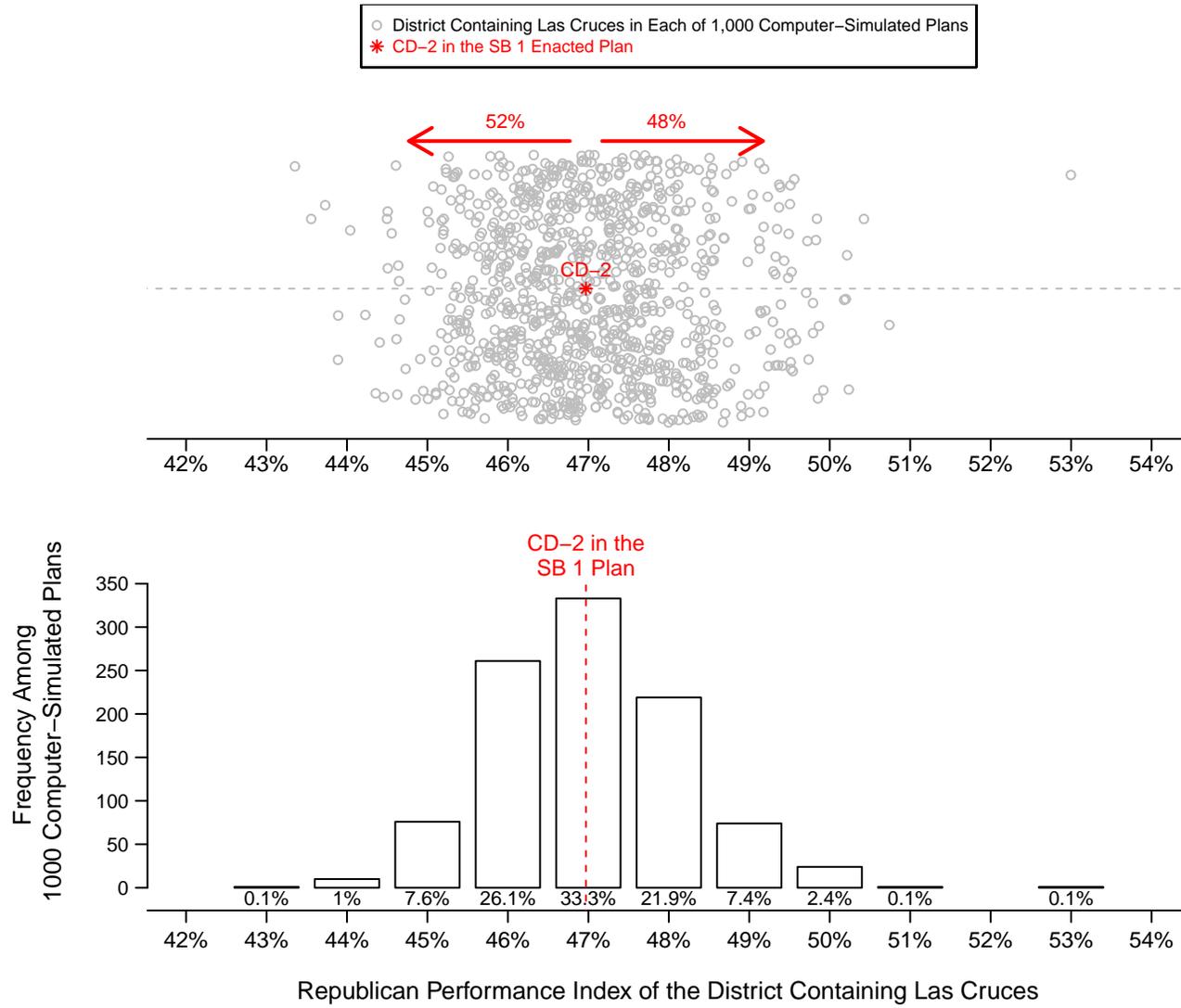
Republican two-party share of registered voters. In Figures 3 and 4, I analyze how the partisanship of CD-2 compares to the district in each computer-simulated plan that similarly contains Las Cruces. These comparisons allow me to determine whether or not the partisanship of the Las Cruces-based district in the SB 1 plan is within the distribution of all of the Las Cruces-based districts in the 1,000 computer-simulated plans.

35. Figure 3 compares CD-2 from the SB 1 plan to the simulated plans' Las Cruces-based districts along each district's Republican Performance Index. The upper half of this Figure is a plot depicting each district's precise Republican Performance Index, while the lower half of the Figure is a histogram showing the statistical distribution of the Performance Index across all computer-simulated plans. In the upper half, the red star depicts CD-2 from the SB 1 plan, while in the lower half, the red dotted line indicates the Performance Index of CD-2.

36. Figure 3 illustrates that CD-2 from the SB 1 plan is almost perfectly at the median of the distribution of the computer-simulated districts in terms of their Republican Performance Index. 48% of the simulated plans produce a Las Cruces-based district that is more favorable to Republicans than CD-2, while 52% of the simulated plans produce a Las Cruces-based district that is less Republican favorable. In other words, CD-2 is extremely close to the median of the distribution of the simulated districts. I therefore conclude that the partisanship of the SB 1 Plan's Las Cruces-based district could very reasonably have emerged from a non-partisan districting process adhering to the criteria outlined in Paragraph 9.

Figure 3:

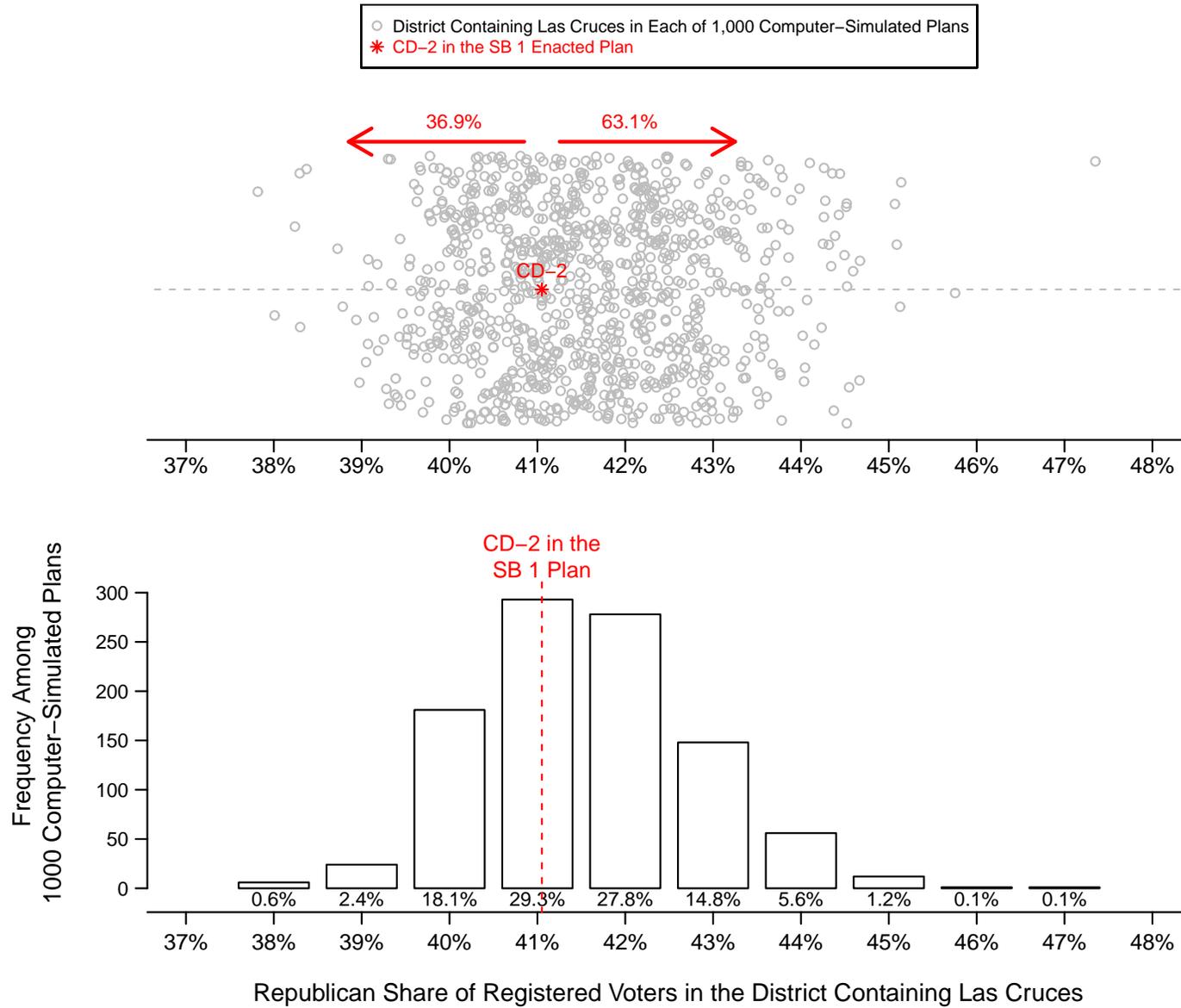
Republican Performance Index of the District Containing Las Cruces
In the SB 1 Plan and 1,000 Computer-Simulated Plans



37. Figure 4 illustrates the same comparisons as Figure 3, except that in Figure 4, the partisanship of each district is measured using the district's Republican two-party share of registered voters. Figure 4 illustrates that my conclusions do not change when using voter registration to measure district partisanship. In the upper half of Figure 4, 63.1% of the simulated plans produce a Las Cruces-based district that is more favorable to Republicans than CD-2, while 36.9% of the simulated plans produce a Las Cruces-based district that is less Republican favorable. In other words, CD-2 is very much within the normal distribution of the simulated plans' Las Cruces-based districts when using voter registration to measure partisanship. Therefore, using either measure of partisanship, I conclude that the partisanship of CD-2 in the SB 1 Plan is neither extreme nor a statistical outlier when compared to Las Cruces-based districts created by the non-partisan computer simulation algorithm.

Figure 4:

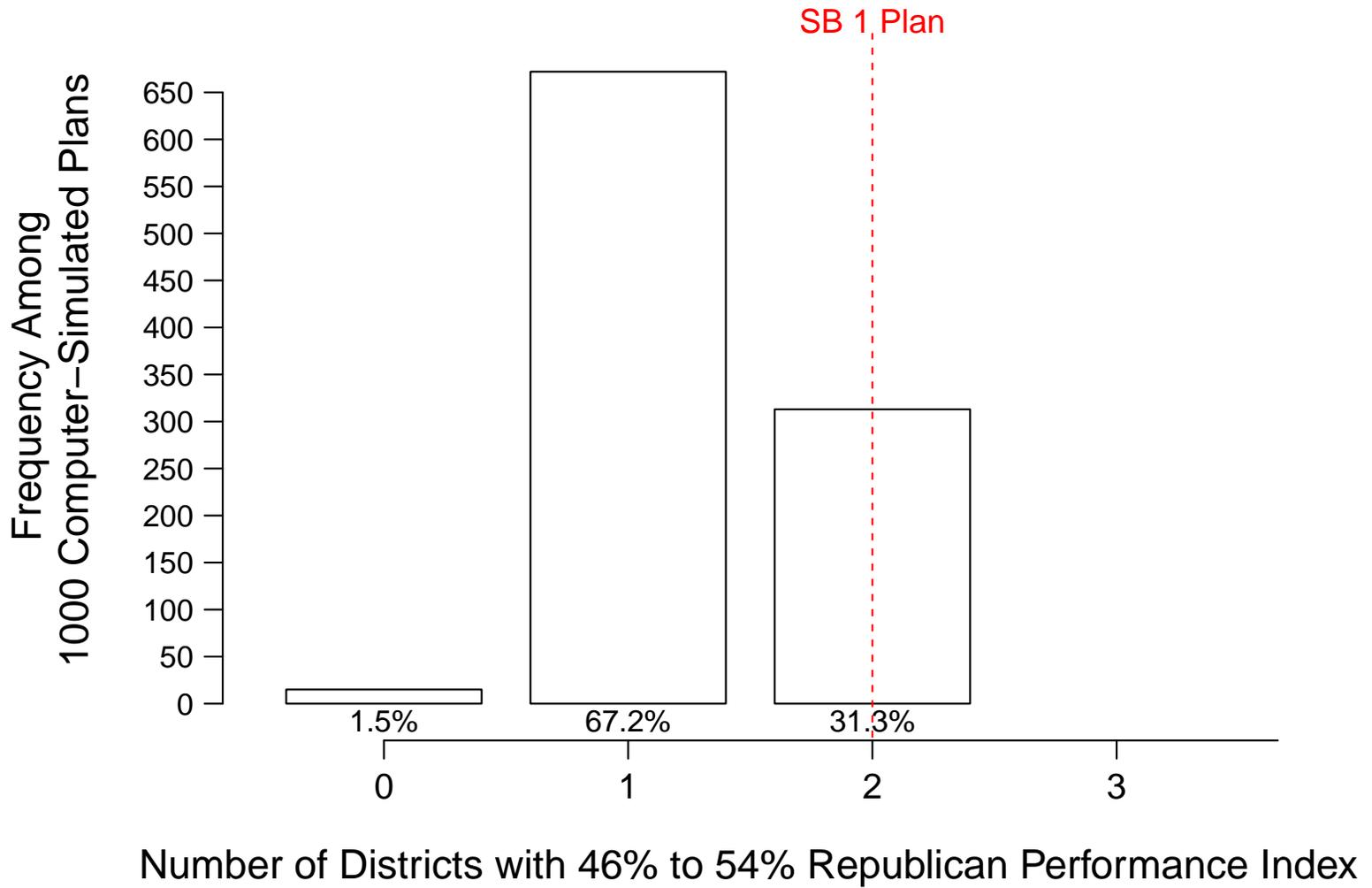
Republican Share of Registered Voters in the District Containing Las Cruces
In the SB 1 Plan and 1,000 Computer-Simulated Plans



38. ***Statewide Comparisons:*** The histogram in Figure 5 reports the number of districts in each computer-simulated plan exhibiting a Republican Performance Index of 46–54%. Within this range of partisanship, a district has relatively close to the same number of Democrat and Republican voters. The vast majority of the computer-simulated plans contain either zero or one such district, while only 31.3% of the simulated plans contain two districts with a Republican Performance Index of 46–54%. No simulated plan contains more than two such districts. Meanwhile, the SB 1 plan, which is depicted in this Figure with a dashed red line, contains two districts with a Republican Performance Index of 46–54%, thus equaling the highest number of such districts ever achieved in the computer-simulated plans. The SB 1 plan contains more such districts than over two-thirds of the computer-simulated plans. Compared to the SB 1 plan, over two-thirds of the computer-simulated plans produced fewer districts with relatively close to the same number of Democrat and Republican voters.

Figure 5:

Comparisons of SB 1 Plan to 1,000 Computer-Simulated Plans



Conclusion:

39. In summary, I programmed a partisan-blind computer algorithm to produce random maps for New Mexico's congressional plan by adhering only to non-partisan districting criteria. I then analyzed the partisan characteristics of these computer-simulated maps as well as the SB 1 plan. I concluded that the partisan characteristics of the SB 1 plan are well within the normal range of these computer-generated districting plans drawn with the partisan-blind algorithm. The SB 1 plan is neither extreme nor a statistical outlier in terms of its partisanship. The partisan characteristics of the SB 1 plan could plausibly have emerged from a partisan-neutral map-drawing process adhering to non-partisan districting criteria.

This 25th day of August, 2023.

A handwritten signature in black ink, appearing to read "Jowei Chen", written over a horizontal line.

Dr. Jowei Chen

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Curriculum Vitae

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Academic Positions:

Associate Professor (2015-present), Assistant Professor (2009-2015), Department of Political Science, University of Michigan.

Research Associate Professor (2016-present), Faculty Associate (2009-2015), Center for Political Studies, University of Michigan.

W. Glenn Campbell and Rita Ricardo-Campbell National Fellow, Hoover Institution, Stanford University, 2013.

Principal Investigator and Senior Research Fellow, Center for Governance and Public Policy Research, Willamette University, 2013 – Present.

Education:

Ph.D., Political Science, Stanford University (June 2009)

M.S., Statistics, Stanford University (January 2007)

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Publications:

Chen, Jowei and Neil Malhotra. 2007. “The Law of k/n: The Effect of Chamber Size on Government Spending in Bicameral Legislatures.”

[*American Political Science Review*. 101\(4\): 657-676.](#)

Chen, Jowei, 2010. “The Effect of Electoral Geography on Pork Barreling in Bicameral Legislatures.”

[*American Journal of Political Science*. 54\(2\): 301-322.](#)

Chen, Jowei, 2013. “Voter Partisanship and the Effect of Distributive Spending on Political Participation.”

[*American Journal of Political Science*. 57\(1\): 200-217.](#)

Chen, Jowei and Jonathan Rodden, 2013. “Unintentional Gerrymandering: Political Geography and Electoral Bias in Legislatures”

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Bradley, Katharine and Jowei Chen, 2014. "Participation Without Representation? Senior Opinion, Legislative Behavior, and Federal Health Reform."

[*Journal of Health Politics, Policy and Law*. 39\(2\), 263-293.](#)

Chen, Jowei and Tim Johnson, 2015. "Federal Employee Unionization and Presidential Control of the Bureaucracy: Estimating and Explaining Ideological Change in Executive Agencies."

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Chen, Jowei and Jonathan Rodden, 2015. "Cutting Through the Thicket: Redistricting Simulations and the Detection of Partisan Gerrymanders."

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[*Electoral Studies*. Volume 44 \(December 2016\): 329-340.](#)

Chen, Jowei, 2017. "Analysis of Computer-Simulated Districting Maps for the Wisconsin State Assembly."

[*Election Law Journal*. Volume 16, Number 4 \(December 2017\): 417-442.](#)

Chen, Jowei and Nicholas Stephanopoulos, 2021. "The Race-Blind Future of Voting Rights."

[*Yale Law Journal*, Forthcoming. Volume 130, Number 4: 778-1049.](#)

Kim, Yunsieg and Jowei Chen, 2021. "Gerrymandered by Definition: The Distortion of 'Traditional' Districting Principles and a Proposal for an Empirical Redefinition."

[*Wisconsin Law Review*, Forthcoming, Volume 2021, Number 1.](#)

Chen, Jowei and Nicholas Stephanopoulos, 2021. "Democracy's Denominator."

[*California Law Review*, Accepted for Publication, Volume 109.](#)

Non-Peer-Reviewed Publication:

Chen, Jowei and Tim Johnson. 2017. "Political Ideology in the Bureaucracy."

[*Global Encyclopedia of Public Administration, Public Policy, and Governance*.](#)

Research Grants:

"How Citizenship-Based Redistricting Systemically Disadvantages Voters of Color". 2020 (\$18,225). Combating and Confronting Racism Grant. University of Michigan Center for Social Solutions and Poverty Solutions.

Principal Investigator. [National Science Foundation Grant SES-1459459](#), September 2015 – August 2018 (\$165,008). "The Political Control of U.S. Federal Agencies and Bureaucratic Political Behavior."

"Economic Disparity and Federal Investments in Detroit," (with Brian Min) 2011. Graham Institute, University of Michigan (\$30,000).

"The Partisan Effect of OSHA Enforcement on Workplace Injuries," (with Connor Raso) 2009. John M. Olin Law and Economics Research Grant (\$4,410).

Invited Talks:

September, 2011. University of Virginia, American Politics Workshop.

October 2011. Massachusetts Institute of Technology, American Politics Conference.

January 2012. University of Chicago, Political Economy/American Politics Seminar.

February 2012. Harvard University, Positive Political Economy Seminar.

September 2012. Emory University, Political Institutions and Methodology Colloquium.

November 2012. University of Wisconsin, Madison, American Politics Workshop.

September 2013. Stanford University, Graduate School of Business, Political Economy Workshop.

February 2014. Princeton University, Center for the Study of Democratic Politics Workshop.

November 2014. Yale University, American Politics and Public Policy Workshop.

December 2014. American Constitution Society for Law & Policy Conference: Building the Evidence to Win Voting Rights Cases.

February 2015. University of Rochester, American Politics Working Group.

March 2015. Harvard University, Voting Rights Act Workshop.

May 2015. Harvard University, Conference on Political Geography.

October 2015. George Washington University School of Law, Conference on Redistricting Reform.

September 2016. Harvard University Center for Governmental and International Studies, Voting Rights Institute Conference.

March 2017. Duke University, Sanford School of Public Policy, Redistricting Reform Conference.

October 2017. Willamette University, Center for Governance and Public Policy Research

October 2017, University of Wisconsin, Madison. Geometry of Redistricting Conference.

February 2018: University of Georgia Law School

September 2018. Willamette University.

November 2018. Yale University, Redistricting Workshop.

November 2018. University of Washington, Severyns Ravenholt Seminar in Comparative Politics.
January 2019. Duke University, Reason, Reform & Redistricting Conference.
February 2019. Ohio State University, Department of Political Science. Departmental speaker series.
March 2019. Wayne State University Law School, Gerrymandering Symposium.
November 2019. Big Data Ignite Conference.
November 2019. Calvin College, Department of Mathematics and Statistics.
September 2020 (Virtual). Yale University, Yale Law Journal Scholarship Workshop
September 2021, Duke University, Redistricting and American Democracy Conference
July 2022, ICPSR Blalock Lecture, University of Michigan

Conference Service:

Section Chair, 2017 APSA (San Francisco, CA), Political Methodology Section
Discussant, 2014 Political Methodology Conference (University of Georgia)
Section Chair, 2012 MPSA (Chicago, IL), Political Geography Section.
Discussant, 2011 MPSA (Chicago, IL) “Presidential-Congressional Interaction.”
Discussant, 2008 APSA (Boston, MA) “Congressional Appropriations.”
Chair and Discussant, 2008 MPSA (Chicago, IL) “Distributive Politics: Parties and Pork.”

Conference Presentations and Working Papers:

“Ideological Representation of Geographic Constituencies in the U.S. Bureaucracy,” (with Tim Johnson). 2017 APSA.

“Incentives for Political versus Technical Expertise in the Public Bureaucracy,” (with Tim Johnson). 2016 APSA.

“Black Electoral Geography and Congressional Districting: The Effect of Racial Redistricting on Partisan Gerrymandering”. 2016 Annual Meeting of the Society for Political Methodology (Rice University)

“Racial Gerrymandering and Electoral Geography.” Working Paper, 2016.

“Does Deserved Spending Win More Votes? Evidence from Individual-Level Disaster Assistance,” (with Andrew Healy). 2014 APSA.

“The Geographic Link Between Votes and Seats: How the Geographic Distribution of Partisans Determines the Electoral Responsiveness and Bias of Legislative Elections,” (with David Cottrell). 2014 APSA.

“Gerrymandering for Money: Drawing districts with respect to donors rather than voters.” 2014 MPSA.

“Constituent Age and Legislator Responsiveness: The Effect of Constituent Opinion on the Vote for Federal Health Reform.” (with Katharine Bradley) 2012 MPSA.

“Voter Partisanship and the Mobilizing Effect of Presidential Advertising.” (with Kyle Dropp) 2012 MPSA.

“Recency Bias in Retrospective Voting: The Effect of Distributive Benefits on Voting Behavior.” (with Andrew Feher) 2012 MPSA.

“Estimating the Political Ideologies of Appointed Public Bureaucrats,” (with Adam Bonica and Tim Johnson) 2012 Annual Meeting of the Society for Political Methodology (University of North Carolina)

“Tobler’s Law, Urbanization, and Electoral Bias in Florida.” (with Jonathan Rodden) 2010 Annual Meeting of the Society for Political Methodology (University of Iowa)

“Unionization and Presidential Control of the Bureaucracy” (with Tim Johnson) 2011 MPSA.

“Estimating Bureaucratic Ideal Points with Federal Campaign Contributions” 2010 APSA. (Washington, DC).

“The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures,” Vanderbilt University Conference on Bicameralism, 2009.

“When Do Government Benefits Influence Voters’ Behavior? The Effect of FEMA Disaster Awards on US Presidential Votes,” 2009 APSA (Toronto, Canada).

“Are Poor Voters Easier to Buy Off?” 2009 APSA (Toronto, Canada).

“Credit Sharing Among Legislators: Electoral Geography’s Effect on Pork Barreling in Legislatures,” 2008 APSA (Boston, MA).

“Buying Votes with Public Funds in the US Presidential Election,” Poster Presentation at the 2008 Annual Meeting of the Society for Political Methodology (University of Michigan).

“The Effect of Electoral Geography on Pork Spending in Bicameral Legislatures,” 2008 MPSA.

“Legislative Free-Riding and Spending on Pure Public Goods,” 2007 MPSA (Chicago, IL).

“Free Riding in Multi-Member Legislatures,” (with Neil Malhotra) 2007 MPSA (Chicago, IL).

“The Effect of Legislature Size, Bicameralism, and Geography on Government Spending: Evidence from the American States,” (with Neil Malhotra) 2006 APSA (Philadelphia, PA).