Redrawing electoral maps to curb gerrymandering: a case study of New York State in 2022

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Abstract

The delineation of electoral district boundaries is a fundamental component of democratic practice in the United States. However, gerrymandering—the manipulation of district boundaries to favor specific interest groups—undermines this process and often leads to contentious debates and legal battles. The primary objective of this study is to quantitatively evaluate four sets of New York State's 2022 congressional district maps for signs of gerrymandering. These maps were proposed by the Independent Redistricting Commission (IRC), the State Legislature, and the State Court, respectively. The quantitative metrics employed integrate factors such as population distribution, state boundaries, and spatial topology to assess district compactness and to identify gerrymandering. The results indicate that the Court-drawn congressional districts exhibit considerably lower levels of gerrymandering than the maps proposed by the IRC and the State Legislature, which exhibit little disparity. As the Supreme Court of the United States has ruled that addressing partisan gerrymandering falls within the jurisdiction of the state, the findings of this study suggest that appointing special map masters by the State Court and reducing or eliminating the influence of political parties in redistricting could generate fairer electoral maps that promote equitable representation of the state's populace.

Keywords: redistricting; electoral maps; gerrymandering; New York State

1. Introduction

Drawing electoral district boundaries is one fundamental component for the functioning of political systems in the United States (Crocker, 2012). Representatives of the House, for example, are elected every two years from the 435 congressional districts in the country. In November of even-numbered years, voters in each congressional district cast their ballots to elect their representative. The candidate who receives the most votes is elected to represent that district in Congress and voters outside the district have no direct impact on the election result. To reflect changes in population, every ten years, after the decennial census, states receives the numbers of the House representatives from apportionment and redraw their congressional district boundaries, as the constitution requires each district has roughly the same population.

Since district boundaries can be used to gather or dilute supporters of a particular political party or candidate, the undemocratic practice of gerrymandering, that is the manipulation of electoral district boundaries to favor particular group interests through "packing" and "cracking", proved to be an enduring challenge to eliminate, despite decades of efforts from political scientists, mathematicians, legal scholars, and engaged citizens (Abramowitz, Alexander, & Gunning, 2006; Ansolabehere & Snyder Jr, 2012). Even though racial gerrymandering against minorities has been ruled unconstitutional by the Supreme Court of the United States (SCOTUS) and therefore largely been prevented or corrected, partisan gerrymandering is still prevalent, partially because SCOTUS refused to judge the cases of partisan gerrymandering and suggested regulating district maps was the jurisdiction of the state. Although it can be reasonably argued that districting is political by nature and partisan gerrymandering also reflects, to a certain extent, the composition of the underlying constituents, extreme gerrymanders that lead to obviously weird-shaped boundaries suppress the representation of certain local communities and become a stain on the merit of democracy.

At the state level in the US, drawing electoral district maps has diverse practices, from governor-appointed committees to independent and third-party expert mapping groups, and to commissions approved by state legislatures. In the last two decades, the State of New York experienced different models of redistricting, particularly related to the 2022 mid-term elections (Table 1). The 2014 *New York Redistricting Commission Amendment* established the rule that a ten-member Independent Redistricting Commission (IRC) should be formed to redraw state legislative and congressional districts from 2021 onwards. Four legislative leaders each choose two commissioners, while the remaining two citizen-commissioners are selected by the eight members. The Commission shall submit proposed district maps to the Legislature, which can approve or reject the plans without modifications. The Legislature can only make amendments if the Commission's plans are rejected twice. Upon the release of the 2020 decennial census data, the IRC started working on redistricting maps in early 2021.

Divided by the party lines, however, the commission failed to reach consensus and had to submit Plan A and Plan B for the district maps. The State Legislature rejected both plans and the IRC could not submit a new plan within the required 15 days window. As a result, the legislature created its own maps, and the governor signed them into law. After that, the district maps of Congress and State Senate faced lawsuits and were struck down by the State Court of Appeals in April 2022. In the end, those two maps were drawn by the special master appointed by the Court.

Table 1. Timeline of Redistricting for 2022 Elections in New York State, USA

Time	Event
2014	New York State enacted a constitutional amendment to form the Independent Redistricting Commission (IRC) to draw district maps for congress, state senate, and state assembly.
Early 2021	Upon the release of new decennial census data, the IRC started to work on the new district maps.
Dec, 2021	The IRC could not reach consensus on the proposed district maps, with irreconcilable division between the Democratic and Republican party lines.
01/03/2022	The IRC submitted two separate plans for Congress, State Senate, and State Assembly, Plan A and Plan B favored by the two parties, to the State Legislature
01/10/2022	The State Legislature rejected both plans. The law required the IRC to submit a new plan within 15 days.
01/24/2022	The IRC decided not to propose a new plan as it was deadlocked.
02/03/2022	The State Legislature, controlled by the Democratic Party, then passed its own plans and the governor, also a Democratic, signed it into law.
04/21/2022	In the ruling of the lawsuits against the district maps approved by the governor, the State of New York Court of Appeals struck down the Congress and State Senate districting maps.
05/16/2022	The special master appointed to redraw New York's legislative districts by the court released the draft maps
05/21/2022	The court released the final maps for New York's 26 congressional and 63 state Senate districts. The State Legislature did not challenge or amend the maps.

The primary objective of this study is to use quantitative metrics to evaluate the degree of gerrymandering in the four sets of congressional district maps for New York State proposed

by the IRC, the State Legislature, and the State Court of Appeals, respectively. Unlike most metrics, the study employs a metric with more comprehensive criteria to assess districts' compactness and gerrymandering, taking into account factors such as population distribution, state boundaries, and geospatial topology.

2. Data and Methods

To conduct the evaluation, the census population data and four sets of congressional district maps were collected from public sources (Table 2).

Table 2. Data for Assessing Gerrymandering of District Maps in New York State

Data	Source	URL	Format
Census Population Enumeration	Decennial Census P.L. 94-171 Redistricting Data	https://www.census.gov/programs-surveys/decennial-census/about/rdo/summary-files.html	Boundary data in Shapefile; Population data in binary format (with import script code)
District Maps submitted by IRC	New York State IRC Plans 2021/2022	https://www.nyirc.gov/plans	Spatial/GIS Data in Shapefile
District Maps by the Legislature and Court	NYS Legislative Task Force on Democratic Research and Reapportionment	https://latfor.state.ny.us/maps/ Also historial archive of the website at https://archive.org/web/	Spatial/GIS Data in Shapefile; PDF maps

While it is straightforward to collect and process the data for gerrymandering assessment, it is rather challenging to quantitively identify and measure gerrymandering despite the availability of numerous metrics. Of the two main categories of gerrymandering metrics or tests, one is based on the deviation of the election results from those implied by the popular vote. One notable example is the efficiency gap (Bernstein & Duchin, 2017; Stephanopoulos & McGhee, 2015). However, these election results-derived metrics essentially converge to the popular vote and ultimately suggest the invalidity of the current electoral system. The other category directly measures the compactness of the boundaries and can be applied without election information (Young, 1988). Existing compactness measurements for gerrymandering, however, target at particular aspects of gerrymandered shapes such as elongation, indentation, bizarreness, or dispersion without adequately integrating them with

spatial context (Fan, Li, Wolf, & Myint, 2015; Lunday, 2014; MacEachren, 1985). Gerrymandered shapes are geometrically complex with multidimensional characteristics, yet most of those geometry-based metrics can only address one aspect and fail to consider the geographic context such as population and sub-population distribution, external boundary constraints, and internal topology (Chambers & Miller, 2013; Niemi, Grofman, Carlucci, & Hofeller, 1990). Most significantly, they only rank districts without offering a cut-off value to consistently identify gerrymandered boundaries.

This paper employs a quantitative gerrymandering metric based on non-overlapping maximum coverage circles that is proposed by Sun (2021). This metric comprehensively and coherently integrates population, boundary constraints, and spatial context. It also reflects roundness, convexity, and closeness. Most noticeably, it offers a natural threshold of zero for gerrymandering identification, which can conservatively but directly and unambiguously identify gerrymandered boundaries. In addition to this comprehensive metric, other simpler measures are also calculated for the purpose of comparison. All the measures for the four sets of electoral district maps are compared statistically.

3. Results

The 2020 census has led to a reduction in the number of seats allocated to the State of New York in the House of Representatives, from 27 to 26. Consequently, there is a need to redraw the congressional districts, which will certainly result in the displacement of at least one incumbent member of the House.
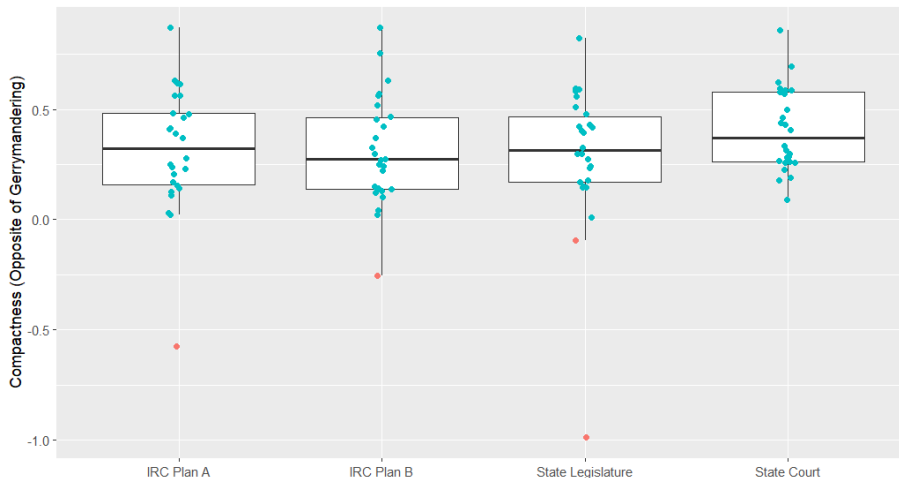

Figure 1. Gerrymandering Measurements of Congressional Maps Proposed for 2022 Mid-Term in New York State. The metric is based on coverage circle path distances proposed by Sun (2021). Negative values (red) indicate clear gerrymanders.

The new congressional district maps submitted by the IRC—including Plan A and Plan B, the State Legislature, and the State Court, as well as the map for the previous decade, are available as interactive web apps at *https://suncodeearth.github.io/nys_cd_maps*. The actual map used for the election is the one proposed by the Court.

From the quantitative measures using the maximum coverage circle path distance-based metric (CCPD) and others, it is clear that the Court-drawn map has higher average and median compactness than those proposed by the IRC and the legislature (Figure 1, Table 3). Note that Moment of Inertia (MOI) related metrics are measuring dispersion, which is positively correlated to gerrymandering. Other metrics, including CCPD, measure compactness, which is negatively correlated to gerrymandering. With the Kruskal-Wallis rank sum test, the IRC Plans are not statistically different (p^1>0.05) from the one proposed by the State Legislature on multiple gerrymandering metrics with or without the consideration of population, state boundary, or spatial topology (Table 3). To the contrast, the difference between the State Court-drawn map is statistically different from other maps, particularly when measured without population (p^2<0.05). This also implies that the Court-drawn districts appear much more compact, although they still bear much gerrymandering when population distribution is considered.

Table 3. Measures of Compactness and Gerrymandering of District Maps in New York State

Metric	IRC Plan A*	IRC Plan B	State Legislature	p^1	State Court	p^2
Polsby Popper	0.28 (0.12) [0.10, 0.60]	0.28 (0.13) [0.13, 0.58]	0.25 (0.09) [0.05, 0.43]	0.9	0.36 (0.11) [0.18, 0.61]	<0.01
Moment of Inertia (MOI) **	1.79 (0.84) [1.07, 5.24]	1.80 (0.67) [1.13, 4.36]	2.02 (1.07) [1.13, 6.49]	0.5	1.54 (0.37) [1.04, 2.41]	0.027
Population weighted MOI **	1.57 (1.17) [0.27, 6.37]	1.59 (0.96) [0.27, 5.15]	1.75 (1.43) [0.33, 7.97]	0.8	1.22 (0.49) [0.23, 2.20]	0.13
Coverage- Circle Path Distance (CCPD)	0.27 (0.22) [-0.33, 0.67]	0.26 (0.18) [-0.12, 0.61]	0.21 (0.24) [-0.62, 0.56]	0.7	0.35 (0.16) [0.07, 0.67]	0.042
Population Weighted CCPD	0.32 (0.28) [-0.58, 0.87]	0.31 (0.25) [-0.26, 0.87]	0.29 (0.33) [-0.99, 0.82]	>0.9	0.41 (0.19) [0.09, 0.86]	0.2

* *Mean (SD) [Min, Max].*
** *MOIs measure dispersion, one characteristic of gerrymandering; other metrics are indicators of compactness, the opposite of gerrymandering.*
[1] *Kruskal-Wallis rank sum test for the differences among IRC Plan A & B, and State Legislature*
[2] *Kruskal-Wallis rank sum test for the difference between State Legislature and State Court*

In addition, the map drawn by the Court also has much less extremely gerrymandered shapes. Noticeably, the map drawn by the State Legislature has two clear cases of gerrymandering, while the IRC plans have one for each. The politicians at the State Capital did not eliminate gerrymandering; instead, they made it even worse. The independent special master appointed by the court, on the contrary, divided that district and made it more compact (Figure 2).
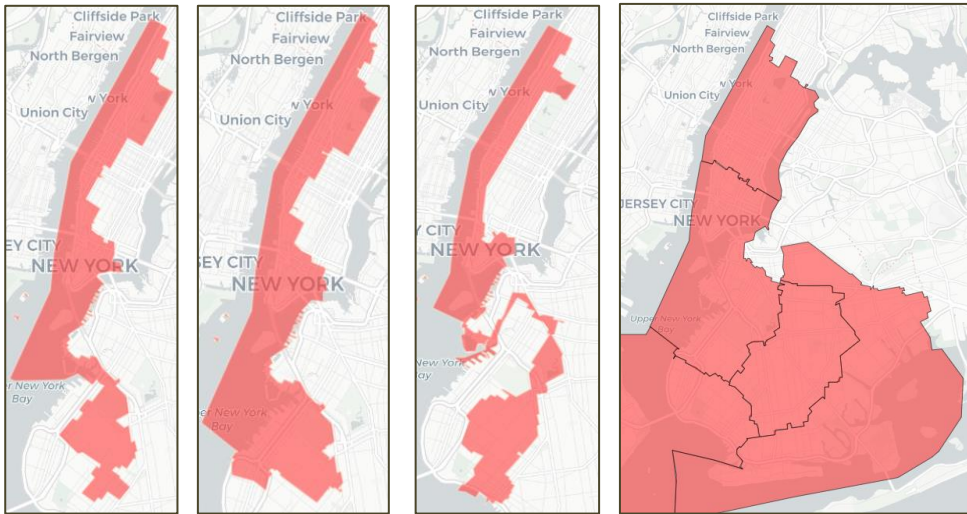

Figure 2. The most gerrymandered district in the plans proposed by IRC Plan A, IRC Plan B, and the State Legislature was revised in the Court-drawn map (from left to right).

4. Conclusion

This paper evaluates the degree of and identifies the cases of gerrymandering in four different sets of congressional district maps for the 2022 mid-term elections in New York State. There are two important implications from the study. First, it is critical to establish a legally and politically accepted metric or test for the identification of extreme gerrymandering. Due to the nature of redistricting, some wiggle room for political flexibility is practically necessary and favorable, which implies that gerrymandering cannot be completely avoided. However, identifying extreme gerrymandering with a quantitative metric helps avoid proposing or submitting district maps that would be rejected by the legislature or challenged in the courts. This metric must have a clearly defined and undisputable cut-off value. The maximum coverage circle path distance metric used in this paper seems appropriate for this task and warrants more case studies. Second, with the polarization of the American voters and politicians, relying on the political system to produce new electoral maps seems inefficient and problematic. Deeply influenced by the results of redistricting, it is impossible for those in the political system to withhold their strongly motivated influences, either directly or

through "independent" commissions. This paper clearly shows that the special master appointed by the court, without direct connection to the State Legislature or other political groups, produced the least gerrymandered congressional district map. For the 2012 election, it was also the court that drew the final congressional district map. Considering the fact that increasingly more redistricting cases end up in court, it might be the time to consider permanently shifting the power of drawing electoral maps to the legal system.

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