

Gerrymandering (Fair Map)

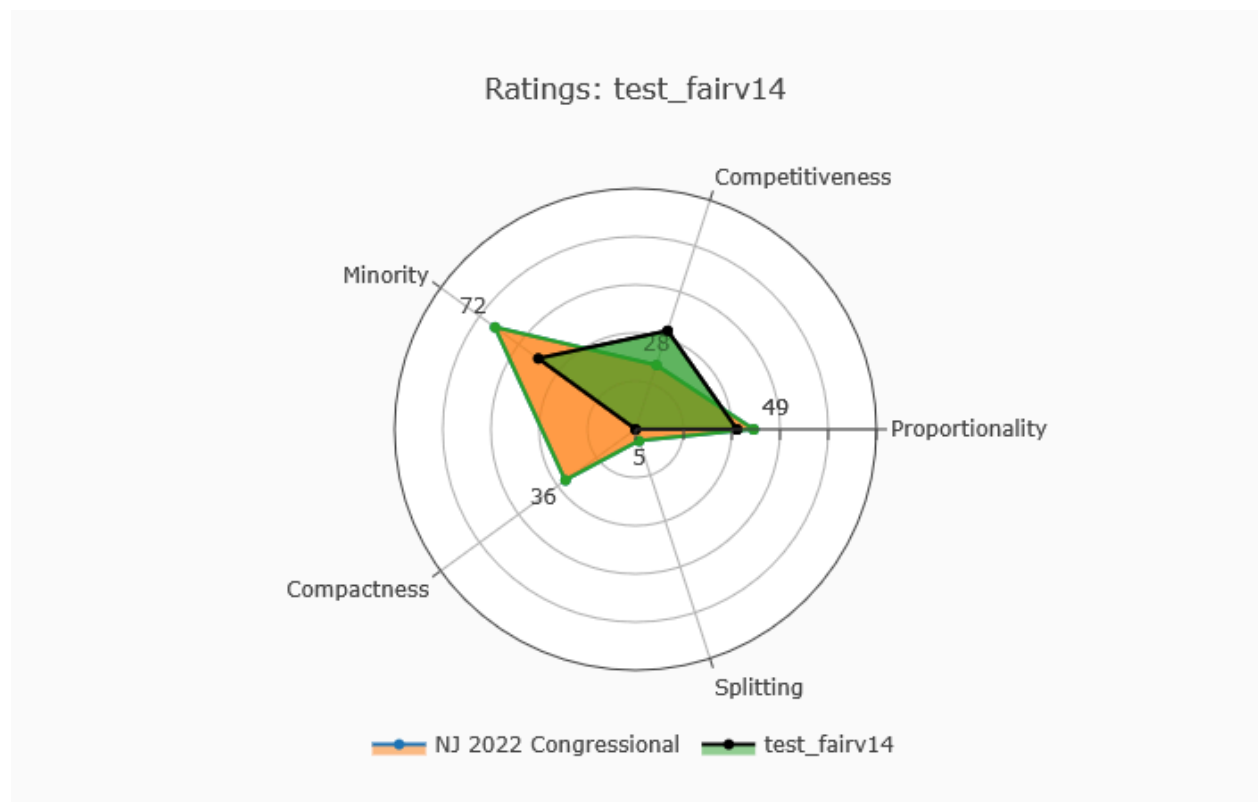
Redistricting the Congressional Map of New Jersey

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This project involves redistricting the 2022 Congressional map for New Jersey to create two distinct maps: one that uses gerrymandering techniques to provide an advantage to a particular party, community, or region, and one that redistricts while being as fair as possible. This report details the modified 'fair' map, which applies various algorithms and functions to manipulate district boundaries while attempting to keep things fair. The algorithm used in this assignment maintains that each district's population falls within $\pm 10\%$ of the ideal district size (total state population divided by number of districts), and therefore ensures a **balanced population** regardless of other manipulations. The algorithm also focused on increasing competitiveness, to ensure fair representation of each party within their districts.

Goals

Our team aimed to create a 'fair map' by focusing on achieving **competitiveness** in closer alignment to the political proportions seen in the overall population of New Jersey. However, **minority representation**, **proportionality**, and **compactness** was neglected and diminished as compared to the 2022 Congressional. What resulted was overall different outcomes for **population balance**, **contiguity**, and **compactness** between the two maps.



Map Name	Proportionality	Competitive	Minority	Compactness	Splitting
Current – test_fairv14	42	43	50	0	0
Compared – NJ 2022 Congressional	49	28	72	36	5

Comparison of Metrics:

1. Proportionality

Proportionality refers to how closely the share of seats won by a political party in an election matches the share of the vote that party received across the state. A map is **more proportional** when the distribution of seats reflects the statewide vote more accurately.

- **Original (NJ 2022 Congressional):** 49
- **Redistricted (Fair):** 42

The fair redistricted map scores lower in proportionality, meaning that it does a worse job of reflecting the actual population distribution in each district. This implies a less fair representation of the state's demographics, and therefore less balanced political representation.

Original Map: Typically, the original map will have relatively balanced proportionality, meaning that districts will roughly represent the population proportions of political parties or communities.

Fair Map: The map has reduced proportionality.

2. Competitiveness:

Competitiveness measures how likely it is that elections in a map's districts will be closely contested between parties—where neither party has a guaranteed win. A more competitive map encourages voter engagement and fairer outcomes. The **competitiveness metric** represents the **percentage of districts** that fall into a competitive range, based on **probability distributions** of partisan vote share.

- **Original (NJ 2022 Congressional):** 28

- **Redistricted (Fair):** 43

The competitiveness score is much higher in the redistricted map, indicating less party dominance or less district-level electoral competition. This is a result of special tuning of our algorithm for fairness, which utilizes the previous unfair map. Specifically, target districts were updated with every iteration of the map after comparison, resulting in much faster and more accurate redistribution of precincts.

Original Map: The original map has districts that are relatively competitive.

Fair Map: This gerrymandered map increases the competitiveness of the map, so multiple parties or candidates have a better chance of winning in each district.

3. **Minority Representation:**

Minority Representation evaluates how well a redistricting map provides minority communities with a meaningful chance to elect candidates of their choice.

- **Original (NJ 2022 Congressional):** 72
- **Redistricted (Fair):** 50

The redistricted map has a lower minority representation score.

Original Map: The original map scores very high on Minority Representation. It may achieve this through ensuring that minority voting power is preserved in a district or group of districts, i.g.: “opportunity districts”.

Fair Map: The fair map scores much lower in terms of Minority Representation, but not so low as to be notably bad in it. The low score is possibly due to “cracking” minority communities (splitting them across multiple districts through redistricting).

4. **Compactness:**

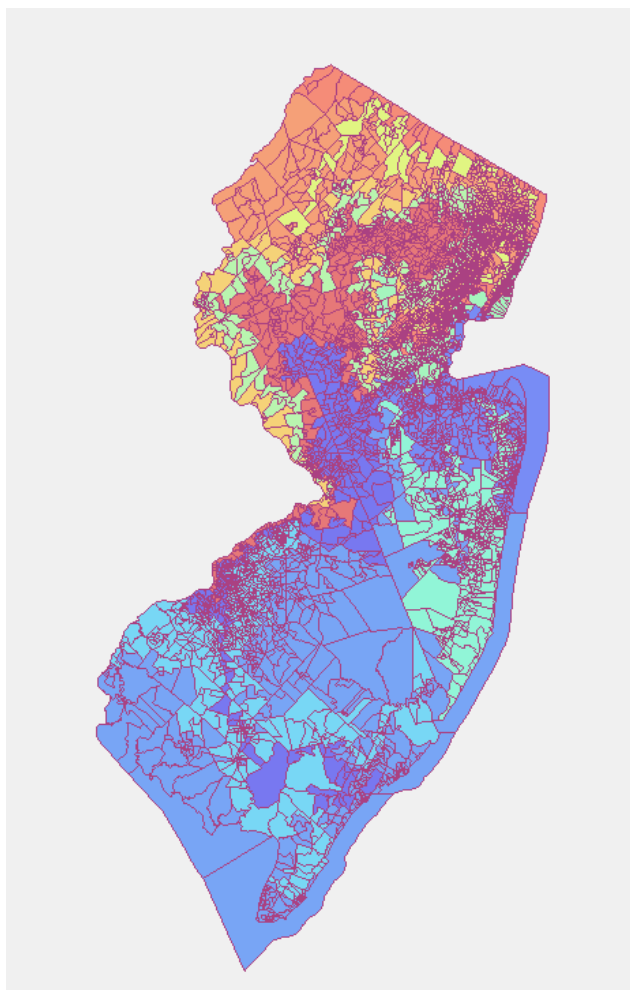
Compactness measures how **geometrically tight and regularly shaped** each district is. More **compact districts** are preferred because they’re easier to understand, appear less manipulated, and tend to keep communities together. The compactness of a map is

relevant for ensuring that a redistricted map is inconspicuous and does not seem “obviously” gerrymandered.

- **Original (NJ 2022 Congressional):** 36
- **Redistricted (Fair):** 0

Original Map: The original map has a much higher compactness score, which indicates that its districts are more geographically and visually coherent. The lower compactness in the redistricted map can be identified in its more irregular shapes.

Fair Map: The compactness score of the unfair map is very low due to the complicated nature of algorithmically incorporating this metric in conjunction with our other goals.



5. Splitting:

Splitting refers to how often political boundaries—like counties or cities—are divided across multiple congressional districts. A map with **fewer splits** better preserves community integrity and makes representation clearer and more accountable.

- **Original (NJ 2022 Congressional):** 5
- **Redistricted (Fair):** 0

The original map has some splitting of counties or municipalities, while the redistricted map has significant splitting along county and city populations.

Redistricted Fair Map

Strengths of the Redistricted Map:

- **Contiguity & Balanced Population:** Each district's population falls within $\pm 10\%$ of the ideal district size. Electoral districts are physically adjacent, achieving adequate contiguity.
- **Increased Competitive Districts:** We achieved our overall goal to create more fairness by increasing the competitive amount of districts to better reflect the populations of republican voters and democrat voters within New Jersey.

Weaknesses of the Redistricted Map:

Weaker Minority Representation: The redistricted map has a notable drop in minority representation, which could be seen as a step backward if the goal is to enhance political power for historically underrepresented groups. However, it isn't a huge drop.

Lower Compactness: The redistricted map's lower compactness results in districts with more irregular shapes.

Significant Splitting: The redistricted map's low score for splitting is due to its lack of compaction and the algorithm used towards creating a more competitive map. The low score reflects numerous divisions across county and city boundaries.

Conclusion

The fair map presents a well balanced population, and achieved our goal of quite competitive districts. It also has notable strengths in proportionality, which contribute to more representative and cohesive districts. However, its lower compactness and reduced minority representation could present significant drawbacks, particularly if ensuring fair minority representation is a priority. That is why we believe that this map would not be a reasonable option for adoption by legislatures. With considerable more tuning, it could be an option however. If we had more time, we could have better addressed how the unfair map was biased against minorities and also increased its compactness. This might have involved increasing the minority representation enough to appear like it makes an impact, while instead the map will normally not end up

without a predetermined result. In terms of our algorithm, we could add a minority_share weight to the map and tweak the results to get a higher score.