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Exploring an Impossibility Theorem for Gerrymandering

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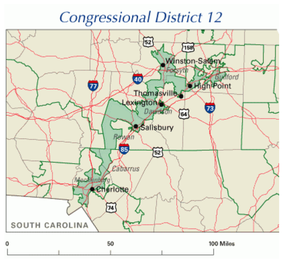
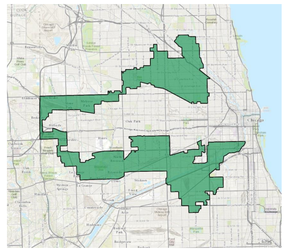
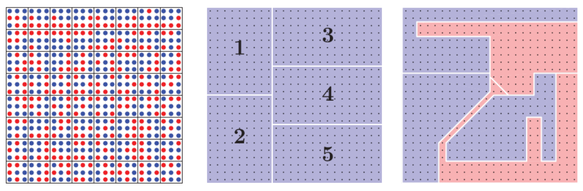
Introduction

Distrust with the electoral system in the United States has grown over the years. States redraw districts every ten years to accommodate the results of the population census. States and Courts have used multiple quantifications regarding population split and shape of districts to measure the intention of the maps. This work will explore an Impossibility theorem for partisan gerrymandering that has risen from the conditions states and Courts consider. The metrics are taken into consideration look at compactness and voter dispersion amount districts. Compactness considers the shape of the district. There is a relationship between how well mixed the population is and the possible district maps that satisfy conditions regarding shape, and voter dispersion.





Methods

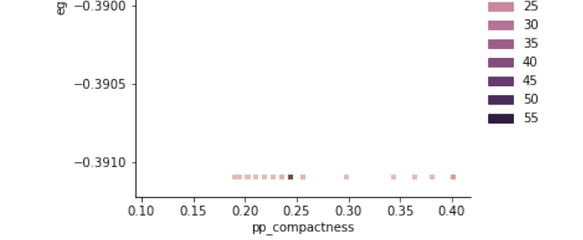


Three diagrams above depict a state with two kinds of voters well mixed with N set to 8. drawing “Nice looking” districts means red (minority party) will not win any districts.

We use undirected graphs to simulate various levels of population homogeneity with respect to party preference. This allows us to calculate three quantifications: 1) one person one vote 2) Polsby Popper compactness 3) Efficiency Gap and create a sample space to study the implications of impossibility theorem.

Results

Example: Below the level of resolution has been set to 10. Ratio of voters is 0.5.



We can extended the code to generate a sample space of possible outcomes. Below we have included result for a sample of 2850 instances.

Conclusions

It seems that drawing maps that allow the minority party to win and adhere to the three conditions discussed earlier becomes impossible if the population is well mixed with voting preference.
Understanding the sample space of possibilities of election outcomes is a critical step in understanding our electoral system. The quantifications we have discussed can help us paint a picture of the intention of the map makers. However, these quantifications alone cannot help us, and human dynamics are complex. Understanding our ever-changing needs and their connections to proposed maps can allow us to paint a complete picture.

References

- Boris Alexeev and Dustin Mixon An impossibility theorem for gerrymandering. 2017.
- *The national map*. The National Map | U.S. Geological Survey. (n.d.). Retrieved December 31, 2021, from https://www.usgs.gov/programs/national-geospatial-program/national-map

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