Interactive Web Mapping for Multi-Criteria Assessment of Redistricting Plans

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Representation in redistricting

- Redistricting draws electoral boundaries

- Normatively, districts should be about representing groups of people with shared interests

- Preserving communities of interest (COI) is a traditional redistricting criterion
  - No clear definition!
How does a political scientist describe community?

• No clear definition of COI – use proxies:
  • Compactness
  • Heat maps (COIs)
  • Split municipalities count
  • Contiguous

• Countable! Meaningful?
How does a geographer describe community?

• Interactions in space/place and time
  • Human mobility flows
    • Quantitative!

• Our claim:
  • districts that capture how people move are normatively better than districts that don’t
    • New to poli-sci redistricting literature!
How to quantify community?

• Modularity ratio
  • Global metric
  • Sum of intra flows/sum inter flow

• Use pop-scaled human mobility flow data (SafeGraph)
Modularity ratio:

\[
\frac{\text{Sum of Intra Flows}}{\text{Sum of Inter Flows}} = \frac{7_{AA} + 9_{BB} + 11_{CC} + 13_{DD}}{1_{AB} + 1_{AC} + 1_{AD} + 4_{BA} + 4_{BC} + 2_{BD} + 3_{CA} + 3_{CB} + 5_{CD} + 2_{DA} + 3_{DB} + 3_{DC}} = \frac{40}{32} = 1.25
\]
How to compare across potential maps?

- Too many potential maps to enumerate completely!
  - Get a representative sample instead

- Recombination (ReCom)\(^1\)
  - Markov chain Monte Carlo (MCMC)

- Common to evaluate for compactness, fairness, and preservation of municipal units (i.e. not splitting counties)

How to make sense of all these metrics???

- Interactive web map!
- Explore trade-offs between criteria
Choose two maps to be displayed.

1. 2020 Enacted Map
2. Max effGap Map
3. Max Compactness Map
4. Max Modularity Map
5. PMC Map

* To choose a new map, uncheck a currently selected map and recheck a new map.

Choose one variable to symbolize the maps.

- population
- White
- Black
- HISPANIC
- Asian
- AmlIndian
- D_votes
- R_votes
- D_percent
- R_percent
- intra_flows
- inter_flows

Current map

Modularity map
Gerrymandering

In the United States, political districts are redrawn every 10 years to reflect new Census data. When redrawing electoral district boundaries, legislators may try to create districts so as to create an advantage for their party; this is gerrymandering. Political gerrymandering is currently legal as long as it is not excessive, though what constitutes "excessive" is difficult to define. While gerrymandering for the purpose of gaining partisan advantage is legal to some extent, gerrymandering to disenfranchise voters on a racial basis is illegal. In either case, gerrymandering seeks to give one party more representatives for the same number of votes, thus diluting the voting power of other parties.

Though political gerrymandering is legal and to some degree unavoidable, many scholars agree that it is harmful for our democracy. Instead of electing the representative of the majority, voters end up with politicians who may not represent their best interests.

Metrics

The following sections describe each metric and how they are calculated.

Modularity:

A community is a group of people that have more in common with each other, on average, than they do with people from another group. Redrawing groups people across geographic space, and therefore can either split communities or keep them intact. Redrawing boundaries in many states have explicit preferences for redistricting plans that follow existing boundaries, such as county lines, which mildly encourage communities to be kept intact. Preliminary in legal challenges to gerrymandered districts, split municipalities are shown as evidence that natural communities were split in order to gain partisan advantage.

Communities of interest and minority-majority districts are two explicit ways of keeping particular communities intact, and both function by keeping groups of people with common policy concerns in a single district. For communities of interest, people from such a group self-identify and advocate for being kept in a single interest so that they can elect a representative that will represent their particular interests. Minority-majority districts are similar, though they are related by the Voting Rights Act as to not "unduly dilute minorities voting power".

None of these community formations, however, attempt to maintain communities across all districts. Framed as an optimization problem, we might ask how we could make districts such that we maintain as many communities as possible within each district, such that we minimize community splitting across all districts. While optimization is re-districting is notoriously difficult, we attempt here to show that under a range of possibilities might fit such a metric were incorporated into redistricting law.

For such an optimization, we need both a formula for defining community strength, and a measurement to use in that formula. For the measurement, we employ human mobility flows from SafeGraph. The mobility flows consist of anonymized cellphone counts that have moved from one census block group to another during a given time span. To quantify community strength, we use modularity, which is frequently used in community detection research. Modularity here is defined as the sum of district intra flow divided by the sum of district inter flows, where intra flows are mobility flows originating in one district and ending in that same district, while inter flow are mobility flows originating in one district and ending in another. By summing across all districts to calculate modularity, we can get a sense of how the districts plan, as a whole, keeps communities intact.

$$\text{Modularity} = \frac{\text{Sum of intra-flows}}{\text{Sum of inter-flows}} = \frac{7.9 \times 9.1 + 11.1 \times 13.3}{1.9 \times 3.9 + 4.4 \times 5.8 + 9.1 \times 13.3} = \frac{60}{32} = 1.25$$

Calculating modularity for the example district plan.

Efficiency Gap

The efficiency gap reflects the difference between the percent effective mixed votes in an election—where a vote is counted if it is cast for the winning candidate or for winning candidates but in excess of what she needed to prevail. Large numbers of votes commonly are cast for losing candidates as a result of the time honored gerrymandering technique of "cracking." Likewise, excessive votes often are cast for winning candidates thanks to the equally well-kept technique of "packing." The efficiency gap essentially aggregates all of a district while cracking and packing choices into a single, tidy number. For more reading on the efficiency gap, you can read here.

To demonstrate how gerrymandering uses both packing and cracking to change election outcomes, we present the following example from the Washington Post. In this example, the Purple and Green parties are competing to win seats in 40-seat population districts and votes for a given party are represented by votes of the same color. The Green party receives 50 votes, yet it is told to turn 30 seats due to how the districts were arranged.
Questions?

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  • MGGG Redistricting Lab!
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End Slide
Pop quiz!

- What is gerrymandering?
Pop quiz!

- What is gerrymandering?
How to “prove” a gerrymander?

- Outlier analysis
  - compare to sample distribution

What is redistricting?

Imaginary state:
- 20 green voters
- 30 purple voters
- 5 districts

Figure: www.washingtonpost.com/graphics/2017/politics/courts-law/gerrymander/