

Use of Simulation Algorithms in the Evaluation of Legislative Redistricting Plans

Kosuke Imai

Harvard University

IQSS Coffee Hour Talk

February 15, 2022

Introduction

- Positions

- ▶ Current: Professor in the Department of Government and Department of Statistics, Harvard University
- ▶ Previous: Professor in the Department of Politics and Center for Statistics and Machine Learning, Princeton University

- Research fields

- ① Causal inference
 - ▶ randomized controlled trials
 - ▶ observational studies
 - ▶ program evaluation
- ② Computational social science
 - ▶ record linkage
 - ▶ analysis of texts, networks, videos
 - ▶ redistricting simulations

Algorithm-Assisted Redistricting Methodology (ALARM)

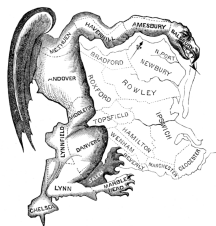
Developing methodology and tools to analyze legislative redistricting.

- What we do:
 - ▶ Develop redistricting simulation algorithms and other related methods
 - ▶ Apply these algorithms and methods to evaluate redistricting plans
 - ▶ Open-source software package *redist* (over 30,000 downloads)



Gerrymandering in the Real World

- Massachusetts Governor Elbridge Gerry's 1812 map



- In many states, the state legislatures are in charge
 - ▶ basic strategies: packing and cracking
 - ▶ availability of granular data and mapping software
 - ▶ partisan and racial gerrymandering
 - ▶ anti-gerrymandering efforts
- Recent key court decisions:
 - ▶ *Shelby County v. Holder* (2013)
 - ▶ *Rucho v. Common Cause* (2019)

Overview of redistricting simulation analysis

- What is redistricting simulation analysis?
 - ▶ generate a large number of **alternative plans** under a specified set of redistricting criteria
 - ▶ compare them with a proposed plan to evaluate its properties

- What are the benefits of redistricting simulation analysis?
 - 1 can control for **state-specific** political geography and redistricting rules
 - 2 **transparency** and ability to isolate a relevant factor
 - 3 mathematical guarantee \rightsquigarrow **representative sample** of alternative plans

- Courts frequently rely upon empirical evidence provided by experts

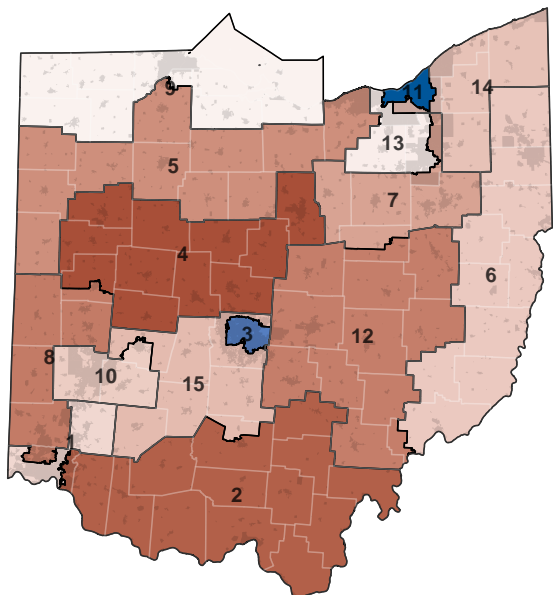
Ohio Congressional Redistricting Case

- Currently 16 districts: 4 Democrats and 12 Republicans
 - ▶ 2020 President: Biden 45%, Trump 53%
 - ▶ 2018 Senate: Brown 53%, Renacci 47%
- After 2020 Census, the number of seats is reduced to 15 districts
- 2018 Ohio voters passed the constitutional amendment
 - ▶ bipartisan support leads to a 10 year map
 - ▶ if that fails, it becomes a 4 year map
- Redistricting
 - ▶ State Senate and House approved the initial map
 - ▶ No bipartisan support \rightsquigarrow 4 year map
 - ▶ November 20: Governor DeWine signed the map

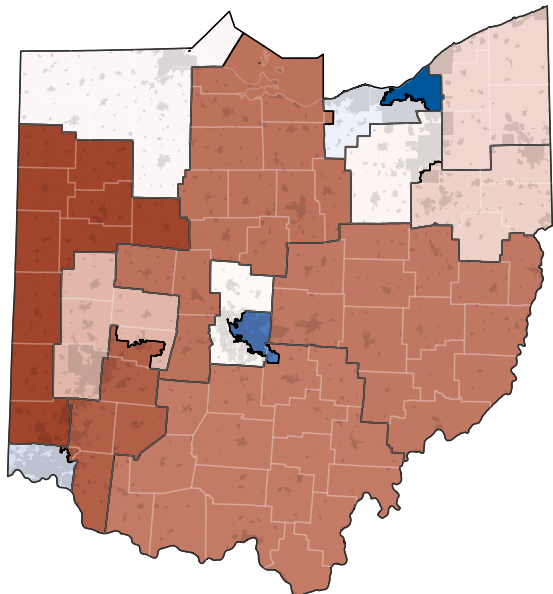
League of Women Voters of Ohio *et al.* v. Ohio Redistricting Commission, *et al.*

- I served as an expert witness for Relators
- Simulation analysis based on Sequential Monte Carlo algorithm
 - ▶ 5,000 alternative plans
 - ▶ contiguous and compact districts
 - ▶ compliant with the Voting Rights Act (Cleveland)
 - ▶ several complicated splitting constraints
 - ▶ Section 2(B)(5): out of Ohio's 88 counties, at least 65 counties should not be split; no more than 18 counties can be split no more than once; no more than 5 counties can be split no more than twice

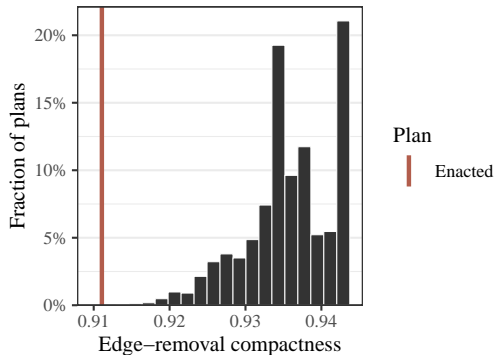
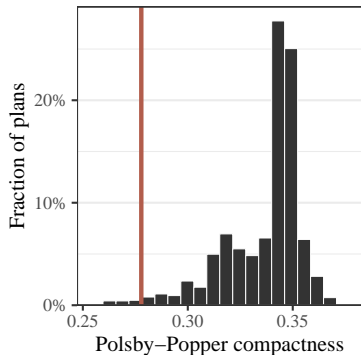
Enacted Plan



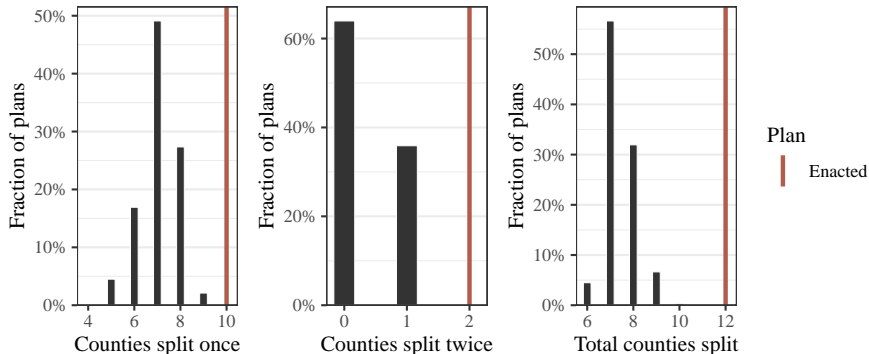
Sample Simulated Plan



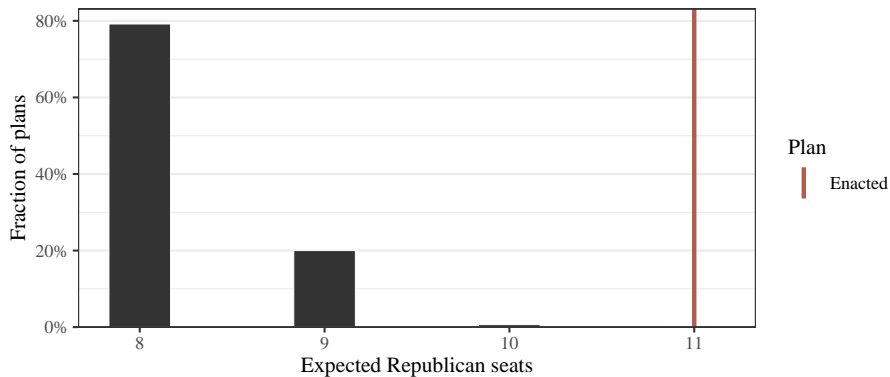
Compactness



Administrative Boundary Splits

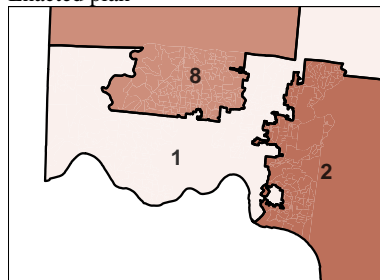


Expected Number of Republican Seats

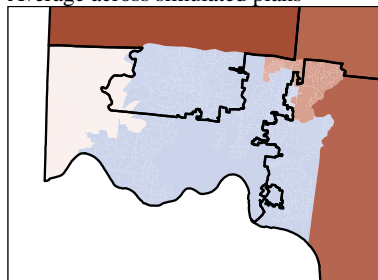


Hamilton County (Cincinnati Area)

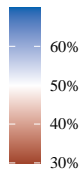
Enacted plan



Average across simulated plans

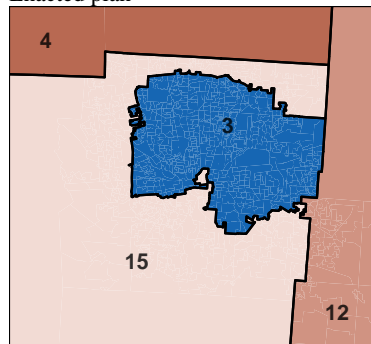


Two-party
vote share

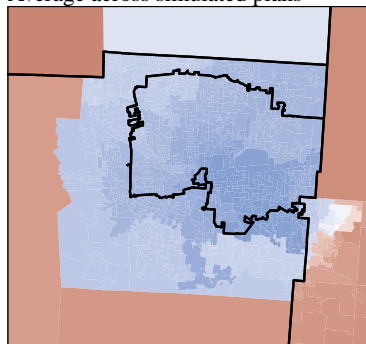


Franklin County (Columbus Area)

Enacted plan



Average across simulated plans



Two-party
vote share



60%

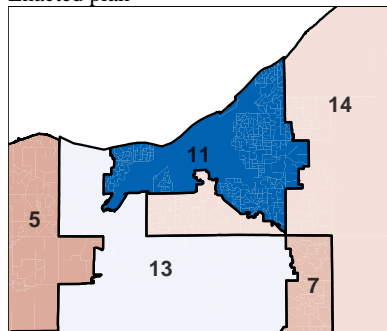
50%

40%

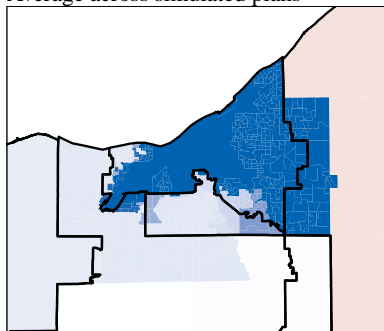
30%

Cuyahoga County (Cleveland Area)

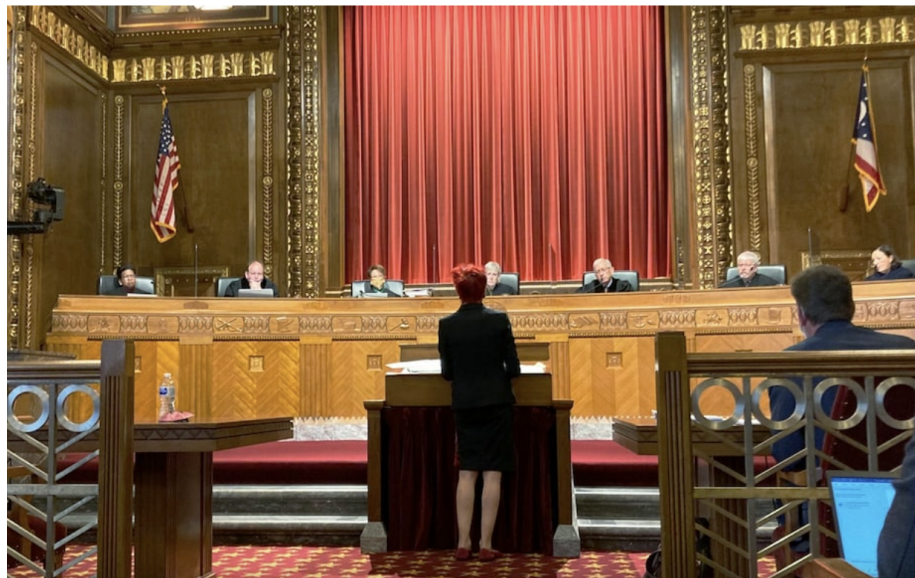
Enacted plan



Average across simulated plans



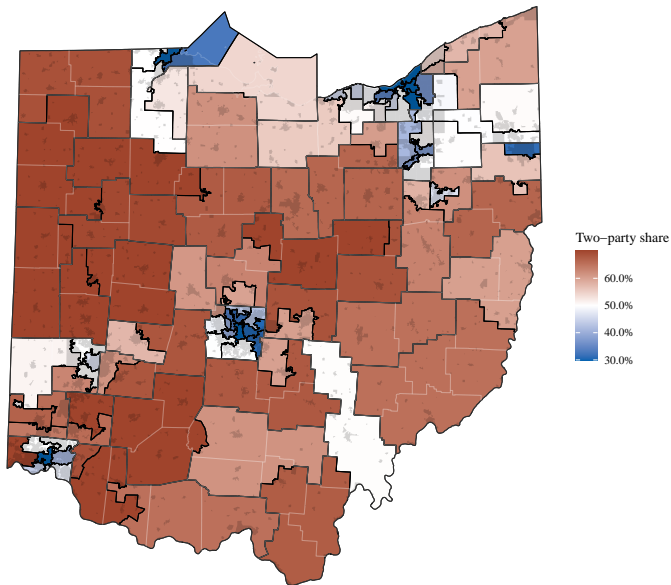
Ohio Supreme Court Strikes Down the Enacted Map



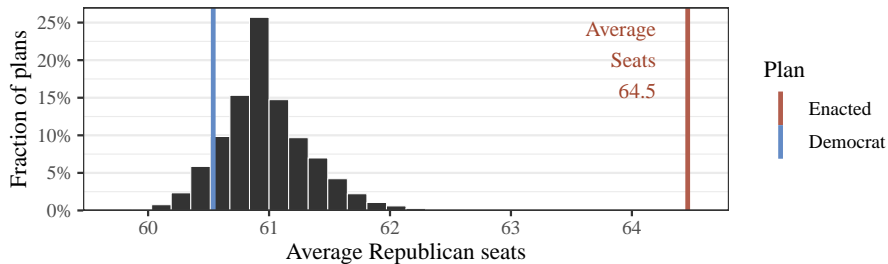
The Court Opinion

Id. at Section 1(C)(3)(a). The above evidence, particularly Dr. Imai's conclusion that the enacted plan will result in, on average, 2.8 more Republican seats than are warranted, shows that the General Assembly's decision to shift what could have been—under a neutral application of Article XIX—Democratic-leaning areas into competitive districts, i.e., districts that give the Republican Party's candidates a better chance of winning than they would otherwise have had in a more compactly drawn district, resulted in a plan that unduly favors the Republican Party and unduly disfavors the Democratic Party.

General Assembly Redistricting Case: Example Simulation



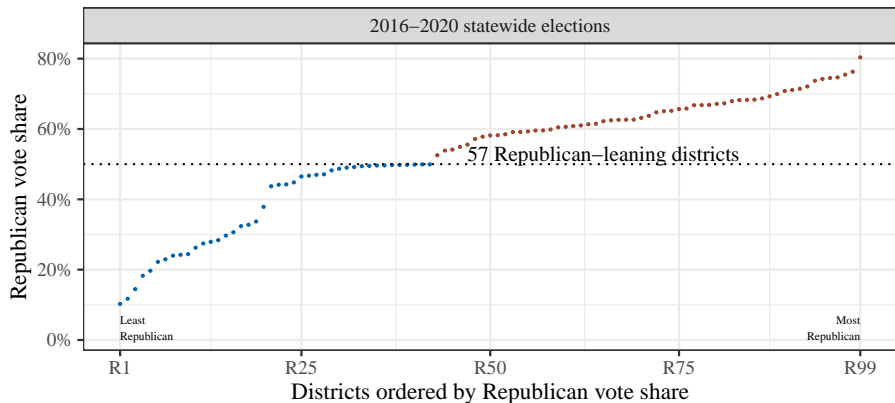
Expected Number of Republican Seats



The Court Strikes Down the Enacted Plan

{¶ 124} Dr. Imai's work also supports the conclusion that the adopted plan's partisan skew is not due to Ohio's political geography. Using Article XI's map-drawing criteria, Dr. Imai generated 5,000 possible district plans. Of those simulated plans, *none* was as favorable to Republicans as the adopted plan. The fact that the adopted plan is an outlier among 5,000 simulated plans is strong evidence that the plan's result was by design.

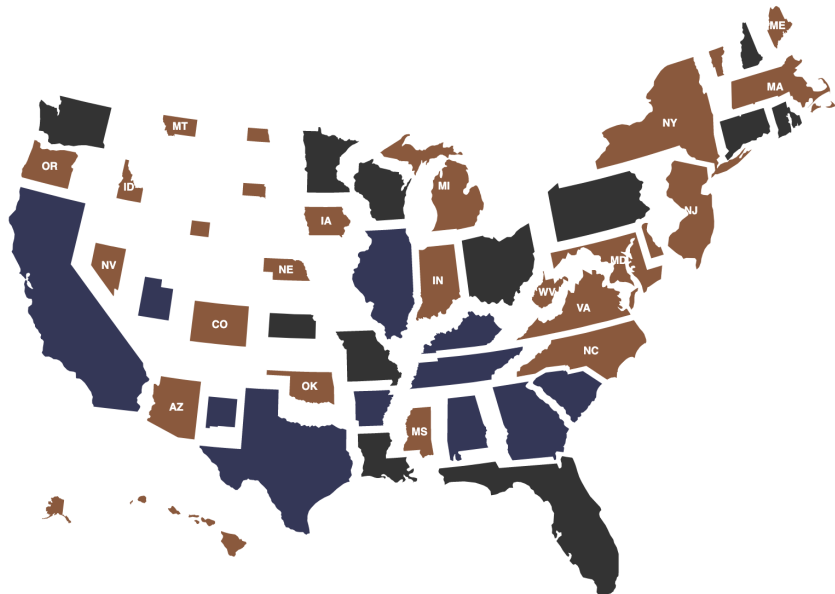
The Revised Plan



The Court Strikes Down the Revised Plan

of the Ohio Constitution. Bluntly, the commission's labeling of a district with a Democratic vote share between 50 and 51 percent (in one case, a district having a 50.03 percent vote share) as "Democratic-leaning" is absurd on its face. Section 6(B) requires the commission to attempt to draft a plan in which the statewide proportion of districts whose voters "favor" each party closely corresponds to the statewide voters' preferences. Here, the quality and degree of favoritism in each party's allocated districts is grossly disparate. When 12 of the 42 "Democratic-leaning" House districts (i.e., more than 25 percent) are very close "toss-up districts" yet there are 0 "Republican-leaning" districts that are similarly close, the proportion of districts whose voters "favor" each party is not being assessed properly.

50 State Redistricting Simulations Project



Concluding Remarks

- Redistricting matters
 - ▶ fair representation and policy outcomes
 - ▶ competitiveness of districts and responsiveness
 - ▶ political polarization

- How should we stop gerrymandering?
 - ▶ independent commission (e.g., Michigan)
 - ▶ use of algorithms and data to detect gerrymandering

- Roles of experts
 - ▶ legislative process
 - ▶ court testimony