Using Ensemble Methods for Computational Redistricting

UNIVERSITY of WASHINGTON
eScience Institute
DATA SCIENCE FOR SOCIAL GOOD

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89%

of Congressional seats in the United States are considered “safe” or uncompetitive

Source: FairVote.org

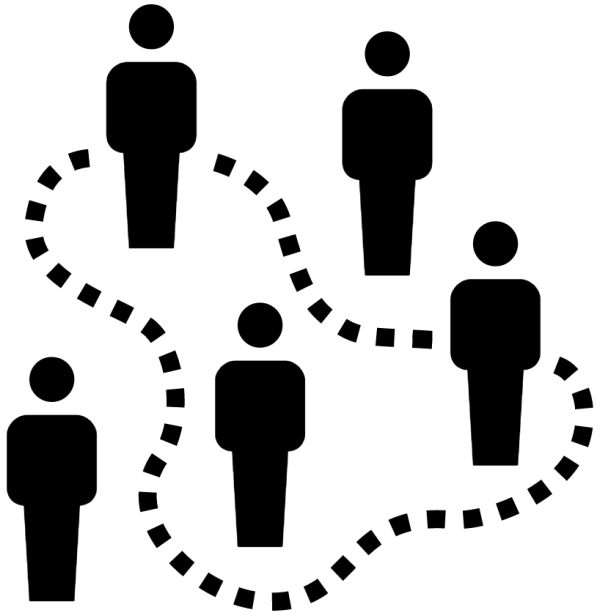
20%

Average approval rating of
Congress over the last 10 years

Source: Pew Research Center

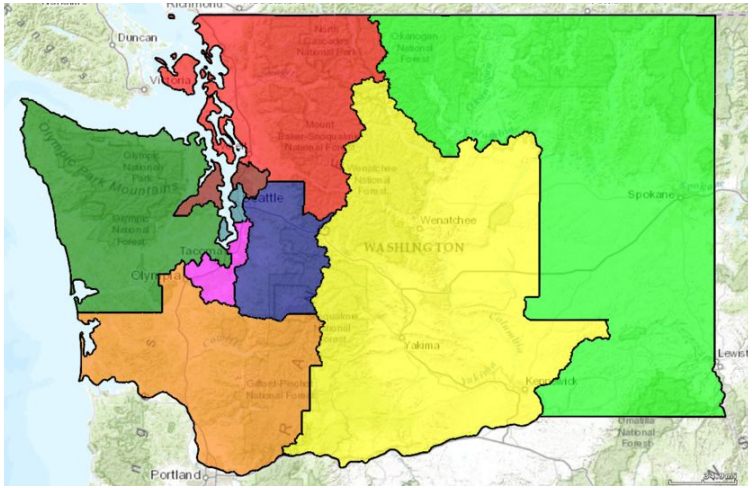
Gerrymandering

- Manipulating electoral district boundaries for personal or partisan gain
- Results in over or underrepresentation of one group at the expense of others
- May be partisan or racial

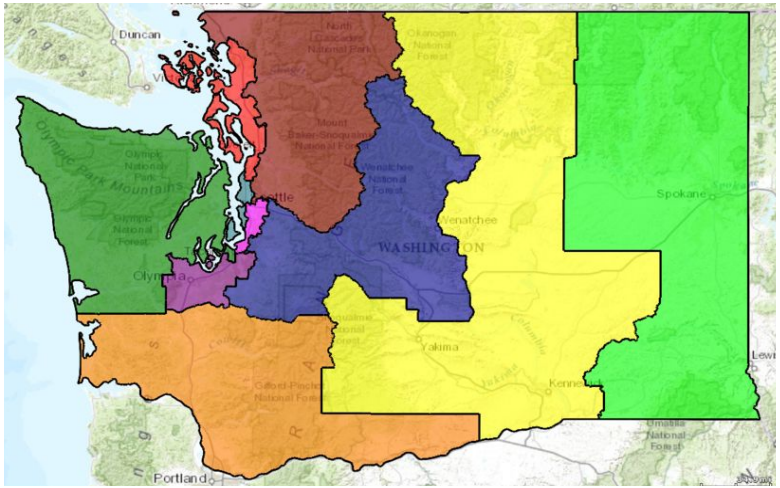


Congressional Redistricting

- Occurs every 10 years to reflect changes in the Census
- State legislatures control the redistricting process
- Each state has its own rules



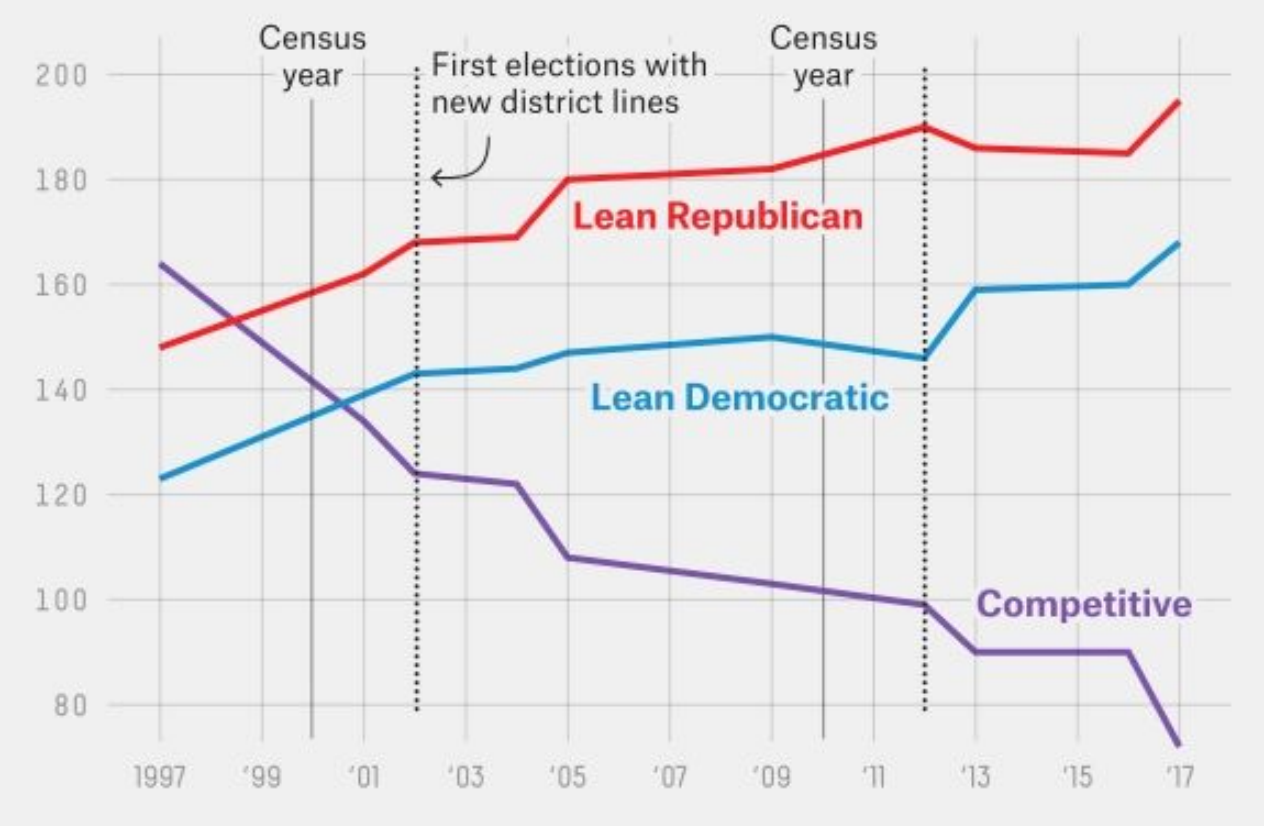
2002 Congressional Map of Washington



2012 Congressional Map of Washington

Source: nationalmap.gov

The US House is Less Competitive than Ever Before



Sources: FiveThirtyEight; Cook Political Report

Computational Methods for Redistricting

A 5x5 Grid has

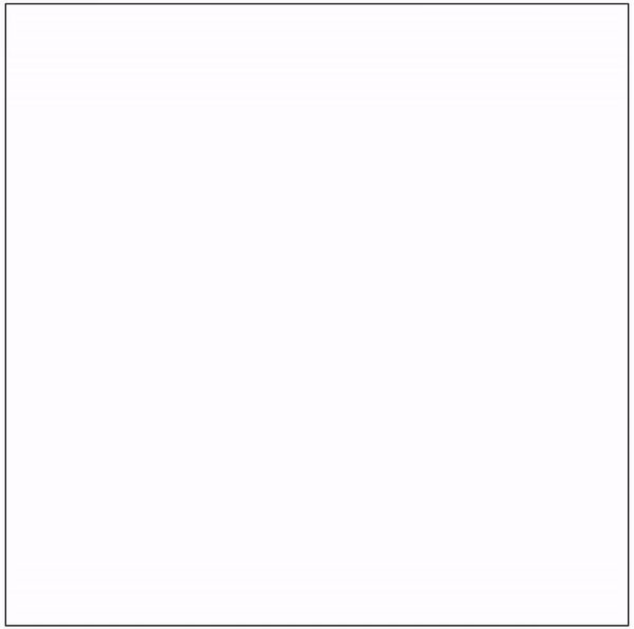
4006

different ways to create five contiguous districts of 5 squares!

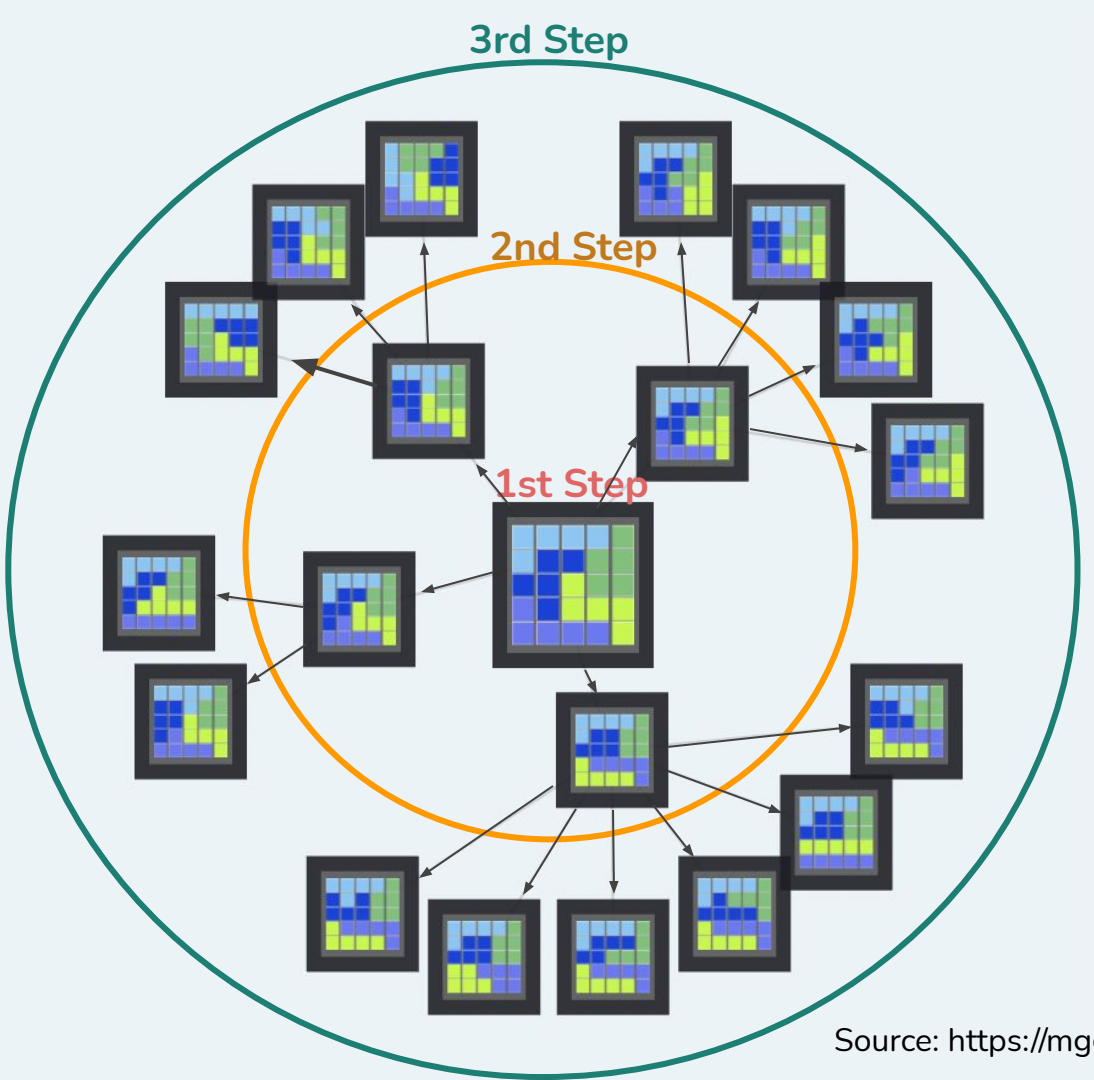
Source: https://mggg.org/metagraph/5x5.html

Markov Chain Monte Carlo (MCMC)

1. Begin with a starting plan
2. Form a Random walk in the state space, incrementally transforming the plan at each step
3. Collect plans visited at each step to build a sample



Source: https://jona.than.ml/qmas/deliverables/01-random_walk/



Source: https://mggg.org/metagraph/5x5.html

GerryChain

A Python library for building ensembles of districting plans using Markov Chain Monte Carlo methods to study political redistricting

A Real World Example

Virginia, 11 Districts

Using GerryChain in State Specific Contexts

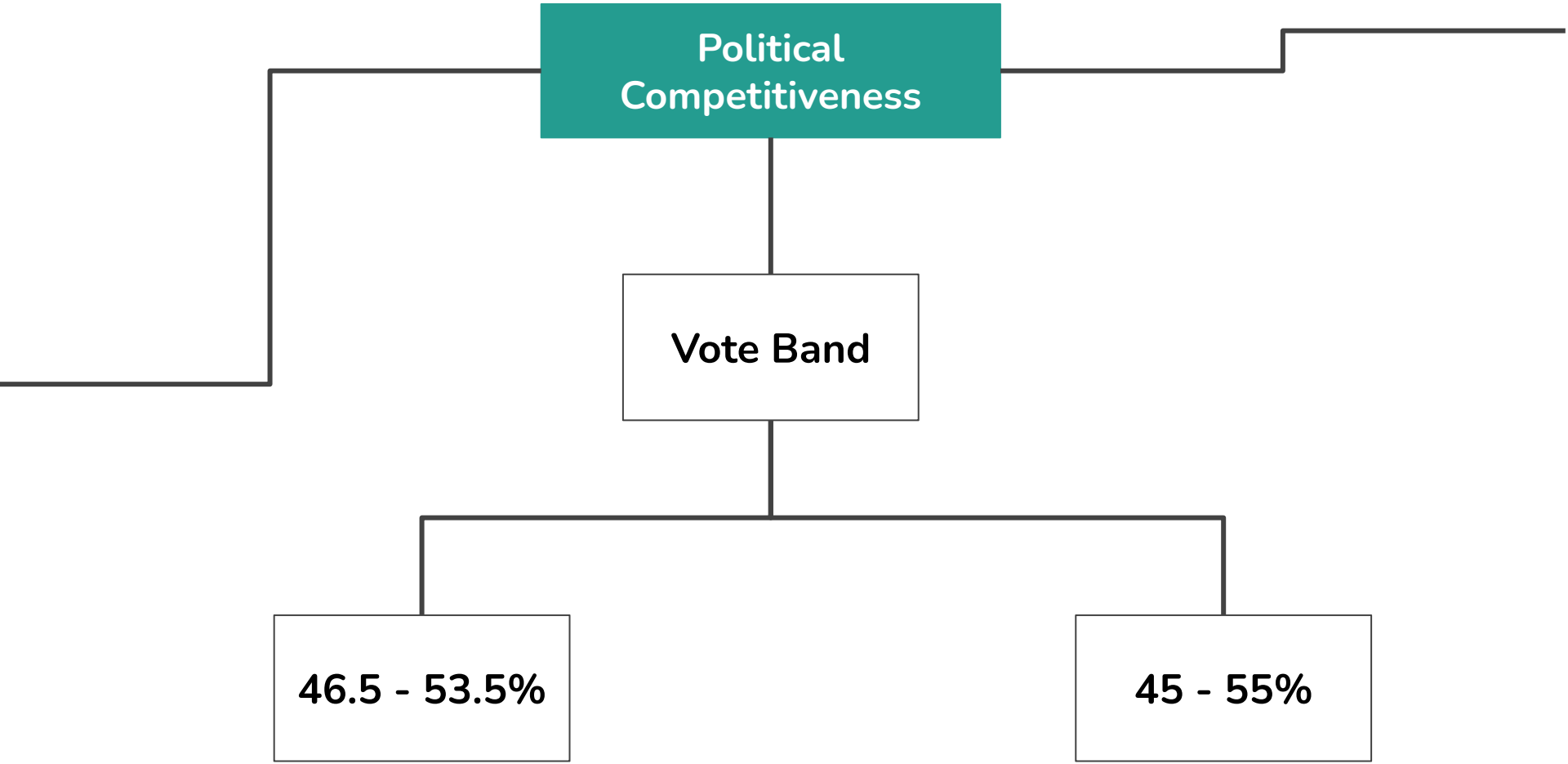
Redistricting Rules in State Contexts

Population Balance	Voting Rights Act	Contiguous Districts
Communities of Interest	Preserve Political Lines	Compactness
Political Competitiveness	Incumbency	Partisan Considerations

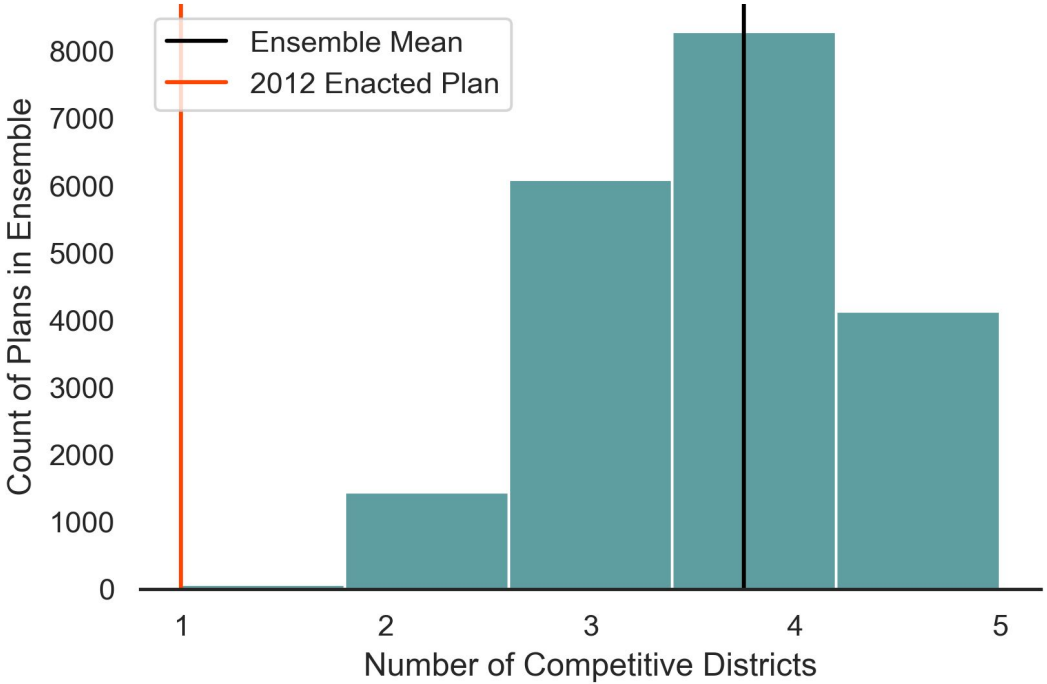
Article V of the Colorado Constitution

Section 44.3:

“Thereafter, the commission shall, to the extent possible, maximize the number of politically competitive districts.”


Political Competitiveness
Vote Band
46.5 - 53.5%
45 - 55%

Vote Band Approach



Redistricting Rules in Georgia

Population Balance	Voting Rights Act	Contiguous Districts
Communities of Interest	Preserve Political Lines	Compactness
Political Competitiveness	Incumbency	Partisan Considerations

Wasted Votes

- Wasted votes are any votes cast for the losing side or votes cast for the winning side in excess of the 50% needed to win.

Bernstein et al, *Notices of the American Mathematical Society* 2017, 64,

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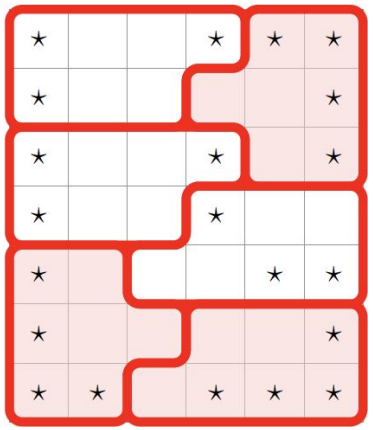
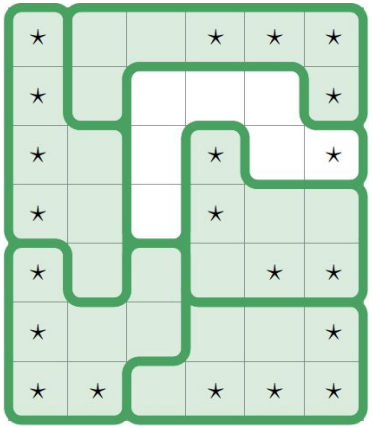
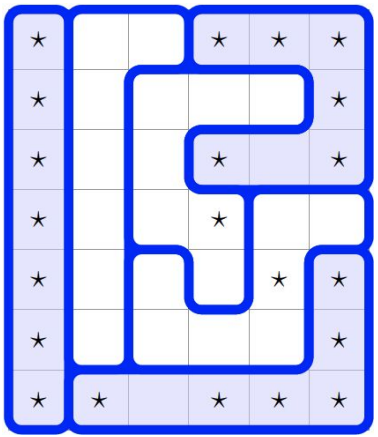
- Wasted votes distributions:



"Competitive"



"Cracked"



"Packed"

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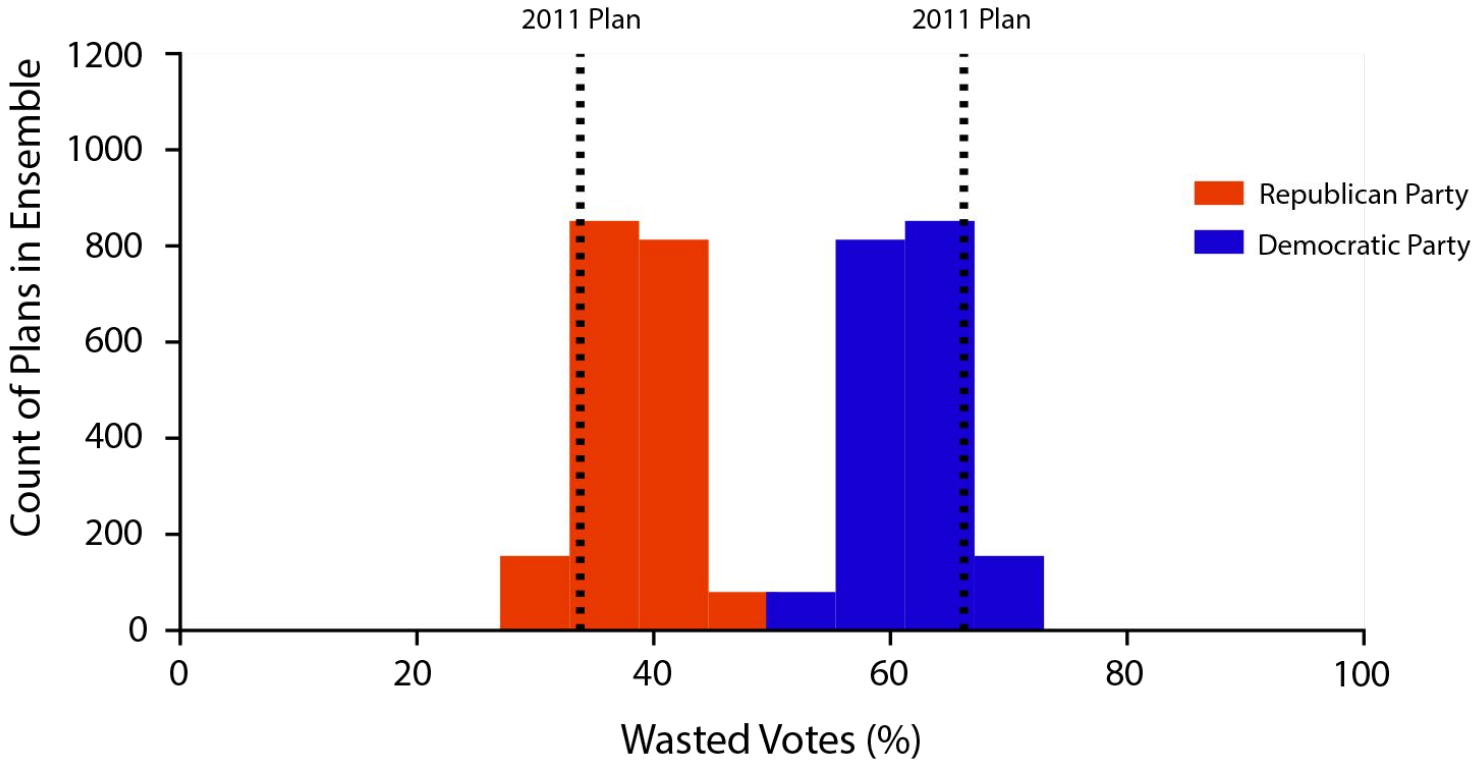
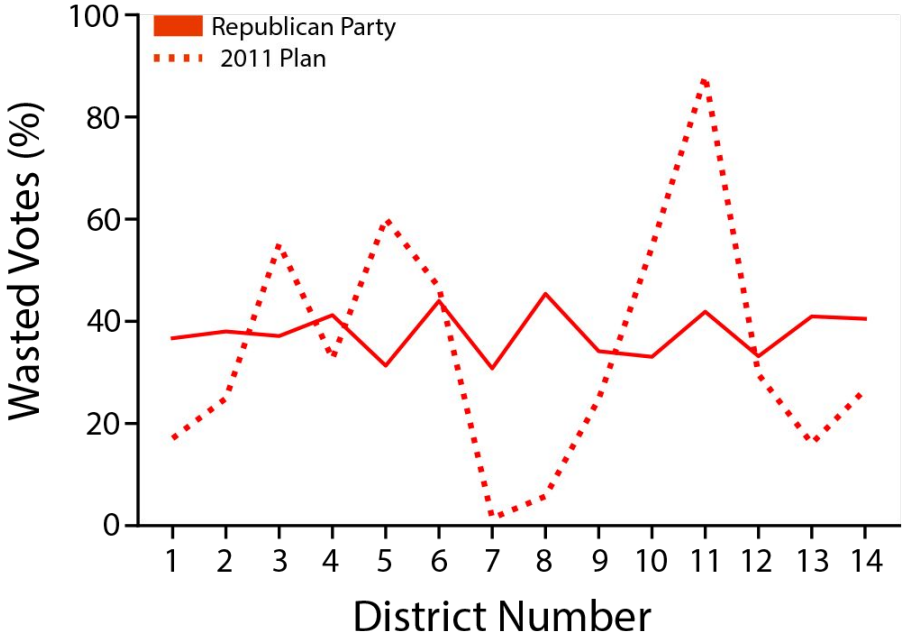
Approach

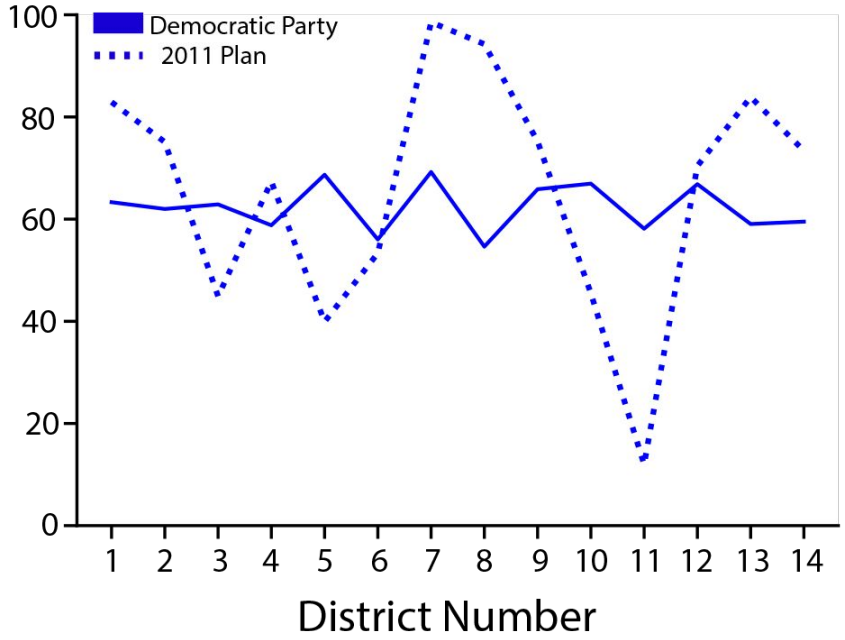
- Assess wasted votes count per district for each proposed plan of the ensemble (2000 plans)
- Calculate the average of wasted votes per district along the ensemble of plans
- Compare wasted vote percentages from the ensemble of plans with percentages of the 2011 enacted map of Georgia using the 2016 presidential election data

Wasted Votes: State



Wasted Votes: Districts





Redistricting Rules in Texas

Population Balance	Voting Rights Act	Contiguous Districts
Communities of Interest	Preserve Political Lines	Compactness
Political Competitiveness	Incumbency	Partisan Considerations

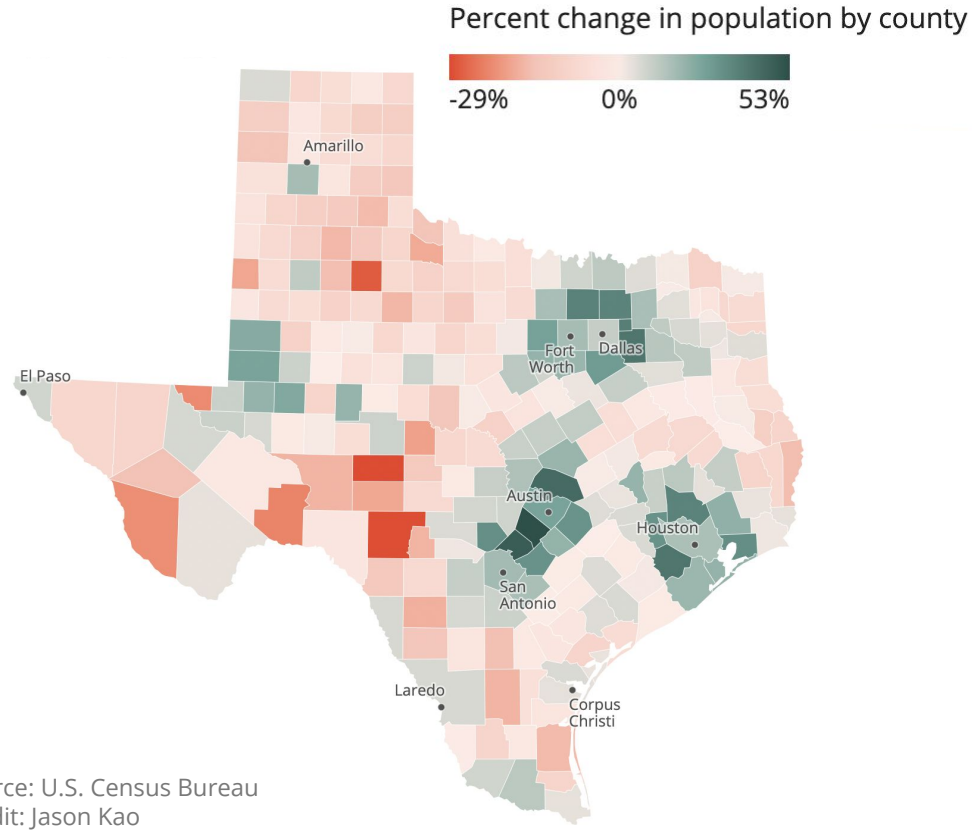
Voting Rights Act (VRA)

Section II

"No voting … practice, or procedure shall be imposed or applied by any State or political subdivision in a manner which results in a denial or abridgement of the right of any citizen of the United States to vote on account of **race or color**….

A violation ...[occurs if] political processes leading to nomination or election in the State or political subdivision are not equally open to participation

Population Shifts in Texas



Source: U.S. Census Bureau
Credit: Jason Kao

15.9% population growth over the last decade (4 million person increase)

2 new congressional seats, increasing number of districts in Texas from **36** to **38**

143 of **254** counties experienced a declining population

Minority Group Effective District -

a district in which minority-preferred candidates are able to both seek nomination in primaries and win the general election

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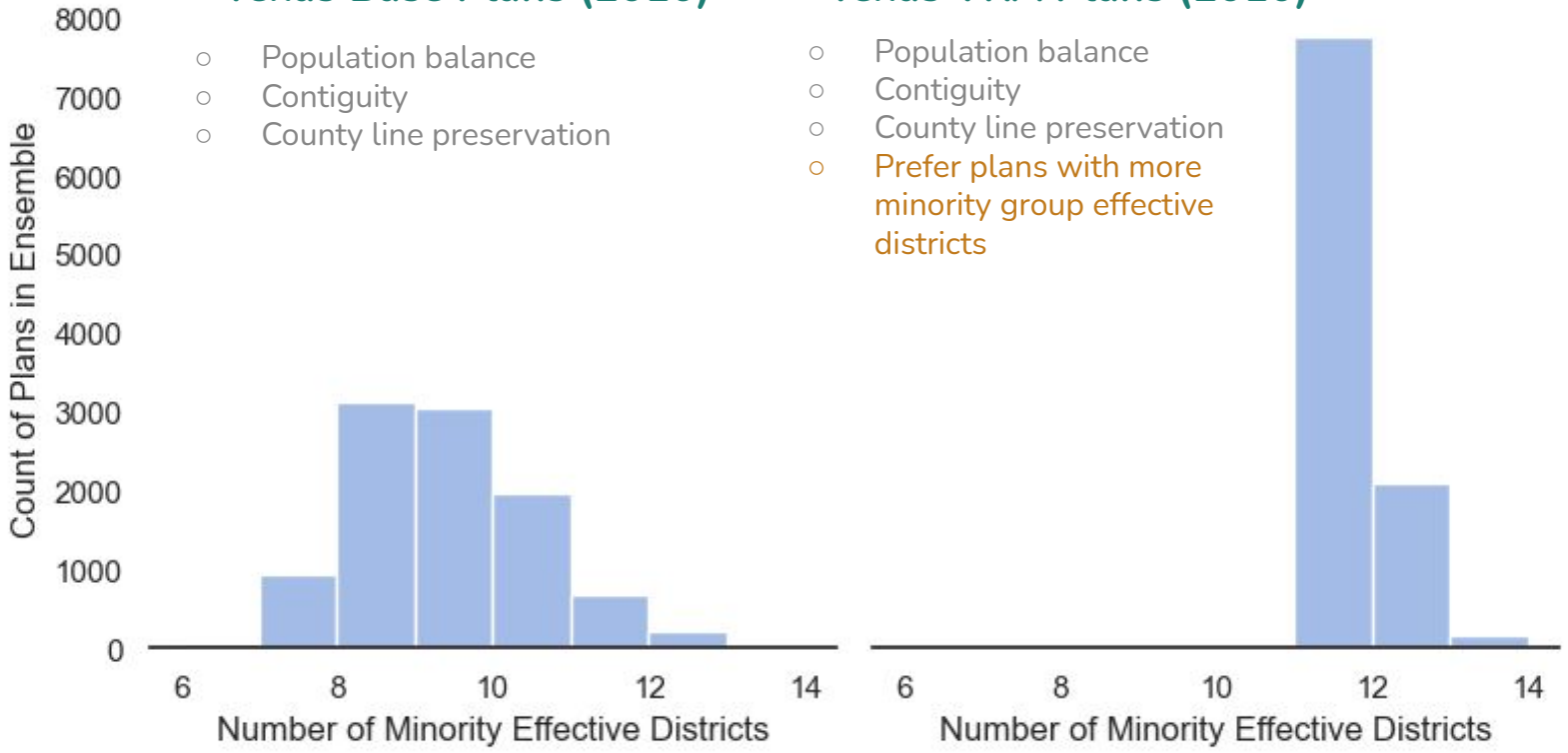
Texas Base Plans (2010)

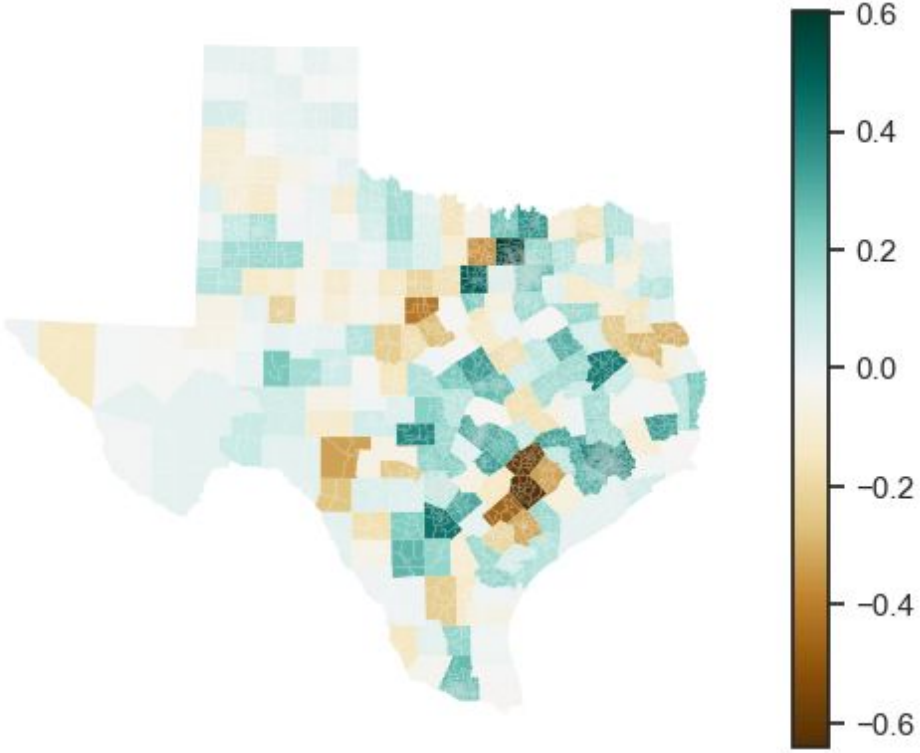
- Population balance
- Contiguity
- County line preservation

Texas VRA Plans (2010)

- Population balance
- Contiguity
- County line preservation
- Prefer plans with more minority group effective districts



Where should the two new districts go?



Difference in average number of districts per county from 2010 to 2020

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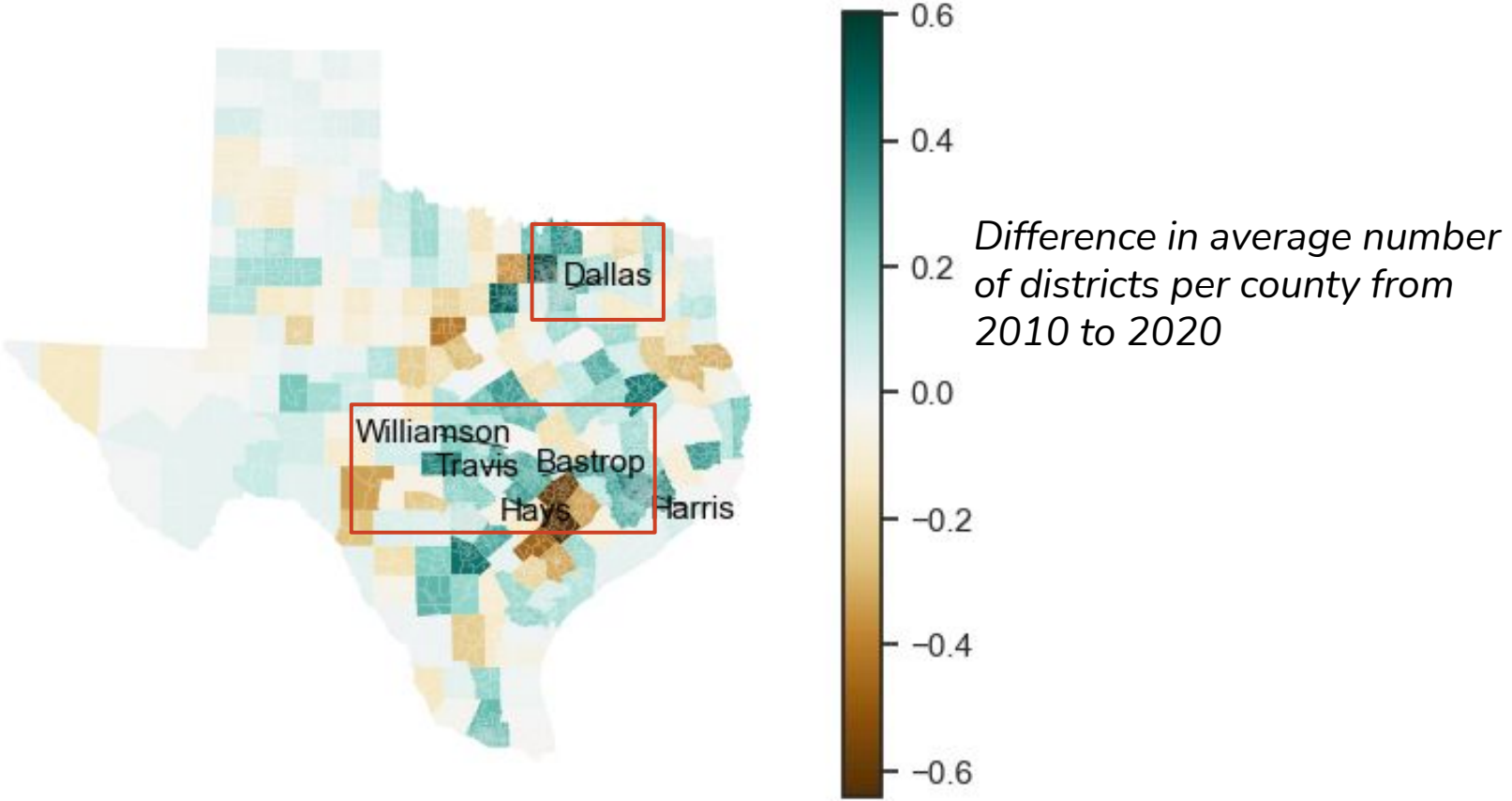


Where should the two new districts go?

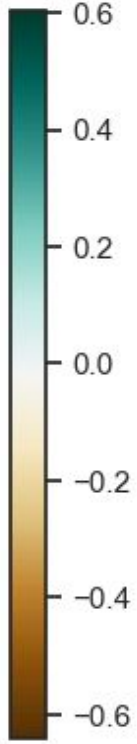
Austin Metro

Dallas Metro

Difference in average number of districts per county from 2010 to 2020

Population Only

Population + Minority Effective Districts



OUTCOMES

Stakeholder Guide

Stakeholder Guide

Provide a set of generalizable guidelines for users of the GerryChain library who wish to apply it to redistricting problems.

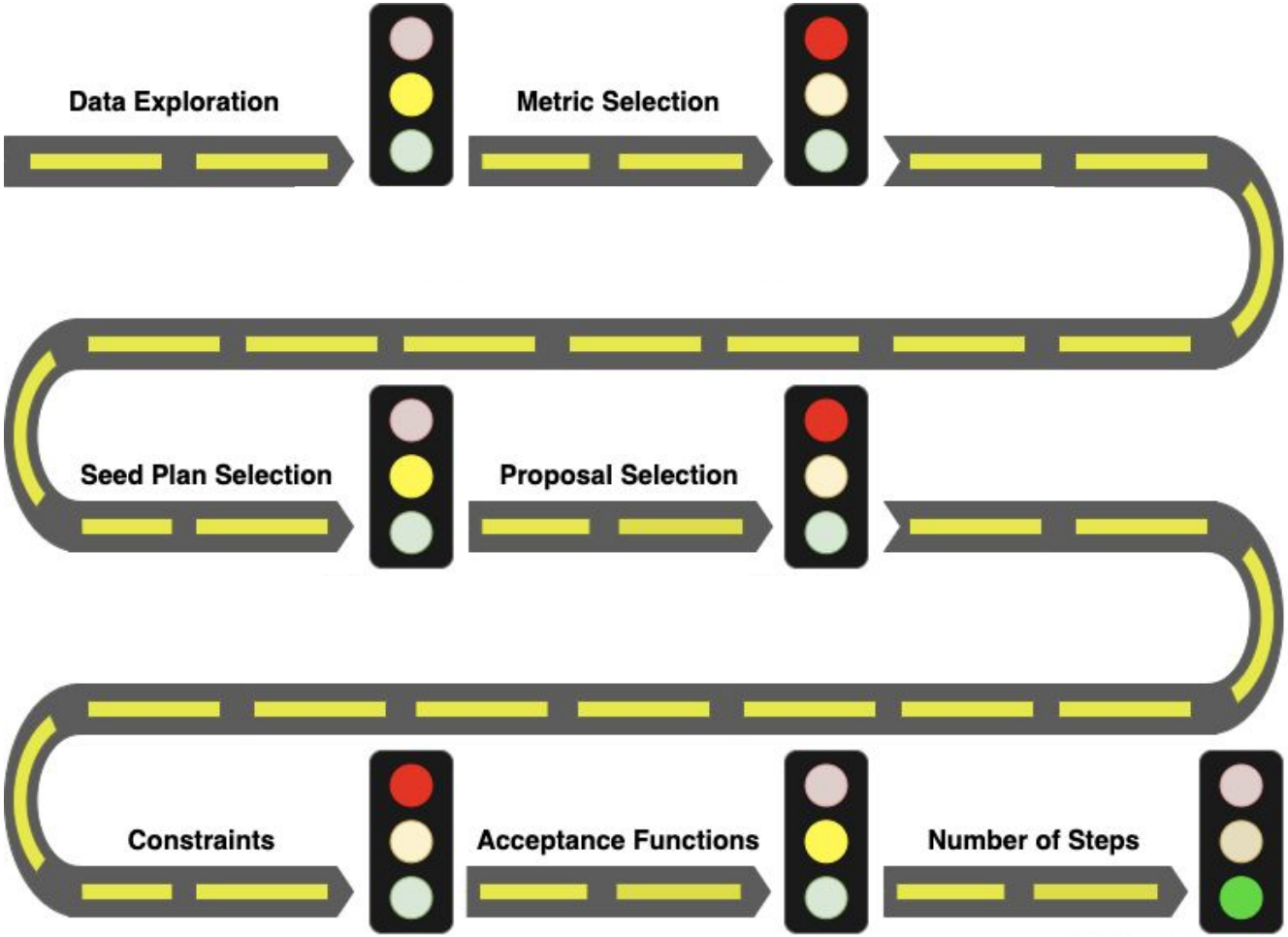
AUDIENCE

Community members, activists, independent electoral commission members

TOPICS

Getting started with GerryChain

Applying GerryChain to state specific contexts


Data Exploration
Metric Selection
Seed Plan Selection
Proposal Selection
Constraints
Acceptance Functions
Number of Steps

Core Principle of Fairness

PROCESS

Maximizing inclusion and transparency
in the map drawing process

OUTCOME

Equal representation of voters

One Person, One Vote

OPINION

Can Americans believe in democracy after this redistricting cycle?

The collision of demographic trends versus the power of redistricting will define much of US politics for the next decade.

By David Daley Updated August 13, 2021, 10 minutes ago

August 13, 2021
7:00 AM PDT
Last Updated 4 hours ago

United States

In U.S. redistricting fight, citizens come armed with a new weapon: their own maps

5 minute read

By Joseph Ax

Census data sets up redistricting fight over growing suburbs

By DAVID A. LIEB and ACACIA CORONADO today

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Thank You!