

## CSE 416, SECTION 3

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### Quality Measures

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### Session Objectives

- Understand the quality measures that can be used to compare the effectiveness of FRA voting as compared with current voting
- Understand the background issues and terminology to the measures of quality
- See examples of the graphs used to display quality measure results

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## Reading

- Seat-Votes Curve

<https://jeffreyshe19.github.io/Seats-Votes-Curves/>

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## MCMC Recap

- For any state, a district plan ensemble contains a set of random district plans using one of the following election techniques
  - Current technique – Single Member Districts (SMD) – winner take all
  - FRA technique – Multi Member Districts (MMD) – ranked choice voting
- Apply measures of fairness to each ensemble and to the current district plan
- Compare the measures of fairness

Since political parties often influence district boundaries, the districts can disadvantage some voter groups

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## Types of Unfairness

- Fewer representatives for the political party not in power
- Fewer representatives for racial and ethnic groups, for example
  - African American
  - Hispanic
  - Asian American

African American voting rights are protected by the 1965 Voting Rights Act (VRA), but that law has been weakened by recent Supreme Court decisions

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## Opportunity Districts

- Sometimes referred to as majority-minority districts
- A jurisdiction in which a racial or ethnic minority (relative to the whole country's population) make up a majority of the local population
- “A majority-minority district is a district in which a racial minority group or groups comprise a majority of the district's total population.” – Ballotpedia
- Threshold is usually considered to be 50%, but could be less for states not showing racially polarized voting

Opportunity districts usually refer to a single minority while majority-minority districts can refer to either a single minority or multiple minorities

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## Voting Rights Act (1965)

- Mandates that no "standard, practice, or procedure shall be imposed or applied by any State or political subdivision to deny or abridge the right of any citizen of the United States to vote on account of race or color."
- Mandates that electoral district lines cannot be drawn in such a manner as to "improperly dilute minorities' voting power"
- Majority-minority districts are created to prevent the dilution of minorities voting strength

Wikipedia reports 26 African American majority-minority districts, 3 Asian-American, and 34 latino majority-minority districts

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## Voter Suppression Examples

- Demands for voter identification
- Voter registration purges
- Making voter registration harder
- Rules and processes that determine who is eligible
- How to register
- How to vote
- When polls are open
- Whether people are put in districts that give them a fair chance of electing their candidate of choice

Voter suppression techniques are enabled by data analysis

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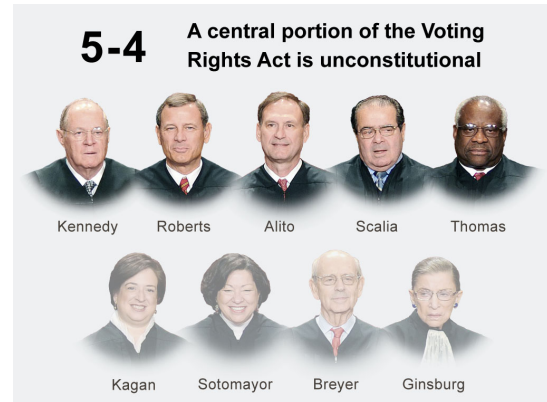
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## 1965 Voting Rights Act

- VRA (1965)
  - Forced selected states to obtain pre-clearance for any election change that might affect the right to vote
  - Very effective in restoring voting rights
- 2013 decision of Supreme Court struck down parts (e.g., preclearance) of the VRA
- Majority-minority provisions remain, but has been used to enable district packing of congressional districts



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## 1986 Supreme Court Decision

- Thornburg v. Gingles
- The court established three criteria for proving racial vote dilution under the Voting Rights Act:
  - A minority group must demonstrate it is large and compact enough to constitute a majority in a single-member district
  - A minority group must demonstrate it is politically cohesive
  - A minority group must demonstrate the majority group votes sufficiently as a group to defeat the minority group's preferred candidate

Establishes the need to study  
measures of racially polarized voting

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## Compare Probability Distributions

- The heart of the project is to compare expected election results of an SMD election with a MMD election
- You will compare various measures of fairness by applying the measures to each plan in the :
  - SMD ensemble
  - MMD ensemble

To apply these measures, we need to estimate the winning candidates in each MMD and SMD random district plan

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## Estimate Results in a SMD Random District Plan

- For each random district plan (i.e., graph)
  - Identify the set of precincts (i.e., nodes in the graph) in each district (i.e., partition)
  - Sum the data stored in each node in a district, for example
    - Votes for each party's candidate
    - Population of significant minorities
  - For each district, determine
    - Political party with the most votes
    - Any minority group that exceeds a population threshold (e.g., 50%)
  - Summarize the data for the district
  - Record the results in “bins” to generate bar chart data

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## Estimate SMD Political Party Winners

- For each precinct
  - Record the results (Republican / Democratic vote totals) from a recent state-wide election, for example
    - President
    - Governor
    - Attorney General
  - Estimate the votes in a future election using the recorded votes for a political party's candidate
- For each district, sum the precinct votes for each party's candidate
- Candidate with the most votes is the estimated winner

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## Estimate MMD Political/Minority Winners

- Develop an algorithm based on the text in the FRA to determine winners in each MMD district
- Calculate potential minority winners in each MMD
  - Minority population exceeds threshold (e.g., 20%) in a 5-member MMD
  - Minority population exceeds threshold (e.g., 25%) in a 4-member MMD
  - Minority population exceeds threshold (e.g., 33%) in a 3-member MMD

You can defer implementation of the FRA algorithm until we cover the details in class

Different thresholds might be in optional use cases

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## Bar Charts

- Study of Michigan redistricting
- Example – seat distribution
- Comparison suitable for opportunity districts and party splits

You can compare the seat distribution for MMD with SMD on separate charts or a single chart

MCMC analysis shows the likelihood of a given seat distribution

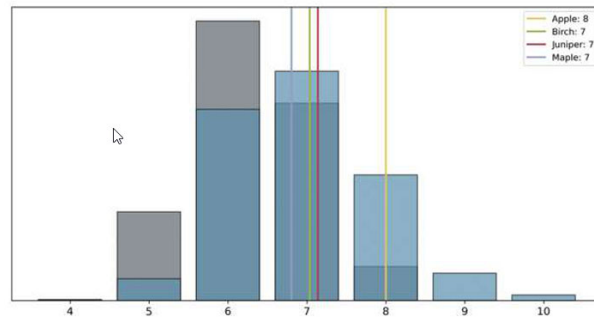


Figure 4. Number of Seats Democrats Would Win with Senate 2018 Results

Image: Institute for Public Policy and Social Science

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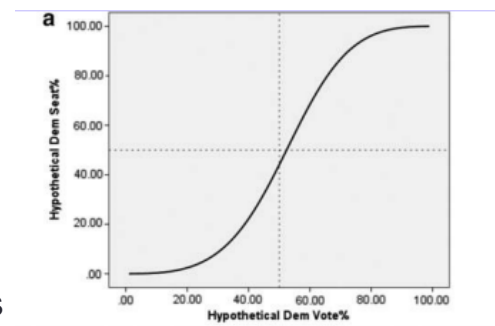
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## Political Fairness - Seat vs. Vote Symmetry

- Plot vote share vs seat share for Republicans and Democrats
- Notion that voting is equal when a 50% vote share results in a 50% seat share
- A shift in the curve indicates gerrymandering
- To calculate, change your vote prediction calculation to generate points to plot
- Helpful to compare multiple district plans



Shen code is a good starting point

Image: Election Law Journal, McDonald & Best

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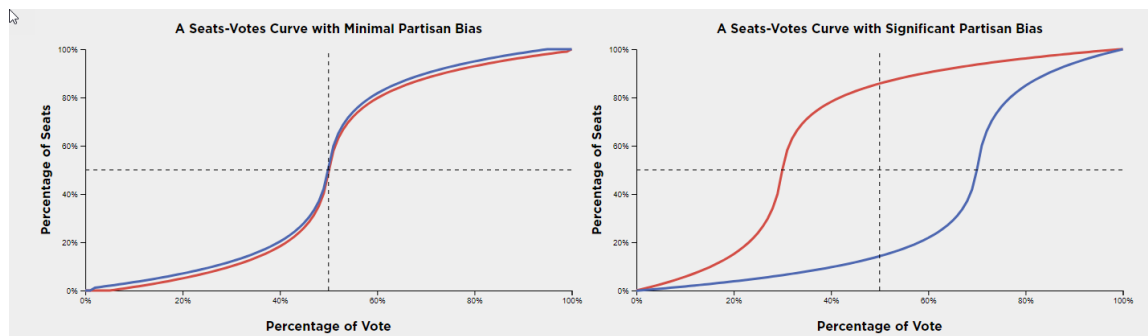
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## Partisan Bias

Interesting to compare the current district plan to ensemble results

- Deviation from 50% seat share at 50% vote share



How do you generate a vote/seat share curve for an ensemble?

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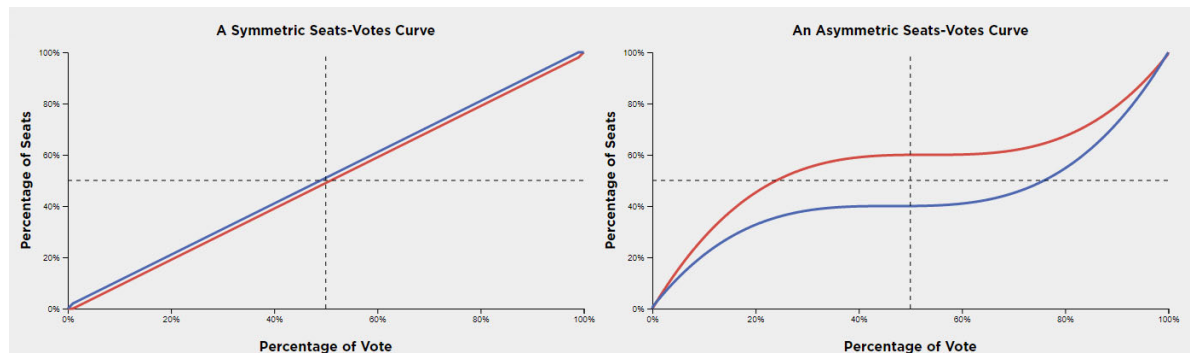
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## Partisan Symmetry

- Average distance between seats-votes curve of one party and that of the other party



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## Responsiveness

- Average slope of the seats-votes curve
- Measures protection of incumbents

A Proportional Plan

An Incumbent Protection Gerrymander

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## Box & Whisker Plot

Example is from the Virginia court case

Y-axis is either % of a minority group or % of votes for a political party

Average for the district

Array of boxes summarizes the ensemble

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## Box & Whisker Analysis

- Used in many redistricting court cases
- For each random district plan
  - Calculate the population percentage for each district using the group of interest (e.g., African American)
  - Sort the districts in increasing order of the group population percentage
  - Repeat above steps for all random district plans
  - Store data
- For each district group (e.g., lowest percentage of the population)
  - Calculate maximum, minimum, 1<sup>st</sup> quartile and 3<sup>rd</sup> quartile
  - Calculate the box (1<sup>st</sup> quartile to 3<sup>rd</sup> quartile) and whiskers (max, min)
  - Plot
- Repeat the process for selected district plans (e.g., enacted)

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## Class Question

- How would you modify the box & whisker plot to compare SMD with MMD?

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## Social Choice Approaches

- Defines the way votes are tabulated
- Simple case: single member district and highest vote total wins
- Thiele rule – each voter provides a set of candidates they like, and each candidate has a weight
- Single Transferable Vote (STV) – rank choice voting for multiple winners in which candidates are eliminated in a **series of rounds**

You will need to encapsulate the logic described in the FRA to implement the STV algorithm

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## Class Question

- How do you model voting preferences in a MMD based on previous election results?

For a SMD MCMC analysis the modeling can be simple. For example, use a statewide race (e.g., Presidential) to predict which party a voter would choose

Multiple MMD strategies might be used

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## What Data is Needed?

- Geospatial boundary data
  - Precinct
  - Congressional district
  - State
- Election results data (e.g., 2020 presidential) by precinct
- Demographic data (e.g., racial) by precinct

The enacted district boundaries provide a good frame of reference in a map display

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## High Level View of the Project

- Build a robust system to
  - Calculate a set of 5,000 SMD district plans (ensemble) for each state selected by the team (using MGGG software)
  - Calculate a set of 5,000 MMD district plans (ensemble) for the FRA process (using the same states)
  - Calculate the votes in each plan based on historical data
  - Calculate the set of winners using FRA social choice for MMD and winner take all for SMD
  - Calculate fairness results (e.g., political) for each of the ensembles
  - Compare and display the comparison of the two ensembles for each state
  - Compare measures with the enacted district plan

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## Sources of Data

- Project Web site suggests many sources of data
- The most accurate data source could be
  - Redistricting Data Hub
  - US Census Bureau
  - State Election Office
  - US Government repository of region borders
- Easier sources of data (including some consolidation) are available
- Sometimes difficult to locate the best source of data

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## Class Question

- How would you organize your GUI?

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## Have You Satisfied the Objectives?

- Understand the quality measures that can be used to compare the effectiveness of FRA voting as compared with current voting
- Understand the background issues and terminology to the measures of quality
- See examples of the graphs used to display quality measure results