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## **Final Project Gerrymandering**

### **Overview**

Most of our legislators (federal, state, and local) are elected from districts. Every ten years, state governments redraw district boundaries in a process known as redistricting. Gerrymandering is the act of purposefully manipulating the redistricting process in order to favor one party or class. Through gerrymandering, a party or class can “steal” an election. That is, the same popular vote can result in different outcomes based on how the district boundaries are drawn. Thus, redistricting presents an ethical dilemma. How should district lines be drawn (or redrawn) in order to accurately represent the will of the people when it comes to election results? As computers are now an indispensable part of this process, this presents an ethical issue in computer science.

In order to understand the impact of gerrymandering on our voting maps, we need to be able to measure it. There are four common ways in which the impact of gerrymandering is measured: efficacy gap, partisan bias, mean-median difference, and declination. These four measures can be used to determine the amount of gerrymandering present in a redistricting plan.

**Efficiency Gap:** Also called “efficacy gap”, this refers to the processes known as “cracking” and “stacking”. Cracking is a practice that spreads an opposing party’s supporters among many districts, so that their preferred candidates lose by relatively narrow margins. Packing is a practice that concentrates a party’s supporters into a few districts, where their preferred candidates win by very large margins. Both of these practices reduce the efficacy of a party’s votes by ensuring that they do not contribute to a candidate’s election. In the case of cracking, all of the party’s votes in a district are cast for the losing candidate. In the case of packing, all of the votes for the winning candidate above the simple majority needed (fifty percent plus one vote) are wasted. All of these votes (the losing votes from cracking and the surplus votes from packing) are considered inefficient votes. The efficiency gap in a redistricting plan is calculated by taking the number of inefficient votes for one party, subtracting the other party’s

inefficient votes, and dividing by the total number of votes cast. This number is used to measure the extent to which the proposed district lines crack and pack one party's voters more than the other party's voters.

**Partisan Bias:** Partisan bias measures the difference between the number of districts each party would win in a perfectly tied election and the fifty percent of districts that they should win in this case. For example, if a party would win 52% of districts by receiving 50% of the votes state-wide, then the partisan bias is 2%. To calculate partisan bias, the observed vote share in each district is shifted by the amount necessary to simulate a tied statewide election. Each party's seat share in this hypothetical election is then determined. The difference between each party's seat share and 50% is the partisan bias.

**Mean-Median Difference:** The mean-median difference is a party's median vote share by district minus its mean vote share by district, across all of a redistricting plan's districts. For example, if a party has a median vote share of 45% per district and a mean vote share of 50% per district, then the plan has a mean-median difference of 5% against this party. When the mean and the median diverge significantly, the district lines are skewed in favor of one party and against the other. Conversely, when the mean and the median are close, the district distribution is more fair to both parties.

**Declination:** Declination is a measure of the extent to which the win/loss threshold has been used to design a redistricting plan. The declination metric highlights asymmetry in the distribution of votes across districts to identify partisan gerrymandering. The actual calculation is statistically sophisticated and is beyond the scope of this paper.

### **Why it Should Be Addressed**

Gerrymandering should be addressed

### **Possible Solutions**

Possible solutions for Gerrymandering include the establishment of Independent Redistricting Committees (IRC's), the passing of federal legislation To ban gerrymandering, and the online use of web tools to identify instances of gerrymandered redistricting maps.

### **Code Component**

For our code component, we wrote a simulation showing that a tied general election with districts containing an equal number of voters each could be won by either party depending on how the district lines are drawn. The user running the code inputs the number of voters per district, the number of districts, and the number of election trials

the user would like to run. The program outputs the total number of votes each party received in each election (always a tie, but output to confirm), the number of districts each party won in each election, the winning party of each election, and the total number of election trials won by each party in the simulation.

The code simulates each election by randomly assigning each vote in a district as either Democrat or Republican with 50% probability of each. The computer then counts the district as a win for the party which received more votes. The program keeps track of the total votes for each party (from the districts) and then adds an appropriate number of votes to each to ensure that the general election is a tie. These added votes are used to determine the winner of the final district. The program then compares the number of districts won by each party to determine the winner of the election trial.

## **References**

1. [Plan Score: Score Electoral District Maps Evaluate their fairness](#)
2. [Campaign Legal Center: How Can We Combat Gerrymandering?](#)