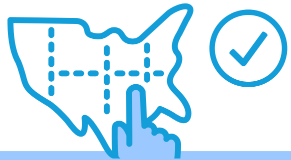

USING MATH MODELING TO IDENTIFY AND CORRECT GERRYMANDERING

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SUSTAINABLE DEVELOPMENT GOALS

10 REDUCED INEQUALITIES

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

Background

- Gerrymandering is a political issue that describes the manipulation of electoral borders to work in the favor of, or against, a specific party
- It is deeply undemocratic, but without objective evidence, action cannot be taken against it (Kirschenbaum & Li, 2021)
- There are two types of gerrymandering: packing and cracking
- Packing describes grouping several voters of the same party in one district to ensure that one district wins by a tremendous margin, but the surrounding districts are less competitive (Jones, 2018)
- Cracking also makes districts less competitive, but it does this by splitting a party's voters across several districts, making them a minority in each one (Jones, 2018)
- Section 2 of the Voting Rights Act states that redistricting to intentionally pack or crack minorities is strictly prohibited (Section 2 of the Voting Rights Act, 2015)

Existing Models

- Many use the efficiency gap, a mathematically accurate measure of the quantity of "wasted votes" (Stephanopoulos & McGhee, 2015)
- Gerrymandering is a combinatorial optimization problem so the solution is usually a rapid randomized algorithm (Chatterjee et al, 2018)
- Several accurate models, but they only account for compactness, preserving old district cores, and geographic symmetry
- They do not consider just representation of minorities

Methodology

1. Define the Problem
2. Make Assumptions
3. Define Variables
4. Solve
5. Analyze the Solution

Phrase 1

Existing mathematical redistricting models focus on compactness or geographical factors and do not account for fair representation of minorities, the purpose of the electoral college system.

Phrase 2

The goal of this project is to develop objective measures to identify and correct minority-targeted gerrymandering.

Identification Model

Gerrymandering Score =
$(\alpha \times EG) + (\beta \times PVDA) + (\gamma \times PVDB)$

EG = |(Party A's wasted votes - Party B's wasted votes)/Total votes|

PVDA = |(Total Party A votes/Total votes) - (Districts Party A won/ Total districts)|

PVDB = |(Total Party B votes/Total votes) - (Districts Party B won/ Total districts)|

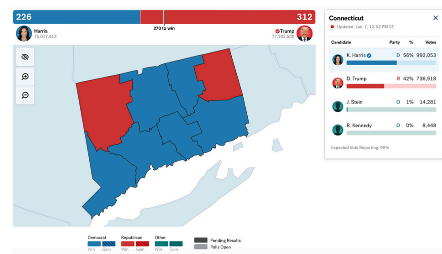
Weights

α = 50% 0.50

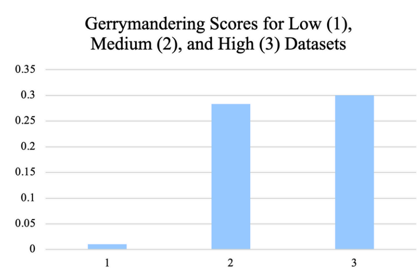
β = 25% 0.25

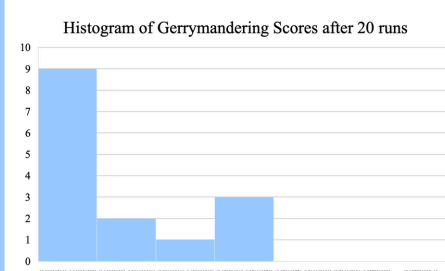
γ = 25% 0.25

Case Study: Connecticut



Source: https://abcnews.go.com/Elections/2024-us-presidential-election-results-live-map/t





Design Matrix

	Chatterjee et al.'s Model	Liu et al.'s Model	Guest et al.'s Model	Correction Model
Equal population	✓	✓	✓	✓
Geographic symmetry	✓			✓
Compactness	✓	✓	✓	
Preservation of historic district centers	✓		✓	
Just representation of minorities				✓

Discussion and Conclusion

Next Steps

- Continue developing the Correction Model; consider the addition of other factors
- Consult with experts in the field: Chatterjee, Guest, Liu, etc.
- Develop accessible app or website to view the extent of gerrymandering and how to fix it when given the user's region

Significance

- Gerrymandering and unfair redistricting has devastating consequences on minority communities communities
- One of the primary purposes of retaining the archaic electoral system is to counteract the majority rule and provide just representation to minorities
- A mathematical model to identify and correct gerrymandering without human bias could revolutionize the redistricting process
- This research aims to protect the rights of minorities and ensure everyone's fundamental right to vote has an equal impact

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