PHPE 308M/PHIL 209F
Fairness

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November 5, 2025

In this report, we investigate potential representational outcomes under the FRA, focusing on the potential for members of racial and ethnic minorities to elect candidates of choice.

MGGG Lab (2022). *Modeling the Fair Representation Act*. https://mggg.org/FRA-Report.

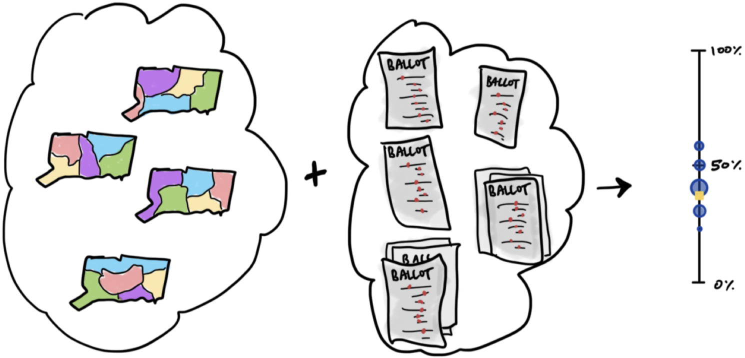

Figure 1. High-level view of methods. We generate an *ensemble* of random multi-member districting plans; we generate *simulated elections* based on voting history in each state; then we run the STV algorithm to combine the districts and votes into outcomes. Figure 7 shows the results for the whole nation, with yellow boxes for the statewide share of minority population and blue circles for the projected share of minority-preferred representation.

Throughout this report, we discuss how the electoral system implemented by the FRA may change the representational landscape for people who have systemically been denied equitable political representation.

Below, we broadly refer to “POC” (people of color) and “White” subgroups, where White refers to those whose census response lists them as non-Hispanic single-race White, and POC is the complement.

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It is important to remember that the models in this report do not predict how many representatives will be people of color themselves, but rather how many will be POC-preferred.

Generating Ballots

- **Plackett-Luce**: voters have an overall preference between two slates and then flip a weighted coin to choose from each;
- **Bradley-Terry**: the likelihood of a given ballot is based on how it ranks the candidates pairwise;
- **Alternating Crossover**: every voter is either a bloc voter whose ballot type puts one slate entirely above the other or an alternating voter who trades off between the two slates;
- **Cambridge Sampler**: ballot types are chosen at random from actual historical RCV elections in Cambridge, MA

Instead of choosing between these models of voter behavior, we run them all and report the results split out by model before aggregating.

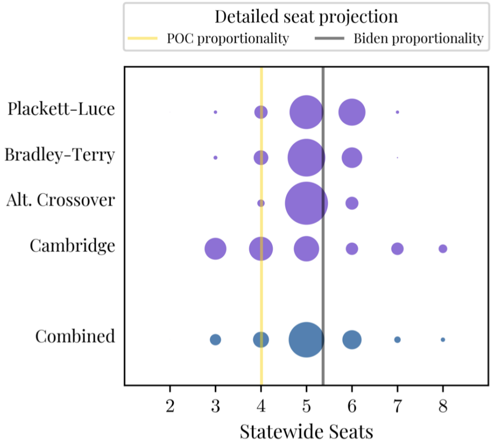
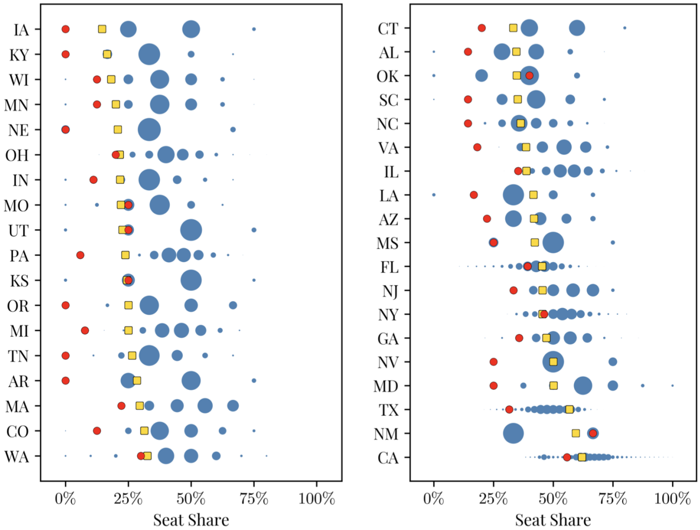


Figure 4. Maryland's 8 seats are grouped into one 3-member district and one 5-member district. The state has just over 50% POCVAP and supported Biden-Harris at roughly 67%.



The yellow squares show the statewide POCVAP share and the red dots show the status quo (2021) POC share of Congressional representation.

Conclusions

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- The results are fairly robust against the possibility of systematically lower turnout by people of color.

Overall conclusion: Single transferable vote in multi-member districts can secure proportional representation for minorities without a race-conscious line-drawing process.

Apportionment

- There are m political parties: $P_1, \ldots, P_m$
- There are n voters. Each votes for exactly one party. Let n_i denote the number of votes that party P_i receives (of course, $\sum_i^m n_i = n$).
- We have parliamentary seats and we need to distribute them among the parties. (In most cases we want to do it proportionally!)

- Apportion parliament seats to states by population. Done in several countries, historically most noteworthily in the United States House of Representatives.

- Apportion parliament seats to parties by vote count. Used in several countries (notably in Europe) that use proportional voting systems. If a party gets α% of the votes, then it should get approximately α% of the seats.

- Allocation of identical items. Suppose there is a collection of many identical items, and we need to allocate them to n agents, where each agent has a claim on the items of different strength. Examples:
  - A transit system needs to assign trains or train drivers to metro lines, in proportion to the number of passengers on the line.
  - A school system assigning teachers to schools by their number of students

Two Examples

Suppose you need to fill $k = 10$ seats.

	Party 1	Party 2	Party 3	Party 4
Number of votes	10	20	20	50
Number of seats	$1 = 10 \cdot \frac{10}{100}$	$2 = 10 \cdot \frac{20}{100}$	$2 = 10 \cdot \frac{20}{100}$	$5 = 10 \cdot \frac{50}{100}$

Two Examples

Suppose you need to fill $k = 10$ seats.

	Party 1	Party 2	Party 3	Party 4
Number of votes	6	7	39	48
Number of seats	$0.6 = 10 \cdot \frac{6}{100}$	$0.7 = 10 \cdot \frac{7}{100}$	$3.9 = 10 \cdot \frac{39}{100}$	$4.8 = 10 \cdot \frac{48}{100}$

Not integral!

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How should you assign seats proportionally? Round up? **Doesn't sum to 10!**

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Number of seats	0	0	4	6

How should you assign seats proportionally?

The Largest Remainder Method

Also called the Hamilton method or the Hare-Niemeyer method.

1. Assign party P_i their *lower quota* $= \lfloor k \cdot \frac{n_i}{n} \rfloor$.
2. Sort the parties by the remainders $k \cdot \frac{n_i}{n} - \lfloor k \cdot \frac{n_i}{n} \rfloor$ and assign the remaining seats to the parties with the highest remainders.

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Lower quota	0	0	3	4
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Number of seats				

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Apportionment Paradoxes

The Method of Largest Remainder may seem like the most natural, even obvious, method for apportionment. But countries using it to make decisions have found that it suffers from several so-called apportionment paradoxes.

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- **The population paradox**. In 1900, Virginia lost a seat to Maine, even though Virginia's population was growing more rapidly.
- **The new states paradox**. In 1907, Oklahoma became a state and would have deserved 5 seats. So the house size was increased from 386 to 391. In the process, New York lost a seat while Maine gained a seat.

Alabama Paradox

	Party 1	Party 2	Party 3
Number of votes	6	6	2
$k = 10$	$4.286 = 10 \cdot \frac{6}{10}$	$4.286 = 10 \cdot \frac{6}{10}$	$1.429 = 10 \cdot \frac{2}{10}$
Number of seats	4	4	2

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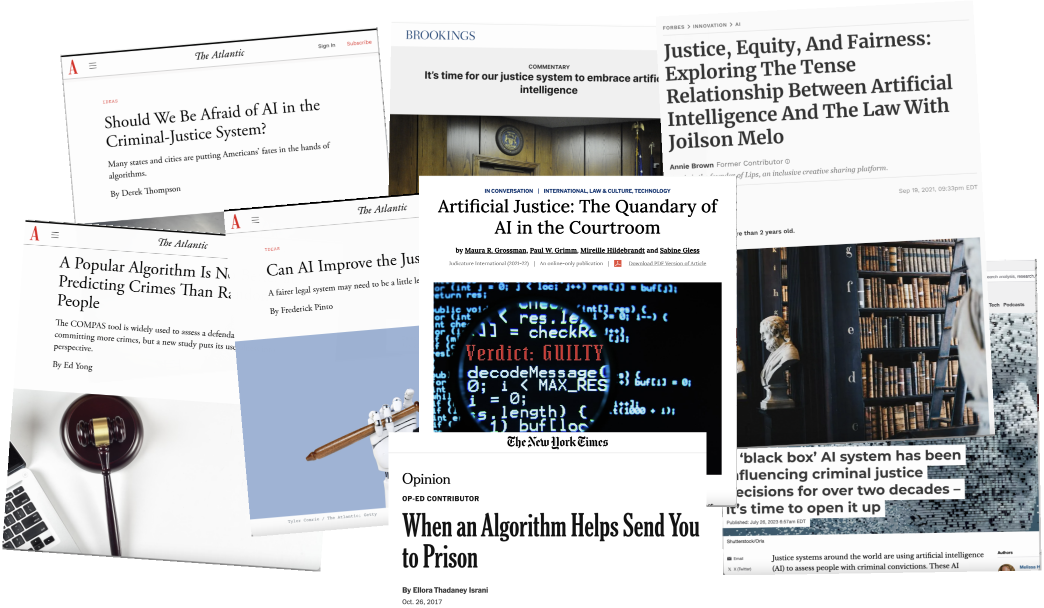
	Party 1	Party 2	Party 3
Number of votes	6	6	2
$k = 10$	$4.286 = 10 \cdot \frac{6}{10}$	$4.286 = 10 \cdot \frac{6}{10}$	$1.429 = 10 \cdot \frac{2}{10}$
Number of seats	4	4	2
$k = 11$	$4.714 = 11 \cdot \frac{6}{10}$	$4.714 = 11 \cdot \frac{6}{10}$	$1.571 = 11 \cdot \frac{2}{10}$
Number of seats	5	5	1

Fairness in AI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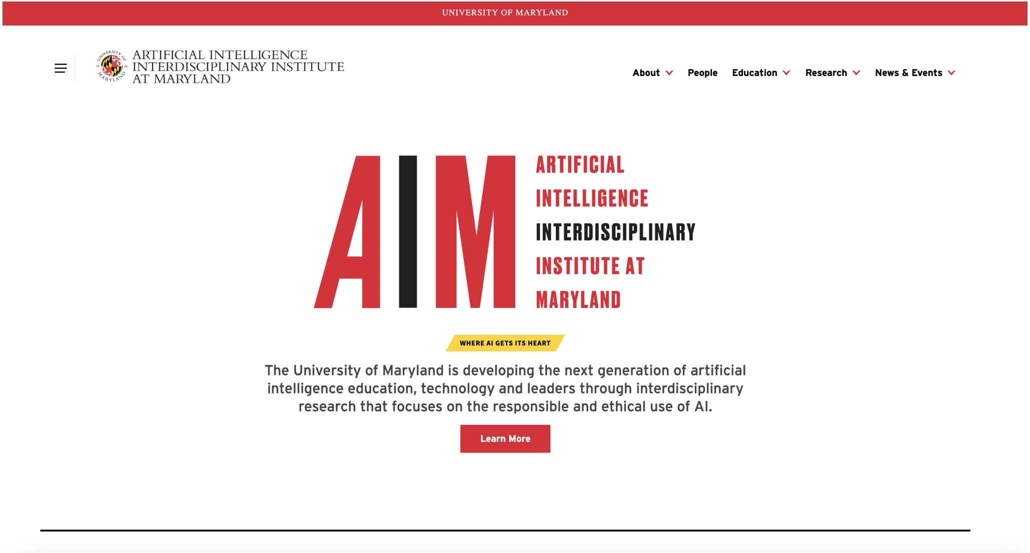

Jana Schaich Borg, Walter Sinnott-Armstrong, and Vincent Contizer (2024). *Moral AI: And How We Get There*. Chapter 4: Can AI be fair?, Penguin Books.