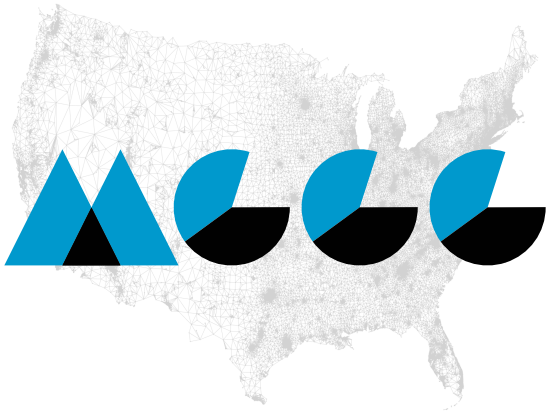
Analysis of Election Systems for Oregon State



MGGG Redistricting Lab

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Contributors

Amy Becker and Moon Duchin contributed to the study design and analysis in this report. We gratefully acknowledge Dara Gold and Thomas Weighill for collaboration on ideas, data, and code used here.

1 Introduction and Study Questions

Oregon State had 3,831,074 residents enumerated in the 2010 Census. Table 1 shows the demographic breakdown of the state by Total Population, Voting Age Population (VAP) and Citizen Voting Age Population (CVAP). We use the term POC (people of color) to refer to residents who are Hispanic or have selected a non-White race in the Census (or both). Other racial group names (Asian, White, etc) denote respondents who identified as non-Hispanic and selected a single racial category. In total the POC share of Oregon CVAP is 16.73%. The distribution of POC residents across the state is shown in Figure 1. Breaking down the POC population further, Oregon has only one individual minority group that makes up more than 5% CVAP share: Hispanic/Latino residents (9.10% of VAP and 7.52% of CVAP).

Race	Share of Total Population	Share of VAP	Share of CVAP
White	78.46%	82.06%	83.27%
POC	21.54%	17.94%	16.73%
Latino	11.75%	9.10%	7.52%
Asian	3.64%	3.65%	3.32%
Black	1.70%	1.58%	1.73%
Other	4.46%	3.60%	4.17%
Total People	**3,831,074**	**2,964,621**	**3,054,030**

Table 1. Total population, Voting Age Population (VAP) and Citizen Voting Age Population (CVAP) by race and ethnicity in Oregon state. Total population and VAP data is from the 2010 Census, and CVAP data is from the 2019 ACS 5-year rolling average.

Oregon is currently divided into 30 state Senate districts, each of which is subdivided into two state House districts that perfectly nest within the Senate district. Each district elects one member for a total of 30 Senators and 60 Representatives. State Senators serve 4-year terms; state Representatives serve 2-year terms. All state legislators must reside in the district they represent, and all legislative voting is district-based.

Even though POC residents comprise over a fifth of the state's population (and just over one sixth of the state's CVAP), they are fairly dispersed, rarely achieving high concentrations in any legislative districts. High levels of racially polarized voting or low POC voter turnout could therefore lead to the near-complete exclusion of POC-preferred candidates from office.

The POC share of the overall population is 21.54%, so the proportional share of the total 90 state legislators (counting Senators and Representatives) would be roughly 19.4. Currently, Oregon is well below that mark with only 12 POC state legislators. It is natural to ask whether some of this disparity could be reduced by changes to the state's election system or to the electoral districts.

We emphasize that these legislators who are themselves people of color may not necessarily have been the candidates preferred by POC voters. POC candidates of choice can come from any racial or ethnic group. In the absence of accurate voter preference data, we use the legislature's racial makeup as an imperfect proxy for representation. Furthermore, we know that no community votes as a monolith, and we take care to consider a range of candidate support and voting polarization levels in this report.

The Oregon State Constitution dictates that, "a senatorial district shall consist of two represen-

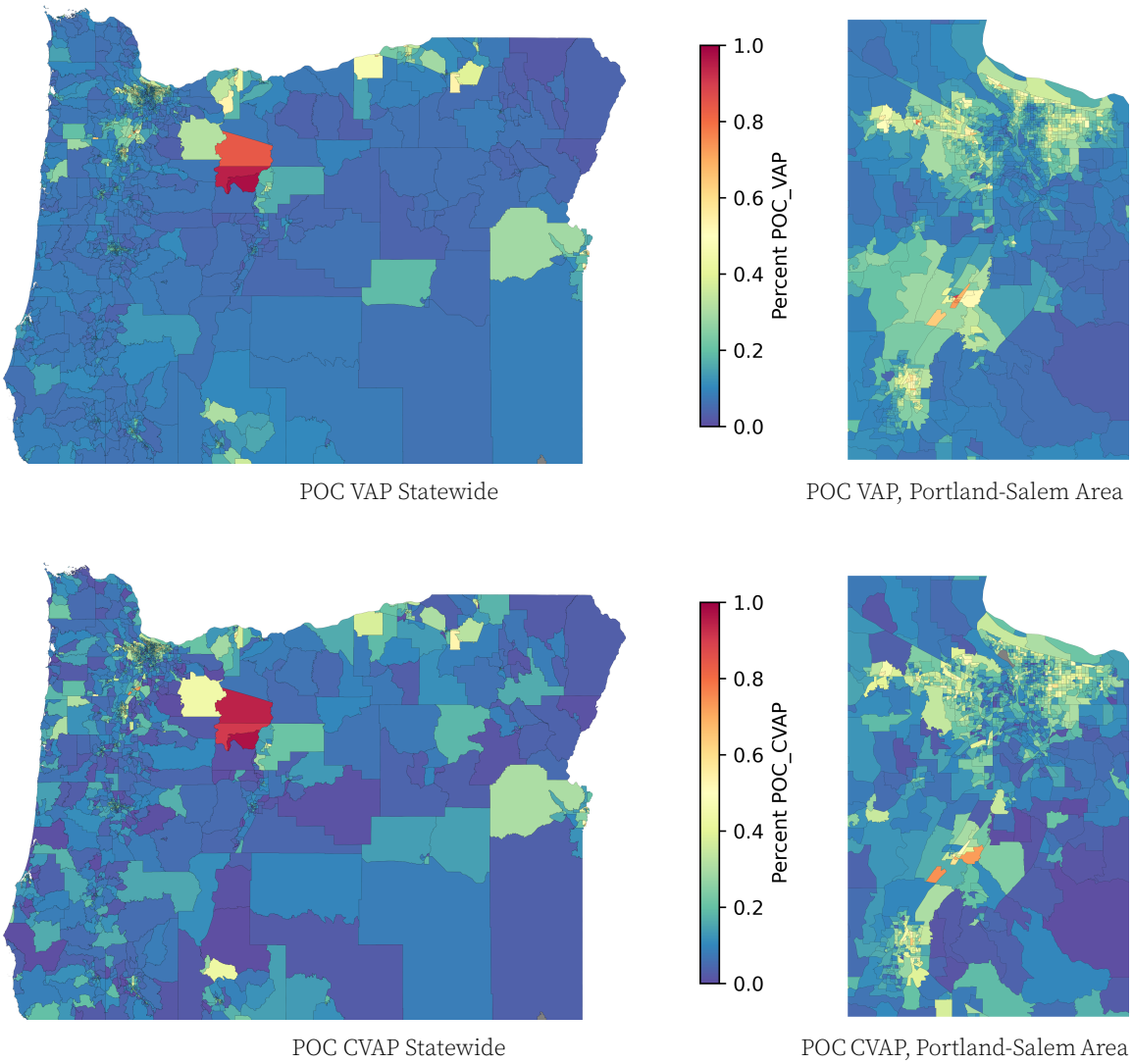


Figure 1. POC VAP and POC CVAP by block group across Oregon with insets for the Portland-Salem area.

tative districts" and, "the Senate shall never exceed thirty and the House of Representatives sixty members."[1] These criteria allow a considerable amount of flexibility in the design of the system and the districts. We will also consider possibilities outside of the Constitutional specifications to see whether even more flexibility could afford more opportunity for POC voters.

Our focus will be identifying options for the design of districts that are suitable for use in combination with ranked choice voting (RCV), with the aim of maximizing the opportunities for people of color to approach proportional levels of representation in Oregon's state legislature.

We consider seven alternative setups: (0) 30 districts, each electing one Senator and subdivided into two House districts, each electing one Representative, all by single-seat Instant-Runoff-Voting (IRV)– this setup is the RCV analog of the current system; (1) 3 districts, each electing nine Senators and subdivided into two House districts, each electing nine Representatives; (2) 4 districts, each electing seven Senators and subdivided into two House districts, each electing seven Representatives; (3) 6 districts, each electing five Senators and subdivided into two House districts, each electing five Representatives; (4) 10 districts, each electing three Senators and subdivided into two House districts, each electing three Representatives; (5) 16 districts, each electing one Senator and subdivided into two House districts, each electing one Representative, all by single-seat Instant-Runoff-Voting (IRV); and (6) 30 districts, each electing five legislators (unicameral). As noted above, some of these alternatives, namely the unicameral syste, would require constitutional amendments—the others fall within the current constraints.

	System 0	System 1	System 2	System 3	System 4	System 5	System 6
Number of Senate Districts	30	3	4	6	10	16	30
Number of House Districts	60	6	8	12	20	32	
District Relation	Nested	Nested	Nested	Nested	Nested	Nested	Unicameral
Number of Senators per Senate District	1	9	7	5	3	1	5
Number of Representatives per House District	1	9	7	5	3	1	
Total Number of Senators	30	27	28	30	30	16	150
Total Number of Representatives	60	54	56	60	60	32	
Ratio of Senators to Representatives	0.5	0.5	0.5	0.5	0.5	0.5	
Total Number of Legislators	90	81	84	90	90	48	150

Table 2. Summary of alternative election systems assessed.

2 Experimental Design

2.1 Ensembles of Alternative Districting Plans

A central technique in this study is a random process for generating alternative valid districting plans. We use an algorithm that produces large numbers of plans while maintaining population balance, contiguity, and reasonable compactness.[2] From each run, we collected a sample of 500,000

[1] https://www.oregonlegislature.gov/bills_laws/Pages/OrConst.aspx

[2] Specifically, we use the ReCom Markov chain implementation designed by the MGGG Redistricting Lab. See https://mggg.org/uploads/ReCom.pdf. We required all districts to be within 5% of ideal district population, and we ensured

valid districting plans, which we will call an *ensemble* of plans.

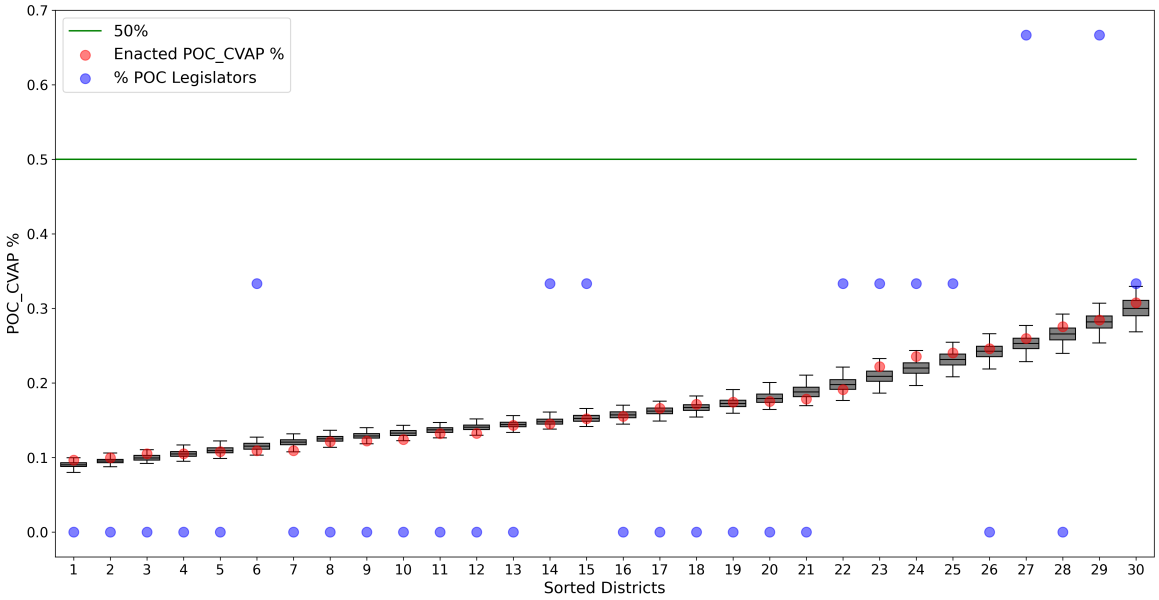


Figure 2. POC CVAP shares by state-legislative district (in sorted order from least POC share to highest). The box and whiskers are drawn from a large random sample of possible 30-district state-legislative plans. The POC CVAP percents of the currently enacted Oregon Senate districts are overlaid in red dots. Blue dots show how many of the three representatives of each Senate district (one Senator, two Representatives from the corresponding nested House districts) are themselves POC identified. Note that seven of the nine districts with the highest POC CVAP share have at least one POC representative.

Figure 2 shows the POC CVAP percentages of the 30 enacted state Senate districts in comparison to the range of POC CVAP percentages observed in the 30-district ensemble. The fact that the red dots fall close to the boxes indicates that the current plan is unremarkable in its POC distribution: the comparison suggests no intention to create more (or fewer) predominantly-minority districts than would be present purely by chance.

For a random sub-sample of 10,000 plans from the ensemble, we simulated an RCV election in each district in the plan. Our methods of simulating elections require several specifications: (a) a choice of model for voter ranking behavior, (b) a candidate pool, (c) a candidate strength scenario, and (d) a level of racial polarization in the electorate. In order to approximate the complexity of real-world elections, we randomize these parameters and use them in conjunction with the actual POC CVAP share of each district. By repeating these trials many times, we obtain an overview of the variability in outcomes that might reasonably be expected if the system were implemented.

Adding up the projections over the districts in a plan, we can make some bottom-line comparisons of likely representation across the electoral system design alternatives. In the next section,

district nesting in Systems 0 through 5 by building Senate districts first, then using spanning tree methods to randomly subdivide those into House districts.

we provide more details of the ranked choice study design

2.2 Ranked Choice Voting (RCV) Models and Parameters

In our RCV study, we implement the standard single transferable vote (STV) system: if a district has magnitude m (i.e., elects m representatives), then the threshold for election is $\frac{1}{m+1}$ first-place votes. For instance, if there are $m = 3$ seats, then $1/4$, or 25%, of the first-place votes suffices for a candidate to be immediately elected. Due to transferred votes, a candidate with 10-15% of the first-place votes (or even fewer) can easily be elected in subsequent rounds of counting if they are frequently ranked second or third by enough voters. Since 16.73% of the state's CVAP (and 17.94% of the state's VAP) is POC, there are excellent prospects for representation in multimember districts with 3 or more seats.

Because RCV is not currently used for many elections in the Pacific Northwest, we are not able to estimate RCV outcomes using ranking data from past elections.[3] Instead, our analysis uses generative models of ranked choice voting behavior—that is, models that produce a set of ballots—to simulate how RCV *could* perform in various scenarios.

2.2.1 Ranking models

We use four different generative models to create simulated ballots which will be tabulated by ranked choice voting systems. All four models begin with three input values: the support from POC voters for POC candidates; the support from White voters for POC candidates; and the estimated POC share of the electorate. The Plackett-Luce (PL) and Bradley-Terry (BT) models rely on classical probabilistic forms of ranking, using what is called a Dirichlet distribution to allocate support to candidates within each group. The Alternating Crossover (AC) and Cambridge Sampler (CS) models are simple alternatives designed for this application. For these, we use estimated probabilities to determine whether a voter will rank a White or POC candidate first, then rely on specific assumptions on how the rest of the ballot will be completed. The AC model assumes that voters are either bloc voters or else alternate between blocs in their support. For instance, a POC voter can only be assigned a ballot of type CCCWWW, ranking all candidates of color above all White candidates, or else WCWCWC. The CS model uses ballot data from a decade's worth of ranked choice city council ballots in Cambridge, MA. Each voter's first choice is determined by classic RPV methods, and then their subsequent ballot is drawn at random from the observed ballot types in Cambridge that have a matching candidate at the top of the ballot.[4]

Models

- **Plackett-Luce:** each position is filled with a random draw;
- **Bradley-Terry:** each ballot is filled using probabilities of pairwise comparisons;
- **Alternating Crossover:** every voter either bloc-votes or alternates;
- **Cambridge Sampler:** ballots are drawn from historical ranking data in Cambridge, MA.

[3] To date, the only known election to use RCV in the Pacific Northwest was the November 2020 County Commissioner race in Benton County, Oregon (https://www.oregonrcv.org/rcv-in-oregon/benton-county/).

[4] For more information about the models, see https://mggg.org/STV.

2.2.2 Election parameters

There are four more election parameters that can vary: the number of seats being elected, the makeup of the candidate pool, the existence of strong candidates, and the polarization level of the voters.

Number of seats and candidate pool

- **1 seat**:
  - (Balanced Pool): 2 POC candidates and 2 White candidates run for office
  - (Unbalanced Pool): 1 POC candidates and 2 White candidates run for office
- **3 seats**:
  - (Balanced Pool): 3 POC candidates and 3 White candidates run for office
  - (Unbalanced Pool): 2 POC candidates and 3 White candidates run for office
- **5 seats**:
  - (Balanced Pool): 5 POC candidates and 5 White candidates run for office
  - (Unbalanced Pool): 3 POC candidates and 5 White candidates run for office
- **7 seats**:
  - (Balanced Pool): 7 POC candidates and 7 White candidates run for office
  - (Unbalanced Pool): 3 POC candidates and 7 White candidates run for office
- **9 seats**:
  - (Balanced Pool): 9 POC candidates and 9 White candidates run for office
  - (Unbalanced Pool): 3 POC candidates and 9 White candidates run for office

We also consider five scenarios of how voters divide or concentrate their support, intended to capture the possibility of elections with consensus strong candidates versus instances with more "spread" in the voting patterns.

Candidate strength scenarios

- **Scenario A: Unanimous Order.** All voters agree on strongest candidates in each group.
- **Scenario B: POC vary POC.** POC voters vary preferences among POC candidates.
- **Scenario C: All Vary Order.** No agreement on strongest candidates.
- **Scenario D: White Vary Order.** White voters don't agree on strongest candidates.
- **Scenario E: Generic.** All levels of agreement equally likely.

As mentioned above, these RCV models require estimates for the rate at which POC and White voters support POC candidates. Typically, we would want to use local single-winner elections to estimate these levels of support. However, precise estimates (with a high degree of confidence) are not always available—especially for districts with low turnout and a small number of precincts. We consider four hypothetical levels of polarization.

Polarization levels

- **Category 1 Polarization:** POC 95% and White 5% support for POC-preferred candidates;
- **Category 2 Polarization:** POC 90% and White 20% support for POC-preferred candidates;
- **Category 3 Polarization:** POC 75% and White 20% support for POC-preferred candidates; and
- **Category 4 Polarization:** POC 60% and White 40% support for POC-preferred candidates.

Finally, the RCV models require estimates for the proportions of POC and White voters as an input. We use CVAP to estimate these proportions. That is, we assume that the proportion of POC voters is roughly equivalent to the proportion of POC citizens of voting age in each district. This estimate makes the implicit assumption that voter turnout is comparable for White and POC voters, which may or may not reflect actual voting behaviors in Oregon.

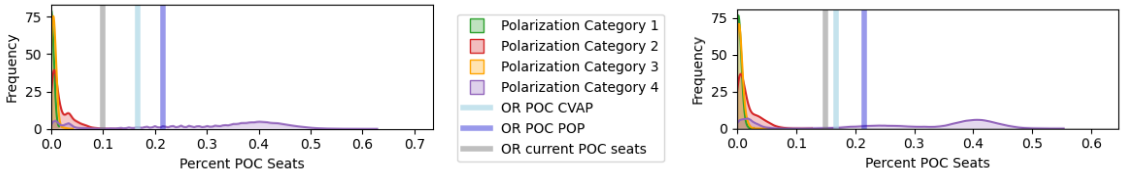
For every combination of model, number of district seats (i.e., district magnitude), candidate pool, candidate strength scenario, we use the actual district-level CVAP share to simulate 100 ranked choice elections. From the outputs, we count how many POC-preferred candidates are elected in each trial, and compute the average across elections.

3 Findings

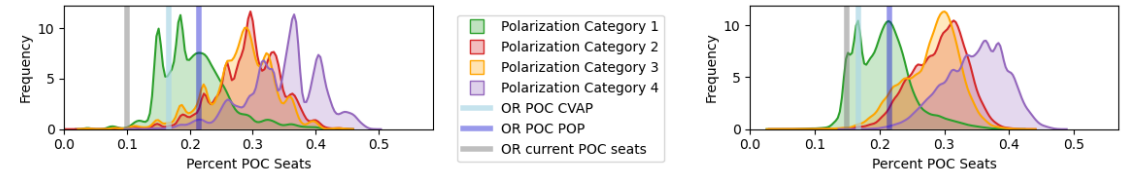
Though there is variability across models and parameters, the top-line findings are striking. Systems employing multi-member districts ($m \geq 3$) are consistently projected to outperform the status quo; in fact, except at the highest level of polarization considered here (Polarization Category 1), they are projected to match or exceed proportional representation for people of color in Oregon.

Results are presented in Figures 3-4 and Table 3. Figure 3 breaks down the results by racial polarization level, while Figure 4 breaks them down by the model of voter ranking behavior.

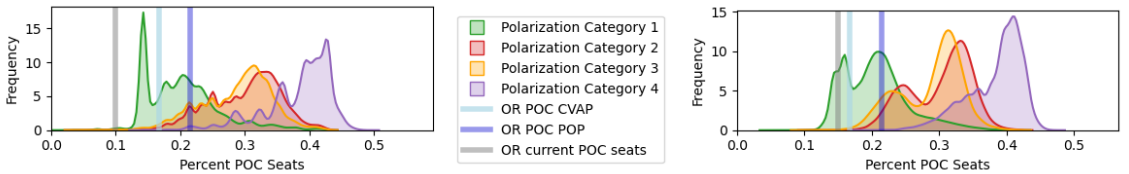
Results suggest that the systems where districts elect a single member—System 0 Senate and House and System 5 Senate and House—would likely underperform for POC voters in most cases, and could only approach proportionality in the case of minimal racial polarization (Polarization Category 4). By contrast, systems with multi-member (non-IRV) districts are consistently predicted to perform significantly better for POC voters, with outcomes approaching and even exceeding proportionality regardless of polarization category.



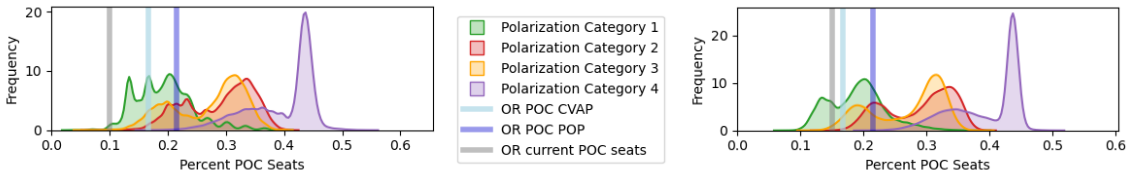
System 0 Senate $(m = 1)$ **System 0 House** $(m = 1)$



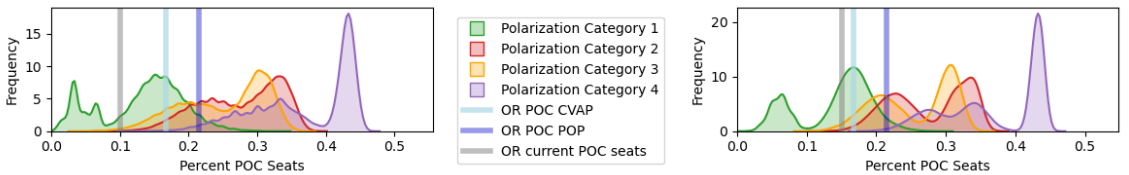
System 1 Senate $(m = 9)$ **System 1 House** $(m = 9)$



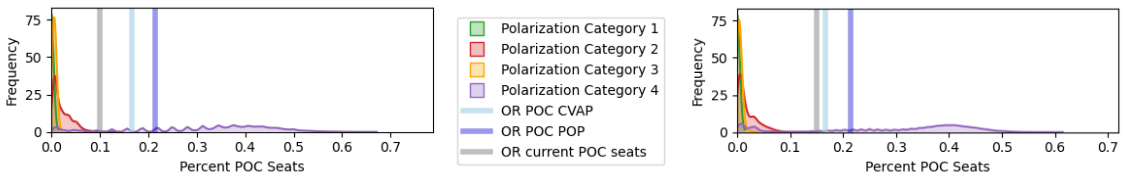
System 2 Senate $(m = 7)$ **System 2 House** $(m = 7)$



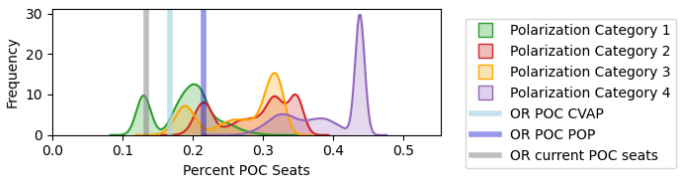
System 3 Senate $(m = 5)$ **System 3 House** $(m = 5)$



System 4 Senate $(m = 3)$ **System 4 House** $(m = 3)$

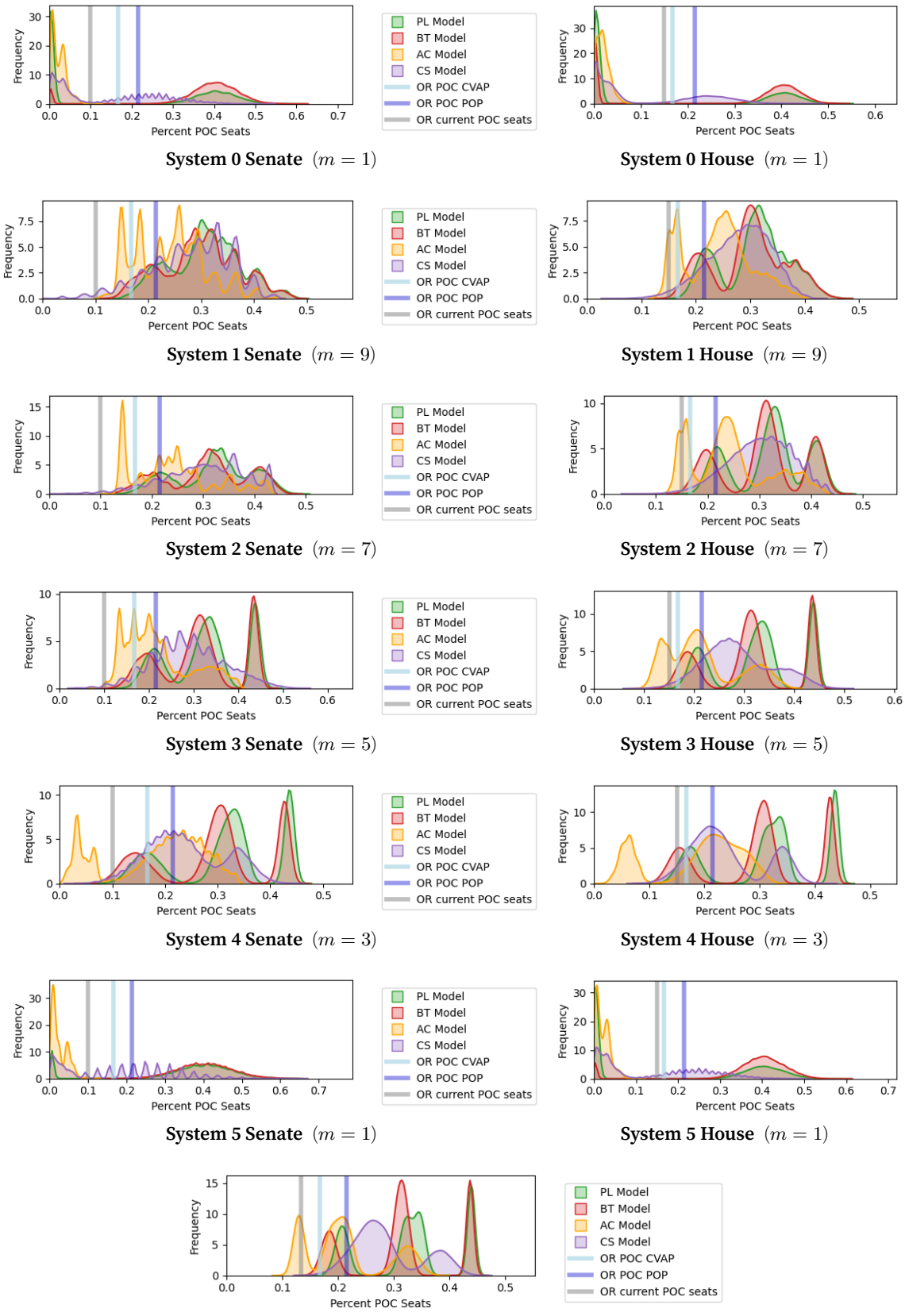


System 5 Senate $(m = 1)$ **System 5 House** $(m = 1)$



System 6 Unicameral $(m = 5)$

Figure 3. RCV simulation outcomes across polarization levels for each election system.



System 0 Senate $(m = 1)$ **System 0 House** $(m = 1)$

System 1 Senate $(m = 9)$ **System 1 House** $(m = 9)$

System 2 Senate $(m = 7)$ **System 2 House** $(m = 7)$

System 3 Senate $(m = 5)$ **System 3 House** $(m = 5)$

System 4 Senate $(m = 3)$ **System 4 House** $(m = 3)$

System 5 Senate $(m = 1)$ **System 5 House** $(m = 1)$

System 6 Unicameral $(m = 5)$

Figure 4. RCV simulation outcomes across voter ranking models for each election system.

	Polarization Category	System 0 ($m = 1$)	System 1 ($m = 9$)	System 2 ($m = 7$)	System 3 ($m = 5$)	System 4 ($m = 3$)	System 5 ($m = 1$)	System 6 ($m = 5$)
Estimated POC-Preferred Senators	1	0-0 (of 30)	4-7 (of 27)	4-7 (of 28)	4-7 (of 30)	1-5 (of 30)	0-0 (of 16)	
	2	0-1 (of 30)	7-9 (of 27)	7-10 (of 28)	6-10 (of 30)	7-10 (of 30)	0-0 (of 16)	
	3	0-0 (of 30)	6-8 (of 27)	6-9 (of 28)	6-10 (of 30)	6-9 (of 30)	0-0 (of 16)	
	4	0-12 (of 30)	8-10 (of 27)	10-12 (of 28)	10-13 (of 30)	8-13 (of 30)	0-7 (of 16)	
Estimated POC-Preferred Representatives	1	0-0 (60)	9-13 (of 54)	9-14 (56)	8-14 (of 60)	4-11 (of 60)	0-0 (of 32)	
	2	0-2 (60)	14-18 (of 54)	14-19 (56)	13-21 (of 60)	13-20 (of 60)	0-1 (of 32)	
	3	0-0 (60)	13-16 (of 54)	13-18 (56)	11-19 (of 60)	12-19 (of 60)	0-0 (of 32)	
	4	1-24 (60)	17-21 (of 54)	20-23 (56)	19-26 (of 60)	16-26 (of 60)	0-13 (of 32)	
Estimated POC-Preferred Total Legislators	1	0-0 (90) 0-0%	13-20 (of 81) 16-24%	13-21 (84) 15-25%	12-21 (of 90) 14-23%	5-16 (90) 5-18%	0-0 (of 48) 0-0%	19-35 (of 150) 13-23%
	2	0-3 (90) 0-3%	20-26 (of 81) **25-33%**	20-29 (84) **24-34%**	19-31 (of 90) **22-35%**	20-31 (90) **22-34%**	0-1 (of 48) 0-2%	32-52 (of 150) **21-35%**
	3	0-0 (90) 0-0%	19-25 (of 81) **24-31%**	19-27 (84) **23-32%**	17-29 (of 90) **19-32%**	18-28 (90) **20-31%**	0-0 (of 48) 0-0%	28-48 (of 150) **19-32%**
	4	1-37 (90) 2-41%	25-31 (of 81) **31-38%**	29-35 (84) **35-41%**	29-39 (of 90) **32-44%**	24-39 (90) **27-44%**	1-20 (of 48) 1-41%	48-66 (of 150) **32-44%**

Table 3. Summary of simulation outcomes across election systems. For each polarization level, each trial fixes a ranking model and averages over scenarios, candidate pools, and districting plans. The reported range shows how those averages range across the models. The blue shading marks the instances in which all four models project representation at least proportional to CVAP share. (Recall that POC population share is 21.5%, POC CVAP share is 16.7%, and the current POC share of legislators is 13.3%.)

4 Conclusion

In this study, we have estimated the opportunity for POC voters to elect candidates of choice under seven different election systems using forms of ranked choice voting.

Our results are summarized in Figure 5. This summary compares the predicted number of seats that POC-preferred candidates could reasonably secure under each voting system. For reference, Figure 5 also shows the number of current seats held by legislators who are themselves people of color, as an imperfect proxy for POC voter representation.

Our analysis shows that the systems that employ single-member districts—System 0 Senate (30 single-member districts) and House (60 single-member districts) and System 5 Senate (16 single-member districts) and House (32 single-member districts)—are not predicted to provide reliable electoral opportunity for POC voters. Only in the presence of extremely low levels of racial polarization could these reasonably perform near-proportionally, and even then the outcome is uncertain.

Across the board, RCV with multi-member districts projects to provide more reliable opportunity for POC voters in Oregon to elect candidates of choice. In particular, Systems 1 through 4 (both chambers) and System 6 (unicameral), under most models and scenarios considered, would secure an expectation that approaches or even exceeds proportionality.

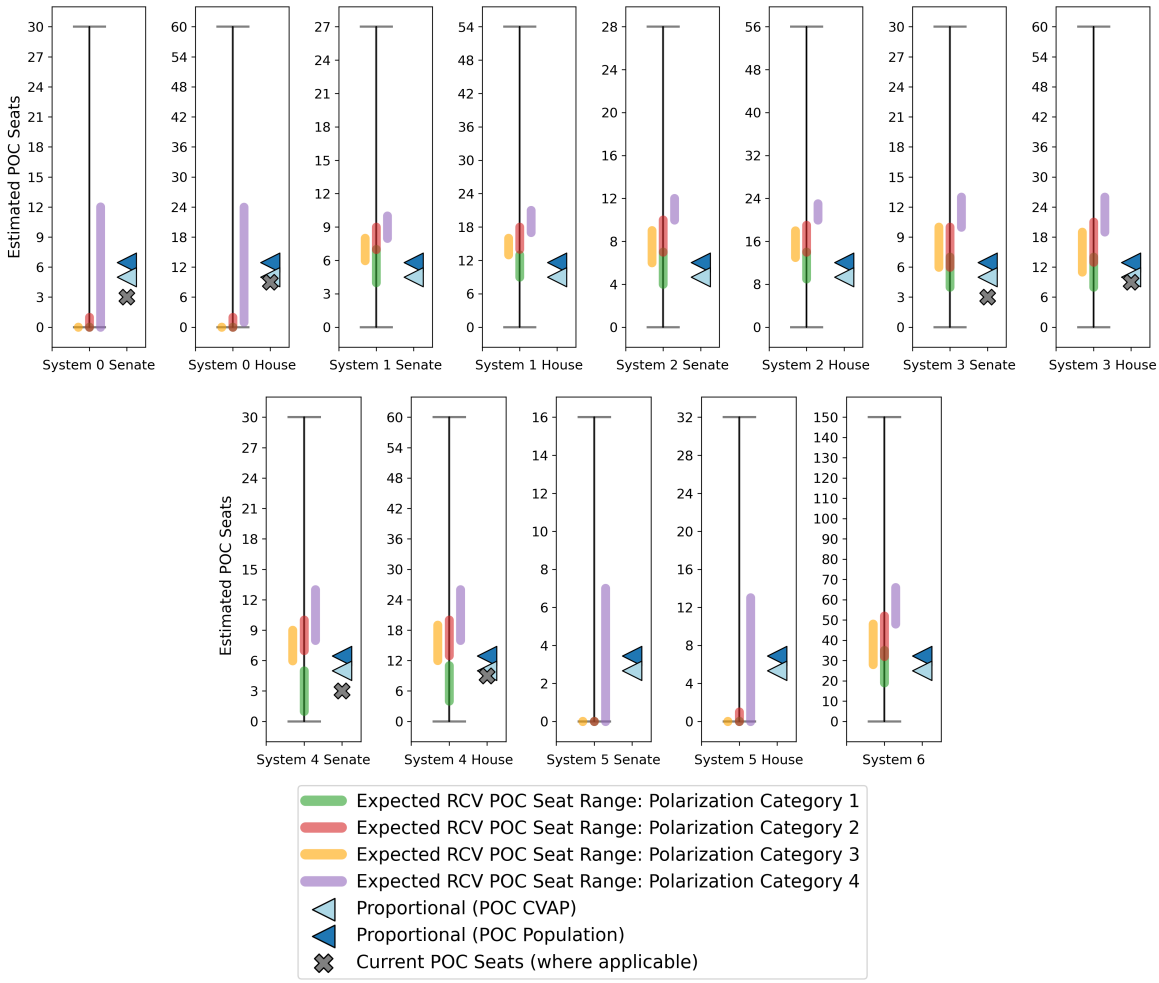


Figure 5. Overall election system performance summary. The multi-member (non-IRV) instances (Systems 1 through 4 Senate and House and System 6 Unicameral) tend to outperform the status quo, and are usually projected to secure proportional representation for people of color. The single-member (IRV) instances (Systems 0 and 5 Senate and House) are projected to be much less successful for POC representation.