Equity Test of a Department Lunch-Invite Planner

David Beckwitt

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Project repository: github.com/DVBeckwitt/equitable-lunch-invites

Abstract

I evaluated a lunch-invite assignment planner intended to support equitable representation across disciplines and sex categories under a fixed seating budget. I implemented our operational definition of equity (accompanying the github) and tested the planner via Monte Carlo trials over synthetic rosters even to extreme discipline imbalance. The planner satisfies the demographic targets very well. The dominant tradeoffs include enforcing seat parity with a small subgroup reduces coverage and increases repeat invitations, while discipline representativeness is bounded primarily by roster imbalance.

Background

I schedule 5000 department lunches with a fixed total number of guest seats. I want assignments that are defensible under our explicit equity definition while remaining practical under small-category/discipline constraints. Because seats are limited, I treat equity as an optimization objective.

Equity definition and planned solution

I define equity using one of two selectable demographic policies: *proportional representation* and *women-to-parity*.

Under *proportional representation*, the share of seats allocated to women matches their share of the roster. This implies equal expected per-person invitation rates for women and men, so the female-to-male invite-rate ratio is 1.

Under *women-to-parity*, women are allocated 50% of seats. If women are underrepresented in the roster, achieving seat parity necessarily requires inviting women at a higher per-person rate than men.

In both policies, the planner also works to preserve representation across disciplines. In practice, it can *anchor* small disciplines so they are not repeatedly omitted when seats are limited.

Test protocol

I evaluated the planner with Monte Carlo simulations on mock rosters of 72 people (12 women, 60 men). I fixed the total number of guest seats for the series at 60. I considered three discipline-roster scenarios: `even`, `discipline_imbalanced`, and `discipline_extreme`, with women and men

assigned to disciplines at random. For each scenario and demographic policy, I ran 5000 randomized trials.

I report five metrics: (i) *female share*, the fraction of selected seats filled by women; (ii) *F/M invite-rate ratio*, the ratio of per-person invitation rates for women versus men; (iii) *discipline total-variation distance* (TV), the distance between selected-seat shares and roster shares across disciplines; (iv) *coverage fraction*, the number of unique invitees divided by roster size; (v) *assignment Gini gap*, defined as the difference between (a) the Gini coefficient of the observed per-person invitation counts and (b) the minimum Gini coefficient achievable under the same seat budget and demographic/discipline constraints (that is, the most even feasible rotation). Figure 1 provides the primary summary.

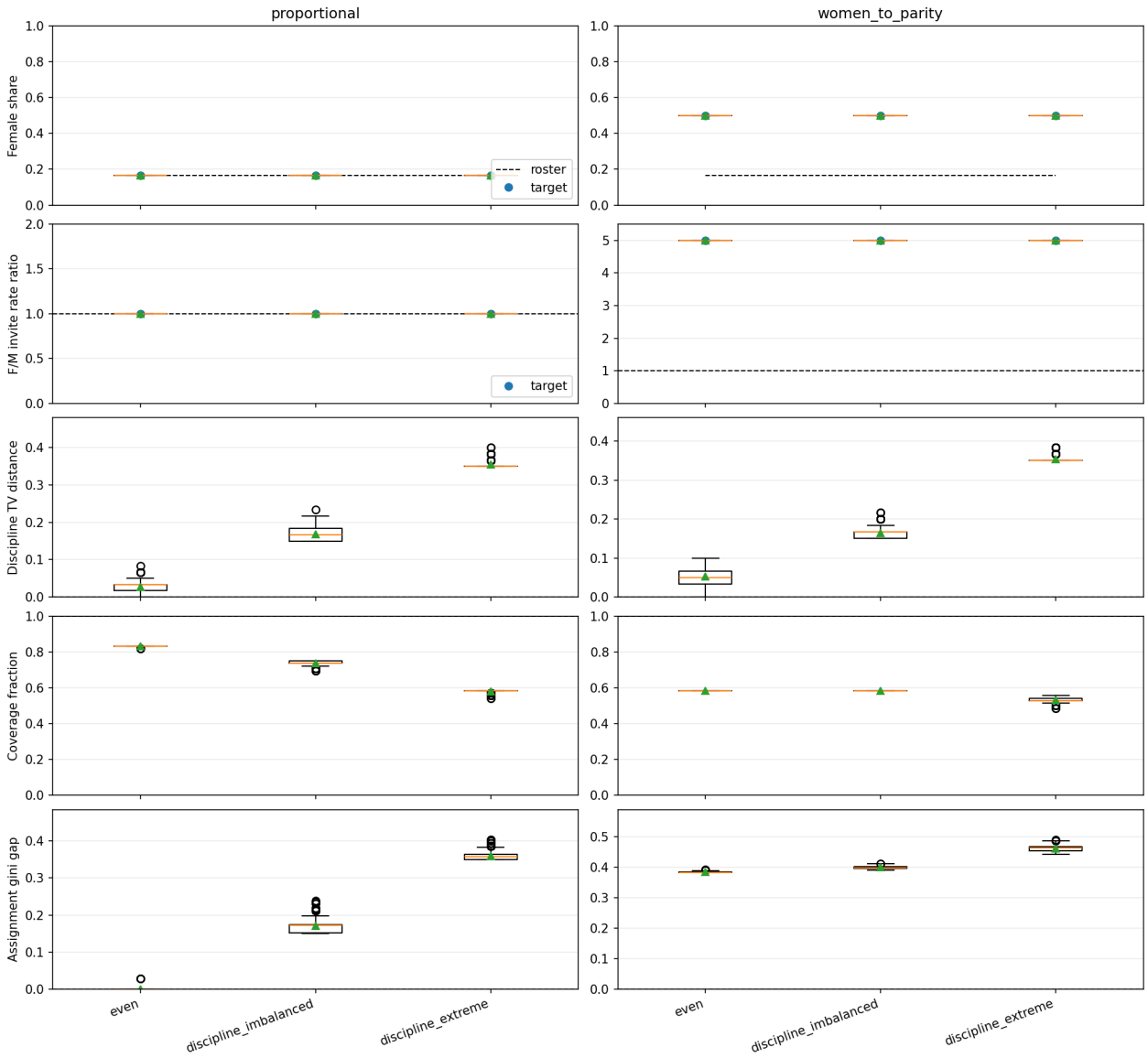


Figure 1: (**a**) Summary dashboard of all reported metrics across discipline scenarios and demographic policies (boxplots over 5000 trials). The demographic panels collapse to lines because targets are enforced exactly. The remaining spread shows the structural tradeoffs that remain once the targets are fixed, chiefly discipline mismatch under discipline-imbalanced rosters and reduced coverage when parity forces repeat invitations.

Results

Demographic targets are met exactly

Figure 2 shows that both demographic policies meet their targets in every scenario. Under proportional, the female share equals the roster proportion, $12/72 = 0.167$, and the female-to-male per-person invite-rate ratio is 1.0. Under women_to_parity, the female share is fixed at 0.500, and the implied invite-rate ratio is 5.0. This ratio follows directly from the roster counts: allocating 30 of the 60 seats to women and 30 to men yields per-person rates of 30/12 and 30/60, respectively, so

$(30/12)/(30/60) = 5$.

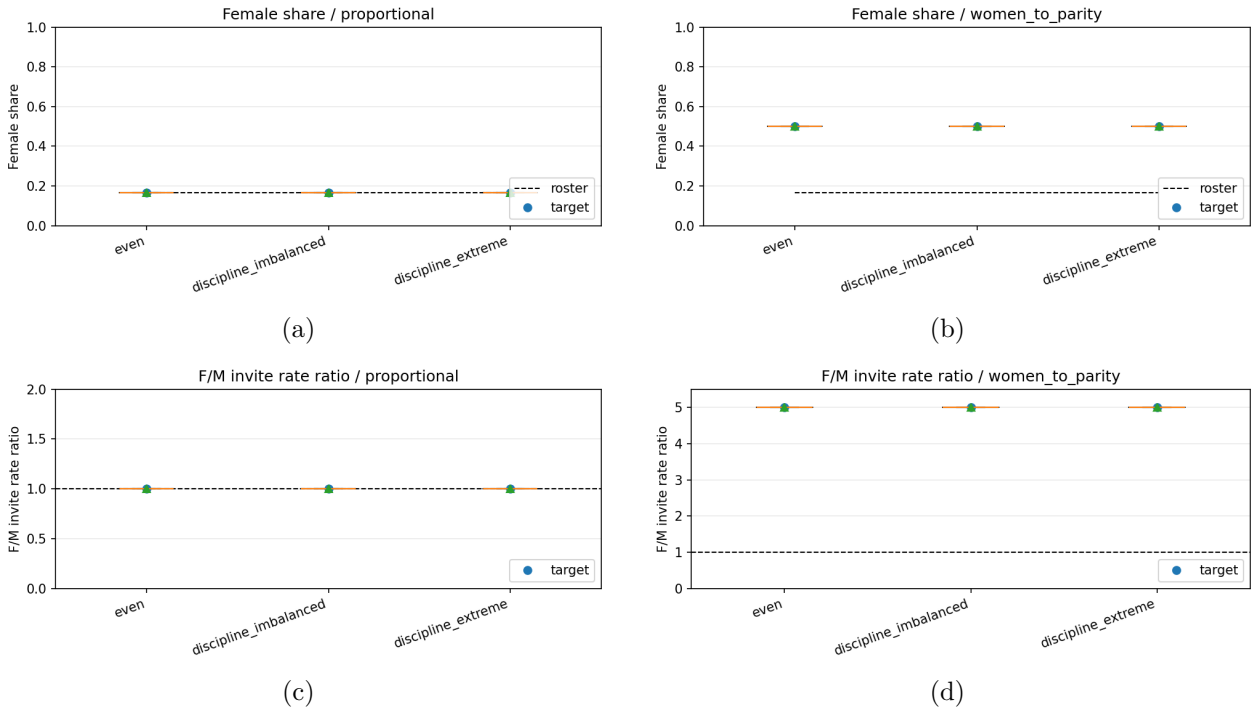
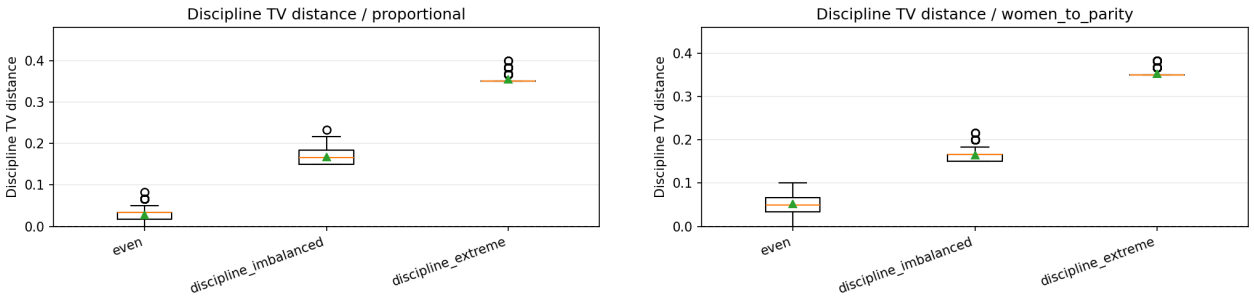


Figure 2: Demographic outcomes across scenarios. (**a**) Under proportional, the female share is fixed at the roster value $12/72 = 0.167$. (**b**) Under women_to_parity, the female share is fixed at 0.500 by construction. (**c**) Under proportional, the per-person female-to-male invite-rate ratio is 1.0, corresponding to equal invite opportunity per person. (**d**) Under women_to_parity, the ratio is 5.0 for this roster because 30 of 60 seats are assigned to women and 30 to men, giving $(30/12)/(30/60) = 5$.

Discipline representativeness is bounded by roster imbalance

Figure 3 shows that discipline TV increases strongly from even to discipline_extreme. Within each scenario, TV is nearly unchanged between demographic policies. I interpret this as a roster-driven limit: when the roster is dominated by one discipline, no fixed-seat assignment can remain perfectly proportional while also preventing small disciplines from being systematically excluded.



(a) (b)

Figure 3: (**a**) Discipline total-variation (TV) distance under proportional increases as the roster becomes more discipline-imbalanced, from a low value in even (mean 0.028) to a high value in discipline_extreme (mean 0.354). (**b**) TV under women_to_parity follows the same pattern (mean 0.053 in even, mean 0.353 in discipline_extreme). The close agreement between policies indicates that discipline mismatch is dominated by the discipline composition of the roster rather than by the demographic policy.

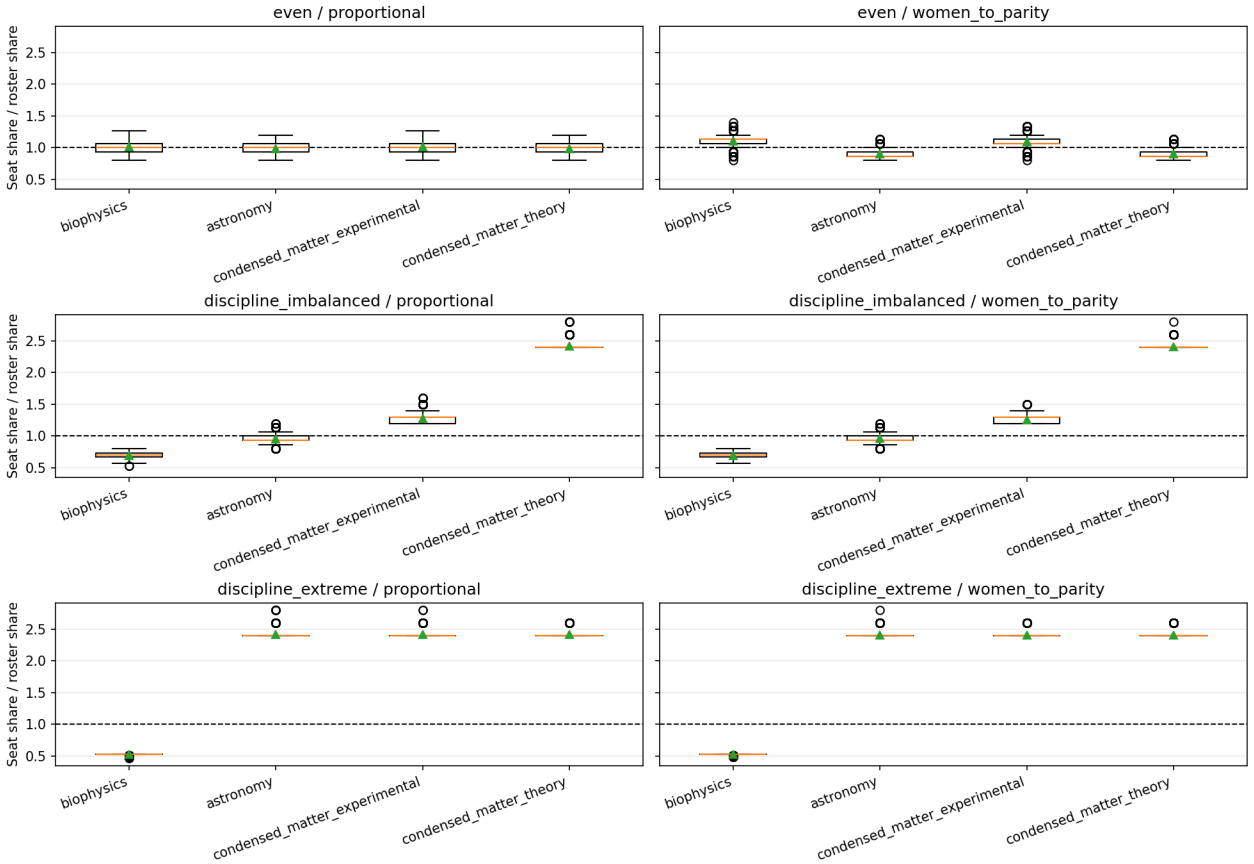


Figure 4: (**a**) Discipline seat-share ratios by scenario and policy (selected share divided by roster share; dashed line at 1). Values above 1 indicate over-selection relative to the roster, and values below 1 indicate under-selection. In the imbalanced and extreme rosters, small disciplines can be systematically over-selected while the dominant discipline is under-selected, which is the visible consequence of enforcing representation of small categories under a fixed seat budget.

Parity trades coverage for representation under a fixed seat budget

Figure 5 reports the coverage fraction and the assignment Gini gap. Under `proportional` with an even discipline roster, coverage reaches the seat-budget ceiling, $60/72 = 0.833$, and the Gini gap is near zero, consistent with an almost perfectly even rotation. As discipline imbalance strengthens, coverage falls and the Gini gap rises, reflecting the increasing need to repeat invitations.

Under `women_to_parity`, coverage is limited by roster composition rather than by the seat budget. With 12 women, allocating 30 of the 60 seats to women forces repeated invitations within that subgroup, so the number of unique invitees is at most $12 + 30 = 42$, giving a hard coverage cap of $42/72 = 0.583$. The observed means in the `even` and `discipline_imbalanced` scenarios sit at this cap, while coverage drops further in `discipline_extreme` as discipline constraints introduce additional repeats. The larger Gini gap under parity follows from the same mechanism: fixed-seat parity concentrates invitations within the smaller subgroup, increasing inequality relative to the most even feasible rotation.

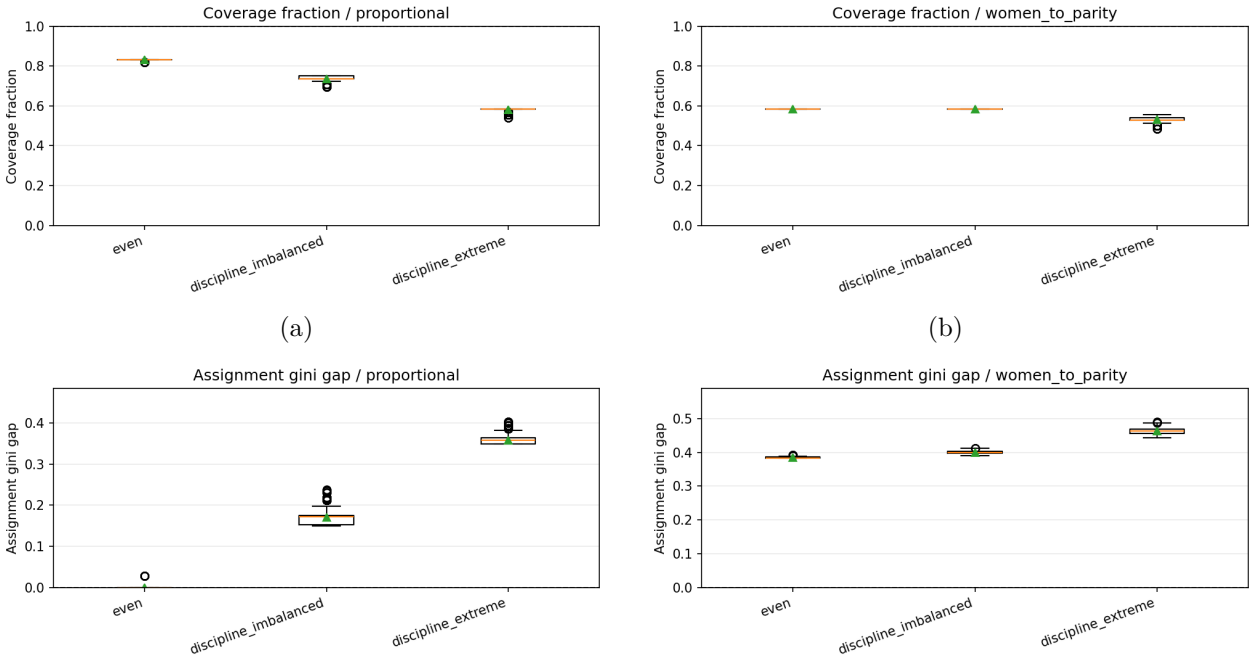
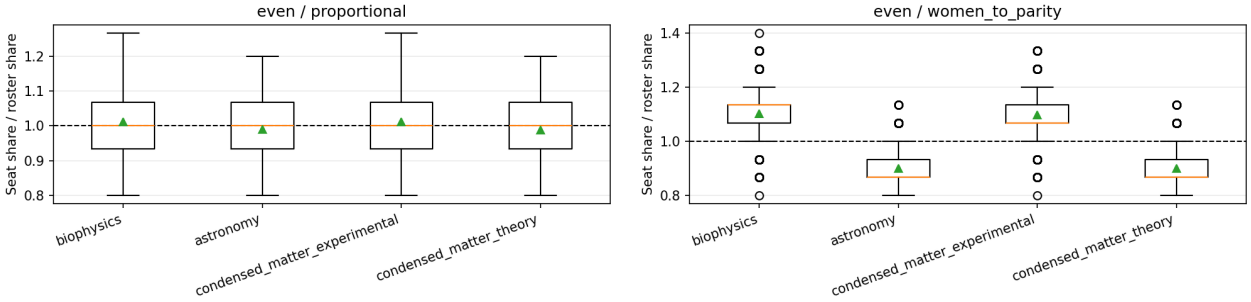


Figure 5: Coverage and assignment inequality across scenarios. (**a**) Under `proportional`, coverage reaches the seat-budget ceiling in `even` (mean $60/72 = 0.833$) and declines as discipline constraints tighten (means 0.737 in `discipline_imbalanced` and 0.580 in `discipline_extreme`). (**b**) Under `women_to_parity`, coverage is capped by the 12-person female subgroup: assigning 30 female seats yields at most $12+30 = 42$ unique invitees, so the maximum coverage is $42/72 = 0.583$, matching the observed mean in `even` and `discipline_imbalanced`; coverage falls further in `discipline_extreme` (mean 0.531) as discipline constraints add repeats. (**c**) The assignment Gini gap under `proportional` is near zero in `even` (mean 0.000) and increases as constraints bind (means 0.171 and 0.359). (**d**) The Gini gap under `women_to_parity` is larger (means 0.384, 0.399, and 0.462) because parity forces repeated invitations within the smaller subgroup under a fixed seat budget.

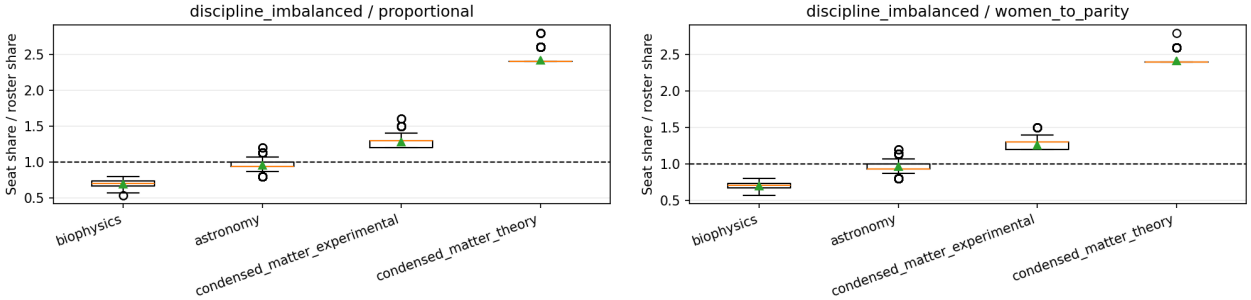
Scenario-specific discipline panels

Figures 6–8 provide the per-scenario discipline seat-share ratios under each policy. These panels identify which disciplines are systematically over- or under-selected relative to roster share in each regime.



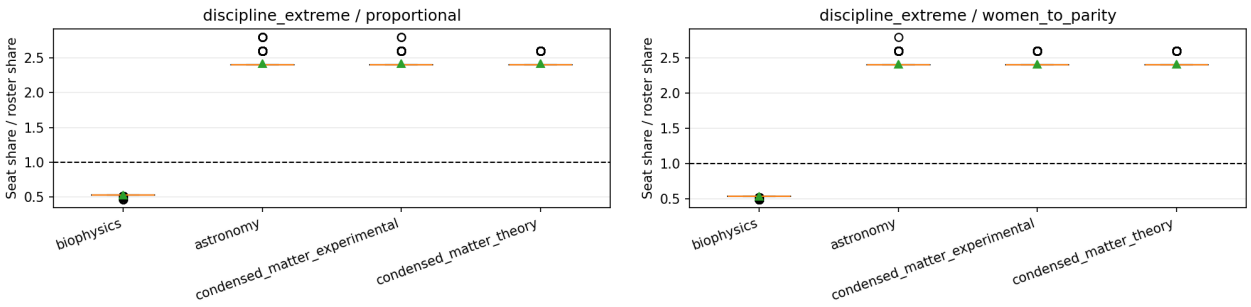
(a) (b)

Figure 6: (**a**) even roster under proportional. Discipline seat-share ratios cluster near 1, which is consistent with near-proportional discipline representation when the roster is balanced. (**b**) even roster under women_to_parity. The discipline ratios remain close to 1, indicating that changing the sex policy does not materially perturb discipline proportionality when discipline constraints are mild.



(a) (b)

Figure 7: (**a**) discipline_imbalanced roster under proportional. Ratios depart from 1, with smaller disciplines tending to be over-selected relative to roster share, which is consistent with protecting minority disciplines against drop-out. (**b**) discipline_imbalanced roster under women_to_parity. The same discipline-level departures persist, indicating that the discipline effects are driven by roster imbalance and discipline constraints rather than by the sex policy.



(a) (b)

Figure 8: (**a**) discipline_extreme roster under proportional. Large departures from 1 are expected because one discipline dominates the roster, so preserving representation of minority disciplines necessarily under-selects the dominant discipline under fixed seats. (**b**) discipline_extreme roster under women_to_parity. The discipline pattern remains essentially unchanged, reinforcing that extreme discipline imbalance is the binding constraint for discipline proportionality in this test.

Numerical summary

Table 1 reports mean metrics across 5000 trials per condition.

Scenario	Policy	female	F/M	TV	coverage	Gini gap
even	proportional	0.167	1.000	0.028	0.833	0.000
even	women_to_parity	0.500	5.000	0.053	0.583	0.384
discipline_imbalanced	proportional	0.167	1.000	0.167	0.737	0.171
discipline_imbalanced	women_to_parity	0.500	5.000	0.164	0.583	0.399
discipline_extreme	proportional	0.167	1.000	0.354	0.580	0.359
discipline_extreme	women_to_parity	0.500	5.000	0.353	0.531	0.462

Table 1: Mean outcomes over 5000 trials per scenario and policy.

Conclusion

Under the stated equity definitions, the planner behaves as intended. It achieves the requested demographic target exactly in both proportional and women_to_parity. The primary equity tradeoff is between parity and breadth: parity improves representation among invitees but necessarily reduces coverage and increases repeat invitations when the subgroup is small under a fixed seat budget. Discipline representativeness is constrained mainly by roster imbalance, with only minor dependence on the demographic policy.