

Optimized Democracy

Spring 2021 | Lecture 14
Sortition

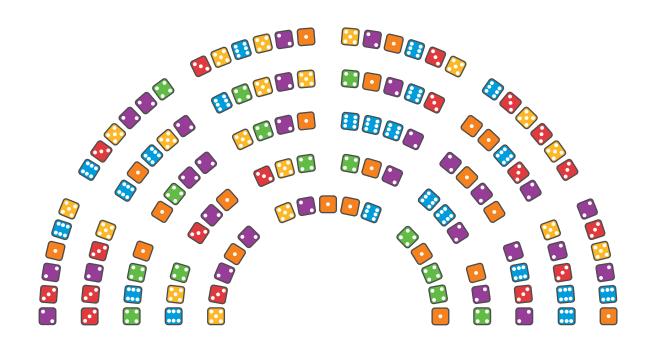
Ariel Procaccia | Harvard University



Jean-Jacques Rousseau

"The people of England deceive themselves when they fancy they are free; they are so, in fact, during the election of Members of Parliament: for, as soon as a new one is elected, they are again in chains, and are nothing."

THE PURSUIT OF RANDOMNESS



Sortition—democracy built on lotteries instead of elections

A BRIEF HISTORY OF SORTITION

462-322 BC

Athens

Council of 500 and magistracies chosen by lot

1328-1530

Florence

The government and legislative council chosen by lot

1776-present

USA

American and French revolutions make democracy synonymous with elections

21st Century

Worldwide

Citizens'
assemblies
organized by local
and national
governments

RANDOM ASSEMBLY REQUIRED



■ Ireland

Established: 2016 Participants: 99

Topic: constitution

■ France

Established: 2019

Participants: 150

Topic: climate

■ Mongolia

Established: 2017

Participants: 669

Topic: constitution

■ S. Australia

Established: 2016

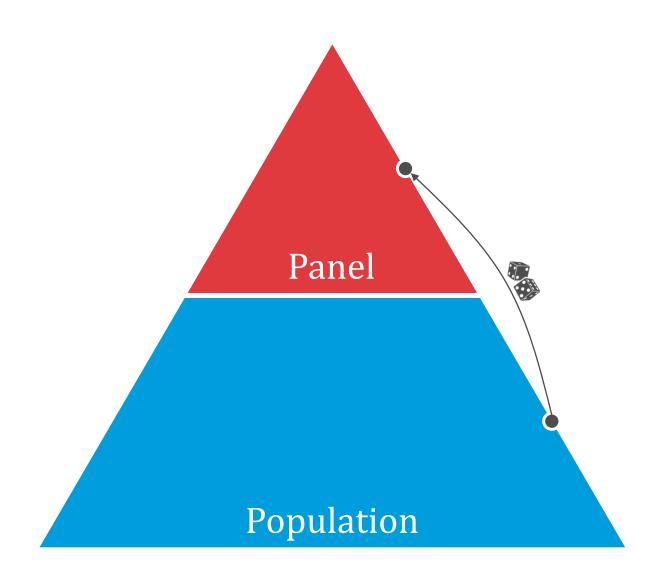
Participants: 50

Topic: nuclear waste

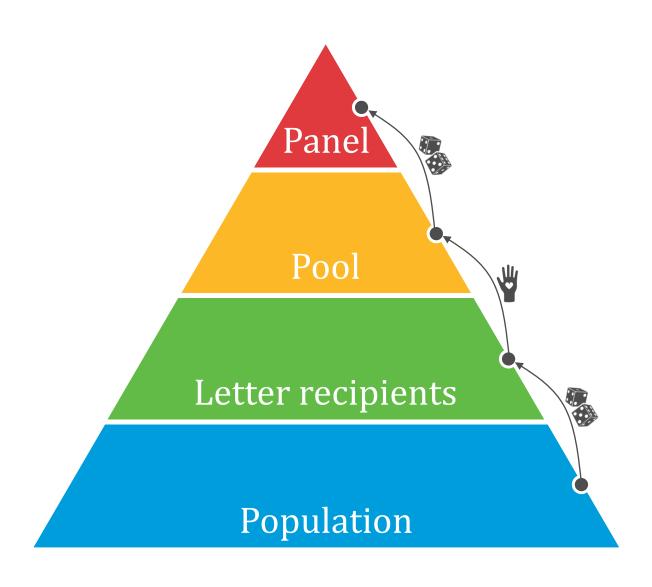


https://www.youtube.com/watch?v=EDGp5eGnnxI

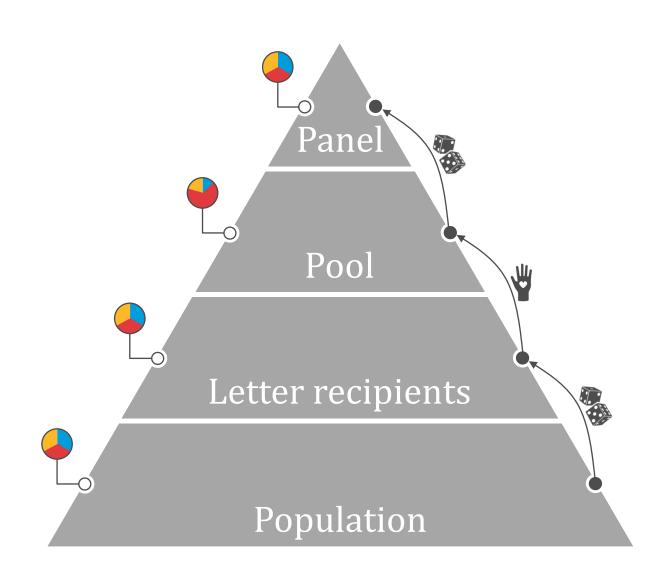
IDEAL SORTITION PIPELINE



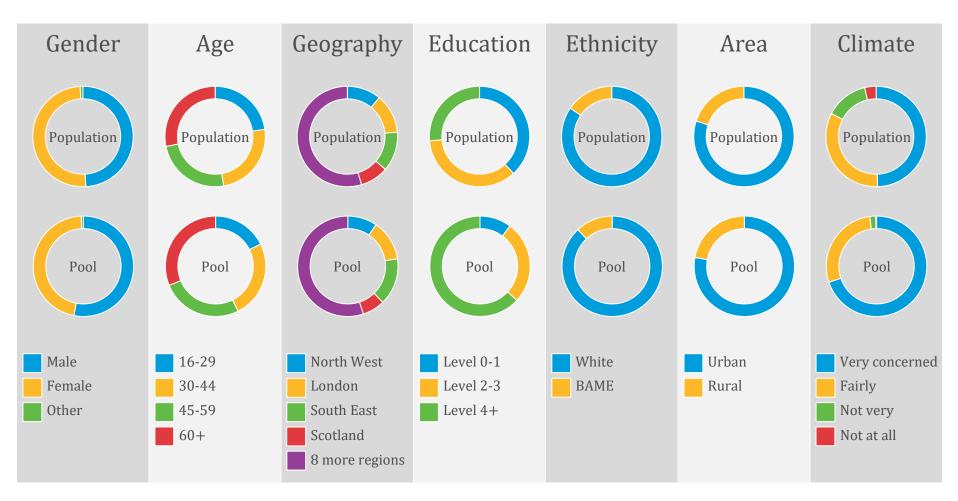
ACTUAL SORTITION PIPELINE



ACTUAL SORTITION PIPELINE



CATEGORIES AND QUOTAS



Climate Assembly UK (2020) Pool size is n = 1727, panel size is k = 110

THE SORTITION MODEL

- Set of features F, where each $f \in F$ has a set of values V_f
- Set of n volunteers N where each $x \in N$ is a vector of feature values
- For each $f \in F$ and $v \in V_f$ there is an upper quota $u_{f,v}$ and a lower quota $\ell_{f,v}$
- The goal is to choose a panel P of k volunteers such that for all $f \in F, v \in V_f$, $\ell_{f,v} \leq \sum_{x \in P} \mathbb{I}[x_f = v] \leq u_{f,v}$
- Finding a quota-feasible panel is NP-hard

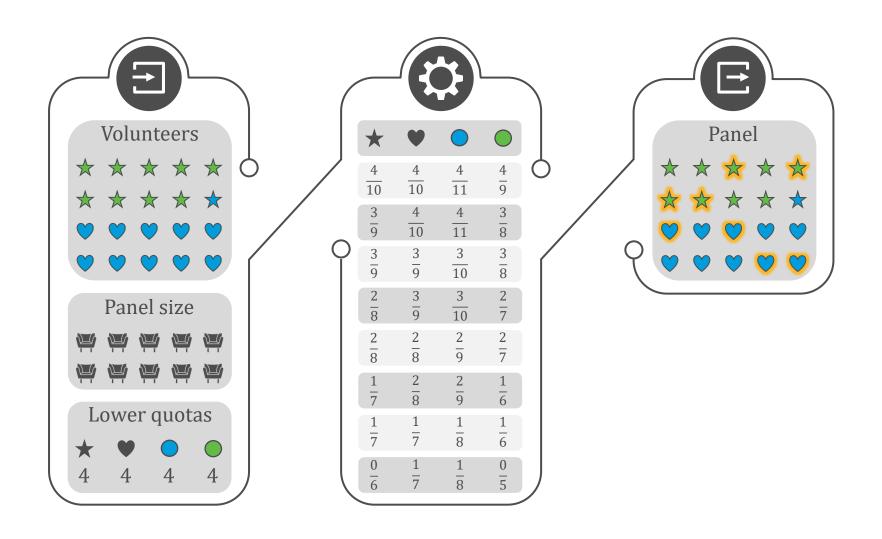
A GREEDY ALGORITHM

- At time t, a partial panel P_t has been selected $(P_0 = \emptyset)$
- For each $f \in F$, $v \in V_f$ define the score of v to be

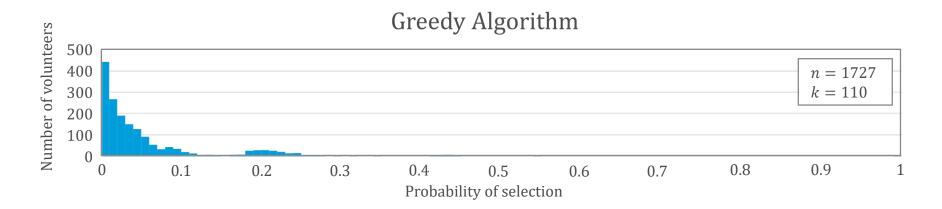
$$\frac{\ell_{f,v} - \sum_{x \in P_t} \mathbb{I}[x_f = v]}{\sum_{x \in N \setminus P_t} \mathbb{I}[x_f = v]}$$

- For v with maximum score, select uniformly at random among $x \in N \setminus P_t$ such that $\mathbb{I}[x_f = v]$
- When all lower quotas have been filled, select uniformly at random among $N \setminus P_t$
- If any quotas cannot be satisfied, restart

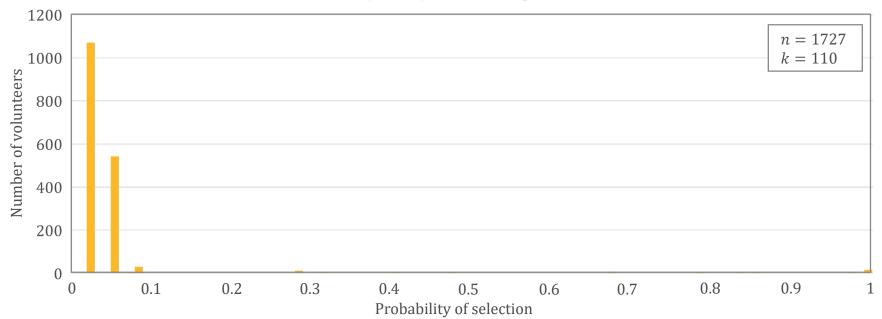
A GREEDY ALGORITHM



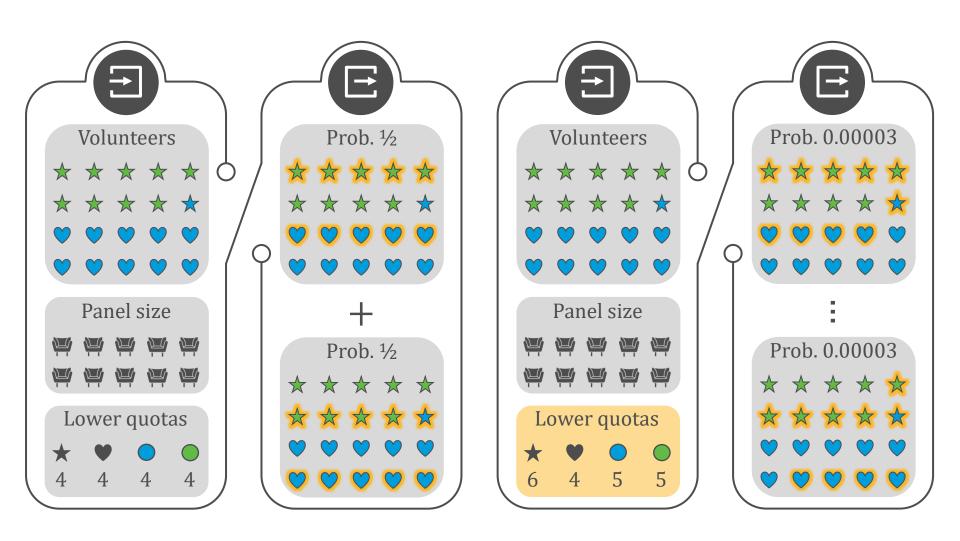
A GREEDY ALGORITHM



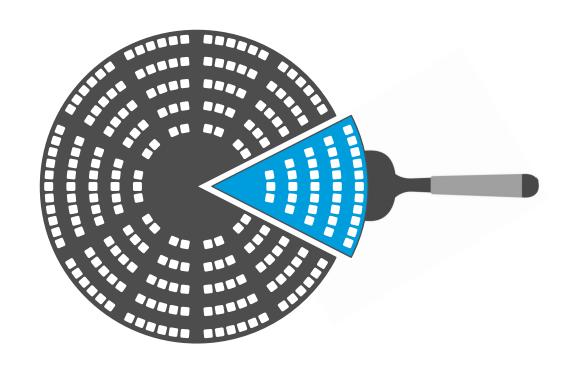
Mystery Challenger



DISTRIBUTIONS OVER PANELS



FROM SORTITION TO FAIR DIVISION



A distribution over panels of size k divides overall selection probability of k between pool members

ALLOCATION RULES

- An allocation rule outputs a distribution $\mathcal D$ over quota-feasible panels of size k
- Maximum Nash Welfare maximizes the product $\prod_{x \in N} \Pr_{P \sim \mathcal{D}} [x \in P]$
- Leximin maximizes min $\Pr_{x \in N} [x \in P]$, subject to that max the second lowest probability, etc.

Poll 1

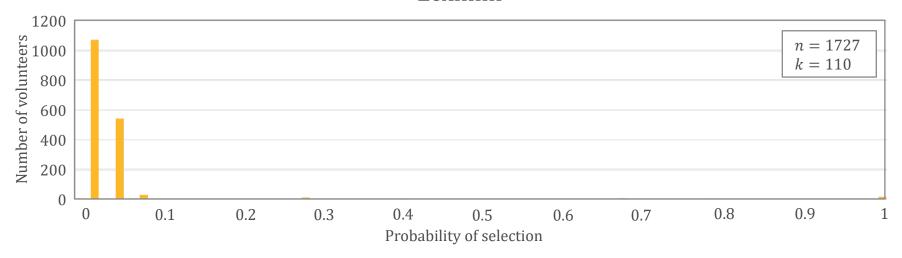
Which of the two rules equalizes volunteers' selection probabilities whenever the quotas make it feasible to do so?

• MNW • Leximin • Both rules • Neither one

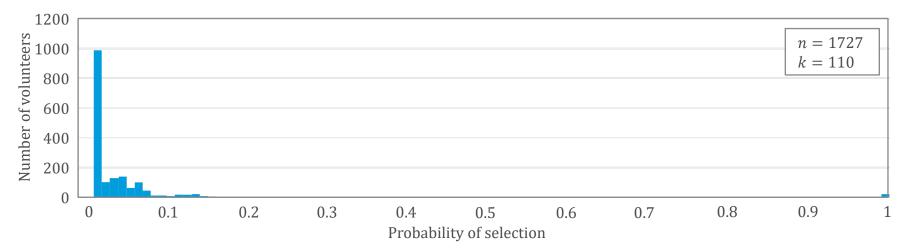


MYSTERY CHALLENGER UNMASKED

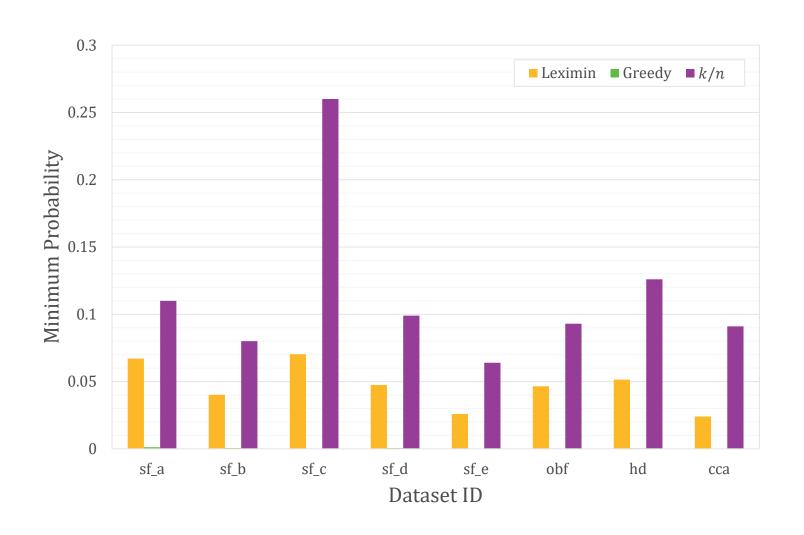
Leximin



Nash Welfare



EVERYONE DESERVES A FAIR CHANCE

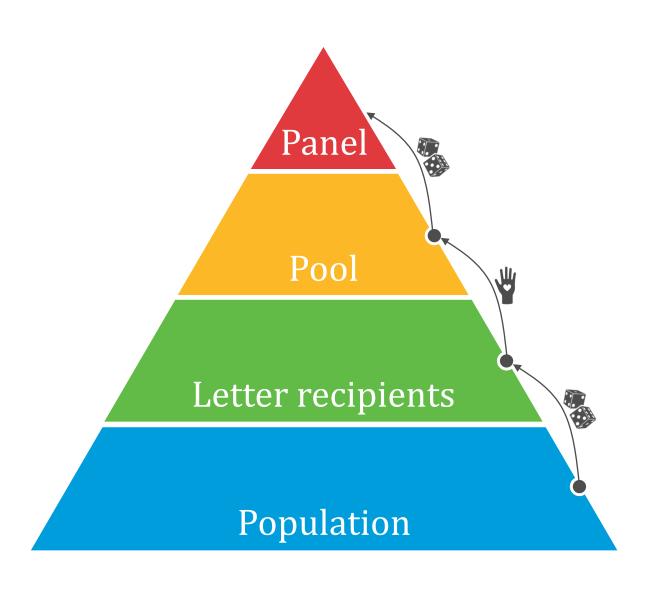




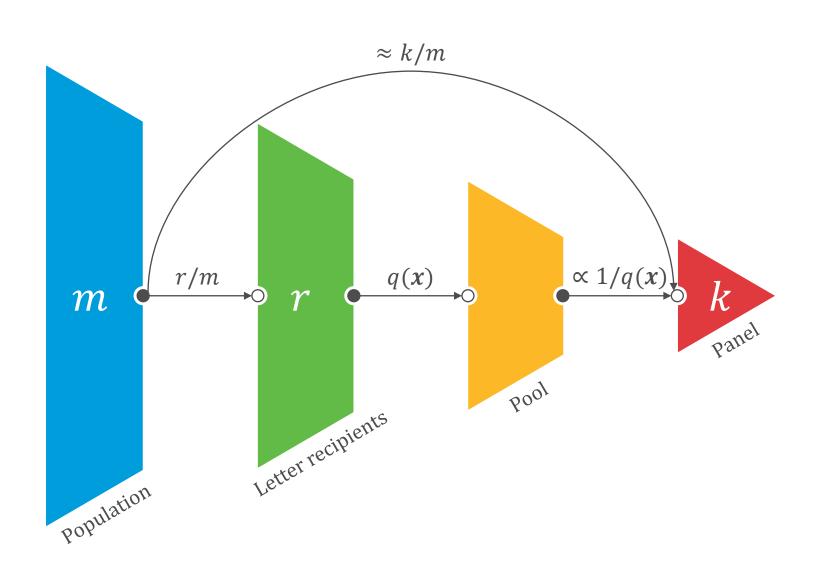
Coming soon to panelot.org



SORTITION PIPELINE, REVISITED



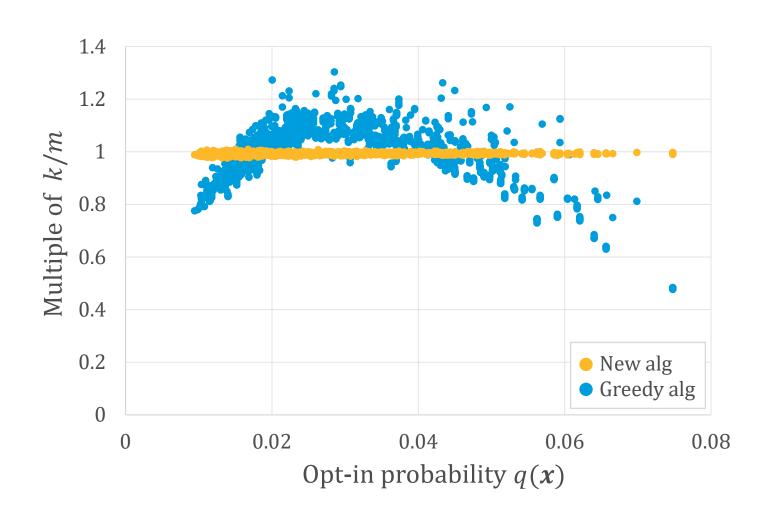
SORTITION PIPELINE, REVISITED



END-TO-END GUARANTEES

- Let M be the population, |M| = m, and let r be the number of letters sent
- Let $m_{f,v} = |\{x \in M : x_f = v\}|$
- Let $q: \prod_{f \in F} V_f \to [0,1]$ give the opt-in probability of each $x \in M$
- Let $\alpha = \min_{x \in M} q(x) \cdot r/k$
- Theorem: Suppose that $\alpha \to \infty$ and $m_{f,v} \ge m/k$ for all $f \in F, v \in V_f$, then there is an allocation rule such that:
 - $\Pr[\mathbf{x} \in P] \ge (1 o(1))k/m$ for all $\mathbf{x} \in M$
 - W.h.p., the quotas $\ell_{f,v}=(1-o(1))km_{f,v}/m-|F|$ and $u_{f,v}=(1+o(1))km_{f,v}/m+|F|$ are satisfied for all $f\in F$ and $v\in V_f$

EMPIRICAL PROBABILITIES



BIBLIOGRAPHY

Flanigan, Gölz, Gupta, Hennig, and Procaccia. Fair Selection of Citizens' Assemblies. Working paper.

Flanigan, Gölz, Gupta, and Procaccia.

Neutralizing Self-Selection Bias in Sampling for Sortition. NeurIPS 2020.