Optimized Democracy

Spring 2023 | Lecture 14

Sortition

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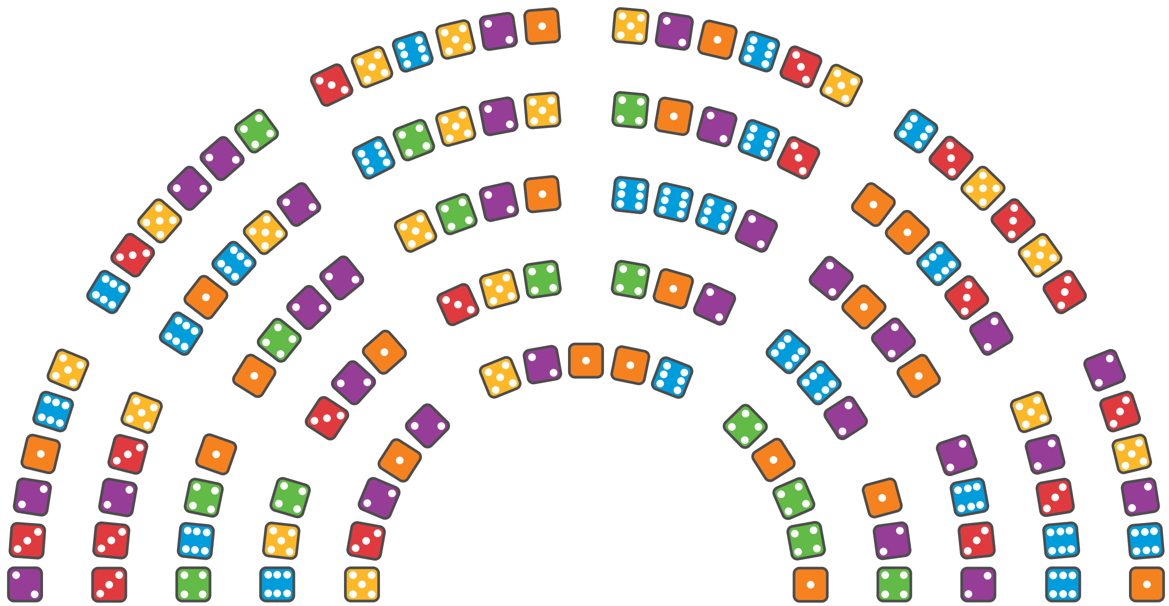
HERE'S A RANDOM IDEA



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

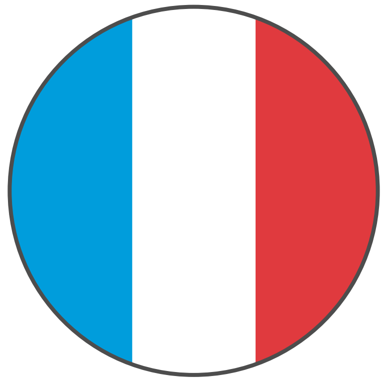
21st Century

Worldwide

Citizens' assemblies organized by local and national governments

RANDOM ASSEMBLY REQUIRED

Ireland
2016
Constitution



France
2019-2020
Climate

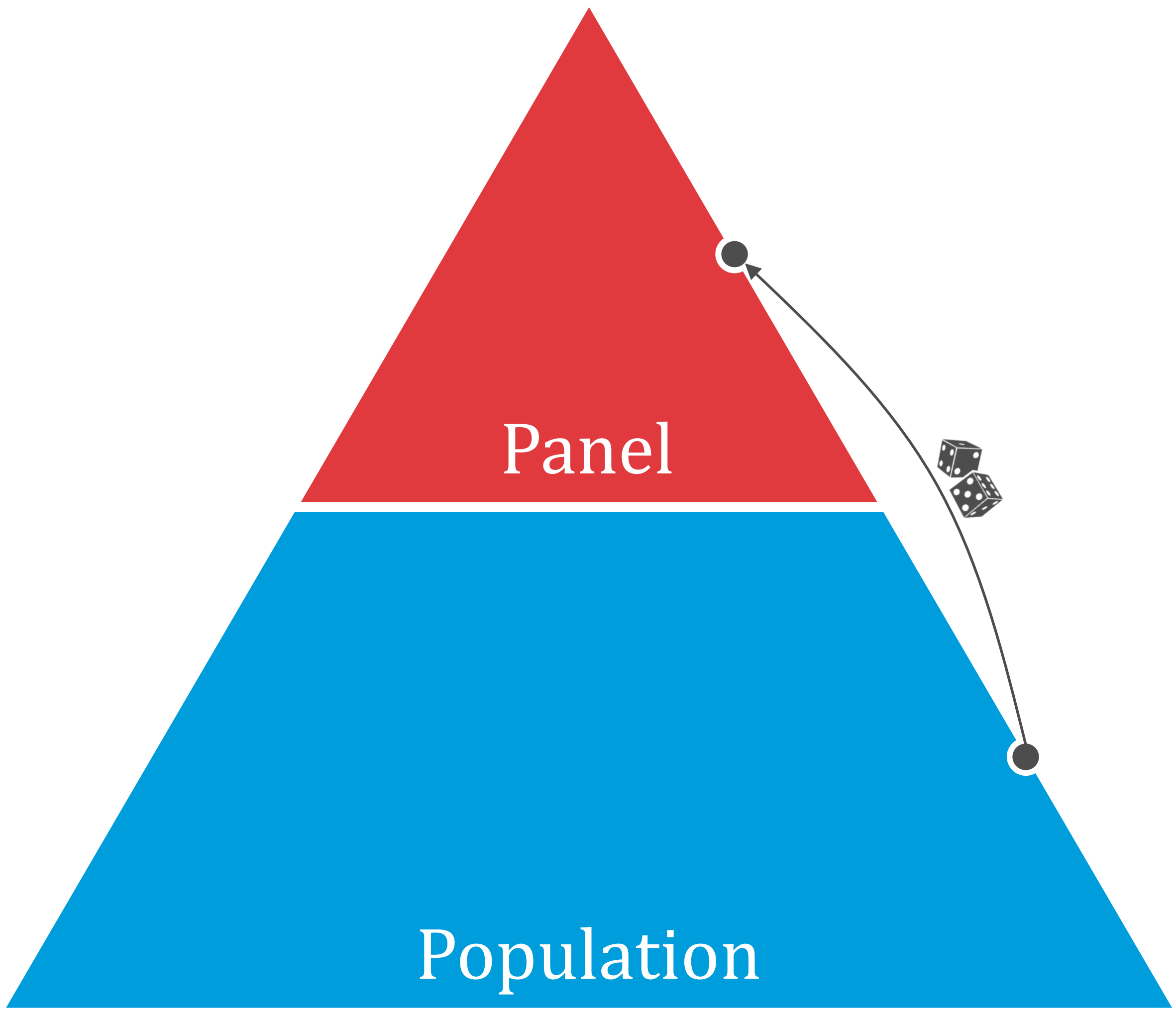
Belgium
Since 2019
Permanent

Climate Assembly UK

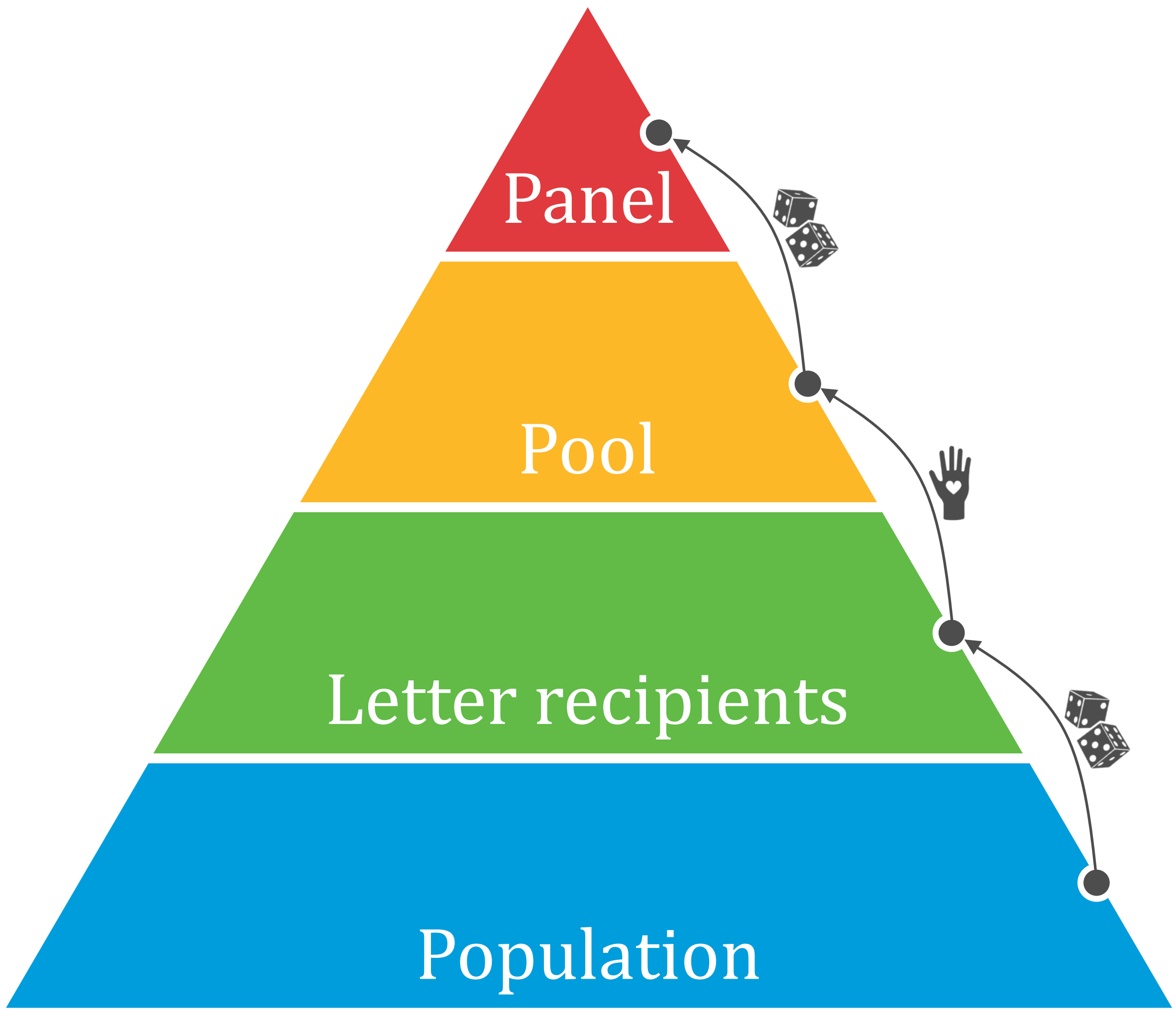
THE PATH TO NET ZERO

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

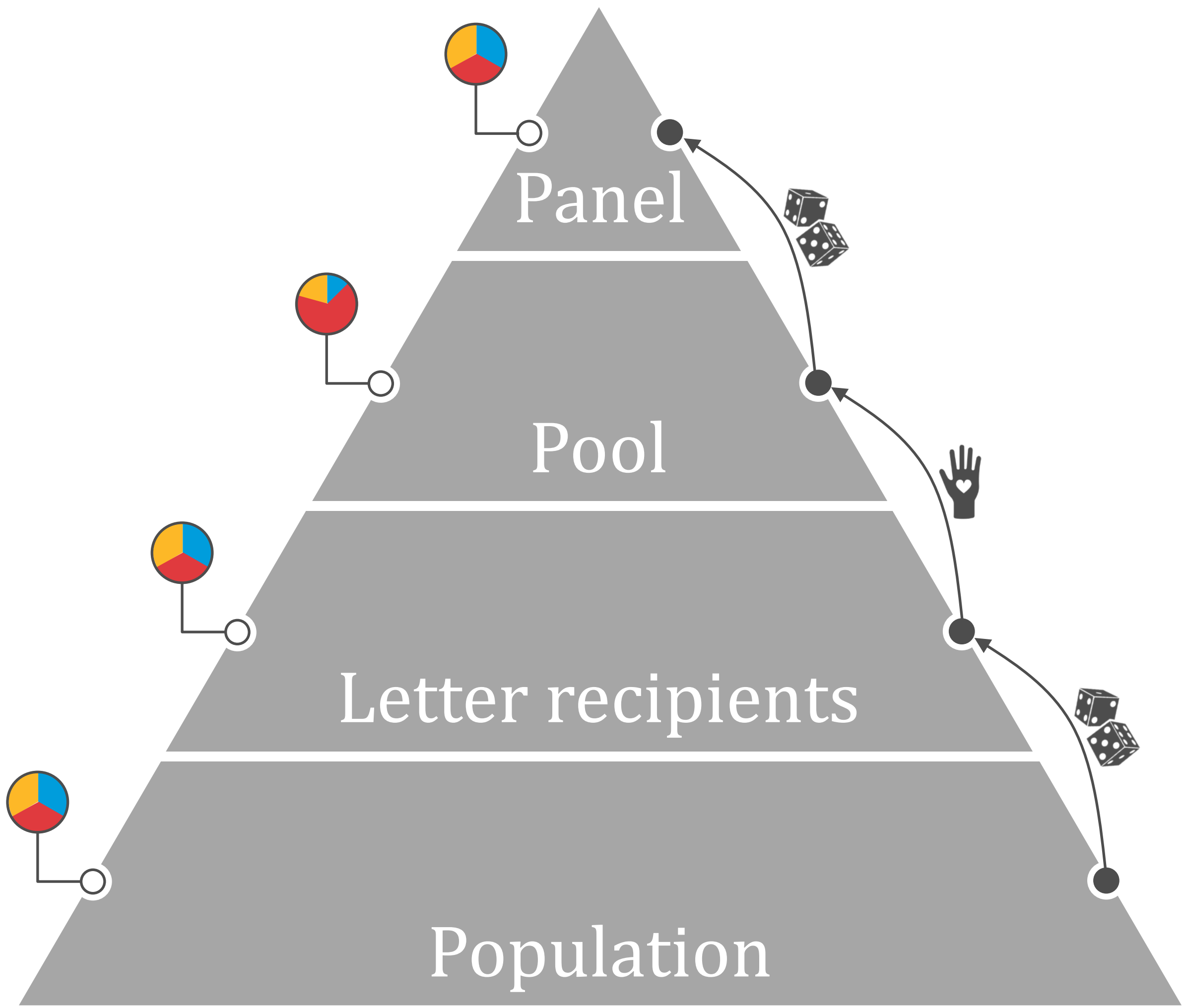
IDEAL SORTITION PIPELINE



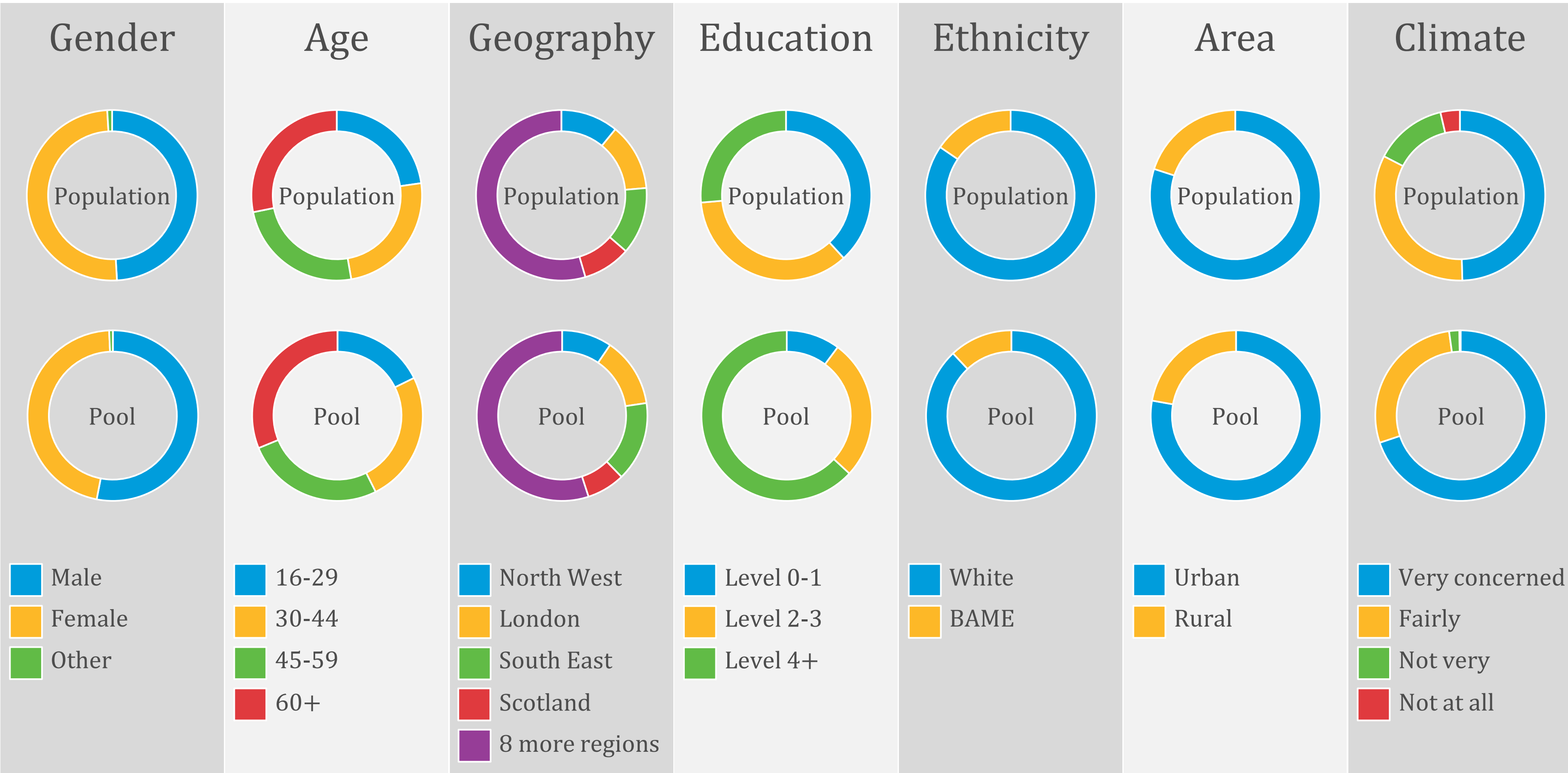
ACTUAL SORTITION PIPELINE



ACTUAL SORTITION PIPELINE



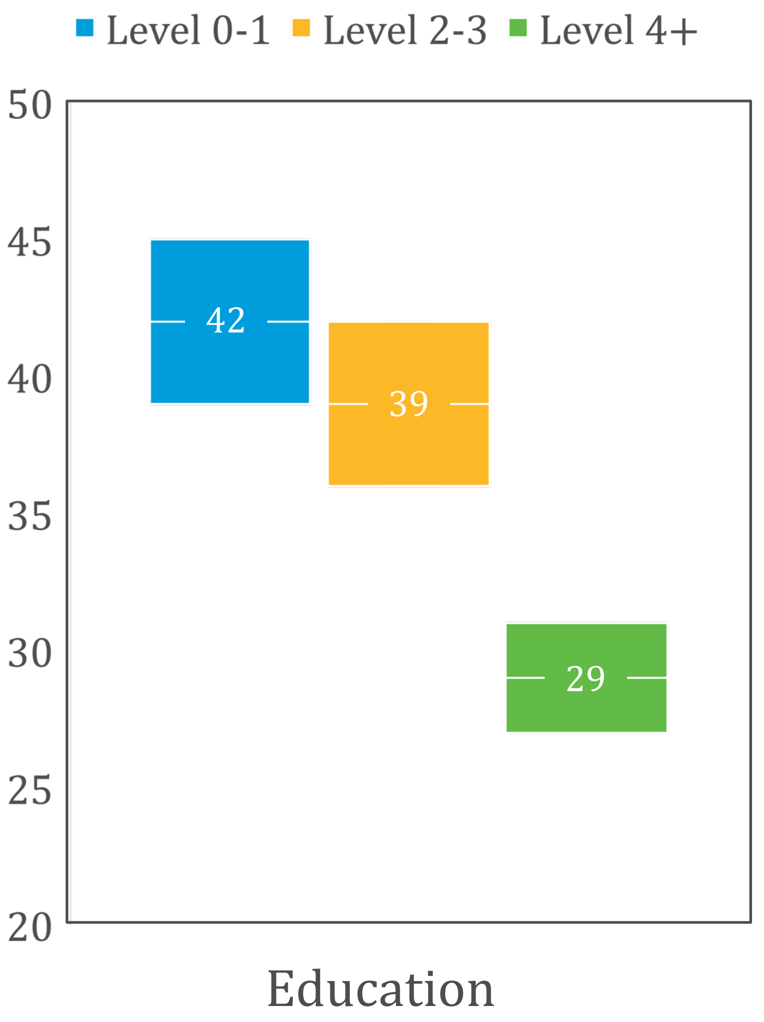
FEATURES



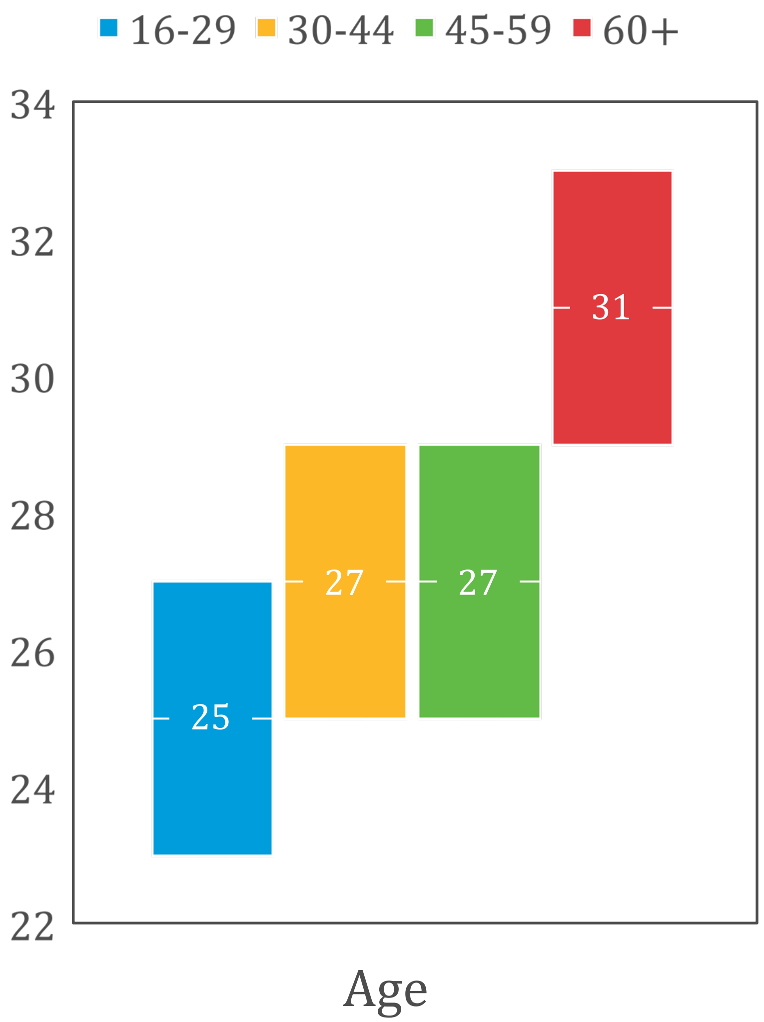
Climate Assembly UK (2020)

Pool size is $n = 1727$, panel size is $k = 110$

QUOTAS



Level 0-1
Level 2-3
Level 4+
50
45
40
35
30
25
20
42
39
29
Education



16-29
30-44
45-59
60+
34
32
30
28
26
24
22
25
27
27
31
Age

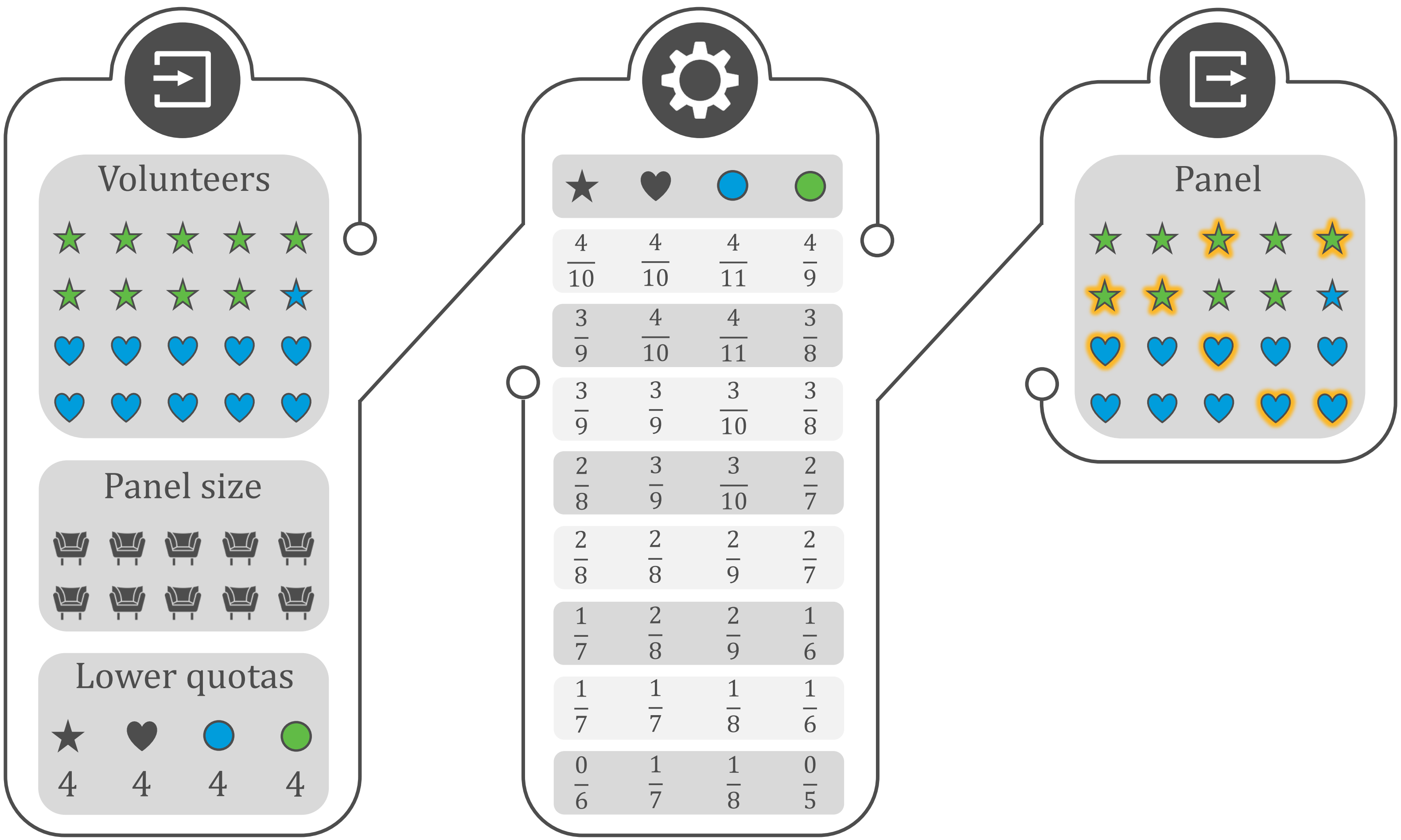
THE SORTITION MODEL

- Set of features F, where each $f \in F$ has a set of values V_f
- Multiset of n volunteers N where each $\boldsymbol{x} \in N$ 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 $f \in F, v \in V_f$, $\ell_{f,v} \leq \left|\{\boldsymbol{x} \in P: x_f = v\}\right| \leq u_{f,v}$
- Finding a quota-feasible panel is NP-hard

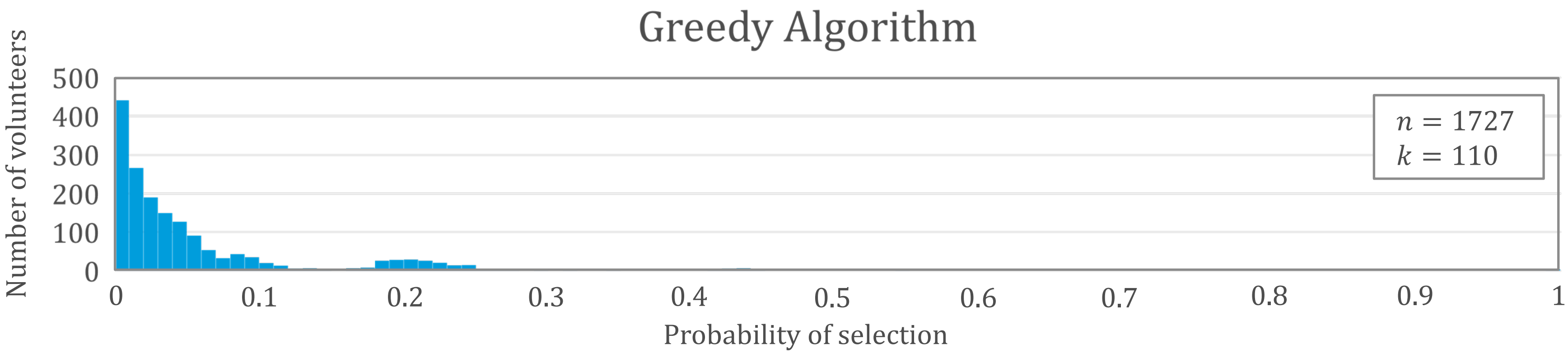
A GREEDY ALGORITHM

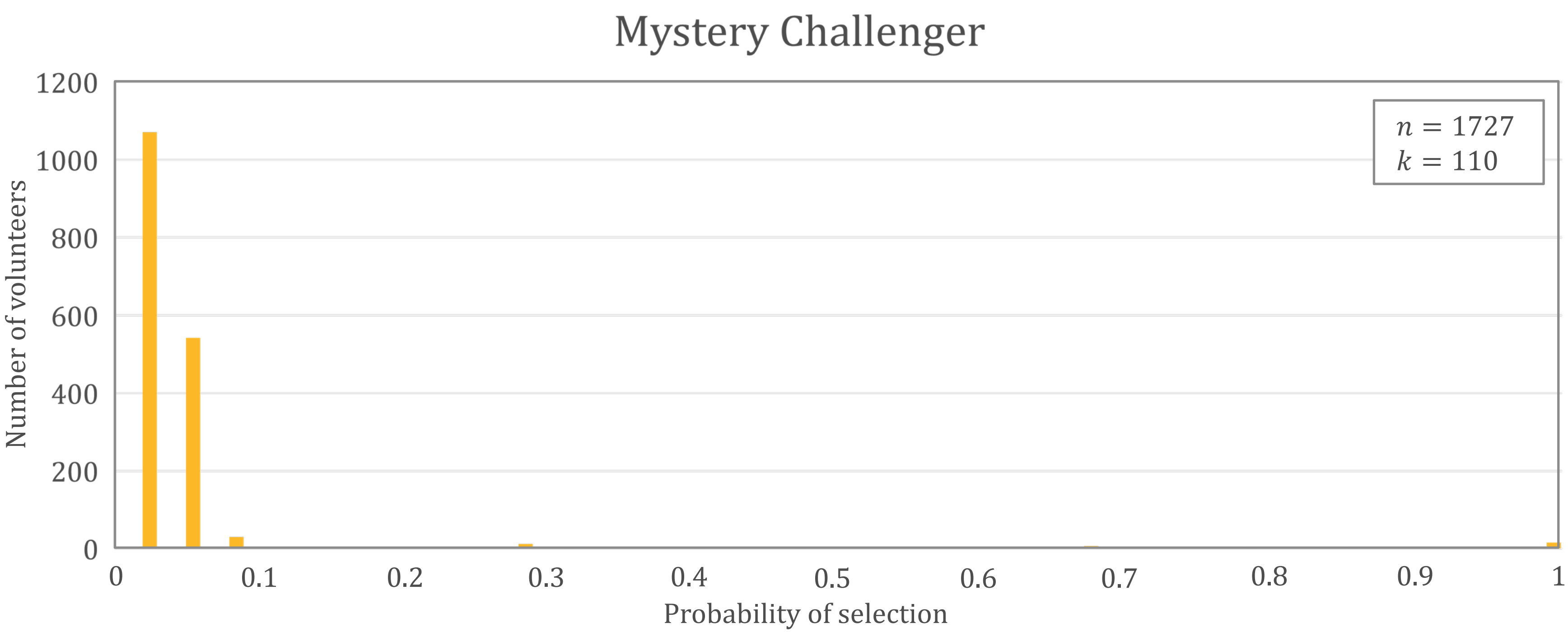
- At time t, a partial panel P_t has been selected ($P_0 = \emptyset$)
- For each $f \in F, v \in V_f$ define the score of v to be
$$\frac{\ell_{f,v} - \left|\{\boldsymbol{x} \in P_t : x_f = v\}\right|}{\left|\{\boldsymbol{x} \in N \setminus P_t : x_f = v\}\right|}$$
- For v with maximum score, select uniformly at random among $\boldsymbol{x} \in N \setminus P_t$ such that $x_f = v$
- 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

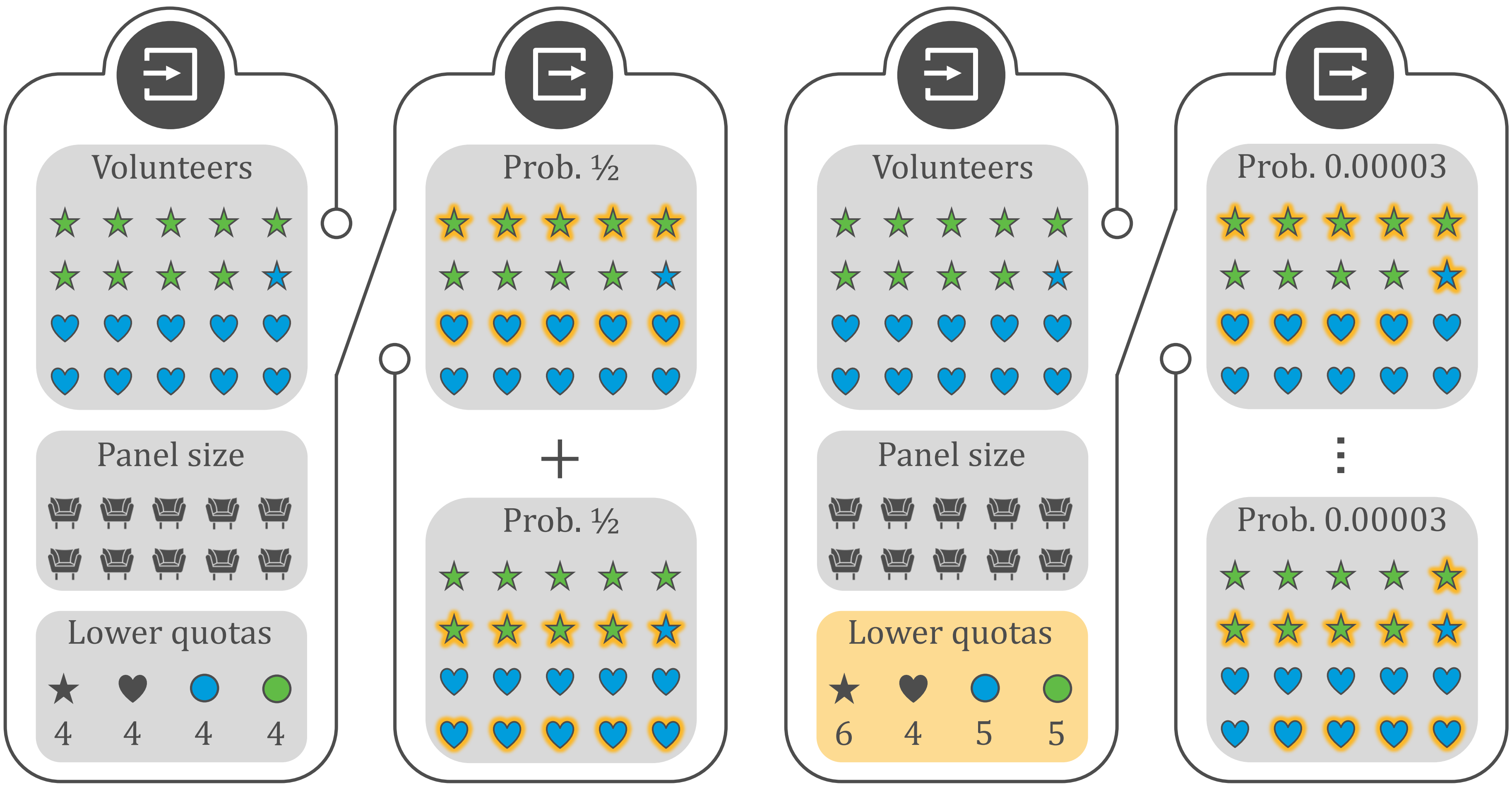


A GREEDY ALGORITHM

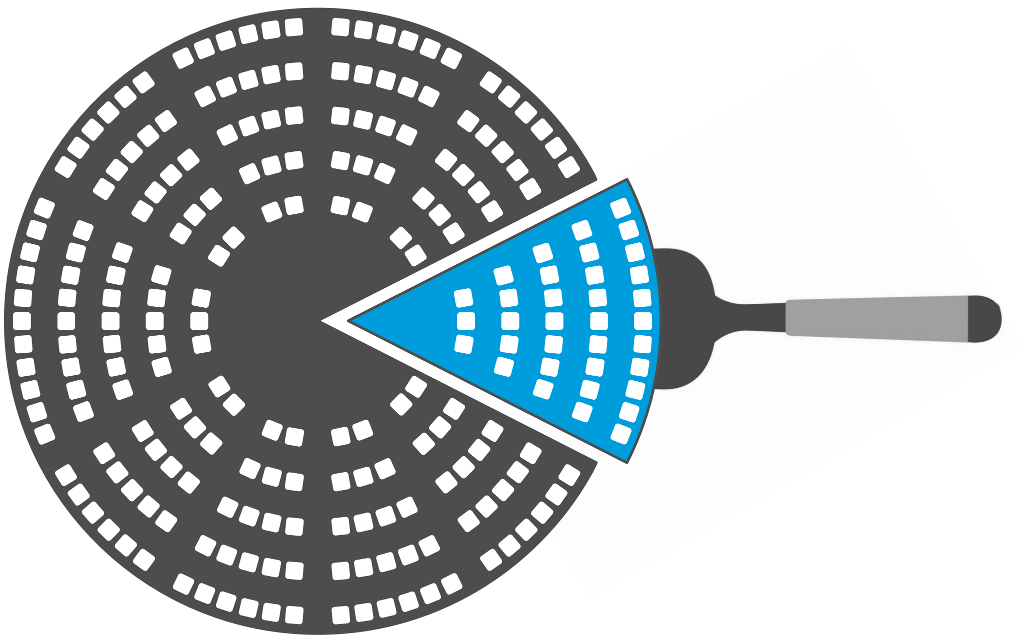




LOADING THE DICE



FROM SORTITION TO FAIR DIVISION



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

ALLOCATION RULES

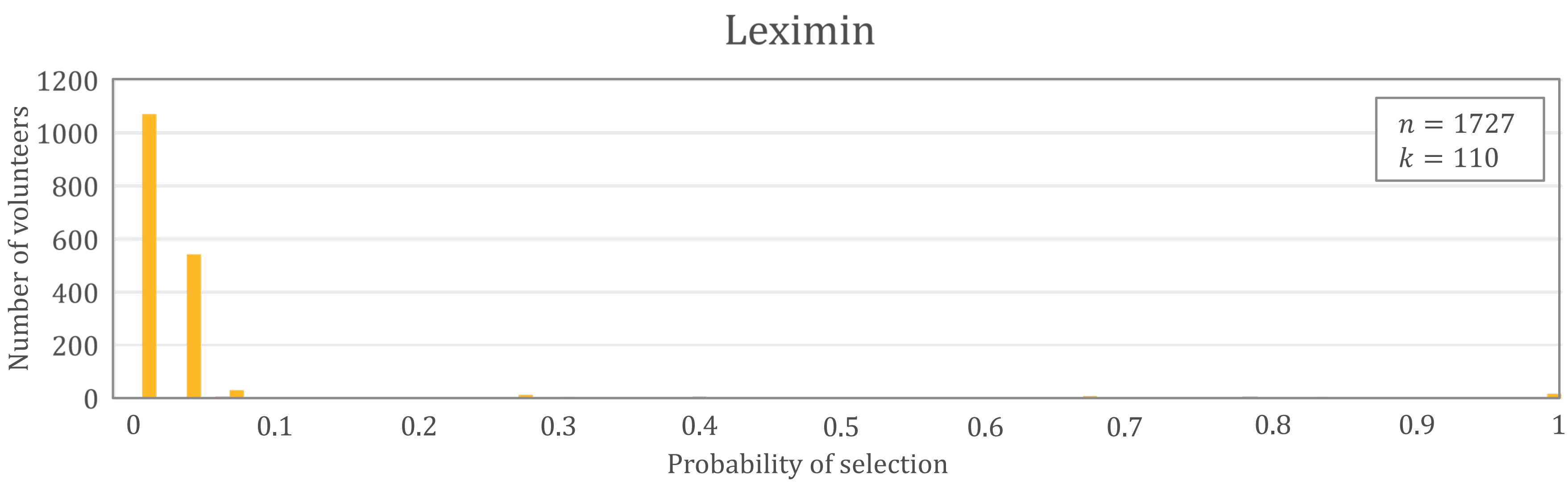
- An allocation rule outputs a distribution $\mathcal{D}$ over quota-feasible panels of size k
- Maximum Nash Welfare maximizes the product $\prod_{\boldsymbol{x} \in N} \Pr_{P \sim \mathcal{D}}[\boldsymbol{x} \in P]$
- Leximin maximizes $\min_{\boldsymbol{x} \in N} \Pr_{P \sim \mathcal{D}}[\boldsymbol{x}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

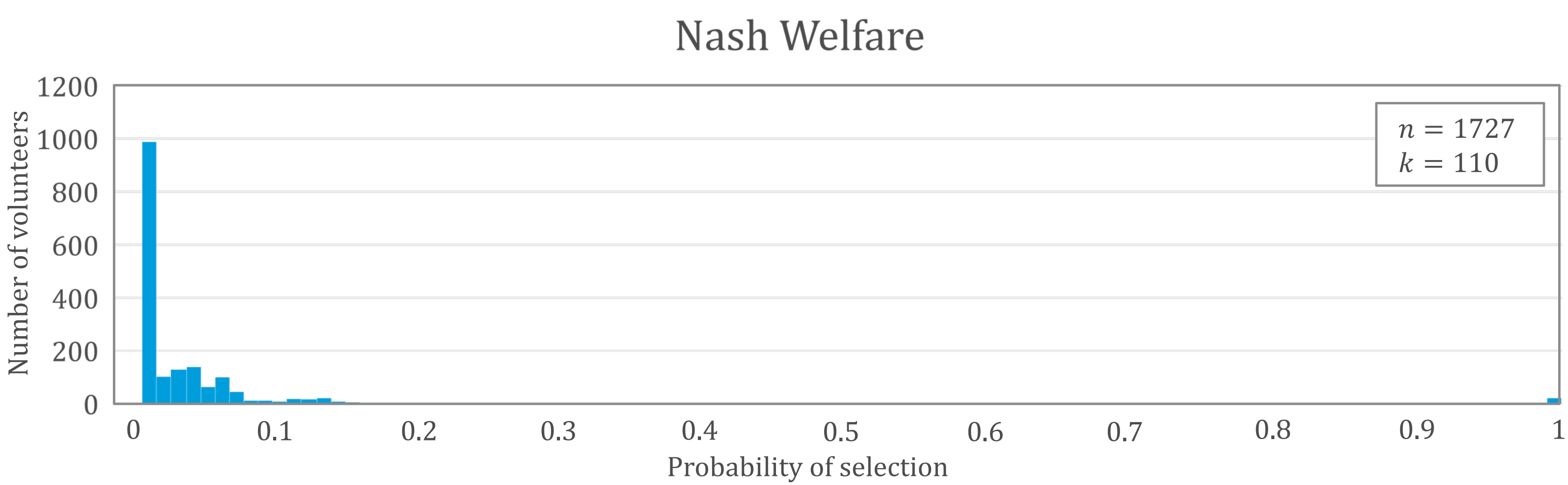
Poll

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

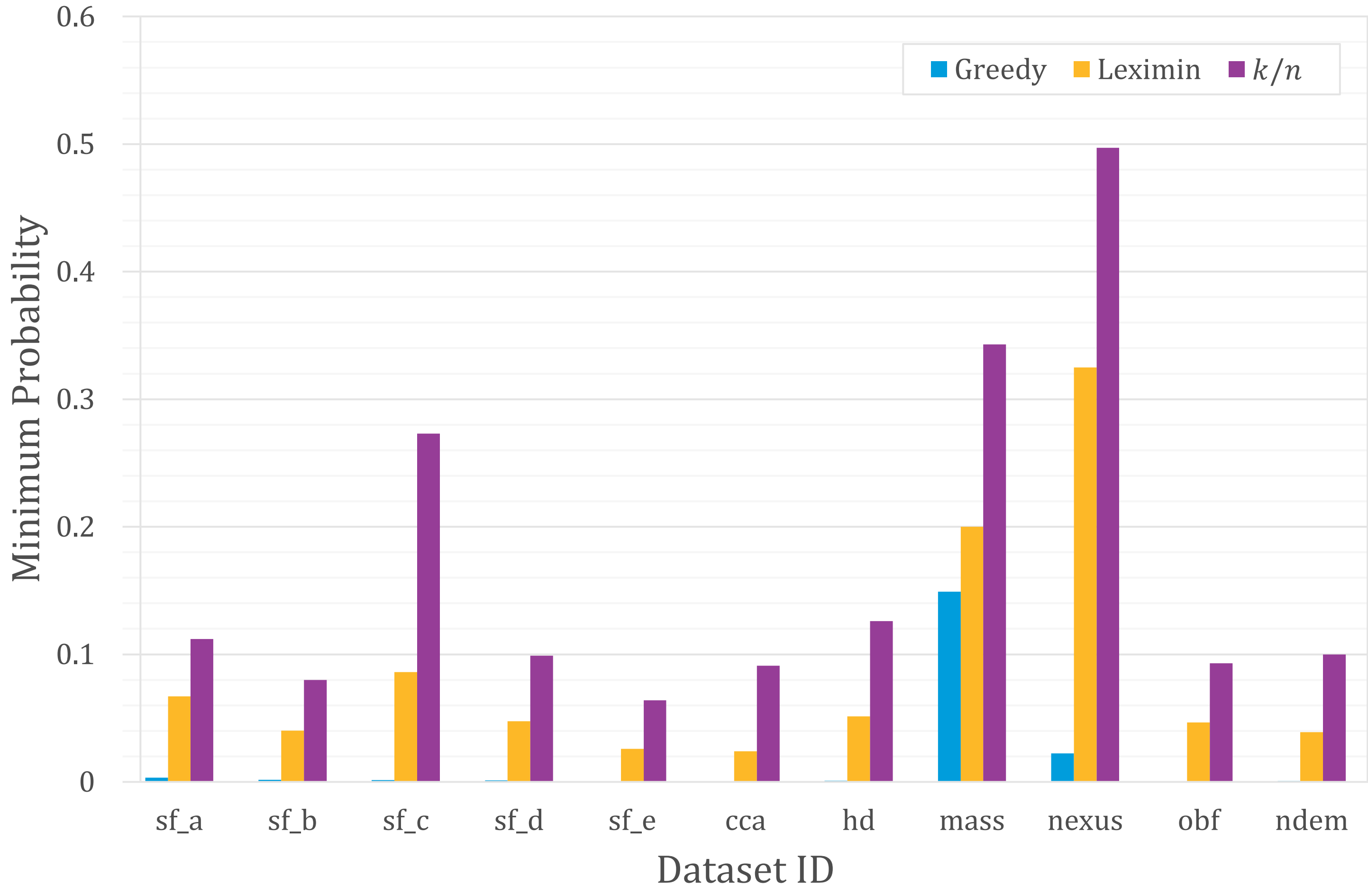
• MNW • Leximin • Both rules • Neither one

MYSTERY CHALLENGER UNMASKED





EVERYONE DESERVES A FAIR CHANCE

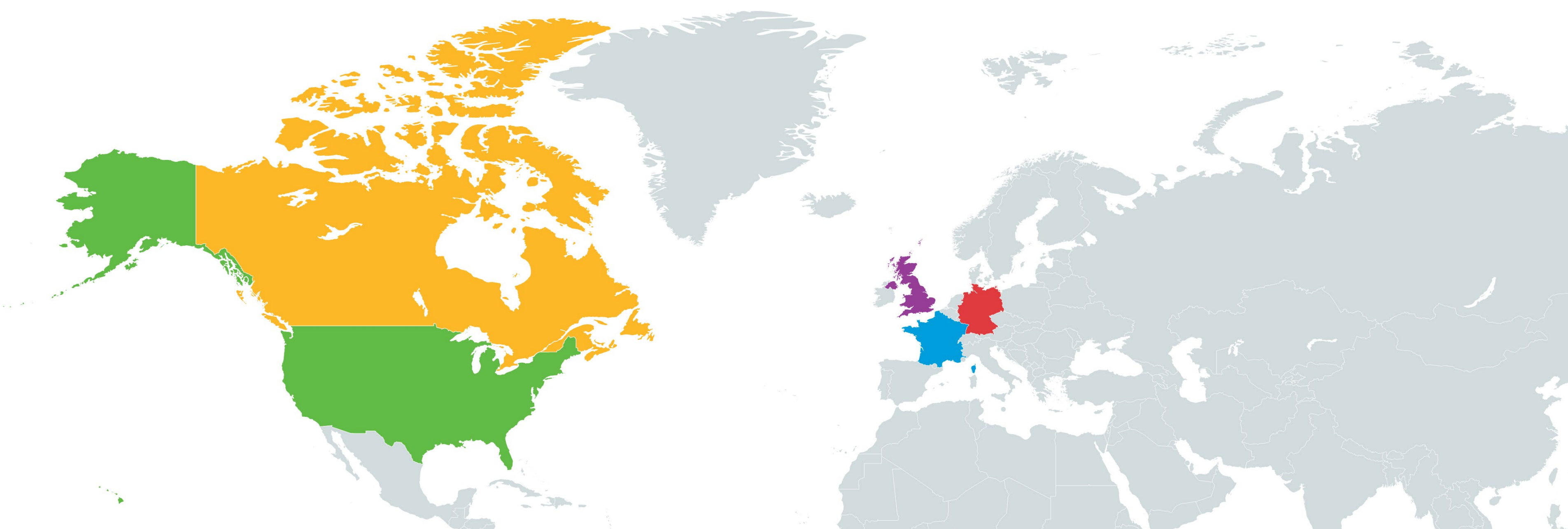


Panelot

Online at panelot.org

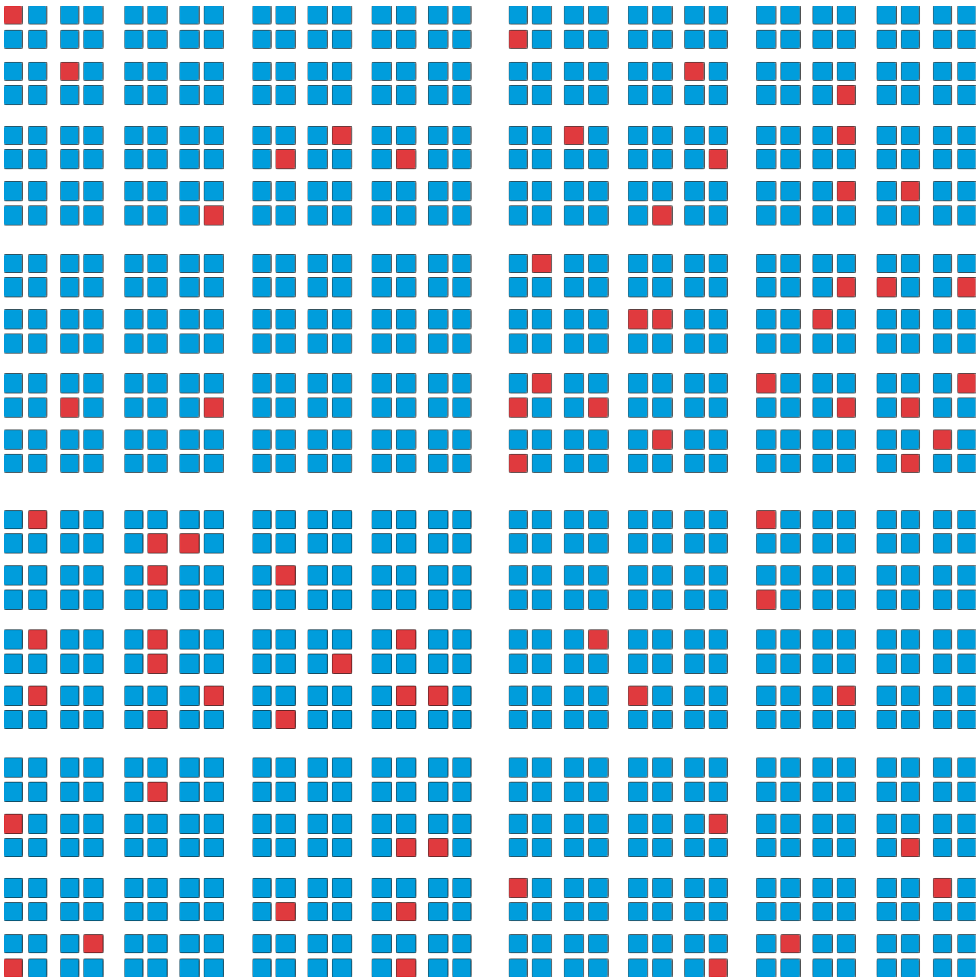
DEPLOYMENT

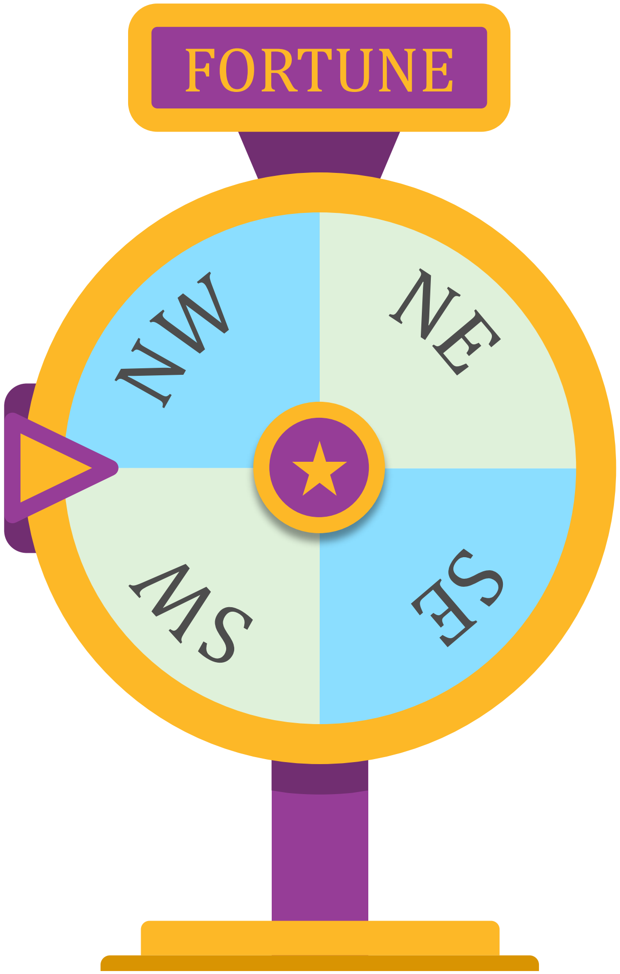
USA	Canada	UK	France	Germany
OF/BY/FOR ALL	MASSLBP	SORTITION FOUNDATION	RESPUBLICA	Baden-Württemberg
HEALTHY DEMOCRACY	modo. the car co-op			Klima-Mitbestimmung JETZT
CASCADIA CONSULTING GROUP				



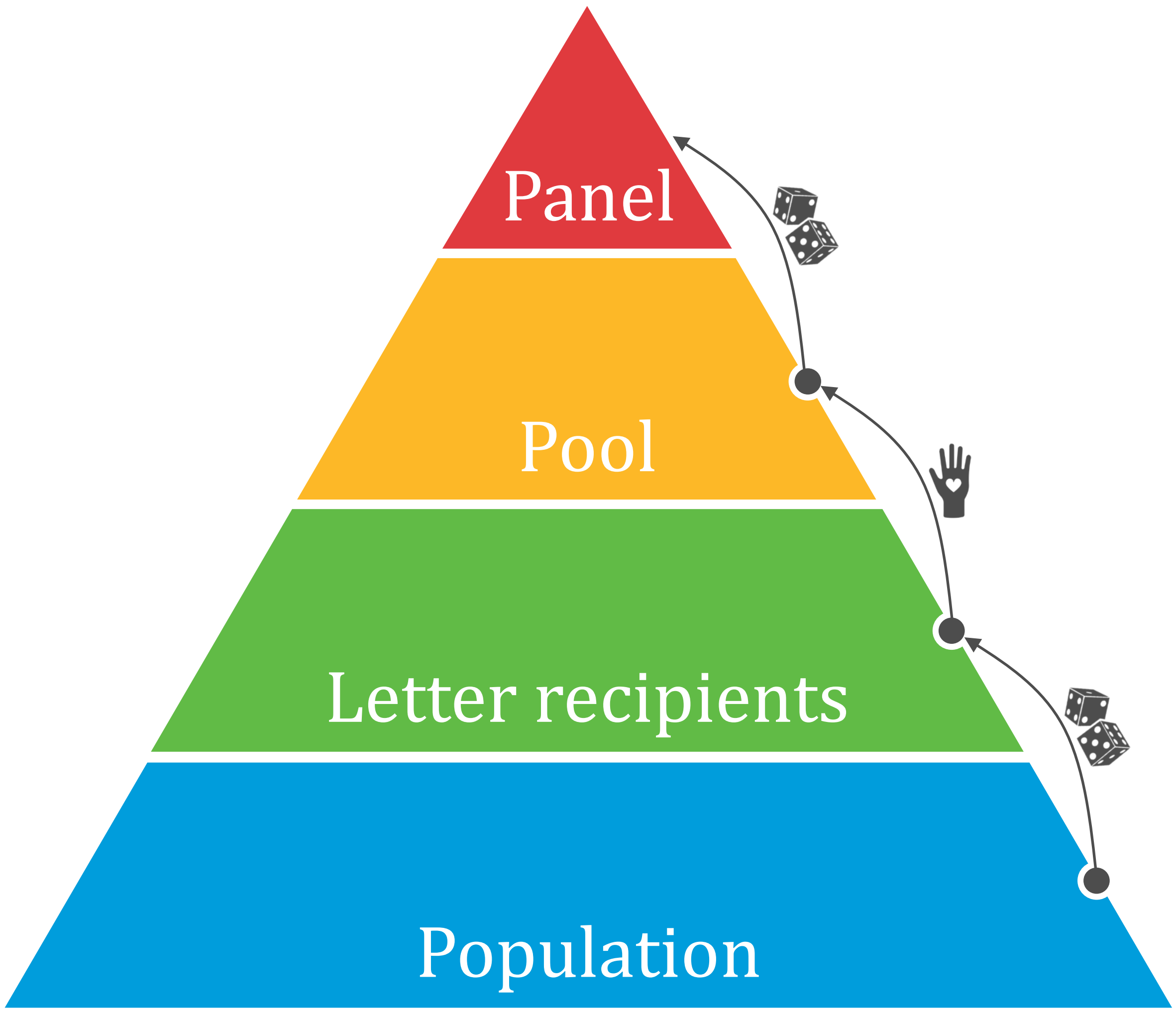

The
Citizens' Panel
on COVID-19
Democratic Lottery

VISUAL SELECTION





SORTITION PIPELINE, REVISITED



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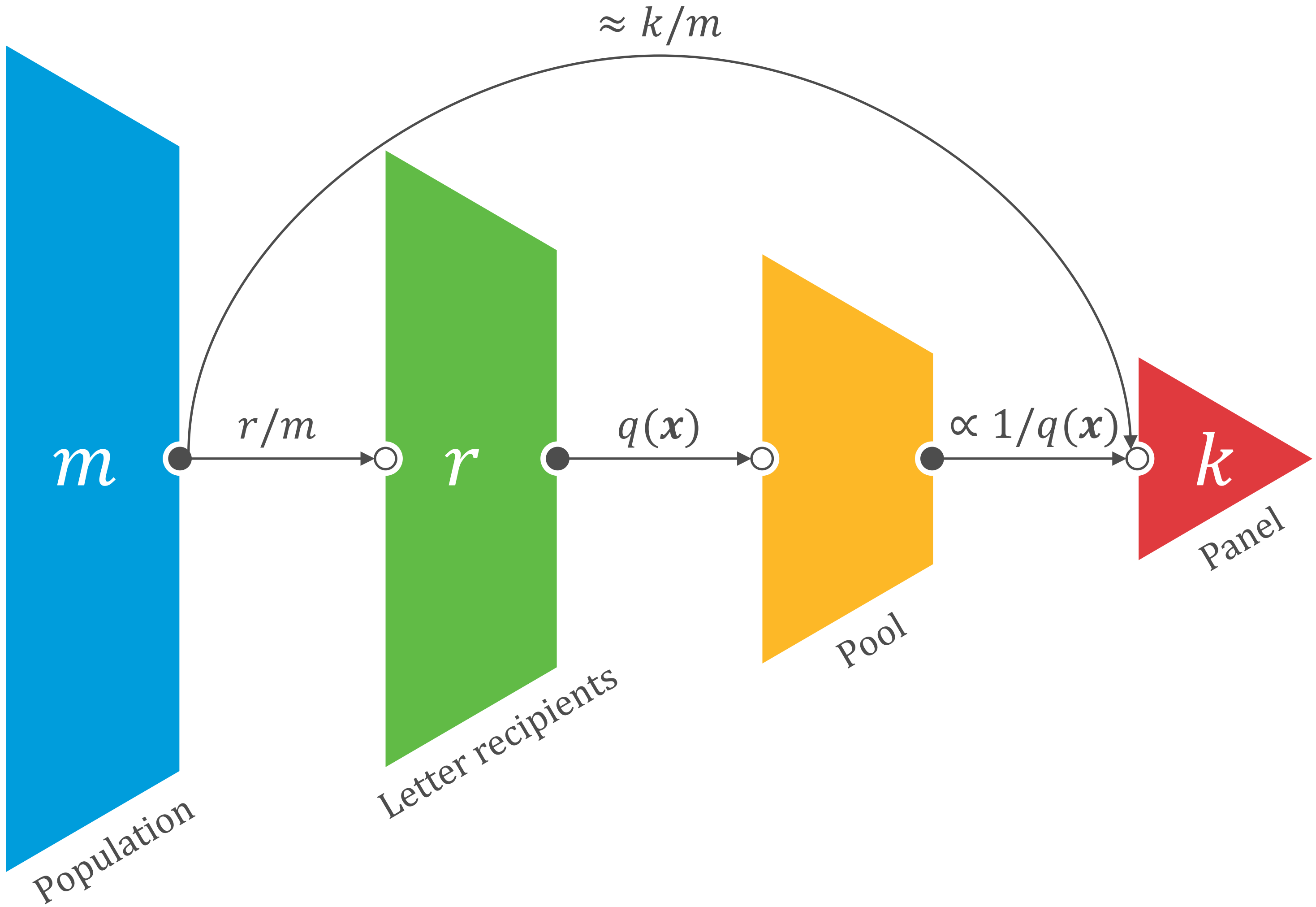
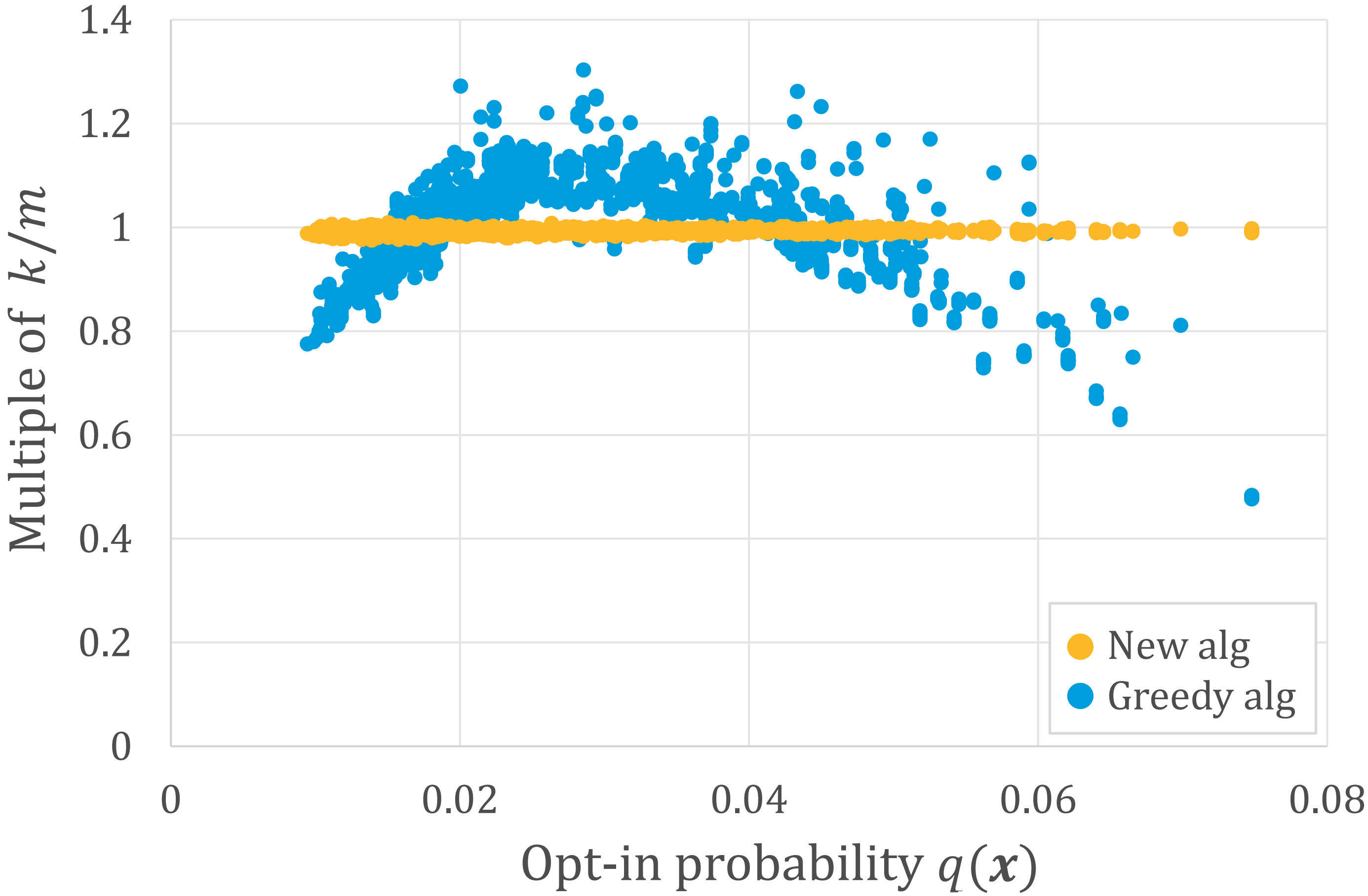


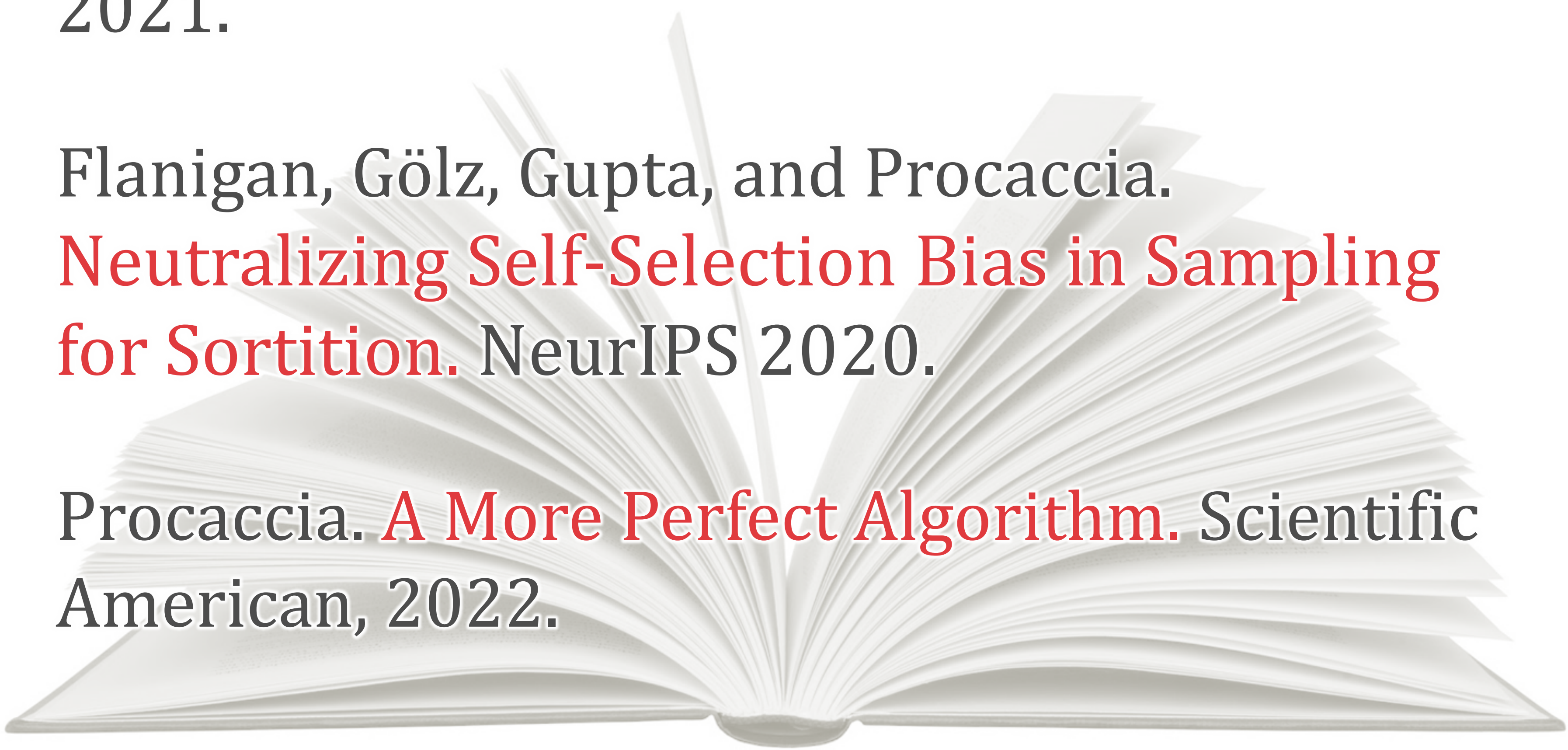
END-TO-END GUARANTEES

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

EMPIRICAL PROBABILITIES



BIBLIOGRAPHY



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Flanigan, Gölz, Gupta, and Procaccia. Neutralizing Self-Selection Bias in Sampling for Sortition. NeurIPS 2020.

Procaccia. A More Perfect Algorithm. Scientific American, 2022.