Weighted representative democracy

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Why representative democracy?

- Many policy problems are extremely complex; a huge investment of time and effort is needed to understand them.
- Most voters do not have the time, the interest, or the educational background to make this investment.
- For this reason, we elect *legislators* to make fully-informed and carefully reasoned decisions on our behalf.
- Ideally, these legislators should make the same decisions that voters *would have made*, if the voters themselves had the time and resources to fully-informed and carefully reasoned decisions.
- Existing representative democracies fall into two classes: *regional representation* and *proportional representation*.

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- We will propose a new system of representative democracy which is in many ways better than both RR and PR.

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The proposal: elections

Our proposed system has two components:

- An *election rule* for electing the legislators;
- A *weighted voting rule* for making decisions within the legislature.

Election rule. Assume a legislature with a fixed number L of seats. Elections work as follows.

1. A set of M candidates run for election (assume $M \geq L$).
2. Each voter selects one candidate as her "representative". She assigns to this representative a number between 0 and 1, representing her "confidence" in this representative.
3. The $M - L$ candidates who received the *smallest* number of votes are eliminated. Voters who voted for these candidates must repeat Step 2 and select one of the remaining L candidates.

In the end, the L most popular candidates form the legislature.
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Decisions in the legislature are made by *weighted votes*, where the *weight* of each legislator is a function of the "confidence" levels of all the voters who chose her as their representative.

For any legislator ℓ , let $\mathcal{I}_\ell := \{$voters who chose ℓ as their representative$\}$.

For all i in $\mathcal{I}_\ell$, let $p_\ell^i \in [0,1]$ be the "confidence" voter i expresses towards ℓ.

Let $w_\ell := \sum_{i \in \mathcal{I}_\ell} (2\,p_\ell^i - 1)$; this is the *weight* of ℓ in the legislature.

Suppose the legislature confronts a binary ("yes/no") question.
Let $\mathcal{L}_+ := \{$legislators who vote yes$\}$. Let $\mathcal{L}_- := \{$legislators who vote no$\}$.

Then the decision of the legislature is "yes" iff $\sum_{\ell \in \mathcal{L}_+} w_\ell > \sum_{\ell \in \mathcal{L}_-} w_\ell$.

Main results (informally): *With high probability in the limit as the population size grows the infinity, the decision made by weighted voting in the legislature will agree with the decision that* would *have been made by the voters themselves through a popular referendum.*

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Model and main result:

Binary decisions

Formal model: voters and representatives

Let $\mathcal{I}$ be the set of voters. Let $I := |\mathcal{I}| < \infty$.
(Our main results are asymptotic statements as $I \to \infty$.)

Let $\mathcal{L}$ be the set of legislators (selected in Step 3 of the election rule).
Each voter i in $\mathcal{I}$ must choose some ℓ in $\mathcal{L}$ as her representative.

For each $i \in \mathcal{I}$, let $\widetilde{\mathbf{p}}^i = (\widetilde{p}^i_\ell)_{\ell \in \mathcal{L}}$ be a random vector in $[0, 1]^{\mathcal{L}}$.

Suppose that in the future, the legislature will face a series as-yet undetermined of binary ("yes/no") policy questions.

For any $\ell \in \mathcal{L}$, $\widetilde{p}^i_\ell$ represents the *probability of agreement* between i and ℓ on each of these questions (*if* voter i were well-informed etc.)

Thus, $\widetilde{\mathbf{p}}^i$ describes the relationship between i and all of the legislators.
It is determined when the set $\mathcal{L}$ is selected in Step 3 of the election.

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Let ρ be a probability distribution on $[0,1]^{\mathcal{L}}$.

Here is our first assumption:

(A) The random vectors $\{\widetilde{\mathbf{p}}^i\}_{i\in\mathcal{I}}$ are independent, identically distributed random variables drawn from ρ.

Note ρ can be any distribution on $[0,1]^{\mathcal{L}}$. (Voters' tendencies to agree with different candidates may be correlated or anticorrelated.)

Here is our second assumption....

(B) For all distinct $\ell, m \in \mathcal{L}$, $\rho\{\mathbf{p} \in [0,1]^{\mathcal{L}} \,;\, p_\ell = p_m\} = 0$.

This says that there is a zero probability that $\widetilde{p}^i_\ell = \widetilde{p}^i_m$ for any voter i.

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Formal model: Policy problems, legislation, referenda

Suppose society faces a sequence of binary decisions, indexed by $t \in \mathbb{N}$.

For all $t \in \mathbb{N}$ and $\ell \in \mathcal{L}$, let $\widetilde{b}_\ell^t \in \{\pm 1\}$ legislator ℓ's view on decision t.

Likewise, for all $t \in \mathbb{N}$ and $i \in \mathcal{I}$, let $\widetilde{b}_i^t \in \{\pm 1\}$ be the view that voter i *would* have on decision t, if she were thoughtful and well-informed.

For all $\ell \in \mathcal{L}$ and all $i \in \widetilde{\mathcal{I}}_\ell$, let

$$\widetilde{a}_{i,\ell}^t \; := \; \widetilde{b}_i^t \cdot \widetilde{b}_\ell^t \; = \; \begin{cases} 1 & \text{if} \quad \widetilde{b}_i^t = \widetilde{b}_\ell^t \quad \text{(i.e. } i \text{ and } \ell \text{ agree);} \\ -1 & \text{if} \quad \widetilde{b}_i^t = -\widetilde{b}_\ell^t \quad \text{(i.e. } i \text{ and } \ell \text{ disagree).} \end{cases}$$

We suppose these policy questions cannot be anticipated in advance.
We will make the following key assumption.....

(C) For all $\ell \in \mathcal{L}$ and all $i \in \widetilde{\mathcal{I}}_\ell$, $\{\widetilde{a}_{i,\ell}^t\}_{t=1}^\infty$ is a set of identically distributed random variables. For any $t \in \mathbb{N}$, $\text{Prob}\left[\widetilde{a}_{i,\ell}^t = 1 \mid \widetilde{p}_\ell^i\right] = \widetilde{p}_\ell^i$.
Furthermore, for any $t \in \mathbb{N}$, the variables $\{\widetilde{a}_{i,\ell}^t\}_{i \in \widetilde{\mathcal{I}}_\ell}$ are independent.

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Theorem

Fix $t \in \mathbb{N}$. Let $\widetilde{D}^t_{\mathcal{L}} \in \{-1, 0, 1\}$ be the legislature's decision ($+1$ means "yes", -1 means "no", and 0 means "undecided").

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Let $P(I) := \text{Prob}\left[\widetilde{D}^t_{\mathcal{L}} = \widetilde{D}^t_{\mathcal{I}}\right] = \text{Prob}\left[\text{Legislature \& referendum agree}\right]$.

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(D) There exists $\epsilon > 0$ such that $\lim_{I \to \infty} \text{Prob}\left[\left|\frac{1}{I}\sum_{i \in \mathcal{I}} \widetilde{b}^t_i\right| > \epsilon\right] = 1.$

Thus, in large populations, "nearly-tied" votes are extremely unlikely.

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Discussion

Some objections

Objection 1. *"If you want to replicate the outcome of a popular referendum, then why not just hold a popular referendum?"*

Response. We do *not* want to replicate an *actual* referendum.

As already noted, many policy decisions (e.g. EU membership) are too complicated to be made by ordinary voters. That's why we elect legislators.

But we want these legislators to choose what the voters *would have* chosen if they were wise and well-informed.

Policy decisions involves both *objective* issues (facts, technical analysis) and *subjective* issues (values, preferences).

An ideal legislature should combine the technical expertise of the legislators with the values and preferences of the population.

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Response. Weighted representative democracy is vulnerable to strategic voting at two levels:

- A voter might select candidate A rather than B as her representative, even though she prefers B, because she believes she might cast the pivotal vote to get A elected to the legislature, whereas B has *no* chance being elected.
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Conclusion

We have proposed a new system of representative democracy.

During an election, any voter can vote for any candidate.

The *weight* of each legislator is (roughly) proportional to the number of voters who voted for her.

For a variety of voting rules (simple majority vote, tournament rules, majority margin rules), we have shown that the decisions made by such a weighted legislature will agree (with high probability) with the decisions that would have been made by a popular referendum in a large population.

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