Weighted representative democracy

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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.

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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. Each voter has selected one of these $L$ candidates as her representative.
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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 $\ell$, let $I_\ell := \{\text{voters who chose } \ell \text{ as their representative}\}$.

For all $i$ in $I_\ell$, let $p^i_\ell \in [0, 1]$ be the “confidence” voter $i$ expresses towards $\ell$.

Let $w_\ell := \sum_{i \in I_\ell} (2p^i_\ell - 1)$; this is the *weight* of $\ell$ in the legislature.

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

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
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 $\ell$ in $\mathcal{L}$ as her representative.

For each $i \in \mathcal{I}$, let $\tilde{p}^i = (\tilde{p}^i_\ell)_{\ell \in \mathcal{L}}$ 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 $\ell \in \mathcal{L}$, $\tilde{p}^i_\ell$ represents the probability of agreement between $i$ and $\ell$ on each of these questions (if voter $i$ were well-informed etc.)

Thus, $\tilde{p}^i$ 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 $I$ be the set of voters. Let $I := |I| < \infty$.

(Our main results are asymptotic statements as $I \to \infty$.)

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

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

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

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

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

Here is our first assumption:

(A) The random vectors $\{\tilde{p}_i\}_{i \in I}$ are independent, identically distributed random variables drawn from $\rho$.

Note $\rho$ 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 $\ell, m \in \mathcal{L}$, $\rho\{p \in [0, 1]^\mathcal{L} ; p_\ell = p_m\} = 0$.

This says that there is a zero probability that $\tilde{p}_i^\ell = \tilde{p}_i^m$ for any voter $i$.

Finally, let $\tilde{w}_\ell := \sum_{i \in \tilde{I}_\ell} (2 \tilde{p}_i^\ell - 1)$. This is $\ell$’s weight in the legislature.
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Finally, let $\tilde{w}_\ell := \sum_{i \in I_\ell} (2\tilde{p}^i_\ell - 1)$. This is $\ell$’s weight in the legislature.
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 $\tilde{b}_t^{\ell} \in \{\pm 1\}$ legislator $\ell$’s view on decision $t$.

Likewise, for all $t \in \mathbb{N}$ and $i \in \mathcal{I}$, let $\tilde{b}_t^i \in \{\pm 1\}$ 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 $i \in \tilde{\mathcal{I}}_{\ell}$, let

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

We suppose these policy questions cannot be anticipated in advance.

We will make the following key assumption.....

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

Furthermore, for any $t \in \mathbb{N}$, the variables $\{\tilde{a}_{i,\ell}^t\}_{i \in \tilde{\mathcal{I}}_{\ell}}$ are independent.
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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 \( i \in \tilde{\mathcal{I}}_\ell \), \( \{\tilde{a}_{i,\ell}^t\}_{t=1}^{\infty} \) is a set of identically distributed random variables. For any \( t \in \mathbb{N} \),

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Furthermore, for any \( t \in \mathbb{N} \), the variables \( \{\tilde{a}_{i,\ell}^t\}_{i \in \tilde{\mathcal{I}}_\ell} \) are independent.
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Let $P(I) := \text{Prob} \left[ \tilde{D}_L^t = \tilde{D}_I^t \right] = \text{Prob} \left[ \text{Legislature & referendum agree} \right]$.

We will need one more assumption....

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

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

Here is our main result....

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Discussion
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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Nevertheless, we suspect that strategic voting will have much less influence over legislative outcome than it does in regional representation.
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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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Thank you.