

Comparing Ways of Obtaining Candidate Orderings from Approval Ballots

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Input: Binary information

→ approval preferences

Output: Ordering of the columns

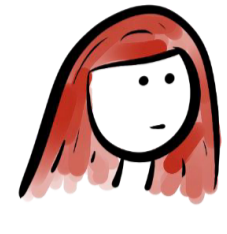


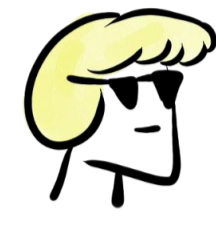
→ axis of the candidates

Ideal World: CIP

→ preferences satisfy candidate interval (CI)

Real World: Near CIP

→ near candidate interval

	 Ann	 Bob	 Cora	 Dan
4 ×		✓	✓	✓
4 ×	✓	✓		
3 ×	✓			✓
1 ×	✓		✓	
1 ×		✓	✓	

Question: what function should the near-axis optimize?

Voter Deletion

Minimizes how many votes are not interval.

Minimal Flips

Minimizes how many ✓ need to be added/removed.

Ballot Completion

Minimizes how many ✓ need to be added.

Minimal Swaps

Minimizes the number of swaps on the axis.

Forbidden Triples

Minimizes the number of triplets (✓, X, ✓).

Family of scoring rules

Minimizes the sum of costs over all voters.

Complexity

All these rules are **NP-Hard** to compute. (Booth, 1975)

Axiomatic Analysis

Responsiveness to Information

Stability ^{VD}

Adding one voter to a profile cannot change the entire set of optimal axes.

Ballot Monotonicity ^{VD BC}

If we add approvals to the ballot of a voter to turn it into an interval of the selected axis, this axis is still selected.

Reaction to Clones

Clone-proximity ^{FT}

Clones should be next to each other on the axis.

Resistance to Cloning ^{VD}

Adding a clone of an existing candidate should not completely change the order of the other candidates.

Theorem: These two axioms are **incompatible**.

Centrists and Outliers

Clearance ^{BC MS FT}

A never approved candidate should not be in a position in which it can break intervals.

Veto-Centrism ^{MS FT}

If all approval ballots are of size $m - 1$, the candidate at the center of the axis is the most approved candidate.

Theorem: Ballot Monotonicity + Resistance to Cloning = ^{VD}.

Experiments

We tested our rules on both **synthetic** and **real** data.

- All five rules generally found **reasonable axes**, with only slight variations.
- In average, ^{FT} seems to return better axes and ^{VD} worse axes.
- Our methods are comparable if not better than **ordinal** methods.

Context: French presidential elections

Data: Voter Autrement experiments

Baseline: 8 poll institutes axes

Example: ^{FT} axes for 2017 and 2022:

LO NPA PS LFI EM R LR DLF FN UPR SP
LO NPA LFI PCF PS EELV EM LR R RN REC DLF

Context: Supreme Court of the US

Data: Justices' opinions on cases

Baseline: Martin-Quinn method

Example: ^{FT} axis for 2021 term:



Lots of applications:

- Political ordering
- Parliament members
- Archeology
- Scheduling
- Poster ordering

Read the full paper !

