The Agenda Choice Problem in Multi-Issue Elections

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Talk Outline

- Example: the dilemma of multi-issue elections
- Formal framework for the study of the agenda choice problem
- Examples for agenda choice functions
- Examples for properties of such functions
- Avenues for future research

Multi-Issue Elections

Three agents need to elect an element of a combinatorial domain:

$$\{\texttt{salad}, \texttt{paté}\} \times \{\texttt{tuna}, \texttt{veal}\} \times \{\texttt{red}, \texttt{white}\}$$

This is difficult:

- Issue-by-issue voting can lead to paradoxical outcomes, for instance if everyone tries to get their favourite combination:

  Agent 1: `salad-veal-red`
  Agent 2: `paté-tuna-red`
  Agent 3: `salad-tuna-white`

- But voting directly on combinations is computationally demanding:
  - ranking all eight combinations (e.g., for Borda) seems excessive
  - only eliciting top combinations (for Plurality) is not helpful

Solution: vote sequentially, e.g., first on starter + mains, then on wine

Sequential Voting

An approach to designing voting procedures for multi-issue elections:

(1) Elicit some basic information from the voters (here: everyone's *dependency graph* over the issues at stake).

(2) Choose an *agenda* (which issues to vote on together in local elections + order of local elections), based on dependencies.

(3) Choose a *local voting procedure* for each local election.

Our proposal: study above "*agenda choice problem*" in its own right.

The Agenda Choice Problem

Given a profile of preferential dependencies between issues, as reported by the voters, choose an agenda (in practice: a set of meta-agendas).

Our formal object of study are *meta-agenda choice functions:*

$$F\colon \mathrm{DG}(\mathcal{I})^{\mathcal{N}} \to 2^{\mathrm{MAG}(\mathcal{I})} \setminus \{\emptyset\}$$

Next:

- some examples for MACFs
- some suggestions for the study of MACFs

Basic Meta-Agenda Choice Functions

All procedures given below map a profile of dependency graphs into a single collective dependency graph: $F : \mathrm{DG}(\mathcal{I})^{\mathcal{N}} \to \mathrm{DG}(\mathcal{I})$. We can then *condense* the collective graph to get a meta-agenda.

- *Majority aggregation:* include edge if a majority of voters do
- *Quota-based aggregation:* include edge if $\geqslant q\%$ of voters do
- *Canonical aggregation:* take the union of the input graphs
- *Distance-based aggregation:* choose graph that is closest to the input profile, for a given metric (e.g., sum of Hamming distances)
- *Constraint-based aggregation:* choose a graph with clusters $\leqslant \ell$ that generates $\leqslant k$ dependency violations

Axiomatic Analysis

We can apply the axiomatic method to the study of MACFs.

For example, *quota-based procedures* satisfy all of these axioms:

- *Anonymity:* symmetry wrt. input graphs
- *Dependency-neutrality:* for dependencies (a, b) and $a', b')$, if each voter accepts both or neither, then so does the meta-agenda
- *Reinforcement:* if the intersection S of sets of meta-agendas for two subelectorates is $\neq \emptyset$, then S is the outcome for their union

For *distance-based procedures*, some axiomatic properties are inherited from properties of the distances chosen:

- Any MACF defined in terms of a *neutral* distance ($=$ invariant under renaming of vertices) on graphs is *dependency-neutral*.
- Any MACF defined in terms of a *symmetric* operator for extending distances between pairs of graphs to a distance between a graph and a set of graphs is *anonymous*.

Last Slide

Main message:

- Balance computational and social choice-theoretic concerns in combinatorial voting via sequential voting with a suitable agenda.
- The agenda choice problem deserves to be studied in its own right.

Research agenda:

- How to properties of the agenda choice function and the local voting rules determine properties of the global voting rule?
- How should we model the "attitude" of voters when faced with uncertainty due to dependency violations induced by the agenda?
- What's the reduction in elicitation complexity achieved by first eliciting dependencies and then voting on small domains?

A paper outlining our model for studying the Agenda Choice Problem in detail is due to appear in the proceedings of IJCAI-2011.

S. Airiau, U. Endriss, U. Grandi, D. Porello, and J. Uckelman. Aggregating Dependency Graphs into Voting Agendas in Multi-Issue Elections. Proc. IJCAI-2011.