Elicitation and Explanation in Social Choice Theory

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Goal

Develop procedures able to help a committee (or a society) choose a suitable voting rule

Involves:

- Axiomatic analysis of voting rules
- Explanation of axioms in non-expert terms
- Preference elicitation methods

Approach

Idea: Automatically find properties which are incompatible

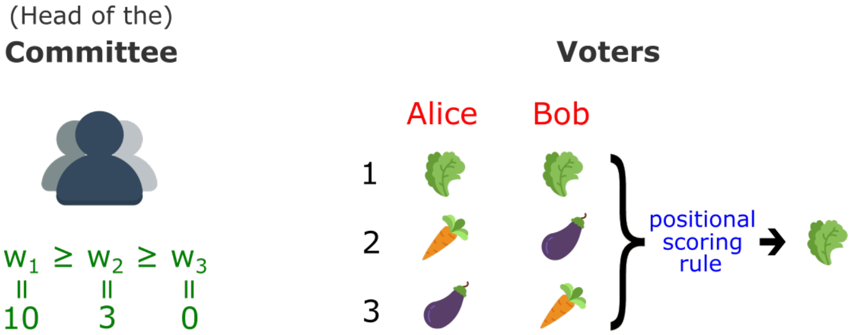
The inconsistencies proofs should be translated to non-expert terms and used for:

- querying the user and infer her preferences depending on her answers
- showing the user that she cannot have everything
- validate whether some choices are "better" than others

More generally: Work on elicitation procedures related to social choice

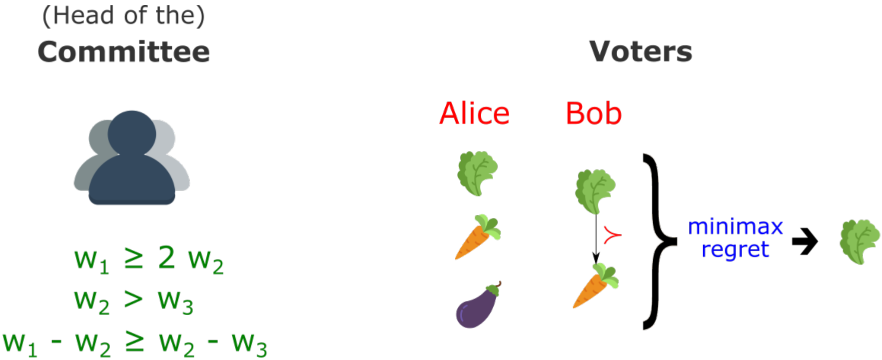
Robust Winner Determination

Setting: Two kind of players



Partial Knowledge

Setting: Incomplete profile and uncertain scoring rule



Goal: Winner determination using an incremental elicitation protocol based on minimax regret

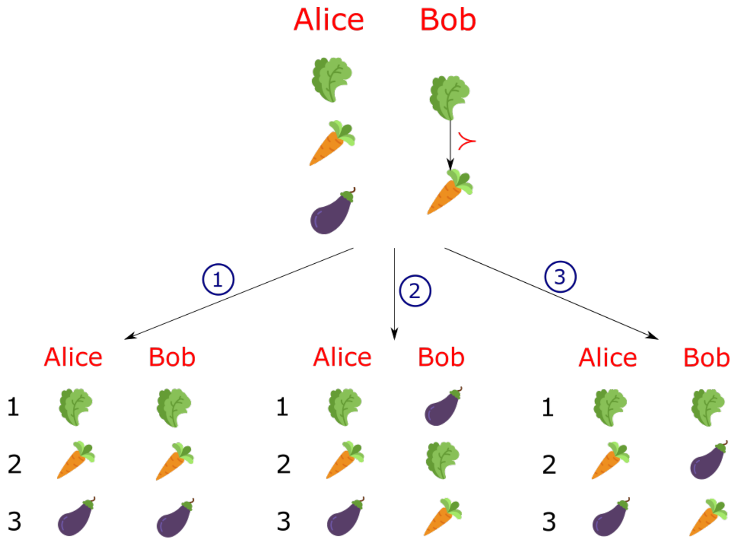
Max Regret

$$\begin{aligned} A &= \{a_1, \ldots, a_m\} && \text{alternatives} \\ N &= \{1, \ldots, n\} && \text{voters} \\ V &= \{\mathbf{v} | \mathbf{v} = (v_1, \ldots, v_n)\} && \text{set of complete preference profiles} \\ W &= \{\mathbf{w} | \mathbf{w} = (w_1, \ldots, w_m)\} && \text{set of scoring vectors} \\ s(a; \mathbf{v}, \mathbf{w}) &= \textstyle\sum_{i \in N} \mathbf{w}_{\mathbf{v}_i(a)} && \text{score of the alternative } a \text{ under the profile } \mathbf{v} \text{ and weights } \mathbf{w} \end{aligned}$$

- **PMR(a, b)** $= \max_{\mathbf{w} \in W} \max_{\mathbf{v} \in V} s(b; \mathbf{v}, \mathbf{w}) - s(a; \mathbf{v}, \mathbf{w})$
- **MR(a)** $= \max_{b \in A} \mathrm{PMR}(a, b)$

The winner is the alternative with minimal MR

Profile Completion



Computing Minimax Regret

Admissible scoring vectors: $W = \{\mathbf{w} | \ w_1 = 10, \ 0 < w_2 \leq 5, \ w_3 = 0\}$

MR() = max {

PMR( ) = 19 ➔ v = 3 w={10,1,0}

PMR( ) = 9 ➔ v = 2 w={10,1,0}

MR() = -1

MR() = 20

MMR = -1 ➔ winner 

Related Works

Incomplete profile

- and known weights: Minimax regret to produce a robust winner approximation (*Lu and Boutilier 2011*, [2]; *Boutilier et al. 2006*, [1])

Uncertain weights

- and complete profile: dominance relations derived to eliminate alternatives always less preferred than others (*Stein et al. 1994*, [3])
- in positional scoring rules (*Viappiani 2018*, [4])

Thank You!

C. Boutilier, R. Patrascu, P. Poupart, and D. Schuurmans.
Constraint-based Optimization and Utility Elicitation using the Minimax Decision Criterion.
Artifical Intelligence, 170(8–9):686–713, 2006.

Tyler Lu and Craig Boutilier.
Robust approximation and incremental elicitation in voting protocols.
In *Proceedings of IJCAI 2011*, pages 287–293, 2011.

William E. Stein, Philip J. Mizzi, and Roger C. Pfaffenberger.
A stochastic dominance analysis of ranked voting systems with scoring.
European Journal of Operational Research, 74(1):78 – 85, 1994.

Paolo Viappiani.
Positional scoring rules with uncertain weights.
In *Scalable Uncertainty Management - 12th International Conference, SUM 2018, Milan, Italy, October 3-5, 2018, Proceedings*, pages 306–320, 2018.