

Simultaneous Elicitation of Committee and Voters' Preferences

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Scenario

Setting: Incompletely specified profile and positional scoring rule

(Head of the)
Committee



$$w_1 > w_2 \geq w_3$$

$$\begin{array}{ccc} \parallel & & \parallel \\ 1 & & 0 \end{array}$$

Voters

Mickey Donald Goofy



positional
scoring
rule



Goal: Development of an incremental elicitation protocol based on minimax regret

Motivation and approach

Who?

- Imagine to be an *external observer* helping with the voting procedure

Why?

- Voters: difficult or costly to order *all* alternatives
- Committee: difficult to *specify* a voting rule precisely and abstractly

How?

- *Minimax regret*: given the current knowledge, the alternatives with the lowest worst-case regret are selected as tied winners

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])

Context

A Alternatives, $|A| = m$

N Voters

$P = (\succ_j, j \in N)$, $P \in \mathcal{P}$ complete preferences profile

$W = (w_k, 1 \leq k \leq m)$, $W \in \mathcal{W}$ (convex) scoring vector that the committee has in mind

W defines a Positional Scoring Rule $f_W(P) \subseteq A$ using scores $s^{W,P}(a)$, $\forall a \in A$

Questions

Questions to the voters

Comparison queries that ask a particular voter to compare two alternatives a and b

$$a \succ_j b \quad ?$$

Questions to the committee

Queries relating the difference between the importance of consecutive ranks r and $r + 1$

$$w_r - w_{r+1} \geq \lambda(w_{r+1} - w_{r+2}) \quad ?$$

Our Knowledge

The answers to these questions define C_P and C_W that is our knowledge about P and W

- $C_P \subseteq \mathcal{P}$ constraints on the profile given by the voters
- $C_W \subseteq \mathcal{W}$ constraints on the voting rule given by the committee

Minimax Regret

Given C_P and C_W :

$$\text{PMR}^{C_P, C_W}(a, b) = \max_{P \in C_P, W \in C_W} s^{P, W}(b) - s^{P, W}(a)$$

is the maximum difference of score between a and b under all possible realizations of the full profile *and* weights

We care about the worst case loss: *maximal regret* between a chosen alternative a and best real alternative b .

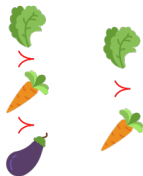
We select the alternative which minimizes the maximal regret

Pairwise Max Regret Computation

The computation of $\text{PMR}^{C_P, C_W}(\text{broccoli}, \text{eggplant})$ can be seen as a game in which an adversary both:

- chooses a complete profile $\mathbf{P} \in \mathcal{P}$

Mickey Donald Goofy



Mickey Donald Goofy



- chooses a feasible weight vector $\mathbf{W} \in \mathcal{W}$

$$(1, ?, 0) \longrightarrow (1, 0, 0)$$

in order to maximize the difference of scores

Elicitation strategies

- **Random:** equiprobably draws a question among the set of the possible ones;
- **Extreme completions:** choses the question that reduces the most the uncertainty;
- **Pessimistic:** selects the question that leads to minimal regret in the worst case;
- **Two phase:** it asks a predefined sequence of questions to the committee and then it only asks questions about the voters.

Thank You!



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