Collective Decision Making with Incomplete Individual Opinions

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In many scenarios of collective decision making agents (human or artificial) may have and report incomplete opinions. They may:

- not be able to compare some of the alternatives;
- not want to think about some of the alternatives;
- not have the resources to judge some of the alternatives.

How to model such incomplete opinions, what are good aggregation rules to use, and what changes in classical results?

Outline

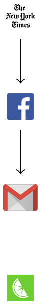
Aggregating Incomplete Preferences
- Weight Rules and Axioms
- Scoring Rules and Strategic Manipulation

Aggregating Incomplete Judgments
- Quota Rules
- Optimal Rules for Truth-tracking

Conclusions

Incomplete preferences

You prefer the NYT app to Facebook, and Facebook to Gmail, but you cannot compare NYT and Gmail.



or

*Based on joint work with Ulle Endriss (accepted in IJCAI-2019).

Weights

The idea

Agents are weighted by the number of pairs they compare.

- Less pairs may mean more focus.
- More pairs may mean more experience.

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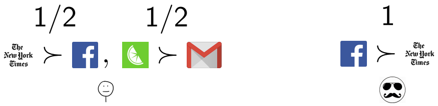
A weight rule maximises the total weight across all agents. E.g.,



: Facebook wins!

We like majorities

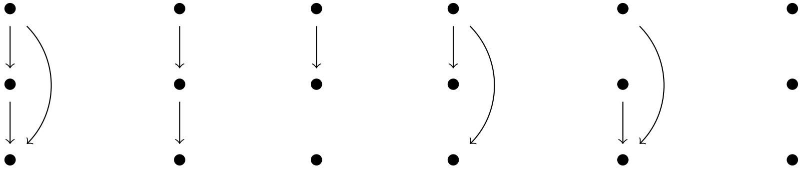
- Absolute majority:
  More than half of the agents have $\succ$.
- Simple majority:
  More agents have $\succ$ than $\succ$.

Theorem

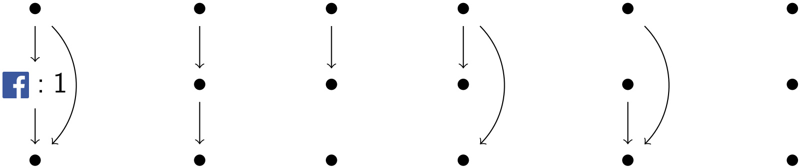
The only weight rule that respects the majority whenever possible is the constant-weight rule.

*Based on work in progress with Justin Kruger.

Shapes of acyclic preferences

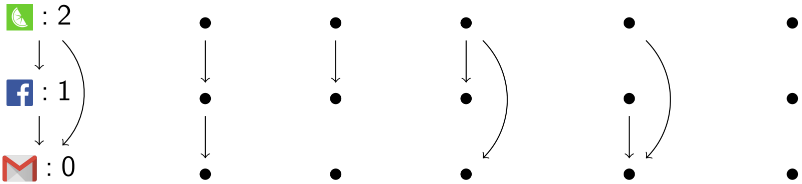


Scoring function



A scoring function $s\colon (\succ, f) \mapsto \mathbb{R}$.

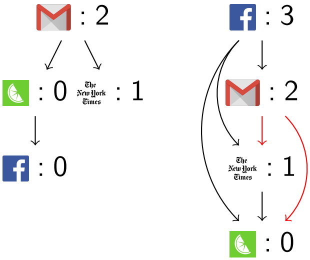
Scoring function



We know that we cannot avoid manipulation for complete preferences... what about incomplete ones?

Manipulation by omission

For two agents:



gets total score 4, gets 3, but the right agent has $\succ$.
She can manipulate by omitting preferences.

Some good and some bad news

Theorem

- *Strategyproofness by omission is possible.*
- *Strategyproofness by addition is possible.*
- *Strategyproofness both by omission and by addition is impossible (besides the constant rule).*

Outline

Incomplete judgments

You only have a day to review a colleague's work. Will you read one of her papers, or two?

	Yes	—
	No	Yes
	No	Yes

*Based on work in progress with Franz Dietrich.

Quota

	
5 ×	–
4 ×	No
2 ×	Yes

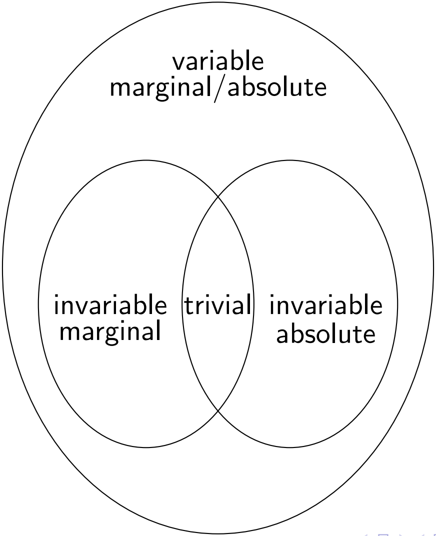
- Quota on the absolute number of “yes” or “no”.
- Quota on the marginal difference between “yes” and “no”.
- Quota that vary in the number of reported judgments.

Quota

7	×	–
3	×	No
1	×	Yes

- Quota on the absolute number of “yes” or “no”.
- Quota on the marginal difference between “yes” and “no”.
- Quota that vary in the number of reported judgments.

Families of Quota rules



*Based on joint work with Ulle Endriss (submitted).

Optimal aggregation rule

		
	Yes	–
	No	Yes
	No	Yes

Suppose professors are accurate with probability p when reviewing both papers, and with probability q when reviewing only one paper.

The optimal aggregation rule a weighted majority with $w_i = \log \frac{p}{1-p}$ if $|J_i| = 2$ and $w_i = \log \frac{q}{1-q}$ if $|J_i| = 1$.

This is reminiscent of the weight rules we saw before!

Optimising the assignment of questions

Suppose we need to judge two independent propositions φ_1, φ_2. Should we ask more questions (with smaller accuracy), or less questions (with higher accuracy)?

The answer here depends on the specific accuracies, and on the number of agents available. E.g., for four agents:

$\varphi 1$ | $\varphi 2$ | $\varphi 1, \varphi 2$ | $\varphi 1, \varphi 2$

if $q < \frac{p^2}{(1-p)^2+p^2}$

(good enough at multitasking)

$\varphi 1$ | $\varphi 1$ | $\varphi 2$ | $\varphi 2$

if $q \geqslant \frac{p^2}{(1-p)^2+p^2}$

(not so good at multitasking)

Outline

Conclusions

Considerations about the incompleteness of preferences and of judgments bring out many interesting research questions.

- In what contexts does incompleteness arise, and what kinds of incompleteness make sense then?
- How to appropriately generalise existing rules and axioms?
- What happens to classical results of social choice (e.g., about axiomatisations, manipulability, truth-tracking, etc.)?