Handling Inconsistent Preferences using Possibilities and Information Fusion*

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Our research focuses on handling uncertainty and inconsistency in the observed preferences of a single user in multiple-criteria decision-making (MCDA). Classically, uncertainty and inconsistency in single-user preferences is either treated through set-based approaches, relying for instance on guarantees from min-max regret bounds (*e.g.* [3]), or treated using some form of average error (*e.g.* [2]). Nevertheless, set-based approaches rely on the strong assumptions that both the user and the model choice are always right, and the other approaches (including probabilistic ones) cannot provide the same level of strong guarantees as set-based approaches, justifying new approaches.

We already proposed another approach using possibility theory to model and reason with uncertain preferential information [1]. Instead of having binary information on the preferences of a user, information is represented through a possibility distribution, capturing the uncertainty of said user. This approach extends set-based approaches, with a natural way to encode and measure inconsistency resulting from inconsistent assessments [4], and various tools inspired from logic for dealing with inconsistency, such as conjunction and disjunction, rather than expectation-based operators.

While we can detect inconsistency, we did not consider how to handle inconsistency. In this talk, we propose to focus on our current research on handling inconsistency, either coming from the user (wrong answers), or from a wrong preference model assumption. We will some experimental results, while also pointing some limitations. Distinguishing the two types of uncertainty is a difficult, yet important, problem we will discuss briefly.

Method	$f(x^*) - f(x)$
Set-based approach	0.125
Possibility approach	0.0373
Naive correction	0.233
Fusion 1 (ℓ-out-of-k)	0.130
Fusion 2 (heuristics MCS)	0.0459
Fusion 2 (best MCS)	0.00695

Table 1: Difference of score between the user preferred alternative x^* and the recommended alternative x. The higher the difference, the worse x is.

- In presence of (reasonable) uncertainty from the user, we can see on Table 1 that our possibility approach can handle uncertainty. In addition, fusion methods provided by the possibility theory framework, unlike a naive correction, can potentially improve the quality of the recommendation, in addition to providing information on the answers (determining the wrong answers).

- We suppose the preferences of a user are modelled with a complex model, taking into account complex interactions between criteria (*e.g.* a Choquet integral). When erroneously using simpler model (supposing little to no interactions between criteria) to recommended alternative, our possibility approach detects inconsistency $8\% - 30\% - 40\%$ of the time after $5 - 10 - 15$ answers, corresponding to cases where the user actually consider complex interactions (the remaining cases, the user does not, hence no detection).

References

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