Information levels in additive group decision models under incomplete information: Bridging the cardinal-ordinal gap

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In the literature, several models for group decision making based on the additive aggregation of group members' utility or value functions have been proposed (Keeney and Kirkwood 1975; Dyer and Sarin 1979; Keeney and Nau 2011). These group aggregation rules usually are based on systems of axioms very similar to those formulated by Arrow (1963) for the case of aggregating ordinal preferences. In contrast to aggregation of ordinal preferences, aggregation of cardinal alues is thus possible in groups. However, it requires group members to specify their preferences in cardinal form, by assigning utility scores to alternatives. This could be difficult for group members, in particular if this information should be provided exactly.

Methods for decision making under incomplete information, which have already been suggested in the context of negotiation problems (Sarabando, Dias et al. 2012), could be employed to simplify this task for group members. They would actually allow information to be specified also only in ordinal form (i.e. as a ranking of alternatives), although this information could then be used to approximate a cardinal utility function. This concept can be applied at various levels along the spectrum between purely cardinal and purely ordinal information, for example, group members could also specify preference information not only as a ranking of alternatives, but also as a ranking of differences of alternatives, which would be one step closer to cardinal information. While it is obvious that providing information closer to exact cardinal utility values will increase the precision of preference statements at the group level, the strength of this effect is not clear.

Uncertainty about parameters of preference functions does not only concern the individual member's preference function. At the group aggregation level, weights of group members can also be considered as uncertain parameters. In a recent paper, Dias and Sarabando (2012) extended Arrow's non-dictatorship condition to the aggregation of cardinal preferences and showed that it can be represented as a constraint on weights of group member in an additive group utility function

In this paper, we report on a comprehensive computational study, in which we attempted to quantify the effect of providing different levels of preference information (exact cardinal values, rankings of differences between alternatives and rankings of alternatives), and of the imposition of different constraints on members' weights in an additive group utility function (equal weights, general random weights and random weights satisfying the Non-dictatorship condition) on outcomes at the group level. Relevant outcome dimensions analyzed refer to the structure of the group preference relation, building on concepts like necessary and possible relations as established in decision making under incomplete information (Dias and Clímaco 2002; Greco, Mousseau et al. 2008); as well as robustness of results, and the strength of impact of individual group members.

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