An overview of bipolar qualitative decision rules

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Abstract Making a good decision is often a matter of listing and comparing positive and negative arguments, as studies in cognitive psychology have shown. In such cases, the evaluation scale should be considered bipolar, that is, negative and positive values are explicitly distinguished. Generally, positive and negative features are evaluated separately, as done in Cumulative Prospect Theory. However, contrary to the latter framework that presupposes genuine numerical assessments, decisions are often made on the basis of an ordinal ranking of the pros and the cons, and focusing on the most salient features, i.e., the decision process is qualitative. In this paper, we report on a project aiming at characterizing several decision rules, based on possibilistic order of magnitude reasoning, and tailored for the joint handling of positive and negative affects, and at testing their empirical validity. The simplest rules can be viewed as extensions of the maximin and maximax criteria to the bipolar case and, like them, suffer from a lack of discrimination power. More decisive rules that refine them are also proposed. They account for both the principle of Pareto-efficiency and the notion of order of magnitude reasoning. The most decisive one uses a lexicographic ranking of the pros and cons. It comes down to a special case of Cumulative Prospect Theory, and subsumes the “Take the best” heuristic.

1 Introduction

It is known from many experiments in cognitive psychology that humans often evaluate alternatives or objects for the purpose of decision-making by considering positive and negative aspects separately. Psychologists have shown (Osgood et al., 1957; Cacioppo and Berntson, 1994; Slovic et al., 2002) that the simultaneous presence of positive and negative arguments prevents decisions from being simple to make, except when all the arguments have different order of magnitude. Under this bipolar view, comparing two
decisions comes down to comparing pairs of sets of arguments or features, namely, the set of pros and cons pertaining to one decision versus the set of pros and cons pertaining to the other. Such kind of information involving negative and positive features is called bipolar. Dubois and Prade (2006) provide a general discussion on the bipolar representation of information. Classical utility theory does not exploit bipolarity. Utility functions are defined up to an increasing affine transformation (they rely on an interval scale), and the separation between positive and negative evaluations has no special meaning.

Cumulative Prospect Theory (CPT, for short) proposed by Tversky and Kahneman (1992) is an attempt to explicitly account for positive and negative evaluations in the numerical setting. It computes the so-called net predisposition for a decision, viewed as the difference between two numbers, the first one measuring the importance of the group of positive features, the second one the importance of the group of negative features. Such group importance evaluations are modelled by non-additive set functions called capacities. More general numerical models, namely bi-capacities (Grabisch and Labreuche, 2002) and bipolar capacities (Greco et al., 2002) encompass situations where positive and negative criteria are not independent from each other.

However, Gigerenzer et al. (1999) have argued that human decisions are often made on the basis of an ordinal ranking of the strength of criteria rather than on numerical evaluations, hence the qualitative nature of the decision process. People choose according to the most salient arguments in favor of a decision or against the others. They seldom resort to explicit numerical computations of figures of merit. This idea is also exploited in Artificial Intelligence in qualitative decision theory (Doyle and Thomason, 1999). Qualitative criteria like Wald’s rule (Wald, 1950) and variants or extensions thereof have been axiomatized along the line of decision theory; see (Dubois and Fargier, 2003) for a survey. So-called conditional preference networks (CP-nets) have been introduced by Boutilier et al. (2004) for an easier representation of preference relations on multidimensional sets of alternatives, using local preference statements interpreted ceteris paribus.

The above qualitative models use preference relations that express statements like “decision a is better than decision b for an agent.” However, people also have some idea of what is good and what is bad for them, a notion that simple preference relations cannot express. Using these poorly expressive models, the best available choice may fail to be really suitable for the decision-maker. In other circumstances, even the worst ranked option remains somewhat acceptable. To discriminate between these two situations, one absolute landmark or reference point expressing neutrality or indiffer-