Decision Making Paradox

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People are fascinated by paradoxes as usually they express true statements or facts which, however, defy common intuition. This particular paradox relates to decision making and it was first identified by Triantaphyllou and Mann in 1989. It was further elaborated in the book by Triantaphyllou on multi-criteria decision making. Since then it has been recognized in the related literature as a fundamental paradox in multi-criteria decision analysis (MCDA) / multi-criteria decision making (MCDM), and decision analysis, in general. This paradox is related to the quest for determining reliable decision making methods.

Description of this paradox

The realization for this paradox comes from the rather straightforward observation that there are numerous decision making methods (both normative and descriptive) each one of which claims to be the "best" one. Furthermore, often times these methods may yield different results when they are fed with exactly the same decision problem and data.

Finding the best decision making method leads to the formulation of a decision problem itself for which the alternatives are the decision making methods themselves. Naturally, one needs to know the best method a-priori in order to select the best method from the available ones.

In the study reported in and an interesting investigation was undertaken. Since in the beginning it was assumed that the best method is not known, the problem of selecting the best method was solved by successively using different methods. The methods used in that study were the weighted sum model (WSM), the weighted product model (WPM), and two variants of the analytic hierarchy process (AHP). It was found that when a method was used, say method X (which is one of the previous four methods), the conclusion was that another method was best (say, method Y). When method Y was used, then another method, say method Z, was suggested as being the best one, and so on.

Two evaluative criteria were used to formulate the previous decision making problem (actually, an MCDM problem). The first criterion was based on the premise that a method which claims to be accurate in multi-dimensional problems (for which different units of measurement are used to describe the alternatives), should also be accurate in single-dimensional problems. For such problems, the weighted sum model (WSM) is the widely accepted approach, thus their results were compared with the ones derived from the WSM. The second evaluative criterion was based on the following situation. Suppose some alternatives are evaluated and one of them is returned as the best alternative (say alternative A). Next, a non-optimal alternative (say alternative B) is replaced by a worse one. Under normal conditions one should expect that the same alternative as before (i.e., alternative A) is the best alternative again. This is also known in the related literature as a ranking reversal. However, this may not happen with some of the methods tested in those experiments. For weights of these two evaluative criteria, all possible combinations were

considered such that their sum was always equal to 1.00.

Methods that have been verified to exhibit this paradox

The following is a partial list of multi-criteria decision making methods which have been confirmed to exhibit this paradox:,

The analytic hierarchy process (AHP) and some of its variants.
The weighted product model (WPM).
The ELECTRE (outranking) method and its variants.
The TOPSIS method.

Looking into the future

Other methods have not been tested yet but it is very likely they may exhibit the same phenomenon. Such methods include the following:

The analytic network process (ANP).
The PROMETHEE (outranking) method.
Multi-attribute utility theory (MAUT).
Dominance-based rough set approach (DRSA)
Aggregated indices randomization method (AIRM)
Nonstructural fuzzy decision support system (NSFDSS)
Grey relational analysis (GRA)
Superiority and inferiority ranking method (SIR method)
Potentially all pairwise rankings of all possible alternatives (PAPRIKA)
Value analysis (VA)

What is the best decision making method has always been a highly contested subject. There is always an ongoing debate on this subject. At the same time, a plethora of competing methods exists. A key role in this quest is played by the study of rank reversals in decision making.

As stated earlier, it is not uncommon such methods to yield different results when they are presented with exactly the same data. Thus, this decision making paradox is likely to persist for many years to come.