# Introduction to decision aid

## Decision aid, operational research and common sense

Decisions have been taken since the beginning of mankind without advanced methods. Common sense seems to have been all that was needed. But when you try to understand how and why most decisions are taken, you notice that common sense does not necessarily lead to the "best" solutions.

The difficulty is to define what the "best" solutions are: the preferences vary from person to person, and everyone may prefer what (s)he thinks is the best choice. In many situations, the best solutions can be calculated, or obtained using algorithms or heuristics. When a problem can be presented in such a way that the solution is the maximum or the minimum possible values that can be possibly obtained, many methods can be used, and they produce similar results. When you need to manage a fleet of trucks in such a way that you minimize the total mileage, some solutions are actually are better than others. These solutions can be proven to be the most effective, and there is little room for personal appreciation. This is basically what 'operational research' covers, by *"scientifically deciding how to best design and operate man-machine systems, usually under conditions requiring the allocation of scarce resources"* (Operations Research Society of America).

The DECIDE library includes several algorithms used in the fields of operational research too, mainly based on graph processing (minimum partial trees, colouring, costs minimizing, etc.). The Files section has also links to files related to some of these algorithms.

These methods are so interesting that they have been extended to cover all kinds of problems, including the ones involving personal preferences. The idea is simple : determine a mathematical function that represents the preferences of a decision maker, and then find its maximum or minimum, taking in account the constraints set by the possible choices.

This is easier said than done, as human preferences cannot be easily reduced to mathematical models. Furthermore, in many cases, there is no unique best solution. When a new airport must be built, there is no such thing as "the best choice" : all choices have pros and cons, and there is no known way of determining a function that correctly models all the preferences. Furthermore, different persons will have a different appreciation depending upon their own vision of the world. In such cases, no solution can be proven to be better than the others, because there simply is no "objective" best solution. Also, the decision maker must often consider more than one aspect, and maximize more than one thing : a balance has to be made between, for example, financial, social and environmental consequences of the choice.

This is what *decision aid* is all about : helping people to make choices between several options (actions), based on several aspects (criteria), taking into account the individual preferences. In practice, this means helping people to find the compromise they prefer, considering their own perception of the world.

*Operational research* and *decision aid* (and the related disciplines) have thus the same objective : finding the best solutions. But the type of problems they help solving is quite different, despite the fact that they have many concepts in common and often use similar mathematical methods.

These disciplines are more and more often taught in universities, sometimes under the generic name of

'scientific management methods'.

The decision aid methods usually have two main objectives : *selection* and *classification* (*ranking*):

- *selection* identifies the best choices between actions, eliminate the worst choices, or group the actions in *classes*
- *ranking* determines a classification of the actions

Very often in the real life though, decision are taken using 'methods' that do not seem very serious when looked at properly : choices are often based on one single criterion (the price or the colour, for example), or even "worst", using some kind of random information (like flipping a coin). DECIDE therefore also includes advanced algorithms for these apparently "weird" methods.

You will need to select the right method depending upon what you need to decide, and the rest of this documentation will guide you trough some of the available methods.

Bear always in mind however that no method can lead to useful results if the data used is inadequate : a serious analysis of the problem and an open discussion with all concerned parties are absolute prerequisites to efficient decision making.

The methods implemented in DECIDE are no panacea. They are very powerful tools that can help you a lot, but only if you use them properly and do not push them beyond their limits.

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