EDITED BY STUART S. NAGEL

APPLICATIONS OF DECISION-AIDING SOFTWARE

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Dedicated to spreading ideas on
the usefulness of decision-aiding software

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Preface

The *essence* of decision-aiding software is that it consists of various forms of microcomputer programming designed to enable users to process a set of (1) goals to be achieved, (2) alternatives available for achieving them, and (3) relations between goals and alternatives in order to choose the best alternative, combination, allocation or predictive decision-rule.

Decision-aiding software should be *distinguished from* at least two other kinds of software that are relevant to making decisions, but do not process goals, alternatives and relations in order to arrive at prescriptive conclusions. One related type of software is information retrieval software. It can be very useful for determining such things as the amount of money spent on a certain expense item in a certain year, the court cases that are relevant to a given subject matter, or any kind of information that might be contained in a statistical almanac, encyclopedia or other compendium of information. Another related type of software is office practice software which can be useful for word processing reports, filing and retrieving in-house information, or doing bookkeeping relevant to financial matters. That kind of software is useful for better organizing the decision-making processes of a government agency, a law firm or any kind of office. Such software, however, does not process goals, alternatives and relations to arrive at prescriptive conclusions.

Decision-aiding software can take a *variety of forms*. The most common might be the following:

1. **Decision-tree software** for making decisions under conditions of risk such as whether to go on strike or accept a management offer. A decision tree is usually pictured as looking like a tree on its side with branches and sub-branches. The branches generally represent alternative possibilities that depend on the occurrence or non-occurrence of probabilistic events.
2. **Linear-programming software** for allocating money, time, people or other scarce resources to activities, places, tasks or other objects to which the resources are to be allocated. In terms of form rather than function, linear programming involves maximizing or minimizing an objective function or algebraic equation

subject to constraints generally in the form of inequalties like greater than or less than.

3. **Statistical software** for predicting how a future event, such as a trial, an election, or a weather occurrence is likely to occur in light of past events or expert opinions. Statistical software generally involves calculating averages or predictive equations in which decisions or other outcomes are related to factual inputs.
4. **Spreadsheet-based software** in which the alternatives tend to be on the rows, the criteria on the columns, relations in the cells, overall scores for each alternative in a column at the far right, and a capability for determining what it would take to bring a second-place or other-place alternative up to first place.
5. **Rule-based software** which contains a set of rules for dealing with a narrow or broad field of decision making. The user gives the computer a set of facts, and the computer applies the rules to the facts in order to determine which alternative decision should be or is likely to be decided. Such software is sometimes referred to as artificial intelligence (AI) or expert systems, but the other forms of decision-aiding software also have characteristics associated with AI and expert systems.
6. **Multi-criteria decision-making (MCDM) software** which emphasizes multiple goals to be achieved, as contrasted to decision trees, linear programming and statistical regression analysis which emphasize a single objective function or a single dependent variable.
7. **Decision-aiding software** that focuses on a specific subject matter, as contrasted to the above software which cuts across all subjects. Subject-specific software could relate to how to decide where to drill an oil well, how to deal with crisis situations in flying a plane, or any other specific decision-making situations.
8. **Software that is useful for generating alternatives, goals or relations**, but that does not process those elements in order to draw a conclusion.

Decision-aiding software enhances various *decision-making skills*. These include:

1. **Choosing among alternatives**, where each alternative is a lump sum choice, meaning that one cannot generally choose parts or multiples of such an alternative. The situation can involve mutually exclusive alternatives, or it can allow for combinations.
2. **Allocating scarce resources** such as money, time or people to such

objects as places or activities. The allocating can be with or without minimum or maximum constraints on how much each object can receive.

3. **Explaining and predicting behavior**, including individual cases or relations, either in the past or the future.
4. **Teaching decision making**, as well as actually making or prescribing decisions.

There are various *obstacles to systematic decision-making* which decision-aiding software helps overcome. Those obstacles include:

1. **Multiple dimensions on multiple goals**. This is sometimes referred to as the "apples and oranges" problem, although the problem appears to become more difficult if the goals are more abstract, like freedom and equality. The measures may simultaneously involve hours, miles, dollars, 1–5 scales, pounds, pollution units and other measures.
2. **Multiple missing information**. In its simplest form, this problem involves knowing the benefits and costs for a number of alternatives with the exception of one benefit or one cost. In its more challenging form, many benefits, costs, probabilities and other inputs are unknown.
3. **Multiple and possibly conflicting constraints**. In its simplest form, there are a number of constraints that need to be met simultaneously, but they do not conflict. In its more challenging form, there may be minimum allocations required for each budget category, but the sum of the minimums adds to more than the maximum budget constraint.
4. **The need for simplicity in drawing and presenting conclusions** in spite of all that multiplicity. This is where spreadsheet-based software can be especially helpful because it can be relatively easy to manipulate and interpret in comparison to decision trees, payoff matrices, systems of simultaneous equations and inequalities, and arrow diagrams.

Other benefits from using decision-aiding software include:

1. Being more **explicit** about goals to be achieved, alternatives available for achieving them and relations between goals and alternatives.