MAUA145: A Pascal program for multi-attribute utility analysis

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Multi-attribute utility analysis is a measurement procedure. It is used most commonly for assessing the utility structure of a decision maker who is contemplating a choice among options that are multi-attribute (i.e., characterized by more than one attribute or property). It is a useful technique for clarifying values and, even more importantly, for choosing systematically among options that are complex in nature. Its use can bring clarity and internal consistency to decisions of bewildering complexity.

The literature on multi-attribute decision analysis includes a variety of different techniques for conducting such an analysis. One of the better known techniques is that advanced by Keeney and Raiffa (Keeney, 1977, 1982; Keeney & Raiffa, 1976). The Keeney-Raiffa method involves a number of steps. First, one assesses utility independence and additive independence among attributes; this provides the basis for correctly specifying a theoretical model. Next, one assesses utility curves from judgments on lotteries and derives the scaling constants for the attributes; this provides a basis for assigning weights to the attributes in the model. Finally, one computes the utilities of all options under consideration; this is the ultimate result, which provides the basis for a decision among the options.

Overview of the program. MAUA145 (Multi-Attribute Utility Analysis, version 1.45) is a computer program that enables a user to conduct a multi-attribute utility analysis via the Keeney-Raiffa method. It guides the user systematically through all the steps in such an analysis and poses questions (in the form of lotteries) to which the user responds via keyboard.

MAUA145 performs the numerous computations intrinsic to such an analysis, thereby saving the user much time and labor. This is especially beneficial with large problems involving many attributes.

MAUA145 can handle problems involving up to 40 attributes and 120 options. Although it enables the user to assess utility independence among attributes, it requires that all attributes included in the final model be utility-independent. A further restriction is the requirement that all terms in the final model be main effects, two-way interactions, or three-way interactions; no higher level interactions (four-way or more) are implemented.

MAUA145 is useful not only for conducting practical analyses of complex problems but also for teaching multi-attribute utility analysis to students. Used in conjunction with formal classroom instruction, it can significantly strengthen students' understanding of the technique. In addition, because it makes large-scale multi-attribute analyses relatively easy to do, students can work on real-life problems of genuine interest.

Input. The user inputs data to MAUA145 via keyboard. The program is structured with a Lotus-type menu, and the user starts an analysis by entering the "DataMatrix" section of the program. The user is prompted for the names of all options and all attributes in the problem. Next, the screen displays a spreadsheet so that the user can enter values for all the attributes of each option. Before exiting from DataMatrix, the user must specify the orientation (direction) of each attribute.

Next, the user enters the "Multi-attribute" section of the program, and the program displays various commands to implement the steps in a Keeney-Raiffa multi-attribute utility analysis: assess utility independence, assess additive independence, specify a formal model, assess utility curves, assess scaling constants, and solve. As the user progresses through these steps, the program displays various lotteries on the screen to which the user can respond.

Output. Primary output is displayed on the screen. At various stages throughout the analysis, the user is shown a summary list of utility independence and additive independence judgments, a summary list of scaling constants, and a set of utility curve displays. Upon completion of the analysis, the screen displays final utility values for all options.

At the user's discretion, three output files can be written to disk: <filename.DAT>, <filename.JUD>, and <filename.OUT>. The .DAT file contains the user's data matrix and the .JUD file contains the user's judgments regarding utility independence, additive independence, utility curves, and scaling constants. These are text files containing data that can be reloaded into MAUA145, thereby enabling the user to reanalyze the problem at a future time without having to reenter this information via keyboard. The .OUT file is a text file that lists the data matrix entries and summarizes all final output—utility independence, additive independence, scaling constants, utility curves, and final utility values. The user can type this file to the screen, route it to a printer, or import it into a word processor.

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Language and computer. MAUA145 was written in Turbo Pascal 4.0 (Borland International, 1987) and uses window and quick-write routines under license from Eagle Performance Software (1988). The program runs on IBM PC, AT, and PS/2 computers (or true compatibles) with 640K under DOS 3.1 or higher.

Program availability. A copy of the program listing is available without charge from H. Andrew Michener (University of Wisconsin-Madison). Working copies of the program on disk—compiled code, documentation file, and help file—may be obtained by sending a blank diskette and reusable mailer, plus \$2 to cover the cost of postage.

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