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Decision Support

Multi-attribute sequential decision problem with optimizing and satisficing attributes

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ABSTRACT

We deal with the multi-attribute decision problem with sequentially presented decision alternatives. Our decision model is based on the assumption that the decision-maker has a major attribute that must be "optimized" and minor attributes that must be "satisficed". In the vendor selection problem, for example, the product price could be the major factor that should be optimized, while the product quality and delivery time could be the minor factors that should satisfy certain aspiration levels. We first derive the optimal selection strategy for the discrete-time case in which one alternative is presented at each time period. The discrete-time model is then extended to the continuous-time case in which alternatives are presented sequentially at random times. A numerical example is used to analyze the effects of the satisficing condition and the uncertainty on the optimal selection strategy.

1. Introduction

In many decision problems, not all decision alternatives are available to the decision-maker (DM) simultaneously. Instead, the DM evaluates only one alternative at a time, and decides whether to make a final choice or continue searching for better alternatives (Korhonen, Moskowitz, Salminen, & Wallenius, 1993). Consider, for example, the problem of hiring an employee or buying a house in the open market. Several decision alternatives (or choices) are presented to the DM randomly and sequentially over time. After evaluating a choice currently available, the DM may either select it and terminate the search process, or reject it and continue the uncertain search process.

In some situations, any choices that have been rejected cannot be recalled at a later stage. Therefore, if the search process is terminated too early, choices superior to the selected choice may not have been presented yet; if the selection is made too late, the superior choices may have been rejected earlier in the search process. In such a case, the DM's goal is to derive the optimal stopping rule that maximizes the probability of selecting the "best choice" (Chun, 1999).

In many complex decision problems, each choice is evaluated in terms of multiple conflicting attributes. We may simply assume that only one of those attributes is a major factor and other attributes are minor ones that can be ignored. Then, the multi-attribute sequential decision problem is simply reduced to a single-attribute decision problem with only one major attribute. In the house *selling* problem, for example, the most important attribute is the offer from a potential buyer (Chun, Plante, & Schneider, 2002). From the seller's point of view, the objective is to find the highest offer in terms of dollar value within a limited time period.

In the house *buying* problem, on the other hand, each house is compared in terms of multiple attributes (or dimensions), such as the asking price, size, age of the house, and so forth. From the buyer's point of view, buying a house is presented as a multi-attribute sequential decision problem. The job search problem is another example of the multi-attribute sequential problem. The job offers are usually compared based on the starting salaries, fringe benefits, locations, future growths, and so forth (Bearden, Murphy, & Rapoport, 2005). In the vendor selection problem in supply chain management, the most popular evaluating criteria are product price, quality, and delivery time. The marriage problem (or the bachelor's dilemma) also involves many conflicting objectives such as the appearance, intelligence, personality, financial security, and so on.

The single attribute sequential decision problem is also known as the secretary problem, marriage problem, job search problem, parking spot problem, or asset-selling problem, with each of them using different assumptions. Since its introduction in the early 1960s, this particular field of study has experienced rapid growth, and its applications extend to a wide variety of managerial decision problems. Readers who are more interested in various types of single-attribute sequential decision problems are referred to many excellent review papers, including Bearden and Rapoport (2005), Ferguson (1989), and Freeman (1983).

For the non-sequential version of multi-attribute decision problems, many decision models, such as analytic hierarchy process

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