Information in Fleeting Opportunities

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ABSTRACT

This paper focuses on the study of information in fleeting opportunities. An application example is the evaluation of business proposals by venture capitalists. The authors formulate the generic problem as a dynamic program where the decision maker can either accept a given deal directly, reject it directly, or seek further information on its potential and then decide whether to accept it or not. Results show well behaved characteristics of the optimal policy, deal flow value, and the value of information over time and capacity. It is presumed that the risk preference of the decision maker follows a linear or an exponential utility function. This approach is illustrated through several examples.

Keywords: Decision Analysis, Multiple Choice Problem, Optimal Policy, Optimal Stopping Problem, Stopping Problem, Value of Control, Value of Information

INTRODUCTION AND LITERATURE REVIEW

In this paper we consider situations in which a decision maker has a flow of fleeting deals coming over time. Each deal represents an investment opportunity that must be accepted or rejected before considering other deals. While evaluating a deal, the decision maker might choose to seek information about the specific deal. The decision maker has a budget constraint and the budget requirements of the deals are approximately equal. This setup is an abstraction for many decision processes including those used by venture capital firms evaluating business proposals and movie producers evaluating script proposals. The main challenge in these situations is evaluating the alternatives for the current deal at hand given what lies in the future. The main activity they engage in is gathering information about the deal at hand or trying to influence its outcomes. This work models these activities as information gathering and control, in the decision analytic sense, and evaluates them within the context of the deal flow.

In this section we overview the literature. The rest of the paper is organized as follows. In section 2 we describe the model and notation. Then in section 3 we present our main results. We extend these to the long-run problems in Section 4. The final section concludes the paper with suggestions for future research.

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A review of decision analysis can be found in Howard (1966, 1968, 1988, 2007). Related work in the literature includes Papastavron et al. (1996) and Kleywegt and Papastavron (1998). These papers study the dynamic stochastic knapsack problem (DSKP) and show that the problem has an optimal policy defined as a threshold. They also study the changes in the optimal policy as the deal flow progresses over time. They exclude the possibility of seeking information and hence require that the decision maker either accept or reject an incoming deal. Furthermore, they do not allow the decision maker to be risk averse.

A more basic structure for this setup is the secretary problem. In the original secretary problem, a series of secretaries is interviewed until one offer is made. The objective is to allocate a single resource (job) to a single request (secretary applicant) with the aim of obtaining one of the best applicants; that is, minimizing the rank of the request granted. Gilbert and Mosteller (1966) first extended the secretary problem to allow for multiple choices. Two kinds of objectives were studied, the first dealing with minimizing the ranks of the requests granted and the other with maximizing rewards. Some of the main problems considered in reward maximization include the asset selling problems and the sequential stochastic assignment problems (SSAP). Kleinberg (2005) considers the DSKP as a generalization of this strand.

In the asset selling problem, also called the ‘full information’ secretary problem, the decision maker holds assets for which offers (deals) come over time. In MacQueen and Miller (1960), the decision maker has a holding cost and the offers are random. In the SSAP, the problem is concerned with assigning people to requests arriving over time. Each person has a known value and each job has a random value, which becomes known upon arrival. One assigning a specific job to a specific person, the decision maker gets the multiplication of their values. Refer to Derman et al. (1972) for a discussion of the SSAP.

The value of information has been studied in a variety of forms in the literature. We are concerned with buying information to improve deal selection: thus we are concerned about the economic value of buying information, the indifference buying price of information (IBP). For a review of this concept, please refer to Howard (1967). The results in this paper can be directly extended to the value of control. We refer the reader to Matheson and Matheson (2005) for more details on this concept.

Results on the value of information given specific decision situations have been characterized in the literature. One such result is that the value of free, but possibly imperfect, information is always nonnegative and is bounded by the value of perfect information. Another one is that the value of information is positive if and only if it changes the optimal decision; if the information does not compel a change in the optimal decisions its value is zero.

Gould (1974) showed the lack of monotonic relationship between the value of information and risk aversion coefficient. Hilton (1981) surveys the properties of the value of information. Hilton further proved the lack of monotonic relationship between the value of information and decision flexibility. In a different domain, Barron and Cover (1988) studied the value of information in repeated gambles with logarithmic utility. They define the value of information in growth ratios and propose bounds.

More recently, Delquié (2008) gives a brief overview of the research on the value of information and attempts to characterize the value of information through the intensity of preference, i.e., the difference in utility across alternatives. Additionally, Bickel (2008) defines and characterizes the relative value of information (RVOI) as the value of imperfect information as it relates to that of perfect information. Using normal priors, exponential utility, and two alternatives, Bickel shows that RVOI is maximal when the decision maker is indifferent between the two alternatives.
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