

## Theory and Methodology

# Rank-based selection strategies for the random walk process

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### Abstract

In many decision situations such as hiring a secretary, selling an asset, or seeking a job, the value of each offer, applicant, or choice is assumed to be an independent, identically distributed random variable. In this paper, we consider a special case where the observations are *auto-correlated* as in the random walk model for stock prices. For a given random walk process of  $n$  observations, we explicitly compute the probability that the  $j$ -th observation in the sequence is the maximum or minimum among all  $n$  observations. Based on the probability distribution of the rank, we derive several distribution-free selection strategies under which the decision maker's expected utility of selecting the best choice is maximized. We show that, unlike in the classical secretary problem, evaluating more choices in the random walk process does not increase the likelihood of successfully selecting the best.

*Keywords:* Decision theory; Dynamic programming; Applied probability

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### 1. Introduction

In many decision situations such as hiring a secretary, selling a house, or seeking a job, it can be construed that a decision maker (DM) receives a random sequence of offers. Following an evaluation of each offer, the DM must decide whether to accept the offer under consideration or reject it and continue the search process. If the decision is irrevocable, the question is when to take the positive decision of accepting an offer. If made too early in the search process, the DM is risking the possibility of later obtaining better offers in the remaining field; if made too late, the field remaining and available may be small.

Such a sequential decision problem under certain assumptions has been called, among other names, the secretary problem, marriage problem, dowry problem, or candidate problem (Ferguson, 1989; Freeman, 1983). In the classical *secretary problem*, an executive is faced with the problem of hiring a secretary from a known number of applicants. The executive can interview the applicants one at a time. After each interview, an irrevocable decision must be made whether to hire or reject the applicant under consideration.

Another sequential selection problem closely related to the secretary problem is that of selling (or buying) an asset (Karlin, 1962; Rosenfield et al., 1983). In the *asset-selling problem*, the price presented at each offer is assumed to be a random variable from a probability distribution, which is assumed to be known a priori in the full information

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