

# OPTIMAL TRADING OF AN ASSET IN THE OPEN MARKET: A DYNAMIC PROGRAMMING APPROACH<sup>1</sup>

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## ABSTRACT

Assuming that the asking price of an asset is a random observation from a known distribution function, we first consider the problem of buying an asset and selling it later within a limited period of time. The optimal strategies, derived by means of a stochastic dynamic programming technique, maximize the present value of the expected profit. We then consider the infinite-stage model where there is no time constraint. As a special case of the optimal selling strategy with finite stages, we also propose an option valuation model for the case where the buyer has the right to purchase a certain asset at a specified exercise price within a specified time. The optimal buying and selling strategies derived in the paper can be extended to various directions such as the serially correlated process and the rank-based trading strategy.

**Keywords:** Probability models, Decision analysis, Dynamic programming.

## RÉSUMÉ

Supposant que le prix demandé d'un capital est une observation aléatoire d'une fonction de distribution connue, nous considérons d'abord le problème d'acheter un capital et de le vendre plus tard au cours d'une période limitée. Les stratégies optimales, dérivées au moyen d'une technique de programmation dynamique stochastique, maximisent la valeur actuelle du profit prévu. Nous considérons alors le modèle d'étapes infinies où il n'y a aucune contrainte de temps. Comme cas spécial de la stratégie de vente optimale avec les étapes finies, nous proposons également un modèle d'évaluation d'option pour le cas où l'acheteur a le droit d'acheter un capital particulier à un prix d'exercice indiqué dans un temps indiqué. Les stratégies achetantes et de ventes optimales dérivées dans le papier peuvent être étendues à de diverses directions telles que le processus séquentiel corrélé et la stratégie marchande basé sur des rangs.

**Mots-clés:** Modèles de probabilité, analyse de décision, programmation dynamique.

## 1. INTRODUCTION

Suppose that an agent is considering buying an asset and selling it back later to make a short-term profit. The asking price or offer  $X_i$  of the asset at time  $i$  is assumed to be a random observation from a known distribution. After each offer is received, the agent must decide whether or not to buy an asset or, if purchased earlier, to sell it at the price. If the agent purchases an asset at the price  $x_j$  and sell it at  $x_k$ ,  $j < k$ , the agent's discounted net profit is given by  $r^k x_k - r^j x_j$ , where the discount factor is  $r$ ,  $0 < r \leq 1$ . For such a decision situation, we propose in the paper the optimal buying and selling strategy that maximizes the expected discounted profit.

Although there is a long and rich history of research devoted to developing optimal buying (or selling) strategy, there is no known effort to date which has considered the problem where the agent is permitted to buy an asset *and* sell it later. We shall show that the optimal buying and selling strategy can be stated with a sequence of critical

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