OPTIMAL TRADING OF AN ASSET
IN THE OPEN MARKET:
A DYNAMIC PROGRAMMING APPROACH

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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.

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 function. 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