

A numerical method for portfolio selection based on Markov chain approximation

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Abstract

In this paper, A portfolio selection problem is approximated by a Markov chain which is modulated by a continuous-time, finite-state, Markov chain. The main ingredient of the Markov chain approximation is to approximate the wealth process and utility function of original utility optimization problem by a controlled Markov chain. under the convergence of the approximation scheme, Policy iteration methods as to obtain the optimal controls. A numerical example is provided to illustrate the reability of the algorithm.

Keywords and phrases: Numerical method, Portfolio selection, Stochastic optimal control, Markov chain approximation.

1. INTRODUCTION

Portfolio selection is one of important problems in mathematical finance, which was first explored by Harry Markowitz. Portfolio selection prblem which attempts to maximize portfolio expected return for a given amount of portfolio risk, or equivalently minimize risk for a given level of expected return, by carefully choosing the proportions of various assets. Although is widely used in practice in the financial industry and several of its creators won a Nobel memorial prize for the this theory in recent years the portfolio selection have been widely challenged by fields such as behavioral economics.

In our model, We consider a continuous-time financial model consisting of two primitive assets, namely, a money market account and a stock. In the real market, investors cannot put too much money in risky assets for the sake of risk management. For example, there is a golden rule: "never borrow money to do risky investment". That is, there is a natural constraint on the portfolio so that the total weight of the risky assets should be no more than 1.

Although, In generally Some of portfolio selection problems can only be described by the associated HJB equations, which are difficult to solve. the associated HJB equation is very difficult to solve explicitly, and generally the solution cannot be deduced in an explicit form. In this paper, rather than focusing on analytic solutions, we present an attempt to solve the problem numerically.

We consider a continuous-time financial model consisting of two primitive assets, namely, money market account and stock. we use the expected utility as the objective of the portfolio