

Assignment 3 Homeword

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1 Introduction

This assignment is based on the Brownian motion theory and constructs a geometric Brownian motion (GBM) model to describe the dynamic evolution of financial asset prices. The research is carried out through three levels: theoretical analysis, MATLAB numerical simulation and financial application. Firstly, the theoretical basis of GBM and its relationship with standard Brownian motion are strictly derived. Secondly, design simulation experiments for the system, generate multiple price tracks and conduct in-depth analysis of the influence of parameters; Finally, the practical application value of the model is demonstrated through the calculation of value at risk. The research finds that GBM can effectively describe the lognormal distribution characteristics of asset prices. The drift rate and volatility parameters respectively determine the long-term trend and fluctuation amplitude. The simulation results are highly consistent with the theoretical prediction. This assignment not only verified the effectiveness of stochastic process theory in financial modeling, but also demonstrated the significant role of computer simulation in quantitative analysis.

2 Research question background and theoretical basis

2.1 Brownian motion and financial modeling

According to the course handouts, Brownian motion (Wiener process) is one of the core models of continuous-time stochastic processes and has the following key properties: