FN6808 Derivative Securities

Course Project

Answer all questions below. You may use any data source and any software for programming, and be sure to specify them in your submission. Attach the codes when submitting the project.

Question 1: Modeling volatility

Find data for historical prices for any publicly traded equity. To ensure the length of data, use daily data for at least 3 years. Fit the historical data to

1. Geometric Brownian motion
2. Any non-constant volatility model

Find market data for option prices for this stock. Use option prices to

3. Show volatility smile
4. Construct term structure of volatility
5. Plot the volatility surface, as a function of time to maturity and moneyness.

Question 2: Vanilla European option pricing

Use the **non-constant volatility model** obtained in Question 1(2). Calculate the price of a European call option (whose today's price can be observed in market) using

1. Monte Carlo

Use the **Geometric Brownian motion** obtained in Question 1(1). Calculate the price of the same European call option using

2. Numerical PDE
3. Binomial Model
4. Black-Scholes formula

For each part of 1 to 3, show how accuracy can be improved by increasing computational time. Lastly,

5. Compare the four calculated prices with the "true price" observed in market. Comment on these methods based on their efficiency and accuracy. Explain any source of error and make suggestions on possible ways to reduce the error.

Question 3: Variance reduction in Monte Carlo

Use the **Geometric Brownian motion** obtained in Question 1(1). Calculate the price of any path-dependent option using

1. Crude Monte Carlo
2. Monte Carlo with **two different (one for each time)** variance reduction techniques, and show how much efficiency is gained.

Deadline of submission: 23:59, 1 Nov, 2023

Submit via email. No hardcopy required.

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