Homework 1

Simulate Stock Price

Consider a stock that pays no dividends, has a volatility of 30% per annum, and provides an expected return of 15% per annum with continuous compounding. The process for the stock price is

$$\frac{dS}{S} = 0.15dt + 0.30dz$$

If S is the stock price at a particular time and ΔS is the increase in the stock price in the next small interval of time,

$$\frac{\Delta S}{S} = 0.15\Delta t + 0.30\varepsilon\sqrt{\Delta t} \quad \text{or} \quad \Delta S = 0.15S\Delta t + 0.30S\varepsilon\sqrt{\Delta t}$$

where ε has a standard normal distribution.

Initial stock price is $100.

(a) (40%) Consider a time interval of 1 week ($\Delta t = 1/52$), please simulate 10 sample paths of stock prices for 1 year and plot them in a time chart.

(b) (25%) Consider a time interval of 1 month ($\Delta t = 1/12$), please simulate 10 sample paths of stock prices for 1 year and plot them in a time chart. Next, consider time interval of 1 trading day ($\Delta t = 1/252$), again simulate 10 sample paths of stock prices for 1 year and plot them in a time chart. Explain your findings.

(c) (25%) Please plot a histogram of the terminal value of stock prices. Please set the number of bins to 100, and change the number of sample paths from 1000 to 10,000 and 100,000. Explain your findings.

Matlab function and syntax:

1. randn(): to generate normally distributed random numbers
2. sqrt(): square root
3. zeros(): to create a matrix of all zeros. e.g. S = zeros(m,n)
4. plot (): to produce a linear 2-D plot

    e.g.

        Time=0:dt:T;
        plot(Time, S);

5. for loop

    e.g.

        for j=1:10

            statement

        end

6. Histogram

e.g. Suppose you would like to plot a histogram of terminal stock prices and set the number of bins to 100. Just store the terminal stock price in a vector "S" and use hist() function.

Nbins=100;

hist(S, Nbins);

*You have to submit your homework and **programs by e3**. Your computer program is part of this assignment.