American University
The Department of Computer Science
Spring 2021

Introduction to Simulation and Modeling, CSC 432/632

Assignment 3
Chapter 8
(Total of 10 points)

Instruction:
For this assignment submit a single file, either MS WORD or PDF in addition to your Python codes with descriptions. The Python codes need to have comments. The assignments must be done **individually**.
Format Requirements for all assignments:

- No page limits
- Single spaced, 12-point or larger font size; 1-inch margins
- Use headers and/or bullets to organize and convey key elements, and page numbers
- Only Latin alphabet characters are allowed (i.e., do not include any words or phrases that contain non-English characters)
- File type: Adobe PDF (recommended) or Word document

1- (2 points) Definitions: Use our textbook, online sources, other books, handouts, and library materials (available virtually at American University Library Website) to answer the following questions.
   a) What is "security" in the financial domain?
   b) Define "drift" and explain about this concept in financial engineering.
   c) What is Brownian Motion
   d) Explain about the use of Lognormal in financial engineering and asset prices. How does the transformation of "return" from actual prices to logarithmic value of return helps the prediction of stock prices?

2- (1 points) Generate a simple Brownian motion in the Python environment. To this end, use n=500 time period and generate random variable to create a Brownian Motion Graph. Explain the relationship between the graph you provided and price fluctuations in stock market.

3- (2 points) Re-do the Amazon stock price trend for Google that can be found in the following link. Explain the details of your analysis. (https://finance.yahoo.com/quote/GOOG/history/).
   a) Select a 5-year time period of your choice and depict the Google shares graph similar to what the book provided in Figure 8.3.
   b) For the same time provide the Logarithmic Value of the returns similar to Figure 8.4. Provide the details of your analysis and include adequate comments in your Python code.

4- (1 points) Explain about applying Monte Carlo Simulation to estimate stock price provided in Page 216 of the book. As the procedure is already explained, you only need to provide steps using which the estimation can be performed.
5- (2 points) Use the data in Problem 3 above to evaluate the first (drift) and second (daily change) components of the Black-Scholes formula. Prepare the Google trend graph similar to Figure 8.5.
6- (2 points) Estimating the VaR for some S&P 500 assets by doing the following steps:
    a) S&P 500 is an important stock market index. Using online sources (with reference) provide a two-paragraph description of the index including the history and major assets.
    b) Using the following stock list, retrieve the data from Yahoo! Finance and provide the statistics of the Portfolio similar to Figure 8.7.

$$\text{StockList} = \{\text{ACN, ADBE, ALL, AAPL, BAC, PG}\}$$

    c) Assess the investment risk of a substantial portfolio of stocks of these companies. Provide detailed explanations.