Assignment 1
Economics 872 - Risk Management
Due: Wednesday May 21, 12:00 noon
Assignment Worth: 5%

In this assignment we will investigate VAR by running monte carlo experiments with some simple portfolios. This assignment is to be done entirely without loops. As well, please document all code (i.e. use comments liberally). You need to hand in the output of your code on paper under my door (MC A421) before the due date and time. As well, you need to email me your code before the deadline (thompsonj@econ.queensu.ca). Your code must run the results you handed in on paper (just hand in one of the parameterizations for each of the two questions).

Question 1:

Jim has a very simple portfolio made up of 100 shares of only one stock. This stock is known to follow a geometric brownian motion:

$$dS = \mu S dt + \sigma S dZ$$

Where Z is a standard brownian motion. Run a monte carlo experiment by generating many sample paths for the stock over 1 time period ($\Delta t = 1$). Use $\mu = 0.4\%$, $\sigma = 1.2\%$ and let the initial stock price be $S_0 = \$10.00$. Use at least $100,000$ sample paths. Calculate and report a relative and absolute VAR with confidence level 99%. Repeat this simulation at the 99.99% confidence level as well as the 95% level. Briefly discuss these results.

Question 2:

Frank, who is a bit more savvy than Jim when it comes to portfolio diversification holds two stocks in his portfolio. Stock 1 is the same stock that Jim holds from question 1. Stock 2 follows the a geometric brownian motion with the following characteristics: $S_0 = \$22$, $\mu = 0.6\%$, $\sigma = 4\%$. Finally, stock 1 and stock 2 have a correlation coefficient $\rho = 0.3$. Frank owns 75 shares of stock 1 and 200 shares of stock 2. Using at least $100,000$ sample paths, perform a monte carlo experiment and calculate (and report) a relative and VAR at the 99% level (use $\Delta t = 1$).

Now let $\rho = -0.3$. Run the monte carlo and calculate (and report) a VAR at the 99% level. Explain how and why your results differ from the case where $\rho = 0.3$.

Now let us say that Frank owns 1000 shares of stock 2 instead of 200, and let $\rho = 0.2$ again. Calculate and report the VAR with your monte carlo code and compare and explain the result with the case where Frank owned only 200 shares.

Hints

- Both course textbooks can help you figure out the theory behind how to run the monte carlo experiments.
- To correlate two IID normal variables, look at the cholesky decomposition.