MMF 2021F ASSIGNMENT #2 Due: 15 October 2019.

This assignment is due at the **start** of the lecture on Tuesday, 15 October 2019.

This assignment asks you to write a MatLab program. Hand-in the program and its output as well as any written answers requested in the assignment. Your program and its output, as well as your written answers, will be marked. Your program should be "well-commented", use good programming style, etc. When first learning to program in MatLab, students often produce long, messy output. Try to format the output from your program so that it is easy for your TA to read and to understand your results. To this end, you might find it helpful to read "A short description of fprintf" on the course webpage. Marks will be awarded for well-formatted, easy-to-read output.

If you have questions about this, ask your TA during the tutorial on October 3 or 10, or ask me in class.

Write a MatLab program that uses Monte Carlo simulation to estimate the price at time $t = 0$ of a European Call Option on a stock with price S_t at time $t \in [0, T]$, where

- the initial stock price is $S_0 = \$100.00$,
- the strike price is $K = \$100.00$ (i.e., the option is *at the money*),
- the time to maturity is $T = 0.25$ (years),
- the risk-free interest rate is $r = 0.02$ (i.e., 2%), and
- the volatility is $\sigma = 0.2$ (i.e., 20%).

Recall that the price of a European Call Option is

$$V = \mathrm{e}^{-rT}\,\mathbb{E}[\max(S_T - K, 0)]$$

where $\mathbb{E}$ is the expectation operator in the *risk-neutral-world*,

$$S_T = S_0\,\mathrm{e}^{\left(r - \frac{\sigma^2}{2}\right)T + \sigma\sqrt{T}Z}$$

in the Black-Scholes model and Z is a standard normal random variable (i.e., $Z \sim N(0, 1)$).

Before your MatLab program performs your main Monte Carlo simulation, it should do a *pilot computation* to estimate how large the number of replications, N, should be so that you can estimate the price of the option to within $\pm\,\$0.01$ at a confidence level of 99%.

Carry out the Monte Carlo simulation with the number of replications, N, estimated in your pilot computation and print the estimated price, $\hat{V}_N$, of the option as well as the associated confidence interval at the 99% confidence level.

Compare your estimated price to the Black-Scholes-formula price computed by the MatLab function `blsprice`.

P.S. Keep the programs that you write for this assignment. In your next assignments, you will write similar programs that implement the variance reduction techniques that we will discuss in class soon.