PRELIM 2

VERSION: DELTA-2

NAME:

1. Prelim 2 has *three* problems and is worth a total of XX points.
2. You may use your course notes (on the computer, iPad, etc., or paper) or other course materials, e.g., discussion problems, to formulate your solutions.
3. Do not consult with any other person regarding the prelim (except the TAs or JV), or use *any form of electronic communication* to discuss the prelim questions. Violation of this policy will result in a ZERO for the prelim.
4. All computer codes and data must be published per the submission policy.
5. Show your work and state all assumptions or simplifications.
6. Good luck!

1. (XX points) You are a Quant at Olin Financial, an up-and-coming hedge fund. You have been tasked with computing the distribution of possible future share price values for firm XYZ. Suppose the share price of firm XYZ at time t, denoted by $S(t)$, is governed by a geometric Brownian motion with the solution:

$$S(t) = S_\circ \exp\left(\left(\mu - \frac{\sigma^2}{2}\right)(t - t_\circ) + \sigma\sqrt{t - t_\circ} \cdot Z(0,1)\right) \tag{1}$$

where $S_\circ$ denotes the initial share price at $t_\circ < t$, μ denotes the rate of return parameter, $\sigma > 0$ denotes the volatility parameter and $Z(0,1)$ denotes a standard-normal random variable.

Assumptions: (i) the implied volatility of an At the Money (ATM) 01/20/2023 option on XYZ is 52.27%; (ii) there are 78 days to 01/20/2023 (from today); (iii) the current share price of XYZ is 270.89 USD/share; (iv) $t_o = 0$ is today.

Use the Jupyter notebook `CHEME-5660-AP2-Equity.ipynb`, and any associated data sets, to answer the following questions:

a) Estimate the rate of return parameter μ from historical OHLC data for firm XYZ.

b) Estimate the volatility parameter σ from historical OHLC data for firm XYZ.

c) Using your estimates of the μ and σ parameters, along with (1), estimate a `LogNormal` distribution of possible future share price values of XYZ on 01/20/2023. Generate N = 10,000 sample paths and let $t_\circ = 0$ (now).

2. (XX points) A trader at Olin Financial, an up-and-coming hedge fund, sold a short strangle on firm XYZ with a 01/20/2023 expiration.

   Assumptions: (i) the short put (contract 1) has a strike price of K_1 = 230.0 USD/share and an implied volatility of 58.97%; (ii) the short call (contract 2) has a strike price of K_2 = 300.0 USD/share and an implied volatility of 52.59%; (iii) there are 78 days to 01/20/2023 (from today); (iv) the current share price of XYZ is 270.89 USD/share; (v) the risk-free rate is 4.10%.

   Use the Jupyter notebook `CHEME-5660-AP2-Options.ipynb`, and any associated data sets, to answer the following questions:

   a) Compute the premiums for the put $\mathcal{P}_1$ and call $\mathcal{P}_2$ contracts for the 12/16 short strangle on firm XYZ using the Cox, Ross, and Rubinstein (CRR) binomial lattice model.

   b) Compute the maximum profit and break-even points for the Olin Financial short strangle position on XYZ.

   c) Compute the probability for the profit at expiration for the short strangle position using the share price estimates from the `Equity` notebook.