Assignment 4

Problem 1 – Generation of Geostatistical Realizations using Monte Carlo Simulation (50 points)
The distributed log-permeability fields are modelled as a multivariate Gaussian distribution with mean log-permeability = 4 and exponential covariance function:

$$\mathbf{c} = \sigma^2 \exp\left(-3\left(\frac{\mathbf{s}}{r_a}\right)^{\gamma}\right),$$

where s is the lag distance, r_a, γ, and σ^2 are the correlation range, exponent and variance respectively. Perform Monte Carlo simulation to generate 200 geostatistical realizations on a 2D grid with 75x75 cells using r_a=35 cells, γ=1, and σ=1 respectively. You must solve this problem by programming in Python (Jupyter Notebook).

Problem 2 – Price Modeling (50 points)
This problem must be solved in Python. A Jupyter Notebook file must be submitted.
The weekly stock prices of a company over the past 2 years (from 28 Oct 2019 to 25 Oct 2021) are in file "stock_price_data.xlsx."

a) Calibrate a geometric Brownian motion model (GBM) to the given historical stock prices, and use the calibrated GBM to forecast the stock price after 3 weeks (i.e., 15 Nov 2021). What is the P5-P95 interval of the stock price after 3 weeks?
b) Calibrate a geometric Ornstein–Uhlenbeck process model (GOU) to the given historical stock prices, and use the calibrated GOU to forecast the stock price after 3 weeks (i.e., 15 Nov 2021). What is the P5-P95 interval of the stock price after 3 weeks?
c) Do you suggest using GBM or GOU to model the stock price?