PSTAT 176/276 – Team Project

Write a module `AmerOption.py` (you can use any platform other than python that you prefer) and an analysis file. Our goal is to use Monte Carlo method and estimate the price of an American put option. In particular, we want to analyse if the estimation can benefit from implementation of the control variates method.

All the computations must be shown in the analysis file.

Problem 1. Make a function `StockVol` to calibrate the stock volatility under geometric Brownian motion model. Input `histoPrice` is an array of 1-year historical prices. You can choose a stock that does not pay dividends for simplicity. The function should return a number that is the historical volatility of the stock.

Problem 2. Make a function `StockPath` to generate `n` stock paths where `n` is one of the inputs, as well as `sigma` which is the volatility of the stock. Other inputs needed (might not be limited to) are `S0`: current stock price; `T`: terminal time in yearly unit; `np`: number of time periods; `r`: interest rate; `delta`: continuous dividend yield of the stock.

Problem 3. Make a function `EurOptPrice` that takes the stock paths to generate the European put option price through Monte Carlo method. One input is `n` stock paths. The function should return the discounted payoff vector, price, and variance.

Problem 4. Make a function `AmeOptPrice` that takes the stock paths to generate the American put option price without control variates. The function should return the discounted payoff vector, price, and variance. In this part, you will need to implement some regression method and you are required to do it by using machine learning or deep learning. Make sure to explain what you did in the analysis file.

Problem 5. Make a function `ContVariate` to implement the control variates method. Note that this part is independent of the prices you computed. You should be able to apply this function to any vectors and estimations.

Problem 6. Choose your favorite underlying stock and a corresponding put option that expires in 1 year. Use 1 year libor yield as the interest rate. You also need to compute the continuous dividend yield. Apply the `ContVariate` function to the American put option price you computed. Do the analysis as if you want to convince your manager that this is the right way to estimate the price of American style option.