Progress Report - Project Group 126
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Progress so far:

After identifying the final members of the team and joining the group on Canvas, we jumped right into the logistics of scheduling a weekly recurring meeting to ensure that we stayed on track and made continual progress. During our initial meeting, we identified our strengths and took actions to conduct background research on our topic - options pricing/trading. Since members of our team all had familiarity in Python, we decided to use this as our programming language of choice. Some of us took on the task of finding packages that would be useful in completing simulations and other packages needed to complete the analytical aspects. In parallel, others began researching papers defining the types of options and relevant literature to support background information on the topic. This work ultimately led to the inception of our problem statement and approach below.

Problem statement, objective and planned approach:

The volatile nature of financial markets imposes various sources of uncertainty on an investor's portfolio. The options market provides a way for investors to combat those uncertainties, by hedging their portfolio against the risk of adverse price movements. We will compare the performance of analytical pricing models with results from various simulation techniques, to determine which pricing method performs the best when compared to actual option prices.

We begin with pricing European call options using the Black-Scholes model. For this model, we assume that the stock price follows a log normal distribution. We also assume that the stock follows a geometric Brownian motion, thus satisfying the stochastic differential equation with a drift. In other words, the stock follows a random process with a growth rate μ.

$$dS_t = \mu S_t dt + \sigma S_t dW_t$$

From here, we can estimate the price of an option contract by calculating the average of the sum of the difference between the max of 0 and all stock price paths (from the simulation) and the strike price (Stock price minus the Strike price is known as option premium, which is the price that you pay for the option) at the time of expiration.

$$\text{European Call Option Price: } C_0 = e^{-rT}\frac{1}{N}\sum_{i}^{N} max(S_T - K, 0)$$

After finding the value at expiration we discount the value using the discount factor e^{-rt} to find the fair value of the option contract today. We can also extend this process for pricing European Put options by calculating the average of the sum of the difference between the max of zero and the strike price minus the stock price, then discounting back to today to find the fair value of the put option.

$$\text{European Put Option Price: } C_0 = e^{-rT}\frac{1}{N}\sum_{i}^{N} max(K - S_T, 0)$$

Next steps:

We are still deciding on the specific underlying assets to use for our analysis. We do, however, have an idea of which stocks to use and have gathered historical option chain data from Yahoo Finance. Subsequently, as we started to bring together our information together, we realized we needed a way to stay organized. This led us to choosing Microsoft Teams as our communication and document sharing platform. We chose GitHub repository to start our version control and Google collab to allow our team to collectively tackle future coding tasks.

As the research project progresses further, we will continually iterate the model for various option contracts. We hope to receive guidance on how to handle pseudo random variables for Time Series analysis using week nine's lecture material. After understanding the process to input pseudo random variables (PRV) into our forecasting and options model, we will design an experiment to understand which model will best answer our problem statement within our level of risk aversion. Interpreting and analyzing the outputs of these models will be key in determining the best possible model. While what we have left to do seems oversimplified here, we completely understand that tying our research together and portraying a comprehensive conclusion is going to be time consuming and may require a few different iterations. Thus, staying the course with our recurring meetings and completing our tasks on time are going to be critical to staying agile as a team.