Portfolio IV - Trends

Model 1 - Simulating Stock Price

I simulated average stock prices over 30 days for varying probabilities p of a daily price increase, ranging from $p \in \{0.4, 0.45, 0.5, 0.55, 0.6\}$. Starting with $S_0 = 100$, each day's price was adjusted by 1% up or down based on p. For each p, 200 simulations were performed to estimate the mean final stock price and its 95% confidence intervals.

The stock price model is defined as:

$$S(t+1) = \begin{cases} S(t) \times (1+r), & \text{with probability } p \\ S(t) \times (1-r), & \text{with probability } 1-p \end{cases}$$

where $r = 0.01$ is the fixed daily percentage change.

Figure 1 shows the average final stock prices with error bars representing 95% confidence intervals. Higher probabilities p lead to higher average prices, as expected.

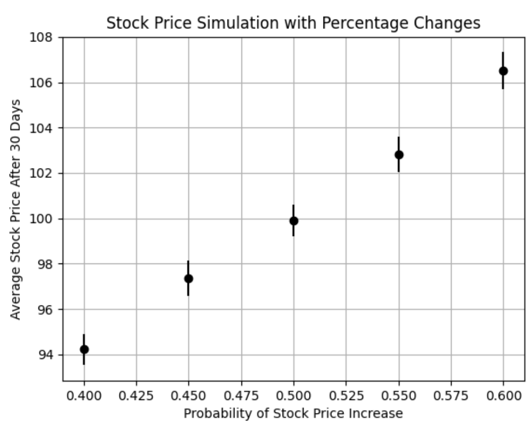

Figure 1: Average stock prices after 30 days for different probabilities of daily price increase. Error bars represent 95% confidence intervals.

Limitations of Model 1

- Assumes a fixed daily percentage of change r, ignoring real market fluctuations.
- Uses a constant probability p, which would never happen in an actual market.

Model 2 - Simulation with Variable Daily Changes

To model realistic stock market volatility and address the first limitation, I updated the simulation by drawing daily percentage changes r from normal distribution $\mathcal{N}(0.1, 0.05)$. All else remained the same and the simulations were repeated under the same conditions, and the results are shown in Figure 2. This shows higher variability in final stock prices, seen from the wider confidence intervals.

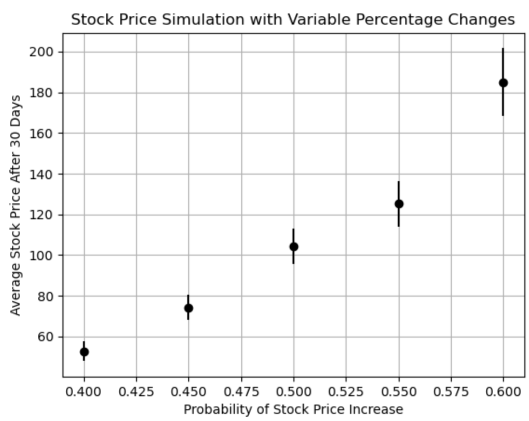

Figure 2: Average stock prices after 30 days using variable daily percentage changes from a normal distribution. Error bars represent 95% confidence intervals.

In doing this, I learned

- To question my models, look at their limitations and iterate on my work by replacing unrealistic assumptions. In this case, fixed percentage changes with variable daily changes from a normal distribution, to better model real-world market volatility.