General Information

The potential client expresses the desire to invest in a portfolio of the following 6 stocks.

- Amazon
- Delta Airlines
- Exxon
- Meta
- Johnson and Johnson
- PayPal

With an additional risk-free security in the form of a Series I Savings bond with a return of 1.3%.

The data utilizes information from the beginning of 2023 to the current day, however the python class can be modified to include whichever starting and ending date desired to reference. In Markowitz portfolio Optimization, it can be finicky to use a ‘large’ time frame, as this form of optimization hinges on minimizing variance. Seeing as this client is risk-adverse, preferring to minimize risk, while obtaining their desired return, it is appropriate to use this optimzation.

The Method, abridged.

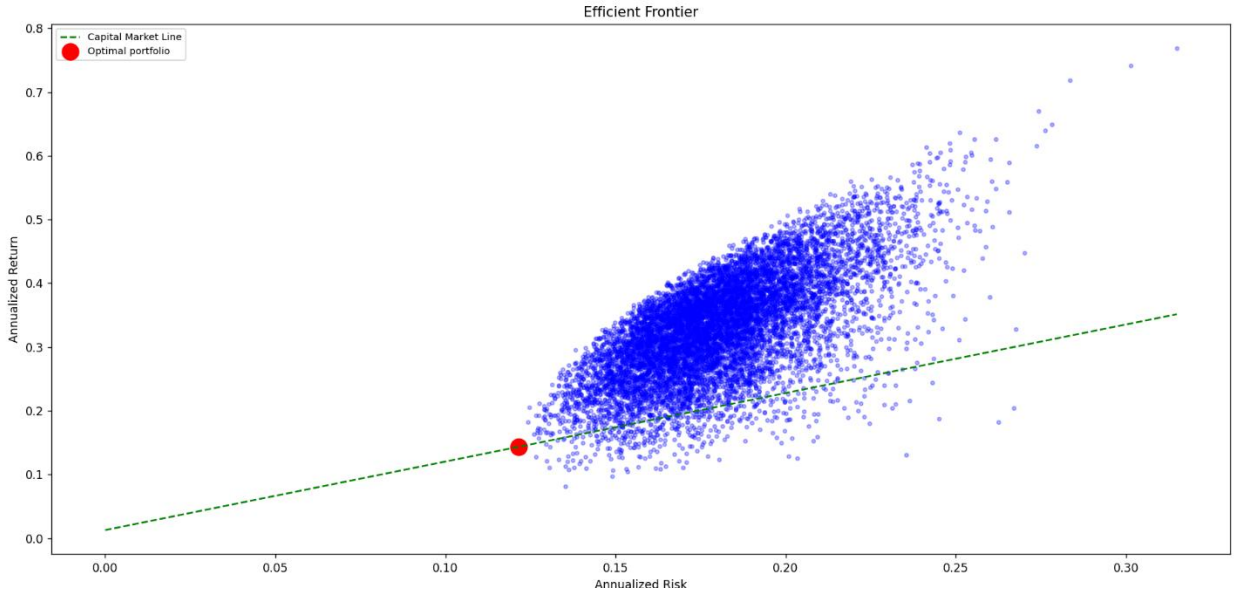
The performance of the portfolio was calculated utilizing a python program, retrieving the statistics directly from Yahoo Finance utilizing the yfinance library, which was then stored in the DataFrame data structure from the pandas library, which is then put in a matrix used to calculate the covariance matrix and its indices other statistics.

Various methods construct the second order statistics utilizing the first order statistics retrieved from the manipulated data on Yahoo Finance, alongside a method that calculates the ‘performance’ of the portfolio, which returns the ‘expected return’ and overall volatility.

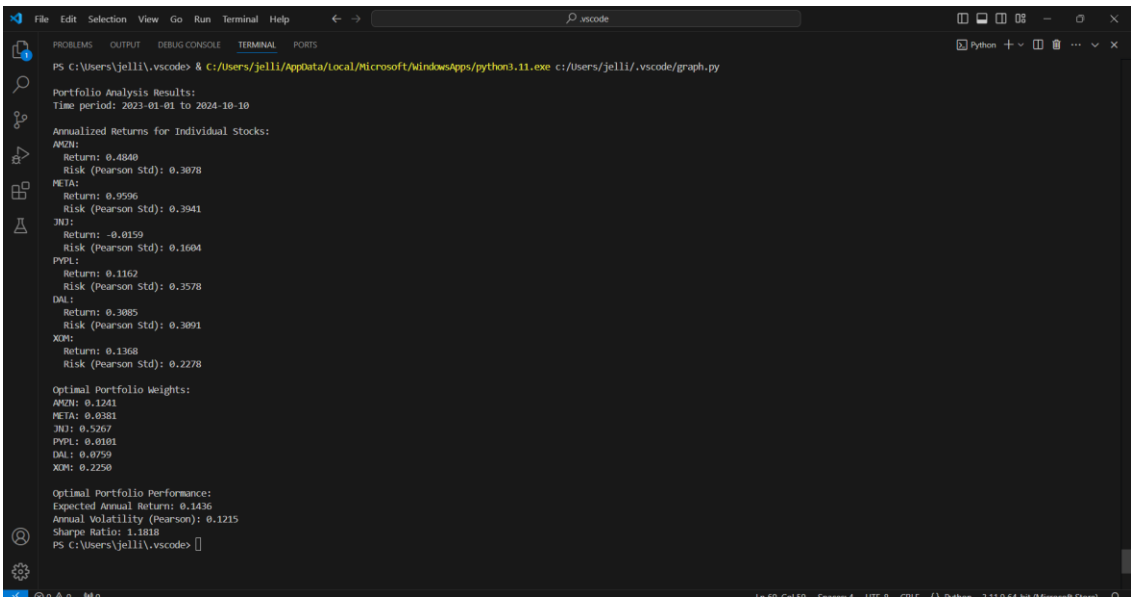
After retrieving all the first and second order statistics, as well as the performance of the portfolio, gradient descent is utilized to retrieve the optimal rates. This is essentially the Lagrange multiplier method, but it is done iteratively. I found this to be effective algorithmically despite having more parameters to adjust.

Analysis

The following graph is from iterating 10,000 times through this method to visually plot the optimal portfolio along the capital market line, it displays the convergence to the optimal portfolio as well.



Additionally, here is the output from my main class that specifies optimal weights, as well as the annual volatility, expected return, and Sharpe ratio.



Recommendations

Looking at the results of the client's desired stocks, the Sharpe ratio is greater than 1 and ergo considered 'good' and suggests profitable returns. However, considering the market in 2023 to now, the ratio being 'good' can be debatable either way.

Paypal and Delta Airlines should be re-evaluated as potential investments based on these results, while also maintaining diversification of stocks as one would not want so much emphasis on a portfolio based on one specific industry given the potential for higher volatility.

Looking into the future, allocating more to Amazon or Meta may be a good idea, as these assets are looking promising in the long term. The high percentage of investment on Johnson and Johnson most certainly could be reallocated to stocks that are more growth oriented, but it is also important to keep in mind maintenance of the client's risk aversion, which is an assumption that is key to this analysis.