Monte Carlo Simulation & Portfolio Optimization

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Motivation and Summary

Assess the financial performance of a stock portfolio that can be customized.

- Create an interface to customize the asset allocation of a portfolio and test the long term expected portfolio growth of that portfolio by using the Monte Carlo simulation to model the probability of the different outcomes.
- Identify an optimal weight distribution for the different assets in the portfolio by determining the optimal Sharpe Ratio for a given portfolio.
- Display how the results compare to a selected benchmark.

Motivation and Summary

- What predictions are valuable to investors?
  - Identify probability of long term expected portfolio growth possibilities.
  - Identify which investment vehicle is more attractive based on sharpe ratio comparison.
- What simulation algorithms can we use to make good predictions?
  - Monte Carlo Simulation
  - Minimize optimization algorithm from scipy
- What data will the users input?
  - List of stocks & benchmark ticker symbols
- What parameters/data will we output?
  - Length of historical prices
  - Number of simulations
  - Number of periods per simulation

Motivation and Summary

- Yahoo Finance to pull historical data
- Pandas to model the data
- Monte Carlo algorithm to simulate future outcomes
- Questions remain:
    - Alternative methods of comparing results.
    - Scalability of the program to accommodate more realistic portfolios
    - Weight allocation

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Discussion

- Did you find what you expected to find? If not, why not?
  - Many of our expectations were met, however we remain uncertain about the integrity of the analysis.
  - We need to do further development and use different data sets to confirm whether our algorithm/code is correct.
- What inferences or general conclusions can you draw from your analysis?
  - The analysis demonstrated that the selected portfolio outperformed the SPY benchmark.
 - The simulation was effective in predicting

Portfolio Optimization

Portfolio Optimization

- How can we select the portfolio weights?
  - Uniformly (all equal)
  - Manually (user choice)

- If we know the prices. Is there an **optimal** portfolio?
  - **Yes**. Weights that maximize the Sharpe Ratio.
  - We have prices for different stocks for a given period of time
    - Prices either historical or expected

- How can we get the good weights?
  - **Monte Carlo Algorithm:** random
  - **Optimization Algorithm:** Mathematical optimization library

Monte Carlo Approach

- Run n Monte Carlo trial to guess the weights
  - At each trial, randomly guess the weights
- After finishing all trials, choose weights that give highest Sharpe Ratio
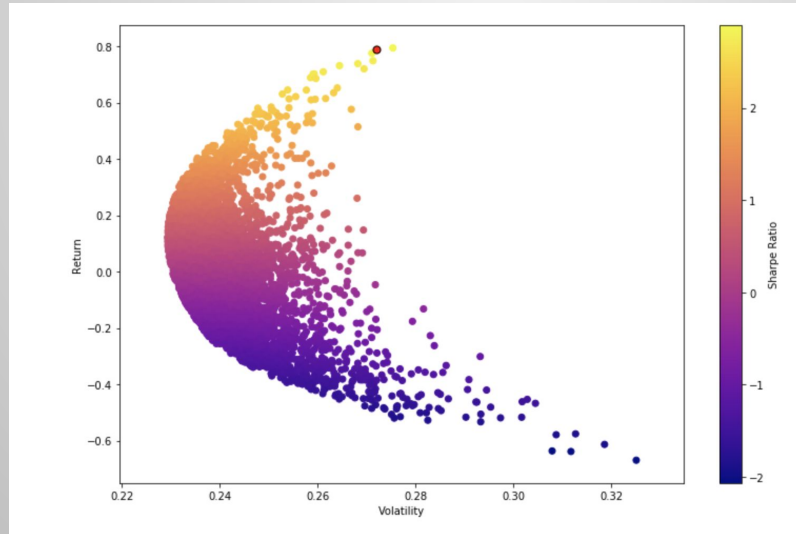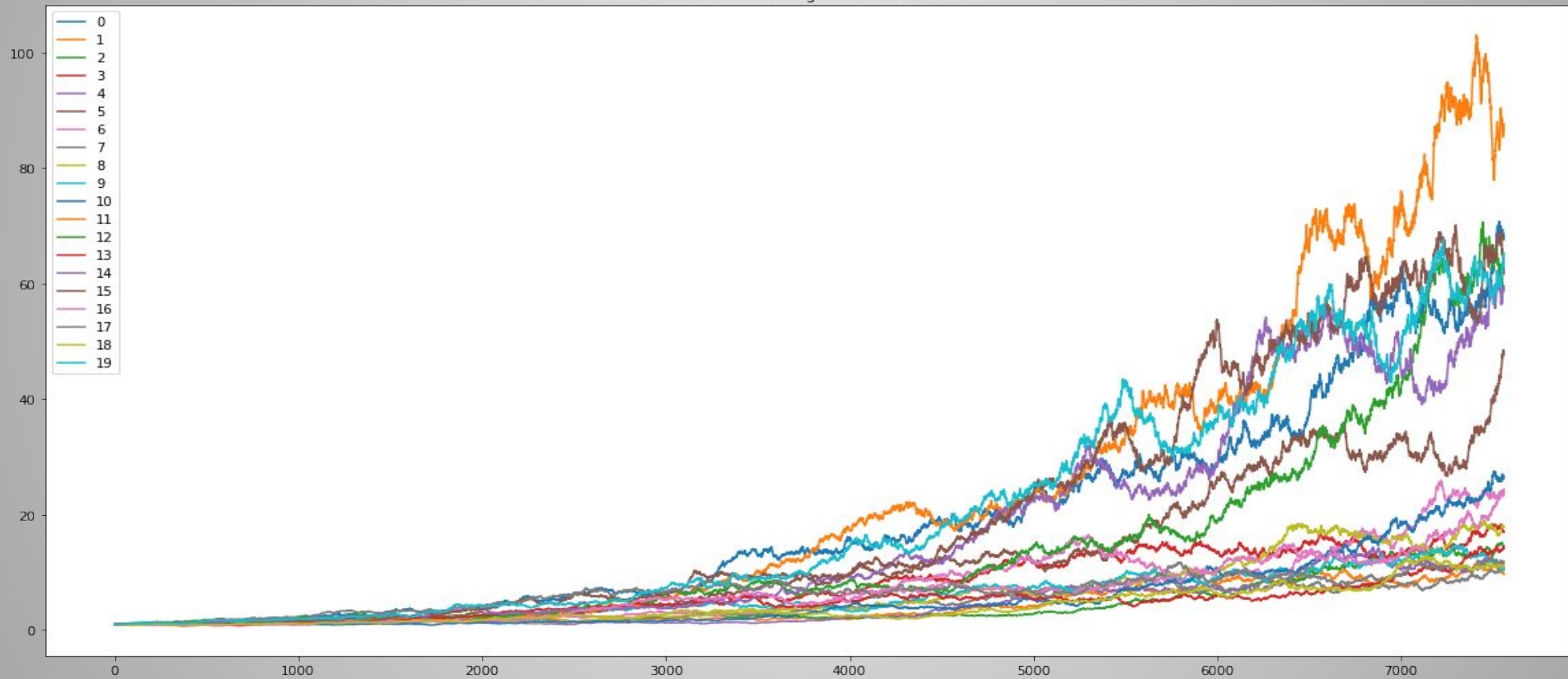
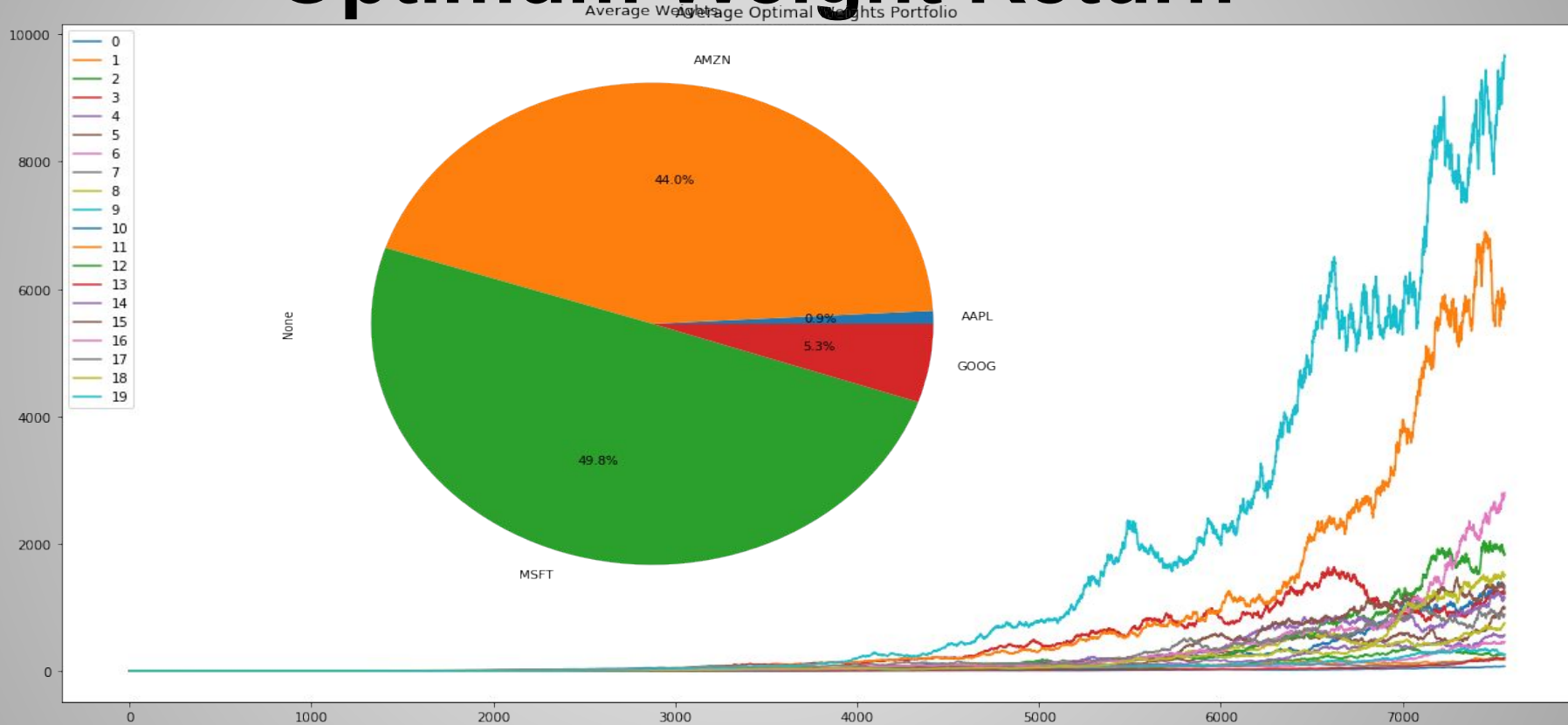# Portfolio Optimization (Optimization)

- We want to find weights that maximize Sharpe Ratio without guessing randomly

- Use optimization algorithm. SciPy has a function for optimization.
  - Find weights that maximize Sharpe Ratio
  - Sum of weights must be = 1
  - Each weight should be between 0 and 1

Uniform weight portfolio Return

Optimum Weight Return

Summary

- Monte-Carlo simulation is great toot for risk-return analysis

- Sharpe Ratio gives better snapshot for portfolio return

- Weight is the crucial factor to maximize return in portfolio

Open Floor For Q & A