Assignment: Efficient Frontier Construction for a 10-Stock Portfolio

InvestoQuest
Deadline - 3rd June

May 31, 2025

Objective

The goal of this assignment is to construct the **efficient frontier** for a portfolio of 10 stocks selected from different sectors. This includes fetching historical stock data, computing returns, simulating random portfolios, performing optimization, and visualizing the efficient frontier with relevant performance metrics.

Instructions and Guidelines

Step 1. Stock Selection (10 marks)
Select **10 stocks** from the S&P 500 index, ensuring sectoral diversification. Justify your choice of stocks in 1–2 sentences each.

Step 2. Data Collection (10 marks)
Use a Python API such as `yfinance` to fetch **daily adjusted close prices** over the past **5 years**. Clean the data by handling missing values appropriately.

Step 3. Return Calculation (10 marks)
Calculate daily logarithmic returns. Then compute the **annualized mean returns** and the **annualized covariance matrix** of returns.

Step 4. Portfolio Simulation (20 marks)
Simulate at least **50,000 random portfolios**. For each portfolio:

- Compute expected return
- Compute volatility (standard deviation)
- Compute the Sharpe ratio (assume risk-free rate is 0%)

Step 5. Efficient Frontier Plotting (20 marks)
Create a scatter plot of portfolio volatility vs return. Highlight the following:

- The **maximum Sharpe ratio** (tangent) portfolio

- The **minimum variance** portfolio
- The **efficient frontier** (upper edge of feasible portfolios)

Step 6. Optimization (15 marks)
Using the `scipy.optimize` library, calculate the optimal weights for:

- Maximum Sharpe ratio portfolio
- Minimum variance portfolio

Step 7. Visualization (10 marks)
Include the following plots:

- Efficient frontier
- All simulated portfolios
- Portfolio weight distributions for the optimal portfolios

Step 8. Analysis and Report (5 marks)
Provide a short analysis discussing:

- Asset contributions and dominant sectors
- Diversification and practical interpretation of results

Submission Requirements

- Submit a Jupyter Notebook or Python script with all code and output.
- Attach a PDF report with plots and commentary.
- Clearly label each section corresponding to the assignment steps.

Suggested Tools

- Python libraries: `numpy`, `pandas`, `matplotlib`, `scipy`, `yfinance`
- Optional: `cvxpy` or `PyPortfolioOpt` for advanced optimization