Portfolio Returns Optimization

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***Abstract*—Developing an approach for optimizing the returns of a portfolio by utilizing the skills developed during the course The objectives of the project can be broken down into the below milestones :**

1) **Building a single index model for covariance for all tickers**
2) **Generating the efficient frontier for a selection of tickers**
3) **Select an initial portfolio and compare the portfolio performance for two cases i.e. no reallocation i.e. we invest once based on the initial weights and they remain same and reallocation case i.e. when we are reallocation based on daily market performance.**

I. Introduction

Portfolio optimization has been a long standing and every changing problem statement where people all around the world are constantly trying to find an optimum way in order reduce their risk and maximize their returns. The goal for this project also follows the same idea of optimizing the portfolio for maximum returns
The objectives of the project can be broken down into the below milestones :

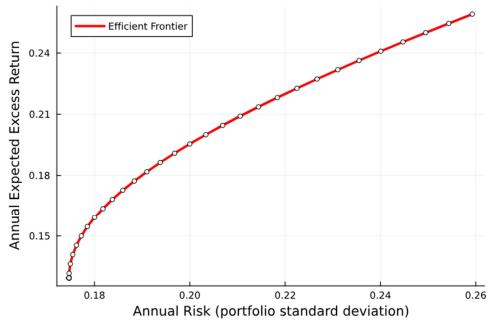
1) Building a single index model for covariance for all tickers
2) Generating the efficient frontier for a selection of tickers
3) Select an initial portfolio and compare the portfolio performance for two cases i.e. no reallocation i.e. we invest once based on the initial weights and they remain same and reallocation case i.e. when we are reallocation based on daily market performance.

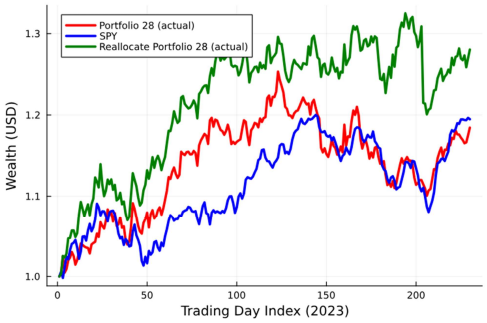
The above objects guides the basic structure of the how the project revolves and a detailed results and discussion are provide in the sections ahead.

II. Results

The results for the project objectives are outlined below :

- The single index models for covariance for all tickers were generated and has been used ahead for calculations
- Apple [AAPL] , Merck and Co Inc [MRK] and Google [GOOGL] was used as the tickers for the portfolio
- The efficient frontier was generated using the single index models and the plot for the same is given below :
- The Portfolio performance simulation has been illustrated in the Julia notebook and has been included as part of the Appendix and the summary plot for this is given in the discussions section





III. Discussion

- The plot for the portfolio performance generated by simulating for 2023 data is given above.
- From the above plot we can see that the daily reallocation strategy has provided us with better results than the non reallocation case and also from the SPY returns
- One of the major reasons for the reallocation case to yield better results is because the reallocation strategy has a feedback mechanism where it considers and factors the market fluctuations and updates the weights for selection accordingly whereas the no allocation strategy does not include or factor the market ups or downs
- One of the other set backs for this approach would be that it is a backward looking strategy and hence will only be able to take its decision based on how the asset performed in the past and will not factor in the future variations or unknown market patterns

IV. Methodology

The main inspiration of the projects were taken from the example notebooks of CHEME 5760 [1] and lab notebooks [2].The overview of the methodology has been summarized below :

- The market open and close data for all the available tickers were used as the starting point. The volume weighted averages were considered for all calculations
- Using this data log returns for all the tickers were computed along with the variances
- Next the single index models for covariance were computed for the tickers Using the developed single index models the efficient frontiers was generated and visualized From the efficient frontier portfolio 28 was selected which had a expected excess return of around 0.13 with a risk of 0.174648 was selected This portfolio was then simulated for 2023 data for the two cases that is with daily reallocation and without reallocation.
- The performance for both the cases along with the spy returns were then plotted in order to visualize the comparison

V. Data and model availability

The model equations were implemented in Julia (v.1.9.3) [3] The model code is available at https://github.com/af626/CHEME5760-AF626-FinaProject.git

References

1. Cheme-5760-examples .
2. Cheme-5760-labs .
3. Bezanson, J., Edelman, A., Karpinski, S. & Shah, V. B. Julia: A fresh approach to numerical computing (2014). arXiv:1411.1607.