

WTW 801. Assignment I: Due 24 October 2021

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Abstract

Instructions: **Answer all questions.** The idea is to learn how portfolio optimization may benefit from some of the BIG DATA characteristics, eg Volume, Velocity, etc. Use Python, Matlab, R or any other software. You need to explain your steps and you may put simplifying assumptions where necessary. You should sign the Plagiarism Form which can be downloaded from the ClickUp.

Total Marks 20.

1 A: Internet Data and the classical portfolio optimization problem (10 Marks)

Consider a Markowitz's Mean-Variance Optimization (MVO) model to the problem of constructing a portfolio of any Johannesburg Stock Exchange (JSE) stocks. One of the assumptions of this problem is that the mean and the variance or covariance is known. However, this has to be estimated. You need to focus on how, eg., the covariance matrix is estimated or shrunk by sampling or other programming techniques studied in other related modules.

- Use historical data. You may consider at least 10 stock counters, either daily, weekly, monthly or yearly data for sufficient entries say at least 1000. (Google e.g., How to download data from, say, Yahoo Finance or **INet BFA**) . Note that **INet BFA** can be accessed via UP Library, E-resources of the Economic Management Sciences)
- Plot the times series for the "Total Return" for at least three assets.
- Use the example Ref [2] page 142, Ch 8 as a guide. Let I_{it} denote the above "Total Return" for asset $i = 1; 2; 3$ and $t = 0; \dots; T$, where $t = 0$ corresponds to 1960 and $t = T$ to 2003. For each asset i , we can convert the raw data I_{it} , $t = 0; \dots; T$, into rates of returns r_{it} , $t = 0; \dots; T$, using the formula

$$r_{it} = \frac{I_{i,t} - I_{i,t-1}}{I_{i,t-1}}.$$

- Set up the portfolio optimization problem.
- Plot the efficient frontier and the composition of efficient portfolios in separate diagrams..

2 B: Internet Data and the large-scale portfolio optimization problem (10 Marks)

Study the problem as presented from page 144 in the Ref [2] page 142, Ch 8. Using data stocks from Section A, above, use any relevant software to answer Exercise 8.6 and 8.7 on page 148.

References

- [1] Luenberger D. G. (1998) *Investment Science*, **CH 8**.
- [2] Gerard Cornuejols and Reha TÄutÄuncÄ *Optimization Methods in Finance*. Carnegie Mellon University, Pittsburgh, PA 15213 USA Summer 2005. [[https : //www.researchgate.net/publication/227390397-Optimization-Methods-in-Finance](https://www.researchgate.net/publication/227390397-Optimization-Methods-in-Finance)].