Assignment – Investment Analysis

This homework covers the topic of portfolio construction. It has 4 sub-tasks, for successful completion, one needs to get at-least one point from each sub-task and at-least 20 points in total.

The assignment can be worked out in any computational software. The output should be a pdf file with answered questions. Enclose the code itself too, so it can be run straight away (with all the input files). In your own interest, please write the code in a readable form (naming, conventions, comments, etc..). Submit your solutions to rusy@karlin.mff.cuni.cz.

The deadline is 18th December 2024, 23:59.

Version X

Assignment

Assume, that you are a consultant of an investor on NASDAQ stock exchange, whose initial capital is 100 000 USD. He is allowed to invest into the following eight stocks – (see enclosed paper with list of stocks) and potentially into the risk-free asset, one-month treasury bond of the US government. The investor is asking for an advice how to invest his capital.

1) **Data**
   Retrieve data of daily returns of the individual assets. These can be downloaded for example at https://finance.yahoo.com. (fill in the company ticker, go to the tab historical data and select time period 1.1.2021 – 25.10.2024). Daily returns are calculated as the logarithm of a ratio of Close and Open price. If data of one of your stocks do not cover the entire period, pick the next one in alphabetical order instead.

   Data about the annual risk-free return can be downloaded at http://www.karlin.mff.cuni.cz/~rusy/AnalyzaInvestic/USYields2024.csv.

   Perform a short exploratory analysis of your data. Discuss the expected values, covariances and auto-covariances of your returns, How these characteristics change in time?

   [5b]

2) **Efficient Portfolios**
   Assume that today is 24.10.2022, after the end of the business day (so all data till 24.10.2022 are observed). Estimate the set of efficient portfolios without the risk-free asset. Show graphically.

   Calculate and plot also the Capital Market Line, this time with the use of the risk-free asset. What is the composition of the tangency portfolio?

   Plot the Security Market Line, estimate where your stocks lie on this chart.

3) **The Markowitz Model**

   Choose a business strategy based on the Markowitz model, either with aim to maximize expected return when conditioning on risk, or to minimize risk subject to some minimum expected return.

   Define parameters of your strategy (maximum risk/minimum return), so these parameters are realistic (they can be also set based on current market behavior)

   Define a way how other inputs for the model (expected asset return and their covariances) will be estimated.

   [3b]

4) **Out-of-Sample Investment**

   Implement the proposed strategy, with the first investment on 25.10.2022 and the final one on 24.10.2024. Every day, evaluate your investment based on the most recent market movements and calculate the new optimal portfolio and invest according to it. Be careful, that into the decision, how to invest the next day, only the data observed till the previous date are used.

   Describe the results of this exercise, comment on the return of the strategy and how it corresponds to the assumed return and your expectations (strategy definition and parameter selection). Compare, how your strategy performs against the average portfolio (all stock in portfolio have equal weight) and against the fixed tangency portfolio as found in 2).

   [10b]

Notes

1) Be careful when working with returns, make sure you only work with daily ones or annual ones.
2) Business year has 252 days.
3) Double check your results, do they make sense at all?