DTU

Introduction to
Financial Engineering
group report 2
due at 8AM, November 4, 2019;

Instructions

In the second group project for Introduction to Financial Engineering, your team acts as stock portfolio managers. An investor has commissioned your team to pick and analyse a portfolio of stocks. Financial data must be chosen, presented and analysed in a report.

In the next pages, the precise analysis to be done is outlined step by step. BUT the ordering of questions is to illustrate the order of which the questions is naturally addressed when doing the various calculations and analysis. You should write one coherent, self-contained report where you provide the theory, the results from your analysis and the conclusions summarized and/or presented in graphs and tables.

ANY REPORT REFERRING TO QUESTION "THIS AND THAT" WILL NOT BE APPROVED – it must take the form of a coherent, self-contained report referring to itself and relevant literature.

Along with the report, you must submit a file/folder with code that documents the calculations. The code must be executable in one click from the desktop of any computer with the correct software included. This means that any sub-functions used must be distributed as well and that data needs to be downloaded from the Internet or entered manually as the first thing in your code.

The total number of pages is 3 including this front page.

Stock data

Your client would like to invest in USD stocks and wants you to pick a diversified portfolio. You may assume that the risk free rate of return is 0.02 (2%). Download daily adjusted closing prices from Yahoo! Finance from January 1, 2014 until January 1, 2019 for eight stocks of the S&P 500 Index[1] fulfilling the following characteristics:

- The stock must be listed in USD
- No two stocks must have strongly[2] correlated returns
- No more than two stocks should represent the same industry groups[3]
- If one of your stocks exhibit some sort of extreme behaviour compared to the rest, it might be a good idea to replace that stock
- IMPORTANT: As soon as you have picked your eight stocks, send an email to nilan@dtu.dk with the chosen tickers! This gives me a chance to see if there is anything odd with your chosen data that might cause confusion or troubles.

Data presentation

After choosing the eight stocks, present the data to your reader. E.g.,:

- Which stocks have you picked and which industries do they belong to?
- How do historical prices/returns look?
- What are the average historical returns (in annualized terms), standard deviation of returns (also in annualized terms) and correlation between returns?
- What does the distribution of returns look like?
- What are the range, skewness, kurtosis and autocorrelation of the returns?
- What is the Sharpe Ratio of the stock?

Portfolio theory

Based on Markowitz portfolio theory, derive and illustrate the optimal portfolio choices. Identify the following portfolios in terms of weights, return and risk:

- Risky-assets only global minimum variance portfolio
- The tangent portfolio
- Risky-assets only global minimum variance portfolio with no short selling allowed
- Risky-assets only maximum return portfolio with no short selling allowed
- The equal weights portfolio
- Risky-assets only minimum variance portfolio, where no more than 20% of the weatlh is allocated to each stock and no short selling allowed
- Risky-assets only minimum variance portfolio, where at least 8% of the weatlh is allocated to each stock and no short selling allowed[4]

[1] Wikipedia seems to have a fairly updated list of S&P companies including their industry, so if you don't know eight tickers, this is a good source of inspiration

[2] Here, we define two stocks to be strongly correlated if $|\rho| > 0.7$

[3] According to the Global Industry Classification Standard, GICS

[4] Hint: For the two final portfolios, you can use the same approach as for the no short selling and add the relevant restriction. But there is not necessarily a solution fulfilling all constraints for all values of $\mu \in [\min\{\mu\}, \max\{\mu\}]$ as there is in the no short selling case.

Portfolio performance

Download daily data from Yahoo! Finance from January 1, 2019 until today for your eight stocks. Calculate, report and comment on the performance of each of your seven portfolios during 2019.

- Many of the metrics used to describe data are also good for reporting performance