DTU

Introduction to
Financial Engineering
group report
due at noon, December 1, 2018;

Instructions

In the group project for Introduction to Financial Engineering, your team acts as portfolio managers. An investor has commissioned your team to pick and analyse various financial assets. 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 as the first thing in your code. If your team does not use Matlab/R, please make arrangements with me such that I can make sure, I have the right software to check 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. Download daily adjusted closing prices from Yahoo! Finance from January 1, 2010 until January 1, 2018 for 12 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

Data presentation

After choosing the 12 stocks, present the data to your reader. E.g.,:

- Which stocks have you picked and which industries do they belong to?
- What does their historical prices look like?
- 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 of the returns, skewness, kurtosis and autocorrelation?
- What is the Sharpe Ratio of the stocks (assuming a risk free return of 0.02)?

Portfolio theory I

Based on Markowitz portfolio theory, illustrate the optimal portfolio choices when borrowing rates are 10% and lending rates are 1%. Identify the following portfolios:

- Risky-assets only global minimum variance portfolio
- The two tangent portfolios corresponding to the borrowing and the lending rate
- 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

Portfolio theory II

Using the definition of dominating assets, remove all dominated stocks from your stock portfolios[4]. Identify the following portfolios[5]:

- Risky-assets only global minimum variance portfolio
- The equal weights portfolio

[1] Wikipedia seems to have a fairly updated list of S&P companies including their industry, so if you don't know 12 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] If you are left with only one stock, then come speak to me to find a way around this

[5] If none of your stocks are dominated by others, then keep the three with the highest Sharpe Ratio.

Capital Asset Pricing Model

Using the S&P 500 index[6] as a proxy for the market, find βs for each of the 12 stocks.

- Illustrate and discuss if your chosen stock data supports the CAPM
- If it does not support the CAPM, briefly discuss why

Portfolio performance

Download daily data from Yahoo! Finance from January 1, 2018 until today for your 12 stocks. Calculate, report and comment on the performance of each of your eight portfolios during 2018.

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

Bond portfolio

Your client would also like to invest in Danish Government bonds. He asks you to invest DKK 100.000 in a portfolio of bonds and wants you to assess the risk of holding this portfolio.

- The portfolio calculations should be done using NASDAQ prices from a November-day *before* November 12, 2018 or *after* November 18, 2018
- The term structure of interest rates should be done with a Nelson-Siegel term structure model fitted to all relevant government bond prices
- Find a portfolio of three bonds with positive portfolio weights, such that the duration of the portfolio is 10
- Using these weights, calculate the convexity and the value increase/decrease, if the interest rate curve shifts up by 1% (100bp)

[6] Ticker: SPY