Exercises Sheet #1

Introduction to Financial Engineering 2022

Note: The choice of software is up to the students. We recommend that you work in Python, but you can also choose to in R or Matlab. We do not provide solutions for all exercises in all languages.

The scope of today's exercises is to learn about financial returns, investigate their properties and compute various relevant numbers describing financial returns.

1. (data, returns) In this exercise, you will download weekly stock prices and investigate data.
   (a) Get weekly historical prices for Exxon Mobil (symbol 'XOM') ranging from Jan 1, 2005 until today `www.finance.yahoo.com` and load the data into your chosen software. For R, it might be convenient to familiarize yourself with the package "quantmod", but Yahoo etc. have in periods blocked users from fetching data using these kind of packages. For Matlab, you can go to the file exchange and download scripts by other users suck as `hist_stock_data`. For Python, use `yfinance`. We recommend that you actually get to working with the data and not getting stuck in automatising the download for now. You can always manually download the data from Yahoo Finance website (click on tab "Historical data" to download the data in .csv format) and make the below analysis and then go back and modify your code to include automatic fetching.
   (b) Plot the adjusted closing price and the closing price in the same graph (Read about adjusted closing prices and price calculations here: `https://blog.data.nasdaq.com/the-comprehensive-guide-to-stock-price-calculation`)
   (c) Are there any differences in the two prices? Which of the two should be used for calculating returns?
   (d) Calculate weekly returns
   (e) Calculate the weekly average return (Remember to use the geometric average!)
   (f) Calculate the standard deviation of returns
   (g) Calculate log returns and the weekly average log return (using aritmetric average) and compare with the "real" weekly returns

2. (data, returns) Get daily historical prices for the following three financial securities[1]

   - SPDR S&P 500 ETF (symbol: "SPY")
   - Financial Select Sector SPDR Fund (symbol: "XLF")
   - iShares MSCI Emerging Markets ETF (symbol: "EEM")

   ranging from Jan 1, 2005 until today from `www.finance.yahoo.com` and load the data into your chosen software.

   (a) Plot the adjusted closing prices in the same graph. Does it make sense to plot them in the same graph or should any adjustment be made?

   (b) Calculate the daily returns, average daily returns, and standard deviation of returns for each of the three securities

   (c) Calculate the variance-covariance matrix of the securities' daily returns (using build-in functions)

   (d) Calculate the correlation of the securities' daily returns (using build-in functions)

3. (data, returns) Using the data from Exercise 1:

   (a) Find the average return of XOM in annual terms using the weekly returns

   (b) Find the average return of XOM in annual terms using the weekly log-returns

   (c) How big is the difference using the two different methods

4. (data, returns) Using the data from Exercise 2:

   (a) Find the average return of the three ETFs in annual terms using the returns

   (b) Find the standard deviation of the three ETFs in annual terms

   (c) Find the variance-covariance matrix in annual terms

[1] These are not stocks, but exchange traded funds. For the purpose of this exercise, you can think of them as stocks.

(d) Do we need to do anything with the correlation matrix to get it in annual terms? Why/why not?

5. (data, returns) Using the data from Exercise 1:

   (a) Plot the week weekly returns. What do you see? Can you identify any major events by inspecting the data?

   (b) Make a histogram of weekly returns. What do you see?

   (c) Make a QQ-plot of weekly returns. Do weekly returns seem to follow a normal distribution?

   (d) Calculate the skewness and excess kurtosis. Do these value indicate that weekly stock returns follow a normal distribution?