CENG 785 - Algorithmic Trading and Quantitative Strategies
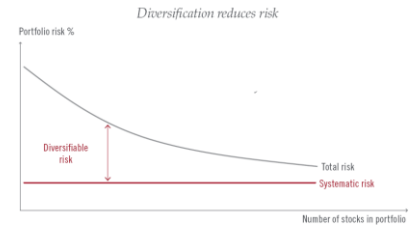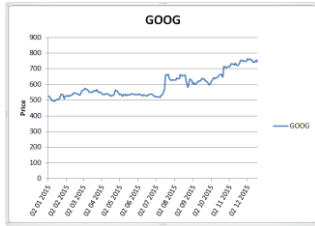
Fall 2016 - Homework 2

Diversified Portfolios &
Time Series Analysis

Selim Temizer

Feedback : Between December 19th and December 23rd, 2016
Due date : December 25th, 2016 (Submission through COW by 23:55)

Part One – Building a Low-Risk Diversified Portfolio (50 points)

As a portfolio manager, you decided to build a portfolio around some of the following 10 companies:

Sector	Stock	Market	Symbol
Energy	Exxon Mobil	NYSE	XOM
Financials	Goldman Sachs	NYSE	GS
Materials	BHP Billiton	NYSE	BHP
Industrials	Deere & Company	NYSE	DE
Utilities	FirstEnergy Corp.	NYSE	FE
Information Technology	Google Inc.	Nasdaq	GOOG
Telecommunication Services	BlackBerry Ltd.	Nasdaq	BBRY
Consumer Discretionary	Wal-Mart Stores Inc.	NYSE	WMT
Consumer Staples	Coca-Cola Company	NYSE	KO
Health Care	Johnson & Johnson	NYSE	JNJ

The daily stock prices for all of those companies (from the beginning of 2016, until now) are provided to you as comma-separated-values (CSV) formatted files. There are also 4 major market indices provided in the same file format.

You have 1,000,000 dollars, and you want to choose 5 of the above companies to be included in your portfolio. The cash values of all 5 companies will be equal (200,000 dollars each) in your portfolio. For building the portfolio, you will want to perform the following analyses:

- Compute the average returns (as ratios) for all companies.

- Compute the risks (as standard deviations of returns) for all companies.

- Compute the alphas and betas for all companies (for each of the 4 indices).

- Compute the Sharpe Ratios for all companies.

- Put all the results on a single spreadsheet (as an Excel file, or any spreadsheet format that I can open).

- Also plot the Sharpe Ratios for all companies on a single Risk-Return graph (as on page 109, Figure 6.11 of Irene Aldridge's book).

- Sort all companies according to their Sharpe Ratios. Pick the most efficient 5 companies and build your portfolio. Specify how many stocks of each company are there in your portfolio (using the most recent purchase prices).

- Compute the average return, risk, alpha and beta of your portfolio.

- Also compute the marginal contribution of each constituent to the portfolio risk.

- Now, further optimize your portfolio (apply the computation on page 359 of Barry Johnson's book for at least 2 steps to reach an optimal weight vector, w^*). For each step, report the average return, risk, alpha and beta of your resulting portfolio.

During your computations, take prices as OHLC averages. And make sure you use *returns* (and not the prices) when computing the covariance matrices.

You may use MS Excel for analysis and computations, and/or you may prepare software (using any language and any libraries you wish) for the computations. Submit all your excel files, source codes, and executable codes. Also copy all results and prepare them as a Word or PDF report when submitting your solution.

Part Two – Time Series based Prediction (50 points)

For each of the 10 companies mentioned in Part One, and using only the provided 1 year historic data, try to predict what the price (average of OHLC) of each company's stock will be on December 26th, 2016 (the day after the submission deadline ☺). You may use Artificial Neural Networks (Java Neuroph library, libraries in other programming languages, etc.) or any other *scientific* method/algorithm of your choice from the artificial intelligence / machine learning domains.

40 points of this part will be about the predictor system implementation (and a brief explanation of all your decisions), and 10 points will be awarded as how close each student gets to the actual prices on December 26th.

In order to increase your prediction accuracy, you may use Yahoo Finance web services to download the price information again if you need to use the prices between December 2nd, 2016 and December 25th, 2016, which are not provided in the CSV data. However, you are not allowed to use any historic data prior to the year 2016.

Part Three – TradeMaster Investment League - Competition Result (30 bonus points)

Write a short report (1-2 pages) on your competition performance including your competition username, starting balance, ending balance, overall score, rank, the strategies and tactics that you employed, approximate number of transactions you performed, etc.

What to submit?   (Use *only ASCII characters* when naming all of your files and folders)

1. All of your solution (source codes, compiled and ready-to-run executable codes with all required run-time libraries, brief documentation of how to run your solution, reports, etc.) for the first part in a directory named "*Part1*". Please organize your solution in subdirectories and make sure that it is easy to understand your subdirectory structure.

2. Similar directories named "*Part2*" and "*Part3*" for your solutions to the other parts.

Zip the 3 items above (tar also works, but I prefer Windows zip format if possible), name the compressed file as <ID>_<FullNameSurname> (with the correct extension of .zip or .tar) and submit it through COW. For example:

e1234567_SelimTemizer.zip

There are a number of design decisions and opportunities for visual enhancements and creative extensions that are deliberately left open-ended in this homework specification. We have enough time until the deadline to discuss your suggestions and make further clarifications as necessary. There will be bonuses awarded for all types of extra effort. Late submissions will NOT be accepted, therefore, try to have at least a working baseline system by the deadline. Good luck.