# Homework 2

# Efficient Frontier

The Excel file contains the historical price data of DJIA components collected from finance.yahoo.com. The monthly prices are the close prices adjusted for dividends and splits (***Adj Close***).

(1) (20%) Estimate the expected returns and the covariance matrix of the monthly returns. Please use the data ranging from June 2013 to June 2018. The monthly return can be computed as simple return, i.e., $r_t = (P_t - P_{t-1})/P_{t-1}$, and the expected return can be estimated by arithmetic average of monthly returns.

(2) (50%) Determine the mean-variance efficient frontier. Describe the objective function, variables, and constraints of the following conditions:
- (a) (25%) No riskless asset
- (b) (25%) With riskless asset. Assume that $Rf = 0.5\%$. (The monthly return of $Rf$ is therefore 0.5%/12)

Please plot your results on the expected return standard deviation space and in **ONE** figure for comparison purposes.

(3) (15%) Find the minimum-variance portfolio (MVP) constructed by only risky assets and its expected return and standard deviation. Please report the composition (weights) of the MVP and plot the MVP in the figure of Problem (2).

(4) (15%) Assume that $Rf = 0.5\%$. Find the tangency portfolio and its expected return and standard deviation. Please report the composition (weights) of the tangency portfolio and plot the tangency portfolio in the figure of Problem (2).


**Matlab function and syntax:**
1. [num,txt,raw] = xlsread(filename)
2. mean(): Average or mean value of arrays
3. cov(): Covariance matrix
4. '   : Matrix transpose
5. sqrt(): Square root
6. zeros(): To create an array of all zeros. e.g. w=zeros(m,n)
7. length(X): To return the length of vector X
8. for loop
    e.g.
        for j=1:10
            statement
        end

9. To plot efficient frontier or a portfolio, you may use Matlab function plot().

e.g.
plot(P_Stdev, P_Mu,'-o');
where P_Stdev is a vector of portfolio standard deviations and P_Mu is a vector of their corresponding mean returns. '-o' is the LineSpec option that specifies the line type, marker symbol and color: LineStyle is Solid line ('-') and marker type is circle ('o').

To plot the results of (2)(a), (2)(b), (3), and (4) in one figure, you can use "hold on" to retain the current graph when adding new graphs to it.

**<u>Your Matlab program is required and is part of this assignment.</u>**

You have to submit your homework in class and programs by e3. Should you have any question about Matlab, please contact the teaching assistant, Mr. Lai (賴兆旎) at rolla1234567890@gmail.com.