Assignment 2
FIE450

Before you start read the following points carefully!

1. Start your `R`-script with the line `rm(list=ls())`
2. Assign intermediate results of each sub task to the variable names given in parenthesis! Only these variables are considered for grading. If they are not there or misspelled then no points are given for this task.
3. Do not round results
4. The assignment shall be solved in one single `R`-script named `Assignment-2.R`. Only this file needs to be handed in.
5. Briefly comment your are `R`-code
6. Do only use the packages `quadprog` and `Matrix`

Data

Use the data file `FIE450-Assignment-2.RData` for solving the current assignment. The data comprise 1-month Treasury Bill rates (`rf`), S&P 500 index returns (`sp500`) and stock returns of S&P 500 constituents (`stocks`). Note that rates of returns given for month t refer to price changes from month t to $t + 1$.

Task 1

Create a dataframe `df` where each row corresponds to a given month and where the first column refers to the Date (`date`), the second column refers to the excess return of the S&P 500 index (`RM`) and all further columns refer to the excess returns of the stocks in the S&P 500 index.

Task 2

Use the data frame `df` from the previous task to find the optimal mean-variance portfolio that promises an expected excess return of 5% p.a. Make sure that short selling is not permitted and that no stock shall have a weight of more than 10%. Conduct the optimization on 2018-06-30 using the past 60 observations of stock returns. Consider only stocks for which you have observations for the entire 60 month period.

Compute:

1. Estimate the expected excess return of the stocks (`mu2`)
2. Estimate the covariance matrix (`Sigma2`)
3. Estimate the optimal portfolio (`omega2`)
4. Compute the minimum and maximum weight of the optimal portfolio (`min.weight2`, `max.weight2`)
5. Compute the annualized standard deviation of the portfolio (`sigma.p2`)
6. Compute the annualized Sharpe ratio (`sr.p2`)

Task 3

Use the data frame `df` from the first task to backtest a *minimum variance strategy*. A minimum variance strategy is a strategy that invests in the optimal portfolio with the lowest variance. Use an expanding window with initially 60 return observations to estimate a single-index model.

Invest in the optimal portfolio according to the weights and hold the portfolio for one month. Then determine a new optimal minimum variance portfolio using the most recent 60+1 return observations. Rebalance the portfolio accordingly using the new weights. Continue until you reach the end of the sample period. For each round consider only stocks in your estimation that had at least 20 return observations.

Compute:

1. Compute the return series that the optimal minimum variance strategy generates (`R.p3`)
2. Compute the annualized mean of this strategy (`mu.p3`)
3. Compute the annualized standard deviation of this strategy (`sigma.p3`)
4. Compute the annualized Sharpe ratio of this strategy (`sr.p3`)
5. Compute the time-series of the value of the portfolio if you invested 1 kronor at the beginning of the sample period (`V.p3`)
6. Compute the time-series of the number of firms within you portfolio. (`n.p3`)

Task 4

Implement a simplified version of a momentum strategy proposed in Jegadeesh and Titman (1993). A momentum strategy is a strategy where you buy the stocks that have performed well in the recent past and sell the stocks that have performed poorly. To be more precise at the end of each month t compute the cumulative return of each stock using the stock return observations from $t-12$ to $t-2$ (i.e. exclude the last month). Then go long in the 50 stocks that performed best and short the 50 stocks that performed worst. The stocks in the long and short portfolio shall be equally weighted.

Compute:

1. Compute the return series that this momentum strategy generates (`R.p4`)
2. Compute the annualized mean of this strategy (`mu.p4`)
3. Compute the annualized standard deviation of this strategy (`sigma.p4`)
4. Compute the annualized Sharpe ratio of this strategy (`sr.p4`)
5. Compute the time-series of the value of the portfolio if you invested 1 kronor at the beginning of the sample period (`V.p4`)