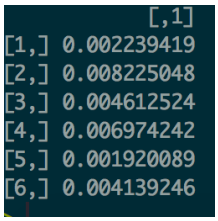
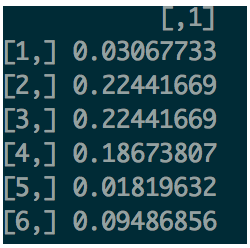
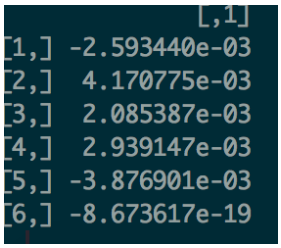


The graph above is the average returns of portfolios, single index model with no short sales allowed perform the highest return, which is 0.008225048; the multgroup model perform the lowest return, which is 0.001920089. Since market return is 0.004139246, the multgroup model (e) and equal allocation (a) model perform below the market S&P 500; the constant correlation model (d), single index model with no short sales allowed (b) and portfolio (c) perform above the market S&P 500.

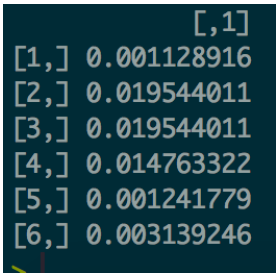
We use sharp ratio, differential return with risk measured by standard deviation, Treynor measure, and differential return with risk measured by beta to do the portfolios' analysis and find the best model with highest return for the period 31-Dec-2008 to 31-Dec-2013.



The sharp ratio for each portfolio above shows that portfolio (b) and portfolio (c) both perform the best result; since the sharp ratio of the market is 0.09486856, the sharp ratio of portfolio (a) and portfolio (e) both bellow the sharp ratio of the market.



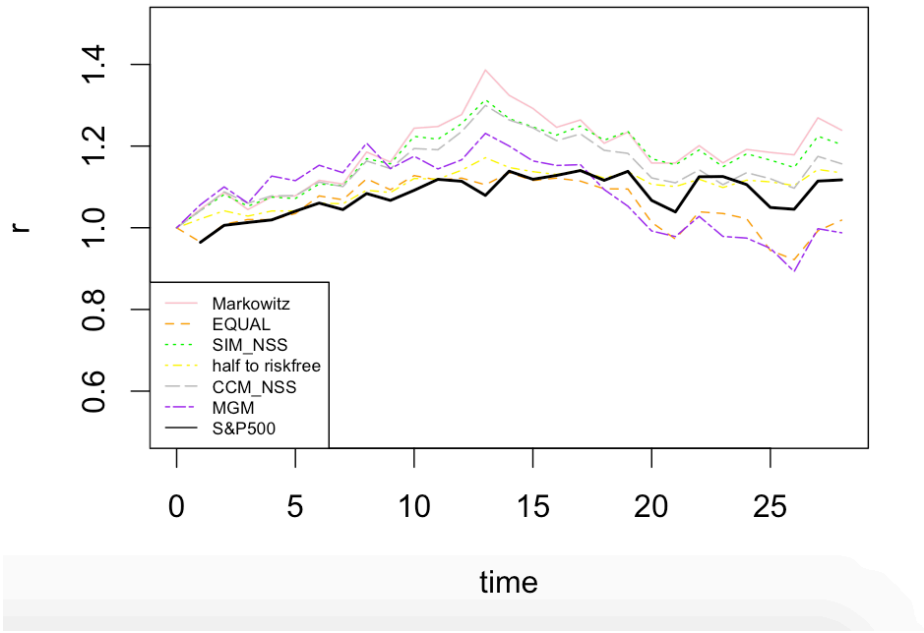
The differential return with risk measured by standard deviation for each portfolio above shows that the portfolio (b) performs the best result, since it has the largest positive standard difference between the portfolio and the market. Also since the returns of portfolio (a) and portfolio (e) is below the market return, the ratios turn to be negative.



The Treynor measure for each portfolio above also shows that the portfolio (b) and portfolio (c) both perform the best among those portfolios. Since the Treynor measure for market is 0.003139246, the Treynor measure of portfolio (a) and portfolio (e) both bellow the Treynor measure of the market.

```
[,1]
[1,] -0.002207108
[2,]  0.006064529
[3,]  0.003032265
[4,]  0.004703890
[5,] -0.001405918
[6,]  0.000000000
```

The differential return with risk measured by beta for each portfolio above shows that the portfolio (b) performs the best among those portfolios. Also since the returns of portfolio (a) and portfolio (e) is below the market return, the ratios turn to be negative.



The plot of the returns of portfolios (a-e) on the space return against time for the period 31-Jan-2014 to 30-Apr-2016 above also proves that single index model perform better than the market for the period Dec-2013 to Dec-2016. The Mutigroup model and equal allocation model perform not so well since the returns of both models turn to be below the market return as time increases.