Introduction to Finance

Coursework Assignment

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1. You can find my code in the file “indiv.Rmd”
   In my coursework I analysed 5 companies: Coca-Cola, Pepsi, Mcdonalds, Unilever and Nestle. I downloaded all data from this website - https://finance.yahoo.com .

   Because of the reason that Nestle has it`s data from 1997, I used the time period from 1997 to 2014.

   My code is divided into parts relative to tasks - You can find the number of the task before each part.

2. I computed the mean, volatility and Sharpe ratio of my chosen stock returns, the market return and investment styles using the entire sample - the table below.

	Mean	Volatility	Sharpe_Ratio
size	0.001750055	0.01671531	0.10469770
value	0.003816952	0.02911217	0.13111191
momentum	0.003474170	0.04517209	0.07690967
investment	0.006849096	0.01965012	0.34855231
pfofitability	0.001905648	0.01961675	0.09714393
low_volatility	0.004149942	0.06056115	0.06852482
return	0.006539908	0.04807245	0.13604275
cola	0.003765292	0.06329546	0.05948754
pepsi	0.005874913	0.05627660	0.10439353
mcd	0.009218010	0.06418064	0.14362601
unilever	0.007916064	0.06430265	0.12310634
nestle	0.010677232	0.05051530	0.21136633

   So, analysing the results, we can see that the best mean return has Unilever, but it also has the largest volatility.
   The Sharpe ratio indicates how well an equity investment performs in comparison to the rate of return on a risk-free investment. The highest Sharpe ratio has Nestle.

3. In the table below You can see the VaR95 of my chosen stock returns, the market return and investment styles. The problem is that I have negative results and I can not explain why. The VaR95 as I know, should hold a positive number.

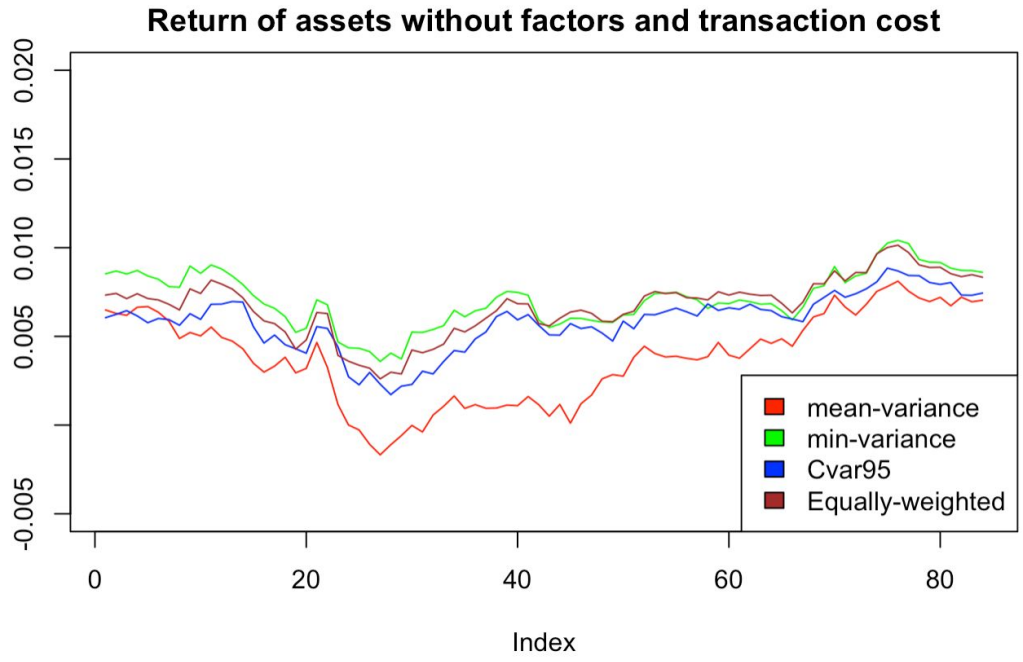
	VaR95 <dbl>
size	-0.02309441
value	-0.04614902
momentum	-0.06270400
investment	-0.01819305
profitability	-0.03076746
low_volatility	-0.08033502
Mkt return	-0.08418815
cola	-0.10761626
pepsi	-0.07801330
mcd	-0.10255466
unilever	-0.10136369
nestle	-0.07591996

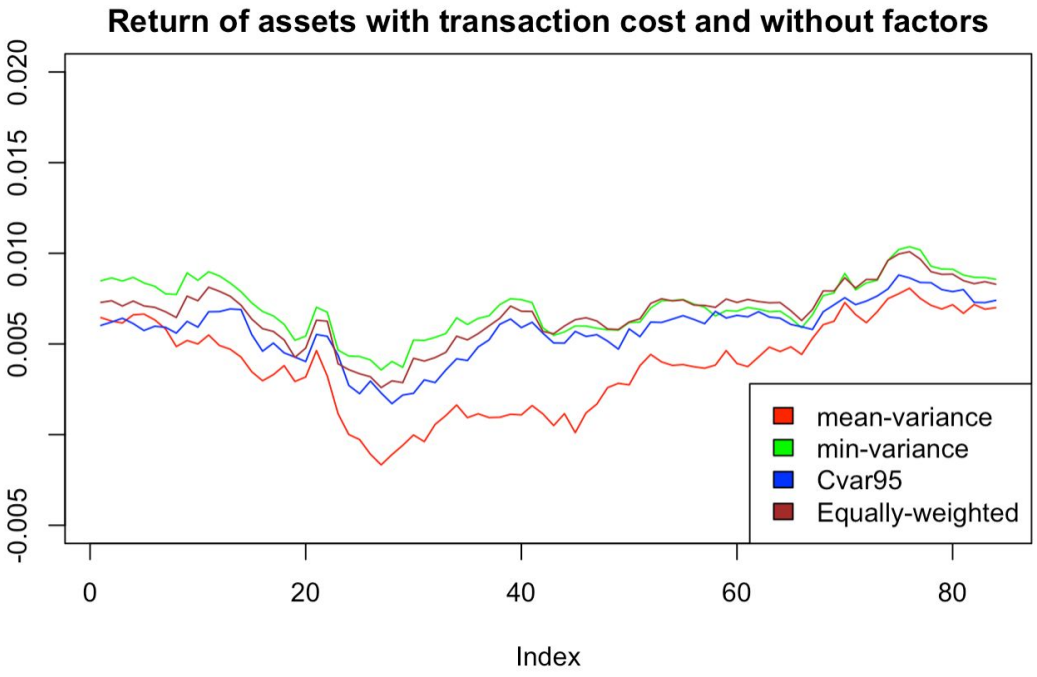
4. Using a rolling window of M = 120 months I ran an out-of-sample analysis where I constructed
   - a mean-variance portfolio with a risk aversion coeffi- cient of 5
   - (ii) a minimum-variance portfolio
   - (iii) a CVaR95 portfolio
   - (iv) an equal-weight portfolio

   that combine the market portfolio and the stock returns of my chosen companies in each estimation window.
   For each estimation window, I constructed an optimal portfolio and repeated this analysis until the end of the sample.
   Also I computed the portfolio returns without transaction costs and when the investor has to pay transaction costs each period. In the latter case, I used a constant transaction cost of κ = 0.5%. Then, computed the mean, volatility and Sharpe ratio obtained for each strategy above.

4.1 I found the returns for each portfolio in every time period and then I plotted them to see the result better. You can see the plots below - Y as returns, X as the time periods -

I have 84 time periods, because I have 204 month of my data and I use the 120 month rolling window.





From plots we can see that equally-weighted and min-variance are the best strategies.

4.2 I found the mean, volatility and Sharpe ratio obtained above with the corresponding statistics of the market return and the investment styles in isolation - You can see it in the table below.

	mean <dbl>	volatility <dbl>	sharpe_ratio <dbl>
return	0.006539908	0.048072450	0.1360427
mean_variance	0.003806473	0.002558492	1.4877800
min_variance	0.007113888	0.001555179	4.5743201
cvar95	0.005820580	0.001596422	3.6460165
equally-weighted	0.006708678	0.001669388	4.0186451

The results from plot are confirmed by statistics - the min-variance portfolio and equally-weighted portfolio have the best mean return and the largest sharpe ratio.

Maybe we can use factor investing to maximize the mean of return and Sharpe ratio for investment styles.

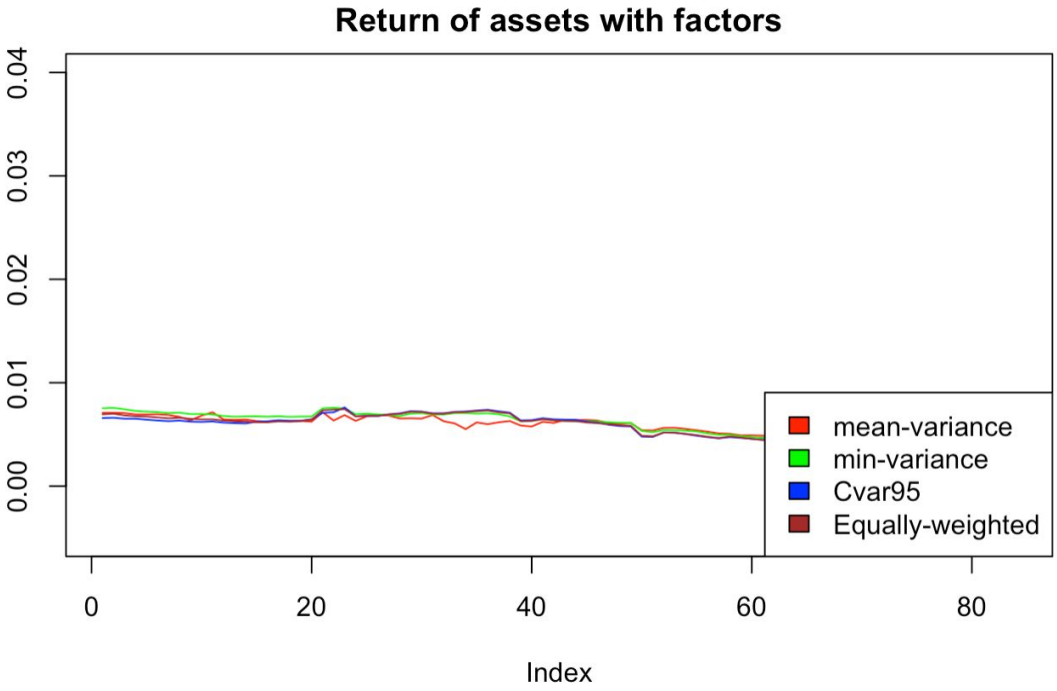
4.3 Using a rolling window of M = 120 months, I ran an out-of-sample analysis where I combined each of the benchmark portfolios from previous part with the six investment styles.

I chose the optimal weights in the six factor portfolios by:

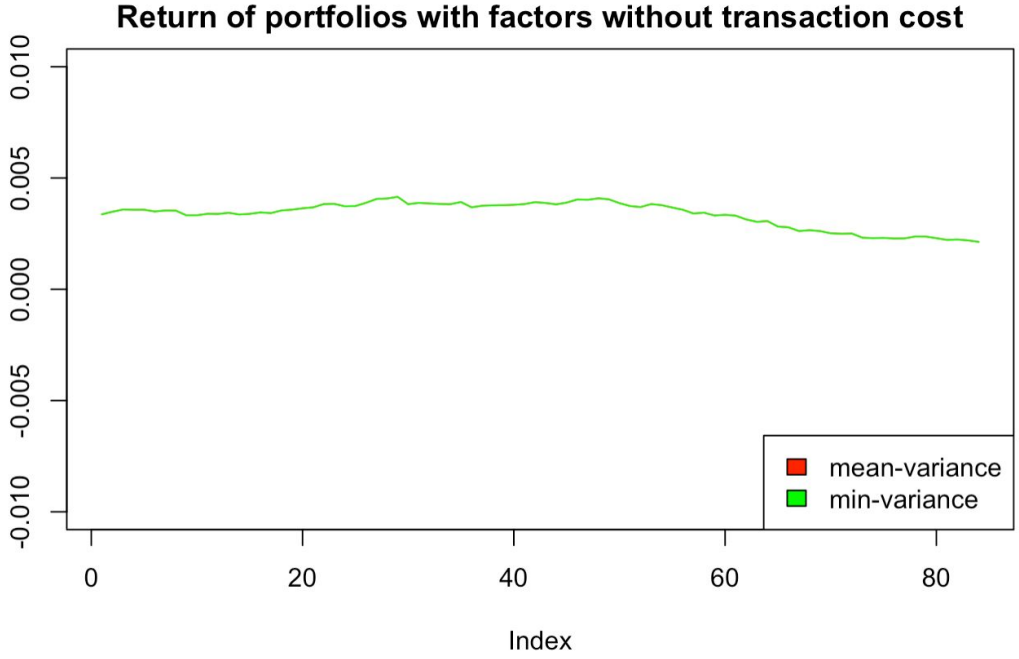
- minimizing the standard deviation of the portfolio return
- maximizing a mean-variance portfolio with a risk aversion coefficient of 5

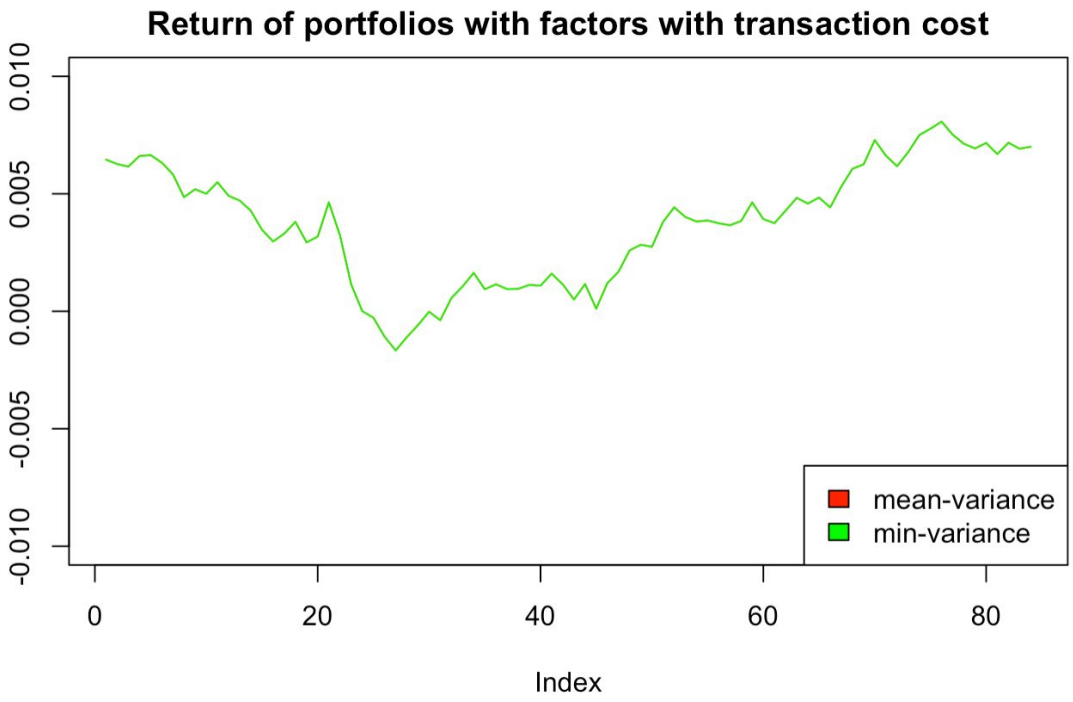
I added the constraint that the sum of all weights on the six factors has to be less than 60%, which is equivalent to imposing a leverage constraint. Also, I added the constraint that the weights on the six factor portfolios are nonnegative.
I constructed the portfolio returns without transaction costs and when the investor has to pay constant transaction cost of κ = 0.5% each period.
I plotted my results - so You can see them below - X and Y axis are the same as in part 4.1 - Y as returns, X as the time periods.

Below is Out-of-sample analysis where I combined each of the benchmark portfolios with the six investment styles



I chose the optimal weights in the six factor portfolios by 1) minimizing the standard deviation of the portfolio return 2) maximizing a mean-variance portfolio with a risk aversion coefficient of 5 . Returns for both strategies are the same.





Below You can see mean coefficients of the six anomalies are exploited by the each portfolio

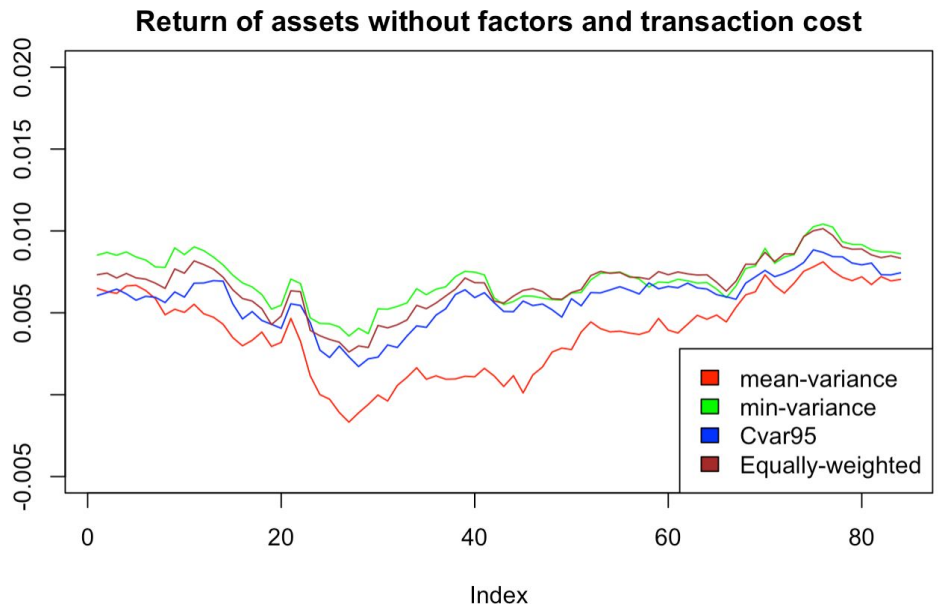
	size <dbl>	value <dbl>	momentum <dbl>	investment <dbl>	profitability <dbl>	low_volatility <dbl>
mean-variance	0.1594984	0.08292977	0.2100785	0	0.1432798	0.004213523
min-variance	0.1631735	0.08367820	0.2249519	0	0.1263550	0.001841375
cvar95	0.2153716	0.06791722	0.1721276	0	0.1406783	0.003905315
equally-weighted	0.2157590	0.08657983	0.1505155	0	0.1448662	0.002279549

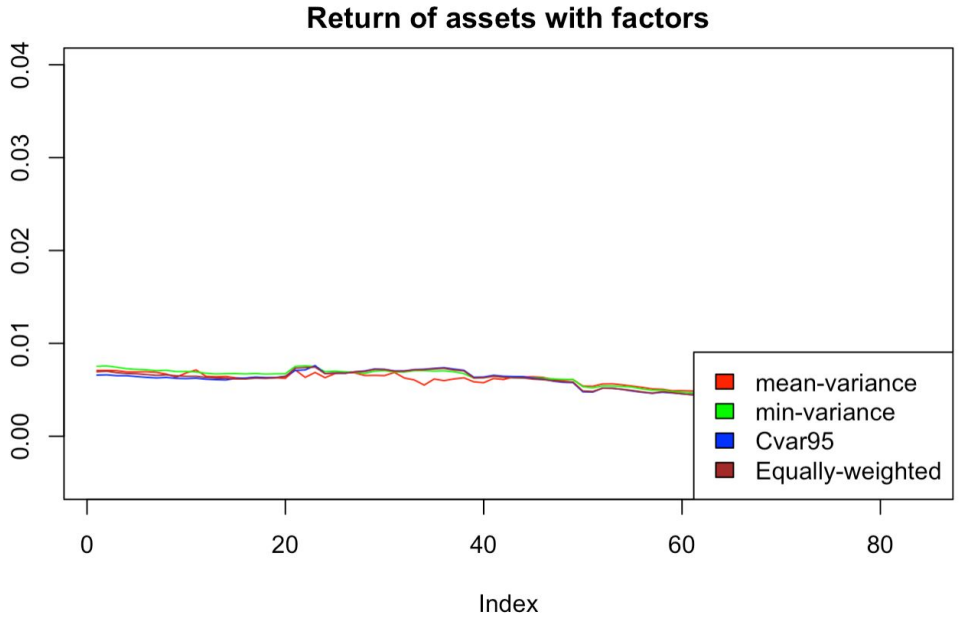
So, we can see that the investment has no impact on any of our portfolios.

Comparing the performance of the resulting mean-variance efficient portfolio with that of the equally weighted portfolio considered in Part 1, we can see that the Sharpe ratio of the mean-variance portfolio is higher than that of the equally weighted portfolio.

	mean <dbl>	volatility <dbl>	sharpe_ratio <dbl>
equally-weighted	0.006708678	0.0016693881	4.018645
mean-variance efficient	0.005714092	0.0009990529	5.719509

Comparing the time evolution of the wealth of an investor who holds this smart-beta portfolio with that of an investor who holds the Markowitz portfolio:





Analysing the plots, we can assume that by holding the smart-beta portfolio investor can minimize the variance of return and can make it more stable,that while holding Markowitz portfolio.

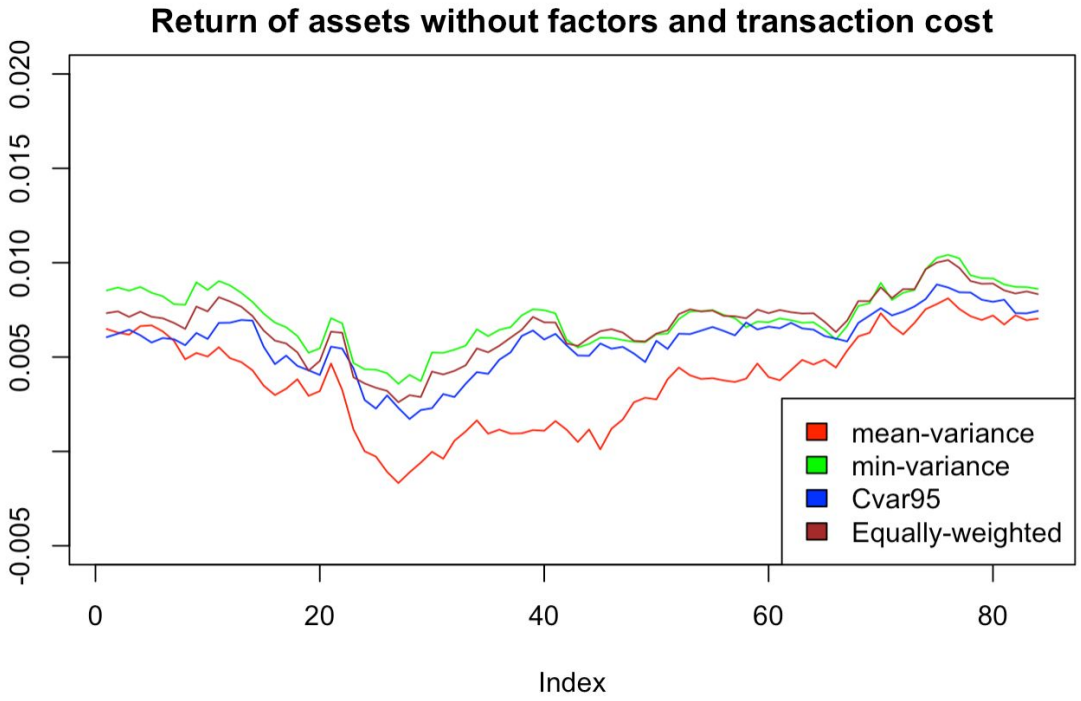
5. Using the out of sample period, I regressed the returns from the strategy that optimally combines the benchmark portfolio and my invest- ment styles on the three factors of Fama and French: the market return, the size and the value.

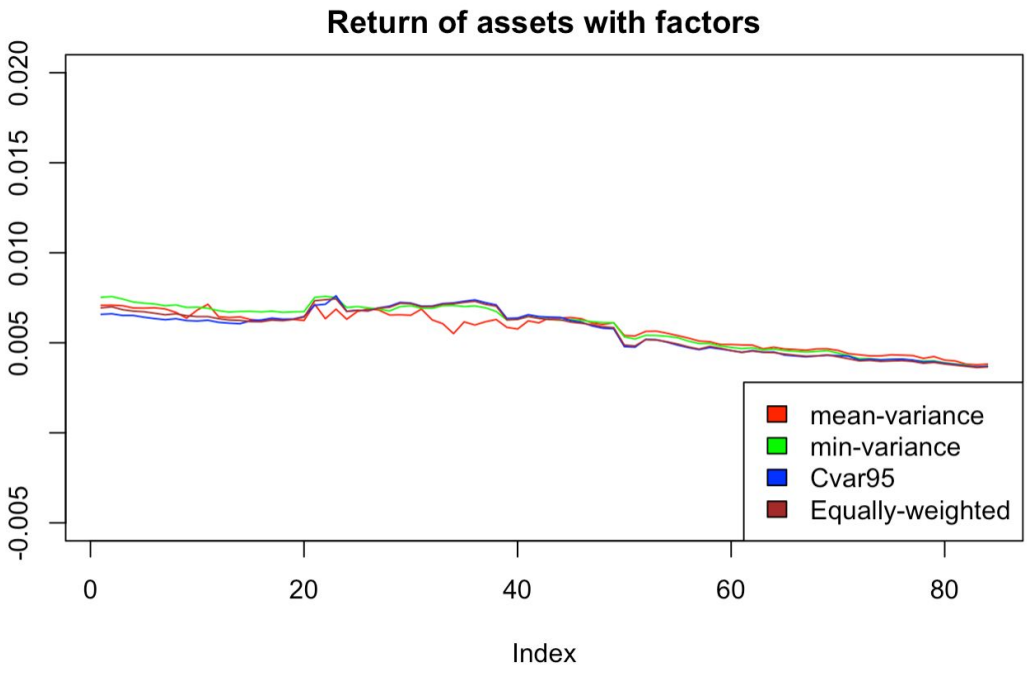
   As the best returns has equally weighted portfolio, I regressed Fama and French model on its return and computed its mean coefficients:

intercept <dbl>	mkt <dbl>	size <dbl>	value <dbl>
0.003914064	0.6245059	-0.7077192	0.3555234

   According to studies conducted by Fama and French revealed that the model can explain more than 90% of diversified portfolios` returns. The hypothesis that over the long-term, small companies overperform large companies, and value companies beat growth companies - analysing our coefficients we can accept this hypothesis - size has large negative effect and value has positive effect on the returns.

6. To clearly seeing the effect of the factors, I reduced the Y interval on the plot of smart-beta portfolio





From these plots we can make a conclusion that holding the smart-beta portfolio reduces the variance of the portfolio and makes the returns more stable. In holding the smart-beta portfolio we can see that the mean-variance portfolio is the best option from the 45th time period, while without factors the best options are minimum variance and equally weighted portfolios.

As You can see, the main problem that the slope of returns from all smart-beta portfolios is negative - in my opinion it can be resulted by the sort of the companies, that I chose - all of them are food companies, and because of the size of the food market and the number of new food companies, we should not use smart-beta portfolio. That is why my choice is to hold the mean variance or the minimum variance Markowitz portfolio.

Conclusions

So, my choice is to hold the Markowitz minimum variance portfolio, because it has the best expected return for next periods.

7. I will show this plot to my boss and say that this is the best option which I have, according to the historical data; also, according to the last periods data, we can predict that this is the best option also for the near future.