Advanced Empirical Finance: Hand-In 1

Marcus Piil Pedersen (xwp674)

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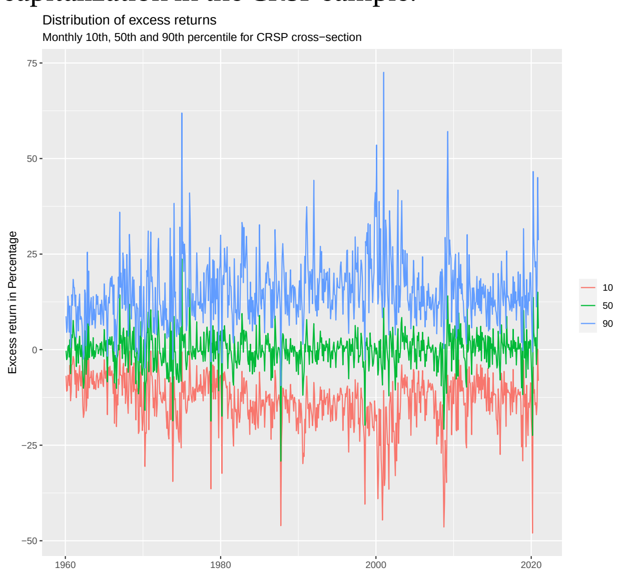
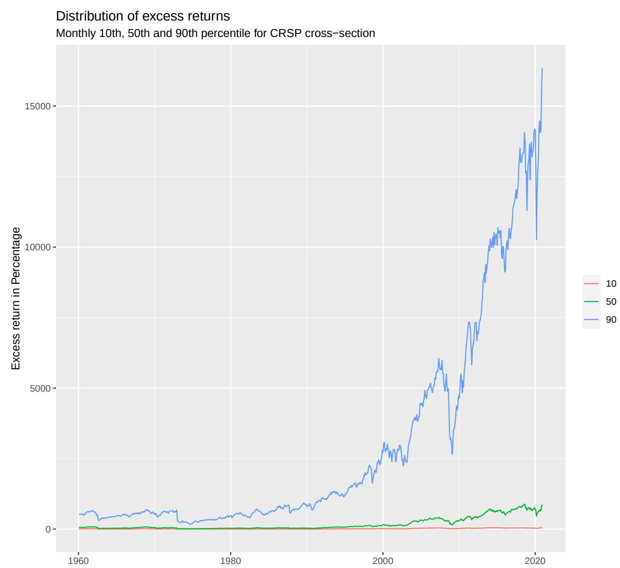
Exercise 1

We start with describing the variables; `permno` is a security/stock identifier. `ret_excess` is the excess return, calculated as returns ($(S_{t+1} - S_t)/S_t$), subtracted with the risk-free rate. `mktcap` is the value of all the firms shares, calculated as share outstanding (`shrout`) times value of stock by end of month (`altprc`). We provide summary statistics of the cross-section of monthly excess returns and market capitalization in the CRSP sample:





Exercise 2

The proposed code will not necessarily work if a stock has data at t, but not at time $t+1$ and then at time $t+2$ again. E.g., if we had excess return on an Apple stock in May 2021, but not in June 2021 and then again in July 2021. In this example, the lagged excess return of July 2021 would be May 2021 data, rather than June 2021 as it is supposed to. This is easily overcome by adding a Boolean logic in the mutate function: `mutate(ret_excess_lag = ifelse((month!=lag(month) + months(1)), as.numeric(NA), lag(ret_excess)))`. The idea of this is that it checks if the previous row's month is exactly one month ago (and that we are observing the same firm). If not, the value return is `NA`.

To access whether there is a significant autocorrelation, we run a linear regression, r_t on r_{t-1}, without intercept. The β is estimated to be -0.0150, and this is statistically significantly with a p-value of

`2.8e-155`, way below 5%. Hence, the regression suggests there is a (rather low) negative, statistically significant (however rather numerically low) auto-correlation in r_t. This indicates there is negative momentum.

Exercise 3

As described earlier, market share is number of share outstanding times value of the stock. If a firm was to increase the number of shares (keeping the value of the firm constant), the stock price would have to decrease, vise versa. This means that changes in the stock prices can be caused by the fundamental value of the firm changing but also because of the number of shares outstanding. Hence, the market share is more appropriate, as it only captures value of the firm.

Statistic of Momentum	Value (%)
Mean of monthly mean	18.91
Mean of monthly standard deviation	92.18
Mean of monthly minimum	-89.06
Mean of monthly 5th quantile	-48.08
Mean of monthly 25th quantile	-16.22
Mean of monthly median	5.61
Mean of monthly 75th quantile	33.00
Mean of monthly 95th quantile	117.72
Mean of monthly maximum	2924.49

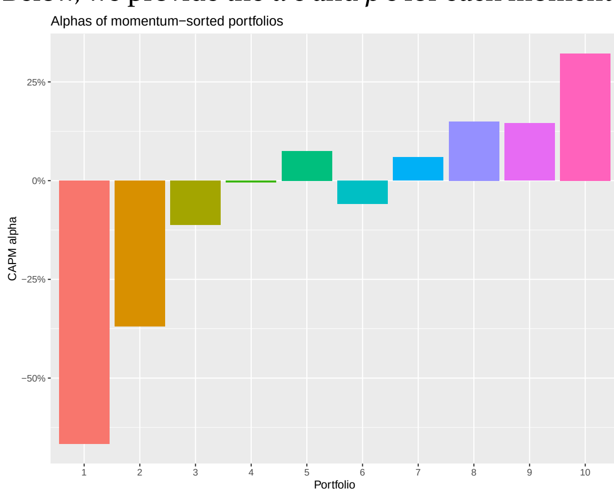
Above, we provide the asked statistics on the momentum. We can read from the table that the mean value of $Mom_{i,t}$ in the average month is 18.91%. Lastly, we find that the momentum has correlation with $\log(mc_{i,t})$ of 0.07, a positive correlation.

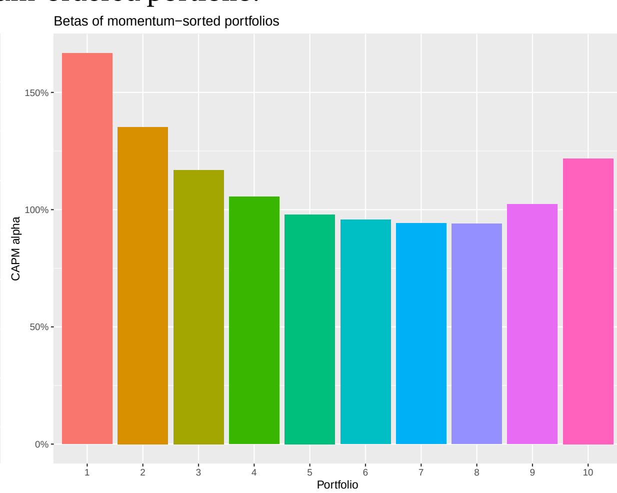
Exercise 4

To understand the portfolios we have created, we give the equally weighted market cap and momentum of each portfolio (across time):

Decile	Momentum Average	Market cap
1	-53.7	290
2	-30.3	907
3	-17.5	1591
4	-7.63	2111
5	1.25	2499
6	10.3	2762
7	20.7	2831
8	34.8	2745
9	59.0	2241
10	183.	1220

Below, we provide the α's and β's for each momentum-ordered portfolio:





Clearly, we see that the 10th decile, the highest-momentum portfolio has the highest α. The low and high momentum portfolios have the highest betas

We run a similar analysis with a linear regression of the longing highest momentum portfolio and shorting the lowest momentum portfolio. We find an α of 0.989. As it is positive the portfolio delivers abnormal excess returns. Furthermore, we find a β of -0.449, meaning the portfolio is not market neutral, but reversely correlated to the market. Lastly, the sharpe ratio (mean excess return divided by the standard deviation of excess return) of the portfolio is 0.0974

Exercise 5

We use the lead function to find the excess returns k-month ahead. We do the same for market cap, because we need to value-weight the excess return with market cap of when we invest. We use the sharpe ratio as the risk-adjusted performance measure. We obtain that:

k	1	3	6	12
Sharpe Ratio	0.16	0.14	0.06	-0.12

We conclude that we obtain the highest risk-adjusted measure for $k = 1$. Furthermore, we observe that the sharpe ratio is higher than the baseline momentum strategy for $k = 1, 3$

1 Exercise 6

Note that a momentum strategy may be quite costly in trading costs, for two primary reasons:

1. Change in portfolio; when a firm experiences a high momentum (around 183%, which is the average monthly momentum of the highest momentum portfolio as shown in the table above) it may not able to maintain such high growth levels. The consequence of this is that majority of our portfolio is being replaced each month, meaning we would have more transactions than if we made a strategy based on size sorts; the largest companies in one month tend to be the largest companies the next month.
2. We saw from the table above that the lowest and highest momentum portfolios have rather low average market caps (290 and 1220 respectively). This makes sense, since the larger the company, the more stable its value is. Another characteristic of smaller firms is that they have fewer stocks/the stocks are less traded, leading to liquidity issues, resulting in higher trading costs. Again, if we traded the largest companies, we would not run into these issues.

An easy way to solve the second problem is to not invest in smaller companies; repeat the method, but without considering the smallest 10%, 20% or 50% of the firms.

Alternatively, we could solve the first issue addressed. Instead of only considering monthly moment, we could consider an average momentum over the last, say 4 months. The momentum numbers will trivially be more stable with this method, leading to less trading. Using this method, we obtain a Sharpe-Ratio of 0.0871, versus the 0.0974 of the baseline momentum strategy.