Mandatory Assignment 1

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General remarks

- You are supposed to hand in one (!) .R or .Rmd script with commented source code and one (!) .pdf report in which you describe your methods and results (e.g. with figures, tables, equations, etc)
- The handed-in .pdf report should have maximum 7 pages in total
- The source code has to create every figure, table and number used for your report. **Figures, tables or numbers in the report that cannot be generated without any effort by the user from your source code are not going to be considered for the evaluation**
- When reporting numbers in your report, please consider a meaningful rounding scheme (there is usually no need to report 6 digits after the comma). Make sure you only use `round()` for the final reported results and not for any intermediate steps
- Within the report describe every major step and make sure that tables and figures are self-explanatory by providing meaningful captions and variable names. You cannot assume that the reader of the report goes through your code in case your description may be confusing
- You increase your chance of helpful feedback as well as your final grade if you provide meaningful comments in the code that explain the purpose of each step
- Minimum requirement: the code needs to run without any error or interruption. Make sure the code loads all required packages in the beginning of the script (you can assume that the user has the packages available locally, so there is no need to include `install.packages()` commands). If your code requires to read-in some data, do not use `setwd()` multiple times but rather once and then provide the relative paths to the files (e.g., `read_csv("data/tidy_finance.sqlite")`). **Hand-ins that do not fulfill this minimum requirement will not receive peer feedback and will not be considered for the final exam**
- The assignments can be written individually or by groups of maximum three students
- The plagiarism rules must be complied and please be aware of the rules for co-written assignments
- All parts must be answered in English, including comments in the code

To qualify for the exam you must no later than the given deadlines during the course:

- Hand in a minimum of 2 out of 3 mandatory assignments
- Provide useful written peer feedback based on specific criteria for a minimum of 2 out of the 3 mandatory assignments to two students from other groups. You have 10 days to provide feedback on the assignments

Deadline to hand in the file on Absalon is **Friday, March 11th, 11pm**.

The momentum effect (inspired by Section 11 of "Empirical Asset Pricing" by Bali, Engle and Murrai, 2016)

Many studies have shown that previous stock returns have the ability to predict future stock returns in the cross section. One of the most prominent such phenomena, documented by Jegadeesh and Titman (1993) and known as the medium-term momentum effect, is that stocks that have performed well in the medium-term past (six to 12 months) are more likely to outperform in the future.

The momentum effect is widely considered a behavioral phenomenon, as including controls for risk in statistical analyses fails to change the result. This mandatory assignment is devoted to an empirical investigation of

the momentum effect. You will start with measurement of momentum. Then you examine of the relation between momentum and future stock returns. Finally, you consider real-world implementation issues of such a momentum strategy.

For that purpose, use the file `tidy_finance.sqlite` (available on Absalon) and collect the monthly CRSP sample. To evaluate portfolio performances, you also need the monthly market excess returns which you can retrieve from the Fama-French 3 factor portfolio returns.

Exercise

1. Read in the monthly CRSP date (`crsp_monthly`) and the monthly market excess returns (`factors_ff_monthly`) from the `tidy_finance.sqlite` database. Very briefly state the definition of the variables `permno`, `ret_excess` and `mktcap`. Provide suitable summary statistics of the cross-section of monthly excess returns and market capitalization in the CRSP sample.

2. Generate a new column `ret_excess_lag` which contains the previous month excess return for the same firm for each row in the sample. Briefly state why `crsp_monthly %>% group_by(permno) %>% mutate(ret_excess_lag = lag(ret_excess))` does *not* provide the correct result if `crsp_monthly` contains implicitly missing values (i.e. `permno-month` combinations that are simply not present in the data). Report suitable summary statistics or visualizations that show if returns r_t and r_{t-1} exhibit autocorrelation that is significantly different from zero. What do your results imply? Is there short-term momentum?

3. Generate a new column `mktcap_lag_12` which contains the firms' market capitalization 12-month prior to the measurement date. Compute the momentum of stock i as the relative change in market capitalization, represented in percentage terms (1.00 is a 1% return) during the period covering months $t-12$ until $t-1$. Specifically, if $mc_{i,t}$ denotes the market capitalization of stock i in month t, compute momentum as
$$Mom_{i,t} = 100\left(mc_{i,t-1} - mc_{i,t-12}\right)/mc_{i,t-12}.$$
Note that `crsp_monthly` already contains a column `mktcap_lag` with $mc_{i,t-1}$. Briefly discuss the difference between computing momentum as the relative change in *prices* or as the relative change in *market capitalization*.
Create summary statistics for $Mom_{i,t}$ as follows: Each month, compute the mean, standard deviation, minimum, fifth percentile, 25th percentile, median, 75th percentile, 95th percentile, and maximum values of the cross-sectional distribution of $Mom_{i,t}$. Then, report the time-series means for each cross-sectional value. What is the mean value of $Mom_{i,t}$ in the average month? What is the cross-sectional standard deviation? Does momentum exhibit a positive correlation with $\log(mc_{i,t})$?

4. Next, examine the relation between momentum and future stock returns. For that purpose, perform univariate portfolio sorts in the following way:

- Compute monthly portfolio breakpoints. Each month, use $Mom_{i,t}$ as a sorting variable. The portfolio breakpoints are the deciles of $Mom_{i,t}$ calculated using all stocks i in the sample during month t.
- To help understand the characteristics of the stocks comprising each of the $Mom_{i,t}$ sorted portfolios, present the equal-weighted average values of $Mom_{i,t}$ and $mc_{i,t}$ for each of the 10 portfolios.
- Compute value-weighted monthly excess returns for the decile portfolios. Report the average excess return, the CAPM alpha and the market beta for the 10 momentum sorted portfolios. Finally, analyse the momentum strategy: a portfolio that goes long past winners (the highest decile) and short past losers (the lowest decile). What do you conclude about the performance of the momentum strategy? Is the strategy market neutral (i.e., does it exhibit a market beta which is zero)? Does the strategy deliver abnormal excess returns (i.e., a positive alpha)?

5. One of the main conclusions in the momentum literature is that the timing of the measurement of momentum plays a substantial role in the nature of the relation between momentum and future stock returns. To assess this in more detail and to examine whether momentum has the ability to predict returns further in the future than the next month, repeat the univariate portfolio sorts but this time

using the k-month-ahead excess return as the outcome variable for values of $k \in \{1, 3, 6, 12\}$. For which time-horizon does the momentum deliver the highest risk-adjusted performance?

6. Most academic studies ignore real world costs and other forms of slippage when examining factors, which is likely a larger issue for momentum due to its higher turnover. The concern is that momentum is so costly to trade that its return premium is diminished in the real world. First, based on your findings in 1. and 3., briefly explain why you think a momentum strategy could be costlier to trade than, say, a strategy based on size sorts. Then, propose an alternative strategy that may be able to effectively capture the momentum premium but which at the same time delivers lower trading costs, e.g. because the turnover is smaller, the strategy takes less extreme (short) positions or is tilted towards stocks that are cheaper to trade. Describe the strategy and implement it within the CRSP sample. Report the resulting Sharpe-ratio and average turnover and compare to the *baseline* momentum strategy from exercise 4.