

Big Data in Finance: Part IV

Homework 7: Momentum Factor

April 4, 2025

Instructor: Kirsten Burr, kburr26@gsb.columbia.edu

TAs: Dian Jiao (dj2526@columbia.edu), Varuun Deshpande (vdeshpande25@gsb.columbia.edu)

Due: April 10, 2025, by 11:59 pm. Late submission will not be accepted.

Goal: Create investable portfolios from a characteristic that has traditionally been associated with future returns: the past performance. The momentum strategy is the one that invests in a portfolio that goes long stock with high past performance (high past returns) and short the ones with low performance (low past returns). Your goal in this homework is to calculate the cumulative returns of the momentum portfolio from 1970.

Delivery: Please submit the homework using the template python file (*submission_momentumfactor.py*) provided on canvas, along with the output graphs from below, to Gradescope.

Tips for submission: You are required to fill in code wherever you see a “TODO” in the python script. Look at the “main()” in the script to understand the flow, the sequence should match the homework questions below. Please do not change any of the names (of the files, any of the functions, output files and graphs), as well as the order in which values are returned from each function. Feel free to email the TAs if you have any questions or difficulties with this.

Setup

For this homework you need the fire_pytools package that you can find in the Bitbucket repository [here](#).

fire_pytools stands for (FI)nance (RE)search python tools and contains a bunch of useful functions, including data download, portfolio sorts, etc.

You should save the fire_pytools in folder in your computer and adapt the code below with the path for the package.

If you decide to download the `fire_pytools` to separate folder and you are using PyCharm, the best way to use an external library in pycharm is by adding the library PATH to your project. Check [here](#) if you have problems.

Calculate past 11-1 returns

In order to calculate the momentum factor, first we need to calculate the "past cumulative returns". This is the only characteristic that you need to construct yourself. But the code is already here for you.

The original Carhart (1997) paper offers many windows of cumulating returns and months to be skipped before the formation date. In the code we have adopted the notation `ret_window_skip`, where `window` is the number of months to cumulate the returns and `skip` is the number of months to be skipped before this return is used for sorting.

`ret_11_1` is the 11 months cumulative returns, skipping 1 month, or, it is cumulative returns from 12 months before to one month before the formation date. This is the characteristic we are going to use to calculate the MOM factor.

Be careful, the `ret_window_skip` notation is not to be confused with the Ken French notation. Since we are going to hold it for the following month, when Ken French report returns, he calls them: "portfolios formed on prior (2-12) return". Again, this for portfolio holding returns, not sorts.

Make sure to be mindful about missing returns. We are going to follow the convention in Daniel and Moskowitz, JFE 2016, that says: "We require that a firm ... [has] a minimum of eight monthly returns over the past 11 months, skipping the most recent month". That means that if there are less than eight valid returns in the 11-period, we should set `ret_11_1` equal to missing.

Portfolio Sorts

Your task in this question is to do portfolio sorting. Use the function "`sort_portfolios`" to sort stocks into portfolio buckets.

Check Ken French's website for Mom factor description.

1. Every end of month, sort stocks into 2 X 3 buckets according to ME and `ret_11_1`. We follow Ken French website, and use 50th percentile for ME and 30th and 70th percentiles for `ret_11_1`. After sorting, print the ME and `ret_11_1` portfolios Apple belonged to each month in 2023.
2. Calculate the ME value weighted returns for each of the 6 portfolios sorted, and report the returns for each portfolio in 2024. Make sure that, for every month, you use information that is available for investors at the time of portfolio formation. Plot the cumulative log returns for each of them.

3. Calculate the MOM returns, and report the returns in 2024. From Ken French website: Mom is the average return on the two high prior return portfolios minus the average return on the two low prior return portfolios,

$$Mom = \frac{1}{2}(SmallHigh + BigHigh) - \frac{1}{2}(SmallLow + BigLow).$$

4. Plot the cumulative returns for the Mom portfolio and report the average returns, standard deviation and Sharpe-Ratio.

Part III: High profitability stock returns

Compare with Fama and French (Ken French website) Download Ken French's **Momentum Factor (Mom)** from Ken French's website. Compare your momentum factor to the data from Fama and French. Report the correlation between the two series, and plot the two series on the same chart for comparison.