Exercise 2: Momentum Strategy

Learning Objective

By the end of this exercise, you should:

- ✓ Understand how to implement momentum trading strategies
- ✓ Understand Loops in SAS

Part 1. Reading

Read the classic paper by Jegadeesh and Titman (1993) that first documents momentum in the US equity market. You only need to read Introduction, Section I, and Section II of this paper.

Part 2. Learn WRDS sample code of momentum strategy

In this part, you are going to run the sample code of momentum strategy on WRDS that replicates the key results in Jegadeesh and Titman (1993). Make sure you can understand the process of implementing a momentum strategy, since this is a typical way to show a return pattern.

For python users: please use mom.ipynb

For SAS users: Additional notes for the sample code:

- In Step 3, you will see a procedure called proc expand, which is used to calculate cumulative past returns. I suggest using proc sql to calculate cumulative past returns (see following codes):

```
* Initial setups;
%let J=6;
%let K=6;

%let begdate=01JAN1963;
%let enddate=31DEC1989;

* Import MSF. This is similar to Step 1&2 in the sample code;
data msf;
  set crsp.msf2018;
  if "&enddate."d >= date >= "&begdate."d and shrcd in (10,11) and exchcd
in (1,2); /* Apply sample filter */
  if dlret ne . then ret = sum(1,dlret)*sum(1,ret)-1; /* This is to
adjust delisting returns */
  ym = year(date)*12+month(date); /* Generate a year-month index */
  keep permno date ym ret dlret prc shrout exchcd;
run;

* Compute Past J-month returns (Including return in current month);
proc sql;
  create table msf2 as
```

```
  select distinct a.*, exp(sum(log(1+b.ret)))-1 as cret_p&J.,
count(b.ret) as obs
  from msf as a left join msf as b
  on a.permno = b.permno and &J -1 >= a.ym - b.ym >= 0
  group by a.permno, a.ym;
quit;

* Require past J-month returns to be calculated without missing returns
in any month;
data msf2;
  set msf2;
  if obs < &J then cret_p&J. = .;
run;
```

- Each month we form winner/loser portfolios and hold the portfolios for 6 months. How do we calculate average monthly returns for the winner/loser portfolio and compute the associated t-statistics in the sample period?
  Suppose our sample period is from month t=1 to t=100. The naïve way is: in each month *t*, we calculate the average monthly portfolio return in the forward six months (t+1~t+6), then we take the average of six-month forward return in the sample period t=1 to 100 as the average monthly returns for the portfolio. However, we cannot do statistical inference (t-statistics) in a naïve way. To see this, suppose you are running the following regression:
  Forward_Ret(t) = Intercept + e(t),
  where Forward_Ret(t) is the six-month forward return for a portfolio in month t, the Intercept would be the estimated average monthly portfolio returns in the six-month forward holding period. e(t) would contain the innovations in returns during month t+1~t+6. Note that e(t-1) would contain the innovations in returns during month t~t+5. Hence, e(t) would be correlated with e(t-1) and the i.i.d. assumption for the error term is violated. In other words, we cannot compute standard errors and t-statistics for the Intercept in the naïve way. If we use this naïve way, you will get a correct point estimate for the portfolio return, but we will have a inflated t-statistic. This is a typical problem associated with overlapping portfolios. If we form portfolio every month and hold the portfolio only for 1 month, we would not have overlapping portfolio, and thus no concern about this issue.

  Jegadeesh and Titman (1993) deal with the overlapping portfolio problem through tracking the calendar time portfolio returns. Specifically, for a J=6, K=6 momentum strategy, in each holding period we will have 6 winner/loser portfolios formed in 6 different months. In each month *t*, we compute the average portfolio returns for the 6 winner/loser portfolios formed at different time as the calendar time portfolio return for the winner/loser portfolios in month *t*. Then, in the sample period t=1 to 100, we will have 100 calendar time portfolio returns

for the winner/loser portfolios. We compute mean of the 100 returns as average monthly returns of winner/loser portfolios and we can use the naïve t-statistics associated with the mean for statistical inference. This is exactly what the sample code does. Please make sure you understand this econometric issue.

Part 3. Extensions

Part 3.1. Extension 1: Simple loop using SAS Macro

At the beginning of WRDS sample code, you need to specific J (formation period) and K (holding period) for the momentum strategy. In Panel A of Table 2 of Jegadeesh and Titman (1993), they report results for J=3/6/9/12 and K=3/6/9/12. For each (J,K) combination, they report average monthly returns and t-statistics for the winner/loser/winner-minus-loser portfolios. Thus, Panel A of Table 2 reports a total of 96 numbers. You are going to replicate this table using SAS Macro to loop over J=3/6/9/12 and K=3/6/9/12. (Search *Loops in SAS* in Google for reference)

In Panel B of Table 2, they skip one week between portfolio formation and portfolio holding period. You are going to do it in a simpler way (also more common way nowadays) by skipping one month between portfolio formation and portfolio holding period. For example, for a J=6 and K=6 momentum strategy, at the beginning of month *t*, you compute cumulative returns for each firm during month t-6~t-2 (5 months in total) as the sorting variable. In this sense, returns in month t-1 is skipped. Then you hold the portfolios from month t to month t+5. You need to re-do Panel B of Table 2 by skipping one month instead of one week.

Part 3.2. Extension 2: Intermediate momentum

Novy-Marx (2012) documents that momentum is primarily driven by firms' performance 12 to seven months prior to portfolio formation. You are going to read Novy-Marx (2012) (no need to read full paper) and replicate Panel A of Table 4 which reports the excess returns of portfolios double-sorted by recent momentum and intermediate momentum.

Notes:

- The author conducts independent double-sorts. For example, to produce a 5X5 portfolios through independently double-sorting on X1 and X2, you first sort all stocks into 5 groups based on X1, then you sort all stocks into 5 groups based on X2. Then the intersections of the 5 portfolios sorted by X1 and 5 portfolios sorted by X2 give you 25 independently double-sorted portfolios.
- Excess returns of a portfolio=Raw portfolio returns – risk-free rate. To get monthly risk-free rate, you log in WRDS, click into "Get Data" – "All Data" and get into the page showing all WRDS data. You can search "Fama" and find the page for downloading monthly Fama-French three factors. In this dataset, the variable RF is the monthly risk-free rate. Another source for this data is from Professor French's website:

https://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html
Please note that you don't need to subtract risk-free rate from the long-short return, since the long-short return is already excess return.

Part 4. Submission of results

You need to submit two tables for me:

- Replication of Table 2 in Jegadeesh and Titman (1993), as described in the Part 3.1 of this document.
- Replication of Panel A of Table 4 in Novy-Marx (2012).

Please send these tables to the public email:
hqsas19@163.com
hqsas2019