

Problem Set 3

Name: Huanyu Liu

Names of whom I discussed this problem set with: Nanhao Wang

Question 1

Using CRSP stock data, define the universe of monthly returns that can be used in calculating momentum portfolios, as well as their ranking return, following the procedure in Daniel and Moskowitz (2016) 1. Your output should be from 1927-2018.

1. Universe of stocks: I restrict the sample to common shares (share codes 10 and 11) and to securities traded in the New York Stock Exchange, American Stock Exchange, or the Nasdaq Stock Exchange (exchange codes 1, 2, and 3).

2. Missing returns: First, I replace all letters in returns and delisting returns to NA. Next, I use the rule that, Holding period returns: $r_{i,t}^h$, Delisting returns: $r_{i,t}^d$

$$r_{i,t} = \begin{cases} r_{i,t}^h & \text{if } r_{i,t}^d \text{ missing} \\ r_{i,t}^d & \text{if } r_{i,t}^h \text{ missing} \\ (1 + r_{i,t}^h)(1 + r_{i,t}^d) - 1 & \text{if both not missing} \end{cases}$$

If both are missing, remove those rows. And remove all those rows with price NA.

3. Market Capitalization: Absolute value of price multiply shares outstanding. Then group-by PERMNO of each firm and shift down to get the value of previous month.
4. Ranking returns: cumulative log return $\log(1 + \text{Ret})$ from month t-12 through month t-2.

Output of question 1:

	Year	Month	PERMNO	EXCHCD	lag_Mkt_Cap	RET	Ranking_Ret
0	1986	1	10000	3	NaN	NaN	NaN
1	1986	2	10000	3	1.61E+04	-0.257143	NaN
2	1986	3	10000	3	1.20E+04	0.365385	NaN
3	1986	4	10000	3	1.63E+04	-0.098592	NaN
4	1986	5	10000	3	1.52E+04	-0.222656	NaN
5	1986	6	10000	3	1.18E+04	-0.005025	NaN
6	1986	7	10000	3	1.17E+04	-0.080808	NaN
7	1986	8	10000	3	1.08E+04	-0.615385	NaN
8	1986	9	10000	3	4.15E+03	-0.057143	NaN

9	1986	10	10000	3	3.91E+03	-0.242424	NaN
10	1986	11	10000	3	3.00E+03	0.06	NaN
11	1986	12	10000	3	3.18E+03	-0.377358	NaN
12	1987	1	10000	3	1.98E+03	-0.212121	NaN
13	1987	2	10000	3	1.58E+03	0	-2.138282
14	1987	3	10000	3	1.58E+03	-0.384615	-2.079441
15	1987	4	10000	3	9.73E+02	-0.0625	-2.390877
16	1987	5	10000	3	9.12E+02	-0.066667	-2.772587
17	1987	6	10000	3	8.52E+02	0	-2.585254
18	1986	1	10001	3	NaN	NaN	NaN
19	1986	2	10001	3	6.03E+03	0.020408	NaN
20	1986	3	10001	3	6.16E+03	0.0252	NaN
21	1986	4	10001	3	6.22E+03	0.009901	NaN
22	1986	5	10001	3	6.28E+03	-0.009804	NaN
23	1986	6	10001	3	6.22E+03	-0.013069	NaN
24	1986	7	10001	3	6.03E+03	-0.010204	NaN
25	1986	8	10001	3	5.97E+03	0.072165	NaN
26	1986	9	10001	3	6.40E+03	-0.003077	NaN
27	1986	10	10001	3	6.32E+03	0.039216	NaN
28	1986	11	10001	3	6.57E+03	0.056604	NaN
29	1986	12	10001	3	6.94E+03	0.015	NaN
...
3545347	2016	7	93436	3	3.14E+07	0.106039	-0.183756
3545348	2016	8	93436	3	3.49E+07	-0.097023	-0.226156
3545349	2016	9	93436	3	3.16E+07	-0.03764	-0.059004
3545350	2016	10	93436	3	3.06E+07	-0.030878	-0.158409
3545351	2016	11	93436	3	2.96E+07	-0.042128	-0.014116
3545352	2016	12	93436	3	2.84E+07	0.128247	-0.152309
3545353	2017	1	93436	3	3.45E+07	0.178951	-0.236822
3545354	2017	2	93436	3	4.07E+07	-0.007701	0.111205
3545355	2017	3	93436	3	4.04E+07	0.113244	0.272019
3545356	2017	4	93436	3	4.57E+07	0.12853	0.08434
3545357	2017	5	93436	3	5.16E+07	0.085777	0.144897
3545358	2017	6	93436	3	5.60E+07	0.060409	0.341411

3545359	2017	7	93436	3	6.03E+07	-0.105473	0.474004
3545360	2017	8	93436	3	5.40E+07	0.100257	0.431873
3545361	2017	9	93436	3	5.94E+07	-0.041585	0.422471
3545362	2017	10	93436	3	5.73E+07	-0.028056	0.556382
3545363	2017	11	93436	3	5.57E+07	-0.06841	0.545272
3545364	2017	12	93436	3	5.19E+07	0.008095	0.559856
3545365	2018	1	93436	3	5.26E+07	0.13798	0.368329
3545366	2018	2	93436	3	5.98E+07	-0.031752	0.211766
3545367	2018	3	93436	3	5.79E+07	-0.224246	0.348752
3545368	2018	4	93436	3	4.52E+07	0.104347	0.209206
3545369	2018	5	93436	3	4.99E+07	-0.031201	-0.165629
3545370	2018	6	93436	3	4.83E+07	0.204474	-0.148671
3545371	2018	7	93436	3	5.85E+07	-0.13066	-0.239024
3545372	2018	8	93436	3	5.09E+07	0.011806	0.058479
3545373	2018	9	93436	3	5.15E+07	-0.12229	-0.177086
3545374	2018	10	93436	3	4.54E+07	0.274011	-0.122874
3545375	2018	11	93436	3	5.79E+07	0.039013	-0.224856
3545376	2018	12	93436	3	6.02E+07	-0.050445	0.088176

Question 2

Define the monthly momentum portfolio decile of each stock as defined by both Daniel and Moskowitz (2016) and Kenneth R. French. Your output should be from 1927-2018.

1. DM decile: For each month, rank each firm's ranking return. we set our breakpoints so that there are an equal number of firms in each portfolio. And the ranking return is from low to high with decile 1 to decile 10.
2. KRF decile: Create breakpoints based on only NYSE stocks ranking return. Then divide all the returns based on those breakpoints into 10 deciles, with decile 1 the lowest and decile 10 the highest. If a firm's ranking return is lower than the first breakpoint, it would be classified as decile 1, and if a firm's ranking return is higher than the last breakpoint, it would be considered as decile 10.

Output of question 2

	Year	Month	PERMNO	lag_Mkt_Cap	RET	DM_decile	KRF_decile
0	1986	1	10000	NaN	NaN	NaN	10
1	1986	2	10000	1.61E+04	-0.257143	NaN	10

2	1986	3	10000	1.20E+04	0.365385	NaN	10
3	1986	4	10000	1.63E+04	-0.098592	NaN	10
4	1986	5	10000	1.52E+04	-0.222656	NaN	10
5	1986	6	10000	1.18E+04	-0.005025	NaN	10
6	1986	7	10000	1.17E+04	-0.080808	NaN	10
7	1986	8	10000	1.08E+04	-0.615385	NaN	10
8	1986	9	10000	4.15E+03	-0.057143	NaN	10
9	1986	10	10000	3.91E+03	-0.242424	NaN	10
10	1986	11	10000	3.00E+03	0.06	NaN	10
11	1986	12	10000	3.18E+03	-0.377358	NaN	10
12	1987	1	10000	1.98E+03	-0.212121	NaN	10
13	1987	2	10000	1.58E+03	0	1	1
14	1987	3	10000	1.58E+03	-0.384615	1	1
15	1987	4	10000	9.73E+02	-0.0625	1	1
16	1987	5	10000	9.12E+02	-0.066667	1	1
17	1987	6	10000	8.52E+02	0	1	1
18	1986	1	10001	NaN	NaN	NaN	10
19	1986	2	10001	6.03E+03	0.020408	NaN	10
20	1986	3	10001	6.16E+03	0.0252	NaN	10
21	1986	4	10001	6.22E+03	0.009901	NaN	10
22	1986	5	10001	6.28E+03	-0.009804	NaN	10
23	1986	6	10001	6.22E+03	-0.013069	NaN	10
24	1986	7	10001	6.03E+03	-0.010204	NaN	10
25	1986	8	10001	5.97E+03	0.072165	NaN	10
26	1986	9	10001	6.40E+03	-0.003077	NaN	10
27	1986	10	10001	6.32E+03	0.039216	NaN	10
28	1986	11	10001	6.57E+03	0.056604	NaN	10
29	1986	12	10001	6.94E+03	0.015	NaN	10
...
3545347	2016	7	93436	3.14E+07	0.106039	4	4
3545348	2016	8	93436	3.49E+07	-0.097023	4	3
3545349	2016	9	93436	3.16E+07	-0.03764	4	4
3545350	2016	10	93436	3.06E+07	-0.030878	3	2
3545351	2016	11	93436	2.96E+07	-0.042128	5	4

3545352	2016	12	93436	2.84E+07	0.128247	4	3
3545353	2017	1	93436	3.45E+07	0.178951	2	1
3545354	2017	2	93436	4.07E+07	-0.007701	4	3
3545355	2017	3	93436	4.04E+07	0.113244	6	6
3545356	2017	4	93436	4.57E+07	0.12853	4	4
3545357	2017	5	93436	5.16E+07	0.085777	5	5
3545358	2017	6	93436	5.60E+07	0.060409	8	9
3545359	2017	7	93436	6.03E+07	-0.105473	9	10
3545360	2017	8	93436	5.40E+07	0.100257	9	10
3545361	2017	9	93436	5.94E+07	-0.041585	9	10
3545362	2017	10	93436	5.73E+07	-0.028056	10	10
3545363	2017	11	93436	5.57E+07	-0.06841	9	10
3545364	2017	12	93436	5.19E+07	0.008095	10	10
3545365	2018	1	93436	5.26E+07	0.13798	9	9
3545366	2018	2	93436	5.98E+07	-0.031752	7	7
3545367	2018	3	93436	5.79E+07	-0.224246	9	9
3545368	2018	4	93436	4.52E+07	0.104347	8	7
3545369	2018	5	93436	4.99E+07	-0.031201	3	2
3545370	2018	6	93436	4.83E+07	0.204474	3	2
3545371	2018	7	93436	5.85E+07	-0.13066	2	2
3545372	2018	8	93436	5.09E+07	0.011806	5	5
3545373	2018	9	93436	5.15E+07	-0.12229	2	1
3545374	2018	10	93436	4.54E+07	0.274011	3	2
3545375	2018	11	93436	5.79E+07	0.039013	2	2
3545376	2018	12	93436	6.02E+07	-0.050445	7	8

Question 3

Calculate the monthly momentum portfolio decile returns as defined by both Daniel and Moskowitz (2016) and Kenneth R. French. Your output should be from 1927-2018.

1. DM Ret: Every month, for each decile, calculate the value weighted return. And the weight is the lagged market cap of each firm divided by the total market capitalization within the same month and same decile.
2. KRF Ret: It's similar to DM Ret except that the KRF decile is used to calculate KRF Ret instead of DM decile.

3. RF is from FF_mkt with the values divided by 100, so that the all the values are formatted in decimal (not percent)

Output of question 3

	Year	Month	RF	decile	DM_Ret	KRF_Ret
0	1927	1	0.0025	1	-0.032149	-0.032149
1	1927	1	0.0025	2	-0.039637	-0.039637
2	1927	1	0.0025	3	0.026585	0.026585
3	1927	1	0.0025	4	0.001283	0.001283
4	1927	1	0.0025	5	-0.005852	-0.004959
5	1927	1	0.0025	6	0.00747	0.006211
6	1927	1	0.0025	7	0.006932	0.006932
7	1927	1	0.0025	8	0.004339	0.004339
8	1927	1	0.0025	9	-0.004112	-0.004112
9	1927	1	0.0025	10	-0.002769	-0.002769
10	1927	2	0.0026	1	0.069617	0.069617
11	1927	2	0.0026	2	0.058773	0.058773
12	1927	2	0.0026	3	0.081154	0.081154
13	1927	2	0.0026	4	0.072006	0.072006
14	1927	2	0.0026	5	0.033876	0.033876
15	1927	2	0.0026	6	0.031713	0.031713
16	1927	2	0.0026	7	0.042339	0.042339
17	1927	2	0.0026	8	0.030973	0.030973
18	1927	2	0.0026	9	0.043915	0.043915
19	1927	2	0.0026	10	0.06996	0.06996
20	1927	3	0.003	1	-0.031291	-0.031291
21	1927	3	0.003	2	-0.027749	-0.027749
22	1927	3	0.003	3	-0.051911	-0.051911
23	1927	3	0.003	4	-0.040301	-0.040301
24	1927	3	0.003	5	-0.004266	-0.004182
25	1927	3	0.003	6	-0.023466	-0.023476
26	1927	3	0.003	7	0.020534	0.020534
27	1927	3	0.003	8	0.00907	0.00907
28	1927	3	0.003	9	-0.000505	-0.000505
29	1927	3	0.003	10	0.060651	0.060651
...
11010	2018	10	0.0019	1	-0.137266	-0.08918
11011	2018	10	0.0019	2	-0.073184	-0.066046
11012	2018	10	0.0019	3	-0.063881	-0.052297
11013	2018	10	0.0019	4	-0.046592	-0.066841

11014	2018	10	0.0019	5	-0.063844	-0.042312
11015	2018	10	0.0019	6	-0.059006	-0.063958
11016	2018	10	0.0019	7	-0.059502	-0.057795
11017	2018	10	0.0019	8	-0.073969	-0.073276
11018	2018	10	0.0019	9	-0.077667	-0.073355
11019	2018	10	0.0019	10	-0.169192	-0.155975
11020	2018	11	0.0018	1	-0.089414	-0.007122
11021	2018	11	0.0018	2	0.016826	0.010207
11022	2018	11	0.0018	3	0.016105	0.015867
11023	2018	11	0.0018	4	0.016084	0.032113
11024	2018	11	0.0018	5	0.042792	0.04661
11025	2018	11	0.0018	6	0.038227	0.037397
11026	2018	11	0.0018	7	0.036529	0.030862
11027	2018	11	0.0018	8	-0.008921	-0.025627
11028	2018	11	0.0018	9	-0.000128	0.014167
11029	2018	11	0.0018	10	0.025245	0.016331
11030	2018	12	0.0019	1	-0.143062	-0.120715
11031	2018	12	0.0019	2	-0.122419	-0.129939
11032	2018	12	0.0019	3	-0.106922	-0.094175
11033	2018	12	0.0019	4	-0.099359	-0.109982
11034	2018	12	0.0019	5	-0.106238	-0.094017
11035	2018	12	0.0019	6	-0.103889	-0.102173
11036	2018	12	0.0019	7	-0.085488	-0.087433
11037	2018	12	0.0019	8	-0.084585	-0.083863
11038	2018	12	0.0019	9	-0.086423	-0.089132
11039	2018	12	0.0019	10	-0.096714	-0.082738

Question 4

Replicate Table 1 in Daniel and Moskowitz (2016), except for α , $t(\alpha)$, β , and $sk(d)$ rows, and the Market column. Match the format and methodology to the extent possible.

1. $\bar{r} - \bar{r}_f$: For each decile, use DM Ret – risk free rate and take mean. For WML, use decile 10 DM Ret minus decile 1 DM Ret within the same month and take mean. Annualize the returns by multiplying 12.
2. σ : For each decile, use DM Ret – risk free rate and take standard deviation. For WML, use decile 10 DM Ret minus decile 1 DM Ret within the same month and take standard deviation. Annualized the standard deviation by multiplying $\sqrt{12}$.
3. Sharpe Ratio: For each decile and WML, divide the mean of excess returns by the standard deviation of excess returns.

4. Skewness: get the skewness of log return ($\log(1 + \text{return})$, not excess return) for each decile and WML.

Output of question 4:

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	WML
r-rf	-2.591369	2.983509	3.229266	6.738536	7.358823	7.369948	9.16303	10.398843	11.370146	15.41103	18.002398
sigma	36.29425	29.970158	25.397386	22.610608	21.086976	20.005442	19.052836	18.720591	20.006936	23.482116	29.707564
SR	-0.071399	0.099549	0.12715	0.298025	0.348975	0.368397	0.480927	0.555476	0.56831	0.656288	0.605987
sk (m)	0.090863	-0.112228	-0.161372	0.12804	-0.097117	-0.213306	-0.588894	-0.528671	-0.753682	-0.809576	-5.044175

Question 5

Calculate the correlation of your portfolio returns with the Daniel and Moskowitz (2016) breakpoints (by decile), to the portfolio returns on Daniel's website. Also calculate the correlation of your portfolio returns with the Kenneth R. French breakpoints (by decile), to the portfolio returns on French's website. Round to 4 decimal places. Correlations should be calculated from 1927-2018.

1. Get the correlation of my replicated DM return with the data from Daniel's website for each decile. And to the same for FRF.

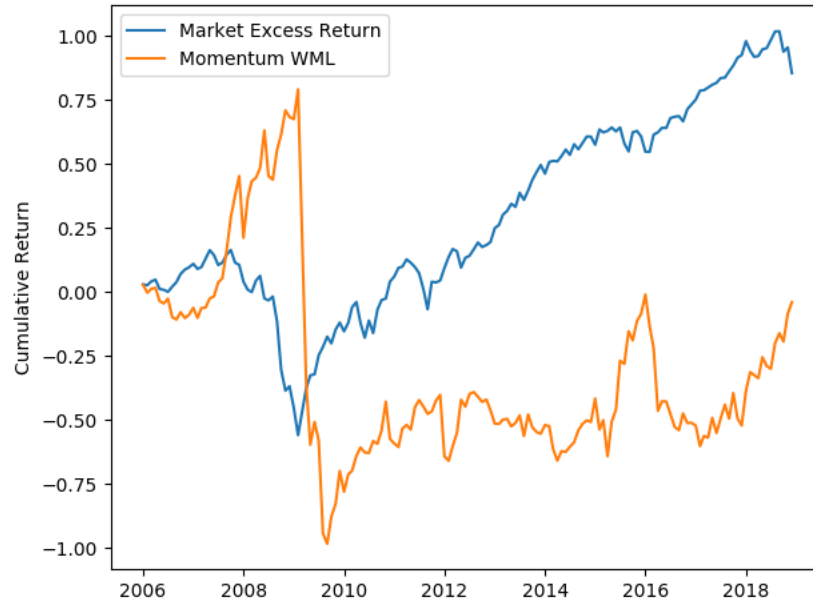
Output for question 5

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	WML
DM correlation	0.9981	0.9987	0.9987	0.9982	0.9980	0.9984	0.9987	0.9990	0.9987	0.9985	0.9964
KRF correlation	0.9979	0.9984	0.9980	0.9977	0.9981	0.9977	0.9976	0.9988	0.9985	0.9990	0.9960

Question 6

Has the momentum anomaly worked in the past few years? Show some empirical evidence.

Yes, the momentum has worked anomaly in the past few years.



Suppose I had 0 investment on both Momentum WML and Market – RF, prior to 2008, momentum portfolio is much better than market portfolio. However, once the financial crisis happened, there was huge loss on momentum portfolio, and it continued underperform market portfolio.

Question 7

Would you implement this trading strategy if you were running your own fund? What are the main implementation challenges to consider?

No, I would not implement this strategy. If it was in long time ago, I would consider this strategy. However, momentum has worked anomaly in recent few years, especially during the financial crisis.

The main implementation challenge is that the turnover is too frequent. The transaction cost will be too high. In addition, sometimes it's difficult to short stocks for the expected price or volume.