

### Problem Set 3

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#### Question 1

**1. Universe of stocks:**

Following Daniel and Moskowitz, 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:**

If both the delisting return (DLRET) and the holding period return (RET) is NA, then delete such record.

**3. Delisting return calculation:**

For most records, it only has RET, if there is only RET, we let  $Ret = RET$ ; if there is only DLRET, we let  $Ret = DLRET$ ; if there are both RET and DLRE, we let  $Ret = (1+RET)*(1+DLRET)-1$

**4. Ranking returns calculation:**

The raking return for each firm is its cumulative log return from month  $t-12$  through month  $t-2$

**5. Lagged market cap calculation:**

Same as PS1.

**6. Sample period:**

1927.01– 2018.12 as required.

The first 16 records are displayed as follows:

Table 1: Record Sample

Year	Month	PERMNO	EXCHCD	lag_Mkt_Cap	Ret	Ranking_Ret
1927	1	10022	1	11.4240000	-0.075893	1.117275e-01
1927	1	10030	1	21.4500000	0.009545	9.211839e-03
1927	1	10057	1	3.0625000	-0.051020	-8.960878e-01
1927	1	10073	1	1.2765000	0.094595	-5.596152e-01
1927	1	10081	1	5.9600000	-0.075000	-5.436344e-01
1927	1	10102	1	28.9120000	-0.017986	2.777758e-01
1927	1	10110	1	4.7500000	0.249211	-3.364721e-01
1927	1	10129	1	39.1500000	-0.006897	1.242579e-01
1927	1	10137	1	41.1480000	0.027559	-1.956498e-01
1927	1	10145	1	296.4802500	0.023875	2.094060e-01
1927	1	10161	1	25.2450000	-0.005882	-1.172845e-01
1927	1	10188	1	3.3896250	-0.099237	-7.008094e-01
1927	1	10196	1	19.0957500	-0.018519	-9.283379e-01
1927	1	10209	1	4.3290000	-0.014423	-6.470571e-01
1927	1	10217	1	20.7281250	0.129851	9.503938e-02
1927	1	10225	1	139.7690000	-0.001027	1.170606e-01

## Question 2

### 1. DM decile:

Breakpoints for the decile portfolios are based on all-firms (i.e., NYSE, AMEX, and NASDAQ). For the all-firm breakpoint portfolios have an equal number of firms in each portfolio as of the formation date. Redo every month.

### 2. KRF decile:

Breakpoints for the decile portfolios are based on just NYSE firms; For the NYSE-breakpoint portfolios have an equal number of firms in each portfolio as of the formation date. Once the breakpoints have been set, sort all firms (NYSE, AMEX, and NASDAQ) into its corresponding decile portfolio. Redo every month.

The first 16 records are displayed as follows:

Table 2: Record Sample

Year	Month	PERMNO	lag_Mkt_Cap	Ret	DM_decile	KRF_decile
1927	1	10022	11.4240000	-0.075893	8	8
1927	1	10030	21.4500000	0.009545	6	6
1927	1	10057	3.0625000	-0.051020	1	1
1927	1	10073	1.2765000	0.094595	2	2
1927	1	10081	5.9600000	-0.075000	2	2
1927	1	10102	28.9120000	-0.017986	10	10
1927	1	10110	4.7500000	0.249211	3	3
1927	1	10129	39.1500000	-0.006897	8	8
1927	1	10137	41.1480000	0.027559	3	3
1927	1	10145	296.4802500	0.023875	9	9
1927	1	10161	25.2450000	-0.005882	4	4
1927	1	10188	3.3896250	-0.099237	1	1
1927	1	10196	19.0957500	-0.018519	1	1
1927	1	10209	4.3290000	-0.014423	1	1
1927	1	10217	20.7281250	0.129851	7	7
1927	1	10225	139.7690000	-0.001027	8	8

### Question 3

**1. DM decile return:**

Return weighted by each firm's lagged market cap for each decile portfolio

**2. KRF decile return:**

Return weighted by each firm's lagged market cap for each decile portfolio

The first 16 records are displayed as follows:

Table 3: Record Sample

Year	Month	decile	DM_Ret	KRF_Ret	Rf
1927	1	1	-0.0321491621	-0.0321491621	0.0025
1927	1	2	-0.0396366162	-0.0396366162	0.0025
1927	1	3	0.0197081426	0.0197081426	0.0025
1927	1	4	0.0042123043	0.0042123043	0.0025
1927	1	5	-0.0059077354	-0.0059077354	0.0025
1927	1	6	0.0073389670	0.0073389670	0.0025
1927	1	7	0.0058668463	0.0058668463	0.0025
1927	1	8	0.0059491186	0.0059491186	0.0025
1927	1	9	-0.0057717547	-0.0057717547	0.0025
1927	1	10	-0.0031485029	-0.0031485029	0.0025
1927	2	1	0.0765678996	0.0765678996	0.0026
1927	2	2	0.0584219720	0.0584219720	0.0026
1927	2	3	0.0783023729	0.0783023729	0.0026
1927	2	4	0.0752224763	0.0752224763	0.0026
1927	2	5	0.0320124832	0.0320124832	0.0026
1927	2	6	0.0420126148	0.0420126148	0.0026

## Question 4

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	WML
mean excess return	-0.0263	0.0227	0.0307	0.0628	0.0705	0.0715	0.0912	0.1037	0.1141	0.1533	0.1796
SD	0.3673	0.3032	0.2603	0.2317	0.2155	0.2040	0.1940	0.1916	0.2033	0.2376	0.2992
SR	-0.0716	0.0749	0.1179	0.2710	0.3271	0.3505	0.4701	0.5412	0.5612	0.6452	0.6452
Skewness	0.0694	-0.1197	-0.1220	0.1425	-0.0892	-0.2553	-0.5508	-0.5378	-0.7810	-0.8309	-5.0942

### 1. Mean excess return:

Average of each decile portfolio monthly return minus the that's months' risk-free rate, multiply by 12. For WML, it's average of decile 10 portfolio monthly return minus the decile 1 portfolio monthly return, multiply by 12

### 2. Standard deviation:

SD of each decile portfolio monthly return minus the that's months' risk free rate, multiply by sqrt(12). For WML, it's SD of decile 10 portfolio monthly return minus the decile 1 portfolio monthly return, multiply by sqrt(12).

### 3. Sharpe ratio:

Mean excess return / Standard deviation

### 4. Skewness:

Skewness of the monthly log returns (not excess) to the portfolios. For WML, it's the realized skewness of  $\log(1+r_{\text{WML}} + r_f)$ .

## Question 5

Data scope: DM from 1927.01 - 2016.12. KRF from 1927.01 - 2018.12

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	WML
<b>DM correlation</b>	0.9966	0.9978	0.9982	0.9982	0.9984	0.9985	0.9986	0.9989	0.9989	0.9991	0.9945
<b>KRF correlation</b>	0.9984	0.9986	0.9984	0.9983	0.9984	0.9978	0.9976	0.9986	0.9986	0.9993	0.9971

## Question 6

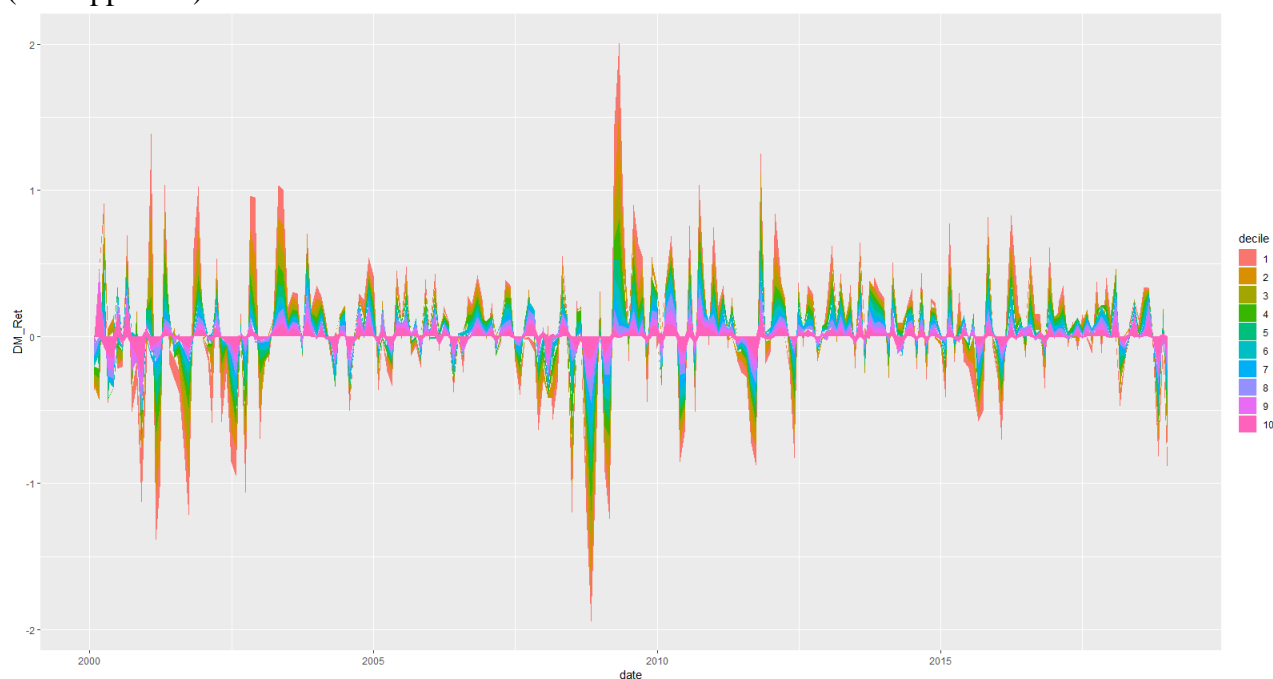
We investigate the performance of momentum after 2000.

First we construct the similar table in Q4, as we can see, the mean excess returns of high decile portfolios and WML are significantly lower than those in 1927-2018 period, and the Sharpe ratio is much lower.

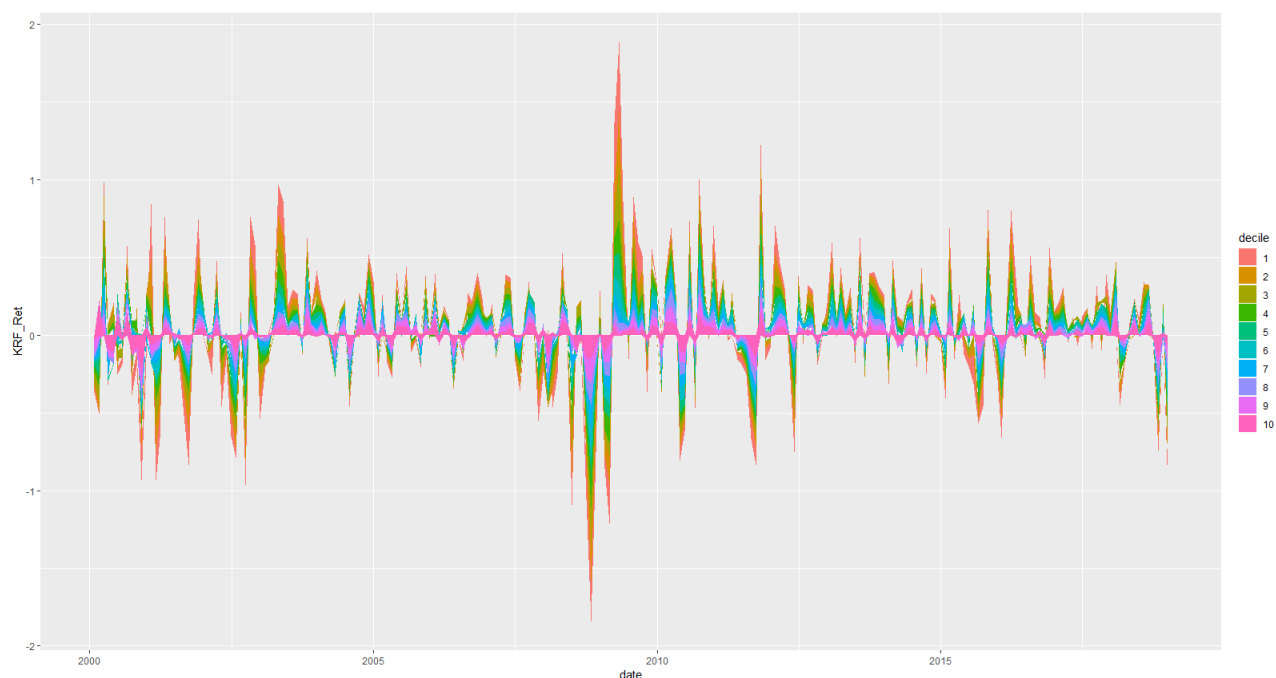
	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6	Decile 7	Decile 8	Decile 9	Decile 10	WML
mean excess return	-0.0150	0.0162	0.0287	0.0607	0.0582	0.0555	0.0607	0.0640	0.0439	0.0812	0.0962
SD	0.4171	0.3105	0.2432	0.1979	0.1771	0.1457	0.1349	0.1450	0.1589	0.2324	0.3802
SR	-0.0360	0.0522	0.1180	0.3067	0.3286	0.3809	0.4500	0.4414	0.2763	0.3494	0.3494
Skewness	0.0098	-0.2873	-0.5158	-0.4876	-0.7166	-0.5004	-0.7603	-0.6396	-0.8887	-0.5600	-2.0825

Then we plot the monthly return of each decile portfolio.

(DM approach)

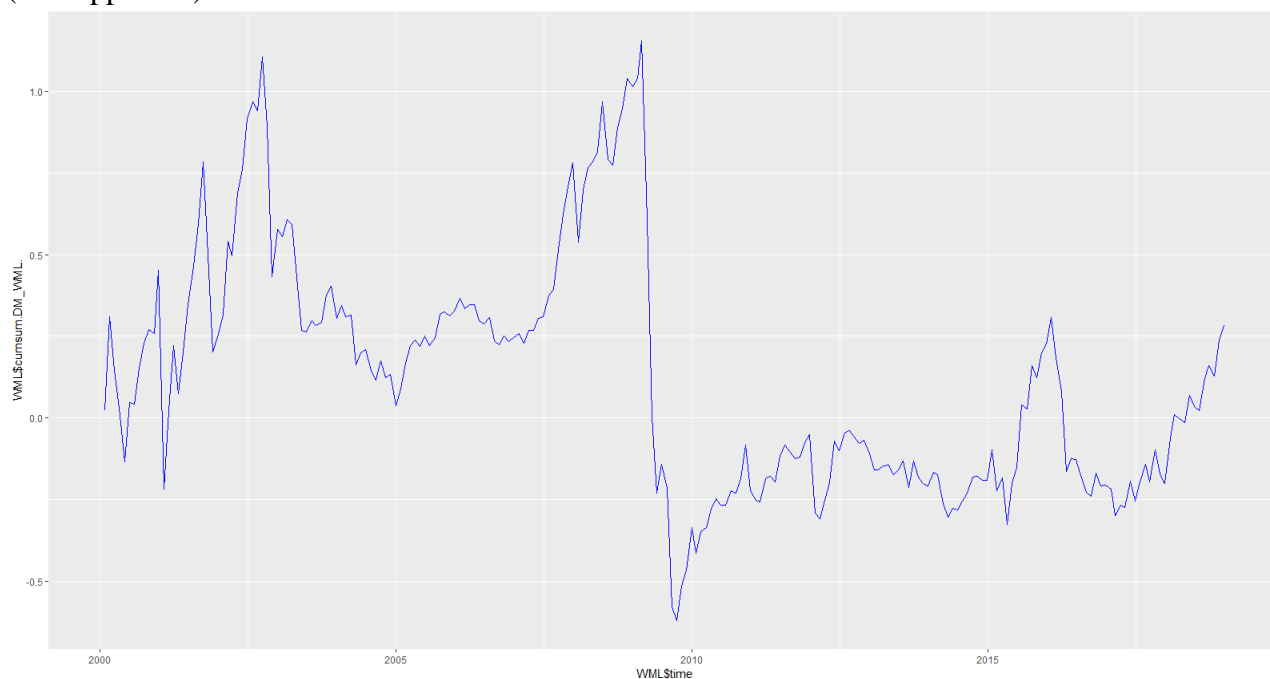


(KRF approach)



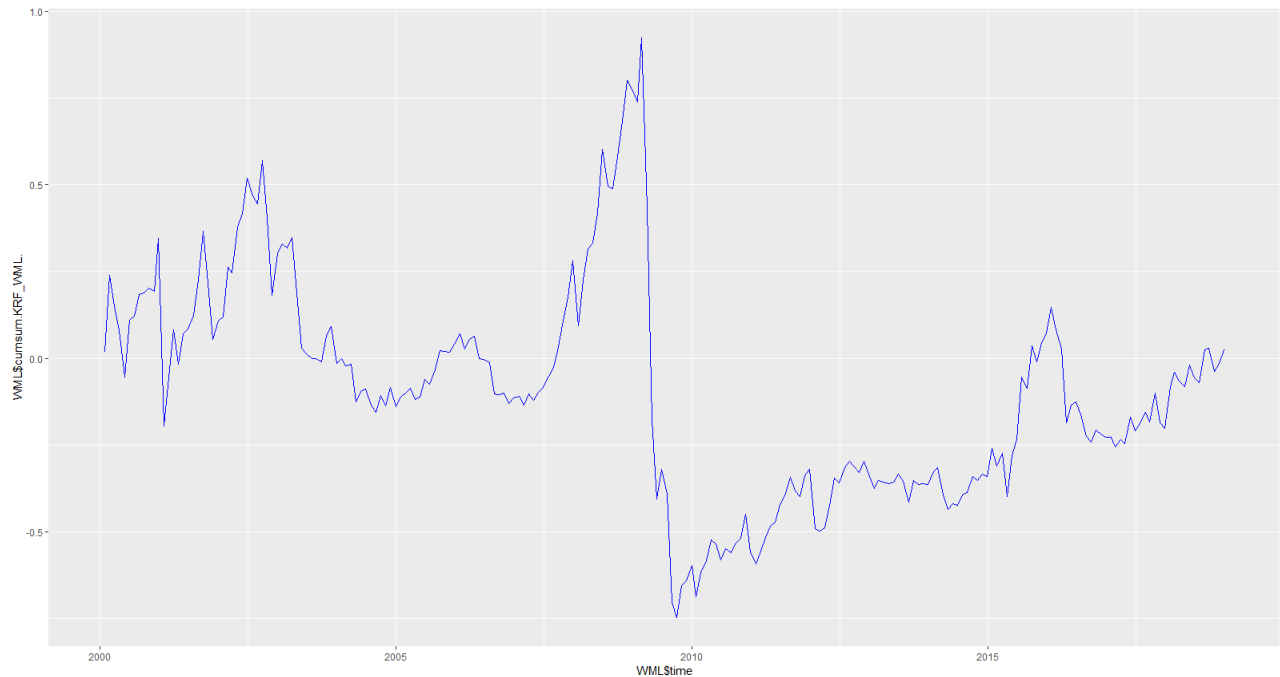
The two graphs give very similar pattern. We can see that, the winner never dominates the loser, but it's much stable than losers. The loser's volatility is very high, and there are lots of extreme values, which can be an implication of reversal effect instead of momentum, especially during financial crisis.

We finally plot the WML portfolio's cumulative log return from 2000 to 2018.  
(DM approach)



(KRF approach)





The two graphs also give the same pattern. We can see that, if we long the winner and short the loser, our strategy experienced several crash down with the largest happened in 2008-2009.

Overall, we can conclude that the momentum anomaly worked in the past few years.

### Question 7

I might implement this trading strategy as we can see from the previous plot of cumulative return of WML portfolio, the net value of the portfolio goes up steadily after 2010 to now.

The main challenge:

- Rebalance cost is high as we rebalance every month.
- If there is a financial crisis, the strategy might crash down so a stop-loss measure might be needed.