PROBLEM SET 3

GOURPRABH

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) . Your output should be from 1927-2019

The dataset that I downloaded from CRSP contained the required input variables (PERMNO, date, SHRCD, EXCHCD, RET, DLRET, PRC, SHROUT) from *December 1925 to December 2019*.

The data restrictions that I placed to make my data resemble that of Daniel and Moskowitz (2016) are -

1. **SHRCD** - I restricted my dataset to rows in which SHRCD had the values *10,11* as detailed by Daniel and Moskowitz (2016). Essentially I restricted my shares to ordinary commons shares of companies incorporated inside the US.

2. **EXCHCD** - I restricted my dataset to rows in which EXHCD had the values *1,2,3* as detailed by Daniel and Moskowitz (2016). Essentially I restricted my firms to one listed on New York, American and NASDAQ stock exchange.

Calculating total returns -
I converted all *NA* rows in my *RET* and *DLRET* data to 0. Then I calculated *total return* for each row as -

$$tot\ ret = (1 + RET)(1 + DLRET) - 1$$

The above formula covers the following three cases -
1. $DLRET = NA$ - The above formula would give back the return data (as DLRET is set to 0 and 1 + DLRET becomes 1).
2. $RET = NA$ - In this case, the above formula gives back DLRET as outlined above.
3. $RET = NA\ and\ DLRET = NA$ - In this case, the above formula returns 0.

Lagged market value
I shifted market equity of each firm, taking care through a valid flag that the previous row contained the data from the same firm, filling *0* in the rows where this operation created NA values.

Ranking return
Daniel and Moskowitz (2016) define ranking return at time t as the cumulative log return from *(t - 12)* to *(t - 2)*.
We first validated using a flag if the following restrictions hold at each time t, before calculating the ranking return at that time -
1. price at *t-13* is not missing
2. return at *t-2* is not missing
3. market value at *t-1* is not missing

We remove all data rows that do not satisfy the above restrictions.

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 1927-2019.

Firm's momentum decile as defined by Daniel and Moskowitz (2016)
Daniel and Moskowitz sort firms in 10 portfolios at the beginning of each month based on their ranking returns calculated in the question above. For this purpose, Daniel and Moskowitz consider the *universe of all stocks* at each month that satisfy the data requirements detailed above. The best performing stocks(i.e one with the returns above the portfolio 10 breakpoint) are put in Decile 10, the second best(i.e one with the returns above the portfolio 9 breakpoint) in Decile 9 and so on.

Firm's momentum decile as defined by Kenneth R. French
Kenneth sort firms in 10 portfolios at the beginning of each month based on their ranking returns calculated in the question above. For this purpose, Kenneth consider the *NYSE stocks* that satisfy the data requirements detailed above. That is, in this case, the breakpoints in the returns are calculated using only NYSE Stocks(Exchange Code = 1). Using those breakpoints, I sorted the *universe of all stocks* at each month into one of the 10 portfolios. The best performing stocks(i.e one with the returns above the portfolio 10 breakpoint) are put in Decile 10, the second best(i.e one with the returns above the portfolio 9 breakpoint) in Decile 9 and so on.

In both cases, we made sure that while sorting firms, the right hand limit was open. This means that if a firm has the exact same returns as the decile breakpoint, we sort the firm in the upper decile rather than the lower decile.

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 1927-2019.

After sorting stocks in decile portfolios as defined in the question above, we calculated the *value-weighted return* of each decile portfolio as outlined below -

Value-weighted return - I first created market weight for each stock in each decile portfolio each month based on its market value last month. The formula I used is -

$$(Market\ \ weight\ \ of\ \ Stock_{ip})_t = \frac{(market\ \ value\ \ of\ \ Stock_{ip})_{t-1}}{Total\ \ lagged\ \ market\ \ value\ \ of\ \ all\ \ Stocks_p}$$

Then, I took a weighted sum of the stocks return in each decile portfolio where the weights were from the formula I calcualted above.

$$(Portfolio\ \ VW\ \ Ret)_{t,p} = sum(Return_{i,t,p} * weight_{i,p})$$

where t stands for the month,
i stands for the specific stock
and p stands for the specific decile portfolio

Risk-free rate -
I take the risk-free rate from the data downloaded from kenneth French's website and divide it by 100 to present in a decimal format.

QUESTION 4

The replicated Panel A of Table 2 in Asness, Frazzinin and Peterson is shown below -

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6
r - rf	-2.6419667	2.4561466	2.9490570	6.3325275	7.1545658	6.9276094
sigma	36.7285140	30.5297455	25.8590355	23.0594266	21.3586061	20.3476099
SR	-0.0719323	0.0804509	0.1140436	0.2746177	0.3349734	0.3404631
sk(m)	0.0901994	-0.1133599	-0.1373606	0.1359425	-0.1684019	-0.2460263

	Decile 7	Decile 8	Decile 9	Decile 10	WML
r - rf	9.2111355	10.4015643	11.3864220	15.1991601	17.8411268
sigma	19.3568097	18.9807612	20.2736484	23.7001427	30.2562782
SR	0.4758602	0.5480056	0.5616366	0.6413109	0.5896669
sk(m)	-0.4649152	-0.5801151	-0.7755071	-0.8398206	-2.2322619

Data period considered : 1927 - 2013/03

WML

I formed WML (Winner minus loser) portfolio return at each month in the period by subtracting return of decile 1 portfolio from the decile 10 portfolio.

Mean Return $\overline{r - r_f}$ -
To calculate this, I took the Arithmetic mean excess return of each decile from the start to the end of the period mentoned above.

Standard Deviation (σ) -
To calculate this, I calculated the standard deviation of each decile portfolio's excess return over the total period.

SHARPE RATION(SR) -
To calculate this, I used the following formula -

$$SR = \frac{\overline{r - r_f}}{\sigma}$$

where $\overline{r - r_f}$ and σ is from the calculaton done above.

sk(m) -
This is calcualted as the full-period realized skewness of monthly log returns to the portfolio. The formula used by the skewness function is -

$$\frac{\sum_{i=1}^{N}(Y_i - \bar{Y})^3/N}{s^3}$$

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 1927-2019.

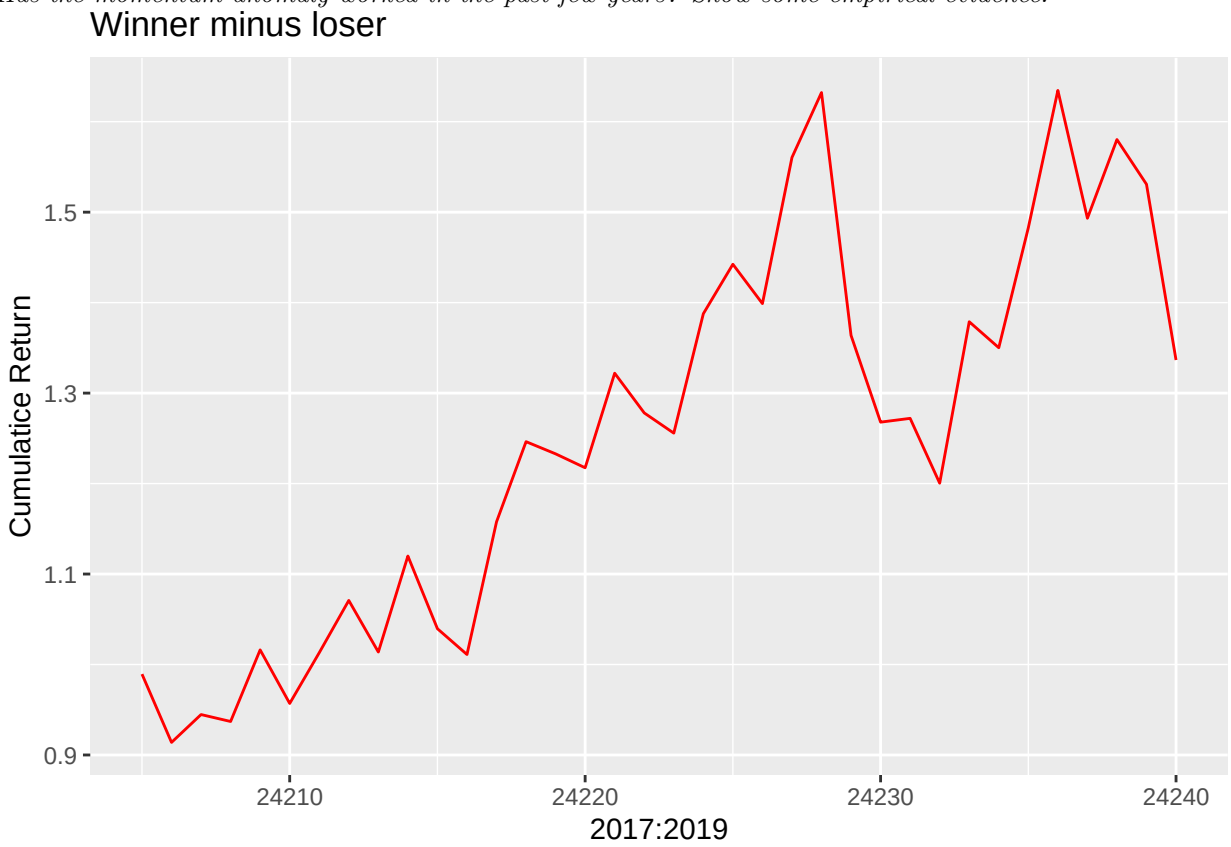
The correlation between our dataset and that of Daniel and Moskowitz , and Kenneth R. French is -

	Decile 1	Decile 2	Decile 3	Decile 4	Decile 5	Decile 6
DM correlation	0.9969411	0.9970526	0.9979975	0.9974986	0.9967782	0.9977961
KRF correlation	0.9985366	0.9978954	0.9980972	0.9974565	0.9967088	0.9968698

	Decile 7	Decile 8	Decile 9	Decile 10	WML
DM correlation	0.9985620	0.9986645	0.9985500	0.997599	0.9941428
KRF correlation	0.9969007	0.9980514	0.9980863	0.997400	0.9959704

QUESTION 6

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



We can see the cumulative excess return of the WML portfolio of Daniel and Moskowitz is positive over the last 3 years.But the cumulative excess return has been negative over the last 1-1.5 years.

QUESTION 7

I would implement this stratey in my firm for emerging markets, not for well-established financial markets of USA and Europe. I believe this strategy would work better in markets with less-sophisticated investors.
The main implementation challenges that I would consider are -
1. The momentum strategy is highly susceptible to crashes. Hence, I will take care to delever from the strategy when the risk is high (based on the expected sharpe ratio of the strategy).
2. Since momentum strategies are the most popular hedge fund strategy, they have been known to move prices away from their fundamental or true prices. I would also take care to delever from the strategy if the returns are constantly moving around (as seen in our graph from the previous section)