UCLA Anderson School of Management
Quantitative Asset Management 431 — Spring 2019

Problem Set 1

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

Question 1

Construct the value-weighted market return using CRSP data, replicating the market return time series available in Kenneth French website. Also calculate the equal-weighted market return, and the lagged total market capitalization. Your output should be from January 1926 to December 2018, at a monthly frequency. Before calculating the portfolio time series, I conduct a series of data cleaning as part of my PS Q1 function. Next, I describe my data cleaning process and their respective assumptions:

1. Universe of stocks: Following Ken French procedure, 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: $r_{i,t}^{d}$
$$r_{i,t} = \begin{cases} r_{i,t}^{h} & if\ r_{i,t}^{d}\ missing \\ r_{i,d}^{d} & if\ r_{i,t}^{h}\ missing \\ \left(1 + r_{i,t}^{h}\right)\left(1 + r_{i,d}^{d}\right) - 1 & if\ both\ not\ missing \end{cases}$$
If both are missing, remove those rows. And remove all those rows with price NA.

3. Market Capitalization: Use last period's market cap to calculate the weight in the following questions. Therefore, market cap is calculated as last period price X last period shares outstanding. And the total market capitalization for each month is the sum of all firms' market cap in that month.

4. Portfolio weights: for each period, it is the market cap of each firm divided by the total market capitalization.

5. Portfolio weights definition: the fraction of each firm's market cap in the total market cap for each month.

6. Sample period: from 1st January 1926 to 31st December 2018

Question 2

Using the risk-free rate of return from French's website, report the following moments of the market excess returns for both time series (4 decimal digits): annualized return, annualized volatility, annualized Sharpe ratio, skewness, and excess kurtosis. Annualized values should be

calculated geometrically. You should be comparing between July 1926 to December 2018, at a monthly frequency.

The summary statistics are in Table 1 below. I report the following five statistics: annualized mean, annualized standard deviation, annualized Sharpe Ratio, skewness, and excess kurtosis. In Column 1, I report the statistics for the replicated value-weighted market portfolio of stocks calculated in the previous question. In Column 2, I report the statistics for the value-weighted market portfolio of stocks from Ken French's website.

Table 1 Summary statistics

	Replication	French's
Annualized Mean	0.078087	0.07809
Annualized Standard Deviation	0.184672	0.184773
Annualized Sharp Ratio	0.42284	0.422626
Excess Skewness	0.187808	0.184505
Kurtosis	7.922651	7.891395

From question, we have a times series of value-weighted market returns, namely $\{r_t\}_{t=1}^{T}$. Let the market return from French's website be given by $\{r_t^F\}_{t=1}^{T}$. I compute these statistics as follows:

1. Sample period: Monthly from July 1926 to December 2018.

2. Excess Skewness: I calculate excess skewness of r_t from the monthly time series directly (no annualization, and no logs) using the full sample, and it is over the monthly time series.

3. Kurtosis: I calculate kurtosis from the monthly time series directly (no annualization, and no logs) using the full sample, and it is over the monthly time series.

4. Annualized Mean:

$$Annualized\ Mean = \frac{Monthly\ Return - RF}{100} \times 12$$

5. Annualized Standard Deviation:

$$Annualized\ Standard\ Deviation = \frac{(Monthly\ Return - RF).std}{100} \times \sqrt{12}$$

6. Sharpe Ratio:

$$Sharpe\ Ratio = \frac{Annualized\ Mean}{Annualized\ Standard\ Deviation}$$

Question 3

Report (up to 8 decimal digits) the correlation between your time series and French's time series, and the maximum absolute difference between the two time-series.

In Table 2 below, I report the time-series correlation between the replicated value-weighted market portfolio of stocks and the value-weighted market portfolio of stocks from Ken French's website. I also report the maximum difference between the two series. I limit the sample to be between July 1926 and December 2018. The difference between the replicated portfolio and the one from French's website is not zero.

Table 2 Correlation and maximum difference

Correlation	0.99998832
Maximum absolute difference	0.00296326

The correlation is very close to 1 but it's not 1 however. And the maximum absolute difference is 0.00296326.

The way of dealing with NA values or letter represented return and delisting returns values such as 'C', 'S', etc. may be different between mine and French's.