Rutgers Business School--Newark & New Brunswick
MQF 22:839:571, Financial Modeling I, Spring 2020
Assignment VI
Assigned: 4/8/20, Due 4/25/20

In this assignment, you are asked to form several simple long-short arbitrage trading strategies. Many hedge funds pursue these types of strategies. First, the files "30_industry_portfolios", "25_portfolios.5x5" and "F-F_research_data_factors" contain monthly returns from 1926.7 to the present for 30 industry portfolios, 25 Fama-French size and book-to-market sorted portfolios, and three Fama-French factors, respectively. The file "F-F_research_data_5factors" contain monthly returns from 1963.7 to the present for five Fama-French factors. The file "Data_q_factors" contain monthly returns from 1967.1 to the present for the Hou, Xue and Zhang (HXZ) q-factors.

Second, you also need to go to CRSP again to collect data on return without dividend for the 10 stocks that you used before. From the return with dividend and return without dividend, you can recover the price per share without dividend and dividend per share.

Third, you already collected the time-series data on book-to-market ratio for each of the 10 stocks from the previous assignment, $\frac{BE_t}{ME_t}$.

1. It is well-known that momentum strategies of buying past winning stocks and selling past losing stocks over the past 6-9 months produce a significant excess return (about 1 percent per month if you buy the top decile and sell the bottom decile). To do a real test, you would have to use data for all traded stocks. But as an exercise, you can only use the three data sets that I provide.

Starting from 1927.01, for each month, you sort the 30-industry portfolios according to their past -month cumulative returns (where $J = 6, 9$). Then you buy 3 portfolios with the highest returns and short sell 3 portfolios with the lowest returns over the past J months. You skip one month and hold this arbitrage portfolio for K months ($K = 6, 9$). You do this experiment for each month until the end of the sample. Now you compute the average return of your long portfolio, short portfolio and arbitrage portfolio (long-short). Test for their statistical significance using the conventional t-test. Is the excess return of the arbitrage portfolio significant? Compute the Sharpe ratio for your long portfolio. Is your Sharpe ratio higher than that of the market portfolio?

2. The excess return on the arbitrage portfolio may be a compensation for risk (either market risk or other factor risks). To test this hypothesis, you run the excess return of your arbitrage portfolio on the market risk premium, on the three Fama-French factors, on the five Fama-French factors, and on the HXZ q-factors, respectively. Specifically, you run the following four *time-series* regressions using the full sample:

$$r_{Long,t} - r_{Short,t} = \alpha + \beta_m (r_{m,t} - r_{f,t}) + \varepsilon_t \quad (1)$$

$$r_{Long,t} - r_{Short,t} = \alpha + \beta_m (r_{m,t} - r_{f,t}) + \beta_{SMB} SMB_t + \beta_{HML} HML_t + \varepsilon_t \quad (2)$$

$$r_{Long,t} - r_{Short,t} = \alpha + \beta_m(r_{m,t} - r_{f,t}) + \beta_{SMB}SMB_t + \beta_{HML}HML_t + \beta_{RMW}RMW_t + \beta_{CMA}CMA_t + \varepsilon_t \quad (3)$$

$$r_{Long,t} - r_{Short,t} = \alpha + \beta_m(r_{m,t} - r_{f,t}) + \beta_{ME}r_{ME,t} + \beta_{I/A}r_{I/A,t} + \beta_{ROE}r_{ROE,t} + \varepsilon_t \quad (4)$$

Report the parameter estimates and test for their statistical significance using the conventional *t*-test. If the excess return obtained from problem 1 above is significant, does the CAPM explain the excess return? Does the Fama-French three-factor model explain the excess return? Does the Fama-French five-factor model explain the excess return? Does the HXZ q-factor model explain the excess return? Is the risk-adjusted return (also called the Jensen α) significant in any case? (Note: When using the Fama-French five-factor model and the HXZ q-factor model, you can start the sample from 1967.1.)

3. A contrarian strategy buys past losers and sells past winners over the past *N* years and holds the arbitrage portfolio for the subsequent *N* years. Use data on the 25 Fama-French size and book-to-market sorted portfolios to implement the following simple contrarian strategy: buy 3 portfolios with the lowest cumulative returns over the past 5 years, sell 3 portfolios with the highest cumulative returns over the past 5 years, and hold this arbitrage portfolio for the subsequent 5 years. Is the excess return of your contrarian arbitrage portfolio significant? Compute the Sharpe ratio for your long portfolio. Is your Sharpe ratio higher than that of the market portfolio? Does the CAPM explain the excess return? Does the Fama-French three-factor model explain the excess return? Does the Fama-French five-factor model explain the excess return? Does the HXZ q-factor model explain the excess return? Is the risk-adjusted return (also called the Jensen α) significant in any case?

4. It was documented that certain financial ratios, such as dividend/price ratio and book-to-market ratio can predict stock returns. To test for the predicting power of book-to-market ratio for stock return, you run the following *time-series* regression for each of the 10 stocks that you used in previous assignments:

$$r_{i,t} = \alpha_{i,t} + \beta_{i,t}\ln\left(\frac{BE_{i,t-1}}{ME_{i,t-1}}\right) + \varepsilon_{i,t} \quad (5)$$

where $r_{i,t}$ is return of stock *i* from t-1 to t and $\frac{BE_{i,t}}{ME_{i,t}}$ is its book-to-market ratio. You use the first 5 years of data (2009.01-2013.12 with 60 monthly observations) to run the above regression and obtain the parameter estimates $\hat{\alpha}_{i,t}$ *and* $\hat{\beta}_{i,t}$, and then you can forecast the return for 2014.01 as follows

$$\hat{r}_{i,t+1} = \hat{\alpha}_{i,t} + \hat{\beta}_{i,t}\ln\left(\frac{BE_{i,t}}{ME_{i,t}}\right) \quad (6)$$

In other words, you use the parameters estimated in the previous period (using observations from 2009.01-2013.12) and the book-to-market ratio for 2013.12 to obtain the forecast of stock return in 2014.01. You use your forecasted returns to rank the 10 stocks. You buy 3 stocks with the highest expected returns and short sell 3 stocks with the lowest expected returns. You then

compute the realized returns of the long and short portfolios when the new observation becomes available next period (2014.01).

Next, you run regression (5) again using observations from 2009.01-2014.01 (61 observations now), and forecast the return for 2014.02. Then you rank stocks according to their expected returns. Buy 3 stocks with the highest expected returns and short sell 3 stocks with the lowest expected returns. You repeat this process until the end of your sample (2018.12). Now you have a time-series of realized returns for the long and short portfolios (2014.01-2018.12).

You compute the average return of your long portfolio, short portfolio and arbitrage portfolio (long-short). Test for their statistical significance using the conventional t-test.

5. Conduct a similar analysis using the dividend/price ratio as a predictor. Specifically, to test for the predicting power of dividend/price ratio for stock return, you run the following *time-series* regression for each of the 10 stocks you used in previous assignments:

$$r_{i,t} = \alpha_{i,t} + \beta_{i,t}\left(\frac{D_{i,t-1}}{P_{i,t-1}}\right) + \varepsilon_{i,t} \qquad (7)$$

where $r_{i,t}$ is return of stock i from t-1 to t, $D_{i,t-1}$ is dividend per share paid from (t-2) to (t-1), and $P_{i,t-1}$ is price per share without dividend at t-1. You use the first 5 years of data (2009.01-2013.12 with 60 monthly observations) to run the above regression and obtain the parameter estimates $\hat{\alpha}_{i,t}$ *and* $\hat{\beta}_{i,t}$. Then you can forecast the return for 2014.01 as follows

$$\hat{r}_{i,t+1} = \hat{\alpha}_{i,t} + \hat{\beta}_{i,t}\left(\frac{D_{i,t}}{P_{i,t}}\right) \qquad (8)$$

In other words, you use the parameters estimated in the previous period (using observations from 2009.01-2013.12) and the dividend/price ratio for 2013.12 to obtain the forecast of stock return in 2014.01. You use your forecasted returns to rank the 10 stocks. You buy 3 stocks with the highest expected returns and short sell 3 stocks with the lowest expected returns. You then compute the realized returns of the long and short portfolios when the new observation becomes available next period (2014.01).

Next, you run regression (7) again using observations from 2009.01-2014.01 (61 observations now), and forecast the return for 2014.02. Then you rank stocks according to their expected returns. Buy 3 stocks with the highest expected returns and short sell 3 stocks with the lowest expected returns. You repeat this process until the end of your sample (2018.12). Now you have a time-series of realized returns for the long and short portfolios (2014.1-2018.12).

You compute the average return of your long portfolio, short portfolio and arbitrage portfolio (long-short). Test for their statistical significance using the conventional t-test.