Due: Before April 14, 11:59pm in Benn Eifert’s emailbox: benn@econ.berkeley.edu

All assignments must be completed using a software or programming language that allows the manipulation of matrices and vectors. No canned statistical packages are allowed.

To complete this assignment, you will need two data files: portfolio_returns_48.txt and factors_ff.txt. The two files are zipped into one file, called homework3_files.zip and can be found on my website. Once unzipped, they will be in text format, separated by tabs. The first file contains returns of 48 industry portfolios, whose exact definition can be found in Siccodes48.txt also in the zipped file. The second file contains 3 portfolio returns which will be used as risk factors. The factors are labeled in the file itself. In this homework, you will reproduce some of the results in Fama and French (1993), published in the Journal of Financial Economics. The ultimate goal is to test the CAPM and a multi-factor asset-pricing model.

1. Let the return of the market portfolio at time $t$ be denoted as $R^M_t$. The returns of all other portfolios are denoted as $R^i_t$ and the risk-free rate is $r^f_t$.

(a) For each asset, run the following regression:

$$R^i_t - r^f_t = \alpha_i + \beta_i \left( R^M_t - r^f_t \right) + \epsilon^i_t$$

(b) From the previous steps, you must have 48 $\alpha_i$s and 48 $\beta_i$s. Plot the $\alpha_i$s with $\pm 2SE$? Are the pricing errors ($\alpha_i$s) big? What do you conclude?

(c) Propose a test to jointly test the hypothesis that the CAPM holds.

(d) Plot the $\beta_i$s against $E \left( R^i_t - r^f_t \right)$, the latter computed as the unconditional mean of the excess return of industry $i$. The CAPM dictates that there must be a close relationship between the $\beta_i$s and the expected excess return. Do you observe such a relationship? What do you conclude?

(e) Reconcile the evidence in part b and c?

2. Let the returns on the SMB and HML portfolios be denoted by $R^{SMB}_t$ and $R^{HML}_t$, respectively. Those factors have been proposed by Fama and French (1993) as additional risk factors. You will use the SMB and HML factors to see if they improve over the performance of the CAPM. Note that $R^{SMB}_t$ and $R^{HML}_t$ are already in excess of the risk free rate.

(a) For each asset, run the following regression:

$$R^i_t - r^f_t = \alpha_i + \beta_{1,i} \left( R^M_t - r^f_t \right) + \beta_{2,i} R^{SMB}_t + \beta_{3,i} R^{HML}_t + \epsilon^i_t$$

(b) From the previous steps, you must have 48 $\alpha_i$s, 48 $\beta_{1,i}$s, 48 $\beta_{2,i}$s, and 48 $\beta_{3,i}$s. Plot the $\alpha_i$s with $\pm 2SE$? Are the pricing errors ($\alpha_i$s) big? How do the results compare to what you found in question 1.a.? What do you conclude?

(c) Produce three graphs, plotting each of the $\beta_{k,i}$s ($k = 1, 2, 3$) against $E \left( R^i_t - r^f_t \right)$, the latter computed as the unconditional mean of the excess return of industry $i$. In particular, your first graph should plot the 48 $\beta_{1,i}$s ($k = 1, 2, 3$) against $E \left( R^i_t - r^f_t \right)$ and should be directly comparable to what you obtained in question 1.b. Do you observe a
relationship between excess returns and the various risk prices? Do you think that SMB and HML are priced factors? Why? Is a three-factor Fama-French model more suitable at capturing the fluctuation in equity returns? In answering the questions, refer to your empirical results.

(d) For an exact definition of the SMB and HML portfolios, go to the Fama and French (1993) article, or to http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/Data_Library/f-f_factors.html. Do you think that the SML and HMB returns are real risk factors? Why? Can you provide economic intuition to justify your answer? (HINT: Don’t spend too much time on this question.)