Problem Set 4

Instructions: Work in a group of 1-3 people. Each group hands in one electronic copy of their answers. Be brief and to the point, but be sure to explain your logic. Do not print data, entire spreadsheets, or programs – instead, copy the relevant statistics to a table. All tables and charts should have legends and explanations. Answers (excluding tables and figures) should be typed and a maximum of six pages. Exceeding these limits will draw a penalty.

In this problem set you will evaluate and test asset pricing models using the time-series framework**.** You will use the Gibbons, Ross, Shanken (GRS) test discussed in class. The most difficult part of the problem set is the GRS test. It is a variant of Hotelling's t^2 test, discussed in the statistics literature. If you find the GRS article difficult to read, any multivariate text that covers the t^2 test can be very helpful. In addition, many articles that use this test have a short summary of the procedure.

In order to proceed you need Microsoft Excel and the file "Problem_Set4.xls". This file contains four spreadsheets:

1) 30 industry value-weight portfolio returns
2) 10 portfolios formed on short-to-intermediate term past returns (from *t*-2 to *t*-12), **note that these portfolios start in 01/1927 rather than 07/1926*
3) 25 portfolios formed on size and BE/ME,
4) And, a proxy for the market portfolio (RM-RF).

Part I: 30 Value-Weight Industry portfolios

a) Using the 30 value-weighted industry portfolios, calculate the sample mean and standard deviation of returns for each of these portfolios. Is there a discernible pattern in the average returns or Sharpe-ratios of the portfolios?

b) Estimate time series regressions, $R_{pt} - R_{ft} = a + \beta_{iM}(R_{Mt} - R_{ft}) + e_{it}$, for each of the 30 industry portfolios. Perform the multivariate GRS test; please report both the GRS *F*-statistic and its *p*-value. Use the market portfolio proxy RM-RF.

c) What is the null hypothesis of the GRS test (be precise), and how is this a test of the CAPM? Explain intuitively the GRS test. How do the time-series regressions implicitly estimate the beta risk premium?

d) Comment on the sign and the magnitude of the intercepts. Does the CAPM have difficulty pricing any portfolios in particular? Why?

Part II: 10 Past Return portfolios

e) Repeat parts a), b), and d) for the 10 past return portfolios.

Part III: 25 Size and BE/ME portfolios

f) Repeat parts a), b), and d) for the 25 size and BE/ME portfolios.

g) Repeat b) for the 25 size and BE/ME portfolios, but this time use the "in-sample" tangency portfolio of the 25 portfolios estimated over the entire sample period and use this portfolio in place of RM-RF.
   - Does the GRS test reject or fail to reject when you use the in-sample tangency portfolio as the market proxy?
   - Is this result surprising?

h) Repeat g) using the "out-of-sample" tangency portfolio of the portfolios estimated over one half of the sample and then applied to returns of the other half and vice versa and then use this portfolio in place of RM-RF. Use the same out-of-sample tangency portfolio you constructed for Problem Set 3:
   a. First, we split the sample into two halves: (1) take all observations from *odd months* in *even years* and *even months* in *odd years* (i.e., if starting in 1980, this would look like: 01/1980, 03/1980, . . . , 11/1980, 02/1981, 04/1981, . . . 12/1981, 01/1982, 03/1982, . . .); and (2) the opposite (take all observations from *even months* in *even years* and *odd months* in *odd years*).
   b. Then, compute the tangency portfolio weights for the 25 portfolios using only the moments estimated from the first sample and apply them to returns in the second sample.
   c. Then, do the reverse---compute the tangency portfolio weights from the second sample and apply those to returns in the first sample.
   d. The resulting return series is your new tangency portfolio returns which you will use to repeat the cross-sectional tests.

Does the GRS test reject or fail to reject when you use the out-of-sample tangency portfolio as the market proxy? Why? Is this result surprising?

i) Repeat b) for the 25 size and BE/ME portfolios, but use the "in-sample" tangency portfolio of the 30 value-weight industry portfolios estimated over the entire sample period in place of RM-RF. Comment on how well you price the 25 size and BE/ME portfolios. Is this surprising? Why or why not?

j) Repeat b) for the 25 size and BE/ME portfolios, but use the "in-sample" tangency portfolio of the 10 past return portfolios estimated over the entire sample period in place of RM-RF. Comment on how well you price the 25 size and BE/ME portfolios. Is this surprising? Why or why not?

k) Report the correlation matrix of the returns on the tangency portfolios of the 30 value-weighted industries, 10 past return portfolios, and 25 size and BE/ME portfolios. Comment on these correlations in light of the results you found in i) and j).