

# Empirical Methods in Finance

## Homework 4

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Please use Matlab/R to solve these problems. You can just hand in one set of solutions that has all the names of the contributing students on it in each group. Use the electronic drop box to submit your answers. Submit the Matlab or R file and the file with a short write-up of your answers separately.

[The quality of the write-up matters for your grade. Please imagine that you're writing a report for your boss at Goldman when drafting answers these questions. Try to be clear and precise.]

### Cross-Sectional Regressions

Download monthly data on the 5 Fama French factors from Kenneth French's web site. Use the data from 1963 through 2015. Use the value-weighted returns. Also, download quintile portfolios (i.e., 5 portfolios corresponding to 20%, 40%, 60%, and 80% breakpoints) sorted on book-to-market, size, operating profitability, investment, and market beta. Use the monthly risk-free rate series provided by French in the same FF factor data set to compute excess returns on these test portfolios.

1. Test the model using a time-series test. That is, run the 25 time series regressions of test asset excess returns on the factors and test whether the alphas are jointly zero. Use both the asymptotic (assuming homoscedastic errors (i.e., no White-standard errors needed) chi-squared test and the exact F-test. Report the results.
2. Now, using the betas you obtained in (1), run cross-sectional OLS regressions and Fama-MacBeth regressions to estimate the prices of risk. Allow for an intercept term.

- (a) Verify that the lambda estimates are the same, whether you use OLS or Fama-MacBeth. Give the standard errors of all coefficients including the intercept (not the alpha's). For OLS, report both the standard errors obtained with and without the Shanken correction. Also, report the cross-sectional  $R^2$ .
3. Now, download the decile (a 10 portfolio sort) portfolios sorted on Momentum, as well as quintile portfolios based on net share issues, residual variance, and the 10 industry portfolios.
- (a) Now, test the 5-factor Fama-French model using Fama-MacBeth cross-sectional regressions (again, including an intercept) and these 30 test assets. Report the results (coefficient values, standard errors and cross-sectional  $R^2$ ) and compare with results in (2).
  - (b) Now, with these 30 test assets, test the CAPM using the Fama-MacBeth procedure. In particular:
    - i. First, get market betas by running time-series regressions of each test asset only on the market factor (and intercept). Next, run Fama-MacBeth regressions on the estimated betas in two different specifications. One with an intercept and one without an intercept. Report the results from both specifications.
    - ii. Plot  $\hat{\lambda}_{t+1}^\beta$  from the specification with and without intercepts, as well as the excess market returns (use the Fama-French market factor). Also, give the correlations between these three time-series. Are the results sensitive to whether we are using an intercept or not?