MFE230E Problem Set 5

Due April 28 6:00pm via bCourses

You may use any package to compute mean-variance frontiers (e.g. `PyPortfolioOpt`, https://pypi.org/project/pyportfolioopt).

Download the following datasets from Ken French's website http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html:

1. `Fama/French5Factors(2x3)`: Fama-French factors (Mkt-RF, SMB, HML, RMW, CMA, RF)
2. `MomentumFactor(Mom)`: Fama-French momentum factor (MOM)
3. `25PortfoliosFormedonSizeandMomentum(5x5)`: 25 size/momentum portfolios

The portfolios are described in detail on Kenneth French's website. For the following exercise, use monthly data from July 1963 to the most recently data that is available. Use value-weighted size/momentum portfolios as test assets. For time-series regressions, calculate OLS, White and Newey-West standard errors. For this problem set, you may use the `statsmodels` package.

1. (a) For each of the 25 size-momentum portfolios, run the CAPM regression:

$$R_t^i - R_t^f = \alpha_i + \beta_i \left(R_t^M - R_t^f \right) + \varepsilon_t^i.$$

   Report the 25 α_i's and β_i's along with their standard errors. Are the β_i's precisely estimated?

   (b) Are the pricing errors ($\hat{\alpha}_i$'s) statistically and economically significant? What do you conclude?

   (c) Plot the fitted mean excess returns on the x-axis and the average excess returns on the y-axis. What does this plot say about the fit of the model?

   (d) Compute t-tests for the null $H_0 : \alpha_i = 0$ for each α_i individually.

   (e) Compute the GRS test for the joint null $H_0 : \alpha_i = 0 \; \forall i$.

   (f) Plot the theoretical Capital Market Line and the mean-variance frontier spanned by the 25 portfolios. How does this figure relate to the regression pricing errors?

   (g) Summarize how well the CAPM model explains the 25 test portfolios.

2. Now, consider the 3-factor Fama-French model. For each asset, run the following regression:

$$R_t^i - R_t^f = \alpha_i + \beta_{MKT,i} \left(R_t^M - R_t^f \right) + \beta_{SMB,i} R_t^{SMB} + \beta_{HML,i} R_t^{HML} + \varepsilon_t^i.$$

   Repeat the exercise in Question 1.

3. Now, consider the 4-factor Fama-French-Carhart model. For each asset, run the following regression:

$$R_t^i - R_t^f = \alpha_i + \beta_{MKT,i} \left(R_t^M - R_t^f \right) + \beta_{SMB,i} R_t^{SMB} + \beta_{HML,i} R_t^{HML} + \beta_{MOM,i} R_t^{MOM} + \varepsilon_t^i.$$

Repeat the exercise in Question 1.

4. (a) Estimate the risk premia of the 4-factor Fama-French-Carhart model model using a cross-sectional regression. Compute the standard errors of the factor premia assuming that the beta's in the first stage are known. Summarize the regression results.

   (b) Compare the estimated risk premia of the four factors to the risk premia implied by the model.

   (c) Compare the pricing errors from the time-series regressions in question 3 to the pricing errors of the cross-sectional regression.

   (d) Plot betas of the four "corner" portfolios estimated from 60-month rolling regressions. Are the betas varying over time?

   (e) Repeat question 4 using the Fama-MacBeth estimation method and compare the results to those from question 4.

5. Optional: Compute the standard errors in question 4 that correct for the fact that the beta's are estimated in the first stage. This is known as the *Shanken-correction*. The correction is derived in the Appendix of the lecture notes. Chapter 12 of Cochrane's "Asset Pricing" book has further details of the 2-stage estimation.