Financial Economics I: Group Project

November 2022

- Please form groups with three students (absolute maximum is three) in each group. Please try to ensure a gender mix and a mix of domestic and international students in the group. This may not be possible but students should attempt to form groups with at least one mix (either gender or domestic/international). Those who cannot find a group should send me an email at conall.osullivan@ucd.ie.
- Each student in the group should contribute to the Python coding and write up. Each student should include a paragraph of their overall contribution to the project in the project submission. Please include student names and numbers at the beginning of the project.
- The datasets accompanying this project are downloaded from Yahoo Finance and from the Fama-French Data Library.
- I have uploaded code that will get you started with the project. The code downloads single stock price data for the *current* constituents of the S&P 500 index, aligns this data with S&P 500 data and then runs an unconditional test of the CAPM (or the market model) using the *full* dataset. In an unconditional CAPM test a separate time series regression is used for each asset to estimate the market betas of each stock using the full dataset. These are called first pass regressions. In a single second pass regression, we then regress the full sample mean excess returns of the assets (dependent variable) on the asset betas (independent variable) estimated in the first pass regressions.

  I have also uploaded an out-of-sample portfolio test code on ETFs. You must take this code and apply it to S&P 100 data as described below.

Requirements

1. Run an unconditional test of the Fama-French 3-factor and 5-factor models as carried out in the example code for the CAPM.

   Comment on your results. (max 1000 words).
2. Run a conditional CAPM test using the S&P 500 constituents as the individual assets. To do this estimate the betas using the oldest five years of data denoting this data window as $[1, m]$. Then regress the mean monthly excess returns of the assets in

month $m+1$ on the previously estimated vector of betas $\beta_{[1,m]}$. Repeat this exercise for the remaining "out-of-sample" months $m+2, m+3, \cdots, T$. Use a rolling window for beta estimates so that the mean returns of the assets in month $m+\tau$ are regressed on the betas estimated in the window $[\tau, m+\tau-1]$, denoted as $\beta_{[\tau,m+\tau-1]}$, where $\tau = m+1, \ldots, T$. Estimate the mean of the intercepts, slopes, t-statistics and adjusted-R-squared from the $T-m$ out-of-sample second pass regressions. Also report the time series standard error of the estimated risk premia given by the standard deviation over all out-of-sample months divided by the square root of the number of out-of-sample months.

Comment on your results (max 1500 words).

3. Solve the weights on two mean variance portfolios using the the S&P 100 (as opposed to S& P 500) as the assets in the portfolio. Set the oldest five years of data $[1, m]$ as the initial in-sample period. Evaluate returns over the subsequent month $m+1$ and rebalance the portfolio at the end of month $m+1$. The first portfolio should be the Global Minimum Variance Portfolio whose weights are given by $w_t^{(GMVP)} = (1/C)\Sigma^{-1}\ell$ where $C = \ell'\Sigma^{-1}\ell$ and where it is assumed Σ is estimated using only information up to time t. Set the second portfolio weights as follows:

$$w_t^{(2)} = a + BE_t\left[\tilde{\mathbf{r}}_{t+1}\right]$$

where

$$a = \frac{\Sigma^{-1}\ell}{\ell'\Sigma^{-1}\ell},$$

and

$$B = \frac{1-\gamma}{\gamma}\left(\Sigma^{-1} - \frac{\Sigma^{-1}\ell\ell'\Sigma^{-1}}{\ell'\Sigma^{-1}\ell}\right)$$

whereas γ denotes the coefficient of relative risk aversion (which you can set to a fixed value of your choice) and where $E_t\left[\tilde{\mathbf{r}}_{t+1}\right]$ is the vector of CAPM expected excess returns of the stocks estimated using information up to time t.
The realised scalar out-of-sample return of a portfolio is given by $r_{t+1} = w_t' \times \mathbf{r}_{t+1}$.
Plot the out-of-sample cumulative realised returns of the two portfolios. Also include in the plot the cumulative realised returns of an equally weighted portfolio and the S&P 100 market portfolio for comparison purposes.
Use the CAPM model to evaluate the out-of-sample performance of the two portfolios. That is, run an ex-post regression with the excess portfolio returns as the dependent variable and the excess S&P 100 market returns as the independent variable.

Comment on your results (max 1500 words).

- In each comment section you can reference a number of other related papers if you like (2 to 3 papers).

- Download your resulting Jupyter Notebook as an IPYNB file and as a HTML file. Convert the HTML file to a PDF document by right clicking on the HTML file and choosing "Print $\rightarrow$ Print to PDF". Submit both the IPYNB file and the PDF file to the appropriate link on Brightspace by close of day on Tuesday the 6^{th} December. Try to submit on time to ensure you have some study time but if an extra day or two is needed just let me know.