Assignment 1

Due 21/9/2017

In the recent finance literatures, it is suggested that asset prices are well described by a so-called factor model. Excess returns are linearly explained from excess returns on a number of factor portfolios. According to CAPM, the intercept term should be zero, just like the coefficient for any other variable included in the model the value of which is known in advance (e.g. a January Dummy). The data set ***assignment1.xlsx*** contains excess returns on three-factor portfolio model. Extended from CAPM, the three-factors model includes two additional variables into the model. The portfolios are re-formed each month on the basis of the most recent available information on firm size and book-to-market value of equity. In addition to risk premium of market portfolio (r_m), the r_{smb} factor is based on the firm size and reflects the difference in returns between a portfolio of stocks with a small firm size and a portfolio of stock with a big firm size. The r_{hml} factor classifies the stocks based on the ratio of book value to market value of equity and computes the difference in returns between a portfolio of stocks with a high book-to-market ratio (value stocks) and a portfolio of stocks with a low book-to-market ratio (growth stocks).

CAPM: $$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \varepsilon_{jt} \quad (1)$$

Fama- French: $$r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \beta_{j2} r_{smbt} + \beta_{j3} r_{hmlt} + \varepsilon_{jt} \quad (2)$$

Where:
- r_{jt} = excess return on portfolio j at time t and
- j = 1, 2, …., 25 portfolios categorized by five groups of firm size and five groups of value of the stock.
- r_{mt} = excess return on market portfolio at time t – representing market risk premium.
- r_{smbt} = return on a small-stock portfolio minus the return on a large-stock portfolio (Small Minus Big) at time t – representing size premium.
- r_{hmlt} = return on a value-stock portfolio minus the return on a growth-stock portfolio (High Minus Low) at time t – representing value premium.

(1) Regress the excess returns on portfolio upon the excess return on the market portfolio with constant term, noting that this corresponds to the CAPM (model (1)).
(2) Make interpretation of the estimated β coefficients, t-test, F-test, R^2 and Adjusted-R^2.
(3) Perform hypothesis testing whether your estimated portfolio has the same risk as the market.
(4) Test the validity of the CAPM by testing whether the constant terms in regression is zero. What are the differences between regressing the models with and without constant term.
(5) Test whether there exists significant January effect in the regression models.
(6) Regress the three-factor model (2) by using OLS. Compare the estimated results with the one-factor (CAPM) model (1).
(7) Test whether there exists a significant first order autocorrelation in the estimated regression model. In case of autocorrelation, what are the consequences of the problem? And how can we solve the problem.
(8) Test whether your estimated portfolio has size premium.
(9) Test whether your estimated portfolio has value premium.

(10) Perform *F*-test for the hypothesis that the coefficients for the two new factors are jointly equal to zero.
(11) Perform Chow-test whether January and other month share the same structure of the Fama-French model (2).

However, some other literatures have claimed that macroeconomic factors play important role in determining the return of the portfolio. Then, the model should be arbitrage pricing model as

$$\text{APT:} \qquad r_{jt} = \alpha_j + \beta_{j1} r_{mt} + \gamma_{j2} r_{\text{int}t} + \gamma_{j3} r_{fxt} + \gamma_{j4} r_{goldt} + \varepsilon_{jt} \qquad (3)$$

Where: r_{intt} = interest rate at time t – expected to have negative relationship.
r_{fxt} = change in exchange rate at time t – expected to have negative impacts.
r_{goldt} = change in gold price at time t –expected to have negative impacts.

(12) Regress the APT (model (3)) of your portfolio. Make interpretation of the estimated result.
(13) Whether there exists serious multicollinearity problem in model (3). Should any independent variables in model (3) be dropped? Give explanation of your decision.
(14) Which of the following hypotheses about the coefficients can be tested using a *t*-test? Which of them can be tested using an *F*-test? In each case, state the number of restrictions.
   (i) $H_0 : \beta_1 = 1$
   (ii) $H_0 : \gamma_2 + \gamma_3 = 1$
   (iii) $H_0 : \gamma_2 + \gamma_3 = 1 \; and \; \gamma_4 = 1$
   (iv) $H_0 : \beta_1 = 0 \; and \; \gamma_2 = 0 \; and \; \gamma_3 = 0 \; and \; \gamma_4 = 0$
   (v) $H_0 : \gamma_2 \gamma_3 = 1$
(15) In question (14) which would you expect to be bigger – the unrestricted residual sum of squares or the restricted sum of squares, and why?
(16) From CAPM model (1), what would be the conceptually differences if we (a) regress the excess returns on portfolio upon the excess return on the market portfolio with constant term or (b) regress the excess return on the market portfolio upon the excess returns on portfolio with constant term? Make comparison of (a) and (b).