Introduction to Quantitative Methods

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Eviews Class 2

The multiple regression model

Using the data contained in the file Fama-French data.xls answer all the following questions.

1 The market model

In this example we use Least Squares to estimate a model that explains the movement of monthly individual stock returns from July 1988 until December 2004.

1.1 Preliminaries

- First, we need to import the data from the Excel file Fama-French data.xls into an Eviews file (and save it). By now you should already know how to do so.
- The data contained in the file Fama-French data.xls are:
  - IBM, MICROSOFT, DELL: STOCK MARKET RETURNS
  - SP500: S&P500 STOCK INDEX RETURNS
  - T-BILL : T-BILL ONE MONTH HOLDING PERIOD RETURNS
  - SMB: RETURNS ON SMALL (MARKET CAPITALIZATION) MINUS BIG STOCKS
  - HML: RETURNS ON HIGH (BOOK-TO-MARKET RATIO) MINUS LOW STOCKS
  - MOMENTUM: RETURNS ON PRIOR MONTH WINNERS MINUS PRIOR MONTH LOSERS

1.2 Regression

- Using the sample 1988:7 to 2004:12, run a regression of stock market excess returns (IBM, MICROSOFT, DELL) on a constant and on the market risk premium. The equation we want to estimate is thus:

$$R_{jt} - R_{TBt} = \alpha_j + \beta_j(R_{Mt} - R_{TBt}) + u_{jt}$$

- The quantity of interest is the significance of α_j, since this parameter defines whether stocks are underpriced or overpriced relative to their contribution to the risk of the market portfolio.

  A positive and significant α_j for a given stock would suggest that the stock is able to earn significant abnormal returns (underpriced) in excess of the market-required return for a stock of this given riskiness

- Simple estimation and tests of the **Capital Asset Pricing Model** (**CAPM**) can be conducted using the above equation, but **Arbitrage Pricing Theory** (**APT**) does not pre-suppose that there is only a single factor affecting stock returns. Stock returns might be purported to depend on their sensitivity to two or more factors that respresent sources of risk.

- Using the sample 1988:7 to 2004:12, run a regression of stock market excess returns (IBM, MICROSOFT, DELL) on a constant, the market risk premium, the premium on the size factor (SMB), the premium of the book-to-market factor (HML), and the premium on winners minus losers (MOM). The equation we want to estimate is thus:

$$\begin{aligned} R_{jt} - R_{TBt} &= \alpha_j + \beta_{1j}(R_{mt} - R_{TBt}) + \beta_{2j}(R_{SMB} - R_{TBt}) \\ &\quad + \beta_{3j}(R_{HMLt} - R_{TBt}) + \beta_{4j}(R_{MOMt} - R_{TBt}) + u_{jt} \end{aligned}$$

1.3 Tests

Perform the following coefficient and residual tests for the single and four factor models illustrated above

Coefficient tests

- For which stocks beta coefficients are significantly different from zero at the 5% level?
- Does the overall market index has a statistically significant effect on IBM, Dell or Microsoft?
- How would you interpret a beta coefficient of more or less than one according to the CAPM?
- Is the coefficient attached to the constant significant at the 5% level? What does this imply for the CAPM as a pricing model?
- Test whether the coefficients on SMB, HML and MOM are jointly significantly different from zero? Interpret the result.

Residual tests

Heteroscedasticity

- Provide a graph of the residuals and comment on it.
- Test formally for homoscedasticity. To do so you need to implement the White test
- Estimate again the model with OLS, and then correct for heteroscedasticity using the White heteroscedasticity consistent estimator
- Is there a difference in the standard errors? Does this change the significance of the α and β coefficients?

Autocorrelation

- Provide the correlogram of the residuals of this regression and comment on it.
- Look at the Durbin Watson statistic. Does it signal the presence of autocorrelation?
- Test formally for autocorrelation up to order 2. To do so you need to implement the Breusch-Godfrey test.
- Estimate again the model with OLS, and then correct for heteroscedasticity/autocorrelation using the Newey-West Heteroscedasticity Autocorrelation Consistent (HAC) estimator
- Once we use the heteroscedasticity-consistent estimator, are the coefficients on the market index and the constant still significant?

1.4 R-squared and Analysis of Variance

- Draw a graph of the actual-fitted-residual decomposition. To do so, click "resids" on the estimation output window:
- Compute the Error Sum of Squares (ESS)
- Compute the total variation of Y (Total Sum of Squares, TSS).
- Compute the explained variation of Y (Regression Sum of Squares, RSS).
- Show that the R-squared is equal to the ratio between RSS and TSS.
- By looking at the Actual-Fitted-Residuals graph, are you satisfied with how this model explains the actual behaviour of individual stock market returns? Motivate your answer.