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Econometrics 1

Homework 2

1. Suppose **b** is the least squares coefficient vector in the regression of **y** on **X** and **c** is any other Kx1 vector. Prove that the difference in the two sums of squared residuals is $(\mathbf{y-Xc})'(\mathbf{y-Xc}) - (\mathbf{y-Xb})'(\mathbf{y-Xb}) = (\mathbf{c - b})'\mathbf{X}'\mathbf{X}(\mathbf{c - b})$.
Prove that this difference is positive.

2. Consider the least squares regression of **y** on K variables (with a constant), **X**. Consider an alternative set of regressors, $\mathbf{Z} = \mathbf{X+P}$, where **P** is a nonsingular non-random matrix. Calculate the residual vectors in the regressions of **y** on **X** and **y** on **Z.** What can you say about them?. What relevance does this have to the question of changing the fit of a regression by adding a constant to the measurement of the independent variables?

3. In the least squares regression of **y** on a constant and **X**, in order to compute the regression coefficients on **X**, we can first transform **y** to deviations from the mean, y, and, likewise, transform each column of **X** to deviations from the respective column means; second, regress the transformed **y** on the transformed **X** without a constant. Do we get the same result if we only transform **y**? What if we only transform **X**?

4. Prove that the adjusted R^2 rises (falls) when variable $\mathbf{x}_k$ is deleted from the regression if the square of the t ratio on $\mathbf{x}_k$ in the multiple regression is less (greater) than one.

5. Suppose you estimate a multiple regression first with then without a constant. Whether the R^2 is higher in the second case than the first will depend in part on how it is computed. Using the (relatively) standard method, $R^2 = 1 - \mathbf{e}'\mathbf{e} / \mathbf{y}'\mathbf{M}^0\mathbf{y}$, which regression will have a higher R^2?

6. (Download dataset ec1_set1.xlsx from website). You have monthly data on Disney stock returns, *DIS_ret*, S&P 500 index returns, percent changes in the Fed's Broad Dollar Index, *FR_FXB*, and the FF factors: *Mkt_RF*, *SMB*, *HML*, and the risk free rate, *RF*. The data covers the period 1973:Jan to 2019:June. First, you transform Disney's returns into excess returns, that is, *DIS_er = DIS_ret – RF*. You fit the following regressions (with a constant):
– Reg 1: a regression of *DIS_er* on *Mkt-RF*.
– Reg 2: a regression of *DIS_er* on *Mkt-RF*, *SMB*, *HML*, and *FR_FXB*.

(a) Explain why specification (Reg 1) is a restricted version of specification (Reg 3), stating and interpreting the restriction.

(b) Perform an *F* test of the restriction. Perform a *t* test of the restriction. Explain whether the *F* test and the *t* test could lead to different conclusions.

(c) Supposing the restriction to be valid, explain whether you expect the coefficient of *Mkt-RF* and its standard error to differ, or be similar, in specifications (Reg 1) and (Reg 2).

(d) Supposing the restriction to be invalid, how would you expect the coefficient of *Mkt-RF* and its standard error to differ, or be similar, in specifications (Reg 1) and (Reg 2)?

(e) At a seminar, a commentator says that DIS has transformed itself, since 1993, embarking on an acquisition spree (Miramax, Capital Cities/ABC/ESPN, Fox Family, The Muppets, Pixar, Marvel, Lucasfilm, 21st Century Fox, etc.). Test whether the commentator's assertion is correct.

(f) What are the implications of the commentator's assertion for the test of the above restriction?