

Elements of Econometrics, 2023-2024

Class teacher: Ksenia Kasianova.

Class 4: Multiple linear regression.

Problem 1

By definition $R_{adj}^2 = 1 - \frac{RSS/(n-k)}{TSS/(n-1)}$.

Compare it with the definition of conventional R^2 , what is the difference? Comment on the meaning of $(n-k)$ and $(n-1)$ in the formula.

Problem 2

(a) Recall F-test for linear restrictions.

(b) Show that test for significance is actually F-test with naive restricted model (model on a constant term).

(c) Let the regression equation be

$$y_i = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \epsilon_i$$

Number of observations equals to 20

Outline briefly how would you test:

(a) $\beta_2 = 0$

(b) $\beta_2 = 1$

(c) β_1, β_2 jointly insignificant

(d) $\beta_1 = \beta_2$

(e) $\beta_1 + \beta_2 = 1$

(f) $\beta_1 + \beta_2 = 1$ against $\beta_1 + \beta_2 < 1$

Problem 3

Let a regression equation be:

$$Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + u_t ; t = 1, 2, \dots, T$$

What are normal equations of OLS for the multiple linear regression in covariance form? Use sample variance and sample covariance functions to represent normal equations of OLS **without taking derivatives**.

Derive formulas for regression coefficients in the case of two regressors?

$$b_2 = \frac{\text{Cov}(X_2, Y)\text{Var}(X_3) - \text{Cov}(X_3, Y)\text{Cov}(X_2, X_3)}{\text{Var}(X_2)\text{Var}(X_3) - [\text{Cov}(X_2, X_3)]^2}$$
$$b_3 = \frac{\text{Cov}(X_3, Y)\text{Var}(X_2) - \text{Cov}(X_2, Y)\text{Cov}(X_2, X_3)}{\text{Var}(X_2)\text{Var}(X_3) - [\text{Cov}(X_2, X_3)]^2}$$