

# First test in Introductory Econometrics

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1. Consider the Gauss-Markov assumptions for the linear regression model:[6 points]
  - (a) Please provide the four assumptions that are required in the *multiple* linear regression model for the unbiasedness property of the OLS estimator.
  - (b) Which additional assumption is needed to make OLS linear efficient ('BLUE')?
  - (c) Which of the assumptions differ from the comparable ones for the simple linear regression model, and in what respect?

2. Gauss-Markov assumptions in applications: state in the following linear regression situations, which of the Gauss-Markov assumptions is violated if any.[8 points]
- (a) A regression of a health indicator on the height and weight of  $n = 500$  persons. The relation appears to be linear, and there does not appear to be any sign of heteroskedasticity. Height and weight are of course positively correlated;
  - (b) A regression of aggregate investment demand on three variables: a long-run interest rate  $r_L$ , a short-run interest rate  $r_S$ , and a so-called term premium defined as  $r_L - r_S$ . Data are taken from  $n = 30$  European countries;
  - (c) A regression of the density of soot particles in the atmosphere on the stock of diesel cars  $D$  across  $n = 150$  municipalities. The relation appears to be linear, the variance of  $D$  appears to be constant in  $i$ , but the error variance appears to be increasing in  $D$ ;
  - (d) The average income of parents (father and mother) is regressed on the average income of their children, with  $n = 250$  pairs of parents. The relation appears to be approximately linear and homoskedastic.[Hint: consider the existence of an unobserved determinant of income such as ability or skills.]

3. Regression output often shows  $t$ -statistics together with the coefficient estimates. [6 points]
- (a) Presume you have the OLS coefficient estimates and also estimates for the variances of these coefficients, but  $t$ -statistics are not provided. How can you construct a  $t$ -statistic for a given coefficient, say the third one?
  - (b) Which null hypothesis is tested by the  $t$ -test on the third coefficient? State the hypothesis explicitly using the corresponding parameter.

4. Regression output routinely shows an object called  $R^2$ . [5 points]

- (a) Suppose the  $R^2$  equals 0.8, and the explained sum of squares  $SSE$  equals 8000. Determine the values of the total sum of squares  $SST$  and of the residual sum of squares  $SSR$ .
- (b) Suppose the regression has 7 regressors (plus an intercept) and it is run over a sample of  $n = 108$  observations. What is the value of the unbiased estimate  $\hat{\sigma}^2$  of the error variance?