

**The International College of Economics and Finance**  
**Econometrics - 2020. Mid-term exam, October 22**

**Part 1. (30 minutes). In each of 12 multiple choice tests indicate the correct answer.**

1. In the Simple Linear Regression Model  $Y_i = \beta_1 + \beta_2 X_i + u_i$  the population covariance of the OLS estimators of the intercept and slope coefficient  $cov(b_1, b_2)$  is

- 1) positive if the mean value of  $X$  is positive;
- 2) negative if the mean value of  $X$  is positive;
- 3) may be positive or negative if the mean value of  $X$  is positive;
- 4) may be positive or negative if the mean value of  $X$  is negative;
- 5) does not depend on the mean value of  $X$ .

2. For the Model  $Y_i = \beta_2 X_i + u$  (Model A assumptions satisfied,  $i=1, \dots, n$ ) the estimator

$$b_2 = \frac{((Y_1 + Y_2 + Y_3)/3) - \bar{Y}}{((X_1 + X_2 + X_3)/3) - \bar{X}} \text{ is:}$$

- 1) non-linear estimator of  $\beta_2$ ;
- 2) unbiased estimator of  $\beta_2$ ;
- 3) efficient estimator of  $\beta_2$ ;
- 4) biased estimator of  $\beta_2$ ;
- 5) not an estimator of  $\beta_2$ .

3. In a simple regression with an intercept  $\hat{Y} = b_1 + b_2 X$ , the estimated slope coefficient  $b_2$  is equal to zero. Then the determination coefficient  $R^2$  is

- 1) Equal to one;
- 2) Not equal to 1 or 0;
- 3) In some situations can be negative;
- 4) Equal to zero
- 5) Can not be calculated for the model due to violation of assumptions.

4. If a new observation and a new explanatory variable are added in the Linear Regression Model, then for OLS-estimation, the following is true:

- 1) The Residual Sum of Squares (RSS) decreases; the Determination Coefficient  $R^2$  may increase, decrease or stay the same;
- 2) The Residual Sum of Squares (RSS) increases; the Determination Coefficient  $R^2$  may increase, decrease or stay the same;
- 3) Both the Determination Coefficient  $R^2$  and the Residual Sum of Squares (RSS) may increase, decrease or stay the same;
- 4) The Determination Coefficient  $R^2$  increases; the Residual Sum of Squares (RSS) may increase, decrease or stay the same;
- 5) The Determination Coefficient  $R^2$  decreases; the Residual Sum of Squares (RSS) may increase, decrease or stay the same;

5. A student added extra explanatory variable to the multiple linear regression model. As a result, the determination coefficient went up, and the adjusted determination coefficient went up also. What of the following can be definitely stated:

- 1) The new explanatory variable's coefficient is significant at the 10% level;
- 2) The new explanatory variable's coefficient is insignificant at the 10% level;
- 3) The absolute value of t-statistic of the new explanatory variable's coefficient is greater than 0.9;
- 4) The absolute value of t-statistic of the new explanatory variable's coefficient is greater than 1.5;
- 5) None of the above.

6. For the Model  $Y_i = \beta_1 + \beta_2 X_i + u$  (Model A assumptions satisfied) the estimator

$$b_2 = \frac{\sum (Y_i - \bar{Y})}{\sum (X_i - \bar{X})} \text{ is, generally speaking:}$$

- 1) biased and inconsistent estimator of  $\beta_2$ ;
- 2) biased but consistent estimator of  $\beta_2$ ;
- 3) unbiased but inefficient estimator of  $\beta_2$ ;
- 4) equal to the OLS estimator;
- 5) can not be calculated;

7. Introduction of two linear restrictions on parameters in a regression model, estimated using OLS

- 1) results in minor increase of the sum of squared errors if at least one of the restrictions is not valid;
- 2) results in significant increase of the sum of squared errors if at least one of the restrictions is valid;
- 3) results in minor increase of the sum of squared errors if both restrictions are valid;
- 4) results in significant increase of the sum of squared errors only if both restrictions are valid;
- 5) all the above is incorrect.

8. A dependence between *EDUC* (aggregate expenditure on education), *GDP* (gross domestic product), and *POP* (total population) is under investigation. Two specifications below are estimated for the sample of 120 countries in 2018.

$$\log \hat{EDUC} = \beta_{11} + \beta_{12} \log GDP - \beta_{13} \log POP \quad (1)$$

$$\log \frac{\hat{EDUC}}{POP} = \beta_{21} + \beta_{22} \log \frac{GDP}{POP} - \beta_{23} \log POP \quad (2)$$

The following statement is **incorrect** about these models :

- 1)  $RSS_1 = RSS_2$
- 2)  $R^2_1 \neq R^2_2$  ;
- 3)  $b_{11} = b_{21}$  ;
- 4)  $b_{12} = b_{22}$  ;
- 5)  $b_{13} = b_{23}$ .

9. There are (1) and (2) versions of the Multiple Regression Model:

$$Y = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + u \quad (1)$$

$$Y - X_4 = \beta_1 + \beta_2 (X_2 + X_3) + u \quad (2)$$

The Model (2) is the Model (1) with the following restrictions:

$$1) \beta_3=0; \beta_4=0; \quad 2) \beta_2=\beta_3; \beta_4=1; \quad 3) \beta_2+\beta_3=1; \beta_4=1; \quad 4) \beta_2=\beta_3; \beta_4=0;$$

5) The Model (2) is not a restricted version of the Model (1).

10. A student regressed  $Y$  and  $\log(Y)$  on  $X$ , with the intercept (regressions 1 and 2 respectively). Then he did Zarembka scaling  $Y^*=Y/\text{geometric mean of } Y$ , and regressed  $Y^*$  and  $\log(Y^*)$  on  $X$  (regressions 3 and 4). Then the following is correct:

- 1) All the coefficients' estimates, including the intercept, are the same in regression 3 as in regression 1;
- 2) All the coefficients' estimates, including the intercept, are the same in regression 4 as in regression 2;
- 3) All the coefficients' estimates, except the intercept, are the same in regression 3 as in regression 1;
- 4) All the coefficients' estimates, except the intercept, are the same in regression 4 as in regression 2;
- 5) None of the above.

11. The population variance of prediction error  $\sigma_{PE}^2$

- 1) is always greater than the population variance of disturbance term  $\sigma_u^2$ ;
- 2) is always less than the population variance of disturbance term  $\sigma_u^2$ ;
- 3) can be greater, less then or equal to the population variance of disturbance term  $\sigma_u^2$ ;
- 4) is always equal to the population variance of disturbance term  $\sigma_u^2$ ;
- 5) is not related to the population variance of disturbance term  $\sigma_u^2$ .

12. Root mean squared error of prediction  $\sqrt{\sum_{t=T+1}^{T+h} (\hat{y}_t - y_t)^2 / h}$  is always

- 1) Greater or equal to the Mean absolute error of prediction  $\sum_{t=T+1}^{T+h} |\hat{y}_t - y_t| / h$
- 2) Less or equal to the Mean absolute error of prediction;
- 3) May be greater or less than the Mean absolute error of prediction;
- 4) Equal to the Mean absolute error of prediction;
- 5) Can not be compared with the Mean absolute error of prediction since it has different dimensity.