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

1) non-linear estimator of β_2; 2) unbiased estimator of β_2; 3) efficient estimator of β_2;

4) biased estimator of β_2; 5) not an estimator of β_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 $b_2 = \dfrac{\sum (Y_i - \bar{Y})}{\sum (X_i - \bar{X})}$ is, generally speaking:

1) biased and inconsistent estimator of β_2;
2) biased but consistent estimator of β_2;
3) unbiased but inefficient estimator of β_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.

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

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

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) $\beta_3=0$; $\beta_4=0$;   *2)* $\beta_2=\beta_3$; $\beta_4=1$;   *3)* $\beta_{2+}\beta_3=1$; $\beta_4=1$;   *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/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 σ_{PE}^2

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