ECONOMETRICS - FINAL EXAM (GADE)

May 08, 2023 – 12:00 AM

| Family name: | Name: |
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INSTRUCTIONS

This exam includes 20 multiple choice questions.

Your answers must be marked on the answer sheet that you will find in the first page. If you want to leave any question unanswered, choose the "Blank" option. This answer sheet is the only part of this exam that will be graded.

A correct answer adds 2 points to the final grade while an incorrect one subtracts 1 point. A blank answer does not add or subtract. The final grade is the number of points divided by 4.

Make sure that you checked your options, including "Blank". Do not unclip the sheets. Use the blank space in the following pages to write notes or to do arithmetic calculations.

YOU HAVE ONE HOUR TO ANSWER THIS TEST

REMINDER

YOU ARE NOT ALLOWED TO USE DEVICES WITH CONNECTIVITY TO THE INTERNET, INCLUDING MOBILE PHONES, TABLETS, SMARTWATCHES OR MP3/4 PLAYERS

Question 1. In the model $\hat{Y} = \hat{\beta}_1 + \hat{\beta}_2 X_2 + \hat{\beta}_3 X_3$, which of the following statements is NOT ALWAYS TRUE?

- A) If the sample average of $Y, X_2 \ge X_3$ are equal to zero, then $\hat{\beta}_1 = 0$.
- B) The Sum of Squared Residual is equal or greater than zero, $SSR \ge 0$.
- C) If we estimate the model $Y = \alpha_1 + \alpha_2 X_2 + u$, The OLS estimate of α_2 is equal to $\hat{\beta}_2$.

Question 2. To obtain a confidence interval for β_2 in the model $Y = \beta_1 + \beta_2 X_2 + U$, we need to estimate $\hat{\beta}_2$, the standard error of $\hat{\beta}_2$ and set the level of confidence $(1 - \alpha)$. Then, which of the following statements is FALSE. The width (length) of the interval will increase with the ...

- A) size of $\hat{\beta}_2$.
- B) standard error of $\hat{\beta}_2$.
- C) level of confidence.

Question 3. Regarding the Variance Inflation Factor (VIF_j) for the slope coefficient j in the regression $Y = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + U$, which of the following statements is TRUE.

- A) $VIF_3 = 1$ reveals a MULTICOLLINIARITY "problem" in this model.
- B) $\text{VIF}_{3} = 1$ reveals a HETEROSKEDASTICITY "problem" in this model.
- C) None of the above.

Question 4. The existence of heteroskedasticity is problematic since (which of the following statements is TRUE):

- A) The OLS estimator becomes biased.
- B) The usual estimate of the variance of the OLS estimator will be biased.
- C) A multicollinearity-robust standard error estimator should be calculated.

Question 5. Influential observations are defined as those that have...

- A) a large impact on the OLS estimates.
- B) a high leverage.
- C) a large OLS residual.

Questions 6 to 9 correspond to the following statement. Consider the following model:

$$Y_i = \beta_1 + \beta_2 X_{i2} + \beta_3 X_{i3} + U_i, \quad i = 1, ..., 44$$

And the next tables that show the OLS estimates of parameters and the estimated variance and covariance matrix of the OLS estimates.

$$\begin{vmatrix} \hat{\beta}_1 \\ \hat{\beta}_2 \\ \hat{\beta}_3 \end{vmatrix} = \begin{bmatrix} -27.05986 \\ 1.498472 \\ 1.27375 \end{bmatrix} v \hat{a} r(\hat{\beta}) = \begin{bmatrix} 32.057666 \\ -0.1290654 \\ 0.00979752 \\ -0.1552826 \\ -0.0069964 \\ 0.0070221 \end{bmatrix}$$

$$\hat{\sigma}_u^2 = 5.9734; Explained Sum of Squares = SSE = 17565.3795$$

Note: Use all available decimals to answer question 6 to 9

Question 6. which of the following statements is TRUE:

- A) Total Sum of Squares (SST) = 17560.4061.
- B) $R^2 = 0.986$.
- C) Sum of Squared Residuals (SSR) = 444.91.

Question 7. The LARGEST associated p-values for the individual t test of the null hypothesis $H_0: \beta_i = 0$ against the alternative $H_1: \beta_i \neq 0$ is:

- A) for β_3 .
- B) for β_2 .
- C) for β_1 .

Question 8. Critical values are reported as: $\Pr[t(41) \le 2.4208] = 0.99$; $\Pr[t(41) \le 1.6829] = 0.95$ and $\Pr[t(41) \le 1.3025] = 0.90$. According to the information provided above, the test of the null hypothesis $H_0: \beta_2 = 1$ against the alternative $H_1: \beta_2 > 1$ indicates that:

- A) The null is rejected at both 1% and 5% level of significance.
- B) The numerical value of the statistic (t^*) for this hypothesis is 15.14.
- C) We fail to reject the null at both 5% and 10% level of significance.

Question 9. Critical values are reported as $\Pr[F(2,41) \ge 3.2257] = 0.05$. According to the information provided above, the null hypothesis that none of the explanatory has an effect on \boldsymbol{Y} (all the slope parameters are zero) ...

- A) is rejected at 5% level of significance because the F-statistic for this hypothesis is = 1470.30.
- B) is NOT rejected at 5% level of significance because the F-statistic for this hypothesis is = 1.64.
- C) is rejected at 5% level of significance because the F-statistic for this hypothesis is = 104.34.

Question 10. Birth weight (*bwght*) is a measure of infant health. Infants with low birth weight are often more vulnerable to disease. One problem of interest is the relationship between maternal smoking and the child's birth weight. To analyze that, a researcher estimates the model [M1]

$$bwght_i = \beta_1 + \beta_2 cigs_i + e_i.$$

The researcher thinks that factors other than number of cigarettes smoked (cigs) that affect birth weight are likely to be correlated with smoking, and therefore those factors should be considered. For example, higher income (faminc) generally results in access to better prenatal care, as well as better nutrition for the mother. To analyze this effect a new model [M2] is estimated:

$$bwght_i = \alpha_1 + \alpha_2 cigs_i + \alpha_3 faminc_i + e_i.$$

According to this, which of the following statements is TRUE?

- A) The OLS estimate of α_2 in [M2] is always equal to the OLS estimate of β_2 in [M1] regardless the value of the *corr(cigs, faminc)*.
- B) The OLS estimate of α_2 in [M2] will be lower in absolute value than the OLS estimate of β_2 in [M1] if corr(cigs, faminc) < 0.
- C) The OLS estimate of α_2 in [M2] will be lower in absolute value than the OLS estimate of β_2 in [M1] if corr(cigs, faminc) > 0.

Questions 11 to 13 correspond to the following statement. Using a sample of 10 workers of three different sectors (agriculture, services, and industry), a regression model [W1] was estimated to explain the behaviour of wages.

$\ln(w_i) = 2.11 - 0.56A_i - 0.45S_i + 0.12 \ educ_i + 0.08exp_i + \hat{u}_i \quad [W1]$

Where, w is the monthly salary (euros), A is a dummy variable that takes a value of 1 if the worker belongs to the *agriculture* sector and zero otherwise. S is a dummy variable that takes a value of 1 if the worker belongs to the *services* sector and zero otherwise, *educ* is years of education and *exp* is years of professional experience.

Question 11. According to the model W1, which of the following statements is TRUE?

- A) Ceteris paribus, the monthly salary for a worker who belongs to the agriculture sector is approximately 0.56% less than the rest of workers.
- B) Ceteris paribus, the monthly salary for a worker who belongs to the agriculture sector is approximately 56.00 % less than a worker that belongs to the industrial sector.
- C) Ceteris paribus, the monthly salary for a worker who belongs to the services sector is approximately 0.45% less than a worker that belongs to the industrial sector.

Question 12. If the estimate of the standard deviation of the effect of education on wage (β_{educ}) is $\widehat{se}(\hat{\beta}_{educ}) = 0.10$ and $\Pr[-2.57 \le t(5) \le 2.57] = 0.95$, which of the following statements is TRUE?

- A) A 95% confidence interval for β_{educ} is [0.02, 0.22]
- B) There is not enough information to compute a 95% confidence Interval for β_{educ} .
- C) The null hypothesis $H_0: \beta_{educ} = 0$ against $H_1: \beta_{educ} \neq 0$ cannot be rejected at 5% level of significance.

Question 13. A beginner student in Econometrics estimates three different equations to test for heteroscedasticity in W1. Could you help this student to choose the right equation? (Choose the right one).

- A) $\ln(w_i) = \gamma_0 + \gamma_1 \widehat{\ln(w_i)} + \gamma_2 \widehat{\ln(w_i)}^2 + e_i$, where $\widehat{\ln(w_i)}$ are the fitted values in W1.
- B) $\hat{u_i}^2 = \alpha_0 + \alpha_1 A_i + \alpha_2 S_i + \alpha_3 educ_i + \alpha_4 exp_i + \alpha_5 educ_i^2 + \alpha_6 exper_i^2 + \alpha_7 A_i educ_i + \alpha_6 exper_i^2 + \alpha_7 A_i educ_i + \alpha_8 exp_i + \alpha_$

 $\alpha_8 S_i educ_i + \alpha_9 A_i exp_i + \alpha_{10} S_i exp_i + \alpha_{11} educ_i exp_i + \alpha_{12} A_i S_i + \xi_i, \quad \text{where } \hat{u}_i \text{are} \quad \text{the}$

residual in **W1**.

C) $\hat{u}_i = \delta_0 + \delta_1 \ln(w_i) + \delta_2 \ln(w_i)^2 + e_i$, where \hat{u}_i are the residual and $\ln(w_i)$ the fitted values in W1.

Questions 14 and 15 refer to the following statement. The manager of **Ben&Jerry's** wants to analyze if sales of ice creams (Y) exhibit seasonality (for example, sales in the first quarter are lower than in the other three quarters). They are going to use quarterly data (4 observation per year) from the first quarter of 2000 to the third of 2022, both included. A model has been specified including 4 seasonal dummy variables as regressors, D_{it} 's, taking the value of 1 in the *i*-th quarter (i = 1, 2, 3, 4) and 0 otherwise.

Question 14. If the manager decides to estimate the next model:

$$Y_t = \beta_0 + \beta_1 D_{1t} + \beta_2 D_{2t} + \beta_3 D_{3t} + \beta_4 D_{4t} + u_t$$

Which of the following statements is TRUE?

- A) The manager might have introduced perfect collinearity in the model, and this is a serious issue for applying OLS to forecast sales.
- B) The manager might have introduced high collinearity (but not perfect) in the model, and this is a serious issue for applying OLS to forecast sales.
- C) None of the above

Question 15. If the manager decides to estimate the next model:

$$Y_t = \alpha_0 + \alpha_1 D_{1t} + \alpha_2 D_{2t} + \alpha_3 D_{3t} + u_t$$

To test whether or not sales exhibit seasonality, the manager should estate one of the next hypotheses. (Choose the right one):

- A) $H_0: \alpha_0 = 0$
- B) $H_0: \alpha_0 = \alpha_1 = \alpha_2 = \alpha_3$
- C) $H_0: \alpha_1 = \alpha_2 = \alpha_3 = 0$

Questions 16 to 17 refer to the following statement. A broker wants to analyze if the returns of the Bank of Santander (SAN) depend on the returns of the IBEX35 and estimates the next model [M1]:

$$SAN_t = 0.609 + 0.78IBEX35_t + \hat{u}_t$$

 $N = 79, R^2 = 0.45, \qquad WH = 0.894 [pvalue = 0.639]$

Questions 16. The White statistic (WH) suggests that the error term could have ... (Select the True option):

- A) Heteroskedasticity.
- B) Homoskedasticity.
- C) Homoskedasticity and multicollinearity.

Question 17. The estimate of the variance and covarince matrix or the errors (u_i) of model M1is:

$$MVC[U] = \begin{pmatrix} 10 & 0 & \cdots & 0 \\ 0 & 10 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 10 \end{pmatrix}$$

Then, which of the following statements is TRUE?

- A) The Gauss-Markov assumption $Var(u_i) = \sigma^2$, for i=1, ..., 79, (AS 6) holds.
- B) The Gauss-Markov assumption $Cov(u_i, u_j) = 0$, (AS7) DOES NOT hold.
- C) None of the above.

Questions 18. A master student found that there is a high correlation between measles (*a highly contagious, serious disease caused by a virus*) cases and Marriage rate in the U.S., see Figure MM1.

Figure MM1



From Figure MM1 (U.S. Marriage rate is the **top one**) you could estate that (select the true statement)

- A) Lower numbers of measles cases are reducing (causality) marriage rates in the U.S.
- B) Lower rates of marriage are reducing (causality) the numbers of measles cases in the U.S.
- C) This might be an example of spurious relationship. i.e., high correlation between these two variables exists by chance and there is no causality.

Question 19. In the model $y_i = \beta_0 + \beta_1 x_i + u_i$, which of the following statements is TRUE?

- A) It would not be possible to compute the OLS estimate of β_1 if the sample $var(x_i) = 0$.
- B) The OLS estimate of β_1 would be equal to 1 if the sample $corr(y_i, x_i) = 1$.
- C) The OLS estimate of β_1 would be equal to the \bar{y} (y sample average) if the $\bar{x} = 0$.

Question 20. The assumption that the error terms in a regression model follow the normal distribution is required for ... (choose the TRUE statement)

- A) unbiasedness of the OLS estimator.
- B) efficiency (minimum variance) of the OLS estimator.
- C) hypothesis testing and inference.

Calculations

ECONOMETRICS - FINAL EXAM, 3rd YEAR (GADE)

May 08, 2023 – 12:00 AM

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