ISEG – Lisbon School of Economics and Management
ECONOMETRICS
First Semester 2018/2019
Exam
February, 4 2019

Duration: **120 Minutes**

Name:

Question:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	Total
Points:	10	10	10	80	20	50	10	10	200

Justify all your answers and show your work on each problem on this test (except for multiple choice questions). **Organize your work**. Work scattered all over the page will receive very little credit. A correct answer in a multiple choice question is worth 10 points; an incorrect one is worth −2.5 points.

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(10) **1**. In the linear multiple regression model with an intercept, which of the following is TRUE:

- ◯ The OLS minimizes the sum of residuals.
- ◯ The R^2 is not valid if the residuals are not normally distributed.
- ◯ The sum of OLS residuals is always equal to zero.
- ◯ None of the above.

(10) **2**. Consider the equation $y_i = \beta_0 + \beta_1 x_{i1} + \ldots + \beta_k x_{ik} + u_i; i = 1, \ldots, n$ and the regression $\hat{u}_i^2 = \alpha_0 + \alpha_1 x_{i1} + \ldots + \alpha_k x_{ik} + v_i$, with $\hat{u}_i$ the OLS residuals of the first equation. Then,

- ◯ If $H_0 : \alpha_1 = \ldots = \alpha_k = 0$ cannot be rejected, then $H_0 : \beta_1 = \ldots = \beta_k = 0$ cannot be rejected as well.
- ◯ If $H_0 : \alpha_1 = \ldots = \alpha_k = 0$ is rejected, then there is evidence that the OLS estimator for the first equation is efficient.
- ◯ Testing $H_0 : \alpha_1 = \ldots = \alpha_k = 0$ jointly leads to the same conclusions as testing $H_0 : \alpha_1 = 0, \ldots, H_0 : \alpha_k = 0$ separately.
- ◯ None of the above.

(10) **3**. Consider the following equation, $wage_i = \beta_0 + \delta_0\, female_i + \delta_1\, male_i + \beta_1\, educ_i + u_i$; $i = 1, ..., n$, where $wage_i$ is the hourly wage, $female_i$ is a dummy variable equal to 1 if the ith individual is a woman, $male_i$ is a dummy variable equal to 1 if the ith individual is a man and $educ_i$ is the number of years of education. Then this equation

- ◯ is equivalent to the equation $wage_i = \beta_0 + \gamma 0\, female_i + \beta_1\, educ_i + u_i$; $i = 1, ..., n$,with $\gamma_0 = \delta_0 - \beta_0$,
- ◯ cannot be estimated due to perfect collinearity,
- ◯ gives OLS estimates $\hat{\delta}_0 = 0$ when $\hat{\delta}_1 \neq 0$,
- ◯ none of the above.

4. To explain the price of an house the following model was specified:

$$\log(price_i) = \beta_0 + \beta_1 \log(lotsize_i) + \beta_2\, bedrooms_i + \beta_3\, garagepl_i + \beta_4\,(bedrooms_i - 3) \times garagepl + \beta_5\, airco_i + u_i, \qquad i = 1, \ldots, 546$$

where the variables have the following meaning:

- ***price*** is the sale price of a house;
- ***lotsize*** is the lot size of the property in square feet;
- ***bedrooms*** is the number of bedrooms;
- ***garagepl*** is the number of garage places;
- ***airco*** is equal to 1 if there is central air conditioning;

The estimated output of this equation is in **Annex**. Other results that may be necessary to solve the following questions are included in the **Annex** as well.

(20) (a) Interpret the estimated coefficients $\hat{\beta}_1$ and $\hat{\beta}_5$, and test their individual significance.

(15) (b) Estimate the effect of having one more garage place (holding the other factors fixed) on the price of the houses with 3 bedrooms and test its statistical significance.

(15) (c) Is the model in Equation 1 misspecified? Justify using an appropriate statistical test.

(15) (d) Equation 3 aims to perform a test. Identify and formalize the test. What can you conclude about it?

(15) (e) Given your results in the previous questions what can you conclude about the properties of OLS in Equation 1?

5. Consider the model,

$$y_t = \beta_0 + \gamma_1\, x_{t-1} + \gamma_2\, x_{t-4} + \rho_1\, z_{t-2} + \rho_2\, z_{t-4} + u_t \tag{1}$$

(10) (a) Choose the correct option:

- ◯ The long-run multiplier associated to x_t is $\beta_0 + \gamma_1 + \gamma_2$.
- ◯ The short-run multiplier of x_t is γ_1.
- ◯ If x_t and z_t are strictly exogenous, then the OLS estimator of the coefficients of model (1) is unbiased.
- ◯ None of the above.

(10) (b) Write the condition that makes model (1) dynamically complete.

6. A researcher in Econometrics estimated the following equations, with quarterly data:

$$\widehat{\log(y_t)} = 0.467 + 0.03\, t - 0.04\, Q_{1t} + 0.02\, Q_{2t} + 0.07\, Q_{3t}, \qquad R^2 = 0.854, \quad n = 100 \tag{2}$$

$$\hat{\hat{u}}_t = \underset{(1.24)}{0.88}\, \hat{u}_{t-1} \tag{3}$$

with Q_{jt}, $j = 1, 2, 3, 4$, the seasonal dummies, and $\hat{u}_t$ the residuals of equation (2), and

$$\widehat{\log(y_t)} = 0.587 + 0.05\, t, \qquad R^2 = 0.672, \quad n = 100 \tag{4}$$

(15) (a) Interpret the estimated coefficient of variable t and variable Q_{1t} in equation (2).

(20) (b) Is there any statistical evidence of seasonality in equation (2)? Justify using an appropriate statistical test.

(15) (c) Is there any statistical evidence of serial correlation in equation (2)? Justify using an appropriate statistical test.

(10) **7**. Consider the following models,

$$y_t = y_0 + \alpha_0 t + e_t + e_{t-1} + \ldots + e_1 \tag{5}$$

$$z_t = e_t - e_{t-1} \tag{6}$$

$$w_t = \alpha_0 + \alpha_1 t + e_t \tag{7}$$

where e_t is a white noise process. Then,

- ◯ only z_t is weak dependent,
- ◯ only z_t and w_t are weakly dependent,
- ◯ only y_t and w_t are weakly dependent.
- ◯ None of the above.

(10) **8**. If a model is dynamically complete then,

- ◯ strict exogeneity is verified,
- ◯ contemporaneous exogeneity is verified but not sequential exogeneity,
- ◯ both, sequential exogeneity and contemporaneous exogeneity are verified,
- ◯ None of the above.