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**ECONOMETRICS - 05/07/2019 - Time: 2 h**

1. Say if the following statements are unambiguously true (True), unambiguously false (False) or impossible to classify the way they are stated (Not necessarily). Write the motivations to your answers **only** in the space provided. A “Not necessarily” answer with no motivations will be considered wrong.

(a) A covariance matrix is invertible.

True ☐

False ☐

Not necessarily ☐

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(b) Suppose you have a sample of iid random variables  $x_1, x_2, \dots, x_n$ , with  $E(x_1) = 1$ . Then,

$$\lim_{n \rightarrow \infty} P \left[ \left( \frac{1}{n} \sum_{i=1}^n x_i \right) > 0 \right] = 1$$

True ☐

False ☐

Not necessarily ☐

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(c) Suppose that  $E(y_i|x_i) = \beta_0 + \beta_1/x_i$ . You can estimate consistently  $\beta_0$  and  $\beta_1$  by using OLS.

True ☐

False ☐

Not necessarily ☐

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(d) Suppose you run a dynamic regression model, and the Godfrey Test statistic with 1 lag equals 10. This should have to be interpreted as absence of serial correlation.

True ☐

False ☐

Not necessarily ☐

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2. You run OLS on a sample with  $n = 100$  observations, for the equation

$$y_i = \beta_1 + \beta_2 x_i + \varepsilon_i$$

and you get the following results:

$$\hat{\beta} = \begin{bmatrix} 9 \\ 1 \end{bmatrix} \quad V(\hat{\beta}) = \hat{\sigma}^2 (\mathbf{X}'\mathbf{X})^{-1} = \begin{bmatrix} 3 & 0.12 \\ 0.12 & 0.064 \end{bmatrix}.$$

Now compute the following quantities:

(a) the sum of squared residuals  $\mathbf{e}'\mathbf{e}$  and the maximum likelihood variance estimate  $\hat{\sigma}^2$ :

$$\mathbf{e}'\mathbf{e} = \quad \quad \quad \hat{\sigma}^2 = \quad \quad \quad$$

(b) the averages of  $x_i$  and  $y_i$ :

$$\frac{1}{n} \sum_{i=1}^n x_i = \quad \quad \quad \frac{1}{n} \sum_{i=1}^n y_i = \quad \quad \quad$$

(c) Test the hypothesis  $\beta_2 = 0$

Test type: \_\_\_\_\_ Distribution: \_\_\_\_\_ Test statistic: \_\_\_\_\_  
Decision: ☐ Reject ☐ Don't reject

(d) Test the hypothesis  $\beta_1 = 10 \cdot \beta_2$

Test type: \_\_\_\_\_ Distribution: \_\_\_\_\_ Test statistic: \_\_\_\_\_  
Decision: ☐ Reject ☐ Don't reject

3. The following ECM model

$$\Delta b_t = k + \sum_{i=1}^3 \phi_i \Delta b_{t-i} + \gamma_1 \Delta y_t + \gamma_2 \Delta y_t^* + \beta_1 b_{t-1} + \beta_2 y_{t-1} + \beta_3 y_{t-1}^* + \varepsilon_t$$

was estimated on quarterly data for the period 1997:1–2016:4. The results are shown in table 1. A description of the variables follows:

Variable	Description
$b_t$	Normalised trade balance for Italy: $\frac{\text{EXP}-\text{IMP}}{\text{GDP}}$ (source: OECD, quarterly national accounts)
$y_t$	log of real Italian GDP (source: OECD, quarterly national accounts)
$y_t^*$	log of real GDP For the Euro Area (source: AWM database)

(a) Comment on the Godfrey test.

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