ECONOMETRICS - FINAL EXAM, 3rd YEAR (GECO & GADE)

June 26, 2019 – 12:00

First family name:	**Second family Name:**
Name:	**GECO/GADE:**
DNI/ID:	**Instructor:**
Mobile:	**E-mail:**

Question 1	**A**	**B**	**C**	**Blank**
Question 2	**A**	**B**	**C**	**Blank**
Question 3	**A**	**B**	**C**	**Blank**
Question 4	**A**	**B**	**C**	**Blank**
Question 5	**A**	**B**	**C**	**Blank**
Question 6	**A**	**B**	**C**	**Blank**
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Question 15	**A**	**B**	**C**	**Blank**
Question 16	**A**	**B**	**C**	**Blank**
Question 17	**A**	**B**	**C**	**Blank**
Question 18	**A**	**B**	**C**	**Blank**
Question 19	**A**	**B**	**C**	**Blank**
Question 20	**A**	**B**	**C**	**Blank**

Correct	**Incorrect**	**Blank**	**Final grade**

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 AND A HALF 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

Questions 1 to 6 refer to the following statement. In finance, the beta of an investment indicates whether the investment is more or less volatile than the market. It is also a measure of the systematic risk that cannot be eliminated by diversification. If a stock fluctuates more (less) than the market over time, then it has a beta greater (less) than 1. We estimated the model in Table 1 to calculate the beta of Banco de Santander, which is the slope of the relationship between the return of Banco Santander (SAN) and the market return (IBEX35). **Note: In your calculations, use all the digits available in the table.**

Table 1. LS using a sample of daily returns from Jan 2nd, 1990 to Nov 24th, 2006

Dependent variable: SAN
Method: Ordinary Least Squares
Sample size: 4409

Variable	Coefficient	std error	t-statistic	p-value
C	0.023515	0.0194074	1.212	0.2257
IBEX35	1.138590	0.0148023	76.92	0.0000

Mean dependent var	0.074148	S.D. dependent var	1.970980
Sum of squared residuals	----------	S.E. of regression	1.287915
R squared	0.573114	Adjusted R squared	0.573017
F(1,4407) statistic	5916.605	P-value (F)	0.00000
Log-likelihood	73.70686	Akaike criterion	14745.37
Schwarz Criterion	14758.15	Hannan-Quinn criterion	4749.880

Question 1. According to Table 1, which of the following statements is TRUE?

A) Investing €1000 in SAN is safer than investing €1000 in IBEX35

B) Investing €1000 in SAN is riskier than investing €1000 in IBEX35

C) Investing €1000 in SAN has the same level of risk than investing €1000 in the IBEX35

Question 2. According to the results in Table 1, we want to test the null that the coefficient associated to IBEX35 is equal to 1, $H_0: \beta = 1$, against the alternative that it is greater than one, $H_0: \beta > 1$ If $Prob[t(4407) \geq 9.363] = 0.00$ Which of the following statements is TRUE?

A) The null must be rejected in favor of the alternative at both, the 5% and 15% level of significance.

B) The null cannot be rejected in favor of the alternative at neither, the 5% nor 15% level of significance.

C) None of the above.

Question 3. According to Table 1, you would conclude that ----- of the variability of returns of Banco de Santander (SAN) is explained by their market risk exposure (IBEX35), and the other ---- is due to specific risks that Banco de Santander is facing. Choose the option that fits best in the previous blank spaces.

A) 57.31%, 42.69%

B) 42.69%, 57.31%

C) 59.16%, 40.84%

Question 4. The Sum of Squared Residuals (SSR) of the model in Table 1 is (**In your calculations, use all the digits available in the table)**

A) 7310.001

B) 8310.001

C) 6310.001

Question 5. Table 2 shows the main White's test regression results to test the null of homoscedasticity for the residuals of the CAPM model in Table 1.

Table 2. White heteroscedasticity test using a sample January 2nd, 1990 to November 24th, 2006 (T = 4409)

Dependent variable: Residuals^2 (from the regression in Table 1)
Method: Ordinary Least Squares
Sample size: 4409

	Coeff.	std. error.	t-statistic	p-value
const	0.124681	0.0897192	1.390	0.1647
IBEX_35	0.282727	0.0643599	4.393	0.0000
IBEX_35^2	0.884658	0.0177851	49.74	0.0000

…where the R^2 of this auxiliary regression is 0.362214 and $Prob\left[\chi_2^2 \geq 1597.002\right] = 0.000$. According to these results which of the following statement is TRUE:

A) …even if we set a 20% level of significance, the null that the variance of the errors is constant is **not rejected.**

B) …the null that the variance of the errors is constant is **rejected** at any of the usual levels of significance: 1%, 5%, 10%

C) …the White test statistic in this case is 0.3662241 and, under the null hypothesis, is distributed as a χ^2_1

Question 6. We estimate now a CAPM model relating the return of REPSOL and the market return (IBEX35). Table 2 shows the results. **Note: In your calculations, use all the digits available in the table.**

Table 3. LS using a sample from January 2nd, 1990 to November 24th, 2006

Dependent variable: REPSOL returns
Method: Ordinary Least Squares
Sample size: 4409

Variable	Coefficient	std error	t-statistic	p-value
C	0.0289953	0.0191622	1.5132	0.1303
IBEX35	0.730660	0.0146153	49.9928	<0.0001
R-squared	0.361885	Adjusted R squared		0.361741
Schwarz Criterion	14758.15	Hannan-Quinn criterion		4749.880

According to Tables 1 and 3, which of the following statements is TRUE?

A) According to the adjusted R-squared, the Model in Table 3 should be preferred over the model in Table 1

B) The correlation between SAN and IBEX35 returns is greater than the correlation between REPSOL and IBEX35.

C) The intercept of the model in Table 3 is statistically significant at the 10% level of significance.

Questions 7 to 10 refer to the following statement. A study about the effect of advertising on cigarette consumption in the US is based on the following regression model, estimated using annual data between 1930 and 1978 (T= 49)

$$\ln S_t = \beta_1 + \beta_2 \ln P_t + \beta_3 \ln AdM_t + \beta_4 \ln AdN_t + \varepsilon_t$$

…where **ln** denotes the natural log, $\boldsymbol{S_t}$ is the number of cigarettes sold by the largest US tobacco companies (millions of units), $\boldsymbol{P_t}$ is the average price for cigarette (US dollars), $\boldsymbol{AdM_t}$ (thousands of US dollars) is the total amount of money spent for cigarette advertising on TV and radio, and finally, **AdNt** (thousands of US dollars) is the total amount of money spent for cigarette advertising on newspaper and billboards. Some estimation results are:

$$\begin{bmatrix}\hat{\beta}_1\\ \hat{\beta}_2\\ \hat{\beta}_3\\ \hat{\beta}_4\end{bmatrix}=\begin{bmatrix}2.50\\ -0.30\\ 0.04\\ 1.45\end{bmatrix};\quad \widehat{\mathbf{var}}(\hat{\beta})=\begin{bmatrix}1.47 & -0.30 & 0.028 & -0.05\\ . & 0.0688 & -0.004 & 0.003\\ . & . & 0.002 & -0.003\\ . & . & . & 0.011\end{bmatrix}$$

Question 7. According to these results (use all available decimals in the calculations):

A) …if the average price per cigarette, **P**, increases by 1 US dollar, Sales (S) are expected to increase by 0.30 million units.

B) …if the average price per cigarette, **P**, decreases by 2%, Sales (S) are expected to increase by 0.60%

C) …if the average price per cigarette, **P**, increases by 1 US dollar, Sales (S) are expected to decrease by 0.30%

Question 8. Please compute the limits of a 95% confidence interval for β_2, bearing in mind that $\text{Prob}(|t(45)| \geq 2.014) = 0.025$ On the basis of this interval, which of the following statements is TRUE?

A) β_2 **IS NOT** statistically significant both, with 1% and 5% level of significance.

B) β_2 **IS** statistically significant at the 5% level of significance.

C) The price elasticity of cigarettes sales **IS** statistically significant at any level of significance.

Question 9. Please test the null $H_0 : \beta_4 = \beta_3$ against the alternative $H_1 : \beta_4 > \beta_3$, , bearing in mind that $\text{Prob}(|t(45)| \geq 10.23) = 0.0000$ On the basis of this test, which of the following statements is TRUE?

A) Effectiveness of newspaper and billboard advertisement is THE SAME as that on TV and radio both, with 10% and 15% levels of significance.

B) Effectiveness of newspaper and billboard advertisement is HIGHER than that on TV and radio both, with 10% and 15% levels of significance.

C) Effectiveness of newspaper and billboard advertisement is SMALLER than that of TV and radio both, with 10% and 15% levels of significance.

Question 10. In 1979 the average price for one cigarette was 0.75 US dollars, 50 thousand US dollars were spent on TV and radio advertisement and other 50 thousand US dollars were spent on newspapers and billboards ads. Under these conditions, the expected value for the **ln** of the cigarettes sales in 1979 would be:

A) 9.36

B) 9.86

C) 8.42

Question 11. Consider the model $\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{U}$, with $E[U] = 0$ and the error variance-covariance matrix is $\text{Var}[\mathbf{U}] = \sigma^2\Sigma$, $\Sigma \neq \mathbf{I}$, being μ and σ constant. Which of the following statements is TRUE?

A) The OLS estimator of $\boldsymbol{\beta}$ is biased.

B) The Gauss-Markov theorem holds and therefore the OLS estimator is the "best" (or more efficient) of all possible estimators.

C) The Gauss-Markov theorem does not hold so, although the OLS estimator is still unbiased, it is not the "best" (or more efficient) of all possible estimators.

Question 12. Consider the general linear model $\mathbf{Y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{U}$. If we detect approximate (not exact) collinearity between two columns of matrix $\mathbf{X}$, then:

A) …the coefficient estimates become very sensitive (large variance) to small changes in the data.

B) …the OLS estimator is biased.

C) …the 95% confidence intervals for the model parameters narrow down.

Question 13. An observation is INFLUENTIAL if

A) …the size of the residual for that observation is "small" and "negative"

B) …dropping it changes the OLS estimates by a significant amount.

C) …dropping it changes the OLS estimates by a non-significant amount.

Question 14. Consider the linear model $Y_t = \beta + U_t$, $t = 1, ..., N$, in which Gauss-Markov assumptions hold. Let (1) $\tilde{\beta}_1 = 1/N \sum_{t=1}^{N} Y_t$ and (2) $\hat{\beta}_2 = Y_2$, be two different estimates of β, where Y_2 is the actual value of Y in *t=2.* Which of the following statements is TRUE?

A) $\tilde{\beta}_1$ is the OLS estimator of β and it is BLUE (Best Linear Unbiased Estimator).

B) $\tilde{\beta}_1$ and $\hat{\beta}_2$ are BLUE.

C) $\tilde{\beta}_1$ is unbiased but $\hat{\beta}_2$ is not.

Question 15. To detect a potential collinearity problem, we computed the variance inflation factors (VIFs) for the 5 regressors included in a linear model. They are shown in the next table.

Regressors	***VIF (j)***
x_{t1}	2.2
x_{t2}	7.9
x_{t3}	150.3
x_{t4}	82.6
x_{t5}	1.6

where $VIF_j = 1/(1-R_j^2)$, and R_j^2 denotes the determination coefficient for a regression of the j-*th* regressor on the other independent variables. According to this information:

A) The lower bound for the VIF is zero.

B) The two variables with the highest collinearity with the rest are the third and the fourth.

C) The upper bound for the VIF is 100.

Question 16. Consider the regression $y_i = \hat{\beta}_1 + \hat{\beta}_2 x_i + \hat{u}_i = \hat{y}_i + \hat{u}_i \quad (i = 1, 2, ..., N)$ where $\hat{\beta}_1$ and $\hat{\beta}_2$ are the OLS estimates for the constant term and the slope, $\hat{y}_i \quad (i = 1, 2, ..., N)$ denotes the fitted values for the dependent variable and $\hat{u}_i \quad (i = 1, 2, ..., N)$ are the OLS residuals. Which one of the following statements is TRUE?

A) $\sum_{i=1}^{N} \hat{u}_i \hat{y}_i = 0$ (the residuals are orthogonal to the fitted values).

B) $\sum_{i=1}^{N} \hat{u}_i x_i \neq 0$ (the residuals are correlated with the explanatory variable).

C) $\sum_{i=1}^{N} \hat{u}_i y_i = 0$ (the residuals are orthogonal to the dependent variable).

Question 17. Identify which of the following statements are TRUE or FALSE.

1. A spurious correlation is an apparent linear relationship between two variables which actually does not exist.
2. Differencing the variables in a spurious regression will not be useful to reveal a spurious relationship.

3. After fitting a model, we should assess whether it complies with the standard assumptions. For example, by testing whether the residuals are autocorrelated or not.
4. Diagnostic checks based on OLS model residuals using both, formal testing procedures and graphical tools, can be useful to detect heteroscedasticity and/or autocorrelation.
5. The histogram for the residuals in a regression model is not useful to detect the presence of outliers in the sample.

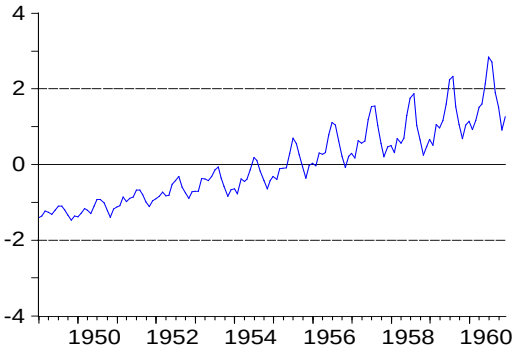
A) 1, 2 and 5 are TRUE. 3 and 4 are FALSE.
B) 2, 3 and 4 are TRUE. 1 and 5 are FALSE.
C) 1, 3 and 4 are TRUE. 2 and 5 are FALSE.

Question 18. We want to determine the key factors that affect the income of households. To this end, we used a sample of 1000 households in US to estimate the model: $S_i = \beta_0 + \beta_1 BC_i + \beta_2 M_i + U_i$, where S is the annual household income (€), BC_i is a dummy variable which takes the value 1 if the family lives in a Big City, and zero otherwise, and M_i is another dummy variable that takes a value of 1 if the family has a mortgage, and zero otherwise. According to the previous model, which of the following statements is TRUE?

A) The expected annual income of a family without a mortgage that is living in a big city is $\beta_0 + \beta_1 + \beta_2$
B) The expected annual income of a family without a mortgage that is living in a small city is β_0
C) The model $S_i = \beta_0 + \beta_1 BC_i + \beta_2 M_i + U_i$ is statistically equivalent to the alternative specification $S_i = \alpha_1 BC_i + \alpha_2 M_i + V_i$, except in the interpretation of the parameters.

Questions 19 and 20 refer to the time series displayed in the following standardized plots:

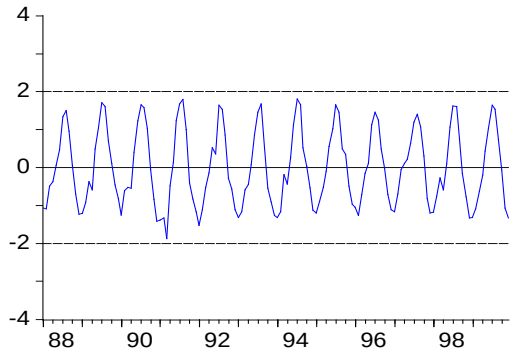
TS 1: Monthly total international airline passengers (thousands) from 1949 to 1960



Sample 1949:01 1960:12
Observations 144

Mean	280.2986
Median	265.5000
Maximum	622.0000
Minimum	104.0000
Std. Dev.	119.9663
Skewness	0.577068
Kurtosis	2.606228
Jarque-Bera	8.922525
Probability	0.011548

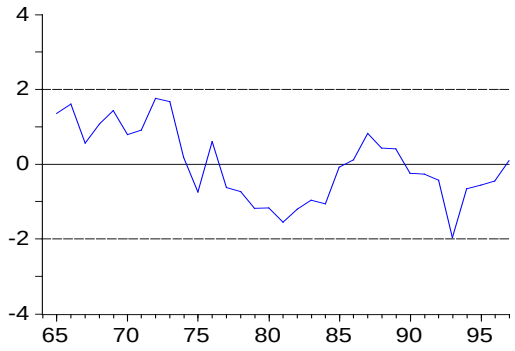
TS 2: Monthly average temperature (°C) measured at Retiro Park in Madrid



Sample 1988:01 1999:12
Observations 144

Mean	15.04306
Median	14.05000
Maximum	27.40000
Minimum	2.200000
Std. Dev.	6.839996
Skewness	0.278520
Kurtosis	1.829484
Jarque-Bera	10.08241
Probability	0.006466

TS 3: Annual percent growth rate of Domestic Consumption



Sample 1965 1997
Observations 33

Mean	3.367965
Median	3.173506
Maximum	7.955505
Minimum	-1.757371
Std. Dev.	2.610798
Skewness	0.104580
Kurtosis	2.083120
Jarque-Bera	1.216073
Probability	0.544419

Question 19. Looking at TS1, TS2 and TS3 we can state that:

A) None of the time series, TS1, TS2 and TS3, are mean stationary.

B) Although TS2 shows a clear seasonal component, it is mean stationary.

C) TS3 does not show a clear seasonal component, therefore it is mean stationary.

Question 20. Looking at TS1, TS2 and TS3 we can state that:

A) TS1 is variance stationary.

B) The local standard deviation of ST1 grows in proportion to its local mean.

C) According to the Jarque-Bera statistic for ST3, this time series is not normally distributed with a 5% level of significance.

Calculations

ECONOMETRICS - FINAL EXAM, 3rd YEAR (GECO & GADE)

May 31, 2019 – 9:00

First family name:	**Second family Name:**
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DNI/ID:	**Instructor:**
Mobile:	**E-mail:**

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