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

June 27, 2016 – 15:30

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**
Question 7	**A**	**B**	**C**	**Blank**
Question 8	**A**	**B**	**C**	**Blank**
Question 9	**A**	**B**	**C**	**Blank**
Question 10	**A**	**B**	**C**	**Blank**
Question 11	**A**	**B**	**C**	**Blank**
Question 12	**A**	**B**	**C**	**Blank**
Question 13	**A**	**B**	**C**	**Blank**
Question 14	**A**	**B**	**C**	**Blank**
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

The exam includes 20 questions.

All your answers to the multiple choice questions 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. The 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, SMART WATCHES OR MP3/4 PLAYERS

Possession of unauthorized items is an infringement of the regulations and could result in **DISQUALIFICATION** from this examination and the overall qualification

Questions 1 to 5 correspond to the following statement. Consider the following demand function for chicken meat:

$$Y_t = \beta_1 + \beta_2 X_{t2} + \beta_3 X_{t3} + \beta_4 X_{t4} + u_t \qquad t = 1,...,23$$

Where Y is the per capita consumption of chicken (in pounds), X_2 is the real disposable per capita income (in dollars), X_3 is the retail price of chicken per pound (in cents), X_4 is the retail price of pork per pound (in cents). The following OLS results, along with the estimated variance matrix of the LS estimator, were obtained using a sample of US annual data, from 1990 to 2013.

```
Model 1: OLS, using the observations 1990-2013 (T = 23)
Dependent variable: Y
Coefficient  Std. Error.    t-Statistic      p-value
-----------------------------------------------------------------
const       38.6472       ---------       ------        2.08e-09
X2          0.0108762     ---------       ------        0.0002
X3         -0.541084      ---------       ------        0.0028
X4          0.174055      ---------       ------        0.0118

Mean of dep. var          39.66957    S.D. of dependent Var.   7.372950
Sum of squared Residuals  75.75855    S.E. of regression       --------
R-squared                 0.936653    Adjusted R-Squared       0.926651
F                          -------     P-value (F)              1.45e-11
Log-likelihood           -46.34424    Akaike criterion         100.6885
Schwarz criterion         105.2305    Hannan-Quinn             101.8308
rho                       0.562093    Durbin-Watson                0.882813
```

Covariance Matrix of the LS estimator

	Const	X2	X3	X4
const	133.196	0.00307994	-0.515143	0.0928149
X2	0.00307994	5,67E-01	-1,69E+00	-9,00E+00
X3	-0.515143	-1,69E+00	0.0249544	-0.00735701
X4	0.0928149	-9,00E+00	-0.00735701	0.00391008

Question 1. According to the results in Model 1, what is the estimate change in the per capita consumption of chicken meat if the real disposable per capita income increases by \$1000 dollars, remaining constant the rest of explanatory variables? (use all available decimals in the calculations):

A) Will increase by approximately 10.87%

B) Will increase by approximately 0.01087 pounds.

C) Will increase by approximately 10.87 pounds.

Question 2. The LS estimate of the error variance is (use all available decimals in the calculations):

A) 75.7585

B) 3.9873

C) 0.9267

Question 3. The test of the null hypothesis $H_0 : \beta_4 = 0$ against the alternative $H_1 : \beta_4 \neq 0$ indicates that:

A) The null is not rejected at 1%, 5% and 10% significance levels.

B) The null is rejected at the 5% level, but it is not rejected at 10%

C) The null is rejected at the 5% level, but it is not rejected at 1%

Question 4. Testing the null hypothesis $H_0 : \beta_3 = -\beta_4$ against the alternative $H_1 : \beta_3 \neq -\beta_4$ concludes that: (Note: $\text{Prob}[t(19) \leq 2.09] = 0.975$ and $\text{Prob}[t(19) \leq 2.86] = 0.995$)

A) The null is rejected at the 5% level, but it is not rejected at 1%

B) The null is rejected at both, 1% and 5% significance levels.

C) The null is rejected at the 5% level, but it is not rejected at 1%

Question 5. The F statistic for the joint hypothesis that all independent variables are not insignificant $(H_0 : \beta_2 = \beta_3 = \beta_4 = 0)$ (use all available decimals in the calculations):

A) Is approximately equal to 45.291

B) Is approximately equal to 93.645

C) Is approximately equal to 73.9303

Questions 6 to 8 correspond to the following statement. To find out if there is any relationship between teacher's pay and per pupil expenditure in public schools, Table 1 shows the LS regression results of a regression relating the average annual teacher salary in thousands of dollars (Salary) as a function of the spending on public schools per pupil in thousands of dollars (Expenditure) for the 51 states of the US in 1985.

Table 1

Dependent Variable: Salary				
Least Squares				
N= 51				
Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	12.12937	1.197351	10.13017	0.0000
Expenditure	3.307585	0.311704	10.61129	0.0000
R-squared	0.696781	Mean of dependent Var		24.35622
Sum of squared Residuals	264.8252	S.D. of dependent Var		4.179426
F(1,49)	112.5995	p-value (F)		0.000000
Akaike criterion	4.563553	Schwarz criterion		4.639311

Looking for evidence about differences between three geographical regions in the US: Northeast and North Central (21 states), South (17 states) and West (13 states), we defined three dummy variables: D1, which is equal to 1 if the state is in the West, and equal to 0 otherwise; D2 which is equal to 1 if the state is in the Northeast and North Central region, and equal to 0 otherwise; and D3 which is equal to 1 if the state is in the South, and equal to 0 otherwise. Adding these variables to the previous model yields the results shown in Table 2.

Table 2

Dependent Variable: Salary				
Least Squares				
N= 51				
Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	13.26911	1.395056	9.511530	0.0000
D2	-1.673514	0.801170	-2.088837	0.0422
D3	-1.144157	0.861118	-1.328687	0.1904
Expenditure	3.288848	0.317642	10.35393	0.0000
R-squared	0.722665	Mean of dependent Var.		24.35622
Sum of squared Residuals	242.2188	S.D. of dependent Var.		4.179426
F(3,47)	40.82341	p-value (F)		0.000000
Akaike criterion	4.552756	Schwarz criterion		4.704271

Question 6. According to Tables 1 and 2, which of the following statements is **FALSE?**

A) If the expenditure in public schools is $1000, the estimated Salary of a teacher in the West region is about $16558, the estimated Salary of a teacher in the Northeast/North Central region is about $14884 and the estimated Salary of a teacher in the South is about $15414

B) The Salary of the teachers in the South is statistically different from that of the teachers in the West at the 5% level, but it is not statistically different at 1%, assuming that Expenditure is the same for both regions.

C) The value of the statistic computed to test whether the Salary of the teachers in public schools is the same in the three regions in the US is equal to 2.19 (rounding to two decimals places). As $\text{Prob}[F(2,47) \leq 3.19] = 0.95$, the previous hypothesis cannot be rejected at the 5% level of significance.

Question 7. According to Tables 1 and 2:

A) Table 2 shows that, when Expenditure is zero, the estimate Salary of the teachers in the South and the Northeast and North Central regions is negative, so there might be a mistake in the model.

B) The reward for extra Expenditure on public Schools are much higher for the teachers in the West region.

C) Assuming that the per pupil expenditure in the public schools is the same, the estimated Salary of the teachers in a state in the Northeast and North Central region is lower than that of the West region by $1673.51

Question 8. Table 3 shows the estimated covariance matrix for the LS parameter estimates in Table 2:

Table 3

	Constant	D2	D3	Expenditure
Constant	1.9462	-0.4038	-0.6514	-0.3954
D2		0.6419	0.3976	0.0019
D3			0.7415	0.0651
Expenditure				0.1009

If $2\times \text{Prob}[t(47)\geq 0.6902]=0.4934$, $2\times \text{Prob}[t(47)\geq 0.4501]=0.6547$ and assuming that the expenditure per pupil in the public schools is the same in the three regions, which of the following statements is **TRUE?**

A) The hypothesis that the teacher salary on public schools in the South is not statistically different from that of teachers in the Northeast and North Central cannot be rejected, neither at 5% nor at 1% level of significance, because the corresponding *t*-statistic is 0.6902 (rounding at two decimal places).

B) The hypothesis that the teacher salary on public schools in the South is not statistically different from that of teachers in the Northeast and North Central cannot be rejected, neither at 5% nor at 1% level of significance, because its t-statistic is 0.4501 (rounding at two decimal places).

C) We will not reject the hypothesis that the teacher's salary on public schools in the West region is not statistically different from zero at any level of significance.

Question 9. Consider the model $Y_i = \beta_1 + \beta_2 X_i + U_i$. If the sample means of Y_i and X_i $(i = 1, 2, ..., N)$ are positive and equal, then the LS estimate of the intercept would be:

A) Equal to zero when the LS estimate of the slope is not equal to one.

B) Greater than zero when the LS estimate of the slope is greater than zero and less than one.

C) Less than zero when the LS estimate of the slope is less than zero.

Question 10. Using a sample of n observations, $y_1, y_2, ..., y_n$, a researcher wants to describe the behavior of the monthly Spanish GDP (Y) using the model $Y_t = \beta_1 + \beta_2 Y_{t-1} + \beta_3 Y_{t-2} + U_t \quad (t = 1, 2, ..., n)$. If $E[U] = 0$ and $E[UU^T] = \sigma^2 I$, which of the following regression model assumptions is NOT fulfilled by the previous model?

A) Errors are not autocorrelated.

B) Parameters are constant.

C) Regressors are non-random.

Question 11. Consider the model $Y_i = \beta_1 + \beta_2 X_i + U_i, (i = 1, 2, ..., 30)$, which fulfills the multiple linear regression model assumptions. If $\bar{t}$ is the t-statistic computed to test the hypothesis $H_0 : \beta_2 = 1$ against the alternative $H_1 : \beta_2 > 1$, which of the following statements is **TRUE?**

A) $\text{Prob}[t(28) \geq \bar{t}]$ is the *marginal level of significance* (p-value) corresponding to the previous test.

B) $1 - \text{Prob}[t(28) \geq \bar{t}]$ is the *marginal level of significance* (p-value) corresponding to the previous test.

C) $\bar{t} = (\hat{\beta}_2 - 1) \times DT_2$, where DT_2 is the standard error (i.e. the estimate standard deviation) of the LS estimate of β_2.

Question 12. In the model $Y_t = \beta_1 + \beta_2 X_t + U_t$, assume that $U_t = \frac{1}{3}(A_t + A_{t-1} + A_{t-2})$, and $A_t \sim \text{NIID}\left(0, \sigma_A^2\right)$, therefore:

A) The error term (U_t) is heteroscedastic.

B) The error term (U_t) is autocorrelated.

C) The expected value of the error is not zero $\left(\text{E}\left(U_t\right) \neq 0\right)$.

Question 13. Which of the following statements is **TRUE**?

A) Regression models relating non-stationary time series may provide spurious results (i.e., an empirical relationship which is complete nonsense).

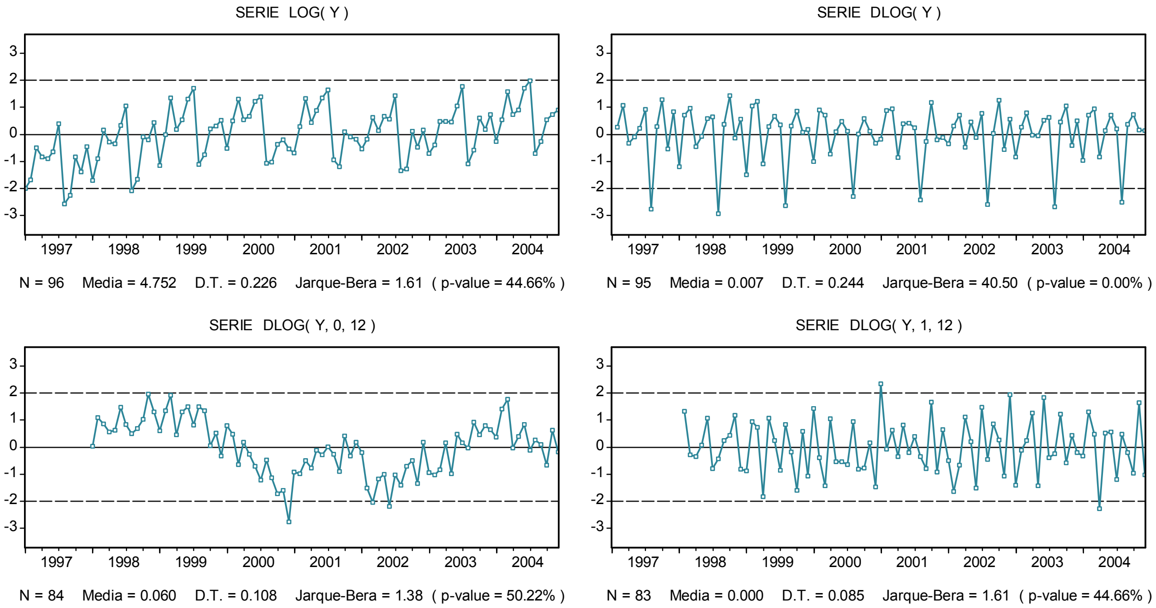
B) There is no specific problem associated with building a regression model relating non-stationary time series.

C) Residual diagnostics for regression models relating non-stationary variables are not suitable tools to detect problems in applied work.

Questions 14 to 15 correspond to the following statement. Figure M1 shows the time series LOG(Y) (natural logarithm of Y), DLOG(Y) (the log differences of Y), DLOG(Y, 0, 12) (seasonal (s=12) log differences of Y), and DLOG(Y, 1, 12) (the differences of the seasonal (s=12) log differences of Y).

[**Note**: $\text{DLOG}\left(\text{Y}\right) = \ln \text{Y}_t - \ln \text{Y}_{t-1}$, $\text{DLOG}\left(\text{Y}, 0, 12\right) = \ln \text{Y}_t - \ln \text{Y}_{t-12}$ and $DLOG(\text{Y}, 1, 12) = \nabla\left(\ln IPI_t - \ln IPI_{t-12}\right) = \nabla_{12}\left(\ln IPI_t - \ln IPI_{t-1}\right)$

Figure M1



Question 14. Which of the following statements is **FALSE**?

A) LOG(Y) is seasonal.

B) DLOG(Y, 0, 12) is not mean-stationary.

C) The series DLOG(Y) is mean-stationary.

Question 15. According to Figure 1, the null hypothesis that DLOG(Y, 1, 12) follows a normal distribution:

A) Cannot be rejected at the 1% level of significance.

B) Is rejected at the 5% level of significance.

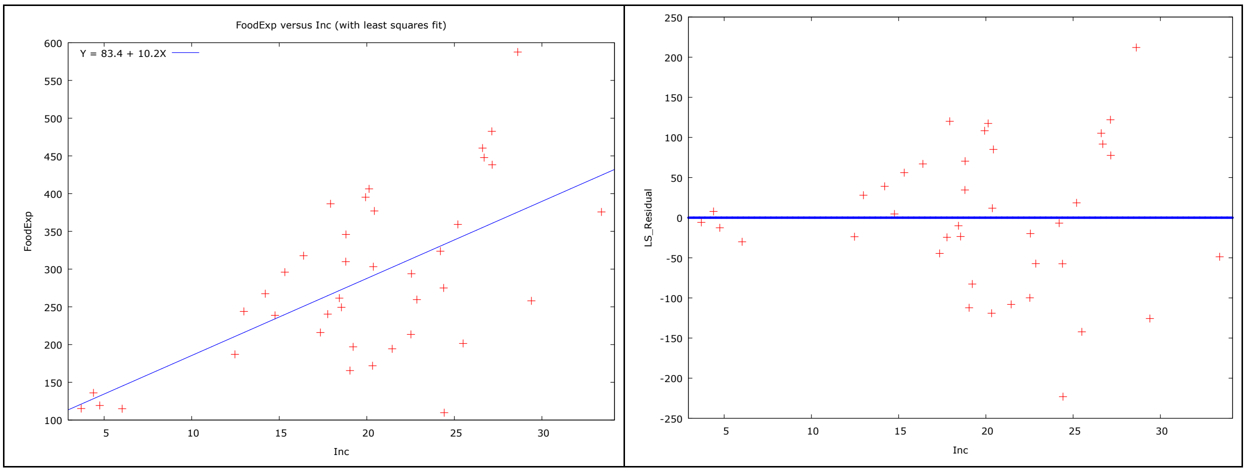
C) Is rejected at the 10% level of significance.

Questions 16 to 19 correspond to the following statement: Given N=40 cross-sectional household observations on weekly food expenditure in euros (FoodEx) and weekly household income in euros (Inc) the model $FoodEx_i = \beta_1 + \beta_2 Inc_i + U_i$ has been estimated. Tables A and B show the results:

Table A

Dependent variable: *FoodEx*				
LS				
N=40				
Variable	Coefficient	Std. Error	t-Statistic	p-value
Constant	36.69080	19.92479	1.841465	0.0734
Inc	0.128289	0.030539	4.200777	0.0002
R-squared	0.317118		Mean. of dep. var.	117.2817
Adjusted R-squared	0.299148		S.D. of dep. var.	40.64271
Sum of squared residuals	43992.18		Akaike criterion	9.940765
F(1,38) statistic	17.6465			

Table B



Question 16. The plots in Table B suggest that

A) The model error term is homoscedastic.

B) The variability of LS residuals is independent of the level of household income.

C) The variability of LS residuals increases as income increases.

Question 17. The answer to the previous question suggests that a reasonable model for the error variance, $\text{Var}(U_i)$, would be:

A) $\text{Var}[U_i] = \sigma^2 \frac{1}{Inc_i^2}$ $(i = 1, ..., 40)$

B) $\text{Var}[U_i] = \sigma^2$ $(i = 1, ..., 40)$.

C) $\text{Var}[U_i] = \sigma^2 Inc_i$ $(i = 1, ..., 40)$

Question 18. The answer to questions 16 and 17 suggests that (indicate which statement is **TRUE**):

A) The estimate for β_2 is statistically significant at both the 10% and 5% level of confidence

B) The standard errors computed for the LS estimates of β_1 and β_2 in Table A are not correct.

C) The *F*-statistic in Table A is suitable to test whether the parameter β_2 is statistically significant.

Question 19. According to the answer to previous questions, which of the following statements is **TRUE?**

A) In the model $\frac{FoodEx_i}{Inc_i} = \beta_1 \frac{1}{Inc_i} + \beta_2 + V_i$, the LS estimator is BLUE (Best linear unbiased estimator).

B) The White heteroscedasticity-consistent standard errors are suitable for estimation the variances of the LS estimates of β_1 and β_2 in Table A.

C) The LS estimator of β_1 and β_2 in $FoodEx_i = \beta_1 + \beta_2 Inc_i + U_i$ is biased.

Question 20. Which of the following statements is **TRUE?**

1. Efficiency of the OLS estimator of β in the General Linear Model (GLM) implies that there is no other linear unbiased estimator of β with a smaller variance.
2. The OLS estimator of β in the GLM is efficient even if the model displays approximate collinearity.
3. The p-value (or marginal significance level) of the individual significance test for a parameter in the GLM can be interpreted as the probability that the null hypothesis is true.
4. It is said that an observation in the GLM is "outlying" or "atypical" if it lies far from the center of the sample; in this situation the corresponding residual is often large.

A) TRUE: 1, 2 and 4. FALSE: 3

B) TRUE: 1, 3 and 4. FALSE: 2

C) TRUE: 1, 2 and 3. FALSE: 4

Calculations

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Question 10	A	B	C	Blank
Question 11	A	B	C	Blank
Question 12	A	B	C	Blank
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Question 14	A	B	C	Blank
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Question 17	A	B	C	Blank
Question 18	A	B	C	Blank
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Question 20	A	B	C	Blank

Correct	Incorrect	Blank	Final grade