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

May 17, 2018 – 09:00

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**
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

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

Question 1: Consider a general linear model estimated with 48 observations. If the *p*-value (or marginal significance level) associated with the residual Jarque-Bera statistic is 0.065, then:

A) …the null that the residuals come from a normal distribution is **not rejected** with a 5% of significance, but it is **rejected** with a 1% significance.

B) …the null that the residuals come from a normal distribution is **not rejected** with a 5% or a 1% significance.

C) …the null that the residuals come from a normal distribution is **rejected** with a 5% significance, but it is **not rejected** with a 1% significance.

Question 2: Given the linear regression model, $Y_i = \beta_1 + \beta_2 X_{i2} + \beta_3 X_{i3} + U_i$, denoted by [A], and a simple regression model, $Y_i = \beta_1 + \beta_2 X_{i2} + U_i$, denoted by [B], then:

A) The adjusted R-squared of model [B] is always larger than the adjusted R-squared of model [A].

B) The R-squared of model [A] is always smaller than the R-squared of model [B].

C) A fair way to choose between models [A] and [B] consists in estimating both and then choosing the one with the smallest Akaike criterion.

Question 3: In the model $Y_t = \beta_0 + \beta_1 X_t + U_t$, if the sample mean of Y_t is zero, then:

A) The R-squared can be calculated as $R^2 = 1 - \frac{SSR}{\sum y_t^2}$, where SSR denotes the sum of the squares of the residuals.

B) The OLS estimator of β_0 is such that $\hat{\beta}_0 = -\hat{\beta}_1$

C) The OLS estimator of β_1 is such that $\hat{\beta}_1 = \frac{\sum Y_t X_t}{\sum X_t^2}$

Question 4: In the model $y_i = \beta_1 + \beta_2 x_i + u_i$ ($i = 1,2,\ldots,40$), which complies with all the standard hypotheses, we want to test $H_0 : \beta_2 = 0$ against $H_1 : \beta_2 \neq 0$ with the usual *t* statistic. If $\bar{t}$ is the value of this statistic and $\text{Prob}\left(-|\bar{t}| \leq t(38) \leq |\bar{t}|\right) = 0.95$, where *t*(38) denotes a Student *t* distribution with 38 degrees of freedom, then:

A) …the null should be rejected with a 1% significance, but not with a 10% significance.

B) …the null should be rejected with a 10% significance, but not with a 1% significance.

C) …the null should be rejected both, with a 10% and a 1% significance.

Question 5. In the context of a linear regression model complying with all the standard assumptions, the Gauss-Markov theorem implies that:

A) …the OLS (Ordinary Least Squares) estimator is the only unbiased estimator of $\boldsymbol{\beta}$.

B) …the OLS estimator of $\boldsymbol{\beta}$ is linear and unbiased, but you can find other linear and unbiased estimators with a smaller variance.

C) …you can find a non-OLS estimator of $\boldsymbol{\beta}$ which, being linear and biased, has a smaller variance than OLS.

Question 6. Consider the regression model $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{U}$ and the (2 x 2) diagonal matrix $\mathbf{X}^T\mathbf{X}$, such that the elements in the main diagonal are 4 and 4. On the other hand, the values in the (2 x 1) vector $\mathbf{X}^T\mathbf{y}$ are 0 and 24, respectively. Then, if the model parameters are denoted by β_1 and β_2, then the OLS estimates of the parameters are:

A) $\hat{\beta}_1 = 1/4$ and $\hat{\beta}_2 = 6$.

B) $\hat{\beta}_1 = 0$ and $\hat{\beta}_2 = 96$.

C) $\hat{\beta}_1 = 0$ and $\hat{\beta}_2 = 6$.

Question 7. If the model $\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \mathbf{U}$ complies with all the classical hypotheses, but there is a high degree of linear correlation between some columns of the matrix $\mathbf{X}$ (i.e., there is approximate collinearity), then:

A) The OLS estimator of $\boldsymbol{\beta}$ is unbiased but does not have minimum variance.

B) There are infinite solutions to the system of normal equations $\mathbf{X}^T\mathbf{X}\hat{\boldsymbol{\beta}} = \mathbf{X}^T\mathbf{y}$.

C) Individual parameter significance tests lead to non-rejection more often that if there were no collinearity.

Questions 8 to 13 refer to the following statement: Using annual data from 1989 to 2000, we estimated by OLS the following regression model:

$$SALES_t = \beta_1 + \beta_2 GPUB_t + \beta_3 PRICE_t + \beta_4 INCOME_t + \beta_5 PCOMP_t + U_t$$

where SALES is the sales volume of a company (million units), GPUB is the advertising investment (million euros), PRICE is the price of the product (euros/unit), INCOME is the aggregate consumer income (billion euros) and PCOMP is the average price of a competing product (euros/unit). Table A displays some OLS results for this model.

Table A

Dependent Variable: SALES Sample: 1989-2000 Observations included: 12				
Variable	Coefficient	Std. error	t-statistic	p-value
Constant	------	-------	-------	0.0151
GPUB	1.167260	-------	-------	0.0002
PRICE	-2.842482	-------	-------	0.0021
INCOME	0.088978	-------	-------	0.0377
PCOMP	1.995104	-------	-------	0.0210
R-squared	0.993693	Mean dependent variable		52.58333
Adj. R-squared	0.990089	Std. deviation dependent var		12.73833
Residual std. deviation	-----------	F-statistic		----------
Sum of squared residuals	11.25705	P- value (F-statistic)		0.00000

Question 8: The estimated error variance (use all the available decimals for calculations) is:

A) 11.2571

B) 1.60815

C) 1.99009

Question 9. If the price of the competing product increases in 2 euros then, according to Table A (use all the available decimals for calculations and then round off the result to three decimal places) the annual sales will increase, *caeteris paribus*, in:

A) 1.995 million units.

B) 3.990 million euros

C) 3.990 million units.

Question 10. According to the information in Table A, the null that the slopes (i.e., all parameters except the constant) in the model are zero (use all the available decimals for calculations and then round off the result to three decimal places) should be:

A) …rejected with a 5% significance, being 275.719 the value of the F-statistic.

B) ...tested with a statistic distributed as a Snedecor-F with 5 degrees of freedom in the numerator and 7 degrees of freedom in the denominator.

C) …rejected with a 5% of significance, being 375.719 the value of the F-statistic.

Question 11. According to the information in Table A (with all the available decimals) the point forecast for sales (in million units), corresponding to an advertising investment of 2 million euros, a price of 0.25 euros per unit, an aggregate buyer income of 2000 million euros and a 0.5 average competitor price:

A) …is 2.7994 million units.

B) …there is not enough information to calculate this forecast.

C) …is 2.2994 million units.

Question 12. According to the information in Table A, the OLS (Ordinary Least Squares) estimate for the constant term:

A) …is 53.728 million euros.

B) …is 52.583 million units.

C) …cannot be computed with the information in Table A.

Question 13. According to the information in Table A, the less significant regressor is:

A) …INCOME.

B) …the constant term.

C) …PCOMP.

Question 14. The model $Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + U_i$ was estimated with a sample of 63 observations. Considering that observations 1, 2 and 3 could be influential, we computed the Cook statistic values shown in the following Table:

Observation	Cook statistic (D_i)
1	1.48
2	2.27
3	1.09

If $\text{Prob}\left[F(3,60) \geq 2.76\right] = 0.05$, we can conclude that, at a 5% level of significance:

A) …the observation corresponding to the 2nd individual is influential.

B) …the observation corresponding to the 1st individual is influential.

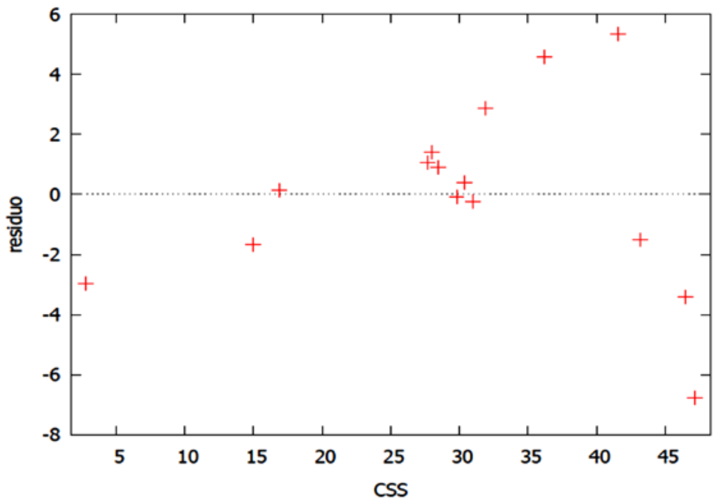
C) …none of the suspect observations is influential.

Questions 15 to 17 refer to the following statement. We have a sample of total contributions to Social Security (CSS_i) and contributions paid by workers ($CSST_i$) in 15 countries in 1982. Table 1 displays some results from an OLS regression of $CSST_i$ on CSS_i, denoted as Model 1, and Figure 1.1 displays the corresponding residuals:

Table 1: OLS results for Model 1

Regressor	Coefficient	t-statistic
Constant (β_0)	3.882	1.690
CSS_i (β_1)	0.211	3.100
Sum of squared residuals	132.77	

Figure 1.1



Question 15: Given the profile of the residuals in Figure 1.1, we conclude that the model in Table 1 may be affected by:

A) …error autocorrelation.

B) …error heteroscedasticity.

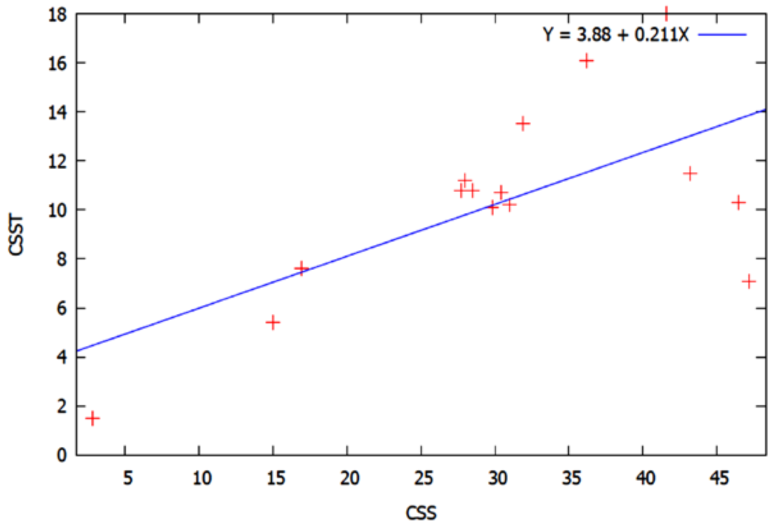
C) …none of the above.

Question 16: Given the information in Figure 1.1 and Figure 1.2 below, which shows the fit of the model in Table 1, we decide to estimate a new model (Model 2):

$$\left(CSST_i \big/ CSS_i\right) = \beta_0 \left(1 \big/ CSS_i\right) + \beta_1 + \left(U_i \big/ CSS_i\right)$$

…where the new error term has a zero mean, constant variance and no autocorrelation.

Figure 1.2



If the OLS estimates for the parameters in Model 2 are efficient, then the functional form of the heteroscedasticity detected in Model 1 is:

A) $\mathrm{var}(U_i) = \sigma^2 CSST_i^2$

B) $\mathrm{var}(U_i) = \sigma^2 CSST_i$

C) $\mathrm{var}(U_i) = \sigma^2 CSS_i^2$

Question 17. To determine if the cost of an increase in Social Security contributions is assumed entirely by the workers, we should test:

A) …the null $H_0 : \beta_1 = 1$ against $H_1 : \beta_1 \neq 1$ using model 2.

B) …the null $H_0 : \beta_1 = 1$ against $H_1 : \beta_1 \neq 1$ using model 1.

C) …the null $H_0 : \beta_1 = 0$ against $H_1 : \beta_1 \neq 0$ using model 2.

Question 18. In the linear regression model $y_t = \beta_0 + \beta_1 x_t + u_t$, fitted to a quarterly sample, we detect serial autocorrelation in the errors according to the model $u_t = \rho u_{t-4} + a_t$, where ρ is a known constant parameter and a_t is an uncorrelated error term. Under these conditions, which of the following transformed models would have non-autocorrelated errors?

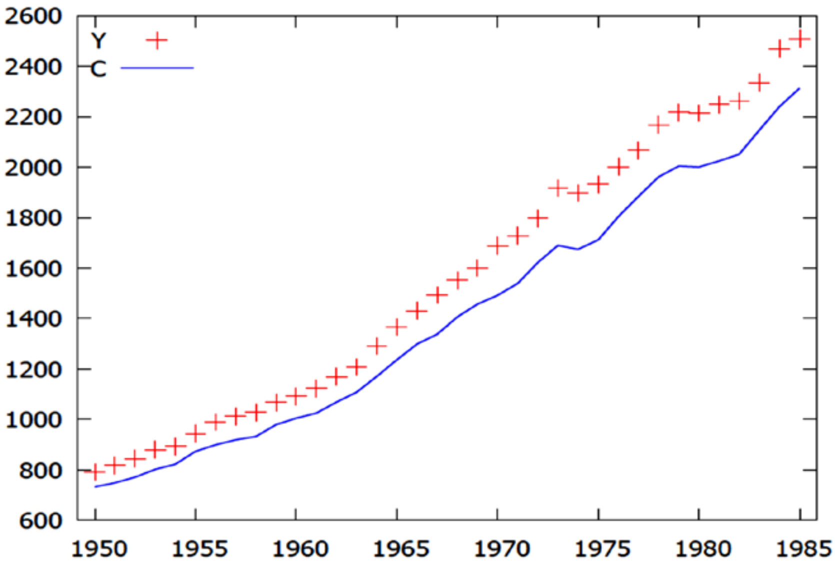
A) $y_t - \rho y_{t-1} = \beta_0(1-\rho) + \beta_1(x_t - \rho x_{t-1}) + a_t$

B) $y_t - \rho y_{t-4} = \beta_0(1-\rho) + \beta_1(x_t - \rho x_{t-4}) + a_t$

C) $y_t - \rho y_{t-2} = \beta_0(1+\rho) + \beta_1(x_t - \rho x_{t-2}) + a_t$

Questions 19 and 20 refer to the following statement. We want to relate *per capita* consumption (denoted by C) with *per capita* income (denoted by Y) using an annual US sample from 1950 to 1985, both years included. Figure B represents both time series and model B provides some OLS results:

Figure B



Model B

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Model B: OLS, using the observations 1950-1985 (T = 36)
Dependent variable: C

             Coefficient  std. error  t-statistic   p-value
const          11.3737     9.62946      1.1811      0.2457
Y              0.898329   0.00584839  153.6029     <0.0001   ***

Mean of dep. var       1409.806   S.D. of dep. var       489.0210
Sum squared resid      12044.20   S.E. of regression     18.82130
R-squared              0.998561   Adjusted R-squared     0.998519
F(1, 34)               23593.84   p-value(F)             6.61e-50
```

Question 19: Given the results in Figure B and Model B:

A) …both variables have a trend and, therefore, the high R-squared value may be misleading because of a problem of spurious correlation.

B) …the R-squared of model B is very satisfactory, since more than 99% of the variability of consumption is explained by the income.

C) …although the R-squared of model B is very high, the adjustment is not good since the residual standard deviation is large.

Question 20. We decided to run a regression between the log variation rates of Consumption and Income, denoted by $ld\_C = \nabla \log(C_t)$ and $ld\_Y = \nabla \log(Y_t)$ respectively, where ∇ denotes a regular difference. The OLS results of this new model and the corresponding residuals are shown in Table C and Figure C, respectively.

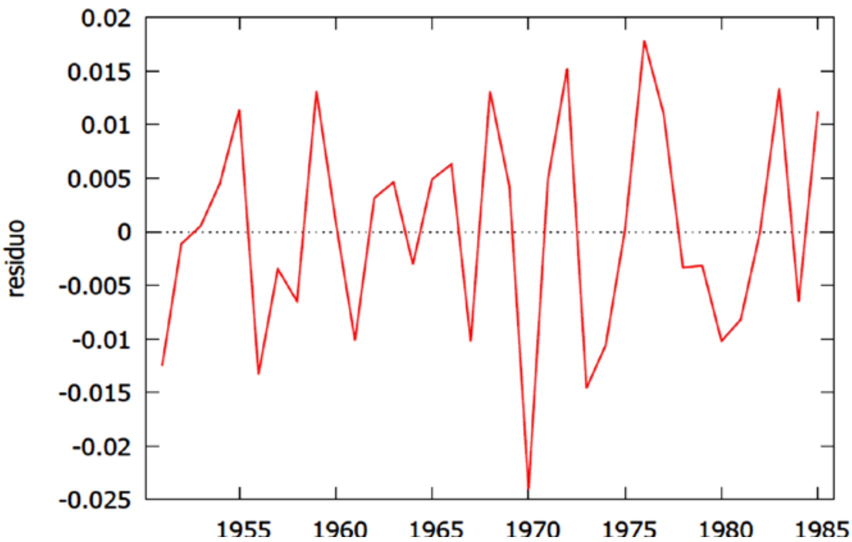
Table C

Model C: OLS, using the observations 1951-1985 (T = 35)
Dependent variable: ld_C

	Coefficient	std. error	t-statistic	p-value	
const	0.00882854	0.00365019	2.4186	0.0213	
ld_Y	0.728074	0.0979606	7.4323	<0.0001	***

Mean of dep. var	0.032820	S.D. of dep. var	0.016241
Sum squared resid	0.003354	S.E. of regression	0.010081
R-squared	0.626017	Adjusted R-squared	0.614684
F(1, 33)	55.23929	P-value (F)	1.53e-08

Figure C



Then, given the results in Table C and Figure C:

A) …model B should be preferred to Model C because its R-squared is larger.

B) …model C should be preferred to Model B, because the trends in C and Y have been treated properly.

C) ...figure C shows that the residuals present clear second-order autocorrelations.

Calculations

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