ECONOMETRICS FINAL EXAM
Friday 28th June 2024

Family Name:	**Name:**
Grade:	**ID:**
Mobile:	**Email:**

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		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 15 MINUTES (75’) TO ANSWER THIS

REMINDER

YOU ARE NOT ALLOWED TO USE DEVICES WITH CONNECTIVITY TO THE INTERNET, INCLUDING MOBILE PHONES, TABLETS, SMARTWATCHES OR MP3/4 PLAYERS

Question 1. Choose the right answer:

A. The value of the correlation coefficient depends on the units of measurement of the variables.
B. The correlation coefficient and the covariance can show different signs.
C. Both answers are incorrect.

Question 2. The following two regression models have been estimated using OLS: [M1]: $\hat{Y} = \hat{\beta}_0 + \hat{\beta}_1 X_1$ and [M2]: $\hat{Y} = \hat{\alpha}_0 + \hat{\alpha}_1 X_1 + \hat{\alpha}_2 X_2$. If $\widehat{corr}(X_1, X_2) > 0$ and $\widehat{\alpha_2} > 0$, Choose the right answer:

A. $\hat{\beta}_1 = \hat{\alpha}_1$
B. $\hat{\beta}_1 > \hat{\alpha}_1$
C. $\hat{\beta}_1 < \hat{\alpha}_1$

Question 3. After the OLS estimation of a multiple linear regression model, the residuals from the estimation (choose the right answer):

A. Add up to zero even if a constant term has not been included in the model.
B. Are orthogonal to the explanatory variables of the model.
C. Have constant variance and covariances equal to zero if the random perturbations of the model have these same characteristics.

Question 4. In the context of a multiple linear regression model, an influential observation (choose the right answer):

A. Is the one that, if we remove it from the sample, significantly affects the OLS estimates of the model parameters.
B. Always shows a residual of large absolute value.
C. Both answers are incorrect.

Question 5. The model $Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \epsilon_i$ shows a known variance so that Var $(\epsilon_i) = \sigma^2 * \frac{1}{X_{i2}{}^2}$ where σ^2 is a constant. Which of the following models would make the errors homoscedastic? Choose the right answer:

A. $Y_i * X_{i2} = \beta_0 * X_{i2} + \beta_1 X_{i1} * X_{i2} + \beta_2 X_{i2} * X_{i2} + v_i$
B. $Y_i / X_{i2} = \beta_0 / X_{i2} + \beta_1 X_{i1} / X_{i2} + \beta_2 + v_i$
C. $Y_i / X_{i2}{}^2 = \beta_0 / X_{i2}{}^2 + \beta_1 X_{i1} / X_{i2}{}^2 + \beta_2 / X_{i2}{}^2 + v_i$

Question 6. The estimation of a simple linear regression model using a sample of 10 individuals results in the following estimated model: $\hat{Y}_i = 2 + 5X_i$. Choose the right answer:

A. The fitted line goes through the point $(\bar{X}, \bar{Y})$, being $\bar{X}$ and $\bar{Y}$ the sample means of the variables X Y, respectively.
B. The correlation coefficient between X and Y is equal to 5.
C. If $X_i = 10$, then $Y_i = 52$.

Question 7. The data that provides information from several individuals across different, regular time periods are labelled:

A. Cross-sectional data.
B. Time series data
C. Panel data.

Questions 8 to 12 refer to the following statement. A database of 630 counties is available and the aim is to assess how the number of crimes per capita depends on some characteristics of the counties. To this aim, the following model has been specified [M3]:

$$\ln crmrte = \beta_0 + \beta_1 avgsen + \beta_2 density + \beta_3 polpc + \beta_4 taxpc + u$$

where "ln" is the natural logarithm (in base e), *crmrte* is the number of crimes per cápita, *avgsen* is the average number of days of the sentences, *density* is the number of individuals per square mile, *polpc* is the number of police officers per capita and *taxpc* is the tax revenue per capita. Results from the OLS estimation of the model are shown in TABLE 1:

TABLE 1
Model 3: OLS, using observations 1-630
Dependent variable: ln crmrte

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	−3.84612	0.0786943	−48.87	<0.0001	***
Avgsen	−0.0157745	0.00681148	−2.316	0.0209	**
Density	0.243215	0.0128536	18.92	<0.0001	***
Polpc	−0.650946	6.65153	−0.09786	0.9221	
Taxpc	0.00139848	0.00161932	0.8636	0.3881	

Mean dependent var	−3.609225	S.D. dependent var	0.572808
Sum squared resid	128.0169	S.E. of regression	0.452578
R-squared	----------	Adjusted R-squared	0.375734
F(4, 625)	95.64586	P-value(F)	1.84e-63
Log-likelihood	−391.9607	Akaike criterion	793.9213
Schwarz criterion	816.1499	Hannan-Quinn	802.5555

Question 8. The estimated increase in crime per capita ("ceteris paribus") given a one-unit increase in *density* is equal to:

A. 0.24%.
B. 24.32.
C. 24.32%.

Question 9. What is the value of the R-squared in TABLE 1?:

A. 0.9564.
B. 0.3797.
C. Cannot be calculated with the available information.

Question 10. Based on the results from TABLE 1, indicate which of the following statements is correct:

A. The variable *avgsen* is statistically significant at the 1% level of significance.
B. The variable *density* is not statistically significant at the 10% level of significance
C. The variable *avgsen* is statistically significant at the 5% level of significance.

Question 11. If you want to test the joint significance of the variables *polpc* and *taxpc* in the model [M3], which one would be the null hypothesis?

A. $H_0: \beta_3 = \beta_4$
B. $H_0: \beta_3 = \beta_4 = 0$
C. $H_0: \beta_3 - \beta_4 = 0$

With the aim to analyze if the variable *density* shows collinearity with the other regressors the model [M4] is specified and its OLS estimation is shown in TABLE 2:

$$density = \beta_0 + \beta_1 avgsen + \beta_2 polpc + \beta_3 taxpc + v$$

TABLE 2
Model 4: OLS, using observations 1-630
Dependent variable: density

	Coefficient	*Std. Error*	*t-ratio*	*p-value*	
Const	0.316444	0.244371	1.295	0.1958	
Avgsen	0.0397507	0.0211204	1.882	0.0603	*
Polpc	−33.2189	20.6401	−1.609	0.1080	
Taxpc	0.0257065	0.00492930	5.215	<0.0001	***

Mean dependent var	1.386062	S.D. dependent var	1.439703
Sum squared resid	1239.752	S.E. of regression	1.407279
R-squared	0.049092	Adjusted R-squared	0.044535
F(3, 626)	10.77281	P-value(F)	6.55e-07
Log-likelihood	−1107.170	Akaike criterion	2222.339
Schwarz criterion	2240.122	Hannan-Quinn	2229.247

Question 12. According to TABLE 2, indicate which of the following statements regarding the Variance Inflation Factor (VIF) of the variable *density* is true:

A. It is equal to 0.049.
B. It is equal to 1.05.
C. It cannot be calculated with the available information.

Question 13. Consider a model estimated using OLS: $Y_i = \hat{\beta}_0 + \hat{\beta}_1 X_i + \hat{U}_i$. If the sample means of Y_i and X_i $(i = 1, \dots, N)$ are positive and identical, then:

A. $0 < \hat{\beta}_1 < 1$ implies that $\hat{\beta}_0 > 0$
B. $\hat{\beta}_1 \neq 1$ implies that $\hat{\beta}_0 = 0$
C. $\hat{\beta}_1 < 0$ implies that $\hat{\beta}_0 < 0$

Question 14. In the following model: $Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + u_i$, the OLS estimated variance for $\hat{\beta}_1$ will be LARGER:

A. The lower is the R-squared of the model: $X_{i1} = \alpha_0 + \alpha_1 X_{i2} + v_i$.
B. The larger is the sample variance of X_{i1}.
C. Both answers are incorrect.

Question 15. Among all the classic hypotheses of the general linear model: $Y = X\beta + U$, the hypothesis that the error term U follows a normal distribution:

A. Is required to obtain the distribution of the OLS estimator for β.
B. Is required to compute the point forecast for the dependent variable.
C. Is required to proof the Gauss-Markov theorem.

Question 16. Using data from the quarterly sales of fridges (Y_t) in a given country between 2010 and 2017 the following model has been estimated using OLS:

$$\hat{Y}_t = 1222.12\, D_{t1} + 1467.5\, D_{t2} + 1569.75\, D_{t3} + 1160.0\, D_{t4}$$

where Y_t is measured in miles of units and $D_{t1}, D_{t2}, D_{t3}, D_{t4}$ are quarterly dummy variables that take the value of 1 in the corresponding quarter (1st, 2nd, 3rd y 4th, respectively) and 0 otherwise. Choose the right answer:

A. The elasticity of sales in the first quarter is equal to 1.22%.
B. The average difference in sales between the third and the first quarter is equal to 1569.75 miles of units.
C. The average of sales in the fourth quarter is equal to 1160 miles of units.

Question 17. Using the same data from Question 16, the following model is estimated using OLS:

$$\hat{Y}_t = \hat{\alpha}_0 + \hat{\alpha}_1 D_{t2} + \hat{\alpha}_2 D_{t3} + \hat{\alpha}_3 D_{t4}$$

Choose the right answer:

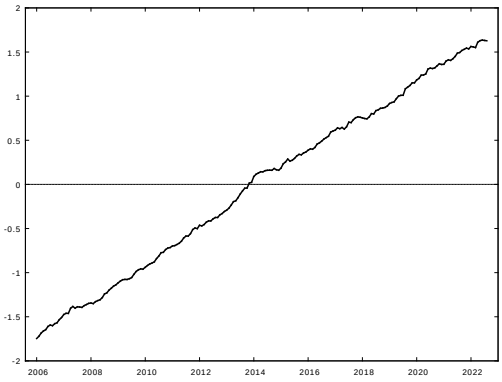
A. $\hat{\alpha}_0 = 245.38$.

B. $\hat{\alpha}_1 = 1467.5$.

C. $\hat{\alpha}_3 = -62.12$.

Questions 18 and 19 are related to two monthly time series: Y_t and X_t (observed from February 2006 until August 2022), that are shown in the following graphs, and to the two following linear regression models estimated using OLS: Model [M5]: $Y_t = \hat{\beta}_0 + \hat{\beta}_1 X_t + \hat{U}_t$ (TABLE 3) and Model [M6]: $\nabla Y_t = \hat{\alpha}_0 + \hat{\alpha}_1 \nabla X_t + \hat{A}_t$ (where ∇ denotes the first regular difference of the corresponding time series, TABLE 4).

SERIES Y_t



SERIES X_t

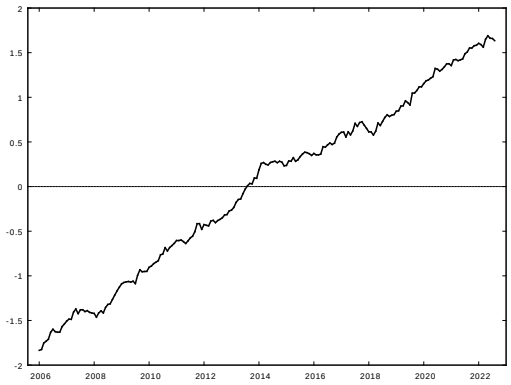


TABLE 3
Model 5: OLS, using observations 1-200
Dependent variable: Y_t

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
Const	-5.54367	0.918088	-6.038	<0.0001
X_t	3.68077	0.0155200	237.2	<0.0001

Mean dependent var	185.6983	S.D. dependent var	104.5411
Sum squared resid	7629.029	S.E. of regression	6.207290
R-squared	0.996492	Adjusted R-squared	0.996474
F(4. 625)	56246.64	P-value(F)	5.2e-245
Log-likelihood	-647.9276	Akaike criterion	1299.855
Schwarz criterion	1306.452	Hannan-Quinn	1302.525
Rho	0.925970	Durbin-Watson	0.137752

Breusch-Godfrey test AR(1):
Test statistic = 171.48 with Pr[$\chi^2(1) \geq 171.487] = 0.0000$

Breusch-Pagan test:
Test statistic = 0.003845 with Pr[$\chi^2(1) \geq 0.003845] = 0.95055$

TABLE 4
Model 6: OLS. using observations s 1-199
Dependent variable: ∇Y_t

	Coefficient	*Std. Error*	*t-ratio*	*p-value*
Const	1.04242	0.0791494	13.17	<0.0001
∇X_t	1.47746	0.0743835	19.86	<0.0001

Mean dependent var	1.772588	S.D. dependent var	1.709104
Sum squared resid	192.6154	S.E. of regression	0.988809
R-squared	0.666966	Adjusted R-squared	0.665275
F(4. 625)	394.5310	P-value(F)	6.40e-49
Log-likelihood	-279.1242	Akaike criterion	562.2483
Schwarz criterion	568.8349	Hannan-Quinn	564.9141
Rho	-0.026001	Durbin-Watson	2.042618

Question 18. Consider the following statements:

[1] Series Y_t is clearly seasonal.

[2] Series X_t is mean stationary.

[3] The residuals from [M5] do not show autocorrelation of order 1.

[4] The residuals from model [M5] show heteroscedasticity.

A. All the above statements are incorrect.

B. Statements [1], [2] and [4] are correct.

C. Only statement [3] is correct.

Question 19. Choose the right answer:

A. Series Y_t and X_t are not cointegrated.

B. Model [M5] shows a non-spurious relationship between series Y_t and X_t.

C. Series Y_t is unrelated in every sense to the series X_t.

Question 20. In the model: $Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \beta_3 X_{i3} + \delta_1 \hat{Y}_i^2 + \delta_2 \hat{Y}_i^3 + u_i$, the RESET:

A. Is the joint significance test for the parameters δ_1 and δ_2.

B. Is the joint significance test for all the parameters in the model.

C. Is the individual significance test for the parameters δ_1 and δ_2.

CALCULATIONS

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