PhD in Economics (XXIth Cycle)
Econometrics test (2019-07-23)

Name: ______________________________

Part I

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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) Suppose you have a sample of iid random variables $x_1, x_2, \ldots, x_n$, with $E(x_1) = 1$. Then,
   $$\lim_{n\to\infty} P\left[\left(\frac{1}{n}\sum_{i=1}^{n} x_i\right) > 0\right] = 1$$
   True ◯ False ◯ Not necessarily ◯

   (b) Suppose that $E(y_i|x_i) = \beta_0 + \beta_1/x_i$. You can estimate consistently β_0 and β_1 by using OLS.
   True ◯ False ◯ Not necessarily ◯

   (c) 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 ◯

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:

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

Now compute the following quantities:

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

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

(b) the averages of x_i and y_i:

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

(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

Part II

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 dsescription 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_i	log of real Italian GDP (source: OECD, quarterly national accounts)
y_i^*	log of real GDP For the Euro Area (source: AWM database)

	Symbol	Coefficient	Std. Error	t-ratio	p-value
const	k	0.2507	0.2285	1.0975	0.2761
Δb_{t-1}	ϕ_1	0.1512	0.1039	1.4551	0.1501
Δb_{t-2}	ϕ_2	0.1025	0.1065	0.9621	0.3393
Δb_{t-3}	ϕ_3	0.3597	0.1031	3.4894	0.0008
Δy_t	γ_1	−0.0678	0.1417	−0.4783	0.6339
Δy_t^*	γ_2	0.3405	0.1689	2.0164	0.0475
b_{t-1}	β_1	−0.1286	0.0402	−3.1985	0.0021
y_{t-1}	β_2	−0.0542	0.0255	−2.1242	0.0371
y_{t-1}^*	β_3	0.0307	0.0105	2.9160	0.0047

Mean dependent var	−0.000128	S.D. dependent var	0.004602
Sum squared resid	0.001131	S.E. of regression	0.003991
R^2	0.324087	Adjusted R^2	0.247928
$F(8, 71)$	4.255388	P-value(F)	0.000326
$\hat{\rho}$	−0.030293	Durbin's h	−0.735309

Breusch-Godfrey test for autocorrelation up to order 4:
F statistic = 0.266455 (p-value = 0.899)
Alternative statistic: TR^2 = 1.252693 (p-value = 0.869)

Table 1: ECM results

(a) Compute the long-run multipliers for the two variables y_t and y_t^*:

$c_y =$ ____________ $c_{y^*} =$ ____________

(b) Do the estimated coefficients β_2 and β_3 have the sign you would expect on the basis of standard macroeconomic theory? (answer on a separate sheet)

(c) A test for the hypothesis $H_0 : \beta_2 + \beta_3 = 0$ was performed, and the corresponding p-value was found to be 0.208. Comment on the economic meaning of the hypothesis test performed above. (answer on a separate sheet)

4. Suppose that you are studying if and to what extent the presence of kids affects the probability that a member of a couple has extramarital affairs. Your sample is made up of 601 individuals and you observe the variables described in Table 2.

	Mean	Std. Dev.	Min.	Max.
Had an affair in the last year	0.250	0.433	0.000	1.000
Presence of kids	0.715	0.452	0.000	1.000
Age	32.488	9.289	17.500	57.000
Religiosity (in increasing order)	3.116	1.168	1.000	5.000
Years of education	16.166	2.403	9.000	20.000
Male	0.476	0.500	0.000	1.000
Years of marriage	8.178	5.571	0.125	15.000

Table 2: Summary statistics of variables

The estimates of two linear models, (1) and (2), for the probability of having an extramarital affair in the last year are reported in Table 3.

	Model (1)			Model (2)		
Variable	Coeff.		Robust Std. Err.	Coeff.		Robust Std. Err.
Presence of kids	0.136	***	0.041	0.067		0.047
Age	0.001		0.002	-0.007	**	0.003
Religiosity	-0.057	***	0.015	-0.062	***	0.016
Years of education	-0.001		0.008	-0.001		0.008
Male	0.035		0.039	0.060		0.040
Years of marriage	–		–	0.019	***	0.006
Constant	0.296	**	0.144	0.442	***	0.151
Observations	601			601		
R^2	0.042			0.051		

Notes: *** Significant at 1%; ** significant at 5%; * significant at 10%

Table 3: Estimates of linear probability model for having an extramarital affair

Answer the following questions on a separate sheet:

(a) The column with standard errors reports the label "Robust". What are standard errors robust to? Why should they be "robust"?

(b) In model (2) the variable "Years of marriage" is added. Why is this variable added to the regression model, if we are only interested in the effect of the presence of kids on the probability of having an extramarital affair?

(c) Given the estimates for Models (1) and (2), what do you conclude about the impact of the presence of kids on the dependent variable? What is the quantitative effect in terms of probability of having an extramarital affair?

(d) How do you explain the fact that the estimated coefficient for the presence of kids in Model (2) is smaller than the one in Model (1)?

(e) What is the impact of an age increase by 10 years on the probability of having an extramarital affair? Compute the F-statistic to test the significance level of the impact of a 10 year age increase.