ISEG – Lisbon School of Economics and Management
ECONOMETRICS
First Semester 2016/2017
Problem Set IV – Time Series (I)

Question:	**1**	**2**	**3**	**4**	**5**	Total
Points:	4	4	4	4	34	50

Justify all your answers (except for multiple choice questions). You are required to show your work on each problem (except for multiple choice questions) and to include the output of EVIEWS used to solve the empirical questions. **Organize your work**. Work scattered all over the page will receive very little credit. A correct answer in a multiple choice question worths 4 points; an incorrect one worths -1 point. **Delivery date: 12th of December**.

(4) **1**. Consider the model $\widehat{\log(y_t)} = -0.05 + 0.12 \log(x_t) - 0.06 \log(x_{t-1}) + 0.05 \log(x_{t-2})$. Then,

- ○ The estimated long-run elasticity is 11% and the estimated short-run elasticity is 12%.
- ○ The estimated long-run elasticity is $\exp(0.05)$ and the estimated short-run elasticity is $\exp(0.12)$.
- ○ The estimated long-run elasticity is 0.06% and the estimated short-run elasticity is 0.12%.
- √ **The estimated long-run elasticity is** 0.11% **and the estimated short-run elasticity is** 0.12%**.**

(4) **2**. Consider the following FDL model $y_t = \alpha + \delta_0 x_t + \delta_1 x_{t-1} + \delta_2 x_{t-2} + u_t$. It is known that

- The estimated immediate change in y due to the one-unit temporary change x at time t is 0.5;
- The estimated change in y one period after the one-unit temporary change in x at time t is 0.2;
- The long-run effect is 0.8.

Then, one can conclude that,

- ○ if $\hat{\alpha} = 0.05$ then $\hat{\delta}_0 = 0.5$, $\hat{\delta}_1 = 0.2$ and $\hat{\delta}_2 = 0.05$.
- ○ $\hat{\delta}_0 = 0.5$, $\hat{\delta}_1 = 0.2$ and $\hat{\delta}_2 = 0.8$.
- √ $\hat{\delta}_0 = 0.5$**,** $\hat{\delta}_1 = 0.2$ **and** $\hat{\delta}_2 = 0.1$**.**
- ○ None of the above.

(4) **3**. Consider the model $y_t = \beta_0 + \beta_1 x_{t-1} + \beta_2 x_{t-2} + u_t$. Then,

- ○ The condition for contemporaneous exogeneity is $\mathrm{E}(u_t|x_t) = 0$.
- ○ The condition for strict exogeneity is $\mathrm{E}(u_t|x_t) = 0$.
- ○ Assuming contemporaneous exogeneity it is possible that $corr(u_t, x_{t-2}) \neq 0$.
- √ **None of the above.**

(4) **4.** Consider the model $y_t = \beta_0 + \beta_1 z_t + \beta_2 z_{t-1} + u_t$, with $E(u_t) = 0$. If $z_t = t^2$ where t is a time trend then it is true that,

- ◯ OLS is not unbiased because the assumption TS.3, strict exogeneity, is not verified.
- ◯ OLS is BLUE because the assumption TS.3, strict exogeneity, is verified.
- √ **In this model $E(u_t) = 0$ is sufficient to have strict exogeneity.**
- ◯ None of the above.

5. Use the data in T4.WF1 to regress the monthly industrial production index of cement in percentage, $ipcm_t$, on the price production index for cement in percentage, $price_t$, the aggregate index of industrial production in percentage, ip_t, controlling for a linear trend and seasonality.

(8) (a) explain how do you have controlled for seasonality in the regression.

Solution: We can use monthly dummy variables to control for seasonality in the regression.

The Eviews file already provides us the regressors jan,...,dec, that take the value of 1 if we are in that month, and 0 otherwise.

To avoid falling into the dummy variables trap, we need to include 11 instead of 12 dummy variables. Adding a linear trend, our model will look like this:

$$ipcm = \beta_0 + \beta_1\, price + \beta_2\, ip + \beta_3\, t + \delta_2\, feb + \delta_3\, mar + \delta_4\, apr + \delta_5\, may + \delta_6\, jun + \delta_7\, jul + \delta_8\, aug + \delta_9\, sep + \delta_{10}\, oct + \delta_{11}\, nov + \delta_{12}\, dec + u$$

Dependent Variable: IPCEM
Method: Least Squares

Sample (adjusted): 12 310
Included observations: 299 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.821790	6.293938	-1.401633	0.1621
PRICE	-0.027258	0.005348	-5.096907	0.0000
IP	1.327819	0.121941	10.88898	0.0000
@TREND	-0.117823	0.032720	-3.600903	0.0004
FEB	5.935248	1.930207	3.074928	0.0023
MAR	23.28685	1.927077	12.08402	0.0000
APR	43.02759	1.920910	22.39959	0.0000
MAY	52.44926	1.919931	27.31831	0.0000
JUN	62.23103	1.953265	31.86001	0.0000
JUL	61.33202	1.915591	32.01729	0.0000
AUG	65.72741	1.934894	33.96951	0.0000
SEP	58.18835	1.968257	29.56339	0.0000
OCT	60.74320	1.954452	31.07939	0.0000
NOV	37.68880	1.944700	19.38027	0.0000
DEC	15.12934	1.916766	7.893162	0.0000

R-squared	0.932606	Mean dependent var	97.50619
Adjusted R-squared	0.929284	S.D. dependent var	25.45749
S.E. of regression	6.769767	Akaike info criterion	6.711675
Sum squared resid	13015.65	Schwarz criterion	6.897316
Log likelihood	-988.3955	Hannan-Quinn criter.	6.785978
F-statistic	280.7181	Durbin-Watson stat	0.610076
Prob(F-statistic)	0.000000		

(8) (b) Interpret the estimated coefficient of the time trend.

Solution: $\hat{\beta}_3 = -0.117823$: ceteris paribus, we estimate that the industrial production index of cement decreases 0.1178 percentage points every month, meaning that less cement is being produced over time.

(8) (c) Choose one estimate of a seasonal effect and interpret it.

Solution: For example, $\hat{\delta}_{11} = 37.69$: the industrial production index of cement in november is 37.69 percentage points higher than in january (our reference month), ceteris paribus.

(10) (d) Is there evidence of seasonality on the monthly industrial production index of cement?

Solution: To answer this question, we need to test if the monthly effects are jointly equal to 0:

$$\begin{aligned} & \text{H0: } \delta_2 = \delta_3 = \delta_4 = \delta_5 = \delta_6 = \delta_7 = \delta_8 = \delta_9 = \delta_{10} = \delta_{11} = \delta_{12} = 0 \\ \text{vs} \quad & \text{H1: } \exists\, \delta_i \neq 0,\ i = 2, ..., 12 \end{aligned}$$

Performing an F-test, our test-statistic is:

$$F = \frac{(SSR_r - SSR_{ur})/q}{SSR_{ur}/(n-k-1)} \sim F(11, 284)$$

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	296.6846	(11, 284)	0.0000
Chi-square	3263.530	11	0.0000

Null Hypothesis: C(5)=C(6)=C(7)=C(8)=C(9)=C(10)=C(11)=
C(12)=C(13)=C(14)=C(15)=0

Directly with Eviews, we get that $F = 296.68$ and the p-value is 0.00: we reject the null hypothesis with a significance level of 5%, meaning there is evidence that the production of cement is affected by monthly seasonality.