1. Consider the following model: $y_t = 1 + 0.5\,z_t + 0.25\,z_{t-1} + z_{t-3} + u_t$, with $E\left(u_t \middle| z_t, z_{t-1}, y_{t-1}, z_{t-2}, y_{t-2}, z_{t-3}, y_{t-3}, z_{t-4}, \ldots\right) = 0$. For each of the following statements indicate whether it is true (T) or false (F).

	The Long Run effect is 2.75.
	The model is not dynamically complete.
	Given a temporary increase in z_t, the Long Run multiplier becomes zero after 4 periods.
	A temporary increase of 2 units in z_t implies an increase of 2 units in y_t after 3 periods.
	The error, u_t, of this model is not serially correlated.

2. Consider the following models $y_t = \alpha + \varepsilon_t$ and $x_t = x_{t-1} + \varepsilon_t$, where $\varepsilon_t \overset{iid}{\sim} N\left(0, \sigma_\varepsilon^2\right)$ and α is an unknown coefficient. For each of the following statements indicate if it is true (T) or false (F).

	$\{y_t\}$ is a stationary and weakly dependent process.
	$\{y_t\}$ is a random walk with a drift.
	$\{x_t\}$ is a stationary and weakly dependent process.
	$\{x_t\}$ is a stable autoregressive process.
	$\{x_t\}$ is a highly persistent process.

3. Consider the model $y_t = \beta_0 + \beta_1 x_t + \beta_2 x_{t-1} + u_t$, with $E\left(y_t \middle| x_t, x_{t-1}, x_{t-2}, \ldots\right) = E\left(y_t \middle| x_t, x_{t-1}\right)$. Indicate all that apply:

	The model is dynamically complete.
	The explanatory variables are contemporaneously exogenous.
	The explanatory variables are strictly exogenous.
	The explanatory variables are sequentially exogenous.

4. Consider the following process: $y_t = 0.6 y_{t-1} + e_t$, where $e_t \overset{iid}{\sim} N\left(0, \sigma^2\right)$, e_t and y_{t-1} are independent of each other. Then,

	$Cov\left(y_t, y_{t+h}\right) = 0$, for any $h \geq 2$.
	$Cov\left(y_t, y_{t+h}\right) = 0$, for any $h \geq 1$.
	$Var\left(y_t\right) = 1.5625\sigma^2$, for any t.
	$Var\left(y_t\right) = 0.36\sigma^2$, for any t.

5. To explain the investment (in millions of euros), *INV*, as a function of the interest rate (in percentage), *INT*, the following equations were estimated with quarterly data:

Equation 1

Dependent Variable: INV
Method: Least Squares
Sample: 1986Q4 2015Q1
Included observations: 114

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	47.66711	3.896775	12.23245	0.0000
@TREND	1.036554	0.035529	29.17523	0.0000
@SEAS(2)	-6.096146	1.997002	-3.052650	0.0029
@SEAS(3)	3.106675	1.860181	1.670093	0.0979
@SEAS(4)	-3.500009	1.878140	-1.863551	0.0652
INT	-21.22080	1.701372	-12.47276	0.0000
INT(-1)	-8.769745	2.885908	-3.038816	0.0030
INT(-2)	-4.207248	1.682268	-2.500938	0.0139
S.E. of regression	6.890089	Akaike info criterion		6.765637
Sum squared resid	5032.172	Schwarz criterion		6.957650

Equation 2

Dependent Variable: INV
Method: Least Squares
Sample (adjusted): 1986Q4 2015Q1
Included observations: 114 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	50.32081	5.840491	8.615853	0.0000
@TREND	1.122111	0.107803	10.40890	0.0000
@SEAS(2)	-5.695074	2.053223	-2.773724	0.0066
@SEAS(3)	2.700896	1.933131	1.397162	0.1653
@SEAS(4)	-2.979889	1.985991	-1.500455	0.1365
INV(-1)	-0.077034	0.097010	-0.794085	0.4290
INT	-21.08577	1.731592	-12.17710	0.0000
INT(-1)	-10.09364	3.603086	-2.801388	0.0061
INT(-2)	-6.078215	3.078789	-1.974223	0.0510
INT(-3)	0.502209	1.755739	0.286038	0.7754
S.E. of regression	6.926932	Akaike info criterion		6.792342
Sum squared resid	4990.168	Schwarz criterion		7.032359

Choose True (T) or False (F) regarding the following statement: "the model of Equation 1 is dynamically complete because…"

	$E\left(INV_t \middle\vert INV_{t-1}, INV_{t-2}, \ldots, INT_t, INT_{t-1}, INT_{t-2}, INT_{t-3}, \ldots\right) = 0$.
	The coefficient of INT_{t-2}, in equation 1, is statistically significant.
	INV_{t-1} and INT_{t-3} are jointly statistically insignificant therefore one may expect that further lags of *INV* and *INT* are jointly statistically insignificant too.
	$E\left(u_t \middle\vert u_{t-1}, u_{t-2}, \ldots, INT_t, INT_{t-1}, INT_{t-2}, INT_{t-3}, \ldots\right) = 0$, where u_t is the error term of equation 1.

6. Consider the following equation $y_t = \alpha - 0.1e_{t-1} + 0.2e_{t-2}$, where $e_t \overset{iid}{\sim} N\left(0,\sigma^2\right)$. Which one of the following statements is FALSE?

	$E\left(y_t\right) = 0$, only when $\alpha = 0$.
	$Corr\left(y_t, y_{t+1}\right) = -2/5$.
	$Var\left(y_t\right) = 0.05\sigma^2$.
	$Corr\left(y_t, y_{t+2}\right) = 0$, only when $\alpha = 0$.

7. Based on quarterly data, the following model was estimated $y_t = \alpha_0 + \alpha_1 y_{t-1} + u_t$, with $t = 0,1,\ldots,n$ and y_t is a stationary process without a trend. Then, the OLS estimator for α_1 …

	… is biased because the errors u_t are most likely autocorrelated.
	… is biased because the trend was omitted as an explanatory variable .
	… is unbiased because the process y_t is $I\left(0\right)$.
	… is biased because $E\left(u_t \middle| y_0, y_1,\ldots, y_{n-1}\right) \neq 0$.

8. Let y_t be a $I\left(1\right)$ process and x_t be a $I\left(0\right)$ process with a trend. For the following models, which of their coefficients cannot be consistently estimated by OLS (select all that apply):

	$y_t = \beta_0 + \beta_1 x_t + \beta_2 t + u_t$
	$\Delta y_t = \beta_0 + \beta_1 x_t + \beta_2 t + u_t$
	$\Delta y_t = \beta_0 + \beta_1 \Delta x_t + u_t$
	$\Delta y_t = \beta_0 + \beta_1 x_t + u_t$

9. Considering the following equation $y_t = \beta_0 + \beta_1 x_t + u_t$, which one of the following statements is FALSE?

	If $u_t = \rho u_{t-1} + e_t$, with $e_t \overset{iid}{\sim} N\left(0,\sigma^2\right)$ and $\left|\rho\right| < 1$, then the model is not dynamically complete.
	If the model is dynamically complete then, for $u_t = \rho u_{t-1} + e_t$, with $e_t \overset{iid}{\sim} N\left(0,\sigma^2\right)$, one must have $\rho = 0$.
	If the model is dynamically complete then, in $y_t = \beta_0 + \alpha y_{t-1} + \beta_1 x_t + u_t$, one must have $\alpha = 0$.
	If the model is dynamically complete then $E\left(u_t \middle| x_t, y_{t-1}, x_{t-1},\ldots\right) = 0$ and x_t is strictly exogenous.

10. Consider the models $y_t = \alpha + y_{t-1} + e_t$, $z_t = e_t + e_{t-1}$, where $e_t \overset{iid}{\sim} N\left(0, \sigma^2\right)$. Then,

	The processes y_t and z_t are both $I(0)$.
	Only the processes y_t is $I(0)$.
	Only the processes z_t is $I(0)$.
	The processes y_t and z_t are both $I(1)$.

11. Assume that the model $y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_t + u_t$ is dynamically complete. For each statement indicate whether it is true (T) or false (F).

	$E\left(u_t \middle| x_t, y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2}\right) = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_t$.
	In the model $y_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 x_t + \beta_3 y_{t-2} + u_t$, $\beta_3 = 0$.
	$Cov\left(u_t, u_{t-s} \middle| y_{t-1}, x_t, y_{t-s-1}, x_{t-s}\right) = 0$ for $s > 0$
	$E\left(y_t \middle| x_t, y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2}\right) = E\left(y_t \middle| x_t\right)$.

12. Consider the following model estimated with annual data:

$$\log\left(cons_t\right) = 1.05 + 0.53\log\left(inc_t\right) + 0.31\log\left(inc_{t-1}\right) + 0.004t + \hat{u}_t,\ t = 2, 3, \ldots, n$$

where *cons* and *inc* are, respectively, the consumption and the disposable income. Determine and interpret the short run and long run elasticities.

13. Consider the process $y_t = \alpha_0 + \alpha_1 t + u_t$, where $\alpha_1 \neq 0$ and $u_t = u_{t-1} + e_t$, with $e_t \overset{iid}{\sim} N\left(0, \sigma^2\right)$. Show that y_t is a random walk with a drift.

14. Are the following equations dynamically complete? Justify your answer.

Equation 1

Dependent Variable: INVPC
Method: Least Squares
Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.052928	0.193637	0.273334	0.7862
PRICE	2.993697	0.716779	4.176597	0.0002
PRICE(-1)	-2.484303	0.716641	-3.466595	0.0014

R-squared	0.365613	Mean dependent var	0.529510
Adjusted R-squared	0.330370	S.D. dependent var	0.090877
S.E. of regression	0.074365	Akaike info criterion	-2.285847
Sum squared resid	0.199088	Schwarz criterion	-2.157880
Log likelihood	47.57401	Hannan-Quinn criter.	-2.239933
F-statistic	10.37387	Durbin-Watson stat	0.672227
Prob(F-statistic)	0.000277		

Equation 2

Dependent Variable: INVPC
Method: Least Squares
Included observations: 39

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.036344	0.139449	-0.260626	0.7960
INVPC(-1)	0.774038	0.132263	5.852243	0.0000
PRICE	2.076251	0.580082	3.579236	0.0011
PRICE(-1)	-4.727543	0.841768	-5.616208	0.0000
PRICE(-2)	2.828948	0.590034	4.794549	0.0000

R-squared	0.708447	Mean dependent var	0.529510
Adjusted R-squared	0.674146	S.D. dependent var	0.090877
S.E. of regression	0.051876	Akaike info criterion	-2.960718
Sum squared resid	0.091498	Schwarz criterion	-2.747441
Log likelihood	62.73400	Hannan-Quinn criter.	-2.884196
F-statistic	20.65418	Durbin-Watson stat	1.884452
Prob(F-statistic)	0.000000		

Equation 3

Dependent Variable: INVPC
Method: Least Squares
Included observations: 39 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.053870	0.138763	-0.388217	0.7004
INVPC(-1)	0.867276	0.191710	4.523898	0.0001
INVPC(-2)	-0.211042	0.186129	-1.133850	0.2653
PRICE	1.913214	0.625230	3.060014	0.0045
PRICE(-1)	-4.250237	0.878768	-4.836588	0.0000
PRICE(-2)	2.457012	0.988758	2.484948	0.0184
PRICE(-3)	0.143262	0.655496	0.218554	0.8284

R-squared	0.733813	Mean dependent var	0.529510
Adjusted R-squared	0.683903	S.D. dependent var	0.090877
S.E. of regression	0.051093	Akaike info criterion	-2.949179
Sum squared resid	0.083537	Schwarz criterion	-2.650591
Log likelihood	64.50900	Hannan-Quinn criter.	-2.842048
F-statistic	14.70273	Durbin-Watson stat	2.128942
Prob(F-statistic)	0.000000		