LISBOA SCHOOL OF ECONOMICS & MANAGEMENT

Financial Forecasting 2018-2019

Master in Finance

ISEG-ULisboa

Practice Exam

1. (2.5 points) True or false

i. The simple exponential smoothing method is an adequate method to forecast series that present trend and seasonality.

☐ True ☐ False

ii. In order to filter out the erratic component of a series, we can use the method of moving averages.

☐ True ☐ False

iii. The process $y_t = y_{t-1} + \epsilon_t$ where $\epsilon_t \sim WN$, is second order stationary.

☐ True ☐ False

iv. The Box-Cox transformation can be used to remove seasonality from a time series.

☐ True ☐ False

v. Given a set of candidate models for the data, the preferred model is the one with the maximum AIC value.

☐ True ☐ False

2. (2 points) Consider the following table that contains information about the adjustment of a model applied to the quarterly series of the number of unemployed individuals in a country. Given that the observed value for 2004Q2 was 1520 obtain the forecast for the periods 2004Q3 and 2004Q4.

Sample: 1981Q1 2004Q1
Included observations: 61
Method: Holt-Winters Additive Seasonal
Original Series: UNEMPLOYED

Parameters:	Alpha		0.6700
	Beta		0.5000
	Gamma		0.0000
Sum of Squared Residuals			448900.5
Root Mean Squared Error			85.78475
End of Period Levels:	Mean		1432.857
	Trend		2.263393
	Seasonals:	Q1	-9.018304
		Q2	4.184970
		Q3	15.98824
		Q4	-11.15491

3. (1 point) Consider the following process $X_t = 2.5 + 0.5\epsilon_{t-1} + 0.3\epsilon_{t-1} + \epsilon_t$ where $\epsilon_t \sim N(0, 1)$. What is the unconditional expected value of the process?

☐ 0 ☐ 2.5 ☐ 12.5 ☐ 3.2

4. (1 point) Consider the following process : $Y_t = \beta Y_{t-1} + 0.5Y_{t-2} + \epsilon_t$. Find the range of values of β that make the process stationary.

5. (1 point) Write in equation form the process Y_t that follows an $ARIMA(1,0,1)(0,0,1)_4$ and show that the process is equivalent to an $ARIMA(p,d,q)$ with restrictions on the parameters. Specify these restrictions.

6. (2 points) The next figure illustrates the time series plot, SACF/SPACF and part of the EViews output for a statistical test applied to the series $INDPRO_t$ (Industrial Production Index).

   (a) Do you think that $INDPRO_t$ is stationary? Justify your answer using the information provided in Figures 1 and 2.

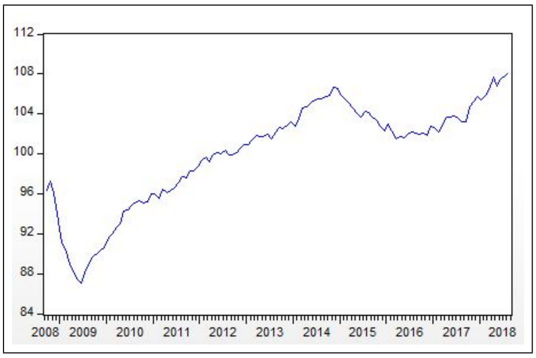
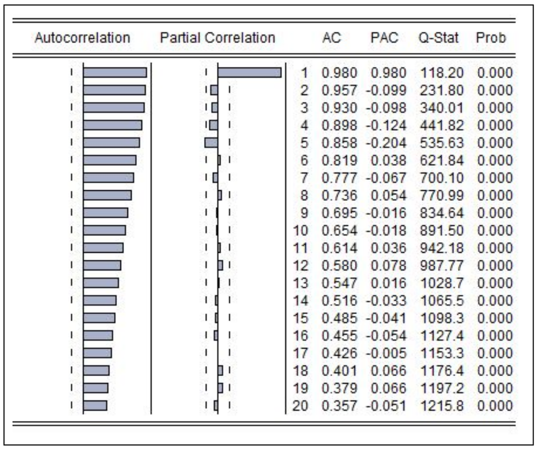


Figure 1: INDPRO plot



	AC	PAC	Q-Stat	Prob
1	0.980	0.980	118.20	0.000
2	0.957	-0.099	231.80	0.000
3	0.930	-0.098	340.01	0.000
4	0.898	-0.124	441.82	0.000
5	0.858	-0.204	535.63	0.000
6	0.819	0.038	621.84	0.000
7	0.777	-0.067	700.10	0.000
8	0.736	0.054	770.99	0.000
9	0.695	-0.016	834.64	0.000
10	0.654	-0.018	891.50	0.000
11	0.614	0.036	942.18	0.000
12	0.580	0.078	987.77	0.000
13	0.547	0.016	1028.7	0.000
14	0.516	-0.033	1065.5	0.000
15	0.485	-0.041	1098.3	0.000
16	0.455	-0.054	1127.4	0.000
17	0.426	-0.005	1153.3	0.000
18	0.401	0.066	1176.4	0.000
19	0.379	0.066	1197.2	0.000
20	0.357	-0.051	1215.8	0.000

Figure 2: INDPRO correlogram

   (b) Do you find evidence for the presence of a unit root? Justify your answer using the information provided in Figure 3 and explain whether this reinforces or weakens your answer to question (a).

Null Hypothesis: INDPRO has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.825893	0.6860
Test critical values:	1% level	-4.036983	
	5% level	-3.448021	
	10% level	-3.149135	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INDPRO)
Method: Least Squares
Sample (adjusted): 2008M10 2018M08
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDPRO(-1)	-0.041130	0.022526	-1.825893	0.0704
C	3.776025	2.078829	1.816420	0.0719
@TREND("2008M09")	0.007279	0.003403	2.139078	0.0345

R-squared	0.037978	Mean dependent var	0.099599
Adjusted R-squared	0.021391	S.D. dependent var	0.640842
S.E. of regression	0.633950	Akaike info criterion	1.951195
Sum squared resid	46.61960	Schwarz criterion	2.021257
Log likelihood	-113.0961	Hannan-Quinn criter.	1.979645
F-statistic	2.289663	Durbin-Watson stat	1.281058
Prob(F-statistic)	0.105861		

Figure 3: INDPRO unit root test

7. (1.5 points) The next figure shows the SACF/SPACF of a time series. Propose two candidate ARMA models that may provide a good fit to the series. Justify your options in detail.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.328	0.328	59.701	0.000
		2	0.257	0.167	96.320	0.000
		3	0.241	0.134	128.64	0.000
		4	0.197	0.069	150.22	0.000
		5	0.066	-0.074	152.68	0.000
		6	0.092	0.026	157.43	0.000
		7	0.083	0.023	161.31	0.000
		8	0.083	0.040	165.16	0.000
		9	0.106	0.067	171.53	0.000
		10	0.080	0.001	175.12	0.000
		11	0.051	-0.018	176.58	0.000
		12	-0.006	-0.071	176.60	0.000
		13	-0.025	-0.048	176.96	0.000
		14	-0.032	-0.014	177.53	0.000
		15	-0.021	0.012	177.78	0.000
		16	-0.046	-0.021	178.99	0.000
		17	-0.031	-0.007	179.54	0.000
		18	0.033	0.061	180.18	0.000
		19	-0.018	-0.033	180.36	0.000
		20	-0.010	0.002	180.41	0.000

8. (1.5 points) The following figure illustrates the correlogram and histogram of the residuals from an estimated model. With the available information, do you think that the model is adequately specified? Justify your answer.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.106	-0.106	0.6076	
		2	-0.385	-0.401	8.7868	0.003
		3	0.105	0.007	9.4100	0.009
		4	-0.020	-0.191	9.4339	0.024
		5	-0.025	-0.008	9.4704	0.050
		6	0.127	0.052	10.439	0.064
		7	-0.012	0.022	10.447	0.107
		8	-0.073	0.004	10.784	0.148
		9	-0.188	-0.254	13.066	0.110
		10	-0.039	-0.147	13.168	0.155
		11	0.400	0.266	23.972	0.008
		12	0.045	0.113	24.111	0.012
		13	-0.313	-0.073	31.074	0.002
		14	0.047	0.001	31.232	0.003
		15	-0.004	-0.109	31.233	0.005
		16	-0.091	-0.076	31.871	0.007
		17	0.017	-0.223	31.895	0.010
		18	0.040	-0.103	32.026	0.015
		19	-0.063	-0.081	32.362	0.020
		20	-0.041	0.058	32.510	0.027
		21	-0.056	-0.090	32.794	0.036
		22	0.271	0.169	39.655	0.008
		23	0.021	-0.059	39.696	0.012
		24	-0.229	-0.016	44.955	0.004

9. (2 points) Given the following estimated model for the process Y_t and the last two observations $y_T = 2.5$ and $y_{T-1} = 2.3$, obtain the one step-ahead forecast $f_{T,1}$ and the variance of the forecast error $\sigma^2_{T+1|T}$.

Dependent Variable: Y
Method: ARMA Maximum Likelihood (OPG - BHHH)
Sample: 1990Q1 2002Q3
Included observations: 51
Convergence achieved after 10 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.297473	0.125209	18.34915	0.0000
AR(1)	-0.245974	0.160855	-1.529163	0.1328

R-squared	0.061463	Mean dependent var	2.294340
Adjusted R-squared	0.022357	S.D. dependent var	1.129905
S.E. of regression	1.117203	Akaike info criterion	3.117779
Sum squared resid	59.91081	Schwarz criterion	3.231416
Log likelihood	-76.50337	Hannan-Quinn criter.	3.161203
F-statistic	1.571718	Durbin-Watson stat	2.186875
Prob(F-statistic)	0.218189		

Inverted AR Roots	-.25

10. (2.5 points) Next figure illustrates Eviews results of an estimated model for the daily returns of an index from January 1, 2001 until September 30, 2011.

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.023	0.005	4.458	0.0000
AR(1)	0.064	0.020	3.21	0.0013
		Variance Equation		
C	0.001	0.000	2.812	0.0049
RESID(-1)^2	0.058	0.004	15.536	0.0000
GARCH(-1)	0.940	0.005	198.17	0.0000

R-squared	-0.001035	Mean dependent var	0.023609
Adjusted R-squared	-0.001407	S.D. dependent var	0.367533
S.E. of regression	0.367791	Akaike info criterion	0.564634
Sum squared resid	364.0128	Schwarz criterion	0.575585
Log likelihood	-755.2792	Hannan-Quinn criter.	0.568594
Durbin-Watson stat	1.895248		

Moreover the realized values of the returns for the last 5 days of September 2011 and corresponding estimated values according to the previously estimated model are the following:

	Observed Values	Fitted values
26/11/2011	0.027	0.032
27/11/2011	-0.349	0.063
28/11/2011	0.050	0.023
29/11/2011	0.844	0.047
30/11/2011	-0.134	0.021

(a) Write explicitly the standard mathematical form of the estimated model.

(b) Obtain the forecast estimate of the volatility for 31/11/2011, knowing that the estimated volatility for 30/11/2011 is 0.224.

11. (2 points) Considering the information presented below regarding the PSI20 Index, identify and describe two stylized facts of financial time series evident in the data (closing prices and respective returns).

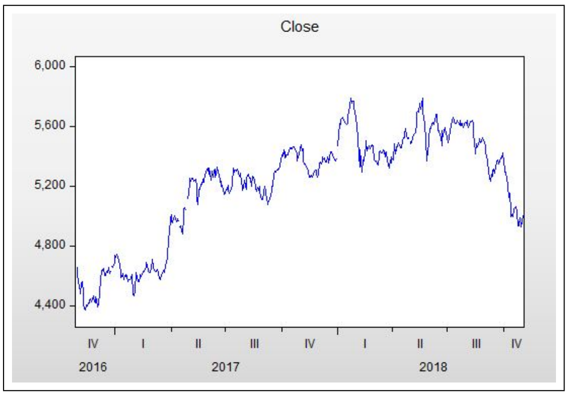


Figure 4: PSI20

	AC	PAC	Q-Stat	Prob
1	0.992	0.992	506.61	0.000
2	0.982	-0.097	1004.4	0.000
3	0.971	-0.081	1491.9	0.000
4	0.959	-0.029	1968.7	0.000
5	0.948	0.021	2435.2	0.000
6	0.937	0.027	2891.8	0.000
7	0.926	0.009	3339.2	0.000
8	0.916	-0.015	3777.2	0.000
9	0.905	-0.028	4205.7	0.000
10	0.894	0.011	4625.0	0.000
11	0.885	0.069	5036.3	0.000
12	0.876	0.043	5440.4	0.000
13	0.868	-0.026	5837.4	0.000
14	0.859	-0.028	6227.2	0.000
15	0.850	0.004	6610.0	0.000
16	0.842	0.021	6986.0	0.000
17	0.833	-0.003	7355.2	0.000
18	0.824	-0.084	7716.7	0.000
19	0.814	0.003	8070.5	0.000
20	0.805	0.014	8416.8	0.000
21	0.795	0.007	8755.7	0.000
22	0.786	-0.011	9087.2	0.000
23	0.776	0.007	9411.6	0.000
24	0.767	-0.012	9728.9	0.000
25	0.758	-0.014	10039.	0.000
26	0.748	0.016	10342.	0.000
27	0.739	0.008	10639.	0.000
28	0.732	0.069	10930.	0.000
29	0.725	0.047	11217.	0.000
30	0.719	-0.027	11499.	0.000
31	0.712	-0.054	11776.	0.000
32	0.705	-0.004	12049.	0.000
33	0.697	-0.008	12316.	0.000
34	0.690	0.050	12578.	0.000
35	0.683	-0.011	12836.	0.000
36	0.676	-0.055	13088.	0.000

Figure 5: PSI20 correlogram

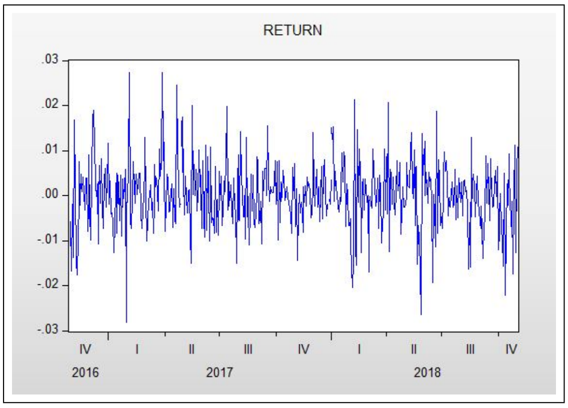
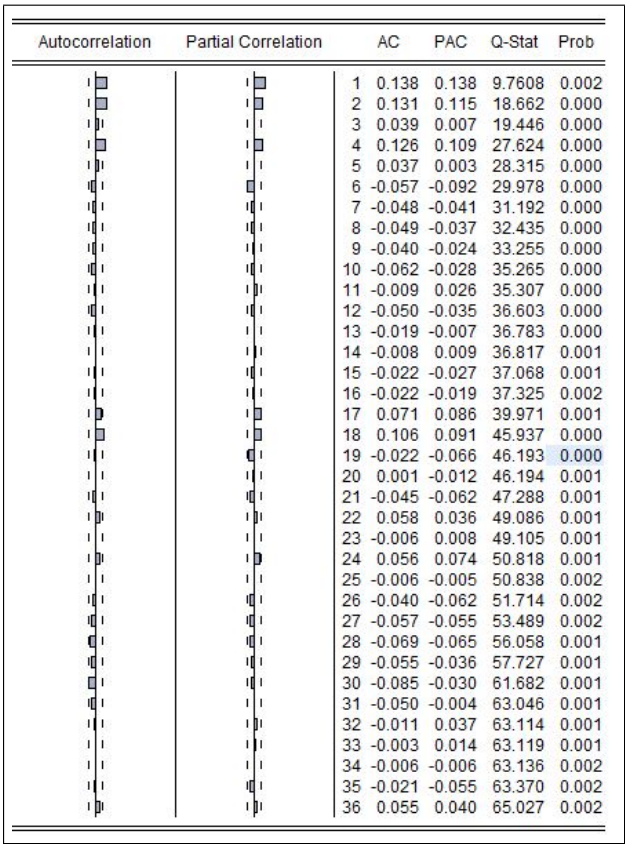


Figure 6: PSI20 returns

	AC	PAC	Q-Stat	Prob
1	0.104	0.104	5.5423	0.019
2	0.048	0.038	6.7472	0.034
3	0.052	0.044	8.1557	0.043
4	-0.086	-0.099	11.994	0.017
5	0.024	0.039	12.287	0.031
6	0.003	0.002	12.292	0.056
7	-0.036	-0.030	12.975	0.073
8	-0.011	-0.017	13.044	0.110
9	-0.050	-0.040	14.337	0.111
10	-0.102	-0.091	19.765	0.032
11	-0.070	-0.053	22.317	0.022
12	-0.003	0.022	22.322	0.034
13	0.026	0.033	22.686	0.046
14	-0.001	-0.018	22.686	0.066
15	0.015	0.008	22.808	0.088
16	-0.004	-0.005	22.817	0.119
17	0.110	0.115	29.252	0.032
18	0.019	-0.015	29.450	0.043
19	0.007	-0.007	29.478	0.059
20	-0.033	-0.062	30.068	0.069
21	0.006	0.027	30.085	0.090
22	0.014	0.009	30.184	0.114
23	-0.007	-0.001	30.214	0.143
24	-0.024	-0.028	30.526	0.168
25	0.002	0.013	30.528	0.205
26	0.027	0.039	30.925	0.231
27	-0.068	-0.059	33.417	0.184
28	-0.059	-0.044	35.295	0.161
29	0.016	0.030	35.436	0.191
30	0.052	0.052	36.888	0.180
31	0.016	-0.007	37.024	0.211
32	-0.023	-0.039	37.308	0.238
33	-0.049	-0.036	38.607	0.231
34	0.021	0.022	38.861	0.260
35	0.022	0.023	39.136	0.289
36	-0.007	-0.015	39.162	0.330

Figure 7: PSI20 returns correlogram



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.138	0.138	9.7608	0.002
		2	0.131	0.115	18.662	0.000
		3	0.039	0.007	19.446	0.000
		4	0.126	0.109	27.624	0.000
		5	0.037	0.003	28.315	0.000
		6	-0.057	-0.092	29.978	0.000
		7	-0.048	-0.041	31.192	0.000
		8	-0.049	-0.037	32.435	0.000
		9	-0.040	-0.024	33.255	0.000
		10	-0.062	-0.028	35.265	0.000
		11	-0.009	0.026	35.307	0.000
		12	-0.050	-0.035	36.603	0.000
		13	-0.019	-0.007	36.783	0.000
		14	-0.008	0.009	36.817	0.001
		15	-0.022	-0.027	37.068	0.001
		16	-0.022	-0.019	37.325	0.002
		17	0.071	0.086	39.971	0.001
		18	0.106	0.091	45.937	0.000
		19	-0.022	-0.066	46.193	0.000
		20	0.001	-0.012	46.194	0.001
		21	-0.045	-0.062	47.288	0.001
		22	0.058	0.036	49.086	0.001
		23	-0.006	0.008	49.105	0.001
		24	0.056	0.074	50.818	0.001
		25	-0.006	-0.005	50.838	0.002
		26	-0.040	-0.062	51.714	0.002
		27	-0.057	-0.055	53.489	0.002
		28	-0.069	-0.065	56.058	0.001
		29	-0.055	-0.036	57.727	0.001
		30	-0.085	-0.030	61.682	0.001
		31	-0.050	-0.004	63.046	0.001
		32	-0.011	0.037	63.114	0.001
		33	-0.003	0.014	63.119	0.001
		34	-0.006	-0.006	63.136	0.002
		35	-0.021	-0.055	63.370	0.002
		36	0.055	0.040	65.027	0.002

Figure 8: PSI20 squared returns correlogram

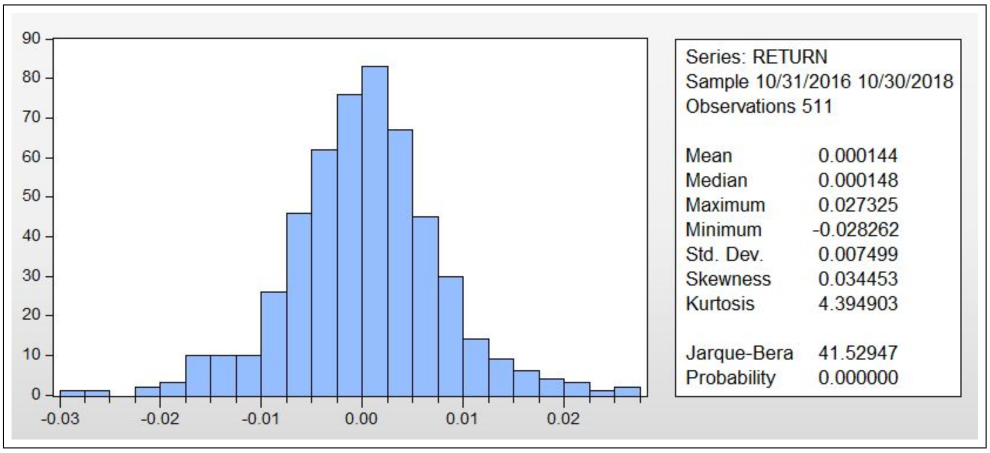


Figure 9: PSI20 correlogram