First Exercise

Equation: UNTITLED Workfile: SESSION3::Session3\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: SGD
Method: Least Squares
Date: 01/30/19 Time: 19:54
Sample: 2000M10 2018M12
Included observations: 219

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.896335	0.093412	9.595450	0.0000
USD	0.729649	0.075465	9.668711	0.0000

R-squared	0.301091	Mean dependent var	1.791516
Adjusted R-squared	0.297870	S.D. dependent var	0.219051
S.E. of regression	0.183550	Akaike info criterion	-0.543571
Sum squared resid	7.310848	Schwarz criterion	-0.512620
Log likelihood	61.52098	Hannan-Quinn criter.	-0.531071
F-statistic	93.48398	Durbin-Watson stat	0.014297
Prob(F-statistic)	0.000000		

Equation: UNTITLED Workfile: SESSION3::Session3\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

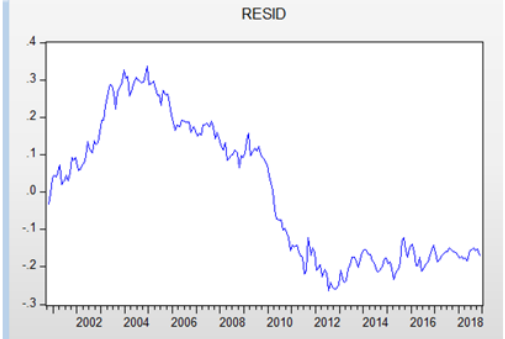
Dependent Variable: D(SGD)
Method: Least Squares
Date: 01/30/19 Time: 19:50
Sample (adjusted): 2000M11 2018M12
Included observations: 218 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000835	0.001453	-0.574769	0.5660
D(USD)	0.865191	0.040209	21.51710	0.0000

R-squared	0.681878	Mean dependent var	0.000369
Adjusted R-squared	0.680406	S.D. dependent var	0.037910
S.E. of regression	0.021432	Akaike info criterion	-4.838757
Sum squared resid	0.099213	Schwarz criterion	-4.807707
Log likelihood	529.4245	Hannan-Quinn criter.	-4.826215
F-statistic	462.9856	Durbin-Watson stat	2.124222
Prob(F-statistic)	0.000000		

Graph: UNTITLED Workfile: SESSION3::Session3\

View | Proc | Object | Print | Name | Freeze | Options | Update | AddText | Line/Shade | Remove



View | Proc | Object | Properties | Print | Name | Freeze | Sample | Genr | Sheet | Graph | Stats | Id

Correlogram of USD

Date: 01/30/19 Time: 20:02
Sample: 2000M10 2018M12
Included observations: 219

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.963	0.963	205.82	0.000
		2	0.927	0.003	397.59	0.000
		3	0.895	0.025	577.01	0.000
		4	0.858	-0.078	742.65	0.000
		5	0.822	-0.004	895.45	0.000
		6	0.786	-0.029	1035.8	0.000
		7	0.744	-0.087	1162.3	0.000
		8	0.709	0.055	1277.6	0.000
		9	0.677	0.022	1383.2	0.000
		10	0.649	0.057	1480.8	0.000
		11	0.622	-0.013	1570.7	0.000
		12	0.598	0.030	1654.3	0.000
		13	0.577	0.027	1732.5	0.000
		14	0.559	0.024	1806.3	0.000
		15	0.544	0.027	1876.5	0.000
		16	0.529	-0.019	1943.2	0.000
		17	0.507	-0.093	2004.9	0.000
		18	0.484	-0.043	2061.3	0.000
		19	0.458	-0.061	2112.0	0.000
		20	0.426	-0.088	2156.2	0.000
		21	0.399	0.046	2195.1	0.000

View | Proc | Object | Properties | Print | Name | Freeze | Sample | Genr | Sheet | Graph | Stats | Ic

Correlogram of D(USD)

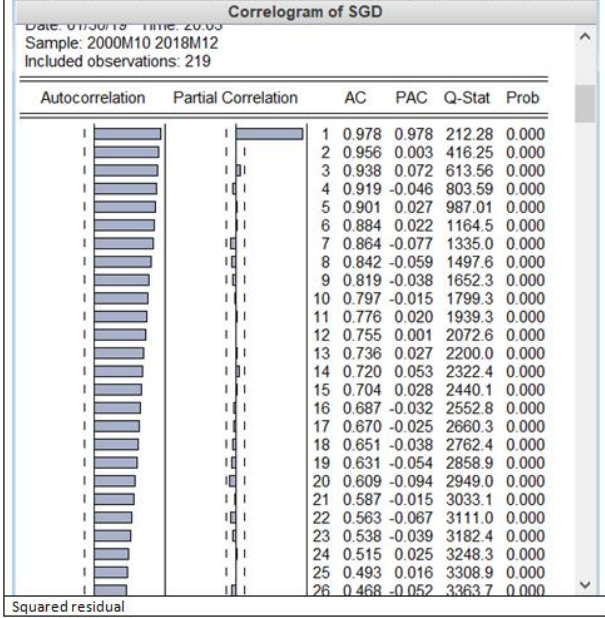
Date: 01/30/19 Time: 20:02
Sample: 2000M10 2018M12
Included observations: 218

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	-0.000	-0.000	2.E-05	0.997
		2	0.016	0.016	0.0603	0.970
		3	0.100	0.100	2.2858	0.515
		4	-0.030	-0.030	2.4842	0.647
		5	-0.048	-0.052	3.0067	0.699
		6	0.110	0.103	5.7663	0.450
		7	-0.180	-0.176	13.092	0.070
		8	-0.057	-0.051	13.842	0.086
		9	-0.047	-0.065	14.354	0.110
		10	0.036	0.080	14.660	0.145
		11	-0.063	-0.055	15.585	0.157
		12	-0.093	-0.122	17.610	0.128
		13	-0.091	-0.072	19.537	0.107
		14	-0.078	-0.092	20.980	0.102
		15	-0.013	0.005	21.019	0.136
		16	0.136	0.115	25.419	0.063
		17	0.033	0.068	25.685	0.080
		18	0.090	0.091	27.636	0.068
		19	0.161	0.122	33.911	0.019
		20	-0.024	-0.065	34.056	0.026
		21	0.062	0.016	34.988	0.028

View | Proc | Object | Properties | Print | Name | Freeze | Sample | Genr | Sheet | Graph | Stats | Ider

Correlogram of SGD

Date: 01/30/19 Time: 20:05
Sample: 2000M10 2018M12
Included observations: 219

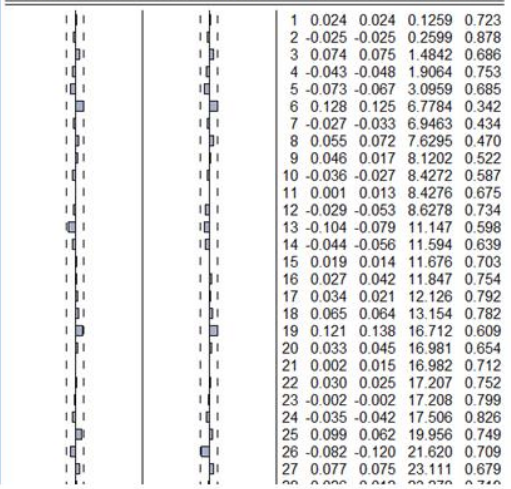


	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1			1	0.978	0.978	212.28	0.000
2			2	0.956	0.003	416.25	0.000
3			3	0.938	0.072	613.56	0.000
4			4	0.919	-0.046	803.59	0.000
5			5	0.901	0.027	987.01	0.000
6			6	0.884	0.022	1164.5	0.000
7			7	0.864	-0.077	1335.0	0.000
8			8	0.842	-0.059	1497.6	0.000
9			9	0.819	-0.038	1652.3	0.000
10			10	0.797	-0.015	1799.3	0.000
11			11	0.776	0.020	1939.3	0.000
12			12	0.755	0.001	2072.6	0.000
13			13	0.736	0.027	2200.0	0.000
14			14	0.720	0.053	2322.4	0.000
15			15	0.704	0.028	2440.1	0.000
16			16	0.687	-0.032	2552.8	0.000
17			17	0.670	-0.025	2660.3	0.000
18			18	0.651	-0.038	2762.4	0.000
19			19	0.631	-0.054	2858.9	0.000
20			20	0.609	-0.094	2949.0	0.000
21			21	0.587	-0.015	3033.1	0.000
22			22	0.563	-0.067	3111.0	0.000
23			23	0.538	-0.039	3182.4	0.000
24			24	0.515	0.025	3248.3	0.000
25			25	0.493	0.016	3308.9	0.000
26			26	0.468	-0.052	3363.7	0.000

Squared residual

Correlogram of D(SGD)

Date: 01/30/19 Time: 20:05
Sample: 2000M10 2018M12
Included observations: 218

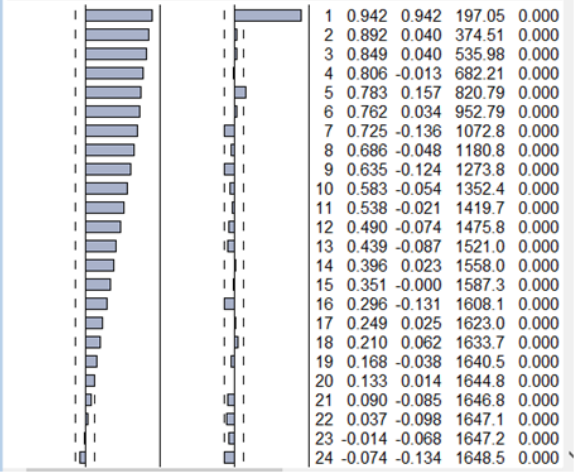


	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1			1	0.024	0.024	0.1259	0.723
2			2	-0.025	-0.025	0.2599	0.878
3			3	0.074	0.075	1.4842	0.686
4			4	-0.043	-0.048	1.9064	0.753
5			5	-0.073	-0.067	3.0959	0.685
6			6	0.128	0.125	6.7784	0.342
7			7	-0.027	-0.033	6.9463	0.434
8			8	0.055	0.072	7.6295	0.470
9			9	0.046	0.017	8.1202	0.522
10			10	-0.036	-0.027	8.4272	0.587
11			11	0.001	0.013	8.4276	0.675
12			12	-0.029	-0.053	8.6278	0.734
13			13	-0.104	-0.079	11.147	0.598
14			14	-0.044	-0.056	11.594	0.639
15			15	0.019	0.014	11.676	0.703
16			16	0.027	0.042	11.847	0.754
17			17	0.034	0.021	12.126	0.792
18			18	0.065	0.064	13.154	0.782
19			19	0.121	0.138	16.712	0.609
20			20	0.033	0.045	16.981	0.654
21			21	0.002	0.015	16.982	0.712
22			22	0.030	0.025	17.207	0.752
23			23	-0.002	-0.002	17.208	0.799
24			24	-0.035	-0.042	17.506	0.826
25			25	0.099	0.062	19.956	0.749
26			26	-0.082	-0.120	21.620	0.709
27			27	0.077	0.075	23.111	0.679

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

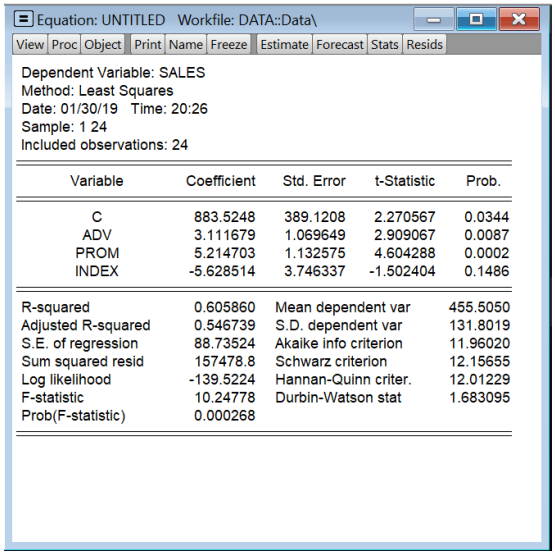
Correlogram of Residuals Squared

Date: 01/30/19 Time: 20:07
Sample: 2000M10 2018M12
Included observations: 219



	Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
1			1	0.942	0.942	197.05	0.000
2			2	0.892	0.040	374.51	0.000
3			3	0.849	0.040	535.98	0.000
4			4	0.806	-0.013	682.21	0.000
5			5	0.783	0.157	820.79	0.000
6			6	0.762	0.034	952.79	0.000
7			7	0.725	-0.136	1072.8	0.000
8			8	0.686	-0.048	1180.8	0.000
9			9	0.635	-0.124	1273.8	0.000
10			10	0.583	-0.054	1352.4	0.000
11			11	0.538	-0.021	1419.7	0.000
12			12	0.490	-0.074	1475.8	0.000
13			13	0.439	-0.087	1521.0	0.000
14			14	0.396	0.023	1558.0	0.000
15			15	0.351	-0.000	1587.3	0.000
16			16	0.296	-0.131	1608.1	0.000
17			17	0.249	0.025	1623.0	0.000
18			18	0.210	0.062	1633.7	0.000
19			19	0.168	-0.038	1640.5	0.000
20			20	0.133	0.014	1644.8	0.000
21			21	0.090	-0.085	1646.8	0.000
22			22	0.037	-0.098	1647.1	0.000
23			23	-0.014	-0.068	1647.2	0.000
24			24	-0.074	-0.134	1648.5	0.000

Second Exercise



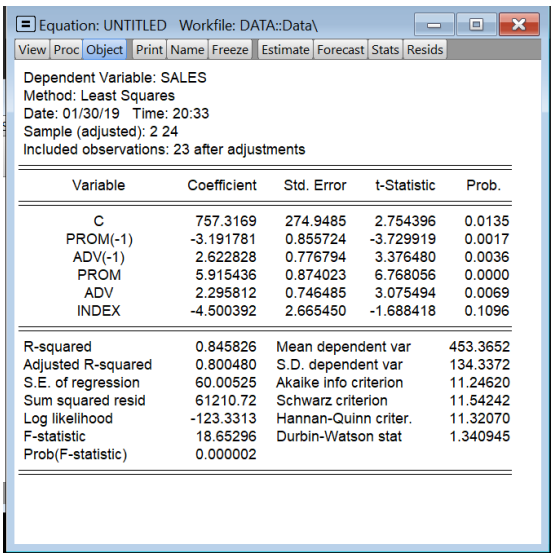
Equation: UNTITLED Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: SALES
Method: Least Squares
Date: 01/30/19 Time: 20:26
Sample: 1 24
Included observations: 24

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	883.5248	389.1208	2.270567	0.0344
ADV	3.111679	1.069649	2.909067	0.0087
PROM	5.214703	1.132575	4.604288	0.0002
INDEX	-5.628514	3.746337	-1.502404	0.1486

R-squared	0.605860	Mean dependent var	455.5050
Adjusted R-squared	0.546739	S.D. dependent var	131.8019
S.E. of regression	88.73524	Akaike info criterion	11.96020
Sum squared resid	157478.8	Schwarz criterion	12.15655
Log likelihood	-139.5224	Hannan-Quinn criter.	12.01229
F-statistic	10.24778	Durbin-Watson stat	1.683095
Prob(F-statistic)	0.000268		



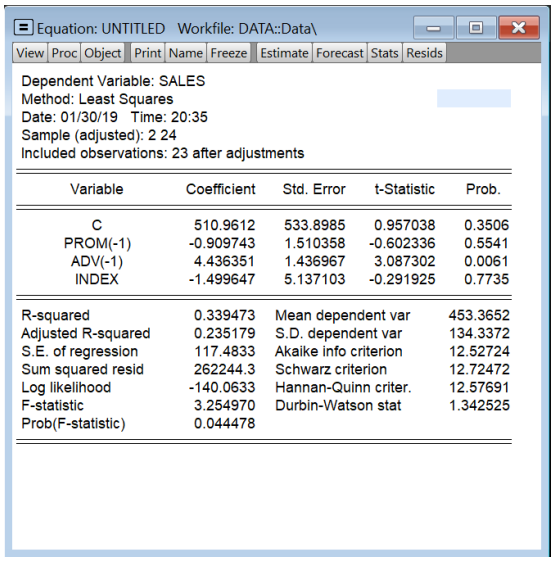
Equation: UNTITLED Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: SALES
Method: Least Squares
Date: 01/30/19 Time: 20:33
Sample (adjusted): 2 24
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	757.3169	274.9485	2.754396	0.0135
PROM(-1)	-3.191781	0.855724	-3.729919	0.0017
ADV(-1)	2.622828	0.776794	3.376480	0.0036
PROM	5.915436	0.874023	6.768056	0.0000
ADV	2.295812	0.746485	3.075494	0.0069
INDEX	-4.500392	2.665450	-1.688418	0.1096

R-squared	0.845826	Mean dependent var	453.3652
Adjusted R-squared	0.800480	S.D. dependent var	134.3372
S.E. of regression	60.00525	Akaike info criterion	11.24620
Sum squared resid	61210.72	Schwarz criterion	11.54242
Log likelihood	-123.3313	Hannan-Quinn criter.	11.32070
F-statistic	18.65296	Durbin-Watson stat	1.340945
Prob(F-statistic)	0.000002		



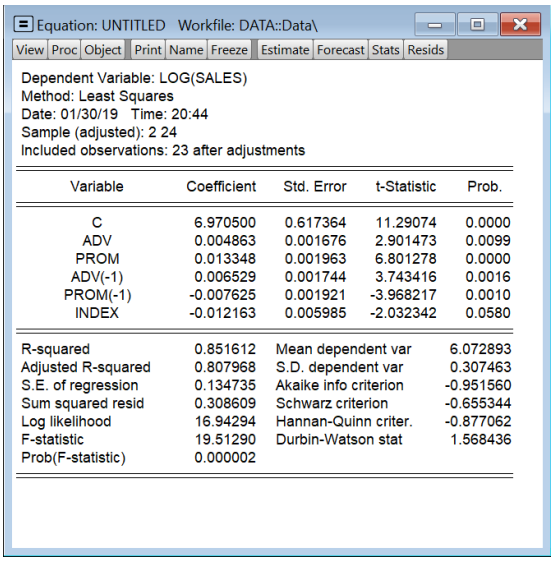
Equation: UNTITLED Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: SALES
Method: Least Squares
Date: 01/30/19 Time: 20:35
Sample (adjusted): 2 24
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	510.9612	533.8985	0.957038	0.3506
PROM(-1)	-0.909743	1.510358	-0.602336	0.5541
ADV(-1)	4.436351	1.436967	3.087302	0.0061
INDEX	-1.499647	5.137103	-0.291925	0.7735

R-squared	0.339473	Mean dependent var	453.3652
Adjusted R-squared	0.235179	S.D. dependent var	134.3372
S.E. of regression	117.4833	Akaike info criterion	12.52724
Sum squared resid	262244.3	Schwarz criterion	12.72472
Log likelihood	-140.0633	Hannan-Quinn criter.	12.57691
F-statistic	3.254970	Durbin-Watson stat	1.342525
Prob(F-statistic)	0.044478		



Equation: UNTITLED Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LOG(SALES)
Method: Least Squares
Date: 01/30/19 Time: 20:44
Sample (adjusted): 2 24
Included observations: 23 after adjustments

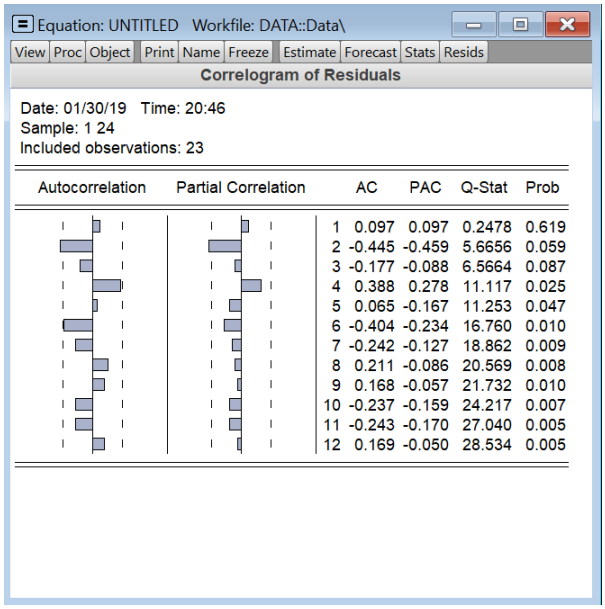
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.970500	0.617364	11.29074	0.0000
ADV	0.004863	0.001676	2.901473	0.0099
PROM	0.013348	0.001963	6.801278	0.0000
ADV(-1)	0.006529	0.001744	3.743416	0.0016
PROM(-1)	-0.007625	0.001921	-3.968217	0.0010
INDEX	-0.012163	0.005985	-2.032342	0.0580

R-squared	0.851612	Mean dependent var	6.072893
Adjusted R-squared	0.807968	S.D. dependent var	0.307463
S.E. of regression	0.134735	Akaike info criterion	-0.951560
Sum squared resid	0.308609	Schwarz criterion	-0.655344
Log likelihood	16.94294	Hannan-Quinn criter.	-0.877062
F-statistic	19.51290	Durbin-Watson stat	1.568436
Prob(F-statistic)	0.000002		

First we tried a few models,

1. Sales ~ Adv + Prom + Index
2. Sales ~ Adv + Prom + Adv(-1) + Prom(-1) + Index
3. Sales ~ Adv(-1) + Prom (-1) + Index
4. Log(Sales) ~ Adv + Prom + Adv(-1) + Prom(-1) + Index

We noted that intuitively advertising and promotion should have a lag effect, yet the Durbin Watson test favoured model #1 (naïve model). However, we noted that the sample size is small hence Durbin-Watson may not be reliable. So we investigate the correlogram for autocorrelation.



Equation: UNTITLED Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Correlogram of Residuals

Date: 01/30/19 Time: 20:46
Sample: 1 24
Included observations: 23

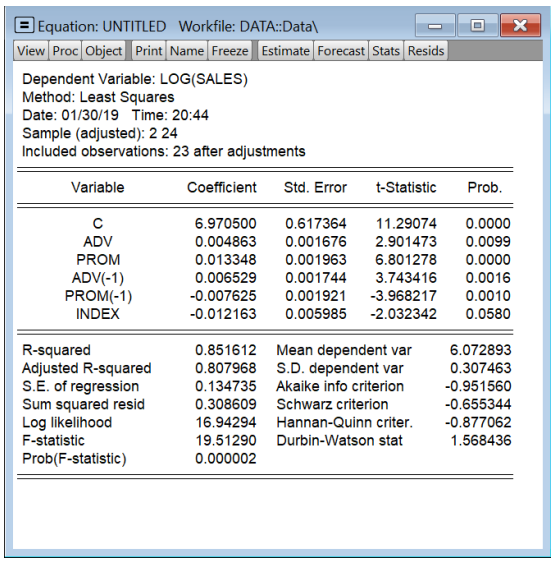
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.097	0.097	0.2478	0.619
		2	-0.445	-0.459	5.6656	0.059
		3	-0.177	-0.088	6.5664	0.087
		4	0.388	0.278	11.117	0.025
		5	0.065	-0.167	11.253	0.047
		6	-0.404	-0.234	16.760	0.010
		7	-0.242	-0.127	18.862	0.009
		8	0.211	-0.086	20.569	0.008
		9	0.168	-0.057	21.732	0.010
		10	-0.237	-0.159	24.217	0.007
		11	-0.243	-0.170	27.040	0.005
		12	0.169	-0.050	28.534	0.005

There is no pattern between the autocorrelation and partial correlation plots, hence we concluded that the model is stationary. We then proceed to interpret the model.

Durbin Watson is also within the acceptable range 1.5 < 1.568 < 2.5.

T-statistics are also either <-2 or >2 (>95% C.I.)

<u>Interpretation</u>



Equation: UNTITLED Workfile: DATA::Data\

View | Proc | Object | Print | Name | Freeze | Estimate | Forecast | Stats | Resids

Dependent Variable: LOG(SALES)
Method: Least Squares
Date: 01/30/19 Time: 20:44
Sample (adjusted): 2 24
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.970500	0.617364	11.29074	0.0000
ADV	0.004863	0.001676	2.901473	0.0099
PROM	0.013348	0.001963	6.801278	0.0000
ADV(-1)	0.006529	0.001744	3.743416	0.0016
PROM(-1)	-0.007625	0.001921	-3.968217	0.0010
INDEX	-0.012163	0.005985	-2.032342	0.0580

R-squared	0.851612	Mean dependent var	6.072893
Adjusted R-squared	0.807968	S.D. dependent var	0.307463
S.E. of regression	0.134735	Akaike info criterion	-0.951560
Sum squared resid	0.308609	Schwarz criterion	-0.655344
Log likelihood	16.94294	Hannan-Quinn criter.	-0.877062
F-statistic	19.51290	Durbin-Watson stat	1.568436
Prob(F-statistic)	0.000002		

1. If Ms Franklin had $1000 to spend on either advertising or promotion, she should spend it on promotion because 1 unit of promotion will give a greater increment of sales than 1 unit of advertising, even after taking into account the lag variables
2. Yes I agree that the meatloaf is counter-cyclical. This is indicated by the inverse relationship between log sales and index as seen in the negative value of the index's coefficient.
3. No, the policy was not followed as seen from the dataset

obs	sales	prom	adv	index
1	504.72	15.6	30	100
2	406.59	22.2	36	102
3	398.55	0	45	104
4	587.76	0	57	104
5	598.92	0	39	104
6	703.62	31.8	21	100
7	387.24	21.3	12	98
8	365.67	3.9	6	96
9	388.71	0	6	98
10	372.96	8.4	30	103
11	603.3	45.3	30	105
12	614.73	50.1	33	107
13	484.38	39.6	6	107
14	227.76	4.2	33	107
15	329.13	0	6	108
16	308.25	0	3	105
17	433.86	0	45	103
18	514.98	13.8	48	108
19	404.7	17.7	0	110
20	245.43	0	15	112
21	433.2	17.4	9	113
22	627.24	37.8	54	112
23	647.61	42.3	36	113
24	342.81	11.4	39	114

4. We find seasonality in the sales of the meatloat mix, based on the trend of the raw data. Seasonal peaks are at multiples of 6 months.