Lecture 3 Workshop

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Part 1

First, we estimate the equation sgd = c_1 + c_2*usd. The output given by Eviews is shown in the following figures.

Dependent Variable: SGD
Method: Least Squares
Date: 01/30/19 Time: 19:50
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		

Date: 01/30/19 Time: 19:58
Sample: 2000M10 2018M12
Included observations: 219

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

From the Durbin-Watson stat, we observe that there is positive autocorrelation. The model needs to be changed to address this. In the second model, we considered the difference between observation at time t and t-1.

Dependent Variable: D(SGD)
Method: Least Squares
Date: 01/30/19 Time: 20:00
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		

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

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.074	0.074	1.2240	0.269
		2	0.066	0.060	2.1780	0.337
		3	0.018	0.009	2.2511	0.522
		4	0.119	0.114	5.4073	0.248
		5	-0.012	-0.030	5.4383	0.365
		6	0.011	0.000	5.4651	0.486
		7	0.037	0.037	5.7709	0.567
		8	0.016	-0.003	5.8282	0.666
		9	0.043	0.044	6.2587	0.714
		10	0.085	0.079	7.9427	0.634
		11	-0.049	-0.076	8.4938	0.669
		12	0.030	0.031	8.7071	0.728
		13	-0.054	-0.064	9.3819	0.744
		14	-0.070	-0.086	10.524	0.723
		15	-0.042	-0.006	10.951	0.756
		16	0.013	0.012	10.992	0.810
		17	0.085	0.100	12.736	0.754
		18	-0.010	-0.005	12.761	0.806
		19	-0.077	-0.099	14.194	0.772
		20	0.014	0.026	14.240	0.818
		21	-0.037	-0.043	14.579	0.843
		22	-0.038	-0.032	14.940	0.865
		23	-0.082	-0.031	16.579	0.829
		24	-0.001	0.002	16.580	0.866

From the above figures, the Durbin-Watson stat is within 1.5 to 2.5, which indicates no autocorrelation. The residuals now look reasonable. The differenced series using the differencing operator D() addresses the autocorrelation problem.

Part 2

We ran several models to explore the autocorrelation effects by examining the Durbin-Watson stat and adjusted R square. The best model is shown below.

Dependent Variable: SALES
Method: Least Squares
Date: 01/30/19 Time: 20:50
Sample (adjusted): 2000Q2 2005Q4
Included observations: 23 after adjustments

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

Q1: Ms. Franklin should choose advertising instead of promotions. Considering amount spent in the current and last quarter, advertising yields consistent increase in sales. On the other hand, effect of promotions is short term as it leads to negative effect on sales for the next quarter. The net effect of advertising on sales is greater than the effect of promotions on sales.

Q2: Even though the coefficient is negative, which indicates negative correlation on sales, but we also observe that the effect on sales is insignificant based on 95% confidence interval.

Q3: The data indicates that the policy was not followed throughout all quarters as we observe spending in both advertising and promotions in the same quarter.

Q4: We observe that there are no seasonal effects when we ran a model to consider discrete seasonal variables as an additional feature.

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Call:
lm(formula = sales ~ ., data = qkitch)

Residuals:
     Min       1Q   Median       3Q      Max
-141.131  -48.787   -7.432   45.939  189.301

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  725.608    699.594   1.037  0.31507
prom           5.408      1.224   4.419  0.00043 ***
adv            3.439      1.300   2.645  0.01764 *
index         -3.628      7.286  -0.498  0.62532
trend         -1.504      5.153  -0.292  0.77408
season2      -83.665     56.849  -1.472  0.16050
season3      -46.574     54.850  -0.849  0.40834
season4      -54.643     54.207  -1.008  0.32844
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 92.3 on 16 degrees of freedom
Multiple R-squared:  0.6588,    Adjusted R-squared:  0.5096
F-statistic: 4.414 on 7 and 16 DF,  p-value: 0.006636
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