DSC5211C - Workshop 3

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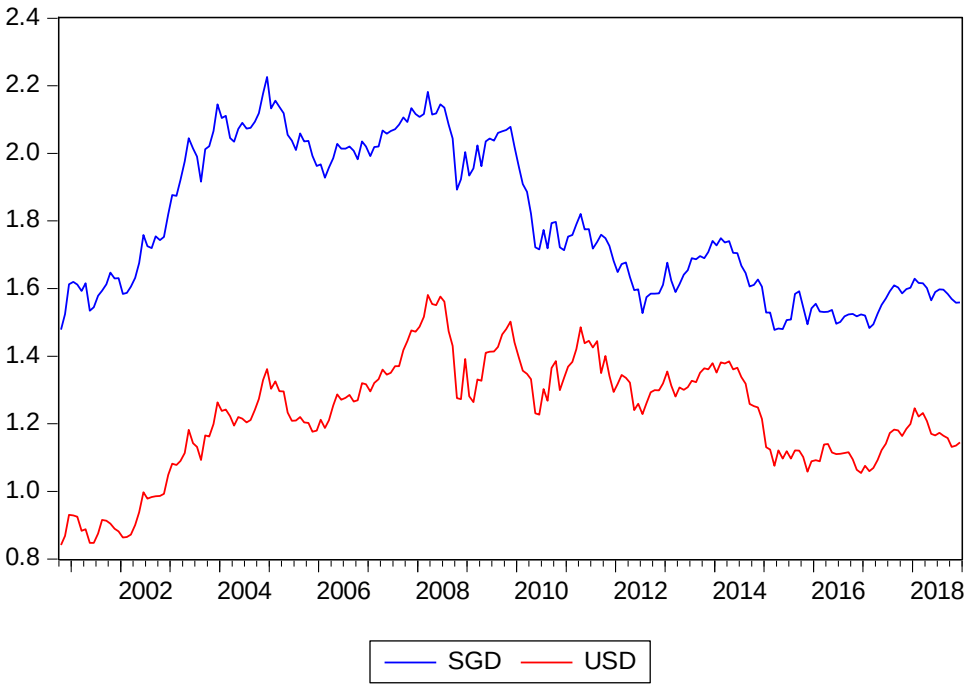
1b)

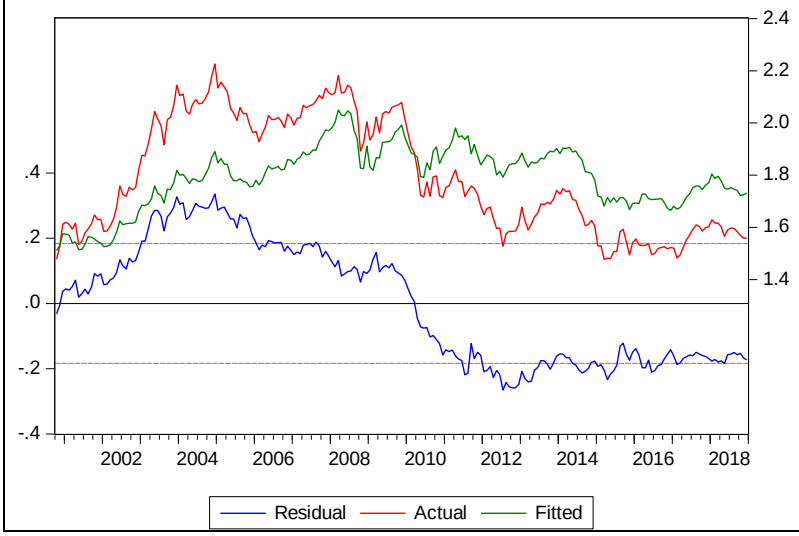


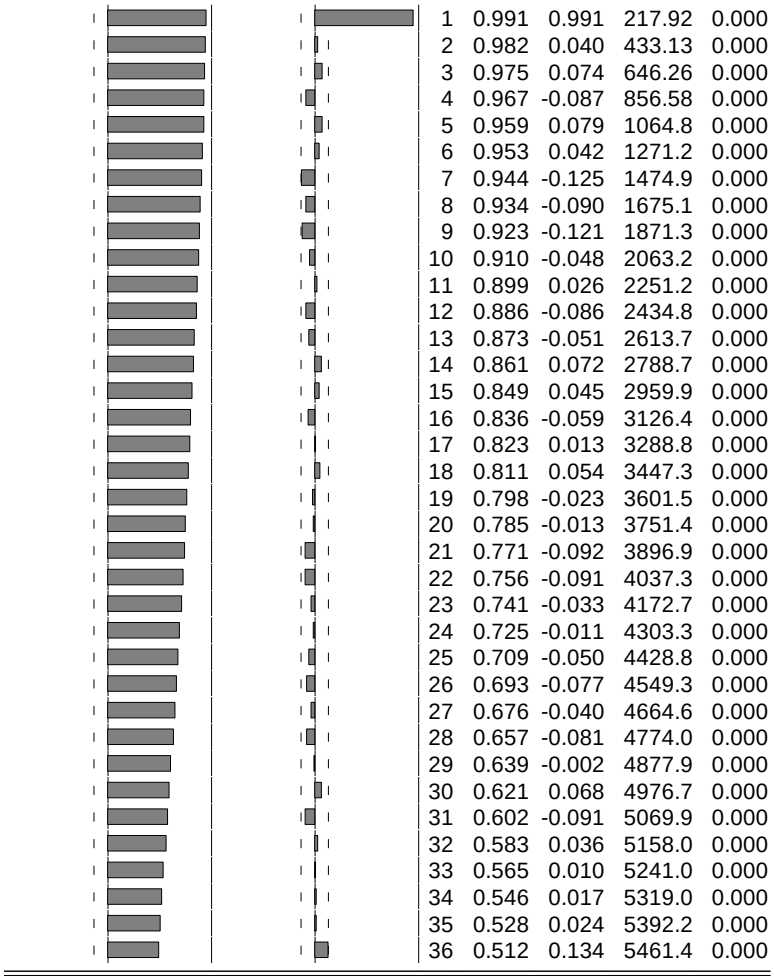
1c)

Results of model	Interpretation
Estimation Output Dependent Variable: SGD Method: Least Squares Date: 01/30/19 Time: 19:57 Sample: 2000M10 2018M12 Included observations: 219	D-W stat is less than 1.5, which suggests that there is positive auto-correlation in the residuals
Representations ========== LS SGD C USD Estimation Equation: ==========	Model suggest that when USD increase by $1, SGD increases by $0.72

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		

SGD = C(1) + C(2)*USD Substituted Coefficients: ========== SGD = 0.896334713217 + 0.729649460315*USD	
Actual Fitted Residual Graph  	The graph suggests that there are trends in the residuals over time and does not satisfy the residual assumption of the model which assumes that residuals must be independence and having the same variance

Date: 01/30/19 Time: 20:03 Sample: 2000M10 2018M12 Included observations: 219 	The results suggest that the residuals are not stationary

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.991	0.991	217.92	0.000
		2	0.982	0.040	433.13	0.000
		3	0.975	0.074	646.26	0.000
		4	0.967	-0.087	856.58	0.000
		5	0.959	0.079	1064.8	0.000
		6	0.953	0.042	1271.2	0.000
		7	0.944	-0.125	1474.9	0.000
		8	0.934	-0.090	1675.1	0.000
		9	0.923	-0.121	1871.3	0.000
		10	0.910	-0.048	2063.2	0.000
		11	0.899	0.026	2251.2	0.000
		12	0.886	-0.086	2434.8	0.000
		13	0.873	-0.051	2613.7	0.000
		14	0.861	0.072	2788.7	0.000
		15	0.849	0.045	2959.9	0.000
		16	0.836	-0.059	3126.4	0.000
		17	0.823	0.013	3288.8	0.000
		18	0.811	0.054	3447.3	0.000
		19	0.798	-0.023	3601.5	0.000
		20	0.785	-0.013	3751.4	0.000
		21	0.771	-0.092	3896.9	0.000
		22	0.756	-0.091	4037.3	0.000
		23	0.741	-0.033	4172.7	0.000
		24	0.725	-0.011	4303.3	0.000
		25	0.709	-0.050	4428.8	0.000
		26	0.693	-0.077	4549.3	0.000
		27	0.676	-0.040	4664.6	0.000
		28	0.657	-0.081	4774.0	0.000
		29	0.639	-0.002	4877.9	0.000
		30	0.621	0.068	4976.7	0.000
		31	0.602	-0.091	5069.9	0.000
		32	0.583	0.036	5158.0	0.000
		33	0.565	0.010	5241.0	0.000
		34	0.546	0.017	5319.0	0.000
		35	0.528	0.024	5392.2	0.000
		36	0.512	0.134	5461.4	0.000

In conclusion, as residuals exhibits trend and is not stationary, we have to correct the model. Another model was used to attempt to address this issue.

Results of model	Interpretation
Estimation Output	D-W stat is around 2 (between 1.5 and 2.5), hence suggest that there is no auto correlation in the residuals. Significance of D(USD) is <0.05, which suggest that it is an important variable

Dependent Variable: D(SGD)
Method: Least Squares
Date: 01/30/19 Time: 20:12
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		

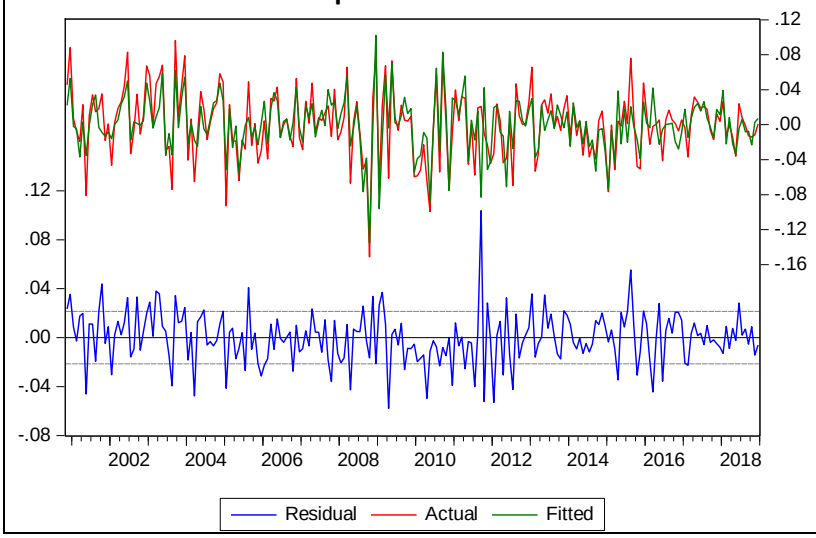
Representations
Estimation Command:
==========
LS D(SGD) C D(USD)

Estimation Equation:
==========
D(SGD) = C(1) + C(2)*D(USD)

Substituted Coefficients:
==========
D(SGD) = -0.000834918895056 + 0.86519063344*D(USD)

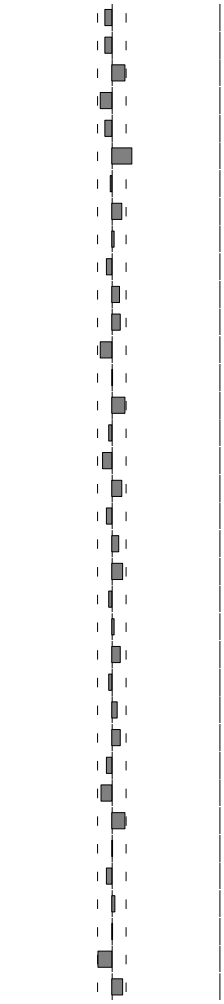
Model suggest that when change in USD from previous period increase by $1, the change in SGD increases by $0.87 from previous period

Actual Fitted Residual Graph



The graph suggests that there are no trends in the residuals

Date: 01/30/19 Time: 20:15
Sample: 2000M10 2018M12
Included observations: 218
Q-statistic probabilities adjusted for 1 dynamic regressor



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.065	-0.065	0.9356	0.333
		2	-0.059	-0.063	1.7014	0.427
		3	0.128	0.120	5.3356	0.149
		4	-0.108	-0.097	7.9294	0.094
		5	-0.065	-0.065	8.8896	0.114
		6	0.194	0.166	17.377	0.008
		7	-0.015	0.022	17.426	0.015
		8	0.106	0.135	19.982	0.010
		9	0.030	-0.009	20.195	0.017
		10	-0.049	-0.007	20.747	0.023
		11	0.077	0.080	22.105	0.024
		12	0.083	0.083	23.696	0.022
		13	-0.108	-0.078	26.405	0.015
		14	0.006	-0.063	26.414	0.023
		15	0.127	0.116	30.233	0.011
		16	-0.030	0.021	30.444	0.016
		17	-0.088	-0.122	32.278	0.014
		18	0.098	0.024	34.600	0.011
		19	-0.041	-0.010	35.011	0.014
		20	0.066	0.112	36.066	0.015
		21	0.109	0.073	38.978	0.010
		22	-0.025	-0.017	39.127	0.014
		23	0.027	0.018	39.313	0.018
		24	0.086	0.095	41.127	0.016
		25	-0.029	0.074	41.332	0.021
		26	0.057	-0.006	42.152	0.024
		27	0.084	0.026	43.942	0.021
		28	-0.044	0.008	44.436	0.025
		29	-0.098	-0.122	46.895	0.019
		30	0.124	0.062	50.848	0.010
		31	0.006	0.004	50.855	0.014
		32	-0.047	-0.063	51.413	0.016
		33	0.037	-0.041	51.777	0.020
		34	0.003	0.013	51.779	0.026
		35	-0.123	-0.111	55.745	0.014
		36	0.108	0.046	58.847	0.009

*Probabilities may not be valid for this equation specification.

This result suggest that the residuals are stationary

The model suggests that there is a positive relationship between USD and SGD.

Case 2

Model:

LOG(SALES) = 7.33231670272 + 0.00689278128116*ADV(-1) + 0.0100220933077*PROM + 0.00537039039407*ADV - 0.0164624348409*INDEX

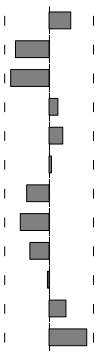
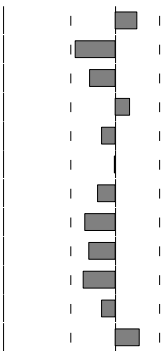
Dependent Variable: LOG(SALES)
Method: Least Squares
Date: 01/30/19 Time: 20:49
Sample (adjusted): 2 24
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.332317	0.823570	8.903090	0.0000
ADV(-1)	0.006893	0.002349	2.933935	0.0089
PROM	0.010022	0.002394	4.187101	0.0006
ADV	0.005370	0.002254	2.382387	0.0284
INDEX	-0.016462	0.007939	-2.073574	0.0527

R-squared	0.714163	Mean dependent var	6.072893
Adjusted R-squared	0.650644	S.D. dependent var	0.307463
S.E. of regression	0.181730	Akaike info criterion	-0.382926
Sum squared resid	0.594466	Schwarz criterion	-0.136079
Log likelihood	9.403649	Hannan-Quinn criter.	-0.320845
F-statistic	11.24325	Durbin-Watson stat	1.419781
Prob(F-statistic)	0.000095		

Results suggest that promotion, advertisement and advertisement from last quarter are significant variables to predict log of sales.

Date: 01/30/19 Time: 20:55
Sample: 1 24
Included observations: 23

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.199	0.199	1.0379	0.308
		2	-0.307	-0.361	3.6190	0.164
		3	-0.352	-0.236	7.1793	0.066
		4	0.087	0.137	7.4069	0.116
		5	0.125	-0.118	7.9057	0.162
		6	0.028	-0.006	7.9330	0.243
		7	-0.200	-0.162	9.3750	0.227
		8	-0.265	-0.271	12.064	0.148
		9	-0.175	-0.243	13.319	0.149
		10	-0.011	-0.289	13.324	0.206
		11	0.159	-0.121	14.536	0.205
		12	0.345	0.224	20.742	0.054

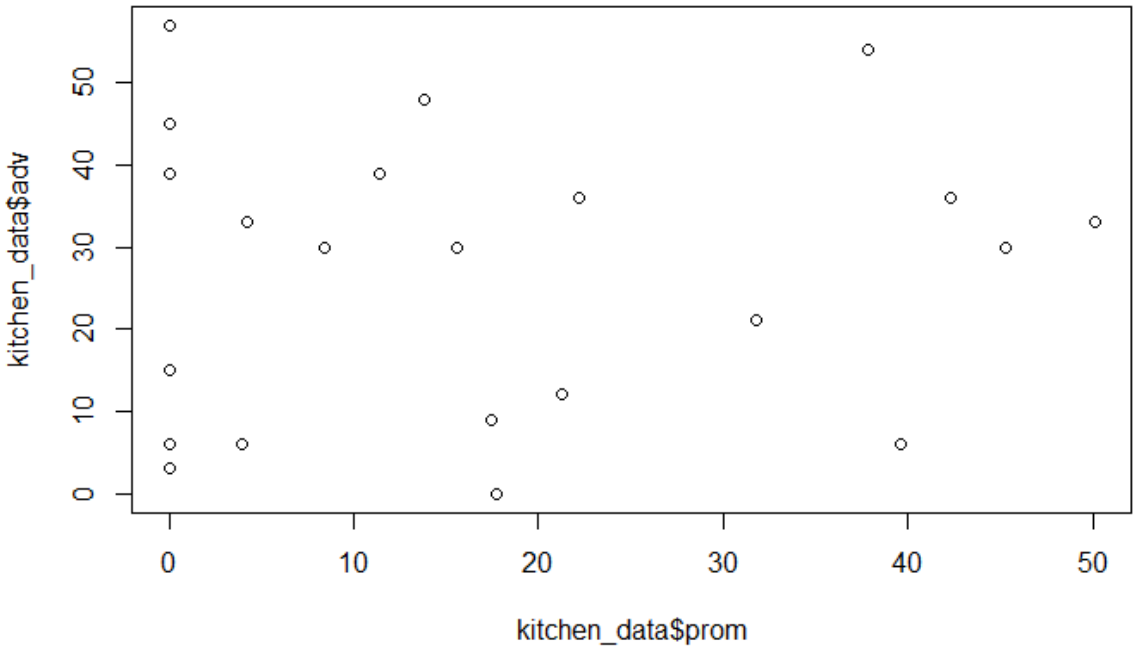
The results suggest that there is residuals are stationary

1) Advertisement is slightly better than promotion. The effects of advertisement is spread over current month and the next month, and every dollar spent on advertisement is expected to increase log(sales) by 0.005370 in the current month and 0.006893 in the next month (total 0.012263 over 2

months), as compare to promotion which only affect log sales by 0.010022. Hence, she should spend on advertisement instead of promotion.

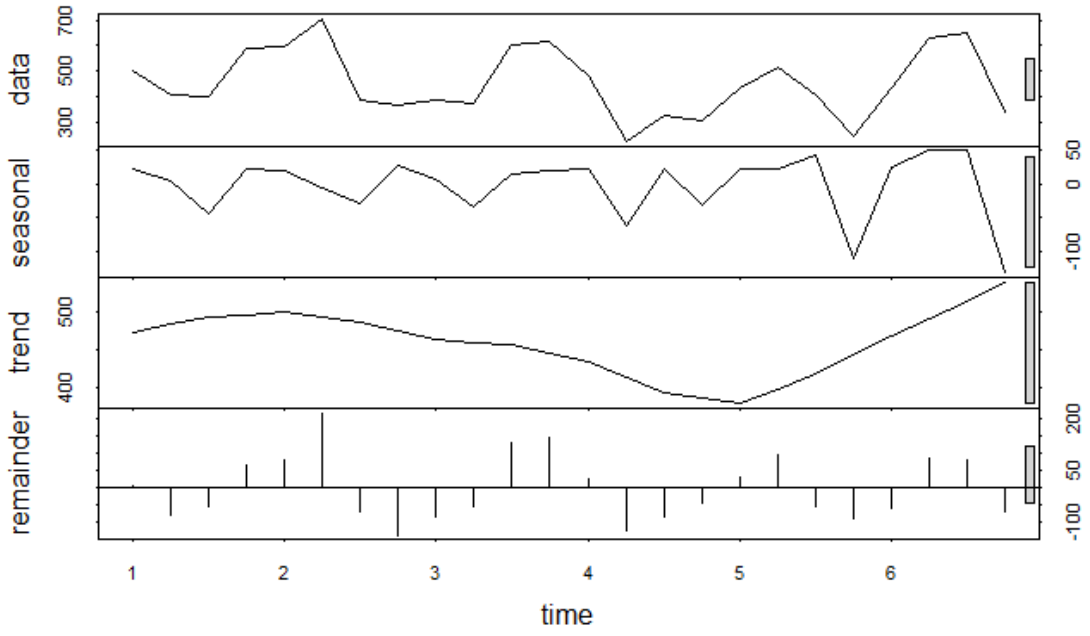
2) Based on this model, we are unable to comment whether meat loaf mix is a counter-cyclical item as “index” (which represent economic conditions) is not a significant variable in this model.

3)



From the plot, the policy is not strictly followed. If it was strictly followed, there should not be data points at the top right corner of the plot, which indicates spending on advertisement and promotion on the same month.

4)



The time series is decomposed into seasonality and trend using stl function in R. There is no clear seasonality between quarters from the decomposed seasonality data.