Q1.

The model is NOT ok, because the series is stationary, this is because DW stat value is about 0 which indicate non-stationary series.

Residuals:

Residuals show clustering of positive or negative errors so there exist autocorrelation also variance is more.

The relationship between SGD, Euro, and USD

Equation: UNTITLED Workfile: UNTITLED::Untitled\

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

Dependent Variable: D(SGD,2)
Method: Least Squares
Date: 01/30/19 Time: 21:11
Sample (adjusted): 2000M12 2018M12
Included observations: 217 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000151	0.002576	0.058680	0.9533
D(SGD(-1))	-0.976132	0.067954	-14.36463	0.0000

R-squared	0.489726	Mean dependent var	-0.000206
Adjusted R-squared	0.487353	S.D. dependent var	0.053002
S.E. of regression	0.037949	Akaike info criterion	-3.695968
Sum squared resid	0.309629	Schwarz criterion	-3.664817
Log likelihood	403.0126	Hannan-Quinn criter.	-3.683385
F-statistic	206.3425	Durbin-Watson stat	1.999945
Prob(F-statistic)	0.000000		

Equation: UNTITLED Workfile: UNTITLED::Untitled\

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

Dependent Variable: D(USD,2)
Method: Least Squares
Date: 01/30/19 Time: 20:15
Sample (adjusted): 2000M12 2018M12
Included observations: 217 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001275	0.002467	0.516935	0.6057
D(USD(-1))	-1.000294	0.068129	-14.68229	0.0000

R-squared	0.500661	Mean dependent var	-8.11E-05
Adjusted R-squared	0.498339	S.D. dependent var	0.051264
S.E. of regression	0.036309	Akaike info criterion	-3.784314
Sum squared resid	0.283448	Schwarz criterion	-3.753163
Log likelihood	412.5981	Hannan-Quinn criter.	-3.771731
F-statistic	215.5696	Durbin-Watson stat	1.997632
Prob(F-statistic)	0.000000		

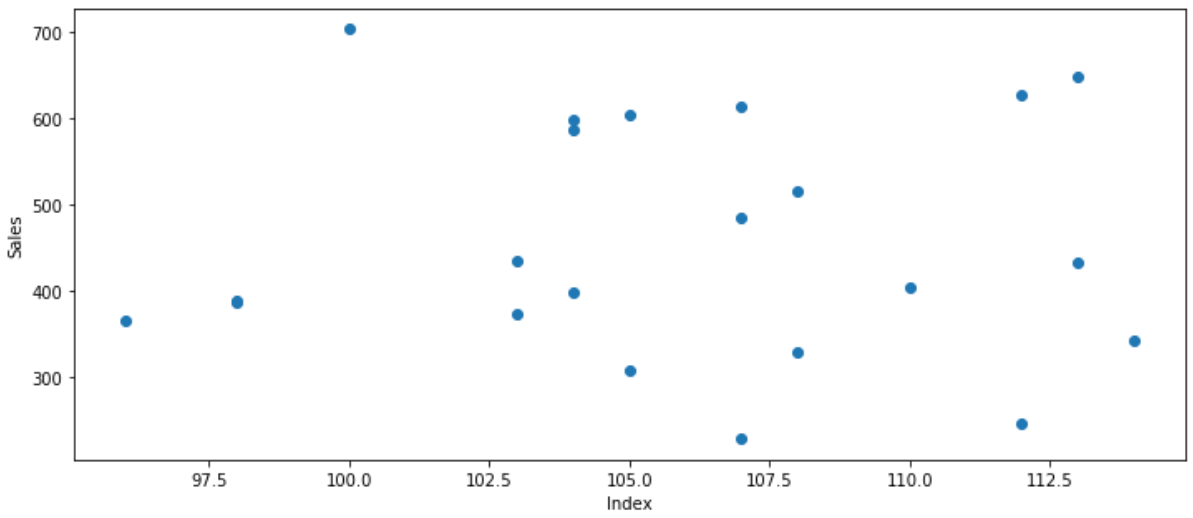
Q2.

Model : Sales ~ constant + prom + adv + index + D(prom(-1)) + D(adv(-1))

```
==============================================================================
Dep. Variable:                  sales   R-squared:                       0.974
Model:                            OLS   Adj. R-squared:                  0.952
Method:                 Least Squares   F-statistic:                     44.59
Date:                Wed, 30 Jan 2019   Prob (F-statistic):           0.000115
Time:                        20:54:21   Log-Likelihood:                -53.578
No. Observations:                  12   AIC:                             119.2
Df Residuals:                       6   BIC:                             122.1
Df Model:                           5
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const        685.4913    306.152      2.239      0.066     -63.637    1434.619
prom           4.7296      0.728      6.498      0.001       2.948       6.511
adv            3.2871      0.765      4.298      0.005       1.416       5.159
index         -3.7552      2.850     -1.317      0.236     -10.730       3.219
diff_prom      3.3758      0.549      6.146      0.001       2.032       4.720
diff_adv      -1.1217      0.536     -2.094      0.081      -2.433       0.189
==============================================================================
Omnibus:                        0.133   Durbin-Watson:                   2.316
Prob(Omnibus):                  0.936   Jarque-Bera (JB):                0.347
Skew:                          -0.001   Prob(JB):                        0.841
Kurtosis:                       2.166   Cond. No.                     4.04e+03
==============================================================================
```

2.1 Based on p-values all the variables except “index” are significant. The coefficient of promotion is higher than adv (both positive). If she has to choose one, she should choose Promotion because on every 1000 dollar spend, she is expected to get about 4730 dollars in sales. And if she spends 1000 dollars in advertising, expected sales is about 3280 dollars.

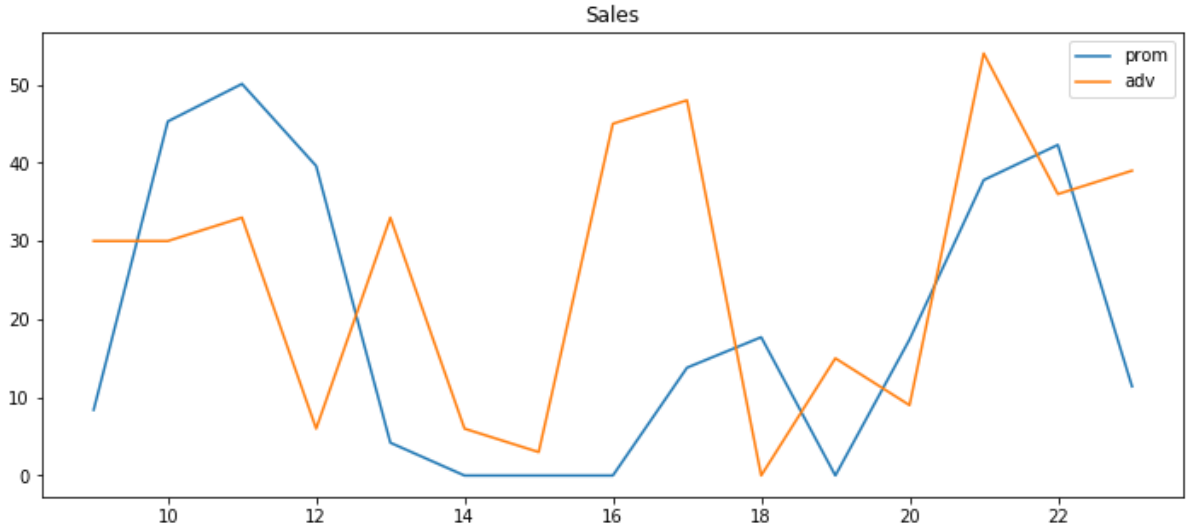
2.2 Sales vs Index



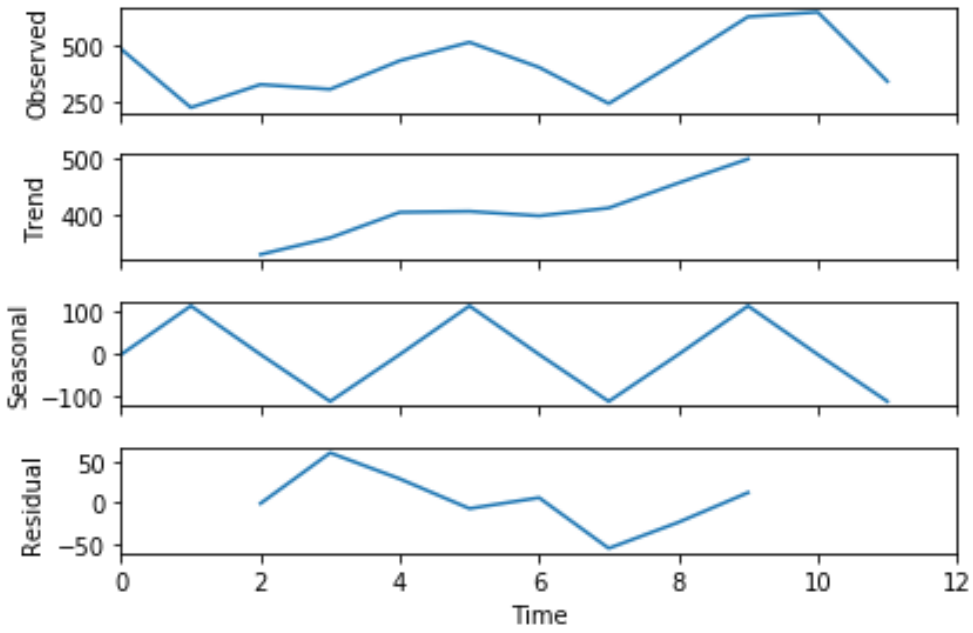
From the model, Index is not-significant (high p-value), one cannot conclude the statement made by the economic analyst.

2.3

Historical Promotion and Adv spend



Based on the graphs, we can observe that there are times when both advertisements and promotions were done.

2.4

When we decompose the sales records. We observe that there exists seasonal component with frequency 4.