PREDICTING THE CHANGE IN PRICE OF COCONUT OIL WITH RESPECT OF TIME

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ABSTRACT

*Coconut oil is play a vital role in for our healthy life. The main purpose of this study is to calculate and predict the change in price of coconut oil with respect of time. This is achieved by taking time series data from **"Index Mundi"**. Our target data was monthly price of Coconut oil US dollar per Metric Ton (2008-2016). The main purpose of this project was, Is coconut really expensive? Has the prices increased or decreased with passage of Time?*

Keywords: Coconut price, ARIMA, MAE, MAPE, RMSE.

INTODUCTION

Years ago Coconut oil was always used in cooking since 1950's and available on local super market. Globally it is grown in 93 countries and in 12.29 million hectare, producing 11.04 million MT (approximately copra). India, Indonesia, Philippines, Thailand, Sri Lanka are the five major players of producing 78 % of the world area and production. The productions of coconut in 2014 top three are Indonesia 35.8 %, Philippines 30.0% and India 23.3% of the total world. In beauty and utility, coconut oil may also used in cooking, for healthy life etc. Now a days, coconut has been a growing Success.

The objective is the study of coconut oil is to forecast its price by using *Time Series Model***.** We forecast the price of coconut oil and apply forecasting check to find out the better and reliable results. In the section 2 comprehensive review on past studies have done ,in section 3 and 4 are about methodology and finding the results according to stated studied respectively, in section 5 comprises conclusion.

LITERATURE REVIEW

There are many debate and research work on price of coconut oil and its forecasting. Some recent studies are discussed as; The objective of this paper is coconuts and its products. Coconut is essential part of life in South Pacific. This project will provide pilot site at ICG in Papua New Guinea to test this approach. This would long term project that would require necessary commitment by the Host country. Bangkok Thailand (2002).The international trend of prices of coconut oil and others. The magnitude of price variation are so high so it is unpredictable change daily, weekly, monthly and yearly prices.Among all major oils the variation are more strong in respect of palm oil and coconut oil.Dr Gigi Elias (2003).In this theory Philip Journal Cardiology the coconut oil is protect us from different disease and make us healthy and strong. It work as an anti- atherogenic. Conrado S. Dayrit et al (2003).Economic Analysis of different processing method of coconut oil production for small scale in Philippines. There are two methods of production of coconut oil are dry and wet method. In all case the price of raw material major effect the cost of production. Matthias Kindermann, Kevin Weis at all (2007).The objective of the paper to check climate

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variability, analysis is based on 31 years from 1971 to 2001.Due to shortage of coconut production the price of coconut products are high. The reduce variability in nut production that is cause by changing in climate. MT N Fernando et al(2007).The coconuts products has many uses in our life and also good for healthy life. If properly make its product it is benefit for us socially and also economically. The production of copra fell 30,800 Tonnes in 1977 to 11,500 Tonnes in 1997, and has remained at this level(Fiji Bureau of Statistic). ShashiKad and Tony Weir (2007).Agalenda has presently cover 20,000 standing coconut trees, which are distributed as 30% of total area. Every year ,approximately 15,000 L of coconut oil sent for sale to Mauritius. Coconut oil is used a alternative of Diesel in Agalenda. Mr Michely Chan &Mrs Poonam V. R. (2010). The coconut is necessary in the early days. Now a days coconut produced hundred thousand square kilometers covering 86 tropical countries. Coconut water sales reached almost half a billion dollars worldwide in 2013.there is one problem coconut oil is costly. Dr Karl's (2014).India stands on 3rd no of the world coconut production according to FAO 2013. The objective of study to analyze the price of coconut oil after and before liberalization. They use yearly average price of coconut oil in three major markets. Specially done for Kerala.Deepa Chandranand Dr. Philo Francis (2015). Coconut oil (CO) has positive effect on health and also cure from disease. It protect us from breast cancer. The effect of long term consumption of CO are unknown. Well-designed randomized objective case should be conducted to illuminate the possible benefits of coconut oil in Human health. Laura Boemeke et al (2015).

After a comprehensive literature review of different studied, we reached at the point coconut oil is play a important role in a society and also economically. Its play a major role for healthy life. Therefore, many techniques & tools used in research but there are mystery no one tells what a change in the price of coconut oil is increase or decrease. Now, we are not only forecast the monthly price of coconut oil we also discuss the accuracy of forecasting model by using MAE, MAPE, RMSE.

OBJECTIVE OF STUDY

The objective of this study to purpose a time series model for forecasting the monthly price of coconut oil. For this study data of Monthly price of coconut oil between April 2008 to March 2016 is taken from "Index Mundi" (monthly price in United State Dollar per metric tons) as in Table 5.

METHODOLOGY

To forecast the price of coconut oil we use time series model .There we use ***Box Jenkins method*.** The box Jenkins method is applicable if it fulfills some assumption. The procedure is defined as below:

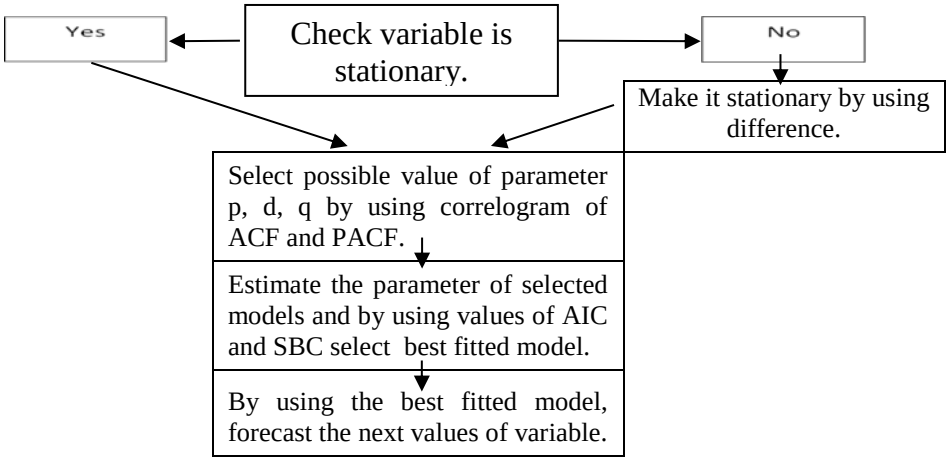

Table 5. Monthly price of coconut oil from April 2008 to March 2016

Month	Price	Month	Price	Month	Price
Apr-08	1443.00	Dec-10	1715.00	Aug-13	894.00
May-08	1502.00	Jan-11	2063.00	Sep-13	982.00
Jun-08	1551.00	Feb-11	2260.00	Oct-13	985.00
Jul-08	1436.00	Mar-11	1925.00	Nov-13	1270.00
Aug-08	1193.00	Apr-11	2088.00	Dec-13	1269.00
Sep-08	1110.00	May-11	2097.00	Jan-14	1270.00
Oct-08	856.00	Jun-11	1803.00	Feb-14	1365.00
Nov-08	719.00	Jul-11	1663.00	Mar-14	1394.00
Dec-08	740.00	Aug-11	1454.00	Apr-14	1356.00
Jan-09	734.00	Sep-11	1310.00	May-14	1403.75
Feb-09	673.00	Oct-11	1208.80	Jun-14	1406.00
Mar-09	625.00	Nov-11	1479.00	Jul-14	1260.00
Apr-09	747.00	Dec-11	1439.00	Aug-14	1177.00
May-09	842.50	Jan-12	1451.00	Sep-14	1181.00
Jun-09	747.00	Feb-12	1411.00	Oct-14	1144.00
Jul-09	685.00	Mar-12	1338.00	Nov-14	1192.50
Aug-09	747.00	Apr-12	1352.50	Dec-14	1215.00
Sep-09	701.00	May-12	1155.00	Jan-15	1159.00
Oct-09	706.00	Jun-12	1056.00	Feb-15	1188.00
Nov-09	729.00	Jul-12	1070.00	Mar-15	1096.00
Dec-09	768.00	Aug-12	1000.00	Apr-15	1079.00
Jan-10	784.00	Sep-12	969.00	May-15	1133.00
Feb-10	798.00	Oct-12	898.00	Jun-15	1110.00
Mar-10	921.00	Nov-12	850.00	Jul-15	1101.00
Apr-10	939.00	Dec-12	785.00	Aug-15	1039.00
May-10	932.00	Jan-13	829.00	Sep-15	1063.00
Jun-10	993.00	Feb-13	861.00	Oct-15	1109.00
Jul-10	1031.00	Mar-13	821.00	Nov-15	1105.00
Aug-10	1170.00	Apr-13	793.00	Dec-15	1150.00
Sep-10	1275.00	May-13	826.00	Jan-16	1155.00
Oct-10	1412.00	Jun-13	896.00	Feb-16	1215.00
Nov-10	1521.30	Jul-13	861.00	Mar-16	1448.00

STATIONARY TEST

When the variable is no change in mean and variance for a long time, it said to be stationary. For applying Box Jenkins methodology, variable must be stationary. There are two methods to check stationary.

1. Graphical Method

In graphical method we use correlogram and line graph.

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2. Empirical Method

Unit root Test

I. Augmented Dickey Fuller Test (ADF Test)

II. Phillips Perron Test (PP Test)

DATA ANALYSIS

In data analysis first of all we check data is stationary or not. If not then make it stationary and make its possible model. The procedure is given below:

General Procedure

Step 1

Hypothesis

Ho: Data is not stationary.

H1: Data is stationary.

Step 2

Level of significance

$\alpha=0.05$

Step3

Test statistic

1. Unit root test
   I. Augmented Dickey Fuller test (ADF Test)
   II. Phillip Perron test (PP Test)
2. Correlogram

Step 4

Calculation

On E-views& Excel

Step 5

Critical region

On the basis of p-value. If the p-value less than level of significance reject Ho otherwise Don't reject Ho.

Step6

Decision

If reject we conclude series is stationary otherwise we say series is non-stationary.

STATIONARY TEST

When the variable is no change in mean and variance for a long time, it said to be stationary. For applying Box Jenkins methodology ,variable must be stationary. There Graphical Method and Empirical Method both are used. In graphical line diagram and correlogram have been utilized. Figure 1 is line diagram and figure 2 is correlogram of monthly price of coconut oil.

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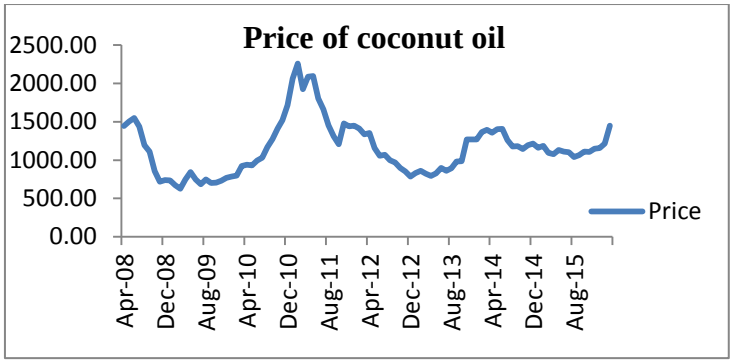
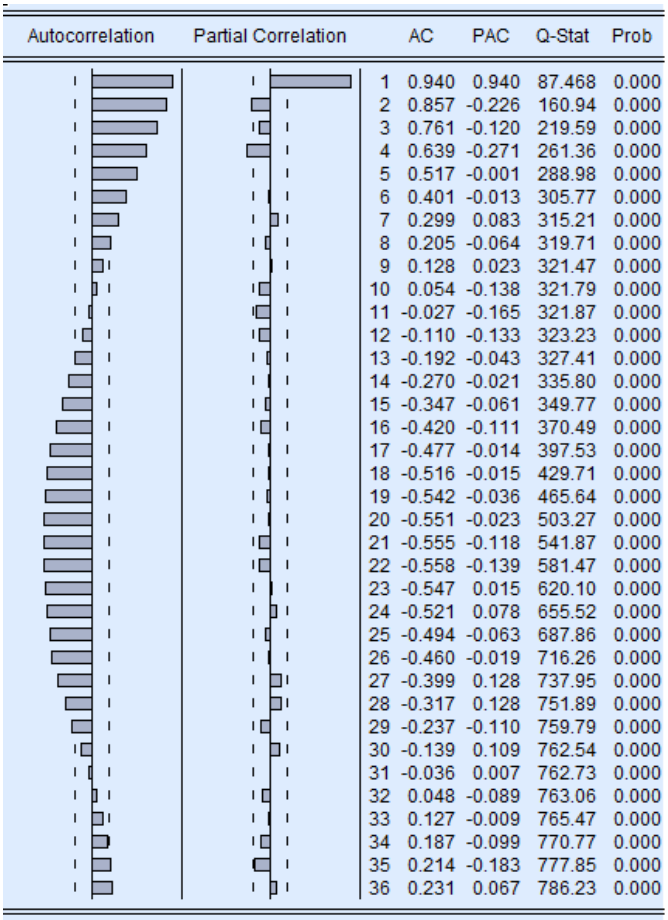


Figure1. Monthly price of coconut oil

Figure 1 shows monthly price on y-axis and time on x-axis. The pattern shows ups and downs in a graph and irregularity in monthly price of coconut oil indicate that it is non stationary.



	AC	PAC	Q-Stat	Prob
1	0.940	0.940	87.468	0.000
2	0.857	-0.226	160.94	0.000
3	0.761	-0.120	219.59	0.000
4	0.639	-0.271	261.36	0.000
5	0.517	-0.001	288.98	0.000
6	0.401	-0.013	305.77	0.000
7	0.299	0.083	315.21	0.000
8	0.205	-0.064	319.71	0.000
9	0.128	0.023	321.47	0.000
10	0.054	-0.138	321.79	0.000
11	-0.027	-0.165	321.87	0.000
12	-0.110	-0.133	323.23	0.000
13	-0.192	-0.043	327.41	0.000
14	-0.270	-0.021	335.80	0.000
15	-0.347	-0.061	349.77	0.000
16	-0.420	-0.111	370.49	0.000
17	-0.477	-0.014	397.53	0.000
18	-0.516	-0.015	429.71	0.000
19	-0.542	-0.036	465.64	0.000
20	-0.551	-0.023	503.27	0.000
21	-0.555	-0.118	541.87	0.000
22	-0.558	-0.139	581.47	0.000
23	-0.547	0.015	620.10	0.000
24	-0.521	0.078	655.52	0.000
25	-0.494	-0.063	687.86	0.000
26	-0.460	-0.019	716.26	0.000
27	-0.399	0.128	737.95	0.000
28	-0.317	0.128	751.89	0.000
29	-0.237	-0.110	759.79	0.000
30	-0.139	0.109	762.54	0.000
31	-0.036	0.007	762.73	0.000
32	0.048	-0.089	763.06	0.000
33	0.127	-0.009	765.47	0.000
34	0.187	-0.099	770.77	0.000
35	0.214	-0.183	777.85	0.000
36	0.231	0.067	786.23	0.000

Figure 2. Correlogram for Monthly price of coconut oil

In figure 2, correlogram of autocorrelation and partial autocorrelation shows that there is high correlation between the values, but with the passage of time decrease.

Table 1.

	ADF		**PP**	
P - values	Level	1st difference	Level	1st difference
None	0.518	0.0000	0.4441	0.0000
Trend	0.0378	0.0000	0.2008	0.0000
Trend &Intercept	0.1045	0.0000	0.4471	0.0000

In empirical methods ADF and PP test used. For ADF test on the basis of P value 0.518 we don't reject Ho at the 5% level of significance For PP test on the basis of P value 0.441 we don't reject Ho at the 5% level of significance and conclude that monthly price of coconut oil is non-stationary. After first difference p-value 0.000 we reject Ho and conclude that monthly price of coconut oil is stationary. Line diagram and correlogram after taking 1st difference.

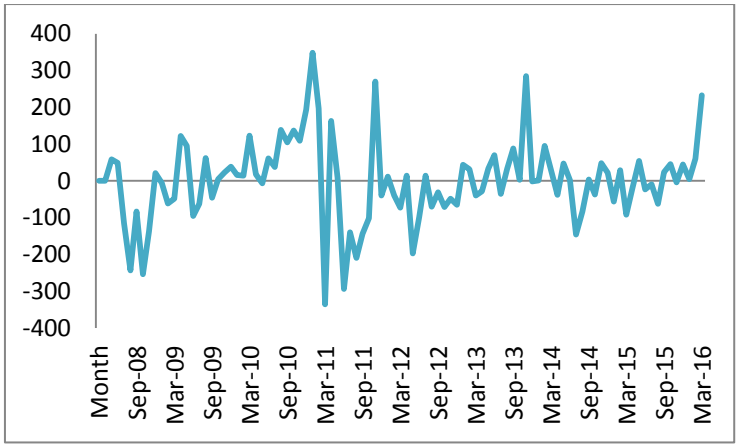
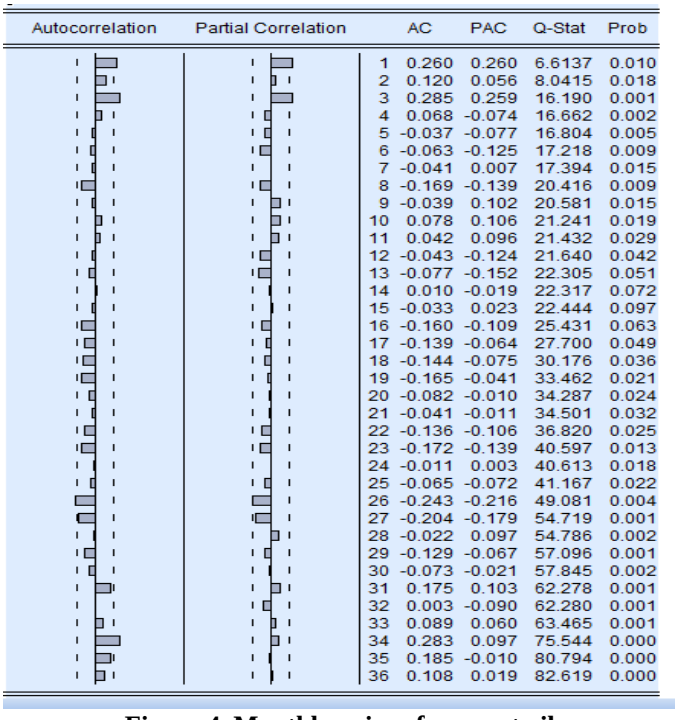


Figure 3. Monthly price of coconut oil



	AC	PAC	Q-Stat	Prob
1	0.260	0.260	6.6137	0.010
2	0.120	0.056	8.0415	0.018
3	0.285	0.259	16.190	0.001
4	0.068	-0.074	16.662	0.002
5	-0.037	-0.077	16.804	0.005
6	-0.063	-0.125	17.218	0.009
7	-0.041	0.007	17.394	0.015
8	-0.169	-0.139	20.416	0.009
9	-0.039	0.102	20.581	0.015
10	0.078	0.106	21.241	0.019
11	0.042	0.096	21.432	0.029
12	-0.043	-0.124	21.640	0.042
13	-0.077	-0.152	22.305	0.051
14	0.010	-0.019	22.317	0.072
15	-0.033	0.023	22.444	0.097
16	-0.160	-0.109	25.431	0.063
17	-0.139	-0.064	27.700	0.049
18	-0.144	-0.075	30.176	0.036
19	-0.165	-0.041	33.462	0.021
20	-0.082	-0.010	34.287	0.024
21	-0.041	-0.011	34.501	0.032
22	-0.136	-0.106	36.820	0.025
23	-0.172	-0.139	40.597	0.013
24	-0.011	0.003	40.613	0.018
25	-0.065	-0.072	41.167	0.022
26	-0.243	-0.216	49.081	0.004
27	-0.204	-0.179	54.719	0.001
28	-0.022	0.097	54.786	0.002
29	-0.129	-0.067	57.096	0.001
30	-0.073	-0.021	57.845	0.002
31	0.175	0.103	62.278	0.001
32	0.003	-0.090	62.280	0.001
33	0.089	0.060	63.465	0.001
34	0.283	0.097	75.544	0.000
35	0.185	-0.010	80.794	0.000
36	0.108	0.019	82.619	0.000

Figure 4. Monthly price of coconut oil

In Figure 3 and 4 shows there is no change in mean and variance with respect to time. So, we conclude that series is stationary at 1st difference.

MODEL IDENTIFICATION AND PARAMETER ESTIMATION

Our data is stationary at first difference d=1 and the values of p, q are selected by using correlogram on the basis of ACF and PACF. We estimate the model of different p and q by using E-views and find the value of R square ,Adjusted R square, AIC and SBC given in table 1.by comparing these values we select ARIMA (1,1,3) as a best fitted model because the value of AIC and SBC are least from all other estimated model and the value of R square

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,Adjusted R square are maximum from all other estimated models. And 2nd best fitted selected model ARIMA (2,1,3).

Table 2

Model (P,d,q)

P	d	q	R square	Adj. R square	AIC	SBC
0	1	1	0.068504	0.058488	12.25194	12.30571
1	1	0	0.07084	0.060741	12.25753	12.31164
1	1	1	0.087	0.06699	12.261	12.342
1	1	2	0.0664	0.0459	12.283	12.364
1	1	3	0.1847*	0.1667*	12.148*	12.229*
1	1	4	0.071	0.0505	12.278	12.359
2	1	1	0.0714	0.0508	12.287	12.369
2	1	2	0.0323	0.0108	12.328	12.41
2	1	3	0.1433**	0.1242**	12.206**	12.288**
2	1	4	0.024	0.0023	12.337	12.418
3	1	1	0.1366	0.11722	12.215	12.297
3	1	2	0.094	0.0737	12.263	12.345
3	1	3	0.1421	0.1229	12.208	12.29
3	1	4	0.0877	0.0672	12.27	12.352

FORECASTING ACCURACY

For forecasting purposes ARIMA (1,1,3) and ARIMA (2,1,3) models are used.

$$D(CP) = c + \alpha AR(p) + \beta MA(q) + u_i$$

C is an intercept, α is coefficient of autoregressive lag values AR(p), β is coefficient of moving average lag values MA(q) and μ shows the residuals of model. In Box-Jenkins model residuals should be IID (independently identically normally distributed).

In ARIMA (1,1,3) we use AR (1) and MA(3) model so its estimated equation is

$$D(CP) = 1.3159 + .2233AR(1) + .4248MA(3)$$

In ARIMA (2,1,3) we use AR(2) MA (3) model so its estimated equation is

$$D(CP) = .1554 + .0134AR(2) + .4527MA(3)$$

For checking the accuracy of forecasting we apply forecasting checks.

I. RMSE (Root Mean Square Error)
II. MAE (Mean Absolute Error)
III. MAPE (Mean Absolute Percentage Error)

We select the model which has minimum RMSE, MAE, MAPE.

Table 3

	ARIMA(1,1,3)	ARIMA(2,1,3)
RMSE	117.31	161.4107
MAE	142.6127	121.2254
MAPE	11.87828	9.982363

We select for the model for Forecast ARIMA (2,1,3) are better than ARIMA (1,1,3) due to less MAE, MAPE, and RMSE.

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ANALYSIS OF FORECASTING VALUE RESULTS

The monthly price of coconut oil from April 2015 until March 2016 are used for forecasting the next 12 values of the monthly price of coconut oil by using both ARIMA (1,1,3) and ARIMA (2,1,3) models. The forecasted results are following:

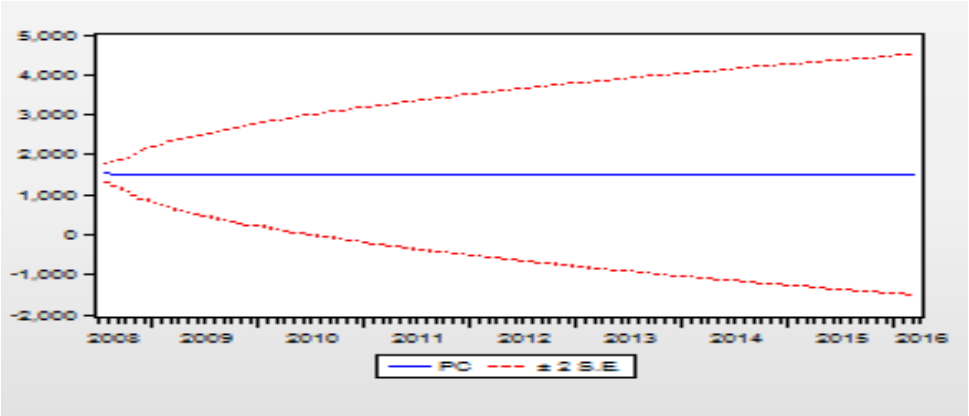

Figure 5. Monthly price of coconut oil

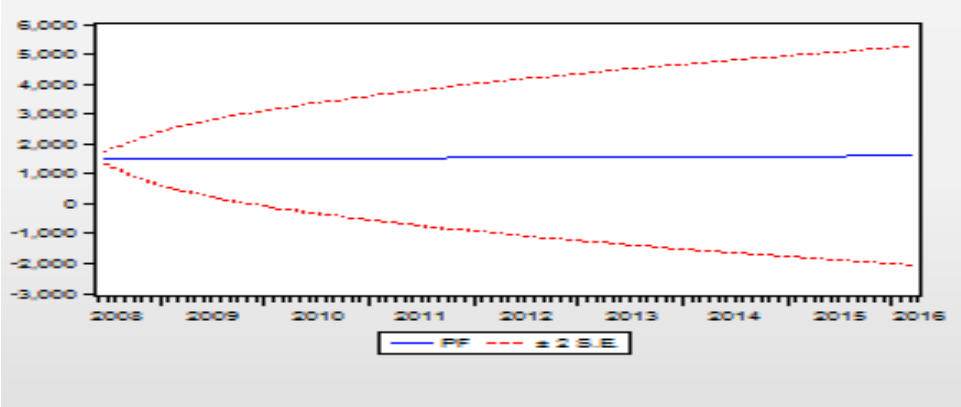

Figure 6. Monthly price of coconut oil

Figure 5 and 6 shows the forecast of ARIMA (1,1,3) and ARIMA (2,1,3) with 2 S.E. In the above figures time are taken on x-axis and price of the Coconut oil on y axis. It clearly indicates that Forecast of ARIMA (2,1,3) are better than ARIMA (1,1,3) due to less MAE, MAPE, and RMSE.

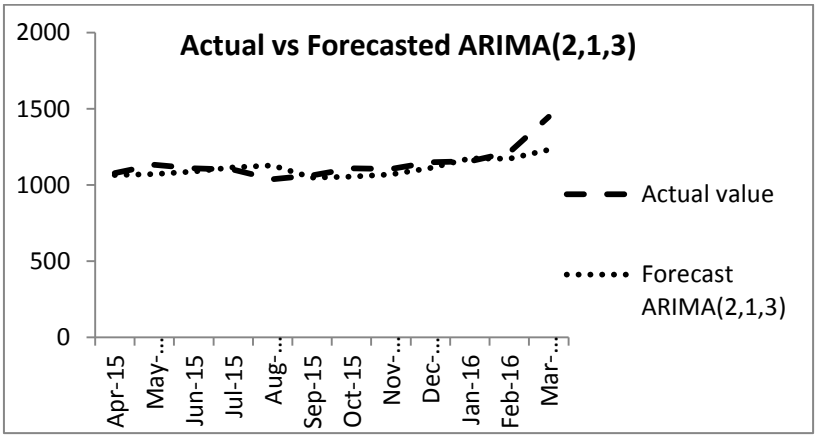

Figure 7. Actual vs Forecasted ARIMA (2, 1, 3)

Figure 7 shows the relation of actual and forecast values of ARIMA (2, 1, 3).

Table 4. Error comparison of ARIMA (1,1,3) and ARIMA(2,1,3)

Year	Actual value	Forecast ARIMA(1,1,3)	Error	Forecast ARIMA(2,1,3)	Error
Apr-15	1079	1047.34668	31.65332	1066.139152	12.86085
May-15	1133	1077.328907	55.67109	1070.703341	62.29666
Jun-15	1110	1104.452332	5.547668	1088.055767	21.94423
Jul-15	1101	1119.331555	-18.3316	1116.701167	-15.7012
Aug-15	1039	1123.662057	-84.6621	1129.051913	-90.0519
Sep-15	1063	1028.529812	34.47019	1048.968702	14.0313
Oct-15	1109	1061.595212	47.40479	1055.212224	53.78778
Nov-15	1105	1084.3306	20.6694	1068.701076	36.29892
Dec-15	1150	1119.772265	30.22774	1112.123791	37.87621
Jan-16	1155	1181.212339	-26.2123	1174.454134	-19.4541
Feb-16	1215	1165.919699	49.0803	1172.192866	42.80713
Mar-16	1448	1242.265678	205.7343	1232.37034	215.6297

RESIDUAL ANALYSIS

In Box-Jenkins methodology residual of best fitted model must be IID (Independent Identically Normally Distributed). For justifying the assumption we make its histogram & correlogram.

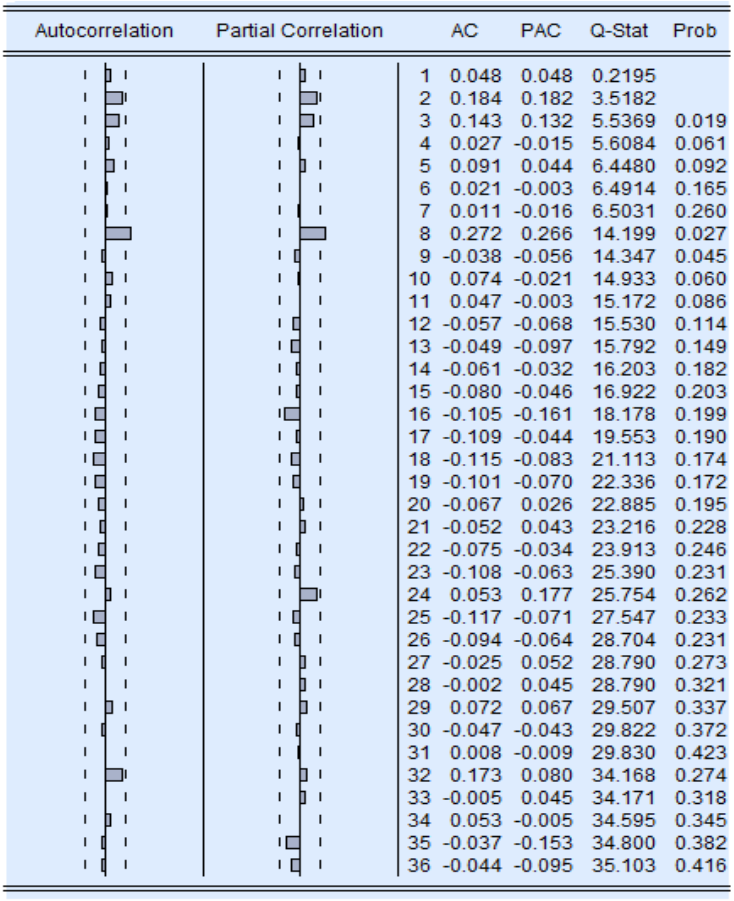

Figure 9.Correlogram of residuals ARIMA(2,1,3)

Correlogram of residuals that are stationary and there is no pattern. So, Histogram and Correlogram shows that ARIMA (2, 1, 3) is best for Forecasting of price Coconut oil.

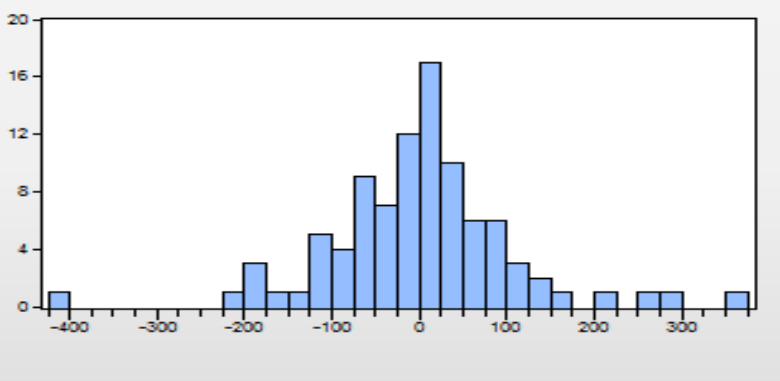

Figure 8. Histogram of residuals ARIMA(2,1,3)

Figure 8 shows that residuals of ARIMA (2, 1, 3) are IID as the bar showing symmetric pattern.

CONCLUSION

In this study, a univariate time series model is selected by using the data of the monthly coconut price from Pakistan Web site. We apply Box-Jenkins methodology for forecasting the monthly coconut price. By using the Line Diagram, correlogram, ADF and PP Test we found that our data is stationary at the 1st difference. After the estimation of models, and by comparing the values of R square adjusted R square AIC and SBC we conclude that ARIMA (1,1,3) and (2,1,3) are very close to each other so we use both models for forecasting purposes. After forecasting the values, we check the accuracy by using MAE, MAPE, and RMSE. From the above study, it is found that ARIMA (2, 1, 3) is more efficient than ARIMA (1, 1,3).

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