Available online www.jsaer.com

***Journal of Scientific and Engineering Research*, 2016, 3(1):162-170**

Research Article

ISSN: 2394-2630
CODEN(USA): JSERBR

Predicting Crude Oil Sales in NNPC Mega Station Awka, Anambra State, Nigeria

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Abstract In the study, the researchers reveal the application of some selected forecasting models. The use of qualitative research method was employed to analysis the collected products data of the case company. The models applied were double exponential smoothing and winters model. The models reveal the future products demand of NNPC Mega Station. The results show that the in future, products demand of the case company will reduce. However, the aforementioned company sales manager will be advice to reveal and to redress their marketing strategies and their sales pattern in other to avoid the company's financial break down. However, the results were recommended to the case company and similar companies for their wide use and applicability.

Keywords Forecasting, Moving Average, Winters Model, Double Smoothing Exponential, Time Series, Petroleum, Diesel, Kerosene

Introduction

Forecasting or **Prediction** is the process of making statements about events whose actual outcomes (typically) have not yet been observed. A commonplace example might be estimation of some variable of interest at some specified future date. Prediction is a similar, but more general term. Both might refer to formal statistical methods employing time series, cross-sectional or longitudinal data, or alternatively to less formal judgmental methods. Usage can differ between areas of application: for example, in hydrology, the terms "forecast" and "forecasting" are sometimes reserved for estimates of values at certain specific future times, while the term "prediction" is used for more general estimates, such as the number of times floods will occur over a long period.

Risk and uncertainty are central to forecasting and prediction; it is generally considered good practice to indicate the degree of uncertainty attaching to forecasts. In any case, the data must be up to date in order for the forecast to be as accurate as possible [1].

Demand forecasting is the activity of estimating the quantity of a product or service that consumers will purchase. Demand forecasting involves techniques including both informal methods, such as educated guesses, and quantitative methods, such as the use of historical sales data or current data from test markets. Demand forecasting may be used in making pricing decisions, in assessing future capacity requirements, or in making decisions on whether to enter a new market [2].

Categories of forecasting methods: Qualitative forecasting techniques are subjective, based on the opinion and judgment of consumers, experts; they are appropriate when past data are not available. They are usually applied to intermediate- or long-range decisions. Examples of qualitative forecasting methods are informed opinion and judgment, the Delphi method, market research, and historical life-cycle analogy.

Quantitative forecasting models are used to forecast future data as a function of past data; they are appropriate when past data are available. These methods are usually applied to short- or intermediate-range decisions. Examples of quantitative forecasting methods are last period demand, simple and weighted N-Period moving averages, simple exponential smoothing, and multiplicative seasonal indexes.

Naïve approach: Naïve forecasts are the most cost-effective forecasting model, and provide a benchmark against which more sophisticated models can be compared. For stationary time series data, this approach says that the forecast for any period equals the historical average. For time series data that are stationary in terms of first differences, the naïve forecast equals the previous period's actual value.

Time series methods: Time series methods use historical data as the basis of estimating future outcomes.

- Moving average, Weighted moving average, Kalman filtering, Exponential smoothing, Autoregressive moving average (ARMA), Autoregressive integrated moving average (ARIMA) (e.g. Box-Jenkins), Extrapolation, Linear prediction, Trend estimation and Growth curve (statistics)

Causal / econometric forecasting methods: Some forecasting methods try to identify the underlying factors that might influence the variable that is being forecast. For example, including information about climate patterns might improve the ability of a model to predict umbrella sales. Forecasting models often take account of regular seasonal variations. In addition to climate, such variations can also be due to holidays and customs: for example, one might predict that sales of college football apparel will be higher during the football season than during the off season [3].

Several informal methods used in causal forecasting do not employ strict algorithms, but instead use the judgment of the forecaster. Some forecasts take account of past relationships between variables: if one variable has, for example, been approximately linearly related to another for a long period of time, it may be appropriate to extrapolate such a relationship into the future, without necessarily understanding the reasons for the relationship.

Causal methods include:

- Regression analysis includes a large group of methods for predicting future values of variable using information about other variables. These methods include both parametric (linear or non-linear) and non-parametric techniques.
- Autoregressive moving average with exogenous inputs (ARMAX)

Quantitative forecasting models are often judged against each other by comparing their in-sample or out-of-sample mean square error, although some researchers have advised against this (Scott & Fred, 1992) [4].

Applications: Climate change and increasing energy prices have led to the use of Egain Forecasting for buildings. This attempt to reduce the energy needed to heat the building, thus reducing the emission of greenhouse gases. Forecasting is used in Customer Demand Planning in everyday business for manufacturing and distribution companies.

While the veracity of predictions for actual stock returns are disputed through reference to the Efficient-market hypothesis, forecasting of broad economic trends is common. Such analysis is provided by both non-profit groups (including government departments and think-tanks) as well as by for-profit private institutions (including brokerage houses and consulting companies) [5].

Forecasting has also been used to predict the development of conflict situations. Forecasters perform research that uses empirical results to gauge the effectiveness of certain forecasting models [1]. However research has shown that there is little difference between the accuracy of the forecasts of experts knowledgeable in the conflict situation and those by individuals who knew much less [6].

Similarly, experts in some studies argue that role thinking does not contribute to the accuracy of the forecast [7]. The discipline of demand planning, also sometimes referred to as supply chain forecasting, embraces both statistical forecasting and a consensus process. An important, albeit often ignored aspect of forecasting, is the relationship it holds with planning. Forecasting can be described as predicting what the future will look like,

whereas planning predicts what the future should look like [6,8]. There is no single right forecasting method to use. Selection of a method should be based on your objectives and your conditions (data etc.) [6-8]. A good place to find a method is by visiting a selection tree. An example of a selection tree can be found here. Forecasting has application in many situations:

- Supply chain management - Forecasting can be used in supply chain management to ensure that the right product is at the right place at the right time. Accurate forecasting will help retailers reduce excess inventory and thus increase profit margin. Studies have shown that extrapolations are the least accurate, while company earnings forecasts are the most reliable. Accurate forecasting will also help them meet consumer demand.
- Economic forecasting, Earthquake prediction, Egain forecasting, Land use forecasting, Player and team performance in sports, Political forecasting, Product forecasting, Sales forecasting, Technology forecasting, Telecommunications forecasting, Transport planning and Transportation forecasting, Weather forecasting, Flood forecasting and Meteorology

Research Method: The use of qualitative research was adapted to analysis the collected products data of the case study company. Forecasting models were employed to analysis and to model the forecasting of the Products data. The forecast will reveal how the future will be or the future trend of the products demand.

Table 1: Monthly Quantity Sales for NNPC Mega Station Company

Year	*Month*	Number of months	Kerosine	Diesel	Petroleum
2012	Jan	1	6180	45185	132100
	Feb	2	4000	36102	99100
	Mar	3	3122	72102	132100
	April	4	5709	40170	66100
	May	5	6092	33170	132100
	June	6	4603	33170	90100
	July	7	5406	35120	66100
	Aug	8	6404	66120	219100
	Sept	9	5833	60120	138100
	Oct	10	3326	54100	231102
	Nov	11	3540	72100	132102
	Dec	12	5709	60100	99160
2013	Jan	13	510	41100	6760
	Feb	14	789	32100	143100
	Mar	15	992	33100	99100
	April	16	3510	28102	231100
	May	17	4980	32108	99100
	June	18	3280	37100	132100
	July	19	3818	31105	99100
	Aug	20	3941	42109	232100
	Sept	21	4423	55100	99100
	Oct	22	6444	60100	68100
	Nov	23	6992	48100	132100
	Dec	24	7402	32100	165100
2014	Jan	25	3502	21100	132100
	Feb	26	2809	27102	198100
	Mar	27	3980	24102	240100
	April	28	5084	18110	99100
	May	29	5036	22110	240100
	June	30	3801	27110	66100
	July	31	3878	26110	132100
	Aug	32	4203	35110	198100
	Sept	33	4536	32110	231100
	Oct	34	3864	29810	99100
	Nov	35	3810	29002	18705
	Dec	36	4385	21700	11002

1. The Forecasting Models Applied includes:

Double Exponential Smoothing: Double Exponential Smoothing forecast (DEF) is composed of two elements: a smoothed error and a trend factor.

$DEF_{t+1} = S_t + T_t$ (1)

Where S_t = Previous forecast plus smoothed error

T_t= Current trend estimate

And $S_t = DEF_t + \alpha(A_t - DEF_t)$ (2)

$T_t = T_{t-1} + \beta(DEF_t - DEF_{t-1} - T_{t-1})$ (3)

Where α and β = smoothing constants.

Winter Modeling

$T_t = \beta(F_t - F_{t-1}) + (1-\beta)T_{t-1}$ (4)

T_t=Trend estimate at time t

F_t=Exponential average at time t

β=fractions,

$f_t = (F_{t-1} - T_{t-1})$ (5)

$F_t = \alpha D_t + (1-\alpha)(F_{t-1} - T_{t-1})$ (6)

where F_t= Forecast for period t

F_{t-1}= Forecast for the previous period

α= Smoothing constant (represents the percentage of the forecast error)

D_t=Demand

$f_{t+1} = (F_t - T_t)$ (7)

f_{t+1}= Winter Forecast

Double Exponential Smoothing for KEROSINE

Forecasts

Period	Forecast	Lower	Upper
37	4262.40	942.3	7582.5
38	4134.08	-964.2	9232.3
39	4005.76	-2958.8	10970.4
40	3877.44	-4986.1	12741.0
41	3749.13	-7028.8	14527.1
42	3620.81	-9079.9	16321.5
43	3492.49	-11136.1	18121.1
44	3364.18	-13195.7	19924.0
45	3235.86	-15257.5	21729.3
46	3107.54	-17321.0	23536.1
47	2979.23	-19385.7	25344.1
48	2850.91	-21451.3	27153.1
49	2722.59	-23517.6	28962.8
50	2594.27	-25584.5	30773.1
51	2465.96	-27651.9	32583.8
52	2337.64	-29719.6	34394.9
53	2209.32	-31787.6	36206.3
54	2081.01	-33855.9	38017.9
55	1952.69	-35924.4	39829.8
56	1824.37	-37993.2	41641.9
57	1696.06	-40062.0	43454.1
58	1567.74	-42131.0	45266.5
59	1439.42	-44200.2	47079.0
60	1311.11	-46269.4	48891.6
61	1182.79	-48338.8	50704.3

62	1054.47	-50408.2	52517.1
63	926.15	-52477.7	54330.0
64	797.84	-54547.2	56142.9
65	669.52	-56616.9	57955.9
66	541.20	-58686.6	59769.0
67	412.89	-60756.3	61582.1
68	284.57	-62826.1	63395.2
69	156.25	-64895.9	65208.4
70	27.94	-66965.7	67021.6
71	-100.38	-69035.6	68834.8
72	-228.70	-71105.5	70648.1

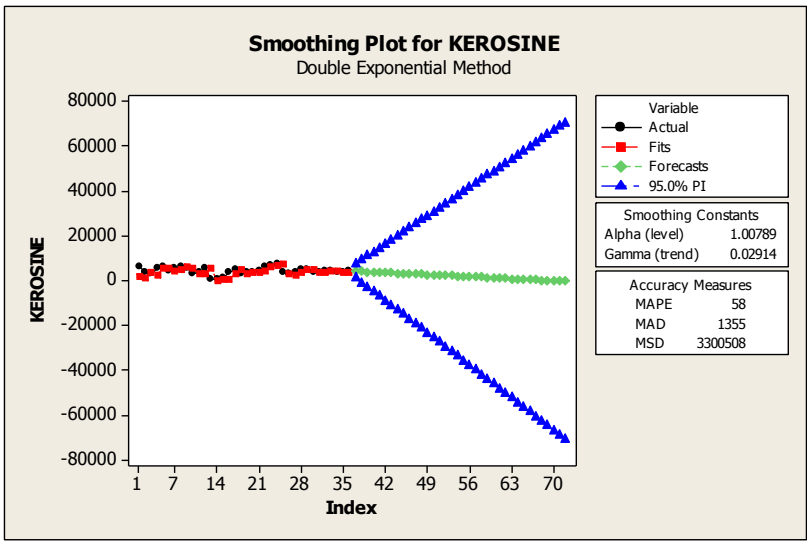

Figure 1: Double Exponential Smoothing Plot for KEROSINE

Winters' Method for KEROSINE

Forecasts

Period	Forecast	Lower	Upper
37	2422.89	-1127.0	5972.78
38	1747.04	-1858.5	5352.55
39	1824.30	-1843.2	5491.82
40	3267.54	-468.1	7003.15
41	3545.09	-264.4	7354.54
42	2352.54	-1536.2	6241.25
43	2429.62	-1543.5	6402.70
44	2447.60	-1614.6	6509.83
45	2296.99	-1858.9	6452.83
46	1941.20	-2312.4	6194.84
47	1770.44	-2584.9	6125.78
48	1877.72	-2582.9	6338.39
49	845.81	-3723.6	5415.18
50	544.66	-4136.6	5225.88
51	492.35	-4303.6	5288.34
52	727.31	-4186.2	5640.79
53	598.17	-4435.3	5631.68
54	251.40	-4904.5	5407.28

55	85.14	-5195.3	5365.58
56	-120.76	-5527.8	5286.28
57	-344.29	-5879.8	5191.24
58	-527.53	-6193.3	5138.28
59	-748.03	-6545.7	5049.69
60	-1152.58	-7083.7	4778.60
61	-731.26	-6797.3	5334.80
62	-657.72	-6860.0	5544.58
63	-839.59	-7179.4	5500.20
64	-1812.92	-8291.4	4665.54
65	-2348.74	-8967.0	4269.50
66	-1849.74	-8608.8	4909.31
67	-2259.34	-9160.2	4641.49
68	-2689.12	-9732.6	4354.40
69	-2985.57	-10172.6	4201.49
70	-2996.26	-10327.7	4335.17
71	-3266.50	-10743.1	4210.04
72	-4182.88	-11805.3	3439.51

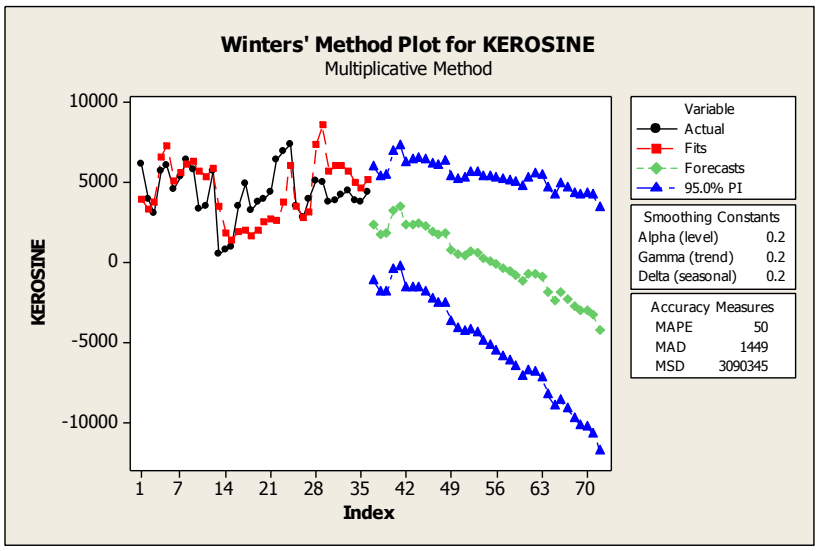

Figure 2: Winters' Method Plot for KEROSINE

Winters' Method for Diesel

Forecasts

Period	Forecast	Lower	Upper
37	18270.7	892.0	35649.4
38	16151.9	-1499.0	33802.9
39	19963.7	2009.2	37918.3
40	13180.9	-5107.0	31468.8
41	13251.8	-5397.6	31901.2
42	14289.8	-4747.6	33327.2
43	12752.6	-6697.8	32203.0
44	18190.6	-1696.2	38077.4
45	17685.2	-2660.0	38030.3
46	16246.6	-4577.3	37070.5
47	15358.2	-5963.5	36680.0

48	10805.3	-11032.1	32642.7
49	8576.9	-13792.7	30946.4
50	7185.8	-15731.3	30103.0
51	8344.1	-15134.9	31823.2
52	5118.1	-18936.1	29172.3
53	4710.2	-19931.6	29352.0
54	4556.3	-20684.5	29797.2
55	3543.5	-22307.2	29394.1
56	4213.3	-22257.1	30683.8
57	3166.6	-23932.9	30266.1
58	1929.6	-25807.6	29666.8
59	751.4	-27631.6	29134.5
60	-355.9	-29392.3	28680.4
61	-1117.0	-30813.7	28579.8
62	-1780.3	-32144.0	28583.4
63	-3275.4	-34312.2	27761.3
64	-2944.7	-34660.4	28770.9
65	-3831.4	-36231.3	28568.5
66	-5177.1	-38266.4	27912.1
67	-5665.7	-39449.0	28117.7
68	-9763.9	-44245.8	24718.0
69	-11351.9	-46536.6	23832.8
70	-12387.4	-48278.8	23504.0
71	-13855.4	-50457.2	22746.4
72	-11517.2	-48833.0	25798.6

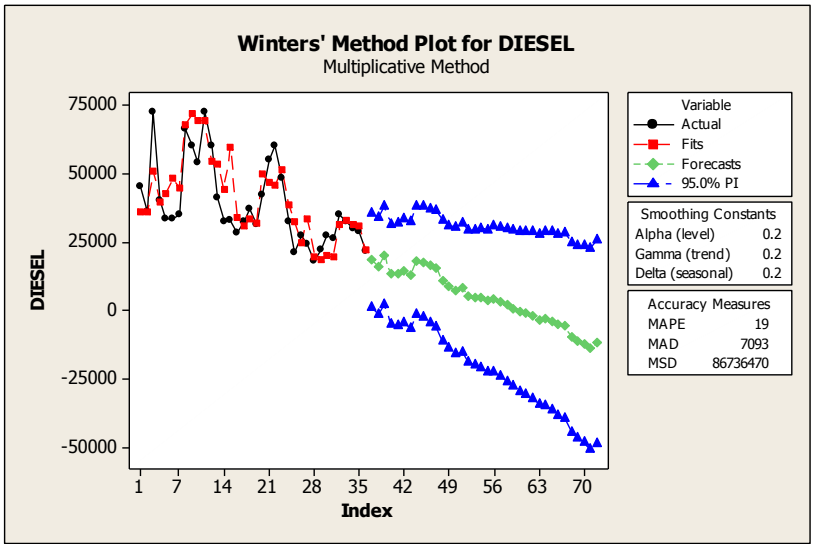

Figure 3: Winters' Method Plot for Diesel

Winters' Method for Petroleum

Forecasts

Period	Forecast	Lower	Upper
37	59680	-68991	188352
38	84820	-45867	215508
39	76153	-56782	209088

40	52880	-82523	188282
41	49686	-88394	187765
42	22464	-118488	163416
43	15004	-129006	159014
44	14637	-132604	161879
45	-2562	-153196	148073
46	-12989	-167168	141191
47	-17031	-174897	140835
48	-23534	-185217	138150
49	-32073	-197696	133551
50	-64745	-234423	104933
51	-81260	-255098	92578
52	-79172	-257269	98924
53	-106996	-289443	75451
54	-73627	-260510	113255
55	-84726	-276124	106671
56	-203465	-399452	-7479
57	-160482	-361126	40162
58	-143457	-348822	61909
59	-110154	-320301	99993
60	-111934	-326918	103051
61	-123826	-343700	96048
62	-214311	-439122	10501
63	-238673	-468468	-8878
64	-211224	-446046	23597
65	-263678	-503566	-23790
66	-169718	-414710	75273
67	-184456	-434587	65674
68	-421568	-676871	-166266
69	-318402	-578908	-57896
70	-273925	-539663	-8186
71	-203276	-474275	67722
72	-200334	-476618	75951

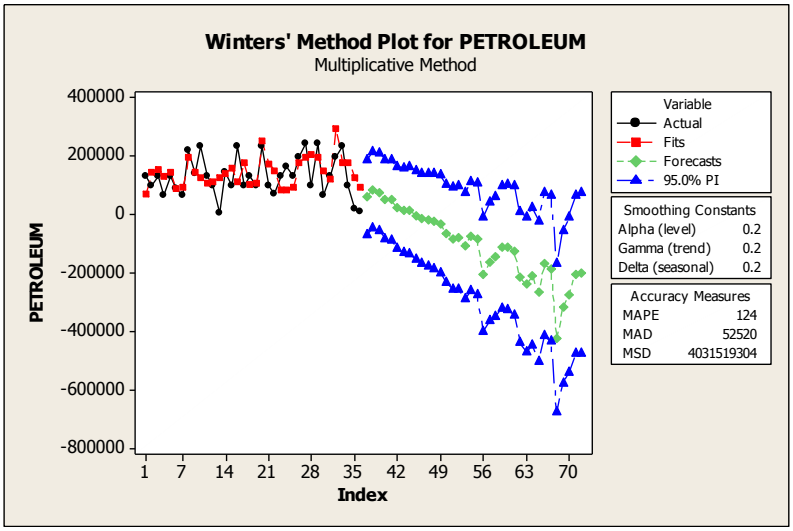

Figure 7: Winters' Method Plot for Petroleum

2. Discussion and Conclusion

The discussion was based on the charts, table, results and the analyses of the products data developed. Some of the charts show the actual and the predicted results of the future products demand in the case study. The charts also show the upper and lower boundary limits of the predicted or forecasting results of the three products demand. The residual plots show the normal probability plots of the forecast. It shows in histogram plots, the frequency accumulation of the residuals or the errors in the forecasts. It also shows the residuals or the errors in the predictions versus the predicted and also the errors in the predictions versus the observed or the periods of the forecasts. The predictive or the forecasting models applied show the forecasting results in the analysis. The application of the models will help to understand the future demand f the products under review. From the findings, results show that the products demands in future will diminish. This is a treat to the case study company, however, the company is strictly advice to restrict steps have seen the failure in the future. Finally, this study and the models were recommended to the case study company.

References

1. Scott Armstrong, Fred Collopy, Andreas Graefe and Kesten C. Green. "Answers to Frequently Asked Questions". Retrieved May 15, 2013.
2. Eric Stellwagen (01August2011) Vice President and Co-founder of Business Forecast Recognized as a leading expert in the field, currently serving on the board of directors of the International Institute of Forecasters (IIF).
3. Nahmias, Steven (2009). Production and Operations Analysis.
4. Scott Armstrong J. and Fred Collopy (1992). "Error Measures For Generalizing About Forecasting Methods: Empirical Comparisons" (PDF). International Journal of Forecasting 8: 69–80. doi:10.1016/0169-2070(92)90008-w.
5. Tembarai Krishnamachari, Rajesh. "Economic and geo-political prognosis for 2015", a sample forecasting report published by the well-known non-profit think-tank South Asia Analysis Group, Paper 5856, Jan 2015.
6. Kesten C. Greene and J. Scott Armstrong (2007). "The Ombudsman: Value of Expertise for Forecasting Decisions in Conflicts" (PDF). Interfaces (INFORMS) 0: 1–12.
7. Kesten C. Green and J. Scott Armstrong (1975). "Role thinking: Standing in other people's shoes to forecast decisions in conflicts" (PDF). Role thinking: Standing in other people's shoes to forecast decisions in conflicts 39: 111–116.
8. "FAQ". Forecastingprinciples.com. 1998-02-14. Retrieved 2012-08-28.