Evaluation of The Most Appropriate Trend Models In Forecasting Some KRPC Products

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***Abstract*— Going by the progress made in the study of trend estimation over the years, in the efforts to further develop the study of forecasting as a sphere of knowledge and apply it in particular to real life situations. Hence, this research work compares linear and quadratic trend models using measurements of accuracy. From the result, it was found that quadratic trend best fit the model for forecasting the production of the selected products of KRPC where all the accuracy measures for quadratic trend model satisfied, which implied that the quadratic trend model best fits the data and should be used to make the forecast**.

Keywords- *Component; Forecasting; Trend; Model Accuracy; Time Series; estimation.*

I. INTRODUCTION

One of the most important tasks before economist and businessmen these days is how to make estimates for the future. For examples, an economist might be interested in estimating the likely population of a country in the years to come so that proper planning on food, jobs creation, housing provision etc. can be adequately addressed. Similarly, a businessman might be interested in knowing his likely cost of raw materials in years to come. This knowledge can enable him to adjust his production accordingly, thereby avoiding the possibility of either unsold stock or inadequate production to meet the demand of his customers.

The first step in making estimates for the future is to gather information about the past. In this connection, one usually deals with statistical data which is collected, observed or recorded at successive intervals of time. Such data is generally referred to as “time-series”. Examples of time series are: observed or recorded production sales, population figures, etc. at different point in time, say, over the last five or ten years. Hence, in the analysis of time-series, time is the most important factor since the variable being analyzed is a function of time. This may be in years, months, weeks, days, hours, or even minutes or seconds. It therefore follows that any definition of the concept of time-series must take recognizance the time fact.

The researches carry out and explained in this project is concerned with the study of estimating trend used in the analysis of time-series data, using the statistical tool technique. This is done with the help of computer software pack that solve time-series problems. After estimating the trend, we used it in determining some forecast. [1] predicted that inflation rate would fluctuate between 13 & 14 percent for most part of 2014. An investment and research firm, Renaissance Capacity said it expected inflation to rise from January and march and average about

15% for the year 2014. However, should the government then be persuaded to phase the removal of petroleum subsidy as a means of easing the burden of prices increase?

Monilola [2] also made a research on forecasting. Her research was concerned with an attempt to determine the most appropriate time services forecasting of demand for some products of the Nigeria tobacco company, Zaria. She collected the data from the company for the period of two years. The data consisted of 24 periods which was divided into two pars the first part was used to analyze the data while the other part was used to test the model. In each case, she calculated the mean absolute error (MAE) and the one with least MAE was chosen as the best model.

Whittaker [3] approach on trend estimation lies in the fact that it requires the optimization of a nonlinear function, which in general may be quite hard, but a different procedure for the trend estimate was introduced. Working with a much simpler optimization problem, the trend estimate obtained is optimal with respect to some function of smoothness and fidelity. The proposed technique is based on fitting, monotonic curve to some time series data.

Kruskal[4] and Barlow et al[5] previously studied the idea of fitting trend to a monotonic curve. [5] for example suggested that an optimal monotonic curve be fitted with analytically with optimality measured in terms of minimum sum of squares. They represent the entire trend problem as a linear program (LP) because the monotonicity constraints and the objective function are linear. Other authors such as [6-8] have made their contributions as well.

II. Materials and Methods

Traditional methods of time series are mainly concerned with decomposing a series into a trend, a seasonal variation and other "irregular" fluctuations. This approach is always the best but still often useful. In time series techniques analysis, a variable to be forecast is modeled as a function of time. Hence,

$$y_t = f(t) + e(t) \quad \ldots\ldots 2.1$$

where y_t is products production for year t, f(t) is a function of time t, e(t) refers to error (i.e. the difference between reported product production and a forecast case for year t). Once a functional relationship between reported products production and time (in other words, a time model) is established, products production can be forecast for year y_{t+1}.

So trend analysis fits a general trend model to time series data and provides forecasts. There are different trend models: Linear, Quadratic, Exponential growth curve e.t.c. The linear trend model is represented by [9]

$$Y_t = \beta_0 + \beta_1 t + e_t \quad \ldots\ldots 2.2$$

In this model β_1 represents the average change from one period to the next.

The Quadratic trend model which can account for simple curvature in the data, is (gupta, 2001):

$$Y_t = \beta_0 + \beta_1 t + \beta_2 t^2 + e_t \quad \ldots\ldots 2.3$$

Measures of Accuracy

There are certain properties that determine the fitness of a model and they are thus;

MAPE: Mean Absolute Percentage Error, measures the accuracy of fitted time series values. It expresses accuracy as a percentage.

$$\text{MAPE} = \frac{\sum_{i=1}^{n} (Y_t - \hat{Y}_t) / Y_t}{n} \times 100 \quad \ldots\ldots 2.4$$

where $Y_t \neq 0$
Y_t = actual value
$\hat{Y}_t$ = fitted values and
n = numbser of observations

MAD: Mean Absolute Deviation, measures the accuracy of fitted time series values. It expresses accuracy in the same unit as the data, which helps conceptualize the amount of error.

$$\text{MAD} = \frac{\sum_{i=1}^{n} (Y_t - \hat{Y}_t)}{n} \quad \ldots\ldots 2.5$$

where Y_t = actual value
$\hat{Y}_t$ = fitted values and
n = number of observations

MSD: Mean Square Deviation. It is very similar to MSE, mean square error, commonly used to measure the accuracy of fitted time series values. MSD is always computed using the same denominator n, regardless of the model, so you can compare MSD values across models. MSE are computed with different degrees of freedom for different models, so you cannot always compare MSE values across models.

$$\text{MSD} = \frac{\sum_{i=1}^{n} (Y_t - \hat{Y}_t)^2}{n} \quad \ldots\ldots 2.6$$

where Y_t = actual value
$\hat{Y}_t$ = fitted values and
n = number of observations

III. ANALYSIS

This analysis deals with the establishing of models explains and captured the up and down movement pattern of the time series data.

TREND ANALYSIS OF PMS

LINEAR TREND
Length 132.000
Fitted Trend Equation
Yt = 28779.9 - 192.134*t

Accuracy Measures
MAPE: 156.185
MAD: 10997.0
MSD: 187033428

QUADRATIC TREND
Length 132.000
Fitted Trend Equation
Yt = 36393.6 - 533.047*t + 2.56326*t**2

Accuracy Measures
MAPE: 145.026
MAD: 10446.5
MSD: 175954853

TREND ANALYSIS OF HHK

LINEAR TREND
Length 132.000
Fitted Trend Equation
Yt = 17453.9 - 112.349*t

Accuracy Measures
MAPE: 461.831
MAD: 6467.12
MSD: 58165789

QUADRATIC TREND
Length 132.000
Fitted Trend Equation
Yt = 22094.6 - 320.142*t + 1.56236*t**2

Accuracy Measures
MAPE: 394.275
MAD: 6090.19
MSD: 54049951

TREND ANALYSIS OF AGO

LINEAR TREND
Length 132.000
Fitted Trend Equation
Yt = 29159.8 - 176.840*t

Accuracy Measures
MAPE: 897.224
MAD: 12296.3
MSD: 213147155

QUADRATIC TREND
Length 132.000
Fitted Trend Equation
Yt = 38734.5 - 605.559*t + 3.22345*t**2

Accuracy Measures
MAPE: 1009.19
MAD: 11365.3
MSD: 195626887

TREND ANALYSIS OF LPFO

LINEAR TREND
Length 132.000
Fitted Trend Equation
Yt = 48032.7 - 371.940*t

Accuracy Measures
MAPE: 964.900
MAD: 14900.4
MSD: 308041781

QUADRATIC TREND
Length 132.000
Fitted Trend Equation
Yt = 64109.2 - 1091.78*t + 5.41236*t**2

Accuracy Measures
MAPE: 665.533
MAD: 12911.4
MSD: 258648010

TREND ANALYSIS OF INTERM PRODUCT

LINEAR TREND
Length 132.000
Fitted Trend Equation

Yt = 3882.68 + 7.60869*t + 1.68638*t**2

Accuracy Measures
MAPE: 141.693
MAD: 16742.7
MSD: 435043422

QUADRATIC TREND
Length 132.000
Fitted Trend Equation

Yt = 8891.81 - 216.680*t

Accuracy Measures
MAPE: 153.792
MAD: 16550.7
MSD: 430248165

TREND ANALYSIS OF INT. FUEL PRODUCT

LINEAR TREND
Length 132.000
Fitted Trend Equation
Yt = 16688.2 - 51.9029*t

Accuracy Measures
MAPE: 45.1985
MAD: 4655.42
MSD: 32181093

QUADRATIC TREND
Length 132.000
Fitted Trend Equation
Yt = 18553.1 - 135.406*t + 0.627840*t**2

Accuracy Measures
MAPE: 44.0281
MAD: 4534.96
MSD: 31516438

IV. RESULTS

Table 1: Comparison Results of the Trend Analysis Techniques

Variables	Measures of Accuracy	Trend Analysis Techniques	
		Linear Trend	Quadratic Trend
PMS	MAPE MAD MSD	156.185 10997.0 187033428	145.026 10446.5 175954853
HHK	MAPE MAD MSD	461.831 6467.12 58165789	394.275 6090.19 54049951
AGO	MAPE MAD MSD	897.224 12296.3 213149155	1009.19 11365.3 195626887
LPFO	MAPE MAD MSD	964.900 14900.4 308041781	665.533 12911.4 258648010
INT. PRODUCT	MAPE MAD MSD	141.693 16742.7 435043422	153.790 16550.7 430248165

Graphical presentation of results

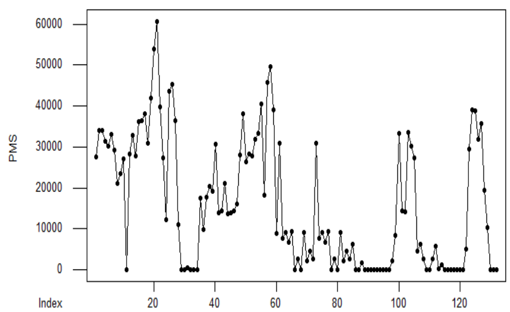

Figure 1: shows the monthly production pattern of PMS in metric tonne.

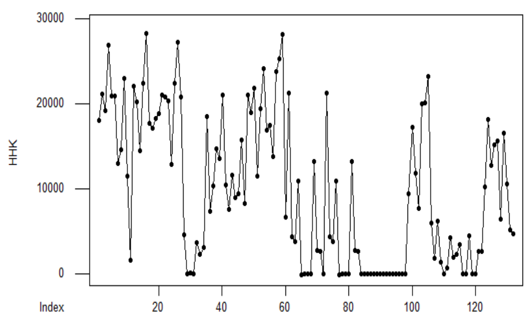

Figure 2: shows the monthly production pattern of HHK in metric tonne.

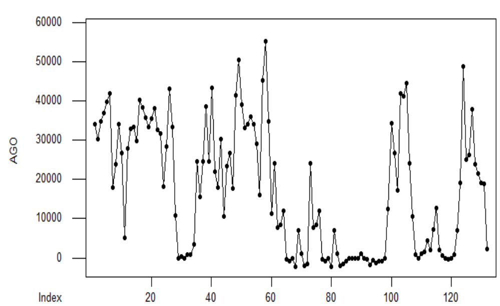

Figure 3: shows the monthly production pattern of AGO in metric tonne.

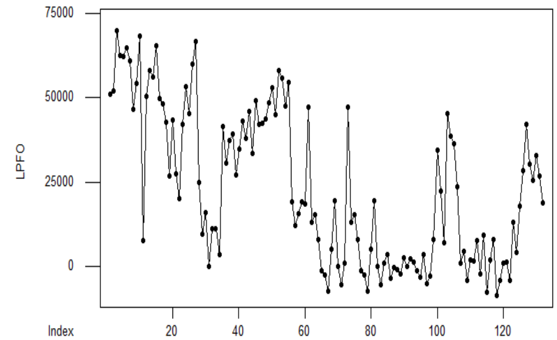

Figure 4: shows the monthly production pattern of LPFO in metric tonne.

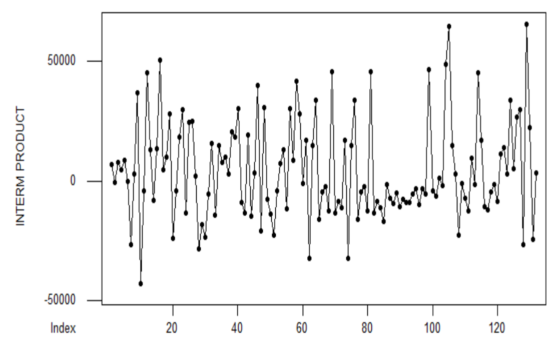

Figure 5: shows the monthly production pattern of INTERM PRODUCT in metric tonne.

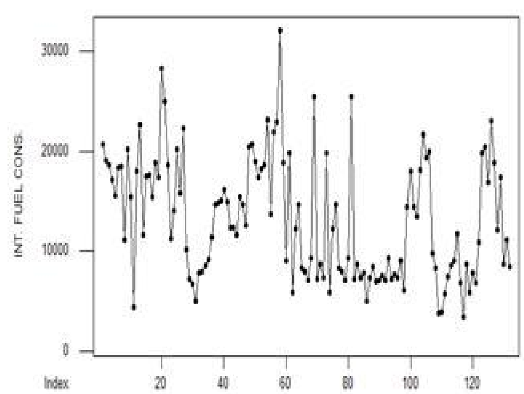

Figure 6: Shows the monthly production pattern of INT. FUEL CONS in metric tonne.

V. Discussion

Based on the above results, it is observed that the Mean Absolute Percentage Error (MAPE) of quadratic trend of all the variables except INT. PRODUCT and AGO considered in this research work is less than the corresponding MAPE of linear trend. But going by the other measures of accuracies i.e MAD and MSD, it is observed that their corresponding values for the quadratic trend is smaller than the linear trend. Hence, quadratic trend is better than the linear trend in this regard. Therefore it is more appropriate for modeling production of some KRPC products.

VI. Conclussions

By comparing the two model i.e linear and quadratic trend using the measurement of accuracy (MAPE, MAD and MSD), it was found that quadratic trend best fit the model for forecasting the production of the selected products of KRPC where all the accuracy measures for quadratic trend model satisfied, which implied that the quadratic trend model best fits the data and should be used to make the forecast.

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