Use of Time Series Analysis for the Determination of the Trend of the Generated Revenue for Mbaitoli Local Government Area of Imo State, Nigeria

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ABSTRACT

In this survey, the least square method was used to estimate the trend in the time series and the trend parameters $\hat{a}$ *and* $\hat{b}$ *were 1.20 and 0.002 respectively. The grand mean (Yt) which is an estimate for the trend value* $\left(\hat{T}_t\right)$ *was equally 1.20. The time - plot of the original data appeared to be fluctuating and this suggested the use of the grand mean as an estimate of the trend. Assessing from the grand mean, the revenue of Mbaitoli Local Government Area of Imo State, Nigeria was on the average of 1.20 x 20,000,000 = 24,000,000 naira monthly. Meanwhile, the time-plot of the detrend series showed that the peaks and troughs repeated itself at a regular interval. The trend of the revenue determined in this study serves as an indicator and a forecast towards achieving a stable economy by the Local Government Authorities.*

Keywords: *Least square, estimate, trend, grand mean, revenue.*

INTRODUCTION

For any Local Government Area to be economically viable, her revenue must be substantial (Ogundana, 1996) even if unstable. However, the Local Government as part of the machinery by which an economy is governed (Kalu, 2000) is very important and therefore, must be effective to ensure the peaceful and orderly existence of her population. Growth and development of any Local Government Area are directly related to the level of revenue generation and its judicious use. Incidentally, the trend of the revenue could have serious relationship with the performance of the Local Government (Eghosa and Stephen, 1985). For instance, the trend of the revenue can determine the average standard of living of the population (Kalu, 2000).

Since the Local Government Area is challenged with the responsibilities of providing basic amenities, good health care and even employment for her local citizenry, the weight and trend of revenue that is generated are of paramount importance. Poor forecast, fluctuation in the expected statutory allocation from the Federal Government/weak leadership may affect adversely, the performance of a Local Government (Mason, 1999) and culminate into untold hardship on the local residents. Even though, the relationship between revenue and development of a Local Government Area is expected to follow a trend line, yet sometimes, most local government areas do not do well. Therefore, the

study sought to determine the trend in which the revenue of Mbaitoli L.G.A follows with a view to working out an empirically tested, substantiated suggestions to the appropriate quarters/authorities. This study gives a detailed position on the time series analysis of revenue of Mbaitoli Local Government Area of Imo State for the period, 2001 - 2005.

MATERIALS AND METHOD

This study was carried out at the headquarters of Mbaitoli Local Area, Imo State, Nigeria. Mbaitoli (South Eastern part of Nigeria) is located in the rain forest region of Nigeria on latitude $6^{o}3^{l}$N and longitude $7^{o}36^{l}$E (Iwu and Nwosu, 2010). Although this area has mixed population of diverse occupations of civil servants, students and other workers, it is not much different from the typical Nigerian rural to semi-rural setting in which members are largely farmers. Data used for this study were from the secondary source, the Account Production Department and the Department of Planning, Research and Statistics of Mbaitoli Local Government Area of Imo State. The data covered a period of 2001-2005. Collections were made with strict consideration of the objectives of the study. The least square method was used to estimate the trend in the time series analysis for its popularity and wide usage. It is known to yield objective results and it is most useful when a forecast is required. For a linear regression model, the trend equation is given by:

$$Y_t = a + b_t + e_t \quad \text{----------[1]}$$

and the least square estimates are:

$$\hat{a} = \overline{Y} - b\bar{t} \quad \text{.....[2]}$$

and

$$\hat{b} = \frac{\sum ty - \sum t \sum y}{n\sum t^2 - \left(\sum t\right)^2} \quad \text{.....[3]}$$

Where

t = the time (Coded values for the months)

n = Total number of observation

Y_t = The total Revenue

Therefore, the estimated trend line is

$$\hat{Y}_t = \hat{a} + \hat{b}_t \quad \text{---------- [4]}$$

After the estimation of the trend values, the value was removed from the series using both additive and multiplicative models, leaving the detrend series which was free of the trend value. The subtraction of the trend value from the series Y_t eliminated the trend value, leaving the detrend series. That is $Y_t = \hat{T}_t + \hat{S}_t + \hat{C}_t + \hat{I}_t - \hat{T}_t = \hat{S}_t + \hat{C}_t + \hat{I}_t$. Hence, the detrend series was given by $Y_t = \hat{S}_t + \hat{C}_t + \hat{T}_t$.

Similarly for the multiplicative model, the division of the time series Y_t by the trend value eliminated the trend, leaving the detrend series. This was achieved by dividing as follows:

$$Y_t = \frac{T_t + \hat{S}_t + \hat{C}_t + \hat{I}}{\hat{T}_t} = \hat{S}_t + \hat{C}_t + \hat{I}_t$$

RESULTS AND DISCUSSION

Following the suggestion raised by the time plot (Figure 1) of the original data (Table 1), the grand mean was used as an estimate of the trend value. This is supported by Nwogu (1995) but stems from the fact that the graph appeared not to be moving upwards nor downwards but fluctuated about a constant value. However, the estimates of the trend parameters $\hat{a}$ *and* $\hat{b}$ (using equations 2, 3 and 4 above) obtained, employing the least square method were 1.20 and 0.002 respectively. Furthermore, results showed that the grand mean (Y_t) which is an estimate for the trend value $\left(\hat{T}_t\right)$ was equally 1.20.

Assessing from the grand mean, the revenue of Mbaitoli L.G.A of Imo State was on the average of $1.20 \times 20{,}000{,}000 = 24{,}000{,}000$ naira. Note that in the original data, each value was divided by the constant, 20,000,000. Therefore, to get the actual average, the estimate was multiplied by the constant. The multiplier theory here is supported by Gupta (1995). Incidentally, when each of the observations (original values) was divided by the trend value (as applied to the multiplicative model), the detrend series for both models resulted (Tables 2 and 3). Meanwhile, the results of the time plots of the detrend data using multiplicative and additive models are presented by figures 2 and 3 respectively. That time series data can be detrend using both the multiplicative and additive models corroborates the works of Spiegel (1992) and Nwachukwu (2005). From the findings of this study, the time-plot of the original data appeared to be fluctuating (that is, tends to be constant) and this suggests the use of the grand mean (1.20) as an estimate of the trend. Meanwhile, the time plot of the detrend series showed that the peaks and troughs repeated itself at regular interval.

Table 1: Original data on Revenue Generated by the Mbaitoli L.G.A. of Imo State for the Period of 2001 - 2005 (in 10^4)

MONTHS	2001	2002	2003	2004	2005	2006
JANUARY	0.85	0.85	1.08	0.60	0.89	1.10
FEBRUARY	1.06	1.07	0.86	1.10	1.20	1.38
MARCH	1.14	1.15	1.17	1.19	1.11	1.49
APRIL	0.58	1.17	1.18	1.20	1.21	0.75
MAY	0.75	0.58	0.59	1.64	1.23	0.97
JUNE	2.11	0.75	0.76	0.78	0.61	1.51
JULY	1.16	1.60	1.61	1.22	1.66	1.52
AUGUST	1.17	1.18	1.20	1.26	1.27	1.62
SEPTEMBER	1.21	1.22	2.11	1.29	1.25	1.58
OCTOBER	1.24	2.14	1.24	2.20	0.78	1.63
NOVEMBER	1.25	1.25	1.27	0.88	1.32	2.06
DECEMBER	1.58	1.27	1.28	1.31	2.22	2.75
TOTAL	14.10	14.23	14.35	14.67	14.75	18.36

Source: Account Production and Planning Research and Statistics Department of Mbaitoli L.G.A. of Imo State

The grand mean of the original data for the period of five years (2001 - 2005) is given by:

$$= \frac{14.10 + 14.23 + 14.35 + 14.67 + 67.14 + 14.75}{60} = \frac{72.100}{60}$$

Grand mean = 1.2017 = estimate of Trend

Table 2: Detrend data using Addictive Model

t	Y_t	$\hat{T}_t$	$(Y_t - \hat{T}_t)$	t	Y_t	$\hat{T}_t$	$(Y_t - \hat{T}_t)$
1	0.85	1.20	- 0.35	31	1.61	120	0.41
2	1.06	1.20	- 0.14	32	1.20	1.20	0.00
3	1.14	1.20	- 0.06	33	2.11	1.20	0.91
4	0.58	1.20	- 0.62	34	1.24	1.20	0.04
5	0.75	1.20	- 0.45	35	1.27	1.20	0.07
6	2.11	1.20	- 0.91	36	1.28	1.20	0.08
7	1.16	1.20	- 0.04	37	0.60	1.20	- 0.60
8	1.17	1.20	- 0.03	38	1.10	1.20	- 0.10
9	1.21	1.20	0.01	39	1.19	1.20	- 0.01
10	1.24	1.20	0.04	40	1.20	1.20	0.00
11	1.25	1.20	0.05	41	1.64	1.20	0.44
12	1.58	1.20	0.38	42	0.78	1.20	- 0.42
13	0.85	1.20	- 0.35	43	1.22	1.20	0.02
14	1.07	1.20	- 0.13	44	1.26	1.20	0.06
15	1.15	1.20	- 0.05	45	1.29	1.20	0.09
16	1.17	1.20	- 0.03	46	2.20	1.20	1.00
17	0.58	1.20	- 0.62	47	0.88	1.20	- 0.32
18	0.75	1.20	- 0.45	48	1.31	1.20	0.11
19	1.60	1.20	- 0.40	49	0.89	1.20	- 0.31
20	1.18	1.20	- 0.0.02	50	1.20	1.20	0.00
21	1.22	1.20	0.02	51	1.11	1.20	- 0.09
22	2.14	1.20	0.94	52	1.21	1.20	0.01
23	1.25	1.20	0.05	53	1.23	1.20	0.03
24	1.27	1.20	0.07	54	0.61	1.20	- 0.59
25	1.08	1.20	- 0.12	55	1.66	1.20	0.46
26	0.86	1.20	- 0.34	56	0.27	1.20	0.07
27	1.17	1.20	- 0.03	57	1.25	1.20	0.05
28	1.18	1.20	- 0.02	58	0.78	1.20	- 0.42
29	0.59	1.20	- 0.61	59	1.32	1.20	0.12
30	0.76	1.20	- 0.44	60	2.22	1.20	1.02

$\frac{\sum_{i=1}^{N} Y_t}{N}$ where $N = 60$

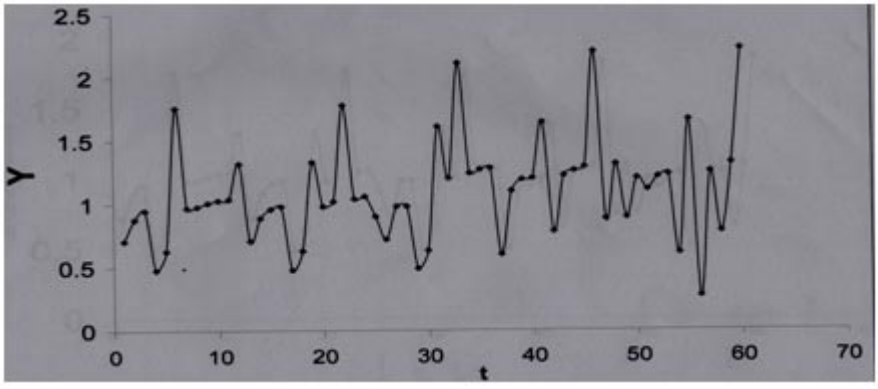

Figure 1: Time Plot of the Original Series

Table 3: Detrend data using Multiplicative Model

t	Y_t	T_t	(Y_t / T_t)	t	Y_t	T_t	(Y_t / T_t)
1	0.85	1.20	0.71	31	1.61	1.20	1.34
2	1.06	1.20	0.88	32	1.20	1.20	1.00
3	1.14	1.20	0.95	33	2.11	1.20	1.76
4	0.58	1.20	0.48	34	1,24	1.20	1.03
5	0.75	1.20	0.63	35	1.27	1.20	1.06
6	2.11	1.20	1.76	36	1.28	1.20	1.07
7	1.16	1.20	0.97	37	0.60	1.20	0.50
8	1.17	1.20	0.98	38	1.10	1.20	0.92
9	1.21	1.20	1.01	39	1.19	1.20	0.93
10	1.24	1.20	1.03	40	1.20	1.20	1.00
11	1.25	1.20	1.04	41	1.64	1.20	1.37
12	1.58	1.20	1.32	42	0.78	1.20	0.65
13	0.85	1.20	0.71	43	1.22	1.20	1.02
14	1.07	1.20	0.89	44	1.26	1.20	1.05
15	1.15	1.20	0.96	45	1.29	1.20	1.08
16	1.17	1.20	0.98	46	2.20	1.20	1.83
17	0.58	1.20	0.48	47	0.88	1.20	0.73
18	0.75	1.20	0.63	48	1.31	1.20	1.09
19	1.60	1.20	1.33	49	0.89	1.20	0.74
20	1.18	1.20	0.98	50	1.20	1.20	1.00
21	1.22	1.20	1.02	51	1.11	1.20	0.93
22	2.14	1.20	1.78	52	1.21	1.20	1.01
23	1.25	1.20	1.04	53	1.23	1.20	1.03
24	1.27	1.20	1.06	54	0.61	1.20	0.51
25	1.08	1.20	0.90	55	1.66	1.20	1.38
26	0.86	1.20	0.72	56	1.27	1.20	1.06
27	1.17	1.20	0.98	57	1,25	1.20	1.04
28	1.18	1.20	0.98	58	0.78	1.20	0.65
29	0.59	1.20	0.49	59	1.32	1.20	1.10
30	0.76	1.20	0.63	60	2.22	1.20	1.85

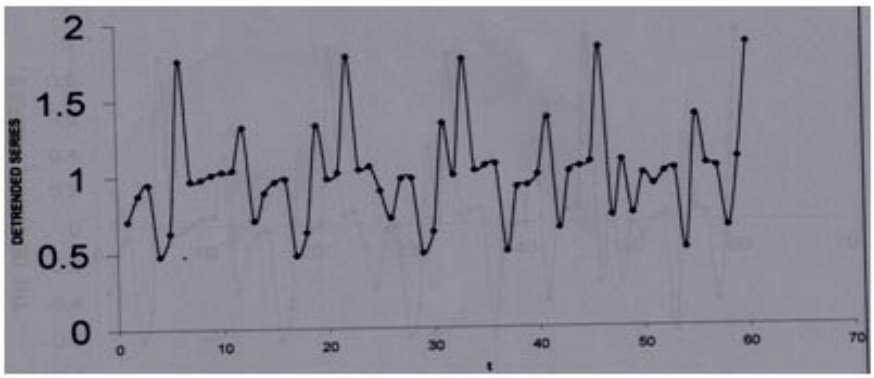

Figure 2: Time Plot of the Detrend Series using the Multiplicative Model

CONCLUSION

The study sought to determine the trend in which the revenue of Mbaitoli L.G.A follows with a view to working out an empirically tested, substantiated suggestions to the appropriate quarters/authorities. This study forms part of a detailed study on the time series analysis of revenue of Mbaitoli Local Government Area of Imo State for the period, 2001 - 2005. The trend of the Mbaitoli L.G.A. determined in this study undoubtedly serve as an indicator and or a forecast that enable the local government authorities/heads to prepare ahead of time and check or contain any economic instability that may follow. However, given the trend of the revenue of this study, it is important that the local government authorities must make judicious use of the revenue that come in, for maximum realization of their targets.

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