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Application of Forecasting Techniques in Nissan Urvan Income Generation of Anambra State Transport Sector

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Abstract: *This research work studies several forecasting techniques to predict future income generation and its implications on the Nissan Urvan income generation in Anambra State Transport sector .This paper presents three forecasting models (time series decomposition method, winter's method and Arima method) to analyze data income generation of Anambra State Transport Sector over the period of 2005-2019, it is important to know the trend in Anambra Transport Sector to elicit patterns of incomes generated. However, the models used were based on applicable methodology to facilitate accurate and faster analysis of data. The results reveal that the future income generated for the products will continuously decrease with time. Having observed the values obtained from the models used, it is recommended that the company should employ time series decomposition forecasting model because it gives more accurate result with less error.*

Keywords: *Trend, Vehicle, Maintenance, Replacement, Income, Forecasting.*

1. Introduction

Vehicles and equipment are subject to deterioration due to their use and exposure to environmental conditions as a result of wear and tear of parts in relative motion and improper lubrication of the sliding parts and should be fully utilized with minimum cost of stoppage and repair (Dieter, 2003).In reality, vehicles' breakdown due to unplanned maintenance (sudden failure) will increase the repair cost and machine downtime (Nakajima, 2009). If this deterioration and breakdown is not checked it may render the vehicles unserviceable, therefore, it is necessary to attend to them from time to time, repair and recondition them so as to enhance their life economically and protect them from failure (Godwin et al 2013). This has brought the role of maintenance and replacement as an important activity in the transportation industries.

Transportation is the hub of the economy, it connects people and makes people and places accessible and enhances social, economic and cultural interactions. Along with power and communication, transport is one of the social overhead capitals which must be developed to a critical minimum level in order to facilitate investments in other sectors (Steven, 2007). Transport remains the cornerstone of civilization. As the society and economic organizations become complex, the relevance of transport grows. Besides, the demand for transport is derived, because it depends on the demand for commodities carried or the benefit of personal travel and each travel is unique in time and space (Fischer, 2010). Hence, the demand for transport services increases with the extension of the input-output relationships of an economy. In Nigeria, transport's contribution to the Gross Domestic Product is relatively low. Vehicles should be fully utilized with minimum cost of stoppage and repair. Therefore; this has brought the role of income as an important activity in the transportation industries. Forecasting is the process of making statements about events whose actual outcomes (typically) have not yet been observed (Latham 2008). A commonplace example might be the estimation of some variables of interest at some specified future date. Prediction is a similar, but more general term. Usage can differ between areas of application: for example, in hydrology, meteorology etc. 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 (Shumway, 1988). However, Nissan Urvan of Anambra State Transport Sector was used as a case study. The work forecasts the income generation of the Nissan Urvan in the Anambra State Transport Sector in order to observe the number of years the vehicles can no longer be more useful to the company. To achieve this objective, three forecasting models (Time Series Decomposition Analysis Model, Winter Analysis Model and ARIMA Analysis Model) were used.

Although, many forecasting approaches and models have been used in the past to forecast the income generation of transportation industries, but could not because such models were archaic, inaccurate, unrealistic and inconsistent which cannot estimate some variables of interest at some specified future date and could not be applied to a wide variety of situations (Dwaikat, 2009).With these proposed forecasting models, income generation of transportation industries can now be more accurate, consistent, realistic and will be modeled as a function of calendar data, meteorological data and economic variables can be established with certainty and product-based organizations can now forecast demand to minimize the cost of inventory while ensuring that their clients have access to their products. The objective of the study is the application of some selected forecasting techniques to forecast the income generated by Nissan Urvan of Anambra State Transport Sector.

2. METHODOLOGY

The research method used is the case study of the income generated by Nissan Urvan vehicles in Anambra State Transport Sector. The data on income generated by Nissan Urvan from 2005 to 2014 were used as actual data and was predicted up to 2019 using forecasting models for the planned period years. The data collected were analyzed using Trend Analysis Model, Winter Analysis Model and ARIMA Analysis Model.

3. METHOD OF DATA ANALYSIS

3.1. Time Series Decomposition Analysis Model

$$F_t = bt + a \quad (1)$$

Where t = Specified number of time periods from t=o

F_t =Forecast for period t

a =Value of F_t at t = 0

b = Slope of the line

$$b = \frac{n\sum ty - \sum t \sum y}{n\sum t^2 - (\sum t)^2} \quad (2)$$

$$a = \frac{\sum y - b\sum t}{n} \text{ or } \bar{y} - b\bar{t} \quad (3)$$

Where, n = Number of periods

y = Value of the time series

3.2. Winter Modeling

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

T_t=Trend estimate at time t

F_t=Exponential average at time t

β=fractions,

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

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

$where F_t$= 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

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

f_{t+1}= Winter Forecast

3.3. ARIMA (Auto-Regressive Integrated Moving Average)

In terms of y, the general ARIMA forecasting model is:

$$\hat{y}_t = \mu + \phi_1 y_{t-1} + \ldots + \phi_p y_{t-p} - \theta_1 e_{t-1} - \ldots - \theta_q e_{t-q} \quad (8)$$

$\mu = constant$

θ's= moving average parameters

p ≥ 1= some number MA terms or AR terms

e= errors

Y_t =Forecast for period t

ϕ= slope coefficient

4. DATA PRESENTATION

Table 1 shows the raw data collected from the case company (i.e.Anambra State Transport Sector).

Table1. *Data of Nissan Urvan vehicle Income Generated(x100)*

S/N code	Years	Income Generated Data
1	2005	19,690
2	2006	22,500
3	2007	25,200
4	2008	28,150
5	2009	30,300
6	2010	32,400
7	2011	33,600
8	2012	25,900
9	2013	39,950
10	2014	40,050

Source: *Anambra State Transport Sector*

5. ANALYSIS AND RESULTS

Table 2 shows the analysis of the time series decomposition. Time series decomposition reveals the influence of the seasonality and trend in the data for over the period under investigation. The trend shows the future increase or decrease in the data under investigation, while the seasonal influence shows the effect of the seasonality in the data.

Table2. *Time Series Decomposition for Nissan Urvan (Income Generated)*

Year	Time Code	Nissan Urvan (Income Generated)	Trend	Seasonal	Detrend	Deseason	Predict	Error
2005	1	98073	99149.5	0.99681	0.98914	98387.0	98833.0	-760.03
2006	2	97824	97186.6	1.00319	1.00656	97512.8	7496.8	327.19
2007	3	96000	95223.8	0.99681	1.00815	96307.4	94919.9	1080.10
2008	4	95150	93261.0	1.00319	1.02026	94847.3	93558.6	1591.38
2009	5	90200	91298.1	0.99681	0.98797	90488.8	91006.8	-806.76
2010	6	88500	89335.3	1.00319	0.99065	88218.4	89620.4	-1120.43
2011	7	86100	87372.5	0.99681	0.98544	86375.7	87093.6	-993.62
2012	8	84897	85409.6	1.00319	0.99400	84626.9	85682.2	-785.23
2013	9	83400	83446.8	0.99681	0.99944	83667.0	83180.5	219.51
2014	10	83000	81484.0	1.00319	1.01861	82735.9	81744.0	1255.96

Table 3 shows the forecasting results of the data using time series decomposition analysis. The forecast shows future five years income generated in the aforementioned company using their Nissan Urvan product.

Table3. *Forecasting Results of Time Series Decomposition*

Period	Forecast
2015	79267.4
2016	77805.8
2017	75354.2
2018	73867.7
2019	71441.1

Figure 1 reveals the results of time series decomposition analysis. It shows the trend of the data, fitness of the data, actual data plot, forecasting results of the data and the accuracy measures in the data. The graph also shows that as the year increases the income generation decreases and vice versa.

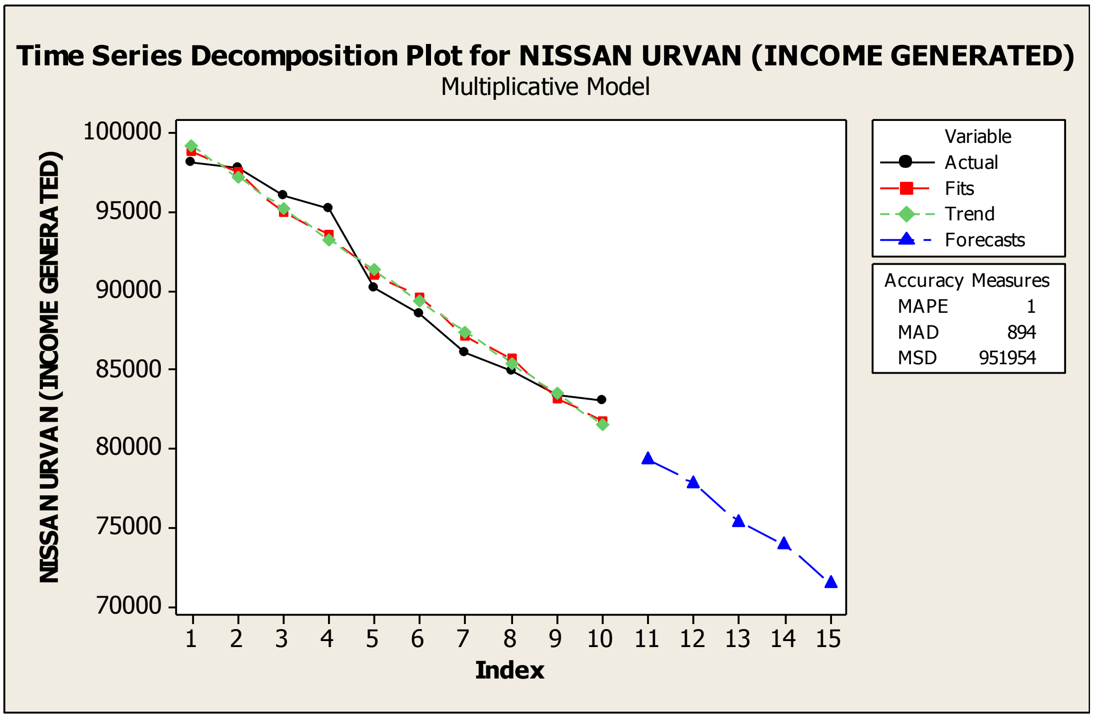

Figure1. *Time Series Decomposition Plot for Nissan Urvan (Income Generated)*

Figure 2 shows the component analysis of the data. It reveals the influence of adjusted seasoning and detrends of the data.

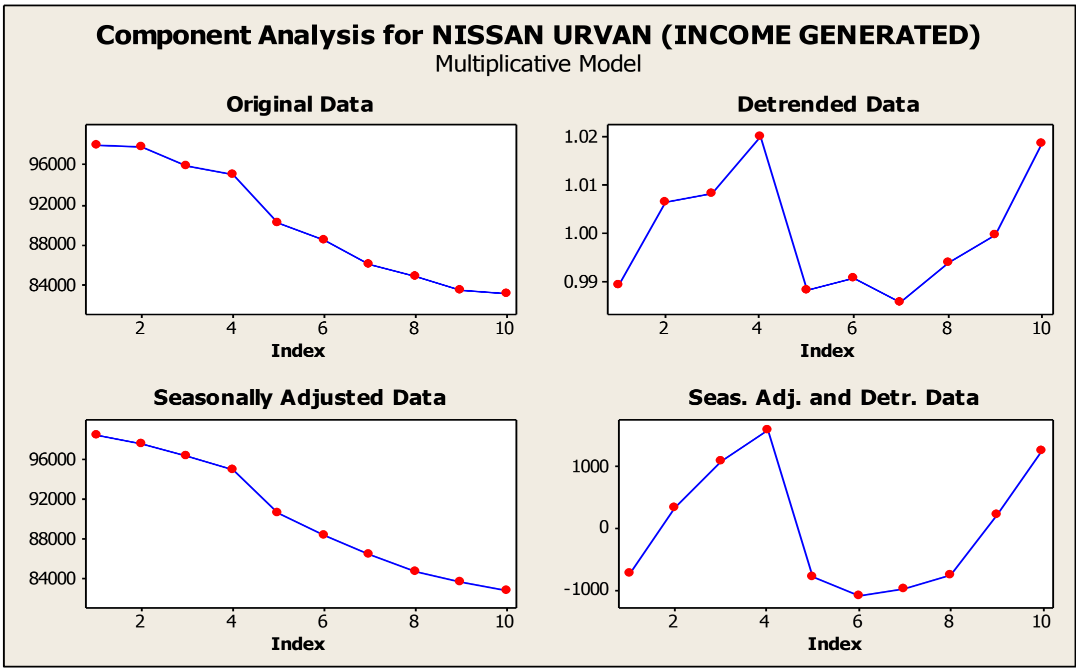

Figure2. *Decomposition - Component Analysis for Nissan Urvan (Income Generated)*

6. Winters' Method for Nissan Urvan (Income Generated)

Table 4 reveals the analysis of winters' method of forecasting in the aforementioned case company using Nissan Urvan product. It reveals the smooth variables, the predicted variables and the estimated error in the data.

Table4. *Analysis of Nissan Urvan using Winters' Method*

Year	Time	Nissan Urvan (Income Generated)	Smooth	Predict	Error
2005	1	98073	99574.9	98513.9	-440.88
2006	2	97824	98099.6	97024.5	799.48
2007	3	96000	97437.6	96391.7	-391.70
2008	4	95150	96189.6	95129.4	20.58
2009	5	90200	95194.0	94134.0	-3933.96
2010	6	88500	93291.1	92074.5	-3574.50
2011	7	86100	90798.1	89446.8	-3346.81
2012	8	84897	88767.3	87282.3	-2385.32
2013	9	83400	86291.5	84720.5	-1320.52
2014	10	83000	84585.7	82959.3	40.66

Table 5 shows the forecasting results of the data using winters' method of analysis. The forecast shows future five years income generated in the aforementioned company using their Nissan Urvan product.

Table5. *Forecasting Results of Winters' Method*

Year	Time Code	Forecast	Lower	Upper
2015	11	81015.3	77033.0	84997.5
2016	12	79724.3	75679.7	83769.0
2017	13	77779.0	73664.8	81893.2
2018	14	76474.7	72284.1	80665.2
2019	15	74542.6	70269.2	78816.1

Figure 3 reveals the results of winters' method analysis. It shows the trend of the data, fitness of the data, actual data plot, forecasting results of the data, smoothing constants, 95% probability confidence level in the forecasting limits and the accuracy measures in the data.

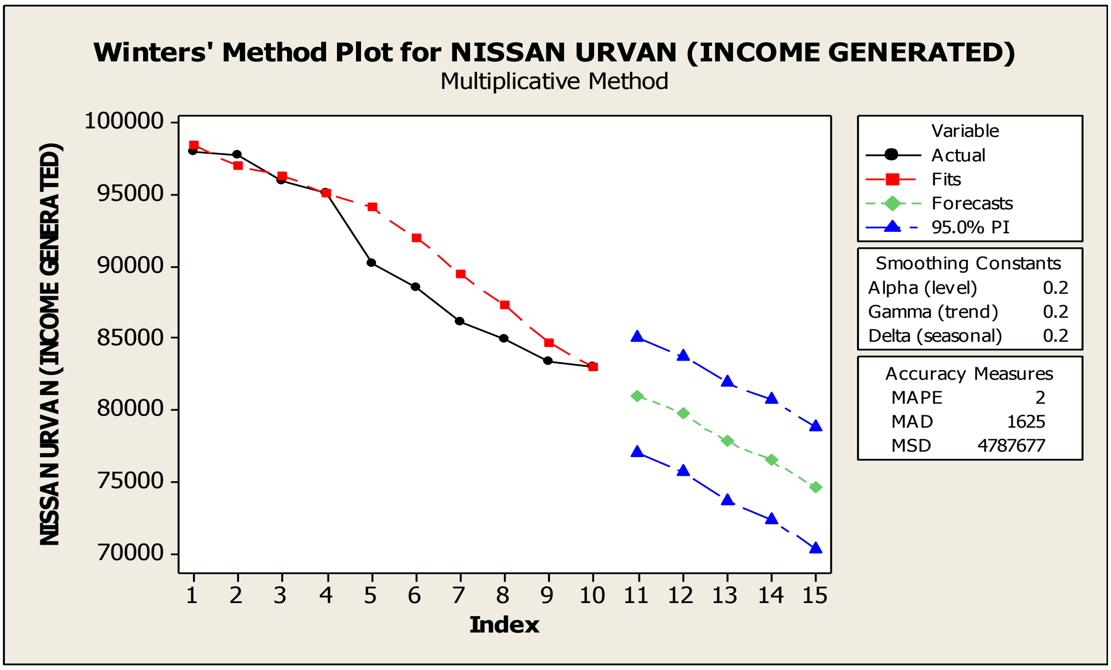

Figure3. *Winters' Method Plot for Nissan Urvan (Income Generated)*

7. ARIMA Model: Nissan Urvan (Income Generated)

Table 6 shows the iterations of the ARIMA techniques. The result shows that the iteration table could not converge after 25 iterations.

Table6. *Estimates at each iteration*

Iteration	SSE	Parameters					
		Parameter 1	Parameter 2	Parameter 3	Parameter 4	Parameter 5	Parameter 6
0	382569526	0.100	0.100	0.100	0.100	0.100	0.100
	90314.500						
1	258682003	-0.050	0.179	0.149	0.018	0.195	0.238
	90778.850						
2	185961866	-0.200	0.217	0.229	-0.078	0.262	0.344
	90935.808						
3	139351884	-0.350	0.263	0.329	-0.220	0.313	0.431
	90984.678						
4	106347022	-0.500	0.280	0.448	-0.366	0.378	0.507
	91018.970						
5	84963141	-0.650	0.237	0.557	-0.484	0.482	0.581
	91026.339						
6	75961601	-0.800	0.109	0.586	-0.522	0.586	0.638
	90906.676						
7	71234165	-0.823	-0.041	0.501	-0.463	0.573	0.618
	90835.462						
8	65651784	-0.896	-0.191	0.404	-0.421	0.543	0.579
	90842.324						
9	60579037	-0.971	-0.341	0.299	-0.385	0.507	0.540
	90936.386						
10	56329059	-1.056	-0.491	0.188	-0.361	0.461	0.506
	91130.684						
11	52692540	-1.150	-0.641	0.072	-0.370	0.399	0.487
	91504.350						
12	50684254	-1.210	-0.719	0.009	-0.410	0.349	0.483
	91913.245						
13	49312697	-1.272	-0.803	-0.051	-0.435	0.302	0.460
	92289.411						
14	48015439	-1.310	-0.859	-0.097	-0.480	0.252	0.448
	92676.104						
15	46300966	-1.379	-0.953	-0.164	-0.514	0.183	0.407
	93134.893						
16	43014368	-1.418	-1.012	-0.231	-0.606	0.061	0.357
	93728.318						
17	38615776	-1.464	-1.075	-0.301	-0.674	-0.089	0.269
	94275.460						
18	34421721	-1.470	-1.079	-0.340	-0.745	-0.239	0.188
	94675.585						
19	30525942	-1.473	-1.078	-0.374	-0.809	-0.389	0.105
	95046.850						
20	27063381	-1.481	-1.085	-0.408	-0.866	-0.539	0.021
	95430.560						
21	24065685	-1.497	-1.115	-0.451	-0.921	-0.689	-0.063
	95853.605						
22	21556091	-1.520	-1.176	-0.511	-0.969	-0.839	-0.148
	96304.428						
23	19692591	-1.533	-1.266	-0.603	-0.992	-0.989	-0.237
	96687.472						
24	18368366	-1.505	-1.382	-0.753	-0.927	-1.128	-0.331
	96831.829						
25	17792468	-1.534	-1.521	-0.850	-0.896	-1.197	-0.328
	96776.194						

Table 7 shows the coefficient of the model used to forecast the future result. The method develops six parameters to estimate the coefficient. The table also reveals the significance level of the six estimated parameters for the analysis of the results in ARIMA technique.

Table7. *Final Estimates of Parameters*

Type	Coef	SE Coef	T	P
MA 1	-1.5340	0.5508	-2.79	0.069
MA 2	-1.5211	0.9992	-1.52	0.225
MA 3	-0.8497	0.7602	-1.12	0.345
SMA 2	-0.8963	0.9365	-0.96	0.409
SMA 4	-1.1975	0.7628	-1.57	0.214
SMA 6	-0.3278	1.2199	-0.27	0.806
Constant	96776	1938	49.94	0.000
Mean	96776	1938		

Where; MA = Mean Average, MA = Square Mean Average, SE = Square error, T = Critical Point, P = Parameters.

Table 8 shows the forecasting results of the data using ARIMA method of analysis. The forecast shows future five years income generated in the aforementioned company using their Nissan Urvan product.

Table8. *Forecasts from period 10*

Year	Time Code	Forecast	Lower	Upper
			95% Limits	
2015	11	86053	81488	90618
2016	12	89557	81198	97916
2017	13	92127	78283	105971
2018	14	93646	76477	110816
2019	15	94793	74022	115564

Figure 4 reveals the results of ARIMA method of analysis. It shows the actual data plot and forecasting results of the data.

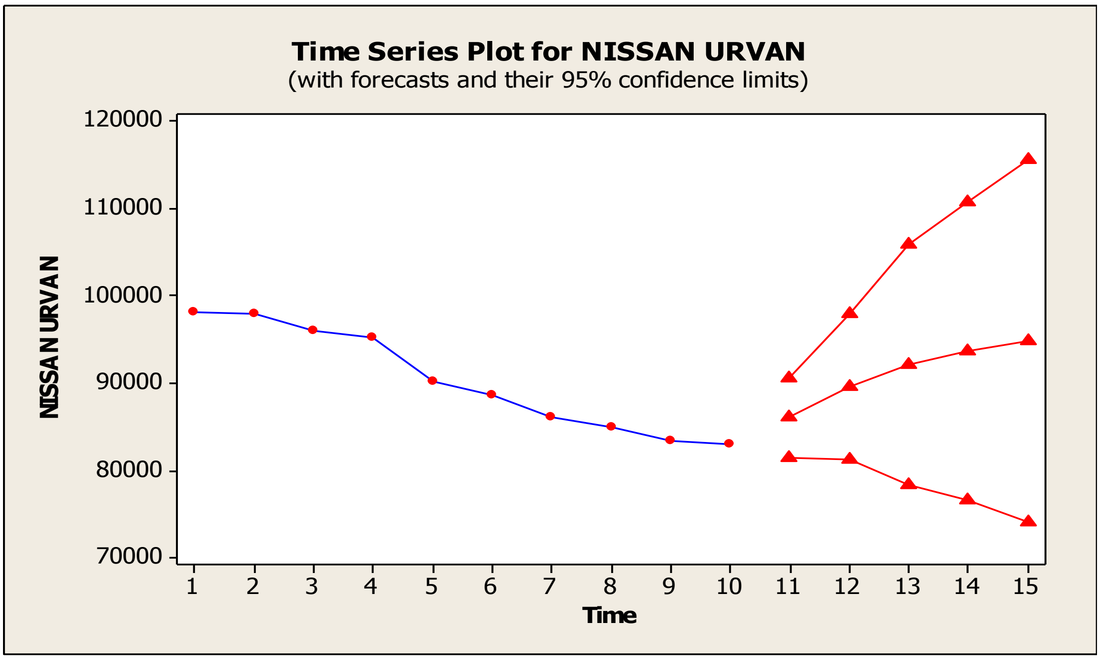

Figure4. *Time Series Plot for Nissan Urvan*

Table 9 is the combination of the winters' forecasting results, ARIMA forecasting results and Decomposition forecasting results for future five years of the case company.

Table9. *Forecasting Results of the Income Generated in Nissan Urvan*

Years	Forecasting Results		
	Winter Method	**Decomposition Method**	**ARIMA Method**
2015	81015.3	79267.4	86053
2016	79724.3	77805.8	89557
2017	77779.0	75354.2	92127
2018	76474.7	73867.7	93646
2019	74542.6	71441.1	94793

8. Discussion

The discussions of the results were based on the data, analysis of the data, charts developed, tables and the results of the data. Table 1 shows the yearly data for income generated from the Nissan Urvan in Anambra State Transport Sector which form the major data used for the analysis and the forecast while Table 9 displays the forecasting results of the income generated in Nissan Urvan from the three models used. The data were analyzed on yearly basis to observe it's seasonal and trend influence on the data as demonstrated in figures (1, 2, 3, 4). The analysis also reveals that the results were within 95% confidence limit as shown in figure 4. It was also observed that there are residuals in the data, the upper and lower boundaries in each of the forecast techniques (i.e. time series decomposition method of analysis, winter's method and ARIMA method of forecasting) selected to run this analysis. From the forecasting results it is more advisable and recommendable to make use of the time series decomposition method in this research than the winter method and ARIMA method because; it is more accurate with less error than the other two methods and secondly, time series decomposition method incorporate both trend and seasonality in its model. However, time series decomposition forecasting results were recommended.

9. Conclusion

The development of an optimum maintenance and replacement strategies in transportation industries that integrates adequately all the key maintenance requirements is critical to the attainment of high performance by supporting improved transportation functions. In general, three forecasting techniques have been looked into from the view point of how best to separate trends and growth cycles, that is, fluctuations in data adjusted for long term and seasonal movements. The most difficult problem for these forecasting models employed in this research work arises out of the residuals in the data, the upper and lower boundaries in each of the forecast techniques. However, it is therefore recommended that further improvement can be made on the software programme such that it reads data from a specified data resource. This will help transport operators to improve on income generation. Having observed the forecasting results, it is also recommended that the case company should be more mindful of their vehicles maintainability and repairs for it might be the cause of continuous dropping in generated income revenue of the Nissan Urvan vehicles. More so, it is recommended that the replacement of the vehicles when the need arises should be seen as critical.

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