Forecasting Road Accident using Least Square Method: A Case Study of Lagos State, Nigeria

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Abstract
The researchers use Least Square Method to forecast Total Road Accident (TRA) and Total Person Killed (TPK) in Lagos State. It was observed that the trend of TRA and TPK continue to reduce and in years to come, it will further reduce the more. The researchers further observed that Government effort in Lagos State is a major factor. It is however recommended that the State Government should not put an end to the developmental programme going on in the state especially in the area of transportation.
Keywords: Death, Accident, Least Square Method, Transportation, Lagos State, Forecasting, Seasonal.

INTRODUCTION

Deaths resulting from road accidents have become a big problem in the under developing countries like Nigeria. The problem grows over time, and has been related to both increase in the number of people plying the road and condition of the road. In Nigeria road accidents reported in year 2002 alone in injury of about 22,970 people who became permanently disabled, and 9,240 died.

Unfortunately, about 80% of the World accidents occur in the developing countries like Nigeria. Road accident are very critical not only because they result in harm and eventual disability or death of people, but also because they result in waste of resources such as those hospital services that could be used for other purposes, and loss of savings and working days of the accident victims which may improve the future life style of their families. Also psychological, road accident can result into low intelligent quotient and permanent disability etc. Every year, millions are killed on the roads in under developing countries and some other millions are seriously injured. The most dominant factor in understanding the chain of events leading to an accident is the human factor and driver's perceptions of the issue are necessary for interventions to be effective. Some countries have provided creative methods of educating people. Internet "talk – back" to accident news are used as an innovative methods that supplement qualitative techniques such as focus group or interviews.

Also, country like France has paid special attention to road accident in order to improve safety on their roads. France has managed to reduce road death from the year 2002 to year 2003 by 20% and plans to reduce accident by 30% before year 2020 is reached (Mohammed, 2008)**.** The same thing is planned and targeted in other developed countries.

Death due to road accident in Nigeria especially Lagos State in Nigeria has become more alarming because of the population size and the traffic density. There has being a serious and fatal cases of death due to road accident in the last few years in Lagos State.

In Nigeria, agencies like Nigeria Police Force (NPF), Federal Road Safety Commission (FRSC) and Lagos State Road Traffic Management Authority Officers (LASMA) and a host of some other non-governmental organization are charged with the responsibility of this ugly situation in the State.

In summary, cases reported on road accidents disaggregated by state for 2002 – 2007 shows that year 2002 recorded the highest reported case in Nigeria with 22,395. In 2002, Lagos State had highest number of cases with 4,527 but record comparatively low figures of 629, 620 and 413 respectively in 2005, 2006 and 2007. Also the number of persons killed on road accidents, state disaggregation shows that in 2002, Lagos recorded the highest number of death with 4,527 people.

However, road accidents are categorized into fatal, serious and minor road accidents. Lagos State recorded the highest number of case between 2002 and 2007 with significant decline in 2005, 98 fatal, 301 serious and 230 minor cases when compared to 668, 1342 and 868 respectively in 2004.

However, many of these accidents occur in some major roads in Lagos and its neighbouring States. These include Lagos/Ibadan expressway, Lagos/Abeokuta expressway, Oshodi/ Apapa express way, Ketu / Mile

2 road, third Mainland Bridge and some others.

In order to put a stop or reduce death due to road accident in Lagos and its environment the State Government has cited the importance of road safety to the agencies involved. The Government also working in the areas of non – motorized vehicle accidents, motor cycle helmet usage, design standards and operational practices, road safety in and around schools, establishment of state own drivers' school in different locations within the state and other research into driver evaluation methods.

In Lagos State, determinant of road accident have been as follows:

1. **ENVIRONMENTAL CAUSES:** Such as weather related causes; including harmattan period and slippery road which resulted in deaths of hundreds along Lagos /Ibadan express way and bad road.
2. **BEHAVIOURAL CAUSES:** Such as carelessness of drivers about traffic signals or giving right to road according to the international conventional rules, overcrowded vehicles such as one motorcycle carrying a family of 5 people; the father in the driver seat, and behind him both his wife and adult daughter and in front of him are 2 boys less than 6 years of age each, and insufficient training for commercial vehicles such as truck and buses on road.
3. **MECHANICAL CAUSES:** Such as driving vehicles that do not observed vehicle safety conditions, many cars do not have working speedometer or rain wipers, bad headlamps, mechanical faults from part of the machine parts.

The researchers tends to use this paper to beam light on death due to road accident in the past, present and to be able to forecast for the future because of the mega city status which the state is aiming at attaining and this will help the State Government at planning very well in order to reduce casualties and the number of death.

PURPOSE OF STUDY

This paper investigate the trend of road accident in Lagos State of Nigeria and some of the factors leading to road accidents and how to prevent them, also peering into the future to know level of death due to road accidents in Lagos State using Time Series. This is necessary because of:

✓ The population of the State.
✓ The economic status of the State.
✓ The population size of the State.
✓ The influx of the people to the State.

There is serious need to address this accident rate in the State so that the State can still be relevant in his commercial and mega city status.

LITERATURE REVIEW

Forecasting techniques is a technique use as an aid in controlling past and present operations in planning for future needs. Though various forecasting methods have been devised, they all have one common goal of predicting the future outcome of a time data.

The decision makers, however needs to be sure of how safe and reliable the results from a model are, in affecting the decision made.

When the causal forces are contrary to the trend in the historical series, forecast errors tends to be large (Armstrong and Collopy, 1992). Since forecasting is an error prone activity, it is very important for the researcher to make use of the best forecasting method in order to reduce the level of error which will in return reduce the level of making a wrong decision.

However, time series forecasting methods involve the projection of future values of a variable based entirely on the past and present observations of that variable.

A time series is a set of quantitative data that are obtained at regular periods over time. This may be the daily closing prices of a company listed on stock market, sales in a particular store which can be in days, weeks, months or in years; it can also be annual sales revenues of a particular firm.

There is a periodic, seasonal or cyclical effects exhibited in many socio-economic and environmental time series. Mohamed (2008) used linear model to road accident in Pakistan. The time series data needs to be checked before embarking on any forecasting proper, so that it can be confirmed that the method applied can give best result with minimum level of error. Some decades back, many researches started using time series for forecasting road accident and death due to road accident in the world.

Abdel H.A. (2005) studied road accident in Kuwait. He used an Autoregressive Integrated Moving Average model and compared it with the Artificial Neutral Network (ANN) Analysis to predict fatalities of the Road Traffic Accident in Kuwait. He concluded that ANN was better in case of long term series without seasonal fluctuations of accidents or auto correlation components.

David, Gary, Swenson, and Tait (2006) used a probabilistic model to study if an event was a cause of a road accident. They used video recordings of the accidents information about vehicles involved before and during the collision. The collected information was used to estimate each driver's initial speed, following

distance, reaction time and braking rate. The Brills model of rear-end accidents was used to stimulate what would have happened, other things being equal, had certain driver actions been other than they were. They studied 3 accidents, they found evidence that short following headways by the colliding drivers were probable causal factors for the collisions, at least one driver ahead of the colliding vehicles probably had a reaction time was longer than his or her following headway, and if the driver's reaction time been equal to his/her following headway, the rear-end collision probably would not have happened.

Ozkan, Turker etal (2005) provided an interesting studies about road accident in 6 countries (Britain, Netherlands, Finland, Greece, Iran & Turkey) the study hypothesized that there were no cultural differences between drivers and those 6 countries. The study investigated the asymmetric relationship between the driver safety skill and accident involvement. The authors had a sample of 242 drivers chosen from each of the six countries, and tried to make the sample close in terms of age and sex. The study found that safety considerations among drivers were higher in Northern and Western European countries than other countries.

The study found that the safety skills in Greece, Iran, and Turkey were relatively lower than those in the other countries in spite of high factor similarity found in driving skills. This study concluded that a negative relationship existed between driving safety skill and the number of accidents in Greece and Iran.

Clarke, David etal (2005) provided a statistical profile for accidents on road of Nottingham, Britain. The study used statistical methods to compare groups of drivers. The youngest and oldest groups of drivers were found to be over–represented in the junction accidents, and were the least likely to stop before turning. The young drivers had particular problems turning onto major roads. Women are more likely than men to stop before turning; they tended to have their collisions with other women and they were under – represented as drivers of the non – turning vehicles.

Keay, Kevin and Simmond, Lan (2006) investigated the impact of rainfall on daily road accidents in the metropolitan area of Mel borne, Australia, over 1987 – 2002. Their analysis show that the effect of rainfall across the year's. Four seasons showed a tendency for larger values in autumn with smaller values in spring. For daily (day – time and night - time) cases there was an approximate 40% decrease in road accident. They obtained a conservative estimate of relative risk of an accident in wet conditions based on a matched – pair analysis of dry and wet periods, and found that the risk was greater than unity in almost all cases suggesting that the presence of rainfall consistently represented a driving hazard. Rainfall occurring after a dry spell had an enhanced effect on the wad accidents count as the spell duration increased.

Brisjs etal (2007) provided a Bayesian Model for ranking hazardous road sites. They discussed the importance of identifying the sites that are more dangerous than others in order to help in better scheduling road safety policies. They proposed a methodology for ranking sites according to their level of hazard. This model made use and the number of fatalities, as well as the number of slight and serious –injuries. Moreover, the model included the use of a cost function to rank the sites with respect to their total expected cost to society. Accident data from 519 intersections in Belgium were used to illustrate the methodology proposed.

Factor, Roni, Mahalel and David, Yair, Gad (2007) discussed a sociological model to explain collisions between two drivers or more. They called those collisions social accidents. They discussed empirical findings from prior studies and explained the road accidents through sociological theories. Sociological theory posts that social groups have unique cultural characteristics, which include a distinctive world view and ways of operating that influences its members. These cultural characteristics may cause drivers in different groups to interpret a given situation differently, therefore; they will make conflicting decisions that may possibly lead to road accidents. The proposed model may contribute to an understanding of the social mechanism related to interaction and communication among drivers by presenting new directions for understanding accidents and collisions. The paper concludes with suggestions for future research that will employ the model to asses it's predictive and practical utility.

Dankmare, Bohning etal (2004) studied that impact of driver's drug use on road accident in Thailand they used the classic capture – recapture statistical model as in the conventional approach. A population – based study was conducted that utilizes all data on treatment episodes of drug users from all 61 health treatment centres in the Bangkok metropolitan region to estimate the size of drug use in the Bangkok metropolitan region and covered a period of 3 months in 2001. They used data from drug users during the period. By their proposed model showed excellent goodness – of fit, unspecified for drug type and also it specified for the major drug types which allowed the prediction of the unobserved number of drug users in a realist way.

RESEARCH METHODOLOGY

The data used for this research work is a secondary source of data; because it was extracted from publication of National Bureau of Statistics (NBS) tilted Vital Statistics of Nigeria and Nigeria Police. Statistical figures on total number of road accident, person injured, person killed were extracted from these publication.

Various methods listed in the previous section were used and least square method was adjudged the best method. Time Series Analysis (Least Square Approach) is used for the analysis to forecast into the future road

accident and death due to road accident in Lagos State, Nigeria.

LEAST SQUARE METHOD
In the linear model, we intent to fit a straight line model:

$\hat{y} = b_o + b_1 X_i$ (1)

The values of b_o and b_1 are calculated from the data using a computational formula.
The predicted value is obtained using (1) which can be used to compute:

$\sum_{i=1}^{n} (Y_i - \hat{y})^2 = \text{minimum}$ (2)

This is referred to as residual.

DATA
The data for the research work was obtained from Federal Bureau of Statistics and Nigerian Police Force Headquarter from 1991 to 2010, covering 20 years.

FINDINGS AND INTERPRETATION
The researcher discovered that there is a strong relationship between Total Road Accident (TRA) and Total People Killed (TPK), the correlation value is $\rho = 0.849$. The result suggests that there is a strong positive relationship between the two variables.
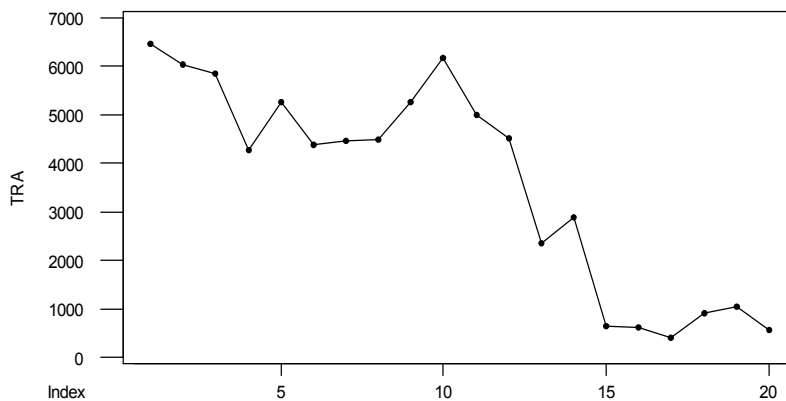


Figure 1: Trend Line Of Total Road Accident

There was a sharp reduction in the number of Road accident in 1992 through 1994 and this level was maintained through until 2010 when there was strong increase in the number of Road Accident as a result of Volume of Traffic in Lagos State. However, there was sharp and significant reduction since then till 2010.

The major contribution or cause of this sharp reduction could be attributed to the effort of the Lagos State Government at fixing the state of facilities in Lagos State to Mega City Standard. Also, the implementation of traffic laws has made it very difficult for Motorists Plying Lagos Roads to be extra careful in their attitude anytime they are on wheel. Moreover, all other Motorists from other States find it difficult to cope with the Traffic Laws, making it impossible for some of them to drive in Lagos State.

Figure 2 below shows the Total Person Killed due to road accident in Lagos State within the year under consideration. It is observed that there was fluctuation in the number of person killed from 1991 to 2001 but 2002 witness the highest number victim with 4,527 people and since then the number has being reduced to minimum with 125 people in 2010.
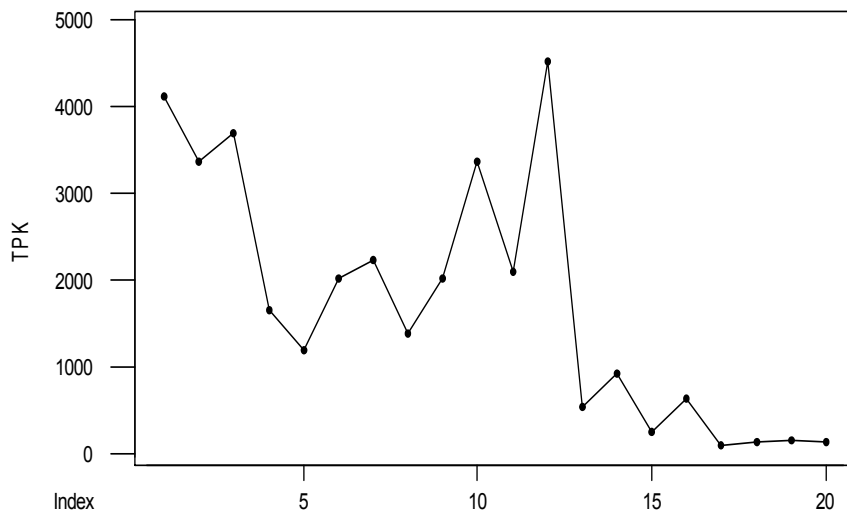
Figure 2: Trend Line of Total Person Killed
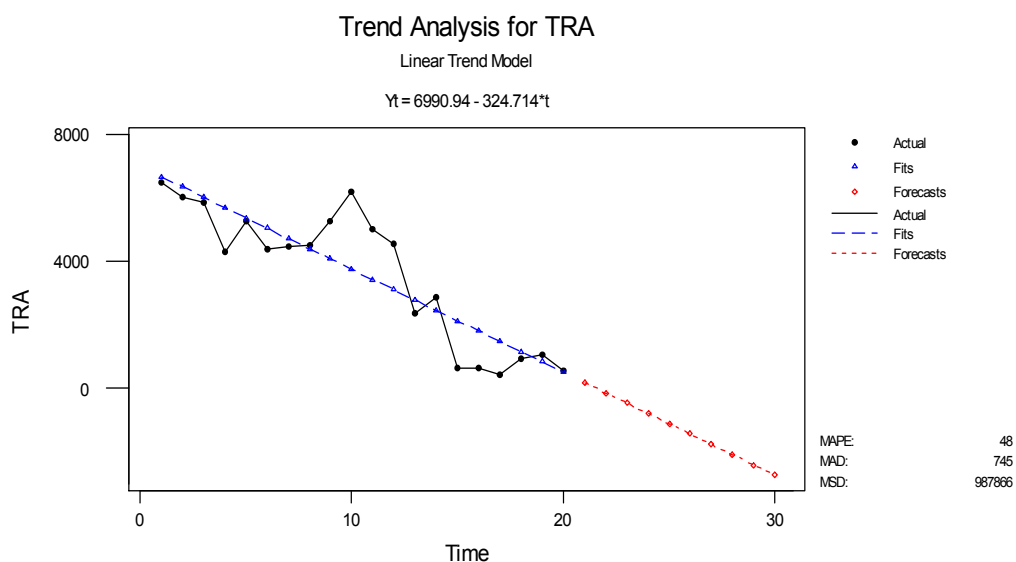
Figure 3: Trend analysis for TRA
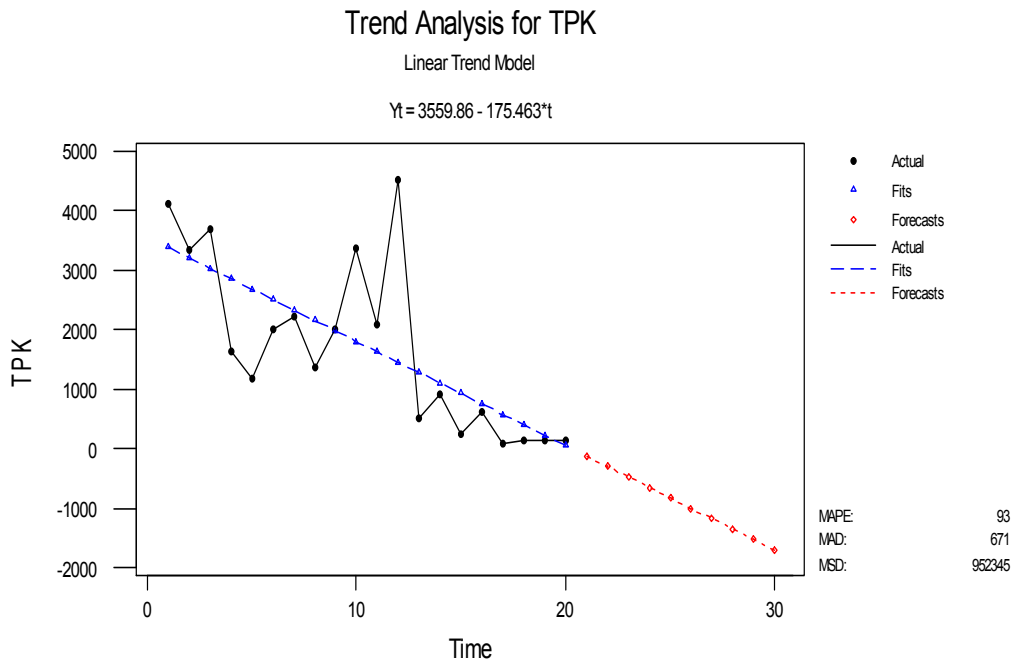
Row Period Forecast
  1   21   171.96
  2   22   -152.76
  3   23   -477.47
  4   24   -802.18
  5   25 -1126.90
  6   26 -1451.61
  7   27 -1776.32
  8   28 -2101.04
  9   29 -2425.75
 10   30 -2750.46

The figure 3 reveals the forecasting trend using the model:
 Yt = 6990.94 - 324.714*t
The model was used to forecast for the next ten years; starting from 2011. The result further reveals that the rate of TRA will continue to reduce every year, except for 2011 which gives positive value of 171.96.

Figure 4: Trend analysis for TPK

Row Period Forecast
  1   21   -124.86
  2   22   -300.33
  3   23   -475.79
  4   24   -651.25
  5   25   -826.72
  6   26 -1002.18
  7   27 -1177.64
  8   28 -1353.11
  9   29 -1528.57
 10   30 -1704.03

The figure 4 reveals the forecasting trend using the model:

$Yt = 3559.86 - 175.463*t$

The model above is used to model TPK in road accident in Lagos State; it also shows that total person killed will continue to decrease every year.

CONCLUSION AND RECCOMMENDATION

The researchers observed that the trend of road accident and persons killed is very important for a state yearning for a mega status, hence the need for this research work. It also observed that the data used in this analysis does not exhibit a particular pattern over the years under consideration.

Our result also reveals an amazing result knowing the population of Lagos State. It shows that the rate of accident and total persons killed will continue to decrease in Lagos State. This development must have being due to one of the following reasons:

1. Government effort at fixing bad roads in Lagos State.
2. Proactive measure at putting an end to excesses of the transporters in Lagos State in drinking and smoking before driving.
3. Government Traffic Laws at stopping excesses of drivers and stopping incompetent drivers from plying Lagos roads.
4. The introduction of drivers' institute in every corner of Lagos State, so that drivers will have proper training before they can sit behind the wheels.
5. The introduction of Traffic Radio station with traffic officers reporting at different parts of Lagos State. This has helped road users in Lagos State to know when, where to go for their daily activities.

With all these observations, it is highly recommended that the State Government should not relent on their effort on road traffic regulations and making sure that more new road networks are constructed. It is also observed that

the state government should step up their effort at introducing new means of transportation like rail system and water transportation; these measures will help at reducing traffic on Lagos roads.

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APPENDIX I

TABLE 1: DATA ON REPORTED ROAD ACCIDENT CAUSALITIES IN LAGOS STATE 1991 – 2010

S/N	YEAR	TOTAL ROAD ACCIDENT	TOTAL PERSON INJURED	TOTAL PERSON KILLED	TOTAL CASUALITY
1.	1991	6,469	7,103	4,110	11,213
2.	1992	6,037	5,495	3,356	8,881
3.	1993	5,844	4,455	3,680	8,135
4.	1994	4,280	2,960	1,640	4,600
5.	1995	5,276	3,329	1,185	4,514
6.	1996	4,388	2,422	2,017	4,439
7.	1997	4,460	2,836	2,223	5,059
8.	1998	4,498	2,320	1,379	3,699
9.	1999	5,276	3,724	2,011	5,735
10.	2000	6,174	3,960	3,361	7,321
11.	2001	4,997	2,661	2,091	4,752
12.	2002	4,527	2,360	4,527	6,887
13.	2003	2,359	1,112	521	1,633
14.	2004	2,878	2,191	913	3,104
15.	2005	629	292	249	538
16.	2006	620	693	620	1,013
17.	2007	413	137	84	221
18.	2008	917	181	124	305
19.	2009	1,033	254	134	388
20.	2010	554	194	125	319

Source: Federal Office of Statistic 1997 to 2007, Police Headquarter Annex Lagos State

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