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TIME SERIES ANALYSIS OF ROAD ACCIDENTS IN KOGI STATE: (A CASE STUDY OF LOKOJA-ABUJA ROAD FROM YEAR 2000-2010)

Dr Hassana Oseiwu Ali
College of Education
Salem University, Lokoja Kogi State
Email: hassanaali53@yahoo.com

ABSTRACT

The major objective of this research is to examine the variation pattern of traffic accident in Kogi State, a case study of Lokoja-Abuja Road. The study used mostly secondary data; accident record and vehicular situation were obtained from the Federal Road Safety Commission. The data were obtained for a period of eleven (11) years from 2000-2011. Statistical analysis was done using the moving average method to smoothing the time series and the least square method was used to predict the reported case of Road Traffic Accident which showed that there is an increase in the rate of Road Traffic Accident. Analysis of variance (ANOVA) was also carried out at 95%, and 99% level of significant to test the coefficient of (β) which the test showed that the trend line fit. Hence, based on the research, it means that the trend equation may be used to forecast the cause of Road Traffic Accidents (RTAs). The study finally made some recommendation to improve Road Safety in the country.

Keywords: *Time Series, Road Accident*

INTRODUCTION

Road transportation is by far the commonest means of transportation in Nigeria compared to other means; air, rail and water. The technology has made life easy compared to the hitherto means of transportation such as animals. When a device is used to move an item; object or human from one location to another is called transportation. Common forms of transportation include planes, trains, automobiles, and other two-wheel devices such as bikes or motorcycles. The lawlessness in our society has provided an enabling ground for lack of obedience to road rules and regulation. The causes of road traffic accidents are conventionally grouped into human, mechanical and environmental factors. The human factor accounts for up to 90% of accidents, in fact the mechanical and environmental factors are just subordinate or less important. Lack of knowledge of road signs and regulations, illiteracy, health problems like poor eye sight, excessive speeding, alcoholism, drug abuse, arrogance, over-confidence are some of the human factors too numerous to mention that cause Road Traffic Accident (RTAs). Mechanical factors include poor vehicle maintenance, tyre blowouts, poor lights, un-roadworthy vehicles, broken down vehicles on the road without adequate warning sign etc. Rainfall, sun reflection, storm, heavy wind, spot holes, un-tarred roads are some of the environmental conditions that contribute to RTAs.

Nigerian roads despite the current effort of Road Maintenance Agency are still in very bad states especially those leading to rural areas. It is a known fact that some very rural areas do not even have un-tarred roads that could link them to the nearest town making pregnant women and other patients die in the cause of using animal transportation means. According to Federal Road Safety Commission not less than 87,320 road users lost their lives between 1990 and 2001 alone, most victims being between 20-40 years of age bracket (Umar; 2013). In fact, Road Accident in Lokoja –Abuja Road area in Kogi State has become more difficult due to the recklessness way of driving, narrowness of the road, and inappropriate police checking point. Lokoja-Abuja road is also the only major road that links the north and the south together, as a result of this, it's always busy and this leads to a lot of crashes and traffic congestion. Despite the important of transportation, its operation constitutes a lot of risk problem such as noise pollution, traffic congestion etc. It was estimated that the number of registered vehicles in Nigeria rose between 1988 – 2004 from 600,000 to 6,000,000 (Umar; 2013). Despite the happiness and change of quality of family lives associated with owning a vehicle, its possession has made so many families bereaved of their breadwinners or lovely ones due to unprecedented rate of Road Traffic Accidents (RTAs).

Time Series

A time series is a collection of observation made in sequence of time. It may also be refers to as a set of observations taken at specific time, usually at equal intervals or Time series analysis refers to problems in which observations are collected at regular time intervals and there are correlations among successive observations. The total production of goods in the country over a number of years, daily closing prices of shares on the stock exchange, hourly temperature recordings are all common example of time series. The units of time series could be hourly, daily, weekly, monthly, yearly. Time series are statistical data that are described over time. Time series analysis does enables the structure of the data to be understood, trends to be identified and forecasts made. According to Ali (2010), a time series consist of data that are collected, or observed over successive increment of time.

Lin, Keogh and Lonardi (2003), defined a time series as a sequence of data points, measured typically at successive points in time spaced at uniform time intervals. Time series are very frequently plotted via line charts. Time series are used in statistics, signal processing, pattern recognition, econometrics, mathematical finance, weather forecasting, earthquake prediction, and control engineering and communications engineering. Time series analysis comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values. Lin, Keogh and Lonardi (2003), time series data have a natural temporal ordering. This makes time series analysis distinct from other common data analysis problems, in which there is no natural ordering of the observations (e.g. explaining people's wages by reference to their respective education levels, where the individuals' data could be entered in any order). Methods for time series analyses may be divided into two classes: frequency-domain methods and time-domain methods. The former include spectral analysis and recently wavelet analysis; the latter include auto correlation and cross-correlation analysis.

Additionally time series analysis techniques may be divided into parametric and non-parametric methods. The parametric approaches assume that the underlying stationary stochastic process has a certain structure which can be described using a small number of parameters (for example, using an autoregressive or moving average model). By contrast, non-parametric approaches explicitly estimate the covariance or the spectrum of the process without assuming that the process has any particular structure

STATEMENT OF RESEARCH PROBLEM

One main cause has forced the researcher to have interest in the review of Road Accident study on our roads which leads to the incessant lost of lives on Abuja-Lokoja Road. As a result of this, a great need occur to further investigate the problem in order to find a better solution to remove or eradicate Road Accident.

Purpose of the study

In view of the data and information gathered, this study is meant:

- To fit a trend line and predict the rate of road accident in the subsequent years.
- To describe the various component of the time series using rate of road accident in Lokoja-Abuja Road in Kogi State from 2000-2010.
- To find out the number of accident cases reported in Federal Road Safety Commission (FRSC).

Research Questions

The research question for this project work is based on the following:

- Is there an increase or decrease in the occurrence of Road Traffic Accidents in Abuja-Lokoja Road?
- Is there any significant difference in the rate of occurrence of Road Traffic Accidents in Lokoja Abuja Road between year 2000-2011

Review of Road Accidents

According to Worley (2006), he said that road traffic accidents-the leading cause of death by injury and the tenth-leading cause of all deaths globally-now make up a surprisingly significant portion of the worldwide burden of ill -health. In his view he said that an estimated 1.2 million people are killed in road crashes each year, and as many as 50 million are injured, occupying 30 percent to 70 percent of orthopedic beds in developing countries hospitals.

He further said that that Developing countries bear a large share of the burden, accounting for 85 percent of annual deaths and 90 percent of the Disability-Adjusted Life Years (DALYs) lost because of road traffic injury. And since road traffic injuries affect mainly males (73 percent of deaths) and those between 15 and 44 years old, this burden is creating enormous economic hardship due to the loss of family breadwinners, which mean that road accident has ruin many homes. In view of this research, the word road accident is not common to Nigerian alone, it is a globally hazard. As in developed countries, driver impairment is an important component of road traffic accidents in developing countries. Driving at excess speeds, while under the influence of alcohol or drugs, while sleepy or tired, when visibility is compromised, or without protective gear for all vehicle occupants are major factors in crashes, deaths, and serious injuries.

A Road Traffic Accident (RTA) is when a road vehicle collides with another vehicle, pedestrian, animal or geographical or architectural obstacle. The RTAs can result in injury, property damage and death. RTA results in the deaths of 1.2m people worldwide each year and injures about 4 times this number (Ohakwe, Iwueze and Chikezie, 2011). In this study, a road traffic accident is defined as accident which took place on the road between two or more objects, one of which must be any kind of a moving vehicle (Jha, Srinivasa, Roy, & Jagdish 2004). Road Traffic Accidents (RTAs) are increasing with rapid pace and presently these are one of the leading causes of death in developing countries.

According to Austroads (1994), road accidents occur as a result of one, or more than one of the following factors: Human factors; Vehicle factors; Road and environmental factors. According to Vanguard (2013), it was reported that NIGERIA is reputed to have the second highest rate of road accidents among 193 countries and deaths from reckless driving are the third leading cause of death in Nigeria. In 2012, at least 473 persons died from a total of 1,115 vehicular accidents nationwide. Vanguard (2013) has shed more light to how large the road accident has been taken many lives in Nigerian. It was reported that April may go down as the worst month in terms of road accidents in 2013, and the analysis is as followed:

April 3: A luxury bus and a smaller bus crashed on the Abuja-Lokoja Road, 18 died. April 5: A petrol tanker set luxury bus and articulated vehicle ablaze at Ugbogui village on Ore-Benin Expressway, 80 people were burnt beyond recognition. April 6: At Dazigan, 11 kilometers from Potiskum, Yobe State, 20 died in an accident. April 11: 10 died on the Damaturu-Gashua Road also in Yobe State. April 14: Seven died on the Abuja-Lokoja Road, a car ran into an articulated vehicle. April 15: Five died on the Asaba-Onitsha Expressway. By the middle of April, 142 people had died from reported motor accidents, 30 per cent of the 473 deaths recorded in 2012 had been covered in only 15 days! Vanguard (2013).

The researcher in this work has now seen it clearly that Lokoja-Abuja road has contributed to most of the accident that happened in Nigeria. In the month of April 3rd 2013, vanguard reported that 18 died on the Abuja-Lokoja Road, and on that same month of April 14th, they also reported that seven died on the Abuja-Lokoja Road, which have make a total number of 25 death recorded on Abuja-Lokoja Road for the month of April, 2013.

According to Nurainie (2011), he said that human error is one of the leading causes is driver error, and this are careless and unnecessary mistakes such as falling asleep at the wheel, following other cars too closely, unsafe overtaking, speeding, not stopping at the red traffic light and other common disregards of road rules the also said that another causes of roads accident is poor road design this can happen when roadways are not constructed appropriately and lead to conditions that allow for accident to occur.

In making further research on the causes of road accident, Sangers(2013) analyzed the following causes which are as follows:

1. **Intoxication:** he said that many accidents are caused by drivers who are intoxicated from alcohol or drugs. This happened when driver got drunked before they drive, and this is what most of our drivers do which has leads to death.
2. **Driver Error:** he said that probably the largest cause of road traffic accidents currently is driver error. These are range from following cars too closely, falling asleep at the wheel, driving too fast, unsafe overtaking and many other careless and unnecessary mistakes. This is refers to as impatience of the drivers.
3. **Distraction:** distraction has also contributed majorly to road accident; this is linked to driver error but is more about the driver being distracted by something outside the car or inside the car. But even things such as changing cds, looking at your mobile phone or checking out your make up in the mirror can all cause accidents.
4. **Road Design:** Sometimes accidents are caused by bad road design. This is when a part of the road or traffic control has been poorly placed, and can lead to increased accidents in the area. If we take a good look at Lokoja-Abuja Road we will discover that narrowness of the road, slope in the area also contributed to the accidents that happened in the area.
5. **Vehicle Defects:** Sometimes a road traffic accident could be caused by a defect in the driver's vehicle. These defects can be anything from brake failure to a tire bursting. Vehicle defects can cause an accident on the road, but sometimes these defects will cause more damage in an accident caused by something else. For example

some cars will have defective airbags which do not deploy correctly, meaning people involved in accidents may suffer worse injuries. This is mostly common to many drivers in the sense that most of them find it too difficult to repair any faulty parts of their vehicle.

To reduced road traffic accident, there must be proper education and training for people which may be by the means of newspaper, radio television, and other publicity, to draw the attention of all road users both to dangers and to safe practices on the road and there should be an enforcement agency which must thoroughly test new drivers to ensure they will not be liable to cause accidents.

Concept of Time Series

Ali (2005), defined a time series as the collection of data that are collected or observed over successive increment of time. She said in order words that any variable that consists of data collected, recorded, or observed over a successive increment of time is also called time series. She also proceeds further that many variable of a vital interest to a business are measures every week, month, quarter, or year. And these variables are called time series variables.

Owen & Frank (1994), defined time series as the statistical series which tells us how data has been behaving in the past. According to him, time series gives us the value of the variable we are considering at various points in time each year for the last 15 years; each quarter for the last five years. He also said that when you look at a typical time series, the data fluctuates so much that it seems unlikely that it can help us a great deal.

Aideyan & Efuwape (2010), defined a time series as the collection of observation made in sequence of time. They also proceed further that the word “TIME” used in this context may either imply physical time, distance or any other quantity representing a process of life whose magnitude is measurable. they said that the interval of time depend on any unit of measurement which could be hourly, daily, weekly, monthly, quarterly or yearly. A time series is denoted by X_t where X_t is the observed value at time t. A time series is defined mathematically by the values Y_1, Y_2,......of a variable Y (sales of a product, etc) at time t_1, t_2,...... thus, it can be said that Y is a function of t. i.e $Y = f(t)$. Time series may also be refers as a sequence of numbers collected at regular intervals over a period of time which enable us to estimate the trend, and make reference to the future data value through forecasting. The duration of time period may be hourly, daily, weekly, monthly or annually.

Merits of time series

1. It is more reliable in term of forecasting
2. It can be used to identify trend
3. It is a useful tool to measure both financial and endogenous growth

Components of Time Series

In time series analysis, there are determinant of change, such as technology, custom of people, weather, consumer task. Therefore, there are four components of time series which are:

- Secular trend
- Seasonal variation
- Cyclical variation
- Irregular variation

Secular Trend: The trend is the long-term movement of a time series. Any increase or decrease in the values of a variable occurring over a period of several years gives a trend. It is also the general direction in which the time series appear to be going over a long interval of time. In secular trend, time series data may show upward trend or downward trend for a period of years and this may be due to factors like increase in population, change in technological progress, large scale shift in consumer's demands, etc. For example, population increases over a period of time, price increases over a period of years, are the major examples of upward trend. Also the sales of a commodity may decrease over a period of time because of better products coming to the market. This is an example of downward trend. It is denoted by T_t (Aideyan & Efuwape 2010).

Seasonal Variation: this is the identical pattern which a time series appears to be following during corresponding months of successive period. Seasonal variations are short-term fluctuation in a time series which occur periodically in a year. This continues to repeat year after year. The major factors that are responsible for the repetitive pattern of seasonal variations are weather conditions and customs of people. For example a sale of umbrella is always high during raining season than dry season. The graph of seasonal variation reflects upward and downward movement of a time series graph about the trend. It is denoted by S_t. (Aideyan & Efuwape 2010).

Cyclical variation: Cyclical variations are recurrent upward or downward movements in a time series but the period of cycle is greater than a year. Also these variations are not regular as seasonal variation. It is a long term oscillation about the trend line of a time series. Cyclical variation is brought about by economic factor. The graph may not necessarily follow a similar pattern after equal interval of time. The ups and downs in business activities are the effects of cyclical variation. It is denoted by C_t (Aideyan & Efuwape 2010).

Irregular Variation: Irregular variations are fluctuations in time series that are short in duration, erratic in nature and follow no regularity in the occurrence pattern. Irregular variations are caused by accidental factor or random shocks. It is divided into episodic fluctuation and residual fluctuation. Episodic fluctuations are those that can be identify, but unpredictable e.g strike, flood, war etc. while Residual fluctuation are neither identifiable, nor predictable. Irregular variation is noticeable when the graph of time series moves in an erratic manner. It is denoted by I_t. (Aideyan & Efuwape 2010).

Time Series Model

A time series model specifies the joint distribution of the sequence X_t of random variables. Time series model study how the four components of time series secular trend (T), seasonal variation(S), cyclical variation(C), and irregular variation relates. There are two models, which are appropriate for decomposition of time series. This will enable us to carry out forecasting, base on the effect of each of them having known the individual influence of each of the component. The two models are:

- Multiplicative model
- Additive model

Multiplicative Model

In multiplicative model, the relationship between the four components is of the form: $X_t = T_t \times C_t \times S_t \times I_t$ where X_t is the sum of the variable T,C,S,I and T stand for secular trend, C stand for cyclical, S stand for seasonal, while I stand for irregular variations.

Additive Model

In additive model, all the four components can we written as $X_t = T_t + S_t + C_t + I_t$, where X_t is the product of the four variables T,S,C,I and T stand for trend, S stand for seasonal, C stand for cyclical, while I stand for irregular variations.

Time Series Analysis

Time series analysis amounts to investigating the factors such as trend (T), seasonal(S), cyclical(C) and Irregular variation (I) and is also refers to as decomposition of time series into its basic component movements. Time series analysis consists of the description of the component movements present in the data. The pictorial or graphical representation i.e the time plot reveals quantitatively the presence of long trend, seasonal variation, cyclical variation as well as irregular variation.

Objective of Analyzing Time Series

The objectives of analyzing time series are:

- Forecasting: this has to do with the process of predicting the future value of the series using a model.
- Description: this is by identifying the pattern of distribution, and also describing the nature of data.
- Explanation: this is by explaining the series using an appropriate model
- Control and interpretation.

Time Plot

A time plot of a data distribution is a graph that plots each data value against the time at which the data value was measured. It may also be refers to as the pictorial or graphical representation of data. The time is always put on the horizontal axis and the variable being measured is on the vertical axis. In order to make the changes over time easier to see, a time plot usually connects the data points by line. Because of the nature of the coordinate system, Time Plot graphs do not have categories. Time graphs are good for graphing the values at irregular intervals, such as sampling data at random times. The major reason for its existence is that, it gives an indication or a sign of the underlying trend if any. Time plot can be used in prize variation over time, trend or cyclical variation, production over time, and money distribution over time. Empirical research has shown that, there might be an increase or decrease in the occurrence of Road Traffic Accident (RTAs).

According to Chijioke (2000), a student of Federal Polytechnic Idah, carried out a research work on Road Traffic Accident in Enugu highway, and discovered that, there was a drastic increased in the occurrence of Road Accident in the area.

Ohakwe & Chikezie (2011), in their research on Analysis of Road Traffic Accidents in Nigeria: A Case Study of Obinze/Nekede/Iheagwa Road in Imo State, Southeastern, Nigeria, also discovered that there was an increase in the rate of occurrence of Road Traffics Accident in the highway, and that most of these accidents happened during December period, when university or polytechnics students go home for break, and returning back during the January period.

Ohunene (2012), in her research work on Road Traffic Accident, a case study of Ankpa Local Government Area in Kogi State, also discovered and observed that the rate of occurrence of Road Traffic accident in the area is drastically reduced, and this could be more better, if people in the area adhere strictly to all the rules and regulations stated by the Federal Road Safety Commission (FRSC).

RESEARCH METHODOLOGY

In this chapter, the relevant of statistical research or investigation depends on the statistical model or statistical tool used in data analysis. Therefore, the statistical tools needed to solve the problem are spelt out.

Research Design

The research design adopted in this research work is descriptive research design and developmental or time series research design to carried out the time series analysis of number Road Accident that occur in Abuja-Lokoja Road area of Kogi state. Descriptive research is used to obtain information concerning the current status of the phenomena to describe "what exists" with respect to variables or conditions in a situation. It is also used to describe the characteristics of a population or phenomenon being studied. While in time series research design, data are collected at certain points in time going forward. There is an emphasis on time patterns and longitudinal growth or change.

Research Area

This research work is strictly focused on the Abuja-Lokoja Road area of Kogi State, to verify the number of accident that occurred, and to also fit a trend line and predict the rate of Road Accident in the coming years.

Sources of Data Collection

But in this project work, secondary data is relevant, and also is in used. Secondary data is the data that have readily available from other sources. Such data are cheaper and more quickly obtainable than the primary data

Validity and Reliability of Data

The data gathered for this research work is more reliable, as it covered a period of 11^{th} years from (2000-2010) and it is collected from the right sources Federal Road Safety Commission (FRSC).

Method of Data Analysis

The method of analyzing data in this research work is as follows; analysis of variance (ANOVA) to test the significant coefficient, least square method and method of moving average.

Method of Estimating Trend

Trend can be investigated in several ways. That is estimation of trend can be achieved in several possible ways such as:

1) Free hand method
2) Moving average method
3) Method of semi-average and
4) Least square method

1) **Free Hand Method:** this is the simplest method of finding a trend line. The procedure involves first the plotting of the time series on a graph and fitting a straight line through the plotted points in such a way that the straight line shows the trends of the series.

2) **Moving Average Method:** The method of moving averages is used not only to fit trend lines but also to seasonal and cyclical variation. It also tends to smoothen out the irregular and seasonal variation present in a series and hence we are left with trend (T_t). For quarterly data, we estimate the trend by finding a 4 – point moving average. For monthly data we find a 12-point moving average. Generally, suppose we have a set of observation X_1, X_2, X_3, X_4..........X_N on a time series denoted by (X_t) then a moving average of the order n is giving as

$$M_t = \frac{X_1 + X_2 + X_3 + \ldots\ldots\ldots X_N}{m}$$

$$M_t = \frac{X_2 + X_3 + X_4 + \ldots\ldots\ldots\ldots X_{N+2}}{m}$$

$$M_{n-m} = \frac{X_{N-m} + X_{n-2} + \ldots\ldots\ldots\ldots X_{N+m}}{m}$$

Advantages of Moving Average Method

(i) This method is easy to understand and calculate.

(ii) This method is not subjective.

(ii) This method is flexible in the sense that a few more observations may be included of moving average is equal to or multiple of the cycle of a cyclical.

Disadvantages of Time Series

- Some observations at both the beginning and the end of the series are lost.
- It is strongly affected by extreme value.
- Trend line produced cannot be described by simple mathematical equation.
- Moving average cannot be obtained for all the years.
- There is no definite rule for fixing the period of moving average.
- This method is suitable only when the trend is liner.
- This method is not suitable for forecasting.

3) Method of Semi-Average: When the method of semi-averages is used, the given time series is divided into two parts preferably with the same number of years. The average of each part is calculated and then a trend line through this average is filled.

4) **Least Square Method:** Among the method of fitting straight line to a series of data, this method is the most frequently used method. The basis of this method is the fitting of a mathematical curve/line to the set of data to find value of trend (T_t) at a given time.

Considering a series X_t with linear trend, the following relationship holds.

$$X_t = a + bt + e_t$$

where (t) is the time period, say, year and X_t is the value of the item measured against time as in the case of this research work number of crashes, (a) is the X_t - intercept and b is the coefficient of (t) indicating slope of the trend line and e_t is the error.

From the relationship i.e $X_t = a + bt + e_t$

Make e_t the subject of the formula i.e

$$e_t = X_t - (a+bt)$$

taken sun of both sides

$$\sum e_t = \sum(X_t - a + bt)$$

squaring both sides to obtain

$$(\sum e_t)^2 = \sum(X_t - a + bt)^2$$

$$\text{Let } Q = (\sum e_t)^2$$

$$\text{Therefore } Q = \sum(X_t - a + bt)^2 \text{ ....(*)}$$

The goal is to fine the value of (a) and (b) that minimize the error. But in multivariate calculus we learn that this required us to find the value of (a, b) such that

$$\frac{\delta Q}{\delta a} = 0, \qquad \frac{\delta Q}{\delta a} = 0,$$

from equation (*), differentiate partially with respect to (a)

$$\frac{\delta Q}{\delta a} = 2\sum(Xt - a - bt). (-1)$$

by implication

$$\sum(X_t - a - bt) = 0 \text{ then we have}$$

$$\sum X_t - na - b\sum t = 0$$

Therefore we have

$$\sum Xt = na + b\sum t \text{ ....1}$$

Consequently, differentiate equation (*) partially with respect to b. i.e

$$\frac{\delta Q}{\delta b} = 2\sum(X_t - a - bt). (-t)$$

then by implication, we left with

$$\sum X_t t - a\sum t - b\sum t^2 = 0$$

Therefore we left with

$$\sum X_t t = a\sum t + b\sum t^2 \text{.........................2}$$

Equation 1 and 2 become the normal equation which shown below:

$$\sum X_t = na + b\sum t \text{.....................1}$$

$$\sum X_t t = a\sum t + b\sum t^2 \text{...................2}$$

From equation 1, make (a) the subject of the formula

$$na = \sum X_t - b\sum t \text{ therefore}$$

$$a = \frac{\sum X_t}{n} - \frac{b\sum t}{n} \text{.........................3}$$

but $\frac{\sum X_t}{n} = \bar{X}_t$, and $\frac{\sum t}{n} = \bar{t}$

therefore $a = \bar{X}_t - b\bar{t}$.

also substitute for a in equation 2 i.e

$$\sum X_t t = \left(\frac{\sum X_t}{n} - \frac{b\sum t}{n}\right)\sum t + b\sum t^2$$

open the bracket, we have

$$\sum X_t t = \frac{\sum X_t \sum t}{n} - \frac{b(\sum t)^2}{n} + b\sum t^2$$

make b the subject of the formula, we have

$$b = \frac{\sum X_t t - \frac{\sum X_t \sum t}{n}}{\sum t^2 - \frac{(\sum t)^2}{n}} \text{........................4}$$

multiply equation 4 through by n, to obtain

$$b = \frac{n\sum X_t t - \sum X_t \sum t}{n\sum t^2 - (\sum t)^2}$$

Thus the trend equation is: $X_t = a + bt$, which will also be used for forecasting in chapter four.

Seasonal Index

Seasonal index may be defined, as the set of numbers showing the relative value of a variable during the month of the year. Seasonal index can be calculated in various ways such as:

- Ratio to moving average or percentage moving average method
- Ratio to trend or percentage trend method
- Average perspective method

Ratio to Moving Average or Percentage Moving Average Method

This is the method in which the observed values i.e the actual data is being express as a percentage of the annual central moving average corresponding to it. As a result of this,

$$\frac{\text{Actual data}}{\text{Central moving average}} \times 100$$

And the percentage contains only the seasonal and irregular variation. i.e

$$\frac{TSI}{T} = IS$$

Ratio to Trend or Percentage Trend Method

Percentage trend method is the method in which the data for each month is being express as percentage of monthly trend values. An appropriate average of the percentage for corresponding moths then gives the required index.

Average Perspective Method

This is the method in which the data of each month is being express as percentages of the average for the year. Then the percentages for corresponding months of different years are averaged using mean or median.

Deseasonalisation of Data

The process of eliminating seasonal fluctuations or deseasonalization of data consists of dividing each value in the original series by the corresponding value of the seasonal index.

Analysis Of Variance (ANOVA)

Analysis of variance (ANOVA) is also one of the important tools used in this project work in analyzing data. It is defined as a collection of statistical models used to analyze the differences between group means and their associated procedures (such as "variation" among and between groups), in which the observed variance in a particular variable is partitioned into components attributable to different sources of variation. As the name suggest, we are analyzing the variance of our data. To accomplish this, we need to partition the variability of the data into sum of square. Analysis of variance (ANOVA) also used to test the hypothesis concerning more than two mean.

In order to analyze data in ANOVA, we need to know the meaning of each of the following:

D.F = Degree of Freedom

SSR = Sum of Square Regression = $\hat{b}\left[\sum X_t.t - \frac{\sum X_t \sum t}{n}\right] = \hat{b}S_{xy}$

SST = Sum of Square Total = $\sum X_t^2 - \frac{(\sum X_t)^2}{n} = S_{yy}$

SSE = Sum of Square Error = SST – SSR

Where SSR has 1 degree of freedom, SST has n-1 degree of freedom, and SSE has n-2 degree of freedom.

Assumption of Anova

Analysis of variance has the following assumption:

- Treatments or treatment combinations are normally distributed with common variance (homogeneity of variance).
- Treatment effect are additive.
- The experimental error are independent and distributed as N(0 δ^2).

Presentation Of Anova Table

Sources of Variation	d.f	Sum of Square	Mean of square	F-calculated	F-tabulated
Regression	1	SSR = $\hat{b}S_{xy}$	$\hat{b}S_{xy}/1$= MSR	MSR/MSE	$F_{1, (n-2)}$
Residual error	n-2	SSE	SSE/n-2= MSE		
Total	n-1	SST	n-1		

Forecasting

Forecasting can be defined as a process of predicting or estimating the future based on past and present data. Forecasting provides information about the potential future events and their consequences for the organization. It may not reduce the complications and uncertainty of the future. However, it increases the confidence of the management to make important decisions. Forecasting is designed to help decision making and planning in the present. Forecasts empower people because their use implies that we can modify variables now to alter (or be prepared for) the future. A prediction is an invitation to introduce change into a system.

Assumption of Forecasting

Assumption of forecasting is that, there is no way to state what the future will be with complete certainty. Regardless of the methods that we use there will always be an element of uncertainty until the forecast horizon has come to pass. There will always be blind spots in forecasts. We cannot, for example, forecast completely new technologies for which there are no existing paradigms. Providing forecasts to policy-makers will help them formulate social policy. The new social policy, in turn, will affect the future, thus changing the accuracy of the forecast.

Data Presentation

The data analyzed and presented on this research work are all on quarterly bases, which is used for calculation and fitting of model. The table below shows the summary of a quarterly of Road Traffic Crashes from 2000-2010.

Table 4.1 Number of Crashes

Qtr/Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1st	5	5	4	3	7	4	7	6	8	5	10
2nd	3	2	2	7	3	5	4	3	2	4	10
3rd	4	3	5	4	5	3	5	2	5	8	5
4th	8	9	7	9	6	5	8	11	10	9	15

Quarterly Data	=	January - March	=	1st Quarter
		April - June	=	2nd Quarter
		July - September	=	3rd Quarter
		October - December	=	4th Quarter

Time Plot

The time plot which is the first step in analysis of data is plotted. i.e the graph of the quarterly data against time, which is shown in appendix I.

As we can see from the appendix I, in the 3rd quarter, the rate at which the accidents occur is very low, follow by the 1st and 2nd quarter, while in the 4th quarter; the rate of occurrence of Road Accident is very high. We also discovered that the graph above exhibit an irregular variation, hence there is no presence of systematic variation in the series.

Table 4.2 Moving Average method is used to smoothen the quarterly trend of Road Traffic Accidents (RTA).

Year	Quarter	Xt	4 years moving total	4 years moving average	Centre moving average	Specific seasonal index
2000	1st	5				
	2nd	3				
			20	5.00		
	3rd	4			5.000	80.00
			20	5.00		
	4th	8			4.875	164.10
			19	4.75		
2001	1st	5			4.625	108.11
			18	4.50		
	2nd	2			4.625	43.24
			19	4.75		
	3rd	3			4.625	64.86
			18	4.50		
	4th	9			4.500	200.00

			18	4.50		
2002	1st	4			4.750	84.21
			20	5.00		
	2nd	2			4.750	42.11
			18	4.50		
	3rd	5			4.375	114.29
			17	4.25		
	4th	7			4.875	143.60
			22	5.50		
2003	1st	3			5.375	55.81
			21	5.25		
	2nd	7			5.500	127.27
			23	5.75		
	3rd	4			6.250	64.00
			27	6.75		
	4th	9			6.250	144.00
			23	5.75		
2004	1st	7			5.875	119.15
			24	6.00		
	2nd	3			5.625	53.33
			21	5.25		
	3rd	5			4.875	102.56
			18	4.50		
	4th	6			4.750	126.32
			20	5.00		
2005	1st	4			4.750	84.21
			18	4.50		
	2nd	5			4.375	114.29
			17	4.25		
	3rd	3			4.625	64.86
			20	5.00		
	4th	5			4.875	102.56
			19	4.75		
2006	1st	7			5.000	140.00
			21	5.25		
	2nd	4			5.625	71.11
			24	6.00		
	3rd	5			5.875	85.11

			23	5.75		
	4th	8			5.625	142.22
			22	5.50		
2007	1st	6			5.125	117.07
			19	4.75		
	2nd	3			5.125	58.54
			22	5.50		
	3rd	2			5.750	34.78
			24	6.00		
	4th	11			5.875	187.23
			23	5.75		
2008	1st	8			6.125	130.61
			26	6.50		
	2nd	2			6.375	31.37
			25	6.25		
	3rd	5			5.875	85.11
			22	5.50		
	4th	10			5.750	173.91
			24	6.00		
2009	1st	5			6.375	78.43
			27	6.75		
	2nd	4			6.625	60.38
			26	6.50		
	3rd	8			7.125	112.28
			31	7.75		
	4th	9			8.500	105.88
			37	9.25		
2010	1st	10			8.875	112.68
			34	8.50		
	2nd	10			9.250	108.11
			40			
	3rd	5				
	4th	15				

$$\text{Seasonal Index} = \frac{Xt}{\text{Centre moving average}} \times 100$$

The specific seasonal index is then arranged into quarters to enable the researcher obtain the corrective factor if the mean is above 400.

Quarters

Year	**1st**	**2nd**	**3rd**	**4th**
2000	-	-	80.00	164.10
2001	108.11	43.24	64.86	200.00
2002	84.21	42.11	114.29	143.60
2003	55.81	127.27	64.00	144.00
2004	119.15	53.33	102.56	126.32
2005	84.21	114.29	64.86	102.56
2006	140.00	71.11	85.11	142.22
2007	117.07	58.54	34.78	187.23
2008	130.61	31.37	85.11	173.91
2009	78.43	60.38	112.28	105.88
2010	112.68	108.11	-	-
$\sum X$	**1030.28**	**709.75**	**807.85**	**1489.82**
$\sum \bar{X}$	**103.028**	**70.975**	**80.785**	**148.982**

Since the total of the mean is above 400, there is need for correction to obtain the actual value for each quarter.

Typical Index = Corrective Factor (C.F) = $\frac{400}{403.77}$

C.F = 0.9907

Typical Index (T.I) = C.F x mean ($\bar{x}$)

1st $\Rightarrow$ 103.028 X 0.9907 = 102.07
2nd $\Rightarrow$ 70.975 X 0.9907 = 70.31
3rd $\Rightarrow$ 80.785 X 0.9907 = 80.03
4th $\Rightarrow$ 148.982 X 0.9907 = 147.60

Typical index (T.I) = 400.01 $\approx$ 400

Table 4.3 the adjustment seasonal variation mean is used to obtain the deseasonalized values.

Year	**Quarter**	**X_t Crashes**	**Seasonal Index**	**Deseasonalized Data**
2000	1	5	102.07	4.90
	2	3	70.31	4.27
	3	4	80.03	5.00
	4	8	147.60	5.42
2001	1	5	102.07	4.90
	2	2	70.31	2.84
	3	3	80.03	3.75
	4	9	147.60	6.10
2002	1	4	102.07	3.92
	2	2	70.31	2.84
	3	5	80.03	6.25
	4	7	147.60	4.72
2003	1	3	102.07	2.94
	2	7	70.31	9.96
	3	4	80.03	5.00
	4	9	147.60	6.10
2004	1	7	102.07	6.86
	2	3	70.31	4.27
	3	5	80.03	6.25
	4	6	147.60	4.07
2005	1	4	102.07	3.92
	2	5	70.31	7.11
	3	3	80.03	3.75
	4	5	147.60	3.39
2006	1	7	102.07	6.86
	2	4	70.31	5.69
	3	5	80.03	6.25
	4	8	147.60	5.42
2007	1	6	102.07	5.88
	2	3	70.31	4.27
	3	2	80.03	2.50
	4	11	147.60	7.45
2008	1	8	102.07	7.84
	2	2	70.31	2.84

	3	5	80.03	6.25
	4	10	147.60	6.78
2009	1	5	102.07	4.90
	2	4	70.31	5.69
	3	8	80.03	10.00
	4	9	147.60	6.10
2010	1	10	102.07	9.80
	2	10	70.31	14.22
	3	5	80.03	6.25
	4	15	147.60	10.16

$$\text{Deseasonalization} = \frac{Xt}{\text{Seasonal Index}} \times 100$$

Deseasonalized Data in table 4.3 will then be used to determine the Least Square Equation.

Table 4.4 Deseasonalized values served as the Xt which is our time series value.

Year	**T**	**Deseasonalized Data (X_t)**	**X_t.t**	**t^2**
2000	1	4.90	4.90	1
	2	4.27	8.54	4
	3	5.00	15.00	9
	4	5.42	21.68	16
2001	5	4.90	24.50	25
	6	2.84	17.04	36
	7	3.75	26.25	49
	8	6.10	48.80	64
2002	9	3.92	35.28	81
	10	2.84	28.40	100
	11	6.25	68.75	121
	12	4.72	56.64	144
2003	13	2.94	38.22	169
	14	9.96	139.44	196
	15	5.00	75.00	225
	16	6.10	97.60	256
2004	17	6.86	116.62	289
	18	4.27	76.86	324
	19	6.25	118.75	361

	20	4.07	81.40	400
2005	21	3.92	82.32	441
	22	7.11	156.42	484
	23	3.75	86.25	529
	24	3.39	81.36	576
2006	25	6.86	171.50	625
	26	5.69	147.94	676
	27	6.25	168.75	729
	28	5.42	151.76	784
2007	29	5.88	170.52	841
	30	4.27	128.10	900
	31	2.50	77.50	961
	32	7.45	238.40	1024
2008	33	7.84	258.72	1089
	34	2.84	96.56	1156
	35	6.25	218.75	1225
	36	6.78	244.08	1296
2009	37	4.90	181.30	1369
	38	5.69	216.22	1444
	39	10.00	390.00	1521
	40	6.10	244.00	1600
2010	41	9.80	401.80	1681
	42	14.22	597.24	1764
	43	6.25	268.75	1849
	44	10.16	447.04	1936
$\sum X$	**990**	**253.68**	**6324.95**	**29370**

$$X_t = a + bt$$

$$\hat{b} = \frac{\sum X_t.t - \frac{\sum X t \sum t}{n}}{\sum t2 - \frac{(\sum t)^2}{n}}$$

$$a = \bar{X}_t - b\bar{t}$$

but $\sum X_t = 253.68$, $\sum t = 990$, $\sum X_t.t = 6324.95$, $\sum t^2 = 293.70$

$$\hat{b} = \frac{6324.95 - \frac{253.95 \times 990}{44}}{29370 - \frac{(255)^2}{44}}$$

$$= \frac{611.075}{27892.15909}$$

$$\hat{b} = 0.0219$$

But $a = \bar{X}_t - b\bar{t}$

where $\bar{t} = \frac{\sum t}{n} = \frac{990}{44} = 22.5$

$$\bar{X}_t = \frac{\sum X_t}{n} = \frac{253.68}{44} = 5.7655$$

$a = 5.7655 - 0.0219 \times 22.5$

$a = 5.2728$

$X_t = 5.2727 + 0.0219t$

To forecast for the 1st, 2nd, 3rd and 4th quarters of 2015

$X_{61} = 5.2728 + 0.0219(61) = 6.6087$

$X_{61} = 5.2728 + 0.0219(62)$

$= 6.6306$

$X_{63} = 5.2728 + 0.0219(63)$

$= 6.6525$

$X_{64} = 5.2728 + 0.0219(64)$

= 6.6744

Table 4.5 shows the forecast for year 2015

Year	Quarter	T	Trend (X_t = a + bt)	Seasonal index	Quarterly forecast
2015	1	61	6.6087	102.07	6.7455
	2	62	6.6306	70.31	4.6619
	3	63	6.6525	80.03	5.3240
	4	64	6.6744	147.60	9.8514

$$\text{Quarterly forecast} = \frac{\text{Trend X Seasonal index}}{100}$$

= 7+5+5+10=27

Forecast for 2016

X_t = a+bt

1st quarter = 5.2728 + 0.0219(65) = 6.6963
2nd quarter = 5.2728 + 0.0219(66) = 6.7182
3rd quarter = 5.2728 + 0.0219(67) = 6.7401
4th quarter = 5.2728 + 0.0219(68) = 6.7620

Estimated quarterly forecast for 2016

= 7+7+7+7 = 28

Table 4.6 Estimation of trend for quarterly data using the Method of Least square.

Year	Quarter	X_t	T	$X_t.t$	t^2
2000	1	5	1	5	1
	2	3	2	6	4
	3	4	3	12	9
	4	8	4	32	16
2001	1	5	5	25	25
	2	2	6	12	36
	3	3	7	21	49
	4	9	8	72	64
2002	1	4	9	36	81
	2	2	10	20	100
	3	5	11	55	121
	4	7	12	84	144
2003	1	3	13	39	169

	2	7	14	98	196
	3	4	15	60	225
	4	9	16	144	256
2004	1	7	17	119	289
	2	3	18	54	324
	3	5	19	95	361
	4	6	20	120	400
2005	1	4	21	84	441
	2	5	22	110	484
	3	3	23	69	529
	4	5	24	120	576
2006	1	7	25	175	625
	2	4	26	104	676
	3	5	27	135	729
	4	8	28	224	784
2007	1	6	29	174	841
	2	3	30	90	900
	3	2	31	62	961
	4	11	32	352	1024
2008	1	8	33	264	1089
	2	2	34	68	1156
	3	5	35	175	1225
	4	10	36	360	1296
2009	1	5	37	185	1369
	2	4	38	152	1444
	3	8	39	312	1521
	4	9	40	360	1600
2010	1	10	41	410	1681
	2	10	42	420	1764
	3	5	43	215	1849
	4	15	44	660	1936
$\sum X$		**255**	**990**	**6389**	**29370**

$$X_t = a + bt$$

$$\hat{b} = \frac{\sum X_t.t - \frac{\sum X t \sum t}{n}}{\sum t^2 - \frac{(\sum t)^2}{n}}$$

$$a = \bar{X}_t - b\bar{t}$$

$$\bar{X}_t = \frac{\sum X_t}{n} \qquad \bar{t} = \frac{\sum t}{n}$$

Where t = time,

X_t = time series values

n = time number of observation

a = intercept of X_t

b = slope of the line

$\sum X_t t = 6389 \qquad \sum t^2 = 29370$

$\sum t = 990 \qquad \sum X_t = 255$

$$\bar{X}_t = \frac{255}{44} = 5.7955$$

$$\bar{t} = \frac{990}{44} = 22.5$$

$$\hat{b} = \frac{6389 - \frac{990 \times 255}{44}}{29370 - \frac{(990)^2}{44}}$$

$$\hat{b} = \frac{651.5}{7,095}$$

$$\hat{b} = 0.0918$$

$a = \bar{X}_t - b\bar{t}$

$= 5.7955 - (0.0918)(22.5)$

$5.7955 - 2.0655$

$a = 3.73$

Therefore,

X_t = 3.73 + 0.0918t

To forecast for the 1st, 2nd, 3rd, & 4th quarter of year 2015

1st quarter = 3.73 + 0.0918(61)
= 9.3298
2nd quarter = 3.73 + 0.0918(62)
= 9.4216
3rd quarter = 3.73 + 0.0918(63)
= 9.5134
4th quarter = 3.73 + 0.0918(64)
= 9.6052

Estimated total for 2015
9+9+10+10 = 38

To forecast for the 1st, 2nd, 3rd, & 4th quarter of year 2016

1st quarter = 3.73 + 0.0918(65)
= 9.9670
2nd quarter = 3.73 + 0.0918(66)
= 9.7888
3rd quarter = 3.73 + 0.0918(67)
= 9.8806
4th quarter = 3.73 + 0.0918(68)
= 9.9724

Estimated total for 2016

10+10+10+10 = 40

Based on the result obtained from the forecasting using moving average method for the year 2015, the researcher observed that in the 1st and 4th quarter of that year, there was high rate of Road Traffic Accident (RTA) follow by the 3rd quarter, but in the 2nd quarter of the same year, the rate of the accident decrease. Furthermore, forecast was also done for the year 2016, which the rate of road Traffic Accidents (RTA) was increased throughout the quarters. But while using the least square method to estimate the trend and forecast for year 2015 and years 2016, the rate of Road Traffic Accident on Abuja-Lokoja road was also increased.

Analysis of Variance (ANOVA)

Hypothesis

H_o: there is no significant different in the rate of occurrence of Road Traffic Accident or crashes between the year 2000-2010

H_1: there is significant different in the occurrence of road crashes

Analysis of variance test is then carried out at

$\alpha = 0.05$ level of significant

$\alpha = 0.01$ level of significant

Test criteria

If $F_{cal} < F_{tab}$, we accept the H_o which is the null hypothesis, but if otherwise, we reject.

$\sum X_t = 255 \quad \sum X_t.t = 6389 \quad \sum t = 990 \quad \sum t^2 = 29370 \quad \sum X_t^2 = 1829$

$$SST = \sum X_t^2 - \frac{(\sum X_t)^2}{n} = S_{yy}$$

$$n = 44$$

$$SST = 1829 - \frac{255^2}{44}$$

$$SST = 351.159$$

$$SSt = \hat{b}\left[\sum X_t.t - \frac{\sum X_t \sum t}{n}\right] = \hat{b}S_{xy}$$

$$= 0.0918[6389 - \frac{(255x990)]}{44}$$

$$SSR = 59.8077$$

$$SSE = SST - SSR$$

$$= 351.159-59.8077$$

$$SSE = 291.3513$$

Table 4.7 ANOVA Table

Sources of Variation	**d.f**	**S.S**	**M.S**	F_{cal}	F_{tab}
Regression	1	59.8077	59.8077	8.6218	5.29
Error	42	291.3513	6.9369		7.20
Total	43	351.159			

CONCLUSION

Since the F-calculated value (8.6218) is greater than the F-tabulated values at 0.05 and 0.01 which are (5.29) and (7.20), we reject the null hypothesis H_0 and accept the alternative hypothesis H_1 and then conclude that there is significant difference in the rate of occurrence of road traffic accident between the year 2000-2010.

Table 4.8 ANALYSIS OF DATA USING SPSS

ANOVA[b]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	59.824	1	59.824	8.624	.005[a]
	Residual	291.335	42	6.937		
	Total	351.159	43			

a. Predictors: (Constant), t

b. Dependent Variable: xt

The Statistical Package for Social Sciences (SPSS) version 17.0 was used to carry out the analysis, which the calculated value is greater than the tabulated value, and we therefore also reject the null hypothesis, and accept the alternative hypothesis, and also conclude that there is significant difference in the rate of occurrence of road accident between the year 2000-2010.

SUMMARY

During this research work, time series analysis was strictly used to carried out statistical analysis of Road Traffic Accidents (RTAs), which was strictly discovered that there is an increased in the rate of occurrence of Road Traffic Accidents, likewise forecasting was also carried out in order to predict the occurrence of road traffic accident for subsequent years, which also showed that there is an increase in the quarterly incident of accident in future or year to come and the analysis of variance (ANOVA) test carried out also showed that model is significantly fit.

CONCLUSION

The current study shows or confirmed that there was an extensive or significant increase in the number of reported cases of RTA. analysis of variance was carried out to check if the model fit i.e whether there is any significant difference in the occurrence of Road Accidents between the year 2000 to year 2010, and a trend value was also obtain to enable forecast for future reference.

The situation of the problem can only be reduced, if people are doing the right or necessary thing by obeying the road rules and regulations and strictly adhere to all preventive measure stated by the FRSC. Government should put everything in a proper shape, by making sure that there is fund for proper construction of roads and also make sure that all the bad roads are maintained properly and put in a good shape.

RECOMMENDATIONS

Having considered the huge loss of life and properties on our highways, most especially Lokoja-Abuja road, the researcher has decided to make the following recommendations, which if properly and thoroughly adhere to; the occurrence of road accident in the future will extremely reduce.

- Heavy penalty should be imposed on those who take alcohol before driving, and also cross speed limit. When this is strictly implemented, nobody will dare to go at high speed.
- Government should make sure that all the roads are maintained properly, and also make permanent contract arrangements in place for maintaining all roads in good condition 24 hours a day, 365 days on year.
- Health of vehicles should be strictly enforced.
- Existing traffic rules should be strictly enforced.
- Road Safety day/ Road Safety week should be observed in all schools every year. Competitions on Road safety tips, slogans, essays, paint etc should be conducted for student of various classes.
- Government should make sure that the money recovered as road tax is fully utilized for construction of roads.

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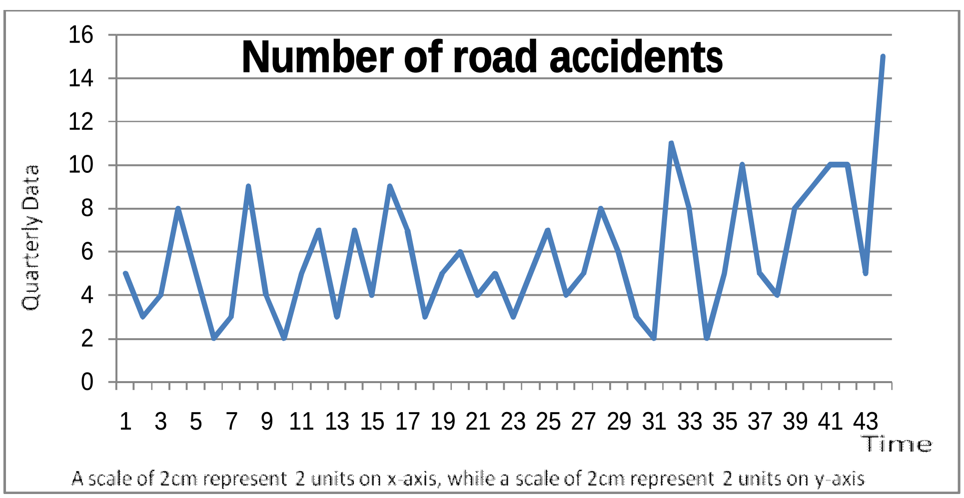
Appendix I



Appendix II
Regression

Variables Entered/Removed[b]

Model	Variables Entered	Variables Removed	Method
1	t[a]	.	Enter

a. All requested variables entered.

b. Dependent Variable: Xt

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.413[a]	.170	.151	2.63373

a. Predictors: (Constant), t

ANOVA[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	59.824	1	59.824	8.624	.005[a]
	Residual	291.335	42	6.937		
	Total	351.159	43			

a. Predictors: (Constant), t

b. Dependent Variable: Xt

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.729	.808		4.617	.000
	t	.092	.031	.413	2.937	.005

a. Dependent Variable: Xt