

TIME SERIES ANALYSIS OF MOTORCYCLE REGISTRATION AND ACCIDENTS IN THE BOLGATANGA MUNICIPALITY

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**Abstract** – The study assessed registration of motorcycles and accidents cases in the Bolgatanga Municipality. Both the survey method and trend analysis was also employed. However, the findings discovered by the study are: motorcycle accidents cases are underreporting within the municipality however the reasons for them not reporting accidents cases to the police are: could not identify the person, thought it was not necessary to report to the police, thought of punishment, distance and fear the police being demand for money. The causes of motorcycle accidents are: hit the back of the vehicle, hit by vehicle, knocked an animal, hit the pavement and hit by a motor. Most of the victims working ability have reduced and some victims resort to borrowing, using savings and/or selling assets, however resulting in financial stress. The public should be educated on the importance of reporting accidents cases to police in order to help reduced under reporting accidents cases in the Municipality. It was predicted in the study that, 2017 total number of motorcycle registered would be increased to 7, 679 and this suggest that, roads in the municipality needs to expanded in order to accommodate these numbers and MTU should corroborated with National Safety Commission to institute public campaign message to educate motor riders on both the importance of reporting accident cases to police and obedience to safety precaution measures in order to mitigate motorist being track by police or law enforcement agencies. Also studies can be done to assess the relationship between motor licensing and accident in Ghana.

**Keywords:** *Time Series Analysis, Linear trend model, Quadratic trend model, Autocorrelation Function, Partial Autocorrelation Function, Stationarity, Parameter Estimation, Parsimonious model, accidents and Differencing*

### 1.1 Background of the Study

Motorcycles are the most popular means of transportation in Northern Ghana. It is required by law that these motorcycles are registered with a number plate before they are put on the roads.

This is done first, to know the number of motorcycles that are in the region; secondly to get some revenue for the state; lastly but not the least to be able to identify the owners in case of accident or theft.

Despite these plausible reasons above, some motorcycles are still found on our roads without number plates. It is also required that users of these motorcycles should possess a rider's license. Before a license is issue, a person riding skills is tested to insure that such a rider can safely use the motorcycle on the road without causing accident on our road or nausea to other riders and road users.

What do to we heard? What do we read in the literature or daily papers? Accidents! According to Agnihotri and Joshi (2006), road traffic injuries and deaths are a growing public health concern worldwide. Banthia et al, 2006 also indicated that road traffic injuries are a major cause of death and disability globally, with a disproportionate number occurring in developing countries.

It is observed that motorcyclists are about three times more likely than car occupants to be injured in a crash and

16 times more likely to die (Branas and Knudson, 2001). Contrary to car crash; in a motorcycle crash, the rider often absorbs all kinetic and compressive energy resulting from the Crash (Janmohammadi et al, 2009).

Road traffic injuries are a major but neglected global public health problem, requiring concerted efforts for effective and sustainable prevention. According to the World Health Organization (2004), of all the systems that people have to deal with on a daily basis, road transport is the most complex and the most dangerous. Worldwide, the number of people killed in road traffic crashes each year is estimated at almost 1.2 million, while the number injured could be as high as 50 million (WHO, 2004). The tragedy behind these figures regularly attracts less media attention than other, less frequent but more unusual types of tragedy.

The total number of road traffic deaths worldwide and injuries is estimated to rise by some 65% between 2000 and 2020 (Kopit and Crooper, 2005; Murray and Lopez, 1999), and in low-income and middle-income countries deaths are expected to increase by as much as 80%. This has called for an increase in efforts and new initiatives to combat the menace.

What is the situation of motorcycle registration and accidents in the Bolgatanga Municipality of Ghana, a developing country like? This is a question that the researcher wishes to address in this term paper.

## 1.2 Problem Statement

Studies in some part of the country – Ghana have shown that road traffic crashes were leading cause of road deaths and injuries, and that majority of road traffic fatalities and injuries occurred on roads in rural areas (Afukaar et al, 2003).

Bolgatanga Municipal Health Administration Annual Reports (2008, 2009) had indicated that road traffic accidents in the region has consistently appeared in the top ten causes of Outpatient Department (OPD) attendance and hospital admissions since 2006.

In Africa, it has been estimated that 59,000 people lost their lives in road traffic crashes in 1990 and that this figure will be 144,000 people by 2020, a 144% increase (Nantulya and Reich, 2002).

This thesis seeks to look into the motorcycle registration and accidents in the Bolgatanga Municipality of the Upper East Region of Ghana.

## 1.3 General Objective

The main objectives of the study are to look at motorcycle registration and motorcycle accidents in the Bolgatanga Municipality.

### 1.3.1 Specific Objectives

- To determine the trend of registered motorcycles between 1980 and 2017
- To determine the trend of motorcycle accidents between 1980 and 2017 in Bolgatanga municipality.
- Develop a suitable time series forecasting model for number of motorcycle registration and accidents cases in Bolgatanga Municipality over the period 1980 - 2017 and use it to estimate 4 years forecast.
- To determine the factors that contribute to causes of motorcycle accidents in Bolgatanga Municipality.
- To determine the relationship between total number of license issued and motor accidents.

## 1.4 Research Questions

- Is there a trend of the registered motorcycles between 1980 and 2017 in the Bolgatanga Municipality?
- Is there a trend of motorcycle accidents between 1980 and 2017 in the Bolgatanga Municipality?
- What is a suitable time series forecasting model for number of motorcycle registration and accidents cases in Bolgatanga Municipality over the period 1980 - 2017 and use it to estimate 4 years forecast.
- What factors cause motorcycle accidents in Bolgatanga municipality?
- What is the relationship between total number of license issued and motor accidents?

### 1.5 Significance of the Study

This study would bring to the public domain the trend of motorcycle in the Upper East Region. It would inform M TTU and the Ghana Highways Authority to put in measures to either maintain existing road structures or expand them.

This research study would help opinion leaders and policy makers to know the causes of motorcycle accidents in the Region. This may help them formulate policies that would mitigate these causes and hence minimize road accidents within the Municipality and beyond.

The study would alert the road safety commission on the trend of motorcycle inflow into the region as well as the causes of motorcycle accidents. Knowing the motorcycle inflow and the causes of road accidents would help the commission play its future campaign message on road safety and also know what to do.

Students and researchers who intend to explore on this subject of study may use the work as reference. Finally, the study would contribute to bridge knowledge gap between previous studies and the current state of the issue at staked. Additionally, this study will set the tone for further research into motorcycles accidents in the Upper East Region.

## LITERATURE REVIEW

### EARLIER FORECASTING MODELS OF ROAD TRAFFIC ACCIDENTS

Many researchers including Smeed (1949) have devoted their research to the area of road accidents and reported pioneering work on the analysis of road accidents. Smeed examined the relationship on a number of road fatalities with those of motor vehicles and the population of twenty countries in 1938 in the following form:

$D/N=0.0003(N/P) 0.67$  (1) where D, N, P are deaths, number of motor vehicles and population respectively. Using the same method as Smeed, Jacobs and Cutting (1986) carried out analysis of fatalities in developing countries for different years and established significant relationships between fatality rates and levels of vehicle ownership. The analysis was repeated for the years 1980 using data from 20 developing countries and a relationship was derived which is as follows

$$D/N=0.00036(N/P) 0.65$$
 (2)

Smeed's analysis was heavily criticized by Andreessen (1985) for model accuracy. 9

He argued that the Smeed's formula cannot be applied universally to all countries. The fatality model similar to Smeed's equation produced by Andreessen in 1985 is of the form:

$$\text{Death}=0.000112(\text{Population}) 0.73259(\text{Number of Vehicles}) 0.33293$$
 (3)

Mekky (1985) used the same time series data for the analysis and studied the effects of a rapid increase in motorization levels on fatality rates in some developing countries. Kim (1990) developed a similar model in Korea and suggested the following equation:

$$\text{Death}=0.25451(\text{Population}) 0.699196(\text{Number of Vehicles}) 0.251414$$
 (4)

In Malaysia two models had been proposed. Aminuddin (1990) proposed a simple linear model and projected 4950 deaths by 2000. Rehan (1995) however improved Aminuddin's model and suggested a similar model to Smeed's and derived the following equation:

$$\text{Death}=0.08193(\text{Population} \times \text{Number of Vehicles}) 0.335$$
 (5)

Using employment and population data, Partyka (1984) developed simple models with a view to understand the various factors affecting the increase in accidents in developing countries. The study on the effects of speed limits on road accidents has been carried out by Fieldwick and Brown (1987). It was found that speed limits have considerable effects on safety in urban and rural areas. Minter (1987) discussed an application of the two models (Wright and Towell) for road safety problems and finally developed a model for estimating the road accidents in U.K.

Pramada and Sarkar (1993) investigated the variations in the pattern of road accidents in various Union Territories of India. Emenalo et al (1987) established the trend 10

curves for the road accidents casualties, and other relevant quantities for Zambia. Pramada and Sarkar (1997) again developed a road accidents model by using the additional parameter of road length. Ameen and Naji (2001)

presented a general modeling strategy to forecast road accident fatalities in Yemen.

### 2.2.0 TIME SERIES AND OTHER STATISTICAL MODELS USED IN RTA

Numerous cross-sectional studies have been conducted in varying scales and scopes in order to understand the relationships between factors and traffic accidents by combining several years of data and performing statistical analysis and constructing statistical models. The multiple regression and Poisson regression are commonly used for modeling the mortality rates and number of deaths in a specific population. However Pococket -al. (1981) pointed out that unweighted multiple regression is not appropriate for modeling mortality rates in different areas which vary in population size. In addition fully weighted regression is usually too extreme. Thus they introduced an intermediate solution via maximum likelihood for modeling death rates. Tsauo et al. (1996) examined the effect of age, period of death and birth cohort in motor vehicle mortality in Taiwan from 1974 – 1992, used data from vital statistic. Log-linear regression was used for fitting the model to perform the effects of variables. Kardara and Kondakis (1997) identified trends of road traffic accident deaths and injuries rates in Greece from 1981-1991 by using linear regression with logarithmic transformation. LaScala et al. (2000) examined correlations between demographic and environmental versus pedestrian injury rates by using a spatial autocorrelation corrected regression model with applying the logarithmic transformation for the injuries rates. Evans (2003) conducted statistical modeling for estimating road traffics and railways accident fatal rates based on past accident data in Great Britain during 1967-2000. In addition Lix et al. (2004) used Poisson regression to investigate the relation of demographic, geographical, and temporal explanatory variables with mortality in difference regions of Manitoba, Canada between 1985and 1999, used data from Vital Statistics records and the provincial health registry.

Yang et al. (2005) used Poisson regression modeling to examine and compare age- and sex-specific mortality rates due to injuries in the Guangxi Province in South Western China in 2002, based on death certificates data. However this study focused only on small areas.

In light of problems associated with ordinary (regression) methods because of the assumption that the observations overtime are independent, several researchers have turned to analyzing road traffic accidents data with time series techniques such as ARMA, ARIMA, DRAG and state space models or structural models as a means to better predict accident variables.

Abdel (2005) studied road accidents in Kuwait. He used an ARIMA model and compared it with ANN to predict fatalities in Kuwait. He concluded ANN was better in case of long term series without seasonal fluctuations of accidents or autocorrelations” components. Wen et al (2005) established a procedure of Road Traffic Injury (RTI) in China by using RTI data from 1951 to 2003. A series of predictive equations on RTI were established based on ARIMA models. They concluded that time series models thus established proves to be of significant usefulness in RTI prediction. Cejun and Chiou-Lin (2004) used two time series techniques; ARMA and Holt-Winters (HW) algorithm to predict annual motor vehicle crash fatalities. They concluded that the values predicted by ARMA models are a little bit higher than the ones obtained by HW algorithm. Ayvalik (2003) also used intervention analysis with univariate Box-Jenkins method to identify whether a change in a particular policy had made an impact on the trends in fatalities and fatality rates in Illinois. He developed ARIMA forecasting model for future trends in motorway fatalities in an effort to provide assistance to policy development in reducing fatality rates in Illinois.

### 2.1 Registered Vehicles

From years 2004 to 2008 there were a total of 15, 475 vehicles registered in the municipality, of which 98% were motorcycles. The annual distribution of registered vehicles is shown in [Appendix A](#). The statistics show an increase in vehicular registration from 2004 to 2008. Annual registered vehicles in Upper East Region, 2004 – 2008

The motorcycle peak increases were in 2006 (over 100%) and 2007 (38%), with 2005 (about 2%) and 2008 (5%) showing lower increases, whilst, the trend of car registrations, showed an up and down increases from 2005 (54%), 2006 (35%), 2007 (62%) and 2008 (14%). The motorcycles were significantly more than the cars over the study period (i.e.,  $t(0.025, 4) = 4.127, p=0.015$ ).

Motorcycles made up 3 percent of all registered vehicles in the United States in 2015 and accounted for only 0.6 percent of all vehicle miles traveled. Per registered vehicle, the fatality rate for motorcyclists in 2015 was 6 times

the fatality rate for passenger car occupants, as shown in Table 2. The injury rate for motorcyclists (1,028) was slightly lower than the injury rate for passenger car occupants (1,035). Per vehicle mile traveled in 2015, motorcyclist fatalities occurred nearly 29 times more frequently than passenger car occupant fatalities in motor vehicle traffic crashes, and motorcyclists were nearly 5 times more likely to be injured. lower than the injury rate for passenger car occupants (1,035). Per vehicle mile traveled in 2015, motorcyclist fatalities occurred nearly 29 times more frequently than passenger car occupant fatalities in motor vehicle traffic crashes, and motorcyclists were nearly 5 times more likely to be injured.

**Table 1 Occupant\* Fatality Rates, by Vehicle Type, 2014 and 2015**

Fatality Rate		Vehicle Type						
		Motorcycles		Passenger Cars		Light Trucks		
		Fatality Rate	Injury Rate	Fatality Rate	Injury Rate	Fatality Rate	Injury Rate	
2014	Per 100,000 Registered Vehicles	54.58		1,088	9.11	985	7.37	633
	Per 100 Million Vehicle Miles Traveled	23.00		459	0.86	93	0.69	60
2015	Per 100,000 Registered Vehicles	57.85		1,028	9.48	1,035	7.70	630
	Per 100 Million Vehicle Miles Traveled	25.38		451	0.89	97	0.72	59

\*Occupants include both riders/drivers and passengers.  
 Sources: Fatalities – FARS 2014 Final File, 2015 ARF; Injured – NASS GES 2014-2015; Vehicle miles traveled and registered motorcycles – FHWA; Registered passenger cars and light trucks - Polk data from R.L. Polk & Co., a foundation of IHS Markit automotive solutions.

Since the study by Box and Jenkins (1976), time series analysis has been popularly adopted for themodeling of dependent, sequential observation. Two useful representations express the behaviour of observed time series processes, namely, the autoregressive (AR) and the moving average (MA), which describe the behaviour of stochastic and dynamic systems (Box et al., 1994). Time series analysis has outperformed other forecasting models because of its well-established theoretical foundation and the ease of estimation (Karlaftis and Vlahogianni, 2009) and its value regardless of a stationary or non-stationary time series, and with or without seasonal components (Lim and McAleer, 2002). It has therefore been successfully and overwhelmingly applied for modeling and forecasting in the transportation management literature, such as air transportation (Inglada and Rey, 2004), safety issues (McLeod and Vingilis, 2008), the modeling of freight and transportation demand (Batchelor et al., 2007), and air quality and transportation emissions (Lau et al., 2009).

Intervention analysis is a transfer function stochastic model and may be understood as an extension to the ARIMA set of time series models. In terms of intervention, such an analysis has been used to study the impact of exceptional external events, including natural disasters, political or economic policy initiatives or changes, technological changes, strikes, sales promotions, advertising and the likes (Liu, 2006). Box and Tiao (1975) provided a procedure, known as intervention analysis, for analyzing a time series in the presence of external events. It exhibits a useful stochastic modeling tool that can rigorously analyze the impact and represent two distinct components: an underlying disturbance term and the set of interventions in the series.

The pioneering application of intervention analysis was a study by Box and Tiao (1975), which provided an analytical framework for examining the effect of two interventions in Los Angeles: the opening of the Golden

State Freeway, and the enforcement of a new law concerning oxidant data.

Over the years, the technique has been widely employed and successfully applied in different fields in the physical and social sciences.

Although intervention analysis has been well-documented in various disciplines, this approach has not attracted much attention from researchers and academics in air travel demand. One study by Coshall (2003) applied the intervention model to assessing the impact of three interventions—the U.S. bombing of Libya in 1986, the Lockerbie air disaster in 1988, and the Persian Gulf crisis during 1990-1991 on the flow of U.K. air passengers to a variety of destinations. Lee et al. (2005) employed intervention analysis to assess the status of recovery after the September 11th terrorist attacks on US air passenger transport demand. Empirical results showed that the demand for US air passenger transport had not yet fully recovered from the attacks but the demand had appeared to be increasing gradually. In Pitfield (2007), the ARMA with intervention model was used to examine the influence of airline alliances on the traffic of constituent airlines for five routes to the US from European hubs (Frankfurt and Paris). A similar methodology was applied by Pitfield (2008) to estimate the impact of the so-called “Southwest Effect” on traffic and market share for key domestic air routes in the USA, where Southwest had started its service. Lai and Lu (2005) compared the SARMA with intervention model with different techniques; the results showed that it outperformed all other techniques when significant intervention in the series existed.

Efforts are made in this research to incorporate the intervention analysis of the ARMA approach to study the Vehicular registration system in Bolgatanga Municipality.

## 2.2 The Trend of Motorcycle Accidents in Ghana

In a research conducted in Ghana by Yankson et al (2010), stated that in developing countries, motorization has been accompanied by rapid growth in road traffic injuries which has become a leading cause death and disability. The second African Road Safety Conference (2011) stated that, developing countries account for about 70 per cent of the world’s road fatalities; and that, 28 and 32.2 per cent of deaths in Africa per 100,000 populations, hence the second leading cause of death in 5 to 44 age group of African is through road accidents. The foregoing assertion is truly reflected in the spate of accident in Ghana. The Chronicle (Monday 11 August 2008 edition) reported that

Ghana records about 10,000 fatal road accidents every year out of which an average of 1600 people perish while 150 people sustain serious injuries robbing the nation of some precious lives.

The global Road Safety Partnership (G R S P) indicated that from 2002 – 2005, 70 per cent of persons killed in road accidents were males and 20.8 per cent are children under six years old. Pedestrians are the very vulnerable group accounting for more than 40 per cent of annual road accidents fatalities with 21% being children under 16 years of age. According to the Building and Road Research Institute (BRRI, 2001), at the national level, an average of 29% of all accidents were pedestrian accidents and the most vulnerable was the 6 – 10 years aged group accounting for 18% of all casualties.

Yankson et al (2010), stated as in many other developing countries pedestrian injuries are most common road traffic death, 43% of all deaths in Ghana was due to pedestrian accident. Atubi (2012) analysis a Thirty-eight separate studies on road accidents, described casualties by the category of road-user. It came out that, Pedestrian fatalities were highest in 75% of the studies accounting for between 41 and 75%, followed by passengers (38-51%) in 62% of the studies. Drivers were third in 55% of the studies, and never ranked first in any country. Pedal and motorcyclists killed ranked first in India.

Passengers ranked first amongst the non-fatal casualties reported in 14 studies.

According to Ameratunga et al (2006), the introduction of pavements (sidewalks) for pedestrians to walk separately from motorized traffic—especially at high-risk crash sites has the potential to lead to substantial reductions in pedestrian injuries. Roads that do not provide pavements, a common scenario in many low-income countries are associated with a two-fold increased risk of a crash compared with those that do. Also implementation of road-design measures to facilitate reductions in speed, through various traffic-calming measures, is another key strategy that can be used with potential reductions in deaths and injuries of 11%. Although these findings from the

Cochrane Injuries Review Group was not based on any reports from low-income and middle-income countries, a before-and-after investigation of the introduction of speed bumps in Ghana showed a 55% reduction in all deaths and a 51% annual reduction in crashes in which a pedestrian was hit. The researchers added, while road safety fatalities and injuries are reducing in the developed world, it is increasing at an alarming rate in the developing countries. Amoah (2011) cited Arthur Kennedy in an article "Perishing on the road" that many of our prominent politicians have been involved in accidents including the Former Presidents of Ghana; Rawlings and Kufour and many other prominent politicians and members of the parliament of Ghana. Amoah again cited Amofa (the deputy director Health Service) stating that, "road accidents kill more Ghanaians annually than typhoid fever, pregnancy related complications, and malaria in pregnancy, diabetes or rheumatism". He added that, the death of three Urologists of the Korle-Bu teaching Hospital on the Kumasi-Accra highway leaves a scarlet in the minds of Ghanaians. Obour 2011; and Akoto-Manu 2011, stated that, statistics of deaths on the Ghanaian roads is too alarming. In 2007, 1346 people were killed, the year 2008 recorded 1520, 2009 recorded 1587, 2010 recorded 1760 and death toll in 2011 was 2,119. Clearly, the spate of road accident in Ghana is on the ascendancy.

The MTTU (2011), cautioned road users to be careful as the accidents are rampant getting to the end of years especially in the months of November and December. According to the G R S P, road accidents kill average of four persons daily in Ghana. The Herald newspaper (November 21, 2011 edition) reported the Vice President of Ghana, Mahama as saying "the current rate of 1800 deaths through road accidents is unacceptable". The situation is too scary as the chronicle (Monday 11 august 2008) reported a popular statement made by Akorsah that "the most deadly disease in Ghana at the moment is motor accidents".

### 2.3 Causes of Road Accident (motorcycle)

Many researchers have come out with the causes, effects and recommendations to vehicular accidents in Ghana and elsewhere. For instance, Ayeboo (2009), identified that the numerous accidents on our road networks have been linked to various causes which include over speeding, drink driving, wrong over taking, poor road network and the rickety vehicles which ply on our roads.

Furthermore, the National Road Safety Commission (NRSC) has identified over twenty causes of road accidents in Ghana which include unnecessary speeding, lack of proper judgment of drivers, inadequate experience, carelessness, wrong overtaking, recklessness, intoxication, over loading, machine failure, dazzling and defective light, boredom, unwillingness to alight from motion objects (vehicles, motor cycles, human being and uncontrolled animals), skid and road surface defect, level crossing and obstruction. Other factors are inadequate enforcement of road laws and traffic regulations, use of mobile phones when driving, failure to buckle the seat belt and corruption, (National Road Safety Commission, 2007).

In spite of all these factors, Ocansey (2011) observed that poor vision of drivers could also be a major contributory factor to road accidents. It was obvious that the actual factors which may be influencing the traffic crashes in Ghana have not been identified since most of the factors stated above have not yet been tested with any mathematical and statistical tool to ascertain the truth or otherwise of their contributions.

Elsewhere, the causes of road accidents have also been linked to one or combination of the following four factors, equipment failure, road design, drivers' behavior and poor road maintenance. However, studies have shown that over 95% of all road crashes are caused by the behavior of the driver and the combination of one or more of the other three factors, (Driving guidelines, no date).

According to the country report on Road Safety in Cambodia, road accident is caused by human factors (road users), road defects and vehicle defects. It was found in the report that road accident in Cambodia was increased by 50% in five years while the fatality rate was doubled. To help reduce the rate of road accident it was suggested that Road accidents Safety Committee was set up, accident data system was established, accident evaluation policy and driver training measures were to be put in place, Ung Chun (2007).

In spite of all these facts, some Ghanaians still associate some of the road accidents in Ghana to superstitions, witchcraft and evil forces, are accidents caused by witches or irresponsible government policies? It is therefore believed that as a result of these spiritual activities, most people die in road accidents so that more blood would be obtained by the witches, wizards and the evil forces for their spiritual activities, Okyere (2006).

Some researchers have also attributed the escalating number of carnage on our roads especially in sub Saharan Africa to bribery and corruption. In a study conducted in Russia to find out the contribution of corruption to road toll, it was found out that people were paying as much as US\$800.00 to obtain driving license without going through any form of driving school ("Russia" Today,2010).

There is enough evidence in South Africa that the government uses over R500 million annually from the Road Safety Fund to fight fraud, bribery and corruption (Arrive Alive, n.d)

According to Chitere and Kibua (2004) the transport industry of Kenya is so much fragmented with the transport ministry, office of the president and other agencies playing conflicting roles which create bureaucracy, bribery and corruption in the industry since security personnel (police) fail to check and introduce transport laws.

Also research by Khayesi (1997) and Lamba et al (1986) shown that most workers of public transports are employed on the bases of relational ties. This practice has not given room to qualify and competent people to work in the transport industry leading to rampant road accidents in Kenya.

There is substantial evidence to prove that the higher the number of road accidents which occur in given time period, the higher the number of casualties who die in the accident.

According to Afukaar et al (2009) in their report presented to the National Road Safety Commission, there was a total of 11320 road accident which killed 1779 people in 2005. The number of road accidents increased to 12038 in 2007 and killed 2024 people. At the end of 2009, there were 12299 road accidents in the country and 2237 lives were lost. However, the report did not fit any model which could be used to estimate the likely road accidents in subsequent years, vis-à-vis the number of casualties who are likely to lose their lives in such accidents.

Interestingly, in a study conducted in South Delhi by Kumar et al (2008), it was found out that most fatal accidents occurred on Saturday but in a study at Nepal, the highest number of road accidents occurred on Sunday and the least number on Monday, Jha and Agrawal (2004).

Coincidentally, it was found in a study at South Africa that most people died through road accidents which occurred on Saturday (20.8%) followed by Sunday with 17.1%, (Injury Mortality Surveillance System, 2005)

Kumar et al (2008) identified November as the month with the highest number of fatal accidents in Delhi, 11.04% of all fatal accidents in Delhi occurred in November. This finding contradicted the result obtained in Nepal by Jha and Agrawal (2004) who suggested that July was the month in which most fatal accidents occurred in Nepal.

In a research conducted in Delhi by Mehta (1968) and Ghosh (1992) found that most people were killed in road accidents which occurred in January but National Crime Record Bureau (2005) reported higher incidence of road accidents with much victims in May and March in India.

These varying results from various researchers in different countries indicate that it will be difficult to use what prevail in one country to estimate for another country since conditions associated with road accidents may vary from country to country.

### 2.4 Reasons for not reporting accidents to the police

Most riders do not have licences (about 71%) and will want to avoid the police. Over 70% of participants were also of the view that most of the accidents are caused either by stray animals on the road and foot-paths. One discussant elaborated: "You see, me when I had my accident, it was due to my own mistake. Besides, my motorcycle is not registered. I don't also have a licence, and on top of that, I was not wearing a helmet, so you want me to go and report myself to the police, no way". (Male Discussant)

Discussants also noted that generally, the social settings of Bolgatanga township discourage litigation. So accidents were usually settled informally. Another participant, a motor fitter (mechanic) noted:

"In Bolgatanga, we are all one big family, so if you have a problem with your family member you don't report to the police. If you do that, the police will collect money from the two of you, why don't you settle it amongst yourself and use that money to treat yourselves and to repair your motorcycle. So that if there is a balance, you can drink beer with it and pour some to your ancestors for saving your lives". (Male Discussant).

According to the expert opinions of the Senior Nurse In-charge of the accident and emergency ward and the Regional Coordinator of National Road safety Commission, Motorcycle accidents accounts for over 80% of all motorcycle accidents cases in the municipality for the past five year.



## 2.6 Economic burden of motorcycle accidents

The economic burden of motorcycle accidents was estimated to be about US\$1.2 million, of which, 52% were accident-related costs (i.e. property damage and administration) and 48% casualty-related costs (i.e. medical costs, out-of-pocket expenses, lost labour out-puts, intangible costs and funeral expenses). Most motorcycle accident victims were in their productive ages and were males. Only a third of the motorcycles were insured. Majority of the riders (71%) did not possess valid driving license and would want to avoid the police. Main motorcycle injuries were head injuries, fractures, lacerations and contusions. Majority of the accidents were caused by lack of formal motorcycle riding training, abuse of alcohol, unrestrained animals and donkey carts.

This is made up of about 51.9% accident-related costs and 48.1% casualty-related costs. The accident-related costs totalling US\$585,415.37 was made up of property damaged costs of 47% and administration costs of 5%. Whilst the casualty-related cost of US\$631,412.32 was made up of labour output costs (21%), out-of-pocket expenditure (17%), medical costs (5%), intangible costs (4%) and funeral costs (1%).

There have been some attempts to quantify the cost of road traffic accidents in economic terms. According to Jacobs et al, (2000), the costs of road crash injuries is estimated at roughly 1% of gross national product in low income countries ,1.5% in middle income countries and 2% in high income countries. The direct economic costs of global road crashes have been estimated at US\$ 518 billion, with the costs in low-income countries – estimated at US\$ 65 billion – exceeding the total annual amount received in development assistance, Jacob et al, (2000). Furthermore, the costs estimated for low-income and middle-income countries are probably significant underestimates. Using more comprehensive data and measurement techniques, the estimated annual costs (both direct and indirect) of road crash injury in European Union (EU) countries alone, which contribute 5% to the global death toll, exceed €180 billion (US\$ 207 billion) Murray and Lopez, (1996). For the United States of America, the human capital costs of road traffic crashes in 2000 were estimated at US\$ 230 billion (Blincoe et al 2002).

According to Keith et al, (2007) motor vehicle collisions generated \$18 billion in social costs in Ontario in 2004. Fatalities in those collisions were the largest single contributor to social costs at \$11 billion. Also significant were the costs of injuries, at \$4 billion and property damage at \$2 billion. Other major contributors to the social costs of motor vehicle collisions were: traffic delays; out-of-pocket expenses; hospital/health care; tow trucks; and police, fire and ambulance services. In a study on patterns of road traffic accidents in Ghana; implications for control, (Afukaar et al, 2003) concluded that out of pocket medical payment were estimated at \$100.05 plus or minus \$228.80 per transport related injuries in urban areas compared with \$21.09 plus or minus \$64.31 for transport related injuries in rural areas. The study provided the overall cost of hospital care per injury without taking into account productivity, property and the human cost of pain, grief and suffering. Clearly, it is as difficult to accurately determine the economic burden of Africa's road traffic accidents, as it is to collate accident data in the first place. There are the problems of under-reporting to contend with, as well as different countries adopting different criteria-such as defining a road traffic accident fatality. Some countries define a fatality as one occurring on the scene, others for periods of 24 hours, three days or 30 days after the event.

In order to estimate the effect of road traffic injury on a household in a least developed country, a survey was conducted in 2007 by the Coalition for Road Safety in the peri-urban middle-income district of MukhKampul in Cambodia, ( Ericson , 2008).It came out that MDGs 1,2,3,4,and 5 are negatively impacted by RTAs. He found out that the pre accident income of the household surveyed was reduced by 45% in the short term and 68% in the long term. Fourteen percent of the household surveyed reported that their children dropped out of school whilst 88% of women spent time caring for the injured.

The source continued that the child mortality rate of the surveyed household was 71 per 1000 live birth which was more than double the provincial rate of 30 deaths per 1000 live births. A study carried out by the Transport Research Laboratory (TRL) for the Global Road Safety Partnership (GRSP), took a closer look at the direct economic impact of road traffic crashes resulting in death or serious injury on individual urban and rural households in Bangladesh and Bangalore, India, (Global Road Safety Partnership, 2002). It came out from the

study that though it may be only one person that is involved in a road crash, the whole household can be affected. Costs to families include funeral costs, loss of work time, loss of the person generating the main, or a substantial proportion, of household income. Often debt is incurred by the bereaved family as a result of loans being taken out to pay funeral costs or to cover lost earnings. From the same source, the findings revealed that where a road crash results in serious injury to a family member, costs include medical costs, costs of searching for new work (often lower paid), expenditure on long term care and rehabilitation and the value of lost earnings of the carer of a family member – the vast majority of households with a serious injury had to have at least one family member give up work to care for the injured. Again many of the poorer households (over 60%) borrowed in order to cope with costs.

Fatalities affect a country in several ways but when it involves highly talented individuals and educated people whose contributions improve national productivity, then RTA represent a huge lost to the nation economically. This was exemplified by the loss of the three Urologist of the Korlebu Teaching Hospital on the Accra -Kumasi highway on the

27th of August, 2005. The huge cost involved in their training notwithstanding, the pains, anguish and probably death of patients who will miss their services is too huge to ignore, considering the fact that at the time of the accidents, there were only seven Urologists in Ghana. Studies have shown that motor vehicle crashes have a disproportionate impact on the poor and vulnerable in society. These are also the people with usually little influence over policy decisions (Nantulya and Reich 2002, Laflamme and Diderchsen, 2002). Even in high-income countries, poor children are at greater risk than children from more prosperous families (Laflamme and Diderchsen , 2002). Poorer people comprise the majority of casualties and lack ongoing support in the event of long-term injury. Lower socioeconomic groups have limited access to post-crash emergency health care (Mock et al, 1997). In addition, in many developing countries, the costs of prolonged medical care, the loss of the family breadwinner, the cost of a funeral, and the loss of income due to disability can push families into poverty (Hijar et al, 2003). In Mexico, the second commonest cause of children being orphaned is traffic crashes (Hijar et al, 2003). In developing countries, the population groups exposed to the highest risks of injury and death from road crashes – for example, pedestrians and users of motorized two-wheelers are from lower socioeconomic groups (Nantulya and Reich, 2002). They face a greater likelihood of injury, since affordable transport poses higher risks in these places than private car users

### 2.7 Motorcycle accidents-A public health concern

Road traffic injuries are a major but neglected global public health problem, requiring concerted efforts for effective and sustainable prevention. According to the World Health Organisation (2004), of all the systems that people have to deal with on a daily basis, road transport is the most complex and the most dangerous. Worldwide, the number of people killed in road traffic crashes each year is estimated at almost 1.2 million, while the number injured could be as high as 50 million. (WHO, 2004).The tragedy behind these figures regularly attracts less media attention than other, less frequent but more unusual types of traged.

What is worse, without increased efforts and new initiatives, the total number of road traffic deaths worldwide and injuries is estimated to rise by some 65% between 2000 and 2020 (Kopit and Crooper, 2005, Murray and Lopez, 1996), and in low-income and middle-income countries deaths are expected to increase by as much as 80%.The majority of such deaths are currently among “vulnerable road users” – pedestrians, pedal cyclists and motorcyclists. In high-income countries, deaths among car occupants continue to be predominant, but the risks per capita that vulnerable road users face are high. (Peden et al, 2004). In Africa, it has been estimated that 59,000 people lost their lives in road traffic crashes in 1990 and that this figure will be 144,000 people by 2020, a 144% increase (Nantulya and Reich, 2002).By contrast, developed countries have experienced a decreasing trend since the 1960s. Because road traffic injuries have long been considered to be inevitable and caused by random, unpredictable events, the international community's response to this worldwide public health crisis came relatively late. The World Health Organization (WHO) arranged a consultation meeting in April 2001, which led to a report, entitled “A 5-year WHO strategy for road traffic injury prevention” that summarizes the main recommendations from the working group (Peden et al 2004). In 2003, the United Nations Secretary-General sounded the alarm with an official statement (United Nations General Assembly ,2003) describing the global public health challenge posed by road traffic injuries and encouraging Member States to address the problem. One of the recommendations is to promote and facilitate research on this subject, especially in low-income countries where knowledge gaps often jeopardize appropriate resource allocation. Much needs to be done, especially in motor

cycle accidents.

Global research and development funding for road traffic injuries were estimated in 1996 to range from US\$24 to US\$33 million, compared with more than US\$900 million for HIV/AIDS (WHO, 1996). Moreover, the overwhelming majority of this money is spent in developed countries (Lagarde, 2007). Around 85% of all global road deaths, 90% of the disability-adjusted life years lost due to crashes, and 96% of all children killed worldwide as a result of road traffic injuries occur in low-income and middle-income countries. Over 50% of deaths are among young adults in the age range of 15–44 years (Peden et al, 2002). Among both children aged 5–14 years, and young people aged 15–29 years, road traffic injuries are the second-leading cause of death worldwide (Peden et al, 2002).

## Research methods

### 3.1 Research Design

A cross-sectional survey data collection approach and quantitative design was used in the study to examine the perception of the public about the motorcycle accidents in the municipality. A cross sectional survey method employed to solicit for primary data from respondents. A desk-top research was used to obtain secondary data involving other people views regarding the study area.

### 3.2 Population

#### 3.2.1 Target population

The target population refers to the population of interest for the purpose of the study and it was defined as motorcycle accidents victims in Bolgatanga Municipality. The accident victims' opinions were solicited to know the causes of motorcycle accident in the municipality.

#### 3.2.2 Sample Frame

The sample frame consists of the list of element from which the sample is actually drawn. It was made up of the list motorcycle accidents cases which were collated from the regional hospital of the Upper East Region.

#### 3.2.3 Sample Size

Saunders *et al.* (2007) indicated that, the size of the sample and the way in which it is selected will definitely have implication for the confidence you can have in your data and the extent to which you can generalize. The sample size of the motorcycle victims was determined using the 2,353 RTA cases in 2015. Using expected motorcycle accident rate of 80% of all RTA cases, and 74% worst acceptable results (absolute precision of 6%) at confidence level of 95%, a sample size of 160 was calculated using Epi-Info Version.

### 3.3 Sample and Sampling Procedure

**Motor cycle accident victims:** Motor cycle accident victims were purposively sampled from the Bolgatanga Municipality. From the 2008 Annual Report of the Municipal Health Administration, a total of 2353 people were involved in motorcycle accidents (i.e. 2034 cases at OPD and 319 In-patients). Initial attempt was made to select RTA cases randomly, however, due to unreliable house numbering system in the Municipality, coupled with the tendency for accident victims to provide false house addresses for fear of being tracked by the police, it was extremely difficult to reach the motorcycle accident victims using the house addresses obtained from the police and hospital sources. Thus, after identifying some willing victims to participate in the study, the Snowball technique was used to obtain the sample size from motorcycle repairers, traditional bone setters and the Accident and Emergency Ward record. Data on all registered motorcycle ranged from 1980 to 2017 were collected. Police record of motorcycle accidents within the study period was also collated.

### 3.4 Data Collection Instruments

A questionnaire was the instrument used for the collection of primary data for the study. A Set of questionnaires containing a 30 items was designed for the respondents of the Bolgatanga Municipality. In this study, a semi-structured-questionnaire was used as the primary research instrument. The questionnaires included most closed-ended questions (pre-coded) to make simpler for the respondents and also for easy analysis. Others are also open-ended to allow accident victims to provide further and better details about their experienced of motorcycle

accident. The nature of the study was explained to respondents, and respondents' confidentiality of any information provided was also assured. Respondents were also provided with detailed instructions as to how the questionnaires would be completed and returned. The rationale behind providing clear instructions and assuring confidentiality of information is based on the fact that this significantly reduces the likelihood of obtaining biased responses (Sekaran, 2003). Also journals and publications were used to solicit other people view and opinion about motorcycle registration and accident and the progress made so far.

### 3.5 Data Collection Approach

Data were obtained from two sources that are primary and secondary and the details are below:

#### 3.5.1 Primary Data Extraction

The study involved the collection of both primary and secondary data. The primary data were collected using structured interviews and administration of questionnaires to obtain information about causes of motorcycle accidents.

#### 3.5.2 Secondary Data Extraction

Data extraction forms were developed to extract secondary data from the records of the regional office of Driver and Vehicle Licensing Authority (DVLA). The data extracted from DVLA records were year/months of registration of motorcycle from 1980 to 2017. Treated accident cases (both in-patient and out-patient cases) were also obtained from hospitals. Data on all registered vehicles from 1980 to 2017 were collected from the Vehicle Registration Log Books of the Drivers and Vehicles Licensing Authority of the Upper East region. Police records of motorcycle accidents within the study period were also collated. Other materials were obtained through reading of journals, publications and articles to enable the researcher assess other perceptions from different stakeholder about the motorcycle registration and accident in the Bolgatanga Municipality

### 3.6 Data Analysis

The data was analyzed to predict the pattern of inflow of motorcycles and accidents in the Bolgatanga Municipality between the periods of 1980 to 2017. Various statistical software such Minitab and Grete were used to analyzed the secondary data and the model identified was ARMA(1,0) or ARIMA(1,0,0) and later it was used to forecast for four years period ranging from 2018 to 2022. The primary was analyzed using Statistical Package for Social Solution (SPSS 16.0). In order to aid effective discussion, the responses were put into cross-tabulation with frequencies and percentages.

## RESULTS AND ANALYSIS

In this study, results refer to the outcome of the various statistical procedures used in analyzing the data collated and coded. The results served as the foundation for interpretation, discussion and drawing conclusion for the purpose of achieving the objectives.

### Motorcycle Accidents

The cross tabulation considered the situations where you own a motorcycle and have an accident with the motorbike or you are not on a motorcycle and been hit by a motorist or car.

**Table 4.1: Motorcycle Accidents**

		do you own a motor bike		Total
		Yes	no	
have you ever had an accident	Yes	35	11	46
	No	2	2	4
Total		37	13	50

(Filed data, 2016)

From table 4.1; 35 of the respondents said they own a motor bike and had an accident, thus 70 percent of the respondents whiles 11 of the respondent said that, they didn't own a motor bike neither do they had an accident.

**Table 4.2: Causes of accidents**

		have you ever had an accident		Total
		yes	no	
if yes, what was the cause of the accident	hit the back of a vehicle	2	0	2
	hit by vehicle	13	2	15
	knocked a pedestrian	6	0	6
	knocked an animal	6	0	6
	hit the pavement	7	0	7
	hit by a motor bike	11	0	11
Total		45	2	47
if no to q10, what is your opinion about motor cycle accident	Drunk whiles riding	1	1	2
	Disobedience of traffic regulations	0	1	1
	Over speeding	1	2	3
Total		2	4	6

Even though 2 of the respondents said they never had an accident but they were hit by motor vehicle which made up cases of hit by vehicle to be 15. Also 4 of the respondents believed that, motor accidents are caused by over speeding, disobedience of traffic regulations and drunk whiles riding. For instance, Ayeboo (2009), identified that the numerous accidents on our road networks have been linked to various causes which include over speeding, drink driving, wrong over taking, poor road network and the rickety vehicles which ply on our roads.

**Table 4.3: Accident Scene**

		which one of the following describes you at the time of the accident			Total
		rider	pedestrians	pillion	
when did the motor bike accident occur	less than one month	6	3	0	9
	between 1-6 months ago	15	1	2	18
	6-12 months ago	9	0	1	10
	more than one year	11	1	0	12
Total		41	5	3	49

From table 4.3, most of the accidents that occurred people were not sitting at the back, only 6.1 percent of the respondents were seated at the back at the time of the accident . Also 15 of the respondents were riders at the time of the accident which they said the accident occurred between 1-6 months ago before the time of the study.

**Table 4.4: Number of Respondents who report accident cases to the police**

		have you ever had an accident		Total
		Yes	no	
did you report to the police	Yes	7	2	9
	No	39	1	40
Total		46	3	49

(Filed data, 2016)

Out of 46 respondents, 84.8 percent of them, have ever had an accident but never reported to the police about the accident. Two (2) of the respondent who said they have ever had an accidents were probably eyewitness of the motor accident and did reported to the police.

**Table 4.5 Reasons for not reporting to the police**

Reasons	Number of Respondent	Percentage (%)
could not identify the person	15	30.0
think is not necessary	14	28.0
fear of punishment	10	20.0
Far from police station	1	2.0
Fear of paying money	10	20.0
Total	50	100.00

(Filed data, 2016)

Respondent were asked to state their reasons for not reporting to the police. Out of the 50 respondents, 30% said could not identify the person, 28% indicated thought it was not necessary to report to the police, 20% thought of punishment, 2% said distance and 20% believed when they report to the police, they would demand for money.

**Table 4.6 impact of accident on working ability**

		what has been the impact of the accident on your working ability			Total
		can still work	working ability reduced	cannot work at all	
have you ever had an accident	Yes	28	14	2	44
	No	2	0	0	2
Total		30	14	2	46

(Filed Data, 2016)

Out of 44 respondent, 28 of the respondents said they have ever had an accident but they can still work while 14 of the respondents indicated that their working ability has reduced but only 2 of the respondents admitted to the fact that, they cannot work at all.

**Table 4.7: Economic burden**

		did you have to sell any property to take care of yourself as a result of the accident		Total
		Yes	no	
have you ever had an accident	Yes	9	36	45
	No	1	1	2
Total		10	37	47

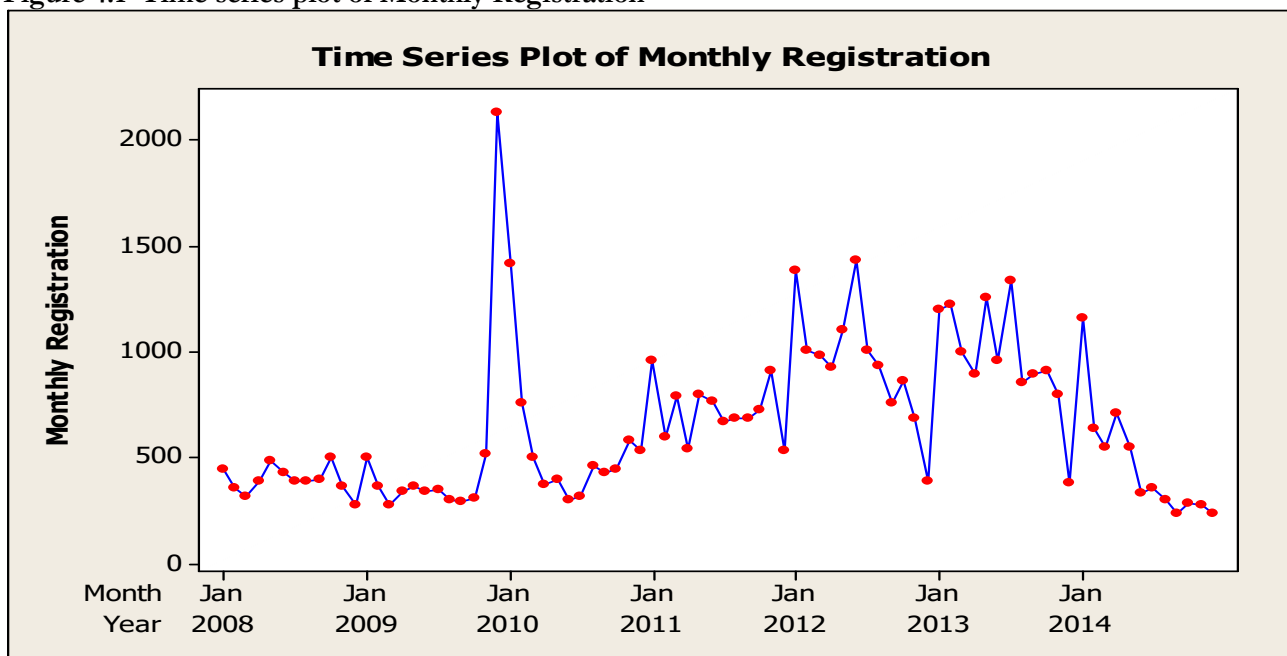
(Filed Data, 2016)

Nine (9) of the respondents agreed that, they had an accident and sold properties. However, only one (1) respondent said s/he never had an accident but solved a property probably to support an accident victim.

#### 4.2: Time series analysis motorcycle registration

The study analyzes the number of motorcycle registered in the Bolga Municipality within the period of 1980 to 2017. In all about 71,777 motorcycles were registered within this period.

Figure 4.1 Time series plot of Monthly Registration



(Filed Data, 2016)

From the plot it can be observed that there are similarities that exist within the months of the year. It can be seen that from the month of January through to July thereabout, the registration keeps reducing and starts rising again from the month of October and then reduces to December.

Table 4.8: shows stationary test (raw data)

ADF	KPSS
$Pd = 0.000574$	$Pd = 0.467$
$p - value = 0.05$	$p - value = .467$

(Filed Data, 2016)

Penalty is less than 0.05 which indicates motorcycle registration data is stationary.

Table 4.9: shows accuracy measures

	ACCURACY MEASURES		
Trend	MAPE	MAD	MSD
Linear	48	251	116201
Quadratic	43.3	231	93013.9
Exponential	42	250	123926

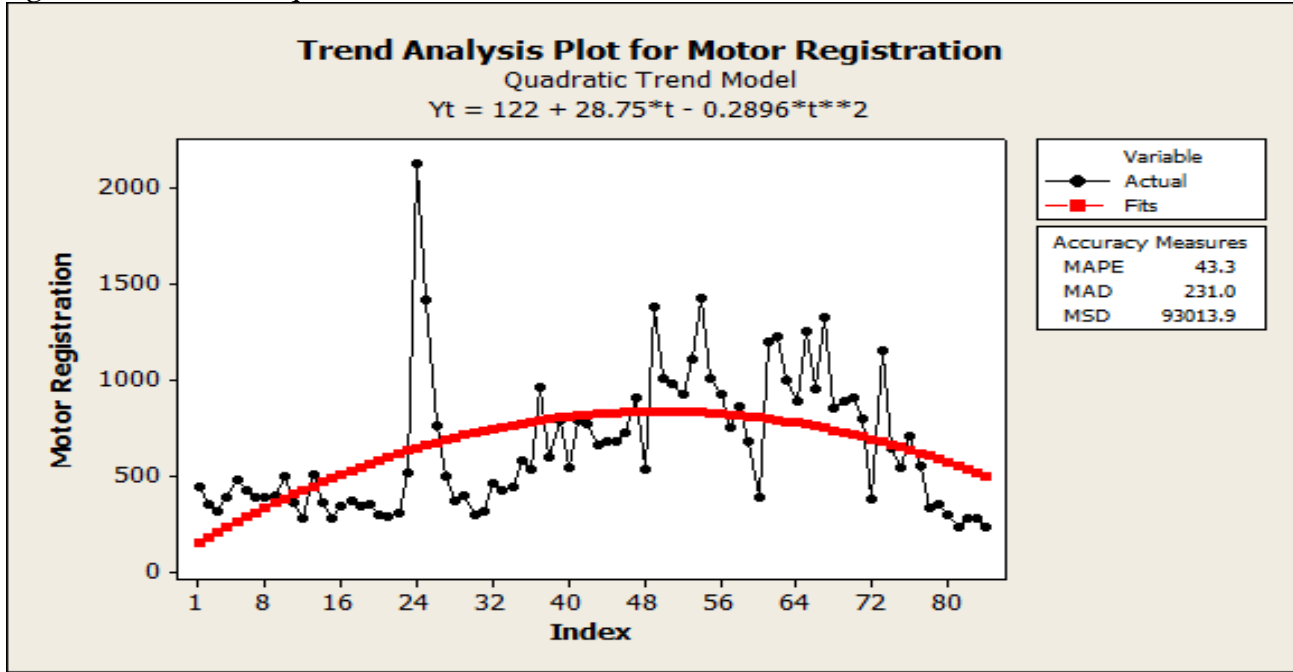
(Filed Data, 2016)

From the table 4.9, it can be observed that, the registration of motorcycle in the municipality exhibit quadratic

trend since it has the lower MAPE, MAD and MSD.

Comparing the measures of accuracy from table 4.9, it can be observed that, quadratic trends assumed the least values and it is clear that, motorcycle registration follows quadratic trend hence, the details are shown below

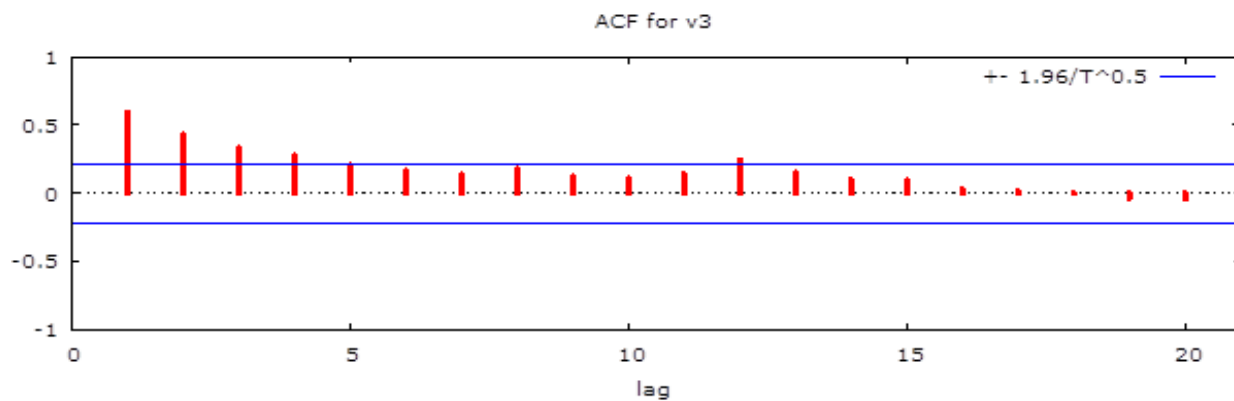
Figure 4.2 shows quadratic trend



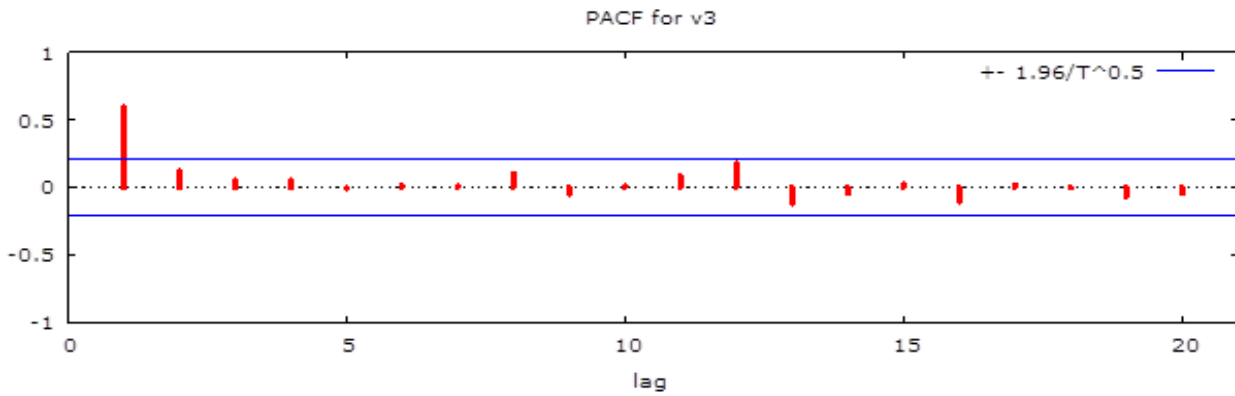
(Filed Data, 2016)

The time series plot in figure 4.2 exhibits quadratic trend. The graph exhibits that, motorcycle registrations are random data in the Bolgatanga Municipality.

Figure 4. Shows ACF and PACF







(Filed Data, 2016)

The ACF graph shows there is periodicity at lag 12. Lag 1 to lag 4 is said to be significant. To further ascertain the behaviour of the series data on motorcycle registration, the PACF graph is plotted above. Apart from lag one (1) in the PACF graph above, the others are all within the confined of the confidence limit.

**Table 4.10: shows Model identification**

From the ACF and PACF plots the following were model were identified.

Model	AIC	BIC	HQC
ARMA(1,1)	1193.861	1203.584	1197.770
ARMA(2,1)	1195.322	1207.477	1200.208
ARMA(3,1)	1197.259	1211.844	1205.122
ARMA(4,1)	1199.498	1216.514	1206.339
ARMA(1,0)	1193.652	1200.944	1196.583

(Filed Data, 2016)

From the penalty statistic table the model with the least AIC, BIC and HQC is ARMA (1,0) = ARIMA(1,0,0) = AR(1).

**Table 4.11: shows Adequacy test (ARCH-LM Test)**

Lag	P-value
12	0.998809
24	0.873715
36	0.436489

(Filed Data, 2016)

From the table 4.11 adequacy test values are greater than 0.05 at the various lags confirmed that, ARMA (1, 0) is Adequate

**Table 4.12: Shows Ljung Box Statistic**

Lag	12	24	36	48
X <sup>2</sup>	8.4	12.7	25.5	33.4
DF	10	22	34	46
P-value	0.589	0.942	.863	0.916

(Filed Data, 2016)

From the adequacy test the ljung box statistic indicates that, the data is free from higher auto-correlation since the p-value is greater than 0.05 at various lags (12, 24, 36, 48). Also from the ARCH-LM test the registration data is not heteroscedastic since the p-values at the various lags is greater than 0.05. Hence the data is homoscedastic.

The model is ARMA (1,0)

The estimator model is  $y = 648.889 + .449633Q1$

**Table 4.13: shows forecast values for 2017.**

95%			
Period	Forecast	Lower	Upper
January	639.41	-69.39	1348.21
February	639.66	-69.14	1348.46
March	639.81	-68.99	1348.61
April	639.9	-68.9	1348.71
May	639.96	-68.84	1348.76
June	639.99	-68.81	1348.8
July	640.01	-68.79	1348.82
August	640.03	-68.78	1348.83
September	640.03	-68.77	1348.84
October	640.04	-68.76	1348.84
November	640.04	-68.76	1348.84
December	640.04	-68.76	1348.85

Total Registration for 2016=7053.92 and 2017=7678.92 from projections

Table 4.13 shows the forecast for 2017 is fairly steadily increasing pattern. That is from January, 2017 to December, 2017 respectively. There is also the lower confidence level (LCL) and upper confidence (UCL) all ranging from January, 2017 to December, 2017. It can be observe from the forecast values that, the roads in the municipality be expanded in order to accommodate this increment.

### 5.1 Summary of Findings

The findings clearly highlighted that, the number of motorcycle registration from 2004 to 2005 experienced an increase and suddenly drop fairly steadily until 2007 where it increased fairly steadily until 2012 and then drop sharply to 2014. Its start to increased again in 2015.

The findings revealed also that, the causes of motorcycle accidents are: hit the back of the vehicle, hit by vehicle, knocked an animal, hit the pavement and hit by a motor.

The forecast for 2017 shows a fairly steadily increasing pattern. That is from January, 2017 to December, 2017. The respondent said the reasons why they didn't report to the police at the time of the accident are: could not identify the person, thought it was not necessary to report to the police, thought of punishment, distance and fear that the police would demand for money. Many of the motorist that have ever had an accident working ability had reduced and they resulted into selling of properties in order settle hospitals bills hence imposing economic burden on the victims as well as the municipality.

### 5.2 Conclusion

In conclusion, motorcycle accidents cases are underreporting within the municipality however the reasons for them not reporting accidents cases to the police are: could not identify the person, thought it was not necessary to report to the police, thought of punishment, distance and fear the police being demand for money. Most of the victims working ability have reduced and some victims resort to borrowing, using savings and/or selling assets, however resulting in financial stress. Also from the findings of ARCH-LM test the registration data is not heteroscedastic since the p-values at the various lags is greater than 0.05. Hence the data is homoscedastic.

### 5.3 Recommendation

**The study recommends the following:**

Since the trend of motorcycle inflow into the region as well as the motorcycle accidents are increasing fairly steadily then is therefore recommended that, road safety commission should play its future campaign message on

road safety to the general public in order to help mitigate road accidents within the region which imposing economic burden in the society at large.

The public should be educated on the importance of reporting accidents cases to police in order to help reduced under reporting accidents cases in the Municipality.

It was predicted in the study that, 2017 total number of motorcycle registered would be increased to 7, 679 and this suggest that, roads in the municipality needs to expanded in order to accommodate these numbers and MITTU should corroborated with national safety commission to institute public campaign message to educate motor riders on both the importance of reporting accident cases to police and obedience to safety precaution measures in order to mitigate motorist being track by police or law enforcement agencies.

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