



Statistical Analysis Factors Influencing Auto-Crash Mortality in Osun State: A Case Study of Federal Road Safety Commission, Osun Sector Command (Rs 111), Osogbo. Nigeria

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Abstract: Motor accident is a major cause of mortality and disability in Nigeria, which explains the reason for the establishment of Federal Road Safety Commission in 1988 to address the carnage and maiming problems on the highways and roads. This paper employed multiple regression statistical tools to establish the relationship existing between accident mortality and factors influencing auto-crash mortality with number of Persons killed representing the dependent variable (Y); Number of Fatal cases (X_1), Number of Serious cases (X_2), number of Minor cases (X_3), and number Injured Persons (X_4) as the independent variables. Secondary data was collected from the record section of Federal Road Safety Commission, Osun command, Osogbo from 2006 to 2012. Preliminary study revealed that number of Fatal cases of auto-crash, number of Serious cases, and number of Injured persons contributed significantly on the regression plane; however, the breakdown of the assumption of multicollinearity necessitated the expunge of the affected collinear variables which are; Minor cases and Serious cases. The final model built for the relationship is $Y = -0.600 + 1.291 \text{ FatalCases} - 0.048 \text{ InjuredPersons}$. The independent variables (X_{is}) jointly contributed significantly on the regression plane. The coefficient of multiple determination computed ($R^2 = 0.743$) implies that 74% of the total variation in Y is adequately explained by the independent variables giving credibility to the predictive power of the model.

Keywords: Auto-crash, model, time series, road safety, multiple regressions.

1. Introduction

Motor vehicle accidents are the major cause of death in adolescents and young adults worldwide. Nearly three-quarters of road deaths occur in developing countries and men comprise a mean 80% of casualties (Odero, *et al*, 1997). An analysis of the traffic crashes data recorded over a seven-year period of 2000-2006 shows that 98,494 cases of traffic crashes were recorded out of which 28,366 were fatal and resulted into 47,092 deaths (FRSC, 2009). This revealing statistics show that Nigeria is placed among the fore front nations (especially the third world nations) experiencing the highest rate of road tragedies in the world.

A motor vehicle crash, an event occurring on a street, road or highway, in which at least one motor vehicle in motion is involved by collision or losing control, and which causes physical injury or damage to property; Fatalities, deaths that occur within 30 days as a result of a motor vehicle crash. This is the standard definition recommended by the Economic Commission for Europe (ECE) and the World Health Organization (WHO, 1979)

Many agree that in the case of highways and road ways, crashes are not just a matter of luck or misfortune, but a combination of multiple conditions or actions. Most of these conditions and actions are predictable occurrences, and thus should not be considered "accident". In this study the term "crash" or "collision" will be used in lieu of the term "accident" (Eze, 2013).

Motor vehicle accidents are the leading cause of death in adolescents and young adults worldwide. Every year, according to statistics, about 1.2 million people are known to die in road accidents worldwide and others sustain severe injuries, while others suffer permanent disabilities due to number of fatal and serious cases of road accident (Olushina, 2012).

Nearly three-quarters of road deaths occur in developing countries with 80% casualties (Odero *et al.*, 1997). In Nigeria, the increasing loss of lives on the road has become a worrisome experience. In 2006, about 4,944 deaths occurred in 9,114 road crashes with 17,390 persons injured. The situation in 2007 was 4,673 killed in 8,477 crashes leaving 17,794 injured. In Ekiti, Kogi and Kwara state, a total of 498

and 391 people died in the year 2006 and 2007 respectively which resulted from 402 and 413 crashes respectively (Omidiji and Ibitoye, 2010).

Armed robbers attempts and attacks are discovered to be one of the major causes of auto-crash on Nigeria roads (Omidiji and Ibitoye, 2010). A conducted survey revealed that auto-crash is a function of traffic volume as shown by Atubi (2012). The research showed that peak rainy season (June, July and September) which may be due to slippery road and poor visibility of the drivers, and the September, October, November and December in Lagos state Nigeria. The peak accident that occurs in the dry season is always due to impatience (Atubi, 2012). Ndefo reported that road failure is another cause of road accidents in Nigeria (Ndefo, 2012).

According to (Eze, 2013), the causes of road traffic accidents are multi-factorial. These factors can be divided broadly into driver factors, vehicle factors and roadway factors. Accidents can be caused by a combination of these factors. Driver factors solely contributes to about 57 per cent of road traffic accidents and 93 per cent either alone or in combination with other factors Driver factors in road traffic accidents are all factors related to drivers and other road users. This may include driver behaviour, visual and auditory acuity, decision making ability and reaction speed. Drug and alcohol use while driving is an obvious predictor of road traffic accident, road traffic injury and death. Speeding, travelling too fast for prevailing conditions or above the speed limit, is also a driver factor that contributes to road traffic accidents. The risk of being injured increases exponentially with speed much faster than the average speed. The severity of injury depends on the vehicle speed change at impact and transfer of kinetic energy. Though vehicles travelling slower than average speed are also at increased risk of road traffic accidents, most involve speed too fast for the conditions.

2. Materials and Methods

The source of Information for this paper is secondary. The data was collected from record section of Federal Road Safety Commission of Nigeria (FRCN) Osun Command, Osogbo, Nigeria from 2006 to 2012. The dependent variable Y is the number of persons killed while the independent variables are the number of fatal cases, number of serious cases, number of minor cases, and number of injured persons which are X₁, X₂, X₃, and X₄ respectively.

2.1. Variable Definitions

Persons Killed (Y): This is the number of who are killed immediately in an auto-crash or after at most 30days of the crash (WHO, 1979).

Number of Fatal Cases: The number of auto-crash resulting in at least one person who dies immediately or at most 30 days after the incident.

Number of Serious Cases: The number of auto-crash resulting in severe damage of vehicle and/or severe injury of the occupant of the vehicle.

$$H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4$$

Versus

$$H_1: H_0 \text{ is false}$$

Number of Persons Injured: This is the number of person(s) who sustain injury as a result of auto-crash.

Minor Cases: These are cases with mild damage of vehicles.

3. Model Specification

Econometrics method was used to quantify the theory and established relationship between dependent variable and independent variables. The typical equation of the General Linear Regression model can be written as:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \dots + \beta_k X_{ki} + U_i \dots \quad (3.1)$$

If we have n joint observations in Y, then we can write the general linear regression model in matrix form

as $Y = XB + U$ where Y is of the order n×1, X is a matrix of order n×k, and K is the number of parameters to be estimated which is equals to 2 in this study.

$$\hat{\beta} = (X^1 X)^{-1} (X^1 Y) \dots \dots \dots \quad (3.2)$$

$$\text{var}(\beta_i) = \sigma_u^2 (X^1 X)^{-1} \quad \text{where}$$

$$\sigma_u^2 = \frac{Y^1 Y - \beta^1 X^1 Y}{n - k - 1} \dots \dots \dots \quad (3.3)$$

$$\text{The Coefficient of Multiple Determination } R^2 = \frac{\beta^1 X^1 Y - n\bar{Y}^2}{Y^1 Y - n\bar{Y}^2} \dots \dots \dots \quad (3.4)$$

R² was used to measure the proportion of variation in Y jointly explained by the four Xs. Tests of significance on individual and joint coefficients were carried out using T and F distributions. The data passed Ordinary Least Squares assumption tests on the data i.e. (Homoscedasticity, Autocorrelation, and Multicollinearity). All analysis were done using Statistical Package for Social Science (SPSS).

Hypotheses 1

These hypotheses confirmed the significance of each of the estimated parameter on the regression plane or otherwise using student t-test.

$$H_0: \beta_i = 0$$

Versus

$$H_1: \beta_i \neq 0 \quad i = 1, 2, 3, 4$$

Decision criteria

Reject Ho if P Value < 0.05, otherwise do not reject

Hypothesis 2

This is the joint test of significance of the estimated parameters combined together on the regression plane using F-test. An upheld of the null hypothesis means that at least one of the variables is significant on the regression plane.

Decision criteria

Reject Ho if P Value < 0.05, otherwise do not reject

Figure 3.2: Persons killed against number of against serious cases

4. Data Analysis

The Scattered Plots:

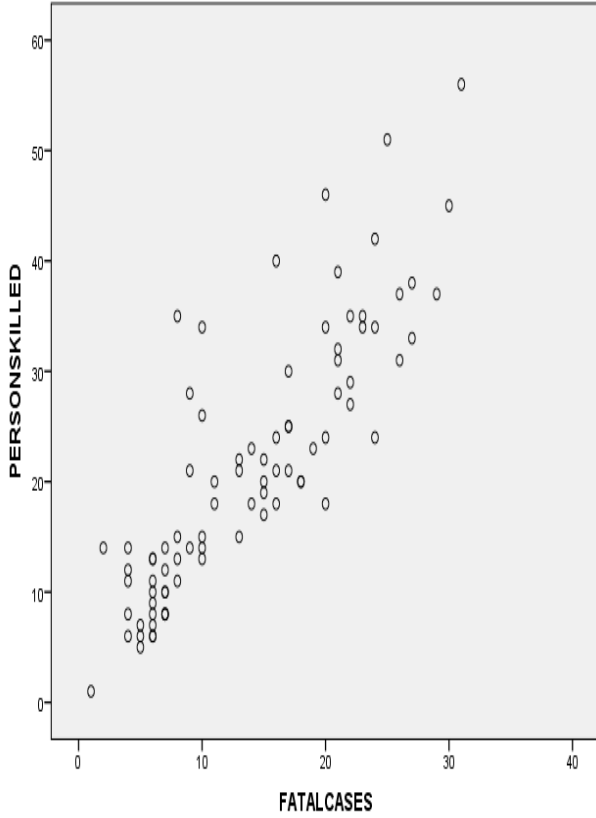


Figure 3.1: Scattered diagram of persons killed against fatal cases

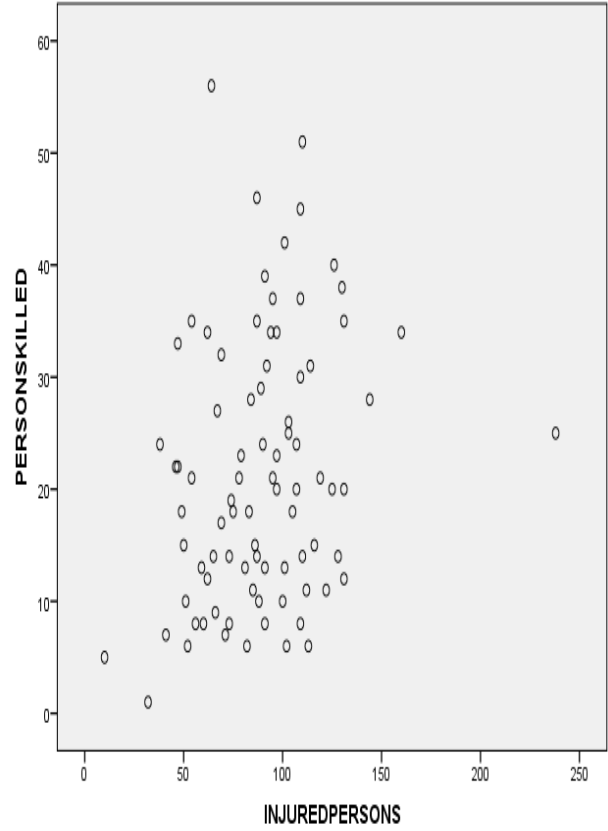
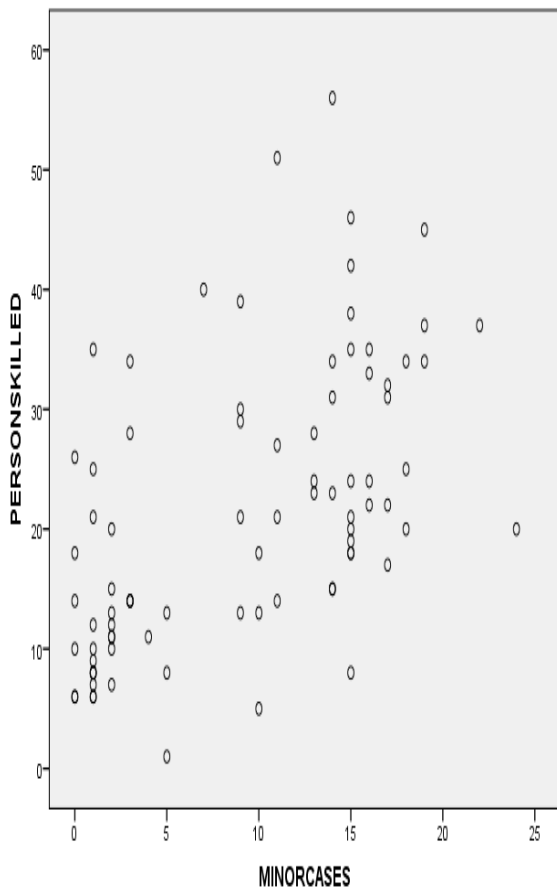


Figure 3.3: Scattered diagram of persons killed against minor cases



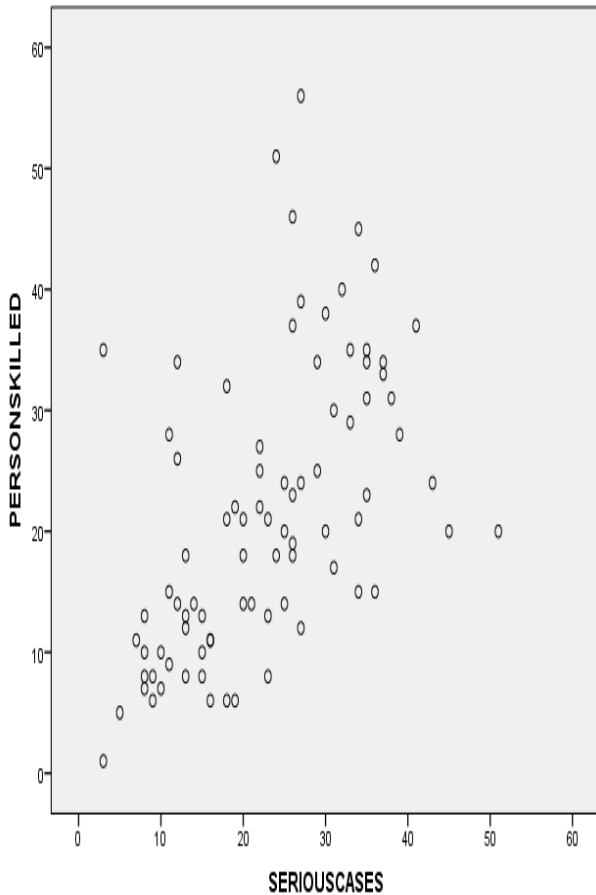


Figure 3.4: Scattered diagram of persons injured against serious cases.

Table 3.1: Estimated parameters and standard errors

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.767	2.133		.360	.720
FATAL CASES	1.624	.142	1.049	11.426	.000
SERIOUS CASES	-.249	.109	-.225	-2.279	.025
MINOR CASES	-.119	.185	-.068	-.642	.522
INJURED PERSONS	.057	.024	.155	2.391	.019

Table 3.2: Test for joint significant of the predictors.

Model	Sum of Squares	ANOVA		F	Sig.
		Df	Mean Square		
1	9105.313	4	2276.328	67.430	.000
	2666.925	79	33.759		
Total	11772.238	83			

Table 3.3: Durbin-Watson and R-Square.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.879 ^a	.773	.762	5.810	2.200

2.4. Preliminary Model

The preliminary model built for the relationship is as stated in (5) below:

$$Persons\ Killed = 0.767 + 1.624 - 0.249\ SeriousCases - 0.119\ MinorCases + 0.057\ InjuredPersons \dots\dots\dots(5)$$

The result reveals that fatal cases, injured persons, and serious cases contributed significantly to auto-crash mortality in Osun state at 0.05 significant level while H₀ is rejected for the said estimated parameters (Referring to Hypothesis 1 above).

The result displayed in the Table 3.2 revealed that jointly, all the independent variables contributed significantly on the regression plane.

Durbin-Watson statistic is 2.200 which is approximately 2 implies that auto-correlation does not exist. R-Square computed is 0.772 implying that 77% of variation in Y is explained by the explanatory variables.

2.5. Test for Normality

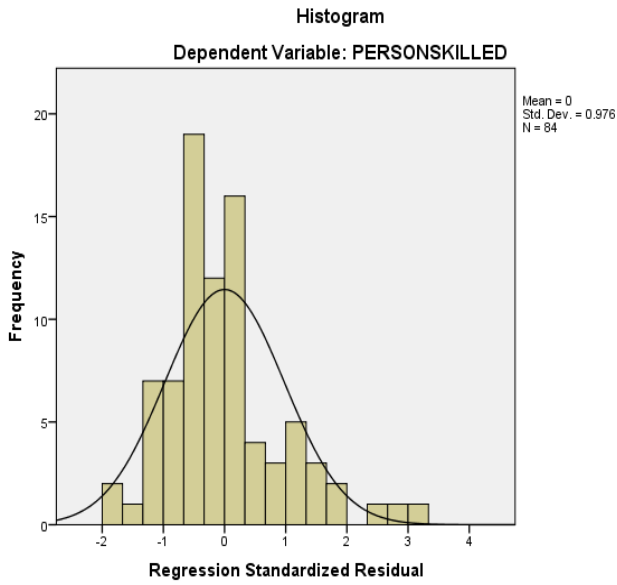


Figure 3.5: Histogram

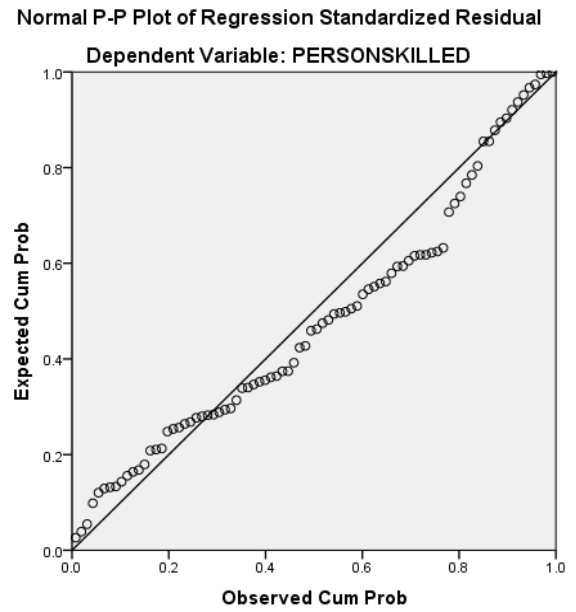


Figure 3.6: Normal P-P Plot of Regression

Table 3.4: Test for Multicollinearity

Mode 1	Dimension	Eigen value	Condition Index	Variance Proportions				
				(Constant)	FATAL CASES	SERIOUS CASES	MINOR CASES	INJURED PERSONS
1	1	4.510	1.000	.00	.00	.00	.00	.00
	2	.333	3.680	.04	.02	.00	.11	.08
	3	.068	8.129	.59	.31	.03	.19	.12
	4	.056	8.981	.17	.66	.32	.06	.08
	5	.033	11.702	.19	.02	.64	.64	.72

Table 3.5: Collinearity Diagnostics

Table 3.6: The Final Model

Model	Collinearity Statistics	
	Tolerance	VIF
FATAL CASES	.340	2.939
SERIOUS CASES	.294	3.399
MINOR CASES	.252	3.963
INJURED PERSONS	.684	1.462

Model		Unstandardized Coefficients		Standardized Coefficients	t	
		B	Std. Error	Beta		
1	(Constant)	-.600	2.173		-.276	.783
	FATAL CASES	1.291	.088	.834	14.667	.000
	INJURED PERSONS	.048	.021	.130	2.290	.025

The Final model

$$\text{Persons killed} = -0.600 + 1.291 \text{ FatalCases} - 0.048 \text{ InjuredPersons} \dots\dots\dots (6)$$

4. Results and Discussion

4.1 Results

The result reported in table 3.1 revealed that fatal cases, serious cases, and number of injured persons contributed significantly to auto-crash mortality in Osun state at 0.05 significant level. H_0 is rejected in hypotheses 1 above. The F-ratio test for the existence of a significant linear relationship between the independent variables taken together and the dependent variable reported in table 3.2 showed that mutually, all explanatory variables contributed significantly on the regression plane. The study further revealed that 77% of the variation in explained variable is adequately explained by the explanatory variables; which adds credibility to the predictive power of the model. Consequent upon the breakdown of the assumption of multicollinearity, The affected variables were expunged and the final model is:

$$\text{Persons killed} = -0.600 + 1.291 \text{ FatalCases} - 0.048 \text{ InjuredPersons}$$

with good predictive power. The model revealed that for a unit increase in the fatal case, there is at least one person who dies in the auto-crash. This study agrees with (Jacobs et al, 1986; Daramola, 2004; and Atubi, 2012) who discovered that Traffic accident injuries and fatalities are a serious problem all over the world Nigeria inclusive. In Nigeria, the incidence has become a very disturbing phenomenon as the country is presently ranked among countries with the highest traffic injuries and fatalities in the world.

5. Conclusion and Recommendation

4.2. Recommendations

It is concluded that auto-crash mortality in Osun state is greatly influenced by the number of fatal auto-crash cases and the number of persons injured as a result of auto-crash. This paper has successfully modeled the relationship between number of persons killed, injured, and the number of fatal auto-crash cases in Osun state, with good predictive power.

Having exhaustively analyzed the data and reported the results, it is recommended that adequate support be given to Federal Road Safety Commission, Osun command in terms of procurement of modern equipments, and by organizing adequate training for corps member for better service delivery though FRSC in the state has greatly impacted by reducing the cases of auto-crash in Osun state, Nigeria (Salako, et al, 2014)

Drivers are advised to always drive with cautions especially during “Ember Months” and during other festive periods in other to reduce the frequency of auto-crash and carnages on roads and highways. Drivers should also

endeavor to obey traffic rules.

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