

Statistical Model Analysis of Dependence on Motor Cycle Transport at Ifedore LGA Ondo Nigeria

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Abstract

Motorcycle ownership models were formulated using Poisson Regression and Negative binomial logistic regression models. Three different zones were selected and classified based on their population density. Data which include factors affecting the ownership of motorcycles were collected by administering well structured questionnaires to the respondents. Data obtained were analyzed with Statistical Package for Social Sciences version 22 (SPSS 22) to formulate predictive models. The two models show quite similar results as they both show that the number of motorcycles owned will reduce as educational status of the rider and average monthly income of household increases while there will be an increase in the number of motorcycles owned as the age range of the rider increases. The number of motorcycles owned is increased by 1.5 times for the lowest income category and 0.4 times for the secondary education category; but this is reduced by 0.54 times for the highest age range of household head category. The test of model effects shows that all the predictor variables are significant. The results of the study will be helpful in low cost transportation planning for the study area.

Keywords: Motorcycle, Negative Binomial, Ownership, Poisson, Regression Model

1.0 Introduction

Transportation is a procedure that involves the movement of commuters, goods and services from a given point of origin to a particular destination. It determines the regional patterns of development, economic viability, environmental impacts and maintenance of socially acceptable levels of quality of life (Okoko, 2006). In Nigeria, transportation has been largely by road. 70 % of road trips are done through the private sector dominated public transport system with motorcycles as means of transportation having the highest percentage in intra-city transport in Nigeria (Oyesiku, 2002). According to Olaore (2011) the use of motorcycle came as a big relief to the prevailing transportation and unemployment problems facing the country, presenting great advantages such as better accessibility to different areas, ease of maintenance, relative cheapness of its use, curbing loss of economic man-hour, lateness to work, and other challenges associated with traffic jam.

Motorcycles have constituted a significant proportion of modal choice for commuters in many Nigeria cities since the late 80's. Gbadamosi (2006) reported that in 1995, an estimated 45,000 motorcycles were in use for public transportation in Lagos metropolis alone. NHTSA, (2011) in their traffic safety fact sheet, stated that in 2004 and 2005, 52 % of all motor vehicle license plates were for motorcycles, which serves as a means of intra-city transport in Nigeria. Olawole (2000) asserted that motorcycle transport

possesses several unique features which have led to their general acceptance as a source of employment among the urban poor and as an alternative transport solution to the problems of commuting in Nigerian cities. Consequently, this study investigates factors affecting motorcycle ownership so as to better formulate policies regarding the use of motorcycles in the study area.

Increased fatality of riders and passengers, environmental concern of the state of most motorcycles, high fare rates charged by operators in relation to quality of service provided and traffic issues created by operators for traffic control and management agencies in the areas are some of the issues associated with its use as a means of transportation between and within urban, sub urban and rural areas. The consequences of the study will help government and important transport regulation organizations in tackling and controlling the expressed issues connected with the utilization of motorcycles in Ifedore Local Government Area and in this manner other areas in developing countries. In the study, a brief literature review is given in Section 1, section 2 describes the study area and this is followed by a description of the methodology for the study in Section 3. In Section 4 the results of the analyses were discussed and the developed model presented with relevant conclusions drawn.

1.1 Literature Review

Ifedore Local Government Area with her headquarters in Igbara-oke is one of the Local governments in Ondo state, Nigeria. It is about 250 m above the sea level and is located in the forest zone with abundant forest resources. According to the 2006 National Population Census figure, it has a population of 176,372 with 89,574 males and 89,798 females. It covers an area of 295 km² (Federal Republic of Nigeria Official Gazette, 2007 and Department of Research and Statistics, Ondo State Ministry of Economic, Planning and Budget, 2009). The Local Government is noted for its significant agricultural activities. The towns/villages under Ifedore Local Government Area are Iigbara-oke, Ilara-mokin, Ibule-soro, Ipogun, Ijare, Bolorunduro, Irese, Igbara-odo, Ero and Owena among others as shown in Figure 1. Across these towns, few industries and tertiary educational institutions are present; among which are All States College of Education, Elizade University, SCC Construction Company and notable Commercial Banks. Land transportation serves as the major mode of transportation with very high dependency on motorcycles for transiting within and between the communities. The existing land use is characterized by a medium density of residential structures within the inner core areas and predominantly farming in the outer core areas. There are quite a good number of open spaces and virgin lands with a general lack of recreational areas except for few school playing fields. See Fig. 1

In Nigeria, several factors have been identified as responsible for increase in the use of motorcycle; Oyesiku and Odufuwa (2002) carried out a study pointing out that the decrease in the supply of new vehicles of all types since the 1970s contributed to the emergence of motorcycles for commercial transportation in Nigeria. Aderamo and Olatujoye, (2013), stated that the commuter without a vehicle, who is the primary customer of public transport, may find it more convenient to use a motorcycle as soon he is able to afford it, particularly when the public transport is not competitive. According to Olubomehin, (2012); the use of motorcycle as a mode of transportation increases tremendously due to the increasing level of poverty of urban residents. In a study carried out by Ikeano, (1991) in Lagos, he affirmed that it was often difficult to get conventional means of transportation to move people into and out of many areas; this inadequacy of the transport system was handled with the emergence of motorcycles for commercial purpose in the streets of Lagos. Also, Ogunsanya & Galtima (1993) studied the use of motorcycle as a means of public passenger traffic in Yola town, Adamawa State. They identified economic depression and inadequate transport facilities as some of the factors that gave rise to the use of motorcycles as means of public transportation in Nigeria.

Anh & Tetsuo (2005) also carried out a study in Hanoi city, Vietnam on household motorcycle ownership behaviour. The results show that increases in number of workers or students, motorcycle price, income, and previous transactions significantly influence current transaction decisions and that sufficient high taxes imposed on motorcycle users could be effective in controlling the ownership. A related study was carried out in Jabotabek, a metropolitan area in Indonesia on motorcycle ownership and uses by Metinet *al.*, (2006), in which person-trip data and land use data were analysed to make inferences on motorcycle ownership and its use in Jabotabek. The results indicate that socio-economic and demographic characteristics are effective on both motorcycle ownership and its use; no land use variable was found to be effective on motorcycle ownership. Location factors such as distance from city centre were found to have negative effects on motorcycle ownership and its use. Land use variables, ratio of commercial land use as well as ratio of underdeveloped land and land diversity are found to decrease motorcycle use. Similarly, public transport supply (bus transit) decreases motorcycle use from the study carried out. Leong and Sadullahet *al* (2007) conducted a study in Penang, Malaysia using multinomial logit model to examine motorcycle ownership.

The study found that total monthly household income, car ownership, total number of driving licenses in the household and number of household members influence motorcycle ownership. It also found that motorcycle will remain as the mode of transport in the near future, particularly in the group of low and middle income households.

Due to the growing popularity in the utilization of motorcycles in sub urban areas like Ifedore Local Government Area, there is a need to investigate patterns associated with their ownership. The results will avail a better understanding of motorcycle ownership and use in such low and middle income areas of developing countries.

2.0 Methodology

Reconnaissance surveys were carried out throughout the study area to examine the behaviour of operators and users. A descriptive research survey was employed which enabled the required data to be collected by administering a well-structured questionnaire to motorcycle owners. For this study, three different zones as shown in Table 1 were selected and classified based on their population density. A total of 1004 questionnaires were distributed, which represent 75 % of the total household selected in the study area. However, the items in the questionnaire were translated to the respondents who were not literate in their native language. A total of 853 questionnaires were retrieved which represents 85 % of the sample distributed.

Data obtained were analyzed using Statistical Package for Social Sciences version 22 (SPSS 22) to formulate a predictive model using Poisson Regression Analysis (Log link) and Negative Binomial Models. Figure 1 is the map of Ifedore local government showing the study area.

Table 1: Selected Study Areas in Ifedore Local Government Area

S/No.	Population Density	Name of the village	No. of questionnaire distributed	No. of questionnaire retrieved
1.		Igbara-oke	366	320
2.	High density	Ilara-mokin	200	171
3.		Ijare	162	138
4.		Isarun	110	95
5.	Medium density	Ibule-soro	72	55
6.		Ipogun	61	50
7.	Low density	Irese	33	24
TOTAL			1004	853

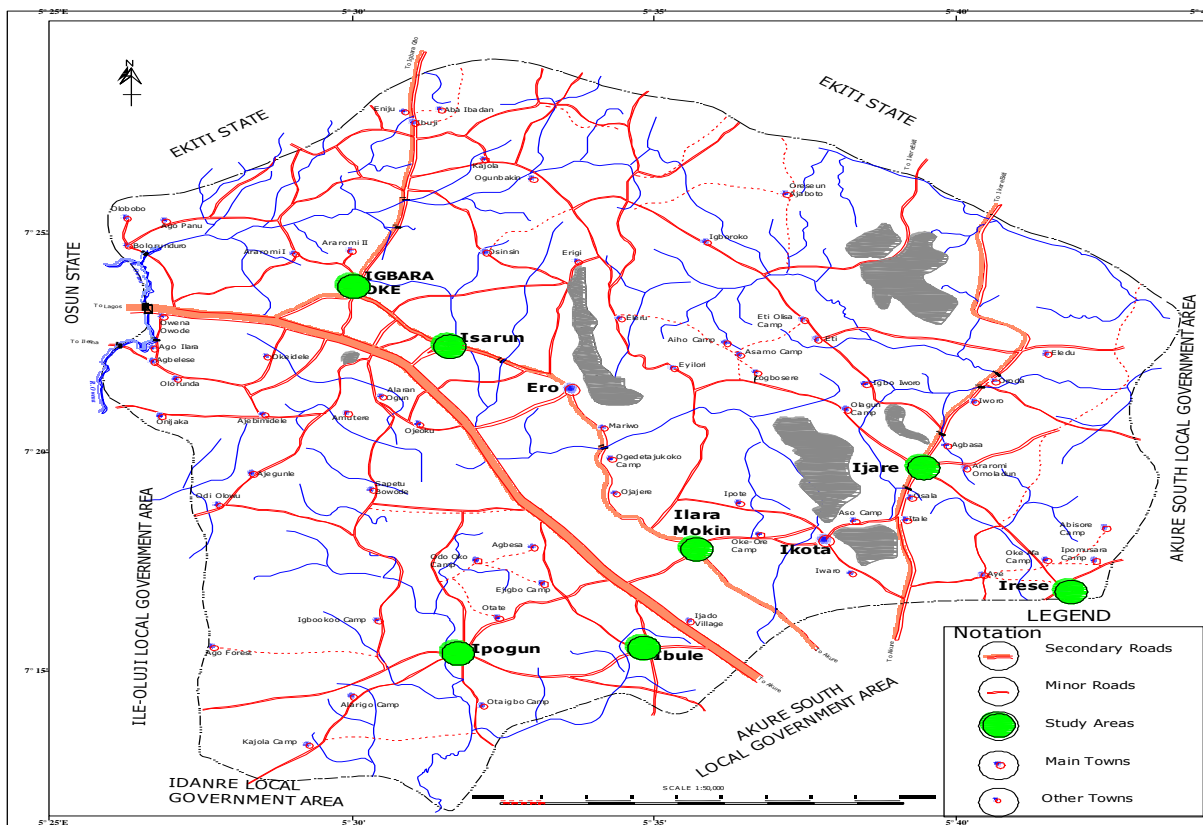


Figure 1: Map of Ifedore Local Government Area Showing the Study Area

Source: Ifedore Local Government Area

2.1 Modeling Framework

The dependent variable for the two models was the number of motorcycles owned, Table 2 below shows the independent variables used in the modeling and their coding.

(a) Poisson Regression Analysis In this analysis, the dependent variable has to be a count and continuous data. The Poisson Regression equation takes the form:

$$\text{Log}_e(Y) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n \tag{1}$$

$$Y = (e^{\beta_0})(e^{\beta_1 X_1})(e^{\beta_2 X_2})(e^{\beta_n X_n}) \tag{2}$$

(b) Negative Binomial Model Since observed data will almost always display pronounced overdispersion, analysts typically seek alternatives to the Poisson model, such as the negative binomial model. The negative binomial model is employed as a functional form that relaxes the equi-dispersion restriction of the Poisson model.

Table 2: Variable Coding Information

Variable	Code	Categories
Factor Age Range	1	41 – 50
	2	31 -40
	3	21- 30
	4	10-20
		Total
Education	1	HND/BSC and above
	2	NCE / OND
	3	secondary education
	4	primary education
		Total
monthly income	1	above 45
	2	35 – 45
	3	25 – 35
	4	15 – 25
	5	less than 15
		Total
how did you get your motorcycle	1	Self
	2	Hire purchase
	3	Loan
	4	Government

3.0 Results and Discussion

(a) Poisson Regression Model

Table 2 shows the Parameter estimates for the variables in the model. Each of these variables has different categories which has a reference which is compared to the other categories. This reference category has a coefficient of zero which you will observe in the B column. For example, in the age category, the reference is when the age was coded as 1 (41-50) which represent the highest categories of age. The Age Range variable generally has a negative effect on number of motorcycles owned. This is only significant in the age range 4 category and shows that there will be 0.45 times fewer number of motorcycle owned than in the 41-50 age range.

Only the OND/NCE and secondary school education categories shows significant influence on the number of motorcycles owned. They show that there will be 0.337 times and 0.301times more number of motorcycles owned than the reference category (HND/BSC and above). This shows that most of the motorcycles as expected are owned by secondary school certificate holders. There will be a 1.514 times more motorcycles owned in the income category 5 than Income category 1, this reduces to 0.348 times as income increases in category 4. It is seen that there is a reduction in the number of motorcycles owned as income increases.

Table 3: Parameter Estimates for Poisson Regression Model

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	.357	.1609	.041	.672	4.919	1	.027
[ageRange=4]	-.450	.1172	-.679	-.220	14.736	1	.000
[ageRange=3]	-.056	.0988	-.249	.138	.318	1	.573
[ageRange=2]	-.097	.0896	-.273	.078	1.179	1	.278
[ageRange=1]	0 ^a	.	.	.	.	.	.
[education=5]	-.089	.1381	-.359	.182	.413	1	.521
[education=4]	.337	.1436	.056	.619	5.518	1	.019
[education=3]	.301	.1254	.056	.547	5.775	1	.016
[education=2]	0 ^a	.	.	.	.	.	.
[income=5]	1.514	.1724	1.176	1.852	77.127	1	.000
[income=4]	.348	.0864	.178	.517	16.201	1	.000
[income=3]	.013	.0702	-.125	.150	.033	1	.856
[income=2]	.110	.0968	-.080	.300	1.295	1	.255
[income=1]	0 ^a	.	.	.	.	.	.
[getMotorcycle=4]	.125	.1019	-.074	.325	1.514	1	.219
[getMotorcycle=3]	-.172	.1073	-.383	.038	2.575	1	.109
[getMotorcycle=2]	.165	.1865	-.200	.531	.786	1	.375
[getMotorcycle=1]	0 ^a	.	.	.	.	.	.
(Scale)	1 ^b						

(b). Negative Binomial Model:

In this model, the Age Range variable generally has a negative effect on number of motorcycles owned. Age range 4 and 2 are the only significant categories here and their effects mean that there will be a reduction in the number of motorcycles owned by 0.544 times and 0.178 times respectively when compared with the reference category 1. This follows the same trend as the Poisson model. Only the OND/NCE and secondary school education categories shows significant influence on the number of motorcycles owned. They show that there will be a 0.411 times and 0.226 times more number of motorcycles owned than the reference category (HND/BSC and above). This also shows that most of the motorcycles are owned by secondary school certificate holders. This is also as stated in the Poisson model above. The income variable in the negative binomial model also shows similar effects as in the Poisson model. The effects show that there will be 1.5 times more motorcycles owned in the income category 5 than the reference category 1. This effect reduces to 0.27 times more motorcycles for category 4. There is a reduction in the number of motorcycles owned as income increases this is also as expected.

The fourth variable ‘how did u get a motorcycle was not significant for both models and is therefore expunged from the model. Table 4 & 5 shows the test of model affects and gives a general certification that the model is significant at the 95 % confidence level.

Table 4: Tests of Model Effects for Poisson Model

Source	Type III		
	Wald Chi-Square	df	Sig.
(Intercept)	155.271	1	.000
ageRange	21.216	3	.000
education	18.532	3	.000
income	96.592	4	.000
getMotorcycle	21.283	3	.000

Table 5: Tests of Model Effects for Negative Binomial Model

Variable	Type III		
	Wald Chi-Square	Df	Sig.
(Intercept)	195.202	1	.000
ageRange	35.036	3	.000
education	30.582	3	.000
income	102.873	4	.000
getMotorcycle	19.995	3	.000

Table 6: Parameter Estimates for Negative Binomial Model

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	.438	.1506	.143	.733	8.461	1	.004
[ageRange=4]	-.544	.1099	-.759	-.328	24.471	1	.000
[ageRange=3]	-.059	.0893	-.234	.116	.430	1	.512
[ageRange=2]	-.178	.0899	-.354	-.001	3.899	1	.048
[ageRange=1]	0 ^a	.	.	.	.	.	.
[education=5]	-.180	.1174	-.410	.051	2.337	1	.126
[education=4]	.411	.1217	.172	.649	11.407	1	.001
[education=3]	.226	.1046	.021	.431	4.675	1	.031
[education=2]	0 ^a	.	.	.	.	.	.
[income=5]	1.489	.1611	1.174	1.805	85.472	1	.000
[income=4]	.273	.0733	.129	.417	13.868	1	.000
[income=3]	-.003	.0649	-.130	.125	.002	1	.968
[income=2]	.056	.0896	-.120	.231	.384	1	.535
[income=1]	0 ^a	.	.	.	.	.	.
[getMotorcycle=4]	.160	.1043	-.044	.365	2.359	1	.125
[getMotorcycle=3]	-.128	.1158	-.355	.099	1.225	1	.268
[getMotorcycle=2]	.126	.1588	-.186	.437	.625	1	.429
[getMotorcycle=1]	0 ^a	.	.	.	.	.	.
(Scale)	1 ^b						
(Negative binomial)	1						

5.0 Conclusion

This study investigates household factors which influence motorcycle ownership for Ifedore Local Government Area using the Poisson and Negative Binomial Regression Models. The household factors considered are; age range of rider, educational qualification of the rider, average household income and the source through which the motorcycle was purchased.

Fewest number of motorcycles will be owned in the 41-50 age range as its coefficients shows that there will be a reduction in the number of motorcycles owned by as much as 0.544 times across the two models. This results shows that there will be a reduction in the number of motorcycles owned as the age range reduces. It is also seen that most of the motorcycles owned are in the secondary school category. The result shows that there will be increase in the number of motorcycles owned by 0.337 times and 0.411 times for both the Poisson and Negative Binomial Models respectively if the respondent is a secondary school certificate holder. The result also shows that there will be increase in the number of motorcycles owned by 1.51 times and 1.48 times for both the Poisson and Negative Binomial Models respectively if the household head's income is in the least category, thereby implying that most of the motorcycles are owned by the least income category.

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