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Road Crash Incidents in Metro Manila: A Cross-Sectional Analysis[1]

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Abstract:

This study examines the status of road crash incidents in Metro Manila for the year 2011.Also, it looks at the degree of association between the number of road crash incidents and the explanatory variables namely; the number of licensed drivers, number of registered motorcycles and motor tricycles, and budget allotted to road infrastructures. The impact of these explanatory variables as well as their collective effect on the number of road crash incidents are measured.

Percentages and weighted means are utilized in the study. In addition, a double log multiple regression model and diagnostic tests are employed in the study. These are the tests for correlation and its significance, autocorrelation, significance of the parameter estimates, overall significance of regression model, multicollinearity, measure of goodness of fit and specification error.

It can be observed that majority of the road crash incidents in Metro Manila are damage to property. Also, most of the crashes

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occurred at daytime but fatal crashes are high during night-time and wee hours in the morning. Moreover, the results of the study show that both the number of licensed drivers and number of motorcycles and motor tricycles have significant positive correlations with the number of road crash incidents. Furthermore, number of licensed drivers and number of motorcycles and motor tricycles have significant impacts on the number of road crash incidents. On the other hand, budget allotted to road infrastructures does not have significant effect on the road accidents. Taken collectively, the number of licensed drivers and number of motorcycles and motor tricycles and budget allotted to road infrastructure exert significant effect on the road crash incidents in Metro Manila. It is therefore recommended that Land Transportation Office should compel those individuals who want to get a driver's license to study in a driving school so that they will be able to learn theoretical techniques, traffic signs and traffic rules and regulations to lessen the road crash incidents due to driver's error/human error. Also, Metro Manila Development Authority should strictly implement the use of the designated lanes for all motorcycles and motor tricycles and firmly restricting private vehicles from using these lanes to avoid road crashes.

Key words: road crash incidents, licensed drivers, budget for road infrastructures, motorcycles and motor tricycles, fatal crashes, damage to property

INTRODUCTION:

Road crash incidents occur when a vehicle collides with another vehicle, hits a pedestrian, animal, or public property. Collision usually may result in injury, damage of property, and even death. In the Philippines, 85 percent of road crash was caused by driver error or violations. Young drivers, male drivers, public jeepney drivers and drivers with low educational attainment had a significantly higher intention to commit traffic violations. Also, social environment is a significant factor that influence the road crash incidents in the Philippines. Intentions to

commit violations were higher when other drivers saw that there were no traffic enforcers around. [1]

The particular problem of young drivers is their risk-taking attitude while older drivers' problems are their slower reflexes, poorer motor control, and less visual perception. Traffic accidents were due to motorcycle accidents with 78.6 percent while about 54 percent of it was drivers under the influence of alcohol.[2] According to Motorcycle Accidents in Depth Study, human error is the leading cause of motorcycle accidents and 50 percent of it were committed by drivers, 70 percent of these accidents were commonly caused by the failure of the drivers to perceive the other vehicles. [3]

In 2013, at least one person is killed in a road accident in Metro Manila for each day according to the Metropolitan Manila Development Authority (MMDA). [3] It only shows that in one year, more than 365 persons are killed in road accidents in Metro Manila alone. Data also show that in less urbanized regions outside of Metro Manila, serious and fatal accidents are more predominant while in Metro Manila damage to property in terms of value per accident occurrence is higher.[4]

Efforts in terms of time and budget that the government allocates towards improving road traffic safety is necessary. Visible program of ensuring the operational roadworthiness of the different classes of vehicles must be developed like designing safer infrastructure and incorporating road safety features into land-use and transport planning. The Department of Infrastructure and Transport in Australia conducted a study on how effective road infrastructure in their country. It is estimated that 27 billion Australian dollars lost annually because of road crashes and over 180,000 deaths because of road traffic accidents since they began to record in 1925. But over the last four decades road traffic accidents began to decline despite the increasing number of registered vehicles and population growth. Over the last four decades road deaths

gradually decreased from 3,798 in 1970 to 1,304 in 2012. [5] The road infrastructure is a big factor in reducing road accident.

There is a need to address the increasing road crash incidents that is why the researcher attempted to determine the status of the road crash incidents and identify the variables that could affect the number of road traffic accidents in the National Capital Region (NCR).

STATEMENT OF THE PROBLEM

General Problem

Generally, this study analyzed the status of the road crash incidents and its determinants in the National Capital Region (NCR) covering the year 2011.

Specific Problem

This study sought to provide answers to the following questions:

1. What is the number of road crash incidents in Metro Manila covering the year 2011?
   - 1.1. By city
   - 1.2. By time of the day
   - 1.3. By accident factor
2. What is the distribution of vehicles involved in the road crash incidents?
3. How do the following explanatory variables affect the number of road crash incidents?
   - 3.1. Number of licensed drivers
   - 3.2. Number of registered motorcycles and motor tricycles
   - 3.3. Budget for road infrastructure
4. Is the effect of each explanatory variable individually significant on the number of road crash accidents?
5. Is the collective effect of the explanatory variables to the number of road crash incidents significant?

6. Is the econometric model used in this study correctly specified?

STATEMENT OF HYPOTHESES

The following null hypotheses were tested:

1. There is no significant relationship between road crash incidents and each of the following variables:
    - 1.1 Number of licensed drivers
    - 1.2 Number of registered motorcycles and motor tricycles
    - 1.3 Budget for road infrastructure
2. Each of the explanatory variables has no significant effect on the number of road crash incidents.
    - 2.1 Number of licensed drivers
    - 2.2 Number of registered motorcycles and motor tricycles
    - 2.3 Budget for road infrastructure

The explanatory variables such as the number of licensed drivers, number of motorcycles and motor tricycles and budget for road infrastructure when taken collectively has no significant effect on the number of road crash incidents.

3. The econometric model used in this study is not correctly specified.

THEORETICAL FRAMEWORK

According to ***Heinrich's Domino Theory*** by H.W. Heinrich, an accident is caused by the mistakes of a person, which can be social environment and inherited factor like alcoholism, fault of a person (carelessness, recklessness, bad temper), unsafe act or condition performing a task that leads to an accident then injury in some cases to those involved. He said that the personal injury is because of the accident due to the fault of a careless person or poorly designed or maintained equipment

which are part of the social environment. Also, he discussed that the injury can be reduced or corrected through the three "Es", engineering, education and enforcement.[6]

In the present study, it focused on the number of road crash incidents in Metro Manila. The number of road crash incidents can be affected by the number of licensed drivers, number of registered motorcycles and motor tricycles and budget for road infrastructure. Budget for road infrastructure and the number of licensed drivers are part of the social environment. When the government allocates less budget for road construction, this may lead to poor and less quality roads for the motorists and drivers that may lead to road accidents. Also, when a person gets a driver's license, he/she is fully aware of the traffic rules and regulations. Driving under the influence of alcohol is prohibited and discussed to the drivers. Thus, an accident may occur because of drunk and reckless driver. Number of registered motorcycles and motor tricycles was included as one of the determinants of road crash incidents since literatures show that this factor affects the number of road crash incidents.

SCOPE AND LIMITATIONS

The study focused on the road crash incidents in the National Capital Region for the year 2011. There were 16 cities included in the study; Caloocan, Las Piñas, Makati, Malabon, Mandaluyong, Manila, Marikina, Muntinlupa, Navotas, Parañaque, Pasay, Pasig, Pateros, Quezon City, San Juan, Taguig, and Valenzuela. The independent variables used are the number of licensed drivers, number of registered motorcycles and motor tricycles, and budget for road infrastructure.

SIGNIFICANCE OF THE STUDY

The study would be beneficial to the government sector particularly the Metro Manila Development Authority and Land Transportation Office. It is timely for the government to look at the factors that affect the increasing road crash incidents in Metro Manila for them to review the traffic rules and regulations as well as the issuance of license to the motorists. Budget for road infrastructure must be given priority by the government to provide safety road for the motorists/drivers and passengers. Also, this study may provide information to the motorists/drivers particularly the causes of road crash incidents in Metro Manila. Through this study, motorists/drivers may become very careful especially when they are in the road.

REVIEW OF LITERATURES

A study on road traffic accidents and casualties in Bangladesh by Mr. Sheikh showed that cities have higher accidents and casualty rates than that of the non-cities. The main venues of accidents and casualties are the national highways where buses and trucks are predominantly involved.[7] A linear regression model was adopted in his study.

Another study conducted by Hammoudi discussed on the major causes of road traffic accidents in Abu Dhabi. [8] According to him, the young people between 18-25 were involved in road traffic accidents especially those who were not wearing seatbelt, using mobile phone and under the influence of alcohol while driving. Also, aggressive driving behavior like speeding, tailgating and jumping red traffic light contributed to road traffic accidents.

In the study of Deus Komba, he discussed the risk factors which are related to road traffic accidents in Tanzania. [9] According to him, age, sex, over speeding, reckless driving,

being a pedestrian or a motor cyclist were identified as risk factors to road crash incidents. Young males are highly involved in road crash incidents and the risk of dying at night was significantly higher than at day time especially when it is raining. He also identified that highway construction, corruption, irresponsibility, poor management, driving while using cellphone, driving without training, failure to respect and obey traffic regulations, bad conditions of vehicles, age of the vehicles and poor condition of the services were contributor of the increasing road traffic accidents in Tanzania. It is recommended in his study that the government of Tanzania should review the law on the employment of drivers i.e. there should be statutory mandate to train the drivers. Also, improvement in the working condition of the police force, new driving license system, and regular vehicle inspection were recommended to lessen the number of road crash incidents.

RESEARCH METHODOLOGY

This chapter discusses the design and procedures undertaken during the conduct of the study. It presents the research design, source of data, and statistical treatment of data.

Research Design

The researchers used descriptive method in determining the number of road crash incidents and its explanatory variables such as the number of licensed drivers, number of registered motorcycles and motor tricycles, and budget for road infrastructure.

Sources of Data

The researchers used secondary data that were gathered from different government institutions such as the Department of Public Works and Highways (DPWH), Metropolitan Manila Development Authority (MMDA), and Land Transportation

Office (LTO). Furthermore, supplementing data from various web sources were used. Specifically, the data on a number of road crash incidents per city in NCR were collected from the Road Safety Unit-Traffic Discipline Office of the Traffic Engineering Center of the Metropolitan Manila Development Authority (MMDA). Data on the budget for infrastructure were gathered from the Department of Public Works and Highways (DPWH). Data on the licensed drivers and number of registered motorcycles and motor tricycles were taken from the Land Transportation Office (LTO).

Data Treatment

The data used were presented in graphical and tabular forms. Regression results and analysis were treated using Econometric Views.

Statistical Treatment of Data

The functional relationship between the number of road crash incidents and the number of licensed drivers, number of registered motorcycles and motor tricycles and budget for road infrastructure was generated using the multiple linear regression analysis.

The following multiple regression model was used:

$$\mathbf{NRCI = \beta_1 + \beta_2\, NLDR + \beta_3\, NRMCMT + \beta_4\, BRI + \varepsilon i}$$

Where:

NRCI = number of road crash incidents

NLDR = number of licensed drivers

NRMCMT = total number of registered motorcycles and motor tricycles

BRI = budget for road infrastructure

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ =parameters, ε_i = Error Term

1. Measure of Correlation

Correlation analysis determines the degree of association or relationship between two variables. The most common measure

of correlation is the Pearson Correlation Coefficient. Hence, it is computed as follows:

$$r = \frac{\sum xy - \frac{\sum x \sum y}{n}}{\sqrt{\left[\sum x^2 - \frac{(\sum x)^2}{n}\right] (\sum x)^2 - \left[\frac{(\sum Y)^2}{n}\right]}}$$

The values of *r* generated by this equation will range from -1 to 1. A value of -1 indicated a perfect inverse correlation between the variables, that is, when the value for the one variable is high – the value for the other variable is low. A value of 0 indicates no relationship between the variables. A value of 1 indicates a perfect correlation between the variables. Other than these, the degrees of correlation are the following:

***r* values**	**Interpretation**
-1.00	Perfect Negative Correlation
-0.99 to -0.60	Strong Negative Correlation
-0.59 to -0.30	Moderate Negative Correlation
-0.29 to -0.01	Weak Negative Correlation
0.00	No Correlation
+0.01 to +0.29	Weak Positive Correlation
+0.30 to +0.59	Moderate Positive Correlation
+0.60 to +0.99	Strong Positive Correlation
+1.00	Perfect Positive Correlation

2. Test of the Individual Significance of the Parameter Estimates

To be able to test the statistical significance of the parameter estimates, the t-test was applied. It was given as:

$$T = \frac{\hat{\beta}_2 - \beta_2}{se(\hat{\beta}_2)}$$

where the value of the estimated parameter is divided by its standard error to get the t-statistic (Gujarati, 2003).

If the value of t-statistic exceeds the critical value of the t distribution at given level of significance with n-k degrees of freedom, accept that β_0, β_1, β_2, β_3, β_4, and β_5 are statistically significant.

3. Test of Overall Significance of the Regression

The overall significance of the regression was tested by getting the ratio of the explained to the unexplained variance through the use of the F-statistic:

$$F = \frac{R^2/(k-1)}{(1-R^2)/(n-k)}$$

If the computed F-value exceeds the critical value from the F-table at 5 percent level of significance with k-1 and n-k degree of freedom, the null hypothesis will be rejected, otherwise, it will be accepted.

Test of Goodness of Fit

To measure the proportion or percentage of the total number of road traffic accidents explained by the independent variables, multiple coefficient of determination was used.

$$R^2 = \frac{1 - b_1\sum x_1 y + b_2\sum x_2 y}{\sum y^2}$$

where R^2 is the coefficient of multiple determination. It is used to determine how well the estimated regression fits the data.

4. Test for Specification Error

Ramsey's RESET was utilized to test if the model is correctly specified using the formula:

$$F = \frac{(R^2_{new} - R^2_{old})/\text{number of new regressors}}{(1-R^2_{new})/(n - \text{number of parameters in the model})}$$

If the result that was obtained in the calculation of F-ratio is higher than the critical value at a specified level of significance, there existed a specification error. On the other hand, if the

calculated F-ratio is smaller than the critical value, it can be concluded that there is no specification error in the model used.

PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

Table 1. Distribution of Road Crash Incidents by Cities in Metro Manila, 2011

City	Fatal	Non Fatal Injury	Damage to Property	Total	Percent (%)	Rank
Caloocan	14	648	2425	3087	4.00	10
Las Piñas	8	522	2547	3077	3.99	11
Makati	24	1075	6061	7160	9.29	2
Malabon	3	224	599	826	1.07	15
Mandaluyong	8	565	3058	3631	4.71	9
Manila	26	663	3555	4244	5.50	4
Marikina	14	1274	2537	3825	4.96	7
Muntinlupa	16	787	2224	3027	3.93	12
Navotas	1	168	625	794	1.03	16
Parañaque	18	912	2976	3906	5.07	5
Pasay	20	576	3167	3763	4.88	8
Pasig	20	1210	5633	6863	8.90	3
Pateros	0	1	35	36	0.05	17
Quezon City	142	5031	19644	24817	32.18	1
San Juan	2	231	1527	1760	2.28	14
Taguig	27	873	2955	3855	5.00	6
Valenzuela	27	1067	1345	2439	3.16	13
Grand Total	370	15,827	60,913	77,110	100.00	
Average Accident Rate Per Day	1.01	43.36	166.88	211.26		

Source:Metro Manila Accident Recording System ,MMDA 2011

The table above shows that the distribution of the road crash incidents by Cities in the National Capital Region for year 2011. It shows that road crash incidents are divided into fatal, non-fatal and damage to property. Out of the 77, 110 road crash incidents, 79 percent of this is damage to property, 20.53 is for non-fatal while 0.48 percent for fatal.

Furthermore, it shows that Pateros has the lowest number of road crash incidents for the year 2011, followed by Malabon and Navotas. These local government units can be considered as the safest in Metro Manila in terms of road

crashes is concerned, since they have lesser records on fatal and non-fatal incidences. This lowest incidence of road crashes in the said cities can be attributed to small land area within NCR, no major arterial road compared to other cities, not considered as a Central Business Districts and manageable traffic direction and control.

Conversely, the City of Quezon dominates all the cities of Metro Manila in terms of fatal road crash incidents followed by Pasig, City of Manila and Makati. This is because of the following factors: these are Central Business Districts (CBD's) with high social and economic activity, top cities that have the biggest land area among the cities in Metro Manila, major thoroughfares such as EDSA, Commonwealth Ave., Quezon Ave., Radial Road 10 and Roxas Blvd. are located within these cities.

These results are consistent with the study of Mohammad Mizanur Rahman Sheikh that cities have higher accidents and casualty rates than that of the non-cities.

Also, it shows that the average accident per day is 1.01 for fatal, 43.36 for non-fatal injury and 166.88 for damage to property. Regardless on the type of incident, on the average, there are 212 accidents in a day.

Table 2. Distribution of Road Crash Incidents by Time of the Day in Metro Manila, 2011

Time Hour	Fatal	Non-Fatal Injury	Damage to Property	Grand
00:00-00:59	11	237	607	855
01:00-01:59	24	383	909	1316
02:00-02:59	26	372	925	1323
03:00-03:59	21	352	835	1208
04:00-04:59	23	399	1024	1446
05:00-05:59	16	489	1203	1708
06:00-06:59	16	709	1834	2559
07:00-07:59	6	809	2763	3578
08:00-08:59	8	831	3137	3976
09:00-09:59	7	768	3465	4240
10:00-10:59	11	816	3960	4787
11:00-11:59	10	794	3927	4731
12:00-12:59	17	857	3429	4303
13:00-13:59	14	660	3114	3788

14:00-14:59	7	700	3624	4331
15:00-15:59	14	715	3725	4454
16:00-16:59	16	751	3334	4101
17:00-17:59	8	825	2885	3718
18:00-18:59	10	670	2673	3353
19:00-19:59	16	746	3211	3973
20:00-20:59	14	684	2797	3495
21:00-21:59	25	611	2564	3200
22:00-22:59	17	598	2152	2767
23:00-23:59	22	541	1784	2347
No Time Indicated	11	510	1032	1553
Grand Total	**625**	**27,294**	**105,613**	**77110**
Day-time (06:00-17:59)	**134 0.17%**	**9,235 11.98%**	**39,197 50.83%**	**48,566 62.98%**
Night-time (18:00-05:59)	**236 0.31%**	**6,592 8.55%**	**21,716 28.16%**	**28,544 37.02%**

On the average, 28,544 or 37.02% of road crashes occurred during the night time i.e. 18:00 P.M. to 5:59 A.M. and without time indicated, while 48,566 or 62.98% occurred during daytime i.e. 6:00 A.M to 17:59 P.M. Even though most of the crashes occurred at daytime, it can be observed in the table that fatal crashes are high during night-time and wee hours in the morning. The result is consistent with the study of Deus Damian Komba that the risk of dying at night is higher than during the day.

Table 3. Distribution of Road Crash Incidents by Accident Factor in Metro Manila, 2011

Accident Factor	Fatal	Non-Fatal Injury	Damage to Property	Total
Human Error (Alcohol suspected)	3	80	63	146
Human Error (Avoided Hitting Animal / Lost Control / Wet-Slippery Road, (Avoided Hitting Another Vehicle, Avoided Hitting Pedestrian)		17	36	53
Human Error (Backing Inattentively)		8	32	40
Human Error (Bad overtaking / Lost Control, Bad Overtaking, Bad Turning, Cut by Another Vehicle,Disobey sign or traffic lights)		9	21	30
Human Error (Driver Error)	3	843	1906	2752
Human Error (Entering One Way / Counter flow, Inattentive, Lost balance, Loss control, Loss control/alcohol suspected, Sudden stop, Tired/asleep, Too close, Too fast, Using mobile phone)	7	84	77	168

Others (Due to Scattered Stones on the Road, Flooded, Heavy Rain, Hit by running person, Hold up, intentional, Poor lighting, Runover pot holes, wet/Slippery road)		14	8	22
Vehicle Defect (Chain Detached, Flat tire, Lost Brake, Mechanical, Sudden stop of Engine, Tire Exploded)	1	25	44	70
No Accident Factor Stated	356	14747	58726	73829
Grand Total	**370**	**15,827**	**60,913**	**77,110**

Among the accident factors shown in table 3, the driver's error is the main cause of accidents with 2,752 i.e. 3 for fatal, 843 for non-fatal injury and 1,906 for damage to property. Second factor that has the highest number of road crash incidents is the human error due to loss of control, loss of balance, too fast, etc. with 168 incidents of which 7 are fatal, 84 are non-fatal injury and 77 are damage to property. Moreover, alcohol suspected is the third main reason for road crash incidents with 146 cases of which 3 are fatal, 80 and 63 for non-fatal injury and damage to property, respectively.

Table 4. Distribution of Vehicles Involved in Road Crash Incidents in Metro Manila, 2011

Vehicle Type	Fatal	% of Total	Non Fatal Injury	% of Total	Damage to Property	% of Total	Total No. of Vehicles
Cycle-Pedicab	20	3.79%	820	3.16%	468	0.39%	1308
Motorcycle	*163*	*30.87%*	*9896*	*38.09%*	*7778*	*6.50%*	17,837
Motor Tricycle	18	3.41%	1483	5.71%	1962	1.64%	3,463
Car	*91*	*17.23%*	*6600*	*25.40%*	*64702*	*54.06%*	71,393
Jeepney	51	9.66%	2350	9.04%	9023	7.54%	11,424
Taxi / Fx	16	3.03%	1267	4.88%	6060	5.06%	7,343
Bus	34	6.44%	811	3.12%	6095	5.09%	6,940
Van	26	4.92%	1196	4.60%	10895	9.10%	12,117
Truck	84	15.91%	957	3.68%	8439	7.05%	9,480
Train	7	1.32%	9	0.03%	3	0.01%	19
Kuliglig	-	-	2	0.01%	10	0.01%	12
Horse-drawn vehicle	-	-	-	-	2	0.01%	2
Push Cart	-	-	2	-	9	0.01%	11
Heavy Equipment	-	-	-	-	1	0.01%	1
Unknown Vehicle	18	3.41%	588	2.26%	4233	3.54%	4,839
TOTAL	528	100%	25,981	100%	119,680	100%	146,189

In the table shown above, there are more than 146 thousand vehicles involved in the road crash incidents. It can be observed that motorcycles have the highest fatality incident rate with 163 or 30.87 percent of the total fatal incidents, then followed by cars with 91 or 17.23 percent. For non-fatal incidents, Motorcycles still have the highest rate with 9,896 or 38.09 percent share, followed by cars with 6,600 or 25.40 percent. For damage to property incidents, cars got the highest rate with 64,702 or 54.02 percent

2. Analysis of Correlation Results

Table 5. Correlation Matrix of the Number of Road Crash Incidents, Number of Licensed Drivers, Number of Motorcycles and Motor Tricycles and Budget for Road Infrastructure

	BRI	NLD	NRMCMT	NRCI
BRI	1.000	0.462	0.374	0.121
NLD	0.462	1.000	0.770	0.777
NRMCMT	0.373	0.770	1.000	0.930
NRCI	0.121	0.777	0.930	1.000

Critical value *0.5140 at 0.05 (two-tail)*

Table 5 shows that the number of licensed drivers and number of registered motorcycles and motor tricycles are strongly correlated to the number of road crash incidents as evidenced by their correlation coefficients of 0.777 and 0.93, respectively. The computed value of the number of licensed drivers and number of registered motorcycles and motor tricycles are greater than the critical value of 0.5140 at 0.05 level of significance. Therefore, it can be concluded that the number of licensed drivers and number of registered motorcycles and motor tricycles are significantly correlated to the number of road crash incidents.

On the other hand, budget for road infrastructure has a weak correlation to the number of road crash incidents. The correlation coefficient of 0.121 is less than the critical value of 0.5140 at 0.05 level of significance. Hence, budget for road

infrastructure is not significantly correlated to the number of road crash incidents.

Results of the Regression Analysis:

Regression Model:

$$\log(NRCI) = -1.1378 - 0.1615\log(BRI) + 0.3141\log(NLDR) + 0.7606\log(NRMCMT)$$

$t-value$ (−0.6900) (−1.1515) (2.4494) (3.3289)

$p-value$ (0.5058) (0.2763) (0.0343) (0.0076)

R^2=0.8183 Durbin-watson stat=1.8239

F-stat=11.2639

Critical Values:

t-value$_{(0.05)}$ = 2.16

F-value$_{(3,13)}$ = 3.41

The results of the regression model on the number of road crash incidents and the three (3) explanatory variables were summarized above.

It shows that the number of licensed drivers and number of registered motorcycles and motor tricycles have significant effect on road crash incidents in 16 cities in the National Capital Region (NCR). The calculated t-value of number of licensed drivers and number of registered motorcycles and motor tricycles are 2.4494 and 3.3289, respectively, which are greater than the critical value of 2.16 at 5 percent level of significance with 3 and 13 degrees of freedom. Hence, the hypothesis that states that there is no significant effect between the number of road crash incidents and number of licensed drivers and number of registered motorcycles and motor tricycles is rejected. Therefore, it can be concluded the number of licensed drivers and number of registered motorcycles and motor tricycles have significant effect on road crash incidents. Holding other factors constant, for every one percent increase in the number of licensed drivers and number of registered motorcycles and motor tricycles, road crash incidents will increase by 0.31 and 0.76 percent, respectively.

This is consistent with the data above that the main cause of road crash incidents is the driver's error. Most of the drivers who get license have limited knowledge on road rules and regulations because most of them only learn how to drive through their peers and not from a reputable driving school where they can learn theoretical techniques and road rules and regulations. Also, according to the reports of MMDA in 2011, motorcycles have the highest fatality incident rate then followed by cars while in non-fatal incidents, motorcycles still have the highest rate, followed by cars.

The calculated t-value of -0.1515 is less than the critical value of 2.16 at 5 percent level of significance on the budget for road infrastructure. This means that hypothesis which states that the budget for road infrastructure has no significant effect on the number of road crash incidents is not rejected. Therefore, budget for road infrastructure has no significant effect on the number of road crash incidents.

The F-computed for the regression model is 11.2639 which is greater than the critical F-value of 3.41 at 0.05 level of significance. Hence, the null hypothesis that the explanatory variables when taken collectively has no effect on the number of road crash incidents is rejected. It is therefore concluded that the explanatory variables such as number of licensed drivers, and the number of registered motorcycles and motor tricycles and budget for road infrastructure when taken collectively have significant effect on the number of road crash incidents.

The calculated coefficient of multiple determination is 0.8183. This means that 81.83 percent of the total variation on road crash incidents is explained by changes in the budget for road infrastructure, number of licensed drivers, and the number of registered motorcycles and motor tricycles.

Table 6. Test for Specification Error

F-statistic	**0.1546**	**Probability**	**0.7034**

The result of the test for specification error in Table 6 indicates that the computed F-Value of 0.1546 is less than the critical value of 3.41 at five percent level of significance. Hence, the hypothesis which states that the econometric model of the study is not correctly specified is rejected. It is therefore concluded that the econometric model is correctly specified, thus, it is suitable for policy formulation.

SUMMARY OF FINDINGS:

1. Out of the 77, 110 road crash incidents, 79 percent of this is damage to property, 20.53 is for non-fatal while 0.48 percent for fatal.
2. Pateros has the lowest number of road crash incidents for the year 2011, followed by Malabon and Navotas whereas City of Quezon dominates all the cities of Metro Manila in terms of road crash incidents followed by Pasig, City of Manila and Makati. In terms of fatal incidents, Quezon City got the highest number with 142 out of the 370 fatal incidents in Metro Manila. This is also true for non-fatal injury and damage to property.
3. The average accident per day is 1.01 for fatal, 43.36 for non-fatal injury and 166.88 for damage to property. Regardless on the type of incident, on the average, there are 212 accidents in a day.
4. On the average, 28,544 or 37.02% of road crashes occurred during the night time i.e. 18:00 P.M. to 5:59 A.M. and without time indicated, while 48,566 or 62.98% occurred during daytime i.e. 6:00 A.M to 17:59 P.M. Even though most of the crashes occurred at daytime, it can be observed in the table that fatal crashes are high during night-time and wee hours in the morning.
5. The driver's error is the main cause of accidents with 2,752 i.e. 3 for fatal, 843 for non-fatal injury and 1,906 for damage to property followed by human error due to

loss of control, loss of balance, too fast, etc. with 168 incidents of which 7 are fatal, 84 are non-fatal injury and 77 are damage to property while alcohol suspected is the third main reason for road crash incidents with 146 cases of which 3 are fatal, 80 and 63 for non-fatal injury and damage to property, respectively.

6. The number of licensed drivers and number of registered motorcycles and motor tricycles are strongly correlated to the number of road crash incidents as evidenced by their correlation coefficients of 0.777 and 0.93, respectively while budget for road infrastructure has a weak correlation to the number of road crash incidents with a correlation coefficient of 0.121.
7. It shows that the number of licensed drivers and number of registered motorcycles and motor tricycles have significant effect on road crash incidents in 16 cities in the National Capital Region (NCR) since the calculated t-value of number of licensed drivers and number of registered motorcycles and motor tricycles are 2.4494 and 3.3289, respectively, are greater than the critical value of 2.16 at 5 percent level of significance. However, the calculated t-value of -0.1515 is less than the critical value of 2.16 at 5 percent level of significance on the budget for road infrastructure, thus, the budget for road infrastructure has no significant effect on the number of road crash incidents.
8. The explanatory variables such as number of licensed drivers, and the number of registered motorcycles and motor tricycles and budget for road infrastructure when taken collectively have significant effect on the number of road crash incidents since the F-computed for the regression model is 11.2639 which is greater than the critical F-value of 3.41 at 0.05 level of significance.
9. Almost 82 percent (81.83%) of the total variation on road crash incidents is explained by changes in the budget for

road infrastructure, number of licensed drivers, and the number of registered motorcycles and motor tricycles.

10. The econometric model is correctly specified since the computed F-Value of 0.1546 is less than the critical value of 3.41 at five percent level of significance.

CONCLUSIONS:

1. Majority of the road crash incidents in Metro Manila are damage to property.
2. On the average, Pateros has the lowest number of road crash incidents whereas Quezon City has the highest number in terms of fatal, non-fatal injury and damage to property.
3. Most of the road crashes occurred at daytime but fatal crashes are high during night-time and wee hours in the morning.
4. Driver's error and alcohol suspected are two of the main causes of road crash incidents.
5. The number of licensed drivers and number of registered motorcycles and motor tricycles are strongly correlated and significant to the number of road crash incidents while budget for road infrastructure is weakly correlated and insignificant.
6. The number of licensed drivers and number of registered motorcycles and motor tricycles have significant effect on road crash incidents in 16 cities in the National Capital Region (NCR) whereas the budget for road infrastructure has no significant effect on the number of road crash incidents.
7. The explanatory variables such as number of licensed drivers, and the number of registered motorcycles and motor tricycles and budget for road infrastructure when taken collectively have significant effect on the number of road crash incidents.

8. The econometric model can be used for policy formulation.

RECOMMENDATIONS:

1. LTO should compel those individuals who want to get a driver's license to study in a driving school so that they will be able to learn theoretical techniques, traffic signs and traffic rules and regulations. This would lessen the road crash incidents due to driver's error/human error.
2. LTO should be strict in the implementation of their policy i.e. seminar should be conducted to remind the drivers about the do's and don'ts in driving and the penalties to the traffic violators should be really imposed.
3. MMDA should strictly implement the use of the designated lanes for all motorcycles and motor tricycles and firmly restricting private vehicles from using these lanes to avoid road crashes.

ENDNOTES

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