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# Analysis of Accidents in San Marcelino St. and Ayala Boulevard Intersection: Pedestrian or Motorist

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**Abstract**—Accidents are unexpected and undesirable events resulting in harm and damage. This study explored the accidents that happened in the San Marcelino St. and Ayala Boulevard Intersection in the span of ten years. This paper presented the frequency of accidents that occur every month and every year and analyzed which of the pedestrian and motorist is the main cause of accidents. The researchers aim to prove that both the pedestrian and motorist are equally responsible for the accidents that happened. Using the data from the Metro Manila Development Authority and Manila Traffic Bureau, this study evaluated the frequency of accidents that happens in the intersection and determined which year and month the highest number of accidents occurred. A survey was conducted to evaluate a person's awareness of the traffic rules and their behavior when in the road. The respondents, motorist and pedestrian, were chosen through Simple Random Sampling. The selected respondents filled up the necessary information and rated their awareness and behavior through a series of questions regarding road safety and traffic rules. The data gathered were analyzed using the measures of central tendency (mean, median, and mode) and Mann-Whitney U Test. The study done showed that the both the pedestrian and motorist are equally responsible for the accidents.

**Index Terms**—Mann-Whitney U Test, Accidents, Pedestrian, Motorist, Metro Manila Development Authority, Manila Traffic Bureau, Measures of Central Tendency, Awareness, Behavior

## I. INTRODUCTION

There are more than 7.3 million registered vehicles in the Philippines, with 4.1 million consisting of motorcycles and tricycles, 1.7 million of jeepneys and 852,225 of cars [1]. There were 10.6 road deaths per 100,000 populations due to road accidents [2]. Thus, road safety has brought growing alarm and warning to everyone in the community and the government due to an increased number of fatal accidents happening daily.

The top 5 causes of road accidents in 2011 were determined to be: “(1) failure to yield right of the way to other vehicle or pedestrian, (2) reckless overtaking, (3) improper turning, (4) following too closely or tailgating and (5) exceeding lawful speed limit”, according to the data gathered by the Traffic

Management Group of the Philippine National Police (2001) [3, 4].

Studies were done to determine the cause of road accidents in the Philippines. According to these studies, 85% of road accidents were caused by driver error or violations. The study showed that young drivers, male drivers, public jeepney drivers and drivers with low educational attainment had a significantly higher intention to commit violations. They also showed that social environments play a significant role because intentions of violating were higher when one sees another driver commit violations and when there are no traffic enforcers around [3,4].

Speaking of their driving skill, males are more optimistic than females. The optimism of an average motorist is almost equal with that of males but higher than females. When the incidence and accident chances of risky behaviors are concerned, males and females had similar views. Males observed said manners to be less serious and less probable to cause accidents [5]. About pedestrians, different gaze patterns occur between males and females before and during crossing. Speaking of gaze patterns, women for the most part concentrate on pedestrians while men put emphasis on the moving automobiles. Females' gazes differ with the type of crossroads unlike in males' [6].

With regards to accident tendency, in average, female drivers were significantly safer than males. This is also true for younger genders. However, speaking of age, older male drivers were significantly not dangerous than older females. In addition, middle-aged drivers were considerably safer than young drivers who were safer than older drivers [5].

Vehicles play an important role in our daily lives. As a developing country, faster means of transporting goods and people is required. The increase of the amount of vehicles coupled with a disorganized city planning and irrational road designs made the general public vulnerable to accidents. Moreover, social environments play a significant role in road behavior specifically the level of education, age group and gender.

The study aimed to determine which of the pedestrian or motorist is the main cause of accidents in the intersection. This was measured by evaluating their awareness of the traffic rules and their behavior when on the road.

## II. RESEARCH DESIGN

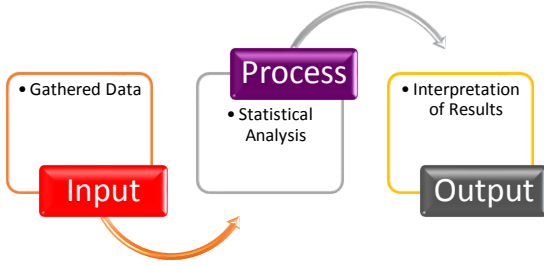


Fig. 1. IPO of the Research

Figure 1 shows that the input of the system which is the survey gathered and the records that came from the MMDA office. The data are analyzed using statistical analysis: Mann Whitney U-Test for the survey and measures of central tendency for the frequency. It will then be interpreted as to what is the main cause of accidents in the San Marcelino – Ayala Boulevard Intersection and the frequency of accidents that occur in the said place.

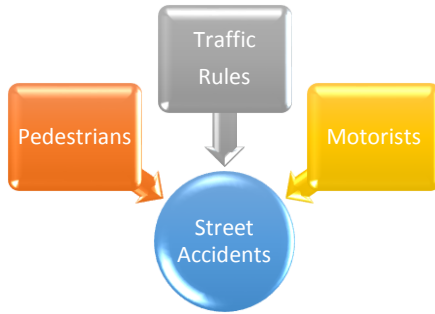


Fig. 2. Conceptual Framework of the Research

Figure 2 shows the main concept of the research. Two individuals are involved in an accident, the motorist and the pedestrian. Their awareness of the traffic rules and road etiquette are one of the reasons for road accidents. An experiment was conducted to determine which individual is most likely the cause of the accident.

## III. METHODOLOGY



Fig. 3. Block Diagram of the Process

Figure 3 shows the flow of process of the device. The first step is the gathering of data involving pedestrians and motorists' awareness to the traffic rules and the obedience of pedestrians and motorists to the traffic rules and regulations. The data gathered and collected will then be analyzed using the corresponding statistical tool. The results will determine if the

data has a relevant effect on the street accidents which is represented by the number of accident cases.

Data gathering was done from July 2015 through personal visits in the Metro Manila Development Authority (MMDA) office and the Manila Traffic Bureau to get records of accidents that happened in the last 10 years. A total of 160 people crossing the San Marcelino Street and Ayala Boulevard Intersection were surveyed. 80 of which are pedestrians and 80 of which are motorists. The respondents were chosen through Simple Random Sampling. The selected respondents are going to fill up the gender and age portion then answer the questions by selecting a single rating for a question along an equally spaced continuum of possible choices. The respondents will be given enough time to assess and rate themselves accordingly. The respondents' road etiquettes and habits in following traffic rules will be evaluated by the questions that are then categorized as positive trait or negative trait.

Different statistical tools were used to process the data gathered from the survey. Equation 1 was used to get the average and equation 2 was used to get the standard deviation of the population sample.

$$\bar{x} (\text{mean}) = \frac{f \sum x}{n} \quad (1)$$

$$\delta = \sqrt{\frac{\sum (\bar{x} - x)^2}{n - 1}} \quad (2)$$

The formula equation 3 for Z-score is used to determine outliers from the data.

$$Z - \text{Score} = \frac{a - x}{\sigma} \quad (3)$$

The data gathered is analyzed using Mann-Whitney U Test equation 4. Mann-Whitney U-Test is a type of the independent samples t-Test that can be done on ordinal (ranked) data [7].

$$z = \frac{U - \frac{n_M n_P}{2}}{\sqrt{\frac{n_M n_P (n_M + n_P + 1)}{12}}} \quad (4)$$

The independent variable was the motorists and pedestrians. The dependent variable are their rating of awareness and obedience to traffic rules.

To determine the frequency of accidents that happened for the last ten years (2005-2014), measures of central tendency were used to analyze the data and tables to illustrate the number of accidents per year. The researchers also included the frequency per month and the weather conditions for each accident.

## IV. RESULTS AND DISCUSSION

The results obtained from the questionnaire were responded by 80 pedestrian and 80 motorist with a total of 160 participants. This study includes the demographic profile of the respondents for it is assumed that the answers of the respondents are influenced by their awareness to the traffic rules. Their characteristics, and their level of awareness to the traffic rules were presented.

### A. Demographic Profile

The profile of the respondents is looked upon in their age and gender because it has a significant relation to the frequency

of road accident. Differences in behaviors and attitudes were found to be largely a function between two sexes.

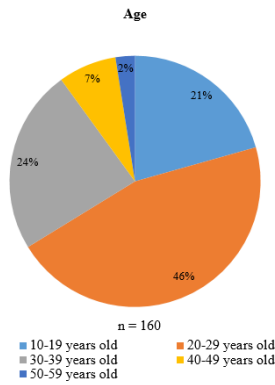


Fig. 4. Age Percentage of Sample

Upon analyzing Figure 4, most of the respondents are from 20-29 years old, forty-six percent (46%) are from 20-29 years old, twenty-four (24%) are from 30-39 years old, twenty-one (21%) are from 10-19 years old, seven percent (7%) are from 40-49 years old and two percent (2%) are from 50-59 years old.

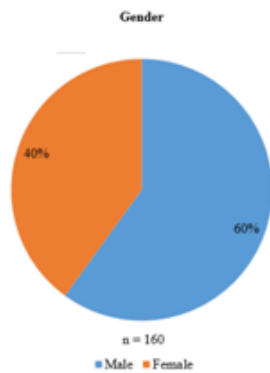


Fig. 5. Gender Percentage of Sample

Figure 5 shows that sixty percent (60%) are male respondents and forty percent (40%) are female respondents. To summarize the given data, the male respondents got a higher percentage than female.

TABLE I. RESPONSE RATE TABLE

Category	Respondents/Population	Rate of Response
Male	95/43616	0.218%
Female	63/45334	0.139%
10-19 years old	33/17147	0.192%
20-29 years old	69/18226	0.379%
30-39 years old	38/13498	0.282%
40-49 years old	12/10242	0.117%
50-59 years old	4/7054	0.057%

Table I shows the number of respondents and population from San Marcelino and Ayala Boulevard Intersection. The number of population is solved by multiplying the population density and the total land area of San Marcelino St. and Ayala

Boulevard Intersection. The total land area of San Marcelino St. and Ayala Boulevard Intersection is 2087.39m<sup>2</sup> while the population density is solved by getting the ratio of the total population of each category in Metro Manila by the total land area of Metro Manila. The total land area of Metro Manila is 38.55km<sup>2</sup> while the total population for each category is 805,503 persons, 837,240 persons, 316,677 persons, 336,603 persons, 249,285 persons, 189,155 persons and 130,268 persons respectively. There are 43,616 male, 45,534 female, 17,147 persons from 10-19 years old, 18,226 persons from 20-19 years old, 13,498 persons from 30-39 years old, 10,242 persons from 40-49 years old and 7,054 persons from 50-59 years old. There are 95 male respondents, 63 female respondents, 33 respondents from 10-19 years old, 69 respondents from 20-29 years old, 38 respondents from 30-39 years old, 12 respondents from 40-49 years old and 4 respondents from 50-59 years old. The response rate for male is 0.218%, female is 0.139%, 10-19 years old is 0.192%, 20-29 years old is 0.379%, 30-39 years old is 0.282%, 40-49 years old is 0.117% and 50-59 years is 0.057%.

## B. Data Analysis

TABLE II. MANN WHITNEY U - TEST FOR POSITIVE TRAITS

Mann Whitney U-Test Results	
UP	3127
UM	3273
Z computed	-0.2491
Alpha Level	0.05
Z @=0.05 (two-tailed)	1.96

Table II shows the results of Mann Whitney U - Test for the questions categorized as positive traits. Since Z is computed,  $|Z| \geq Z_{\alpha/2}$ , the null hypothesis  $H_0 (\mu_1 - \mu_2 = 0)$  which is that the pedestrians and motorists are equally responsible for the accidents was accepted, in terms of the questions categorized as positive trait.

Table III shows the results of Mann Whitney U - Test for the questions categorized as negative traits. Since Z is computed,  $|Z| \geq Z_{\alpha/2}$ , the null hypothesis  $H_0 (\mu_1 - \mu_2 = 0)$  which is that the pedestrians and motorists are equally responsible for the accidents was rejected, in terms of the questions categorized as negative traits.

TABLE III. MANN WHITNEY U - TEST FOR NEGATIVE TRAIT

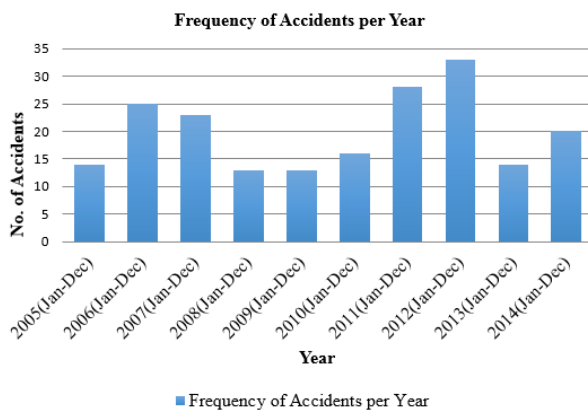
Mann Whitney U-Test Results	
UP	3866
UM	2534
Z computed	-2.272803697
Alpha Level	0.05
Z @=0.05 (two-tailed)	1.96

Table IV shows the number of accidents that happened in San Marcelino St. and Ayala Boulevard Intersection from January of 2005 to December of 2014. There are 14 accidents in 2005, 25 accidents in 2006, 23 accidents in 2007, 13 accidents in 2008, 13 accidents in 2009, 16 accidents 2010, 28 accidents 2011, 33 accidents in 2012, 14 accidents in 2014, and 20 accidents in 2014 summing a total of 199 accidents in 10 years.

The table also shows the mean of accidents in 10 years which is 19.9 or approximately 20 accidents per year which is computed using the formula of mean, where  $x$  is the data and  $n$  is the total number of data.

TABLE IV. DATA FOR THE FREQUENCY OF ACCIDENTS FROM THE YEAR 2005-2015

Year	Frequency of Accidents per Year
2005	14
2006	25
2007	23
2008	13
2009	13
2010	16
2011	28
2012	33
2013	14
2014	20
TOTAL	199
Mean	19.9



Data Source: Metro Manila Development Authority (MMDA) and Manila Traffic Bureau

Fig. 6. Frequency of Accidents per Year

Figure 6 shows the graph of accidents that happened in San Marcelino – Ayala Boulevard Intersection. The highest frequency happened in the year 2012 and the lowest frequency happened during 2008-2009. It shows a decrease and increase in number in the remaining years with no specific pattern.

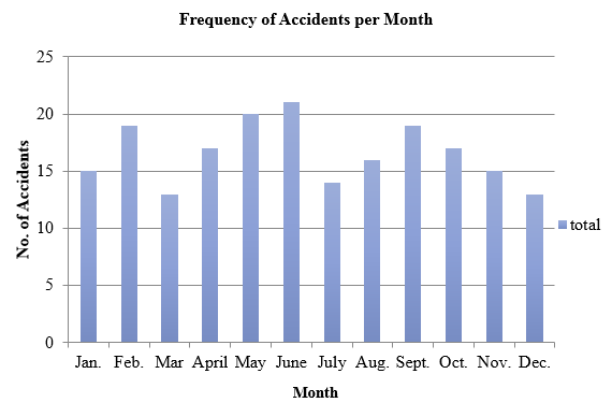
Based on the table and the computed mean, on the average, 20 accidents happened every year.

Table V shows the number of accidents per month that happened in San Marcelino St. and Ayala Boulevard Intersection from the year 2005 to 2014. There are total of 12 accidents in January, 21 accidents in February, 17 accidents in March, 13 accidents in April, 18 accidents in May, 14 accidents in June, 14 accidents in July, 14 accidents in August, 13 accidents in September, 14 accidents in October, 12 accidents in November, and 9 accidents in December. The table also shows the mean of accidents in 10 years per month which is 16.58 or approximately 17 accidents per month which is computed using

the formula of mean, where  $x$  is the data and  $n$  is the total number of data.

TABLE V. DATA FOR THE FREQUENCY OF ACCIDENTS FROM THE YEAR 2005- 2015 PER MONTH

YEAR	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
2005	1	1	2	0	0	5	1	0	0	2	1	1
2006	4	2	3	3	4	1	0	3	3	1	0	1
2007	3	5	1	1	2	1	1	1	4	2	2	0
2008	0	2	0	3	3	1	0	1	0	1	0	2
2009	1	2	1	0	2	0	3	0	0	1	2	1
2010	0	0	0	2	0	0	4	3	2	1	4	0
2011	1	0	2	1	5	1	2	6	3	2	3	2
2012	2	2	3	3	1	8	2	0	7	1	2	2
2013	0	2	0	2	0	4	0	0	0	3	1	2
2014	3	3	1	2	3	0	1	2	0	3	0	2
TOTAL	15	19	13	17	20	21	14	16	19	17	15	13
Mean	16.58											



Data Source: Metro Manila Development Authority (MMDA) and Manila Traffic Bureau

Fig.7. Frequency of Accidents per Month

Figure 7 shows the graph of accidents per month that happened in San Marcelino – Ayala Boulevard Intersection. The graph shows that the highest frequency of accidents happens in the month of June and the lowest number of accidents happens on March.

TABLE VI. WEATHER CONDITION FROM THE YEAR 2005-2015

YEAR	Jan.	Feb.	March	April	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
2005	Dry	Dry	Dry			Dry	Dry			Dry	Dry	Dry
2006	Dry	Dry	Dry	Dry	Dry	Dry		Dry	Dry	Dry	Dry	Dry
2007	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry
2008		Dry		Dry	Dry	Dry		Dry		Dry		Dry
2009	Fair	Fair	Fair		Fair		Fair			Fair	Fair	Fair
2010		Dry		Fair			Fair	Fair	Fair	Fair	Fair	
2011			Fair		Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
2012		Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair		Fair
2013	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair			Fair	
2014	Fair	Fair	Fair	Fair			Fair		Fair			

Table VI shows the mode of weather condition that the accidents happen in. For the last ten years, 38 months has dry weather during accidents and 48 have fair weather. Since neither fair nor dry weather has no effect on accidents, it can be said that weather conditions have minimal effect on road accidents.



## V. CONCLUSION

The study showed that both pedestrians and motorists are not aware to the existing traffic rules and their behavior are not conditioned to the situation. This was based from the results of the Mann-Whitney U Test which showed that the pedestrians has the most of number of the highest means in relation to disobeying and not being aware of the traffic rules. The researchers also assessed the records of accidents that happened for the last ten years in the said place. The result clearly stated that both the motorists and the pedestrians are equally responsible for the road accidents.

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## APPENDIX: AYALA BOULEVARD CORNER SAN MARCELINO STREETS (SOURCE: GOOGLE MAPS)

