Journal of the Eastern Asia Society for Transportation Studies, Vol. 6, pp. 1597 - 1609, 2005

THE INTRA-DAY EFFECT OF THE STRICT IMPLEMENTATION OF THE YELLOW LANE POLICY ON VEHICULAR FLOW ALONG INTERRUPTED AND UNINTERRUPTED SEGMENTS OF EPIFANIO DELOS SANTOS AVENUE (EDSA)

Juan Paulo J. DE GUZMAN
Research Assistant
College of Engineering
De La Salle University
Taft Avenue, Manila
Philippines
Tel: (02) 844-1475
E-mail : jpaulo_deguzman@yahoo.com

Alexis M. FILLONE
Assistant Professor
Department of Civil Engineering
De La Salle University
Taft Avenue, Manila
Philippines
Fax: (02) 524-4611 loc 226
E-mail: fillonea@dlsu.edu.ph

Abstract: Various traffic management schemes have been implemented through the years to solve, if not minimize traffic congestion along EDSA. The most recent one is the strict implementation of the Yellow Lane Policy (YLP). Under the said scheme, buses were segregated into their own lane, separate from other vehicular traffic. This study evaluated the effects of the said policy by examining vehicular flow during the morning, noon and afternoon peak periods conducted before and after the strict implementation of the said policy. The vehicular flow values were then multiplied by the average vehicle occupancy, hence coming up with commuter-flow values. This set of values was then used as the dependent variable in a natural log model regressed against the number of violations as the dependent variable. Ultimately, analysis showed that during the time of the observation, the YLP has not improved commuter flow along the chosen segments of EDSA.

Key Words: Traffic management schemes, Commuter flow, Natural log model, Regression analysis, 'Yellow lane policy'

1. INTRODUCTION

The lack of land to expand and construct additional lanes and the increasing flow of vehicles traveling through Epifanio Delos Santos Avenue (EDSA) are causing recurrent traffic congestion on the said roadway. Various traffic management schemes have been implemented to solve, if not, minimize traffic congestion. One of these schemes is the "Yellow Lane Policy". This scheme was first implemented during the late 1980's but was junked when the government started building flyovers on EDSA. In re-implementing the traffic scheme, buses were confined to two lanes on the outermost side of EDSA marked by a yellow line. Private vehicles are banned from entering the lane except when executing a right turn into an intersection or when unloading passengers. Private vehicles would only be allowed to enter the lane thirty meters away from their turn. A broken line marked this distance. In addition to that, stickers were posted on the rear of the buses to remind private vehicles not to overtake the buses and that they are not allowed on the yellow lane. The Yellow Lane Policy was implemented as early as July of 2003, however it was only strictly implemented on the 8th of December of the same year.

2. METHODOLOGY

In order to efficiently capture the effect of the strict implementation of the Yellow Lane Policy (YLP), two major issues were taken into consideration. The first one was to select a suitable segment of EDSA to film and analyze the vehicular flow with the YLP in place, while the second one, was to schedule the time of video recordings.

For us to select a suitable segment, two factors were again considered. Specifically these are the condition of flow and the presence of an appropriate vantage point.

Condition of Flow For our data not to be prejudice, both interrupted and uninterrupted flow conditions of traffic were taken into account in choosing an appropriate segment of EDSA.

Vantage Point In selecting an appropriate vantage point, several factors were considered to ensure a good angle for the footage. Such factors include, location of the structure, height of the structure and availability of an adequate place to mount the camera.

Time of Recording In order to capture the effect of strict implementation of the YLP, two independent video recordings were done. The first one was completed on the fourth quarter of 2003, before the strict implementation of the YLP while the second footage was completed on the first quarter of 2004, after the strict implementation of the YLP. Moreover, to capture the intra-day effects of the YLP, three separate recordings were done on all peak hours.

Figure 1. Metropolitan Manila Development Authority (MMDA) Building

Figure 2. MMDA Video Capture

First Segment The first segments was situated in between the Buendia and Guadalupe segments of EDSA. The vantage point in this segment was the nine-story Metropolitan Manila Development Authority (MMDA) building (Figure 1). Figure 2 is a video capture of the footages taken in MMDA. In the figure, it can be seen that the flow is uninterrupted. As planned, independent video recordings were done before and after the strict implementation of the YLP on all peak hour periods. The length of the segment was measured as one hundred thirty meters.

Second Segment The second segment was situated in Cubao. In this segment our vantage point, was the thirty-two-story Regalia Tower (Figure 3). Figure 4 is a video capture of our

footage in REGALIA; in this figure it can be observed that the flow is interrupted due to the presence of a stoplight at the end of the segment. Lastly, like what was done in MMDA, independent video recordings were also accomplished before and after the strict implementation of the YLP on all peak hour periods. The length of the segment was measured as one hundred thirteen meters.

Figure 3. Regalia Park Tower

Figure 4. Regalia Video Capture

2.1 Vehicular Flow Analysis

Since, EDSA has five lanes, we marked the traffic lanes into nine lines of traffic in consideration of vehicles passing between lanes 1 and 2, 2 and 3, and so on. We then counted the number of vehicles as they passed by a boundary line, which we have assigned and marked on the television monitor in the laboratory. In addition to that, the vehicles were classified as they passed through the boundary line. Vehicle classifications are as follows: private cars, jeepneys, taxicabs and cargo trucks. Counting was done every 15-minutes, thus the 15-minute vehicle flow (De Guzman, P. *et al.*, 2004).

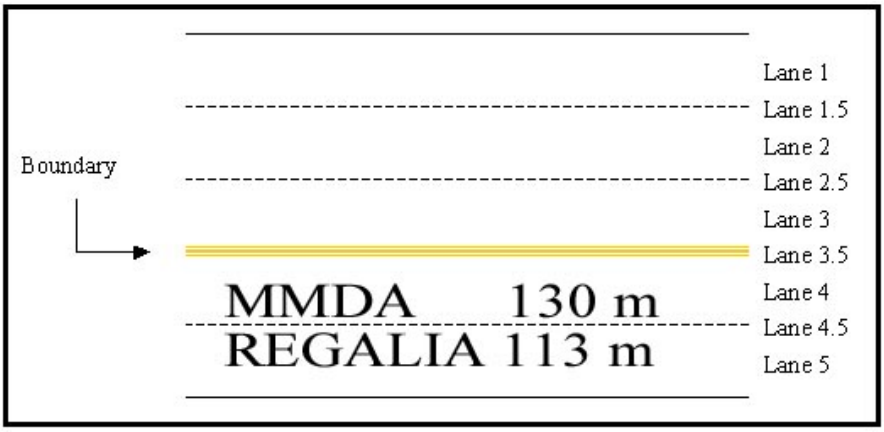


Figure 5. Lane Allocation

Figure 5 shows the lane distribution on EDSA wherein, lanes marked 1 to 3.5 being the Inner Lane, the lane allotted only for private vehicles and other light public utility vehicles and lanes marked 4 to 5 being the Yellow Lane, the lane allotted only for public utility vehicles

such as buses, jeepneys and taxicabs. The length of the segment in MMDA was measured to be as one hundred thirty meters, while one hundred thirteen meters was the total length of segment that was measured in Regalia.

Table 1 is an example of the tabulation that was done on all the vehicles passing through our segment. The same procedure was applied on all footages. This set of data was taken from MMDA Morning Peak; the video was taken before the strict implementation of the Yellow Lane Policy.

Table 1. Example of 15-min Vehicular Flow

Time Interval	**Vehicle type**	**Yellow Lane Markings**			**Inner Lane Markings**					
		5	**4.5**	**4**	**3.5**	**3**	**2.5**	**2**	**1.5**	**1**
06:00 – 06:15	CAR	2	2	15	19	205	8	195	24	270
	BUS	22	51	68	3	15	6	3	0	0
	TRUCK	0	0	0	0	0	0	0	0	0
	JEEPNEY	2	1	5	0	0	0	0	0	0
	TAXI	1	0	11	51	38	36	8	9	2

Statistical Analysis on Vehicular Flow Since vehicular flow is the main factor to be considered in the comparison of the before and after commuter-flow, statistical analysis was conducted to determine if the set of values gathered were normally distributed and if there was significant differences between the two sets of data. Table 2, summarizes the results of the statistical analysis. Results would show that the set of vehicular flow values are indeed normally distributed and that there were no significant difference between the before and after flow. This is most likely due to the fact that the only difference prior to the strict implementation of the YLP was that the private vehicles are now strictly segregated from buses. Knowing now that the two set of values are normally distributed, a direct comparison can now be done on the before and after flows.

Table 2. Statistical Analysis of the 15-min Vehicular Flow

Segment	**F**	**F Critical**	**Variance**	**T Stat**	**t Critical**	**Remarks**
MMDA	1.473	2.014	Equal	1.438	2.013	No significant difference
REGALIA	1.412	2.014	Equal	0.367	2.013	No significant difference

2.2 YLP Violations

Once the data for the 15-min flow was tallied, the number of vehicles violating the YLP can easily be noted. Private vehicles and trucks tallied on the yellow lane are considered as violations, the same goes for buses tallied on the inner lane. Table 3, shows the summary of the number violations that has occurred on our chosen segments of EDSA during the time of our study. Please take note that all values are expressed in passenger car units (PCU).

Table 3. Summation of YLP Violations

Violations	MMDA1		MMDA2		REGALIA1		REGALIA2	
	Yellow	Inner	Yellow	Inner	Yellow	Inner	Yellow	Inner
Morning	520	128	542	160	972	683	918	718
Noon	127	313	288	223	353	570	431	878
Afternoon	1386	20	878	128	438	775	893	655

2.3 Average Intra-Day Vehicle Occupancy

Since the YLP has only separated private vehicles from public utility vehicles, it was assumed that the number of occupants inside these vehicles remained the same. Thereby, eliminating the need to have separate before and after surveys to get the average vehicle occupancy. However, since the number of commuters varies throughout the day, three separate intra-day surveys were done for all vehicle types. In addition to that, the number of commuters also varied depending on the location thus independent surveys was done for MMDA and Regalia. Three hundred samples were gathered per vehicle type. All surveys were done during the first quarter of 2004.

Roadside Survey In this type of survey the surveyor was stationed on a location that allowed him/her to adequately see the number of occupants inside the moving vehicles. Due to human limitations, this type of survey was only applied on vehicles that have a small capacity, vehicles such as private cars and taxicabs.

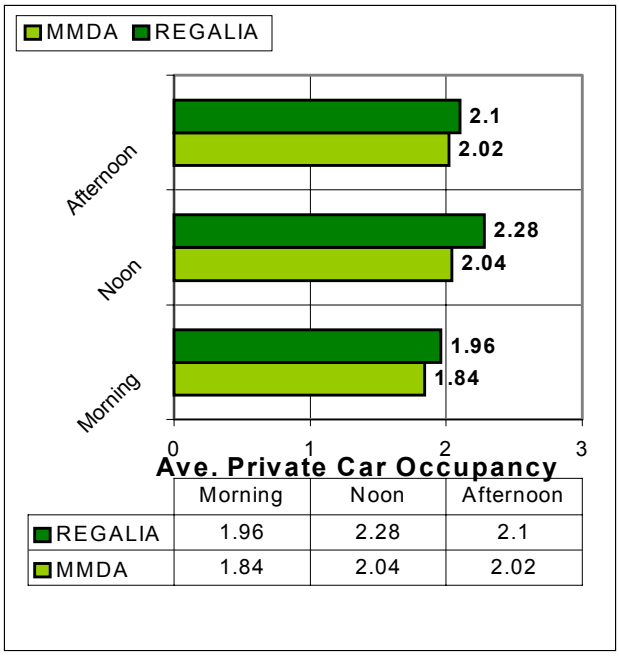
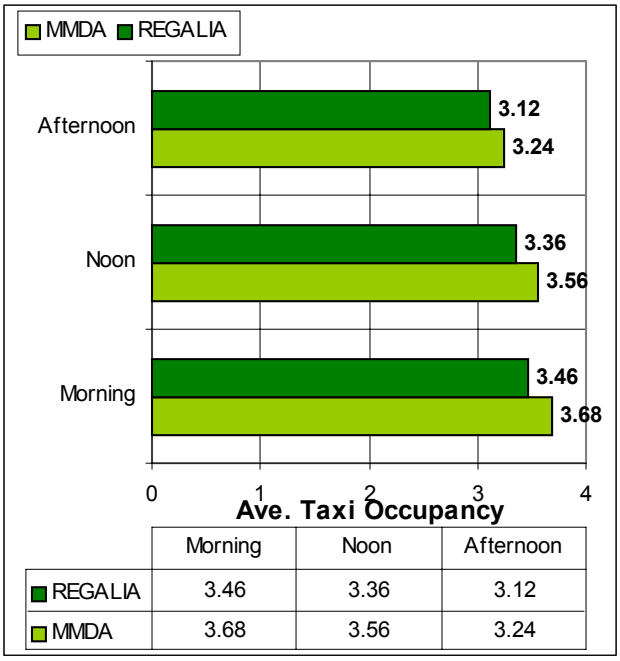


Figure 5. Average Private Car Occupancy (Pax/Veh)



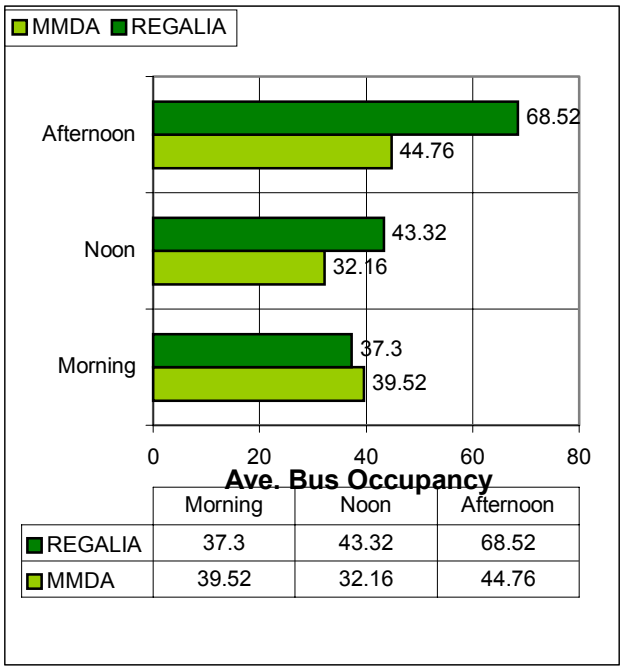
	Morning	Noon	Afternoon
REGALIA	3.46	3.36	3.12
MMDA	3.68	3.56	3.24

Figure 6. Average Taxi Occupancy (Pax/Veh)

It can be observed in Figure 5 that the average occupancy of private vehicles remains almost the same all throughout the day. It can also be observed that most private vehicles are not maximized to their full capacity. This means that private car owning drivers tend to ride alone, especially during the morning peak period.

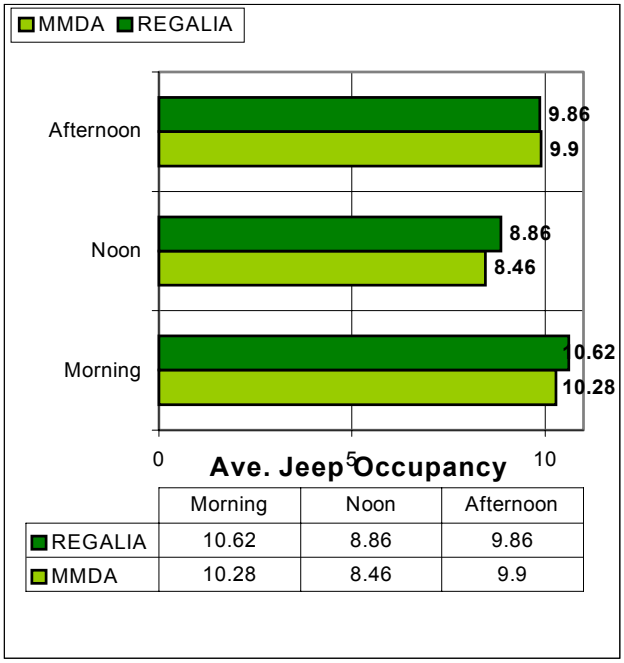
Meanwhile, it is evident on Figure 6 that the average occupancies observed for taxicabs are much higher than the values observed for private vehicles. Moreover, the taxicab's occupancy is at its highest during the morning peak; this is probably because commuters going to work in the morning with a common destination tend to ride taxicabs together.

Onboard Survey This type of survey was used to compute for the average occupancy of vehicles with large capacities, in our study these are jeepneys and buses.



	Morning	Noon	Afternoon
REGALIA	37.3	43.32	68.52
MMDA	39.52	32.16	44.76

Figure 7. Average Bus Occupancy (Pax/Veh)



	Morning	Noon	Afternoon
REGALIA	10.62	8.86	9.86
MMDA	10.28	8.46	9.9

Figure 8. Average Jeepney Occupancy (Pax/Veh)

It can be observed from Figure 7 that the average capacity of buses was exceeded during the afternoon peak in Regalia, Cubao. This trend is very common on some parts of EDSA, especially around shopping malls or business areas. On these parts of the Avenue passengers are forced to stand on bus aisles just to get to their destination. Lastly, Figure 8 shows the average occupancy of jeepneys along our chosen segments on EDSA. However, it should be noted that at present time public utility jeepneys are only allowed at some parts of EDSA.

3. ANALYSIS

In order to evaluate the effects of the strict implementation of the YLP, a common benchmark has to be established. This benchmark would serve as a point of comparison for the change in the condition of traffic flow, regardless of vehicular speed, density, time of the day, lane and vehicle type. Thus in this study, the effectiveness of the strict implementation of the YLP was measured in terms of the number of commuters that has passed through our segments for every 15-minutes, hence the commuter flow values were established.

3.1 Commuter Flow Analysis

Commuter flow is simply the product of the 15-minute Flow (Vehicle/15-min) and the Average Vehicle Occupancy (Commuter/Vehicle). The set of values calculated was then summated according to their respective peak period and lane allocation, a summary of these values can be found on Table 4.

Table 4. Summation of Commuter Flow

Violations	**MMDA1**		**MMDA2**		**REGALIA1**		**REGALIA2**	
	Yellow	**Inner**	**Yellow**	**Inner**	**Yellow**	**Inner**	**Yellow**	**Inner**
Morning	36771	22004	35465	21063	25901	23640	24761	24868
Noon	24964	24126	25439	19702	29788	24523	29395	31463
Afternoon	49453	13648	40028	15940	49631	36699	56993	35100

A direct comparison was then made on the before and after data for both segments. Table 5 shows a summary of these results. Be reminded that since these values represent the number of commuters that were able to pass through our segment, an increase in value would yield a positive outcome, meaning the YLP has improved the condition of traffic and yield a negative outcome when a decrease in value is experienced.

Table 5. Descriptive Comparison of Before and After Commuter-Flow

Commuter-Flow	MMDA		REGALIA	
	Yellow	Inner	Yellow	Inner
Morning	-1305.00	-940.66	-1140	1228.86
Noon	475.92	-4424.68	-392.62	6940.104
Afternoon	-9424.66	2292.42	7363.18	-1598.82

By mere inspection it can easily be established that most of the time, YLP has decreased the number of commuters that were able to passed through our segments. However, these parameters alone are not enough to verify that the YLP is ineffective. So, the number of violations was taken into consideration. Table 6, summarizes the descriptive comparison

between the number of violations incurred before and after the strict implementation of YLP. Take note that DEC stands for decrease and INC for increase.

Table 6. Descriptive Comparison of Before and After Violations

Violations	MMDA		REGALIA	
	Yellow	Inner	Yellow	Inner
Morning	22	13	-54	14
Noon	161	-36	78	123
Afternoon	-508	43	455	-48

The two parameters (Commuter-Flow and Violation) were then paired. For example, in MMDA Yellow Lane during the morning peak a "DEC-INC" trend was experienced. This means that a decrease in Passenger-Flow and an increase in Violations were experienced. The same principle was applied for the rest of the data. As a result, three cases were established depending on the combination of parameters. These three cases are summarized on Table 7.

Table 7. Commuter Flow/Violation Cases

Case	Commuter Flow	Violation
1	DEC	INC
2	INC	INC
3	DEC	DEC

In Case 1, it is quite evident that after the strict implementation of the YLP, the commuter flow has decreased. This means that the YLP has actually lessened the number of commuters that were able to pass through our segment. In Case 2, commuter flow is directly proportional to the number of violations incurred, both having an increasing trend. This implies that the more drivers disregard the YLP, the more commuters are able to cross our segment. This in turn means that junking the YLP would actually improve traffic flow. For Case 3, commuter flow is also directly proportional to the number of violations incurred. However, this time both parameters have a decreasing trend. This implies that the number of commuters that were able to cross the segments is decreased when drivers follow the YLP. Given this situation, it is again evident that junking the YLP would actually improve traffic flow.

3.2 Linear Regression Modeling

In Cases 2 and 3, it was observed that the change in the number of violations is directly proportional to the change in commuter-flow. This in turn, led to the assumption that a linear relationship exists between the two. To verify this assumption it is important to estimate the relationship between commuter-flow and the number of violations. To accomplish this task, a Linear Model was derived. In this model the number of violations incurred during the time of our study was considered as the independent variable (x) while the commuter-flow values as the dependent variable (y). The method of least squares was used to estimate the regression line for the sample data. Figure 9 shows the scatter plot of the raw data with a simple linear regression superimposed on it.

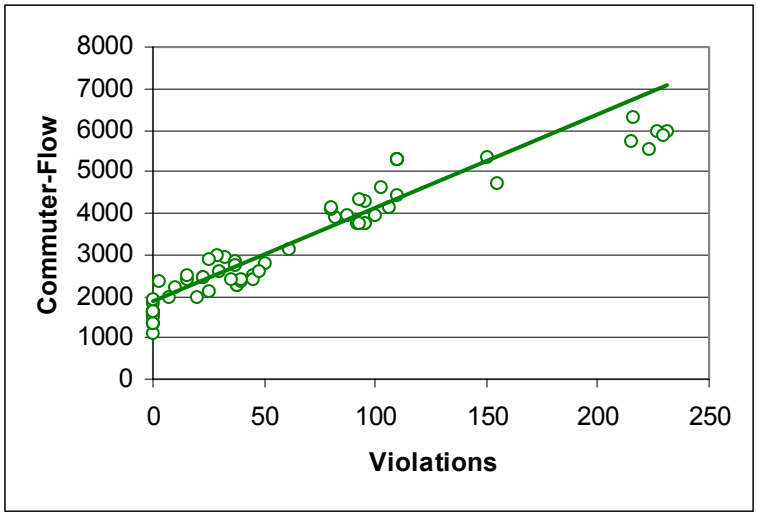


Figure 9. Scatter Plot of the Linear Model

The simple linear regression fit Eq. (1) to the data produced the fitted model is

$$\hat{y} = 22.524x + 1878.4 \ (R^2 = 0.72) \qquad \textbf{Eq. (1)}$$

Plotting methods can illustrate and detect violation of assumptions made on model errors as well as detecting the proper form of the model. Figure 11 shows the residuals, plotted against the number of violations.

The residual plot, shown in Figure 10 is hardly an ideal set of residuals. It does not show a random fluctuation around a zero value. Instead it shows clusters of positive and negative values. To get around this problem and gain some type of idea regarding the normal error assumption, a normal probability plot of the residuals was generated. In this type of plot distribution, the vertical axis represents the empirical distribution function on a scale that produces a straight-line plot when plotted against the residuals themselves. This is illustrated on Figure 11.

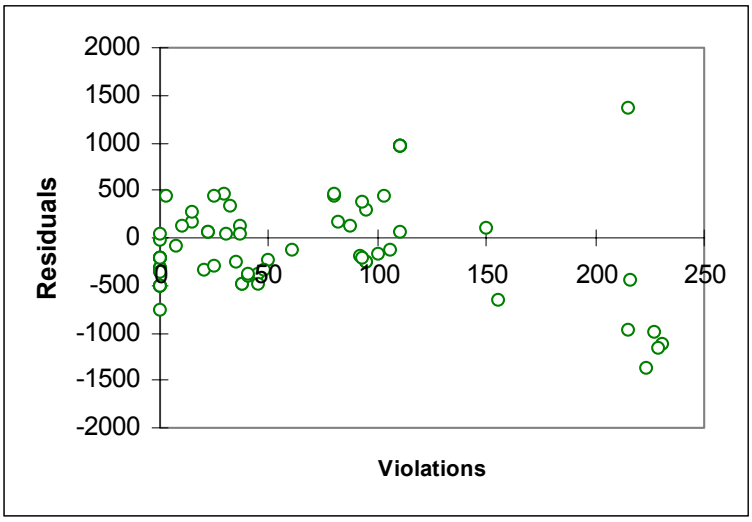


Figure 10. Residual Plot for the number of Violations

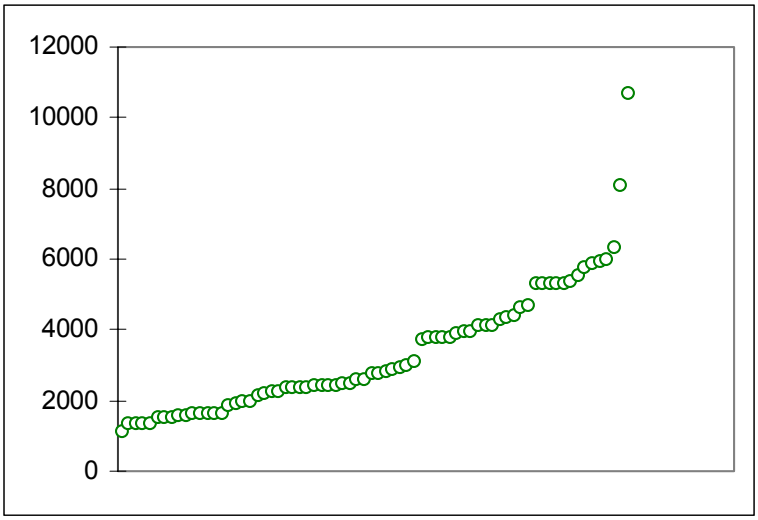


Figure 11. Normal Probability Plot of Residuals for Violations Incurred

It can be observed on Figure 11, that the normal probability plot does not return the straight-line appearance that is normally seen on a linear regression plot. This is another indication of a flawed, perhaps excessively naive choice of a regression model.

3.3 Natural Log Transformation Model

Both type of residual plots and the scatter plot itself suggests a rather more complex model is needed. One possibility is to use a natural log transformation (Walpole, 1998) . In this type of model, a regression between ln y and x was used. A scatter plot of this data can be seen on Figure 12.

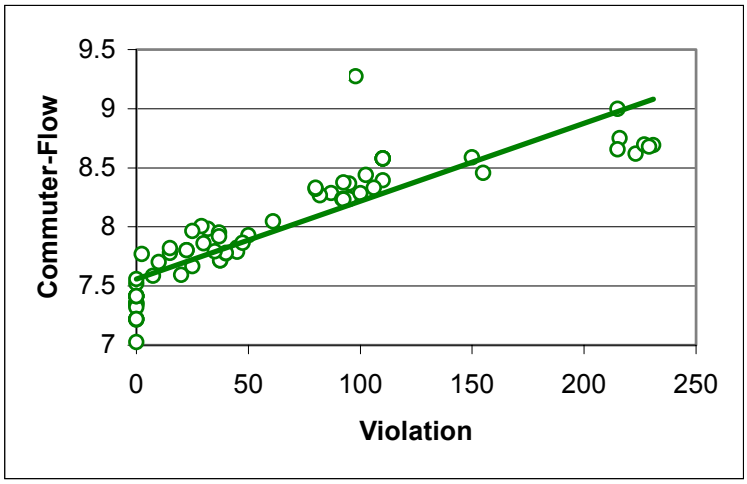


Figure 12. Scatter Plot of the Natural Log Model

The natural log regression fit (Eq. 2) to the data produced the fitted model

$$\hat{y} = 0.0066x + 7.5604 \ (R^2 = 0.7699) \qquad \textbf{Eq. (2)}$$

The increase in the coefficient of determination, R^2 suggest that the transformed model is more appropriate to estimate the line relating violation and commuter-flow. Moreover, the t-Stat value, and the P-value, as well as the standard error all suggest a strong evidence that a

significant relationship exist between violation and commuter-flow, thus validating the assumptions made for case two and three. Table 8 summarizes the regression statistic output of the transformed model.

Table 8. Natural Log Regression Statistics Output

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**Lower 95%**	**Upper 95%**
Intercept	7.560366	0.04	189.0105	1.49E-96	7.48059	7.640143
X Variable	0.006579	0.00043	15.30598	4.98E-24	0.005721	0.007436

4. CONCLUSION AND RECOMMENDATION

It is evident in our analysis that during the time of our study, the strict implementation of the Yellow Lane Policy has in fact reduced the volume of commuter flow along the segments studied, thus the result is opposite to what it was expected to improve.

Moreover, the natural log model suggests that commuter-flow is directly proportional to the number of violations incurred. This led us to believe that as more drivers comply with the strict implementation of YLP, the lesser the number of commuters that are able to cross the segment.

In conclusion, the Metropolitan Manila Development Authority should think of a better traffic management scheme that would actually improve the traffic condition on EDSA because based from our findings, the YLP is definitely far from being effective.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the help of Mr. John Paul Lim and Mr. Bradford Liao, the undergraduate thesis mates of the main author.

REFERENCES

a) Books and Books chapters

Walpole, R.E., Myers, R.H., and Myers, S.L. (1998) **Probability and Statistics for Engineers and Scientist**, 6th Ed., Prentice-Hall International, Inc.

b) Papers presented to conferences

De Guzman, P., Fillone, A., Lim, J. P., Liao, B. (2004) The Effect of the Strict Implementation of the Yellow Lane Policy on Vehicular Flow along Epifanio De Los Santos Avenue (EDSA). **TSSP 12th Annual Conference**, Mactan Waterfront Hotel, Cebu 23-24 July 2004