

Investigating the influencing factors on the frequency of speeding violations: A case study of citizens of Tehran

Ali Farzaneh Movahed¹, Ali Shafaat^{2*}, Meeghat Habibian³

¹MSc student in Civil and Environmental Engineering Department, Amirkabir University of Technology.

²Assistant Professor in Architecture and Urban Design Department, Shahid Beheshti University.

³Assistant Professor in Civil and Environmental Engineering Department, Amirkabir University of Technology.

ABSTRACT

As the most frequent driving violation, speeding has been the cause of 21% of accidents in the first three months of 1398 in Tehran. Speeding behavior has roots in drivers' attributes and attitudes toward driving, which has not been studied enough for drivers in Tehran. This study examined the association between speeding violation frequency and drivers' attributes, including socioeconomic characteristics and attitudes toward driving. A Zero-inflated negative binomial regression model developed using a cohort of 470 adult drivers. Results show that the hours of physical activity and exercise per week, some perceptions such as "other drivers move slowly" and "Traffic violations are an immoral act" affect the occurrence and the frequency of speeding. Besides, having delays in most trips that the person is driving, driving experience less than five years, and having vehicle body insurance directly affect the frequency of speeding. Based on the results, it can be concluded that reviewing the rules can be helpful in reducing speeding violations, for instance, adding some penalties in body insurance contracts for the number of speeding violations. Also, education courses for raising public awareness toward violations can be practical, especially for drivers with more experience and speeding violations.

KEYWORDS

Driving violations, speeding violation, individual characteristics, attitudes, zero-inflated negative binomial regression model.

* Corresponding Author: Email: Shafaat@outlook.com

1. Introduction

Vehicle, human factors, and the environment are the three main factors whose interactions influence road safety [1]. In Iran's major metropolitans such as Tehran and Mashhad, speeding is the most frequent unsafe traffic violation [2]. Previous studies showed that human errors and traffic violations are among the most important factors in accidents [3]. This was the reason that many studies were conducted on traffic violations [4-6]. The studies found that vehicle characteristics and factors such as possessing insurance influence overspeeding.

Other studies show that in addition to other individual characteristics, the chance of speeding increases by increasing drivers' experience and capability [7, 8]. It also is emphasized in the literature that drivers typically attempt to save time, and this is one of the main reasons of traffic violation [9]. The root cause for such attempts is that they are under time pressure (as they are late), and driving in such situations increases the chance of speeding as well as other violation [10]. Moreover, studies show that anger and not trusting in traffic laws' efficiency are positively correlated with traffic violation [11]. This study investigates the relationship between personal characteristics and the number of overspeeding in a short period using a count model. The model is introduced in the methodology section.

2. Methodology

Count models were used to estimate the frequency of events and have been used widely in traffic and safety engineering. The problem is that since in many cases, the number of occurrences has excessive zero observations. The model should address this issue, otherwise; the model fitness decreases.

In such a situation, if the data has overdispersion and the mean and variance of the dependent variable are not equal, a Zero-inflated negative binomial should be used to address both issues. Finally, according to the confirmation of the conditions mentioned for the dependent variable in this study (i. e., frequency of over speeding), a zero-inflated negative binomial model was used [12]:

$$y_i = 0 \quad P = p_i + (1 - p_i) \left[\frac{1/\alpha}{(1/\alpha) + \lambda_i} \right] \quad (1)$$

$$y_i = y \quad y = 1, 2, 3, \dots \quad P = (1 - p_i) \left[\frac{r((1/\alpha) + y) u_i^{y/\alpha} (1 - u_i)^y}{r(1/\alpha) y!} \right] \quad (2)$$

Equation 1, calculates the probability of y_i equal to zero, and equation 2, is the probability of y_i (number of violations) equals to the y (positive numbers). To test the zero inflation assumption, Vuong statistic is computed and reported in Table 1. As can be seen, it is larger than 2.58, which shows that the data has excessive zeros.

3. Sample

Data collected using a designed self-reported questionnaire. Drivers who had access to their traffic violation records were asked to participate. In Iran, drivers can inquire about traffic violations online using data on the back of their vehicle registration card. The questionnaire was distributed on paper and online. The response rate was approximately 20%, and in the end, 600 drivers participated.

According to the Cochran formula, for a population of 7 million and a significance level of 95%, the minimum sample size should be 384. After the screening procedure, 470 valid responses remained, which were used to build the model. This sample size is larger than the minimum recommendation based on calculating the Cochran formula.

4. Results and Discussion

The model was built using independent variables reported in Table 1. However, different combinations of other variables such as age, sex, education, and income level have been tested but no significant correlation was found based on the sample data.

Table 1 reported the variables that are either related to zero violation probability for safe drivers, and the variables that correlated to the number of violations. Log-likelihood was used in model estimation and the comparison between the maximum log-likelihood and restricted log-likelihood (constant only) shows the model significance.

The results show that having collision insurance; as an essential variable with a marginal effect of 0.204 increases the likelihood of over speeding. This significance may be since people with full-option collision insurance are more confident about possible compensation.

The results consistent with previous studies reveal that drivers who believe they are late on appointment that need driving [9, 10] and drivers with more than five years of driving experience [5] are more likely to have a higher speeding violations. The marginal effect values

of these two variables are equal to 0.064 and 0.152, respectively.

Table 1. Zero-inflated negative binomial estimation of traffic violation frequency in

Variable	β	t value	Marginal effect
Negative Binomial Count Model			
Constant	-1.388	-7.98	-
Collision Insurance (1 if has the insurance, 0 otherwise)	0.580	3.29	0.204
Driver's experience (1 if it is more than 5 years, 0 otherwise)	-0.436	-1.69	-0.152
Driver believes he/she is late on appointment which need driving (0 strongly disagree, 1 disagree, 2 neutral, 3 agree, 4 strongly agree)	0.182	1.89	0.064
Zero violation probability state as logistic function			
Constant	-7.017	-1.85	-
Physical activity (hours per week)	-1.502	-1.72	0.034
Driver believe that violating traffic laws is unethical (0 strongly disagree, 1 disagree, 2 neutral, 3 agree, 4 strongly agree)	2.901	2.23	-0.066
Driver believe that other drivers move slow (0 strongly disagree, 1 disagree, 2 neutral, 3 agree, 4 strongly agree)	-1.186	-1.86	0.027
Number of observation		470	
LL		-339.03	
Restricted LL		-350.87	
α		1.35	
Chi-squared Test		18.13 (0.0004)	
Vuong statistic		3.60	

Three variables are also significant in the sub-model for zero violation probability state (including duration of physical activity per week, believing that violating traffic laws is unethical, and believing that other drivers move slowly), indirectly affecting the frequency of speeding violations.

5. Conclusions

This article intended to contribute to the literature by using a relatively complete set of variables (including socioeconomic variables, vehicle characteristics,

individual lifestyle, driving experience, and theoretical factors related to violations) and applying the zero-inflated negative binomial method. The results showed that having facilities that reassure the driver that the collision damage will be compensated, leads to more speeding violations. Safety planners in this regard can restrict the use of these facilities for violators by applying the correct rules. Based on the results, having more driving experience and wrong attitudes towards driving and violations can increase the likelihood of higher speeding violations. In this way, education courses for raising public awareness toward violations can be practical, especially for drivers with more experience and speeding violations.

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