ROAD ACCIDENT SEVERITY ANALYSIS IN CYBERABAD & HYDERABAD USING ORDERED PROBIT MODEL

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Abstract: In this paper, a brief practical review is presented on the statistical evidence showing the Accidents have been a major social problem in the developed countries of world for over fifty years. It is only in the past decade that developing countries like India have began to experience large increase in the number of road accidents taking place and having found it necessary to institute road safety programs. Road accidents in Hyderabad can be studied by identifying the high accidents occurred area having a peak rate. The road accidents study can be done in two areas of Hyderabad city. The project involves identifying of road accidents in seven variations and finally giving solutions. The two areas namely Hayathnagar and Safibabad are the mainly facing alarming road accidents. The road accidents study of two areas is done by conduction two types of data collections. Data collection is done from the police stations of two areas. Based on those data the suitable recommendations and counter measures are given for Hyderabad city and also for Indian cities. By conducting some type of survey in remaining areas of Hyderabad can reduce and prevent road accidents The occurrence and outcome of traffic crashes have long been recognized as complex events involving interactions between many factors, including the roadway, driver, traffic characteristics, and the environment. This study is concerned with the outcome of the crash. Method: Accident injury severity levels are analyzed using the ordered probit modeling methodology. Models showed the significance of victim's gender, vehicle type, type of collision, time of collision, and victim's age on the injury severity level. Results: The results suggest that vehicles involving higher level of severity are unknown vehicles. Pedestrian are more prone to higher severity level. Other conclusions also are presented like hit & run and rear end collisions are associated with more severe injuries

Keywords: Accidents, Model, Severity, injuries, Hyderabad, Secunderabad, Probit model.

I. INTRODUCTION

Traffic safety is a major concern because of the economic and social costs of traffic crashes. The impact that traffic accidents have on society is significant. Individuals injured (or killed) in traffic accidents must deal with pain and suffering, medical costs, wage loss, and vehicle repair costs. For society as a whole, traffic accidents result in enormous costs in terms of lost productivity and property damage. It is assumed that there is total 2% loss of GDP only due to road accident in India. Clearly, efforts to improve our understanding of the factors that influence accident severity are warranted. So the common practice in transportation engineering is a thorough study of traffic accidents and gets an understanding of the factor affecting them. Severity of injury sustained by victim involved in crashes is of considerable interest to policy makers & safety engineers. Transportation system is meant for movement of people and goods from one place to another place safely. Thus safety is one of the main aspects of the transportation system. Motorization has been happening rapidly throughout the world. This has increased the mobility of the people from one place to other and the accidents also. Road accidents became a serious problem. Accidents are social problems affecting people in many ways. Serious losses caused by road accidents demand the attention of the society and call for the solution of the problem. The prevention of road accidents should not be considered as purely technical exercise. It involves many factors like government, educator, engineers, enforcement, voluntary organizations etc. Investigation of accident severity is one of the important concerns to traffic safety because this is aimed not only at prevention of accidents but also at reduction of their severity. One way to accomplish the aim of the latter is to the identify the most probable factors such as driver and passenger characteristics, seasonal effects, weekly variation, time of day variation, collision type, vehicle type, and traffic and geometric conditions that affect accident severity.

II. NEED FOR PRESENT STUDY

Demand for transport is increasing day by day due to industrialization and urbanization during recent years. But the road infrastructure has not been developed along with the travel demand due to lack of resources. This imbalance is creating problem. Road accidents are not only occurring due to a single factor like driver's negligence or ignorance of traffic rules and regulations, but also due to many other related factors such as changes in road condition, vehicle condition, road user behavior, environment and combinations of other factors. Among the factors responsible for road accidents, the effect of road environment can be reduced if its influence is analyzed. Upgrading the total road network would be time consuming and huge financial resources are required, which may be difficult to implement. The quick and cost effective step in improving road safety may be identifying accident prone locations and improve them instead of improving the complete road network. In this work attention is paid to determine the effects of road environment factors on accidents.

Objective and Scope of the Study

The main objectives of the present study are presented bellow

- To study the distribution of fatal, non-fatal and vehicle damaged accidents took place during 2013-2015.
- To analyze the cause of accidents during 2013-2015.
- To apprise the hourly incidents of total accidents
- To provide safety measures to reduce pedestrians accidents.
- To study the causes of accidents and to suggest corrective treatment at potential location.
- To evaluate existing designs.
- To support proposed designs.
- To carry out before and after studies and to demonstrate the improvement in the problem.
- To make computations of financial loss.
- To give economic justification for the improvements suggested by the traffic engineer.

III. LITERATURE REVIEW

Gray et al. (2008) observed that young male drivers are over-represented in car accidents in Great Britain. While investigating the factors affecting the severity of these young male drivers they observed that driving in darkness, trips during early morning and towards the end of the week (Friday and Saturday) are related with higher severities. They also observed that carriageway hazards such as passing a site where accident occurred may increase severity of crashes at a site afterwards that specific site. They also observed higher levels of severities during overtaking maneuvers, and on the single carriageway of speed limit 60 mph. Other variables leading to higher severities were driving on main roads, not being at a junction, towing something like a caravan or trailer, young male drivers of age group 20-22, and finally in fine weather condition with no high winds.

Kockelman and Young (2001) applied ordered probit models to examine the risk of different injury levels sustained under all crash types, two-vehicle crashes, and single-vehicle crashes. The results suggest that pickups and sport utility vehicles are less safe than passenger cars under single-vehicle crash conditions. In two-vehicle crashes, however, these vehicle types are associated with less severe injuries for their drivers and more severe injuries for occupants of their collision partners (including drivers and passengers). Crash types such as roll-over and head-on accidents resulted in more severe injuries. Female drivers are also found to be involved with higher crash severities. Pai and Saleh (2007) estimated statistical models to identify whether a specific maneuver by motorcycle or vehicle (e.g., overtaking or changing lanes) is more hazardous to motorcyclists in sideswipe collisions at T-junctions. The modeling results show that injuries to motorcyclists were greatest when an overtaking motorcycle collided with a turning vehicle and such effect appeared to be more severe at unsignalized junctions. Quddus et al. (2002) investigated factors leading to increase in the probability of severe injuries of motorcyclists and identified that motorcyclist who is not from Singapore experienced higher crash severities compared to Singaporean motorcyclists. , Among other factors they found that increased engine capacity, headlight not turned on during daytime, collisions with pedestrians and stationary objects, driving during early morning hours and motor cycles with pillion passengers experienced higher severities. Additionally they observed that in collisions where the motorcyclists are at fault, they sustained higher levels of injuries than otherwise. Abdel-Aty (2003) applied ordered probit models for analysis of driver injury severity levels at roadway sections, signalized intersections, and toll plazas. He found that older drivers, male drivers, and those not wearing a seat belt will have a higher probability of a severe injury and both signalized intersections and roadway sections models showed higher level of injuries in rural areas, possibly due to higher speeds. He also found that driver's violation was significant in case of signalized intersection. Alcohol, lighting conditions, and the existence of a horizontal curve affected the likelihood of injuries in the roadway sections' model. A variable specific to toll plazas, vehicles equipped with Electronic Toll Collection, had a positive effect on the probability of higher injury severity at toll plazas. Duncan et al. (1998) applied ordered probit model to find injury severity in truck-passenger car rear-end collisions. they investigated that darkness; high speed differentials; high speed limits; grades, especially when they are wet; being in a car struck to the rear (as opposed to being in a car striking a truck to the rear); driving while drunk; and being female are the variables that increase passenger vehicle occupant injury severity. They also found that cars being struck to the rear with high speed differentials and car rollovers are significantly vulnerable. They also indentified variables associated with reduced severity levels and those were snowy or icy roads, congested roads, being in a station wagon struck to the rear (as opposed to a sedan), and using a child restraint. Khattak et al. (2002) reported that alcohol consumption, horizontal curves, higher speed limits, overturning, striking fixed object, accident in rural areas are the factors , which are causing higher level of severity to the older drivers. They also found that crashes involving farm vehicles resulted in significantly higher injury levels as compared with other types of vehicles. They identified that injury level were low on city streets as compared with other classes of road way.

IV. METHODOLOGY

Primary objective of this study is to develop a statistical model that identify the factors that are resulting higher crash severity. Here crash severity is dependent variable and independent variables are those factors affecting crash severity. So selection of an appropriate statistical model that correlates crash severity and factors affecting crash severity in better way was most important step in model development process.

Model Setup

To calibrate the accident severity model, data based on reported accidents in the period from 2013 to 2015 were used

in the study. During this period, there were no of accidents
In the proposed ordered probit model, the dependent variable used is accident severity which may take on one of three values based on the recorded degree of injury involved, viz, fatal, seriously injured and slightly injured. The accident is classified based on the worst condition sustained among the casualties. In the RangaReddy district accident reporting system, a casualty is considered fatal if the person is killed within 30 days of the accident. A seriously-injured casualty is one who had suffered some kind of fracture, concussion, internal lesions, crushing, severe cuts and laceration or severe general shock requiring hospitalization or other forms of bodily pain requiring at least 7 days of medical leave. A person is considered to be slightly injured if the victim had suffered from other forms of injury requiring conveyance from the accident scene to hospital by an ambulance or otherwise, the medical treatment requires medical leave of at least 3 days.

To develop the model for the respective studies of all crash model it is necessary to pre-select various factors consisting of victim, vehicle, crash, road, pedestrian and environmental characteristics that could be reasonably expected to influence accident severity. One way of sorting out these factors is to deliberate upon similar research works where those factors have been used. Also some factors selected are thought to have influence on accident severity in RangaReddy district condition.

Several factors were dropped after correlation test between variables. For example, type of road and speed limit were found strongly correlated. The type of road was a better indicator in predicting injury severity than speed limit; therefore type of road was kept in the model. Some other factors were also excluded because they are found to be statistically insignificant. These include the day of week, gender of driver, surveillance camera, race of driver, central business district area, electronic road pricing hours if in central business district area, area of occurrence and make of vehicle. Eventually 49 variables from 13 factors are retained in the final model. . It is noted that a majority of these variables are categorical dummy in nature shows the existence of effect. the independent variables are organized into 5 groups

- General characteristics,
- Vehicle characteristics,
- Road characteristics,
- Driver characteristics and
- Crash characteristics.

Ordered response models recognize the indexed nature of various response variables; in this application, driver injury severities are the ordered response. Underlying the indexing in such models is a latent but continuous descriptor of the response. In an ordered probit model, the random error associated with this continuous descriptor is assumed to follow a normal distribution. In many studies on severity of accidents, discrete models have been used to identify factors affecting the severity.

In contrast to ordered response models, multinomial logit and probit models neglect the data's ordinality, require estimation of more parameters (in the case of three or more alternatives, thus reducing the degrees of freedom available for estimation), and are associated with undesirable properties, such as the independence of irrelevant alternatives (IIA, in the case of a multinomial logit (Ben-Akiva and Lerman, 1985)) or lack of a closed-form likelihood (in the case of a multinomial probit (Greene, 2000)). The ordered probit can be estimated via several commercially available software packages and is theoretically superior to most other models for the data analyzed in this work.
The general specification of each single equation model is:
$Y_n^* = \beta' x_n + \varepsilon_n$,
Where, Y_n^* is the latent and continuous measure of injury severity faced by the accident victim 'n' in a crash, x_n is a vector of explanatory variables measuring the attributes of accident victim.β' is vector of parameters to be estimated, and ε_n is a random error term which assumed to follow a standard normal distribution with mean zero and variance one. The observed and coded discrete injury severity variable, Y_n, is determined from the model as follows:

V. ANALYSIS AND RESULTS

5.1 Introduction

Vanastalipuram division. Three years i.e. 2013-2015 data is collected is collected from Hayathnagar Police Station. The clear data is noted from the Police FIR sheets. Data is separated in to seven categories.

5.2 Total Accidents in Hayathnagar during 2013-2015 Month Wise

Table 5.1 Total Accidents in Hayathnagar Month Wise

Total Accidents in Hayathnagar				
Month wise				
Month	**Fatal Accidents**	**Non-Fatal Accidents**	**Vehicle Damaged Accidents**	**Total Accidents**
January	18	40	3	61
February	18	33	3	54
March	13	42	3	58
April	20	30	3	53
May	23	32	6	61
June	16	43	4	63
July	17	31	4	52
August	14	33	4	51
September	15	29	4	48
October	13	32	0	45
November	14	38	1	53
December	13	38	4	55
Grand Total	**194**	**421**	**39**	**654**

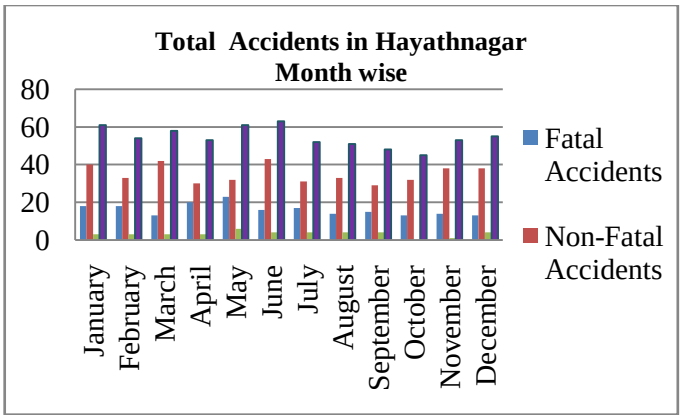

Fig 5.1: No. of Accidents Occurred in Hayathnagar Month Wise

VI. CONCLUSIONS

A safe and efficient transportation system is the primary measure of the quality of service provided by the system. Provision of safe and efficient transportation system is the responsibility of traffic and transportation engineers. The study presented in this thesis work provides methodological as well as empirical knowledge on the effect of several factors affecting crash injury severity. The development of such statistical model helps to gauge the performance of system providing traffic safety professional with information needed for efficient planning and improvement programs as well as strengthening enforcement programs. The primary objective of this study was to identify the factors that are contributing to higher injury severity levels. In order to achieve this objective, various factors such as, seasonal variation, weekly variation, hourly variation, type of vehicle involved in crash, crash location, type of collision, and victim gender have been investigated to find how they influence crash injury severity. Three distinct statistical model, namely all crash model, truck involved crash model, and pedestrian involved crash model have been developed. In order to identify the factors that affect crash injury severity a suitable methodology has been followed. The methodology includes data collection, selection and development of all three models and interpretation of the model findings. Statistical model selected for development of all three cases is ordered probit regression methodology. Recommendations to take precautionary measures for enhancement of traffic safety on national highways are also discussed. Finally future scope of the study is discussed

6.1 Discussions and Recommendation

In this model the developed study on crashes occurring in night, are resulting higher level of crash severity. Particularly accidents occurring between midnight to early morning hours are more sensitive to higher level of crash severity. This may be due to poor illumination and absence of warning measures such as retro-reflective signs which helps in roadway hazard identification. Hence to avoid such crashes proper illumination in night hours on highways along with retro-reflective materials is strongly recommended. For this purpose installation of solar lights may be very effective.

Pedestrians, bicycles, motorcycle and auto-rickshaws are facing higher crash severity. This is mainly because of the discontinuous service roads leading to wrong side movement of traffic in order to avoid long detours. Hence it is logical to provide separate service lane for local traffics. There is lack of proper facilities for vulnerable road users to cross highway forcing them midblock crossing. Therefore, infrastructure and planning such as additional side walk and cross walks that would act to separate vulnerable road users are needed. Educational programs to encourage riders to use helmet will be very effective and is highly recommended.

In accused vehicle categories trucks are resulting higher crash severity. Most of trucks on highways are overloaded and old and also there is absence of safety features in trucks. Also, a high percentage of these vehicle fleets are old, thus improperly maintained and lack safety features such as antilock braking. The crashworthiness of these vehicles is also low. In addition, they are hard to locate at night since they have neither tail lights nor reflective tapes. As a result, they are highly involved in crashes and the chance of survival of the truck users is also very low. Therefore developing stronger enforcement strategies and education programs in order to remove overloading and to improve the safety features in truck is strongly recommended and could only be done through government policies. Hit and run type of crashes is also resulting in higher level of crash severity. There is no remedy for hit and run type of crashes except enforcement and stringent punishment.

Overturning crashes are also resulting higher crash severity. To take care of overturning crashes pavement distress such as potholes and rutting should be removed. Also median openings and turning radius are to be re-designed for better safety..

6.2 Future Scope of Study

This study has a lot of scope for prevention of road accidents in the future. In this study was limited for two areas only but following same kind of work for remaining areas to reduce accidents rate in Cyberabad and Hyderabad.

This kind of study is suitable for any city in India.

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