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Road accidents prediction modeling at intersections

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Abstract-

The issue of road accidents is an increasing problem in developing countries. This could be due to increasing road traffic/vehicle occupancy. This has been increasing over years. Regulating traffic on roads is an important task. There by reducing accidents in accident prone zones. The accident was drastically increased over a decade from 4% to 31%. This is a alarming issue. The analysis and identification of such road accident prone zones is essential to reduce the accidents. A model was developed based on intersection parameters and no. of accidents by regression analysis.

Index Terms- intersection parameters; major traffic; minor traffic; correlation coefficient; regression analysis; regression model

INTRODUCTION

The issue of road accidents is an increasing problem in developing countries. This could be due to increasing road traffic/vehicle occupancy. This has been increasing over years. Regulating traffic on roads is an important task. There by reducing accidents in accident prone zones. The accident was drastically increased over a decade from 4% to 31%. This is a alarming issue. The analysis and identification of such road accident prone zones is essential to reduce the accidents. The factors influencing such accidents are to be analyses for remedies. Using regression Models, factors influencing road accidents have analyzed using SPSS model. The study area selected is part of Hyderabad. Telangana (GHMC) with heavy traffic.The objective of the paper is to review relation between accident per year and intersection Parameters. To develop prediction models and test their validity. To suggest improvement measures to prevent road accidents and to derive a model for accident parameters.

Factors responsible for road accidents: The paper considers Identifying factors influencing road accidents, identifying intersection parameters and collection of data. Using statistical methods, regression models have to be developed Factors influencing road accidents: These can be grouped into following. 1. Vehicle related factors: this may be due to inherent design limitations or defects to lack of maintenance, failure of components like brakes, tires and lighting. Visibility, speed and vehicle lighting are also important. 2. Road related factors: this includes pavement design and conditions, horizontal curves, insufficient lane and shoulder width, vertical curves. 3. Road user related factors : psychological factors of the users, alertness and intelligence, patience of driver, drivers experience and age 4. Environmental related factors: rain, reduced visibility, bad weather etc. heavy fog and mist and heavy rain also plays important role. Analysis considerations: 1. A data of 1-3 year was considered for moderate to heavy Traffic locations 2. Segments of minimum 0.15 km in region of accident prone locations were taken for analysis. Methods for identifying high accident locations: a) Spot map method: simplest way is to examine accident spot

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map which gives spots of max no. of accidents. b) Accident frequency method: it is based on accidents frequency; locations are classified from high to low accident areas. c) Accident rate method it is comparing no. of accidents at location with no. of vehicles travel resulting accident rate.

ACCIDENT PREDICTION MODELING TECHNIQUES

Multiple Linear Regression Model

Y be the number of accidents per year as dependent variable and X_1, X_2 and X_3 are the independent variables representing the traffic volume(AADT), length of the segment (km) and number of median openings per km respectively. Then the Multi Linear Regression model is in the form as follows

$$Y = D + AX_1 + BX_2 + CX_3 \quad (2.1)$$

Where,

A,B,C = coefficients or proportions of the independent variables

D = model constant

Multiple Linear Regression model has various shortcomings to use for predicting the number of accident. First, dependent variables are assumed to follow normal distribution in this model, but the number of accident is not so. And it is assumed that there is no relation between error and independent variable, but this assumption is not always true in case of accident in actuality. In addition, this model can deduce the negative number that could not appear as the number of accident. Moreover, when accident did not happen in any spot, this method always predicts zero as the number of accident, and this result strains the truth that zero number means that spot absolutely safe.

Neumann and Glenn on (1982) described a theoretical model that relates accident on crest curves to available sight distance. The development of this model was not based on accident data, rather the model relied on intuitively logical relationship and engineering judgment. Highway designers to systematically evaluate the cost effectiveness spot improvement of location with deficient SSD's can use the model. The model is as follows:

$$N = ARH(L)(V) + ARh\,(Lr)(V)(F_{ar})$$

Where, N = Number of accident on a segment of highways containing a crest curve. ARH = Average accident rate for specific highways L = Length of highway segment in miles. V = Traffic volumes in millions of vehicles. L = Length of restricted sight distance in miles Far = A hypothetical accident rate factor that varies according to both the severity of the sight restriction and the nature of the hidden hazard

Glen on (1983) developed model in the basis of the available literature, sufficient evidence appears to indicate that in general, horizontal curves experience higher accident rates than tangents and that accident rates and that accidents are generally increase as a function of increasing degree of curvature. Glen on horizontal Curve Model reported in the FHWA report accident relationship is presented below:

$$A = AR_S\,(L)\,(V) + 0.0336(D)\,(V)$$

Where, A = total number of accidents on the segment ARs = accident rate on comparable

straight segment in accident L = length of highway segment in miles V = Traffic volume in millions of vehicles D = curvature in degrees Lc = length of curved component in miles

Luis F. Miranda-Moreno et al (2005) developed Alternative Risk Models for Ranking Locations for Safety Improvement. The authors compared the performance and practical implications of these models and ranking criteria when they are used for identifying hazardous locations. This research investigates the relative performance of three alternative models: the traditional negative binomial model, the heterogeneous negative binomial model, and the Poisson lognormal model. In particular, this work focuses on the impact of the choice of two alternative prior distributions (i.e., gamma versus lognormal) and the effect of allowing variability in the dispersion parameter on the outcome of the analysis. Henry **C. Brown et al (2006)** considered the effects of access control on safety on urban arterial streets. Access control techniques are used to improve traffic performance and safety on highways. One important benefits of access control is improved safety. For a quantitative assessment of the benefits of access control on safety, impact models are needed to predict crash frequencies based on the geometric and access control characteristics of the segments. The objective of this research was to develop regression models to predict crash frequencies on urban multilane arterial segments. To develop these models, data were collected on geometric and access control characteristics of the segments and the number of crashes on the segment by severity type. Negative binomial regression models were developed to predict the total number of crashes, number of property-damage0only crashes, and number of fatal and injury crashes.

SUMMARY

The phenomenal growth of road transport has brought along with it the serious problem of traffic accidents. There has been an increasing trend in the number of road accidents as well as casualties from year to year. The present study is mainly intended to determine the effect of intersections parameters and traffic parameters on the road accidents. Field visits have been made to select the variables which influence the accidents mostly at the intersections. Suitable models have been developed by the software package for the available data. An attempt has been made to develop Poison regression model for accidents to intersection parameters.

Conclusions: Relation between accidents/year and various intersection parameters were found and a model was developed from regression analysis. As number of intersections increase, accident rate increases, major traffic, unpaved shoulder, speed and turning radius have positive relation with accident rate. Minor traffic shows negative relation with accident rate.

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