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Modeling of Road Accident in Rajasthan

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ABSTRACT

Road accidents have developed into a major threat to the world population and even more for developing countries which are tackling with the high rate of growth of their vehicles on the road. As per world health organization (WHO), more than 20 million people die or get severely injured due to road accidents every year. At a time, road accidents take toll on the lives of the people in small number but on a whole, it is far more life threatening than some of the worst diseases that mankind has faced till now. Victims of road accidents are not only affected at a physical level but also at mental level and their family members are also considered the victims who have also been disturbed by the condition of their loved ones. Developing country like India is also facing the same threat and with the growth in population and number of vehicles at a fast paced level, it has caused physical and mental sufferings as well as huge economic losses to the country. This present paper deals with the development of road accident models for Rajasthan. This model is developed using multiple linear regression analysis based on the road accident data of Rajasthan. With the help of developed model, we can predict the number of road accidents, fatalities and injuries for the state of Rajasthan.

Keywords: Road accidents; Sufferings; Rajasthan; Multiple linear regressions

INTRODUCTION

Rajasthan is the largest state of India in terms of area. It is among under top five states with maximum road accidental deaths. It has over one 1.23-Crore registered vehicles and about 7.479-Crore of population. Rajasthan has 38 National Highways with total length of 8016 km and 85 State Highways with total length of 11,716 km.

A Report was published in International Journal of Research in Management and Technology exclaiming that 70 percent of fatalities in Road acc idents occur in India due to alcohol consumption. Rajasthan is among under top five states with maximum rood accidental deaths. So a need was realized to form a Road Accident model for Rajasthan that can help in predicting the Road accident, deaths and injuries for the state.

LITERATURE REVIEW

Singh and Suman (2001) studied accident and prediction model for National Highway-77. It focuses on effect of traffic volume on accident rate and developed road accident model using AADT (Annual Average Daily Traffic). Output of this model showed that number of accidents increases with AADT.

Valli (2004) developed road accident models for large metropolitan cities of India. Conclusion brought out from this paper is that there is a need for major policy development to decrease the growth rate of personalized vehicles and encouraging the use of public transport vehicles.

Desai and Patel (2011) analyzed road accident data and developed model for Ahmadabad city using Regression analysis. It used number of road accidents as dependent variable and traffic volume as independent variable.

Singh and Mishra (2004) conducted road accident analysis for Patna city. Output of this model showed that the main causes of road accidents in Patna city are encroachment and congestion.

METHODOLOGY

The study aims at conducting the road accident analysis of Rajasthan. With this objective, in view data for road accidents in Rajasthan for past few years were collected. Road accident model is developed after analysis of data and particular causes of road accidents are find out.

Data Collection and Analysis

The road accident data is collected for the state of Rajasthan. Collected data include number of accidents, population, and number of vehicles, fatalities and number of injuries. Accident data is obtained from various sites and Ministry of Road transport and Highways as well as from police records. The data obtained is tabulated in Table l.

Table I: Vehicle, population and accident data for Rajasthan

S. No.	Year	Total number of road accident	Total Fatalities	Injuries	Number of registered motor vehicles (X1)	Total population (X2)
1	2002	22,672	5,995	27,689	28,52,856	5,76,87,913
2	2003	22,770	6,503	28,990	34,44,952	5,89,02,704
3	2004	22,890	6,234	28,756	40,37,048	6,01,17,495
4	2005	23,115	6,793	29,986	46,29,144	6,13,32,286
5	2006	23,348	7,154	29,794	52,06,269	6,25,47,077
6	2007	23,885	8,143	31,155	57,72,480	6,37,61,868
7	2008	23,704	8,388	30,857	63,51,744	6,49,76,659
8	2009	25,114	9,045	32,317	69,97,531	6,61,91,450
9	2010	24,302	9,163	31,033	77,87,493	6,74,06,241
10	2011	23,245	9,232	28,666	87,33,560	6,86,21,012
11	2012	22,969	9,528	28,135	98,03,283	6,98,31,012
12	2013	23,592	9,724	27,424	1,09,15,452	7,10,41,283
13	2014	24,628	10,289	27,453	1,21,02,223	7,23,07,157
14	2015	24,072	10,510	26,153		7,35,29,325
15	2016	23,066	10,465	24,103		7,47,91,568

A total of 15 years data from 2002- 2016 was available. Out of this, 9 years data has been used for the development of models using multiple linear regression analysis. Data of 4 years has been used for the validation of the developed models. The models have been developed using Excel package of MS Office 2013.

Model for Number of Accidents

Model is developed for road accidents of Rajasthan using data of year 2002-2007and 2012-2014 whereas the data for the year 2008-2011 will be used for the validation of model. Table 2 shows the model developed for number of road accidents for Rajasthan.

The validation of the model has been done and results are shown in Table 3 resulting in percentage difference between actual and predicted values within the range of -486%-3.10%. It points out that the accident model is able to predict the values with good accuracy. Table 3 shows data form validation of model for number of accidents for Rajasthan.

Table 2: Model developed for number of road accidents for Rajasthan

Dependent variable	Independent variable	Model	R2	Adjusted R2	F significance	T-sat
Number of accidents	X1= No. of registered vehicles X2= population	Y= -0.00053 x1 +0.000417 x2	0.99	0.85	$3.73*10^{-11}$	-8.32 57.81

Table 3: Data for validation of model for number of accidents for Rajasthan

Sr.No.	Year	Actual no. of accident	Predicted number of accidents	Percentage error
1	2008	23704	23728	0.10
2	2009	25114	23893	-4.86
3	2010	24302	23981	-1.30
4	2011	23245	23986	3.10

The depicted equation *Y= -0,00053X+0.000417X2* can be used for future prediction of total number of road accidents in Rajasthan with the help of variables i.e. XI number of registered motor vehicles in Rajasthan, X2 = population in Rajasthan. Here Y represents number of road accidents in Rajasthan.

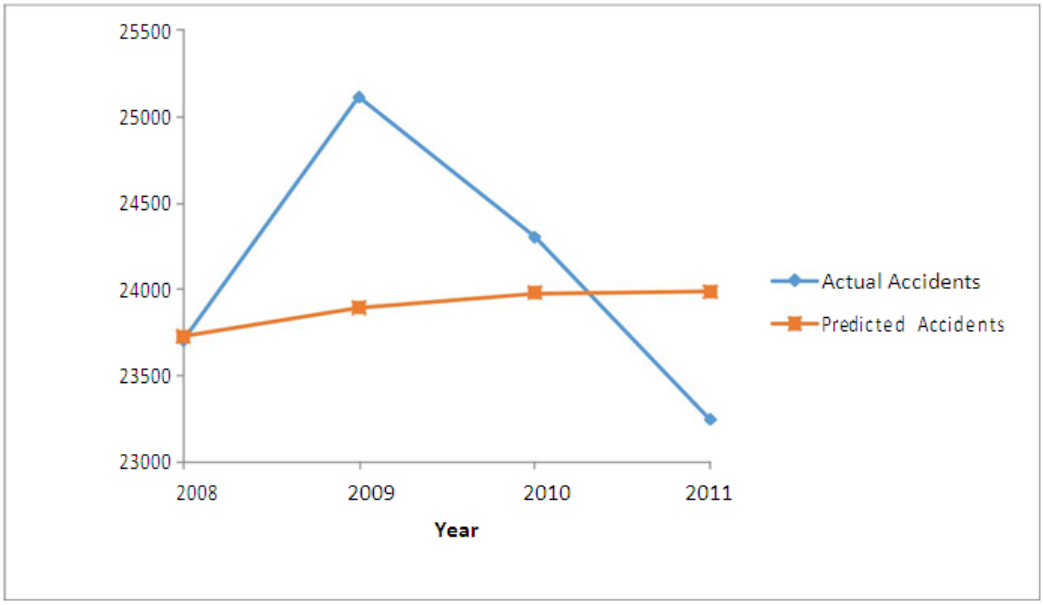

Figure I: Variation of actual and predicted accidents with year

Model for Number of Fatalities

Model is developed for number of fatalities for the state of Rajasthan using data of the year 2002 -2007 and 2012-2014 whereas the data for the year 2008-2011 will be used for the validation of model. Table 4 shows the model developed for number of fatalities for the state of Rajasthan.

Table 4: Model developed for number of fatalities due to road accidents in Rajasthan

Dependent variable	Independent variable	Model	R2	Adjusted R2	F significance	T-sat
Fatalities	X1= No. of registered vehicles X2= population	Y= 0.000327X1+00000885x2	0.99	0.85	$8.84\ E^{-10}$	8.88 21.18

The validation of the model has been done and results are shown in Table 5 resulting in percentage difference between Actual and Predicted values within the range of -3.20 % to - 9.93%. It points out that the fatality model is able to predict the values with good accuracy Table 5 shows the data for validation of model for number of fatalities due to road accidents for Rajasthan.

Table 5: Data for validation of model for number of fatalities due to road accident for Rajasthan

S. No.	Year	Actual no. of fatalities	Predicted number of fatalities	Percentage error
1	2008	8388	7828	-6.60
2	2009	9045	8146	-9.93
3	2010	9163	8511	-7.11
4	2011	9232	8929	-3.20

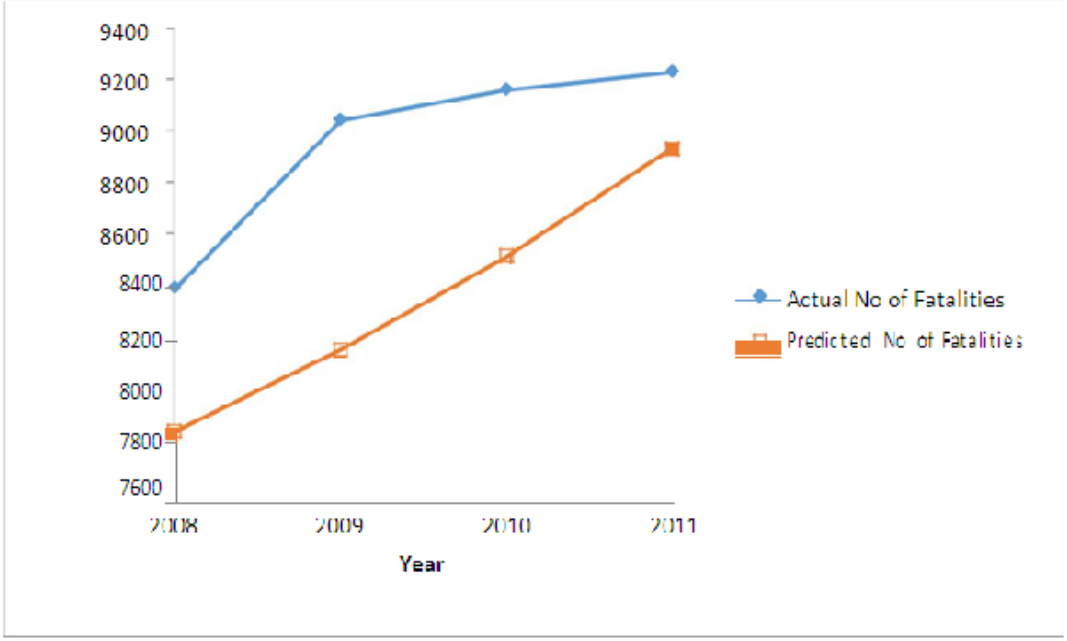

Figure 2: Variation of actual and predicted fatalities with year

The depicted equation Y- 0.000327X1+00000885x2, can be used for future prediction of total number of fatalities due to road accidents in Rajasthan with the help of variables i.e. X1- number of registered motor vehicles in Rajasthan, X2 population in Rajasthan. Here Y represents number of fatalities due to road accidents in Rajasthan.

Model for Number of Injuries

Model is developed for number of injuries cue to road accidents for the state of Rajasthan using data of the year 2002 -2007 and 2012-2014 whereas the data for the year 2008- 2011 will because for the validation of model. Table 6 shows the model developed for number of injuries for the state of Rajasthan.

Table 6: Model for number of injuries due to road accidents for Rajasthan

Dependent variable	Independent variable	Model	R2	Adjusted R2	F significance	T-sat
Number of injuries	X1= No. of registered vehicles X2= population	Y= 0.00107X1 + 000558X2	0.99	0.85	-4.24 E^{-10}	-9.03 41.67

The validation of the model has been done and results are shown in Table 7 resulting in percentage difference between actual and predicted values within the range of-0.97% to .8.87%. It points out that the injury model is able to predict the values with good accuracy

Table 7: Data for validation of the model for number of injuries due to road accidents for Rajasthan

S.No.	Year	Actual no. of injuries	Predicted number of injuries	Percentage error
1	2008	30857	39501	-4.52
2	2009	32317	37910	-8.87
3	2010	31033	35681	-5.64
4	2011	28666	32763	-0.97

The depicted equation Y·0.00107X1 + 000558X2 can be used for future prediction of total number of injuries due to road accidents in Rajasthan with the help of variables i.e. X1 –number of registered motor vehicles in Rajasthan, x2-population in Rajasthan. Here Y represents number of injuries due to road accidents in Rajasthan.

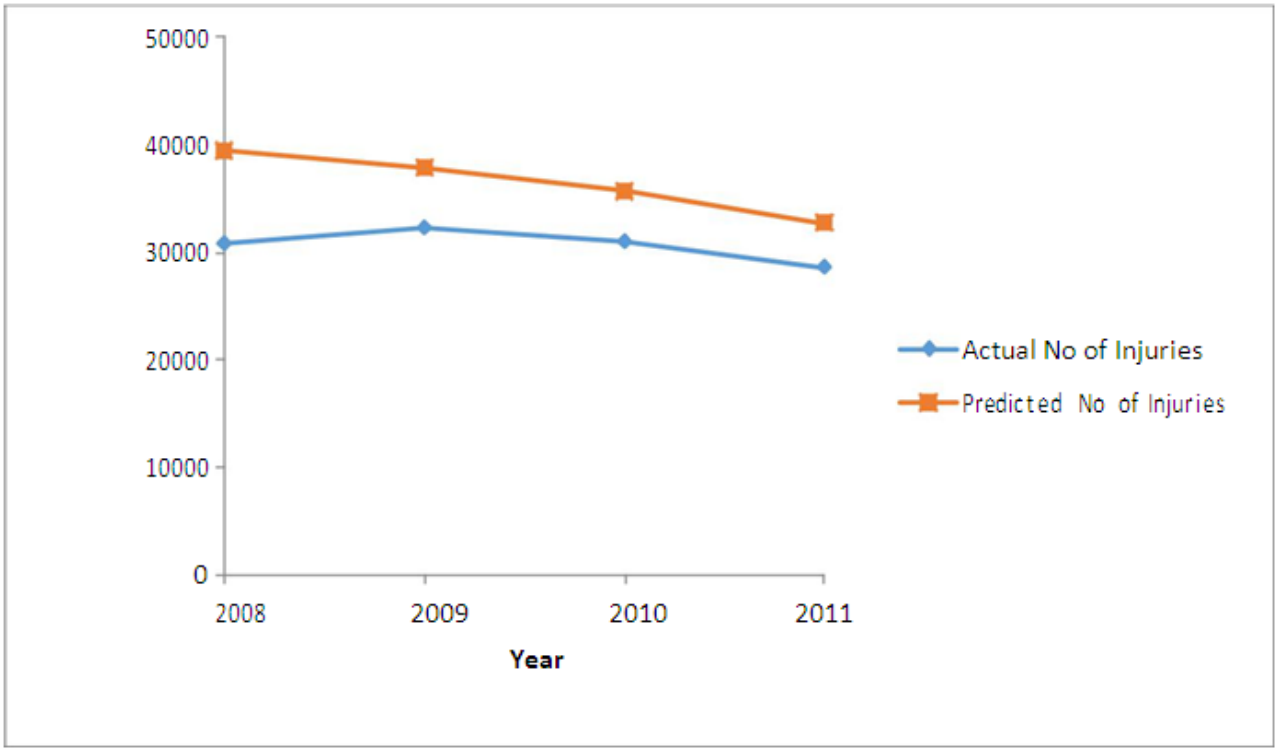

Figure 3: Variation of actual and predicted injuries with year

CONCLUSION

Road accident model developed has been prepared for prediction of number of road accidents, number of accidental deaths and number of accidental injuries for Rajasthan using multiple linear regression models. Road accident models for number of fatalities give an error of 3.20 to-9.93 percent. It provides good results which can be used for the estimation of future. Road accidents and injuries give a maximum error of-9.93 % showing that the accident and injury model is a good model. From regression analysis it is seen that F significance value for all three models is less than 0.05 which gives us idea about good correlation between dependent and independent variables. T-stat values were higher than t-critical value of 2.57 which shows usefulness of both the independent variables in predicting the number of dependent va riable. In Rajasthan, Jodhpur district has become one of the most dangerous districts for driving in ten road accidents in India. The district is ranked fifth in the country, in terms of number of people dying per 100 accidents. A total of 526 accidents were reported that claimed 264 lives and left

525 injured. What's ironic is that these accidents are taking place at a time when the state government is spending rupee 3000 crore every year for road maintenance and development. With nearly 26 people being killed nearly every day in the state the effective utilization of funds remains under cloud.

Other than that fault of pedestrian, fault of mechanical defect, bad weather, bad roads were minor reasons for road accidents in Rajasthan. Fault of driver mainly constitute substance abuse so it calls for stricter laws against drunk driving and creating awareness in society on safe driving Other than that common reasons are overtaking from wrong side, not maintaining speed limit, no following road signs and signals The cause of accident is within us. It is not totally about the infrastructure. It's high time we introduce a penalty on rash driving by cancellation of license

For further work in this, more independent variables can be used for modeling.

SCOPE FOR FUTURE STUDY

The present work 'Road accident model for Rajasthan' has been carried out to develop road accident model for the state of Rajasthan to find out level of safety of the roads of the state. This study has the scope for further research as given under:

- **The study has used data for the past 15 years i.e. 2002-2016. It is experienced that more data may be used for the organization of this study for better output.**
- **The present study used regression analysis for model development. Model development can be**
- **conducted using ANN (Artificial Neutral Network) and negative binomial regression analysis as well.**
- **More independent variables such as length of the roads, density of state can be incorporated in the model.**

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