

Analysis & Prediction of Road Accident Data for Indian States

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Abstract

This paper studies Linear trend mathematical model which is based on time series for forecasting of no. of road accidents in Indian states. Forecasting is done for five segments as total no. of accidents, total no. of people injured, total no. people killed, total no. of people killed on National highways and total no. of people killed on State highways. Analysis and forecasting are done for Uttar Pradesh, Tamil Nadu, Maharashtra, Karnataka, Rajasthan. This model is state variant and forecasts the accident data for the year 2017, 2018, 2019, 2020 (Data for 2017 is not available till date). The data taken for modeling is from the year 2012 to 2016.

Keywords: Road accident, accident forecasting, trend analysis, Road accidents in Indian states

INTRODUCTION

Road accidents are negatively related to urbanization, motorization, and expansion with road length. Now a day, Road accidents are recognized worldwide as a major problem for people health. Road accidents are one of the main reasons for deaths and disabilities. This imposes the huge socio-economic cost. In India, road accidents are one of the most important causes of death and health loss. This is more among the person of age group 15 to 49 years.

During last data available (2016), the total no. of reported accident data is 4,80,652, in which 1,36,071, are fatal accidents and 1,50,785 people are killed. If we compare this from the year 2015, The no. of road accidents and total no. of people injured are decreased by 4.1% and 1.1% respectively, but the no. of person killed in road accidents are increased by 3.2%. Table 1 shows total no. of road accidents, severity index and percentage change in road accidents over previous year.

Table 1: Road accident parameters 2015 & 2016

Parameter	2016	2015	% Change over year
Total Accidents in the country	4,80,652	5,01,423	-4.1
Total number of Persons Killed in the country	1,50,785	1,46,133	3.2
Total number of Persons Injured in the country	4,94,624	5,00,279	-1.1
Accident Severity (No. of persons killed per 100 accidents)	31.4	29.1	7.9

In statewise comparison, top three states in road accidents in 2016 are Tamil Nadu, Madhya Pradesh, Karnataka. Tamil Nadu has 14.9% share in total no. of road accidents, while Madhya Pradesh has 11.2% and Karnataka has 9.2 % share.

In total no. of person killed category, top three states are Uttar Pradesh, Tamil Nadu, Maharashtra. Uttar Pradesh has 12.8% share in total no. of person killed while Tamil Nadu has 11.4% and Maharashtra has 8.6 % share.

In total no. of person injured category, top three states are Tamil Nadu, Madhya Pradesh, Karnataka. Tamil Nadu has a share of 16.6% in total no. of person injured while Madhya Pradesh has 11.7 % and Karnataka has 11.0% share.

Table 2 shows the inter state comparison among thirteen Indian states based on total no. of road accidents in 2015 & 2016.

Table 2: Inter-state comparison for total no. of road accidents

	2016		2015
	Percentage Share	Number of Road Accidents	Number of Road Accidents
Share of 13 States	86.5	415734	4.4814
Tamil Nadu	14.9	71431	69059
Madhya Pradesh	11.2	53972	54947
Karnataka	9.2	44403	44011
Maharashtra	8.3	39878	63805
Kerala	8.2	39420	39014
Uttar Pradesh	7.4	35612	32385
Andhra Pradesh	5.2	24888	24258
Rajasthan	4.8	23066	24072
Telangana	4.7	22811	21252
Gujrat	4.5	21859	23183
Chhattisgarh	2.8	13580	14446
West Bengal	2.8	13580	13208
Haryana	2.3	11234	11174

MODEL DESCRIPTION

For the analysis and forecasting of road accident linear trend mathematical models are used. To develop this mathematical model, road accident data from year 2012 to year 2016 is collected from internet sources and other government agencies. The moving average of data is calculated to generate trend line. Then seasonal and irregular components (S_t , I_t respectively) are calculated. Then data is deseasonalize (No. of road accident with respect to State / Seasonal component) for regression

analysis. After regression analysis, with the help of intercept trend equation is generated. With the help of this trend equation, forecasting is done for next two years.

ANALYSIS & FORECASTING

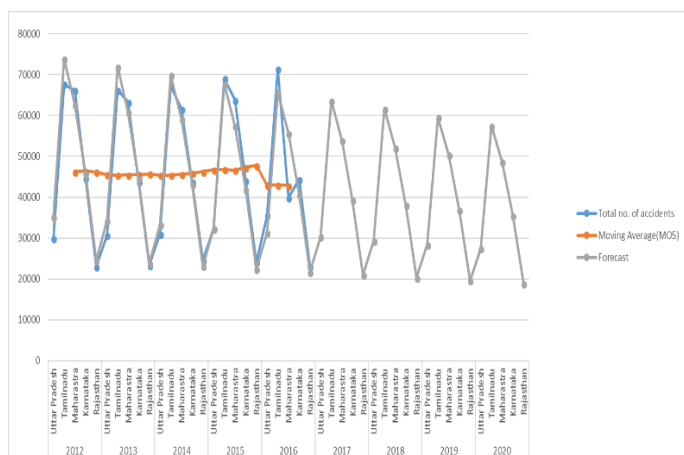
The study is done for five categories and each for five Indian states. Categories are listed below:

- Total no. of road accidents
- Total no. of people injured in road accidents
- Total no. of people killed in road accidents
- Total no. of people killed in road accidents happened on National highways
- Total no. of people killed in road accidents happened on State highways

A. Analysis & Forecasting for Total no. of road accidents:
 The collected data is shown in table 3.

Table 3: Total no. of road accidents for year 2012 to 2016

S.N.	States/Year	2012	2013	2014	2015	2016
1	Uttar Pradesh	29913	30683	31034	32385	35612
2	Tamil Nadu	67672	66238	67250	69059	71431
3	Maharashtra	66201	63315	61627	63805	39878
4	Karnataka	44624	43844	43713	44011	44403
5	Rajasthan	23048	23378	24628	24072	23066



Graph 1: Analysis and forecasting for total no. of road accidents

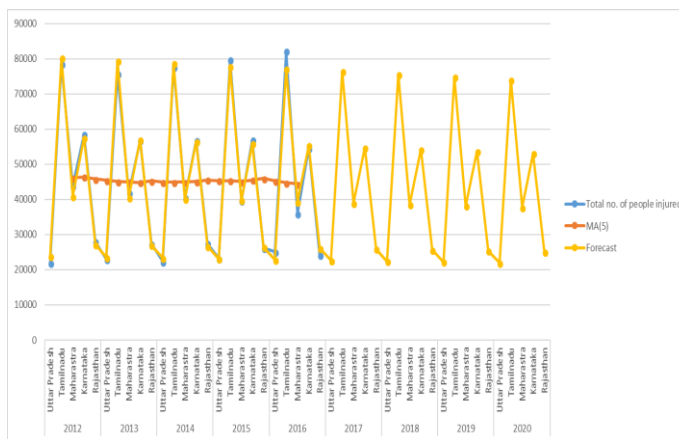
From regression analysis, the linear trend equation for total no. of accident is ,

$$\text{Total no. of accident} = 49239.56 - 270.79 t$$

B. Analysis & Forecasting for Total no. of people injured in road accidents: The collected data is shown in table 4.

Table 4: Total no. of people injured in road accidents for year 2012 to 2016

S.N.	States/Year	2012	2013	2014	2015	2016
1	Uttar Pradesh	21915	23024	22337	23205	25096
2	Tamil Nadu	78488	75681	77725	79746	82163
3	Maharashtra	43831	41972	40455	39606	35884
4	Karnataka	58611	56781	56831	56971	54556
5	Rajasthan	28031	27424	27453	26153	24103



Graph 2: Analysis and forecasting for total no. people injured in road accidents

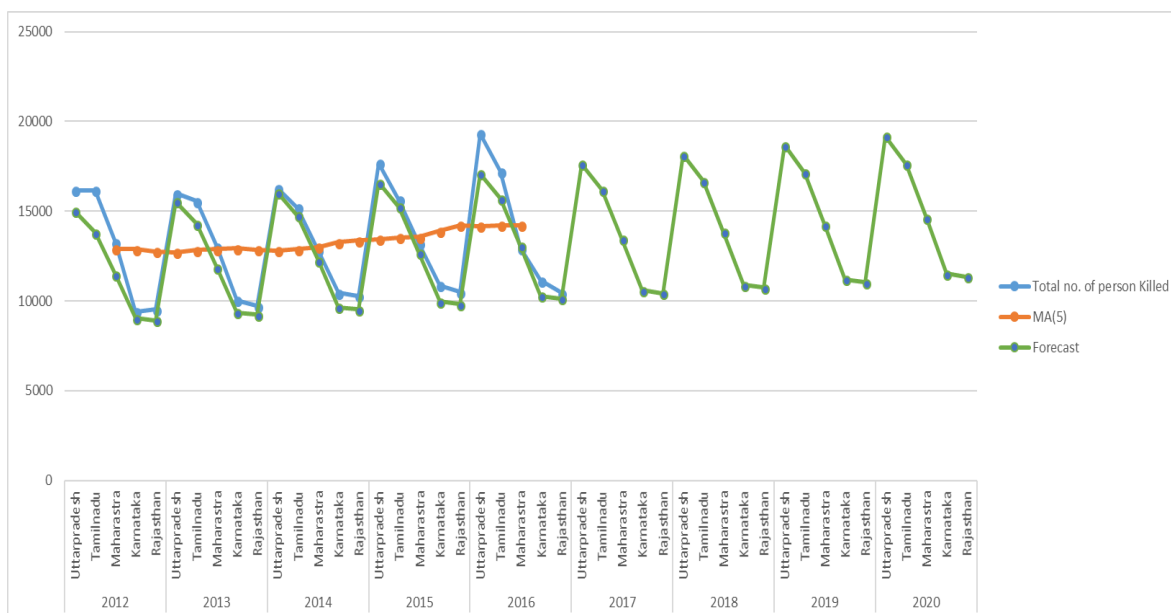
From regression analysis, the linear trend equation for total no. of people injured is,

$$\text{Total no. of people injured} = 46042.15 - 88.38 t$$

C. Analysis & Forecasting for Total no. of people killed in road accidents: The collected data is shown in table 5.

Table 5: Total no. of people killed in road accidents for year 2012 to 2016

S.N.	States/Year	2012	2013	2014	2015	2016
1	Uttar Pradesh	16176	16004	16287	17666	19320
2	Tamil Nadu	16176	15563	15190	15642	17218
3	Maharashtra	13272	13029	12803	13212	12935
4	Karnataka	9401	10046	10452	10856	11133
5	Rajasthan	9539	9724	10289	10510	10465



Graph 3: Analysis and forecasting for total no. people killed in road accidents

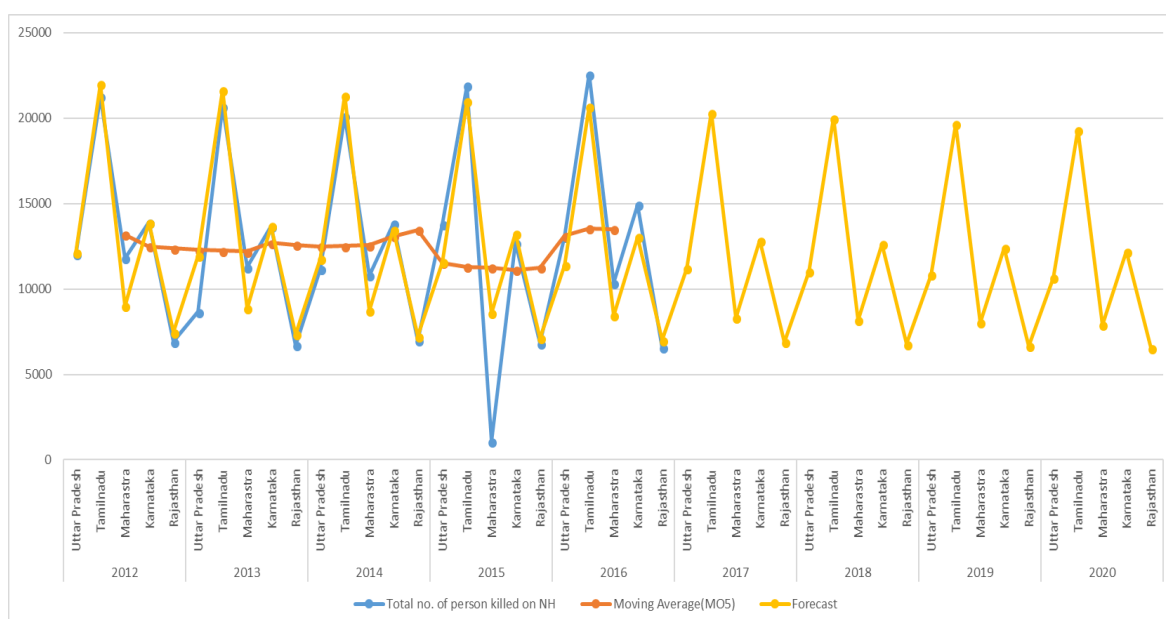
From regression analysis, the linear trend equation for total no. of people Killed is,

$$\text{Total no. of people Killed} = 11448.95 - 80.25 t$$

D. Analysis & Forecasting for Total no. of people killed in road accidents on National highways: The collected data is shown in table 6.

Table 6: Total no. of people killed in road accidents on National Highways for year 2012 to 2016

S.N.	States/Year	2012	2013	2014	2015	2016
1	Uttar Pradesh	12028	8652	11157	13802	13078
2	Tamil Nadu	21262	20686	20109	21902	22573
3	Maharashtra	11805	11289	10788	1083	10364
4	Karnataka	13898	13678	13827	12705	14933
5	Rajasthan	6916	6707	6991	6821	6567



Graph 4: Analysis and forecasting for total no. people killed in road accidents on National highways

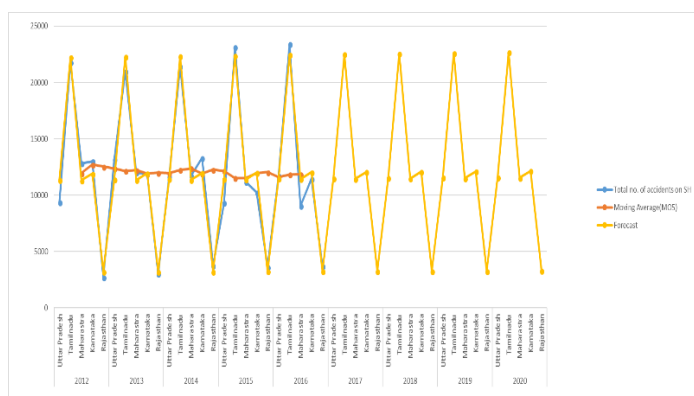
From regression analysis, the linear trend equation for total no. of people Killed on National Highways are :

$$\text{Total no. of people Killed} = 12832.17 - 38.80 t$$

E. Analysis & Forecasting for Total no. of people killed in road accidents on State highways: The collected data is shown in table 7.

Table 7: Total no. of people killed in road accidents on State highways for year 2012 to 2016

S.N.	States/Year	2012	2013	2014	2015	2016
1	Uttar Pradesh	9362	13196	11669	9320	11715
2	Tamil Nadu	21810	20984	21441	23165	23405
3	Maharashtra	12846	12029	11760	11184	9052
4	Karnataka	13012	11898	13308	10254	11462
5	Rajasthan	2723	3029	3774	3638	3695



Graph 5: Analysis and forecasting for total no. people killed in road accidents on State highways

From regression analysis, the linear trend equation for total no. of people Killed on State Highways are :

$$\text{Total no. of people Killed} = 11917.60 - 5.88 t$$

RESULT & DISCUSSIONS

From above study, following results are drawn:

- **Forecasting for total no. of accidents:** Forecasting for total no. of accidents for year 2017 & 2018 is given in table 8.

Table 8: Forecasting for total no. of accidents for year 2017 & 2018

Year/State	Uttar Pradesh	Tamil Nadu	Maharashtra	Karnataka	Rajasthan
2017	30358	63666	53897	39371	21030
2018	29384	61610	52145	38083	20338
2019	28410	59554	50393	36795	19645
2020	27436	57498	48641	35507	18953

- **Forecasting for total no. of people injured in accidents:** Forecasting for total no. of people injured in accidents for year 2017 & 2018 is given in table 9.

Table 9: Forecasting for total no. of people injured in accidents for year 2017 & 2018

Year/State	Uttar Pradesh	Tamil Nadu	Maharashtra	Karnataka	Rajasthan
2017	22632	76837	38937	54789	25916
2018	22403	75613	38542	54232	25652
2019	22174	74840	38147	53675	25388
2020	21946	74067	37752	53118	25124

- **Forecasting for total no. of people killed in accidents:** Forecasting for total no. of people injured in accidents for year 2017 & 2018 is given in table 10.

Table 10: Forecasting for total no. of people killed in accidents for year 2017 & 2018

Year/State	Uttar Pradesh	Tamil Nadu	Maharashtra	Karnataka	Rajasthan
2017	17623	16193	13443	10589	10436
2018	18145	16670	13837	10897	10739
2019	18667	17148	14231	11206	11041
2020	19190	17625	14624	11514	11343

- **Forecasting for total no. of people killed in accidents on National highways:** Forecasting for total no. of people injured in accidents for year 2017 & 2018 is given in table 11.

Table 11: Forecasting for total no. of people killed in accidents on National highways for year 2017 & 2018

Year/State	Uttar Pradesh	Tamil Nadu	Maharashtra	Karnataka	Rajasthan
2017	11212	20328	8321	12836	6891
2018	11028	19994	8183	12623	6776
2019	10844	19659	8047	12411	6662
2020	10660	19325	7909	12198	6547

- **Forecasting for total no. of people killed in accidents on State highways:** Forecasting for total no. of people injured in accidents for year 2017 & 2018 is given in table 12.

Table 12: Forecasting for total no. of people killed in accidents on State highways for year 2017 & 2018

Year/State	Uttar Pradesh	Tamil Nadu	Maharashtra	Karnataka	Rajasthan
2017	11517	22516	11459	12066	3262
2018	11545	22571	11487	12095	3270
2019	11574	22627	11515	12125	3278
2020	11602	22681	11543	12154	3286

CONCLUSION

From above results, following conclusions are drawn:

- 1) The total no. accidents are decreasing in every states except Maharashtra.

- 2) The total no. of person injured during road accidents are increasing in Maharashtra, Karnataka and Rajasthan. On the other hand, this is decreasing in Uttar Pradesh and Tamil Nadu.
 - 3) The total no. of person killed during road accidents are increasing in Maharashtra and Rajasthan for year 2018. On the other hand, this is decreasing in Uttar Pradesh, Tamil Nadu & Karnataka.
 - 4) The total no. of person killed on National highways during road accidents are increasing in Tamil Nadu and Rajasthan for year 2018. On the other hand, this is decreasing for Uttar Pradesh, Maharashtra and Karnataka.
 - 5) The total no. of person killed on State highways during road accidents are increasing in Maharashtra and Karnataka for year 2018. On the other hand, this is decreasing in Uttar Pradesh, Tamil Nadu & Rajasthan.
 - 6) Since Road accidents depends on three E's. This stands for Engineering, Education and Enforcement of law. So, each state have their own geography and their own rules & regulations. This study only shows trend analysis based on previous data.
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