Development of a Mathematical Model on Traffic Management for Major Junctions in Pune City

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Abstract— Traffic Congestion or traffic jams is one of the major issues in most metropolitan cities like Pune. This paper presents the development of mathematical model and traffic management for critical junctions in Pune city. In this research, correlation and regression model is developed by knowing the factors causing traffic congestion. Initially, traffic at various junctions at peak hours is counted and the factors causing congestion are found. These factors are then rated by the effect they have on congestion. Then, with the help of SPSS (Statistical Package for Social Sciences) Software by IBM, correlation and regression models are developed by taking these ratings as input; also calculating this data by the standard analytical method. We studied traffic at major junctions in Pune city and developed the relationship between the factors causing traffic congestion and then provided proper remedial solutions focused on the junctions taken into consideration.

Indexed Terms-- Congestion, correlation and regression models, remedial solutions.

I. INTRODUCTION

The transportation system is important in everyone's life. Traffic congestion is a major issue in our daily lives. There are several reasons for the sudden surge in the traffic, in many regions. The main reason can be defined as an increase in the population, which in turn has caused a rise in the number of vehicles on the road. Also, there are several other issues for traffic congestion like insufficient infrastructure, ineffective management of capacity (i.e. poor traffic timing), work zone, special events, emergencies, unconstraint demands etc. Representation of traffic flows is an essential adjunct to both urban and non-urban planning. Since they are important working tools for governments and consultants, traffic models have received a great deal of attention from academic and other analysts. Traffic flow may be treated as a fluid without considering the individual elements, or individual vehicles may be modelled.

II. LITERATURE REVIEW

The work presented in this paper is the design of a simple simulator for the simulation and study of vehicular traffic on the intersection of roads. One of the biggest challenge in developing a smart city is the intelligent management of vehicular traffic in the city. S. Javaid, A. Sufian, S. Pervaiz and M. Tanveer (2018) This model enabled predicting densities and group velocities of vehicles in different segments of road was implemented and tested using Matlab. A parallel traffic simulation approach was presented in which aimed at reducing the time for simulating emergency vehicular traffic scenarios. S. B. Yoginath and K. S. Perumalla. Dissect the traffic congestion has expanded dangerously fast, particularly in metropolitan urban communities. Traffic congestion prompts increment in clamor contamination, voyaging time, contamination, and fuel wastage, and so forth. There are present moment and long-term reasons for traffic congestion. Transient causes incorporate traffic signal disappointments, inefficient law requirements, insufficient road foundation, mishaps, and so forth. Long term causes are credited to the financial development of the general public, changes in the way of life of individuals, and so on. N. B. Soni; Jaideep Saraswat (2017)

III. METHODOLOGY

A mathematical model is a description of a system using mathematical concepts and language. The process of developing a mathematical model is termed as Mathematical Modelling. A mathematical model may help to explain a system and study the effects of different components and to make predictions about its behavior. Mathematical models can take many forms, including dynamic systems, statistical models, differential equations, or theoretic models.

a. Correlation and regression model
b. Simulation model

(A) CORRELATION AND REGRESSION MODEL

Simple regression is used to examine the relationship between one dependent and one independent variable. After performing an analysis, the regression statistics can be used to predict the dependent variable when the independent variable is known.

(B) SIMULATION MODEL

SPSS (Statistical Package for Social Sciences) software is used for forecasting the values. After performing analysis, we compare the values from both of the models and determine the results.

IV. DATA COLLECTION

The data was collected over consecutive days using primary research and using this data, the factors causing traffic congestion were decided. Then by ranging these factors causing traffic congestion like speed, type of road surface, traffic volume, type of vehicle, population, parking issue, poor traffic management, carriageway width, improper planning of city development, road surface quality between 0-5 on the basis of the table given below and carrying out analysis. Using error analysis, the correlation between these factors was found.

RANGE	CRITERIA
0-1	LOW
1-2	AVERAGE
2-3	GOOD
3-4	BEST
4-5	BETTER

V. DISCUSSION

As per our observation, we observe that the data that we predicted using present time data which we calculated for analytical method or conventional method and for predicted data or software-oriented readings, we observe that the Total Percentage Error Value for the Pune University chowk is the most in comparison to the Jehangir chowk and the Shashtri Nagar chowk.

VI. VALIDATION

We can validate the above results on the basis of the total percentage value, which tells us the accurate percentage value between the readings comparing the factors.

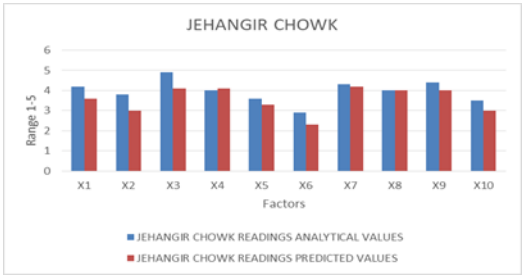
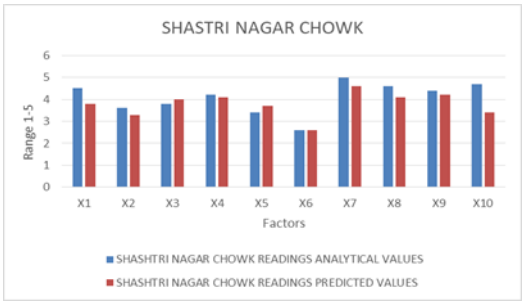


Figure no.1



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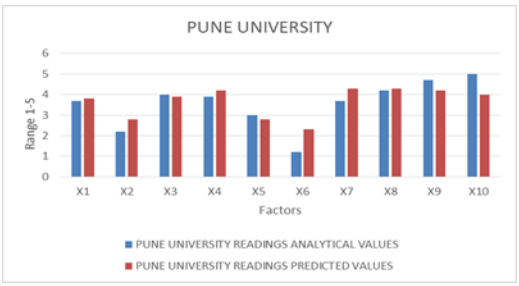

Figure no.3

CONCLUSION

- Correlation coefficient is a statistical concept, which helps in establishing a relationship between Predicted and actual values obtained in a statistical experiment.
- The calculated value of the correlation coefficient explains the exactness between the predicted and actual values.
- As observed in Pune, The Public transport infrastructure is not that efficient, giving rise to a number of two-wheeler and four-wheeler drivers.
- Applying smart Traffic systems for real-time data and surveys of traffic density and traffic volume may reduce factors causing traffic congestion in peak hours.

APPENDIX

LIST OF FACTORS	A-JEHANGIR CHOWK	B-SHASTRI NAGAR	C-UNIVERSITY ROAD	AVERAGE RATING
Speed (X1)	3.8	4	3.5	3.7
Type of Road Surface Rigid/Flexible) (X2)	3	3.2	2.5	2.9
Traffic Volume (X3)	4.2	3.5	4.6	4.1
Type of Vehicles (X4)	4.3	4	4.5	4.2
Population (X5)	3	3.3	3.5	3.2
Parking Issues (X6)	2.5	3	1	2.1
Poor Traffic Management (Signalling) (X7)	4	4.9	4.8	4.5
Carriageway Width (X8)	4.2	4.5	4	4.2
Improper Planning Of City Development (X9)	4.1	4.5	4.2	4.2
Road Surface Quality (X10)	3	3.5	2.5	3

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