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Regression Modelling on Impact of Urbanization on Right of Way Capacity

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Abstract

The present study tries to understand the urbanization in terms of population density. The effect of population on right of way capacity is determined through a model developed using Multiple Linear Regression (MLR) analysis. The width of the right of way and population density are considered as independent variables in the model. The traffic volume at different mid-blocks and signalized intersections is considered as dependent variable. The MLR model is developed to predict the variation of traffic volume with respect to the population density and right of way width. The regression statistics such as p-values and t-stat values indicate that the independent variables have a significant impact on the dependent variable. The results of the model are used to predict the change in traffic volume when there is considerable change in ROW width and population density.

1. Introduction

Urbanization planning is the process of regulating and controlling the provision of transport to facilitate the efficient operation of the economic, social, and political life of the country at the lowest social cost.Urbanization is the major problem when we are dealing with the right of way, traffic, and mobility. The change of land use, average car ownership, socio-economy, average earnings, shopping activity, industrial activity are templates for urbanization. Vianna et al; (2017) presented a methodological procedure that underpins the feasibility of implementing an integrated parking system based on telematics resources and also included the development of logic architecture for processing and transferring data and information. Reinke and Malarkey; (2017) discussed the methods of integrated transportation planning for implementation by a metropolitan planning organization, developed for the Puget Sound Regional Council and also discussed how integrated transportation planning will fit into the strategic planning process. Cradock et al. (2018) examined bicycle and pedestrian related investments authorized by federal transportation legislation in 3,140 counties in the United States by region, population size and urbanization, social and economic characteristics; and indicators of travel-related walking and bicycling. Three key policy recommendations for improving public health outcomes were drawn from this research. Velarde (2019) presented Implementation of a Mathematical Model to Improve Sustainability in the Handling of Transport Costs in a Distribution Network. This work considers the application of a mathematical model using mixed-integer linear programming for the vehicle routing problem. The model

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aims at establishing the distribution routes departing from a distribution centre to each customer in order to reduce the transport cost associated with these routes. Kim (2020) developed Mathematical model for cost-efficient installation of public transportation system which analyses the way how theorems in network theory could be applied to choosing locations for placing each of bicycle stations in the city efficiently. Ben-Avika et al. (2019) presented a real time system DynaMIT to generate guidance for travelers. The main principle on which DynaMIT was based is that information should be consistent, and user optimal. Cho and Hwanc (2020) developed a flow evolution model by using the dynamical system approach for a vehicular network equipped with predicted travel information. The concerned system variables, path flow, and predicted minimal travel time of an origin-destination pair were measured on the peak-hour-average base for each day. Mishra and Das (2016) studied a three -dimensional transportation problem with similar structured objective function, i.e., the sum of a linear and linear fractional function, and developed a simplex type technique for solution along with computational tests for local minimum. Gupta et al. (2013) studied a paradox in Linear Fractional Transportation Problems with mixed constraints and established a sufficient condition for the existence of a paradox. A Paradoxical range of flow was also obtained for any flow in which the corresponding objective function value was less than that of the original Linear Fractional Transportation Problem with mixed constraints.

2. Methodology

The present study tried to understand the urbanization in terms of population density. The effect of population on right of way capacity is determined through a model developed using Multiple Linear Regression (MLR) analysis. The width of the right of way and population density are considered as independent variables in the model. The traffic volume at different mid-blocks and signalized intersections is considered as dependent variable. The MLR model is developed to predict the variation of traffic volume with respect to the population density and right of way width.

3. Study Area

Hyderabad city, capital of Telangana state is chosen as the study area. The city of Hyderabad also serves as the central hub of transport and logistics within the state. Five mid-block sections and five signalized intersections were chosen to determine the Los. The LOS for these mid-blocks and signalized intersections is determined to understand the quality of roads in the study area.

The mid-block sections and signalized intersections chosen for the study of traffic volume are given in Table 1

Table 1 Mid-block sections and signalized intersections chosen for the study

Mid-block Section S.No	**Name of the Mid-block sections**	**Signalized intersection S.No**	**Name of the Signalized intersections**
I	Mehadipatnam to Gachibowli	**I**	PV Narasimha Rao Intersection
II	Jubliee Hills to Banjara Hills	**II**	Jubliee Hills check post
III	Tarnaka to ECIL	**III**	AS Rao Nagar Intersection
IV	Gandhi Bhavan to LB Nagar	**IV**	Malakpet intersection
V	Secretariat to Necklace road	**V**	Lumbini Park Intersection

4. Field data collection

Different type of field data is collected to develop the model for mid-block sections and signalized intersections chosen for the study. The type of data collected from the field are traffic volume using video-graphic method. The width of the right of way including all the details of it was observed and collected from the field. The population data of the required locations was taken from the Statistics department of Telangana state.

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5. Data Analysis

The field collected data such as traffic volume is converted to PCU/hr. using the PCU factors given in INDO HCM 2017. The total width of the right of way is computed based on different details observed from the field. The population density was quantified using the population and area of the required locations. The analyzed data is used for the development of MLR model.

6. Results and Discussions

The urbanization in the form of population density has a significant impact on the traffic volume based on the right of way details. To understand this relationship a MLR model was developed.The width of the ROW (W) and population density (PD) are considered as the independent variables and traffic volume. The regression outputs of the MLR model is given in Table 2.

Table 2 Regression outputs

Dependent Variable: Traffic volume			
Independent variables	**Coefficient**	**p-value**	**t-stat value**
Intercept	1542	0.00	3.54
W	708.1	0.01	2.98
PD	153.9	0.00	5.64
R^2 value : 0.79			

The MLR model developed in the study obtained an R^2 value of 0.79. The p-values and t-stat values obtained in the model indicate that all the independent variables have significant impact on the traffic volume.

Conclusions

The present study attempted to establish a relationship between right of way capacity and urbanization. The traffic volume on different mid-blocks and signalized intersections is considered as the dependent variable and width of the ROW (W) and population density (PD) are considered as the independent variables using Multiple Linear Regression (MLR) method. The regression statistics such as p-values and t-stat values indicate that the independent variables have a significant impact on the dependent variable. The results of the model are used to predict the change in traffic volume when there is considerable change in ROW width and population density.

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