Estimation of Service levels of Pedestrian facilities using Statistical methods

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Estimation of Service levels of Pedestrian facilities using Statistical methods

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<u>DECLARATION OF ORIGINALITY</u>

I hereby declare that this submission is entirely belongs to my own work done during the course of Master's Degree and I assure to the best of my knowledge that this work does not contain any piece of work that was taken directly from the work done by any researcher in the past nor it was taken from any article that was published in the past. This work was not submitted to any other university for the award of any other degree.

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This is to certify that the thesis mentioned above submitted by Dudi Praveena (214CE3078) in the partial fulfilment of the requirement for the degree of Master of Technology in Civil Engineering at National Institute of Technology Rourkela is a reliable work carried out by her under my supervision and guidance.

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ABSTRACT

Despite the fact that, strolling is a huge extent of each excursion, Pedestrinas are regarding as most helpless street clients. Pedestrians are presented to an assortment of natural circumstances while they go on various roadways. It is important to know the strolling conditions keeping in mind the end goal to know how diverse transport facilities are serving and how neighborly they are towards Pedestrinas. Numerous analysts have considered a few variables which contributes amount estimation of nature of administration. Clients' supposition which can gather specifically was dismissed in all perspectives. In India, a few works have been done on quantitative methodology which can't speaks to the varieties in human discernment as those works didn't consider the client observations. The center of this study is to assess person on foot administration levels for 3 unique facilities walkways, signalized and un-signalized crossing points at fair sized urban communities of India.

Key words: Pedestrian satisfaction level, Multinomial logit model, Ordinal logit model

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Chapter-1

Introduction

1.1 General:

A generous extent of each model trek incorporates strolling. Along these lines, the requirements of pedestrians' ought to be considered in the configuration of any transportation facilities in admiration of their wellbeing, openness and advantageous portability. Surveying the person on foot facilities and strolling conditions is more troublesome, as they are presented to assortment of natural circumstances. The working conditions particularly at various facilities like walkways, roundabouts, fragments, signalized and Un-signalized convergences are hard to gauge. To oblige the urban populace, facilities must be given keeping in mind the end goal to achieve their fulfillment level in parts of security, solace and accommodation.

Roadway Capacity Manual (2000) characterized the LOS as "a quality measure portraying operational conditions inside a movement stream, by and large as far as such administration measures as velocity and travel time, opportunity to move, activity interferences, and solace and comfort". Level of administration (LOS) essentially portrays the current working conditions for a specific method of go in a transportation framework. The HCM entitles six levels of administration, A-F; depict operations from best to most exceedingly terrible for every kind of office. Assessment of person on foot LOS is significantly more unpredictable, as the working states of passerby facilities, their level of accommodation and Pedestrians' experience are mulling over. An endeavor was made to build up a person on foot administration level model for moderate sized urban communities at various facilities.

1.2 Problem Statement:

In numerous nations, recognition information was utilized to assess person on foot level of administration. However, in India, restricted works had been done on client recognitions where it is high with quantitative examination particularly in passerby level of administration. No legitimate strategies are there by considering the view of walkers specifically. Thus, it is critical to build up a model for administration level of various facilities in light of client

observations in which the Pedestrians' gives appraisals for the facilities taking into account their experience.

1.3 Objectives of the study:

The objectives of this study are:

- ➢ To recognize the factors affecting the pedestrians LOS.
- ➢ To build a model for the evaluation of pedestrians LOS.

1.4 Organization of Report:

This report contains of six chapters. The first chapter provides a brief introduction of this work, problem statement and aims of this study. The second chapter consists of the past studies on pedestrian level of service, and other papers in which the logit models were used. The third chapter consists of detailed procedure for different methods used in this work. The fourth chapter gives an idea on the areas which are selected for data collection. The fifth chapter explains about the results and analysis of the work. The sixth chapter shows the summary and conclusions of the work. Limitations and future scope is also included in this chapter. References are added at the end of report. Overall framework of this study is shown in fig.1

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Fig.1 Framework of the study

Chapter-2

Literature review

2.1 General:

This chapter consists of pedestrian level of service at different facilities. The pedestrians and bicycle level of service which considered the user perceptions are presented. The different methods used by researchers to develop LOS models are discussed in this chapter. Every researcher represented the level of service in different manner such as very satisfied, strongly agreed, excellent etc.

2.2 Pedestrian Level of Service (LOS):

Ling et al. (2014) had proposed a modified method of pedestrian simulation, pedestrian crossing video simulation (PCVS) to estimate the pedestrian level of service. Validity and reliability of the model was verified with Contingent Field Survey (CFS) analysis. Results showed that increase in delay, turning traffic, mixed two-wheeler volume have negative impact on LOS. Pedestrian volume and refuge island presence and two-step crossing improves LOS.

Muraleetharan et al. (2005) have proposed a method for the determination of pedestrian level of service at intersections using a stepwise multi-variable regression analysis. This paper concludes that 'turning vehicles' having more influence on level of service of pedestrians than other factors and the safety of pedestrians decreases with increase in turning vehicles. Authors recommended that to design the signal system in order to minimize the pedestrian-vehicle interaction.

Josephat and Ismail (2012) have developed a binary logit model for customer satisfaction of airlines using SPSS software. Using binary logit model, Askar (2006) have worked on how much extent the perceived innovation characteristics associated with probability of task related Information and Communication Technology (ICT) use among secondary school teachers.

Miyazaki and Fernandez (2011) have worked on privacy and security risk in online shopping based on user perceptions.

Jensen (2007) had created person on foot and bike fulfillment models at portions utilizing total logit relapse. Results presumes that sort and width of the facilities are most vital parameters which influences the Pedestrinas and bicyclist administration levels. Creator clarified the LOS criteria in view of parts of the reaction fulfillment level. Jensen (2012) extended the work to Roundabouts, convergences and different intersections for Pedestrinas and bicyclists. Likewise, built up the model for person on foot extensions and passages. Paper reasons that length of intersection or size of circuitous impacts LOS.

Chapter-3

Methodology

3.1 General:

From the literature review, it was found that many methodological approaches are there (other than quantitative methods) to define pedestrians' level of service based on user perceptions. The methodologies used in this study are Multinomial logit model and Ordinal logit model. The detailed explanation about those methodologies are presented in this chapter.

3.2 Logit model:

3.2.1 Binary logit model:

When the dependent variable have the possibility of getting two outcomes, this model is useful. Multinomial logit model is the extension of binary logit model. When the dependent variable having more than two possibility of outcomes, then multinomial logit model is used. When the category of variables is ordered, then the ordinal logit model is used. The ordinal logit model is also known as the proportional odds model. Sometimes parallel lines model and parallel regression model are also used. Unlike the other two logit models, SPSS gives the location values which includes the coefficients of independent parameters and threshold values includes the cumulative constant values of all categories of dependent variable.

$$\log \frac{P(Y \leq j/x)}{1 - P(Y \leq j/x)} = \beta' x \qquad \text{where } j=1,2,\ldots\ldots m\text{-}1 \qquad (3.1)$$

Chapter-4

Study area and data collection

4.1 General:

To develop a proper model for the pedestrians to meet their satisfaction level at sidewalks, signalized and un-signalized intersections, the perception data was collected from 9 different mid-sized cities. In this chapter, description of different cities, from which the data collected are given. The data collection methods and the validation of different models are also described.

4.2 Study area:

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Fig. 4.1.map showing the data collection cities of India

Bhubaneshwar is the largest city and also capital of Odisha state. It is the center of religious and economic importance in Eastern India. As per 2011 census, the population is around 8.5 lakhs. Bhubaneshwar is having wide roads in grid form in the central city. It is the second largest city in Odisha state, one of the eastern Indian state. As, it is famous for silver filigree works, this city is also known as Millennium city or Silver city. As per 2011 census, the population of Cuttack is around 6.1 lakh. Jamshedpur is the first well planned city of India and is a part of Jharkhand state. Its urban area is the 3rd largest place in Eastern India. As per 2011 census, the population of this city is around 9.3 lakhs. Ranchi is the capital city of Jharkhand state. As per 2011 census, this city has the population of 10 lakhs. It is the 46th largest urban city of India. In 2000, after declaration of it as new state, there was a sudden increase in population. Raipur is the capital city of Chhattisgarh state. As per 2011 census, the population of this city is 10.1 lakhs. Vijayawada is one of the cities of the state Andhra Pradesh. It is one of the Metropolis in the state. As per 2011 census, the city having the population around 10.5 lakhs. Tirupati is one of the cities of the Andhra Pradesh state. This city is referred to as "Spiritual capital of Andhra Pradesh". As per 2011 census, the population of this city is 3.75 lakhs. Visakhapatnam is one of the Metropolis of Andhra Pradesh state, as the other being Vijayawada As per 2011 census, the population of this city is around 17.3 lakhs. Vizianagaram is one of the cities in the

state of Andhra Pradesh. It is known to the "City of Victory". As per 2011 census, the population of this city is around 2.3 lakhs.

4.3 Data collection:

Rating used in questionnaire is shown in table 4.1. Traveler intercept survey is used to collect data from pedestrians. The % of each observed category for facilities are represented in fig.4.2

Table 4.1 Rating given in the Questionnaire

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Fig 4.2 Percentage of pedestrians of each service level of facility for observed data

4.3.1 Demographic analysis:

Demographic analysis of the collected data is shown in the fig. 4.3

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Fig 4.3 Overall satisfaction of responses with respect to Demographic variables

Chapter-5

Results and Analysis

5.1 General:

Responses were collected using questionnaire which was given on six point Likert-scale ranging from extreme satisfaction to extreme dissatisfaction. Rating given to the all the questions under a particular parameter was calculated as score of that particular parameter. A model was developed for each facility using Multinomial logistic regression and Ordinal regression with logit link. The results and validation of the model are discussed in this chapter.

5.2 Multinomial model:

As, the outcome variable having more than two categories, the multinomial logit model is used. The data was analyzed using SPSS (Statistical Package for Social Sciences) software of version 20.0.0. In multinomial logit model, the odds ratio of independent parameters are not same across the response category. For each category of outcome variable the model developed is different.

The data collected at the sidewalks from all the cities are analyzed to develop pedestrian's service level model. In SPSS, using likelihood ratio, the data fitness to model is shown in table 5.1

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5.1 Fitness of user perception data to the model

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Basic Multinomial logit model is:

$$\text{logit(P)} = \alpha_i + \beta_i X_i$$

Where, α_i is the intercept parameter of the response level of satisfaction

β_i is the coefficient of parameter

X_i is the parameter score.

Average probability of satisfaction level, service level and category of each sidewalk are presented in the table 5.2. Similarly, for all the sidewalks, it is calculated and average values of them for a city are represented in table 5.3

5.2 Predicted category of each sidewalk for Vijayawada city
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5.3 Average service level and category of sidewalks for each city
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From the likelihood method, the significance indicates that the data fits the model well, which is shown in table 5.4. There is an improvement in model after using parameters. Average probability of satisfaction level, service level and category of each sidewalk are presented in the table 5.5. Similarly, for all the sidewalks, it is calculated and average values of them for a city are represented in table 5.6

5.4 Fitness of user perception data to the model
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5.5 Predicted category of each signalized intersection for Jamshedpur city
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5.6 Average service level and category of signalized intersections for each city
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From the table 5.7, it is known that the data used for the development of model fits well. Average probability of satisfaction level, service level and category of each sidewalk are presented in the table 5.8. Similarly, for all the sidewalks, it is calculated and average values of them for a city are represented in table 5.9

5.7 Fitness of user perception data to the model

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5.8 Predicted category of each un-signalized intersection for Raipur city
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5.9 Average service level and category of un-signalized intersections for each city

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5.10 Coefficients of each parameter for each satisfaction level using Multinomial logit model

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5.3 Ordered model:

From the likelihood method, whether the data fits to the model or not is checked. From the table 5.11, the data fits the model well. Insignificance from test of parallel lines shown in table 5.12. Average probability of satisfaction level, service level and category of each sidewalk are presented in the table 5.13. Similarly, for all the sidewalks, it is calculated and average values of them for a city are represented in table 5.14

5.11 Fitness of user perception data to the model

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5.12 Test of Parallel Lines

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5.13 Predicted category of each Sidewalk for Tirupati city

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5.14 Average service level and category of Sidewalks for each city

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From the likelihood method, whether the data fits to the model or not is checked. From the table 5.15, the data fits the model well. Insignificance from test of parallel lines shown in table 5.16. Average probability of satisfaction level, service level and category of each sidewalk are presented in the table 5.17. Similarly, for all the sidewalks, it is calculated and average values of them for a city are represented in table 5.18

5.15 Fitness of user perception data to the model

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5.16 Test of Parallel Lines

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5.17 Predicted category of each Sidewalk for Tirupati city
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5.18 Average service level and category of Sidewalks for each city
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From the likelihood method, whether the data fits to the model or not is checked. From the table 5.19, the data fits the model well. Insignificance from test of parallel lines shown in table 5.20. Average probability of satisfaction level, service level and category of each sidewalk are presented in the table 5.21. Similarly, for all the sidewalks, it is calculated and average values of them for a city are represented in table 5.22.

5.19 Fitness of user perception data to the model
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5.20 Test of Parallel Lines
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5.21 Predicted category of each Sidewalk for Jamshedpur city
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5.22 Average service level and category of Sidewalks for each city
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Chapter-6

Summary and conclusions

6.1 Summary:

Numerous specialists have considered a few variables which contributes amount estimation of nature of administration. Clients' feeling which can gather was ignored in all viewpoints. In this way, it is vital to build up a model for administration level of Pedestrinas at various facilities in view of client discernments in which the walkers' gives evaluations for the facilities in light of their experience. Person on foot observation information was gathered utilizing a poll which incorporates the elements influencing the administration level. Around 2730 reactions were gathered at 3 facilities for 9 urban communities of India.

The information was subjected to centrality test (probability technique) utilizing SPSS programming. The variables which are measurably noteworthy ($p<0.05$) are mulled over to build up the solid model. Activity, Speed, Comfort, Maintenance and Esthetics are critical variables in all the models. Age, sexual orientation, unit size are likewise huge in some displays. 20% of the information for every office is utilized for the acceptance reason. Results demonstrates that the models created are legitimate.

6.2 Conclusions:

From this study, the following conclusions were made:

- ➢ From the responses, 56.2% pedestrians are male and 43.8% pedestrians are female. 38.1% pedestrians are young aged, 37% pedestrians are middle aged and 24.9% pedestrians are old aged.
- ➢ less facilities are in the category B. very less percentage (negligible) of facilities are in category A, E and F.

6.3 Future Scope:

- ➢ Proper strategy can be discover to classify the administration levels.
- ➢ Service levels of the facilities can be figure by thinking of some as more parameters.

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