

## DEVELOPMENT OF MULTINOMIAL LOGIT MODEL: A CASE STUDY OF NEW WEST ZONE AHMEDABAD

Chirag Parmar<sup>1</sup>, Prof. Srinath Karli<sup>2</sup>, Vaibhav Solanki<sup>3</sup>, Deep Patel<sup>4</sup>

<sup>1</sup>PG Student, <sup>2</sup>Professor, Civil Department, HGCE, Vahelal, Ahmedabad, <sup>3</sup>Asst. Professor, Civil Department, SSIT, Bhat, Gandhinagar, <sup>4</sup>Asst. project manager, Tata Consulting engineer

**Abstract:** Transport condition in most Ahmedabad cities is rapidly deteriorating because of the increasing travel demand and inadequate transportation system. Indian cities of all sizes are facing the crisis of urban transport. Despite investments in road infrastructure and plans for land use and transport development, problems of congestion, accidents and pollution are continuously increasing. Efficient transport policies and strategies are required for the proper development of a city considering all the aspects of transportation. Planning of efficient public transport policies to provide seamless travel is needed for attracting travellers towards public transport to develop sustainable cities with reduced use of private vehicles and therefore there is need for understanding the behaviour of travellers to frame the policies. The behaviour of people in the study area towards public transport is analysed by conducting revealed as well as stated preference survey. Two Type of survey are taken house hold survey and cordon line survey and also use logit and regression model and transcade software for better understand model split analysis.

### I. INTRODUCTION

Transport engineering is the application of technology and systematic principles to the planning, functional design, operation and management of amenities for any mode of transportation in order to provide for the safe, efficient, rapid, comfortable, convenient, economical, and environmentally companionable movement of people and goods. The planning features of transportation engineering relate to elements of urban planning and include technical forecasting decisions and political factors. Technical forecasting of passenger travel generally involves an urban transportation planning model, requiring the estimation of trip generation (how many trips for what purpose), trip distribution (destination choice, where is the traveler going), mode choice (what mode is being occupied), and route assignment (which roads or routes are being used). more sophisticated forecasting can include other aspects of traveler decisions, including auto ownership, trip chaining (the decision to link individual trips together in a tour) and the choice of residential or business location (known as land use forecasting. passenger trips are the focus of transportation engineering because they often represent the peak of demand on any transportation system.

### II. MODAL SPLIT ANALYSIS

The third stage in travel demand modeling is modal split. The trip matrix or O-D matrix obtained from the trip distribution is sliced into number of matrices representing each mode.

First the significance and factors affecting mode choice problem will be discussed. Then a brief discussion on the classification of mode choice will be made. Two types of mode choice models will be generally used. Binary mode choice and multinomial mode choice. Main characteristics of public transport is that they will have some particular schedule, frequency etc. On the other hand, private transport is highly flexible. It provides more comfortable and convenient travel. It has better accessibility also. The issue of mode choice, therefore, is probably the single most important element in transport planning and policy making. It affects the general efficiency with which we can travel in urban areas. It is important then to develop and use models which are sensitive to those travel attributes that influence individual choices of mode.

Types of modal split models: 1. Trip-end modal split models 2. Trip-interchange modal split 3. Aggregate and disaggregate models 4. Binary logit model 5. Multinomial logit modal 6. Probit modal

### III. AIM AND OBJECTIVES THE STUDY

The main of this study is to develop a mode choice modal for work trips in new west zone of Ahmedabad city that can be used to simulate the behaviour of individuals to wards motorized and non-motorized modes.

Objectives

1. To study the factors affecting mode choice and various types of mode choice models.
2. To develop the most suitable model for work trips in study area.

### IV. LITERATURE REVIEW

Naveen Eluru, Travel Mode Choice and Transit Route Choice Behavior in Montreal: Insights from McGill University Members Commute Patterns. The main study of this paper includes the effect of the performance of the public transportation system on the commuter travel mode and transit route choice. The multinomial logit model is used for the travel mode choice and mixed multinomial logit model is used for the transit route choice component. The detailed socio-demographic and residential location information is also collected for the same. [1]. Hilmi Berk CELIKOGLU Calibration of Logit Modal split models with feed forward Back-propagation neural networks  
Calibrating modal usage is key to develop precautions before the forthcoming investments for an urban area. In this study and ANN utility function estimating model and a LR equation model for utility function are developed and compared. Among the performed calibrations, significant

improvements in the prediction are made by the neural network method due to its flexibility to adapt to nonlinear relationships. Another advantage of the application of neural networks is being trained with measurements, hence; the included propagation effects are more realistic. Facing the local minima problem is a drawback of Calibration of logit modal split models with feed forward the FFBP training algorithm. It can be said that various kinds of learning algorithms should be assessed during the training process to overcome this drawback. [4]

Kevin B. Modi, Dr. L.B Za, Transportation Planning Models Review. The main objective of this paper is to present an overview of the travel demand modelling for transportation planning. Mainly there are four stages model that is trip generation, trip distribution, modal split and trip assignment. The choice of routes in the development of transportation planning depends upon certain parameters like journey time, distance, cost, comfort, and safety. The scope of study includes the literature review and logical arrangement of various models\ used in Urban Transportation Planning. [5]

V. METHODOLOGY AND STUDY AREA

Types of Travel Survey

Traveler and trip related data (including the real mode choice of the traveler) required for estimation of mode decision models are generally obtained by surveying a sample of travellers from the population of interest. The most widely recognized sorts of reviewing strategies for mode choice modelling are describe below.

Home interview survey

From the above surveys the home interview survey is chosen to obtain trip-related information of travelers.

Methodology:

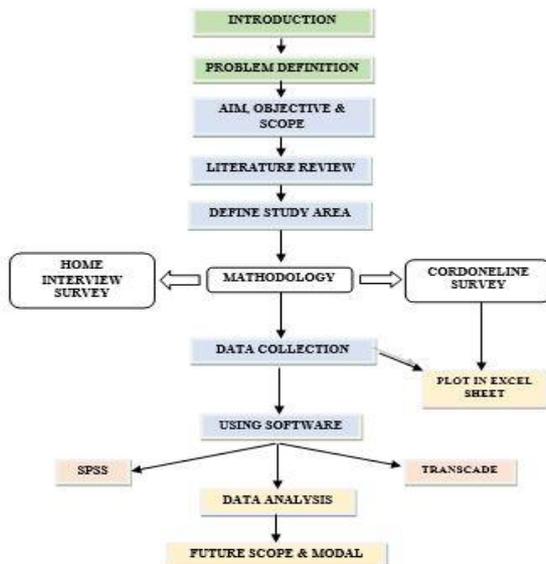


Fig. 4.1: Flowchart of methodology

Study Area location, Ahmedabad:

Ahmedabad lies at 23.03°N 72.58°E in western India at 53 meters (174 ft.) above sea level on the banks of the Sabarmati River, in north-central Gujarat. It covers an area of 464 km2 (179 sq. mi). The Sabarmati often dried up in the summer, leaving only a small stream of water, and the city is in a

sandy and dry area. Though with the execution of the Sabarmati River Front Project and Embankment, the waters from the Narmada River have been diverted to the Sabarmati to keep the river flowing during the year, thereby eliminating Ahmedabad's water problems.

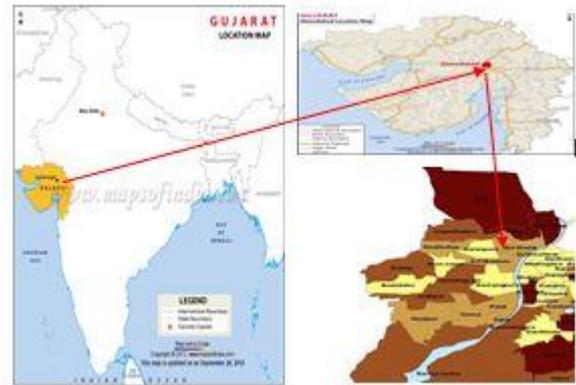


Fig. 4.2: Study Area location

Ahmedabad Population Growth:

The area where Ahmedabad is located has been populated since the 11th century. Sultan Ahmed Shah named the city Ahmedabad after himself in 1411 A.D. when he took control of the city. The census done in 1871 showed a population of 116,900. By 1911 there were over a quarter of a million people and over a half million by the 1941 census. The city passed the 1 million resident mark by the 1961 census with over 1.1 million residents.

Table 4.1 Year wise population in Ahmadabad

Year	Population	Growth rate	Growth
1990	32,55,000	14.90%	400000
1995	37,90,000	16.80%	535000
2000	44,27,000	18.20%	637000
2005	52,38,000	18.60%	811000
2010	62,10,000	18.20%	972000
2015	73,43,000	6.30%	1133000
2020	84,52,000	8.40%	656000
2025	94,90,000	12.30%	1038000

VI. DATA COLLECTION

As we deliberate earlier Ahmedabad is biggest city of Gujarat and most development city which is consist two main public transportation which are Ahmedabad municipal transport service (AMTS) and bus rapid transit system (BRTS) which is covered whole Ahmedabad city.

1. Population in new west zone

Table 5.1 Population in new west zone

Name of ward	Ward no.	Total no. of household	Total population
Sarkhej	33	32618	165478
Bodakdev	19	29298	149875
Thaltej	8	22749	115875

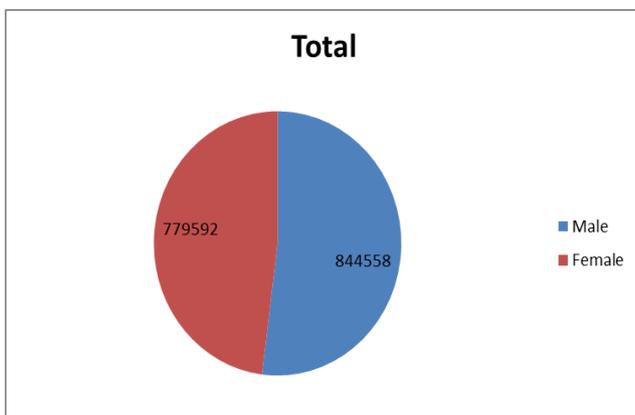
Maktampura	34	25576	136276
Jodhpur	20	22968	112346
Gota	1	37852	187235
	Total	324226	1624151

Male and Female ratio:

Here describe the male and female ratio of new west zone around 844585 male and 779592 female are living in new west zone of Ahmedabad

Table 5.2 Male and Female ratio

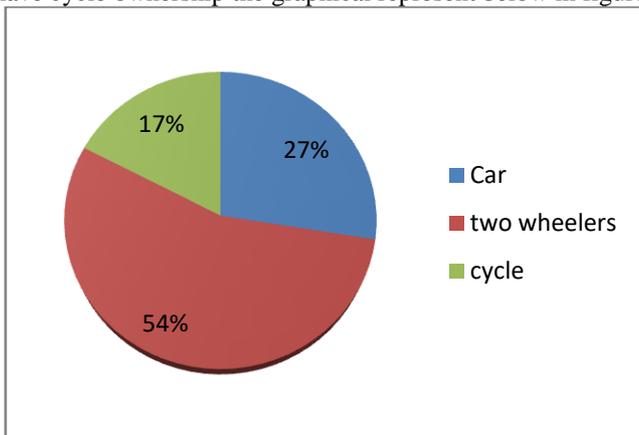
Sex	Male	Female
Total	844558	779592
Frequency	52%	48%



Graph 5.1 Graph male and female ratio new west zone

House hold vehicle ownership:

The vehicle ownership is most important things for transportation planning. In new west zone of Ahmedabad around 54% of peoples are used two wheelers for trips and 27% of people used car for travelling and 17% of people have cycle ownership the graphical represent below in figure.

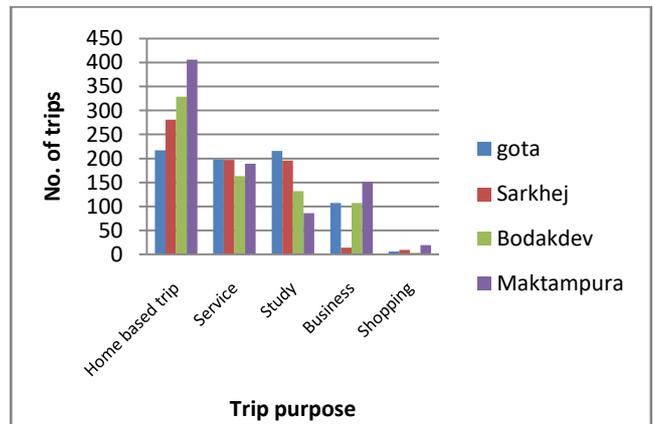


Graph 5.2 Trips by different mode of transport  
 Trip purpose:

Here represent trip purpose as per data collection around 54% of total trips are home based trips and lowest percent of shopping trips. thaltej word has a highest number of working trips and home based trips and vejalpur has a lowest trips in daily routine. Different types of trips are represented below figure.

Table 5.2 Trip purpose for different zone of new west

Trip purpose	Gota	Sarkhej	Bodakdev	Maktampura
Home based trip	217	281	329	406
Service	198	197	163	189
Study	216	196	132	86
Business	107	14	107	151
Shopping	6	9	3	19



Graph 5.3 Trip purpose for different ward

Data collected by means of household survey providing information about the socio-economic character and their travel behaviour of a population, offers an important source of information for transport planning application. In next chapter mathematical model is developed for the above analyzed data.

## VII. MODEL DEVELOPMENT

The present study intended to develop multinomial logit model for model split analysis. For this purpose data had been collected by home interview survey as per codel guidelines. The collected data had been inserted into Microsoft excel 2007 and various analysis have been performed to find the correlation between various variables. For all five modes total travel time and total travel cost are being computed. The mode with moderate travel time and travel cost is most commonly chosen by the commuters. Percentage share of different vehicles is shown below in table.

Table 6.1: Percentage share of vehicles

Mode	Marginal percentage
2 wheeler	27%
4 wheeler	43%
Public transport	30%

Sample coding has been illustrated in below table.

Table 6.2: Coefficients of model for public

Mode	B	Standard error	Wald	Df	95% confidence interval for Exp(B)		
					LB	UB	
Public	Intercept	-0.381	1.017	0.135	1		
	G	0.017	0.431	0.006	1	0.464	2.223
	TT	-0.43	0.429	0.789	1	0.324	1.454
	TC	0.031	0.438	0.002	1	0.437	2.353
	I	0.817	0.419	3.187	1	1.012	5.154

Table 6.3: Coefficients of model for private

Mode	B	Standard error	Wald	Df	95% confidence interval for Exp(B)		
					LB	UB	
Public	Intercept	-0.381	1.017	0.135	1		
	G	0.017	0.431	0.006	1	0.464	2.223
	TT	-0.43	0.429	0.789	1	0.324	1.454
	TC	0.031	0.438	0.002	1	0.437	2.353
	I	0.817	0.419	3.187	1	1.012	5.154

The following models were developed:

$$P(\text{Private}) = -0.295 + 0.21(G) + 0.171(TT) - 0.09(TC) - 0.078(I)$$

$$P(\text{Public}) = -0.381 + 0.017(G) - 0.43(TT) + 0.031(TC) + 0.817(I)$$

The results from model shows that for work trips public transport is majorly used and social and personal trips are done by private mode.

Model validation:

From the data collection 70% data was used for development of model and 30% data was use for calibration and validation purpose. The model considered is 92.00% accurate and the difference is only 5.3% which seems excellent. The sign of each variable in model is convincible and consistent with hypothesis.

## VIII. CONCLUSION

The main aim of present study is to develop a mode choice model which could deliver information to concerned authorities which are responsible for decision and policy making for urban transportation development. Mode choice model for new west zone, Ahmedabad city was developed using multinomial linear logit modeling method.

Following observations were made from the study:-

1. Public transport is mostly chosen by females whereas private transport is mostly chosen by males.
2. Auto and walk are found to be less popular amongst working peoples.
3. The people between age group 18-35 (72%) are selecting private vehicles for their journey whereas people >45 years are preferring public transport.
4. In the higher income groups the most of the trips are

preferred by four wheeler vehicle which is most responsible for traffic congestion and increased journey time.

From the analysis and modeling it is distinct clear that age, income, time of travelling and cost of travelling are most influencing factors in selection of mode of travel. The propose model would be beneficial to authorities as the validation of model is seems good.

## REFERENCES

- [1] Naveen Eluru "Travel Mode Choice and Transit Route Choice Behavior in Montreal: Insights from McGill University Members Commute Patterns"
- [2] Marko Matulin, "Different approaches to the modal split calculation in urban areas"
- [3] Kevin B. Modi, Dr. L.B Zala, Dr. T.A. Desai "Transportation Planning Models Review"
- [4] R. Naveen and A. Siva Kumar "A Study on Urban Modal Split and its Development in Salem City"
- [5] Lohit Talawar "Model Split Analysis for the Selected Corridor-Bangalore City"
- [6] Shweta J Chauhan. Akshar Patel, BrijenPrajapati, Nilay Kanoji "Travel Demand Modeling Techniques"
- [7] Bageshree Panara, Srinath Karli. "Modal Split Analysis"
- [8] Maja M. POPOVIĆ, Jadranka J. JOVIĆ "Concept of expert system for modal split in Transportation planning" Yugoslov Journal of Engineering.
- [9] Ashalatha et al. (2013) "Mode Choice Behavior of Commuters in Thiruvananthapuram City."
- [10] Hensher, D. A "Development of commuter and non-commuter mode choice models for the assessment of new public transport infrastructure projects: A case study"
- [11] Xianyu (2013) "Developed Multinomial Logit model by using household travel survey data from Beijing, China"