

Mode Choice Analysis using Statistical Models and Soft Computing Models: A Review

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Abstract

Traffic congestion problems are common in all urban areas in India. Mode choice plays a very important role in the four-stage travel demand modelling in the transportation planning process. It affects the efficiency of the commuters' travel within the city. Various socioeconomic, land, travel factors are responsible for the mode choice selection. This paper reviews the various researches carried out to define the mode choice of the people living in various cities of India and Abroad. This paper specifically gives attention to various models like Multinomial Logit Model, Neural network model and software such as Statistical Data Processing Software (SPSS) are used in the analysis and the modelling process. Parameters such as age, gender, income, Travel Time, Travel Cost, Travel distance plays a vital role in deciding the mode choice of the commuters.

Keywords: - *Mode choice, Transportation planning, Travel Behaviour, Multinomial Logit Model, Mode Choice Modelling*

INTRODUCTION

Mass residential area planning is critical in deciding the mode preferences and travel actions of commuters living in similar societies. One of the essential steps in four-modelling is the choice of mode, which directly affects policymaking decisions. It can be said that a decision on which model to use in various conditions is a method of arriving at. A commuter's choice of a particular mode affects the overall efficiency of travel within the city. Mode selection models deal with the behaviour of human decision making and thus tend to attract researchers for further study of selecting

a commuter. One of the most important models of transport planning is the choice of transport mode. Three major factors influence mode choice behaviour: socioeconomic factors, travel characteristics, and built environment characteristics. On average, the developing-world cities are denser than developed-world cities, and vehicle ownership is also growing. The global car and motorcycle fleet has experienced enormous growth over the same era. Over the following decades, motor-vehicle fleets will double. This trend is driven by households in developing-world cities, particularly in India. Several researchers

have done various works in the field of mode choice. Various soft wares such as Statistical Data Processing Software (SPSS), NLogit, or LIMDEP are used to develop multiple mode choice statistical models such as Multinomial Logit model, Nested Logit model, Mixed Logit models and artificial intelligence models such as Neural Network models.

LITERATURE REVIEW

Bhat (1995) developed a new heteroscedastic Extreme Value model of intercity mode choice that overcame the 'IIA' property of the widely used Multinomial Logit model. Exploration of the effect of enhanced rail service of business travel in the Toronto- Montreal corridor was calculated by Multinomial Logit (MNL), alternative nested logit models, and the heteroscedastic model. The results pointed to the shortcomings of the Multinomial Logit and nested logit models in the study of options behaviour in intercity mode and the usefulness of the heteroscedastic model proposed in this paper.

For Delhi results, Sekhar (1999) performed a mode choice analysis. Study of option based on MNL and Artificial Neural Network (ANN) model was formulated in this study style, and the comparative study between both was performed. The ANN model based on vehicle ownership was developed, and the Algorithm for backpropagation was used to train the ANN model. The relative significance of the input parameters was established, and the use of Object-Oriented Programming (OOP) to implement the ANN network was made. Study findings established that the Multinomial logit model was outperforming the ANN model.

Addelwahab and Abdel-Aty (2001) developed a mode selection model for Florida, USA. The mode selection model was measured at a nested logit structure of three levels—the overall model used for maximum probability estimation of complete knowledge. Among the significant variables entered in the model are access time for transit, waiting time for transit, transfer number, travel time for vehicles, fare and ownership of cars in the home.

Xie et al. (2003) examined the ability and efficiency of two new pattern recognition data mining methods in work travel mode modelling: decision trees (DT) and neural networks (NN) modelling. Model data sets from the San Francisco Bay Area Travel Survey (BATS) 2000 are used for model estimation and evaluation. Models are defined, estimated and comparatively evaluated with Multinomial Logit (MNL). The prediction results showed that the two data mining models provided comparable but slightly better performance in terms of simulation results than the Multinomial Logit Model. In contrast, the DT model displayed the highest estimation efficiency and the clearest interpretability, and in most situations, the NN model delivered superior prediction performance.

Kamba et al. (2007) applied the Multinomial Logit model during their study on identifying factors that prevent car users from switching over to public transport.

Prashker et al. (2008) examined various factors that affect the choice of location of the individual's residence and the role of the commute trip in that decision. Attempts were made to describe how socioeconomic factors and community characteristics affect residential decisions,

focusing on behavioural disparities between the genders. The study was based on the data from the Israel Census for the metropolitan area of Tel Aviv and both descriptive statistics and a Logit preference model estimate. The findings concluded by showing the significance of both the area characteristics and the distance to the commute when selecting a residential location and major discrepancies between men and women. The value of commute distance in the choice of residential location decreased with an increase in one's income level, educational level and car number in one's household.

Ravi Sekhar et al. (2009) researched the use of Neural Networks applications of modelling in the mode of choice for Indian metropolitan cities of second order. Their research considered Vishakhapatnam and Nagpur City's mode choice behaviour and implemented Multinomial logit and Artificial Neural Network Models. This research concluded that solutions for the Neural Network outperform current data analysis and forecast techniques such as logit models.

Ramali et al. (2010) developed the binomial logit model to evaluate the variables affecting people's choice of mode for making their market ride. The field of study was Makassar, in Indonesia. The samples of the households surveyed were 347 out of 2527. System production has been the enemy of private modes such as car or two-wheelers and para-transit or public transport. Input parameters included socioeconomic and travel characteristics. Classification accuracy for model production was found to be 84.5 per cent, and the maximum likelihood was found to be 0.467, which is appropriate because the probability range is greater than 0.2.

Ashalatha et al. (2013) conducted research where Multinomial Logistic Regression was used to test commuters' mode of choice behaviour in Thiruvananthapuram. They sought to classify the various factors that led to particular mode selection. The research used Multinomial Logistic (MNL) modelling. The results showed that travel time and travel cost as the age of the commuters played an essential role in determining the Thiruvananthapuram city's mode of choice. As the age increased, the preference for cars grew, decreasing the preference for two-wheelers. An increase in time and cost per distance caused the commuters to shift their mode from public transport to cars and two-wheelers.

Tushara et al. (2013) researched "Modeling job trip selection models in Calicut Region." Under this study, the employees' mode preference behaviour in Calicut city was investigated. The Multinomial Logit Model (MNL) with Statistical Data Processing Software SPSS was used to classify travel patterns and mode selection of Calicut City employees working. The main aims of this study were to define the different variables influencing employee mode choice behaviour and then establish a travel mode choice model for work trips in Calicut City. The results showed that age, gender, employment, time, and cost are the most significant factors influencing the behaviour of mode choice. For their work trips, 62.8 per cent of employees chose two-wheelers as their crucial mode. The least preferred methods among working groups are auto and walk.

Minal and Sekhar (2014) prepared a paper on "Analysis of Mode Selection: Data, Models and Future." The study's objective was to perform a thorough overview of various modelling

approaches associated with mode option analysis and the same bottlenecks. This paper focused on various models such as models of the Artificial Neural Network (ANN) and model of the Fuzzy method, which are used for modal split analysis. Comparative analysis has been made between various modelling techniques. The findings demonstrated the various facets of mode choice as a planning method for transportation. Hybrid models looked more promising to tackle India's heterogeneous traffic. The paper also concluded that Neuro-Fuzzy Models gives better results than individual models.

Chanda et al. (2016) researched "Modeling job trip selection models: a Kolkata case study." Through this analysis, it was calculated the modal share of the Garia-Park Corridor work trips through Kolkata. The parameters selected for the modelling were Travel Time (TT), Travel Cost (TC), Comfort, Convenience (Waiting Time), Reliability and Dust and Noise. A questionnaire survey is used to collect the needed data, and Psychometric Scaling Technique is used to scale the preferences specified. The study's objective was to evaluate the Weight Vector of the different attributes and share the model using Logit Software and establish the utility function. The results showed that the Travel Time, Travel Cost and Waiting Time were only considered for the development of utility functions. It was found that 82% of working trips favoured buses, 17% favoured para-transits, and only 1% wanted personal cars.

Panara et al. (2017) carried out work on models of mode choice in Ahmedabad City's west region. The study's goals were to classify people's travel behaviour and study the factors influencing mode

choice and different mode choice models. This also concentrated on designing the most appropriate model for study area work trips and comparing the model created with the current model. SPSS programming has been used in model development, and travel time and travel costs are known as autonomous variables.

Desai et al. (2018) researched "Analysis of the choice of mode and its dependence on time, cost, distance and intent of travel: a case study of wards in Ahmedabad City's southern region." The main aim of this study was to identify people's actions in choosing travel mode and to identify the factors influencing trip-makers' mode choice behaviour. It also concentrated on updating the trip modes preferences survey and planning the Multinomial logit model for various modes of transportation.

Juremalani et al. (2018) conducted research. They analyzed shopping trip characteristics in Vadodara City under mixed traffic conditions so that land use could be planned and built to facilitate the use of non-motorized vehicles accordingly. Socioeconomic factors were considered, along with the travel characteristics. The findings concluded that the use of bicycles and walking was more dependent on journey distance and was also restricted to just 3 km and 2 km. Beyond that, the use of motor vehicles increased.

CONCLUSIONS

Several mode selection studies show the mode selection analysis as a major step in transportation planning's four-stage modelling. It can be assumed that deciding the mode option is very important as it determines which mode will be used by the majority of people living in a given place. Several characteristics are to be considered in deciding

which model to use. Among various logit models, the Multinomial logit model is the most commonly used, as it is the standard model used to pick mode. These Nested logit models, mixed logit models, Fuzzy logic models and Neural Network models have also been considered. Work trips have been the main focus of the researchers. There is a need to study the other trips of the commuters as that also plays an essential role in deciding the mode choice.

It can be seen that major researches have been focused on the city level analysis, and specific location has not been targeted. There is a critical need to study the commuter's behaviour living in specific locations rather than considering the city as a whole, as many factors remain untouched. At the same time, we look at the city as a whole.

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