

A Review on Mode Choice Analysis Employing Statistical and Soft Computing Models

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Abstract

Traffic congestion is a common occurrence in India's urban areas. The efficiency of commuters' movement within the city is determined by mode choice, which is a key component of the transportation planning process' four-stage travel demand modelling. A number of economic, land, and travel concerns determine mode choice. This research looks at a number of studies that have been carried out to identify the mode preferences of people in various places in India and abroad. The analysis and modelling procedure in this study uses a variety of models, including the Multinomial Logit Model and the Neural Network Model, as well as software, such as Statistical Data Processing Software (SPSS). Commuters' mode of transportation is influenced by their age, gender, income, trip time, travel cost, and journey distance.

Keywords: - *The terms "mode choice," "transportation planning," "travel behaviour," "multinomial logit model," and "mode choice modelling" can all be used to explain how people travel.*

INTRODUCTION

In similar civilizations, mass residential area development is critical in affecting commuters' mode preferences and travel behaviours. One of the most crucial tasks in four-modelling is selecting a mode

which has a direct impact on policymaking decisions. A selection on which mode to use in specific scenarios might be defined as a technique of arriving at. A commuter's mode of transportation has an effect on the overall efficiency of mobility within the

city. Models of mode selection deal with human decision-making. Hence they appeal to scholars interested in learning more about how to choose a commuter. One of the most important forms of transportation planning is transportation mode selection. Three major factors influence mode choice behaviour: socioeconomic factors, travel characteristics, and built environment elements. In developing-world cities, population density is higher than in developed-world cities, and automobile ownership is on the rise. The global car and motorcycle fleets have risen considerably over the same time span. In the next few decades, the number of cars on the road will double. This trend is being driven by households in developing-world cities, particularly in India. A number of academics have worked on various initiatives related to mode choice. Statistical Data Processing Software (SPSS) NLogit, or LIMDEP are used to create various mode choice statistical models such as Multinomial Logit model, Nested Logit model, Mixed Logit model, and artificial intelligence models such as Neural Network models.

LITERATURE REVIEW

Bhat (1995) developed a new heteroscedastic Extreme Value model of

intercity mode selection that overcomes the IIA issue of the Multinomial Logit model.

The effect of better rail service on business travel in the Toronto-Montreal corridor was calculated using the Multinomial Logit (MNL), several nested logit models, and the heteroscedastic model. The results indicated the limitations of the Multinomial Logit and nested logit models in the analysis of intercity option behaviour, as well as the usefulness of the heteroscedastic model proposed in this work. In the case of the Delhi results, Sekhar (1999) conducted a model selection analysis. In this study style, an options study based on MNL and an Artificial Neural Network (ANN) model was formulated, and a comparative study was performed.

The ANN model was developed based on vehicle ownership, and the Algorithm for backpropagation was used to train the ANN model. The relative importance of the input parameters was determined, and the ANN network was implemented using Object Oriented Programming (OOP). According to the study's findings, the Multinomial logit model outperformed the ANN model. Addelwahab and Abdel-Aty (2001) developed a mode selection model

for the US state of Florida. A three-level nested logit structure was used to evaluate the model selection model. The overall model for calculating the maximum likelihood of full knowledge. Among the significant variables entered into the model are access time for transit, waiting time for transit, transfer number, travel time for vehicles, fare, and homeownership of cars.

X Xie et al. (2003) investigated the capability and efficacy of two new pattern recognition data mining methods in the context of work travel mode modelling: decision trees (DT) and neural networks (NN). Model data sets from the San Francisco Bay Area Travel Survey (BATS) 2000 are used for model estimation and evaluation.

Multinomial Logit is used to define, estimate, and compare models (MNL). The prediction results revealed that the two data mining models provided comparable but slightly better simulation results than the Multinomial Logit Model, with the DT model displaying the highest estimation efficiency and the clearest interpretability and the NN model delivering superior prediction performance in most situations.

Kamba et al. (2007) used the Multinomial Logit model to identify factors that

discourage car users from using public transportation.

Prashker et al. (2008) investigated the factors that influence a person's choice of residence location, as well as the role of the commute trip in that decision. There was an attempt to describe how socioeconomic factors and community characteristics influence residential decisions, with a focus on gender differences in behaviour. The study incorporated Israel Census data for the Tel Aviv metropolitan area, as well as descriptive statistics and a Logit preference model estimate.

The findings concluded by demonstrating the importance of both area characteristics and commute distance when selecting a residential location, as well as significant gender differences. The value of commute distance in the choice of residential location decreased as one's income level, educational level, and the number of cars in one's household increased.

Ravi Sekhar et al. (2009) looked into the use of Neural network modelling applications as a mode of choice for second-order metropolitan cities in India. They employed Multinomial Logit and Artificial Neural Network Models to look

at the mode choice behaviour of Vishakhapatnam and Nagpur City. According to the findings, neural network solutions surpass current data analysis and forecasting techniques like logit models.

Ramali et al. (2010) developed the binomial logit model to investigate the factors that influence people's choice of mode for getting to the market. The study took place in Makassar, Indonesia. A total of 347 households were surveyed, out of a total of 2527.

Private modes of mobility, such as cars and two-wheelers, have long been pitted against system production, as have paratransit and public transportation. The input parameters included socioeconomic and travel characteristics. The highest likelihood was determined to be 0.467, which is reasonable given the probability range of more than 0.2. The maximum likelihood was determined to be 84.5 percent, while the classification accuracy for model production was found to be 84.5 percent.

Ashalatha et al. (2013) used Multinomial Logistic Regression to test commuters' mode of choice behaviour in Thiruvananthapuram. They attempted to classify the many elements that influenced

mode choice. In this study, Multinomial Logistic (MNL) modelling was used. According to the data, journey duration and cost, as well as commuter age, played a significant effect in influencing Thiruvananthapuram's mode of choice. People's preferences for vehicles climbed as they grew older, whereas their preferences for two-wheelers fell. Commuters switched from public transit to cars and two-wheelers when time and expense per kilometre increased.

Tushara et al. (2013) conducted research on "Modeling job trip selection models in the Calicut Region." This study looked into the mode preference behaviour of Calicut city employees. 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 primary objectives of this research were to identify the various variables that influence employee mode choice behaviour and then to develop a travel mode choice model for work trips in Calicut City.

According to the findings, the most important factors influencing mode choice behaviour are age, gender, employment, time, and cost. Sixty-two percent of

employees chose motorcycles as their primary mode of transportation for work trips. Among working groups, driving and walking are the least preferred modes of transportation.

"Mode Selection Analysis: Data, Models, and the Future," published by Minal and Sekhar (2014). The goal of this research was to give a full overview of the many modelling approaches utilized in mode option analysis, as well as the bottlenecks that come with them.

Many models for modal split analysis were described in this article, including models based on the Artificial Neural Network (ANN) and models based on the Fuzzy approach. A comparison of several modelling approaches was carried out. The results revealed a variety of aspects of model selection as a transportation planning strategy. For India's diversified traffic, hybrid versions appeared to hold greater potential. Furthermore, Neuro-Fuzzy Models outperform individual models, according to the findings.

A paper titled "Modeling job trip selection models: a case study of Kolkata" was published by **Chanda et al. (2016)**. This study was used to calculate the modal share of Garia-Park Corridor work trips

through Kolkata. The criteria considered in the modelling were Travel Time (TT), Travel Cost (TC), Comfort, Convenience (Waiting Time), Reliability, and Dust and Noise. To collect the necessary data, a questionnaire survey is used, and the reported preferences are scaled using a Psychometric Scaling Technique. The goal of this study was to use Logit Software to analyze the Weight Vectors for various features and the model's sharing, as well as to build the utility function. The findings revealed that when building utility functions, journey time, travel cost, and waiting time were all considered. Buses were preferred by 82 percent of working trips, 17 percent preferred paratransit, and only 1% preferred personal autos.

Panara et al. (2017) conducted mode selection model research in Ahmedabad's western region. The study's goals were to identify people's travel habits and to investigate the factors that influence mode selection as well as the various types of mode selection models. Furthermore, this focused on developing the best model for study area work visits and comparing it to the current model. The model was created using SPSS programming, and trip time and expenditures are referred to as autonomous variables.

Desai et al. (2018) published "Analysis of mode selection and its relationship to time, cost, distance, and purpose of travel: a case study of wards in Ahmedabad's southern region" in their article. The primary goal of this study was to determine how people behave when it comes to mode selection and what factors influence trip makers' mode selection behaviour. It also concentrated on improving the trip mode choice survey and creating a multinomial logit model for various modes of transportation.

Juremalani et al. (2018) studied and analyzed shopping trip characteristics in Vadodara City under mixed traffic conditions in order to design and build land use to accommodate non-motorized vehicle use. In addition to travel factors, socioeconomic characteristics were investigated. The findings revealed that bicycle and walking use was more dependent on journey distance and was also limited to only 3 and 2 kilometres, respectively, after which significant use of motor vehicles occurred.

CONCLUSIONS

Several mode selection studies show that model selection analysis is an important step in the four-stage transportation planning modelling process. Mode

selection is assumed to be critical because it determines which mode will be used by the majority of people living in a given location. When deciding which model to use, several factors must be considered. Among the many logit models, Because it is the standard model for mode selection, the multinomial logit model is the most commonly used model.

In addition to these, the nested logit model, mixed logit model, fuzzy logic model, and neural network model were taken into account. The primary focus of the researchers has been on work trips. There is a need to investigate commuters' other trips as well, as they play a significant role in mode choice. It is clear that major studies have concentrated on city-level analysis, with no specific location in mind. Many factors are overlooked when we look at the city as a whole, so it is critical to study commuter behaviour in specific locations rather than the city as a whole.

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