Statistical Model for Airport Access Mode Choice to Address Congestion at Airport

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Abstract - **The prediction of air passenger's mode choice decision to and from airport forms a key analytical component of airport management system. And help to define strategies of Inbound and Outbound process together to minimize congestion at airport terminal. The goal of this proposed model is to perform mode choice analysis by using customized Multinomial Logit Model (MNL) for Indian transport facilities and factors associated with it. The resulting parameters used to perform decision making process for airport expansion and management schema. In addition, it helps to define smart solution for ease congestion at airport terminal**

INTRODUCTION

As recent studies show that, airport access mode implies 1/6 traffic from city center to airport and passengers are crawling in traffic to and from airport. Current airport expansion schema need to provide compatibility with efficient and high speed airport access. Mode choice models help to predict passenger's most attractive mode of transport, preference of passenger's arrival time and give useful insight into route decisions to minimize congestion at and around airports.

Airport access mode choice creates impact on air service quality, passengers' service time and supplementary reasons for airport congestion. To address the above challenges, this thesis paper helps to improve the existing approaches and strategic planning of airport access mode.

To develop a statistical approach for the understanding and evaluation of the airport access mode choice problem, Indian airports are considered with several alternatives of transportation modes and some most affecting factors. The approach presented and illustrated in this thesis paper is able to serve common platform for better integration planning and decision-making schemes for airport management system and airport congestion control. Additionally, the calibrated model and factors considered with Indian transportations are capable to assist the planning of airport ground access services at international airports.

LITERATURE REVIEW

Aleksandra (2016) stated which factors are influencing more in choice of transport mode for Warsaw Chopin Airport (WAW).Here simple statistical analysis is compared with regression tree model. Homogeneity factors in passengers group is used for regression tree algorithm. This decides which predictor is important and how it is used for mode split.

As past studies has shown Multinomial Logit models, exhibit very high levels of prediction performance compare to other model of statistical analysis.

In this paper *Amir Reza Mamdoohi et al (2013)* stated that Mode choice modeling has potential to predict and analyze factors affecting Air passengers flow to airport terminal. Based on data gathered Multinomial Logit Model is used to define result that access mode choice is significantly affected by travel time, travel cost trip purpose and economical status.

Built Environment BEs studies and transport mode access choice proposed that more choice need to be diverted to less use of private car and more public transport usage. By considering this factor, *Mahdi Yazdanpanah (2017)* uses hybrid choice model (HCM) to capture the effect of the latent variable within the choice process the result oriented helps to policymakers must focus on finding a better solution for more convenient access of Airport terminal. HCM is composed of attributes of alternatives, explanatory variables, and the latent variable to the utility function of the transportation modes.

Lothar Bondzio describes choice behavior of departing passenger and effect in quality of airport access on its travel behavior. Model proposed estimation in random utility for airport choice and airport access mode choice. This aggregate results focus on specific approach for policies and decision making aspect.

Airport Ground Access and Egress Passenger Flow Model (AGAP) proposed by *Dr. Milan Stefani*k work on innovative approach to passengers and baggage flow simulation in door to door transportation process. The separate algorithm of transport modes choice is embedded in AGAP Model for evaluation of passengers more preferred transportation in term of travel cost, travel time and comfort.

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Stephane Hess et al (2006) presented an analysis of air travel choice behavior in the San Francisco Bay. Formulated model combines choice of airport, airline and access mode for departing passengers. It also defines correlation along these three dimensions for airport commercial development. The result stated that this analysis have a significant impact on the attractiveness of an airport, airline and its growth.

The analysis method is more effective for the airport access mode choice by passengers. *Ilgin Gokasar (2017)* used Multinomial Logit (MNL) focus is on how transit areas of influence affect the mode choice for travelling to airports. The results orient conclude that significant factors and variables that directly affects the access to Atatürk International Airport (IST) in Istanbul.

Use of public transit for airport access has been recommended or its evidence presented by several studies *(Monteiro and Hansen, 1996; Gupta et al., 2008; Budd et al., 2011).*

Separation of passengers in terms of trip purposes as business and non-business were considered to be essential in several studies *(Harvey, 1986; Hess and Polak, 2006; Gupta et al., 2008; Tam et al., 2008; Akar, 2013; Choo et al., 2013).*

Yu-ChunChang(2013) had used survey data from Taiwanese sample data for analysis. The study shows which factors are really affecting for airport access mode choice. The analysis concludes that elderly passengers are more like to travel by private transport than public transport.

Mei-Ling Tam et al (2011) proposed analysis method. The paper initially determines impact of travel time reliability on mode choice decisions. It also identifies service quality in calibration of airport access. Multinomial Logit (MNL) is used as statistical model to forecast strategic planning of Hong Kong International Airport.

PROBLEM STATEMENT

The thesis paper focuses on Airport access mode choice for Indian Airport and transportation system. The problem elaborated that identifying most preferred transportation mode by passengers and influencing factors for this preference. In order to deal with this scenario, resulting prediction creates smooth interface between airport access and congestion control system. The five types of transportation mode and Factors influencing the choice of mode are considered in this thesis paper.

Transportation Mode: Car, Bus, Metro, Taxi, Auto.

Factors influencing the choice of mode: Seasons ,Travel Cost, Time of Day, Group size, Purpose of air travel, Travel comfort, Travel class, Economical status.

PROPOSED WORK

4.1 Introduction
Transportation Mode (Dependent Variable): Car, Bus, Metro, Taxi, Auto
Factors influencing choice of transportation mode (X): Predictors
X1-Seasons: (summer, winter, Rainy)

X2-Time of Day: (Morning = 6am to 9 am, Mid-Morning= 9am to 12 noon, Afternoon= 12pm to 3pm, Mid-Afternoon= 3pm to 6pm, evening=6pm to 9pm, night=9pm to 12noon, mid-night =12am to 3am, early morning =3am to 6am)

X3- Group size: (1-2, 2-4, 4-10, 10-30)

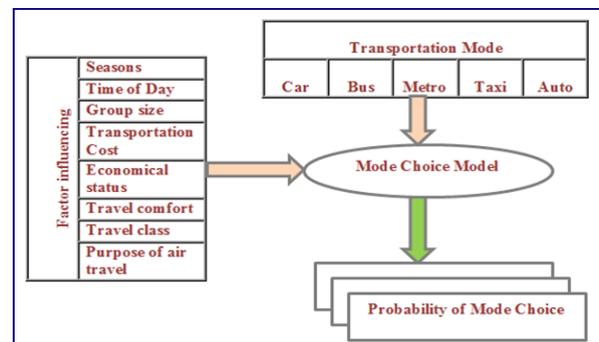X4-Transportation Cost

X5- Economical status: (High, Medium)

X6-Travel comfort (1-High, 2-Medium, 3 -Low)

X7- Travel class (1-economy; 2-business,3- first)

X8-Purpose of air travel (1-private; 2- business)

4.2 Working Model
The working model described with the help of following diagram. The Multinomial Logit Model considers inputs of total eight influencing factors and available transportation mode for Indian Airport. The output is depicted as probabilities of preferred transport mode choice by air passengers.

Fig. 1

4.3 Variables Declaration

m: Transportation modes

n: Total number of Factors
b(m): Perception of mode m / Weightage of each factor like (b1, b2, b3, b4, b5, b6, b7, b8)

Pm : Probability of travelling on mode m

Exp (Um) = e, about 2.17, raised to the power of Um

U(m): The utility of travel by mode m

4.4   Steps for the Multinomial Logit Model

Step 1: Input *Dependent Variable and* Predictors to Model.

Step 2: Calculate Utility of Each Mode of Transportation.

$$U(m) = b(m) + \sum_{i=1}^{n=8} bi * Xi\,(m)$$

Step 3: Calculate exponential of utility Exp(Um).

Step 4: A multinomial Logit model gives the proportion of travelers who would use mode m (Pm) as the following.

Pm = [Exp (Um)] / [Sum of Exp (Um)]

Step 5: Display the Results.

CONCLUSION AND FUTURE WORK

In order to provide more information on how to improve the service of various transport modes and supplement for airport congestion control, the model gives results into prediction probabilities. The proposed Multinomial Logit Model (MNL) is customized for Indian Airport which is able to calculate impact of passenger's preferred arrival time (PAT) and ultimately congestion at airport terminal. It also helps to define the interface between airport access systems with Airport management system. Furthermore, it can be extended for decision making process in airport expansion schemes and strategic planning to manage the passenger's flow at airport terminal.

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