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ACTIVITY BASED MODELING FOR MODE CHOICE ANALYSIS OF TOWNS-A CASE STUDY IN KERALA

SOOSAN GEORGE T[1], KRISHNAPRIYA M. G[2] & MILIMOL PHILIP[3]

[1]Professor, Department of Civil Engineering, MACE, Kothamangalam, Kerala, India

[2]Research Scholar, MACE Kothamangalam, Kerala, India

[3]M.Tech Student, Government RIT Kottayam, Kerala, India

ABSTRACT

Transportation planning is a science that seeks to study the problems that arrive in providing transportation facilities in an urban, regional or national setting and to prepare a systematic basis for planning such facilities. Trip based approach have been used to formulate model in early times. The behavioral inadequacy of the trip-based approach, and the consequent limitations of the approach in evaluating demand management policies, has led to the emergence of the activity-based approach to demand analysis which views travel as a derived demand; derived from the need to pursue activities. We have collected 150 samples, 50 each from three urban areas in Ernakulam district of Kerala, India by house hold survey. The study required data regarding household characteristics, economic status, and trip characteristics. These variables are used for the model formulation. We have analyzed the data using the software, SPSS and a mode choice model was formulated for each of the three places.

KEYWORDS: Activity Based Approach, Mode Choice, Multinomial Logit Model, SPSS, Travel Behavior

INTRODUCTION

The need for realistic representations of behaviour in travel demand modelling is well acknowledged in the literature. The result has been an increasing realization in the field that the traditional statistically-oriented trip based modeling approach to travel demand analysis needs to be replaced by a more behaviorally-oriented activity-based modeling approach. Travel demand is an important tool in transportation planning which is generated using socio economic data such as house hold size, automobile availability and employment data. Mode choice analysis is the third step in the conventional four-step transportation forecasting model, following trip generation and trip distribution but before route assignment. Mode choice is an important component of a traveler's decision regarding trip making. Similar to any decision making process, mode choice also includes the factors like decision maker, alternatives, attributes of the alternatives and decision rules for selecting a particular alternative from the available alternatives. This study is an effort to understand the various factors influencing the mode choice in the study area and then to develop separate mode choice models for the three study areas.

LITERATURE REVIEW

The activity-based approach requires time-use survey data for analysis and destination. A time-use survey entails the collection of data regarding all activities (in home and out-of-home) pursued by individuals over the course of a day (or multiple days). Travel constitutes the medium for transporting oneself between spatially dislocated activity participations. The examination of both in-home and out-of-home activities facilitates an understanding of how individuals substitute out-of-home activities for in-home activities (or vice-versa) in response to changing travel conditions. This, in

turn, translates to an understanding of when trips are generated or suppressed. It is important to note that administrating time-use surveys is similar to administrating household travel surveys, except for collection of in-home as well as out of-home activities. The information elicited from respondents is a little more extensive in time-use surveys compared to travel surveys, but experience suggests that the respondent burden or response rates are not significantly different between time-use and travel surveys.

The activity-based approach does require more careful and extensive preparation of data to construct entire "sequences" of activities and travel. On the other hand, such intensive scrutiny of data helps identify data inconsistencies which might go unchecked in the trip-based approach .For example, there might be "gaps" in an individual's travel diary because of non-reporting of several trips, these will be identified during data preparation for activity analysis, but may not be identified in the trip-based approach since it highlights individual trips and not the sequence between trips and activities.

STUDY AREA

We have chosen our study area as Perumbavoor, Kothamangalam and Muvattupuzha since Perumbavoor is a satellite town of Kochi city and a municipality in Ernakulam District in the Indian state of Kerala. Kothamangalam is the gateway to high range. The highway NH-85 Ernakulam - Madurai- Rameswaram passes through this town. Muvattupuzha is the junction of three districts namely Ernakulam, Kottayam, Idukki.

THEORETICAL FRAMEWORK

The Multinomial logit model is more popular and widely used one due to its computational tractability. However, this model application is cautioned because of IIA property. The proposed model formulation to predict the mode choice in the present study is as follows:

$$Pin = \frac{exp(Vin)}{\sum_{m \epsilon M} exp(Vim)} \text{ ---------- } (1)$$

Where, Pin= probability of choosing mode, i‟ by decision maker „n‟ from a choice set, Jn Vin, Vkn = Observed component of disutility for modes‟ i‟ &‟k‟ respectively. Multinomial logistic regression is used to analyse relationships between a dependent variable and independent variables. It compares multiple groups through a combination of logistic regressions. The group comparisons are equivalent to the comparisons for a dummy-coded dependent variable, with the group with the highest numeric score used as the reference group.

For each independent variable, there would be two comparisons. Multinomial logistic regression provides a set of coefficients for each of the two comparisons. The coefficients for the reference group are all zeros, similar to the coefficients for the reference group for a dummy-coded variable. Thus, there are three equations, one for each of the groups defined by the dependent variable. The three equations can be used to compute the probability that a subject is a member of each of the three groups. A case is predicted to belong to the group associated with the highest probability.

DATA COLLECTION

The study required data regarding household characteristics, economic status, and trip characteristics. Household characteristics include gender and family size. Economic status includes their annual income, floor area, educational qualification, type and number of owned vehicle. Trip characteristics include purpose of trip, origin, destination, mode they used. Mode is categorized into private vehicles, public vehicles and by walk. These variables can be used in the model formulation to develop suitable mode choice models. All these data were obtained by household survey. We have

collected 150 samples, 50 each from Muvattupuzha, Perumbavoor and Kothamangalam, three most important towns of Ernaulam district of Kerala, India.

PRELIMINARY ANALYSIS

From table 1 it is clear that males prefer to travel by private vehicles compared to females, who mostly depend on public vehicles for their travel needs.

Table 1: Effect of Gender on Mode Choice

Gender	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
Male	53.3%	38.3%	63.4%	28 .6%	49.0%	28 .9%
Female	38 .3%	52.1%	41.9%	48 .4%	19.5%	52.4%

From table 2 it is clear that there is not much influence of family size on mode choice.

Table 2: Effect of Family Size on Mode Choice

Family Size	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
3	2 8%	24%	71.9%	21.1%	52.9%	29.4%
4	18 %	34%	68 .7%	29.9%	28 .8 %	50.0%
5	31%	24%	38.1%	47.6%	40.7%	35.6%
6	23%	18 %	39.4%	42.4%	72.7%	18 .2%

Table 3 shows that public vehicles are mostly used by employed people where as the unemployed people use private vehicles.

Table 3: Effect of Occupation on Mode Choice

Occupation	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
Employed	32.9%	53.9%	20.0%	69.5%	22.7%	55.7%
Unemployed	59.5%	35.3%	2.6%	10.1%	54.7%	2 .2%

Table 4 shows that highly qualified people use private vehicles where as students and the less qualified ones depend on public vehicles.

Table 4: Effect of Qualification on Mode Choice

Qualification	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
Student	16.1%	61.3%	17.3%	74.7%	23.6%	59.7%
Sslc	33.3%	42.9%	73.7%	10.5%	45.1%	7. 8%
Predegree	30.0%	60.0%	90.9%	9.1%	62.5%	25.0%
Conventional	26.7%	66.7%	91.7%	8.3%	54.5%	18 .2%
Professionel	40.7%	57.0%	65.2%	17.4%	42.3%	34.6%
Masters	77.4%	19.4%	75.0%	25.0%	21.4%	64.3%

As per table 5 high income people has an affinity towards private vehicles than the low income people.

Table 5: Effect of Annual Income on Mode Choice

Annual Income	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
< 50,000	29.4%	58.8%	39.1%	30.4%	41.0%	34.9%
50,000-99,999	28.6%	53.3%	50.0%	44.4%	100.0%	0.0%
1,00,000-2,49,999	53.9%	35.7%	61.1%	35.4%	43.0%	26.6%
2,50,000-5,00,000	58%	34. 8%	73.9%	26.1%	37.0%	50.0%

From table 6 we can understand that shopping and job trips are by private vehicles, but educational trips are done by public vehicles.

Table 6: Effect of Purpose on Mode Choice

Purpose	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
Job	63%	33.5%	83.6%	12.7%	53.4%	29.3%
Education	29.4%	57.4%	17.6%	72.5%	25.0%	60.0%
Home	46.6%	43.6%	59.5%	31.5%	39.1%	37.4%
Shopping	42.3%	34.6%	75.0%	6.2%	22.2%	22.2%

EXPLANATORY VARIABLES

The explanatory variables used in the mode choice model development using SPSS are as given below.

Table 7: Explanatory Variables

Symbol	Explanation	Symbol	Explanation
EMP	Employed	Inc_2	10000-50000
UEP	Unemployed	Inc_3	50001-99999
ST	Student	Inc_4	100000-249999
SS	Sslc	Inc_5	250000-500000
PR	Predegree	Jb	Job
CN	Conventional	Pry	Prayer
PRF	Proffessional	Edu	Education
INC_1	<10000(income)	Hm	Home

MODEL DEVELOPMENT

The main factors influencing the mode choice for trips of the study area are occupational status, annual income, qualification, purpose etc. The coefficients of the formulated model in the three places are summarized in Table 8.

Table 8: Parameter Estimates

Variables	Muvattupuzha		Kothamangalam		Perumbavoor	
	Private	Public	Private	Public	Private	Public
INTERCEPT	51.283	17.768	16.008	17.005	16.099	17.078
EMP	-2.180	12.503	18.181	18.272	1.5	2.263
UEP	2.085	11.986	18.762	18.201	2.429	1.780
ST	-12.480	-9.96	-3.758	-2.062	1.407	-.638
SS	-16.263	-14.068	-1.925	.967	.770	-1.826
PR	-3.077	-0.190	-2.397	-.464	3.211	1.423
CN	-3.312	-0.404	-2.184	-.461	1.664	.180
PRF	-15.597	-13.266	-.701	.804	1.656	.252
JB	-18.992	2.527	.573	.149	-.668	-.984
PRY	-5.781	-1.9320	0	0	-2.670	-20.059
EDU	-20.430	3.253	.804	.794	-.390	-.610
HM	-19.610	-2.866	.752	.576	-.604	-.949
SHP	-20.004	-3.738	0	0	0	0
INC1	-17.168	-15	-1.209	.974	-17.914	-17.095
INC2	-17.428	-13.7	-.36	.920	-.533	-17.880
INC3	-1.420	-0.263	.917	1.094	-18.046	-17.092
INC4	-2.605	-0.486	0	0	-17.644	-16.995
INC5	0	0	0	0	0	0

CONCLUSIONS

In all the three locations employed persons prefer public vehicle than private, whereas unemployed people have a positive effect on public vehicle. Professionals prefer private vehicle compared to public vehicle in Kothamangalam and Perumbavoor. As far as purpose is considered, people prefer public vehicle for education in the three locations. In case of income, as the income increases the preference to private vehicle increases. The travel characteristics like origin, destination and duration are important but it does not appear in the mode choice models. No such variables are significant in the study. It may be due to the selected study area. Weight ages for the attributes may not suit the socioeconomic characters of the location.

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