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Mode Choice Modelling for Work Trips in Kathmandu Valley

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Abstract
Choice of particular mode in work trips has significant impact in transport planning decision.The research focuses on investigating the factors that affect the employed people's choice for transport mode and develop mode choice model for work trips in Kathmandu Valley.Multinomial logistic regression model with statistical data processing software SPSS explain travel patterns and mode choice of employees residing in Kathmandu Valley. Monthly income, gender, travel time and travel cost significantly affect the choice of transport mode.

Keywords
Mode choice, Work trips, Multinomial logistic regression model

1. Introduction

Work trips are centre of focus of urban transportation planning and policy analysis. Work trips are one of the reasons for traffic congestion in peak hours. Mode choice is an important criterion which affects traffic congestion. People may choose a mode out of many available modes and many factors are responsible for a mode choice decision.A proper analysis of the mode choice decisions can help in addressing issues such as forecasting demand for new modes of transport, mitigating traffic congestion, allocating resources, examining the general efficiency of travel and providing information about the traveller's behaviour.

Kathmandu Valley is the centre of administration, industrial, commercial, social and economic activities due to which it is the most densely populated region in Nepal and its population has been increasing rapidly during the past two decades.[1]It is considered to be the engine of growth and economic hub of Nepal.In 2022, population in the Kathmandu Valley is assumed to be 3,835,600 with an annual growth rate of 4.18%.[1]Motorcycle and car ownership of household in Kathmandu Valley will increase to 1.72 and 2.40 times of the present level.

Mode choice behaviour varies from place to place due to differences in socio-economic behaviour,traveller's attitude and infrastructure facilities.Without knowing the traveller's needs and preferences it's very difficult to make solutions for present conditions in the city.Therefore, there is a need to develop mode choice model for Kathmandu Valley in order to know the factors that affect the mode choice, factor which influence the people to shift from one mode to other mode, demand for various modes which in future help in developing suitable transport policies to solve the congestion problem.

2. Literature Review

Mode choice behaviour is an important stage in urban transportation planning.Mode choice is the key aspects of travel demand modelling. To understand the behaviour of mode choice is necessary, as the interconnectivity and complexity of mode choice behaviour are the backbones of mode choice modelling.Various researches have been carried out to understand the relation between mode choice and the factors influencing the mode choice behaviour. But the impact of mode choice behaviour varies from place to place due to differences in socio-economic behaviour, infrastructure facilities and traveller's attitude. Since the number of vehicle is increasing rapidly with rapid increase in population in Kathmandu Valley, there is a need for study of mode choice behavior for proper policy making. Some cases of different cities are studied in order to get idea about mode choice behaviour.

[2]Essam Almasri et al (2013) investigated the factors that affect the employed people's choice for transport

modes and developed mode choice model for work trips in Gaza city. The results of this research showed that the factors which significantly affect the choice of transport modes were: total travel time, total cost divided by personal income, ownership of means of transport, distance, age and average family monthly income.

[3]R Ashalatha et al (2013) discussed various factors about selection of mode in Thiruvananthapuram.The study used multinomial logistic regression to analyse the mode choice behaviour of commuters in Thiruvananthapuram city which include variables like socioeconomic variables, transport system variables and attitudinal variables.Multinomial logistic regression revealed that those who own both car and two-wheeler prefer two-wheeler for shorter trips and car for longer trips. Age, gender and income have a massive role in choice of mode.The study concluded that as age of the people increases they prefer cars than two-wheeler. Increase in time per distance and increase in cost per distance cause the commuters to switch to car and two-wheeler from public transport.

[4]G.Tejaswi et al (2015) found that income, travel time and travel cost play an important role in decision of mode choice. The coefficient of gender was positive which indicates females were more likely to use public transport than all other modes. Higher income groups were able to purchase and maintain private cars and thus private car trips were more frequent as the income increases. Higher income groups were more likely to use four-wheeler than two-wheeler.

[5]Tushara T et al (2013) developed a mode choice model for work trip of Calicut city.The study considered different categories of work trips as government, private and self.Travel modes consider were car, two-wheeler, bus, auto and walk; among which most influenced mode on the Calicut city was two-wheeler.Age, gender, income, time and cost were proved to be the significant factors that influence the mode usage of the employees.

3. Study Area and Survey

[1]The Ring Road is one of the vital roads in Kathmandu Valley which has links to major arterial radial roads from the Kathmandu City Core Area to the borders of Kathmandu Valley. High population is concentrated inside Ring Road which encloses part of Kathmandu and Lalitpur District; maximum working population from all over the country resides and works in this region. Maximum working areas lies inside ring road which leads to congestion in major parts of city during peak hours.Work trips are normally done by government employees, private employees and businessperson by both public and private modes. So, people of age 15-64 years residing in Kathmandu Valley whose working places are inside ring road were considered.Revealed preference survey was considered for the mode choice i.e.people respond to the current travel behaviour in the questionnaire developed.

4. Design of Questionnaire

At first pilot questionnaire was developed which consist of socioeconomic characteristics (name, gender, marital status, age, income, occupation, vehicle ownership), trip characteristics (distance, travel time, cost) and attitudinal variables (comfort, safety).About 50 questionnaires were distributed among the people to improve the clarity, validity and content of questionnaire. After receiving the feedback, the questionnaire was refined and final version of questionnaire was used in conducting the survey. Variables used in the final survey are:

Socioeconomic variables:Socioeconomic variables used in the survey are gender, marital status, age, occupation, monthly income, household size and vehicle ownership which are believed to be important factors in mode choice.

Transport system variables:Transport system variables used in the survey are distance, travel cost, in vehicle travel time, out of vehicle travel time (walking time, waiting time).

5. Sampling and Sample Size

Survey helps to estimate the true value of one or more population characteristics.In order to draw conclusion from a sample that will accurately reflect the population, careful attention must be given to determine the needed sample size and sampling process. Simple random sampling was considered for the collection of data. Assuming the population to be normally distributed, empirical formulas given by Levy and Lemeshow (2008) were used to determine the sample size.

$$no = \frac{Z^2 pq}{e^2} \tag{1}$$

Where no = sample size for infinite population; Z = statistical parameter corresponding to confidence level (Z is 1.96 for 95% confidence interval); e = desired margin of error (adopted as 5%); p = hypothesized true proportion for population (adopted as 0.5 to account for the worst case) and q=1-p

$$n = \frac{no}{1 + ((no - 1)/N)} \quad (2)$$

Where n= sample size for finite population; N = population size. Based on the equation, the minimum sample size was obtained as 385.

6. Preliminary Data Analysis

A convenient sample of 700 questionnaires was obtained through the interview at work places and through the Google form.Data was collected at different workplaces i.e. government offices, private offices and business places.

Travel mode

358 people prefer two-wheeler,98 people prefer four-wheeler,219 people prefer public vehicles and 25 people prefer walking as a travel mode for their work trips.Two-wheeler is chosen by majority of people for the work trips.

Vehicle ownership

Among 700 respondents, 358 people have two-wheeler, 98 people have four-wheeler and 244 people have no vehicle.

Gender wise mode selection

Male prefer two-wheeler and female prefer public vehicle among all the modes for the work trips.60.14% of male choose two-wheeler for the work trips and 49.64% of female choose public vehicle for the work trips.

Marital status wise mode selection

Among married people, 51.11% choose two-wheeler. Similarly,51.2% of unmarried people choose two-wheeler.

Occupation wise mode selection

Two-wheeler is most preferred mode in occupation wise mode selection.52.66% people with private job choose two-wheeler,49.53% people with government job choose two-wheeler and 52.1% people with business choose two-wheeler.

Age wise mode selection

Among various modes, people with 15-24 years prefer public vehicle, 25-34 years prefer two-wheeler,35-44 years prefer two-wheeler,45-54 years prefer four-wheeler and 55-64 years prefer four-wheeler for their work trips.

Income wise mode selection

Among various modes, people with income less than NRs.15000,NRs.15000-25000 prefer public vehicle, people with income NRs.25000-35000,NRs.35000-45000,NRs.45000-55000,NRs.55000-65000 and NRs.65000-75000 prefer two-wheeler and people with income greater than NRs.75000 prefer four-wheeler.

7. The Multinomial Logit Model

To understand the relations between characteristics and mode choice of the employees, a multinomial logit model is applied to distinguish the difference among the mode usage of employees. Multinomial logit model is the simplest and most popular practical discrete choice model which is based on random utility theory.Net utility Ujq is defined as:

$$U_{jq} = V_{jq} + \varepsilon_{jq}$$

Where,$V_{jq} = \sum_k \theta_{kj} x_{jqk}$ is systematic part of the utility function and ε_{jq} is random part. Based on the hypothesis of rational choice, Probability of alternative i chosen by individual q can be formulated as:

$$P_n = e^{V_n} / \sum_{m=M} e^{V_m}$$

The MNL model structure has been widely used for mode choice models primarily due to its simple mathematical form, ease of estimation and interpretation and the ability to add or remove choice alternatives.

8. Model Development

Three categories of mode usage namely: two-wheeler, four-wheeler and public vehicle would serve as the

alternatives adopted by employees i.e. dependent variables.Age, gender, marital status, income, occupation, distance, cost, time are the independent variables which are applied into the model to formulate the measurable utility. The software used for modeling is SPSS (Statistical Package for the Social Sciences).In SPSS, multinomial logistic regression is carried out.One category of the dependent variable is chosen as reference category. All the parameters in the model are interpreted with reference to it. The coefficients are estimated through an iterative maximum likelihood method.Public vehicle is considered as reference category.

Summary of data

Out of 700 data, 675 data were taken into consideration after neglecting walking mode.From 675 samples, 450 samples were taken for model calibration and 225 samples were taken for model validation.Table 1 shows case processing summary of the variables taken for the model.

Table 1: Case processing Summary

		N	Marginal Percentage
Type of vehicle used	2 wheeler	358	53.0%
	4 wheeler	98	14.5%
	Public	219	32.4%
Gender	Male	404	59.9%
	Female	271	40.1%
Marital status	Married	431	63.9%
	Unmarried	244	36.1%
Age (Years)	15-44	585	86.7%
	45-64	90	13.3%
Occupation	Private job	275	40.7%
	Government job	315	46.7%
	Business	85	12.6%
Monthly income (NRs.)	Upto 35000	383	56.7%
	Above 35000	292	43.3%
Valid		675	100.0%
Missing		0	
Total		675	
Subpopulation		377[a]	

a. The dependent variable has only one value observed in 362 (96.0%) subpopulations.

Correlation between distance, travel time and travel cost showed that distance, travel time and travel cost are highly correlated to each other. It causes the problem of multicollinearity i.e.some variables become statistically insignificant when they should be significant. So, distance is excluded from the analysis.

Model Fitting Information

Intercept only model describes a model that does not include any predictor variables and simply fits an intercept to predict the output variable. Final model describes a model that includes the specified predictor variables and has been arrived through an iterative process that maximizes the log likelihood of the outcomes.The final model is an improvement on the intercept-only model. The chi-square statistic is the difference between the –2 log-likelihoods of the null/intercept-only and final models.Since the significance level of the test is less than 0.05, it can be concluded that the final model is outperforming the null model. Table 2 shows a statistical comparison of intercept-only model and final model.

Table 2: Model Fitting Information

Model	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	851.072			
Final	131.901	719.171	16	.000

Pseudo R square

Pseudo R square value explains the variation in dependent variable due to the independent variable. Here Nagelkerke's Pseudo R square is 0.934 which mean the independent variables are contributing 93.4% to the model.

Table 3: Pseudo R square

Cox and Snell	.798
Nagelkerke	.934
McFadden	.829

Likelihood ratio test

Likelihood ratio test show the contribution of each variable to the model.Likelihood ratio test is a hypothesis test measured by -2 log likelihood statistics.For each effect,-2 log likelihood is computed and chi square statistics is the difference in -2 log likelihood of the final and reduced model.Since marital status and age have significant greater than 0.05 so they are not statistically significant with the mode. Remaining, travel cost, travel time, monthly income, gender and occupation are statistically significant to the mode choice.

Table 4: Likelihood ratio test

Effect	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	df	Sig.
Intercept	131.901[a]	.000	0	.
TravelcostNRs	576.389	444.488	2	.000
Traveltimeminutes	585.588	453.686	2	.000
Gender	149.467	17.566	2	.000
Maritalstatus	135.423	3.521	2	.172
AgeYears	134.478	2.577	2	.276
Occupation	152.696	20.795	4	.000
MonthlyincomeNRs	149.679	17.777	2	.000

The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

a. This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Parameter Estimate

Parameter estimate summarize the effect of each predictor. The parameter estimate shows the effect of each predictor for the people's choice of four-wheeler relative to public vehicle and two-wheeler relative to public vehicle. B value represents the estimated multinomial logistic regression coefficients for the model. Exp (B) values are odd ratios for the various categories of the predictors compared with the reference category. The term 'df' represent the degree of freedom for each of the variable included in the model. The term 'Sig' represent the significance of the estimated coefficient i.e. p value which is used for checking the hypothesis. If p value is less than level of significance(in our case, it is 0.05) then we reject null hypothesis or vice versa.

Table 5: Parameter Estimate

Type of vehicle used[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp (B)	
								Lower Bound	Upper Bound
2 wheeler	Intercept	.036	1.731	.000	1	.983			
	TravelcostNRs	1.029	.162	40.394	1	.000	2.797	2.037	3.841
	Traveltimeminutes	-.800	.126	40.308	1	.000	.449	.351	.575
	[Gender=1]	2.354	.621	14.393	1	.000	10.531	3.121	35.537
	[Gender=2]	0[b]	.	.	0	.	.	.	.
	[Maritalstatus=1]	1.176	.650	3.276	1	.070	3.241	.907	11.580
	[Maritalstatus=2]	0[b]	.	.	0	.	.	.	.
	[AgeYears=1]	.471	.988	.228	1	.633	1.602	.231	11.098
	[AgeYears=2]	0[b]	.	.	0	.	.	.	.
	[Occupation=1]	-.185	1.052	.031	1	.861	.831	.106	6.537
	[Occupation=2]	1.353	1.095	1.526	1	.217	3.869	.452	33.103
	[Occupation=3]	0[b]	.	.	0	.	.	.	.
	[MonthlyincomeNRs=1]	-2.305	.751	9.429	1	.002	.100	.023	.434
	[MonthlyincomeNRs=2]	0[b]	.	.	0	.	.	.	.
4 wheeler	Intercept	-.290	2.488	.014	1	.907			
	TravelcostNRs	1.992	.245	66.209	1	.000	7.333	4.538	11.850
	Traveltimeminutes	-1.845	.238	59.898	1	.000	.158	.099	.252
	[Gender=1]	2.731	1.107	6.088	1	.014	15.354	1.754	134.427
	[Gender=2]	0[b]	.	.	0	.	.	.	.
	[Maritalstatus=1]	.960	1.306	.540	1	.462	2.611	.202	33.777
	[Maritalstatus=2]	0[b]	.	.	0	.	.	.	.
	[AgeYears=1]	-.901	1.323	.464	1	.496	.406	.030	5.426
	[AgeYears=2]	0[b]	.	.	0	.	.	.	.
	[Occupation=1]	-2.873	1.577	3.321	1	.068	.057	.003	1.242
	[Occupation=2]	2.625	1.514	3.005	1	.083	13.803	.710	268.484
	[Occupation=3]	0[b]	.	.	0	.	.	.	.
	[MonthlyincomeNRs=1]	-4.738	1.345	12.407	1	.000	.009	.001	.122
	[MonthlyincomeNRs=2]	0[b]	.	.	0	.	.	.	.

a. The reference category is: Public.

b. This parameter is set to zero because it is redundant.

Null hypothesis states that there is no significant relation between dependent and independent variables.

Analysis of Multinomial Logistic Regression Model of Two-wheeler in Relation to Public Vehicle

Gender: Odds of selecting two-wheeler compared to public vehicle increase by 10.531 times if person is male rather than female keeping all other independent variables constant.The significance of estimated coefficient is less than 0.05, so gender is statistically significant with two- wheeler. Female prefer public vehicle; male prefer two-wheeler for their work trips and gender have significant impact on mode choice.

Occupation: Odds of selecting two-wheeler compared to public vehicle decrease by 16.9% if occupation is private rather than business keeping all other independent variables constant. Similarly, odds of selecting two-wheeler compared to public vehicle increase by 3.869 times if occupation is government job rather than business keeping all other independent variables constant.The significance of estimated coefficient is greater than 0.05, so occupation is not statistically significant with two-wheeler.Two-wheeler is more preferred by government employees than other employees but occupation have no significant impact on mode choice

Monthly income: Odds of selecting two-wheeler compared to public vehicle decrease by 90% if monthly income is up to NRs.35000 rather than above NRs.35000 keeping all other independent variables constant. The significance of estimated coefficient is less than 0.05, so monthly income is statistically significant with two-wheeler.Person having high income prefer private vehicle i.e. two-wheeler rather than public vehicle and monthly income have significant impact on mode choice.

Marital status: Odds of selecting two-wheeler compared to public vehicle increase by 3.241 times if people are married rather than unmarried keeping all other independent variables constant. The significance of estimated coefficient is greater than 0.05, so marital status is not statistically significant with two-wheeler. Married person prefer two-wheeler rather than public vehicle but marital status have no significant impact on mode choice.

Age: Odds of selecting two-wheeler compared to public vehicle increase by 1.602 times if age lies between 15-44 years rather than 45-64 years keeping all other independent variables constant.The significance of estimated coefficient is greater than 0.05,so age is not statistically significant with two-wheeler.Person with 15-44 years prefer two-wheeler compared to person with 45-64 years but age have no significant impact on mode choice.

Travel time: Odds of selecting two-wheeler compared to public vehicle decrease by 55.1 % for 1 minute increase in travel time in two-wheeler compared to public vehicle keeping all other independent variables constant. The significance of estimated coefficient is less than 0.05, so travel time is statistically significant with two-wheeler. As travel time increases in two-wheeler, people prefer public vehicle rather than two-wheeler and travel time have significant impact on mode choice.

Travel cost: Odds of selecting two-wheeler compared to public vehicle increase by 2.797 times for each rupee increase in travel cost in two-wheeler compared to public vehicle keeping all other independent variables constant. The significance of estimated coefficient is less than 0.05,so travel cost is statistically significant with two-wheeler. As travel cost increases in two-wheeler, people still prefer two-wheeler rather than public vehicle and travel cost have significant impact on mode choice.

Analysis of Multinomial Logistic Regression Model of Four-wheeler in Relation to Public Vehicle

Gender: Odds of selecting four-wheeler compared to public vehicle increase by 15.354 times if person is male rather than female keeping all other independent variables constant.The significance of estimated coefficient is less than 0.05, so gender is statistically significant with four-wheeler.Male prefer four-wheeler;female prefer public vehicle for their work trips and gender have significant impact on mode choice.

Occupation: Odds of selecting four-wheeler compared to public vehicle decrease by 94.3% if occupation is private rather than business keeping all other independent variables constant. Similarly, odds of selecting four-wheeler compared to public vehicle increase by 13.803 times if occupation is government job rather than business keeping all other independent variables constant.The significance of estimated coefficient is greater than 0.05, so it is not statistically significant with four-wheeler. Four-wheeler is more preferred by government employees than other employees but occupation have no significant impact on mode choice.

Monthly income: Odds of selecting four-wheeler compared to public vehicle decrease by 99.1% if monthly income is up to NRs.35000 rather than above NRs.35000 keeping all other independent variables constant. The significance of estimated coefficient is less than 0.05, so monthly income is statistically significant with four-wheeler.Person having high income prefer private vehicle i.e. four-wheeler rather than public vehicle and monthly income have significant impact on mode choice.

Marital status: Odds of selecting four-wheeler compared to public vehicle increase by 2.611 times if people are married rather than unmarried keeping all other independent variables constant. The significance of estimated coefficient is greater than 0.05,so marital status is not statistically significant with four-wheeler. Married person prefer four-wheeler rather than public vehicle but marital status have no significant impact on mode choice.

Age: Odds of selecting four-wheeler compared to public vehicle decrease by 59.4% times if age lies between 15-44 years rather than 45-64 years keeping all other independent variables constant. The significance of estimated coefficient is greater than 0.05, so age is not statistically significant with four-wheeler. Person with 45-64 years prefer four-wheeler compared to person with 15-44 years but age have no significant impact on mode choice.

Travel time: Odds of selecting four-wheeler compared to public vehicle decrease by 84.2 % for 1 minute increase in travel time in four-wheeler compared to public vehicle keeping all other independent variables constant.The significance of estimated coefficient is less than 0.05, so travel time is statistically significant with four-wheeler. As travel time in four-wheeler increases, people prefer public vehicle rather than four-wheeler and travel time have significant impact on mode choice.

Travel cost: Odds of selecting four-wheeler compared to public vehicle increase by 7.333 times

for each rupee increase in travel cost in four-wheeler compared to public vehicle keeping all other independent variables constant. The significance of estimated coefficient is less than 0.05, so travel cost is statistically significant with four-wheeler. As travel cost in four-wheeler increases, people still prefer four-wheeler rather than public vehicle and travel cost have significant impact on mode choice.

Utility functions for different modes:

- V(two-wheeler)= -0.797+0.927(Travelcost)-0.715(Travel time)+2.411(Gender=1)-1.609(Monthly income=1)
- V(four-wheeler)= -0.980+1.730(Travelcost)-1.609(Travel time)+2.151(Gender=1)-3.975(Monthly income=1)

9. Model Validation

Model validation is important process to evaluate the performance of the model and its ability to predict modal split for data other than that used for calibration process. From 225 samples, model is validated with same model specification. The prediction ability of the model validated is 92.9% as shown in table 6.Two-wheeler has 94.7% prediction accuracy, four-wheeler has 87.2% prediction accuracy and public vehicle have 93.1% prediction accuracy.The model has overall 92.9% accuracy which indicates that 92.9% of the actual choices and the predicted choices of the people match.

Table 6: Validation Success Table

	Predicted			
Observed	2 wheeler	4 wheeler	Public	Percent Correct
2 wheeler	108	2	4	94.7%
4 wheeler	5	34	0	87.2%
Public	5	0	67	93.1%
Overall Percentage	52.4%	16.0%	31.6%	92.9%

Observation from Model Development

Gender: Preference of public vehicle is more in female and gender have significant impact on mode choice.

Occupation: Occupation have no significant impact on mode choice.

Monthly income: People having higher income prefer two-wheeler and four-wheeler and monthly income have significant impact on mode choice.

Marital status: Marital status have no significant impact on mode choice.

Age: Age have no significant impact on mode choice.

Travel cost: Despite increase in travel cost in two-wheeler and four-wheeler, preference of two-wheeler and four-wheeler is higher compared to public vehicle and travel cost have significant impact on mode choice. It shows people are not sensitive in case of travel cost as they want to reach the work places on time and to save travel time people may prefer two-wheeler despite increase in the cost. For government employees who travel by using four-wheeler, cost may not be important factor as they are not cost bearer to four-wheeler mode. Businessperson and private job holder who have high monthly income afford four-wheeler for their work trips for the comfort journey.

Travel time: When there is increase in time in two-wheeler and four-wheeler, people prefer public vehicle rather than two-wheeler and four-wheeler and travel time have significant impact on mode choice. It shows people are sensitive in case of travel time i.e. when there is increase in travel time in particular mode their utility decreases and travel time plays significant role in their work trips.

10. Conclusion and Recommendation

Mode choice model for work trips in Kathmandu Valley was developed. Travel time, travel cost, gender and monthly income were found to be significant factor that influence the mode usage of the employees. The study was carried out within a small time frame, so limitation exists in sample size and design of questionnaire.Stated preference survey can be applied in further studies and advanced discrete choice models like probit model, generalized extreme model can be used for model predictability in further studies.

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References

[1] JICA. *Data Collection Survey on Traffic Improvement in Kathmandu Valley*.

[2] Sadi Alraee Essam Almasri. Factors affecting mode choice of work trips in developing cities-gaza as a case study. *Journal of Transportation Technologies*, 2013.

[3] V.S.Manju R.Ashalatha and Arun Baby Zacharia. Mode choice behaviour of commuters in thiruvananthapuram city. *Journal of Transportation Engineering*, 2013.

[4] Aramesh G.Tejaswi, S.Amenendra Kumar and M.Kumar. Development of mode choice model using multinomial logit approach in hyderabad city. *International Journal of Research in Engineering and Technology*, 2015.

[5] Bino I Koshy Tushara T, Rajalakshmi P. Mode choice modelling for work trips in calicut city. *International Journal of Innovative Technology and Exploring Engineering*, 2013.