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Factors Effecting the Usage of Public Transport Multinomial Logit Model

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***Abstract*- Urban transportation is a mixed traffic , accessibility is very much required in countries like India for the movement of commuters in their daily life without time laps with in aspects of public participation, for overall development. Commuters prefers various modes to overcome the time laps, urban transport planner has to meet the demand of commuter.**

Present study focused to increase the public transport accessibility in safe and efficient way, to reduce the congestions and also to reduce the journey time .Surveys are conducted to collect the data. This study helps in analyzing the commuters mode choice and by using a simple mathematical model. SPSS is used to develop and validate the model. multinomial logit model is adopted to analyze mode choice behavior. The total mode share includes walk, bicycle, auto-rickshaw, two wheeler, car and bus in which two wheelers form the major share.

***Index Terms*-** *Activity based approach, House hold travel survey, Mode choice, Logit models, SPSS*

I. INTRODUCTION

The choice of a transport mode is probably one of the most important classic models in transportation planning. Transport modeling is used as an effective tool to manage sustainable development in most of the developed countries. Considerable investments have been made in transport planning and policy making in order to observe the travel behavior and forecast the future demand of travel. This forecasting needs to incorporate the designing of transport systems, by making use of global infrastructure and understanding the travel behavior of the residents of the study area, and develop a system that can accommodate the travel demands for the future. The model specification developed for the study, for various trip lengths and trip purposes, considered all the commonly used travelling modes in the study area. Several level- of-service attributes of the modes and household parameters that were assumed to influence the travel behavior of the targeted population, were tested in order to generate approximate model specification for each trip purpose

II. STUDY AREA

The area proposed for the study is Visakhapatnam and the area is located along coastal line, Bay of Bengal and the proposed corridor is Gajuwaka to Pothinamallayya Palem. The study area had wide range of trip attraction points and showing its remark as industrial zone constituting pharmaceutical industries, steel plant and port and these influences commuters prefer different modes into the city to pursue their activities.

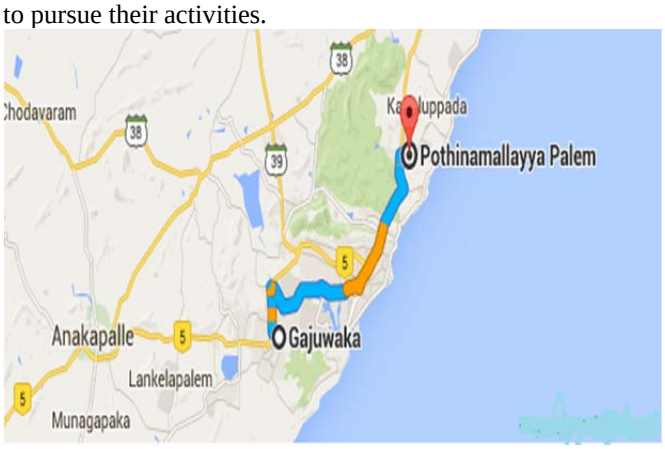

Figure:1

III. SOCIO-ECONOMIC CHARACTERISTICS

The different socio economic characteristics of study area drawn from preliminary analysis of the data collected using excel are given below and profession status of the study area as shown below. Fig 2 shows the farmers have 0.4% of total profession, clearly indicates the study area is urban area.

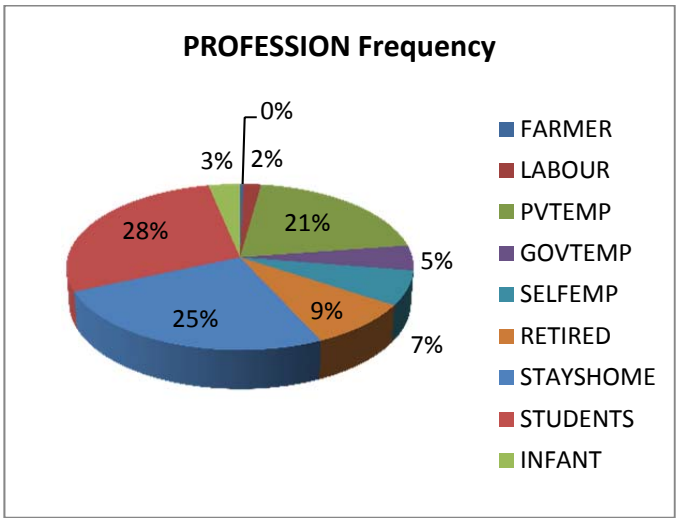

Figure: 2

- Sample population consists of 51% male and 49% female which satisfies the census data 2015.About 62% of the sample population comes under the working group of age between 23 and 60

When the sample is analyzed based on occupation/profession, about 40.5% are nonworking group(consisting of infants, homemakers, and people of age more than 60). When students are included , the actual non-working category comes about 65.8%. Among working group majority is the private employee 59.7% of total working group. Here government employees are only 4.9% of total sample which is 14.2% of working community. The literacy rate of current study area is about 82% .

IV. EFFECT OF VARIABLES ON MODE CHOICE

Below table 1 shows the effect of house hold on mode choice. Household with size four shows that utilization of different modes is maximum for each and every mode and the average size of the household is four from the survey

Table 2 shows households with 2 cars utilizing car as their mode to maximum extent and house-holds with 1 car utilizes both car and bike as well and utility of 2 wheeler may be due to less delay trips with-in the study area and 3.1% of the households are utilizing more public transport who doesn't hold a single car when compared with who holds single car but doesn't utilizing public transport at all who holds two cars.

Table 3 shows clear indication that who doesn't hold 2-wheeler utilizes public transport much when compared with other cases

Table 4 indicates who hold license uses private transport when compared to public transport.

Table: 1 Effect of household size on mode choice

HHS	TRIP MODE									TOTAL %
	NONE %	CAR %	BUS	2WH %	3WH %	CYCLE %	MULTIMODE %	SC-BUS %	WALKING %	
1	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.1
2	9.9	14.0	4.9	5.9	0.0	12.5	18.2	2.0	4.4	7.3
3	13.7	20.0	13.6	14.7	25.4	0.0	9.1	14.0	13.3	15.0
4	36.1	48.0	35.8	51.5	52.5	62.5	45.5	38.0	55.6	43.4
5	26.2	10.0	37.0	22.5	15.3%	25.0	18.2	30.0	20.0	24.4
6	8.3	4.0	7.4	2.5	1.7	0.0	0.0	10.0	6.7	5.8
7	2.9	2.0	0.0	0.5	0.0	0.0	9.1	4.0	0.0	1.7
>7	2.9	2.0	1.2	2.0	5.1	0.0	0.0	2.0	0.0	2.3
TOTAL	100	100	100	100	100	100	100	100	100	100

Table:2 Effect of car ownership on mode choice

	CAR			TOTAL
	0	1	2	
NONE	41.0%	14.3%	0.0%	38.1%
CAR	1.8%	40.5%	100.0%	6.1%
BUS	10.2%	7.1%	0.0%	9.9%
BIKE	23.8%	34.5%	0.0%	24.8%
AUTO	8.0%	0.0%	0.0%	7.2%
CYCLE	1.1%	0.0%	0.0%	1.0%
Multi-Mode	1.4%	1.2%	0.0%	1.3%
School Bus	6.8%	0.0%	0.0%	6.1%
WALKING	6.8%	0.0%	0.0%	6.1%
TOTAL	100.0%	100.0%	100.0%	100.0%

Table :3 Effect of 2-wheeler ownership on mode choice

Trip Mode	Bike Ownership				Total
	No 2wheeler	1 2-wheeler	2 2-wheeler	3 2-wheeler	
None	45.3%	15.7%	18.2%	20.0%	38.1%
Car	5.8%	5.9%	18.2%	20.0%	6.1%
Bus	11.1%	5.9%	9.1%	0.0%	9.9%
2-wheeler	11.9%	65.9%	54.5%	40.0%	24.8%
3-wheeler	9.0%	1.6%	0.0%	0.0%	7.2%
Cycle	1.3%	0.0%	0.0%	0.0%	1.0%
Multi-Mode	1.1%	2.2%	0.0%	0.0%	1.3%
School Bus	7.6%	1.6%	0.0%	0.0%	6.1%
Walking	6.8%	1.1%	0.0%	20.0%	5.5%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Table: 4 Effect of license ownership on mode choice

	LICENSE OWNERSHIP		TOTAL
	NO	YES	
NONE	54.2%	10.9%	38.1%
CAR	1.5%	13.8%	6.1%
BUS	10.6%	8.6%	9.9%
2-WHEELER	7.2%	54.9%	24.8%
3-WHEELER	8.7%	4.6%	7.2%
CYCLE	1.4%	0.3%	1.0%
MULTIMODE	0.8%	2.3%	1.3%
SCHOOL BUS	8.5%	2.0%	6.1%
WALKING	7.2%	2.6%	5.5%
TOTAL	100.0%	100.0%	100.0%

V. INFLUENCING VARIABLES

After multiple iterations variables are determined which are affecting the mode choice are vehicle ownership, license ownership, purpose of travel, trip duration, trip cost, trip waiting time, trip walking time.

VI. MODEL OUTPUT

The factors which were found influencing the mode choice of rural residents were vehicle ownership, purpose, license ownership, total trip walking time, waiting time, cost and duration. The results obtained after the multinomial logistic analysis using SPSS are given in table 5

Table: 5 Parameter estimates

TMODE		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
CAR	Intercept	-9.714	2.092	21.560	1	.000			
	V_OWN	.277	.245	1.283	1	.257	1.319	.817	2.131
	L_OWN	-.193	.342	.318	1	.573	.825	.422	1.611
	POT	.288	.263	1.202	1	.273	1.334	.797	2.232
	T_DUR	-.116	.047	5.996	1	.014	.890	.811	.977
	TR_COST	2.979	.633	22.163	1	.000	19.665	5.690	67.967
BUS	Intercept	-5.861	1.663	12.427	1	.000			
	V_OWN	-.595	.437	1.854	1	.173	.552	.234	1.299
	L_OWN	-.008	.267	.001	1	.975	.992	.588	1.672
	POT	.100	.206	.234	1	.628	1.105	.738	1.656
	T_DUR	-.064	.035	3.342	1	.068	.938	.877	1.005
	TR_COST	-.491	.757	.421	1	.517	.612	.139	2.700
	TR_WTT	3.261	.608	28.780	1	.000	26.079	7.922	85.847
	TR_WKT	1.495	.423	12.508	1	.000	4.460	1.948	10.215
3-WH	Intercept	-4.083	1.450	7.932	1	.005			
	V_OWN	-.478	.384	1.554	1	.213	.620	.292	1.315
	L_OWN	.108	.203	.281	1	.596	1.114	.748	1.658
	POT	.336	.178	3.577	1	.059	1.399	.988	1.982
	T_DUR	-.090	.034	7.001	1	.008	.914	.855	.977
	TR_COST	.204	.678	.091	1	.764	1.226	.325	4.634
	TR_WTT	2.396	.589	16.573	1	.000	10.982	3.464	34.810
	TR_WKT	1.281	.413	9.632	1	.002	3.601	1.603	8.086
CYCLE	Intercept	8.287	2.605	10.123	1	.001			
	L_OWN	-3.746	1.393	7.232	1	.007	.024	.002	.362
	POT	.473	.346	1.872	1	.171	1.605	.815	3.159
MULTIMODE	Intercept	-10.839	2.612	17.227	1	.000			
	V_OWN	-.478	.450	1.130	1	.288	.620	.257	1.497
	L_OWN	.077	.349	.048	1	.826	1.080	.545	2.140
	POT	.080	.311	.067	1	.796	1.083	.589	1.992
	T_DUR	-.126	.043	8.567	1	.003	.881	.810	.959
	TR_COST	1.141	.869	1.724	1	.189	3.131	.570	17.199
	TR_WTT	3.606	.683	27.884	1	.000	36.837	9.659	140.487
	TR_WKT	1.548	.452	11.698	1	.001	4.700	1.936	11.409
SCBUS	Intercept	-8.553	1.835	21.724	1	.000			
	L_OWN	-.346	.391	.781	1	.377	.708	.328	1.524
	POT	.772	.224	11.917	1	.001	2.163	1.396	3.352
	T_DUR	-.032	.035	.855	1	.355	.968	.904	1.037
WALKING	Intercept	9.915	3243.544	.000	1	.998			
	L_OWN	-1.069	.515	4.302	1	.038	.344	.125	.943
	PURPOSE	.014	.282	.003	1	.960	1.014	.583	1.764
	T_DURN	-.122	.101	1.478	1	.224	.885	.726	1.078
	TR_WKT	2.416	.514	22.095	1	.000	11.200	4.090	30.668

Reference category: 2-WHEELER

(**V_OWN=vehicle own, L_OWN=license ownership, POT= purpose of travel, T_DUR=trip duration, TR_COST= trip cost, TR_WTT= trip waiting-time, TR_WKT= trip walking-time, 3WH= 3-wheeler, SCBUS= school bus**)

No numerical problems are encountered since none of the independent variables have standard error greater than 2 and hence we can interpret the results. Two-wheeler is the basic unit of comparison, so it is not presented in the table Overall almost all parameters have the expected signs.

VII. CONCLUSION

- A multinomial logit model to study the mode choice behavior of urban residents is developed. The study helped to draw socio-economic characteristics of a typical urban area.
- The activity based approach really helped to study the travel pattern in a realistic way.
- Multiple iterations been done to find the influencing variables which influences the selection of mode by commuter.
- For the empirical analysis, the data used is collected by means of household survey of every individual and software tool SPSS is used to develop the model. Vehicle ownership, License ownership, Purpose, Trip duration, Trip-cost, Trip waiting time and Trip walking time are found to be most influencing factors for the choice of the mode.
- The developed model has dependency between the dependent variable and independent variables.
- This developed model has satisfied the improvement criteria (more than 25%) accuracy by chance.
- The developed model could greatly help the policy makers and will be the area of interest for public transport providers who are interested in attracting choice raiders.
- The developed model shows that risk criteria for bus over reference mode really helps to facilitate to check over/under estimation of provided facilities.
- Decision tree technique helped to cross check with the division of age groups, working, non-working groups and influence of bus-pass holding on public transport usage.
- Interpretation of results shows that trip waiting time, trip walking time and trip duration factors affects the usage of public transport by the commuter.
- Due to increase in economic status and less delays with in the traffic may be the reason for selection two-wheeler as their major mode.
- Utility concept describes that the summation of all values for reference group is zero. So the value for mode two-wheeler is zero (i.e. 2WH=0)
- Current analysis shows that implementation of mini-buses to current study area helps to increase use of public transport by commuters.

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