Trip Production Model Development by Multiple Classification Analysis

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Abstract: The travel demand is continuously growing due to rapid development of infrastructure, business opportunity and higher education. Estimating the number of trips generated in the city is basic and the most important step in travel demand forecasting. Transport generated trips are considered with an aim to improve the accuracy of Transport trip production models. Trip production model can be developed by two methods- Regression Analysis and cross- classification Analysis (category analysis). Trip production models in India have traditionally been developed using simple regression analysis. In this research selected area of Ahmedabad city is taken as study area for developing trip production models. Home Interview Survey (HIS) was used to collect Socio-economic and demographic data of different wards of study area. The Aim of this research is to develop trip production models by Regression analysis and Multiple Classification Analysis (MCA). Comparison between the results of MCA and linear regression analysis will also be carried out. Nomograms will be developed based on MCA tables and can be used to estimate trip rate values for other cities with similar socioeconomic characteristics. MCA table has been developed for three different scenario based on correlation and ANOVA test. Based on correlation and ANOVA test three models for MCA and Regression are developed for three different scenario. Results of MCA show that Family size, Number of school/college going children and Number of employed person in Household give the best grouping among all the independent variables. Standardized coefficients of the regression equations show that Number of school/college going children in household and family size has the maximum effect on trip rate followed by employed person in Household. Whereas Household income and Vehicle ownership has comparatively lesser effect. Statistical analysis of MCA and linear regression models shows that Model 1 is more relevant than Model 2 and Model 3. Model 1 is based on Family size, Number of school/college going children and Employed person in household as independent variables and trip production rate is dependent variable.

Index Terms: **Multiple Classification Analysis (MCA), Nomograms, Regression, Trip generation, Trip production models**

I. INTRODUCTION

Transportation is one of the major part of economy and society. Necessity of transportation is increasing rapidly. Transportation is consider as one of the major urban problem. To solve and to develop new transportation facilities transportation planning is an important step. Travel demand forecasting is the basic requirement of any transportation planning. For the accurate and effective transportation planning accuracy in trip generation stage is important. This review considers the need for studies in this area, through studying trip generation stage and its various categories. Trip generation stage aim at predicting total number of trip produced and attracted to each zone.

Trip is a one way movement between origin and destination. If either origin or destination of trip is home then trip is called home-based trip. In non-home based trip origin and destination of the trip is non-home end. Number of trip produced from any area is determine by trip production model. There are two methods used for development of trip production model: 1) Regression analysis 2) Cross-classification analysis (category analysis)

Linear regression and category analysis are the representative methodologies used for trip production. They have widely been applied to empirical studies and may have shown acceptable performance from the planning perspective However, there are also limitations of these traditional frameworks. For regression-based trip generation models, three typical drawbacks have been observed. First, the number of trips is treated as a continuous random variable though it is a discrete one (Badoe, 2007). People, for example, can make two trips per day, people cannot make 1.7 trips per day. Second, the dependent variable may take on negative values due to the assumption of normal distribution for the disturbance of trip rates (Badoe, 2007). In trip generation, the dependent variable is zero for a significant fraction of the observations. For those who make trips, the travel demand can be measured; but for those who do not, the spatial interaction cannot be recorded and is set equal to zero. Namely, although the data for trip generation are censored, the regression model cannot address the nature. Finally, the model does not represent traveller behaviour theory because it simply matches a statistical relationship between the dependent variable and a set of independent variables (Badoe, 2007; Lim and Srinivasan, 2011). It is difficult to observe travellers' behavioural mechanisms in trip-making, such as utility maximization and cost minimization.

Also there are some drawbacks in cross classification analysis. First, a naıve approach in choosing independent variables and their strata for classification is not statistically justifiable but only empirically acceptable. The method bears no statistical goodness-of-fit measures, so the calibration cannot be verified. Second, the cell-by cell calculation reduces the reliability of cell values. In particular, the uncertainty increases when there are cells with small samples and/or large variances. This calculation mechanism also requires large sample sizes, which incurs much cost and time (Ortuzar and Williamson, 2011; 158).

There has been research to overcome and/or mitigate these limitations. Multiple classification analysis is also found in the literature as an alternative approach to a simple category model for person trips (Stopher and McDonald, 1983) and for freight movements (Bastida and Holguin-Veras, 2009). This model adopts a statistically justifiable approach based on analysis of variance (ANOVA). The cell value is estimated with the grand and group means (Stopher and McDonald, 1983).

Regression Analysis

Regression analysis is simply termed as a method for investigating functional relationships among variables. In other words, regression relates a variable y to the variables X_1, X_2, X_3... X_n While the variable y is termed as the dependent variable, the variables X_1, X_2, X_3,..,X_n are known as independent variables or explanatory variables as they describe the variations in the value of Y (dependent variable). Regression analysis helps us to generate the best surface to the observed data . The best surface is described by the principle of least squares i.e. the squared sum of the residuals or deviations from the estimated line is minimized.

Multiple Classification Analysis

The conventional category analysis suffers from two important methodological drawbacks: a non-statistical basis and cell-by-cell calculation. The multiple classification method can overcome these disadvantages. A statistically justifiable approach based on a series of ANOVAs is applied to select independent variables and their strata. First, one-way ANOVAs between trip rates and each candidate variable are used to find the best grouping for each variable. In this process, measures such as an F statistic and R^2 can be used. Once statistically significant independent variables have been identified, multi-way ANOVAs between trip rates and two or three candidate variables are applied. It is an extensive trial-and-error procedure to examine the best classification scheme. The eta-square, which is the ratio of the sum of squares of the candidate variable to the corrected total in the ANOVA output, can be used to determine more contributable variables (Stopher and McDonald, 1983). A grand-group mean approach is used to estimate the cell value. The grand mean is calculated over the entire sample, while the group mean is computed from the row and column sums of the category table. A cell value is found by adding the deviations of the cell to the grand mean; this process is different from the cell-by-cell calculation in the conventional category analysis (Stopher and McDonald, 1983).

Paper is aim to address following objectives:

- Understanding the Independent variables that affect the Trip Production
- To develop trip production models by conducting Home Interview Survey (HIS) using Regression analysis
- To develop trip production models by conducting Home Interview Survey (HIS) using Multiple Classification Analysis (MCA).

II. STUDY AREA

Ahmedabad is the largest city of Gujarat state. Ahmedabad is located at 23.03°N 72.58°E on the banks of the Sabarmati River in north-central Gujarat. Ahmedabad is the fifth most populous city in India. According to the 2011 census, the population of Ahmedabad city was 5,577,967. The city had a literacy rate of 89.62%; 93.96% of the men and 84.81% of the women were literate. Ahmedabad is fastest growing cities in the world and rapid urbanization will lead to more people migrating from different parts of the state and the country. In the metropolitan city like Ahmedabad, traffic congestion and pollution are biggest problems. Ahmedabad has emerged as the industrial and economic hub and it is second largest producer of Cotton in India.

For this study 9 wards are selected around L.D. College of engineering, Ahmedabad in which this study is carried out. L.D. College of engineering is situated in Navarangpura wards and other eight wards around the Navarangpura is selected. Selected wards are shown in figure and table below.

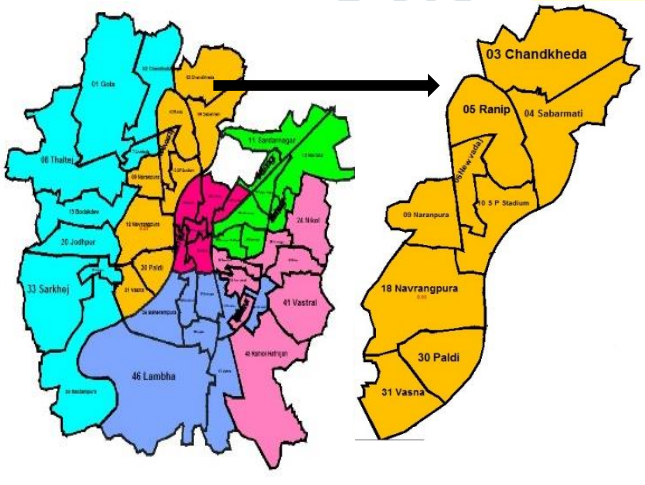

Fig. 1 Study area

Table 1: Wards of study area

Sr. No.	Name of ward
1	Navarangpura
2	Paldi
3	Vasna
4	Naranpura
5	SP Stadium
6	Ranip
7	Sabarmati
8	New Wadaj
9	Chandkheda

III. DATA COLLECTION

Home interview survey is conducted to collect data from selected study area of Ahmedabad city. Population of the study area is 7,27,756 as per census 2011 and average houshold size is 4.9. For this study population is forecasted for year 2018 using average growth factor. Forecasted Population of study area in 2018 is 10,74,026.

For the sample size calculation two approach has been used (1) As per Standards of Bureau of Public Roads (2) Statistical Formula by Hogg and tennis (2009). Sample size as per BPR standard for population greater than 10, 00,000 is 1 in 100 household. As per BPR standard sample size for home interview survey is 2192 and as per statistical formula it is 1200. For this study 2400 household is interviewed which is greater than Sample size required by BPR standard and Statistical formula.

The following data were collected for each household

• Demographic and Socioeconomic characteristics like gender, age, Family size, Vehicle ownership, Number of employed person, Number of school/college going children, Annual income, occupation; and

• Trip characteristics like trip purpose, trip origin and destination, trip time, trip length, and the mode of transport used for each of the trips.

The socioeconomic characteristics that have been identified from the literature to affect trip production are used for trip production analysis. Out of all the variables, Family size, household income, and vehicle ownership, Number of Employed person and Number of School/college going children in Household are considered to be the most influential.

DATA ANALYSIS

Descriptive statistics of the identified independent variable is shown in table. Which contain Minimum and maximum with mean and standard deviation of Different variables.

Table 1: Descriptive statistics

Variables	Minimum	Maximum	Mean	Std. Deviation
Daily Household Trips	1	10	2.81	1.25s
Family Size	1	12	4.06	1.428
Employed person	0	7	1.45	.763
School/College going children	0	7	1.04	.915
Vehicle Ownership	0	6	2.01	1.073

Socio-economic Characteristics

Collected data shows that in study area 36% people are employed and 64% are either unemployed or school or college going children out of which 26% are School or college going Children. Vehicle ownership are classified into cycle, Two-wheeler, and four-wheeler. Data analysis shows that out of total vehicle ownership there are 65% two wheeler, 20% four wheeler and 15% cycle. Annual Household Income is classified into four groups as per data available from urban development and housing department. As per income group Household are classified as shown in fig. 2

Table 3: Income group

Income Group	Income
EWS	< 1 Lakh
LIG	1 Lakh to 2.5 Lakh
MIG	2.5 Lakh to 5 Lakh
HIG	>5 Lakh

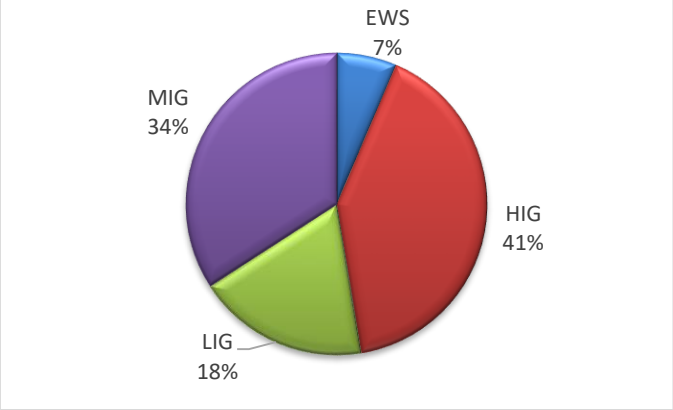

Fig. 2 Classification of Household based on Income group

Trip Charesteristics

Classification of trips according to its purpose is important to be carried out since people do the travels for various reasons. In this research, 13510 trips are either attracted or produced from 2400 households of study area. In trip production model development one-way trips produced or generated from households of study area is only considered. Total produced trips from household of study area is 6763 trips, all of the trips are home based trip where origin of the trip maker is home. Home based work, study, shopping and other are consider in the survey. Out of all the trips 57% of trips are Work trip, 35% trips are educational trips, 6% shopping trips and 2% other trips which include recreation, social etc.

Age is also another factor which affect the trip making behavior, from the analysis it is found that person in age group 16-30 are the major trip maker which produced 34% of the total trips followed by age group 31-45 which produced around 26% of the total trips. Analysis also shows that with increase in age, number of trip production decrease. People with age more than 61 years only produce 4% of total trip which generally include recreational and social. Classification of trip according to age group is shown in fig.3.

Classification of trips according to its mode is important to be carried out since people travels with different modes. Trips are generated by different modes like Two-wheeler, Four-wheeler, Public transport, Bicycle, walk, School van, Private cab, Company bus and auto are consider in this research. From the analysis it is found that Maximum trips are done by two-wheeler which is 52% of the total trips. Public transport and walk trips are both 11%. There are basically two public transport facility available in Ahmedabad city which include AMTS and BRTS. Other modes of trips are car (10%), bicycle (9%), Auto rickshaws (3%) and School/college bus (4%). Classification of trips according to mode is shown in fig. 4.

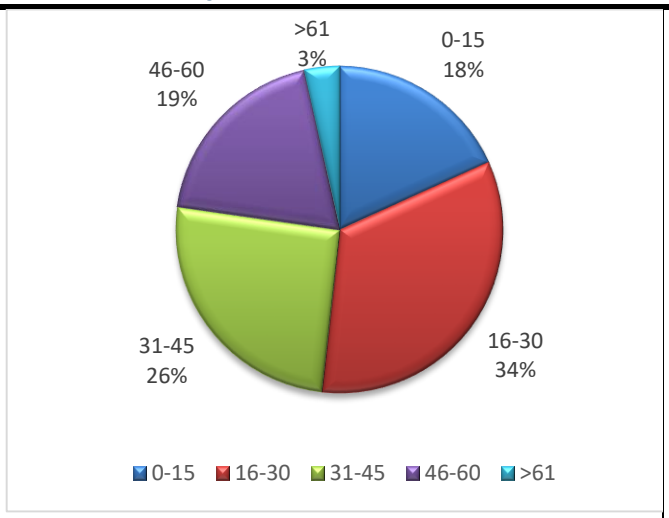

Fig.3 Classification of trips according to Age group

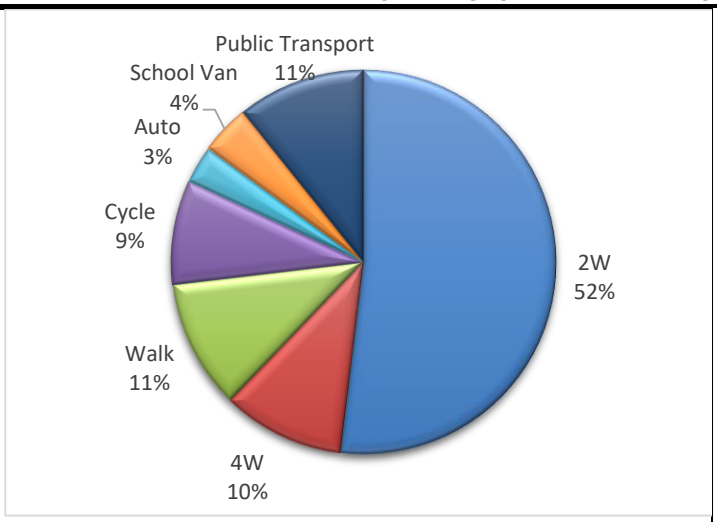

Fig.4 Classification of trips according to mode

IV. Multiple Classification Analysis

Variable grouping

The socioeconomic characteristics that have been identified from the literature to affect trip production are used for trip production analysis. Out of all the variables, Family size, Number of employed person and number of school/college going children in household, household income, and vehicle ownership are considered to be the most influential. The observations for these variables are used for the current analysis, and their significance is established. The observations in each variable are divided into a few classes for MCA analysis. As explained in Guevara and Thomas (2007), the variable boundaries are stratified in such a way that there are enough observations to accurately describe each cell of the MCA table. Independent variables were grouped initially to be analysed using SPSS program based on Home Interview Survey. Variable analysis was performed into two stages. The first stage was to calculate the correlations between dependent and independent variables by determining Pearson correlation test. The test of variance ANOVA was the second stage aimed to determine if the independent variable explain variation for trip making. Based on result of ANOVA and Correlation test MCA table have been generated for three scenario, i.e. for

Model 1: Family size, Number school/college going children and Number of Employed person in Household
Model 2: Family size, Number school/college going children and Vehicle Ownership of Household
Model 3: Family size, Number school/college going children and Income of Household

The MCA tables for trip rates are generated in two steps. First, tables with Number of Trips and Number of Household in each cell is generated and the average of the trips produced per household for each combination of variables is calculated.

Nomograms: MCA Charts

Nomograms are charts with trend lines indicating the relationship between different variables affecting trip rates. These are generated based on the MCA tables and hence have been generated for each of the three scenarios of analysis separately. Trend lines are plotted for trip rates for different Models. These trend lines can be used to interpolate the trip rates for any particular Area by calculating the average values of this combination of variables in that particular area. Fig. 3 to Fig. 5 present the nomograms for the three Models of MCA shown from Tables 4–9.

The aforementioned charts can be used to plot the average values of various variables to obtain the average trip rates for the scenario required. These charts can be of use even for combinations of variables for which cross-classification cells are not available, and also to get an approximation on trips produced in other cities with similar socioeconomic characteristics for which detailed trip rate data are not available. These nomograms can be considered as the base and can be updated in the future by adding data from more cities regarding their trip rate and socioeconomic characteristics.

Multiple Classification Analysis tables

Model 1: Family size, Number school/college going children and Employed Person

MCA table for trip rate is developed for the identified indipendent varianbles family size, Number of school/college going children and Number of Employed person in Houshold which is shown in table 4

Table 4. Model 1: Family size, Number of school/college going children and Income

Employed Person	School/college going children/HH	Family Size		
		1,2,3	4,5,6	7+
0	0	0.25	0.98	0.72
	1	0.81	1.54	1.29
	≥ 2	1.20	1.93	1.68
1	0	1.46	2.19	1.93
	1	2.02	2.75	2.50
	≥ 2	2.42	3.15	2.89
2+	0	2.43	3.16	2.91
	1	3.00	3.73	3.47
	≥ 2	3.39	4.12	3.87

Goodness of fit statistics is shown in table 5 for Model 1 which shows Coefficient of Determination (R^2), df(degree of freedom), F-value and Significance of variables at 95% confidence interval.

Table 5. Model 1: Goodness of fit statistics

Sample	Sum of Squares	df	Mean Square	F	Sig.
(Combined)	1470.190	6	245.032	323.794	0.000
Family Size	99.489	2	49.744	65.734	0.000
Scholl/college going children	487.282	2	243.641	321.957	0.000
Employed Person	336.047	2	168.023	222.033	0.000
Model	1470.190	6	245.032	323.794	0.000
Residual	1277.395	1688	0.757	R^2= 0.535	
Total	2747.585	1694	1.622		

Trip rate nomogram is develop for Model 1(Family size, Number school/college going children and Number of Employed person in Household) is shown in fig.5

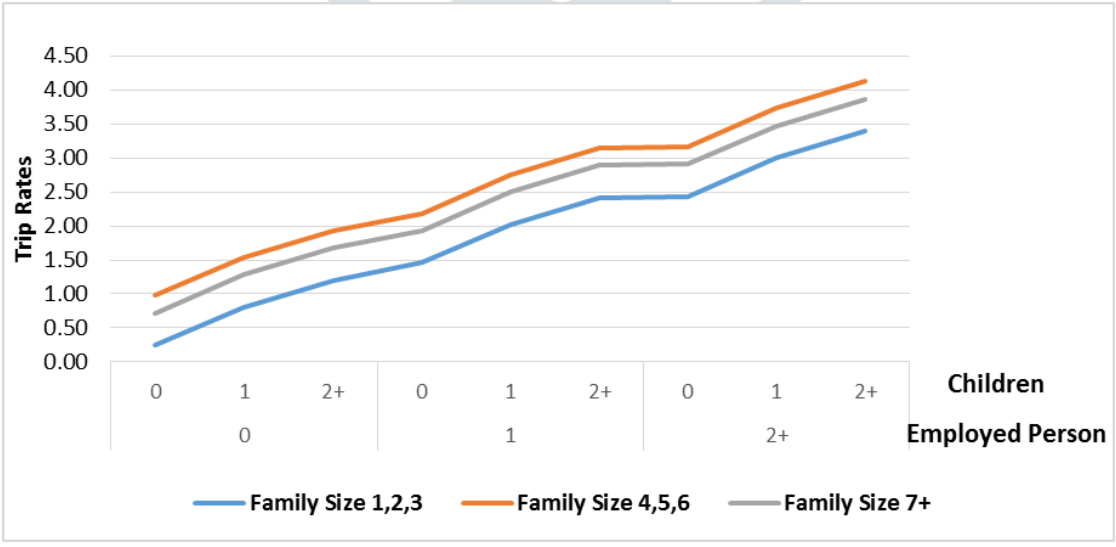

Fig.5: Trip rate Nomogram for Model 1

Model 2: Family size, Number school/college going children and Vehicle Ownership of Household

MCA table for trip rate is developed for the identified indipendent varianbles family size, Number of school/college going children and Vehicle Ownership which is shown in table 6

Table 6. Model 2: Family size, Number of School/college going children and Vehicle Ownership

Vehicle Ownership	School/college going children	Family Size		
		1,2,3	4,5,6	7+
≤1	0	1.47	2.05	3.44
	1	2.00	2.58	3.98
	≥ 2	2.75	3.33	4.73
2	0	1.92	2.50	3.89
	1	2.45	3.03	4.43
	≥ 2	3.21	3.79	5.18
≥3	0	2.09	2.67	4.06
	1	2.62	3.20	4.59
	≥ 2	3.37	3.95	5.35

Goodness of fit statistics is shown in table 7 for Model 2 which shows Coefficient of Determination (R^2), df (degree of freedom) F-value and Significance of variables at 95% confidence interval.

Table 7. Model 2: Goodness of fit statistics

Variables	Sum of Squares	df	Mean Square	F	Sig.
(Combined)	1207.042	6	201.174	220.429	0.000
Family Size	289.322	2	144.661	158.507	0.000
School/College going children	271.075	2	135.538	148.511	0.000
Vehicle ownership	72.899	2	36.449	39.938	0.000
Model	1207.042	6	201.174	220.429	0.000
Residual	1540.543	1688	0.913	R^2=0.439	
Total	2747.585	1694	1.622		

Trip rate nomogram is develop for Model 2 (Family size, Number school/college going children and Vehicle Ownership of Household) is shown in fig.6

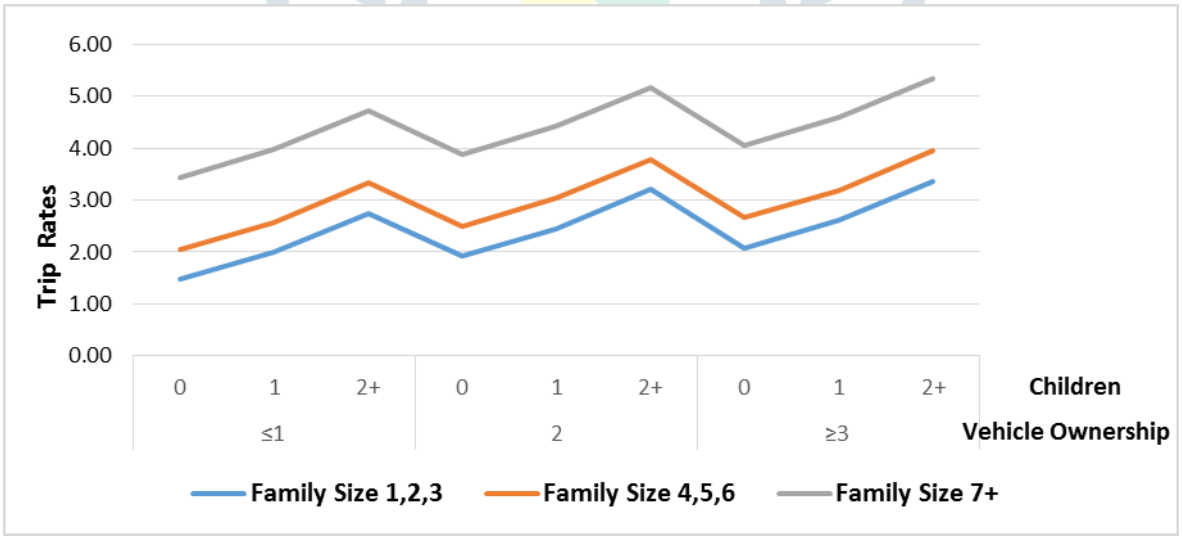

Fig.6: Trip rate Nomogram for Model 2

Model 3: Family size, Number school/college going children and Household Income
Income MCA table for trip rate is developed for the identified indipendent varianbles family size, Number of school/college going children and Household Income is developed which is shown in table 8

Table 8. Model 3: Family size, School/college going children and Household incomeIncome

Income	School/college going children	Family Size		
		1,2,3	4,5,6	7+
LIG	0	1.11	2.07	3.52
	1	1.69	2.65	4.09
	≥ 2	2.24	3.20	4.65
MIG	0	1.86	2.83	4.27
	1	2.44	3.40	4.84
	≥ 2	2.99	3.95	5.40
HIG	0	1.35	2.31	3.75
	1	1.93	2.89	4.33
	≥ 2	2.48	3.44	4.88

Goodness of fit statistics is shown in table 9 for Model 3 which shows Coefficient of Determination (R^2), df (degree of freedom) F-value and Significance of variables at 95% confidence interval.

Table 9. Model 3: Goodness of fit statistics

Variables	Sum of Squares	df	Mean Square	F	Sig.
(Combined)	1232.397	6	205.400	228.826	0.000
Family Size	362.946	2	181.473	202.170	0.000
School/college going Children	291.627	2	145.813	162.444	0.000
Household Income	98.255	2	49.127	54.730	0.000
Model	1232.397	6	205.400	228.826	0.000
Residual	1515.188	1688	0.898	R^2= 0.449	
Total	2747.585	1694	1.622		

Trip rate nomogram is develop for Model 3 (Family size, Number school/college going children and Household Income) is shown in fig.5

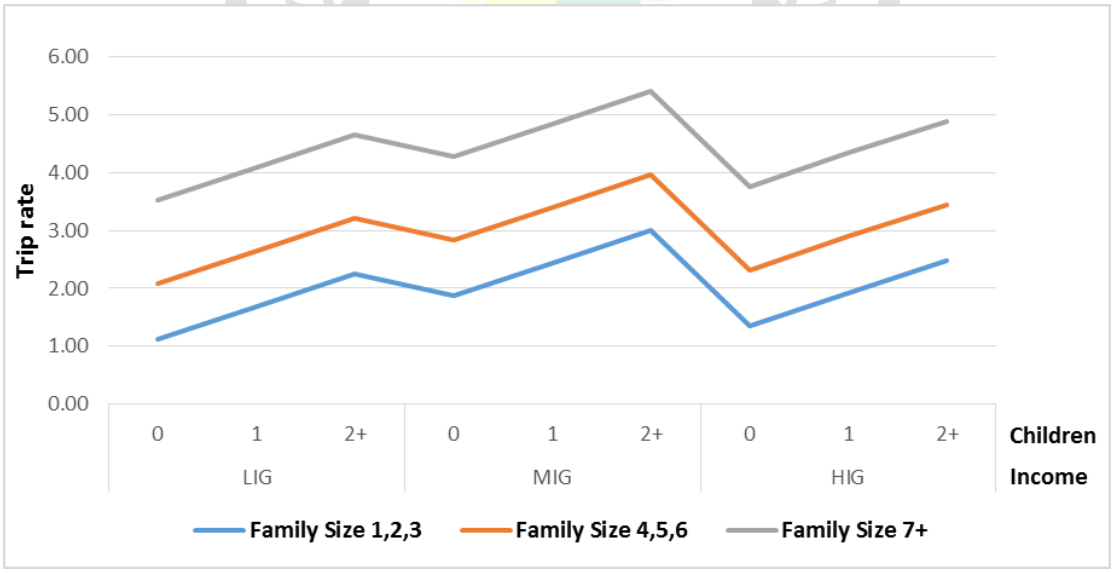

Fig.7: Trip rate Nomogram for Model 3

V. Regression Analysis

Linear regression analysis using software package SPSS has been carried out for trip rates for the same three scenarios as the MCA analysis.

In all the scenarios, the trip rate (TR) is taken as the dependent variable, whereas household size, employed person in household, number school/college going children, vehicle ownership of the household and household income are taken as the independent variables. The results of this regression analysis are presented from Eqs. (1)- (3), and their respective coefficients are shown from Tables 10-12.

Model 1: Family Size, School/college going children and Employed person

$$\mathbf{Y = 0.451 + 0.064X_1 + 0.839X_2 + 0.841X_3} \quad (1)$$

Coefficient of determination R^2 = 0.638; standard error = 0.7672

Where, Y= Total produced trips per Household (Trip rate), X_1=Family Size, X_2= Number of School/college going children, X_3=Employed person in Household

Model 2: Family Size, School/college going children and Vehicle Ownership

$$\mathbf{Y = 0.616 + 0.305X_1 + 0.526X_2 + 0.208X_3} \quad (2)$$

Coefficient of determination R^2 =0.497; standard error = 0.904

Where, Y= Total trips per Household (Trip rate), X_1=Family Size, X_2= Number of School/college going children, X_3=Vehicle Ownership

Model 3: Family Size, School/college going children and Household Income

$$\mathbf{Y = 0.071 + 0.340X_1 + 0.539X_2 + 0.260X_3} \quad (3)$$

Coefficient of determination R^2 =0.504; standard error = 0.898

Where, Y= Total trips per Household (Trip rate), X_1=Family Size, X_2= Number of School/college going children, X_3=Household Income, Here household income is classified into four groups as discuss in data analysis. For regression model development in SPSS coding for Household income group is coded in SPSS for regression analysis as: EWS-1, LIG-2, MIG-3 and HIG-4.

All three regression models indicates shows good correlation ($R^2 > 0.40$) among variables. It is observed that the variables household size, Number of Student, Employed person and income of the household are significant at 95% Confidence Interval in all the scenarios. Even the magnitude of standardized coefficients of the equations reveals that Number of Student in Household has the maximum effect on the trip rate followed by the Number of Employed person in the household and Family Size. Also Vehicle ownership and Income of Household has a much smaller effect. Regression statistics of all three model are shown in table 10-12.

Table 10. Model 1: Regression Statistics

Model	Variable	Variables		Standardized Coefficients	t	Sig.	Colliniarity statistics
		B	Std. Error	Beta			VIF
Model 1	(Constant)	0.451	0.057		7.937	0.000	
	Total Person	0.064	0.018	0.073	3.544	0.000	1.992
	Total Employed	0.841	0.030	0.509	28.100	0.000	1.644
	Total Children	0.839	0.025	0.618	32.962	0.000	1.537

Table 11. Model 2: Regression Statistics

Model	Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Colliniarity statistics
		B	Std. Error	Beta			VIF
Model 2	(Constant)	0.616	0.069		8.985	0.000	
	Total Person	0.305	0.018	0.347	16.666	0.000	1.462
	Total Children	0.526	0.027	0.387	19.550	0.000	1.32
	Motorized	0.208	0.022	0.176	9.603	0.000	1.135

Table 12. Model 3: Regression Statistics

Model	Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Colliniarity statistics
		B	Std. Error	Beta			VIF
Mode 3	(Constant)	0.071	0.095		0.749	0.454	
	Total Person	0.340	0.017	0.388	19.610	0.000	1.334
	Total Children	0.539	0.027	0.397	20.160	0.000	1.325
	Income	0.260	0.024	0.186	10.829	0.000	1.011

VI. Comparison of MCA and Regression Results

The differences between MCA and regression models are compared for the three scenarios developed. The R^2 value and standard error of estimate is compared for all three scenario for both MCA and Regression model. Coefficient of determination (R^2) For MCA model 1 is 0.535, MCA model 2 is 0.439 and MCA model 3 is 0.449. Coefficient of determination for all three MCA models is greater than 0.4, which shows good correlation (Gadepalli 2013). Coefficient of determination (R^2) for regression model 1 is 0.638, regression model 2 is 0.497 and regression model 3 is 0.504. The value of R^2 for all three regression models is greater than 0.4 (Gadepalli 2013).

For the comparison of MCA and regression models (Justin S. Chang 2014) used Coefficient of determination (R^2), correlation coefficient (r) and RMSE (root mean square error) values for observed and estimated trips. MCA and regression models comparison is shown in table 13 below.

Table 13: Comparison of MCA and Regression Models

Models	Coefficient of determination (R^2)	RMSE	Correlation coefficient (r)
MCA Model 1	0.535	0.870	0.661
MCA Model 2	0.439	0.955	0.660
MCA Model 3	0.449	0.947	0.632
Regression Model 1	0.638	0.766	0.799
Regression Model 2	0.497	0.903	0.705
Regression Model 3	0.504	0.897	0.710

VII. CONCLUSION

Multiple Classification Analysis method as an alternative of Cross Classification Analysis method of developing trip production models. Socio-economic, demographic, travel demand data collected by home interview survey. Data are collected from 2400 households from selected study area of Ahmedabad. Trip production model is developed by Regression analysis and Multiple Classification Analysis based on data collected. SPSS software is used for data analysis and model development. Developed trip production models would be able to forecast the number of trips production in future.

For the model Different variables groups are selected by Correlation and ANOVA test between Dependent and Independent variables. From the correlation and ANOVA test three different scenario are considered are (1)Family size, Number of student and Employed person in Household (2) Family size, Number of student and Vehicle ownership (3) Family size, Number of student and Income of Household. The selection of the independent variable for the study was based on the review of these studies and also based on its influence on the dependent variable.

The MCA analysis has been carried out and Trip rate tables are developed for all three scenario. Nomograms have been developed for all these scenarios from the MCA tables. These charts can be used to interpolate the trip rates for various combinations of variables in the city. Other cities with inadequate trip rate data having similar socioeconomic characteristics can use the charts to predict their trip rates based on prevailing local characteristics. Linear regression models have also been developed for the same scenarios.

Magnitude of standardized coefficients of the regression equations show that Number of student in household and family size has the maximum effect on trip rate followed by employed person in Household. Whereas Household income and Vehicle ownership has comparatively lesser effect.

MCA goodness of fit statistics of all three models shows that R^2 value for all models is greater than 0.4, which shows good correlation (Gadepalli 2013). R^2 value for Model 1 is higher than other two MCA models and RMSE value for Model 1 is lower

than other two MCA models. Hence, Model 1 is considered more acceptable from all three MCA models. Regression goodness of fit statistics of all three regression models also shows that regression model 1 is more acceptable than other two models because R^2 value is comparatively high and RMSE value is comparatively low for regression model 1.

Statistical analysis of MCA and regression shows that model 1 is more relevant to actual trip production criteria. Trip production model based upon Family size, Number of school/college going children and Employed person in Household is more acceptable.

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