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Developing Shopping Trip Generation Model in Residential Area of Ahmedabad City - A Case Study of Gurukul Area

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Abstract: *Safe, economic and timely transportation of passengers and goods/freight is necessary for the development of any nation. Efficient shopping activities are important for the transportation. Due to increased population and shopping malls and retails/wholesale hub, satisfying the need for the fast supply of consumers' products at regional and urban level becomes essential. Special shopping activities are inevitable to develop for the uninterrupted movement of public at regional level. At urban area level it is interesting to know about the movement of people. In the highly dense populated urban area, trips of shopping may be considerable to affect the passenger vehicle trips. How these trips increase with respect to increase in population? Which commodities generate more trips of supply? What is the influence of shop area on these trips? Which are the other factors significant to generate these trips? These are the questions to be answered in the context of today's rapid urbanization, which may be helpful to develop shopping trip generation model on the urban road network.*
Looking at the above, this study is aimed to study about the shopping trip generation in the urban residential area. Very few researchers have tried to develop the model of trip generation of shopping activities for the urban area in India. In this study highly dense populated residential area of Gurukul of Ahmedabad city is selected. Home interview of house-hold, inventory of shopping area, shopkeepers' personal interview, and other required data are collected. By statistical analysis significant parameters for different types of commodities are determined for the trip generation of shopping activities and different models are developed. For the selected area, average daily trips of shopping are estimated based on total population of the area, total shopping area, average distance from the wholesaler and average daily consumption of the commodities. The results indicate that it is possible to estimate daily shopping trips for the similar type of residential area.

Keywords: Transportation planning, shopping activities, Trip generation, urban level

1. INTRODUCTION

Urban transportation covers the movement of both people and goods within an urban area. At the individual level, urban transportation can be characterized by a trip. However, at the metropolitan area level, millions of these individual trips define urban transportation (Barber, 1995). A trip is as a journey made by an individual between two different points. Each trip is performed using one or multiple transportation modes for a defined purpose at a given time. Personal trips are commonly classified based on their main purpose (Barber, 1995); work trips, shopping trips, social trips, recreational trips, school trips, home trips and business trips. This paper focuses on shopping trips, and the factors that determine the aggregate number of shopping trips generated in metropolitan areas. A shopping trip can be defined as a trip to any retail center, irrespective of the size and type of the store or shop, and whether a purchase is made or not (Barber, 1995). Thus, going to a retail center, or a store by any means of transportation at any time period of the day is a sufficient condition for an individual to perform a shopping trip.

This report attempts to answer two specific questions. The first one is: What are the factors that affect the total number of personal shopping trips generated in Ahmedabad metropolitan areas? The second one is an extension to the first question: Do the demand for technology-related products, and telecommunication technologies, particularly on-line shopping, have any observable effect on personal shopping trips generated in these areas? The report tries to answer these questions via an empirical model based on cross-sectional data at the metropolitan level.

2. TRIP GENERATION

Trip generation is the first stage of the classical first generation aggregate demand models. The trip generation aims at predicting the total number of trip generated and attracted to each zone of the study area. In the other words this stage answers the questions to "how many trips" originate at each zone, from the data on household and socioeconomic attributes. Trip generation provides the linkage between land use and travel. Figure 1.1 gives an idea about trip generation process which may be separated into two phases. In the first, an understanding and quantification of travel-land use linkage is developed. In the second phase, the results of the quantification are applied to forecasted land use characteristics to develop future travel estimates.

3. LITERATURE REVIEW

Gurukul area - Coordinates: 23° 3' 5" N, 72° 32' 6" E**.**

Gurukul is in the new west zone of Ahmedabad. Majority of the residential development in Ahmedabad is concentrated in West Ahmedabad. In this area many shops and shopping complexes are established. Many different areas developing very rapidly in present and it will also develop in future. Public transport facilities and delivery vans are the main media through which shopping activity done by road. Location of Ahmedabad and Gurukul are shown in figures 1.3 and figure 1.4. Commodity wise shops locations in the study area are shown in figure 1.5. Figure 1.6 shows the different road stretches used for traffic volume count in the study area.

Figure 1.1: India map

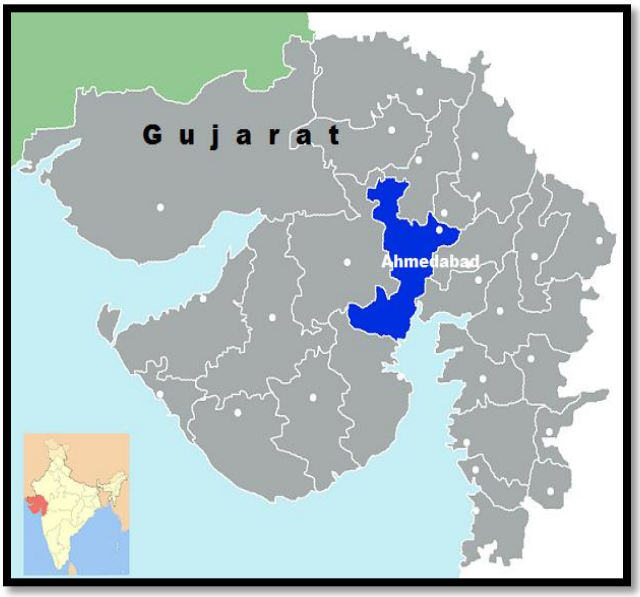


Figure 1.2: Gujarat map

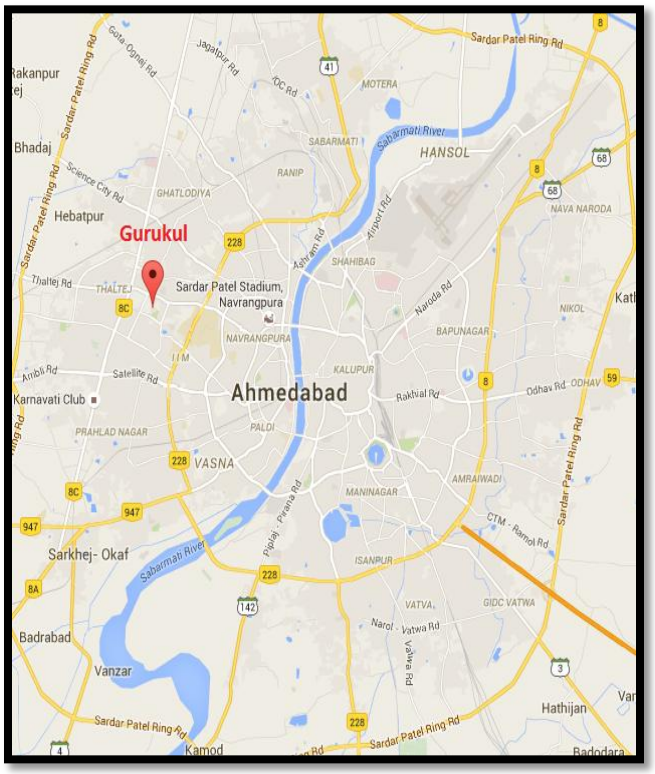


Figure 1.3: Ahmedabad map

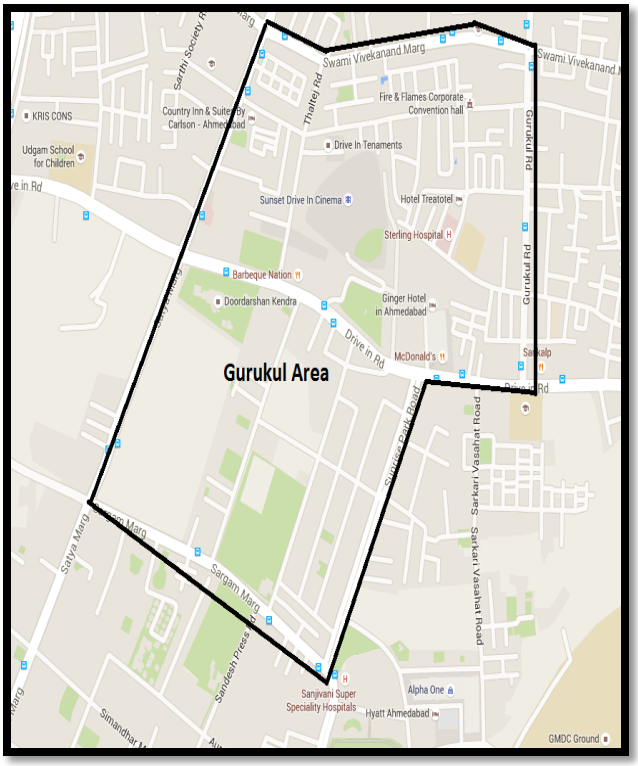


Figure 1.4: Gurukul area map

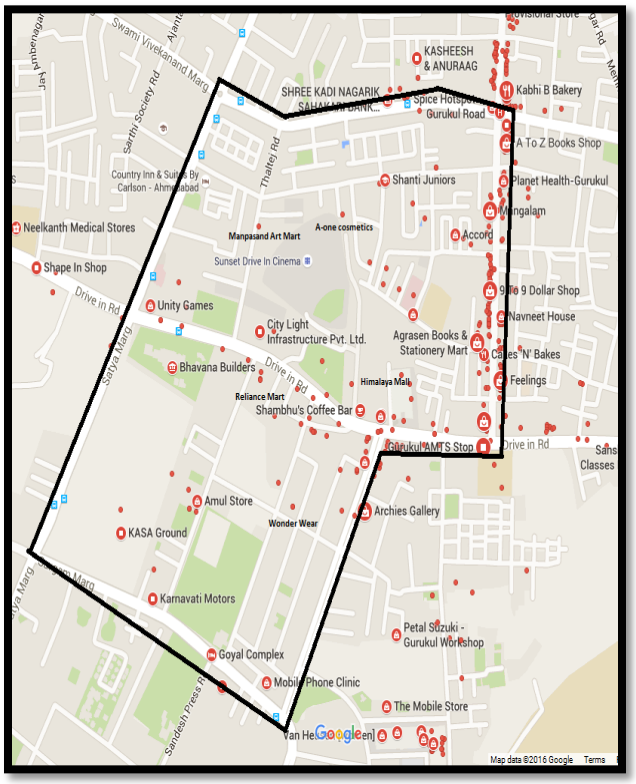


Figure 1.5: Location of shops

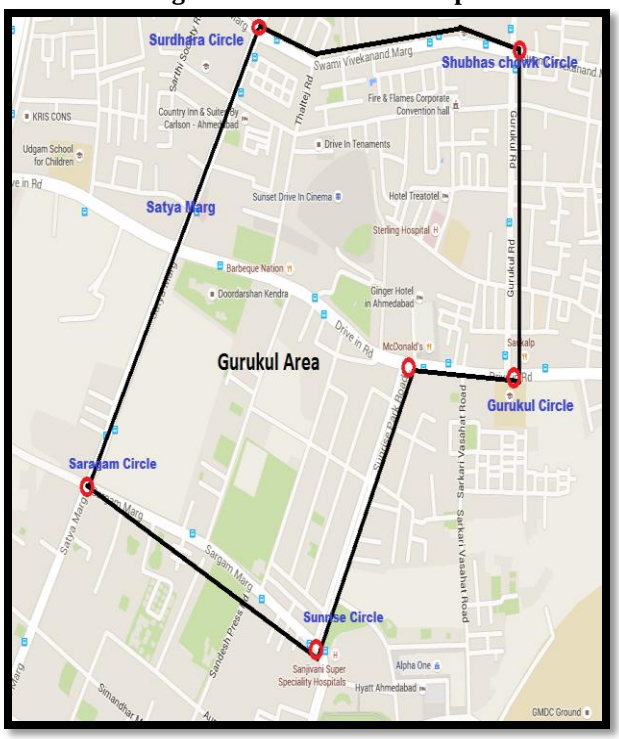


Figure 1.6: Study area map with different Road stretches

4. DATA COLLECTION AND ANALYSIS:

Home interview survey had taken at five locations of road stretches divided into study area. The process consist collection of origin and destination data. The survey is essentially intended to yield data on the travel pattern of the residents of the household and the general characteristics of the household influencing trip making. The information on the travel pattern includes number of trips made, their origin and destination, purpose of trip, travel mode, time of departure from origin and time of arrival at destination and so on. The information on household characteristics includes type of dwelling unit, number of residents, age, sex, race, vehicle ownership, number of drivers, family income and so on. Based on these data it is possible to relate the amount of travel to household and zonal characteristics and develop equations for trip generation rates.

The sections are described below:

Road Stretch A: Gurukul circle to Subhash Chock circle
Road Stretch B: Subhash Chock Circle to Surdhara Circle
Road Stretch C: Surdhara Circle to Sargam Circle
Road Stretch D: Sargam circle to Sunrise Circle
Road Stretch E: Sunrise Circle to Gurukul Circle

TABLE 1.1: Data collections of House hold Interview

	H.H	No. of Worker	Vehicle ownership	Avg. Distance From Shop	Shopping trips/day
Stretch A	117	72	107	65.5	119
Stretch B	144	79	130	88.6	153
Stretch C	127	84	114	68.7	141
Stretch D	119	81	117	59.3	145
Stretch E	122	90	108	69.4	160

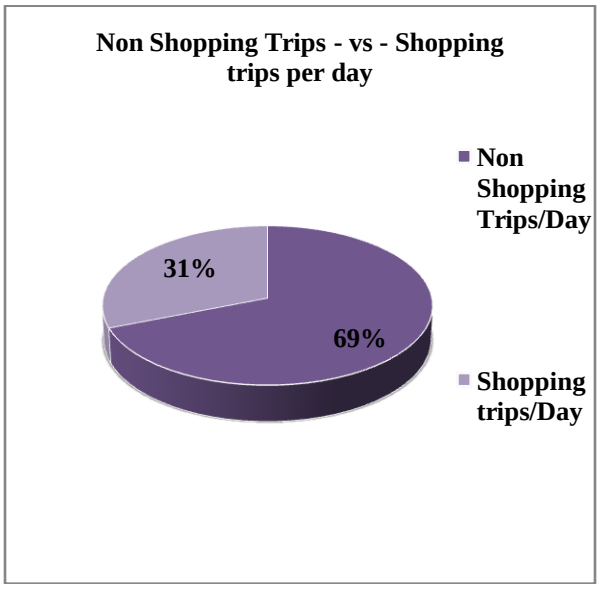
TABLE 1.2: Data collection of Trips / Day

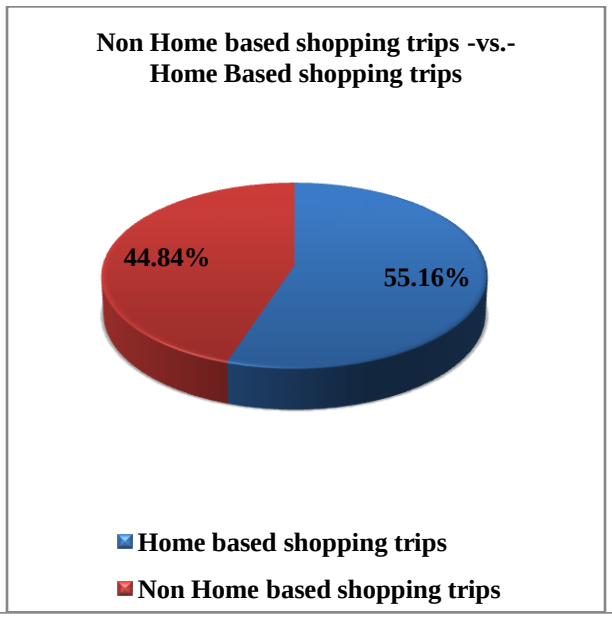
Total Trips/Day	Non-shopping trips/day	Shopping trips/day
2416	1668	748
100%	69.03%	30.97%

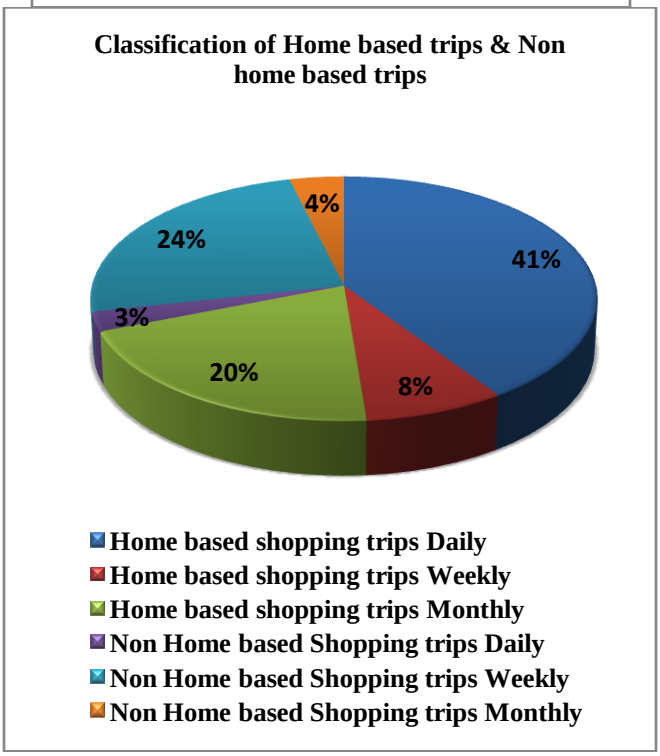
TABLE 1.3: Opinion survey of shopkeeper

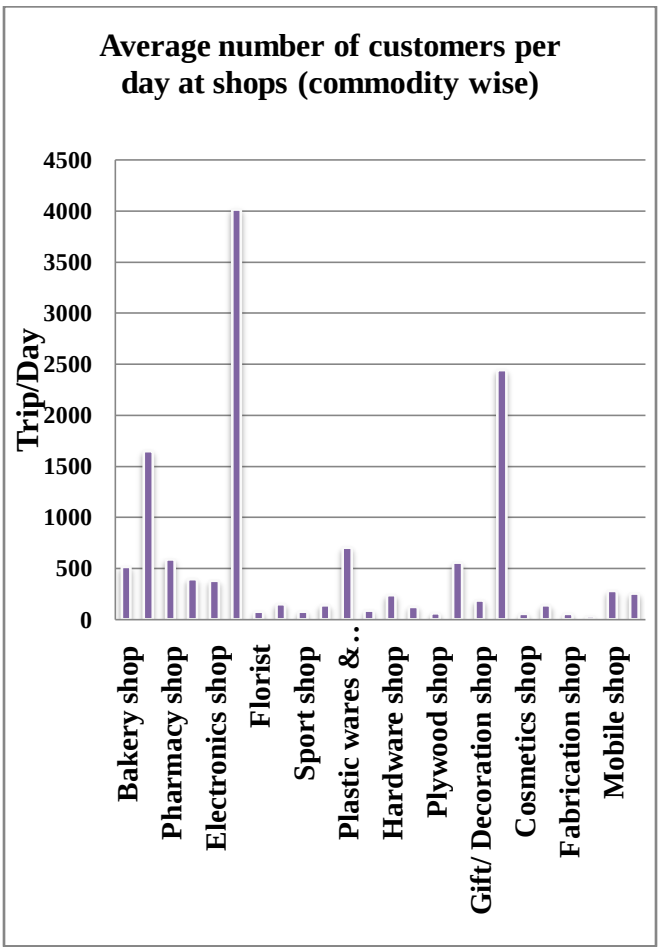
Commodity	No. of shops visited in Study Area	Total Area of all Shops (Sq .m)	Total number of Cust /Day	Total number of employee
Bakery	5	117.99	514	49
Grocery	13	233.06	1648	42
Pharmacy	8	156.76	589	21
Dairy	3	51.09	395	6

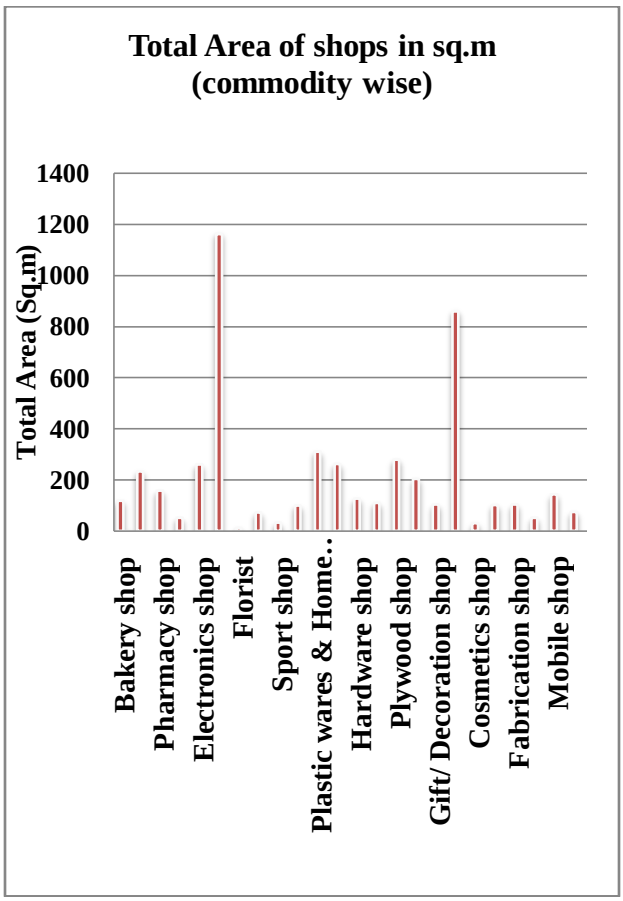
Electronics	13	259.29	377	74
Food / hotel	32	1160.2	4011	349
Florist	3	12.23	76	4
Toy store	2	71.82	150	18
Sport shop	3	31.59	75	15
Stationery	3	99.24	140	10
Plasticware/Homeapp	12	309.44	703	99
Furniture	4	261.53	87	16
Hardware	5	125.87	237	23
Opticians	7	110.18	123	23
Plywood	2	279	60	8
Footwear	8	202.8	554	59
Gift/ Décor	5	102.57	184	20
Clothing	29	857.57	2439	289
Cosmetics	2	30.66	52	4
Bag	6	101.27	137	23
Fabricatio	5	102.55	56	10
Jwelery	3	51	30	13
Mobil	10	142.14	277	28
Watch	7	74.78	252	22
Total	190	4944.45	13166	1225











5. CATEGORY ANALYSIS OF TRIPS/DAY:

From the home interview survey, it is clear vision about the share of House hold size with respect to total trips per day as a various types like stretch, commodity, mode, distance and travel time.

Table 1.4: Category Analysis- Stretch wise

X	Y (Trips/day)				
HH Size	**Stretch-A**	**Stretch-B**	**Stretch-C**	**Stretch-D**	**Stretch-E**
2	38	46	44	46	42
3	46	40	40	48	57
4	28	16	29	34	49
5	7	17	22	17	12
6	6	4	6	8	4

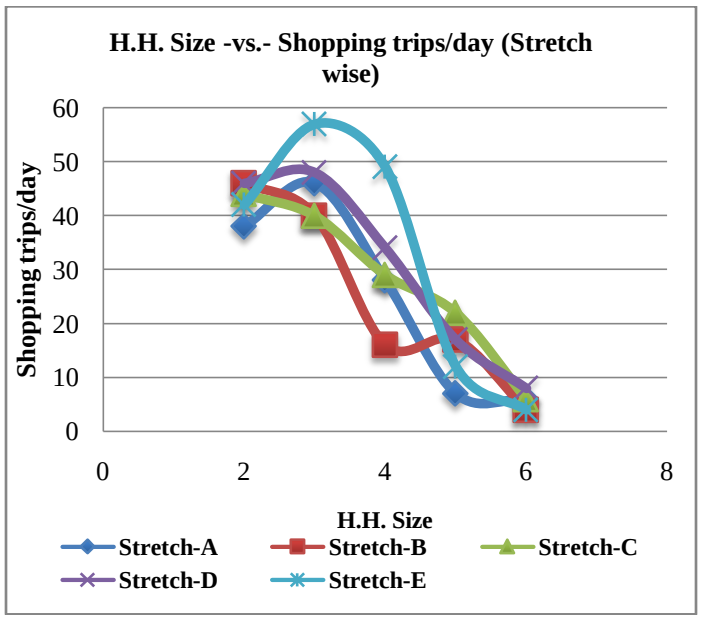


Table 1.5: Category Analysis- Commodity wise

X	Y (Trips/day)			
H.H. Size	**Milk**	**Vegetable**	**Flower**	**Ice cream-Juice**
2	76	19	10	25
3	68	25	9	28
4	40	17	13	18
5	16	13	11	10

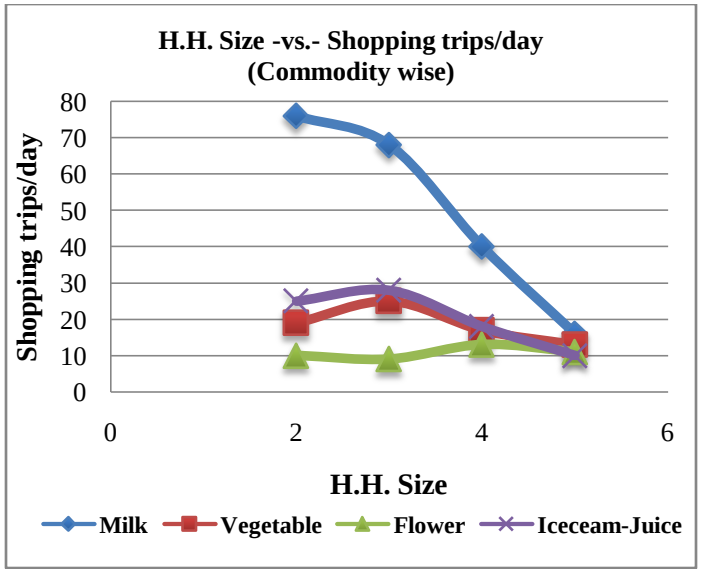


Table 1.6: Category Analysis- Mode wise

X	Y (Trips/day)		
HH Size	**Walk**	**2W**	**4W**

2	45	40	4
3	48	58	7
4	24	39	7
5	15	12	9

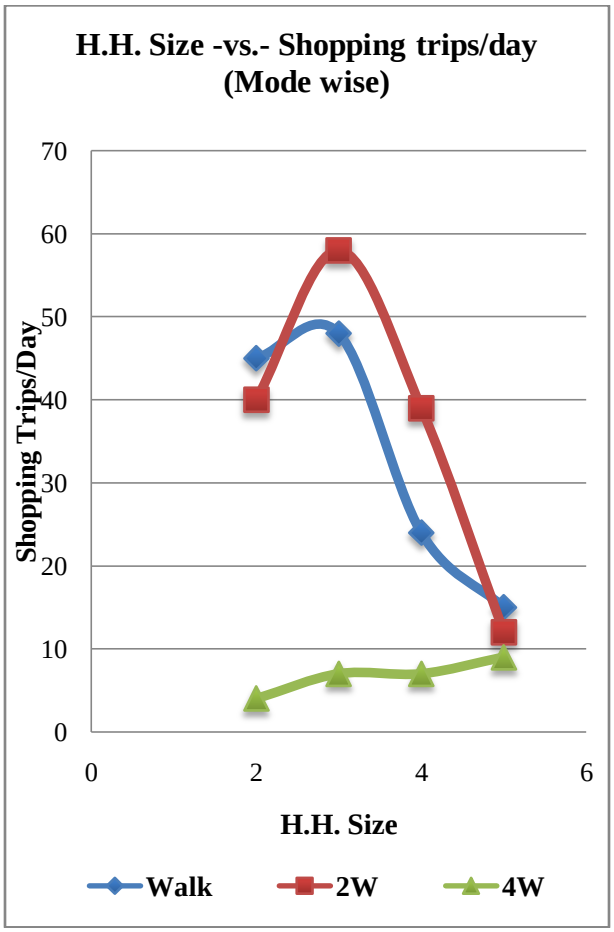


Table 1.7: Category Analysis- Distance wise

X	**Y (Trips/day)**				
HH Size	**0-1 Km**	**1-2 Km**	**2-3 Km**	**3-4 Km**	**>4 Km**
2	85	80	29	15	7
3	50	78	51	22	30
4	28	41	66	21	4
5	4	33	29	12	9

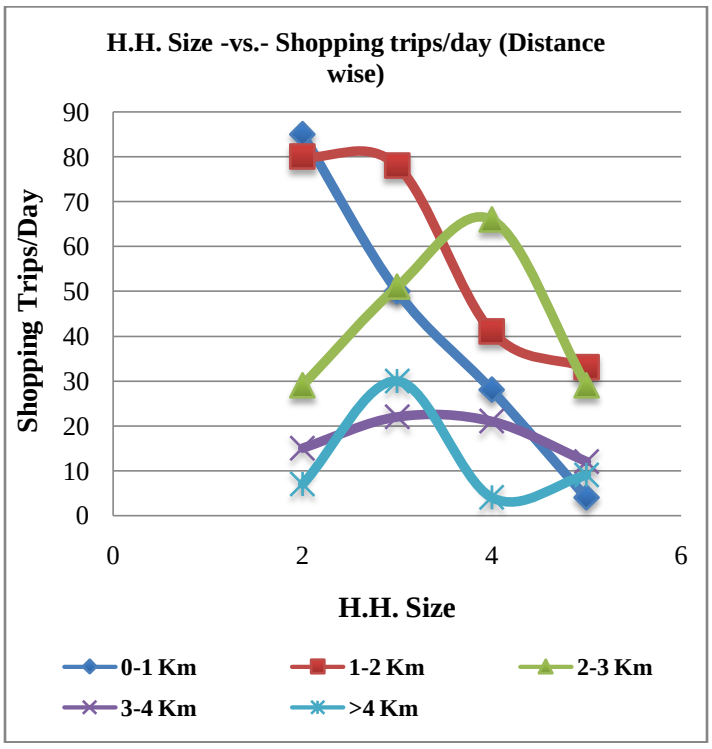
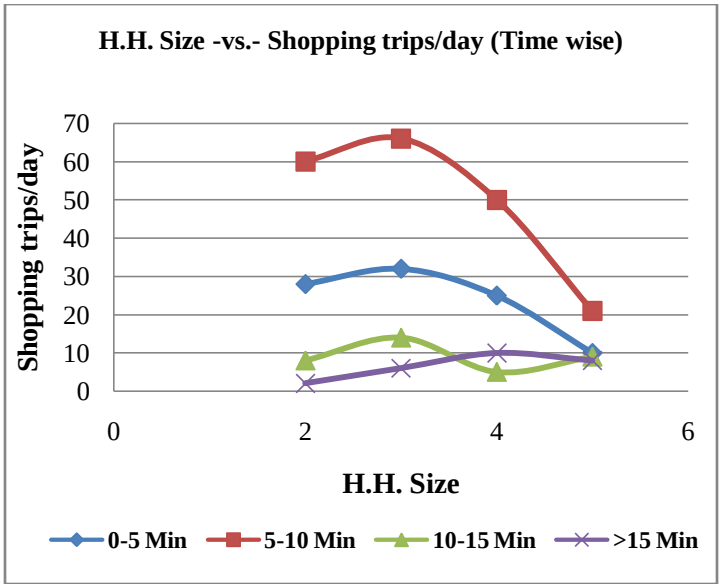


Table 1.8: Category Analysis- Time wise

X	Y (Trips/day)			
HH Size	**0-5 Min**	**5-10 Min**	**10-15 Min**	**>15 Min**
2	28	60	8	2
3	32	66	14	6
4	25	50	5	10
5	10	21	9	8



6. MODEL DEVELOPMENT:

6.1 Total trip generation model:

Using the various data from the house hold, the trip generation model is developing using the multiple regression analysis. The regression analysis conducted few times. The final projected total trip generation model is:

Y=0.772+3.341HH-0.0854W+1.101VO... (I)

Where,
Y= Total trips per day
HH= House hold
W=Number of worker
VO=Vehicle ownership

6.2 Shopping trip generation model (Home start) Production base:

Using the various data from the house hold, the trip generation model is developing using the multiple regression analysis. The final projected shopping trip generation model is:

Y=1.424+0.473HH-0.098W+0.462ATD… (II)

Where,
Y= Number of shopping trips per day
HH= House hold
W= Number of worker
ATD= Average travel distance (km)

6.3 Shopping trip generation model (Shop-end) Attraction base:

Using the various data from the shopkeeper's interview, the trip generation model (attraction) is developing using the multiple regression analysis. The regression analysis conducted few times. The final projected shopping trip generation model is:

Y= -38.70+1.408AS+5.823E… (III)

Where,
Y= Total number of customers per day
AS= Area of shops (sq.m)
E= Number of Employee

7. CONCLUSION

- The total person trips produced per day from the home interview survey reveals that House hold size; number of workers and vehicle ownership are significant parameters. The linear regression analysis gives r^2 value of 0.634, which may be considered as quite satisfactory linear relationship.
- The share of shopping trips per day is observed about 31% of the total trips.
- The linear regression analysis for the daily shopping trips produced from home reveals that parameters like; House hold size, number of workers, vehicle ownership and average travel distance of shops from home are giving r^2 value of **0.363,** which may not be considered statistically very good linear relationship. It seems that shopping trips have very poor relationship with considered socio-economic parameters than the total daily trips. So, the shopping trips may be roughly estimated as 30% of total daily person trips generated for the house-holds.
- From the knowing that, variables for model generation is not figured out perfect significance, a category analysis has been carried out using commodity, travel distance, travel time and mode wise for house hold for shopping trips per day. It is observed that average daily shopping trips for the house hold size 2 and 3 are more.
- Percentage share of non home based shopping trips with respect to home based shopping trips per daily, weekly and monthly is also determined. It is observed that (i) Daily home-based shopping trips are more than daily non-home based shopping trips; (ii) Weekly non-home based shopping trips are more than weekly home based shopping trips; (iii) Monthly home-based shopping trips are more than monthly non-home based shopping trips. Overall home based shopping trips are about 55% and non-home based trips are about 45%.
- It is observed that large amount of shopping trips per day are at dairy and food shop, cloths and grocery shop.
- The floor area of food/hotel and clothing shops are more compared to all other commodity shops.
- To develop the shopping trip attraction model at the shop end, the independent variables that mostly attract the number of daily shopping trips per shop are the area of shop (AS) and the number of employee working into shop

(E). The r^2 value **0.884** indicates that there is very good linear relationship and both variables are significant. This result is consistent with the findings of previous studies in developing as well as developed area in city.

- From the collection of data, it is observed that on-line activity of shopping is also made by people. But, there is no consistent information about the frequencies of online shopping by people. Therefore, the quantification of reduction of daily shopping trips due to on-line shopping could not be carried out.
- Statistical tests that are used in 'Daily shopping trips produced from home' model are T- test, F – test. The F-statistics tests the hypothesis that all the coefficients of the multiple regression models are simultaneously zero; that is, all the independent variables jointly have no impact on the dependent variable. T-test value of developed model of shopping trip generation is significant at 95% level of significance.
- In this study it is observed that on an average daily 2 trips per square meter of shop area are attracted.

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