Urban Transportation Planning
Prof. Dr. V. Thamizh Arasan
Department of Civil Engineering
Indian Institute of Technology, Madras

Module No. # 03
Lecture No. # 11
Trip Generation Analysis Contd.

This is lecture 11 on Urban Transportation Planning; we will continue discussing on Trip Generation Analysis in this lecture also. Let us briefly recollect what we did in the previous class, we just took one numerical example of trip production involving only one independent variable, just to understand the basic analytical principles involved in development of trip production model.

We found finally that, in practice, the example of this kind may not be directly applicable; you will have to deal with more than one independent variable. And sometimes, it may be necessary to have different sets of independent variables, depending on the trip purpose for which we develop trip production models. This implies that there is going to be a set of trip production models for a study area, trip production model for trips made for work then another model for trips made for education, shopping and so on.

Now, we are very clear about this statistical measure used normally to check the goodness of the regression analysis, starting from coefficient of determination e test and comparison of standard error of estimate with standard deviation and so on. We will just continue our discussion on trip production analysis, and I have just shown here, another analysis named category analysis, why category analysis or what is the difference between the normal trip production analysis and category analysis?

You may recall that, the numbers that we dealt with in trip production model represented the average values, zonal average values. Zonal averages, in fact may not be able to bring out all the different characteristics of households in traffic zones. For example, the average household size in two traffic zones could be 4, same averages, but the range of the household size in one zone could be from 1 to 11, in another zone between 3 and 6.

So, practically there is going to be a distinct difference between these two zones, but we treat these two zones as similar zones for the purpose of trip production, because we deal

with zonal averages. And if you consider vehicle ownership, again taking averages will create similar problem, the range of vehicle ownership in one zone need not be same in another zone, even though the number will be same for any two zones considered at a time.

So, to take care of this particular problem of zonal averages, not reflecting the actual household characteristics, many researches based on practical studies have suggested another methodology of analyzing trip production following a different procedure, and this procedure is called category analysis. The main principle involved here is, that the households are taken as basic units of trip production, whereas in the previous case, we consider traffic zones as units of trip production whereas here, we take households as units of trip production directly and categorize the households based on their important characteristics, that is why this analysis is called category analysis.

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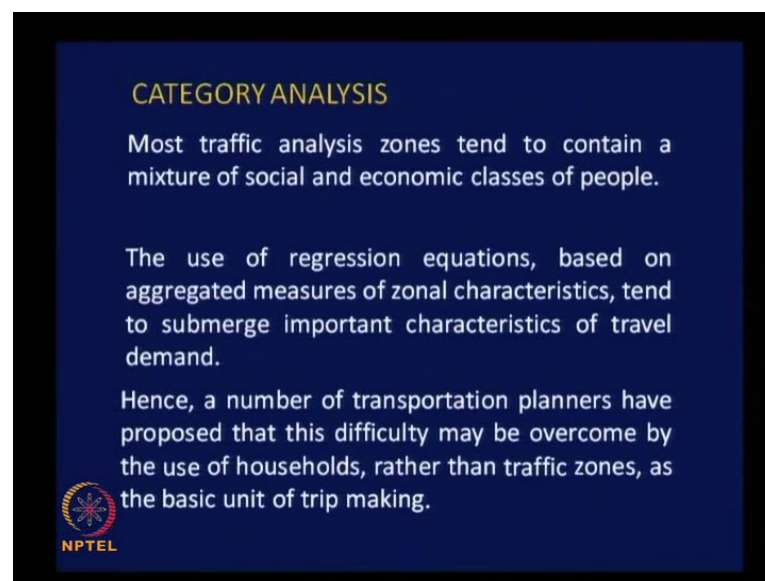
And most traffic analysis zones tend to contain a mixture of social and economic classes of people, as I indicated to you, the use of regression equations, based on aggregated measures of zonal characteristics tends to submerge important characteristics of travel demand. Because travel demand is influencer significantly by household size, household income, household vehicle ownership and so on. Since, we deal with averages, a distinct characteristic or influence of these variables will not be reflected truly in the case of regression analysis. Hence, a number of transportation planners have proposed that this

difficulty may be overcome by the use of households, rather than traffic zones as a basic unit of trip making, that is the main difference between the previous analysis and this analysis. The basic unit of trip making is taken as household here, whereas previously we consider the basic unit as traffic zones.

Let us see, how to take basic unit of trip production as household and proceed with the analysis, it is very simple, there is no statistical procedure involved, simply observing the data and tabulating in a convenient way, so that we are able to understand the trip making or trip production characteristics of different categories of households right.
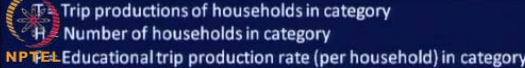
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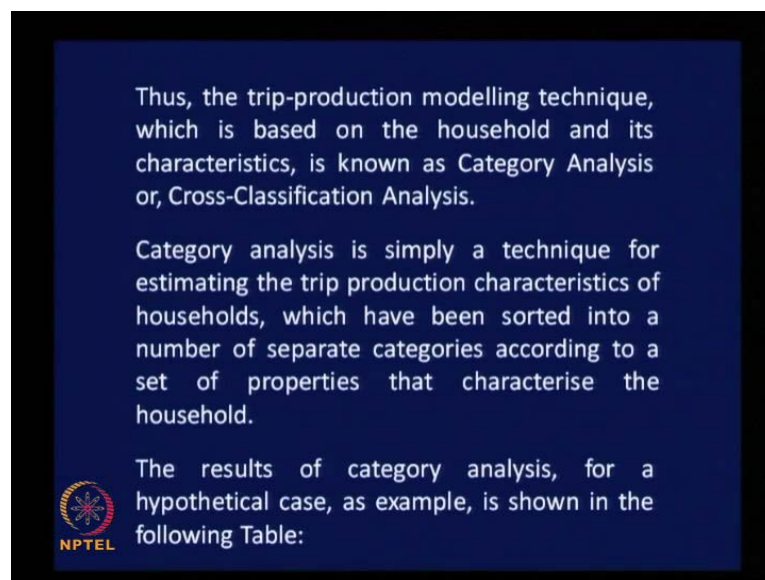
Thus, trip-production modeling technique, which is based on the household and its characteristics, is known as category analysis or cross-classification analysis. Classifying households across various factors, that is why it is also called as cross-classification analysis.

Category analysis is simply a technique for estimating the trip production characteristics of households, which have been sorted into a number of separate categories according to a set of properties that characterize the household. Now, the question is, what are the properties that are to be chosen to characterize the households? This is where we need to be very careful, the choice of characteristics, so that we captured a trip production of households without of much error.

Let us see, how to go about doing this particular aspect, of course the results of category analysis for a hypothetical case, as example is shown here to demonstrate how to go about capturing the appropriate characteristic of households in category analysis.

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Number of motor vehicles		Number of persons per household						Total
		1	2	3	4	5	6+	
0	T	240	1080	1020	1000	880	1125	5345
	H	800	1200	600	500	400	450	3950
	P	0.30	0.9	1.70	2.00	2.20	2.40	1.35
1	T	301	4844	5781	7466	4956	4879	28227
	H	344	2793	2472	3092	2046	1889	12636
	P	0.875	1.73	2.34	2.41	2.42	2.58	2.23
2+	T	8	644	2220	3231	2424	3002	11521
	H	5	294	717	1022	726	870	3634
	P	1.6	2.16	3.10	3.16	3.34	3.45	3.17
Total	T	549	6568	9021	11697	8260	9006	45101
	H	1149	4287	3789	4614	3172	3209	20220
	P	0.48	1.53	2.38	2.54	2.60	2.80	2.23

T Trip productions of households in category
H Number of households in category
P Educational trip production rate (per household) in category

Let us consider this table; on top, I have given the title for the rows as number of persons per household, we have considered 1 person household, 2 person household, 3 person household, 4, 5 and 6 plus. We have got six different categories of households based on the household size, that means households size is taken as very important characteristic, and then number of motor vehicles owned by households, we have considered three categories, 0 vehicle owning households, 1 motor vehicle and then more than 2 motor vehicles, 2 or more motor vehicles, so three categories of households.

And I have just indicated under each vehicle owner ship three letters as T H and P, as you can read, T stands for trip productions of households in their particular category, H number of households in their particular category, and P educational trip production rate per household in category. This implies that, it is possible to do category analysis for different trip purposes differently. In this case, it has been found that vehicle ownership and household size may be appropriate variables for educational trip production analysis, which may or may not be holding good everywhere, may be under our situation it may be different. This is a very general example, I have taken from international literature,

because I had the numbers, so that it is easy for us to understand the procedure of doing this analysis.

This is the value for no vehicle owning households of different sizes, and the numbers of trips made or produced are 240 and H stands for number of households of these category 800 households, and trip rate comes to be 0.3 per household of size 1 with 0 vehicle ownership. If we look for the trip rate for households of 6 plus size with no vehicle ownership, it is 2.4; therefore the average total comes to 1.35. If we put all the household categories together taking vehicle ownership as the basis for all categories of households owning 0 vehicles or the trip rate for this particular purpose is 1.35 <mark>clear.</mark>

This is just based on the field observed data <mark>clear</mark>, we are just tabulating the field observed data. Daily trip, always when we say trip it is daily trip made on a typical working day. Then, if you consider 1 vehicle owning households, we find that for the same household size, the trip rate is increasing. If you consider one person household previously we found the trip rate was 0.3, here it is 0.875 clearly indicates the influence of vehicle ownership on trip rate. And similarly, if you compare the final value, it was 1.35 earlier, it is now 2.23, again the influence of vehicle ownership is significantly brought out in this particular case.

And let us look at the details for households owning 2 or more motor vehicles, and for same one person household, you see trip rate is most doubling compared to the previous value it is 1.6 and 2.16 for 2 person household and 3.1 0 for 3 person household and so on, and the average for all the household sizes owning 2 or more vehicles becomes 3.17 <mark>right</mark>. Now let us sum up along the columns also, to look at similar averages for the set of data, we find for 1 person household irrespective of the vehicle ownership, the average trip rate for education is 0.48, for 6 persons and more it is 2.8 and the average the last column is given as 2.23 <mark>right</mark>, irrespective of the vehicle ownership of the households.

This is simply tabulating the available information, which provides us some basic idea about the trip rate related to the relevant characteristics of households. You can prepare similar table for work trips, shopping trips and so on, only a point to be noted here very carefully is, we must choose the appropriate factors here, they have chosen two factors; household size and vehicle ownership, it need not necessarily be the same two factors for other trip purposes that is the only difference.

Now, you may wonder why we need to consider households as trip making units and how are we going to finally get the trip production rate for subsequent analysis, because we have clearly understood earlier, that your trip analysis is going to be zone based; we had understood trips as one way movements between zones and triodes, there is no change in the particular analytical approach.

Now, we have come back to households and just getting information about trip production of different categories of households, ultimately we need to know the zonal level trip production, that is our ultimate objective, how to get that information for this table? This question has to be answered, otherwise our discussion is not completed.

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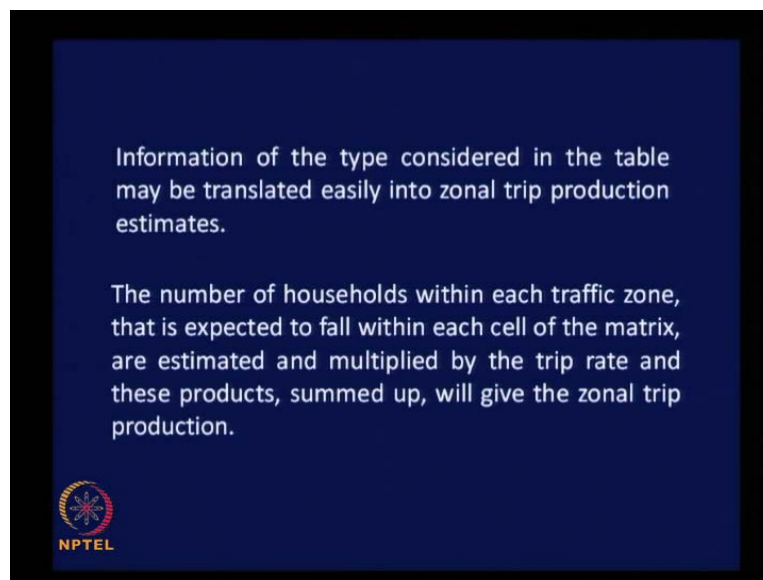
Let us take a small example, and try to understand how to convert the results of category analysis into zonal trip productions right. Of course, information of the type considered in table may be translated easily into zonal trip production estimate, it is not easily, there is some procedure to be followed. And the number of households within each traffic zone, that is expected to fall within each cell of the matrix, each cell of the matrix 1 person household 0 vehicle ownership, 1 person household 1 vehicle ownership, that is how you must understand, the cells of the matrix that we had seen earlier, the table is nothing but, a matrix, is it not? Otherwise, I will just go back and tell you clearly what is understood by the cell. So, each square is a cell, because it has got a distinct identity this number pertains to 3 percent household owning no vehicle, so that is how we need to

understand the cells in this particular table, are estimated and multiplied by the trip rate and these products summed up will give the zonal trip production, is it clear? May be, I will try to make it little more clear with a small example.

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Number of Households and Total Trips Made, Categorized by Household Size and Car-Ownership Level.

Household size	Car Ownership					
	0		1		2 or More	
	No. of Households	No. of Trips	No. of Households	No. of Trips	No. of Households	No. of Trips
1	925	1,098	1,872	4,821	121	206
2	1,471	2,105	1,934	6,129	692	1,501
3	1,268	1,850	3,071	13,989	4,178	19,782
4 or more	745	1,509	4,181	18,411	4,967	25,106

Let us say, this is the information pertaining to a traffic zone, number of households and total trips made category wise by household size and car ownership level, household size considered here are 1, 2, 3, 4 or more just an example, number of household of that category, the numbers are given here, you can assume that this pertains to the whole of the urban area; even though numbers look small compared to Indian scale these numbers represent the whole of the urban area, represent the whole of the urban area either a town or city right. And of 2 percent households 1,471 and so on, then number of trips made by the household which we actually collect, information is collected from the households by conducting service in the base year, so that the information is provided.

And similarly, for 1 person, 2 or more person households, we have collected the information, is not 1 person, one car owning household and two or more car owning households, number of households of that category is shown here and then number of trips made by this households, last two columns pertain to households owning 2 or more cars, is it not? This is the total number representing the whole of the traffic zone, can we just find out the trip rate for each of these categories of households from the given information, just trip rate; what is the trip rate for one person household owning no

vehicle, what do we get, simply divide 1098 by 925, is it not. Total number of trips made divided by the number of households of that category gives you the trip rate per day. We do this division for all the values and you can easily get the trip rate for each category of household that is the first step clear.

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And if you do, so you will get a result of this kind household size 1, 2, 3, 4 or more car ownership 0, 1, 2 or more and we have got the trip rate for different categories of households is that clear, now our interest is to get zonal trip production rates.

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You take a particular traffic zone, one zone and find out the actual number of households belonging to each of these categories that can be easily found, is it not. You can find out in a traffic zone, how many one person households owned no car, how many one person households owned only 1 car and how many one person households are owning more than two or two or more cars, is it not.

So, like that do that for different household sizes 1, 2, 3, 4 or more and get the actual number of households of each category, then we have already calculated the trip rate for each of these categories and simply multiplied these numbers by the corresponding trip rates. For example, we know there are 24 households in that particular traffic zone with only one person owning no vehicle what is the trip rate for this household, which we have already arrived at 1.19, is it not.

So, 24 into 1.19 should give you the trip production for that particular household right, that is what we do here, so we get trip production for the traffic zone by multiplying the number of households of that particular category with the corresponding trip rate. So, finally it is possible for us to get zonal trip production values, this is our interest 3109, that is what is our interest is really is it not, really you would like to know total tip production for a particular traffic zone, is that clear fine.

And we had been discussing about different factors that influenced trip production starting from household size, household income, and household vehicle ownership and so on. Let us look at some real life situation data pertaining to these factors that we had been discussing so far.

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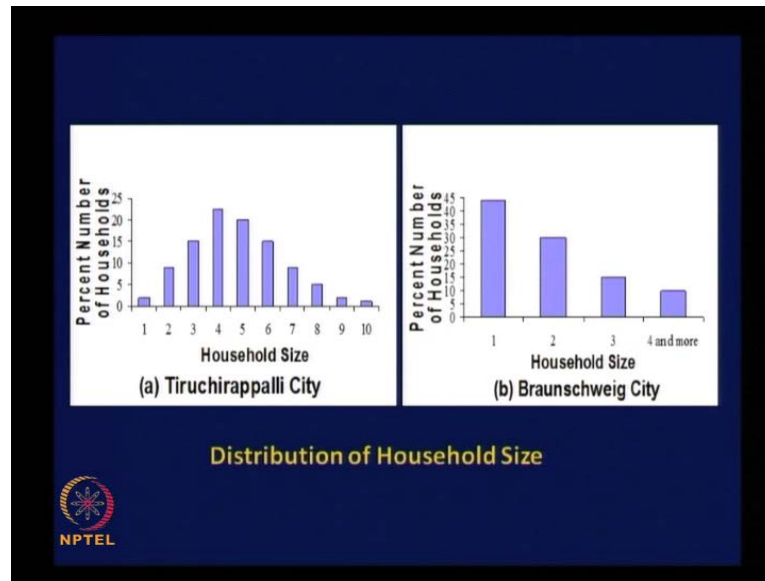
I will show you one information about distribution of household size; we have been talking about one person household 2 person, 3 person and so on, how exactly household sizes there are distributed in our country in a particular town or city. I have information about one city named Tiruchirappalli, this city is in the geographic centre of Tamil Nadu State, and the population of this city is more than 1,000,000. Of course, this information is more than a decade old, but does not matter, distribution has not changed and I have, I am just going to use this information for comparison of similar information in a city in a developed country, and I have checked where we are now, and where we are tending to in the future.

You can say that household size here is more or less normally distributed right and peak values are 4 and 5, most common household sizes are 4 persons per household, five persons per household and the other common values are 3 and 6, 3 and 6 are also quiet common significant percentages and the distribution is just normal.

When I just collected this data for a research purpose here of course, this data was obtain from the department of town and country planning, the government of Tamil Nadu; they had collected extensive data the whole of the data was made available to us for doing some research and that is how we got this information. Interestingly at the same time I had a collaborative project in Germany, in one a Germany university located in the city named Brown's wake, Brown's wake is a northern part of Germany nearer to the city of

well known city of Berlin. And I was also able to get involved myself in that planning work, which was just going on, my counterpart was involved in the planning process a professor in the technically university of Brown's wake. And this is the information pertaining to Brown's wake city about distribution of household size, one person household nearly 45 percent, 2 person household around 30 percent, 3 person only around 15 percent, four and more around 10 percent.

Look at the distributions, distinctly different distribution, may be negative exponential kind of distribution in that particular city, this distribution is reflective of the household size distribution most cities in Europe, probably in America and Canada too.

Why it is so, why is such significance proportion of one person household, any response

(())

Yeah it is a very general, but vague answer I expect a specific answer

(())

Good more or less you are touching the right point, economic prosperity brings independent, then how economic prosperity and independence influence household size distribution? Both of your more or less of correct they are cultural as well as economic aspects to this result. In most European culture, it is common practice to encourage children in families to go out of family as soon as they complete schooling, and live separately, under the remote care of the parents.

This is partly a cultural aspect and partly, because of some kind of economic independence, the objective of this kind of living in my opinion is to give youngsters freedom of thought, as well as give them an experience of managing themselves, all the affairs related to their life. And in the process they will try to be more and more independent, initially parents support them economically and in course of time they become economically independent too, they start earning while learning.

They run they own household and in the process they also choose their own life partners, their independent of course, in certain cases if they advice of parents and if you look at the way the elderly people live, parents of the parents they do not what to live with their

wants, their age may be 80 plus or 90 plus still they would like to be independent, living independently, because they can support themselves economically.

As long as they could move on their own, they want to live just independently without depending on their wants. So, they are three generations living independent of one another, you can think of the households size; so that is the reason why are the distribution of household sizes distinctly different compare to what we have in our country.

Living independent does not mean that they cut off their relationship, once and for all they fix specific days or dates to meet, spend some time together, enjoy a little bit and then go back to their respective homes. Normally weekends, you can see this kind of families coming together three generation, sitting together, chatting for sometime, eating together and then going back to their respective homes.

Do you think that, this kind of life style is good or not acceptable, why, why not acceptable to Indian situation or other words, why there is joint family system with more number of people in Indian families, what is the basic? Rather than stabilize, we can say the members of Indian families are not economically independent, as he rightly point it out, once you slowly pick up economic independence our Indian families also or likely to get scattered and the size will become smaller and smaller that is a trend.

We should anticipate as urban transportation system planners, what is going to happen to the household size in our country in future, because we are planning for 20 years ahead, so we must anticipate a significant decrease in the household size, compare to what is today right. Grand parents sticking want to their wants taking care of grand children all these things are fine to some extend, but the bottom line is economic dependence; once independence comes, you will find that family is become smaller and smaller household size decreases drastically.

I do not know, how many of you agree with my statement, but if you agree that generally, socially and economically we are tending towards developed countries this statement also holds good right.

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Distribution of Household size in Chennai Metropolitan Area

Sl.No.	Household Size	Sampled no. of Households	Percentage
1	1	558	3%
2	2	6364	32%
3	3	7993	40%
4	4	4121	21%
5	5	760	4%
6	6	164	1%
7	7 and above	40	0%
	Total	20000	100%

Source: CTS - 2008

Let us look at, similar details pertaining to other factors that we discussed on trip production analysis, this is the recent information pertaining to this city, Chennai city a comprehensive transportation study was completed in the year 2008 for Chennai city, and you can see the percentage of households of different sizes.

Here, also you can find 3 person households constitute 40 percent, 2 person household constitute 32 percent, this is the trend in most of the metropolitan cities in India today, family size has already become small 2 person households 32 percent, and 3 person household 40 percent and 4 person household 21 percent. Of course, this number 20,000 is the sample files, is not the total number of households in the city, they have just taken 2 percent sample, so it is 2 percent of 10 million is 20,000 right.

Yes please

Sir, when we began describing the household, we also discussed about institutional households.

No, this yes not including institutional households, this statistic is for a normal household.

Yes

That is not inclusive, it is a good question, if includes institution households then the numbers may not reflect, any meaning full result that is why we are dealing with normal households, institution household statistics is not included here, understand. Here, we have the proof already just few minutes before, I said we are tending towards very significance decrease in household size is happening right now.
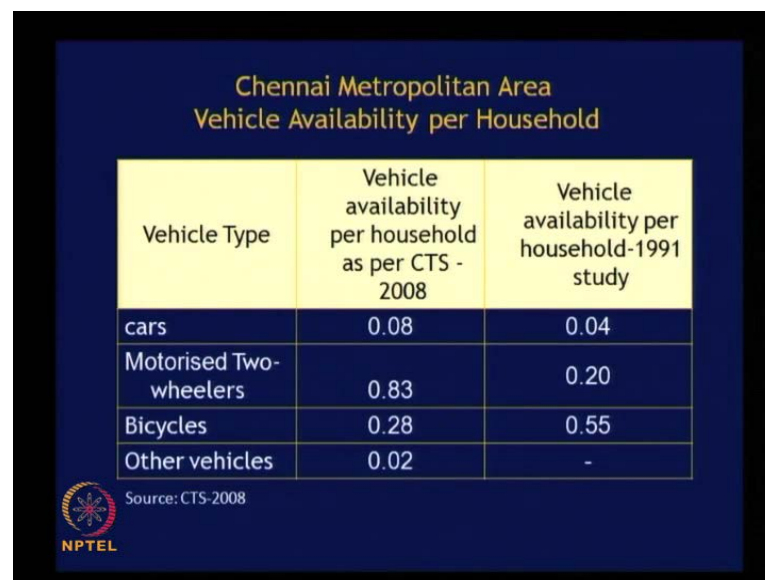
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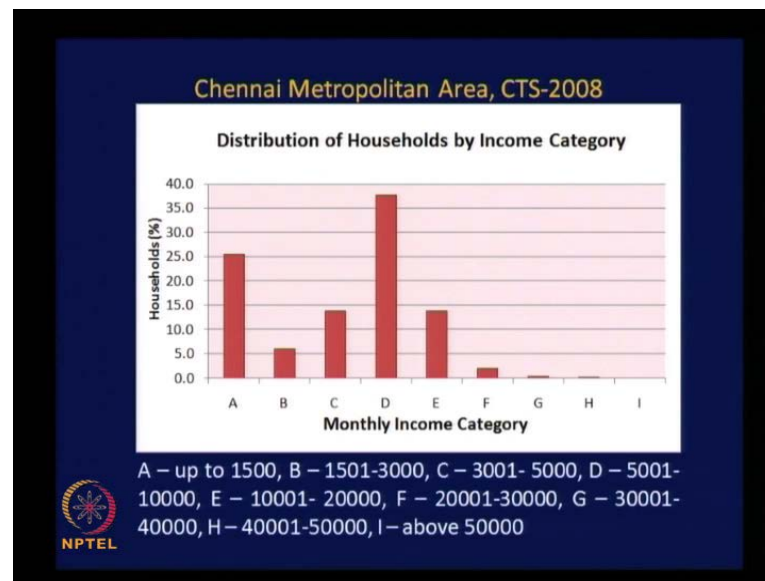
This is the income distribution, in the same city based on the same study CTS 2008, we find that about 25 percent of the households have income of 1500 or less per month, this is the reality of metropolitan cities, even though when we look at the overall development etcetera, we get very green picture, if we get into economic aspects of the whole of the population is not that row say, mainly because of the fact that nearly one third of the population of most metropolitan city is in our country are living in slums.

So, that factor have to be understood very clearly this is the metropolitan area, not municipal boundary, metropolitan area normally considered as the planning area for urban transportation system planning purpose. And other ranges you can see for yourselves, category B income range is 1500 to 3,000 of course it is much less, category C 3000 to 5,000 significant, nearly 13 percent, 5,000 to 10,000 D is the predominant income range more than 36 percent of the households have income of simply 5,000 to 10,000; 10,000, 20,000 is around 14 percent and 20 to 30 very small percentage and 30 40 still smaller, 40 50 much less and above 50 negligible.

And this is the reality that we must take this numbers with a pinch of salt, I have already told you getting accurate information about income from the households is not that easy right. So, you can easily guess that these values might have been under statements, they would have given normally lesser income value or if you look at the information given by the different sections of the society, it is likely that very low income groups give a little higher number and very high income group give the lower number that is also likely.

So, in general I must understand that these numbers are prone to error, we need not take this numbers very seriously, but still these are indicative of the reality indicators, general indicators of the reality.

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One more information about trip production aspect, this is vehicle availability per household in Chennai metropolitan area, if you consider cars we have 0.08 cars per household and of course, motorized two-wheeler ownership is relatively high 0.83 per household and bicycle less than motor cycle is very interesting, only 0.28 per household people do not like bicycle, they like motor cycles much.

And other vehicles three-wheelers and other including animal drawn vehicles, other category 0.02 most interesting aspects is you compare this numbers with the previous values obtain in the year 1991, shown in the last column. You can find that the car ownership has simply doubled right, and motor cycle ownership has (()) becomes four

times in a span of how many years just nearly a two decade let us say, in two decades, car ownership is doubling and motor cycle ownership is (()) is a very high rate of growth of vehicle ownership, even though total number is less rate of growth is very high. And bicycle ownership has decreased, has become nearly half of the previous value 0.55 to 0. 28 of course, regarding other vehicle they did not collect data previously.

So, we need to understand that there is significant rate of growth of motor vehicle ownership in our country, in spite of the lower level of car ownership our traffic in urban areas is not manageable as of today, and when the car ownership increases, what to do still get worse (()). May be later, we will discuss about implications of planning on traffic management, when we discuss about sustainable transportation system, nearly at the end of the course right.

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Chennai Metropolitan Area – Daily Trip Production Details

Sl. No.	Household size	No. of Households	No. of person Trips	Person Trips per household	Trips per Person
1	1	558	1228	2.2	2.2
2	2	6364	28638	4.5	2.3
3	3	7993	38366	4.8	1.6
4	4	4121	21429	5.2	1.3
5	5	760	4180	5.5	1.1
6	6	164	951	5.8	1.0
7	7 and above	40	252	6.3	0.9
Total		20000	95044	4.8	1.62

Source: CTS-2008

Now, one additional information which may be of interest to us in connection with trip production is this, daily trip production details of Chennai metropolitan area are shown here. Household size is given from 1 to 6 as well as 7 and above then number of household in each category same as we have seen earlier, total number is 20,000 the number of person trips made by households of different categories, one person household two person households and so on. And then person trips per households is given in the last, but one column, last column gives a per capita trip rate, trips made by one person per day in a particular household right.

And you can see as the household size increases, the trip rate comes down, initially it is 2.2 of course, in the case of 2 person household is likely more otherwise, there is decrease in trend, 1.6, 1.3, 1.1 then 1 and then 0.9. Our interest is the average of all, the average per capita trip rate today is just 1.62 trips per head, per day, if the population of this metropolitan city is taken as 10000000 then roughly 16000000 trips are reduced per day. And we have the provide for or we have to meet this demand of 16000000 trips, which is reduced everyday, that is the total demand and we must make this demand by planning a appropriate transportation system.

If the total demand can be met by a simple means then it is easier, if it total demand for a Chennai city of a particular commodity is known you can easily recruit that amount of the commodity and distribute easily. Let us say for example, the demand for rice the whole of the city, sugar or some other commodity, you can prequel a whole lot and store the commodity warehouse, identify the distribution centers and distribute the commodity total demand is known and distribution centers are known you can just distribute make the demand without much of difficulty.

Can we do in the similar fashion to make the transportation demand, 16000000 trips per day provide enough number of vehicles to meet this many trips, is that the way to meet this demand, demand for transportation is a very complex commodity, why <mark>why</mark> it is complex, because as I said earlier demand for transportation is spread over space and time, each trip is different from one and another.

If you take a particular trip there are a set of attributes for a trip, the origin, destination, time of start, time of finish, more used, transfers made between modes if necessary <mark>right</mark>, so these all the attributes of the trips, these attributes are different for different trips. So, when such is a situation, how to meet this kind of a demand each one would like to go from one point to another point at a particular time using a particular mode of transportation, at a particular time period.

That is where meeting transportation demand becomes extremely difficult and you cannot treat demand for transport as simply demand for a general commodity, it is a very complex commodity and we need to have our own methodology of meeting this demand. Later on in the course of our discussion, you will know how to really meet the demand for transportation while appropriate planning procedures.

So, this completes our discussion on trip production analysis, you may recall we started our discussion on trip generation analysis, and trip generation has got two parts; trip production and trip attraction <mark>right</mark>. So, this means that we had completed our discussion only on one part of trip generation analysis.

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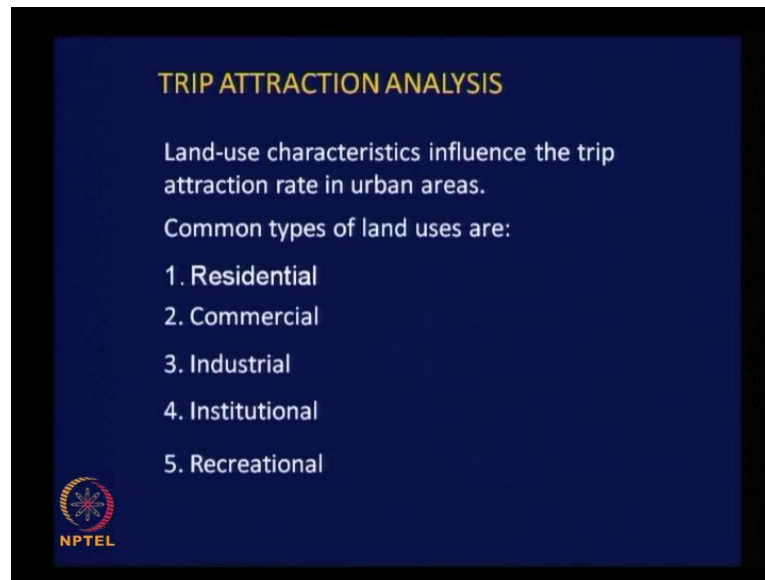
Let us look into, the other aspect trip attraction analysis, we may recall trips associated with non home zones or trip attractions or non-residential zones or trip attractions, we have managed to identify factors that influence trip production, all the factors are related to household characteristics. On the same lines, is it possible to identify some factors, which might influence trip attraction since, trips are attracted by non residential zones household characteristics cannot be taken as factors influencing trip attraction; we must look for some other set of factors, any suggestion.

We need to look for land-use characteristics, the factors that are reflecting the type and intensity of use of land users will be useful for us to explain trip attraction, and land-use characteristics influence the trip attraction rate in urban areas. And we had already classified the urban land users into different types starting from, residential, commercial, industrial, institutional, and recreational and so on.

Now, it is a question of deriving or identifying some factors associated with these different types of land users, which will really influence the trip attraction <mark>right</mark> of course, we are going to leave out the first category residential, because that is related to

trip production <mark>right</mark>; we must look for factors associated with other land users, commercial, industrial, institutional, recreational and so on. Can we think of some factors reflecting the extend in intensity of commercial land-use, it need not be at a disaggregate level, you need not to worry about the different types of shop that will be available in commercial area, total number of shops and the things like that; some aggregate information reflecting the type and intensity of land users, that is what we are going to use in trip attraction modeling.

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I will give you some examples, identifying causal variables for trip attraction analysis, retail trade floor area, it may not be very specific and very accurate, but still in the absences of accurate disaggregate information, we must go in for some kind of approximate aggregate information. In that context this will be more appropriate, retail trade floor area, you have number of shops at least the floor area of all the shops together will give you some idea about the intensity of this particular land-use in that traffic zone.

Similarly, service and office floor area, in the case of institutional land users, what is the spread of this activities office and services, then manufacturing in whole sale floor area, if you are looking for some factors in industrial, land-use, look for floor area which is actually use for manufacturing purpose whole sale ling and so on.

Then the other way of looking at the intensity of land-use at non residential land is, look at the number of employment opportunities in retail trade, you have commercial area if

more number of people is employed in commercial activity that is also reflective of the intensity of commercial activity in that area, so this is also possible. If you get accurate data of this type that can also be tried out as a factor influencing trip attraction; number of employment opportunities in service and office similar to the previous one.

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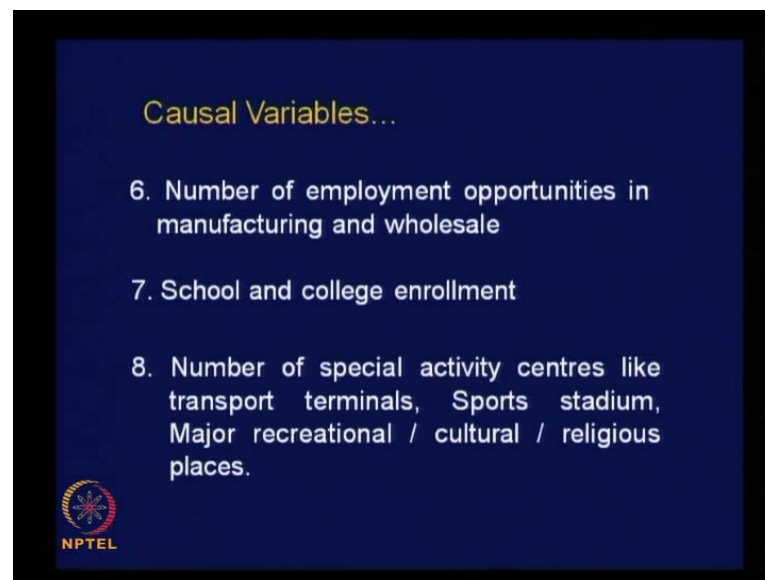
And number of employment opportunities in manufacturing and whole sale, in the case of educational institutions school and college enrollment, number of students attending a particular school college in a particular traffic zone. They good indicator of its ability to attract trips, most of the educational trips will be attracted towards they particular zone, so college or school enrollment could be every important factor.

And in additional to zonal characteristic there could be some special factors ladders, we have intensity bus terminal located in a particular area, in a city, and people making intercity trips will be converging towards that particular point, so one traffic zone. Like that number of special activity centers like transport terminals, railway stations, bus stands, and so on, sport stadium, major recreational, cultural and religious places.

If such activity centers are located in zones, you must include this fact also in to your modeling process, so that ultimately you get fairly accurate value about trip attraction of a particular zone right. To summarize what we have seen in this class, I would say that first we discussed about category analysis and has a substitute for normal regression analysis of trip production. We know the basic difference between regression analysis

and category analysis respective of trip production model. Regression analysis is zone based where as category analysis is household base, we should also realize the fact that even though we do category analysis based on household or taking households as trip making units. Finally, we need to convert the information that we get in category analysis into zonal information to get ultimately the zonal trip production rates.

Then we saw a set of interesting examples of households characteristics, starting from household, size household ownership, vehicle ownership and household income and so on, and the moral of the story is that household characteristics of developing countries are tending towards the households characteristics of developed countries. And has planners, we must understand the trend or the change in the different characteristics of households and understands the possible future scenario and incorporate that information in the planning process.

Finally, we discussed about trip attraction with specific reference to identification of different factors influencing trip attraction, we will continue the discussion on trip attraction in the next class, we will summed up our discussion for today with this.