Urban Transportation Planning
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Lecture No. #24
Trip Distribution Analysis Contd

This is lecture 24 on urban transportation planning, we will continue our discussion on trip distribution analysis in this lecture. You may recall, we discussed about the structure of w constrained gravity model in the previous class, and then we understood the method of calibration of w constrained gravity model with aid of a numerical example. Calibration mainly involves determination of the parameter related to the friction factor f i j right.

And the calibration process involves take into account, the trip production adjustment factor as well as trip attraction adjustment factor. You may recall we assumed a trial value for the parameter alpha also the value of unity for the trip production adjustment factor y j, is it not? Then started the iterative process until both X i, and y j balanced; then the balanced values of X i and y j along with the assume value of alpha was substituted in the parent equation or the parent w constrain gravity model to get values of T i j.

Thereby, you will be able to get a matrix giving the result of your trip distribution using w constrain gravity model, then this matrix should be compared with the actual observed distribution matrix cell by cell. And the effectiveness of matching of your model generated matrix with the sealed observed matrix can be tested using statistics like normalized 5, normalized (( )) as well as coefficient of determination, that is what we discussed in the previous class. To check whether we have captured the essence of the previous lecture, let us just pose few questions to us, and let us try to answer the questions.

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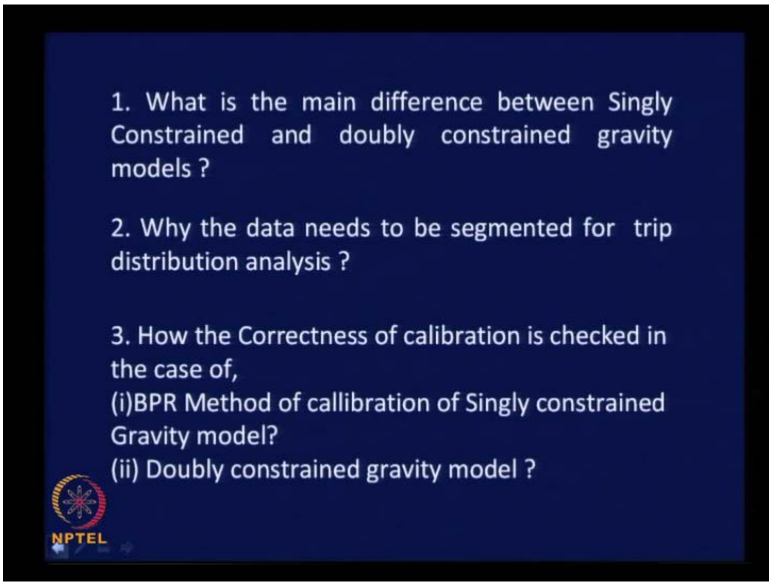

The first question is this, what is the main difference between the singly constrained doubly constrained gravity models. You should not simply answer that singly constrain model is having one constraint, doubly constraint model has 2 constrains. It should be more detailed, and technical answer. Any volunteers only one difference - main difference between singly constraint and doubly constraint gravity models. The answer is this, the constrained related to trip production - zonal trip production is built into the model itself, in the case of singly constrained gravity model. In the case of doubly constraint gravity model, we take both the constrains related to trip production as well as trip attraction in the model structure itself.

So, that the constrains are given input to the model, and get the constrained model formulation before the actually start distributing the trips using gravity model right, constrains related to production. As well as attractions go into the model structure in the case of doubly constraining gravity model, whereas in the case of singly constrain gravity model, the constrains will be only production is taken into account clear. So, that is how we need to understand the difference between these two models. One other question which is very relevant is this, why the data needs to be segmented fir trip distribution analysis? I hope all of you understand what we really mean by data segmentation. What is data segmentation? Physical meaning of the word segmentation I think all of you should be able to appreciate, segmenting is separating in two parts. Is it not? Why should we segment the data for trip distribution analysis.

Please you remember when we collect trip distribution data for base year condition, we will have information about distribution of trip from one zone to all other zones irrespective of the distances involved, irrespective of the more used right; irrespective of the propose for which the trips are made. All this information I will collected together right. So, it is a (( )) of all this types of trips distributed from 1 zone to all other zones, but we want to segregate or segment the data for the purpose distributor of trips why? Because trip distribution pattern depends on certain important factors; trip distribution pattern is influenced by the mode used for travel, as indicated to you are repeatedly; if the mode is just foot, trip distribution pattern is going to influence only the adjoining zones from zone under concentrations, is it not?

If it is bicycle, it may extend over a slightly larger region. Motorized modes may extend over the entire urban area irrespective of the distance. So, that is how mode used for trip influences distribution of trips; obviously, we need to segment data based on mode used for transportation. Is it not? Before you distribute the trips. And if you feel that in a particular urban area, the trip purpose also influences distribution of trips which may be true in most cases. Take for example, shopping trips - shopping trips mostly may have influence over the adjoining zones, very rarely people go over long distance for shopping unless it is the very important retail purchase, normally we do shopping in the adjoining areas.

And a educational trips are relatively shorter compare to work trips, if you look at the average length of education trips, and work trips in any urban area, you will find that the average length of work trips is slightly more than the average length of educational trips, because we put mostly children in school - in the schools around the residential areas unless the parents are very particular to put their wards in specified schools. After liking which might be in farer places, which may not constitute a major percentage proportion right.

So, there is reason to segregate data based on trip purpose also because distribution pattern might depend on the purpose of trip 2, is it not? So, that is the question here, why the data needs to be segmented for trip distribution analysis, because trip distribution is influenced by factors like trip purpose, mode of travel and so on. Therefore, there is a need for segmenting data, before we do trip distribution analysis clear. As we did in the case of motorized analysis, we did not put everything together and did mode choice analysis, this segmented data. Is it not? On the same lines there is a need for data segmentation for distribution also.

Third and the last question is this, how the correctness of the calibration is checked in the case of, number one BPR method of calibration of singly constraint gravity model. How do we check the correctness of calibration? In the model calibration process you may recall we just express f i j as a function of T i j right, in B P R method also we express the friction factor as a function of mostly travel time and very rarely travel distance. And how do we check the correctness of calibration what do we do in BPR method of calibration, at the end of the calibration process what do we do? You may recall, we are using discontinuous function right to get the different functional forms for the frictional factor; it is not a single function. And discontinuity is based on the segmented travel time, put all the trips involving times of 0 to 5 minutes as 1 group right, and then try to fit a functional form for that particular data set.

Then put all the trips involving travel times between 5 and 10 minutes, and identify a functional form and do calibration right. So, after completing the entire data set, what we do is we find out based on the results of the calibration, what proportion of trips fall under each segment. What percentage proportional trips fall under each segment 0 to 5 minutes, 5 to 10 minutes, 10 to 15 minutes and so on, and after doing the calculation we can draw the trip length frequency distribution curve. And and the same thing can be done using the actual observe data on the same set of axis to draw both the trip length frequency distribution curves, is it not?

And then check visually for matching of the 2 curves, if they are not matching then there is a need for correction for the friction factor which was derived based on the functional form assumed for T i j; do correction for the f i j value, and repeat the process until there is a reasonable match between the 2 trip length frequency distribution curves developed based on a gravity model, and based on the actual observe data. That is how we check for the correctness of calibration by BPR procedure, clear.

And how do we do the same thing in the case of w constraint gravity model. What do you get what form of result you get when you use w constraint gravity model for trip distribution; would you be getting trip length frequency distribution curve or something else. We will be getting a matrix giving trip interchange information between zonal pairs at the end of right distribution of trips using w constraint gravity model, we simply get a matrix. And you will have a matrix based on field observe data for base year condition.

So, there are 2 matrices available. It is a question of comparing the 2 matrices by comparing the values of the corresponding cells 1, 1 it 1, 1; 1, 2 with1, 2, 1 on so right. This comparison can be done using set of statistics as we discussed earlier, and basically we will be comparing to matrices, and check for the closeness of the two matrices using standard statistical measures, like normalized 5, normalized (( )) and coefficient of determination right, until a satisfaction result is obtained. That is how the correctness of calibration is checked in the case of w constraint gravity model right. So, please take a over view, and have a comparison of the 2 methods; that will help you to understand basic principles involved in the exercise much better, clear. You may recall at the end of the previous class, we took up a case study to understand the application of gravity model for trip distribution to a real life situation, the city considered was the city of Thiruchirapalli.

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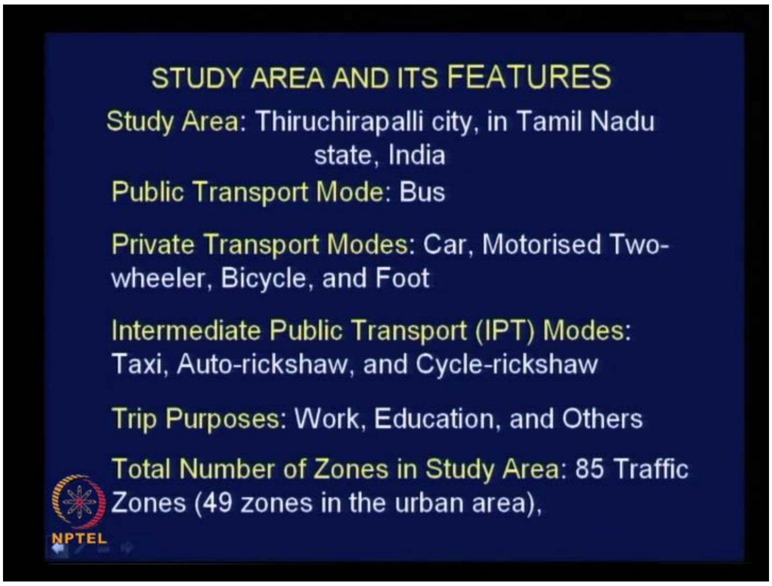

And I gave you some information about the city - the city is located in Tamil Nadu state India, and the public transport mode available is only bus, and private transport modes car motorized 2 wheeler, bicycle, and foot intermediate public transport modes taxi, auto, rickshaw, and cycle rickshaw. And then trip purposes as we have seen earlier or only 3 work education and others, and total number of traffic zones the study area 85 out of which 49 zones were in the urban area. And it will be appropriate to show you the picture of the study area of the city so that you can have a feel of urban area, and total planning area, and so on.

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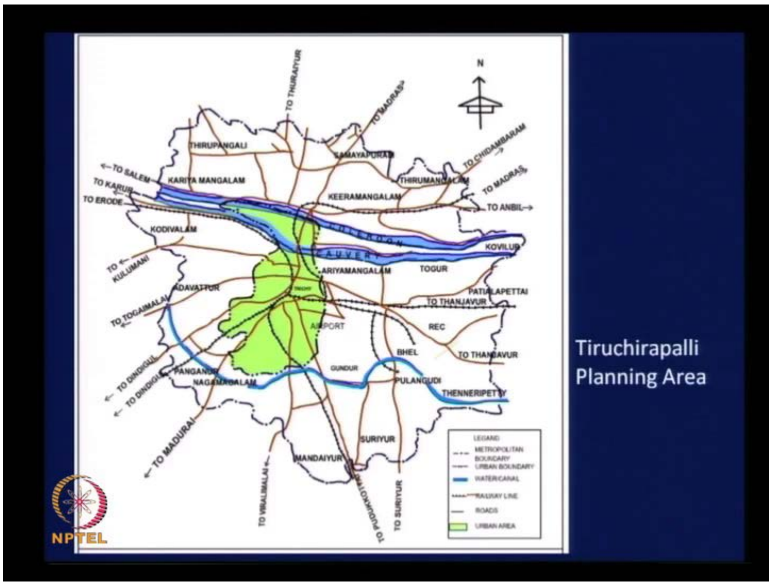

So, this is how? The study area looks: The green colored portion is a urban area, the boundary of the green green colored portion is the municipal boundary - municipal administrative boundary. And the outer boundary indicated here is a planning area boundary, this implies that we collect information about socio economics characteristics, and transport system characteristics in the whole of the area bounded by the outer line. Clear, look at the proportion of area of the urban pocket, and the whole of the planning area.

The area surrounding the urban pocket is huge. So, we should not have an impression that urban transportation system planning means working within the municipal boundary, it is not so right. Then you may wonder why we should go so far, and how do we fix a boundary, where to stop and so on right, and how do you fix a boundary. You must have some reconnaissance survey, and identify the places around the urban area, where from people commute the city center on a regular bases. That means, such people on contributing to the city's traffic, congesting city's roads right. So, their movement is unstoppable, because they commute on regular bases.

So, unless you include that area also in your planning study, you will not be getting the realistic picture of the traffic on city roads right. So, we have to identify the adjoining areas which contribute to the city's traffic on a regular bases, include all those areas into your planning process, and then fix boundary; that is a basic principle, clear. And the surrounding areas may not be truly urban areas, there will be just panchayats - town panchayats, major panchayat, minor panchayat, and so on right, but still you may have to include, because they all contribute to the city's traffic, clear.

So, that is how you must be able to pursive, the planning area boundary in the case of urban transportation system planning. Another interesting aspect is that the total number of traffic zones, where 85 out of which 49 zones, where within the urban area; very small area more number of relatively large number of zones, and for rest rest of the area which is very large we have fixed only small number of zones. Why still we believe that, we may get fairly high period result in spite of this kind of courser division of the area surrounding the municipal boundary.

Why should we have more zones in a smaller urban area compare to the number of zones in the peripheral areas are outside the urban boundary; obviously, the intensity of socio economic activities is very high in the urban area. Even if you say take a small area the number of people living will be large compare to the peripheral areas, if you take one panchayat there will be a cluster the houses as bunch in one location rest of the area will be just agricultural land, right. Whereas, here it is heavily built up, and activities are concentrated, so obviously, we need to divide the area into very small land use parcels. So, that within that area the land use is more or less homogenous, and still the number of people involved are more relatively large in number compare to the concentration of population outside the city boundary.

That is a logic of having more number of traffic zones for the smaller size of the municipal area, and then less number of traffic zones. And another important aspect is when you divide the traffic zones, we are fixing one centroid, and consider that as a trip origin or destination. Is it not? When you consider very large areas outside the municipal boundary, and when you fix only one point as you indicated to a earlier, then we will be doing a approximation. Later the approximation representing all the trips spread over a vast area to be emanating from a single point. Is it not, but in practice what we do is we divide of course, the peripheral areas into larger land use parcels, but the spreader the population, spread of socio economic activities will not be uniform throughout. The it will be over smaller cluster right, 1 or 2 states in a village right. Fix that as your zone centroid, it need not necessarily be the geometric centroid of the area consider.

It is the centroid of intensity of activity in that particular land use parcel, then you can accurately represent really the trip origin as well as trip destination. That is how we manage fixing the zone centroid in the less populated peripheral areas, clear. So, that is how we can justify having more number of zones within the urban area, and less number of zones outside. And you can see 2 major reverse criss crossing, the city in addition a small water course on the southern part, that is why I said the city is basically an agricultural city. And city's economy is agro based, clear except for a one major industry Bharath heavy electrical located somewhere here.

The rest of the area is with lot of green fields mainly paddy, and so on with this understanding of the study here, let us a go further to see how to distribution analysis was done for this particular case. What I will be discussing is not the distribution which was done for the practical purpose of planning, it is a demonstration after distribution is a kind of demonstration project involving the zones only in the urban area. So, our distribution discussion is concerned concerned with the 49 zones right within the urban area; it is possible to mark of some areas still analyze a distribution of trips. One thing is you must leave of the trips which go beyond your urban boundary; consider all the trips which are getting distributed within the urban area, and then do trip distribution analysis is possible.

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Zone No. (1)	Trip Purpose					
	Work		Education		Others	
	Production (2)	Attraction (3)	Production (4)	Attraction (5)	Production (6)	Attraction (7)
1	1,852	532	2,397	387	1,323	120
2	2,428	5,168	2,609	8,835	805	1,773
3	0	1,687	0	10,928	6	238
4	5,888	8,580	6,948	4,270	2,503	4,426
5	1,739	2,666	1,515	1,320	780	312
6	5,916	7,579	8,238	5,813	4,770	4,366
7	4,404	16,431	4,348	7,439	3,816	6,353
8	4,855	6,110	6,027	10,592	2,150	1,614
9	10,423	21,524	9,576	1,206	3,428	3,590

This is a data of trip production attraction in the base year within the municipal boundary. You can see some important numbers, if you look at zone 3, there is no trip production for work, there is no home for household where from people go for work from this particular zone. Also there is no trip production for education, and there are your negligible number of trips produced for other purposes right, basically this zone is a trip attraction zone. We can say purely a trip attraction zone, clear; and the if you look at the numbers of a trip produced and attracted, you can see a vast variation of course, least value is zero as you have seen. The numbers touch, what is a maximum that you see in this table about 16431 trip attractions for zone 7. Here, there is one 21000 plus also right 0 to 21000 vast variation, that is how we come across numbers in practice.

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Zone No. (1)	Trip Purpose					
	Work		Education		Others	
	Production (2)	Attraction (3)	Production (4)	Attraction (5)	Production (6)	Attraction (7)
10	3,514	5,007	3,085	5,859	117	1,238
11	25,796	12,829	25,549	24,121	508	349
12	21,524	9,777	24,011	14,988	510	656
13	5,050	1,202	3,779	1,709	93	19
14	0	365	0	441	0	11
15	0	561	0	71	0	32
16	3,954	2,229	3,638	2,380	1,206	792
17	575	1,248	492	384	6	6
18	2,897	2,527	4,725	2,409	40	140

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And the same data for other zones 10 to 18, and you can see the numbers have reached values of 25,796 appears to be the maximum of trip production, and attraction also has touched nearly 24,121 appears to be the maximum of the trip attraction values. Here again, you can see zone 14; there is no trip production its only an attraction zone, 15 also there is no trip production. Only trip attraction that too the attraction values are much less, what could be the type of urban area with this kind of characteristics when you look at the data you must have a feel of the feel condition.

Then only you will be able to appreciate your results of analysis very less number of trip attractions. Mostly some could be some work places as I said it is agro based economy may be some agriculture fields, which attracts trips (( )) go to feel for work right. There may not be large number of trip attractions to fields, elevated number. So, that is how you must have feel of the land use of the area when you look at these numbers, and when you look at trip attraction numbers of say 24,121; obviously, you must think of an very intense commercial area or industrial area and so on, right.

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Zone No. (1)	Trip Purpose					
	Work		Education		Others	
	Production (2)	Attraction (3)	Production (4)	Attraction (5)	Production (6)	Attraction (7)
19	10,104	17,805	11,444	22,662	2,639	1,702
20	8,519	12,567	4,069	8,232	10	1,528
21	704	244	577	208	162	37
22	72	6	72	24	0	0
23	564	522	144	72	0	0
24	10,844	6,396	10,975	6,453	1,421	659

And then zone 19 to 24 similar variations, and you can see mainly the large numbers are related to work and education; obviously, because of the high percentage of trips made for these two purposes.

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Zone No. (1)	Trip Purpose					
	Work		Education		Others	
	Production (2)	Attraction (3)	Production (4)	Attraction (5)	Production (6)	Attraction (7)
25	6,957	4,963	8,985	7,734	1,065	1,059
26	0	2,763	0	2,880	0	346
27	1,732	3,689	2,647	6,362	145	694
28	12,583	5,000	19,996	11,974	5,654	1,462
29	1,423	599	2,182	648	226	33
30	1,399	758	2,186	1,730	192	85
31	814	423	2,322	2,086	388	217
32	2,136	494	332	215	0	48
33	7,898	4,306	10,158	3,725	910	694
34	3,523	3,821	3,822	8,706	469	686
35	2,714	2,423	4,310	4,295	415	472

And then zone 25 to 35. So, we have come across quite effused zones with a no trip production, only purely trip attraction zones. And values vary from 0 to 25000 plus this data has to be used for distribution of trips, how are you going to use this data. We have already segmented the data based on trip purpose work education others.

So, we can take data pertaining to work trip separately, and distributed trips; take the data pertaining to education trip separately distribute, and then other trips that is one way. Other possibilities identify the modes used, and distribute the trips based on mode used for travel.

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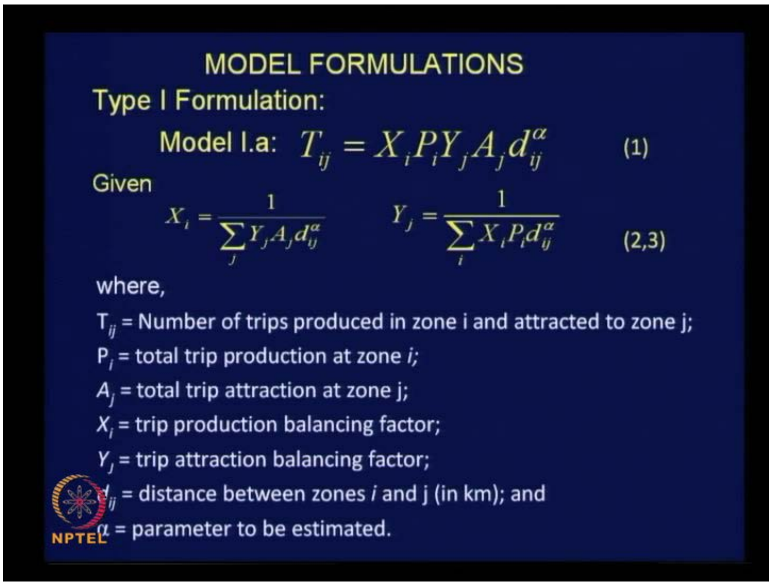

Since, it is a demonstration project, we want it to show the result of both the gravity models, both the types of gravity model w constraints as well as single constraint; singly constraint gravity model of only one type was used, and here type one formulation shown as model 1 a is a doubly constrained gravity model right. And the f i j formulation given here is d i j raise to power alpha; expressed as a function of travel time or travel distance, and interestingly in this particular case travel distance was taken or friction factor was expressed as a function of travel distance.

The reason is this; this distribution process pertains to only city area, where road network was found to be more or less uniform. And another reason is that the travel time information obtained was found to be not that accurate, there were some grace parts which we were not that confident of make use of travel time information. As an alternative you just look for travel distance as an alternative, and found that nothing wrong in using travel distance as per as this part is concerned, because road network is more unless uniform, a level of conjunction traffic composition everything was almost same, because it is confine to urban area.

So, as a special case travel distance was using, its not common very rarely people use travel distance this is one of the cases were travel distance has been used, explain travel deterrence f i j. And this is model 1 a and of course, as you know X i is given as 1 by sigma j 1 to n y j A j d i j raise to power alpha and y j, as we know 1 by sigma I is equal to 1 to n X i P i d i j raise to power alpha. And the explanation for all the notations used are known to you T i j is nothing but number of trips produced in zone i, and attract it to zone j, then when we write T i j we are talking about base year T i j or horizon a T i j .

Base year T i j.

Base year T i j, if we are calibrating the model. For the purpose of calibration, we will substitute base year data as T i j, once you complete your calculation of the parameter value or once you complete your calibration process, then use a model, then your T i j is your horizon here T i j that that will be estimating. Is it not? Even that notation is same we need to be careful, what we really mean by T i j, and P i total to production at zone i, for calibration it is the base year value. A j total trip attraction zone j, and excite trip production balancing factor, y j trip attraction balancing factor, and d i j distance between zones i and j. I said distance not time in kilometers, and alpha parameter to be estimated. This was module 1 a, and we try it other formulations also for f i j.

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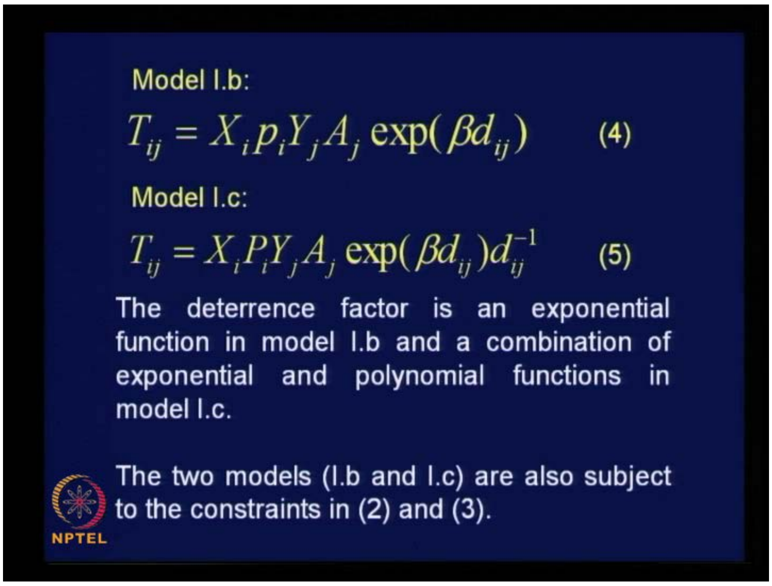

Model 1 b had a different formulation for f i j, it was e power beta d i j. And model 1 c had 2 parameter formulation e power beta d i j into d i j raise to power minus 1; the other parameter value was given directly. We did not estimate both the parameter simultaneously, one parameter value was assumed as minus 1.

So, we had three formulations in the doubly doubly constrained gravity model, and then the deterrence factor is an exponential function in model 1 b as we have seen, and a combination of exponential in polynomial functions in model 1 c. Is it not? The two models 1 b, and 1 c are also subject to the constraints in two and three, as we have seen constraints related to X i and y j constraints related to production and attraction, that is a main.

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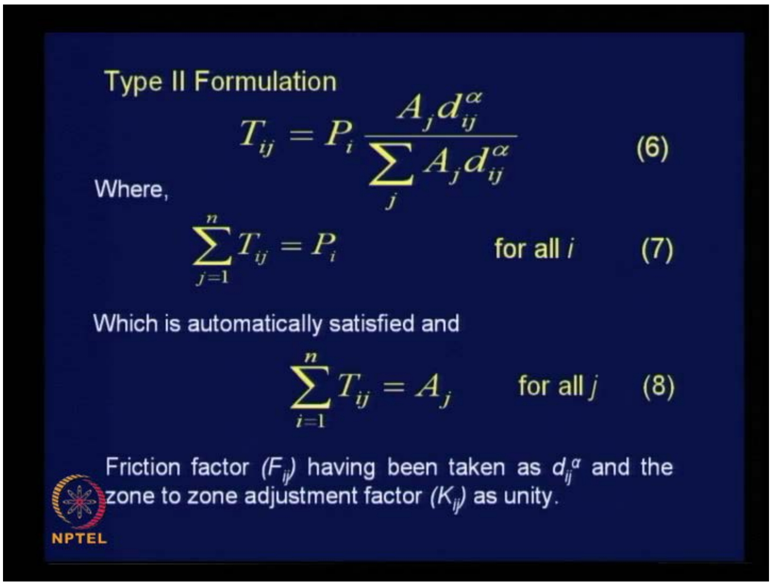

Then type two formulations is this. What is this formulation? It is a very simple singly constraint gravity model f i j has been written as d i j raise to power alpha, otherwise it is a singly constraint gravity model. The functional form for the friction factor has been directly taken as a simple polynomial function as d i j raise to power alpha, and the constraint which is taken care of in the model is sigma j is equal to 1 2 n T i j equal to P i is inbuilt into the model which is automatically satisfied, and other constrain has to be satisfied during distribution process. i is equal to 1 to n, T i j to be equal to A j, is it not?

So, total we have considered 3 plus 1, 4 model formulation - 3 formulation and w constrained category, and one under singly constrained category. And the functional forms for f i j has been fixed for all the 4 cases, and how do we calibrate using doubly constrained gravity model. The same procedure we assume a value for alpha, we assume initial value of y j, not y j A j, is it not? Yes y j related to the trip attraction factor - adjustment factor right, then go about doing (( )) process and finally, put this values into the w constraint gravity model.

The same exercise was done for trial values of alpha, initially one value of value of alpha can be assumed, and and you can complete the iterative process, then assume another value of alpha and so on, and then check which value of alpha gives you better result. Of course, this is known to us friction factor f i j having been taken as d i j power raise to power alpha, and zone to zone adjustment factor k i j, in this case is taken as unity, otherwise you will not get this formation.

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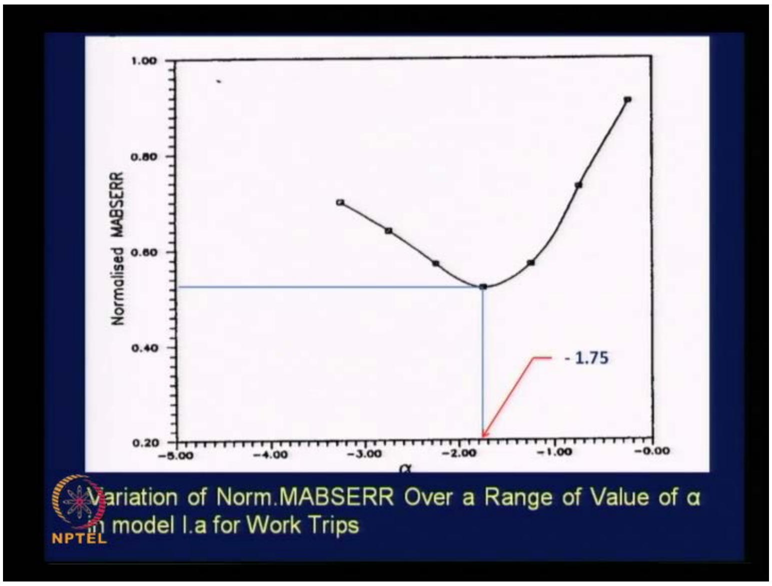

I am giving you the directly the result of w constraint gravity model. I have shown you the data set, we have used the same data set, the formulations are shown to you right, and this pertains to variation of normalized main absolute error, over a range value of alpha for model 1 a model 1 a right. I hope all of you remember model 1 a formulations, it is a w constraint gravity model right, d i j power alpha its simple polynomial function right. So, how many trial values of alpha has been tried, 7 trial values of alpha, 7 values have been tried 1, 2, 3, 4, 5, 6, 7 values; we have tried with seven values of alpha, and how do we choose the value of alpha finally.

Our objective is to choose right value for alpha, it is the parameter. Look at y axis normalized main absolute error, we would like the error to be minimum or obviously, we must look for the alpha value with least error. Is it not? And if you do so we find this is the lowest point in the curve used the least error, and corresponding value of alpha is minus 1.75, clear. So, this is how we calibrated model 1 a, which is under w constraint formulation. Once you know the value of alpha, then you can right the calibrated form of the gravity model like this.

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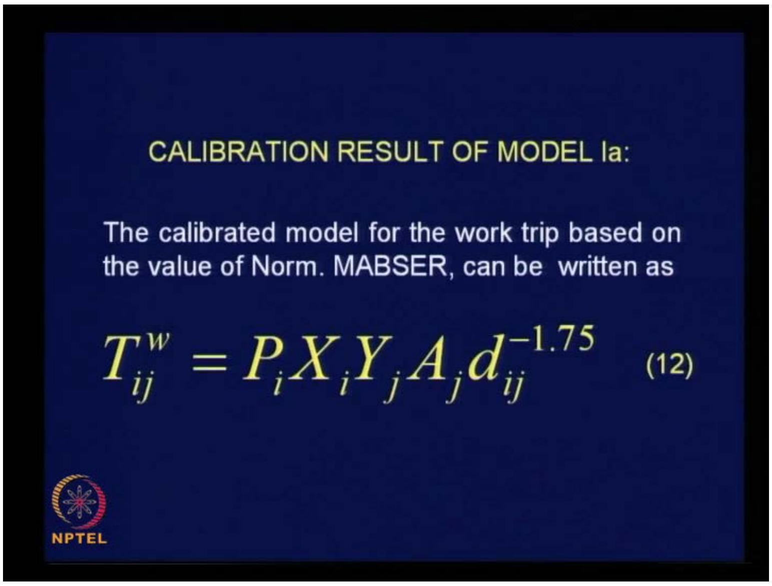

This is the calibrated gravity model, very simple. The calibrated model for the work trip based on the value of normalized mabserr can be written as T i j, w; I am writing purposely, because this calibration was done one using data pertaining work trip. P i X i y j A j d i j raise to power minus 1.75.

Now, this model is ready for application for as an air condition right, what do you get for original condition? How will you apply this model for original condition? What are the values that will be known for you known under horizon air condition; obviously, will not know T i j that is what you want. Is it not?. So, to get horizon air value of T i j, you should know the values of P i and A j corresponding to the horizon here socio economic condition right unless you predict to the values of P i and A j you will not be able to distribute the trips, and horizon air conditions clear.

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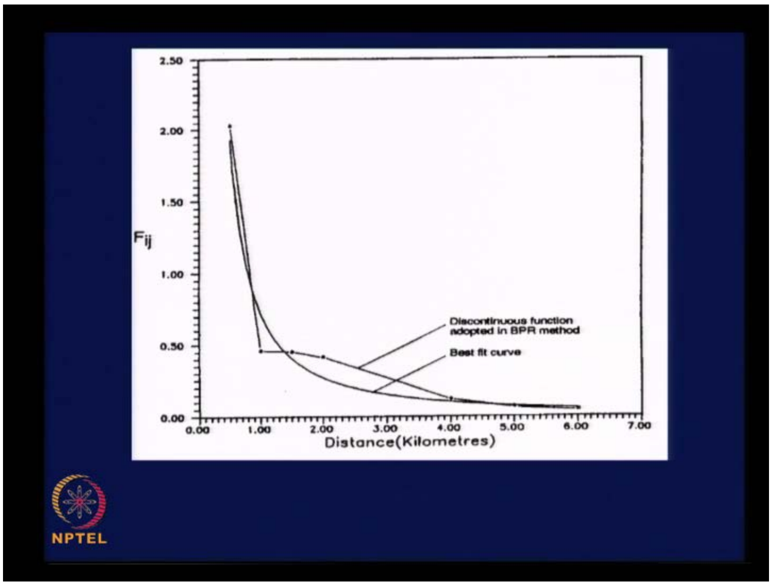

Now, the other model you see BPR method, singly constrained gravity model; I am not showing the other formulation; just as an example, I have shown you one case model 1.a. Now, just I am passing on to model 2 or type 2 formulation, where we just discussed about singly constrained gravity model, the method adopted was BPR method of calibration right. And you can see the distance segment used here. If you are making a continuous this do not worry about this curve, this is just to show you the difference between yeah discontinuous function and a continuous function. What was actually done was assumption of a discontinuous function; and for each segment, a separate function was assumed. Clear? And as an example, I will show you the result of matching of the trip length frequently distribution curves for one case was this is functional form of frictional factor in model 2 for work trips again.

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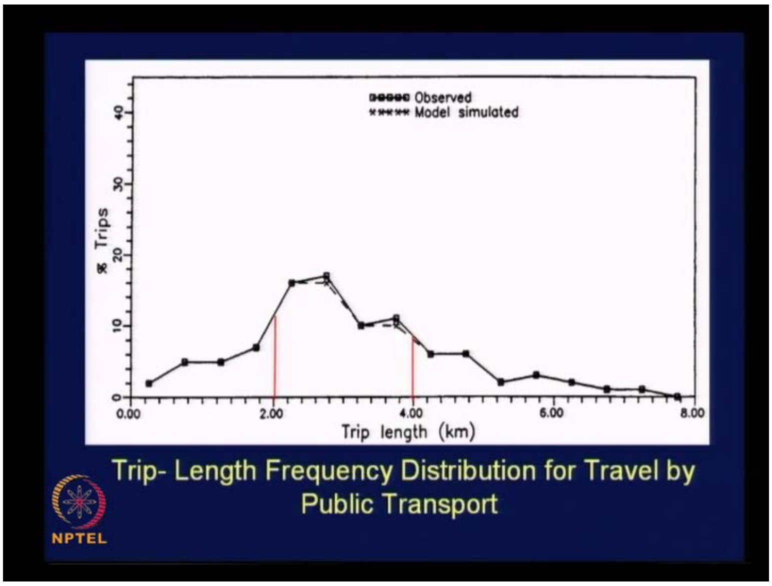

This is how the accuracy of calibration by BPR method was checked for this particular case. Trip length frequency distribution for travel by public transport mode is based on mode used for travel right. And you can see some numbers along x axis 0, 2.00, 4.00, 6.00, 8.00; and then percentage of trips 0, 10, 20, 30, 40 and so on. What is it mean? Let us just look at this point. When I produce a point vertically corresponding to trip length of 2 kilometers, we just intersects a curve somewhere here right; it is not touching any point. And when I produce another point corresponding to distance of 4 kilometer, it is just again going and touching the curve midway between two points.

Now based on this information, can you tell me, what is the distance segment that has been considered for drawing this trip length frequency distribution curves? Distance segment or length of one segment in kilometers, 2 kilometers, but you have now more number of points here. Since I have indicated the 2 and 4 with the red line, you are just sending 2 kilometers or what? Why so many points, how did we get these points? This is percentage of trips out of the total right, how many points you have from 0 to 2, 1, 2, 3, 4, and if you consider this as a point then 5 or how many segments you had 1, 2, 3, 4 segments right.

So, this point pertains to trip length of what distance. Suppose, I say that this point pertains to trip length of 0 to 0.5 kilometer, 0 to 0.5 kilometer - 0.5 kilometer is somewhere here, let us say 0 to 0.5. Then 0.5 to 1 kilometer after this point, we gave between that, then 1 to 1.5; this 1.5 to 2 representing represented by this point clear. So, we segment a distance and, then fix a mid points as representative points to indicate the percentage proportional trips pertaining to each segment of the trip length. That is how we draw the trip length frequency distribution curves. And it was done for observed case as well as model calibrating or model simulated values, you can find almost perfect matching except for a minor deviation in this stretch. And this was finally accepted as a final value subsequent iterations, let to more separate curves. So, then this was identified as as the point of convergence, and this was found to be the correct calibration result.

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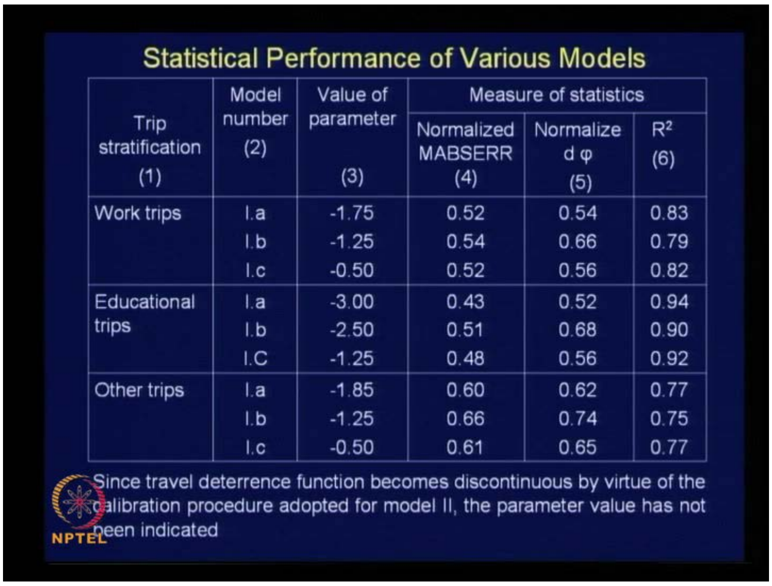

Statistical Performance of Various Models

Trip stratification (1)	Model number (2)	Value of parameter (3)	Measure of statistics		
			Normalized MABSERR (4)	Normalized φ (5)	R^2 (6)
Work trips	I.a	-1.75	0.52	0.54	0.83
	I.b	-1.25	0.54	0.66	0.79
	I.c	-0.50	0.52	0.56	0.82
Educational trips	I.a	-3.00	0.43	0.52	0.94
	I.b	-2.50	0.51	0.68	0.90
	I.C	-1.25	0.48	0.56	0.92
Other trips	I.a	-1.85	0.60	0.62	0.77
	I.b	-1.25	0.66	0.74	0.75
	I.c	-0.50	0.61	0.65	0.77

Since travel deterrence function becomes discontinuous by virtue of the calibration procedure adopted for model II, the parameter value has not been indicated

Let us look at this statistical performance of the models, that we listed earlier, you may recall we had data pertaining to work trips, education trips, and other trips. We deserve it have these formulations model 1 a, 1 b, and 1 c as w constrain model. In addition, we want it to have singly constrained model to be calibrated by BPR method, where trip type two is not listed here, the results pertain to type 1 all w constrained model. And you can see the value of the parameter, here pursuing the first case it is alpha; second case, and third case it is beta e power beta something we had, you may (( )), recollect the model right.

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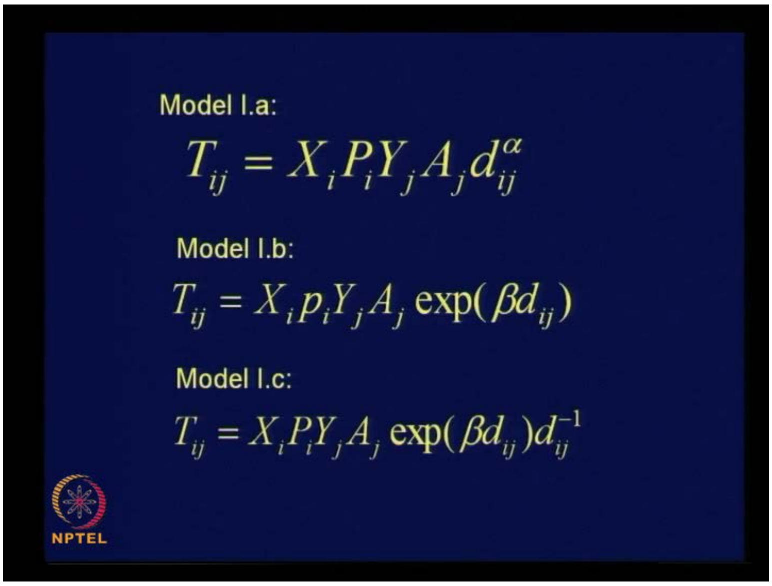

Or if you want to look the three models; these are the 3 models we are talking about. 1 a - the parameter is alpha, 1 b - the parameter is beta and 1 c also, since we assumed value of unity here again, it is a value of beta right. So, that is what we have listed here, and we should have a feel of the logical aspects related to the results that we have got. For example, for work trips in the case of model 1 a, we have minus 1.75 as the parameter value, for educational trips we have minus 3.00, for other trips 1.85. The value of alpha represents what? Travel the extend of travel iterance; d i j raise to power some negative quality. Is it not? Or the numerator d i j is normally should come in the denominator, Is it not, because it is raise to some negative value right. And when the negative value is higher, what is the meaning? Travel iterance is more; obviously, is it not. So, you will be righting d i j power minus 1.5 or you can say the numerator divided by d i j raise to power 1.5, 1.75, is it not?

So, these numbers indicate increased iterance or in other words you should say that iterance for travel for work is relatively less compare to iterance for travel for education, is it right. People have more travel resistance, when they make education trips compare to the travel resistance realized by people for making when making trips for work. Is it true? What is the result of increased travelled iterance for educational trips, decreased travel distance obviously. Practically, if you look at you have some choice of educational place, in the form of schools and colleges with respect to a residential area; if you look at the possibility of making education trip, there will be number of schools around a major residential locality right. There will be number of colleges. So, people can choose a school or college depending upon the distance of travel, and you cannot choose a work place right.

So, your work place is fixed; so obviously, irrespect to with the distance implication you may have to travel, choice is less in the case of almost (( )), in the case of travel for work. So, when you fix your destination; obviously, when there is a choice you try to minimize travel - travel distance right. So, that is how the iterance for travel for education is shown here, as higher than a (( )) difference for work trips. Are you able to appreciate this point or unless you have a feel of that, and there is no point in looking at the stable and this numbers.

And of course, difference between these parameter values are because of the variation the functional form, that is how 1.75 minus 1.25 minus 0.5 you are getting, but if you compare the corresponding value the same will be reflected 1 b, and 1 b; it is minus 1.25 it is minus 2.5, again increased deterrence for educational trips. Whereas, for other trips which is a trips for made for shopping, social recreation, and so on, values are different. We will not be able to explain very clearly these numbers; whereas, it is possible to compare these 2 values. And look at the statistics the values of normalized mabserr, and normalized 5 or all less than 1, and r square values as you could see ranges between 0.94 and 0.75. You know what is meant by this r square values, we have discussed discussed enough about implication of r square value.

Normally, statisticians say that if the value of normalized 5 is less than 0.6 0.65, we can say that the error is acceptable, there is error that it is within acceptably met. The same range is given for normalized mean absolute error also, you may question why not fix it as 0.5 or 0.8, it is up to us, it depends on the accuracy that way insist on a particular case. So, you must take a over view as I was mentioning earlier, if you are basic issue that you are analyzing is complex, and data is broad based then you will not be able to get very accurate result. In another case if it is quite compact, if the data is homogeneous you can anticipate higher level of accuracy depending upon expectation, you can fix any guiding value as an acceptable value of 5 or normalized mabserr, clear.

Let us look back, and see what we discussed so far, we mainly discussed about the application of trip trip distribution models for distribution of trips in Thiruchurapalli city.

And we had a feel of the trip production, trip attraction data for the purposes of work education as well as other purposes in the city of Thirucurapalli. And then we considered three formulations of w constrained gravity model, and one formulation of singly constrained gravity model, and try to understand the application and the corresponding results of these models for this particular case.

In the process, we also found as to how to go about fixing, the right value of the parameter in respect of 1 model - namely alpha based on the normalized mabserr value, and the guiding value of alpha right. Finally, we have seen the logical correctness of the parameter estimates, when you put all the parameter estimates together we are able to appreciate the logical correctness of the parameter values based on the trip purpose right. We will stop here, and continue with the rest of it in the next class.