Dept. of Civil Engineering

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Sub: Urban Transport Planning				Code: 17CV751/18CV745
Date: 27/01/2022	Duration: 90 mins	Max Marks: 50	Sem: VII	Branch (sections): CIVIL (A and B)

Answer any Five Questions

		Marks	OBE CO	OBE RBT
1.	Explain minimum path tree with Moore's algorithm	[10]	CO4	L2
2	What do you understand by capacity restraint technique and explain the methods based on this principle.	[10]	CO4	L2

Capacity restraint assignment techniques This is the process in which the travel resistance of a link is increased according to a relation between the practical capacity of the link and the volume assigned to the link. This model has been developed to overcome the inherent weakness of all-or-nothing assignment model which takes no account of the capacity of the system between a pair of zones. This method clearly restrains the number of vehicles that can use in any particular corridor. The whole system, if assigned with volumes which are beyond the capacity of the network, then it redistributes the traffic to realistic alternative paths.

Steps:

- Here the procedure is similar to all-or-nothing assignment as far as the initial data input are concerned. The additional data fed is the capacity of each link. The best paths are determined in the same way as in all-or-nothing assignment by building the minimum path trees.
- Traffic is then assigned to the minimum paths, either fully or in stages.
- As the assigned volume on each link approaches the capacity of the link, a new set of travel time on the link is calculated.
- This results in a new network with a different minimum path tree, differing significantly from the earlier minimum path tree. As a consequence, assigning the inter-zonal volumes to the new tree produces a new volume on each link.
- This iterative process is repeated until a satisfactory balance between volume and speed is achieved.

Some of the capacity restraint methods are:

a) Smock Method:

In this method all-or-nothing assignment is first worked out. In an iterative procedure, the link travel times are modified according to the following function.. Smock model is used to compute link travel timeas:

$$T_A = T_0 e^{\left(\frac{V}{C} - 1\right)} \qquad (27)$$

Where, $T_A \leq 5T_0$

T_A = adjusted travel time which is used to determine the minimum paths or routes.

T_0 = Original travel time

e = exponential base

V = assigned volume

C = computed link capacity

In the second iteration, the adjusted travel time (TA) is used to determine the minimum paths. The resulting link volumes are averaged and these are again used to calculate the

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<td>adjusted travel time for next iteration.
b) Bureau of Public Roads (BPR) Method:
The formula used to update the link travel time is:
$$T_N = T_0\left[1 + 0.15\left(\frac{Assigned \quad Volume}{Practical \quad capacity}\right)^4\right]$$
$$T_N = T_0\left[1 + 0.15\left(\frac{V}{C}\right)^4\right] \qquad (26)$$
Where, T_0 = free flow time or base travel time at zero volume
T_0 = 0.87 * travel time at practical capacity
V = assigned volume
C = practical capacity</td>
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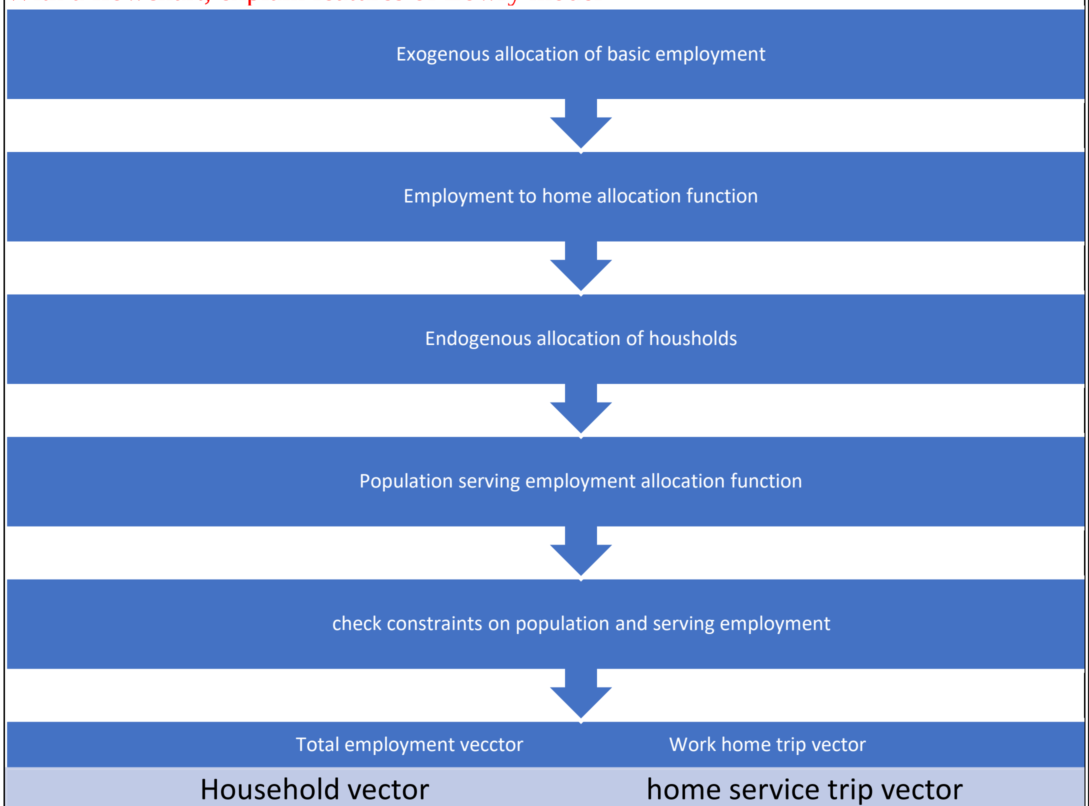
<td>2.</td>
<td>With a flowchart, explain features of Lowry model


Silent futures ;
• 1.a) The cote assumption of the Lowery model assumes that regional and urban growth (or deline) is a function of the expansion (or contraction) of the basic sector. this employment is in turn having impacts on the employment of two other sectors, retail and residential b) it is assumed that the location of basic industry is independent of the location of residential areas and service centers
• Population is allocated in proportion to the population potential of each zone and service employment in proportion to market potential of each zone
• the model ensures that populations located in any zones dose not violate a miximum density or holding capacity constraint is placed on each category of service employment
• Lowry model relates population and employment at one particular time horizon</td>
<td>[10]</td>
<td>CO4</td>
<td>L2</td>
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3.	Estimate the future trip distribution by Furness method(up-to 2 iteration) from fallowing data.	[10]	CO4	L3

O/D	1	2	3	4	Future trips
1	-	50	60	30	280
2	40	-	70	20	390
3	20	60	-	40	300
4	50	70	30	-	220
Future trips	200	500	340	150	

Internal Assessment Test III – January 2022

5.	Using intervening opportunity model, compute trip interchange – e – T_{A-A}, T_{A-B}, T_{AC}, T_{B-A}. T_{B-B}. Total trips produced and attracted are given below.	[10]	CO4	L3

Zones	Trips produced	Trips attracted
A	1250	800
B	1850	1200
C	450	3900

The zonal factors are given as L_A=0.06; L_B =0.05; L_C=0.07 The order of closeness is given below:

O / D	A	B	C
A	1	2	3
B	2	1	3
C	2	3	1

6.	Discuss on Traffic Assignment Applications in India.	[10]	CO4	L2

Applications of Traffic Assignment Some of the applications of traffic assignment analysis to the network are:

1. To determine the deficiencies in the existing transportation system by assigning the future trips to the existing system

2. To evaluate the effects of limited improvements and additions to the existing transportation system by assigning estimated future trips to the improved network.

3. To develop construction priorities by assigning estimated future trips for intermediate years to the transportation system proposed for those years.

4. To test alternative transportation system proposals by systematic and readily repeatable procedures.

5. To provide design hour traffic volumes on highway and turning movements at junctions.

Thus, the assignment process is useful to both to the transport planner because to evaluate how the proposed transport system will work and to the highway designer for geometric design of individual links and intersections.

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URBAN TRANSPORT PLANNING

PROBLEMS

PROBLEMS ON GRAVITY MODEL

Problem-1

A self-contained town consists of four residential areas A, B, C and D and two industrial estates X and Y. Generation equations show that, for the design year in question, the trip from home to work generated by each residential area per 24 hour day are as follows :

A	1000
B	2250
C	1750
D	3200

Calculate and tabulate the inter zonal trips for journeys from home to work.

There are 3700 jobs in industrial estate X and 4,500 in industrial estate Y. It is know that the attraction between zones is inversely proportional to the square of the journey times between zones. The journey times in minutes from home to work to work are :

Zones	X	Y
A	15	20
B	15	10
C	10	10
D	15	20

SOLUTION;

$$T_{i\text{-}j} = \frac{Pi \frac{Aj}{(d_{i-j})^2}}{\sum \frac{Ai}{(d_{i-n})^2}}$$

$$T_{A\text{-}x} = \frac{1000 \times \frac{3700}{(15)^2}}{\frac{3700}{(15)^2} + \frac{4500}{(20)^2}} = \frac{1000 \times 16.5}{16.5 + 11.25} = 594$$

$$T_{A\text{-}y} = \frac{1000 \times \frac{4500}{(20)^2}}{\frac{3700}{(15)^2} + \frac{4500}{(20)^2}} = 406$$

$$T_{B\text{-}X} = \frac{2250 \times \frac{3700}{(15)^2}}{\frac{3700}{(15)^2} + \frac{4500}{(10)^2}} = 602$$

$$T_{B\text{-}Y} = \frac{2250 \times \frac{4500}{(10)^2}}{\frac{3700}{(15)^2} + \frac{4500}{(10)^2}} = 1648$$

$$T_{C\text{-}X} = \frac{1750 \times \frac{3700}{(10)^2}}{\frac{3700}{(10)^2} + \frac{4500}{(10)^2}} = 790$$

$$T_{C\text{-}Y} = \frac{1750 \times \frac{4500}{(10)^2}}{\frac{3700}{(10)^2} + \frac{4500}{(10)^2}} = 960$$

$$T_{D\text{-}X} = \frac{3200 \times \frac{3700}{(15)^2}}{\frac{3700}{(15)^2} + \frac{4500}{(20)^2}} = 1900$$

$$T_{D\text{-}Y} = \frac{3200 \times \frac{4500}{(20)^2}}{\frac{3700}{(15)^2} + \frac{4500}{(20)^2}} = 1300$$

The result are tabulated in the matrix below:

	X	Y	$T_{i\text{-}j}$ FOR ORIGIN ZONE A,B,C,D. TOTAL PRODUCTIONS
A	594	406	1000
B	602	1648	2250
C	790	960	1750
D	1900	1300	3200
TOTAL CALCULATED ATTRACTIONS ,C_j	3886	4314	8200
TOTAL PREDICTED ATTRACTIONS, A_j	3700	4500	8200

It can be seen that the total attractions do not tally with the predicted attractions therefore the total attractions first adjusted ,using the fallowing formula

$$A_{jK}=\frac{A_j}{C_{j(m-1)}} * A_{j(m-1)}$$

For second iteration m=2:

$$A_{jK}=\frac{A_j}{C_{j(m-1)}} * A_{j(m-1)}$$

A_{j2} for zone x $=\frac{3700}{3886} * 3700 = 3523$

A_{j2} for zone Y $=\frac{4500}{34314} * 4500 = 4694$

Recalculating:

$$T_{i-j}=\frac{Pi\frac{Aj}{(d_{i-j})^2}}{\sum\frac{Ai}{(d_{i-n})^2}}$$

$$T_{A\text{-}x} = \frac{1000 \times \frac{3523}{(15)^2}}{\frac{3523}{(15)^2} + \frac{4694}{(20)^2}} = 572$$

$$T_{C\text{-}X} = \frac{1750 \times \frac{3523}{(10)^2}}{\frac{3523}{(10)^2} + \frac{4694}{(10)^2}} = 750$$

$$T_{A\text{-}y} = \frac{1000 \times \frac{4694}{(20)^2}}{\frac{3523}{(15)^2} + \frac{4694}{(20)^2}} = 429$$

$$T_{C\text{-}Y} = \frac{1750 \times \frac{4694}{(10)^2}}{\frac{3523}{(10)^2} + \frac{4694}{(10)^2}} = 999$$

$$T_{B\text{-}X} = \frac{2250 \times \frac{3523}{(15)^2}}{\frac{3523}{(15)^2} + \frac{4694}{(10)^2}} = 563$$

$$T_{D\text{-}X} = \frac{3200 \times \frac{3523}{(15)^2}}{\frac{3523}{(15)^2} + \frac{4694}{(20)^2}} = 1829$$

$$T_{B\text{-}Y} = \frac{2250 \times \frac{4694}{(10)^2}}{\frac{3523}{(15)^2} + \frac{4694}{(10)^2}} = 1687$$

$$T_{D\text{-}Y} = \frac{3200 \times \frac{4694}{(20)^2}}{\frac{3523}{(15)^2} + \frac{4694}{(20)^2}} = 1371$$

The result are tabulated in the matrix below:

	X	Y	T_{i-j} FOR ORIGIN ZONE A,B,C,D. TOTAL PRODUCTIONS
A	572	429	1000
B	563	1687	2250
C	750	999	1750
D	1829	1371	3200
TOTAL CALCULATED ATTRACTIONS ,C_j	3714	4486	8200
TOTAL PREDICTED ATTRACTIONS, A_j	3700	4500	8200

The results now closer to the total predicted attraction if more accuracy is needed further iteration can be done

PROBLEM 2

The total trips produced in and attracted to the three zones A,B and C of a survey area in the design year are tabulated as

ZONE	TRIPS PRODUCED	TRIPS ATTRACTED
A	2000	3000
B	3000	4000
C	4000	2000

It is known that the trips between two zones are inversely proportional to the second power of the travel time between zones which is uniformly 20 minutes. If the trip interchange between zones B and C is known to be 600 , calculate the trip interchange between zones A and B , A and C , B and A , and C and B.

SOLUTION:

$$T_{i\text{-}j}=\frac{KPiA_j}{t^n}$$

$$T_{B\text{-}C}=\frac{KP_AA_C}{t^2}$$

$$600=\frac{K*3000*2000}{20^2}$$

K=0.04

$$T_{A\text{-}B}=\frac{0.04*2000*4000}{20^2}=800$$

$$T_{A\text{-}C}=\frac{0.04*2000*2000}{20^2}=400$$

$$T_{B\text{-}A}=\frac{0.04*2000*3000}{20^2}=900$$

$$T_{C\text{-}B}=\frac{0.04*4000*4000}{20^2}=1600$$

Problem-3

The number of trips produced in and attracted to the three zones 1, 2 and 3 are tabulated as:

Zone	1	2	3	Total
Trips produced (P_I)	14	33	28	75
Trips attracted (A_j)	33	28	14	75

As a result of calibration, the friction factors to be associated with the impedance values between the various zones have been found to be follows :

Impedance Units	Friction Factor
1	82
2	52
3	50
4	41
5	39
6	26
7	20
8	13

zone	1	2	3
1	8	1	4
2	3	6	5
3	2	7	4

Distribute the trips between the various zones

The impedance values between the various zones can be taken from the following matrix:

$$T_{(i-j)m} = \frac{P_i A_{jm} F_{i-j}}{\sum (A_{jm} F_{i-j})}$$

$$T_{1-1} = \frac{P_1 A_2 F_{1-1}}{A_1 F_{1-1} + A_2 F_{1-2} + A_3 F_{1-3}}$$

$$T_{1-1} = \frac{14*33*13}{33*13+28*82+14*41} = 1.82$$

$$T_{1-2} = \frac{14*28*82}{3299} = 9.74$$

$$T_{1-3} = \frac{14*14*41}{3299} = 2.44$$

$$T_{2-1} = \frac{P_2 A_1 F_{2-1}}{A_1 F_{2-1} + A_2 F_{2-2} + A_3 F_{2-3}}$$

$$T_{2-1} = \frac{33*33*50}{33*50+28*26+14*39} = 18.62$$

$$T_{2-2} = \frac{33*28*26}{2924} = 8.22$$

$$T_{2-3} = \frac{33*14*39}{2924} = 2.44$$

$$T_{3-1} = \frac{P_3 A_2 F_{3-1}}{A_1 F_{3-1} + A_2 F_{3-2} + A_3 F_{3-3}}$$

$$T_{3-1} = \frac{28*33*52}{33*52+28*20+14*41} = 16.86$$

$$T_{3-2} = \frac{28*28*20}{2850} = 5.50$$

$$T_{3-3} = \frac{28*14*41}{2850} = 5.64$$

Zones	1	2	3	Total P_i
1	1.82	9.74	2.44	14.00
2	18.62	8.22	6.16	33.00
3	16.86	5.50	5.64	28.00
Total $C_j(1)$	37.30	23.46	14.24	75.00

Second iteration

It will be seen that the total trip attraction do not equal the desired attractions. Further iterations are, therefore, necessary. The following formula can be used to adjust the attraction factors :

$$A_{jm} = \frac{A_j}{C_{J(m-1)}} \times A_{j(m-1)}$$

		zones	
Desired attraction (total) A_j	1	2	3
	33	28	14
Actual attraction $C_j(1)$	37.30	23.46	14.24
Adjusted attraction factor $A_j(2-1) = A_{J(1)}$	33	28	14
Adjusted attraction factor $A_j(m) = A_{J(2)}$	$\frac{33 * 33}{37.30}$ = 20.19	$\frac{28 * 28}{23.46}$ = 33.41	$\frac{14 * 14}{14.24}$ = 13.76

Using the above values of $A_{J(2)}$

$$T_{1\text{-}1} = \frac{14*29.19*13}{29.19*13+33.41*82+13.76*41} = 1.44$$

$$T_{1\text{-}2} = \frac{14*33.41*82}{3683.25} = 10.41$$

$$T_{1\text{-}3} = \frac{14*13.79*41}{3683.25} = 2.15$$

Zones	1	2	3	Total P_i
1	1.44	10.41	2.15	14.00
2	16.81	10.01	6.18	33.00
3	15.45	6.80	5.75	28.00
Actual attraction $C_j(2)$	33.70	27.22	14.08	75.00

Third iteration

It will be seent hat the attraction figures, though considerably closer to the desired values then the first iteration , need still further to be adjusted. The adjusted attration , $A_{J(3)}$ *are calculated as below*

		zones	
	1	2	3
Desired attraction (total)A_j	33.70	27.22	14.08
Adjusted attraction, $C_j(3-1) = A_2$	28	28	14
Adjusted attraction factor $A_{j(3)}$	$\frac{33 * 29.19}{33.70}$ = 28.58	$\frac{28 * 33.41}{27.22}$ = 34.36	$\frac{14 * 13.76}{14.08}$ = 13.63

The process is continued with new values of $A_{J(3)}$ till a satisfactory agreement is reached between the desired and actual attraction figures

PROBLEMS ON OPPURTUNITY MODEL

1.The number of trips produced in an attracted to the three zones 1,2, and 3 are tabulated below:

Zone	1	2	3	Total
Trips produced (P_I)	14	33	28	75
Trips attracted (A_j)	33	28	14	75

The order of closeness of the zones is including by the fallowing matrix:

zone	1	2	3
1	1	2	3
2	2	1	3
3	2	3	4

The zonal L factors are given below :

Zone	L Factor
1	0.04
2	0.02
3	0.04

Distribute the trips between the zones:

SOLUTION:

$$T_{i\text{-}j}=Q_i(e^{-LB} - e^{-LA})$$

$$T_{11}=14\,(e^{-0.04*0} - e^{-0.04*33}) = 10.26\ say\ 10$$

$$T_{12}=14\left(e^{-0.04*33} - e^{-0.04*(32+28)}\right) = 2.52\ say\ 3$$

$$T_{13}=14\left(e^{-0.04*(32+28)} - e^{-0.04*(33+28+14)}\right) = 2.52\ say\ 3$$

$$T_{21}=33\left(e^{-0.02*28} - e^{-0.02*(28+33)}\right) = 9.11\ say\ 9$$

$$T_{22}=33\,(e^{-0.02*0} - e^{-0.02*28}) = 14.15\ say\ 14$$

$$T_{23}=33\left(e^{-0.02*(33+28)} - e^{-0.02*(33+28+14)}\right) = 2.3\ say\ 2$$

$$T_{31}=28\left(e^{-0.04*14} - e^{-0.04*(14+28+33)}\right) = 14.5\ say\ 14$$

$$T_{32}=28\left(e^{-0.04*(14+33)} - e^{-0.04*(14+28+33)}\right) = 2.87\ say\ 3$$

$$T_{33}=28\left(e^{-0.04*0} - e^{-0.04*14}\right) = 12.00$$

Zone	1	2	3	Total
1	10	2	1	13
2	9	14	2	25
3	14	3	12	29
Destination total	33	19	15	67

It is seen that only 67 out of 75 trips have been distributed by this stage. Further iteration are needed. The destination total can be adjusted by the formula

$$D_{j(m)}=\frac{D_j}{D_{j(m-1)}} * D_{j(m-1)}$$

The iteration is carried until a reasonable closeness is obtained between the total trips and calculated trips.