Sem VII 15CV751 Urban Transportation Planning

IAT-III solutions

1 (a) What are the applications of traffic assignment?

1. To determine the deficiencies in the existing transportation system by assigning future trips
2. To evaluate the effect of limited improvements and additions to the existing system by assigning estimated future trips to the improved network
3. To develop construction priorities by assigning estimated future strips for intermediate years to the transportation system proposed for those years.
4. To test alternative transportation system proposals by systematic and readily repeatable procedure
5. To provide design hour traffic volume on highway and at junctions.

(b) Why is All or nothing assignment considered as the least desirable technique?

If time is the governing factor for choice of min path other important factors such as cost,reliability and safety are neglected. But a driver may attach more value to these neglected factors causing error in assigned flow. If cost is the governing factor, different person will value cost differently. It is also difficult to quantify all the cost involved in a journey.

Since this technique is based on the principle that shortest path is preferred too many vehicles will tend to be assigned to more attractive routes. This may cause congestion on these route and this technique will not have any account for this factor. So, all facilities in the network are not properly utilised properly in this procedure.
If motor way is available people tend to prefer using this facility for longer journeys. If travel time or cost is the sole factor, this technique will not reflect this tendency.
Small differences between journey time by different route between same origin and destination can result in unrealistic journey path.

2.0 What do you understand by capacity restraint technique and explain the methods based on this principle?

Travel resistance is increased according to relation between practical capacity of link and volume assigned to link.
This technique was developed to overcome the limitations in All or nothing technique where only time was considered to determine shortest path.
This method considers traffic volume of links.
Procedure:

1. Best path are determined based on minimum path tree.
2. Traffic volumes are assigned to mini path tree.
3. As the assigned volume approaches capacity of link, new travel time are calculated.
4. Based on this new travel time again min path tree is constructed.
5. This process is repeated, until a satisfactory balance between traffic volume and speed is achieved.

Methods based on this technique are as follows.
Smock method

$T_A = T_0 e^{(V/C-1)}$

T_A = Adjusted travel time on link

T_0= original travel time

V= traffic volume on link.

C= capacity of link

$T_A \leq 5T_0$

BPR method

$T_N = T_0 [(1+0.15 (V/C)^4]$

T_N = link travel time at assigned volume

T_0 = Base travel time at zero volume

V= traffic volume on link

C= capacity of link

3. What is pre-distribution modal split and what are the advantages and disadvantages of it?

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In this the modal split is considered prior to trip distribution. This method is also known as trip end modal split.

There are two possibilities in this procedure.

1. At the trip generation stage itself
2. After trip generation but before trip distribution.

Case 1

If the modal split is considered at the trip generation stage itself it is necessary to derive separate multilinear regression equation for each mode of transport (like, car, public transport-bus, train etc).

The factors that influence this type of modal split are car ownership, residential density, accessibility from origin zone CBD to other zones.

Case 2

In this method mode of travel does not influence trip generation.

After determining trip production and distribution, these trips are allocated to public or private cars based on relative attractiveness of each mode as measured by variables considered to govern modal split.

Advantages:

- Easy and less costly as compared to post distribution model.
- The possibility of separate public and private transport distribution is a desirable feature because of differing trip length by car and public transport.
- This method reflects features like income, car ownership, family structure and employment which are the characteristics affecting trip generation.

Disadvantages

- This method is not suitable to studies involving planning of improvement to public transport system.
- It does not consider trip generation characteristics
- It is insensitive to future development in inter-zonal travel
- In this method the characteristics of transportation system are fed on average area wide basis. So, fails to reflect a particular zone to zone combination precisely.

(4) Total trips = 600

$U = a_k - 0.3c - 0.02T$

$U_{bus} = 0 - 0.3\times1 - 0.02\times30 = -0.9$ (If $T = 30$ min)

$= 0 - 0.3\times1 - 0.02\times25 = -0.8$ (If $T = 25$ min)

$U_{Rail} = 0.4 - 0.3\times1.5 - 0.02\times20 = -0.45$ ($T = 20$ min)

$U_{auto} = 2.0 - 0.3\times2.5 - 0.02\times15 = 0.95$ ($T = 15$ min)

$= 2.0 - 0.3\times2.5 - 0.02\times10 = 1.05$ ($T = 10$ min)

Prob. of choosing each mode $P_i = \dfrac{e^{-U_i}}{e^{-U_i} + e^{-U_j} + e^{-U_k}}$

$i, j, k \rightarrow$ modes. i = bus ; j = Rail ; k = auto

$$P_{bus} = \frac{e^{-(-0.9)}}{e^{-(-0.9)} + e^{-(-0.45)} + e^{-0.95}} = 0.557$$ (If $T = 30$ min, 20 min, 15 min)

$$= \frac{e^{-(-0.8)}}{e^{-(-0.8)} + e^{-(-0.45)} + e^{-1.05}} = 0.532$$ [If $T = 25$ min, 20 min, 10 min]

$$P_{Rail} = \frac{e^{-(-0.45)}}{e^{-(-0.9)} + e^{-(-0.45)} + e^{-0.95}} = 0.355$$ [If $T = 30$ min, 20 min, 15 min]

$$= \frac{e^{-(-0.45)}}{e^{-(-0.8)} + e^{-(-0.45)} + e^{-1.05}} = 0.378$$ [If $T = 25$, 20, 10 min]

(4)

$$P_{auto} = \frac{e^{-0.95}}{e^{-(-0.9)} + e^{-(-0.45)} + e^{-0.95}} = 0.087$$

[T = 30 min, 20 min, 15 min]

$$P_{auto} = \frac{e^{-(+0.05)}}{e^{-1.05} + e^{-(-0.8)} + e^{-(-0.45)}} = 0.084$$

[T = 25, 20, 10]

Trips (bus) = $0.532 \times 600 = 320$

Trips (Rail) = $0.378 \times 600 = 227$

Trips (auto) = $0.084 \times 600 = 51$

[T = 25, 20, 10]

Trips (bus) = $0.557 \times 600 = 335$

Trips (Rail) = $0.355 \times 600 = 213$

Trips (auto) = $0.087 \times 600 = 53$

[T = 30 min, 20, 15]

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(5) $T_{ij} = Q_i \left(e^{-L_i B} - e^{-L_i A} \right)$

$T_{A-A} = 1250 \left(e^{-0.06 \times 0} - e^{-0.06 \times 800} \right) = 1250$

$T_{A-B} = 1250 \left(e^{-0.06 \times 800} - e^{-0.06(800+1200)} \right) \simeq 0$

$T_{A-C} = 1250 \left(e^{-0.06(800+1200)} - e^{-0.06(800+1200+3900)} \right) \simeq 0$

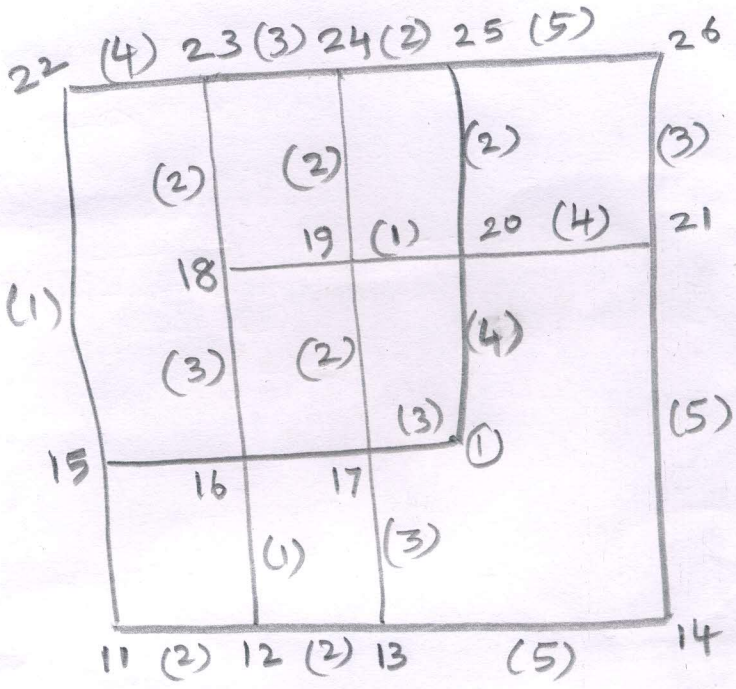
$T_{B-A} = 1850 \left(e^{-0.05 \times 1200} - e^{-0.05(1200+800)} \right) \simeq 0$

$T_{B-B} = 1850 \left(e^{-0.05 \times 0} - e^{-0.05(1200)} \right) = 1850$

The results show that all trips are distributed with in zones.

6. **Explain minimum path tree with Moore's Algorithm.** (5)

Moore's algorithm is a computer programme designed to assign the traffic in a street network. This method is based on finding the shortest path by building minimum path tree.
The procedure is as follows:
The highway network is described by a system of links and nodes.
A link is a selection of highway network between two intersections.
A node is a centroid of a zone or intersection of two or more nodes.
All these data are coded and stored
The programme is made to select the minimum path between the zones and assign predicted trips to these paths.
Traffic volumes are thus accumulated to the each section of network.
The minimum path is the route travel which has least accumulation of time, distance, or other parameters like safety, comfort etc. 8
The sequence of nodes which defines the links comprising the mini path between any two zone centroid is called tree.
The tree is determined by starting from zone centroid and progressively selecting the shortest path to the terminal zone centroid.
When traffic is accumulated for each link, link may get overloaded.
In such case adjustments should be made in accordance with travel time flow relationship.



2

Zone centroid = (1)

The above network consists of zone centroid & number of links & nodes.
Travel time on each link is indicated in brackets

$T_{1-17} = 3$ min
$T_{1-20} = 4$ min
→ T_{1-17} is selected.

This process is continued till we reach min path.