CEE 123 Transport Systems 3: Planning & Forecasting

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Homework #7 -- Trip Assignment Modeling [S O L U T I O N S]

The following problems deal with a hypothetical, 4-zone region (this data was used in prior homework assignment). Table 1 summarizes activity system and **HBW** trip generation data (Ps and As) for 2020, and estimates of activity system variables for 2030. Use the Table 2 base Trip Distribution in all problems.

Table 1. Base and Future HBW Trips and Demographic Data Summary

Zone	HBW P(i) '20	HBW A(j) '20	HH(i) Households '20	HH(i) Households '30	C(i) Cars '20	C(i) Cars '30	W(i) Workers '20	W(i) Workers '30	E(j) Empl. '20	E(j) Empl. '30	I(i) Inc. both
1	825	710	321	330	447	460	390	395	300	300	Low
2	775	800	402	470	360	420	345	480	360	450	Med
3	910	970	330	300	396	375	582	570	600	690	High
4	865	895	375	420	450	465	399	450	456	455	Med
Tot	3375	3375	1428	1520	1653	1720	1716	1895	1716	1895	N/A

Table 2. Base Travel Time and Trip Distribution Matrix

From\To	1	2	3	4	From\To	1	2	3	4	P(i)
1	5	16	13	18	1	250	125	375	75	825
2	16	7	20	12	2	100	400	50	225	775
3	13	20	2	9	3	205	60	225	420	910
4	18	12	9	3	4	155	215	320	175	865
					A(j)	710	800	970	895	3375

Problem 5. PA to OD by Time-of-Day (10 points)

Using the base 24-hour Home-based Work (HBW) person-trip production-attraction matrix in Table 2 and the conversion factors in Table 5, **develop** the corresponding (a) AM-peak period, (b) PM-peak period, and (c) off-peak period origin-destination matrices for HBW person-trips.

Table 5. Temporal Distribution of Trips by Purpose

Analysis Period	HBW P-A	HBW A-P	HBO P-A	HBO A-P	NHB P-A	NHB A-P
1. AM-peak (7-9:00am)	0.30	0.00	0.06	0.02	0.04	0.04
2. PM-peak (4-7:00pm)	0.03	0.30	0.09	0.15	0.12	0.12
3. Off-peak (other)	0.17	0.20	0.33	0.33	0.34	0.34

Solution:

To convert PA trips to OD trips, apply the following equation:

$$T_{ij}^{OD} = PAFactor*T_{ij}^{PA} + APFactor*T_{ji}^{PA}$$

The following tables show the results for AM-peak, PM-peak, off-peak, and total ODs for HBW trips only. Note that due to round-off error, row and column sums do not exactly match trip purpose totals.

Table 5(a) AM-peak HBW OD Table [0.30, 0.00]

ORG\DST	1	2	3	4	O(i)

ORG\DST	1	2	3	4	O(i)
1	75	38	113	23	249
2	30	120	15	68	233
3	62	18	68	126	274
4	47	65	96	53	261
D(j)	214	241	292	270	1013

Table 5(b) PM-peak HBW OD Table [0.03, 0.30]

ORG\DST	1	2	3	4	O(i)
1	83	34	73	49	239
2	41	132	20	71	264
3	119	17	74	109	319
4	27	74	136	58	295
D(j)	270	257	303	287	1114

Table 5(c) Offpeak HBW OD Table [0.17, 0.20]

ORG\DST	1	2	3	4	O(i)
1	93	41	105	44	283
2	42	148	21	81	292
3	110	20	83	135	348
4	41	82	138	65	326
D(j)	286	291	347	325	1249

Table 5(d) Total HBW OD Table [0.50, 0.50]

ORG\DST	1	2	3	4	O(i)
1	250	113	290	115	768
2	113	400	55	220	788
3	290	55	225	370	940
4	115	220	370	175	880
D(j)	768	788	940	880	3375

Problem 6. Vehicle Occupancy (5 points)

Convert the AM-peak HBW O-D matrix of person-trips (see problem 5) to vehicle trips, using Table 6 parameters. **Express** as an O-D matrix.

Table 6. Base Year Vehicle Occupancy by Trip Purpose

Type	Trip purpose	Average Vehicle Occupancy
1. HBW	Home-based Work	1.10 persons/vehicle
2. HBO	Home-based Other	1.33 persons/vehicle
3. NHB	Non-home-based	1.25 persons/vehicle

Solution:

Each element of the AM-peak HBW OD-matrix is divided by the average HBW vehicle occupancy (1.1 persons/vehicle) to obtain the number of vehicle-trips. Although not shown, a similar process would be applied to the HBO and NHB matrices that would result from application of PA and AP factors as in Problem 5. All vehicle-trip matrices by purpose are combined prior to trip assignment (see Problem 8).

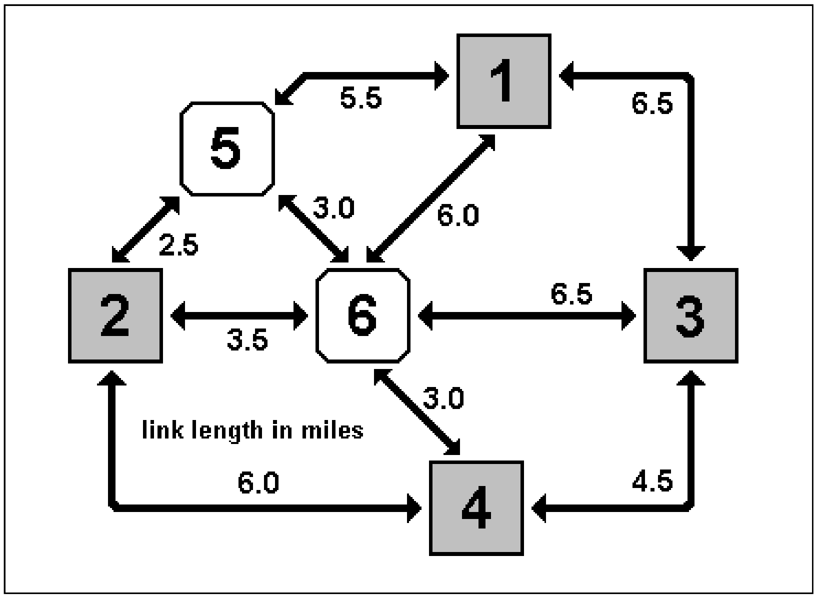
Table 6a. AM-peak Vehicle-trip O-D Matrix (AVO=1.1)

- Person-trips -					-- Vehicle-trips ---					
Fr\To	1	2	3	4	Fr\To	1	2	3	4	O(i)

1	75	38	112	23	1	69	34	102	20	225
2	30	120	15	68	2	27	109	14	61	211
3	62	18	68	126	3	56	16	61	115	248
4	47	65	96	52	4	42	59	87	48	236
					Tot	194	218	265	244	920

Problem 7. Identify Paths (10 points)

The following network represents the area in question, with node numbers 5 and 6 representing major network interchanges where no activities occur (these are not centroids). Links are labeled with link length (in miles). Assume for the AM-peak period average auto speeds of 30 mph.



Apply Dijkstra's Algorithm, showing all work, to find the minimum path tree for TAZ 1 (row 1 of the skim table). Inspect the network and apply symmetry to complete the skim table. **Verify** this skim table with that in Table 2. **Find** and **tabulate** predecessor nodes to identify the minimum paths for trip assignment.

Solution:
The minimum path tree for TAZ 1, using Dijkstra's Algorithm, is shown. Skim times check with the corresponding values in the base travel time matrix in Table 2.

Table 7a. Base Network: Minimum Path Tree for Node 1

Iter	From/To k	From/To j	Update Path Length w(j): Min{[w*(k)+t(k,j)],	w(j)}	= w(j)	Select Min Dec	Select Min Node	Pred. Node PN(j)
0	1				0	Root	1	
1	1	3	0 + 13 = 13	inf	13			
		5	0 + 11 = 11	inf	11	Add	5	P(5)= 1
		6	0 + 12 = 12	inf	12			
1	1	3	0 + 13 = 13	inf	13			
		6	0 + 12 = 12	inf	12	Add	6	P(6)= 1
2	5	2	11 + 5 = 16	inf	16			
		6	11 + 6 = 17	12	12	Del		
1	1	3	0 + 13 = 13	inf	13	Add	3	P(3)= 1
2	5	2	11 + 5 = 16	inf	16			
3	6	2	12 + 7 = 19	16	16	Del		
		3	12 + 13 = 25	13	13	Del		
		4	12 + 6 = 18	inf	18			

```
-----------------------------------------------------------------------
  2    5    2    11  +   5  = 16    inf     16    Add    2   P(2)= 5
            4    12  +   6  = 18    inf     18
  4    3    4    13  +   9  = 22     18     18    Del
            6    13  +  13  = 26     12     12    Del
-----------------------------------------------------------------------
  2    5    4    12  +   6  = 18    inf     18    Add    4   P(4)= 6
  5    2    4    16  +  12  = 28     18     18    Del
-----------------------------------------------------------------------
  6    4    Finished
-----------------------------------------------------------------------
```

Table 7b. Base Network: Minimum Path Skims and Paths

From\To	1	2	3	4
1	-	16 [1-5-2]	13 [1-3]	18 [1-6-4]
2	16 [2-5-1]	-	20 [2-6-3]	12 [2-4]
3	13 [3-1]	20 [3-6-2]	-	9 [3-4]
4	18 [4-6-1]	12 [4-2]	9 [4-3]	-

Last Updated: 2 June 2025