CE361 Introduction to Transportation Engineering — HW Posted: Monday 20 September 2004
Homework 4 Solutions — Due: Friday 1 October 2004

TRANSPORTATION PLANNING AND DEMAND MODELING

1. **HH-Based Regression for Trip Generation.** The zonal equations:

   P(i) = 53 + 6.1 HHs/zone + 4.5 vehs/zone + 3.4 jobs/zone

   A(j) = 58 + 4.3 HHs/zone + 5.2 jobs/zone

   A. (15 points) Productions and attractions for each zone in a table with the format of FTE Table 4.6.

TAZ	pop	HH	vehs	empl	P(i)	A(i)	Bal. A(i)
1	0	0	0	1000	3453	5258	8288
2	0	0	0	1500	5153	7858	12386
3	3000	1100	1400	0	13063	4788	7547
4	2000	900	1600	0	12743	3928	6191
Totals	5000	2000	3000	2500	34412	21832	34412

   One P and one A calculation done by hand.

   P(4) = 53 + (6.1*900) + (4.5*1600) + (3.4*0) = 53 + 5490 + 7200 + 0 = 12,743

   A(1) = 58 + (4.3*0) + (5.2*1000) = 58 + 0 + 5200 = 5258

   B. (5 points) Balance the P and A values for each zone as described at the start of FTE Section 4.3.3.

   The revised values appear in a new column "Bal. A(j)" in the table created in Part A.

2. (20 points) **Trip Distribution by Gravity Model.** How many trips produced in Zone 3 will be attracted to each of the four zones if P(3) = 16,850 and a = 1.0, b = 3.8, and c = -0.25 in the Tanner Function?

P=	16850	from Zone 3				
a =	1	b =	3.80	c =	-0.25	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Zone j	A(j)	t(3j)	F(3j)	A(j)F(3j)	AF(j)/sum(AF)	T(3j)
1	8500	8.2	382.110	3247939.1	0.311	5241
2	12000	7.4	315.963	3791551.8	0.363	6119
3	7500	3.4	44.717	335375.1	0.032	541
4	6000	9.9	511.134	3066804.9	0.294	4949
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	34000			10441670.9	1.000	16850

3. (20 points) **Mode Choice**. Utility function $V_m = a*TTT_m$. What value of **a** (to the nearest 0.001) in the utility function will cause $p_{bus} = 0.20$ and $p_{auto} = 0.80$?

   Using Tools/Solver in Excel:

TTT:	57.5	33.6			0.2	0.8
a	V(bus)	V(auto)	e^V(bus)	e^V(auto)	p(bus)	p(auto)
-0.058	-3.335	-1.9489	0.0356	0.1424	0.200	0.800

4. **Trip Assignment**. The capacity values are at LOS "C".
   A. (15 points) **Equilibrium condition.** Using Equation 4.13, determine the flows V(A) and V(B) -- to the nearest 5 vph -- that occur when the 5850 vph are assigned to routes A and B so that user equilibrium occurs.

Use Tools/Solver in Excel so that t(A) – t(B) =0:

Rte	t(0)	a	b	C
A	47	0.15	4.0	3260
B	21	0.40	5.5	1440
OD flow	5850			

V(A)	V(B)	t(A)	t(B)	t(A)-t(B)
3930	1920	61.89	61.89	-6.7E-07

B. (5 points) **Equilibrium travel time.** Show that the travel times on the two routes are equal.

(4.13) $t_A = 47\left[1 + 0.15\left(3930/3260\right)^{4.0}\right] = 61.89$; $t_A = 21\left[1 + 0.40\left(1920/1440\right)^{5.5}\right] = 61.88$