CE 361 Introduction to Transportation Engineering	Out: Wed. 24 September 2003
Homework 4 (HW 4)	Due: Fri. 3 October 2003

TRAVEL DEMAND MODELS

1. **ITE Trip Generation.** (15 points) An automobile company is planning to build a 1.8 million square foot factory in Zone 1 in Middleville. Use the appropriate information in Figure 4.5 to compute the expected number of trip ends at the factory. From the values you compute, which single value would you choose?

2. **Trip Generation by Zonal Regression.** MRPC staff members have collected data from ten industrial zones. The "T/day" column in Table 4.2 contains the number of vehicles observed entering or exiting industrial sites in each TAZ on an average workday. The "empls" column contains the number of employees in each zone.
   A. (5 points) What linear equation of the form T = a + bX best fits the data in Table 4.2?
   B. (5 points) Does the value of b make sense to you? Explain why (not).
   C. (5 points) If $a \neq 0$ in the best-fit equation, does that make sense to you? Explain why $a \neq 0$ is (not) a reasonable value.

T/day	empls
974	363
838	360
555	135
849	256
392	97
714	277
160	78
587	174
545	235
627	295

3. **Trip Generation by Cross-Classification.** (15 points) Zone 8 in Mythaca is largely residential. Your client has provided the zone's expected household composition in the horizon year to you in the Table below. Use the household trip rates in Table 4.2 to estimate the number of home-based trips per day that will be produced by Zone 8.

Persons per HH	Vehicles per Household			
	0	1	2	3+
1	100	300	150	40
2	110	250	50	75
3	90	250	50	85
4	150	210	60	35
5+	20	50	50	35

4. **Trip Distribution by the Gravity Model.** (15 points) Using acceptable Trip Generation procedures, the recent Middleville Area Transportation Study (MATS) has produced the horizon-year (H-yr) production and attraction totals for each zone, as shown in Table 3a below. MATS has also

determined that $F_{ij} = 1000\ t_{ij}^{-2.4}$. The H-year t_{ij} values are given in Table 3b. (∞ = infinity) Using the new F_{ij} equation and the format of Table 4.9, calculate the predicted values of T_{21}, T_{23}, and T_{24}.

Table 3a. MATS H-year Productions and Attractions				
Zone	1	2	3	4
P_i	1100	300	1600	1000
A_j	1400	600	500	1500

Table 3b. H-year Interzonal Travel Times (minutes)				
T_{ij}	1	2	3	4
1	∞	13	18	13
2	13	∞	13	18
3	18	13	∞	16
4	13	18	16	∞

5. **MNL Mode Choice Model.** A group of teachers in the Mythaca School District have agreed to stop commuting by motor vehicle. Instead, each of these teachers will choose each morning between walking and bicycling to school, depending on the weather. The utility functions for the two non-motorized modes for these teachers are:

$U_{bike} = 0.0 - 0.5\ t_{bike} - c_3\ W_{bike}$

$U_{walk} = +2.9 - 0.5\ t_{walk}$

where W is a weather-related variable and t is travel time in minutes. W=0 in good weather; W=1 in bad weather.

A. (10 points) When the weather is good, what is the probability that a "non-motorized" teacher with a choice between a 15-minute walk and a 6-minute bike ride will choose the bicycle mode?

B. (10 points) At what value of the weather coefficient c_3 will the teacher in Part A be equally likely to choose walk and bicycle in bad weather?

6. **Trip Assignment.** An expressway connecting Zones 3 and 1 has an LPF t(X) = 8.0 + 5.7 V(X), where V(X) is in 1000s of vehicles per hour in a given direction. The old arterial streets between Zones 3 and 1 are still available, with an LPF of t(A) = 9.9 + 13.5 V(A).

a. (10 points) If all drivers from Zone 3 to Zone 1 want to minimize their individual travel times, at what flow rate V(X) will drivers begin to divert back to the arterial route?

b. (10 points) If T(3,1) = 2663 vph during the peak hour, find the equilibrium travel time from Zone 3 to Zone 1 and calculate V(X) and V(A) for the peak hour.