UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE AND ENGINEERING

FINAL EXAMINATIONS, DECEMBER 2001

Fourth Year - Program 1

CIV 531F - TRANSPORTATION PLANNING

Examiner - E.J. Miller

Closed Book Examination - one 8.5 x 11 inch standard aid sheet permitted.

Any type of calculator may be used.

The examination consists of 8 questions. Marks for each question are indicated in brackets in the right-hand margin beside each question. The total mark for the examination is 60.

Please attempt all questions.

1. Briefly discuss the roles which federal, provincial and municipal governments play in planning and delivering transportation services in the Greater Toronto Area. [10]

2. Table 1 presents measures of effectiveness for 3 alternatives compared against the do-nothing alternative. Using a benefit-cost analysis, determine which alternative is preferred on economic grounds. [6]

Table 1: Data for Question 1

	Alternative			
Measure of Effectiveness	**1**	**2**	**3**	**$/unit**
Accident Reductions	10	20	0	10000 $/accident
Travel Time Savings (min)	300000	250000	325000	0.5 $/min
Tonnes CO2 Reduced	100	150	75	5000 $/tonne
Annual Op.+Cap. Cost ($)	500000	750000	350000	

3. Table 2 presents capital costs and measures of effectiveness for 10 alternative under consideration. Construct efficiency frontiers for these alternatives. Which (if any) alternatives can be dropped from further consideration based on this analysis? [6]

Table 2: Data for Question 3

Alt.	Time Savings	Pollution Reduction	Capital Cost
1	2	8	10.0
2	5	8	9.0
3	6	7	11.0
4	8	6	10.0
5	8	2	9.5
6	10	9	21.0
7	11	7	19.5
8	11	6	20.0
9	12	6	22.0
10	14	4	20.5

4. Two roads (1 and 2) connect a suburb with a central business district (CBD). Road 1 is an expressway, road 2 is an arterial road. Their volume-delay functions are:

$$t_1 = 20 + V_1 \qquad t_2 = 30 + 2V_2$$

where V_1 and V_2 are the volume flows on roads 1 and 2, respectively, and times are expressed in minutes. The average hourly flow from the suburb to the CBD, V, varies by time of day, with V = 20, 15 and 5 for the peak, mid-day and evening periods, respectively (all flows are expressed in 1000's of trips per hour). What are the equilibrium flows on roads 1 and 2 during each time period? Briefly discuss the extent to which this simple model captures realistic aspects of travellers' route choices. [8]

5. Buses arrive at a bus stop every five minutes. The capacity of a bus (seated plus standing

passengers) is 60 people. Passengers arrive at the stop at a uniform rate of 5 persons/minute during the morning peak period. Table 3 shows the loadings of 4 buses which arrive during the time period 8:05 to 8:20 a.m. (i.e., the number of passengers already onboard each bus when it arrives at the bus stop). Assuming that everyone wishing to board the 8:00 a.m. bus did so (i.e., there was no queue of passengers at the stop after the 8:00 a.m. bus left), what is the average wait time for passengers who arrive at the stop between 8:00 and 8:20? [8]

Table 3: Data for Q. 5

Bus Arrival Time	No. Onboard
8:05	40
8:10	50
8:15	25
8:20	20

6. We have discussed in class how the logsum (i.e., inclusive value) term of a logit mode choice model can be interpreted as a measure of accessibility. It can also be shown to be a measure of consumer surplus. Given the following auto (mode=a) and transit (mode=t) utility functions for a simple two-mode logit mode choice model and the data shown below, what is the benefit which an individual trip-maker receives if the auto travel time is reduced from 20 minutes to 15 minutes? [6]

$V_a = 0.5 - 0.04*T_a - 0.2*C_a$ $\quad V_t = -0.04*T_t - 0.2*C_t$

V_m = systematic utility for mode m (m=a,t)

T_m = travel time, mode m (min) $\quad T_a = 20 \quad T_t = 30$

C_m = travel cost, mode m ($) $\quad C_a = 5.00 \quad C_t = 1.50$

7. Transit modal shares have been declining somewhat in the GTA over the past 15 years. Discuss the major reasons why you feel that this has been the case. At the same time, transit modal shares and per capita ridership levels within the GTA are still very high compared to most other North American urban areas. What are the major factors accounting for this? [10]

8. Table 4 presents base year O-D flows for a two-zone system. Origin (O_i) and destination (D_j) trip generation equations for this system are:

$O_i = 0.6*POP_i$ $\quad D_j = 0.8*EMP_j$

Table 6 provides zonal population (POP) and employment (EMP) data for a future forecast year. Using biproportional updating, estimate the future year O-D flow table. Do two row plus column adjustments.

[6]

Table 4: Base Year O-D Flows

O\D	1	2
1	200	50
2	30	100

Table 5: Pop & Emp Data

Zone	POP	EMP
1	500	300
2	200	200