Final Exam (3rd Year Civil)
Transportation Planning & Traffic Engineering

Date: Tuesday 14 June 2011 Time: 09:30am – 12:30pm
Total Grade: 100 Points Instructor: Dr. Mostafa Abo-Hashema, Professor

Notes: 1. Answer all questions and assume any reasonable data you may need.
2. No aids other than calculators. *There are three additional pages for Tables and Charts*
3. Answer should be neat, specific, and in order
4. Start each question in a new page.

Question No. 1 (12 points)

For each of the following statements, choose the correct "a" or "b" or "c" to complete the statement:

DO NOT REWRITE THE STATEMENT

JUST SELECT/WRITEDOWN "a" or "b" or "c" CORRESPONDING TO EACH NUMBER

1. To study the movements between origins and destinations, data collection procedure must be made. The selection of data collection technique depends on
    a. trip purpose
    b. study purpose
    c. population
2. The study of transportation movements between origins and destinations identifies
    a. population in each zone
    b. number of Trips between zones
    c. network performance
3. In the final stage of transportation planning for a specific city, assessment has been made to verify if the desired purposes have been achieved or not. If the answer was "NO", what would you suggest in the next step?
    a. Change the proposed network
    b. Change the principals purposes
    c. Change the traffic volume inside the city in the future
4. Percent of available opportunities to the number of workers is considered main indicator in the transportation planning. If this percent is greater than "1" in a specific area, that means this area is
    a. educational
    b. high population
    c. attracted to trips

5. Model calibration means
    a. hypothesize a mathematical form of the relationship
    b. to determine how well the calibrated model explains the data
    c. to estimate the parameters of the model based on the data
6. The purely residential zone has
    a. no attraction trips
    b. no production trips
    c. both attraction and production trips
7. Availability of parking and transit influence
    a. Trip Distribution
    b. Mode Choice
    c. Trip Assignment
8. The 30^{th} highest hourly volume is
    a. more than 29 hours within the year
    b. more than 31 hours within the year.
    c. Less than 31 hours within the year
9. Capacity is referred to
    a. maximum speed
    b. maximum density
    c. maximum flow rate
10. PIEV Time is
    a. Reaction and Perception Time
    b. Distance between a vehicle and obstruction
    c. Time to pass a slow vehicle
11. Which of the following statements is false as related to transportation planning
    a. Trip distribution always follows trip generation
    b. Modal choice allocation always precedes traffic assignment
    c. Network minimum path algorithms are part of modal choice allocation
12. The time mean speed is
    a. less than space mean speed
    b. greater than the space mean speed
    c. equal to space mean speed

Question No. 2 (18 points) *[Trip Distribution]*

Consider a study area consisting of four zones. The observed base-year productions, attractiveness and trip-interchange volumes are shown below. The base-year interzonal impedances are specified in terms of travel time in minutes and are also shown below. It is required to calibrate the gravity model to find the value of "c" to reproduce the observed trip-interchange volumes, assuming that K_{ij} is the same unit value for all zones. **One-iteration only is required**.

Trip Productions and Attractiveness for a Four-Zone Study Area

Zone	1	2	3	4
Trip Productions	250	440	0	0
Attractiveness	4	3	6	5

Observed Trip-interchange Volumes

O \ D	1	2	3	4
1	19	62	65	104
2	262	34	68	76
3	0	0	0	0
4	0	0	0	0

Base-year interzonal impedances (Travel Time, min)

Zone	1	2	3	4
1	5	2	3	2
2	2	6	6	5
3	3	6	5	5
4	2	5	5	6

Question No. 3 (15 points) *[Modal Split]*

Given the utility expression:

$$U_k = a_k - 0.04X_1 - 0.035X_2 - 0.03X_3 - 0.005X_4$$

where,

- X_1: *Access plus egress time (mins)*
- X_2: *waiting time (mins)*
- X_3: *riding time (mins)*
- X_4: *out-of-pocket cost (cents)*

Apply the logit model to calculate the market shares and the fare-box revenue of the following travel modes:

	Attribute	X_1	X_2	X_3	X_4
o	*Automobile*	*10*	*0*	*25*	*130*
o	*Bus*	*25*	*20*	*45*	*70*

- *Mode specific constants, a_k, (Automobile: -0.12, Bus: -0.56)*
- *T_{ij} = 5000 person trips per day (future or target year)*

If Rapid Transit (RT) is introduced to the city (in addition to the automobile and public bus), what is the effect on the market shares and the fare-box revenue?

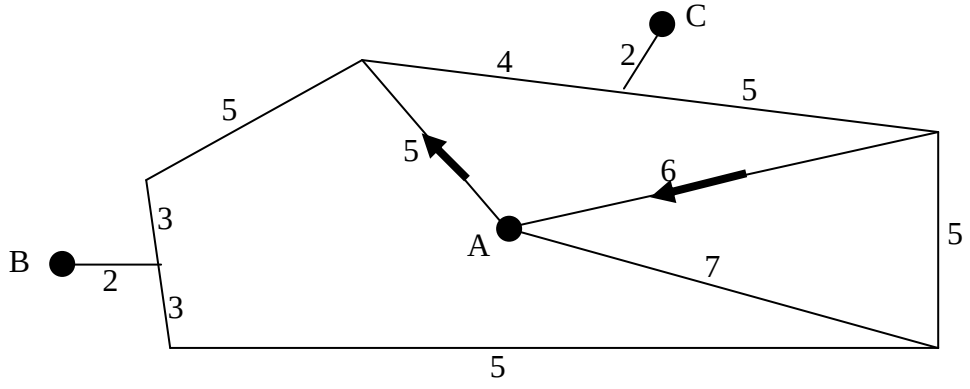
Attribute	***X1***	***X2***	***X3***	***X4***
RT	*15*	*5*	*35*	*90*

The mode specific constant is -0.41

Question No. 4 (10 points) *[Trip Assignment]*

Assign the O/D matrix shown in the below table to the network of the three-zone area shown in the below Figure using All-Or-Nothing method. The numbers shown in the Figure are the travel time along these links, expressed in minutes.

O \ D	A	B	C	**P_i**
A	0	5943	7056	**12999**
B	4177	0	6885	**11062**
C	8835	5784	0	**14619**
A_j	**13012**	**11727**	**13941**	**38680**



Note that:

- **All links are two-way link except two links as shown in the figure by the arrow.**
- **Final Assigned Network should be drawn. Show your calculation steps.**

Question No. 5 (12 points) *[Traffic Operations]*

A. In 2010, a traffic volume study was performed on a rural road to determine the variation in hourly traffic volumes throughout the year. The collected data were analyzed to determine the design hourly volume (DHV), which found to be 2750 vph. Estimate the DHV for the year 2030, if traffic-forecasting shows that about 45% of the current traffic volume will be added to the road as developed and generated traffic in the next 20 years. In addition, consider an annual growth rate of 2.5% in the car ownership

B. Five cars are traveling a 150-feet section of a road at constant speed of 50, 60, 65, 75, and 79 ft/sec, calculate the average spot speed and the space mean speed for this group of vehicles

C. If a traffic flow of 1500 vehicle per hour was measured, what would be the average headway between these vehicles?

Question No. 6 (18 points) *[Freeway: Capacity & LOS]*

An existing six-lane freeway has the following information:

- Six lanes
- Level terrain
- 10 percent trucks
- PHF = 0.95
- FFS = 65 mph (measured in field)
- Growing urban area
- 5,000-vph volume (in one direction) (existing, i.e. current)
- 5,600-vph volume (in one direction, at the end of 3 years)
- Beyond 3 years, traffic grows at 4 % per year

What is the current LOS during peak periods? What LOS will occur at the end of 3 years (i.e. in 3 years)? To avoid the condition of demand exceeding capacity, when should a fourth lane be added in each direction?

Note that:

⇒ *Assume that percent trucks and PHF remain constant over time.*
⇒ *Assume no buses and no RVs.*
⇒ *Assume familiar driver population given the freeway type and area type.*

Question No. 7 (15 points) *[Two-Way Highway: Capacity & LOS]*

A rural two-lane highway in mountainous terrain has a 6 percent grade of 2 miles. Other relevant characteristics include:

a. *Roadway characteristics*: 12-ft lanes; 8-ft shoulders; 60 percent no passing zones.
b. *Traffic characteristics*: 70/30 directional split; 12 percent trucks; 7 percent recreational vehicles; 1 percent buses; 80 percent passenger cars; PHF = 0.85.

What is the maximum volume, which can be accommodated on the grade at an average upgrade speed of 40 mph?

$$Q_{ij} = P_i \frac{A_j \cdot F_{ij} \cdot K_{ij}}{\sum_{j=1}^{n} A_j \cdot F_{ij} \cdot K_{ij}} \qquad F_{ij} = \frac{1}{W_{ij}^{c}} \qquad p(k) = \frac{e^{U_k}}{\sum_{x} e^{U_x}}$$

$$(DHV)_{future} = (1+AGF)^n \times (DHV)_{now} + (DHV)_{now} \times (f_2 + f_3 + f_4)$$

$$V_p = \frac{V}{PHF * N * f_{HV} * f_P} \qquad f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)}$$

$$FFS = FFS_i - f_{Lw} - f_{Lc} - f_n - f_{ID} \qquad SF_i = 2800 * \left(\frac{v}{c}\right)_i * f_d * f_w * f_{HV}$$

$$SF_i = 2800 * \left(\frac{v}{c}\right)_i * f_d * f_w * f_g * f_{HV} \qquad I_P = 0.02(E - E_0)$$

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1) + P_B(E_{B-1})} \qquad f_g = \frac{1}{1 + P_P I_P}$$

$$f_{HV} = \frac{1}{[1 + P_{HV}(E_{HV} - 1)]} \qquad E_{HV} = 1 + [(0.25 + P_{T/HV})(E - 1)]$$