Final Exam (3rd Year Civil)

Transportation Planning & Traffic Engineering

2nd Term - 2010/2011

Question #1

Q1

12

1.	b	(1)	7.	b	(1)
2.	b	(1)	8.	b	(1)
3.	a.	(1)	9.	c	(1)
4.	c	(1)	10.	a	(1)
5.	c	(1)	11.	c.	(1)
6.	a	(1)	12.	b	(1)

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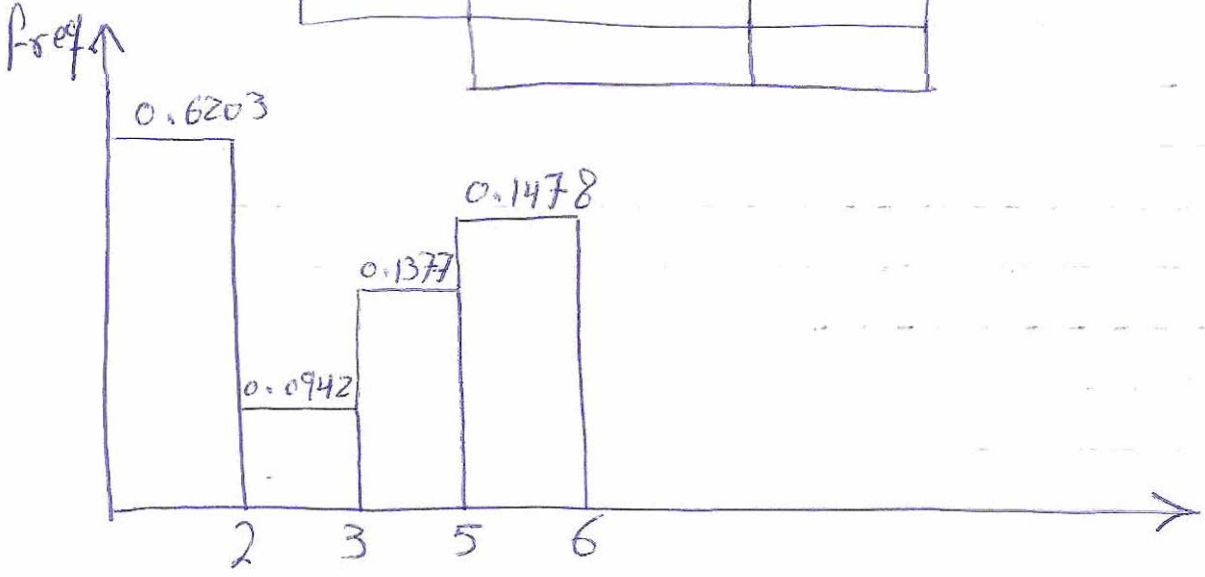
Question #2

18 Q2

i \ j	1	2	3	4	P_i
1					250
2					440
3					0
4					0
	4	3	6	5	690

W	Q_{ij}	Freq.
2	62 + 104 + 262 = 428	0.6203
3	65 + 0 = 65	0.0942
5	19 + 76 = 95	0.1377
6	34 + 68 = 102	0.1478

(2)



Assume, $c = 2$ $\quad F_{ij} = \dfrac{1}{w_{ij}^{c}}$

F_{ij}

	1	2	3	4
1	0.04	0.25	0.1111	0.25
2	0.25	0.0278	0.0278	0.04
3	0.1111	0.0278	0.04	0.04
4	0.25	0.04	0.04	0.0278

(1)

For $i=1$ $\quad P_i = 250$ $\quad Q_{ij} = P_i \dfrac{A_j F_{ij} k_{ij}}{\sum A_j F_{ij} k_{ij}}$

Zone(j)	A_j	F_{ij}	k_{ij}	AFk	$\frac{AFk}{\Sigma AFk}$	P_i	Q_{ij}
1	4	0.04	1	0.16	0.0566	250	14
2	3	0.25	1	0.75	0.2653	250	66
3	6	0.1111	1	0.6666	0.2358	250	59
4	5	0.25	1	1.25	0.4423	250	111
				2.8266	1.0		256

(3)

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For $i = 2$ $\quad P_i = 440$

Zone (i)	A_j	F_{ij}	K_{ij}	AFK	$\frac{AFK}{\Sigma AFK}$	P_i	Q_{ij}
1	4	0.25	1	1	0.6897	440	303
2	3	0.0278	1	0.0834	0.0575	440	25
3	6	0.0278	1	0.1668	0.115	440	51
4	5	0.04	1	0.2	0.1379	440	61
				1.45	1.0		440

(3)

Calculated OD

	1	2	3	4	P_i
1	14	66	59	111	250
2	303	25	51	61	440
3	0	0	0	0	0
4	0	0	0	0	0
A_j	317	91	110	172	690

(2)

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W	Q_{ij}	Freq.
2	66+111+303 = 480	0.6957
3	59+0 = 59	0.0855
5	14+61 = 75	0.1087
6	25+51 = 76	0.1101
	690	1

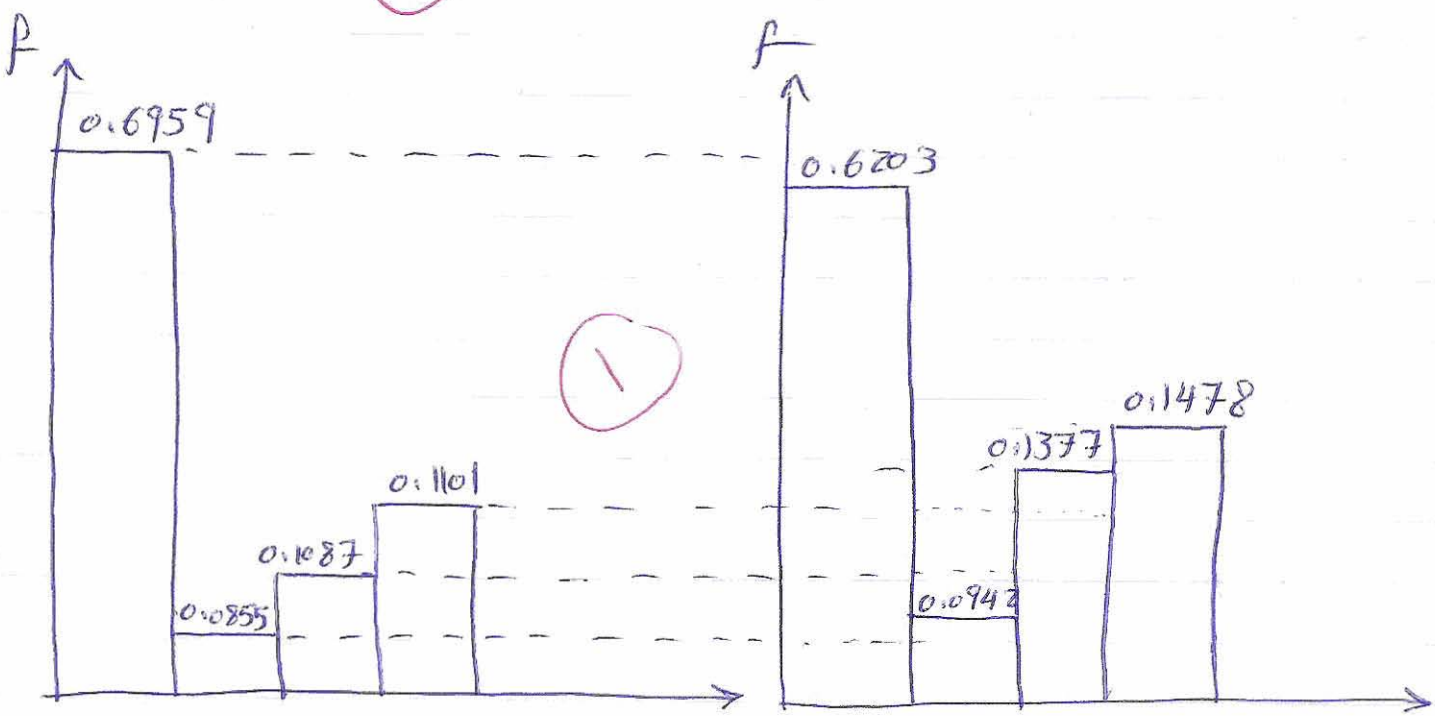
(2)

$F_2 = 0.25 * \frac{0.6203}{0.6957} = 0.2229$ (1)

$F_3 = 0.1111 * \frac{0.0942}{0.0855} = 0.1224$ (1)

$F_5 = 0.04 * \frac{0.1377}{0.1087} = 0.0507$ (1)

$F_6 = 0.0278 * \frac{0.1478}{0.1101} = 0.0373$ (1)



(1)

Question #3

15 Q3

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

$$U_{auto} = -0.12 - 0.04(10) - 0.035(0) - 0.03(25) - 0.005(130)$$

$$U_{auto} = \underline{-1.92} \quad (1)$$

$$U_{Bus} = -0.56 - 0.04(25) - 0.035(20) - 0.03(45) - 0.005(70)$$

$$U_{Bus} = \underline{-3.96} \quad (1)$$

$$P(k) = \frac{e^{uk}}{\sum e^{ux}}$$

$$P_{auto} = \frac{e^{-1.92}}{e^{-1.92} + e^{-3.96}} = \underline{0.88} \quad (1)$$

$$P_{Bus} = \frac{e^{-3.96}}{e^{-1.92} + e^{-3.96}} = \underline{0.12} \quad (1)$$

Market shares

Auto = $5000 * 0.88 = 4400$ trips/day (1)

Bus = $5000 * 0.12 = 600$ trips/day (1)

The Fare-box revenue = $600 * 0.70 = \$420$/day (1)

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$$U_{RT} = -0.41 - 0.04(15) - 0.035(5) - 0.03(35) - 0.005(90)$$

$$U_{RT} = -2.685 \quad (1)$$

$$P_{auto} = \frac{e^{-1.92}}{e^{-1.92} + e^{-3.96} + e^{-2.685}} = 0.63 \quad (1)$$

$$P_{Bus} = \frac{e^{-3.96}}{e^{-1.92} + e^{-3.96} + e^{-2.685}} = 0.08 \quad (1)$$

$$P_{RT} = \frac{e^{-2.685}}{e^{-1.92} + e^{-3.96} + e^{-2.685}} = 0.29 \quad (1)$$

Market shares

Auto = $5000 * 0.63 = 3150$ trips/day (1)

Bus = $5000 * 0.08 = 400$ trips/day (1)

RT = $5000 * 0.29 = 1450$ trips/day (1)

The Fare-box revenue = $400 * 0.70 + 1450 * 0.9$

= #1585 /day (1)

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Question #4

Q4

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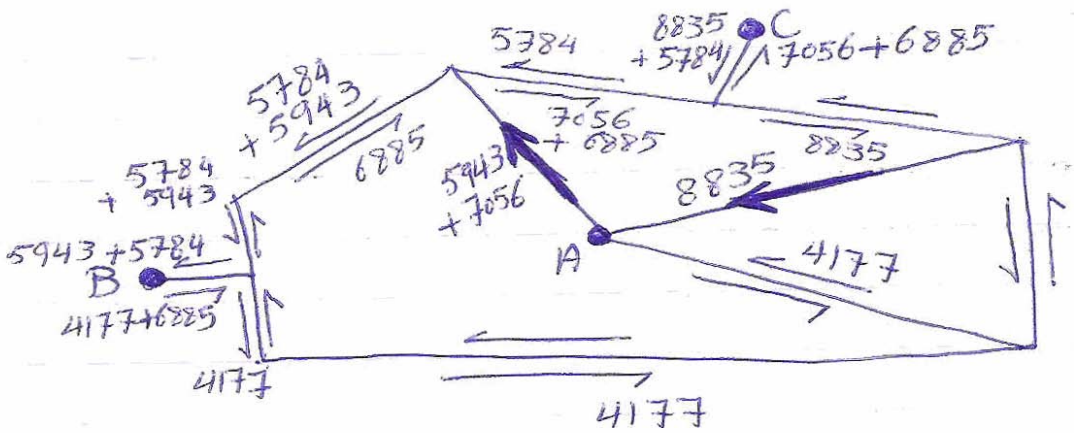

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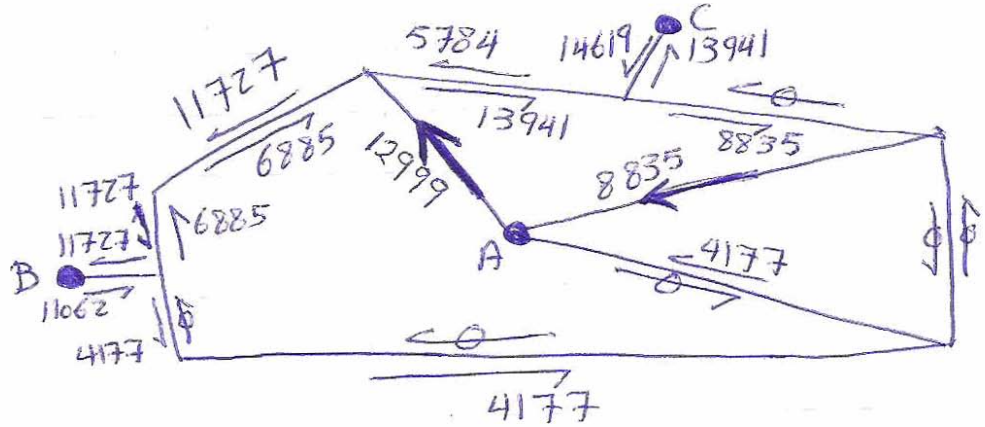

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Question #5 — 12 — Q5

a. $DHV_{now} = 2750$ vph

$DHV_{2030} = ??$

$n =$ # of years $= 20$ yrs

Annual Growth Rate $=$ AGF $= 2.5\%$

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

$$(DHV)_{2030} = [2750 * (1 + 0.025)^{20}] + [2750 * 0.45]$$

$$(DHV)_{2030} = \underline{5744} \text{ vph} \quad (4)$$

B. $L = 150'$

Car #	speed (V) ft/sec.	time (t) sec.
1	50	3
2	60	2.5
3	65	2.31
4	75	2
5	79	1.899

$V = \frac{L}{t}$

$t = \frac{L}{V}$

n = # of cars = 5 (2)

$$t' = \frac{\sum_{i=1}^{n} t_i}{n} = 2.34 \text{ sec.} \quad (1)$$

$$\text{Average spot speed} = \frac{\sum_{i=1}^{n} V_i}{n} = \underline{65.8 \text{ ft/sec}} \quad (1)$$

$$\text{Space Mean speed} = \frac{L}{t'} = \frac{150}{2.34} = \underline{64 \text{ ft/sec.}} \quad (1)$$

C. $q = 1500$ vph

$$\text{headway } (h) = \frac{1}{q} = \frac{\text{one hour}}{q}$$

$$h = \frac{60 * 60}{1500} = \underline{2.4 \text{ sec.}}$$

(3)

Q6

Question #6

18

$n = 3$, level, $P_T = 10\%$, PHF = 0.95, FFS = 65 mph (Field)

$V_{current} = 5000$ vph ‖ After 3 years

$V_{3yrs} = 5600$ vph ‖ AGF = 4%

$$V_p = \frac{V}{PHF * N * f_{HV} * f_p}$$

assume, $f_p = 1.0$ & $P_R = 0$

Current:-

$$V_p = \frac{5000}{0.95 * 3 * f_{HV} * 1.0} = \frac{5000}{0.95 * 3 * 0.952 * 1.0} = 1843 \text{ pcphpL}$$ (2)

$$f_{HV} = \frac{1}{1 + P_T(E_T - 1) + P_R(E_R - 1)} = \frac{1}{1 + 0.10(1.5 - 1)} = 0.952$$ (2)

From Table 3.2 $\rightarrow E_T = 1.5$ (1)

Table 3.1 $\Longrightarrow$ Current LOS = D (2)

End of 3 years

$$V_p = \frac{5600}{0.95 * 3 * 0.952 * 1.0} = 2064 \text{ pcphpL}$$ (2)

From Table 3.1 $\Longrightarrow$ $LOS_{3 years} = E$ (2)

* we can consider after 3 years is named now

Flow Rate (V_p) = 2064 pcphpL

Volume (V) = 5600 vph [Consider or name as now]

LOS = E

* To not exceed Capacity of LOS E :-

Capacity (Max. Flow Rate), $V_{p_{max}}$ = 2350 pcphpL (From Table 3.1)

$$2350 = \frac{V}{0.95 * 3 * 0.952 * 1.0}$$

∴ Max. Volume = 6376 vph [Future]

This could happen in # of years

$$(DHV)_{future} = (DHV)_{now} * (1 + \%AGF)^n$$

$$6376 = 5600 * (1 + 0.04)^n$$

n = 3.3 years

∴ Fourth Lane should be added after 3.3 years after the end of 3 years

or 6.3 years from now

Question #7

15 Q7

Given 2-lan Highway

Rural, Mountainous, 12' Lane, 8' shoulder

grade = 6% (2 miles)

60% no passing zone

DD = 70/30, $P_T = 12\%$, $P_R = 7\%$, $P_B = 1\%$

PHF = 0.85, Av. upgrade speed = 40 mph

⟶ Max. Vol. = ??

$$(SF)_i = 2800 \left(\frac{V}{C}\right)_i * f_d * f_w * f_g * f_{HV}$$

$$f_g = \frac{1}{1 + P_p I_p} \quad \& \quad I_p = 0.02 (E - E_0)$$

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

Table 8.2 ⟹ Av. upgrade speed = 40 mph

∴ LOS = D (1)

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Table 8.7 $\Rightarrow \left(\frac{V}{C}\right)_D = 0.83$ (1)

Table 8.8 $\Rightarrow f_d = 0.78$ (1)

Table 8.5 $\Rightarrow f_w = 1.0$ (1)

Table 8.9 $\Rightarrow E = 10.7$ (1)

Table 8.9 $\Rightarrow E_o = 1.3$ (1)

$P_{HV} = P_T + P_R + P_B = 0.12 + 0.07 + 0.01 = 0.20$ (1)

$P_{T/HV} = \frac{P_T}{P_{HV}} = \frac{0.12}{0.20} = 0.60$ (1)

$I_p = 0.02\,(10.7 - 1.3) = 0.188$ (1)

$f_g = \frac{1}{1 + 0.80 * 0.188} = 0.87$ (1)

$E_{HV} = 1 + (0.25 + 0.60) * (10.7 - 1) = 9.25$ (1)

$f_{HV} = \frac{1}{1 + 0.20\,(9.25 - 1)} = 0.38$ (1)

$SF_D = 2800 * 0.83 * 0.78 * 1.0 * 0.87 * 0.38 = 599$ vph (1)

Volume $= V = SF * PHF = 599 * 0.85$

$= \underline{509}$ vph (2)

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