

CE 450 Transport Policy and Planning
Final Exam
Open Book: 100 points

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Instructions: Read questions carefully. Be sure to show clearly organize all your work. To receive full points, show all work, box solutions.

1.1 List 3 key questions that you would like to answer from a traffic impact analysis? (6 points)

- What is the affected area for a given proposed change?
- What is the expected time frame / long term impact in traffic patterns & volume?
- How will the roadways need modified if at all to address the impact?

1.2 What are the thresholds that might trigger to conduct a traffic impact study? (4 points)

Adding a new development or shopping-center
any situation where a change will lead to
Site-generated traffic accounting for 5% or more
of a roads peak hour capacity.

1.3 List two performance measures that you use to evaluate traffic impact. (5 points)

Existing Level of Service
Future Level of Service (No project)
Future LOS (w/ project)

2.1 List 5 performance measures to identify high risk locations related to traffic crashes. (5 points)

Average crash frequency
 Crash rate
 EPDO avg crash frequency
 Relative Severity Index
 Critical Rate

2.2 In a transportation safety improvement project, three safety countermeasures can be implemented as shown in the table below. The crash modification factors (CMF) are given for each of them. Using the information below, which combination of safety countermeasures will provide you maximum crash reduction with minimum cost? (10 points)

Selected Safety Countermeasure	CMF	Implementation Cost	Cost/% reduction
1. Portable rumble strips (PRS)	0.89	\$ 5,000	\$454.55
2. Speed Feedback Display (SFD)	0.863	\$ 5,600	\$408.76
3. Automated Speed-Camera Enforcement (ASCE)	0.83	\$ 10,000	\$588.2
PRS + SFD	$0.89 \cdot 0.863 = 0.768$	\$5000 \$5600 \$10600	\$456.90
PRS + ASCE	$= 0.89 \cdot 0.83 = 0.7387$	\$15000	\$574.05
SFD + ASCE	0.716	\$15,600	\$549.30
SFD + ASCE + SFD	0.637	\$20,600	\$567.49

Assuming
 None are
 mutually exclusive

ex.

PRS Cost/% reduction
 $\$5000 / [(1 - 0.89) \cdot 100] = \454.55

Best option by
 Cost/% of Crashes reduced
 is Speed-Feedback Display
 For combinations only
 PRS + SFD

2.3 According to FHWA, the comprehensive crash costs for different crash severity are provided in the table below. Let's say, in the city of Fort Wayne, 75% crashes are PDO, 23% Injury and remaining fatal. On an average day, in the city of Fort Wayne, there are total 10 crashes. Estimate the overall crash costs. (10 points)

Crash Severity Level	Average Crash Cost
Fatal	\$ 4,509,991
Injury	\$ 220,000
Property damage only (PDO)	\$ 8,325.00

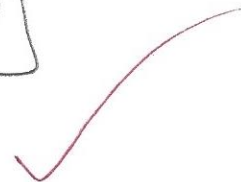
PDO-75%

Inj.-23%

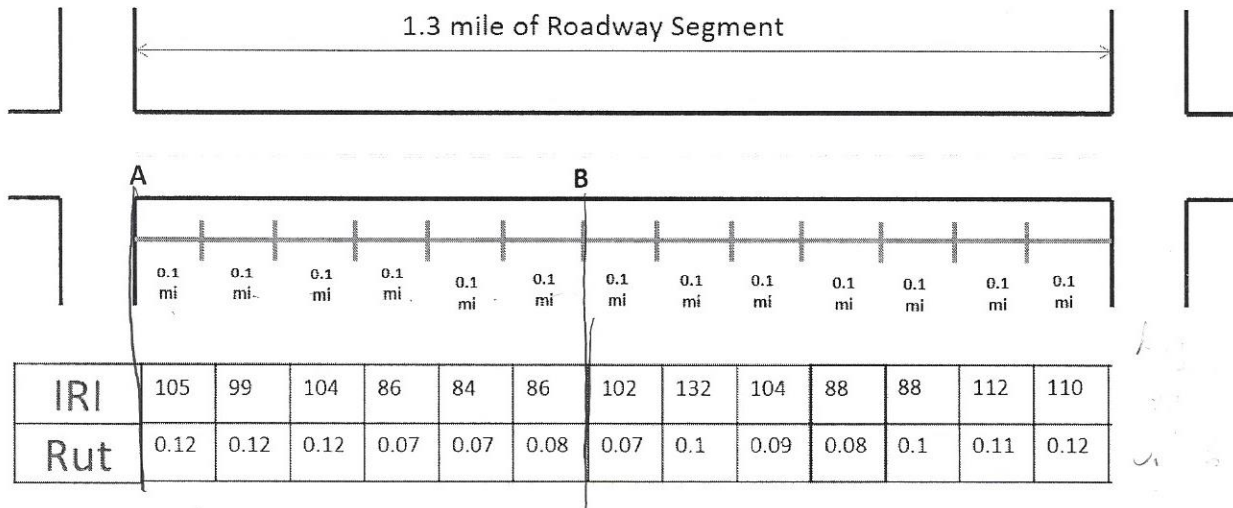
Fatal-2%

$$\text{Overall costs} = 10 [0.75 \cdot \$8,325 + 0.23 \cdot \$220,000 + 0.02 \cdot \$4,509,991]$$

$$= \$1,470,435.70$$



3. Calculate existing pavement serviceability index (PSI) of a roadway segment starts point A and ends B? What would be the next year PSI? The PCI of this segment is 75. A typical pavement deterioration data is given in the table below. (15 points)



$n = 6$
 $IRI_{avg} = 94$
 $Rut_{avg} = 0.0967$

Year	PSI
1	4.5
2	4
3	3.5
4	3.25
5	2.5
6	2
7	1.25
8	1

$$PSI = 5.35e^{-0.0058 \cdot IRI} - 4RUT^2 - 3\left(1 - \left(\frac{PCI}{100}\right)\right)$$

A

$$PSI = 5.35e^{-0.0058(94)} - 4(0.0967)^2 - 3\left(1 - \frac{75}{100}\right)$$

$$= 2.31 \quad \approx 5.5 \text{ yrs.}$$

1 year later $\approx 6.5 \text{ yrs.}$

$$PSI \approx 1.6$$

4. A transit agency is evaluating alternatives for a light rail line construction. Three alternatives are evaluated for five different criteria (see following table). Evaluate the alternatives using ranking method, select which one is the best. (15 points)

No	Criterion (MOE)	Ranking	Alt 1	Alt 2	Alt 3	Weight	Max%
1	Daily ridership (1000s)	1	25	23	20	5	33.3%
2	Annual return on investment (%)	2	13	14	11	4	26.7%
3	Length of line (mi)	4	8	7	6	2	13.3%
4	Passengers seated in peak hour (%)	3	25	35	40	3	20%
5	Auto drivers diverted (1000s)	5	3.5	3	2	1	6.7%

$$\Sigma = 15 = 100\%$$

Alt 1

$$33.3 \cdot \frac{25}{25} + 26.7 \cdot \frac{13}{14} + 13.3 \cdot \frac{8}{8} + 20 \cdot \frac{25}{40} + 6.7 \cdot \frac{3.5}{3.5} = \boxed{90.6}$$

Alt 2



$$33.3 \cdot \frac{23}{25} + 26.7 \cdot \frac{14}{14} + 13.3 \cdot \frac{7}{8} + 20 \cdot \frac{35}{40} + 6.7 \cdot \frac{3}{3.5} = \boxed{92.2}$$

Alt 3

$$33.3 \cdot \frac{20}{25} + 26.7 \cdot \frac{11}{14} + 13.3 \cdot \frac{6}{8} + 20 \cdot \frac{40}{40} + 6.7 \cdot \frac{2}{3.5} = \boxed{81.4}$$

Best option is ALT 2

5. Let's say, you are working for NIRCC in Fort Wayne as a Transportation Planner. Your responsibility is to measure the congestion of each roadway segment in city boundary. As an example, the average AM and PM traffic volume is given on Interstate 469 from Maplecrest to Interstate 69 in the table below. Determine whether this roadway segment is congested or not. (10 points)

Street	from street	to street	AM Peak Vol (2 lanes)	PM Peak Vol (2 lanes)	Length
Inter 469	Maplecrest	Inter 69	3500	3700	2.26

Table 2
Lane Capacities

Highway Class					
Land Use	Interstate	Expressway	Two-Way Arterial	One-Way Arterial	Collector
CBD	1800	745	605	650	480
CBD Fringe	1800	790	715	715	575
Suburban	1800	865	715	805	575
Rural	1800	820	590	n/a	540
Outlying CBD	1800	790	715	715	575

Table 3
Benchmark V/C Ratios

Highway Class					
Land Use	Interstate	Expressway	Two-Way Arterial	One-Way Arterial	Collector
CBD	0.80	0.90	0.90	0.90	0.90
CBD Fringe	0.80	0.90	0.90	0.90	0.90
Suburban	0.80	0.90	0.80	0.80	0.80
Rural	0.80	0.90	0.80	0.80	0.80
Outlying CBD	0.80	0.90	0.90	0.90	0.90

$$\frac{V}{C} = \frac{\text{Vol}/\# \text{ lanes}}{\text{Cap}}$$

AM

$$\frac{3500/2}{1800} = 0.97$$

is > 0.80

Congested

PM

$$\frac{3700/2}{1800} = 1.03$$

is > 0.80

Congested

6. List the sources of transportation revenues and highway expenditures by type. (10 points)

Transportation
Revenue
Sources:

Taxes
Fees or charges
Investment income
Fines & Penalties

expenditures

Maintenance
Highway & traffic services
Administration
Highway Patrol & Safety
Interest on debt
Capital Outlay

7. What are the common environments issues with transportation improvement project? How do you mitigate issues related to water resource? (10 points)

affect on:

- water resources
- Endangered Species
- Cultural resources
- Preserve park / reserved lands

Mitigation:

- Mitigation banking
- Stream & wetland creation
- Sediment / Run-off control
- Water quality monitoring
- Restoration
- Preservation