CE 474
Traffic System Design (Fall 2004)
Assignment # 1: Due date: Friday September 17, 2004 by 5:00 PM

1)-Using the following data to construct a headway distribution curve. If the minimum gap accepted is 4.0 seconds, determine the probability that a vehicle approaching on a side street will have to wait more than 3 gaps before merging into traffic.

Gap size	Observed frequency
< 2	22
2 – 3	49
3 – 4	63
4 – 5	111
5 – 6	86
6 – 7	64
7 – 8	43
> 8	66

Total Observations: 504

Observations less than 4 seconds: 134

Probability of a gap less than 4 seconds = 134/504 = 0.266

Probability of a gap more than or equal 4 seconds = 1- 0.266 = 0.734

Probability of waiting exactly 3 gaps before merging into traffic = probability of the first three gaps less than 4 seconds and fourth gap more than or equal 4 seconds.

= 0.266 x 0.266 x 0.266 x 0.734 = 0.014

Probability of waiting exactly 2 gaps before merging into traffic = 0.266 x 0.266 x 0.734 = 0.052

Probability of waiting exactly 1 gap before merging into traffic = 0.266 x 0.734 = 0.195

Probability of waiting exactly 0 gap before merging into traffic = 0.734 =

Probability of waiting 3 or less gaps before merging into traffic = 0.014+0.052+0.195+0.734 = 0.995

Probability of waiting more than 3 gaps = 1 – 0.995 = 0.005 = 0.5%

2)-Left Turn Vehicles randomly arrive at a signalized intersection that has a separate left turn phase. The number of left turn vehicles arriving during hour is 200 vehicles. The length of the cycle is 90 seconds. Determine the minimum length of left turn storage bay so that during only one cycle in the design hour will the left turning vehicles block the through traffic. (Assume that the stored left-turn vehicles occupy 30 feet.) If the left turn volume has doubled, in what percentage of cycles the through vehicles will be blocked.

Cycle length = 90 seconds   40 cycles per hour

m = average LT vehicles per cycle = 200/40 = 5 vehicles/cycle

Assuming that the LT bay can store "n" vehicles

Then the probability of more then n vehicles arriving during any given cycle should be less than 1/40 or 0.025

Or the probability of "n" vehicles or less arriving during any given cycle should be more than 0.975

From the Table: n = 10 vehicles. Minimum length required – 300 ft

X	P(X)	P(X≤_)
1	0.03369	0.03369
2	0.084224	0.117914
3	0.140374	0.258288
4	0.175467	0.433755
5	0.175467	0.609223
6	0.146223	0.755446
7	0.104445	0.85989
8	0.065278	0.925168
9	0.036266	0.961434
10	***0.018133***	***0.979567***
11	0.008242	0.987809
12	0.003434	0.991243

3)-A small drive-it-through-yourself car wash, in which the next car cannot go through the washing procedure unless the car in front is completely finished, has the capacity to hold on its grounds a maximum of four cars (including the one in the wash). The company found the arrivals to be Poisson with mean rate of 12/hour, and its service time to be exponential with a mean of 4 minutes. What is the average number of cars lost to the car wash firm as a result of its capacity limitation? The car wash works is open 10 hours/day.

The system is M/M/1 queue system

Arrival rate = μ = 12 vph

Service rate = λ = 15 vph

ρ = 12/15 = 0.8

x	P(x)	Cumm
0	0.200	0.2
1	0.160	0.360
2	0.128	0.488
3	0.102	0.590
4	0.082	0.672
5	0.066	0.738
6	0.052	0.790
7	0.042	0.832

Probability of 5 vehicles or less in the system [one served and four waiting in queue = 0.738

Probability of more than 5 vehicles arriving = 1 – 0.738 = 0.262

Average number of vehicles lost = 0.262 * 12 *10 = 31.44 vehicles /day