CE 361 Introduction to Transportation Engineering — Out: Wed. 1 September 2004

Homework 2 (HW 2) — Due: Mon. 13 September 2004

TRAFFIC FLOW – THEORY AND PRACTICE

- "FTE" = Fundamentals of Transportation Engineering, the textbook for CE361.
- For every problem, identify the problem by its number and **name**, be clear, be concise, cite your sources, attach documentation (if appropriate), and let your methodology be known.
- Note: Mythaca County staff will send you via e-mail a file (gar701) containing observations for 30 consecutive time periods on the 3 EB lanes of Interstate Highway 25, which is northeast of Mythaca. Use these data in Problems 2 and 4.

1. (10 points) **Traffic volumes and flow rates.** Problem 2.5 in FTE. Which of the two methods of calculating average headway presented in class on 30 August 2004 did you use?

In the table below, "Duration" = End Time – Start Time, Flow rate = Vehicles/Duration, and Headway = (1/flow rate)*3600 sec/hr.

	Time	Vehicles	Flow rate vph	Avg. headway
A.	45 min	511veh	681.3vph	5.28sec
B.	26.75min	481 veh	1078.9vph	3.34 sec
C.	30 min	249 veh	498vph	7.23sec

In this exercise, only the Start and End Times were given – not the times at which the first and last vehicles were observed. This means that the second method presented in class on 30 August – the one that used the duration of the observation period – was used.

2. (10 points) **Speed distributions.** Problem 2.11 in FTE, but use the data in the spreadsheet emailed to you by Mythaca County.

A. 0.85*30 speeds = 25.5, so the 85th percentile speed falls between 25th and 26th slowest speeds, or the 6th and 5th fastest speeds -- 62 and 63 km/hr. Use 62.5 or 63 km/hr.
B. Because each 20-second value is a mean value of one or more vehicles, speeds toward the upper of lower extreme are lost. The 85th percentile speed based on 20-second means will be lower than the 85th percentile speed based on individual vehicle speeds.

3. (10 points) **Measuring Lane Occupancy.** Problem 2.22 in FTE.

A. (2.6) $t(P) = (L_V + EL) / S$ = [31.8 ft + 9 ft] / [(46.9 mph) * 1.47 fps/mph] = 0.59 sec
B. (2.7) $t'(P) = t(P) – EL/S$ = 0.59 sec – [9 ft / (46.9 mph*1.47 fps/mph)] =0.46 sec

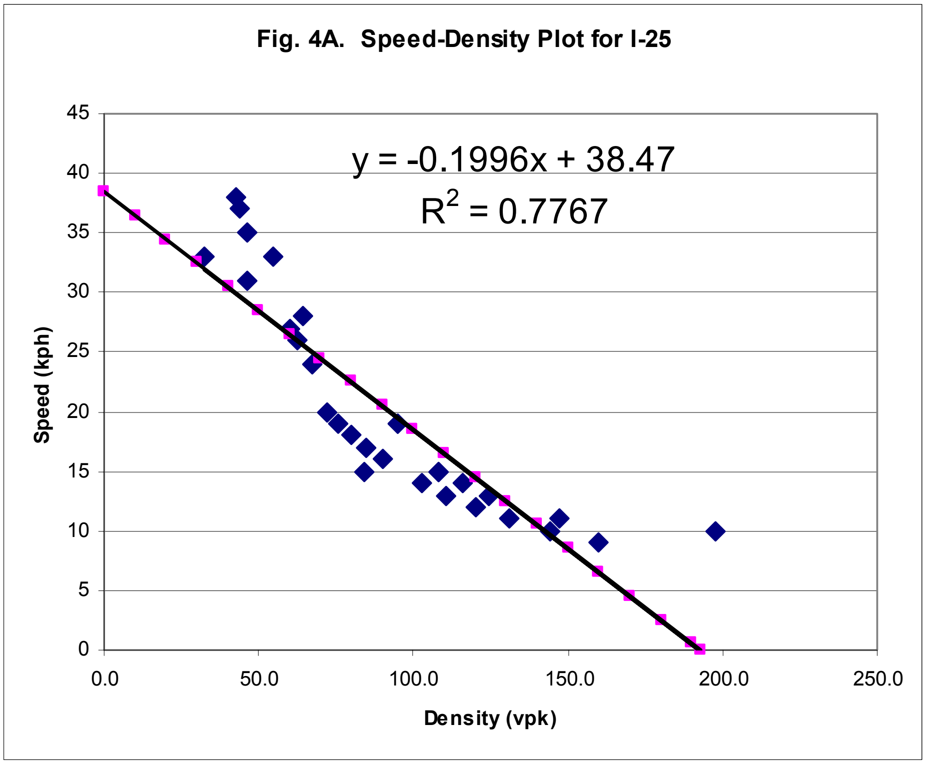
4. (30 points) **Speed-density-flow relationships.** Problem 2.40 in FTE, but use the data in the spreadsheet emailed to you by Mythaca County.

A. (7 pts) Speed-density plot and line fit on next page. Free-flow speed = 38.47 kph and Jam density = 38.47 mph/0.1996=192.7 veh/km.
B. (7 pts) Flow-density plot and curve fit on next page. (5 pts) Use D_j = 192.7 and S_f = 38.47 in (2.19).
When D = 30 vpk, $q = S_f\left(D - \frac{D^2}{D_j}\right) = 38.47\left(30 - \frac{30^2}{192.7}\right)$ = 974.4 veh/hr. (4 pts) The scatter plot does <u>not</u> have the shape of the curve generated using Greenshields Model parameters.
C. (7 pts) Speed-flow plot curve fit on page 3.

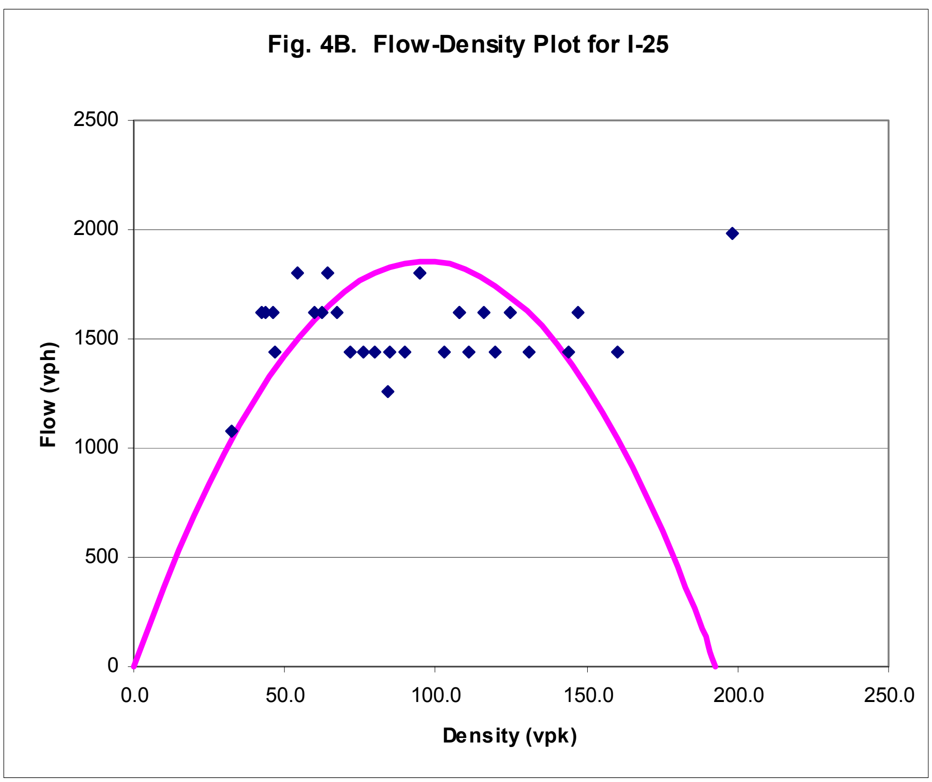
5. (10 points) **Poisson Processes.** Problem 2.50 in FTE.

For vehicles on major street: Arrival rate, λ = 1200 veh/hr * 1 hr/3600 sec = 0.3333 veh/sec.
Specified time between vehicle arrivals, x= 5 sec. $Pr(x \geq 5) = e^{-\lambda x} = e^{-0.3333 * 5} = 0.189$

4A. Speed-density plot and line fit.



4B. Flow-density plot and curve fit.



4C. Speed-flow plot curve fit.