CE 455/555 Intelligent Transportation Systems
Winter Quarter 2006

Problem Set 1 (Due February 28, 2006)

1. GPS Data Decoding

GPS data is becoming more and more prevalent in our daily lives. See if you can decode one line of raw GPS data. See: http://vancouver-webpages.com/peter/nmeafaq.txt

$GPGSV,3,1,11,01,79,164,48,03,38,226,47,08,27,086,30,09,14,050,00*7F

Next, download the Excel file "comet.xls" from the course web site. This file contains some latitude/longitude data for one of the Comet tow trucks in Portland. Plot the data in such a way that you can display and then calculate the average speed of the tow truck during the given time period. Did the tow truck stop during the given period? **BONUS**: *Plot the truck's path on a GIS map of Portland*.

2. Loop Detector Data Analysis

First, download the Excel file containing "floop20.nc3" from the course web site. Start your Excel application and open the file from within Excel. This file contains "almost raw" data from lane 3 (third from left) northbound station 20 on the I-880 freeway (see map on web site for location). The first column contains the time (number of seconds since midnight). the second column is the count (number of vehicles per reporting period) and the third column is the occupancy (percent of reporting period time that detector was occupied by a vehicle).

Explore the data file. Plot the raw count and occupancy data so you can look at it. What is the length of time contained in the file? What is the total count, average count, standard deviation of the count, average occupancy and standard deviation of the occupancy? Is any data cleaning necessary before performing these calculations? Can you say anything about the character of the traffic conditions during the time period analyzed? Is there any congestion? If so, when? How can you tell?

Now plot the average flow measured at 30-second, one-minute, 5-minute and 15-minute intervals on the same graph. Are there differences visible in the data measured over the different sampling periods? **BONUS**: Plot the count and occupancy data *cumulatively* on one graph with separate vertical axes, as described in a paper located at: http://web.pdx.edu/~bertini/paper.pdf; then plot a second graph where you subtract a background flow or occupancy rate from both curves to reveal the details.

3. Incident Management

Imagine a 4-lane freeway with a capacity of 8800 vehicles per hour (vph). Imagine that the freeway is flowing near capacity at 7800 vph, and a major incident occurs, restricting its flow to

2200 vph (i.e., the incident blocks 3 lanes). Assume the incident duration is 2 hours. Draw a cumulative vehicle arrival curve showing the total delay experienced by vehicles due to the incident. How many vehicles are affected by the incident?

Imagine that an incident management program could reduce the incident's duration by half. Draw another cumulative vehicle arrival curve (using the same scale as above) and determine the total delay attributable to the incident with its shorter duration. How many vehicles are affected now?

Now try to quantify the benefits (in dollars) of the incident management program on this one incident. Assume that the traffic stream on the freeway consists of 8% trucks and that the average automobile occupancy is 1.15. Assume that the value of a person's time in an auto is $10/hr., and the value of a truck driver's time is $25/hr. Also, it has been shown at General Motors Research that the fuel consumption of slow-traveling vehicles (<40 mph) is approximated by the equation: $E=k_5L+k_6T$, where k_5=90mℓ/km, k_6=0.44 mℓ/sec, L=distance traveled and T=travel time.

4. Transit AVL Data Analysis

This exercise will provide an opportunity to explore some Tri-Met AVL data and test some simple uses for this data. First, download the file *route14.zip* from the course website by right-clicking on the filename and saving to a file. Unzip the file, then open the Excel application and open the file from within Excel. This is a large spreadsheet with 13,886 lines of Bus Dispatch System (BDS) data from Tri-Met Route 14 on Thursday, February 1, 2001.

We will focus our analysis on the morning peak trips from location 1831 (SE Foster/94th Avenue) to location 9573 (North Terminal, a layover/bus staging area near NW 4th and Hoyt). You will investigate 5 inbound trips (listed below) occurring between 7-9 a.m.

Vehicle	Train	Leave 1831	Arrive 9573	Trip Time
2154	1408	7:18	8:03	0:45
2153	1405	7:30	8:15	0:45
2156	1406	7:43	8:27	0:44
2163	1403	7:52	8:39	0:47
2140	1404	8:10	8:58	0:48

Once you have extracted the data for the above-listed trips, prepare one graph that clearly displays a time-space diagram (x-axis is time, y-axis is distance). The graph should consist of 5 trajectories showing how the buses speeds vary with time. What is the average trip time? What is the average dwell time? Write a short paragraph describing what you can see in the data itself and from the graph. **BONUS**: Add trajectories (using a light line type or color) for the corresponding *scheduled* runs. You can download the schedule data from the Tri-met web site or ask me to email it to you. What can you see now? **SUPER BONUS**: *Plot the trips on a GIS map*.