CEE 123 Transport Systems 3: Planning & Forecasting

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Homework #4 -- Performance, Demand, Equilibration (40 points) [Due: Monday 26 April 2021]

Problem 1 (10 points)
Three routes connect an origin and a destination with performance functions given as:

- Route #1: $t_1 = 5 + 1.5\ x_1$
- Route #2: $t_2 = 12 + 3.0\ x_2$
- Route #3: $t_3 = 2 + 0.2[x_3]^2$

with travel time t (in minutes), and route volume x (in kvph). The total O/D demand is 4.0 kvph.

a. Determine user equilibrium flows (volumes and travel times)
b. If all routes are not used, at what volume will all routes be used?

Problem 2 (10 points)
A multilane highway has two southbound lanes, each with a capacity c of 1.2 kvph per lane. Southbound traffic consists of 2.5 kvph with 1 occupant, 0.5 kvph with two occupants, 0.3 kvph with 3 occupants, and 20 buses per hour with 50 occupants each (assume a bus is represented as 1 passenger car equivalent (PCE). The BPR-type performance functions is:

$t_1 = t_o\ [1 + 1.15(x/c)^{6.87}]$

with travel time t (in minutes), 15 minute initial travel time, and route volume x and capacity c (both in kvph). Flows on the facility are currently in user equilibrium. An additional lane is being added (with c = 1.2 kvph). Assume that all qualified higher occupancy vehicles will use the new lane. What would the *total person-hours of travel* be if this new lane was open to:
(a) All traffic?
(b) Vehicles with 2 or more occupants only?
(c) What would the results would be if the new lane was restricted to vehicles with 3 or more occupants?

Problem 3 (20 points)
This problem is part of the Miasma Beach Project and provides you the opportunity to estimate trip generation models using Excel (as was done in Hw 1). using the data provided in Task 3, Tables 2 and 3, estimate a home-based other (HBO) trip production and a home-based other (HBO) trip attraction model for the six internal TAZs.

1. Pick an explanatory variable from Table 2 that you think would be most strongly related to HBO productions in a TAZ. Estimate this model.
2. If this model gives acceptable results, add a second variable that you think would also be strongly related to HBO productions (if results are not acceptable, choose another single variable). Estimate this model.
3. Compare the two models. Which would you choose and why?
4. Repeat parts 1-3 for HBO attractions.

Problem EC (10 points) [Extra Credit for 123; Required for 223]
Two routes connect an origin and a destination with performance functions given as:

Route 1: $t_1 = 3 + 1.5[x_1/c_1]^2$ Route 2: $t_2 = 5 + 4[x_2/c_2]$

with travel time t (in minutes), and volume x and capacity c (both in kvph). The total O/D travel demand is 6.0 kvph, and route 1 and 2 capacities are 2.0 and 1.5 kvph, respectively. The routes are currently in user equilibrium. Proposed capacity improvements will increase capacity on route 2 to 2.5 kvph. It's estimated that

each 1-minute reduction in route travel time will attract an additional 0.5 kvph to the corridor (generated traffic from latent travel demand). Find the equilibrium (UE) flows after the route 2 improvements.

Last Updated: 19 April 2021