CEE 123 Transport Systems 3: Planning & Forecasting (Spring 2025)

Homework #4 -- Performance, Demand, Equilibration [40 points]

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 highway has two southbound lanes, each with a capacity c of 1.2 kvph per lane. Traffic 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. The 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, and (c) 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 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 a second single variable instead). Estimate this model.
3. Compare the two models. Which would you choose and why?
4. Repeat parts 1-3 for HBO attractions.

Problem 4 (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.

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