CEE 123 Transport Systems 3: Planning & Forecasting

Spring 2024: Michael G. McNally (mmcnally-at-uci-dot-edu) [15450]

Homework #4 -- Performance, Demand, Equilibration (40 points) [Due: Friday, 26 April 2024]

Problem 1 (10 points)
Three routes connect a suburban origin and a downtown destination (x in kvph; t in minutes):

Route #1: $t_1 = 4 + 2x_1$
Route #2: $t_2 = 8 + 1x_2$
Route #3: $t_3 = 9 + 2x_3$

a. If the total O/D flow is 5.0 kvph, find the User Equilibrium (UE) flow pattern {x,t}.
b. If the total O/D flow is 2.0 kvph, find the path flows that minimize total system travel time.
c. How does this System Optimal solution compare with the UE Solution in Part a?

Problem 2 (10 points)
Mr. Dunphy has two alternate routes when he drives from the desert (where he lives) to the sea (where he works). Route 1 has a higher base travel time but it's less sensitive to traffic congestion. There are linear performance functions (with travel time in minutes and volume in 1000s of VPH, or kvph).

Performance Parameter	Route 1	Route 2
Intercept (Free Flow Time)	2.0	1.0
Slope (Route Sensitivity)	1.0	2.0

The current travel demand function is linear: base demand is 15 (1000s of trips) but is reduced by 2 (1000s of trips) for each added minute of travel time. **Solve** algebraically or graphically for the user equilibrium flows.

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 work (HBW) trip production and a home-based work (HBW) 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 HBW 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 HBW 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 HBW 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: 15 April 2024