Homework 5: Transportation Planning

Textbook Assignment

| Problem | Points [Variable] | Answer |
|---------|-------------------|--|
| 8.5 | 10 | E[T] = 1.455 |
| 8.7 | 10 | 1775 drive alone, 974 share a ride, 1251 take the bus |
| 8.8 | 10 | 66 trips to SC1, 7 trips to SC2, 118 trips to SC3, 3809 trips to SC4 |

Additional Required Work (70 points)

WSDOT wishes to know the impact of closing the westbound lanes of the SR 520 bridge for a 24-hour period on a weekday (this is quite likely for inspection after a storm). Estimate the impact of this proposed lane closure on morning peak hour traffic to include:

- 1. The increase in travel time on I-90 and SR 522 (Lake City Way) due to the bridge closure.
- 2. The resulting level of service (LOS) on the I-90 bridge (westbound direction multipurpose lanes only, not express lanes) as a result of the SR 520 bridge closure.
- 3. The travel time savings that can be realized for the remaining two routes (SR 522 and I-90) by using a system optimal route choice solution instead of a user equilibrium route choice solution.

Information available to you from past consultant reports follows.

Report #1 Summary

There are 3 primary routes from the east side to downtown Seattle. 15,000 Kirkland and Bellevue area households generate 81% of all trips on these 3 primary routes. Remaining trips are generated by other households not in the immediate vicinity of the Lake.

The three primary routes are:

| Route Name | Route Description |
|------------|---|
| SR 520 | South on I-405, west on SR 520, then south on I-5 |
| SR 522 | North on I-405 (if necessary), southwest on SR 522, then south on I-5 |
| I-90 | South on I-405, west on I-90, the north on I-5 |

Report #2 Summary

Estimates a Poisson regression model for trip generation and a logit model for mode choice for these same 15,000 households during the morning peak hour. This study concluded that each of the 15,000 households could be placed in one of four profile categories (this is a bit of a simplification, but necessary to limit busywork). Each profile category is associated with a specific set of variables for each model as listed in the "Trip Generation Poisson Regression Model" and "Mode Choice Logit Model" tables on the following pages.

Report #3 Summary

Surveyed the east side and found that a carpool accommodates 2.2 person-trips on the average, and a bus accommodates 50 person-trips on the average.

Report #4 Summary

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Estimates the highway performance functions (HPFs) for the SR 520, SR 522 and I-90 routes as:

$$t_{520} = 12 + 2.154x_{520}$$

$$t_{522} = 20 + 3.211x_{522}$$

$$t_{90} = 15 + 1.223x_{90}$$

The "t" values are in minutes and the "x" values are in thousands of vehicles per hour.

Trip Generation Poisson Regression Model

| | | Profile 1 | Profile 2 | Profile 3 | Profile 4 |
|--|-------------|---------------------|---------------------|------------------|---------------------|
| Number of Households in the profile | | 5,000 | 3,000 | 6,000 | 1,000 |
| Model Parameters | | | | | |
| Variable | Coefficient | Profile 1 values | Profile 2 values | Profile 3 values | Profile 4 values |
| Constant | -0.2 | 1 | 1 | 1 | 1 |
| Education (undergraduate degree or higher) | 0.08 | 0 | 1 | 1 | 1 |
| Income | 0.000012 | 55,000 | 40,000 | 75,000 | 62,000 |
| Whether or not household uses car to work more than three times a week | 0.065 | 1 | 0 | 1 | 1 |
| Whether or not household uses the bus to work at least once a week | -0.12 | 0 | 0 | 0 | 1 |
| Number of autos owned in the last ten years | 0.06 | 1 | 3 | 4 | 2 |
| Number of non-workers | -1 | 1 | 2 | 1.5 | 0 |
| Senior household (age>60 for all members) | -1 | 0 | 1 | 0 | 0 |
| Internet connection at home | -0.1 | 1 | 0 | 1 | 0 |
| Number of kids | 0.15 | 0 | 0 | 1.5 | 0 |

Mode Choice Logit Model

| Variable | Coefficient | Profile 1 values | Profile 2 values | Profile 3 values | Profile 4 values |
|---|-------------|---------------------|---------------------|---------------------|---------------------|
| Car logit equation | | | | | |
| Constant | 0.1 | 1 | 1 | 1 | 1 |
| Car Accessibility/Availability (High) | 0.15 | 0 | 1 | 1 | 0 |
| Peak Hour Destination Parking in dollars per hour | -0.025 | 2 | 1 | 3 | 4 |
| Travel Time Cost for Car (1 if High) | -0.05 | 0 | 0 | 1 | 1 |
| Income | 0.025 | 55 | 40 | 75 | 62 |
| Master's Degree or Higher | -0.025 | 0 | 0 | 1 | 1 |
| Kids | 0.2 | 0 | 0 | 1.5 | 0 |
| Carpool logit equation | | | | | |
| Constant | 0.05 | 1 | 1 | 1 | 1 |
| Carpool Accessibility/Availability (High) | 0.15 | 0 | 1 | 0 | 1 |
| Peak Hour Destination Parking Waive for Carpool | 0.3 | 0 | 1 | 1 | 1 |
| Travel Time Cost for Carpool (1 if High) | -0.1 | 0 | 0 | 1 | 0 |
| Income | -0.01 | 55 | 40 | 75 | 62 |
| Master's Degree or Higher | 0.2 | 0 | 0 | 1 | 1 |
| Kids | -0.1 | 0 | 0 | 1.5 | 0 |
| Bus logit equation | | | | | |
| Bus Accessibility/Availability (High) | 0.3 | 0 | 1 | 1 | 1 |
| Travel Time Cost for Bus (1 if High) | -0.15 | 1 | 1 | 1 | 0 |

Hints and Recommendations

Your report will require work in several parts. For each part, clearly state your assumptions as part of your answer. Show your work (e.g., calculations, spreadsheets, etc.).

Part 1

Using the Poisson regression model, find the total number of household trips for the 15,000 subject households during the morning peak hour. Knowing that these trips make up 81% of all trips, you should be able to estimate the total number of trips.

Part 2

Using the logit model, determine the mode split of these trips between buses, cars and carpools.

Part 3

Using this mode split and the estimated person-trips per vehicle from report #3, you can determine the <u>total vehicle generation</u> during the morning peak hour.

Part 4

Knowing the total vehicle generation during the morning peak hour you can assign the vehicles to the three routes using user equilibrium or system optimal route choice. You must decide which assignment is most appropriate and then justify your choice. You can then do the same thing again using only the SR 522 and I-90 routes.

Part 5

To determine the LOS on I-90 you will need to determine bridge characteristics. Keep in mind which direction the express lanes are traveling during the morning peak hour and who is allowed on these lanes (carpools and buses only). You need to make assumptions about where the carpools will be on I-90 (in the HOV express lanes or in the general purpose lanes). Please do not actually go out on the bridge and measure things like lane width. You may estimate these items from online resources at WSDOT's transportation data office Web page (http://www.wsdot.wa.gov/mapsdata/tdo). Items of specific interest are:

- Viewing the roadway: SRWeb (<u>http://www.wsdot.wa.gov/mapsdata/tdo/srweb.htm</u>)
- Percent trucks: Annual Traffic Report (http://www.wsdot.wa.gov/mapsdata/tdo/annualtrafficreport.htm)