# Appendix K: LCOG Trip-Based Travel Demand Model Methodology Report

# LCOG "Kate" v1.0 Trip-Based Travel Demand Model
# Methodology Report

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# 2020 Kate v1.0 Trip-Based Demand Model

This document summarizes the technical specifications for the travel demand model used in the central Lane County area. It includes descriptions of the model structure, model application, the variables employed in model equations and their coefficients.

The model, which uses the person trip as the unit of analysis, was originally developed by Metro for use in the Portland-Vancouver metropolitan area and subsequently modified and transferred to the Lane Council of Governments (LCOG) to be applied in the region consisting of the Eugene-Springfield metropolitan area and Coburg.

The underlying model is regularly updated to incorporate new data and research findings. Since the last report in 2015, a number of model enhancements have been implemented. When compared to the previous trip-baed model used by LCOG, the Kate model offers the following methodological advances:

- All major model components have been re-estimated using data collected in the 2011 Oregon Household Activity Survey (OHAS), Portland/Vancouver and Eugene area samples.
- The auto and transit access network has been substantially revised. Centroid connector distances are a function of TAZ size, which both improves representation of vehicle-miles driven on local streets and results in median transit walk distances that are consistent with those observed in OHAS. Intra-zonal distances are also a function of zone size and connector lengths rather than the older “nearest neighbor” method.
- TAZ transit coverage factors have been eliminated, and walk access to transit has been added to all non-freeway links. Where previous transit access + egress distances were limited by connector lengths (typically a total of 0.26 miles), walk access + egress is now capped at one mile, and a new transit mode choice variable discourages trips where out-of-vehicle time exceeds in-vehicle time.
- Walk distance (Wdist) is calculated using the transit access network, which includes pedestrian-only facilities.
- Destination choice logsums now include both travel time and travel cost variables, as well as alternative-specific constants for the available modes to each destination zone.

Features of former models that have been rendered unnecessary by these enhancements include:

- The share of trips by transit from a given TAZ was restricted by transit coverage factors
- Each transit boarding node required a centroid connector. Most transit trips boarded the nearest route, even if walking a few blocks to a more direct route would eliminate a transfer or result in less travel time.

An outline of the document structure is provided below. Most of the document describes the modeling of internal person trips. The flow chart shown in Appendix A gives a visual description of the logic contained in sections B through G.

- Section A describes the base input data used in all stages of model specification.
- Section B describes pre-generation—the development of household characteristics by TAZ.
- Section C describes the trip generation models for internal person trips by trip purpose.
- Section D describes the multimodal accessibility functions used in the mode choice model.
- Section E describes the destination choice model for internal person trips.
- Section F describes the mode choice model.
- Section G describes the time of day (peaking) factors.

# A Input Data

The Kate model requires a variety of input data.

## A.1 Land Use and Access Measurement Data

### A.1.a Socioeconomic and Land Use Data

The socioeconomic and land use data used in Metro's modeling process are listed below:

- H.I.A. – Sixty-four categories of households are formed when the following characteristics are cross-classified:
  - Household size by four groups (1, 2, 3, 4+)
  - Income class by four groups (< $25K, $25-$50K, $50-$100K, > $100K), 2010 dollars
  - Age of household head by four groups (25<, 25-54,55-64, >65)
- Employment categories
  - Agriculture, Mining, and Forestry
  - Arts, Entertainment, and Recreation
  - Construction
  - Education
  - Food Services and Drinking Places
  - Government
  - Health and Social Services
  - Manufacturing (except high-tech)
  - Manufacturing – High Tech
  - Other Services
  - Professional and Business Services
  - Retail and Consumer Services
  - Transportation, Warehousing, and Utilities
  - Wholesale Trade
- Number of local intersections

### A.1.b Accessibility Measure Calculation

The following base accessibility variables are computed for use in the model:

- Number of employees within 30 minutes of transit travel time (includes walk and wait time)
- Households within ½ mile of each zone
- Retail employment within ½ mile of each zone
- Total employment within ½ mile of each zone
- Number of local intersections within ½ mile of each zone

Composite accessibility measures (commonly referred to as "mix" variables) are then developed to account for both the relative magnitudes of and the interactions between three urban design variables known to affect travel behavior. This has an added benefit of eliminating the collinearity problem associated with using these variables individually:

- Household density
- Employment density
- Intersection density (a measure of street connectivity)

Two accessibility variables are computed: one uses retail employment density (MixRet) and the other uses total employment density (MixTot). The household and employment values are normalized to intersection units using geometric means. The natural log is used to transform the variables' units for compatibility with other variables in the auto ownership, multimodal accessibility, and mode choice models. Here is the equation form:

```
Mix  =   Ln ((int*(emp*(int.mean / emp.mean)) * (hh*(int.mean / hh.mean))) /
         (int + (emp*(int.mean / emp.mean)) + (hh*(int.mean / hh.mean))))
```

where:

- int = Number of local intersections within ½ mile of each zone
- emp = Retail OR Total employment within ½ mile of each zone
- hh = Households within ½ mile of each zone
- int.mean = Mean int value across all zones
- emp.mean = Mean emp value across all zones
- hh.mean = Mean hh value across all zones

## A.2 Travel Time Data

Travel time is an important variable in the destination choice and mode choice models.

Door-to-door travel time is used for the model estimation, and zone-to-zone travel time is used for the calibration. Travel time data in this section refer to zone-to-zone travel time.

For all modes but bike and walk, two sets of weekday travel time matrices are developed:

- Peak: A.M. 2-hour peak (07:00-08:59)
- Off-Peak: Mid-day 1-hour (12:00-12:59)

Household survey data are used to estimate the percentage of peak vs. off-peak travel for each trip purpose (except school). These factors determine which proportion of trips experience peak vs. off-peak travel times in the multimodal accessibility functions and mode choice models:

**TABLE 1. Peak Factors Applied to Skims in Mode Choice Models**

| Trip Purpose | | Peak Skims | Off-Peak Skims |
|---|---|---|---|
| HBW | Home-Based Work | 0.5482 | 0.4518 |
| HBshop | Home-Based Shopping | 0.3017 | 0.6983 |
| HBrec | Home-Based Recreation | 0.3796 | 0.6204 |
| HBoth | Home-Based Other | 0.3985 | 0.6015 |
| NHBW | Non-Home-Based Work | 0.4452 | 0.5548 |
| NHBNW | Non-Home-Based Non-Work | 0.3731 | 0.6269 |
| HBcoll | Home-Based College | 0.4892 | 0.5108 |

### A.2.a Auto Skims

Auto skims are saved from assignments run within the Emme software package using its proprietary SOLA algorithm. These equilibrium assignments use volume-delay functions in calculating congested times based on link length, capacity, and free-flow speed. Autos and freight trucks are assigned simultaneously, with trucks represented as passenger car equivalents (PCEs) to account for the additional road space that they consume as well as being subjected to parameters in the path choice algorithm that cause them to prioritize higher order facilities

### A.2.b Transit Skims

Transit assignments follow the auto assignments, with transit speed determined as a function of the underlying auto speed except where transit vehicles operate on exclusive right-of-way. The transit pathfinding algorithm considers auxiliary (walk) time, wait time (initial and transfer), boarding time, and in-vehicle time. Wait times at certain nodes and in-vehicle times on certain line segments are reduced by applying factors designed to account for perceptions of time that vary by stop and vehicle characteristics.

Wait times are calculated as 50% of line headway, with composite times considered where multiple lines are available. Timed transfer locations receive no special consideration. In order to maximize consistency with the mode choice model, walk times in the transit assignments are weighted by a factor of 2.42, which is the time equivalent of the HBW mode choice coefficient on auxiliary time. Similarly, boarding time is calculated as the time equivalent of the HBW mode choice coefficient on the number of transfers, with the resulting value of 3.86 minutes applied universally.

The transit assignment algorithm is multi-path and allocates trips among eligible paths by (1) distributing flow between multiple outgoing centroid connectors using an embedded logit model based on total transit time to the destination; and (2) distributing flow between multiple lines at a stop node by considering frequency and total transit time to destination.

The peak and off-peak transit skims saved from these assignments account for differences in levels of transit service and network congestion. The following matrices are developed for each time period:

- In-vehicle time by transit sub-mode (bus, BRT)
- Walk time (access + transfer + egress)
- First wait time
- Transfer wait time
- Number of transfer boardings

Initial wait time and total accumulated transfer wait time each have a maximum value of 30 minutes, meaning that any higher value in these skim matrices will be set to 30 minutes. In addition, transit is considered to be unavailable for trips between zone pairs where more than one mile total walking distance is required.

## A.3 Trip Cost Data

Travel cost is an input to the mode choice model. All cost values are in 2010 dollars.

### A.3.a Auto Operating Cost

Auto operating cost varies by mode:

- Drive Alone = ($0.1774 / mile*distance) + (½ of parking charge in attraction zone)
- Shared Ride Driver = [($0.1774 / mile*distance) + (½ of parking charge in attraction zone)] * .667
- Shared Ride Passenger = [($0.1774 / mile*distance) + (½ of parking charge in attraction zone)] * .333
- Park and Ride = $0.1774 / mile*distance (between production zone and lot)

### A.3.b Parking Charges

The parking charge used as an input to auto cost varies by trip purpose:

- Home-based work (HBW) and home-based college (HBcoll) use long-term parking charge.
- Other trip purposes use short-term parking charge (½ of long-term parking charge).

### A.3.c Transit Fare

Transit fares used in the model are calculated as averages weighted by LTD cash and non-cash fares, and vary by attraction zone based on the number of employees in each TAZ that have a group pass. In addition, the transit fares assumed for home-based college (HBcoll) trips account for the fact that University of Oregon and Lane Community College students receive transit passes that enable them to travel throughout the transit system for free.

## A.4 Transportation Service Inputs

Various transportation service inputs are applied at different stages in the model:

- Transit routes with average frequencies for the AM peak, PM peak, and midday off-peak periods
- Park-and-ride lot locations and capacities
- Zone-to-zone generalized costs from dedicated bicycle network

# B Pre-Generation

Several models must be run before starting the travel demand process. This stage is called pre-generation and includes the worker model, the auto ownership model, and the children model.

These models were estimated using a multinomial logit procedure. The listed utilities are converted into probabilities to determine the number of workers, cars, and children in each TAZ. The following example probability is used for zero-worker households:

$$Prob_{0\text{-worker HH}} = U_{0\text{-workerHH}} \,/\, ( U_{0\text{-workerHH}} + U_{1\text{-workerHH}} + U_{2\text{-workerHH}} + U_{3\text{-workerHH}} )$$

The parameters used in the pre-generation models are unchanged from the Portland Metro implementation.

## B.1 Worker Model

The worker model estimates the number of households with 0, 1, 2, and 3 or more workers.

### B.1.a Variable Definitions

| | | |
|---|---|---|
| HHsize | = | 1 person, 2 person, 3 person, 4+ person |
| Workercl | = | 0 worker, 1 worker, 2 worker, 3+ worker |
| Income1 | = | 1 if 2010 household income < $25,000 |
| Income2 | = | 1 if 2010 household income >= $25,000 and < $50,000 |
| Income3 | = | 1 if 2010 household income >= $50,000 and < $100,000 |
| Income4 | = | 1 if 2010 household income >= $100,000 |
| Agecat1 | = | 1 if age of household head 18-24 |
| Agecat2 | = | 1 if age of household head 25-54 |
| Agecat3 | = | 1 if age of household head 55-64 |
| Agecat4 | = | 1 if age of household head >=65 |

### B.1.b Calibrated Choice Utilities

Constants may differ from the original estimation due to the calibration process. These coefficients are the same as in the calibration code.

***0 worker households***

U = **exp (** 7.9 – 2.1436*HHsize + 6.1394*Income1 + 3.0767*Income2 + 0.9966*Income3 – 6.4436*Agecat1 – 3.7234*Agecat2 – 3.4183*Agecat3 **)**

***1 worker households***

U = **exp (** 6.99 – 1.8731*HHsize + 3.7194*Income1 + 2.2650*Income2 + 0.7563*Income3 – 2.9635*Agecat1 – 0.4402*Agecat2 – 1.3386*Agecat3 **)**

***2 worker households***

U = **exp (** 5.315 – 1.2747*HHsize + 1.2257*Income1 + 0.7633*Income2 + 0.2345*Income3 – 0.7721*Agecat1 + 0.6739*Agecat2 – 0.4320*Agecat3 **)**

***3+ worker households***

U = **exp (** 0 **)**

### B.1.c Estimated Variable Coefficients

**TABLE 2. Worker Model**

| Variable | 0 worker | | 1 worker | | 2 worker | |
|---|---|---|---|---|---|---|
| | Coefficient | Z-Statistic | Coefficient | Z-Statistic | Coefficient | Z-Statistic |
| Calib Constant | 7.9 | | 6.99 | | 5.315 | |
| Constant | 8.1802 | 43.3 | 7.2623 | 40.1 | 5.3724 | 29.6 |
| HHsize | -2.1436 | -50.8 | -1.8731 | -48.1 | -1.2747 | -34.1 |
| Income1 | 6.1394 | 30.4 | 3.7194 | 19.1 | 1.2257 | 6.2 |
| Income2 | 3.0767 | 28.8 | 2.2650 | 24.3 | 0.7633 | 8.3 |
| Income3 | 0.9966 | 12.9 | 0.7563 | 13.3 | 0.2345 | 4.4 |
| Agecat1 | -6.4436 | -32.1 | -2.9365 | -16.1 | -0.7721 | -4.1 |
| Agecat2 | -3.7234 | -27.7 | -0.4402 | -3.4 | 0.6739 | 5.1 |
| Agecat3 | -3.4183 | -24.3 | -1.3386 | -9.7 | -0.4320 | -3.1 |

The worker model was estimated from 2012_5yr PUMS for the 4-county Portland Metro region. The 3+ worker choice utility is held constant at zero. Income4 and Agecat4 are the reference categories for Income and Agecat.

## B.2 Auto Ownership Model

Auto ownership is an important input to the mode choice models.

The model estimation dataset includes all (OHAS) surveyed households that reported income and whose locations could be geocoded.

### B.2.a Variable Definitions

Hhsize1 = 1 person
Hhsize2 = 2 person
Hhsize3 = 3 person
Hhsize4 = 4+ person
Worker0 = 0 worker
Worker1 = 1 worker
Worker2 = 2 worker
Worker3 = 3+ worker
Income = 1 if 2010 household income < $25,000
= 2 if 2010 household income >= $25,000 and < $50,000
= 3 if 2010 household income >= $50,000 and < $100,500
= 4 if 2010 household income >= $100,000
SFPC = Percentage of TAZ dwellings that are single-family detached units
logMIXTHM = LN (Total employment accessibility within ½ mile + 1) (see Section A.1.b)
Tot30Tk = (Total employment within 30 minutes by mid-day transit) /1000

### B.2.b Calibrated Choice Utilities

***0 car households***

U = **exp (** -3.0278 + 4.9228*h1w0 + 3.8632*h1w1 + 1.6074*h2w0 + 0.9721*h2w1 + 0.7961*h2w2 + 2.6325*h3w0 + 0.75*h3w1 + 0.4637*h3w2 + h4w0 + 0.5*h4w1 + 0.25*h4w2 – 1.6745*income – 2.0721*sfpc + 0.0169*Tot30Tk + 0.4233*logMIXTHM **)**

***1 car households***

U = **exp (** -1.4954 + 6.3568*h1w0 + 5.9245*h1w1 + 4.0594*h2w0 + 3.4905*h2w1 + 2.9585*h2w2 + 3.4712*h3w0 + 3.5113*h3w1 + 2.6011*h3w2 + 2.6011*h3w3 + 2.8079*h4w0 + 3.2346*h4w1 + 2.8861*h4w2 – 0.8833*income – 1.5633*sfpc + 0.0102*Tot30Tk + 0.2223*logMIXTHM **)**

***2 car households***

U = **exp (** -1.8268 + 2.7548*h1w0 + 2.3944*h1w1 + 2.5439*h2w0 + 2.0346*h2w1 + 1.8537*h2w2 + 2.0169*h3w0 + 1.7867*h3w1 + 1.5335*h3w2 + 0.7326*h3w3 + 1.2802*h4w0 + 2.2461*h4w1 + 2.0506*h4w2 – 0.1749*income + 0.0038*Tot30Tk + 0.1544*logMIXTHM **)**

***3+ car households***

U = **exp (** 0 **)**

### B.2.c Estimated Variable Coefficients

**TABLE 3. Auto Ownership Model**

| **Variable** | **0 car** | | **1 car** | | **2 car** | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | -3.0278 | | -1.4954 | | -1.8268 | |
| Constant | -1.3028 | -1.63 | -1.4954 | -1.82 | -1.8268 | -3.87 |
| HHsize1:Wkr0 | 4.9228 | 9.00 | 6.3568 | 8.36 | 2.7548 | 6.95 |
| HHsize1:Wkr1 | 3.8632 | 7.17 | 5.9245 | 7.96 | 2.3944 | 6.94 |
| HHsize2:Wkr0 | 1.6074 | 2.85 | 4.0594 | 5.58 | 2.5439 | 8.65 |
| HHsize2:Wkr1 | 0.9721 | 1.75 | 3.4905 | 4.82 | 2.0346 | 7.25 |
| HHsize2:Wkr2 | 0.7961 | 1.28 | 2.9585 | 4.08 | 1.8537 | 6.80 |
| HHsize3:Wkr0 | 2.6325 | 3.58 | 3.4712 | 4.35 | 2.0169 | 4.84 |
| HHsize3:Wkr1 | 0.7500 | *fixed* | 3.5113 | 4.49 | 1.7867 | 5.28 |
| HHsize3:Wkr2 | 0.4637 | 0.96 | 2.6011 | 3.48 | 1.5335 | 5.38 |
| HHsize3:Wkr3 | -- | na | 2.6011 | 3.48 | 0.7326 | 1.93 |
| HHsize4:Wkr0 | 1.0000 | *fixed* | 2.8079 | 3.30 | 1.2802 | 2.16 |
| HHsize4:Wkr1 | 0.5000 | *fixed* | 3.2346 | 4.34 | 2.2461 | 7.33 |
| HHsize4:Wkr2 | 0.2500 | *fixed* | 2.8861 | 3.90 | 2.0506 | 7.39 |
| Income | -1.6745 | -12.72 | -0.8833 | -10.36 | -0.1749 | -2.50 |
| SFPC | -2.0721 | -5.23 | -1.5633 | -6.06 | -- | na |
| Tot30Tk | 0.0169 | 7.24 | 0.0102 | 5.52 | 0.0038 | 2.39 |
| logMIXTHM | 0.4233 | 5.13 | 0.2223 | 5.34 | 0.1544 | 4.64 |

The 3+ car choice utility is held constant at zero. HHSize4:Wkr3 is the reference category for Size x Wkr.

While the Worker and Children models use only HIA demographic inuts, Auto Ownership is influenced by changes in land use and transit service.

## B.3 Children Model

The school trip purpose requires the calculation of the number of households with 0, 1, 2, or 3+ children.

### B.3.a Variable Definitions

HHsize = 1 person, 2 person, 3 person, 4+ person
Age4 = 1 if age of household head 18-24
= 2 if age of household head 25-54
= 3 if age of household head 55-64
= 4 if age of household head >=65

### B.3.b Calibrated Choice Utilities

This model was not changed in calibration.

***0 child households***

U = **exp (** -4.069012*HHsize + 6.922379*Age4 **)**

***1 child households***

U = **exp (** -2.425297*HHsize + 4.598579 *Age4 **)**

***2 child households***

U = **exp (** -0.6128247*HHsize + 1.639239*Age4 **)**

***3+ child households***

U = **exp (** 0 **)**

### B.3.c Estimated Variable Coefficients

**TABLE 4. Children Model**

| Variable | 0 child | | 1 child | | 2 child | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| HHsize | -4.069012 | -24.3 | -2.425297 | -15.5 | -0.6128247 | -4.0 |
| Agecat4 | 6.922379 | 22.8 | 4.598579 | 15.5 | 1.639239 | 5.5 |

The 3+ child choice utility is held constant at zero.

# C Trip Generation

Average weekday person trips are generated for eight trip purposes:

- HBW – Home-Based Work
- HBshop – Home-Based Shopping
- HBrec – Home-Based Recreation
- HBoth – Home-Based Other (excludes school and college)
- NHBW – Non-Home-Based Work
- NHBNW – Non-Home-Based Non-Work
- HBcoll – Home-Based College
- HBsch – Home-Based School

For each zone, the number of households in each demographic category is multiplied by a production rate. The number of trips is then factored up to match regional control totals by applying a calibration factor which varies by purpose. The demographic categories, production rates, and calibration factors are described by purpose in the following subsections.

Most home-based trips are generated by production zone in the two steps described above, then they are attached to an attraction zone within the destination choice models. Non-home-based trips add an extra step within generation: the allocation of trip productions to zones according to the non-home TAZs where they actually occur. NHBW trip productions are allocated to workplace TAZ's, while NHBNW trip productons are allocated to place of trip origin. Finally, school and college generation models incorporate trip attraction, whereas the other purposes address attraction through the destination choice models.

The parameters used in the generation models are unchanged from the Portland Metro implementation.

## C.1 HBW (Home-Based Work)

### C.1.a Productions

HBW trips are produced solely by the number of workers in a household:

- Input Variable: Number of workers
- Output: Person trips (all modes), by zone of production (home)

**TABLE 5. HBW Production Rates**

| Workers | Rate |
|---|---|
| **1** | 1.386047 |
| **2** | 2.462282 |
| **3+** | 3.578358 |

### C.1.b Attractions

HBW trip attractions are estimated by the following procedure:

- A regional average trip rate per employee is generated by dividing the sum of HBW productions by total employees.
- Trip attractions are generated by multiplying the average trip rate by the total employment in each TAZ.

### C.1.c Scaling

Final HBW trips are generated by the following procedure:

- Total employment (multiplied by a calibration factor of 1.36) is divided by total productions to produce a production factor.
- Final HBW trips are calculated by multiplying the number of productions in each TAZ by the production factor.

## C.2 HBshop (Home-Based Shopping)

HBshop productions are generated by a cross-classification model:

- Input Variables: Household size, Number of workers
- Output: Person trips (all modes), by zone of production (home)

**TABLE 6. HBshop Production Rates**

| | **Workers** | | | |
|---|---|---|---|---|
| **HHsize** | **0** | **1** | **2** | **3+** |
| **1** | 0.5889655 | 0.3597194 | | |
| **2** | 1.02852 | 0.7578216 | 0.6313181 | |
| **3** | 1.371429 | 1.121711 | 0.9657534 | 0.8703704 |
| **4+** | 1.847826 | 1.260241 | 0.9130435 | 1.14375 |

The resulting trips are multiplied by a calibration factor of 1.025.

## C.3 HBrec (Home-Based Recreation)

HBrec productions are generated by a cross-classification model:

- Input Variable: Household size by worker status
- Output: Person trips (all modes), by zone of production (home)

**TABLE 7. HBrec Production Rates**

| **HHsize** | **all household members work** | **some household members do not work** |
|---|---|---|
| **1** | 0.1783567 | 0.2772414 |
| **2** | 0.4122894 | 0.5582865 |
| **3** | 0.5462963 | 0.7933884 |
| **4+** | | 1.43126 |

The resulting trips are multiplied by a calibration factor of 1.025.

## C.4 HBoth (Home-Based Other)

HBoth productions are generated by a cross-classification model:

- Input Variable: Household size by worker status
- Output: Person trips (all modes), by zone of production (home)

**TABLE 8. HBoth Production Rates**

| HHsize | all household members work | some household members do not work |
|---|---|---|
| **1** | 0.6723447 | 1.187586 |
| **2** | 1.421209 | 2.076545 |
| **3** | 1.916667 | 2.613932 |
| **4+** | | 4.027823 |

The resulting trips are multiplied by a calibration factor of 1.025.

## C.5 NHBW (Non-Home-Based Work)

Production of non-home-based trips in trip-based models takes place in two steps. First, household trip generation rates are used to determine how many trips are produced regionally. Then, those productions are spatially allocated to where they actually originate. A set of TAZ allocation weights were estimated using transposed destination choice (i.e., "origin choice") models with TAZ size variables only.

### C.5.a Production Totals

Total NHBW productions are initially generated solely by number of workers in the household:

- Input Variable: Number of workers
- Output: Person trips (all modes), regional control totals

**TABLE 9. NHBW Household Production Rates**

| Workers | Rate |
|---|---|
| **0** | 0.107864 |
| **1** | 0.835659 |
| **2** | 1.723404 |
| **3+** | 2.33209 |

The resulting trips are multiplied by a calibration factor of 1.025.

### C.5.b Production Spatial Allocation

NHBW Productions are allocated to TAZs using the following production allocation weights shown in Table 10. Total regional productions are scaled to control totals obtained from household productions above. See Section E.1.b for a description of employment sectors used here and in the Destination Choice models.

**TABLE 10. NHBW Production Allocation Weights**

| TAZ Variable | Coefficient | T-Statistic |
|---|---|---|
| Agrfrm | 1.0000 | *fixed* |
| Areart | 0.3906 | 2.78 |
| Constr | 4.2207 | 5.69 |
| Educat | 2.7456 | 6.17 |
| FoodSv | 1.0000 | *fixed* |
| Govmnt | 4.0960 | 8.45 |
| Health | 1.5311 | 2.20 |
| MHitec | 1.7315 | 2.58 |
| Mfacrt | 1.7315 | 2.58 |
| Othser | 2.7732 | 3.07 |
| Probns | 2.0138 | 3.84 |
| Retcns | 1.0000 | *fixed* |
| Tranwu | 1.9232 | 2.08 |
| Wholes | 1.7315 | 2.58 |
| households | 0.4462 | -4.49 |

## C.6 NHBNW (Non-Home-Based Non-Work)

### C.6.a Pre-Production

NHBNW productions are initially estimated by a cross-classification model:

- Input Variables: Household size by worker status
- Output: Person trips (all modes), regional control totals

**TABLE 10. NHBNW Production Rates**

| HHsize | all household members work | some household members do not work |
|---|---|---|
| **1** | 0.511022 | 1.165517 |
| **2** | 0.9187314 | 1.651685 |
| **3** | 1.425926 | 1.956316 |
| **4+** | | 3.161211 |

The resulting trips are multiplied by a calibration factor of 1.025.

### C.6.b Production Spatial Allocation

NHBNW Productions are allocated to TAZs using the following production allocation weights shown in Table 12. Total regional productions are scaled to control totals obtained from household productions above. See Section E.1.b for a description of employment sectors used here and in the Destination Choice models.

**TABLE 12. NHBNW Production Allocation Weights**

| TAZ Variable | Coefficient | T-Statistic |
|---|---|---|
| Agrfrm | 0.0898 | -2.88 |
| Areart | 0.3694 | -4.21 |
| Constr | 0.0016 | -2.70 |
| Educat | 0.1845 | -15.56 |
| FoodSv | 0.2753 | -7.54 |
| Govmnt | 0.1653 | -12.26 |
| Health | 0.0926 | -14.28 |
| MHitec | 0.0016 | -2.70 |
| Mfacrt | 0.0016 | -2.70 |
| Othser | 1.0000 | *fixed* |
| Probns | 0.0498 | -12.01 |
| Retcns | 0.4971 | -7.96 |
| Tranwu | 0.0424 | -5.05 |
| Wholes | 0.0016 | -2.70 |

## C.7 HBcoll (Home-Based College)

### C.7.a Productions

HBcoll productions are generated by a cross-classification model:

- Input Variables: Household size, Age group (age of household head)
- Output: Person trips (all modes), by zone of production (home)

**TABLE 11. HBcoll Production Rates**

| | Age Group | | | |
|---|---|---|---|---|
| **Hhsize** | **<25** | **25-54** | **55-64** | **>65** |
| **1** | 0.5384615 | 0.0473684 | 0.0059761 | 0.007837 |
| **2** | 0.375 | 0.1138107 | 0.0289079 | 0.0183357 |
| **3** | 0.6666667 | 0.1226576 | 0.1610487 | 0.1413043 |
| **4+** | 0.8333333 | 0.1359852 | 0.468254 | 0.2758621 |

The resulting trips are multiplied by a calibration factor of 1.5

Note that HBColl productions apply to households only, since group quarters (e.g., dormitories, fraternities) were not surveyed.

## C.8 HBsch (Home-Based School)

HBsch productions are generated by a cross-classification model using the combined Portland-Vancouver-Salem-Eugene samples of the 2011 OHAS. HBSchool person-trips include both students and adult escorts for the home-to-school and school-to-home trip.

- Input Variables: Household size, Number of children
- Output: Person trips (all modes), by zone of production (home)

**TABLE 12. HBsch Production Rates**

| | Children | | | |
|---|---|---|---|---|
| **HHsize** | **0** | **1** | **2** | **3+** |
| **1** | -- | -- | -- | -- |
| **2** | -- | 1.978448 | -- | -- |
| **3** | -- | 1.84793 | 3.326389 | -- |
| **4+** | -- | 2.248879 | 3.441193 | 5.103783 |

## D Multimodal Accessibility Functions

Modal accessibility functions were estimated as an input to the destination choice and mode choice models. For each trip purpose, they measure the utility of choosing one of seven discrete modes.

**Drive alone** – only available to households with at least one car
**Drive with passenger** – only available to households with at least one car
**Auto passenger**
**Transit by walk access** – only available if total walk distance (access + transfer + egress) does not exceed one mile
**Transit by park-and-ride access** – only available if attraction zone has parking cost; only available for home-based non-school trips; utilities and lot usage for formal park-and-ride lots and informal park-and-ride locations are calculated by a nested park-and-ride lot choice model
**Bike** – utilities and distances are produced by a stand-alone tool based on a dedicated bicycle network
**Walk** – only available for trips with a distance less than five miles

The logsum of all modal utilities is a key input to the destination choice model (Section E). It is generated as follows for each trip purpose (and for some purposes, by income group):

$$\mathbf{Ln}\left( U_{\text{Drive Alone}} + U_{\text{Drive with Passenger}} + U_{\text{Auto Passenger}} + U_{\text{Walk to Transit}} + U_{\text{Park\&Ride}} + U_{\text{Bike}} + U_{\text{Walk}} \right)$$

The parameters used in the multimodal accessibility functions are unchanged from the Portland Metro implementation with the exception of the alternative-specific constants, which were re-estimated.

## D.1 Variables Used in Multimodal Accessibility Functions

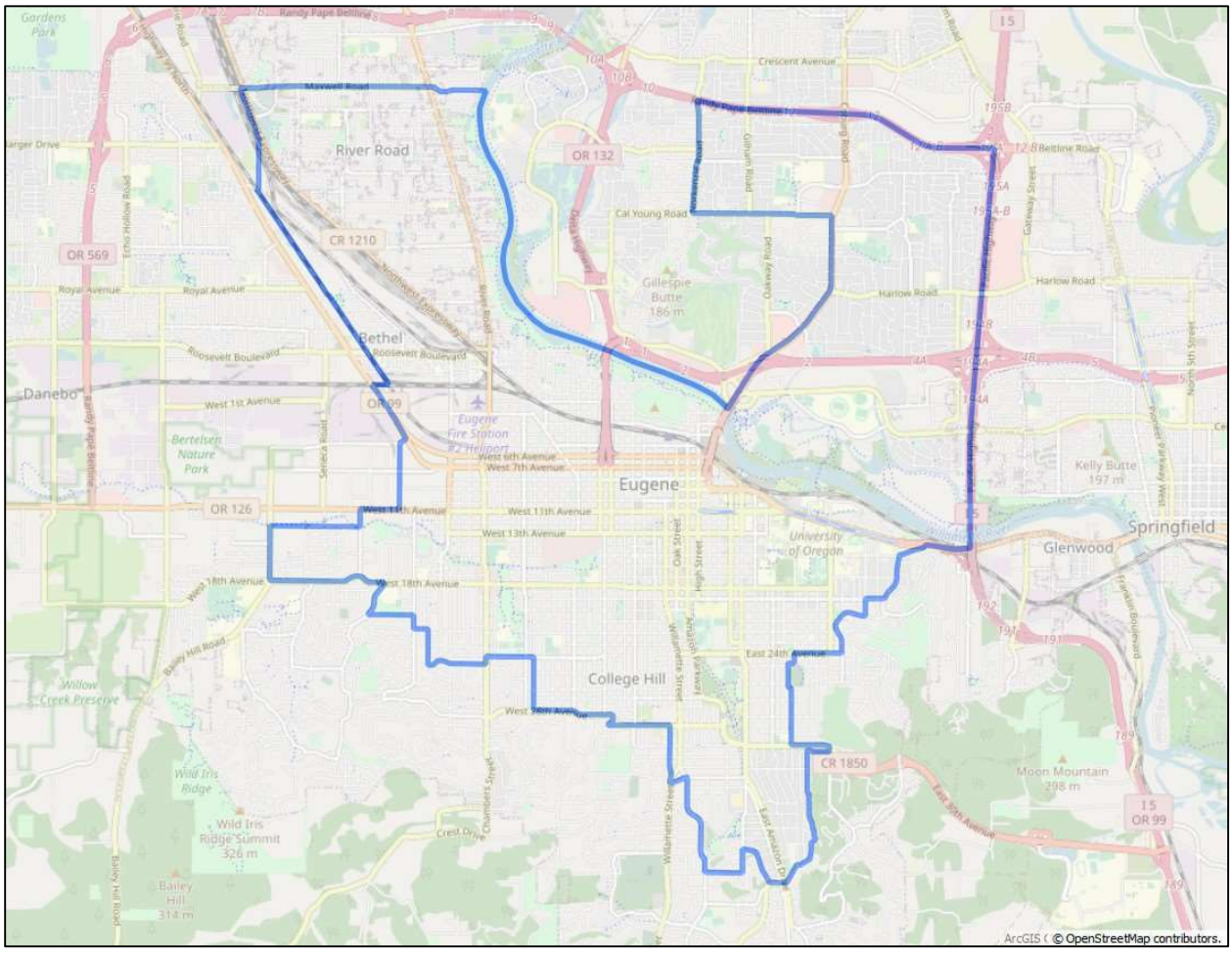
### D.1.a Variable Definitions

IvTime = In-vehicle travel time (minutes, varies by mode)
WalkTime = Walk time (minutes), by mode:
- Drive Alone: vehicle egress at trip end (5 min in CBD, 2 min elsewhere)
- Shared Ride: Drive Alone walk time plus 5 minutes
- Transit Modes: access to first stop plus egress from last stop at 3 mph
- Walk: zone-to-zone time via key walk-accessible links at 3 mph (for trips < 5 miles)

TranWait1 = Transit initial wait time (minutes)
TranWait2 = Transit transfer wait time (minutes)
TranModc = Transit mode constant (varies by transit path)
TranStypc = Transit stop type constant (varies by transit path)
TranXfrs = Transit # of transfers
TrOVIV = ratio of total out-of-vehicle time to in-vehicle time
Formal = 1 if considering formal park-and-ride lots
Informal = 1 if considering informal park-and-ride locations
Shadow = Park-and-ride lot shadow cost (calculated by lot choice model)
BikeDist = Bicycle trip distance (miles)
Cbutil = Bicycle commute route attractiveness
Nbutil = Bicycle non-commute route attractiveness
BikeResPref = 1 if production zone in bicycle user residential preference area (see Figure 1)
LowInc = 1 if household income <$25K (2010$)
MidInc = 1 if household income $25-100K (2010$)
HighInc = 1 if household income $100K+ (2010$)
OpCost = Out-of-pocket cost, by mode:
- Drive Alone: 100% of $0.1774 / mile (2010$)
- Drive with Passenger: 66.7% of $0.1774 / mile (2010$)
- Auto Passenger: 33.3% of $0.1774 / mile (2010$)
- Walk-access Transit: transit fare (2010$)
- Park-and-ride: $0.1774 / mile for auto leg, transit fare for transit leg

PkgCost = Parking cost, by mode:
- Drive Alone: 100% of long-term parking charge in attraction zone
- Drive with Passenger: 66.7% of long-term parking charge in attraction zone
- Auto Passenger: 33.3% of long-term parking charge in attraction zone

**FIGURE 1. Bicycle User Residential Preference Area**




## D.2 HBW (Home-Based Work)

### D.2.a Peak / Off-Peak Weights

HBW: 54.82% peak skims, 45.18% off-peak skims

### D.2.b Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0414*IvTime – 0.1*WalkTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost – 0.509*LowInc*PkgCost – 0.509*MidInc*PkgCost – 0.461*HighInc*PkgCost **)**

***Drive with Passenger***

U = **exp (** -3.57 – 0.0414*IvTime – 0.1*WalkTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost – 0.509*LowInc*PkgCost – 0.509*MidInc*PkgCost – 0.461*HighInc*PkgCost **)**

***Auto Passenger***

U = **exp (** -3.55 – 0.0414*IvTime – 0.1*WalkTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost – 0.509*LowInc*PkgCost – 0.509*MidInc*PkgCost – 0.461*HighInc*PkgCost **)**

***Transit by Walk Access***

U = **exp (** -1.07 + TranModc + TranStypc – 0.0414*IvTime – 0.0543*TranWait1 – 0.061*TranWait2 – 0.1*WalkTime – 0.16*TranXfrs – 0.4*TrIVOV – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost **)**

***Park and Ride***

Park and Ride uses older model specifications; only the mode-specific constant and informal constant were recalibrated in 2017. The coefficient on auto in-vehicle time is doubled in order to maintain a balance between auto and transit time that is comparable to the observed relationship; otherwise, too many trips include unreasonably high auto times as travelers choose to drive to the periphery of the CBD before boarding transit.

U = **exp (** 1.85 + 0.75***ln**(**exp**(Formal*0.5***ln**( $\sum_{1 \to N}$ [**exp**((U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) + **exp**(Informal*0.5***ln**( $\sum_{1 \to N}$ [**exp**((-4.5 + U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) **)**

where

U$_{AutoLeg}$ = -0.0414*2*IvTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost

and

U$_{TransitLeg}$ = -0.0414*IvTime – 0.0543*TranWait1 – 0.061*TranWait2 – 0.1*WalkTime – 0.16*TranXfrs – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost

and

*N* = number of formal park-and-ride lots or informal par-and-ride locations under consideration

***Bike***

U = **exp (** 0.294 – 0.469*BikeDist + 0.0274*Cbutil + 0.762*BikeResPref **)**

***Walk***

U = **exp (** -0.315 **–** 0.1*WalkTime **)**

### D.2.c Estimated Variable Coefficients

**TABLE 13. HBW Multimodal Accessibility Functions – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | | | *-3.57* | | *-3.55* | |
| IvTime | -0.0414 | *fixed* | -0.0414 | *fixed* | -0.0414 | *fixed* |
| WalkTime | -0.1 | *fixed* | -0.1 | *fixed* | -0.1 | *fixed* |
| LowIncOpCost | -0.309 | *fixed* | -0.309 | *fixed* | -0.309 | *fixed* |
| MidIncOpCost | -0.252 | *fixed* | -0.252 | *fixed* | -0.252 | *fixed* |
| HighIncOpCost | -0.252 | *fixed* | -0.252 | *fixed* | -0.252 | *fixed* |
| LowIncPkgCost | -0.509 | *fixed* | -0.509 | *fixed* | -0.509 | *fixed* |
| MidIncPkgCost | -0.509 | *fixed* | -0.509 | *fixed* | -0.509 | *fixed* |
| HighIncPkgCost | -0.461 | *fixed* | -0.461 | *fixed* | -0.461 | *fixed* |

**TABLE 14. HBW Multimodal Accessibility Functions – Transit Modes**

| Variable | Walk Access | | Park and Ride | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | -1.07 | -8.19 | 1.85 | *fixed* |
| Ivtime | -0.0414 | *fixed* | -0.0414 | *fixed* |
| Wait1 | -0.0543 | *fixed* | -0.0543 | *fixed* |
| Wait2 | -0.061 | *fixed* | -0.061 | *fixed* |
| WalkTime | -0.1 | *fixed* | -0.1 | *fixed* |
| Transfers | -0.16 | *fixed* | -0.16 | *fixed* |
| TrIVOV | -0.4 | *fixed* | | |
| LowIncOpCost | -0.309 | *fixed* | -0.309 | *fixed* |
| MidIncOpCost | -0.252 | *fixed* | -0.252 | *fixed* |
| HighIncOpCost | -0.252 | *fixed* | -0.252 | *fixed* |
| Nested Park & Ride Lot Choice Model | | | | |
| Informal Constant | | | -5.0 | |
| Park & Ride Nest | | | 0.75 | |
| Formal Nest | | | 0.5 | |
| Informal Nest | | | 0.5 | |

**TABLE 15. HBW Multimodal Accessibility Functions – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | 0.294 | 3.95 | -0.315 | -2.66 |
| BikeDist | -0.469 | *fixed* | | |
| Cbutil | 0.0274 | *fixed* | | |
| BikeResPref | 0.762 | *fixed* | | |
| WalkTime | | | -0.1 | *fixed* |

## D.3 HBshop, HBrec, HBoth (Other Home-Based)

### D.3.a Peak / Off-Peak Weights

HBshop: 30.17% peak skims, 69.83% off-peak skims
HBrec: 37.96% peak skims, 62.04% off-peak skims
HBoth: 39.85% peak skims, 60.15% off-peak skims

### D.3.b Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0315*IvTime – 0.125*WalkTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost – 0.731*LowInc*PkgCost – 0.393*MidInc*PkgCost – 0.393*HighInc*PkgCost **)**

***Drive with Passenger***

U = **exp (** -1.4*Shop – 1.12*Rec – 1.11*Oth -0.0315*IvTime – 0.125*WalkTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost – 0.731*LowInc*PkgCost – 0.393*MidInc*PkgCost – 0.393*HighInc*PkgCost **)**

***Auto Passenger***

U = **exp (** -1.83*Shop – 1.48*Rec – 1.58*Oth -0.0315*IvTime – 0.125*WalkTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost – 0.731*LowInc*PkgCost – 0.393*MidInc*PkgCost – 0.393*HighInc*PkgCost **)**

***Transit by Walk Access***

U = **exp (** -0.0991*Shop – 0.634*Rec – 0.693*Oth + TranModc + TranStypc – 0.0315*IvTime – 0.05*TranWait1 – 0.05*TranWait2 – 0.125*WalkTime – 0.16*TranXfrs – 1*TrIVOV – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost **)**

***Park and Ride***

Park and Ride uses older model specifications; only the mode-specific constant and informal constant were recalibrated in 2017. The coefficient on auto in-vehicle time is doubled in order to maintain a balance between auto and transit time that is comparable to the observed relationship; otherwise, too many trips include unreasonably high auto times as travelers choose to drive to the periphery of the CBD before boarding transit.

U = **exp (** -3.1*Shop – 2*Rec – 2.2*Oth + 0.75***ln**(**exp**(Formal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) + **exp**(Informal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((-4 + U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) **)**

where

U$_{AutoLeg}$ = -0.0315*2*IvTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost

and

U$_{TransitLeg}$ = -0.0315*IvTime – 0.05*TranWait1 – 0.05*TranWait2 – 0.125*WalkTime – 0.16*TranXfrs – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost

and

*N* = number of formal park-and-ride lots or informal par-and-ride locations under consideration

***Bike***

U = **exp (** 1.53*Shop + 1.11*Rec + 1.32*Oth – 0.223*BikeDist + 0.126*Nbutil + 0.929*BikeResPref **)**

***Walk***

U = **exp (** -0.392*Shop + 0.306*Rec – 0.471*Oth – 0.125*WalkTime **)**

### D.3.c Estimated Variable Coefficients

**TABLE 16. HBshop, HBrec, HBoth Multimodal Accessibility Functions – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Shop Constant | | | -1.4 | | -1.83 | |
| Rec Constant | | | -1.12 | | -1.48 | |
| Oth Constant | | | -1.11 | | -1.58 | |
| IvTime | -0.0315 | *fixed* | -0.0315 | *fixed* | -0.0315 | *fixed* |
| WalkTime | -0.125 | *fixed* | -0.125 | *fixed* | -0.125 | *fixed* |
| LowIncOpCost | -0.255 | *fixed* | -0.255 | *fixed* | -0.255 | *fixed* |
| MidIncOpCost | -0.255 | *fixed* | -0.255 | *fixed* | -0.255 | *fixed* |
| HighIncOpCost | -0.174 | *fixed* | -0.174 | *fixed* | -0.174 | *fixed* |
| LowIncPkgCost | -0.731 | *fixed* | -0.731 | *fixed* | -0.731 | *fixed* |
| MidIncPkgCost | -0.393 | *fixed* | -0.393 | *fixed* | -0.393 | *fixed* |
| HighIncPkgCost | -0.393 | *fixed* | -0.393 | *fixed* | -0.393 | *fixed* |

**TABLE 17. HBshop, HBrec, HBoth Multimodal Accessibility Functions – Transit Modes**

| Variable | Walk Access | | Park and Ride | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Shop Constant | -0.0991 | -0.53 | -3.1 | *fixed* |
| Rec Constant | -0.634 | -2.34 | -2 | *fixed* |
| Oth Constant | -0.693 | -4.98 | -2.2 | *fixed* |
| IvTime | -0.0315 | *fixed* | -0.0315 | *fixed* |
| TranWait1 | -0.05 | *fixed* | -0.05 | *fixed* |
| TranWait2 | -0.05 | *fixed* | -0.05 | *fixed* |
| WalkTime | -0.125 | *fixed* | -0.125 | *fixed* |
| TranXfrs | -0.16 | *fixed* | -0.16 | *fixed* |
| TrIVOV | -1 | *fixed* | | |
| LowIncOpCost | -0.255 | *fixed* | -0.255 | *fixed* |
| MidIncOpCost | -0.255 | *fixed* | -0.255 | *fixed* |
| HighIncOpCost | -0.174 | *fixed* | -0.174 | *fixed* |
| Nested Park & Ride Lot Choice Model | | | | |
| Informal Constant | | | -4.5 | |
| Park & Ride Nest | | | 0.75 | |
| Formal Nest | | | 0.5 | |
| Informal Nest | | | 0.5 | |

**TABLE 18. HBshop, HBrec, HBoth Multimodal Accessibility Functions – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Shop Constant | 1.53 | 7.53 | -0.392 | -3.46 |
| Rec Constant | 1.11 | 3.71 | 0.306 | 2.38 |
| Oth Constant | 1.32 | 9.20 | -0.471 | -5.98 |
| BikeDist | -0.223 | *fixed* | | |
| Nbutil | 0.126 | *fixed* | | |
| BikeResPref | 0.929 | *fixed* | | |
| WalkTime | | | -0.125 | *fixed* |

## D.4 NHBW (Non-Home-Based Work)

### D.4.a Peak / Off-Peak Weights

NHBW: 44.52% peak skims, 55.48% off-peak skims

### D.4.b Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0452*IvTime – 0.157*WalkTime – 0.194*OpCost – 0.557*PkgCost **)**

***Drive with Passenger***

U = **exp (** -2.58 – 0.0452*IvTime – 0.157*WalkTime – 0.194*OpCost – 0.557*PkgCost **)**

***Auto Passenger***

U = **exp (** -2.77 – 0.0452*IvTime – 0.157*WalkTime – 0.194*OpCost – 0.557*PkgCost **)**

***Transit by Walk Access***

U = **exp (** 0.458 + TranModc + TranStypc – 0.0452*IvTime – 0.118*TranWait1 – 0.118*TranWait2 – 0.157*WalkTime – 0.16*TranXfrs – 0.194*OpCost – 1*TrOVIV **)**

***Bike***

U = **exp (** -0.91 **–** 0.22*BikeDist + 0.0829*Nbutil + 1.11*BikeResPref **)**

***Walk***

U = **exp (** **-**0.0611 – 0.157*WalkTime **)**

### D.4.c Estimated Variable Coefficients

**TABLE 19. NHBW Multimodal Accessibility Functions – Auto Modes**

| **Variable** | **Drive Alone** | | **Drive with Passenger** | | **Auto Passenger** | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | | | -2.58 | | -2.77 | |
| IvTime | -0.0452 | *fixed* | -0.0452 | *fixed* | -0.0452 | *fixed* |
| WalkTime | -0.157 | *fixed* | -0.157 | *fixed* | -0.157 | *fixed* |
| OpCost | -0.194 | *fixed* | -0.194 | *fixed* | -0.194 | *fixed* |
| PkgCost | -0.557 | *fixed* | -0.557 | *fixed* | -0.557 | *fixed* |

**TABLE 20. NHBW Multimodal Accessibility Functions – Transit Modes**

| Variable | Walk Access | |
|---|---|---|
| | Coefficient | T-Statistic |
| Constant | 0.458 | 2.65 |
| IvTime | -0.0452 | *fixed* |
| TranWait1 | -0.118 | *fixed* |
| TranWait2 | -0.118 | *fixed* |
| WalkTime | -0.157 | *fixed* |
| TranXfrs | -0.16 | *fixed* |
| OpCost | -0.194 | *fixed* |
| TrIVOV | -1 | *fixed* |

**TABLE 21. NHBW Multimodal Accessibility Functions – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | -0.91 | -4.96 | -0.0611 | -0.63 |
| BikeDist | -0.22 | *fixed* | | |
| Nbutil | 0.0829 | *fixed* | | |
| BikeResPref | 1.11 | *fixed* | | |
| WalkTime | | | -0.157 | *fixed* |

## D.5 NHBNW (Non-Home-Based Non-Work)

### D.5.a Peak / Off-Peak Weights

NHBNW: 37.31% peak skims, 62.69% off-peak skims

### D.5.b Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0278*IvTime – 0.125*WalkTime – 0.15*OpCost – 0.335*PkgCost **)**

***Drive with Passenger***

U = **exp (** -0.433 – 0.0278*IvTime – 0.125*WalkTime – 0.15*OpCost – 0.335*PkgCost **)**

***Auto Passenger***

U = **exp (** -1.36 – 0.0278*IvTime – 0.125*WalkTime – 0.15*OpCost – 0.335*PkgCost **)**

***Transit by Walk Access***

U = **exp (** -3.49 + TranModc + TranStypc – 0.0278*IvTime – 0.0781*TranWait1 – 0.0841*TranWait2 – 0.125*WalkTime – 0.16*TranXfrs – 1*TrIVOV – 0.15*OpCost **)**

***Bike***

U = **exp (** -1.87 **–** 0.251*BikeDist + 0.0829*Nbutil + 0.879*BikeResPref **)**

***Walk***

U = **exp (** -0.631 – 0.125*WalkTime **)**

### D.5.c Estimated Variable Coefficients

**TABLE 22. NHBNW Multimodal Accessibility Functions – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | | | -0.433 | | -1.36 | |
| IvTime | -0.0278 | *fixed* | -0.0278 | *fixed* | -0.0278 | *fixed* |
| WalkTime | -0.125 | *fixed* | -0.125 | *fixed* | -0.125 | *fixed* |
| OpCost | -0.15 | *fixed* | -0.15 | *fixed* | -0.15 | *fixed* |
| PkgCost | -0.335 | *fixed* | -0.335 | *fixed* | -0.335 | *fixed* |

**TABLE 23. NHBNW Multimodal Accessibility Functions – Transit Modes**

| Variable | Walk Access | |
|---|---|---|
| | Coefficient | T-Statistic |
| Constant | -3.49 | -33.48 |
| IvTime | -0.0278 | *fixed* |
| TranWait1 | -0.0781 | *fixed* |
| TranWait2 | -0.0841 | *fixed* |
| WalkTime | -0.125 | *fixed* |
| TranXfrs | -0.16 | *fixed* |
| TrIVOV | -1 | *fixed* |
| OpCost | -0.15 | *fixed* |

**TABLE 24. NHBNW Multimodal Accessibility Functions – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | -1.87 | -5.99 | -0.631 | -6.93 |
| BikeDist | -0.251 | *fixed* | | |
| Nbutil | 0.0829 | *fixed* | | |
| BikeResPref | 0.879 | *fixed* | | |
| WalkTime | | | -0.125 | *fixed* |

## D.6 HBcoll (Home-Based College)

### D.6.a Peak / Off-Peak Weights

HBcoll: 48.92% peak skims, 51.08% off-peak skims

### D.6.b Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0346*IvTime – 0.08*WalkTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost – 0.463*LowInc*PkgCost – 0.383*MidInc*PkgCost – 0.184*HighInc*PkgCost **)**

***Drive with Passenger***

U = **exp (** -3.9 – 0.0346*IvTime – 0.08*WalkTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost – 0.463*LowInc*PkgCost – 0.383*MidInc*PkgCost – 0.184*HighInc*PkgCost **)**

***Auto Passenger***

U = **exp (** -2.55 – 0.0346*IvTime – 0.08*WalkTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost – 0.463*LowInc*PkgCost – 0.383*MidInc*PkgCost – 0.184*HighInc*PkgCost **)**

***Transit by Walk Access***

U = **exp (** -1.06 + TranModc + TranStypc – 0.0346*IvTime – 0.055*TranWait1 – 0.055*TranWait2 – 0.08*WalkTime – 0.15*TranXfrs – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost **)**

***Park and Ride***

Park and Ride uses older model specifications; only the mode-specific constant and informal constant were recalibrated in 2017. The coefficient on auto in-vehicle time is doubled in order to maintain a balance between auto and transit time that is comparable to the observed relationship; otherwise, too many trips include unreasonably high auto times as travelers choose to drive to the periphery of the CBD before boarding transit.

U = **exp (** 2.85 + 0.75***ln**(**exp**(Formal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) + **exp**(Informal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((-5.5 + U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) **)**

where

U$_{AutoLeg}$ = -0.0346*2*IvTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost

and

U$_{TransitLeg}$ = -0.0346*IvTime – 0.055*TranWait1 – 0.055*TranWait2 – 0.08*WalkTime – 0.15*TranXfrs – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost

and

*N* = number of formal park-and-ride lots or informal par-and-ride locations under consideration

***Bike***

U = **exp (** 0.625 – 0.3*BikeDist + 0.108*Cbutil **)**

***Walk***

U = **exp (** -0.235 – 0.08*WalkTime **)**

### D.6.c Estimated Variable Coefficients

**TABLE 25. HBcoll Multimodal Accessibility Functions – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | | | -3.9 | | -2.55 | |
| IvTime | -0.0346 | *fixed* | -0.0346 | *fixed* | -0.0346 | *fixed* |
| WalkTime | -0.08 | *fixed* | -0.08 | *fixed* | -0.08 | *fixed* |
| LowIncOpCost | -0.463 | *fixed* | -0.463 | *fixed* | -0.463 | *fixed* |
| MidIncOpCost | -0.383 | *fixed* | -0.383 | *fixed* | -0.383 | *fixed* |
| HighIncOpCost | -0.184 | *fixed* | -0.184 | *fixed* | -0.184 | *fixed* |
| LowIncPkgCost | -0.463 | *fixed* | -0.463 | *fixed* | -0.463 | *fixed* |
| MidIncPkgCost | -0.383 | *fixed* | -0.383 | *fixed* | -0.383 | *fixed* |
| HighIncPkgCost | -0.184 | *fixed* | -0.184 | *fixed* | -0.184 | *fixed* |

**TABLE 26. HBcoll Multimodal Accessibility Functions – Transit Modes**

| Variable | Walk Access | | Park and Ride | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | -1.06 | -5.08 | 2.85 | *fixed* |
| IvTime | -0.0346 | *fixed* | -0.0346 | *fixed* |
| TranWait1 | -0.055 | *fixed* | -0.055 | *fixed* |
| TranWait2 | -0.055 | *fixed* | -0.055 | *fixed* |
| WalkTime | -0.08 | *fixed* | -0.08 | *fixed* |
| TranXfrs | -0.15 | *fixed* | -0.15 | *fixed* |
| LowIncOpCost | -0.463 | *fixed* | -0.463 | *fixed* |
| MidIncOpCost | -0.383 | *fixed* | -0.383 | *fixed* |
| HighIncOpCost | -0.184 | *fixed* | -0.184 | *fixed* |
| Nested Park & Ride Lot Choice Model | | | | |
| Informal Constant | | | -6.0 | |
| Park & Ride Nest | | | 0.75 | |
| Formal Nest | | | 0.5 | |
| Informal Nest | | | 0.5 | |

**TABLE 27. HBcoll Multimodal Accessibility Functions – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Constant | 0.625 | 0.13 | -0.235 | -0.73 |
| BikeDist | -0.3 | *fixed* | | |
| Cbutil | 0.108 | *fixed* | | |
| WalkTime | | | -0.08 | *fixed* |

# E Destination Choice

The destination choice models were developed using a multinomial logit estimation procedure. Only HBW has separate models by income group. For other home-based trip purposes, income-specific LogSums are weighted.

The destination choide models were completely re-estimated for the LCOG implementation.

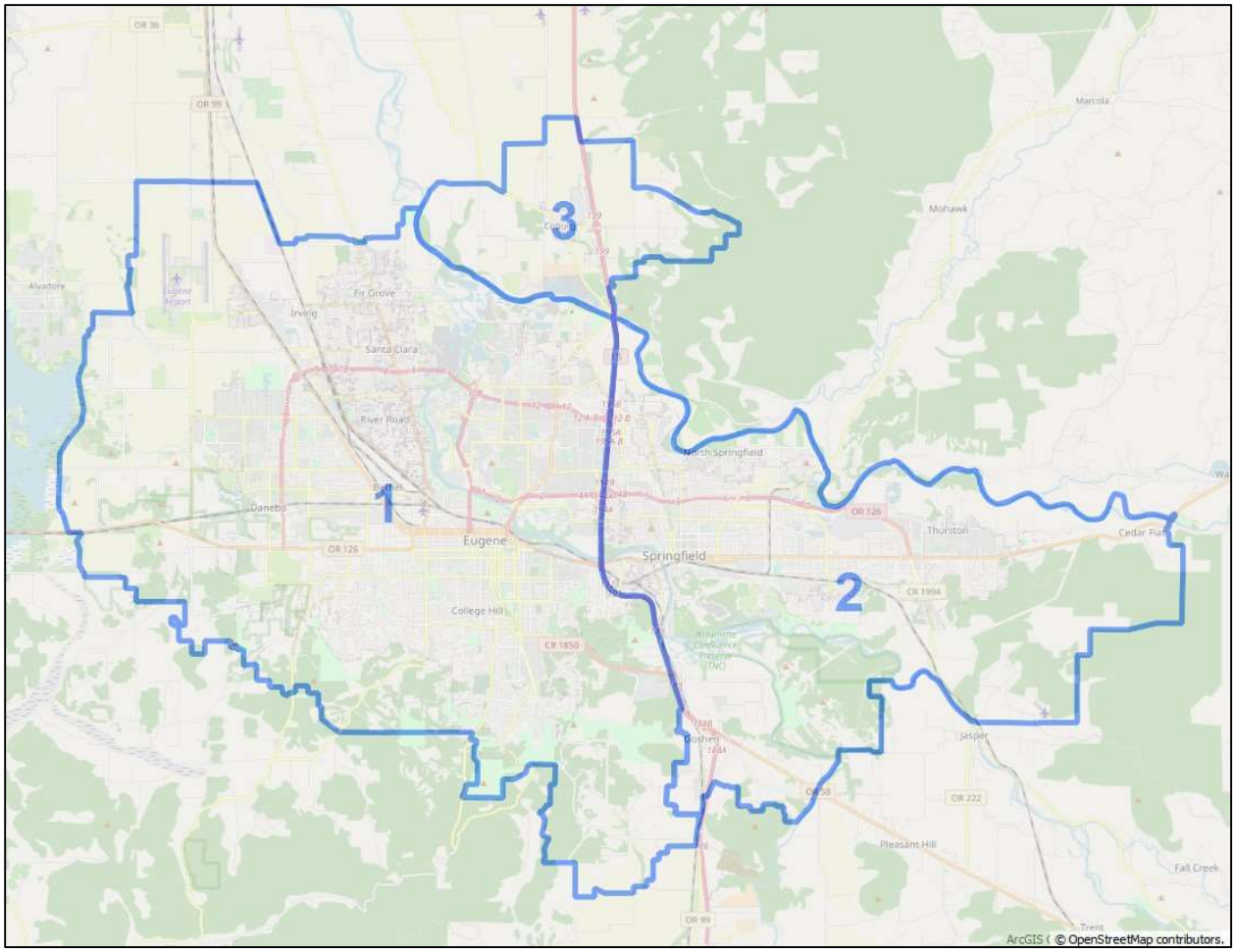
## E.1 Variables Used in Destination Choice Models

### E.1.a Accessibility Variable Definitions

The numbers in the district interaction variables represent travel associated with the districts displayed in Figure 2.

| | | |
|---|---|---|
| LogSum | = | Logsum of multimodal accessibility functions (all modes) |
| LogDist | = | Log of [distance (miles) + 1] |
| Eug2Spr | = | 1 if trip is produced in Eugene (1) and attracted to Springfield (2) |
| Spr2Eug | = | 1 if trip is produced in Springfield (2) and attracted to Eugene (1) |
| AllCob | = | 1 if trip has one end in Coburg (3) and the other end in Eugene (1) or Springfield (2) |
| IntraDist | = | 1 if trip does not cross a district boundary |

**FIGURE 2. District Interaction Variables Used in Destination Choice**



### E.1.b Zonal Size Variable Definitions

Zonal size variables are applied at the attraction zone.

**TABLE 28. Zonal Size Variables Used in Destination Choice Models**

| Name | Employment Sectors | NAICS |
|---|---|---|
| AerEmp | **Arts, Entertainment, and Recreation** | 71 |
| AmfEmp | **Agriculture, Mining & Forestry** | 11,21 |
| ConEmp | **Construction** | 23 |
| EduEmp | **Education** | 61 |
| FsdEmp | **Food Services and Drinking Places** | 722 |
| GovEmp | **Government** | All where owner = public, except 61 (edu) |
| HssEmp | **Health and Social Services** | 62 |
| MfgEmp | **Manufacturing (except high tech)** | 31-33 (except 334) |
| MhtEmp | **Manufacturing - High tech** | 334 |
| OsvEmp | **Other Services (except Public Administration)** | 81 |
| PbsEmp | **Professional and Business Services** | 51-56 |
| RcsEmp | **Retail and Consumer Services** | 44,45,721 |
| TwuEmp | **Transportation, Warehousing and Utilities** | 22,48,49 |
| WtEmp | **Wholesale Trade** | 42 |
| Households | **Households** | |
| OutAcres | **Outdoor Activity Acres** | |
| ParkAcres | **Park Acres** | |
| CollEnr | **College Enrollment** | |

## E.2 HBW (Home-Based Work)

### E.2.a Calibrated Choice Utilities

***HBW – Low Income Households***

U = **exp (** 0.2*LogSum – 1.615*LogDist*Eug2Spr – 1.353*LogDist*Spr2Eug – 1.59*LogDist*AllCob – 1.04*LogDist*IntraDist + 0.2417*AerEmp + 1*AmfEmp + 0.0164*ConEmp + 0.1054*EduEmp + 0.2417*FsdEmp + 0.0164*GovEmp + 0.1381*HssEmp + 0.0376*MfgEmp + 1*MhtEmp + 0.2417*OsvEmp + 0.0646*PbsEmp + 0.0693*RcsEmp + 0.0164*TwuEmp + 0.1466*WtEmp **)**

***HBW – Middle Income Households***

U = **exp (** 0.2*LogSum – 1.277*LogDist*Eug2Spr – 2.102*LogDist*Spr2Eug – 1.25*LogDist*AllCob – 0.82*LogDist*IntraDist + 1*AerEmp + 0.12*AmfEmp + 0.208*ConEmp + 0.591*EduEmp + 0.3499*FsdEmp + 0.5605*GovEmp + 0.5769*HssEmp + 0.3042*MfgEmp + 1*MhtEmp + 1*OsvEmp + 0.2753*PbsEmp + 0.12*RcsEmp + 0.1979*TwuEmp + 0.2645*WtEmp **)**

***HBW – High Income Households***

U = **exp (** 0.2*LogSum – 0.447*LogDist*Eug2Spr – 0.676*LogDist*Spr2Eug – 1.12*LogDist*AllCob – 0.86*LogDist*IntraDist + 0.5735*AerEmp + 0.1097*AmfEmp + 0.5735*ConEmp + 0.5735*EduEmp + 0.1097*FsdEmp + 0.5735*GovEmp + 0.5735*HssEmp + 0.5735*MfgEmp + 1*MhtEmp + 1*OsvEmp + 0.5735*PbsEmp + 0.1097*RcsEmp + 0.5735*TwuEmp + 0.1097*WtEmp **)**

### E.2.b Estimated Variable Coefficients

**TABLE 29. HBW Destination Choice Model**

| Variable | Low Income <25K | | Middle Income 25-100K | | High Income 100K+ | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| LogSum | 0.2 | *fixed* | 0.2 | *fixed* | 0.2 | *fixed* |
| Calib LogDist * Eug2Spr | -1.615 | | -1.277 | | -0.447 | |
| LogDist * Eug2Spr | -0.665 | -4.87 | -0.477 | -7.81 | -0.497 | -7.22 |
| Calib LogDist * Spr2Eug | -1.353 | | -2.102 | | -0.676 | |
| LogDist * Spr2Eug | -0.353 | -2.18 | -0.602 | -5.93 | -0.696 | -5.29 |
| LogDist * AllCob | -1.590 | -2.43 | -1.250 | -3.29 | -1.120 | -2.61 |
| Calib LogDist * IntraDist | -1.040 | | -0.820 | | -0.860 | |
| LogDist * IntraDist | -1.340 | -7.08 | -1.120 | -11.35 | -1.160 | -10.10 |
| AerEmp | 0.2417 | -2.63 | 1 | *fixed* | 0.5735 | -2.06 |
| AmfEmp | 1 | *fixed* | 0.1200 | -4.84 | 0.1097 | -4.61 |
| ConEmp | 0.0164 | -3.08 | 0.2080 | -2.92 | 0.5735 | -2.06 |
| EduEmp | 0.1054 | -4.33 | 0.5910 | -2.57 | 0.5735 | -2.06 |
| FsdEmp | 0.2417 | -2.63 | 0.3499 | -2.66 | 0.1097 | -4.61 |
| GovEmp | 0.0164 | -3.08 | 0.5605 | -2.48 | 0.5735 | -2.06 |
| HssEmp | 0.1381 | -3.86 | 0.5769 | -2.55 | 0.5735 | -2.06 |
| MfgEmp | 0.0376 | -3.63 | 0.3042 | -3.95 | 0.5735 | -2.06 |
| MhtEmp | 1 | *fixed* | 1 | *fixed* | 1 | *fixed* |
| OsvEmp | 0.2417 | -2.63 | 1 | *fixed* | 1 | *fixed* |
| PbsEmp | 0.0646 | -4.04 | 0.2753 | -4.93 | 0.5735 | -2.06 |
| RcsEmp | 0.0693 | -4.12 | 0.1200 | -4.84 | 0.1097 | -4.61 |
| TwuEmp | 0.0164 | -3.08 | 0.1979 | -2.94 | 0.5735 | -2.06 |
| WtEmp | 0.1466 | -2.69 | 0.2645 | -2.59 | 0.1097 | -4.61 |

## E.3 HBshop, HBrec, HBoth (Other Home-Based)

### E.3.a LogSum Weights

**TABLE 30. HBshop, HBrec, HBoth LogSum Weights**

| Income Group | HBShop LogSum Weight | HBRec LogSum Weight | HBoth LogSum Weight |
|---|---|---|---|
| Low Income < $25K | 0.208 | 0.191 | 0.242 |
| Middle Income $25-100K | 0.695 | 0.650 | 0.619 |
| High Income $100K+ | 0.097 | 0.159 | 0.139 |

### E.3.b Calibrated Choice Utilities

***HBShop***

U = **exp (** 1.33*LogSum – 3.95*LogDist*Eug2Spr – 3.82*LogDist*Spr2Eug – 0.949*LogDist*AllCob – 1.99*LogDist*IntraDist + 0.0773*FsdEmp + 0.1588*OsvEmp + 1*RcsEmp **)**

***HBRec***

U = **exp (** 0.547*LogSum – 1.693*LogDist*Eug2Spr – 1.699*LogDist*Spr2Eug – 0.906*LogDist*AllCob – 2.05*LogDist*IntraDist + 0.2322*AerEmp + 0.0074*EduEmp + 0.0529*FsdEmp + 0.045*GovEmp + 0.0012*Households + 0.2837*OutAcres + 1*ParkAcres/10 **)**

***HBoth***

U = **exp (** 0.789*LogSum – 1.05*LogDist*Eug2Spr – 0.505*LogDist*Spr2Eug – 1.6*LogDist*AllCob – 1.56*LogDist*IntraDist + 1*AerEmp + 0.0129*AmfEmp + 0.0392*ConEmp + 0.2753*EduEmp + 1*FsdEmp + 0.4892*GovEmp + 0.3746*HssEmp + 0.0129*MfgEmp + 0.0129*MhtEmp + 1*OsvEmp + 0.1212*PbsEmp + 0.357*RcsEmp + 0.0392*TwuEmp + 0.0392*WtEmp + 0.1327*Households **)**

### E.3.c Estimated Variable Coefficients

**TABLE 31. HBshop, HBrec, HBoth Destination Choice Models**

| Variable | HBshop | | HBrec | | HBoth | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| LogSum | 1.33 | *fixed* | 0.547 | *fixed* | 0.789 | *fixed* |
| Calib LogDist * Eug2Spr | -3.950 | | -1.693 | | -1.050 | |
| LogDist * Eug2Spr | -1.450 | -16.00 | -0.893 | -13.84 | -1.350 | -26.89 |
| Calib LogDist * Spr2Eug | -3.820 | | -1.699 | | -0.505 | |
| LogDist * Spr2Eug | -1.320 | -12.55 | -0.899 | -8.60 | -0.905 | -17.17 |
| LogDist * AllCob | -0.949 | -3.03 | -0.906 | -2.55 | -1.600 | -8.31 |
| Calib LogDist * IntraDist | -1.990 | | -2.050 | | -1.560 | |
| LogDist * IntraDist | -2.290 | -23.21 | -2.050 | -28.11 | -1.860 | -35.12 |
| AerEmp | | | 0.2322 | -7.99 | 1 | *fixed* |
| AmfEmp | | | | | 0.0129 | -5.10 |
| ConEmp | | | | | 0.0392 | -4.84 |
| EduEmp | | | 0.0074 | -14.96 | 0.2753 | -10.90 |
| FsdEmp | 0.0773 | -6.46 | 0.0529 | -16.77 | 1 | *fixed* |
| GovEmp | | | 0.0450 | -16.42 | 0.4892 | -5.81 |
| HssEmp | | | | | 0.3746 | -8.61 |
| MfgEmp | | | | | 0.0129 | -5.10 |
| MhtEmp | | | | | 0.0129 | -5.10 |
| OsvEmp | 0.1588 | -8.23 | | | 1 | *fixed* |
| PbsEmp | | | | | 0.1212 | -8.92 |
| RcsEmp | 1 | *fixed* | | | 0.3570 | -7.17 |
| TwuEmp | | | | | 0.0392 | -4.84 |
| WtEmp | | | | | 0.0392 | -4.84 |
| Households | | | 0.0012 | -12.30 | 0.1327 | -21.50 |
| OutAcres | | | 0.2837 | -6.65 | | |
| ParkAcres / 10 | | | 1 | *fixed* | | |

## E.4 NHBW & NHBNW (Non-Home-Based)

### E.4.a Calibrated Choice Utilities

***NHBW***

U = **exp (** 0.57*LogSum – 1.87*LogDist*Eug2Spr – 1.74*LogDist*Spr2Eug – 1.75*LogDist*AllCob – 1.75*LogDist*IntraDist + 0.5684*AerEmp + 0.0189*AmfEmp + 0.0189*ConEmp + 0.2254*EduEmp + 1*FsdEmp + 0.2837*GovEmp + 0.1275*HssEmp + 0.0189*MfgEmp + 0.0189*MhtEmp + 0.0954*OsvEmp + 0.1313*PbsEmp + 0.5684*RcsEmp + 0.0954*TwuEmp + 0.0189*WtEmp + 0.1023*Households **)**

***NHBNW***

U = **exp (** 1.65*LogSum – 1.59*LogDist*Eug2Spr – 1.334*LogDist*Spr2Eug – 0.852*LogDist*AllCob – 1.38*LogDist*IntraDist + 0.3694*AerEmp + 0.0898*AmfEmp + 0.0016*ConEmp + 0.1845*EduEmp + 0.2753*FsdEmp + 0.1653*GovEmp + 0.0926*HssEmp + 0.0016*MfgEmp + 0.0016*MhtEmp + 1*OsvEmp + 0.0498*PbsEmp + 0.4971*RcsEmp + 0.0424*TwuEmp + 0.0016*WtEmp **)**

### E.4.b Estimated Variable Coefficients

**TABLE 32. Non-Home-Based Destination Choice Models**

| Variable | NHBW | | NHBNW | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| LogSum | 0.57 | 6.31 | 1.65 | 14.50 |
| LogDist * Eug2Spr | -1.87 | -24.73 | -1.19 | -21.90 |
| LogDist * Spr2Eug | -1.74 | -18.65 | -0.934 | -14.53 |
| LogDist * AllCob | -1.75 | -23.56 | -0.852 | -4.43 |
| LogDist * IntraDist | -1.75 | -23.56 | -1.68 | -31.85 |
| AerEmp | 0.5684 | -3.47 | 0.3694 | -4.21 |
| AmfEmp | 0.0189 | -6.11 | 0.0898 | -2.88 |
| ConEmp | 0.0189 | -6.11 | 0.0016 | -2.70 |
| EduEmp | 0.2254 | -9.28 | 0.1845 | -15.56 |
| FsdEmp | 1 | *fixed* | 0.2753 | -7.54 |
| GovEmp | 0.2837 | -6.66 | 0.1653 | -12.26 |
| HssEmp | 0.1275 | -9.61 | 0.0926 | -14.28 |
| MfgEmp | 0.0189 | -6.11 | 0.0016 | -2.70 |
| MhtEmp | 0.0189 | -6.11 | 0.0016 | -2.70 |
| OsvEmp | 0.0954 | -3.65 | 1 | *fixed* |
| PbsEmp | 0.1313 | -8.37 | 0.0498 | -12.01 |
| RcsEmp | 0.5684 | -3.47 | 0.4971 | -7.96 |
| TwuEmp | 0.0954 | -3.65 | 0.0424 | -5.05 |
| WtEmp | 0.0189 | -6.11 | 0.0016 | -2.70 |
| Households | 0.1023 | -16.99 | | |

## E.5 HBcoll (Home-Based College)

### E.5.a LogSum Weights

**TABLE 33. HBcoll LogSum Weights**

| Income Group | HBcoll LogSum Weight |
|---|---|
| Low Income < $25K | 0.343 |
| Middle Income $25-100K | 0.566 |
| High Income $100K+ | 0.091 |

### E.5.b Calibrated Choice Utility

U = **exp (** 0.2*LogSum – 1.35*LogDist*Eug2Spr – 1.35*LogDist*Spr2Eug – 1.35*LogDist*AllCob – 1.35*LogDist*IntraDist + 0.1119*CollEnr **)**

### E.5.c Estimated Variable Coefficients

| Variable | HBcoll | |
|---|---|---|
| | Coefficient | T-Statistic |
| LogSum | 0.2 | *fixed* |
| LogDist * Eug2Spr | -1.35 | *fixed* |
| LogDist * Spr2Eug | -1.35 | *fixed* |
| LogDist * AllCob | -1.35 | *fixed* |
| LogDist * IntraDist | -1.35 | *fixed* |
| CollEnr | 0.1119 | -9.61 |

## E.6 HBsch (Home-Based School)

U = **exp ( ln (** $ATTR_j$ **)** – 0.6*$T_{ij}$ + 0.012*$T_{ij}^2$ **)**

Where:

i = from zone
j = to zone
T = mid-day auto travel time

## F Mode Choice Model

Modal accessibility functions were estimated as an input to the destination choice and mode choice models. For each trip purpose, they measure the utility of choosing one of seven discrete modes.

**Drive alone** – only available to households with at least one car
**Drive with passenger** – only available to households with at least one car
**Auto passenger**
**Transit by walk access** – only available if total walk distance (access + transfer + egress) does not exceed one mile
**Transit by park-and-ride access** – only available if attraction zone has parking cost; only available for home-based non-school trips; utilities and lot usage for formal park-and-ride lots and informal park-and-ride locations are calculated by a nested park-and-ride lot choice model
**Bike** – utilities and distances are produced by a stand-alone tool based on a dedicated bicycle network
**Walk** – only available for trips with a distance less than five miles

Probabilities are applied to distributed trips to determine the number of trips by each mode. An example probability of choosing the Drive Alone mode follows:

$$Prob_{Drive\ Alone} = U_{Drive\ Alone} / ( U_{Drive\ Alone} + U_{Drive\ w/Pass} + U_{Passenger} + U_{Walk\ to\ Transit} + U_{Park\&Ride} + U_{Bike} + U_{Walk} )$$

The parameters used in the mode choice models are unchanged from the Portland Metro implementation with the exception of (1) those associated with the bicycle mode, which were re-estimated; and (2) the alternative-specific constants, which were adjusted during model calibration.

## F.1 Variables Used in Mode Choice Models

### F.1.a Variable Definitions

IvTime = In-vehicle travel time (minutes, varies by mode)
WalkTime = Walk time (minutes), by mode:
- Drive Alone: vehicle egress at trip end (5 min in CBD, 2 min elsewhere)
- Shared Ride: Drive Alone walk time plus 5 minutes
- Transit Modes: access to first stop plus egress from last stop at 3 mph
- Walk: zone-to-zone time via key walk-accessible links at 3 mph (for trips < 5 miles)

TranWait1 = Transit initial wait time (minutes)
TranWait2 = Transit transfer wait time (minutes)
TranModc = Transit mode constant (varies by transit path)
TranStypc = Transit stop type constant (varies by transit path)
TranXfrs = Transit # of transfers
TrOVIV = ratio of total out-of-vehicle time to in-vehicle time
Formal = 1 if considering formal park-and-ride lots
Informal = 1 if considering informal park-and-ride locations
Shadow = Park-and-ride lot shadow cost (calculated by lot choice model)
BikeDist = Bicycle trip distance (miles)
Cbutil = Bicycle commute route attractiveness
Nbutil = Bicycle non-commute route attractiveness
BikeResPref = 1 if production zone in bicycle user residential preference area (see Figure 1)
LowInc = 1 if household income <$25K (2010$)
MidInc = 1 if household income $25-100K (2010$)
HighInc = 1 if household income $100K+ (2010$)
OpCost = Out-of-pocket cost, by mode:
- Drive Alone: 100% of $0.1774 / mile (2010$)
- Drive with Passenger: 66.7% of $0.1774 / mile (2010$)
- Auto Passenger: 33.3% of $0.1774 / mile (2010$)
- Walk-access Transit: transit fare (2010$)
- Park-and-ride: $0.1774 / mile for auto leg, transit fare for transit leg

PkgCost = Parking cost, by mode:
- Drive Alone: 100% of long-term parking charge in attraction zone
- Drive with Passenger: 66.7% of long-term parking charge in attraction zone
- Auto Passenger: 33.3% of long-term parking charge in attraction zone

MixRetP = Retail employment access within ½ mile of production zone (see Section A.1.b)
MixTotA = Total employment access within ½ mile of attraction zone (see Section A.1.b)
Cval0 = 1 if no cars in household
Cval1 = 1 if fewer cars than workers in household (cars > 0)
HH1 = 1 if 1 person household
HH2 = 1 if 2 person household
HH34 = 1 if 3+ person household
Work1 = 1 if one (and only one) worker in household

## F.2 HBW (Home-Based Work)

### F.2.a Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0414*IvTime – 0.1*WalkTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost – 0.509*LowInc*PkgCost – 0.509*MidInc*PkgCost – 0.461*HighInc*PkgCost – 1.9*Cval1 **)**

***Drive with Passenger***

U = **exp (** -3.32 – 0.0414*IvTime – 0.1*WalkTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost – 0.509*LowInc*PkgCost – 0.509*MidInc*PkgCost – 0.461*HighInc*PkgCost – 1.02*Cval1 - 1.4*HH1 + 0.729*HH34 **)**

***Auto Passenger***

U = **exp (** -3.56 – 0.0414*IvTime – 0.1*WalkTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost – 0.509*LowInc*PkgCost – 0.509*MidInc*PkgCost – 0.461*HighInc*PkgCost + 0.299*HH2 + 0.0297*ln(MixRetP) + 0.0506*ln(MixTotA) **)**

***Transit by Walk Access***

U = **exp (** -2.34 + TranModc + TranStypc – 0.0414*IvTime – 0.0543*TranWait1 – 0.061*TranWait2 – 0.1*WalkTime – 0.16*TranXfrs – 0.4*TrIVOV – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost + 0.08*ln(MixTotA) + 1.34*Cval0 + 0.349*Cval1 + 0.784*Work1 **)**

***Park and Ride***

Park and Ride uses older model specifications; only the mode-specific constant and informal constant were recalibrated in 2017. The coefficient on auto in-vehicle time is doubled in order to maintain a balance between auto and transit time that is comparable to the observed relationship; otherwise, too many trips include unreasonably high auto times as travelers choose to drive to the periphery of the CBD before boarding transit.

U = **exp (** 1.85 + 0.75***ln**(**exp**(Formal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow – 1.498*Cval1) / (0.5*0.75))] )) + **exp**(Informal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((-4.5 + U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow – 1.498*Cval1) / (0.5*0.75))] )) **)**

where

U$_{AutoLeg}$ = -0.0414*2*IvTime – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost

and

U$_{TransitLeg}$ = -0.0414*IvTime – 0.0543*TranWait1 – 0.061*TranWait2 – 0.1*WalkTime – 0.16*TranXfrs – 0.309*LowInc*OpCost – 0.252*MidInc*OpCost – 0.252*HighInc*OpCost

and

*N* = number of formal park-and-ride lots or informal par-and-ride locations under consideration

***Bike***

U = **exp (** 0.12 – 0.469*BikeDist + 0.0274*Cbutil + 0.762*BikeResPref + 0.0517*ln(MixTotA) **)**

***Walk***

U = **exp (** -0.88 **–** 0.1*WalkTime + 0.107*ln(MixRetP) **)**

### F.2.b Estimated Variable Coefficients

**TABLE 34. HBW Mode Choice Model – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | | | -3.32 | | -3.56 | |
| Constant | | | -3.72 | -31.72 | -4.41 | -19.18 |
| IvTime | -0.0414 | -4.74 | -0.0414 | -4.74 | -0.0414 | -4.74 |
| Calib WalkTime | -0.1 | | -0.1 | | -0.1 | |
| WalkTime | -0.0791 | -14.01 | -0.0791 | -14.01 | -0.0791 | -14.01 |
| LowIncOpCost | -0.309 | -2.83 | -0.309 | -2.83 | -0.309 | -2.83 |
| MidIncOpCost | -0.252 | -6.34 | -0.252 | -6.34 | -0.252 | -6.34 |
| HighIncOpCost | -0.252 | -6.34 | -0.252 | -6.34 | -0.252 | -6.34 |
| LowIncPkgCost | -0.509 | -13.53 | -0.509 | -13.53 | -0.509 | -13.53 |
| MidIncPkgCost | -0.509 | -13.53 | -0.509 | -13.53 | -0.509 | -13.53 |
| HighIncPkgCost | -0.461 | -11.65 | -0.461 | -11.65 | -0.461 | -11.65 |
| Ln(MixRetP) | | | | | 0.0297 | 1.46 |
| Ln(MixTotA) | | | | | 0.0506 | 2.37 |
| Cval1 | -1.9 | -18.06 | -1.02 | -5.07 | | |
| HH1 | | | -1.4 | -3.3 | | |
| HH2 | | | | | 0.299 | 2.69 |
| HH34 | | | 0.729 | 5.45 | | |

**TABLE 35. HBW Mode Choice Model – Transit Modes**

| Variable | Walk Access | | Park and Ride | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | -2.34 | | 1.85 | |
| Constant | -2.34 | -13.25 | -6.504 | -7.3 |
| Ivtime | -0.0414 | *-4.74* | -0.0414 | *-4.74* |
| Wait1 | -0.0543 | -3.69 | -0.0543 | -3.69 |
| Wait2 | -0.061 | -4.66 | -0.061 | -4.66 |
| Calib WalkTime | -0.1 | | | |
| WalkTime | -0.0791 | -14.01 | -0.0791 | -14.01 |
| Transfers | -0.16 | *fixed* | -0.16 | *fixed* |
| Calib TrIVOV | -0.4 | | | |
| TrIVOV | -0.0519 | -2.65 | | |
| LowIncOpCost | -0.309 | -2.83 | -0.309 | -2.83 |
| MidIncOpCost | -0.252 | -6.34 | -0.252 | -6.34 |
| HighIncOpCost | -0.252 | -6.34 | -0.252 | -6.34 |
| Ln(MixTotA) | 0.08 | *fixed* | | |
| Work1 | 0.784 | 5.58 | | |
| Cval0 | 1.34 | 6.22 | | |
| Cval1 | 0.349 | 2.07 | -1.498 | -3.3 |
| Nested Park & Ride Lot Choice Model | | | | |
| Informal Constant | | | -4.5 | |
| Park & Ride Nest | | | 0.75 | |
| Formal Nest | | | 0.5 | |
| Informal Nest | | | 0.5 | |

**TABLE 36. HBW Mode Choice Model – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | 0.12 | | -0.88 | |
| Constant | -2.51 | -7.35 | -1.82 | -4.74 |
| BikeDist | -0.469 | -9.56 | | |
| Cbutil | 0.0274 | 10.79 | | |
| BikeResPref | 0.764 | 4.68 | | |
| Calib WalkTime | | | -0.1 | |
| WalkTime | | | -0.0791 | -14.01 |
| Ln(MixTotA) | 0.0517 | *fixed* | | |
| Ln(MixRetP) | | | 0.107 | 2.54 |

## F.3 HBshop, HBrec, HBoth (Other Home-Based)

### F.3.a Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0315*IvTime – 0.125*WalkTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost – 0.731*LowInc*PkgCost – 0.393*MidInc*PkgCost – 0.393*HighInc*PkgCost – 0.704*Cval1 **)**

***Drive with Passenger***

U = **exp (** -1.25*Shop – 1.17*Rec – 1.01*Oth -0.0315*IvTime – 0.125*WalkTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost – 0.731*LowInc*PkgCost – 0.393*MidInc*PkgCost – 0.393*HighInc*PkgCost – 0.436*Cval1 – 1.63*HH1 + 0.889* HH34 **)**

***Auto Passenger***

U = **exp (** -0.73*Shop – 0.23*Rec – 0.38*Oth -0.0315*IvTime – 0.125*WalkTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost – 0.731*LowInc*PkgCost – 0.393*MidInc*PkgCost – 0.393*HighInc*PkgCost – 1.41*HH1 + 0.256*HH34 **)**

***Transit by Walk Access***

U = **exp (** -2.47*Shop – 3.93*Rec – 3.83*Oth + TranModc + TranStypc – 0.0315*IvTime – 0.05*TranWait1 – 0.05*TranWait2 – 0.125*WalkTime – 0.16*TranXfrs – 1*TrIVOV – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost + 0.213*ln(MixTotA) + 1.96*Cval0 + 0.665*Cval1 **)**

***Park and Ride***

Park and Ride uses older model specifications; only the mode-specific constant and informal constant were recalibrated in 2017. The coefficient on auto in-vehicle time is doubled in order to maintain a balance between auto and transit time that is comparable to the observed relationship; otherwise, too many trips include unreasonably high auto times as travelers choose to drive to the periphery of the CBD before boarding transit.

U = **exp (** -3.1*Shop – 2*Rec – 2.2*Oth + 0.75***ln**(**exp**(Formal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) + **exp**(Informal*0.5***ln**( $\sum_{1\rightarrow N}$ [**exp**((-4 + U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) **)**

where

U$_{AutoLeg}$ = -0.0315*2*IvTime – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost

and

$U_{TransitLeg}$ = -0.0315*IvTime – 0.05*TranWait1 – 0.05*TranWait2 – 0.125*WalkTime – 0.16*TranXfrs – 0.255*LowInc*OpCost – 0.255*MidInc*OpCost – 0.174*HighInc*OpCost

and

*N* = number of formal park-and-ride lots or informal par-and-ride locations under consideration

***Bike***

U = **exp (** 1.61*Shop + 3.1*Rec + 1.59*Oth – 0.223*BikeDist + 0.126*Nbutil + 0.929*BikeResPref + 0.212*ln(MixTotA) **)**

***Walk***

U = **exp (** -0.74*Shop + 0.41*Rec – 0.13*Oth – 0.125*WalkTime + 0.188*ln(MixRetP) **)**

### F.3.b Estimated Variable Coefficients

**TABLE 37. HBshop, HBrec, HBoth Mode Choice Model – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Shop | | | -1.25 | | -0.73 | |
| Calib Rec | | | -1.17 | | -0.23 | |
| Calib Oth | | | -1.01 | | -0.38 | |
| Shop | | | -1.56 | -32.21 | -1.89 | -34.42 |
| Rec | | | -1.17 | -20.87 | -1.4 | -22.98 |
| Oth | | | -0.983 | -28.87 | -1.5 | -38.77 |
| IvTime | -0.0315 | -2.16 | -0.0315 | -2.16 | -0.0315 | -2.16 |
| Calib WalkTime | -0.125 | | -0.125 | | -0.125 | |
| WalkTime | -0.0906 | -27.55 | -0.0906 | -27.55 | -0.0906 | -27.55 |
| LowIncOpCost | -0.255 | -7.47 | -0.255 | -7.47 | -0.255 | -7.47 |
| MidIncOpCost | -0.255 | -7.47 | -0.255 | -7.47 | -0.255 | -7.47 |
| HighIncOpCost | -0.174 | -3.99 | -0.174 | -3.99 | -0.174 | -3.99 |
| LowIncPkgCost | -0.731 | -3.1 | -0.731 | -3.1 | -0.731 | -3.1 |
| MidIncPkgCost | -0.393 | -5.2 | -0.393 | -5.2 | -0.393 | -5.2 |
| HighIncPkgCost | -0.393 | -5.2 | -0.393 | -5.2 | -0.393 | -5.2 |
| Cval1 | -0.704 | -9.07 | -0.436 | -5.25 | | |
| HH1 | | | -1.63 | -16.37 | -1.41 | -14.85 |
| HH34 | | | 0.889 | 22.77 | 0.256 | 5.75 |

**TABLE 38. HBshop, HBrec, HBoth Mode Choice Model – Transit Modes**

| Variable | Walk Access | | Park and Ride | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Shop | -2.47 | | -3.1 | |
| Calib Rec | -3.93 | | -2 | |
| Calib Oth | -3.83 | | -2.2 | |
| Shop | -4.95 | -9.89 | -7.023 | -3.8 |
| Rec | -4.4 | -8.63 | -7.023 | -3.8 |
| Oth | -5.03 | -10 | -7.023 | -3.8 |
| IvTime | -0.0315 | -2.16 | -0.0315 | -2.16 |
| Calib TranWait1 | -0.05 | | -0.05 | |
| TranWait1 | -0.0824 | -4.7 | -0.0824 | -4.7 |
| Calib TranWait2 | -0.05 | | -0.05 | |
| TranWait2 | -0.074 | -4.42 | -0.074 | -4.42 |
| Calib WalkTime | -0.125 | | -0.125 | |
| WalkTime | -0.0906 | -27.55 | -0.0906 | -27.55 |
| TranXfrs | -0.16 | *fixed* | -0.16 | *fixed* |
| Calib TrIVOV | -1 | | | |
| TrIVOV | -0.121 | -3.11 | | |
| LowIncOpCost | -0.255 | -7.47 | -0.255 | -7.47 |
| MidIncOpCost | -0.255 | -7.47 | -0.255 | -7.47 |
| HighIncOpCost | -0.174 | -3.99 | -0.174 | -3.99 |
| Ln(MixTotA) | 0.212 | 6.18 | | |
| Ln(MixRetP) | 0.203 | 5.2 | | |
| Cval0 | 1.96 | 12.4 | | |
| Cval1 | 0.665 | 3.93 | | |
| Nested Park & Ride Lot Choice Model | | | | |
| Informal Constant | | | -4 | |
| Park & Ride Nest | | | 0.75 | |
| Formal Nest | | | 0.5 | |
| Informal Nest | | | 0.5 | |

**TABLE 39. HBshop, HBrec, HBoth Mode Choice Model – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Shop | 1.61 | | -0.74 | |
| Calib Rec | 3.1 | | 0.41 | |
| Calib Oth | 1.59 | | -0.13 | |
| Shop | -3.74 | -11.64 | -2.6 | -15.29 |
| Rec | -2.73 | -8.63 | -1.41 | -8.44 |
| Oth | -3.73 | -12.05 | -2.15 | -13.83 |
| BikeDist | -0.223 | *fixed* | | |
| Nbutil | 0.126 | 7.05 | | |
| BikeResPref | 0.929 | 5.45 | | |
| Calib WalkTime | | | -0.125 | |
| WalkTime | | | -0.0906 | -27.55 |
| Ln(MixTotA) | 0.212 | *fixed* | | |
| Calib Ln(MixRetP) | | | 0.188 | |
| Ln(MixRetP) | | | 0.229 | 13.99 |

## F.4 NHBW (Non-Home-Based Work)

### F.4.a Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0452*IvTime – 0.157*WalkTime – 0.194*OpCost – 0.557*PkgCost **)**

***Drive with Passenger***

U = **exp (** -2.68 – 0.0452*IvTime – 0.157*WalkTime – 0.194*OpCost – 0.557*PkgCost **)**

***Auto Passenger***

U = **exp (** -2.87 – 0.0452*IvTime – 0.157*WalkTime – 0.194*OpCost – 0.557*PkgCost **)**

***Transit by Walk Access***

U = **exp (** 0.03 + TranModc + TranStypc – 0.0452*IvTime – 0.118*TranWait1 – 0.118*TranWait2 – 0.157*WalkTime – 0.16*TranXfrs – 0.194*OpCost – 1*TrOVIV **)**

***Bike***

U = **exp (** -1.18 **–** 0.22*BikeDist + 0.0829*Nbutil + 1.11*BikeResPref + 0.1*Ln(MixTotA) **)**

***Walk***

U = **exp (** -1.49 – 0.157*WalkTime + 0.248*ln(MixRetP) **)**

### F.4.b Estimated Variable Coefficients

**TABLE 40. NHBW Mode Choice Model – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | | | -2.68 | | -2.87 | |
| Constant | | | -2.43 | -46.75 | -2.99 | -48.6 |
| IvTime | -0.0452 | -2.49 | -0.0452 | -2.49 | -0.0452 | -2.49 |
| WalkTime | -0.157 | -16.7 | -0.157 | -16.7 | -0.157 | -16.7 |
| OpCost | -0.194 | -3.33 | -0.194 | -3.33 | -0.194 | -3.33 |
| PkgCost | -0.557 | -5.41 | -0.557 | -5.41 | -0.557 | -5.41 |

**TABLE 41. NHBW Mode Choice Model – Transit Modes**

| Variable | Walk Access | |
|---|---|---|
| | Coefficient | T-Statistic |
| Calib Constant | 0.03 | |
| Constant | -1.76 | -2.76 |
| IvTime | -0.0452 | -2.49 |
| TranWait1 | -0.118 | -5.07 |
| TranWait2 | -0.118 | -5.07 |
| WalkTime | -0.157 | -16.7 |
| TranXfrs | -0.16 | *fixed* |
| OpCost | -0.194 | -3.33 |
| Calib TrIVOV | -1 | |
| TrIVOV | 0 | *fixed* |
| Calib Ln(MixTotA) | 0 | |
| Ln(MixTotA) | -0.161 | -6.18 |

**TABLE 42. NHBW Mode Choice Model – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | -1.18 | | -1.49 | |
| Constant | -4.96 | -52.56 | -2.12 | -5.52 |
| BikeDist | -0.22 | *fixed* | | |
| Nbutil | 0.0829 | 2.29 | | |
| BikeResPref | 1.11 | 2.67 | | |
| WalkTime | | | -0.157 | -16.7 |
| Calib Ln(MixRetP) | | | 0.248 | |
| Ln(MixRetP) | | | 0.2553 | 10.6 |
| Ln(MixTotA) | 0.1 | *fixed* | | |

## F.5 NHBNW (Non-Home-Based Non-Work)

### F.5.a Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0278*IvTime – 0.125*WalkTime – 0.15*OpCost – 0.335*PkgCost **)**

***Drive with Passenger***

U = **exp (** -1.73 – 0.0278*IvTime – 0.125*WalkTime – 0.15*OpCost – 0.335*PkgCost **)**

***Auto Passenger***

U = **exp (** -2.56 – 0.0278*IvTime – 0.125*WalkTime – 0.15*OpCost – 0.335*PkgCost **)**

***Transit by Walk Access***

U = **exp (** 0.16 + TranModc + TranStypc – 0.0278*IvTime – 0.0781*TranWait1 – 0.0841*TranWait2 – 0.125*WalkTime – 0.16*TranXfrs – 1*TrIVOV – 0.15*OpCost + 0.128*ln(MixTotA) + 0.135*ln(MixRetP) **)**

***Bike***

U = **exp (** -0.86 **–** 0.251*BikeDist + 0.0829*Nbutil + 0.879*BikeResPref + 0.172*ln(MixTotA) **)**

***Walk***

U = **exp (** -2.26 – 0.125*WalkTime + 0.301*ln(MixRetP) **)**

### F.5.b Estimated Variable Coefficients

**TABLE 43. NHBNW Mode Choice Model – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | | | -1.73 | | -2.56 | |
| Constant | | | -0.491 | -18.74 | -1.37 | -41.17 |
| IvTime | -0.0278 | -1.63 | -0.0278 | -1.63 | -0.0278 | -1.63 |
| Calib WalkTime | -0.125 | | -0.125 | | -0.125 | |
| WalkTime | -0.0886 | -14.68 | -0.0886 | -14.68 | -0.0886 | -14.68 |
| OpCost | -0.15 | -2.94 | -0.15 | -2.94 | -0.15 | -2.94 |
| PkgCost | -0.335 | -5.91 | -0.335 | -5.91 | -0.335 | -5.91 |

**TABLE 44. NHBNW Mode Choice Model – Transit Modes**

| Variable | Walk Access | |
|---|---|---|
| | Coefficient | T-Statistic |
| Calib Constant | 0.16 | |
| Constant | -3.8 | -4.82 |
| IvTime | -0.0278 | -1.63 |
| TranWait1 | -0.0781 | -2.85 |
| TranWait2 | -0.0841 | -2.97 |
| Calib WalkTime | -0.125 | |
| WalkTime | -0.0886 | -14.68 |
| TranXfrs | -0.16 | *fixed* |
| Calib TrIVOV | -1 | |
| TrIVOV | -0.15 | *fixed* |
| OpCost | -0.15 | -2.94 |

**TABLE 45. NHBNW Mode Choice Model – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | -0.86 | | -2.25 | |
| Constant | -4.26 | -7.47 | -3.73 | -11.9 |
| BikeDist | -0.251 | -2.67 | | |
| Nbutil | 0.0829 | *fixed* | | |
| BikeResPref | 0.879 | 3.07 | | |
| Calib WalkTime | | | -0.125 | |
| WalkTime | | | -0.0886 | -14.68 |
| Ln(MixRetP) | | | 0.301 | 10.1 |
| Ln(MixTotA) | 0.172 | *fixed* | | |

## F.6 HBcoll (Home-Based College)

### F.6.a Calibrated Choice Utilities

***Drive Alone***

U = **exp (** -0.0346*IvTime – 0.08*WalkTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost – 0.463*LowInc*PkgCost – 0.383*MidInc*PkgCost – 0.184*HighInc*PkgCost – 1.36*Cval1 **)**

***Drive with Passenger***

U = **exp (** -3.87 – 0.0346*IvTime – 0.08*WalkTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost – 0.463*LowInc*PkgCost – 0.383*MidInc*PkgCost – 0.184*HighInc*PkgCost **)**

***Auto Passenger***

U = **exp (** -1.95 – 0.0346*IvTime – 0.08*WalkTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost – 0.463*LowInc*PkgCost – 0.383*MidInc*PkgCost – 0.184*HighInc*PkgCost **)**

***Transit by Walk Access***

U = **exp (** -0.76 + TranModc + TranStypc – 0.0346*IvTime – 0.055*TranWait1 – 0.055*TranWait2 – 0.08*WalkTime – 0.15*TranXfrs – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost + 0.763*Cval0 + 0.528*Cval1 + 0.1*ln(LogMixTotA) **)**

***Park and Ride***

Park and Ride uses older model specifications; only the mode-specific constant and informal constant were recalibrated in 2017. The coefficient on auto in-vehicle time is doubled in order to maintain a balance between auto and transit time that is comparable to the observed relationship; otherwise, too many trips include unreasonably high auto times as travelers choose to drive to the periphery of the CBD before boarding transit.

U = **exp (** 2.85 + 0.75***ln**(**exp**(Formal*0.5***ln**( $\sum_{1 \to N}$ [**exp**((U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) + **exp**(Informal*0.5***ln**( $\sum_{1 \to N}$ [**exp**((-5.5 + U$_{AutoLeg}$ + U$_{TransitLeg}$ + Shadow) / (0.5*0.75))] )) **)**

where

U$_{AutoLeg}$ = -0.0346*2*IvTime – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost

and

U$_{TransitLeg}$ = -0.0346*IvTime – 0.055*TranWait1 – 0.055*TranWait2 – 0.08*WalkTime – 0.15*TranXfrs – 0.463*LowInc*OpCost – 0.383*MidInc*OpCost – 0.184*HighInc*OpCost

and

*N* = number of formal park-and-ride lots or informal par-and-ride locations under consideration

***Bike***

U = **exp (** 7.63 – 0.3*BikeDist + 0.108*Cbutil **+** 0.1*Ln(MixTotA) **)**

***Walk***

U = **exp (** -0.95 – 0.08*WalkTime + 0.119*ln(MixRetP) **)**

### F.6.b Estimated Variable Coefficients

**TABLE 46. HBcoll Mode Choice Model – Auto Modes**

| Variable | Drive Alone | | Drive with Passenger | | Auto Passenger | |
|---|---|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | | | -3.87 | | -1.95 | |
| Constant | | | -3.08 | -12.85 | -3.01 | -16.8 |
| IvTime | -0.0346 | -1.48 | -0.0346 | -1.48 | -0.0346 | -1.48 |
| Calib WalkTime | -0.08 | | -0.08 | | -0.08 | |
| WalkTime | -0.0615 | -4.25 | -0.0615 | -4.25 | -0.0615 | -4.25 |
| LowIncOpCost | -0.463 | -2.36 | -0.463 | -2.36 | -0.463 | -2.36 |
| MidIncOpCost | -0.383 | -3.58 | -0.383 | -3.58 | -0.383 | -3.58 |
| HighIncOpCost | -0.184 | -1.61 | -0.184 | -1.61 | -0.184 | -1.61 |
| LowIncPkgCost | -0.463 | -2.36 | -0.463 | -2.36 | -0.463 | -2.36 |
| MidIncPkgCost | -0.383 | -3.58 | -0.383 | -3.58 | -0.383 | -3.58 |
| HighIncPkgCost | -0.184 | -1.61 | -0.184 | -1.61 | -0.184 | -1.61 |
| Cval1 | -1.36 | -3.5 | | | | |

**TABLE 47. HBcoll Mode Choice Model – Transit Modes**

| Variable | Walk Access | | Park and Ride | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | -0.76 | | 2.85 | |
| Constant | -2.07 | -1.99 | -1.175 | -3.4 |
| IvTime | -0.0346 | -1.48 | -0.0346 | -1.48 |
| Calib TranWait1 | -0.055 | | -0.055 | |
| TranWait1 | -0.0296 | -1.15 | -0.0296 | -1.15 |
| Calib TranWait2 | -0.055 | | -0.055 | |
| TranWait2 | -0.0296 | -1.15 | -0.0296 | -1.15 |
| Calib WalkTime | -0.08 | | -0.08 | |
| WalkTime | -0.0615 | -4.25 | -0.0615 | -4.25 |
| TranXfrs | -0.15 | *fixed* | -0.15 | *fixed* |
| LowIncOpCost | -0.463 | -2.36 | -0.463 | -2.36 |
| MidIncOpCost | -0.383 | -3.58 | -0.383 | -3.58 |
| HighIncOpCost | -0.184 | -1.61 | -0.184 | -1.61 |
| Cval0 | 0.763 | 1.28 | | |
| Cval1 | 0.528 | 1.35 | | |
| Nested Park & Ride Lot Choice Model | | | | |
| Informal Constant | | | -5.5 | |
| Park & Ride Nest | | | 0.75 | |
| Formal Nest | | | 0.5 | |
| Informal Nest | | | 0.5 | |

**TABLE 48. HBcoll Mode Choice Model – Nonmotorized Modes**

| Variable | Bike | | Walk | |
|---|---|---|---|---|
| | Coefficient | T-Statistic | Coefficient | T-Statistic |
| Calib Constant | 7.63 | | -0.95 | |
| Constant | -3.73 | -7.49 | -1.83 | -1.29 |
| BikeDist | -0.3 | *fixed* | | |
| Cbutil | 0.108 | 2.33 | | |
| Calib WalkTime | | | -0.08 | |
| WalkTime | | | -0.0615 | -4.25 |
| Ln(MixRetP) | | | 0.119 | 0.81 |
| Ln(MixTotA) | 0.1 | *fixed* | | |

## F.7 HBsch (Home-Based School)

The HBsch model assumes fixed mode shares developed from OHAS data for all trips in the Eugene-Springfield-Coburg model area. Walk trips longer than one mile and bike trips longer than four miles (90$^{th}$ percentile OHAS distances) are disallowed and apportioned among remaining modes.

**TABLE 49. HBsch Mode Choice Model**

| Mode | HBsch Mode Share |
|---|---|
| Auto Driver | 0.276 |
| Auto Passenger | 0.164 |
| Transit | 0.028 |
| Walk | 0.391 |
| Bike | 0.049 |
| School Bus | 0.092 |

## G Time of Day Factors

Time of day travel is estimated separately for auto and transit, and the factors are direction-specific. Factors can be estimated for any hour by using start time data from the 2010-11 household activity survey. Hourly peaking factors for both Production->Attraction and Attraction->Production trip ends for all trip purposes are provided in the tables on the following pages.

**TABLE 50. Hourly peaking factors: HBW and HBO**

| Time Period | HBW Auto PA | HBW Auto AP | HBW Transit PA | HBW Transit AP | HBO Auto PA | HBO Auto AP | HBO Transit PA | HBO Transit AP |
|---|---|---|---|---|---|---|---|---|
| **0:00 - 0:59** | - | 0.0011 | - | - | - | 0.0015 | - | - |
| **1:00 - 1:59** | 0.0002 | 0.0007 | - | 0.0324 | - | 0.0005 | - | - |
| **2:00 - 2:59** | - | 0.0026 | - | - | - | - | - | - |
| **3:00 - 3:59** | 0.0043 | 0.0007 | - | - | 0.0002 | - | - | - |
| **4:00 - 4:59** | 0.0070 | - | - | - | 0.0025 | - | - | - |
| **5:00 - 5:59** | 0.0740 | - | 0.0200 | - | 0.0031 | 0.0005 | - | - |
| **6:00 - 6:59** | 0.0639 | 0.0005 | 0.0783 | - | 0.0122 | 0.0019 | 0.0033 | - |
| **7:00 - 7:59** | 0.1243 | 0.0046 | 0.2149 | - | 0.0309 | 0.0071 | 0.1423 | - |
| **8:00 - 8:59** | 0.0755 | 0.0036 | 0.0083 | 0.0462 | 0.0483 | 0.0140 | 0.0388 | 0.0244 |
| **9:00 - 9:59** | 0.0364 | 0.0129 | 0.0346 | - | 0.0364 | 0.0122 | 0.1199 | 0.0348 |
| **10:00 - 10:59** | 0.0221 | 0.0410 | - | 0.0052 | 0.0515 | 0.0286 | 0.0595 | 0.0039 |
| **11:00 - 11:59** | 0.0177 | 0.0110 | 0.0413 | 0.0031 | 0.0307 | 0.0388 | 0.0555 | 0.0167 |
| **12:00 - 12:59** | 0.0203 | 0.0181 | 0.0048 | 0.0366 | 0.0266 | 0.0294 | 0.0576 | 0.0858 |
| **13:00 - 13:59** | 0.0379 | 0.0308 | - | 0.0214 | 0.0317 | 0.0246 | - | 0.0167 |
| **14:00 - 14:59** | 0.0103 | 0.0239 | 0.0067 | - | 0.0510 | 0.0411 | 0.0529 | 0.0238 |
| **15:00 - 15:59** | 0.0051 | 0.0352 | - | 0.0316 | 0.0342 | 0.0370 | 0.0303 | 0.0284 |
| **16:00 - 16:59** | 0.0084 | 0.0759 | 0.0324 | 0.1855 | 0.0263 | 0.0507 | 0.0459 | 0.0632 |
| **17:00 - 17:59** | 0.0056 | 0.1125 | - | 0.1938 | 0.0382 | 0.0541 | - | 0.0251 |
| **18:00 - 18:59** | 0.0109 | 0.0340 | - | - | 0.0370 | 0.0592 | - | 0.0251 |
| **19:00 - 19:59** | 0.0010 | 0.0163 | - | - | 0.0180 | 0.0195 | - | - |
| **20:00 - 20:59** | 0.0002 | 0.0144 | - | 0.0026 | 0.0071 | 0.0281 | - | 0.0459 |
| **21:00 - 21:59** | 0.0009 | 0.0121 | - | - | 0.0078 | 0.0289 | - | - |
| **22:00 - 22:59** | 0.0069 | 0.0092 | - | - | 0.0012 | 0.0229 | - | - |
| **23:00 - 23:59** | 0.0035 | 0.0023 | - | - | 0.0002 | 0.0043 | - | - |

**TABLE 51. Hourly peaking factors: HBS and HBR**

| Time Period | HBS Auto PA | HBS Auto AP | HBS Transit PA | HBS Transit AP | HBR Auto PA | HBR Auto AP | HBR Transit PA | HBR Transit AP |
|---|---|---|---|---|---|---|---|---|
| **0:00 - 0:59** | - | - | - | - | - | - | - | - |
| **1:00 - 1:59** | - | - | - | - | - | - | - | - |
| **2:00 - 2:59** | - | - | - | - | - | 0.0057 | - | - |
| **3:00 - 3:59** | - | - | - | - | - | - | - | - |
| **4:00 - 4:59** | - | - | - | - | 0.0044 | - | - | - |
| **5:00 - 5:59** | 0.0015 | - | - | - | 0.0334 | 0.0010 | - | - |
| **6:00 - 6:59** | 0.0038 | 0.0004 | - | - | 0.0191 | 0.0305 | - | - |
| **7:00 - 7:59** | 0.0069 | 0.0041 | 0.0039 | - | 0.0207 | 0.0113 | - | - |
| **8:00 - 8:59** | 0.0098 | 0.0074 | 0.0039 | - | 0.0446 | 0.0055 | - | - |
| **9:00 - 9:59** | 0.0364 | 0.0175 | 0.0298 | - | 0.0310 | 0.0133 | 0.0359 | - |
| **10:00 - 10:59** | 0.0270 | 0.0267 | 0.0964 | 0.0039 | 0.0228 | 0.0231 | 0.5181 | - |
| **11:00 - 11:59** | 0.0321 | 0.0259 | 0.0270 | 0.0496 | 0.0228 | 0.0223 | - | - |
| **12:00 - 12:59** | 0.0233 | 0.0375 | 0.0579 | 0.0323 | 0.0154 | 0.0172 | - | 0.0263 |
| **13:00 - 13:59** | 0.0683 | 0.0665 | 0.0714 | 0.0435 | 0.0191 | 0.0175 | - | - |
| **14:00 - 14:59** | 0.0259 | 0.0529 | 0.1445 | 0.0824 | 0.0127 | 0.0106 | 0.0526 | 0.1120 |
| **15:00 - 15:59** | 0.0308 | 0.0424 | - | 0.2071 | 0.0208 | 0.0175 | - | 0.0359 |
| **16:00 - 16:59** | 0.0123 | 0.0483 | 0.0145 | 0.0053 | 0.0547 | 0.0420 | - | 0.0526 |
| **17:00 - 17:59** | 0.0245 | 0.0723 | - | 0.1123 | 0.0801 | 0.0566 | - | 0.1402 |
| **18:00 - 18:59** | 0.0137 | 0.0606 | - | 0.0145 | 0.0319 | 0.0396 | - | 0.0263 |
| **19:00 - 19:59** | 0.0424 | 0.0446 | - | - | 0.0563 | 0.0557 | - | - |
| **20:00 - 20:59** | 0.0052 | 0.0383 | - | - | 0.0031 | 0.0536 | - | - |
| **21:00 - 21:59** | 0.0268 | 0.0067 | - | - | 0.0072 | 0.0353 | - | - |
| **22:00 - 22:59** | 0.0255 | 0.0063 | - | - | 0.0007 | 0.0306 | - | - |
| **23:00 - 23:59** | - | 0.0255 | - | - | 0.0057 | 0.0047 | - | - |

**TABLE 52. Hourly peaking factors: College and School**

| Time Period | College Auto PA | College Auto AP | College Transit PA | College Transit AP | School Auto PA | School Auto AP | School Transit PA | School Transit AP |
|---|---|---|---|---|---|---|---|---|
| **0:00 - 0:59** | - | - | - | - | 0.0004 | 0.0004 | - | - |
| **1:00 - 1:59** | - | - | - | - | - | - | - | - |
| **2:00 - 2:59** | - | - | - | - | - | - | - | - |
| **3:00 - 3:59** | - | - | - | - | - | - | - | - |
| **4:00 - 4:59** | - | - | - | - | - | - | - | - |
| **5:00 - 5:59** | - | - | - | - | - | - | - | - |
| **6:00 - 6:59** | - | - | 0.0197 | - | 0.0035 | 0.0015 | 0.0072 | - |
| **7:00 - 7:59** | 0.0741 | - | 0.0354 | - | 0.0796 | 0.0102 | 0.4704 | - |
| **8:00 - 8:59** | 0.0116 | 0.0009 | 0.1626 | - | 0.2216 | 0.1718 | 0.0830 | - |
| **9:00 - 9:59** | 0.0343 | 0.0026 | 0.0928 | - | 0.0152 | 0.0266 | 0.0165 | - |
| **10:00 - 10:59** | 0.0239 | 0.0080 | 0.1771 | 0.0250 | 0.0043 | 0.0054 | 0.0062 | - |
| **11:00 - 11:59** | 0.3265 | 0.0111 | 0.0297 | 0.0704 | 0.1509 | 0.1357 | - | - |
| **12:00 - 12:59** | 0.0057 | 0.0463 | - | - | 0.0038 | 0.0188 | 0.0039 | - |
| **13:00 - 13:59** | 0.0040 | 0.0115 | 0.0208 | 0.0669 | 0.0025 | 0.0032 | - | 0.0165 |
| **14:00 - 14:59** | 0.0041 | 0.0106 | - | 0.0268 | 0.0315 | 0.0175 | - | 0.0807 |
| **15:00 - 15:59** | 0.0017 | 0.0271 | - | 0.0435 | 0.0106 | 0.0294 | - | 0.3056 |
| **16:00 - 16:59** | 0.0040 | 0.2505 | - | 0.0044 | 0.0016 | 0.0083 | - | 0.0039 |
| **17:00 - 17:59** | 0.0207 | 0.0910 | 0.0060 | 0.1584 | 0.0092 | 0.0105 | - | - |
| **18:00 - 18:59** | 0.0076 | 0.0066 | - | - | 0.0011 | 0.0202 | - | 0.0062 |
| **19:00 - 19:59** | - | - | - | 0.0547 | - | 0.0006 | - | - |
| **20:00 - 20:59** | - | 0.0086 | - | 0.0060 | 0.0011 | 0.0015 | - | - |
| **21:00 - 21:59** | - | 0.0055 | - | - | 0.0007 | 0.0007 | - | - |
| **22:00 - 22:59** | - | 0.0015 | - | - | - | - | - | - |
| **23:00 - 23:59** | - | - | - | - | - | - | - | - |

**TABLE 53. Hourly peaking factors: Non-Home, Externals, and Trucks**

| Time Period | NHBW Auto PA | NHBW Auto AP | NHBW Transit PA | NHBW Transit AP | NHBNW Auto OD | NHBNW Transit OD | Externals | Heavy Trucks | Medium Trucks |
|---|---|---|---|---|---|---|---|---|---|
| **0:00 - 0:59** | - | - | - | - | 0.0002 | - | 0.0132 | 0.0151 | 0.0055 |
| **1:00 - 1:59** | - | - | - | - | - | - | 0.0132 | 0.0161 | 0.0048 |
| **2:00 - 2:59** | - | - | - | - | - | - | 0.0132 | 0.0142 | 0.0062 |
| **3:00 - 3:59** | - | - | - | - | 0.0002 | - | 0.0132 | 0.0166 | 0.0068 |
| **4:00 - 4:59** | 0.0004 | 0.0004 | - | - | - | - | 0.0132 | 0.0217 | 0.0140 |
| **5:00 - 5:59** | 0.0004 | 0.0049 | - | - | 0.0008 | - | 0.0132 | 0.0297 | 0.0200 |
| **6:00 - 6:59** | 0.0024 | 0.0035 | - | - | 0.0038 | - | 0.0560 | 0.0445 | 0.0355 |
| **7:00 - 7:59** | 0.0136 | 0.0578 | - | 0.0174 | 0.0328 | 0.0138 | 0.0628 | 0.0564 | 0.0540 |
| **8:00 - 8:59** | 0.0111 | 0.0888 | - | 0.0096 | 0.0520 | 0.0100 | 0.0628 | 0.0609 | 0.0830 |
| **9:00 - 9:59** | 0.0195 | 0.0402 | 0.0141 | 0.2320 | 0.0580 | 0.0192 | 0.0558 | 0.0721 | 0.0869 |
| **10:00 - 10:59** | 0.0246 | 0.0440 | 0.0124 | - | 0.0635 | 0.0325 | 0.0558 | 0.0778 | 0.0847 |
| **11:00 - 11:59** | 0.0447 | 0.0514 | 0.0167 | - | 0.0759 | 0.0634 | 0.0558 | 0.0750 | 0.0837 |
| **12:00 - 12:59** | 0.0457 | 0.0432 | 0.1494 | 0.0096 | 0.0880 | 0.0677 | 0.0558 | 0.0717 | 0.0821 |
| **13:00 - 13:59** | 0.0456 | 0.0457 | - | 0.3149 | 0.1027 | 0.0538 | 0.0558 | 0.0691 | 0.0791 |
| **14:00 - 14:59** | 0.0351 | 0.0311 | 0.0174 | 0.0089 | 0.1223 | 0.0741 | 0.0596 | 0.0666 | 0.0801 |
| **15:00 - 15:59** | 0.0489 | 0.0418 | 0.0316 | 0.0220 | 0.1045 | 0.0905 | 0.0724 | 0.0573 | 0.0727 |
| **16:00 - 16:59** | 0.0774 | 0.0209 | 0.0279 | 0.0174 | 0.0775 | 0.1972 | 0.0724 | 0.0465 | 0.0551 |
| **17:00 - 17:59** | 0.1036 | 0.0052 | 0.0861 | 0.0052 | 0.0877 | 0.1865 | 0.0724 | 0.0364 | 0.0429 |
| **18:00 - 18:59** | 0.0221 | 0.0028 | - | - | 0.0309 | 0.0190 | 0.0596 | 0.0352 | 0.0330 |
| **19:00 - 19:59** | 0.0055 | 0.0059 | - | - | 0.0392 | - | 0.0326 | 0.0298 | 0.0227 |
| **20:00 - 20:59** | 0.0032 | 0.0025 | - | 0.0071 | 0.0346 | 0.1723 | 0.0326 | 0.0259 | 0.0169 |
| **21:00 - 21:59** | 0.0005 | 0.0009 | - | - | 0.0079 | - | 0.0326 | 0.0228 | 0.0120 |
| **22:00 - 22:59** | 0.0046 | - | - | - | 0.0169 | - | 0.0132 | 0.0200 | 0.0099 |
| **23:00 - 23:59** | 0.0002 | - | - | - | 0.0006 | - | 0.0132 | 0.0186 | 0.0084 |

# Appendix A – Metro Model Forecasting Model Structure