Southeast Florida Regional Planning Model -- SERPM 7.0

Coordinated Travel – Regional Activity Based Modeling Platform (CT-RAMP)

Model Development Report

DRAFT

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Introduction

This document describes the specification of the Southeast Florida Regional Planning Model, version 7.0 (SERPM 7.0). This model has been developed to ensure that the regional transportation planning process can rely on forecasting tools that will be adequate for new socioeconomic environments and emerging planning challenges. It is equally suitable for conventional highway projects, transit projects, and various policy studies such as highway pricing and managed lane analysis.

The SE Florida model is based on the CT-RAMP (Coordinated Travel Regional Activity-Based Modeling Platform) family of Activity-Based Models (ABM). The CT-RAMP framework, which is fully described in the following section, adheres to the following basic principles:

- The CT-RAMP design corresponds to the most advanced principles of modeling individual travel choices with maximum behavioral realism. In particular, it addresses both household-level and person-level travel choices including intra-household interactions between household members.
- Operates at a detailed temporal (half-hourly) level, and considers congestion and pricing effects on time-of-day and peak spreading.
- Reflects and responds to detailed demographic information, including household structure, aging, changes in wealth, and other key attributes.
- Is implemented in the Common Modeling Framework (CMF), an open-source library developed by Parsons Brinckerhoff specifically for implementing advanced travel demand models.
- Offers sensitivity to demographic and socio-economic changes observed or expected in the dynamic SE Florida metropolitan region. This is ensured by the enhanced and flexible population synthesis procedures as well as by the fine level of model segmentation. In particular, the SERPM ABM incorporates different household, family, and housing types including a detail analysis of different household compositions in their relation to activity-travel patterns.
- Accounts for the full set of travel modes. Our experience with previously developed ABMs has shown that mode choice is one of the least transferable model components, because each region has a specific mix of modes developed in the context of the regional urban conditions.
- Integrates with other model components. The CT-RAMP model is one component (person travel) and can easily integrate with other components such as the existing SERPM truck model.
- Provides detailed inputs to traffic micro-simulation software. The CT-RAMP models operates at a half-hour time scale, which can provide detailed inputs to traffic micro-simulation software for engineering-level analysis of corridor and intersection design.

SERPM 7.0 was developed by transferring the model developed for the San Diego Association of Governments (SANDAG). As described below, some model components were re-estimated using the SE Florida portion of the Florida 2009 NHTS Add-On. The entire model system was calibrated to match travel behavior targets developed with these data and other local data sources, including American Community Survey 5-Year estimates, Census 2010, and Department of Motor Vehicles registrations.

Model Features and Southeast Florida Planning Needs

The SERPM ABM is designed to meet the transportation planning needs of the Southeast (SE) Florida region, considering current and future projects and policies and also taking into account regional special markets. The model system addresses requirements of the metropolitan planning process, relevant federal requirements, and provides support to FDOT, the County MPOs and other stakeholders. The ABM structure fully complies with the following major planning applications:

- *RTP, TIP, and Air Quality Conformity Analysis*. The ABM will be carefully validated and calibrated to replicate observed traffic counts and other monitoring data sources with the necessary level of accuracy. The output of traffic assignment can be processed in a format required by the emission calculation software used by SE Florida.
- *Corridor Studies, Development Impact Studies, and other planning studies*. The ABM will produce traffic and transit forecasts at a level of detail suitable for routine planning studies conducted by FDOT, MPO staff and other model users.
- *FTA New Starts Analysis*. The ABM application software package includes an option that produces the model output in a format required by FTA for the New Starts process. This output can be used as a direct input to the FTA Summit program, used for the calculation and analysis of projectuser benefits. In order to meet the FTA "fixed total demand" requirement for comparison across the Baseline and Build alternatives, the ABM includes a run option for the Build alternative with certain travel dimensions fixed from the Baseline run.
- *Different highway pricing and managed lanes studies*. One of the advantages of an ABM over a 4-step model is a significantly improved sensitivity to highway pricing. Highway pricing may include various forms of toll roads, congestion pricing, dynamic real-time pricing, daily area pricing, license plate rationing and other innovative policies that cannot be effectively modeled with a simplified 4-step model. The explicit modeling of joint travel was specifically introduced to enhance modeling of HOV/HOT facilities.
- *Other transportation demand management measures*. There are many new policies aimed at reducing highway congestion in major metropolitan areas, including telecommuting and teleshopping, compressed work weeks, and flexible work hours. ABMs are specifically effective for modeling these types of policies since these models are based on an individual micro-simulation of daily activity-travel patterns.
- *Enhanced Environmental Justice analysis*. The model system features a full micro-simulation of the population, providing the ability to perform virtually unlimited market analysis. Winners and losers analyses can be performed across highly disaggregated user groups, providing information for Title VI and other types of environmental justice studies.

Person and Trip Market Segmentation

The SERPM7 ABM has its roots in a wide array of analytical developments. They include discrete choice forms (multinomial and nested logit), activity duration models, time-use models, models of individual micro-simulation with constraints, and entropy-maximization models, among others. These advanced modeling tools are combined in the ABM design to ensure maximum behavioral realism, replication of the observed activity-travel patterns, and ensure model sensitivity to key projects and policies. The model is implemented in a micro-simulation framework. Micro-simulation methods capture aggregate behavior through the representation of the behavior of individual decision-makers. In travel demand

modeling these decision-makers are typically households and persons. The following section describes the basic conceptual framework at which the model operates.

Treatment of Space

Activity-based and tour-based models can exploit more explicit geographic and location information, but the advantages of additional spatial detail must be balanced against the additional efforts required to develop zone and associated network information at this level of detail, as well as against the increases in model runtime associated primarily with path-building and assignment to more zones.

The use of a spatially disaggregate zone system helps ensure appropriate model sensitivity. Use of large zones may produce aggregation biases, especially in destination choice, where the use of aggregate data can lead to illogical parameter estimates due to reduced variation in estimation data, and in mode choice, where modal access may be distorted. Smaller zones help minimize these effects, and can also support more detailed network assignments. Strategies to address the modal access limitations of large zones through the use of transit sub-zonal procedures are discussed in the transit network section of this document.

The SERPM ABM operates on micro-zones (MAZs). The current SE Florida MAZ system design consists of approximately 12,000 zones. To avoid computational burden, SERPM 7.0 relies on a 4,200 Transportation Analysis Zone (TAZ) system for highway skims and assignment, but performs transit calculations at the more detailed MAZ level. This is accomplished by generalizing transit stops into pseudo-TAZs called Transit Access Points (TAPs), and relying on Cube to generate TAP-TAP skims such as in-vehicle time, first wait, transfer wait, and fare. All access and egress calculations and ultimate Origin MAZ – Boarding TAP – Alighting TAP- Destination MAZ path are computed within custom-built software, and rely upon detailed geographic information regarding MAZ-TAP distances and accessibilities. A graphical depiction of the MAZ – TAP transit calculations is given in Figure 1. All activity locations are tracked at the MAZ level.

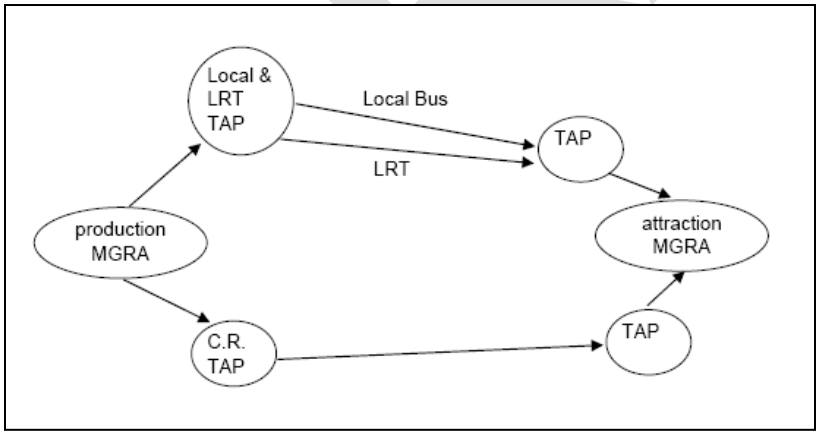


Figure 1: Example MAZ – TAP Transit Accessibility

Decision-Making Units

Decision-makers in the model system include both persons and households. These decision-makers are created (synthesized) for each simulation year based on tables of households and persons from 2005-

2009 American Community Survey (ACS) data and forecasted TAZ-level distributions of households and persons by key socio-economic categories. These decision-makers are used in the subsequent discrete-choice models to select a single alternative from a list of available alternatives according to a probability distribution. The probability distribution is generated from a logit model which takes into account the attributes of the decision-maker and the attributes of the various alternatives. The decision-making unit is an important element of model estimation and implementation, and is explicitly identified for each model specified in the following sections.

PersonType Segmentation

The SERMP 7.0 ABM system is implemented in a micro-simulation framework. A key advantage of using the micro-simulation approach is that there are essentially no computational constraints on the number of explanatory variables that can be included in a model specification. However, even with this flexibility, the model system will include some segmentation of decision-makers. Segmentation is a useful tool to both structure models (for example, each person type segment could have their own model for certain choices) and also as a way to characterize person roles within a household. Segments can be created for persons as well as households.

A total of eight segments of person-types, shown in Table 1, are used in SERPM 7.0. The person-types are mutually exclusive with respect to age, work status, and school status.

Further, workers are stratified by their occupation, to better match workers to jobs by industrial category. The occupation categories are shown in Table 2. These will be used to segment destination choice size terms for work location choice.

Table 1: Person Types

Number	Person-Type	Age	Work Status	School Status
1	Full-time worker	16+	Full-time	None
2	Part-time worker	16+	Part-time	None
3	College student	18+	Part-time or None	College +
4	Non-working adult	16 – 64	None	None
5	Non-working senior	65+	None	None
6	Driving age student	16 – 19	Part-time or None	Pre-college
7	Non-driving student	6 – 15	None	Pre-college
8	Pre-school	0 – 5	None	None

Table 2: Occupation Types

Number	Description
1	Unemployed
2	White collar labor
3	Service labor
4	Retail and food labor
5	Blue collar labor

Household Type Segmentation

Household-type segments are useful for pre-defining certain data items (such as destination choice size terms) so that these data items can be pre-calculated for each segment. Pre-calculation of these data items reduces model complexity and runtime. The household segmentation actually varies for any given model component, but to be complete the segmentation is presented here. The segmentation is based on household income, and includes five segments, as shown in Table 3.

Table 3: Household Types

Type	Description	Household Income (2009dollars)
1	Low Income	0-$25,000
2	Medium-Low Income	$25,000 - $50,000
3	Medium income	$50,000 - $75,000
4	Medium-High Income	$75,000 - $100,000
5	High Income	$100,000 or more

Activity Type Segmentation

The proposed set of activity types is shown in Table 4. The activity types are also grouped according to whether the activity is mandatory, maintenance, or discretionary, and eligibility requirements are assigned determining which person-types can be used for generating each activity type. The classification scheme of each activity type reflects the relative importance or natural hierarchy of the activity, where work and school activities are typically the most inflexible in terms of generation, scheduling and location, whereas discretionary activities are typically the most flexible on each of these dimensions. However, the order in which the activities are generated are scheduled is informed by both activity type and activity duration.

Each out-of-home location that a person travels to in the simulation is assigned one of these activity types.

Table 4: Activity Types

Type	Purpose	Description	Classification	Eligibility
1	Work	Working at regular workplace Work-related activities outside the home	Mandatory	Workers and students
2	University	College Technical / Vocational School	Mandatory	Age 18+
3	High School	Grades 9-12	Mandatory	Age 14-17
4	Grade School	Grades K-8	Mandatory	Age 5-13
5	Escorting	Pick-up/drop-off passengers (auto trips only)	Maintenance	Age 16+

6	Shopping	Shopping away from home	Maintenance	Age 5+(1)
7	Other Maintenance	Personal business/services Medical appointments	Maintenance	Age 5+(1)
8	Social/Recreational	Recreation Visiting friends or family	Discretionary	Age 5+(1)
9	Eat Out	Eating outside of home	Discretionary	Age 5+(1)
10	Other Discretionary	Volunteer work Religious activities	Discretionary	Age 5+(1)

(1) If joint travel, then all persons are eligible.

Treatment of Time

SERPM 7.0 functions at a temporal resolution of one-half hour. There are a total of 40 half-hour time periods, since the hours between midnight and 4:30 AM have been aggregated into a single period. Temporal integrity is ensured so that no activities are scheduled with conflicting time windows, with the exception of short activities/tours that are completed within a one-half hour increment. For example, a person may have a very short tour that begins and ends within the 8:00 am-8:30 am period, as well as a second longer tour that begins within this time period, but ends later in the day.

Time periods are typically defined by their midpoint in the scheduling software. For example, in a model system using 1/2-hour temporal resolution, the 9:00am time period would capture activities or travel between 8:45am and 9:15am. If there is a desire to break time periods at "round" half-hourly intervals, either the estimation data must be processed to reflect the aggregation of activity and travel data into these discrete half-hourly bins, or a more detailed temporal resolution must be used, such as half-hours (which could then potentially be aggregated to "round" half-hours).

A critical aspect of the model system is the relationship between the temporal resolution used for scheduling activities, and the temporal resolution of the network simulation periods. Although each activity generated by the model system is identified with a start time and end time in one-half hour increments, level-of-service matricesare created for more aggregate time periods. The SERPM implementation currently uses five aggregate periods – early A.M., A.M. Peak, Midday, P.M. Peak, and night. However, currently the three off-peak periods are represented by a single set of off-peak LOS matrices. The trips occurring in each time period reference the appropriate transport network depending on their trip mode and the mid-point trip time. The definition of the aggregate time periods is given in Table 5, below.

Table 5: Time Periods for Level-of-Service Skims and Assignment

Number	Description	Begin Time	End Time
1	Early	10:00 P.M.	5:59 A.M.
2	A.M.Peak	6:00 A.M.	8:59 A.M.
3	Midday	9:00 A.M.	2:59 P.M.
4	P.M.Peak	3:00 P.M.	6:59 P.M.
5	Evening	7:00 P.M.	9:59 P.M.

Trip Modes

Table 5 lists the trip modes defined in the SERPM 7.0ABM. There are 26 modes, including auto by occupancy and path choice (free, HOV, toll), walk and bike non-motorized modes, and walk and drive access to five different transit line-haul modes. The model allows drive egress for commuter rail trips.

Table 6: Trip Modes

Number	Mode
1	Auto SOV (Non-Toll)
2	Auto SOV (Toll)
3	Auto 2 Person (Non-Toll, Non-HOV)
4	Auto 2 Person (Non-Toll, HOV)
5	Auto 2 Person (Toll, HOV)
6	Auto 3+ Person (Non-Toll, Non-HOV)
7	Auto 3+ Person (Non-Toll, HOV)
8	Auto 3+ Person (Toll, HOV)
9	Walk-Local Bus
10	Walk-Express Bus
11	Walk-Bus Rapid Transit
12	Walk-Urban Rail
13	Walk-Commuter Rail
14	PNR-Local Bus
15	PNR-Express Bus
16	PNR-Bus Rapid Transit
17	PNR-Urban Rail
18	PNR-Commuter Rail
19	KNR-Local Bus
20	KNR-Express Bus
21	KNR-Bus Rapid Transit
22	KNR-Urban Rail
23	KNR-Commuter Rail
24	Walk
25	Bike
26	School Bus

General Model Design

The general design of the SERPM 7.0 CT-RAMP implementation is shown in Figure 2 below. The following outline describes the basic sequence of sub-models and associated travel choices:

1. ***Synthetic population:***
   - 1.1. Zonal distributions of population by controlled variables
   - 1.2. Household residential location choice (allocation to zones)
2. ***Long term level:***
   - 2.1. Usual location for each mandatory activity for each relevant household member (workplace/university/school)
3. ***Mobility Level:***
   - 3.1. Free Parking Eligibility (determines whether workers pay to park if workplace is an MGRA with parking cost)
   - 3.2. Household car ownership
   - 3.3. Transponder ownership for use of toll lanes
4. ***Daily pattern/schedule level:***
   - 4.1. Daily pattern type for each household member (main activity combination, at home versus on tour) with a linkage of choices across various person categories, and an indicator at the household level determining whether one or more joint tours is made by 2 or more household members
   - 4.2. Individual mandatory activities/tours for each household member (note that locations of mandatory tours have already been determined in long-term choice model)
     - 4.2.1. Frequency of mandatory tours
     - 4.2.2. Mandatory tour time of day (departure/arrival time combination)
   - 4.3. Joint travel tours (conditional upon the available time window left for each person after the scheduling of mandatory activities)
     - 4.3.1. Joint tour frequency
     - 4.3.2. Travel party composition (adults, children, mixed)
     - 4.3.3. Person participation in each joint tour
     - 4.3.4. Primary destination for each joint tour
     - 4.3.5. Joint tour time of day (departure/arrival time combination)
   - 4.4. Individual non-mandatory activities/tours (conditional upon the available time window left for each person after the scheduling of mandatory and joint activities)
     - 4.4.1. Person frequency of non-mandatory tours
     - 4.4.2. Non-mandatory tour primary destination
     - 4.4.3. Non-mandatory tour departure/arrival time

4.5. Individual at-work subtours (conditional upon the available time window within the work tour duration)

4.5.1. Person frequency of at-work sub-tours

4.5.2. Primary destination for each at-work sub-tour

4.5.3. At-work sub-tour departure/arrival time

5. Tour level

5.1. Tour mode

5.2. Frequency of secondary stops (and their purpose)

5.3. Location of secondary stops

5.4. Departure time for secondary stops

6. Trip level

6.1. Trip mode choice conditional upon the tour mode

6.2. Auto trip parking location choice

6.3. Trip assignment

Choices that relate to the entire household or a group of household members and assume explicit modeling of intra-household interactions (sub-models 3.2, 4.1, 4.3.1, 4.3.2) are shadowed in **Figure 2**. The other models are assumed to be individual-based for the basic design.

The model system uses synthetic household population as a base input (sub-model 1). It is followed by long-term choices that relate to the usual workplace/university/school for each worker and student (sub-model 2.1). Medium-term mobility choices relate to free parking eligibility for workers in parking constrained areas (sub-model 3.1), household car ownership (sub-model 3.2), and transponder ownership (sub-model 3.3). The daily activity pattern type of each household member (model 4.1) is the first travel-related sub-model in the modeling hierarchy. This model classifies daily patterns by three types: 1) mandatory (that includes at least one out-of-home mandatory activity), 2) non-mandatory (that includes at least one out-of-home non-mandatory activity, but does not include out-of-home mandatory activities), and 3) home (that does not include any out-of-home activity and travel). However, the pattern type sub-model leaves open the frequency of tours for mandatory and non-mandatory purposes (maintenance, discretionary) since these sub-models are applied later in the model sequence.

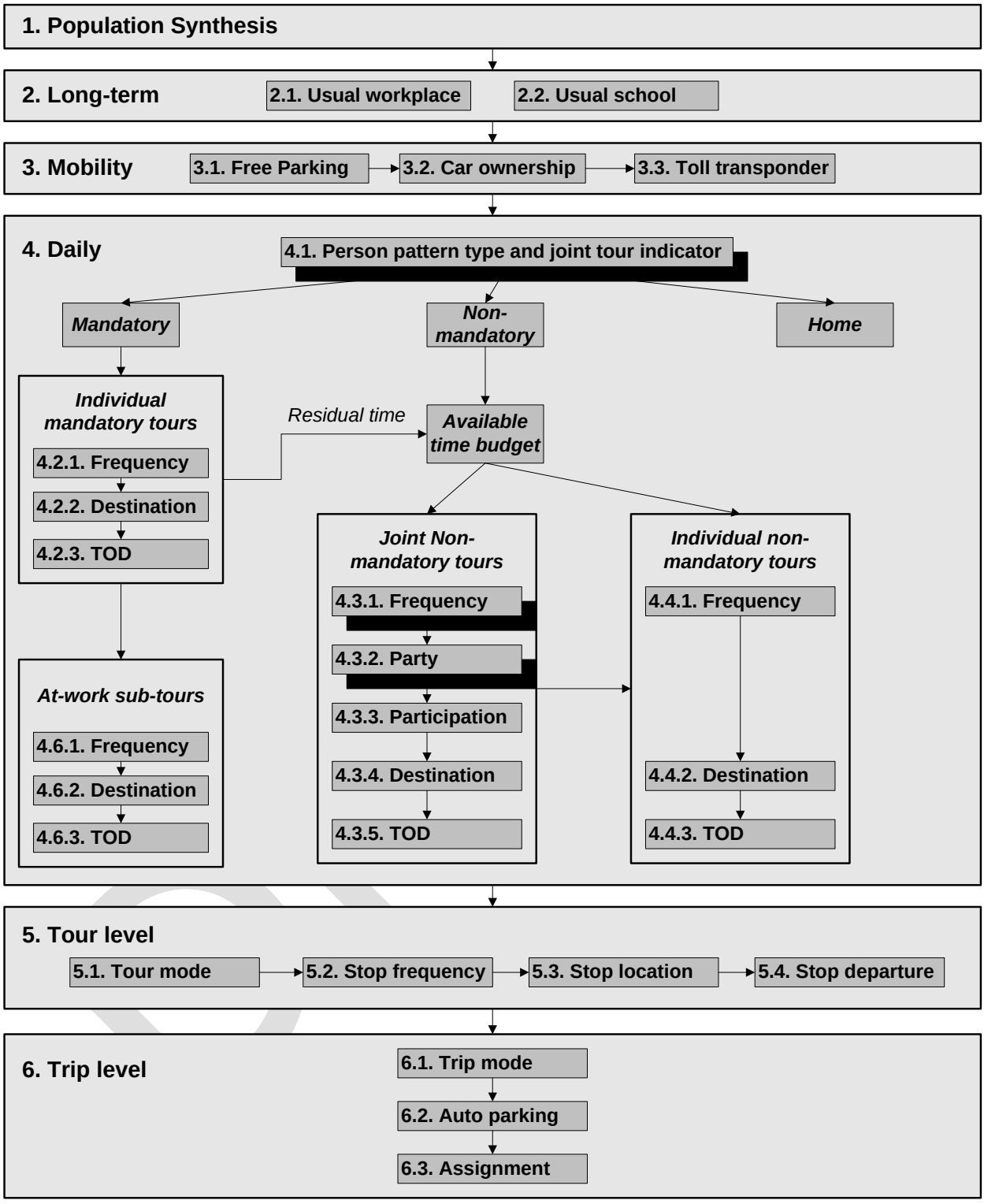


Figure 2: Basic Model Design and Linkage between Sub-Models

The pattern choice set contains a non-travel option in which the person can be engaged in in-home activity only (purposely or because of being sick) or can be out of town. In the model system application, a person who chooses a non- travel pattern is not considered further in the modeling stream. Daily pattern-type choices of the household members are linked in such a way that decisions made by some members are reflected in the decisions made by the other members.

The next set of sub-models (4.2.1-4.2.2) defines the frequency and time-of-day for each mandatory tour. The scheduling of mandatory activities is generally considered a higher priority decision than any decision regarding non-mandatory activities for either the same person or for the other household members. As the result of the mandatory activity scheduling, "residual time windows" are calculated for each person and their overlaps across household members are estimated. Time window overlaps, which are left in the daily schedule after the mandatory commitment of the household members has been made, constitute the potential for joint activity and travel.

At-work sub-tours are modeled next, taking into account the time-window constraints imposed by their parent work tours (sub-models 4.5.1-4.5.3).

The next major model component relates to joint household travel. This component produces a number of joint tours by travel purpose for the entire household (4.3.1), travel party composition in terms of adults and children (4.3.2), and then defines the participation of each household member in each joint household tour (4.3.3). Model 4.3.1 only generates joint tours if the CDAP model 4.1 generates a joint tour indicator for the household. It is followed by choice of destination (4.3.4) and time-of-day (4.3.5).

The next stage relates to non-mandatory tours--shopping, escort, other maintenance, visit, eating out and other discretionary tours. Non-mandatory tours are generated by individuals (4.4.1). Their destination and time of day are chosen next (4.4.2 and 4.4.3).

The next set of sub-models relate to the tour-level details on mode (5.1), exact number of intermediate stops on each half-tour (5.2), stop location (5.3), and stop departure time (5.4). It is followed by the last set of sub-models that add details for each trip including trip mode details (6.1) and parking location for auto trips (6.2). The trips are then assigned to highway and transit networks depending on trip mode (6.3).

Model Input Data and Calibration Target Data

Zonal Data

The input zonal data for SERPM7 includes household and population socio-economic data, employment data, school enrollment data, parking supply data, hotel and motel room data, airport enplanements data and vehicle volumes at external stations. The household, person, school enrollment and employment data are prepared and maintained by the Miami-Dade, Broward, and Palm Beach MPOs, each for their respective county. The parking supply data for 2010 was developed from parking facility inventories conducted by Florida DOT District 4 and 6. The other input data were obtained from published sources and FDOT traffic counts.

As indicated above, SERPM7 operates at two levels of spatial detail – TAZs and MAZs. The household and population socio-economic data are required at the TAZ level. These data are used as population synthesis control totals. A summary of the 2010 input person and household employment data is shown in The transit lines are divided into five modal groups: local bus, express bus, bus rapid transit, urban rail (light and heavy), and commuter rail. There are four transit operators in the region, each employing a different fare structure – Miami-Dade Transit, Broward Transit, Palm Tran, and Tri-Rail. A detailed line mode code identifies the operator and type of service, for coding purposes. Table 11 shows the correspondence between transit providers and the mode codes for the different types of the transit services existing and planned in SE Florida.

Table 11: SERPM 7 Classification of Transit Providers and Modes

Route Type	Operator / Fares System Code		Mode	
	Code	Name	Code	Name
Tri-Rail	11	Tri-Rail	111	Commuter
Metrorail	25	Metrorail	121	Urban Rail
Regional LRT		Regional LRT	131	Urban Rail
Inter-County Express Bus	33	I-95 Inter-County Express	151	Express
Exclusive ROW Cir-Reg	13	Exclusive ROW Circulator	181	Local
Trolleys/Shuttles-Reg	12	Tri-Rail Shuttles	191	Local
Trolleys/Shuttles-Reg	12	Tri-Rail Shuttles	192	Local
LRT	25	MDT LRT	231	Urban Rail
Busway Flyers	27	MDT Busway Flyers	241	BRT
MAX/KAT Buses	27	MDT MAX/KAT	242	Express
BRT	28	MDT BRT	243	BRT
Express	22	MDT Express	251	Express
I-95 Express	24	MDT I-95 Express	252	Express
Inter-County Express	24	I-95 Inter-County Express	253	Express
Metromover	26	Metromover	281	Local
Trolleys/Shuttles	21	MDT Trolleys/Shuttles	291	Local
Local Bus	21	MDT Local	292	Local
Shuttle	23	MDT Shuttle	293	Local
LRT	35	BCT LRT	331	Urban Rail
Rapid Bus	34	BCT Rapid Bus	341	Local

BRT	35	BCT BRT	342	BRT
Breeze	32	BCT Breeze	351	Express
Express	33	BCT Express	352	Express
Exclusive ROW Circulator	31	BCT Exclusive ROW Circ.	381	Local
Trolleys/Shuttles	31	BCT Trolleys/Shuttles	393	Local
Local Bus	31	BCT Local	391	Local
Local Bus	31	BCT Local	392	Local
LRT	43	Palm Tran LRT	431	Urban Rail
BRT	43	Palm Tran BRT	441	BRT
Express	42	Palm Tran Express	451	Express
Exclusive ROW Circulator	41	Palm Tran Exclusive ROW Cir.	481	Local
Trolleys/Shuttles	41	Palm Tran Trolleys/Shuttles	491	Local
Local Bus	41	Palm Tran Local	492	Local

. The employment and school enrollment data are required at the MAZ level. A summary of the 2010 input employment and school enrollment data is shown in Table 8. The parking supply, hotel/motel room data and special generator input data are described in Table 9.

Transportation Networks

The SERPM7 highway network is maintained in Cube Voyager format. This network includes all streets of facility type collector or above. The facility type codes are consistent with those used in previous SERPM versions (see **Error! Reference source not found.**).

The SE Florida region includes multiple toll facilities and HOV lanes. In 2010 there is one managed lane facility, the I-95 express lanes. Additional express lane facilities are anticipated in future year networks. The cost of using the toll facilities is coded on the network links, at the point where the cost is incurred (i.e., location of toll plazas and collection points). The cost of using the managed lanes is computed as a function of the volume-to-capacity ratio on the managed lane facility, based on a function developed by Florida Turnpike.

The allowable occupancy levels on all managed lane facilities (HOV and HOT), as well as the toll discounts, when applicable, are handled entirely via facility type coding and attribute fields in the input network. Similarly, the input network includes an attribute to account for reversible lanes, which are expected to operate on I-595 in the near future.

Free-flow speeds are calculated following a methodology adapted from the one proposed in NCHRP 387. In brief, the free-flow speed is calculated as a linear function of the posted speed limit. A further adjustment to the speed is made on signal-controlled facilities. A description of the free-flow speed methodology is available in Appendix B.

The routing, access, mode and fare information for each transit line and each transit provider in the region is maintained in a set of transit network files. The transit data also includes auxiliary data, such as the number of spaces at park and ride nodes, fixed-guideway links coded on the highway network, and station micro-coding links. The walk access links are generated from MAZ centroids to each transit stop within ¾ mile, and drive access links are generated to the four closest park and ride lots to each zone.

Table 7: Person and Household Socio-Economic 2010 Input Data

	Miami-Dade	Broward	Palm Beach	Region
Households	867,352	686,047	547,809	2,101,208
Households, 1 person	204,223	197,539	165,614	567,376
Households, 2 person	237,847	214,137	198,656	650,640
Households, 3 person	161,975	111,564	75,194	348,733
Households, 4 person	263,307	162,807	108,345	534,459
Households, Income < $25,000	254,021	155,630	121,030	530,681
Households, $25,000 < Income < $50,000	222,946	174,102	133,873	530,921
Households, $50,000 < Income < $75,000	149,689	128,825	100,573	379,087
Households, $75,000 < Income < $100,000	87,976	81,493	65,440	234,909
Households, Income > $100,000	152,720	145,998	126,893	425,611
Households, 0 workers	202,757	171,286	191,053	565,096
Households, 1 workers	351,439	276,823	198,347	826,609
Households, 2 workers	243,893	194,671	129,409	567,973
Households, 3+ workers	69,263	43,267	29,000	141,530
Households, SFDU	501,897	373,044	253,793	1,128,734
Households, MFDU	351,905	294,603	278,474	924,982
Households, Other DU	13,520	18,400	15,542	47,462
Households, no Children	554,117	464,846	399,407	1,418,370
Households, with Children	313,235	221,201	148,402	682,838
Persons	2,475,945	1,731,174	1,307,193	5,514,312
Persons, age 0 to 17 years old	545,285	390,635	268,570	1,204,490
Persons, age 18 to 24 years old	236,807	144,108	100,360	481,275
Persons, age 25 to 34 years old	337,103	221,622	145,525	704,250
Persons, age 35 to 49 years old	566,632	391,618	258,937	1,217,187
Persons, age 50 to 64 years old	438,460	337,940	252,374	1,028,774
Persons, age 65 to 79 years old	253,871	168,327	185,577	607,775
Persons, age 80 and older	97,787	76,924	95,850	270,561
Persons, Hispanic non-white	1,617,906	428,410	248,940	2,295,256
Persons, Hispanic white	377,570	766,285	785,551	1,929,406
Persons, other race/ethnicity	480,469	536,479	272,702	1,289,650
Persons, male	1,193,747	836,411	630,453	2,660,611
Persons, female	1,282,198	894,763	676,740	2,853,701
Group quarters	40,057	16,894	19,970	76,921
Group quarters, institutionalized	20,640	10,931	12,309	43,880
Group quarters, college	10,608	1,152	4,167	15,927
Group quarters, other	8,809	4,811	3,494	17,114

Table 8: Employment and Student Enrollment 2010 Input Data

	Miami-Dade	Broward	Palm Beach	Region
Total Employment	**1,125,068**	**867,879**	**637,711**	**2,630,658**
Agriculture, Mining, Forestry, Fishing	3,974	2,240	4,365	10,579
Construction	71,076	77,494	49,516	198,086
Utilities	4,120	487	1,111	5,718
Manufacturing	67,621	49,355	27,661	144,637
Wholesale Trade, Warehousing	78,459	50,973	26,801	156,233
Transportation	42,784	23,661	10,241	76,686
Retail Trade	138,084	113,544	80,732	332,360
Professional, Business Services	257,597	230,949	167,801	656,347
Post-Secondary Education	21,210	13,644	10,912	45,766
Health Services	112,649	69,207	65,972	247,828
Personal Services	102,421	79,824	55,945	238,190
Amusement Services	19,217	25,257	21,581	66,055
Hotel and Motel Services	22,714	11,270	10,840	44,824
Restaurant and Bar Services	77,159	59,708	48,102	184,969
Government	53,767	28,475	29,144	111,386
Elementary and Secondary Education	52,216	31,791	26,987	110,994
School & College Enrollment	**635,545**	**381,969**	**247,290**	**1,264,804**
University and College	241,267	101,377	51,775	394,419
Public Schools Grade K to 8	237,904	156,874	125,176	519,954
Public Schools Grade 9 to 12	102,704	67,758	48,828	219,290
Private Schools Grade K to 8	36,205	34,297	17,458	87,960
Private Schools Grade 9 to 12	17,465	21,663	4,053	43,181

Table 9: Other Land Use Input Data Items

Data Item	Description
Parking Supply	
Spaces available for hourly parking	Number of stalls, separately for on/off-street facilities
Cost of hourly parking	In 2010 constant dollars
Spaces available for daily parking	Number of stalls, separately for on/off-street facilities
Cost of daily parking	In 2010 constant dollars
Spaces available for monthly parking	Number of stalls, separately for on/off-street facilities
Cost of monthly parking	In 2010 constant dollars, equivalent cost per day
Hotel and motel rooms	
Regional shopping mall flag	Indicates whether MAZ contains a special generator regional mall
Beach flag	Indicates whether MAZ contains a special generator beach

Table 10: Facility Type Codes and Capacity Calculation Attributes

FTC1: MAJOR Classification	FTC2: MINOR Classification	Capacity Lookup Table	Capacity Calculation Attributes							Capacity Adjustment Attributes		
			FREEWAY (FRWY)	UNINTERRUPTED (UNINTRP)	HOV	KTOLL	LOWSPEED (LOWSPD)	SIGNAL SPACING (SIG_SPACE)	POSTED SPEED (POSTSPD)	TWOWAY	DIVIDED	LEFTTURN
10 FREEWAYS	11 Freeway Segments	FRWYPCE.DAT	1									
	12 Freeway Segments (I 595 - Broward)	FRWYPCE.DAT	1									
20 UNINTERRUPTED ROADWAYS	21 Uninterrupted Segments	HWYPCE.DAT		1				**> 1.5**	**>40**	X	X	X
40 Higher Speed Interrupted Facility	41 Higher Speed Interrupted Facility	ARTPCE.DAT						**<= 1.5**	**>=35**	X	X	X
50 CENTROID CONNECTORS	51 Internal	n/a										
	52 External	n/a										
60 Lower Speed Facility & Collector	61 Lower Speed Facility & Collector	LOWPCE.DAT					1		**< 35**	X	X	X
70 RAMPS	71 On	ONPCE.DAT										
	72 Loop On	LONPCE.DAT										
	73 Off	OFFPCE.DAT										
	74 Loop Off	LOFFPCE.DAT										
	75 Freeway-to-Freeway (included in FRWY)	FRWYPCE.DAT	1									
80 HOV	81 **2+ Persons HOV Segments**	FRWYPCE.DAT	1		1							
	82 **3+ Persons HOV Segments**	FRWYPCE.DAT	1		1							
	83 AM and PM Peak Only Ramps	**n/a**			**1**							
	84 AM Peak Only Ramps	**n/a**			**1**							
	85 PM Peak Only Ramps	**n/a**			**1**							
	86 All Day Ramp	**n/a**			**1**							
90 TOLL	91 Freeway Segments	FRWYPCE.DAT	1			1						
	92 Uninterrupted Segments	HWYPCE.DAT	1			1						
	93 On	TONPCE.DAT				1						
	94 Off	TOFFPCE.DAT				1						
	95 Toll Plaza	n/a				1						

NOTES:

1. Posted Speed and Signal Spacing determine the "Uninterrupted" designation for Non-Toll and Non-HOV facilities.
Toll and HOV facilities are considered to be freeway segments. CDs, Expressways, and Parkways are considered Uninterrupted regardless of posted speed.

2. All possible variables/adjustments are shown here; some may not be triggered for a given link depending on whether the roadway is divided, is oneway and/or has a left-turn bay.

The transit lines are divided into five modal groups: local bus, express bus, bus rapid transit, urban rail (light and heavy), and commuter rail. There are four transit operators in the region, each employing a different fare structure – Miami-Dade Transit, Broward Transit, Palm Tran, and Tri-Rail. A detailed line mode code identifies the operator and type of service, for coding purposes. Table 11 shows the correspondence between transit providers and the mode codes for the different types of the transit services existing and planned in SE Florida.

Table 11: SERPM 7 Classification of Transit Providers and Modes

Route Type	Operator / Fares System Code		Mode	
	Code	Name	Code	Name
Tri-Rail	11	Tri-Rail	111	Commuter
Metrorail	25	Metrorail	121	Urban Rail
Regional LRT		Regional LRT	131	Urban Rail
Inter-County Express Bus	33	I-95 Inter-County Express	151	Express
Exclusive ROW Cir-Reg	13	Exclusive ROW Circulator	181	Local
Trolleys/Shuttles-Reg	12	Tri-Rail Shuttles	191	Local
Trolleys/Shuttles-Reg	12	Tri-Rail Shuttles	192	Local
LRT	25	MDT LRT	231	Urban Rail
Busway Flyers	27	MDT Busway Flyers	241	BRT
MAX/KAT Buses	27	MDT MAX/KAT	242	Express
BRT	28	MDT BRT	243	BRT
Express	22	MDT Express	251	Express
I-95 Express	24	MDT I-95 Express	252	Express
Inter-County Express	24	I-95 Inter-County Express	253	Express
Metromover	26	Metromover	281	Local
Trolleys/Shuttles	21	MDT Trolleys/Shuttles	291	Local
Local Bus	21	MDT Local	292	Local
Shuttle	23	MDT Shuttle	293	Local
LRT	35	BCT LRT	331	Urban Rail
Rapid Bus	34	BCT Rapid Bus	341	Local
BRT	35	BCT BRT	342	BRT
Breeze	32	BCT Breeze	351	Express
Express	33	BCT Express	352	Express
Exclusive ROW Circulator	31	BCT Exclusive ROW Circ.	381	Local
Trolleys/Shuttles	31	BCT Trolleys/Shuttles	393	Local
Local Bus	31	BCT Local	391	Local
Local Bus	31	BCT Local	392	Local
LRT	43	Palm Tran LRT	431	Urban Rail
BRT	43	Palm Tran BRT	441	BRT
Express	42	Palm Tran Express	451	Express
Exclusive ROW Circulator	41	Palm Tran Exclusive ROW Cir.	481	Local
Trolleys/Shuttles	41	Palm Tran Trolleys/Shuttles	491	Local
Local Bus	41	Palm Tran Local	492	Local

Calibration Target Data

In 2008 Florida participated in the National Household Travel Survey (NHTS) Add-On program, which collected travel data from approximately 15,900 households throughout the state. In Southeast Florida, the NHTS sampled 4,524 households, of which 2,662 were usable for understanding and modeling typical weekday travel. The unusable households reported weekend travel, were poorly geo-coded, or were missing adult travel diaries. The Southeast Florida 2008 NHTS Add-On suffered from various methodological problems that limited, though not precluded, its usefulness for activity-based travel demand modeling purposes. The most critical limitations include the following:

- *Small sample size.* Given a sampling rate of approximately 1 observation for every 1,000 households in the region, on average, the survey was not large enough to support detailed analyses of travel behavior in the region, particularly for subareas and/or subpopulations within the region. Because certain infrequent populations were under-sampled, some households in the Southeast Florida NHTS exhibit expansion factors substantially higher than 1,000, and as high as 17,000. The wide spread exhibited by the expansion factors can cause biases when the data are tabulated across multiple dimensions, since certain households have very influential weights.
- *Captured weekend only travel for some households*. More than one-quarter of all the households recruited for the Southeast Florida NHTS Add-On were assigned to report travel on a weekend day. Since SERPM7 forecasts typical weekday travel only, the entire weekend subsample was not usable for modeling purposes.
- *Over-sampled households that include retired persons*. Approximately 37% of all the persons that returned complete travel diaries are non-working adults age 65 or older. In reality, this subgroup represents only approximately 20% of the total population. It is possible to weight the observations so that estimates of total trip making are not biased by the over-representation of the retired population. There is however a substantial loss of information because other types of households, such as households with working adults, households with workers that commute long distances, transit-using households and households with children represent, overall, a small sample in absolute terms.
- *Incomplete household diaries*. To reduce respondent burden, NHTS by design omitted collecting the trip diaries of children younger than 5 years old, and accepted a household as a complete observation if at least half of the adult household members returned a diary. The SERPM7 modeling framework is designed to forecast travel accounting for the interactions among household members, and in doing so more closely approximates real, observed travel behavior. For this reason the estimation and calibration of the model requires travel data from all members of a household. Approximately one-tenth of the NHTS Add-on sample was not usable for certain models due to missing adult trip diaries.
- *Failed to capture seasonal residents* in large enough numbers. Although Florida added a question to the NHTS to identify seasonal residents, the sample was not designed to specifically target this subpopulation. As a result, very few of the surveyed households are in fact seasonal residents. The subsample of seasonal resident households is too small to support any type of comparative travel behavior analysis.
- *Sample design failed to capture key behaviors in sufficiently large numbers.* Due to the national nature of NHTS, the sample design was not adjusted to local conditions, and as a result infrequent but important behaviors were not captured in sufficiently large samples to provide confidence in the observed patterns. Among the more important behaviors that were missed one can cite current transit users and people making long commutes.

- NHTS did not ask for information that is critical to understand certain travel choices in Southeast Florida, such as the availability of free/subsidized parking at work, whether workers hold more than one job, whether the usual workplace is a fixed or variable location, work schedule flexibility, regular use of a transit pass or other discounted fare, and use/ownership of a SUNPASS transponder to pay tolls, among others.

In spite of these limitations, the 2008 NHTS data were used intensively in the development of SERPM7. While the sample is insufficiently large to support the original estimation of most of the submodels that comprise SERPM7, it provided sufficient information to develop region-wide calibration targets for most submodels. In developing these calibration targets, the NHTS data were supplemented with a wide variety of other data sources, including Census and American Community Survey data, Longitudinal Employment – Household Dynamics data, data from the Florida Department of Motor Vehicles, SUNPASS account sales data, transit on-board survey data, transit ridership data, and school attendance data, among others. The SERPM7 calibration targets were compared to similar targets developed for other regions, to verify that the aggregate tabulations of travel behavior across various person types and types of travel exhibited similar relationships.

Because the SERPM7 models could not be estimated with local data, a complete model specification was adopted, patterned after the San Diego Association of Governments (SANDAG) activity-based model. The adequacy of the model transfer was evaluated by examining how well the transferred model, without updates, matched the calibration targets developed from NHTS data. The transferred model was in fact able to reproduce fairly well the Southeast Florida travel behavior at an aggregate level. The submodels that performed least well are, not surprisingly, the tour and trip location models. This can be explained partly by differences in model region size between San Diego County and Southeast Florida, and partly also due to differences in multi-modal accessibilities and the composition and location of employment. The development of the tour-level mode choice models also relied on various relationships of transit tours to transit trips obtained from a recent Atlanta on-board survey, given the near lack of transit tour observations in the NHTS Southeast Florida sample.

All models were calibrated to SE Florida conditions, as ascertained by comparisons to the targets developed from the wide range of local, available data. In addition, the highway and transit assignments were validated to available traffic counts and transit ridership estimates.

Core Demand Sub-Models and Procedures

This section describes each model component in greater detail, including the general algorithm for each model, the decision-making unit, the choices considered, the market segmentation utilized (if any), and the explanatory variables used.

Model 1.1—Population Synthesis

The population synthesis procedure takes into account zonal and regional controls and includes a procedure to allocate households to MAZs. A synthetic population is created using thePopSynII software designed for the San Diego Association of Governments. The population synthesizer takes as an input disaggregate household and person records as well as zonal-level marginal distributions of households and persons by various characteristics. These marginal distributions are used as controls which the synthetic population attempts to match.

The population synthesis approach includes the following steps:

1. Create a sample of households in each TAZ.
2. Balance the individual household weights to ensure the controlled totals across all person and household dimensions.
3. Create a list of households and persons by discretizing the individual weights.

The advantage of working with the list of households compared to a multi-way distribution is that both person and household variables can be incorporated. If only household or person attributes are controlled, the proposed procedure yields exactly the same multidimensional distribution as conventional matrix balancing.

General Formulation

Since the population synthesis procedure is applied for each TAZ separately we formulate the model for a single TAZ. Introduce the following notation:

$i = 1,2...I$	=	household and person controls,
$n \in N$	=	seed set of households in the PUMA (or any other sample),
w_n	=	a priori weighs assigned in the PUMA (or any other sample),
A^i	=	zonal controls,
$a_n^i \geq 0$	=	coefficients of contribution of household to each control.

The principal flexibility of the procedure is that the contribution coefficients can take any non-negative value while in the conventional procedure the contribution coefficients are implied to be Boolean incidence indicators (belong or not belong). An example is shown in Table 12 below for controls specified by household size and person age brackets.

Table 12: Controls and contribution coefficients

HH ID	HH size				Person age				HH initial weight
	1	2	3	4+	0-15	16-35	36-64	65+	
	i = 1	i = 2	i = 3	i = 4	i = 5	i = 6	i = 7	i = 8	ω_n
$n=1$	1							1	20
$n=2$		1			1	1			20
$n=3$			1			1	2		20
$n=4$				1		2	2		20
$n=5$				1	1	3	2		20
….									…
Control	100	200	250	300	400	400	650	250	

The first household has one person of age 65+. The second household has two persons: one of age 0-15 and another one of age 16-35. The third household has three persons: one of age 16-35 and another two of age 36-64. The fourth household has four persons: two of age 16-35 and another two of age 36-64. The fifth household has size persons: one person of age 0-15, three persons of age 16-35, and two persons of age 36-64.

The balancing problem can be written as a convex mathematical program of the entropy-maximization type in the following way:

$$\min_{\{x_n\}} \sum_n x_n \ln \frac{x_n}{w_n}, \qquad (1)$$

Subject to constraints:

$$\sum_n a_n^i x_n = A^i, (\alpha^i), \qquad (2)$$

$$x_n \geq 0\ , \qquad (3)$$

where α^i represents dual variables that give rise to balancing factors.

The objective function expresses the principle of using all households uniformly (proportionally to the assigned *a priori* weight). The constraints ensure matching the controls.

By forming the Lagrangian and equating the derivatives to zero we obtain the following solution:

$$x_n = k \times w_n \times exp\left(\sum_i a_n^i \alpha^i\right) = w_n \times \prod_i \left[exp\left(\alpha^i\right)\right]^{a_n^i} = w_n \times \prod_i \left(\hat{\alpha}^i\right)^{a_n^i}, \qquad (4)$$

where $\hat{\alpha}^i$ represents balancing factors that have to be calculated. Note that the balancing factors correspond to the controls, not to households. For each household, the weight is calculated as a product of the initial weight by the relevant balancing factors exponentiated according to the

participation coefficient. A zero participation coefficient automatically results in a balancing factor reset to 1 that does not affect the household weight.

Solution Algorithm

The problem formulated in the previous section has a unique solution that can be achieved by the following iterative procedure:

Step 0: Set the iteration counter $k = 1$. Set zero-iteration weight $x_n(0,0) = w_n$.

For $k = 1$ to K (number of iterations):

For $i = 1$ to I (number of controls):

Step 1: Calculate balancing factor

$$\hat{\alpha}^i(k,i) = \frac{A^i}{\sum_n a_n^i x_n(k-1,i-1)}. \quad (5)$$

Step 2: Apply balancing factor (note exponentiation!)

$$x_n(k-1,i) = x_n(k-1,i-1) \times \left[\hat{\alpha}^i(k,i)\right]^{a_n^i}. \quad (6)$$

Step 3: Set starting weights for the next iteration

$$x_n(k,0) = x_n(k-1,I). \quad (7)$$

Step 4: Calculate convergence criterion:

$$C(k) = \max_i\{abs\left[\hat{\alpha}^i(k,i) - 1\right]\} \quad . \quad (8)$$

If $C(k) \leq \varepsilon$ (degree of accuracy) or $k = K$ **Stop**.

Note that the solution is unique and independent of the order of controls. Normally, 100 iterations guarantee very good degree of convergence.

Base Year Controls

The population synthesizer first develops a "base year" population distribution using year 2005-2009ACS data. A set of controlled-for attributes are defined, and Census Summary File 1 and ACS tabulations are used to develop single and multi-dimensional distributions of these attributes. These attributes, which are specified at the TAZ level in the base-year, include:

Household Controls:

- Housing Unit Type
- Household Size
- Household Income
- Number of Workers in Household
- Presence of Children in Household

Persons in Household Controls:

- Age
- Occupation
- Gender
- Race/Ethnicity
- Type of Group Quarters

Once this distribution is established, the population synthesis tool then samples the ACS PUMS records to create a fully enumerated representation of the population.

Each household is grouped into categories defined by nine dimensions, shown below:

Household Level:

- Income in 2009 dollars (5)
  - <$25,000
  - $25,000-$50,000
  - $50,000-$75,000
  - $75,000-$100,000
  - $100,000 or more
- Household size (4)
  - 1
  - 2
  - 3
  - 4+
- Number of Workers (4)
  - 0
  - 1
  - 2
  - 3+;
- Type of Housing Unit (3)
  - Single-Family
  - Multi-Family
  - Mobile Home
- Presence of Children in Household
  - No children present
  - One or more children present

Persons in Household Level:

- Age (9)
  - 0-4
  - 4-14
  - 15-17
  - 18-24
  - 25-34
  - 35-54
  - 55-64
  - 65-79
  - 80+
- Occupation (5)
  - Unemployed
  - White collar labor
  - Service labor
  - Retail labor
  - Blue collar labor
- Gender
  - Male
  - Female
- Race/Ethnicity
  - Hispanic
  - White Non-Hispanic
  - Other Non-Hispanic

Group quarter residents are treated as a separate category of households. In the PUMS data, each group quarter resident has a record in the person format as well as a record in the household format representing a one-person pseudo-household containing only that individual. These fields are distinguished from the normal household records by the UNITTYPE field, which indicates if the record is a household record, a non-institutional group quarters record, or an institutional group quarters record. This field is used to distinguish the type of household, and group quarter residents are otherwise treated just like any other household record. Institutional group quarter residents are generated so that the total population matches control totals. However, because institutional residents are not expected to travel, these records are not printed to the population output file used by the model system.

Combinations of the dimensions that are excluded or merged include:

- Illogical combinations of workers and household size
- For group quarters, no distinctions are made by any of the household attributes listed above

Each of the household and person categories listed above constitutes a controlled attribute. The total number of households and persons that belong to each of these categories, for each TAZ, was obtained from Census 2010 or ACS 2005-2009 tabulations. Since the ACS totals by TAZ do not always match the Census totals, the former were adjusted so that the total number of households (and persons) is consistent across all categories.

A comparison of the base year synthetic population to the control totals is shown in Figure 3.

Future-Year Control Totals

The forecast-year control totals will be based on regional population projections. Any control totals not explicitly defined for a future year will be assumed to follow the percent distribution of the base year controls. At a minimum, a future year scenario requires the total number of households, persons and group quarter residents at the TAZ level.

Model 1.2—Residential Location Choice

Number of Models: 1
Decision-Making Unit: Households
Model Form: Monte Carlo Draws
Alternatives: MAZs

The population synthesizer operates at a zonal (TAZ) level. Every household is automatically assigned to a TAZ based on the marginal distributions generated for each TAZ. The residential location choice model assigns aMAZ to each household as follows:

1. The quantity of housing by type (single-family, multi-family, mobile-home, and non-institutional group quarters) for each MAZ is provided as input to the model (Q_h).
2. A probability for each housing type is computed as the quantity of housing by type for the MAZ divided by the sum of housing by type across all MAZs in the TAZ ($P_{i,h}=Q_{i,h}/\Sigma Q_h$).
3. A Monte-Carlo random number draw is made for each synthetic household, and that household will select a residential MAZ based on its housing type and the probability distribution for that housing type across all MAZs in the TAZ.

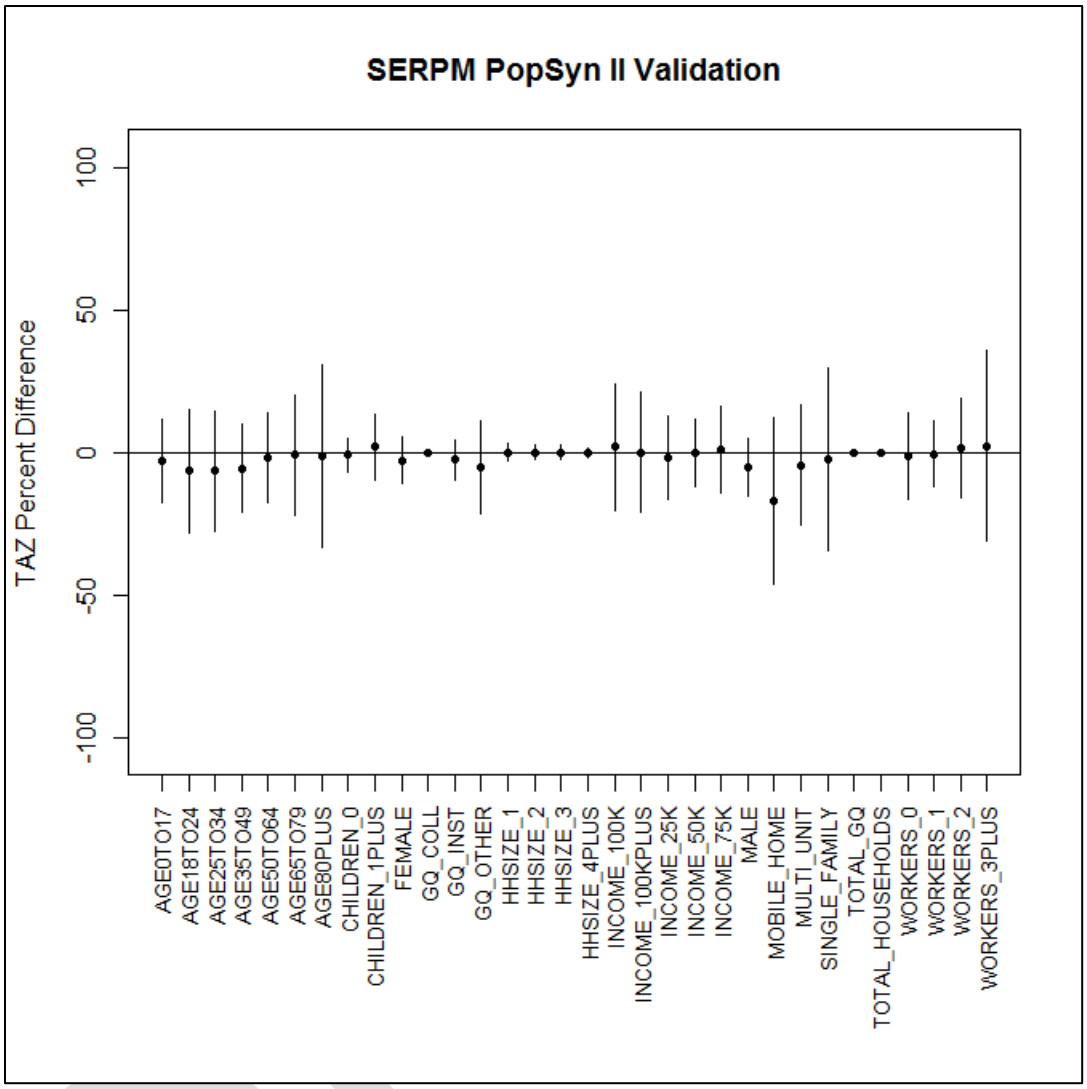


Figure 3: Base Year Synthetic Population Validation

Model 2.1—Usual Workplace and School Location Choice

Number of Models:	4 (Work, Grade School, High School, College)
Decision-Making Unit:	Workers (for work location), Persons age 5-13 (for grade school), Persons age 14-17 (for high school), College Students (for college)
Model Form:	Multinomial logit
Alternatives:	MAZs

The *workplace location choice* model assigns a workplace MAZ for every employed person in the synthetic population. Every worker is assigned a regular work location TAZ and MAZ according to a multinomial logit destination choice model.

Table 13 shows the specification of the workplace location model. This model was originally estimated with data from San Diego, and calibrated to SE Florida conditions based on targets derived from the 2009 NHTS. The size term of this model was developed using Census 2006-2010 PUMS data for SE Florida, in particular a tabulation of workers by occupation and industry (Table 14). The size term for each worker occupation group is specified as the weighted sum of employment at each destination MAZ, where the weights equal the factors shown in Table 14. Note that size terms vary according to worker occupation, to reflect the different types of jobs that are likely to attract different (white collar versus blue-collar) workers. Accessibility is measured by a 'representative' mode choice logsums based on peak period travel (A.M. departure and P.M. return), as well as distance to the workplace.

Since mode choice logsums are required for each destination, a two-stage procedure is used for all destination choice models in the CT-RAMP system in order to reduce computational time[1]. In the first stage, a simplified destination choice model is applied in which all TAZs are alternatives. The only variables in this model are the size term (accumulated from all MAZs in the TAZ) and distance. This model creates a probability distribution for all possible alternative TAZs (TAZs with no employment are not sampled). A set of alternatives are sampled from the probability distribution, and each for each TAZ, an MAZ is chosen according to its size relative to the sum of all MAZs within the TAZ. These sampled alternatives constitute the choice set in the full destination choice model. Mode choice logsums are computed for these alternatives and the destination choice model is applied. A discrete choice of MAZ is made for each worker from this set of alternatives. In the case of the work location choice model, a set of 40 alternatives is sampled.

The application procedure utilizes an iterative shadow pricing mechanism in order to match workers at their workplace to input employment totals. The shadow prices are written to a file and can be used in subsequent model runs to cut down computational time.

[1] It would be computationally prohibitive to compute a mode choice logsum for each of 12,000 MAZs and every worker in the synthetic population.

Table 13: Out of Home Usual Workplace Location Model

Observations:	3,390(x10)
Final log likelihood:	-112,604
Rho-Squared (0):	0.0897
Rho-Squared (constant):	0.0847

Utility Terms	Coefficient	t-Stat
Mode Choice Logsums	0.547	16.08
Total Employment Accessibility		
Low Income Group (<=$60K)	1.091	8.91
Medium Income Group ($60K-$100K)	2.402	19.03
High Income Group (>$100K)	3.386	29.04
Non-Mandatory Accessibility		
Low Income Group (<=$60K)	-1.181	-8.92
Medium Income Group ($60K-$100K)	-2.485	-17.98
High Income Group (>$100K)	-3.506	-27.30
Distance	0.266	14.00
Distance Square Root	-1.604	-22.95
Distance Squared	-0.004	-10.86
Distance Cubed	0.00002	6.04
Part time Worker		
Distance	-0.116	-23.37
Distance Squared	0.0004	2.34
Female		
Distance	-0.025	-15.68
Low Income Group (<=$60K)		
Distance	0.194	9.49
Distance Square Root	-0.872	-10.03
Distance Squared	-0.002	-9.24
High Income Group (>$100K)		
Distance Squared	0.0002	3.86
Calibration Adjustments		
Distance	0.010	
Distance, Part time Workers	0.064	
Min(Distance, 10)	0.8707	
Min(Distance,10) Square Root	-1.123	
Min(Distance, 10) Squared	-0.0816	
Min(Distance, 10) Cubed	0.0032	
Size Function		
Total Employment	1.0000	

Table 14: SE Florida Out of Home Workplace Model Size Term Specification

Worker Industry	Worker Occupation			
	White Collar	Services	Blue Collar	Retail
Agriculture	0.2319	0.0349	0.7152	0.0180
Utilities	0.5936	0.0044	0.3893	0.0126
Construction	0.2165	0.0016	0.7691	0.0128
Manufacturing	0.4145	0.0055	0.5015	0.0785
Wholesale Trade	0.3811	0.0027	0.2057	0.4104
Retail Trade	0.2614	0.0347	0.1477	0.5563
Transportation	0.4229	0.0603	0.4834	0.0334
Professional Services	0.6374	0.0493	0.1692	0.1442
Amusement Services	0.4326	0.3589	0.1417	0.0668
Education K-12	0.8306	0.0712	0.0927	0.0055
Education College	0.8991	0.0435	0.0405	0.0170
Health Services	0.7044	0.2432	0.0470	0.0053
Personal Services	0.3073	0.2830	0.3663	0.0434
Hotel & Motel Services	0.3568	0.2847	0.3314	0.0270
Restaurants & Bars Services	0.1491	0.7169	0.0465	0.0874
Public Administration	0.5467	0.3521	0.0976	0.0036

Source: American Community Survey, 2006-2010 release

The calibration of the out-of-home usual workplace location choice model focused on matching the observed origin-destination distance frequency distribution derived from the 2009 NHTS, as well as the worker flow distribution derived from the 2010 ACS. The calibration process consisted of adjusting the distance terms and shadow prices. The final distance terms are shown in Table 13.

Table 15: Average Out-of-Home Work Location Distance

Worker Class	Observed	Estimated
Full-Time Workers	10.6 miles	10.8 miles
Part-Time Workers	7.5 miles	7.6 miles

Figure 4: Work Location Choice Distance Frequency Calibration

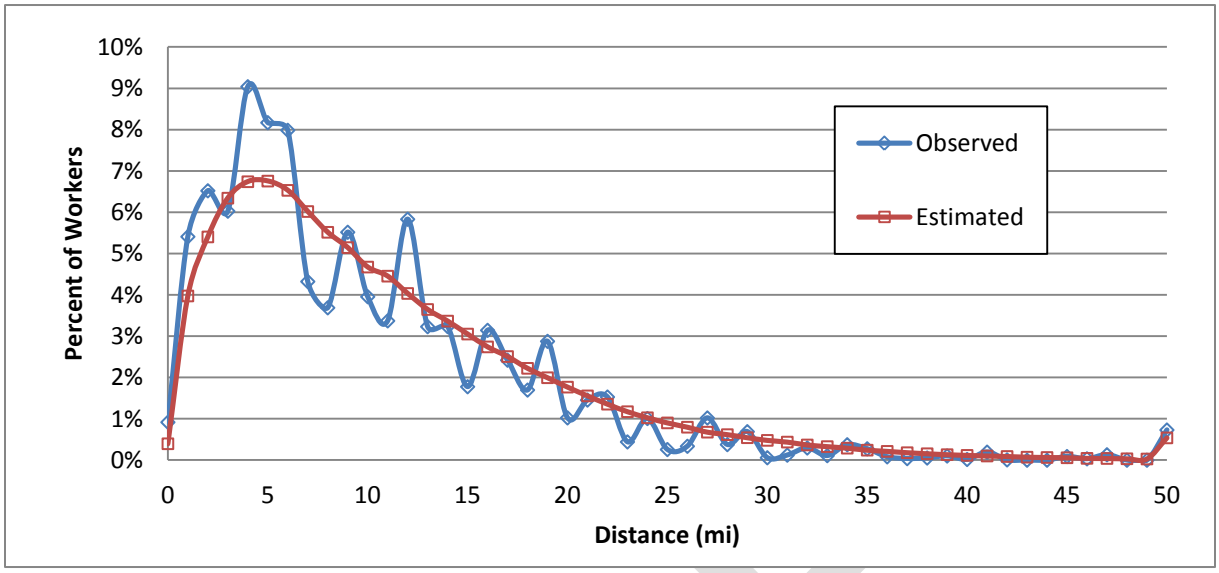


Figure 5: Model Estimated and ACS Worker Flow Comparison

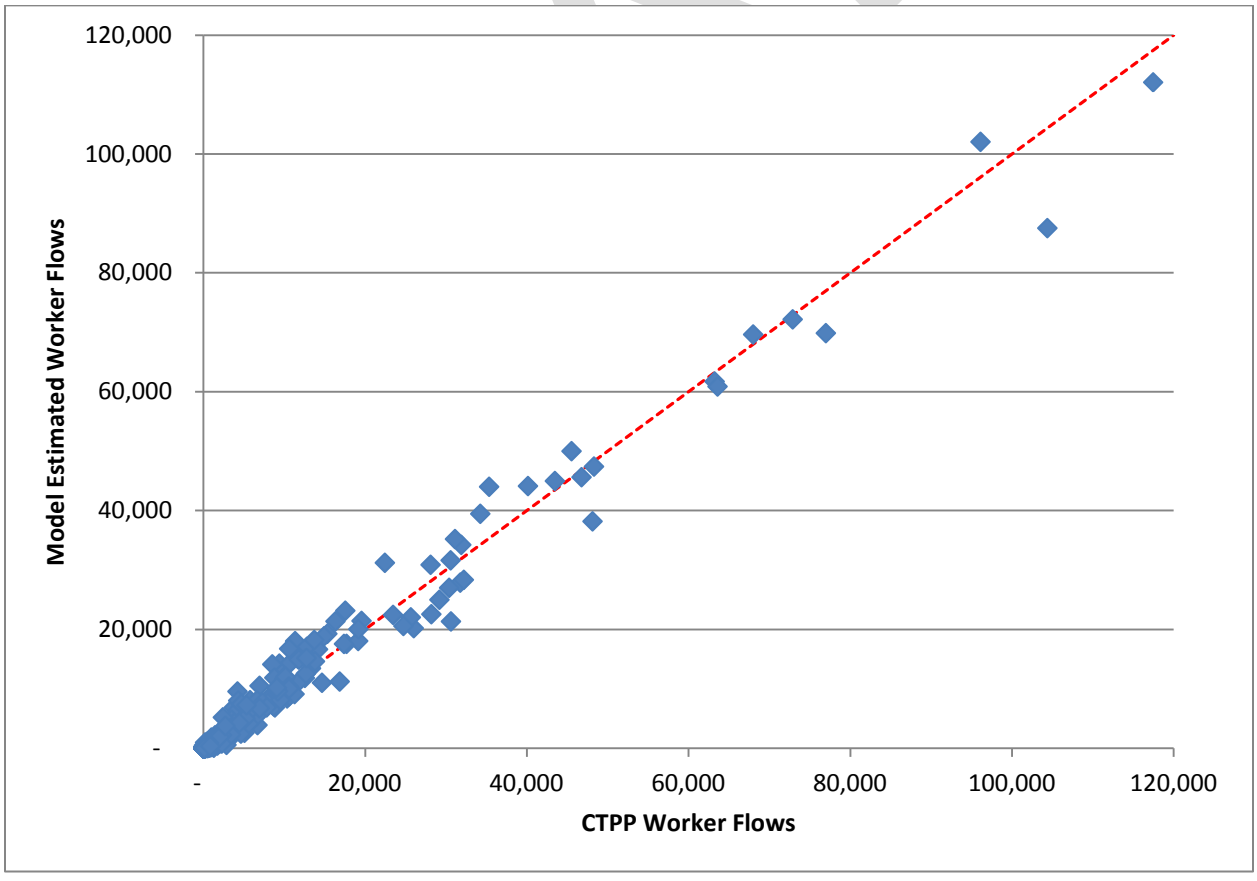


Table 16: District Worker Flows

Observed Worker Flows from 2010 CTPP

Scaled by Origin District to Match Employed Residents

		DESTINATION DISTRICT																					
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	27,803	9,259	8,397	7,238	2,506	4,442	3,110	2,155	524	80	655	144	196	218	-	20	27	-	-	11	4	**66,789**
	2	5,356	45,314	35,166	30,468	10,300	13,298	7,807	6,656	1,000	344	1,743	215	866	57	4	77	33	-	-	96	10	**158,810**
	3	2,433	19,668	96,679	48,408	13,381	32,078	12,807	11,337	1,929	393	3,449	601	1,134	140	10	44	194	24	39	34	-	**244,781**
	4	910	3,887	17,603	46,512	11,795	11,644	16,760	6,407	1,682	229	1,263	187	774	269	-	34	76	72	34	29	29	**120,196**
Miami CBD	**41**	32	530	1,934	5,191	4,305	995	2,182	1,212	112	24	313	48	71	-	-	16	6	-	-	-	-	**16,973**
	5	1,005	5,087	30,752	31,948	8,819	104,993	11,403	16,427	6,977	990	11,867	1,699	3,018	203	-	150	356	10	43	106	48	**235,903**
	6	149	1,420	6,056	8,220	4,694	3,753	30,414	6,471	986	92	853	273	538	67	-	26	10	21	20	-	15	**64,080**
	7	1,287	3,081	12,588	26,101	10,653	17,605	19,206	48,473	10,635	1,196	6,635	1,233	4,121	923	15	54	356	20	81	73	-	**164,336**
SE Broward	**8**	161	709	2,906	4,791	2,057	5,736	3,729	10,665	72,430	9,949	25,491	8,627	29,008	3,773	176	526	653	33	366	161	134	**182,081**
Ft Lauderdale CBD	**81**	-	33	117	33	52	142	-	279	2,979	2,695	1,107	260	1,809	318	-	59	78	-	20	-	-	**9,979**
SW Broward	**9**	505	1,934	14,427	11,743	4,037	22,077	4,118	13,946	42,767	8,694	115,558	15,076	24,332	3,761	49	655	561	167	324	196	98	**285,025**
NW Broward	**10**	182	566	2,048	1,782	906	2,846	823	2,428	19,300	5,230	23,627	63,694	40,434	15,036	263	1,910	1,736	320	541	381	96	**184,148**
NE Broward	**11**	67	261	1,300	1,041	515	830	574	1,445	17,554	5,160	8,778	10,262	64,207	13,839	67	1,873	1,159	200	559	466	128	**130,285**
S Palm Beach	**12**	9	79	550	387	277	745	255	477	3,465	1,277	2,422	4,278	12,743	76,629	910	10,530	5,589	1,186	2,252	687	220	**124,966**
	13	51	16	172	96	157	152	33	135	511	118	473	653	1,276	5,516	10,652	8,034	7,359	1,359	2,021	2,420	591	**41,794**
	17	23	52	383	331	97	216	728	363	2,159	608	1,104	1,609	5,258	32,675	4,750	68,986	28,505	5,729	7,934	7,053	686	**169,248**
	14	63	15	24	72	44	54	262	19	512	145	190	173	819	4,723	1,225	9,417	33,931	5,121	9,121	4,383	466	**70,779**
West Palm Beach CBD	**141**	-	-	-	-	-	69	-	-	-	-	40	-	12	280	23	618	1,776	1,250	374	228	-	**4,670**
	18	10	-	112	85	51	85	102	15	145	41	224	25	468	2,919	589	3,466	12,977	1,984	31,868	2,776	150	**58,093**
	15	21	-	106	15	11	48	89	115	646	212	503	329	1,178	4,610	2,957	6,582	13,726	2,279	9,022	12,682	842	**55,971**
	16	-	-	-	121	-	55	-	-	37	11	88	92	265	359	422	864	1,282	162	429	634	5,699	**10,520**
Total		**40,067**	**91,909**	**231,321**	**224,585**	**74,656**	**221,862**	**114,400**	**129,027**	**186,352**	**37,488**	**206,385**	**109,479**	**192,525**	**166,316**	**22,111**	**113,941**	**110,391**	**19,935**	**65,046**	**32,415**	**9,215**	**2,399,425**

Modeled Worker Flow

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	30,976	16,261	10,460	3,468	968	2,274	814	460	203	35	375	86	136	103	5	45	54	5	23	16	24	**66,789**
	2	8,626	63,779	45,905	13,720	4,221	11,691	3,496	2,676	1,086	109	2,083	235	393	304	30	129	133	20	86	34	55	**158,810**
	3	2,893	28,059	119,234	28,679	7,526	30,948	8,603	6,834	3,231	268	6,070	586	848	436	33	136	133	25	100	59	84	**244,781**
	4	295	3,524	21,409	43,045	12,421	14,779	7,959	7,733	3,711	393	3,301	340	924	201	6	39	35	6	29	14	34	**120,196**
Miami CBD	**41**	19	248	1,419	2,651	8,680	1,223	1,046	765	415	48	250	35	110	33	1	14	8	-	3	3	5	**16,973**
	5	323	4,070	33,339	18,770	6,329	91,214	10,176	20,778	16,211	1,496	23,670	3,231	4,458	1,084	40	176	209	44	128	64	95	**235,903**
	6	63	1,045	6,863	6,798	3,258	6,640	24,496	7,556	3,499	356	1,675	306	995	270	9	54	80	28	48	25	19	**64,080**
	7	85	1,198	10,913	13,155	5,021	21,459	10,575	51,073	24,354	2,275	12,884	2,541	6,471	1,689	28	193	179	40	126	46	34	**164,336**
SE Broward	**8**	21	243	3,218	2,903	1,174	7,240	2,599	13,868	72,234	10,311	23,009	9,190	27,220	7,350	98	751	244	51	203	95	63	**182,081**
Ft Lauderdale CBD	**81**	-	9	89	70	29	181	53	304	2,821	2,671	754	451	1,971	473	5	54	21	5	11	3	5	**9,979**
SW Broward	**9**	151	1,485	10,448	6,743	1,858	26,393	3,101	14,629	45,408	6,026	114,091	21,758	22,981	7,699	186	745	548	100	330	156	191	**285,025**
NW Broward	**10**	21	91	644	490	210	2,280	349	2,318	17,645	3,579	21,686	59,821	44,065	25,465	864	2,640	948	205	333	428	68	**184,148**
NE Broward	**11**	5	25	404	365	163	970	300	1,664	15,743	4,078	6,575	12,058	61,243	22,695	305	2,288	800	189	208	176	35	**130,285**
S Palm Beach	**12**	5	26	138	111	55	270	93	434	3,971	1,181	2,354	7,910	17,705	73,313	1,260	10,129	3,425	745	819	949	75	**124,966**
	13	4	11	45	23	9	59	15	40	230	45	190	644	1,194	4,339	10,155	8,510	7,318	1,075	2,248	5,214	429	**41,794**
	17	1	15	95	75	25	106	48	113	1,038	258	465	1,730	5,244	28,906	6,801	72,833	30,423	5,829	7,499	7,500	246	**169,248**
	14	3	1	15	10	8	21	8	21	68	20	36	105	388	2,413	1,491	7,818	38,243	4,453	10,810	4,751	99	**70,779**
West Palm Beach CBD	**141**	-	-	1	3	-	3	-	3	5	1	3	6	34	166	64	589	1,913	1,283	404	191	4	**4,670**
	18	-	3	20	14	8	38	13	25	100	34	41	44	156	669	418	2,253	12,949	1,189	36,615	3,476	31	**58,093**
	15	28	15	38	36	10	59	28	34	129	33	121	273	415	2,170	3,895	5,409	14,283	1,794	10,624	15,964	618	**55,971**
	16	4	19	45	24	23	60	30	26	76	14	90	35	80	65	249	194	231	35	101	326	8,794	**10,520**
Total		**43,521**	**120,125**	**264,738**	**141,150**	**51,993**	**217,905**	**73,799**	**131,350**	**212,176**	**33,229**	**219,723**	**121,385**	**197,029**	**179,840**	**25,941**	**114,995**	**112,171**	**17,119**	**70,744**	**39,489**	**11,005**	**2,399,425**

Difference (Modeled - Observed)

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	3,174	7,002	2,063	-3,771	-1,538	-2,168	-2,296	-1,695	-322	-45	-280	-58	-60	-116	5	25	27	5	23	6	19	-
	2	3,271	18,465	10,739	-16,748	-6,078	-1,607	-4,311	-3,980	86	-236	339	20	-473	246	26	52	99	20	86	-62	45	-
	3	459	8,391	22,555	-19,730	-5,854	-1,131	-4,204	-4,503	1,302	-126	2,621	-15	-286	296	23	93	-62	1	61	25	84	-
	4	-615	-364	3,806	-3,467	626	3,135	-8,801	1,325	2,029	163	2,038	153	150	-68	6	5	-41	-66	-5	-15	5	-
Miami CBD	**41**	-13	-282	-516	-2,540	4,375	227	-1,135	-447	303	23	-63	-13	39	33	1	-2	1	0	3	3	5	-
	5	-683	-1,017	2,586	-13,178	-2,491	-13,779	-1,227	4,350	9,234	507	11,803	1,532	1,439	881	40	27	-148	34	84	-42	47	-
	6	-87	-375	806	-1,423	-1,437	2,887	-5,918	1,085	2,513	265	822	33	457	203	9	28	70	7	28	25	3	-
	7	-1,202	-1,884	-1,676	-12,946	-5,631	3,853	-8,631	2,599	13,719	1,079	6,249	1,309	2,350	766	13	139	-177	20	45	-27	34	-
SE Broward	**8**	-140	-466	312	-1,888	-883	1,504	-1,130	3,202	-196	362	-2,482	563	-1,788	3,577	-79	225	-409	18	-164	-66	-71	-
Ft Lauderdale CBD	**81**	0	-24	-28	37	-23	39	53	25	-158	-24	-353	191	163	155	5	-5	-57	5	-8	3	5	-
SW Broward	**9**	-354	-449	-3,979	-5,001	-2,179	4,316	-1,017	683	2,640	-2,668	-1,467	6,681	-1,351	3,938	137	90	-13	-67	6	-40	93	-
NW Broward	**10**	-161	-475	-1,404	-1,292	-696	-566	-475	-110	-1,655	-1,651	-1,941	-3,873	3,631	10,429	601	730	-788	-115	-208	46	-28	-
NE Broward	**11**	-62	-236	-896	-676	-353	140	-274	218	-1,811	-1,083	-2,203	1,796	-2,965	8,856	238	414	-359	-11	-351	-289	-93	-
S Palm Beach	**12**	-4	-52	-412	-276	-222	-475	-162	-43	506	-95	-69	3,632	4,962	-3,317	350	-401	-2,164	-441	-1,433	262	-145	-
	13	-47	-4	-127	-73	-149	-93	-18	-95	-281	-73	-283	-9	-82	-1,178	-497	476	-41	-284	227	2,794	-162	-
	17	-21	-37	-288	-256	-72	-109	-680	-251	-1,122	-351	-639	121	-14	-3,769	2,051	3,847	1,917	99	-435	447	-440	-
	14	-61	-13	-9	-62	-36	-32	-255	2	-444	-125	-154	-68	-431	-2,310	266	-1,600	4,312	-668	1,689	369	-367	-
West Palm Beach CBD	**141**	0	0	1	3	0	-67	0	3	5	1	-38	6	22	-114	41	-29	136	33	30	-37	4	-
	18	-10	3	-92	-72	-43	-48	-89	10	-45	-7	-183	18	-312	-2,250	-171	-1,214	-28	-796	4,747	701	-118	-
	15	6	15	-68	21	-1	11	-61	-82	-517	-179	-382	-57	-763	-2,440	938	-1,174	557	-485	1,602	3,282	-224	-
	16	4	19	45	-98	23	5	30	26	40	3	2	-57	-185	-294	-173	-671	-1,050	-127	-328	-308	3,095	-
Total		**3,454**	**28,216**	**33,417**	**-83,435**	**-22,664**	**-3,957**	**-40,601**	**2,323**	**25,824**	**-4,259**	**13,338**	**11,906**	**4,504**	**13,524**	**3,830**	**1,054**	**1,781**	**-2,817**	**5,698**	**7,074**	**1,790**	-

The *grade school location* choice model assigns a school location for every grade-school-aged person (5-13 years old) in the synthetic population. The size term in this model is grade school enrollment. Similarly, the *high school location* choice model assigns a school location for every high-school aged person (14-17 years old) in the synthetic population. The size term for this model is the high school enrollment. The grade school and high school location choice model parameters include person/household characteristics, representative school mode choice logsums, distance, and size terms.

These models could be refined to account for school enrollment boundaries; however doing so requires assigning students to public versus private schools. Alternatively, the school boundaries could be used to calibrate enrollment zone – specific constants, so as to better match enrollment at each school. The *university location choice* model assigns a university location for every university student in the synthetic population. The size term in this model is university enrollment. The University location choice model parameters include person/household characteristics, representative university mode choice logsums, distance, and size terms. University activities are located at the MAZ level.

Table 17: Average Usual School Location Distance

Student Segment	Observed	Estimated
Grade K-8 Students	3.2 miles	3.3 miles
Grade 9-12 Students	4.2 miles	4.7 miles
College Students	8.4 miles	9.4 miles

Figure 6: Grade School Trip Length Frequency Distribution

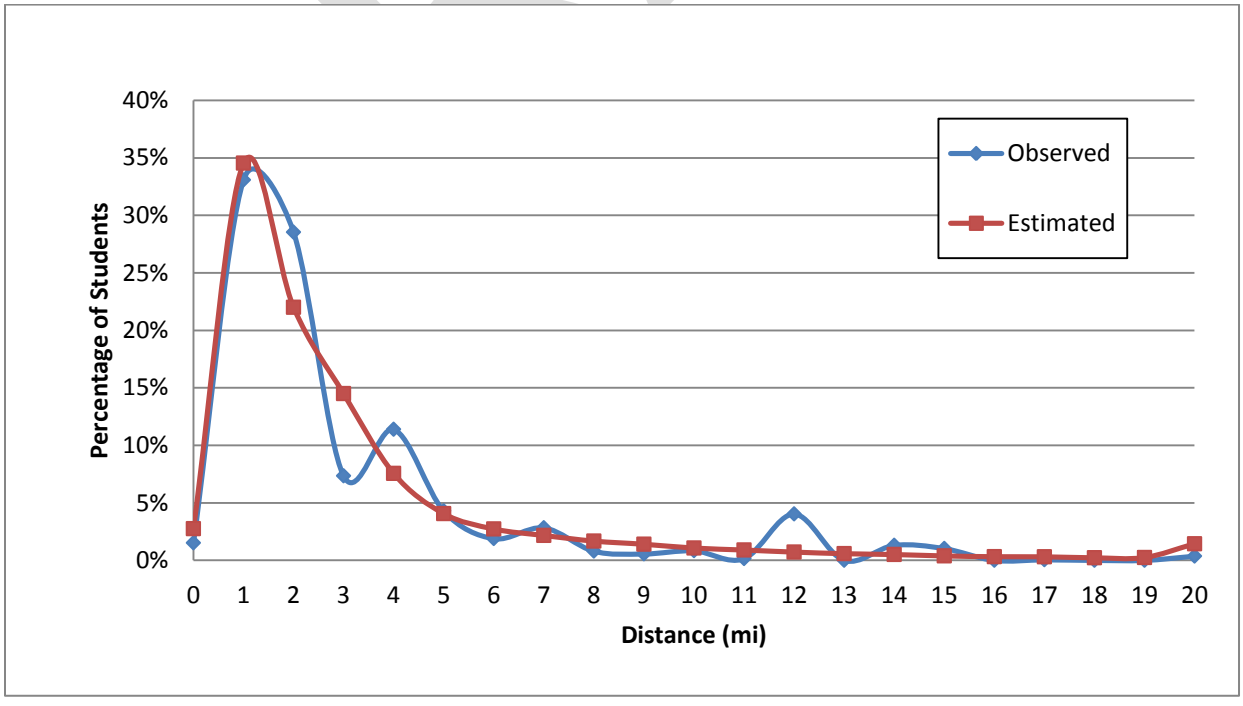


Figure 7: High School Trip Length Frequency Distribution

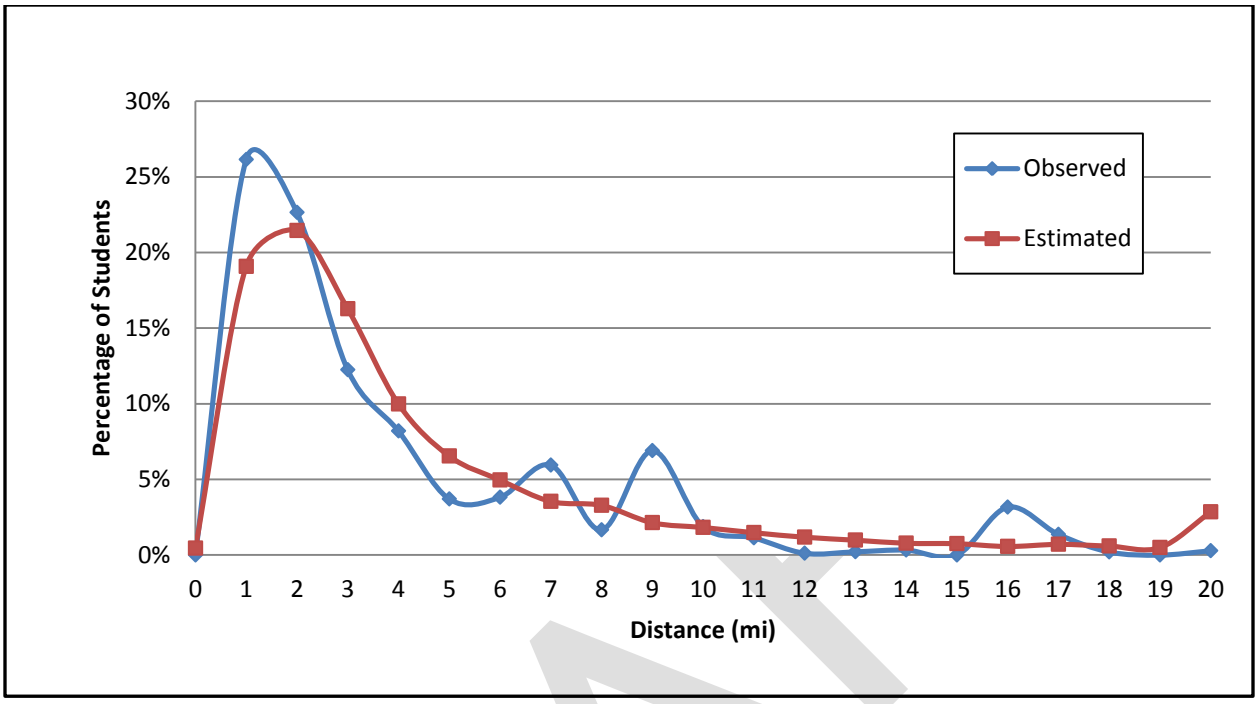


Figure 8: College/University Trip Length Frequency Distribution

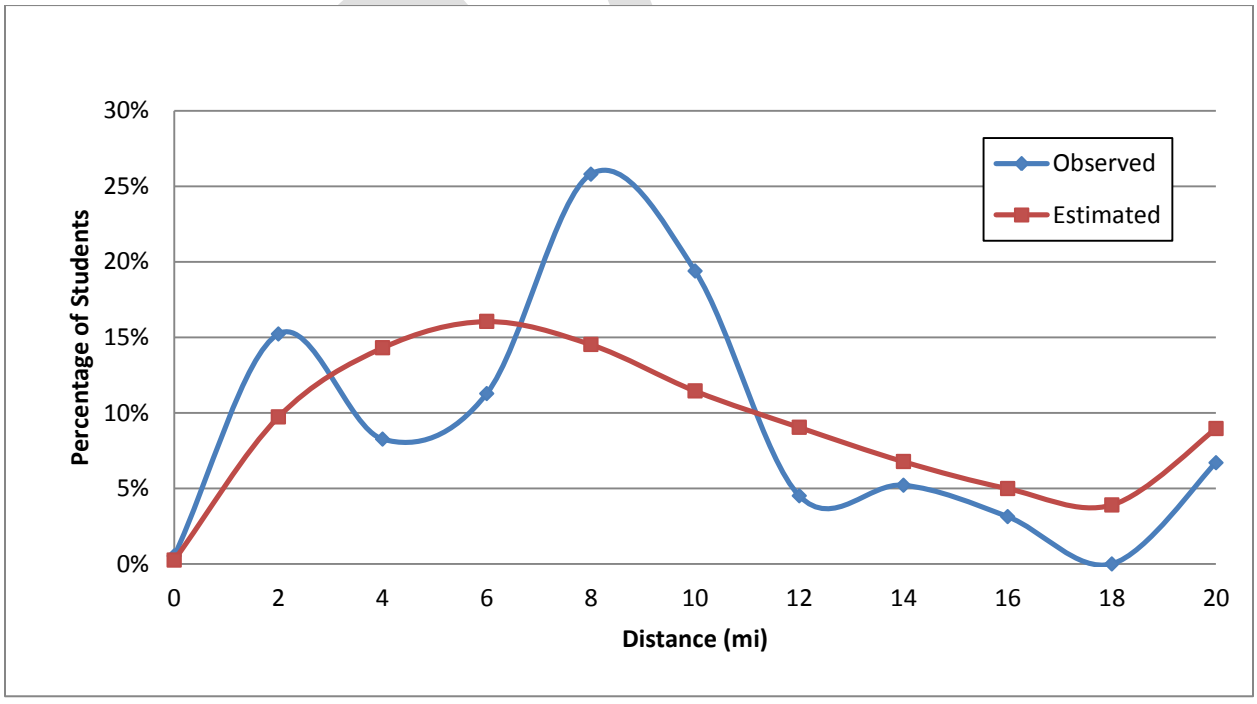


Table 18: Grade School Student Flows

Observed Grade School Student Flows from 2009 NHTS

Scaled by Origin District to Match Students

		DESTINATION DISTRICT																					
ORIGIN DISTRICT		1	2	3	4	41	5	6	7	8	81	9	10	11	12	13	17	14	141	18	15	16	Total
South Dade	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	640	42,807	609	823	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44,880
	3	-	3,682	50,055	2,013	-	1,989	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57,740
	4	-	-	1,962	20,028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21,990
Miami CBD	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	-	-	-	-	60,550	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60,550
	6	-	-	-	-	-	-	5,590	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5,590
	7	-	-	1,607	-	-	8,507	18,502	10,044	-	-	-	-	-	-	-	-	-	-	-	-	-	38,660
SE Broward	8	-	-	-	-	-	-	-	-	19,039	-	13,471	-	-	-	-	-	-	-	-	-	-	32,510
Ft Lauderdale CBD	81	-	-	-	-	-	-	-	-	920	-	-	-	-	-	-	-	-	-	-	-	-	920
SW Broward	9	-	-	-	-	-	-	-	-	2,558	-	74,898	503	-	-	-	-	-	-	-	-	-	77,960
NW Broward	10	-	-	-	-	-	-	-	-	-	-	-	43,876	544	-	-	-	-	-	-	-	-	44,420
NE Broward	11	-	-	-	-	-	-	-	-	-	-	-	-	21,800	-	-	-	-	-	-	-	-	21,800
S Palm Beach	12	-	-	-	-	-	-	-	-	-	-	-	-	522	20,976	-	-	741	-	-	-	-	22,240
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,065	-	1,795	-	-	-	-	12,860
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	6,806	9,516	26,949	-	-	-	-	-	43,270
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	13,750	-	-	-	-	13,750
West Palm Beach CBD	141	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	420	-	420
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,850	-	-	8,850
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,318	-	1,333	-	740	11,179	-	15,570
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total		640	46,489	54,234	22,864	-	71,046	24,092	10,044	22,517	-	88,369	44,379	22,866	27,782	22,899	26,949	17,619	-	9,590	11,599	-	523,980

Modeled Grade School Student Flow

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	23,270	1,730	560	70	-	230	50	50	-	-	-	-	-	-	-	-	-	-	-	-	-	**25,960**
	2	1,900	35,190	5,700	430	40	1,390	110	120	-	-	-	-	-	-	-	-	-	-	-	-	-	**44,880**
	3	100	3,690	47,380	2,420	130	3,280	330	410	-	-	-	-	-	-	-	-	-	-	-	-	-	**57,740**
	4	10	70	1,430	16,240	840	1,850	480	1,070	-	-	-	-	-	-	-	-	-	-	-	-	-	**21,990**
Miami CBD	**41**	-	-	20	450	530	50	40	30	-	-	-	-	-	-	-	-	-	-	-	-	-	**1,120**
	5	10	20	930	550	30	55,540	210	3,260	-	-	-	-	-	-	-	-	-	-	-	-	-	**60,550**
	6	-	-	10	100	20	140	4,830	490	-	-	-	-	-	-	-	-	-	-	-	-	-	**5,590**
	7	-	30	70	700	50	4,760	680	32,370	-	-	-	-	-	-	-	-	-	-	-	-	-	**38,660**
SE Broward	**8**	-	-	-	-	-	-	-	-	28,040	370	3,180	340	580	-	-	-	-	-	-	-	-	**32,510**
Ft Lauderdale CBD	**81**	-	-	-	-	-	-	-	-	610	300	10	-	-	-	-	-	-	-	-	-	-	**920**
SW Broward	**9**	-	-	-	-	-	-	-	-	6,220	40	68,600	2,680	420	-	-	-	-	-	-	-	-	**77,960**
NW Broward	**10**	-	-	-	-	-	-	-	-	1,400	50	1,860	39,600	1,510	-	-	-	-	-	-	-	-	**44,420**
NE Broward	**11**	-	-	-	-	-	-	-	-	2,400	100	500	2,350	16,450	-	-	-	-	-	-	-	-	**21,800**
S Palm Beach	**12**	-	-	-	-	-	-	-	-	-	-	-	-	-	21,070	60	1,060	20	-	-	30	-	**22,240**
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	620	8,780	2,100	370	-	70	910	10	**12,860**
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	1,890	1,380	38,300	1,150	-	180	370	-	**43,270**
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	130	100	1,170	10,420	-	1,050	880	-	**13,750**
West Palm Beach CBD	**141**	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	30	360	-	10	-	-	**420**
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	30	30	150	530	-	7,900	210	-	**8,850**
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	390	820	1,010	1,110	-	1,590	10,630	20	**15,570**
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	20	20	20	-	-	10	20	4,000	**4,090**
Total		**25,290**	**40,730**	**56,100**	**20,960**	**1,640**	**67,240**	**6,730**	**37,800**	**38,670**	**860**	**74,150**	**44,970**	**18,960**	**24,170**	**11,190**	**43,840**	**13,960**	**-**	**10,810**	**13,050**	**4,030**	**555,150**

Difference (Modeled-Observed)

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	23,270	1,730	560	70	-	230	50	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1,260	-7,617	5,091	-393	40	1,390	110	120	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	100	8	-2,675	407	130	1,291	330	410	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	10	70	-532	-3,788	840	1,850	480	1,070	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miami CBD	**41**	-	-	20	450	530	50	40	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	10	20	930	550	30	-5,010	210	3,260	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	-	-	10	100	20	140	-760	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	30	-1,537	700	50	-3,747	-17,822	22,326	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE Broward	**8**	-	-	-	-	-	-	-	-	9,001	370	-10,291	340	580	-	-	-	-	-	-	-	-	-
Ft Lauderdale CBD	**81**	-	-	-	-	-	-	-	-	-310	300	10	-	-	-	-	-	-	-	-	-	-	-
SW Broward	**9**	-	-	-	-	-	-	-	-	3,662	40	-6,298	2,177	420	-	-	-	-	-	-	-	-	-
NW Broward	**10**	-	-	-	-	-	-	-	-	1,400	50	1,860	-4,276	966	-	-	-	-	-	-	-	-	-
NE Broward	**11**	-	-	-	-	-	-	-	-	2,400	100	500	2,350	-5,350	-	-	-	-	-	-	-	-	-
S Palm Beach	**12**	-	-	-	-	-	-	-	-	-	-	-	-	-	94	60	1,060	-721	-	-	30	-	-
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	620	-2,285	2,100	-1,425	-	70	910	10	-
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-4,916	-8,136	11,351	1,150	-	180	370	-	-
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	130	100	1,170	-3,330	-	1,050	880	-	-
West Palm Beach CBD	**141**	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	30	360	-	10	-	-	-
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	30	30	150	530	-	-950	210	-	-
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	390	-1,498	1,010	-223	-	850	-549	20	-
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	20	20	20	-	-	10	20	4,000	-
Total		**24,650**	**-5,759**	**1,866**	**-1,904**	**1,640**	**-3,806**	**-17,362**	**27,756**	**16,153**	**860**	**-14,219**	**591**	**-3,906**	**-3,612**	**-11,709**	**16,891**	**-3,659**	**-**	**1,220**	**1,451**	**4,030**	-

Table 19: High School Student Flows

Observed High School Student Flows from 2009 NHTS

Scaled by Origin District to Match Students

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	3,467	14,901	-	612	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**18,980**
	3	-	409	20,401	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**20,810**
	4	-	-	10,550	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**10,550**
Miami CBD	**41**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	-	267	-	-	34,633	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**34,900**
	6	-	-	-	-	-	535	5,088	1,236	-	-	-	-	-	-	-	-	-	-	-	-	-	**6,860**
	7	-	-	104	1,007	4,388	6,686	9,515	303	47	-	-	-	-	-	-	-	-	-	-	-	-	**22,050**
SE Broward	**8**	-	-	-	-	-	-	-	-	4,569	-	8,851	-	-	-	-	-	-	-	-	-	-	**13,420**
Ft Lauderdale CBD	**81**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW Broward	**9**	-	-	-	-	-	-	-	-	991	-	39,859	-	-	-	-	-	-	-	-	-	-	**40,850**
NW Broward	**10**	-	-	-	-	-	-	-	-	-	-	-	23,223	1,687	-	-	-	-	-	-	-	-	**24,910**
NE Broward	**11**	-	-	-	-	-	-	-	-	416	-	-	-	10,104	-	-	-	-	-	-	-	-	**10,520**
S Palm Beach	**12**	-	-	-	-	-	-	-	-	-	-	-	-	-	11,310	-	-	-	-	-	-	-	**11,310**
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,113	-	2,507	-	-	-	-	**4,620**
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11,850	-	-	-	-	-	**11,850**
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West Palm Beach CBD	**141**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,358	-	4,002	-	-	**5,360**
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,676	3,244	-	**5,920**
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,090	**2,090**
Total		**-**	**3,876**	**46,222**	**1,007**	**5,000**	**41,855**	**14,604**	**1,539**	**6,023**	**-**	**48,710**	**23,223**	**11,791**	**11,310**	**2,113**	**11,850**	**3,865**	**-**	**6,678**	**3,244**	**2,090**	**245,000**

Modeled High School Student Flow

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	7,600	1,640	370	10	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**9,630**
	2	310	15,050	3,570	10	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**18,980**
	3	20	2,260	17,940	410	30	110	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	**20,810**
	4	20	470	2,520	6,290	470	260	150	370	-	-	-	-	-	-	-	-	-	-	-	-	-	**10,550**
Miami CBD	**41**	-	-	10	10	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**60**
	5	10	1,080	3,870	940	90	27,110	130	1,670	-	-	-	-	-	-	-	-	-	-	-	-	-	**34,900**
	6	10	570	1,350	480	180	510	3,050	710	-	-	-	-	-	-	-	-	-	-	-	-	-	**6,860**
	7	-	500	1,630	750	140	3,030	380	15,620	-	-	-	-	-	-	-	-	-	-	-	-	-	**22,050**
SE Broward	**8**	-	-	-	-	-	-	-	-	9,540	50	2,810	100	920	-	-	-	-	-	-	-	-	**13,420**
Ft Lauderdale CBD	**81**	-	-	-	-	-	-	-	-	370	30	30	-	20	-	-	-	-	-	-	-	-	**450**
SW Broward	**9**	-	-	-	-	-	-	-	-	2,450	30	36,620	1,130	620	-	-	-	-	-	-	-	-	**40,850**
NW Broward	**10**	-	-	-	-	-	-	-	-	1,710	20	2,230	17,070	3,880	-	-	-	-	-	-	-	-	**24,910**
NE Broward	**11**	-	-	-	-	-	-	-	-	830	10	280	890	8,510	-	-	-	-	-	-	-	-	**10,520**
S Palm Beach	**12**	-	-	-	-	-	-	-	-	-	-	-	-	-	8,490	60	2,510	60	20	120	50	-	**11,310**
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	80	2,980	710	60	50	240	500	-	**4,620**
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	230	720	9,520	380	170	610	220	-	**11,850**
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	10	40	320	3,400	710	1,070	100	-	**5,650**
West Palm Beach CBD	**141**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	10	160	-	-	-	**200**
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	170	-	5,150	20	-	**5,360**
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	380	180	420	50	1,900	2,980	10	**5,920**
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	20	-	10	10	120	1,870	**2,090**
Total		**7,970**	**21,570**	**31,260**	**8,900**	**950**	**31,070**	**3,730**	**18,390**	**14,900**	**140**	**41,970**	**19,190**	**13,950**	**8,810**	**4,260**	**13,290**	**4,500**	**1,170**	**9,100**	**3,990**	**1,880**	**260,990**

Difference (Modeled-Observed)

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	7,600	1,640	370	10	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	310	11,583	-11,331	10	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	20	1,851	-2,461	410	30	110	20	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	20	470	-8,030	6,290	470	260	150	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miami CBD	**41**	-	-	10	10	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	10	1,080	3,603	940	90	-7,523	130	1,670	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	10	570	1,350	480	180	-25	-2,038	-526	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	500	1,526	-257	-4,248	-3,656	-9,135	15,317	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE Broward	**8**	-	-	-	-	-	-	-	-	4,971	50	-6,041	100	920	-	-	-	-	-	-	-	-	-
Ft Lauderdale CBD	**81**	-	-	-	-	-	-	-	-	370	30	30	-	20	-	-	-	-	-	-	-	-	-
SW Broward	**9**	-	-	-	-	-	-	-	-	1,459	30	-3,239	1,130	620	-	-	-	-	-	-	-	-	-
NW Broward	**10**	-	-	-	-	-	-	-	-	1,710	20	2,230	-6,153	2,193	-	-	-	-	-	-	-	-	-
NE Broward	**11**	-	-	-	-	-	-	-	-	414	10	280	890	-1,594	-	-	-	-	-	-	-	-	-
S Palm Beach	**12**	-	-	-	-	-	-	-	-	-	-	-	-	-	-2,820	60	2,510	60	20	120	50	-	-
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	80	867	710	-2,447	50	240	500	-	-
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	230	720	-2,330	380	170	610	220	-	-
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	10	40	320	3,400	710	1,070	100	-	-
West Palm Beach CBD	**141**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	10	160	-	-	-	-
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-1,188	-	1,148	20	-	-
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	380	180	420	50	-776	-264	10	-
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	60	20	-	10	10	120	-220	-
Total		**7,970**	**17,694**	**-14,962**	**7,893**	**-4,050**	**-10,785**	**-10,874**	**16,851**	**8,877**	**140**	**-6,740**	**-4,033**	**2,159**	**-2,500**	**2,147**	**1,440**	**635**	**1,170**	**2,422**	**746**	**-210**	-

Table 20: College/University Student Flow

Observed College/University Student Flows from 2009 NHTS

Scaled by Origin District to Match Students

ORIGIN DISTRICT		DESTINATION DISTRICT 1	2	3	4	41	5	6	7	8	81	9	10	11	12	13	17	14	141	18	15	16	Total
South Dade	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	-	1,987	25,170	-	-	-	-	1,803	-	-	-	-	-	-	-	-	-	-	-	-	-	28,960
	3	-	14,437	44,122	-	-	-	-	681	-	-	-	-	-	-	-	-	-	-	-	-	-	59,240
	4	-	-	-	4,693	10,907	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15,600
Miami CBD	41	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	1,300	2,696	20,195	-	9,079	-	7,700	-	-	-	-	-	-	-	-	-	-	-	-	-	40,970
	6	-	-	-	-	1,766	-	8,324	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,090
	7	-	-	2,260	2,186	-	22,940	-	5,262	-	-	1,512	-	-	-	-	-	-	-	-	-	-	34,160
SE Broward	8	-	-	-	-	-	-	-	-	7,178	5,286	2,274	7,132	-	-	-	-	-	-	-	-	-	21,870
Ft Lauderdale CBD	81	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SW Broward	9	-	-	-	-	-	1,218	-	-	188	-	39,015	-	4,369	-	-	-	-	-	-	-	-	44,790
NW Broward	10	-	-	-	-	-	-	-	-	-	-	13,529	16,301	-	-	-	-	-	-	-	-	-	29,830
NE Broward	11	-	-	-	-	-	-	-	-	-	-	-	-	13,867	1,333	-	-	-	-	-	-	-	15,200
S Palm Beach	12	-	-	-	-	-	-	-	-	-	-	-	-	-	9,043	-	5,189	-	-	-	-	3,908	18,140
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	17	-	-	-	-	-	-	-	-	-	-	7,683	-	-	-	-	9,757	-	-	-	-	-	17,440
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8,740	-	-	-	-	-	8,740
West Palm Beach CBD	141	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9,970	-	-	9,970
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2,355	3,935	-	-	-	-	6,290
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,250	1,250
Total		-	17,723	74,249	27,074	12,673	33,237	8,324	15,446	7,366	5,286	64,014	23,433	18,235	10,377	-	26,040	3,935	-	9,970	-	5,158	362,540

Modeled College/University Student Flow

ORIGIN DISTRICT		DESTINATION DISTRICT																				
		1	2	3	4	41	5	6	7	8	81	9	10	11	12	13	17	14	141	18	15	16	Total
South Dade	1	6,800	2,730	750	40	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10,370
	2	1,150	18,560	7,930	550	440	300	20	10	-	-	-	-	-	-	-	-	-	-	-	-	-	28,960
	3	180	17,460	32,440	4,110	2,440	2,230	80	270	-	-	30	-	-	-	-	-	-	-	-	-	-	59,240
	4	-	700	3,160	4,380	5,300	1,350	120	570	10	-	10	-	-	-	-	-	-	-	-	-	-	15,600
Miami CBD	41	-	20	70	210	2,020	40	20	50	-	-	-	-	-	-	-	-	-	-	-	-	-	2,430
	5	-	860	7,250	3,130	2,000	19,270	50	5,810	70	-	2,530	-	-	-	-	-	-	-	-	-	-	40,970
	6	-	60	520	1,930	2,960	1,510	870	2,240	-	-	-	-	-	-	-	-	-	-	-	-	-	10,090
	7	-	40	1,510	3,610	3,330	8,590	140	15,410	140	-	1,360	10	20	-	-	-	-	-	-	-	-	34,160
SE Broward	8	-	-	60	410	390	3,040	10	5,670	2,050	790	8,970	80	400	-	-	-	-	-	-	-	-	21,870
Ft Lauderdale CBD	81	-	-	-	-	-	60	-	160	260	270	420	-	50	-	-	-	-	-	-	-	-	1,220
SW Broward	9	-	90	1,260	740	310	9,660	10	3,800	1,130	110	27,470	50	160	-	-	-	-	-	-	-	-	44,790
NW Broward	10	-	-	10	40	-	870	-	450	1,750	420	19,800	3,760	2,400	330	-	-	-	-	-	-	-	29,830
NE Broward	11	-	-	-	10	10	350	-	1,100	2,040	920	6,000	1,330	2,730	710	-	-	-	-	-	-	-	15,200
S Palm Beach	12	-	-	-	-	-	10	-	90	630	390	3,010	2,770	2,140	9,100	-	-	-	-	-	-	-	18,140
	13	-	-	-	-	-	-	-	-	20	-	30	390	60	990	-	1,310	100	130	-	-	-	3,030
	17	-	-	-	-	-	-	-	-	50	30	70	850	730	10,350	-	4,650	180	520	10	-	-	17,440
	14	-	-	-	-	-	-	-	-	-	-	-	10	10	850	-	3,010	1,610	2,120	1,130	-	-	8,740
West Palm Beach CBD	141	-	-	-	-	-	-	-	-	-	-	-	10	-	120	-	300	70	550	20	-	-	1,070
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	760	960	680	7,540	-	-	9,970
	15	-	-	-	-	-	-	-	-	-	-	-	90	10	360	-	2,460	980	980	1,410	-	-	6,290
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1,250	1,250
Total		8,130	40,520	54,960	19,160	19,250	47,280	1,320	35,630	8,150	2,930	69,700	9,350	8,710	22,840	-	12,490	3,900	4,980	10,110	-	1,250	380,660

Difference (Modeled-Observed)

		DESTINATION DISTRICT																				
ORIGIN DISTRICT		**1**	**2**	**3**	**4**	**41**	**5**	**6**	**7**	**8**	**81**	**9**	**10**	**11**	**12**	**13**	**17**	**14**	**141**	**18**	**15**	**16**	**Total**
South Dade	**1**	6,800	2,730	750	40	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	1,150	16,573	-17,240	550	440	300	20	-1,793	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	180	3,023	-11,682	4,110	2,440	2,230	80	-411	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	-	700	3,160	-313	-5,607	1,350	120	570	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Miami CBD	**41**	-	20	70	210	2,020	40	20	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	5	-	-440	4,554	-17,065	2,000	10,191	50	-1,890	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	6	-	60	520	1,930	1,194	1,510	-7,454	2,240	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	7	-	40	-750	1,424	3,330	-14,350	140	10,148	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SE Broward	**8**	-	-	-	-	-	-	-	-	-5,128	-4,496	6,696	-7,052	400	-	-	-	-	-	-	-	-	-
Ft Lauderdale CBD	**81**	-	-	-	-	-	-	-	-	260	270	420	-	50	-	-	-	-	-	-	-	-	-
SW Broward	**9**	-	-	-	-	-	-	-	-	942	110	-11,545	50	-4,209	-	-	-	-	-	-	-	-	-
NW Broward	**10**	-	-	-	-	-	-	-	-	1,750	420	6,271	-12,541	2,400	-	-	-	-	-	-	-	-	-
NE Broward	**11**	-	-	-	-	-	-	-	-	2,040	920	6,000	1,330	-11,137	-	-	-	-	-	-	-	-	-
S Palm Beach	**12**	-	-	-	-	-	-	-	-	-	-	-	-	-	57	-	-	-	-	-	-	-	-
	13	-	-	-	-	-	-	-	-	-	-	-	-	-	990	-	1,310	100	130	-	-	-	-
	17	-	-	-	-	-	-	-	-	-	-	-	-	-	10,350	-	-5,107	180	520	10	-	-	-
	14	-	-	-	-	-	-	-	-	-	-	-	-	-	850	-	-5,730	1,610	2,120	1,130	-	-	-
West Palm Beach CBD	**141**	-	-	-	-	-	-	-	-	-	-	-	-	-	120	-	300	70	550	20	-	-	-
	18	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	760	960	680	-2,430	-	-	-
	15	-	-	-	-	-	-	-	-	-	-	-	-	-	360	-	105	-2,955	980	1,410	-	-	-
	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-
Total		**8,130**	**22,797**	**-19,289**	**-7,914**	**6,577**	**14,043**	**-7,004**	**20,184**	**784**	**-2,356**	**5,686**	**-14,083**	**-9,525**	**12,463**	**-**	**-13,550**	**-35**	**4,980**	**140**	**-**	**-3,908**	-

Model 3.1—Employer Parking Provision and Reimbursement Model

Number of Models: 1
Decision-Making Unit: Workers whose workplace is in parking-priced areas
Model Form: Multinomial Logit
Alternatives: 3 (free on-site parking, parking reimbursement, no free/subsidized parking)

This model predicts whether workers who work in the CBD or some other area where parking is not free have access to free or subsidized parking. This model was transferred from San Diego to SE Florida since there are no local data available to re-estimate it. The model is implemented in two steps. The first step is the choice between free on-site parking, parking reimbursement, or neither; the second step determines the amount of reimbursement relative to the average cost of parking at the destination MAZ. Table 21 shows the specification of the Free Parking Eligibility Model. Note that the choice of no free/subsidized parking is the reference choice and therefore has a utility of zero.

Table 21: Employer Parking Provision Model Estimation Results

Explanatory Variable	Free Parking		Parking Reimbursement	
	Coefficient	t-Stat	Coefficient	t-Stat
Household income				
$100K or more	1.870	4.01	0.612	3.210
$60K - $100K	0.858	1.65		
Logsum weighted average monthly cost			0.368	3.23
Percent of blue collar employment			-1.840	-2.04
Percent of health and education employment			2.260	4.20
Constant	-5.150	-5.43	-4.370	-10.630

The amount of re-imbursement is simulated by Monte Carlo draws. The percentage of parking reimbursement is modeled as a log-normal distribution, as shown by the SANDAG parking behavior survey data. This distribution allows re-imbursement proportions higher than 100%. In these cases, the worker pays no parking cost in mode choice, and is allowed to park in MAZs with prevailing parking costs higher than the cost at his/her destination MAZ.

Model 3.2—Car Ownership

Number of Models: 1
Decision-Making Unit: Households
Model Form: Nested Logit
Alternatives: 0, 1, 2, 3, 4+ autos

The household car ownership model predicts the number of autos (including motorcycles, vans, and trucks for personal use) available to a household. In this model, household car ownership is a

dependent variable derived from the activity needs of the household based on household characteristics, and the characteristics of persons within the household. The car-ownership model is applied after the work, university, and school location choices and includes relative auto, transit, and non-motorized accessibilities to both mandatory activities (at a person level) and non-mandatory activities (at a household level) as explanatory variables. In this model, car sufficiency is used to stratify household composition and educational level variables.

The auto ownership model is formulated as a nested logit choice model with five alternatives. The nested structure is illustrated in Figure 9. At the first level of the nesting structure, the choices are split into 0 cars and 1 or more cars. A household's choice of having or not having cars represents the most significant car ownership decision and is placed at the highest level in the nested structure. At the next level of the model, the choice of 1 or more cars is further split into 1 car and 2 or more car choices. Finally, the 2 or more car choice is split into 2, 3 and 4 or more car choices. The nesting coefficient at 0 cars and 1 plus car level was estimated at a value of 0.668, and the nesting coefficient at 1 car and 2 plus cars level was set to 1.0, which essentially reduces the 3-level choice structure to a bi-level choice structure.

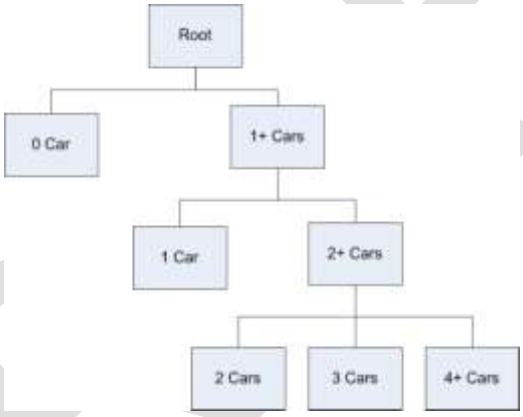


Figure 9: Auto Ownership Nesting Structure

The auto ownership model includes the following explanatory variables:

- Household size:
  - Number of driving age household members
- Household composition:
  - Ratio of workers (full time and part time) to driving age household members
  - Ratio of pre-driving age school children to driving age household members
  - Ratio of retirees under age 80 to driving age household members
  - Ratio of retirees age 80 and over to driving age household members
- Household income group ($2007):
  - Low income (less than $30,000)
  - Low-Medium income ($30,000-60,000)
  - High-Medium income ($60,000-100,000)
  - High income ($100,000 and more)

- Education:
    - Non high school graduate
    - High school graduate
- Zonal accessibility indices from residential zones to potential destinations:
    - Non-motorized accessibility to non-mandatory activities in off peak period
    - Difference between auto accessibility and transit accessibility to non-mandatory activities in off perk period.
- Zonal density indices:
    - Intersection density by MAZ.
    - Population density by MAZ.
    - Retail employment density by MAZ.
- Household residence type:
    - Detached dwelling unit.
    - Non-detached dwelling unit.
- Household mandatory activity auto dependency indices:
    - Workers' mandatory activity auto dependency
    - Students' mandatory activity auto dependency
- Household mandatory activity rail mode indices:
    - Workers' mandatory activity rail mode indices (sum of rail mode shares of all workers)
    - Students' mandatory activity rail mode indices (sum of rail mode shares of all university and driving age students)

The zonal accessibility indices for non-mandatory activities take the form of destination choice logsums and represent a result of the summation of attractions across all destinations. They are calculated across destination zone attractions by mode (auto, transit, and walk) and time-of-day period. Off-peak skims are used for creation of non-mandatory accessibilities. Refer to Appendix A for a comprehensive description of all accessibility terms.

The mandatory rail mode share represents how much a household's mandatory tours (work and school tours) are dependent on the rail mode. The household mandatory activity rail mode index is calculated using the ratio of the rail mode in-vehicle time over the total transit in-vehicle time for trips that used rail as part of their transit path, stratified by person type (worker versus student). The household rail mode index is obtained by aggregating individual rail indices of worker/student members in the household. All mandatory mode choice logsums and accessibilities are calculated using A.M. peak skims.

Population and retail employment densities are calculated as floating densities, as opposed to zonal densities. The floating area is defined by a circle of ½ mile radius centered at each MAZ. Similarly intersection density is calculated as the number of intersections within a 1/2 mile radius of each MAZ centroid.

Household composition and education variables are stratified using relative car sufficiency, which is calculated as the difference between number of cars in the alternative and the number of driving age members in a household:

i. Insufficient households (relative car sufficiency = -1) if there are fewer cars then drivers in the households

ii. Sufficient households (relative car sufficiency = 0) if there are the same number of cars in the household as drivers
iii. Over-sufficient households (relative car sufficiency = 1) if there are more cars than drivers in the household

The mandatory tour auto dependency represents how much a household's mandatory tours (work and school tours) are dependent on the auto mode. The household mandatory activity auto dependency variable is calculated using the difference between the single-occupant vehicle (SOV) and the walk to transit mode choice logsum, stratified by person type (worker versus student). The logsums are computed based on the household MAZ and the work MAZ (for workers) or school MAZ (for students). The household auto dependency is obtained by aggregating individual auto dependencies of each person type (worker versus student) in the household. More specifically, the calculation follows these steps:

Step 1: Calculate non-motorized mode availability factor using this formula:

$$0.5 \times MIN[MAX(distance, 1.0), 3.0] - 0.5,$$

where *distance* is the skimmed distance from home to work or school.

This function takes the value of 0 if *distance* ≤*1.0*, then linearly grows from 0 to 1, reaches 1 at *distance*=*3*, and stays at 1 for *distance*≥ *3*. The function indicates that non-motorized accessibility to work or school is highest when they are located within one mile of home, monotonically decreases as the distance increases to 3 miles, and they are assumed to be non-accessible by non-motorized means if located more than 3 miles away from home.

Step 2: Calculate auto dependency for each worker and student using this formula:

If$(SOV\ Logsum - Walk\ to\ Transit\ Logsum)\ \geq 0$, set auto dependency to:

$$MIN[(SOV\ Logsum - Walk\ to\ Transit\ Logsum)/unit\ utility\ , 1.0]$$

Otherwise, set auto dependency to 0.

This formula states that when transit accessibility is better than auto accessibility, then the worker (or student) is not considered auto dependent. Further, it states that the degree of auto dependency increases with the difference between auto and transit accessibility. Unit utility is a factor that converts logsum units into hours.

Step 3: Set household work tour auto dependency by adding up auto dependency values across household worker members (part time and full time workers).

Step 4: Set household school tour auto dependency by adding up auto dependency values across household student members (driving age school students and university students)

Step 5: Multiply household work tour auto dependency by non-motorized mode availability factor.

Step 6: Multiply household school tour auto dependency by non-motorized mode availability factor.

The SOV Logsum and Walk to Transit Logsum represents the ease of travel between two MAZs across these two modes. Including these mode choice logsums as measures of impedance is preferable to using skimmed highway or transit travel times directly, because it provides the auto ownership model with sensitivity to fare and auto cost components, and it ensures that the model is fully consistent with mode choice. Since at this stage of the model flow the location of non-work activities is not known, destination choice logsums are used to represent accessibility to non-mandatory activities. The destination logsum is continuous and consistent with mode choice.

The car ownership model estimation results are summarized in Table 22. Comparisons of the model estimated auto ownership and comparable data from ACS are shown in Figure 10 and Figure 11.

Table 22: Car Ownership Model Estimation Results

Observations:	3651
Likelihood –Constants only:	-5041
Final log likelihood:	-3353
Rho-Squared w.r.t. Zero:	0.43
Rho-Squared w.r.t. Constants:	0.33
Nesting coefficient 1:	0.668
Nesting coefficient 2:	1.000

Variable	Relevant types	Coefficient & t-Statistic by Choice Alternative									
		0 car		1 car		2 cars		3 cars		4+ cars	
		Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Number of driving age household members	0	ref	ref								
	1	-2.874	-1.4	ref	ref	-1.400	-2.3	-2.851	-4.0	-3.725	-4.1
	2	-5.196	-2.5	-3.298	-5.5	ref	Ref	-1.242	-3.1	-2.662	-4.1
	3	-4.984	-2.3	-3.702	-5.2	-0.475	-1.1	ref	Ref	-0.799	-1.2
	4+	-9.149	-3.4	-5.964	-6.0	-1.362	-2.0	-0.785	-1.1	ref	ref
Ratio of workers to drivers	over-sufficient					0.711	2.7	0.711	2.7	0.711	2.7
	sufficient	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
	insufficient	-2.192	-4.3	-0.610	-1.6	-0.610	-1.6	-0.610	-1.6		
Ratio of pre-driving age school children to drivers	over-sufficient					0.000		0.000		0.000	
	sufficient	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
	insufficient	-2.649	-2.8	-0.896	-1.8	-0.896	-1.8	-0.896	-1.8		
Ratio of driving age school children to drivers	over-sufficient					0.163	1.1	0.163	1.1	0.163	1.1
	sufficient	ref	ref	ref	ref	ref	ref	ref	ref	ref	Ref
	insufficient	-0.519	-1.3	-0.028	-0.1	-0.028	-0.1	-0.028	-0.1		
Ratio of young retirees (less than 80 years old) to drivers	over-sufficient					0.429	1.8	0.429	1.8	0.429	1.8
	sufficient	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
	insufficient	-0.571	-1.0	-0.297	-0.7	-0.297	-0.7	-0.297	-0.7		
Ratio of old retirees (80 years old or older) to drivers	over-sufficient					-1.349	-4.2	-1.349	-4.2	-1.349	-4.2
	sufficient	ref	ref	ref	ref	ref	ref	ref	ref	ref	ref
	insufficient	0.911	0.9	0.348	0.4	0.348	0.4	0.348	0.4		

Variable	Relevant types	Coefficient & t-Statistic by Choice Alternative									
		0 car		1 car		2 cars		3 cars		4+ cars	
		Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Household income	<$30k	3.974	9.6	0.946	5.5	ref	ref	-0.900	-3.1	-1.401	-2.9
	$30k-$60k	1.375	3.1	0.513	3.6	ref	ref	-0.458	-2.6	-0.407	-1.6
	$100k+	-0.663	-3.8	-0.663	-3.8	ref	ref	0.130	1.0	0.216	1.1
Household education attainment (no one in household attained a high-school diploma)	over-sufficient					-0.264	-1.1	-0.264	-1.1	-0.264	-1.1
	sufficient	ref	ref	ref	ref	ref	Ref	ref	Ref	ref	Ref
	insufficient	1.149	1.8	0.647	1.2	0.647	1.2	0.647	1.2		
Non-mandatory activity accessibility	non-motorized	0.091	0.4	0.060	0.9	ref	ref	-0.079	-1.8	-0.151	-2.6
	auto-transit	-0.301	-4.3	-0.014	-0.9	ref	ref	0.000		0.000	
Urban form	intersection density	0.000		0.000		ref	ref	-0.489	-1.7	-0.489	-1.7
	population density	0.069	4.1	0.034	3.9	ref	ref	0.000		0.000	
	retail density	0.112	2.1	0.044	1.8	ref	ref	0.000		0.000	
Housing unit type	detached	-2.657	-8.2	-0.791	-6.6	ref	ref	0.640	4.2	0.808	3.3
Mandatory activity auto dependency	worker	-0.247	-2.2	-0.247	-2.2	ref	ref	0.156	2.1	0.156	2.1
	student	-0.066	-0.3	-0.066	-0.3	ref	ref	0.000		0.000	
Mandatory activity rail mode index	worker	0.256	1.4	0.256	1.4	ref	ref	-0.309	-1.7	-0.309	-1.7
	student	0.281	0.5	0.281	0.5	ref	ref	0.000		0.000	

Figure 10: Household Auto Ownership

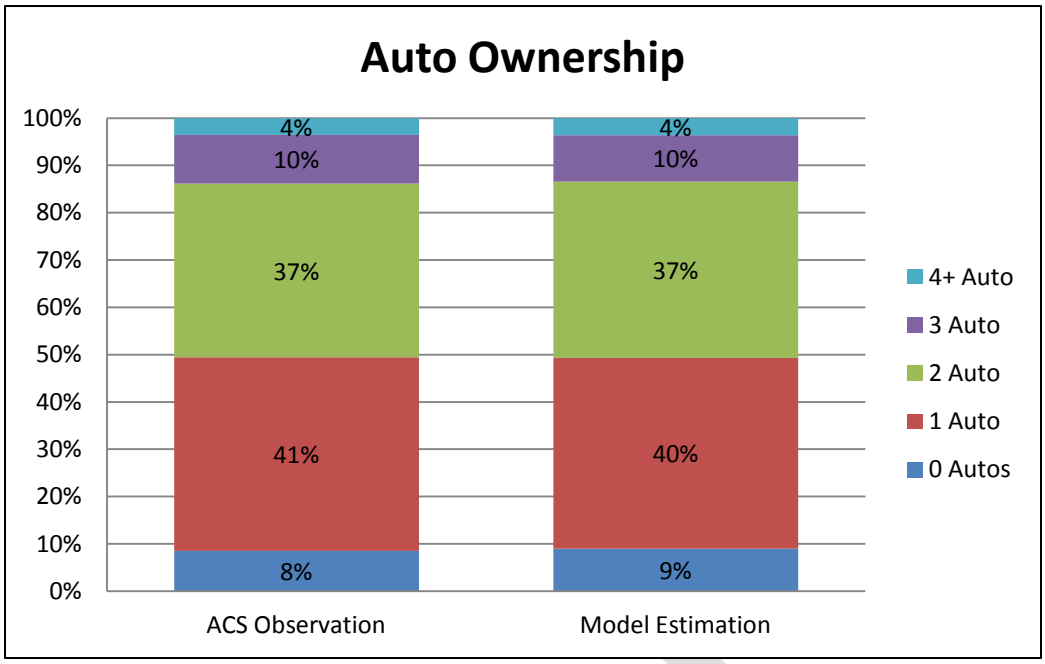
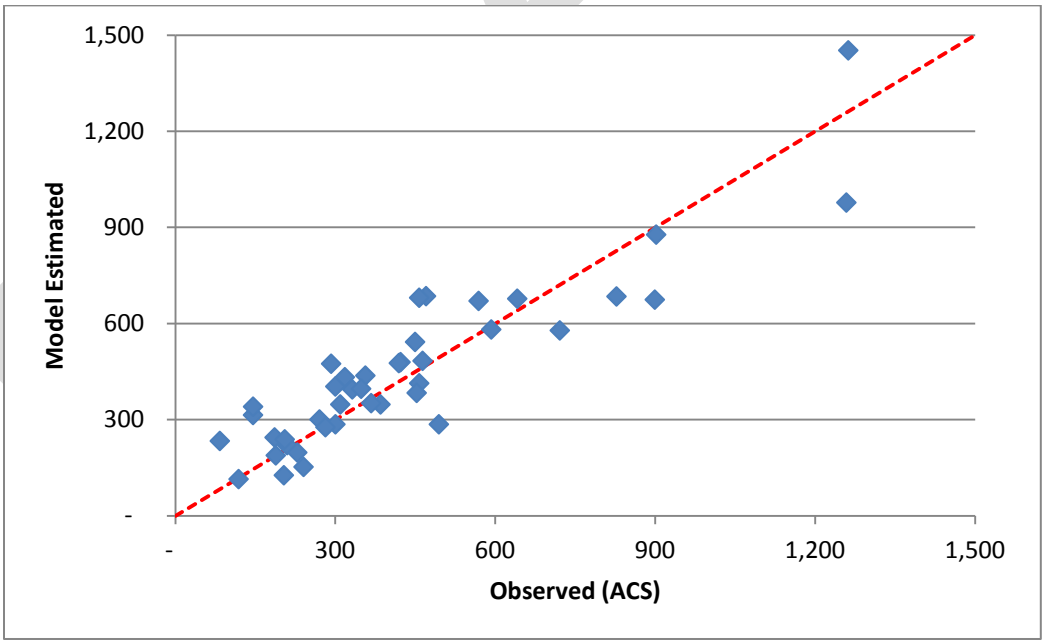


Figure 11: Zero Car Households, by PUMA



Model 3.3—Toll Transponder Ownership

Number of Models: 1
Decision-Making Unit: Households
Model Form: Multinomial Logit
Alternatives: Yes and No

This model predicts whether a household owns a toll transponder (SUNPASS) unit. This model is required because in 2010 the cost of using toll facilities in SE Florida is lower for SUNPASS users. The model is based on SUNPASS sales data – the number of active SUNPASS accounts by TAZ. While the data comprise individual sales records, no information is known about the SUNPASS account holders besides their address. Therefore the model was estimated as a regression model that predicts the probability of owning a transponder unit for each zone based on aggregate characteristics of households in that zone and distance to the nearest major toll facility (such as the Florida Turnpike or 95 Express Lanes). Once the probability of owning a transponder unit is known, each household in that zone will determine whether they own a unit based on a Monte Carlo simulation. Table 23 shows the selected model estimation results. The reference case is no transponder. The model was calibrated so that on average, 2/3 of the households in the region are predicted as SUNPASS owners.

Table 23: SUNPASS Ownership Model Estimation Results

Explanatory Variable	Transponder Ownership	
	Coefficient	t-Stat
Distance to nearest toll facility		
5 miles or less	-0.01445	-3.95
More than 5 miles	-0.02978	-16.85
Average time savings (toll path relative to free path)	0.07320	20.19
Constant	0.3831	22.50

Model 4.1—Coordinated Daily Activity Pattern (DAP)

Number of Models: 1
Decision-Making Unit: Households
Model Form: Multinomial Logit
Alternatives: 3 for one person households,
13 for two person households,
47 for three person households,
153 for four person households,
475 for five or more person households

The next set of sub-models relates to personal DAPs and the generation of individual tours by purpose for all persons in the synthetic population.

The DAP is classified by three main pattern types:

- *Mandatory pattern (M)* that includes at least one of the three mandatory activities – work, university or school. This constitutes either a workday or a university/school day, and may include additional non-mandatory activities such as separate home-based tours or intermediate stops on the mandatory tours.
- *Non-mandatory pattern (NM)* that includes only maintenance and discretionary tours. By virtue of the tour primary purpose definition, maintenance and discretionary tours cannot include travel for mandatory activities.
- *At-home pattern (H)* that includes only in-home activities. At-home patterns are not distinguished by any specific activity (such as work at home, take care of child, being sick, etc). Cases with complete absence from the model area (e.g., business travel) are also combined with this category.

Statistical analyses implemented with the Columbus, Atlanta, and San Francisco Bay Area data have shown that there is a strong correlation between DAP types of different household members, especially for joint NM and H types. For this reason, the DAP for different household members is not modeled independently. Instead, DAPs are chosen simultaneously for all members of a household. The household utility consists of the sum of various person and household level utility terms:

- individual household member utilities associated with each person's chosen pattern (M, NM, H);
- interaction terms that measure the utility from coordinating activities (i.e., household members exhibit the same DAP); and,
- utility associated with joint travel (for choices that include joint travel).

The choice structure includes 363 alternatives with no joint travel and 328 alternatives with joint travel, totaling to 691 alternatives as shown in Table 24. Note that the choices are available based on household size.

The total number of possible DAP type combinations is significant for large households. However, there are several considerations that significantly reduce the dimensionality of the simultaneous model. First of all, mandatory DAP types are only available for appropriate person types (workers and students). Even more importantly, intra-household coordination of DAP types is relevant only for the NM and H patterns. Thus, simultaneous modeling of DAP types for all household members is essential only for the

trinary choice (M, NM, H), while the sub-choice of the mandatory pattern can be modeled for each person separately.

Table 24: Formulation of CDAP choices

Household Size	Alternatives no Joint Travel	Alternatives with Joint Travel	All Alternatives
1	3	0	3
2	3x3=9	3x3-(3x2-1)=4	13
3	3x3x3=27	3x3x3-(3x3-2)=20	47
4	3x3x3x3=81	3x3x3x3-(3x4-3) =72	153
5 or more	3x3x3x3x3=243	3x3x3x3x3-(3x5-4)=232	475
Total	363	328	691

The CDAP model features simultaneous modeling of trinary pattern alternatives for all household members with the subsequent modeling of individual alternatives, as shown in Figure 12. Tour frequency choice is a separate choice model conditional upon the choice of alternatives in the trinary choice. This structure is more powerful for capturing intra-household interactions than sequential processing.

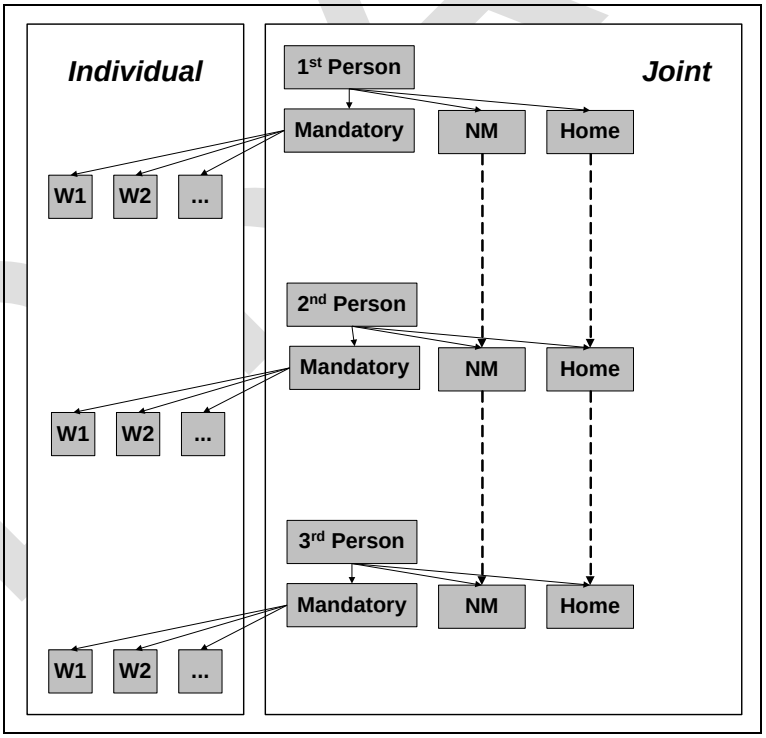


Figure 12: DAP Type Choice Structure

Simultaneous modeling of potentially joint alternatives for all household members assumes that for each person only a trinary choice (M, NM, H) is considered. Even for a household of five persons the

simultaneous combination of trinary models results in a total of 243 (i.e., 3^5) alternatives that is a manageable number in estimation and application.

For households of size greater than five, the model is applied for the top five household members (by priority order), while the rest of the household members are processed sequentially. The priority order by which members are selected for inclusion in the main model is shown in Table 25. When choosing among children of the same person type, the youngest child has priority. Approximately 5% of SE Florida households consist of more than 5 persons, per the 2010 U.S. Census.

Table 25: Person-Type Priority Ranking for CDAP

Person Type	Priority Ranking
Full-time worker	1
Part-time worker	2
Pre-school Child	3
Pre-Driving Age Child	4
Driving Age Child	5
Non-Working Adult	6
Retiree	7
University Student	8

The CDAP model contains a number of explanatory variables including person and household attributes, accessibility measures, and density/urban form variables. Since the model features intra-household interactions, a number of the parameters in the model are specified as interaction terms. These terms are based on the contribution to the total utility of an alternative from either a two-person interaction, a three-person interaction, or an entire-household interaction. For example, the contribution of a two-worker interaction to the utility for each worker to stay home on the simulation day is expected to be positive, indicating that it is more likely that both workers will attempt to coordinate their days off to engage in recreational opportunities together. Similarly, the contribution of a pre-school child to a worker mandatory pattern is expected to be negative, indicating the likelihood that if a pre-school child stays at home, a worker also is more likely to stay at home with the child.

The specification of this model is shown in Table 26 and Table 27. This model was transferred from San Diego. This model is calibrated to match the distribution of daily activity patterns (M, NH and H) for each person type. The calibration targets were derived from the 2009 NHTS. Comparisons between observed and modeled shares of each daily activity pattern by person type appear in Figure 13.

The model shows the following effects:

- *Person type:* The person type specific constants indicate that, all else being equal, full-time workers and school children are most likely to have mandatory patterns; and, non-workers and retirees are least likely to carry out mandatory activities.

- *Gender:* The interaction of person type with females shows that among workers and university students, females are less likely to stay at home, while among retirees and non-workers they are more likely to stay at home.
- *Age:* Among very young children (under age 6), the chances of going to school increases with age. Among children of age 6 to 15 yrs, the likelihood of going to school for children 13-15 yrs old is less than children under 13 yrs. This may reflect an increasing likelihood of participation in other activities that conflict with school as age increases.
- *Car ownership/sufficiency:* Non-workers and retirees are more likely to travel for non-mandatory activities and full-time workers are less likely to travel for only non-mandatory activities if there are more cars than workers in the household. This shows that the travel pattern for non-workers and retirees is affected by the availability of a car. Full-time workers are less likely to have only non-mandatory pattern because non-workers or other family members are more likely to take care of maintenance activities if a car is available. In zero car households or less cars than workers households, very young children (under age 6) are more likely to stay at home.
- *Household income:* Generally, household income has a positive effect on travel. Full time workers in low-income households are more likely to engage in non-mandatory activities or stay at home as compared to carrying out mandatory activities. However, part-time workers and university students from low income households (less than 30K) are more likely to attend mandatory activities. Pre-driving age school students from low income households are more likely to stay at home. Non-workers and retirees from high income households (more than 100k) are less likely to stay at home and pre-school children from high income households (more than 60k) are more likely to attend mandatory activities (e.g., day care or play schools).
- *Accessibility:* University students are more likely to travel to mandatory activities if accessibility to university location is high. University students have higher flexibility in terms of scheduling classes and may be able to schedule classes to minimize travel to school to avoid congestion. Better accessibilities to non-mandatory destinations improve the chances of making non-mandatory travel for full time workers, non-workers and driving school age children.
- *Usual work location:* Workers are much less likely to travel for mandatory activities if their usual work location is home. Also, they are more likely to stay at home and involve in non-mandatory activities due to flexible schedule and travel time savings. Workers who reported not having any usual work location are less likely to have mandatory travel.
- *Dwelling type:* Living in a detached home increases the likelihood of staying at home for retirees, pre-driving age school children and workers.
- *Two-way interactions:* The two-way interaction terms by person type combinations are estimated for same pattern types (MM, NN or HH). All possible interactions were tried in the estimation, except for mandatory patterns involving non-workers and retirees, and combinations with unobserved cases.
    - All estimated two-way interactions are positive
    - For mandatory (M) pattern, some of the largest interactions are found among school children (SD and SP). The interactions are also positive between part-time worker and workers, and among workers (particularly, part-time workers) and children.

    - For non-mandatory (N) pattern, the largest positive interactions are among pairs of children who are age 6 or older. For younger children (age less than 6), significant positive interactions are found with adults (particularly, part-time workers, non-workers and driving age school children) and other children.
    - For at home (H) pattern, largest interactions are between children of similar age group (i.e., pre-driving age child with pre-driving age child and driving age school child with driving age school child), and between non-worker and pre-driving age children.
- *Three –way interactions:* Three-way interaction terms (MMM, NNN or HHH) were considered for specific person type combinations because there are many possible three-way combinations.
    - Combination of three full time workers shows a positive interaction. If two full time workers go to work then the third one is also likely to go to work/school.
    - Combination of three children show negative for HHH pattern. Since, this works on top of the positive two-way interaction term, it reduces the strong positive impact of two-way interaction for three children at home.
- *Same pattern for all household members:* The estimates show all negatives for non-mandatory and at home patterns. The strength of the negative coefficient increases with household size. However, for mandatory patterns, the coefficients are not very significant for household size 3 and 5, which could be dependent on household composition. There is a strong positive affect for four member households. These coefficients will offset the effect of two-way and three-way interaction terms for larger households. (Note: the number of two-way interaction terms increase significantly with household size - a three person household has 3 terms, a four person household has 6 terms and a five-person household has 10 terms)
- *Joint travel:*
    - For a household member with a mandatory pattern, the chances of participating in joint travel are higher with better accessibility to work/school location.
    - The probability of joint travel in a household is higher with greater number of adults or children with non-mandatory pattern.
    - The likelihood of joint travel is reduced if all adults stay at home. In most cases, children are accompanied by adults for travel on a joint tour.
    - Low income (<30K) households are less likely to have joint travel whereas has higher income (>60K) are more likely to have joint travel.
    - Members of a household with fewer cars than workers are more likely to have joint tours. Whereas in a car sufficient household, people tend to have more individual tours.

Table 26: Coordinated Daily Activity Pattern Model Estimation Results

Observations:	3,651
Likelihood -Constants only:	-8,024
Final Likelihood:	-5,451
Rho-Squared w.r.t. Zero:	0.495
Rho-Squared w.r.t. Constants:	0.321

	FW *Full Time Worker*		PW *Part Time Worker*		US *University Student*		NW *Non-Worker*		RT *Retiree*		SD *Driving Age Child*		SP *Pre-Driving Age Child*		PS *Pre-School Child*	
Utility Terms	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constants																
Mandatory	2.9114	18.00	2.9274	7.90	1.7642	3.19	-3.1521	-7.43	-2.7055	-5.57	3.2036	6.08	7.0644	6.67	1.1000	3.15
Non-Mandatory	-0.7695	-0.34	1.3675	3.81	-0.3138	-0.53	0.5130	0.19	0.9234	5.19	-3.4315	-0.34	2.5740	2.39	0.6017	2.18
Home All Day																
Age																
Age 0-1, Mandatory															-1.5151	-4.17
Age 0-1, Non-Mandatory															0.3702	1.30
Age 4-5, Mandatory															3.2965	6.60
Age 4-5, Non-Mandatory															1.1392	2.19
Age 13-15, Mandatory													-0.8582	-2.96		
Age < 35 yrs, Mandatory			-0.7095	-2.07												
Age < 35 yrs, Non-Mandat.	-0.1450	-0.93	-1.4213	-3.86												
Household Income																
Mandatory																
Less than $30K	-0.7201	-3.76	0.1285	0.52	0.4359	1.00							1.2007	1.74		
Between $30K and $60K																
Between $60K and $100K															0.2952	1.27
More than $100K									-0.1418	-0.13					0.2952	1.27

Table 20: Coordinated Daily Activity Pattern Model Estimation Results (cont.)

	FW *Full Time Worker*		PW *Part Time Worker*		US *University Student*		NW *Non-Worker*		RT *Retiree*		SD *Driving Age Child*		SP *Pre-Driving Age Child*		PS *Pre-School Child*	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Household Income (cont.)																
Home All Day																
Less than $30K	-0.5331	-1.81											1.8947	2.38		
Between $30K and $60K																
Between $60K and $100K					0.6352	1.14										
More than $100K					0.6352	1.14	-0.2468	-1.00	-0.2388	-1.31						
Gender																
Female, Mandatory	0.3032	1.86	0.0610	0.19	1.2429	2.18			-0.7751	-1.14						
Female, Non-Mandatory	0.7718	4.09	0.4176	1.28	2.2549	3.48	0.1475	0.74	-0.3729	-2.71	0.7991	1.35				
Car Sufficiency																
Mandatory																
Zero Cars	-0.3377	-2.02													-0.5917	-1.00
Fewer Cars than Workers	-0.3377	-2.02													-0.4778	-0.77
Cars Equal to Worker																
More Cars than Workers											0.0988	0.20				
Non-Mandatory																
Zero Cars															-1.4389	-2.48
Fewer Cars than Workers															-0.5259	-1.01
Cars Equal to Worker																
More Cars than Workers	-0.0870	-0.66					0.2122	1.09	0.8642	5.14						

Table 26: Coordinated Daily Activity Pattern Model Estimation Results (cont.)

	FW *Full Time Worker*		PW *Part Time Worker*		US *University Student*		NW *Non-Worker*		RT *Retiree*		SD *Driving Age Child*		SP *Pre-Driving Age Child*		PS *Pre-School Child*	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Accessibility																
Mandatory																
Work/School Accessibility					0.0243	0.09										
Usual Work Place is Home	-2.4147	-12.39	-2.8801	-11.0												
No Usual Work Location	-0.3777	-1.79	-0.6869	-2.17												
Non-Mandatory																
Work/School Accessibility																
Usual Work Place is Home	0.8762	4.55														
Retail Accessibility	0.0445	0.29					0.0069	0.04			0.1570	0.24				
Dwelling Type																
At Home																
Detached HH	0.1538	0.96	0.0862	0.27					0.7415	5.05			2.0230	2.10		
Two Person Interactions																
Mandatory																
Full Time Worker																
Part Time Worker																
University Student	0.0627	0.35	0.5967	1.66	0.3881	0.74										
Non-Worker																
Retiree																
Driving School Child			0.0000								0.6854	0.86				
Pre-Driving School Child	0.1434	1.41	0.4024	1.79	0.2755	1.09					0.3692	1.41	0.7729	2.59		
Pre-School Child	0.3851	2.54	0.4453	1.49	0.4148	1.02					0.5467	0.85				

Table 26: Coordinated Daily Activity Pattern Model Estimation Results (cont.)

	FW *Full Time Worker*		PW *Part Time Worker*		US *University Student*		NW *Non-Worker*		RT *Retiree*		SD *Driving School Child*		SP *Pre-Driving School Child*		PS *Pre-School Child*	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Two Person Interactions																
Non-Mandatory																
Full Time Worker	0.1500	0.64														
Part Time Worker																
University Student																
Non-Worker																
Retiree					0.8526	2.22										
Driving School Child	1.0053	2.24			0.9678	1.00	0.7134	1.26								
Pre-Driving School Child	0.3041	0.90	0.3248	0.56			0.8509	2.54			1.8265	3.95	2.5719	5.09		
Pre-School Child	0.0000		0.9231	3.07	0.9241	2.31	1.1721	5.19			1.1744	1.00	0.7036	1.52	0.4338	1.22
Home All Day																
Full Time Worker	0.7511	2.04														
Part Time Worker	0.0000		0.7897	1.07												
University Student			1.6170	2.13												
Non-Worker			1.1606	2.22	0.6370	0.80	1.2214	2.98								
Retiree	0.6692	2.26	0.7915	2.02	0.1955	0.20	0.8544	2.97	1.0484	5.40						
Driving School Child	1.3472	2.77			2.2375	3.40	1.1160	1.62			3.1920	2.20				
Pre-Driving School Child			1.8203	1.80			1.9740	3.56					5.6222	7.75		
Pre-School Child	0.7797	1.90	1.7547	3.35	1.7118	2.87	2.1615	6.54	1.9117	5.20			2.8078	3.91	3.2327	7.40
Three Person Interactions																
Mandatory																
FWxFW	0.2980	2.03	0.2032	1.22												
FWxPW			-0.6279	-1.33									-0.0432	-0.31	-0.0432	-0.31
FWxKD*													-0.1301	-1.17	-0.1301	

Table 26: Coordinated Daily Activity Pattern Model Estimation Results (cont.)

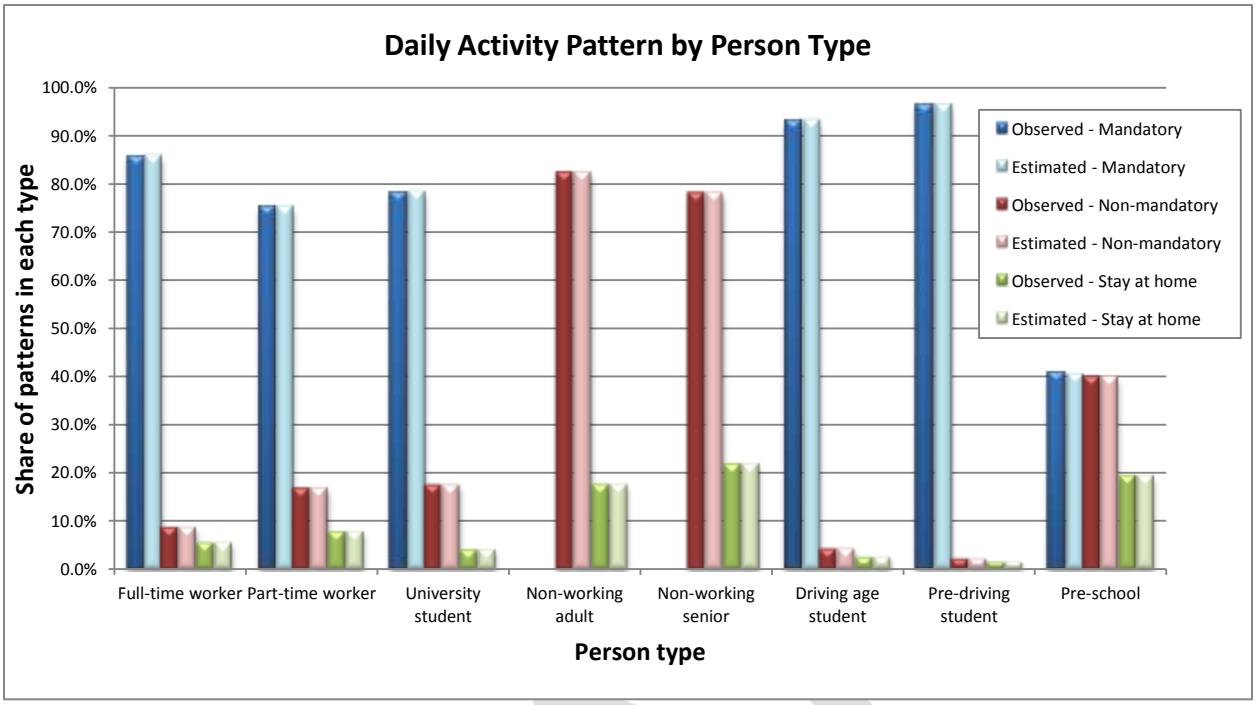
	FW *Full Time Worker*		PW *Part Time Worker*		US *University Student*		NW *Non-Worker*		RT *Retiree*		SD *Driving School Child*		SP *Pre-Driving School Child*		PS *Pre-School Child*	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Three Person Interactions																
Mandatory (cont.)																
PWxPW													-0.1524	-0.32	-0.1524	-1.43
PWxKD													-0.1259	-0.54	-0.1259	-0.89
KDxKD													-0.0112	-0.06	-0.0112	-0.06
Non-Mandatory																
FWxFW													-0.5454	-0.87	-0.5454	-0.87
FWxPW													-1.7459	-1.76	-1.7459	-1.76
FWxNW							-0.9496	-0.88					-0.1659	-0.65	-0.1659	-0.65
FWxKD													0.4687	1.64	0.4687	1.64
PWxPW			1.8781	1.52												
PWxNW																
PWxKD													-0.6913	-1.12	-0.6913	-1.12
NWxKD													-0.4894	-1.41	-0.4894	-1.41
KDxKD													-0.0582	-0.11	-0.0582	-0.11
Home All Day																
FWxPW							1.5072	1.87					0.8382	1.08	0.8382	1.08
FWxNW													0.4246	0.42	0.4246	0.42
FWxKD													0.1548	0.26	0.1548	0.26
PWxKD													-0.7547	-0.98	-0.7547	-0.98
NWxNW													-2.2535	-1.72	-2.2535	-1.72
NWxKD													-0.9024	-0.87	-0.9024	-0.87
KDxKD													-1.3723	-2.27	-1.3723	-2.27

* KD is for Pre-Driving School Child and Pre-School Child

Table 27: Coordinated Daily Activity Pattern Model Estimation Results - Joint Travel Terms

Utility Terms	Mandatory		Non-Mandatory		At Home		Joint	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Same Pattern for All HH Members								
Three Person households	-0.1140	-0.73	-0.4673	-1.56	-0.1538	-0.31		
Four Person Households	0.4569	2.45	-0.4669	-0.80	-0.4645	-0.50		
Five Person Households	-0.2607	-0.88	-1.4859	-1.43	-9.0000			
Joint Travel								
Constant							-3.1506	-1.92
Accessibility to Non Mandatory destinations							0.0550	0.50
Work Accessibilities for Persons with Mandatory Dap							0.1722	2.13
Number of Adults with Non-Mandatory DAP							1.2557	13.08
Number of Adults with Mandatory DAP							0.0080	0.10
Number of Pre-driving age Children with Non-							1.6898	12.20
Number of Pre-driving age Children with Mandatory							0.1088	1.76
If All Adults are stay at home							-0.9888	-0.90
Household Income								
Less than $30K							-0.1925	-1.13
Between $30K and $60K								
Between $60K and $100K							0.1043	0.85
More than $100K							0.1043	0.85
Car Ownership								
Zero Cars								
Fewer Cars than Workers							0.0884	0.36
Cars Equal to Worker								
More Cars than Workers							-0.0059	-0.05

Figure 13: Daily Activity Pattern by Person Type



Model 4.2.1—Individual Mandatory Tour Frequency

Number of Models: 1
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: 1 work tour, 2 work tours, 1 school tour, 2 school tours, 1 work & 1 school tours

Based on the DAP chosen for each person, individual mandatory tours, such as work, school and university tours are generated at person level. The model is designed to predict the exact number and purpose of mandatory tours for each person who chose the mandatory DAP type at the previous decision-making stage. Since the DAP type model at the household level determines which household members engage in mandatory tours, all persons subjected to the individual mandatory tour model implement at least one mandatory tour.

DAPs and subsequent behavioral models of travel generation include various explanatory variables that relate to household composition, income, car ownership, location of work and school activities, land-use development, residential and employment density, and accessibility factors. The specification of the Individual Mandatory Tour Frequency model is shown in Table 28. Comparisons between observed and modeled tour frequency distributions appear in Figure 14. This model was calibrated to match the distribution of persons by number of mandatory tours, tour purpose(s), and person type. The calibration targets were derived from the 2009 NHTS.

Table 28: Mandatory Tour Frequency Model Estimation Results

Observations:	4791
Likelihood – constants only:	-7668
Final log likelihood:	-1096
Rho-Squared (0):	0.857
Rho-Squared (constant):	0.734

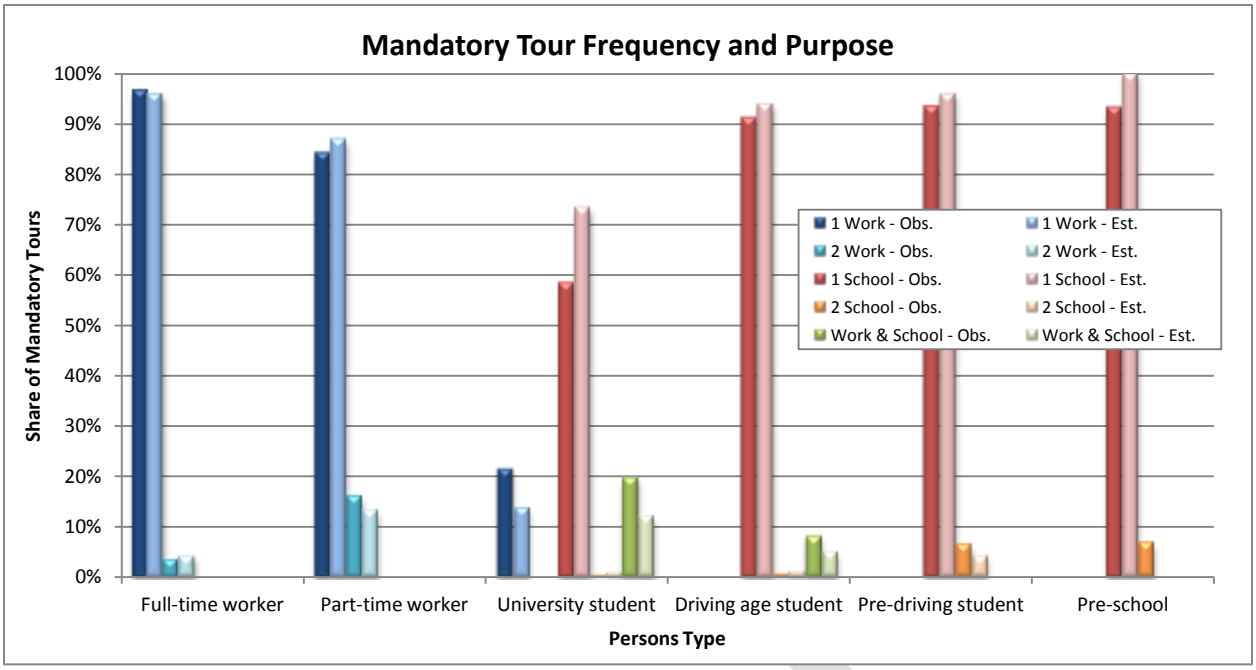
Explanatory Variables	1 Work		2+ Work		1 School		2+ School		1 Work, 1 School	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Constant										
Full-time worker	ref		-1.071	-0.41	n/a		n/a		n/a	
Part-time worker	ref		-1.778	-0.66	n/a		n/a		n/a	
University student	-0.935	-1.93	n/a		ref		-2.329	-4.73	-0.898	-1.57
School child 16-17	-2.810	-3.42	n/a		ref		-2.230	-5.80	-3.449	-3.09
School child 6-15	n/a		n/a		ref		-3.838	-9.65	n/a	
Person is female										
Full-time worker	ref		-0.172	-0.99						
Part-time worker	ref		0.726	1.55						
University student	-0.186	-0.37			ref		-1.207	-1.36	-0.627	-1.09
School child 16-17	-0.845	-0.67			ref		-1.566	-2.00	2.225	2.04
School child 6-15					ref		-1.124	-1.70		
Age older than 35 and University student	1.374	1.03								
Distance to work or school (dummy)										
Workplace within 0-0.5 miles			0.642	1.75						
Workplace within 0.5-3 miles)			1.217	6.14						
School within 0.5-2 miles							0.492	1.93		
Workplace or school within 0-0.5 miles									0.194	0.16
Workplace or school within 0.5-3 miles									0.184	0.42

Table 22: Mandatory Tour Frequency Estimation Results (cont.)

Explanatory Variables	1 Work		2+ Work		1 School		2+ School		1 Work, 1 School	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Minimum travel time to workplace (in min), excluding non-mot										
Full or part-time worker			-0.022	-3.28						
University student									-0.008	-0.60
No cars in household			-0.662	-1.40					-0.662	-1.40
Fewer cars than drivers in household							-0.955	-1.84		
Number of pre-school children in household										
Full or part-time worker			-0.039	-0.21					-0.143	-0.38
University student							-1.534	-1.6	-0.143	-0.76
Number of children not going to school			-0.437	-1.32						
Non-family household (dummy)										
University student	-1.094	-1.29							-1.094	-1.29
School child 16-17	-1.094	-1.29							-1.094	-1.29
Household income $50K or higher and University student	0.689	1.614								

Terms that apply to non-available choices in model application were excluded from this table.

Figure 14: Mandatory Tour Frequency by Person Type



Model 4.2.2—Individual Mandatory Tour Time of Day Choice

Number of Models: 1
Decision-Making Unit: Tours
Model Form: Multinomial Logit
Alternatives: 861 (combinations of tour departure and arrival half-hour periods)

After individual mandatory tours have been generated, the tour departure time from home and arrival time back at home is chosen simultaneously. Note that it is not necessary to select the destination of the tour, as this has already been determined in Model 2.1. The tour time of day choice model is a discrete-choice construct that operates with tour departure-from-home and arrival-back-home time combinations as alternatives. The utility structure is based on "continuous shift" variables, and represents an analytical hybrid that combines the advantages of a discrete-choice structure (flexible in specification and easy to estimate and apply) with the advantages of a duration model (a simple structure with few parameters, and which supports continuous time). The model has a temporal resolution of one-half hour that is expressed in 861 half-hour departure/arrival time alternatives.

The model utilizes direct availability rules for each subsequently scheduled tour, to be placed in the residual time window left after scheduling tours of higher priority. This conditionality ensures full consistency of the entire day activity and travel schedule for each person as an outcome of the model. Tours are sequenced and scheduled in priority order in the following categories, from highest to lowest priority:

- Work tours made by workers, school/university tours made by students
- Work tours made by students, school/university tours made by workers
- Joint maintenance tours
- Joint shopping tours

- Joint visit tours
- Joint discretionary tours
- Joint eating out tours
- Escort tours
- Individual maintenance tours
- Individual shopping tours
- Individual visit tours
- Individual discretionary tours
- Individual eating out tours

Two or more tours of the same priority are sequenced and scheduled in chronological order, earlier to later. Once a tour is scheduled, no other tour may be scheduled during that period, so the availability for all remaining tours in the scheduling sequences is affected. Joint tours are treated differently because their scheduling is constrained by (and affects) the available time windows of all household members participating in the tour.

The model utilizes household, person, and zonal characteristics, most of which are generic across time alternatives. However, network LOS variables vary by time of day, and are specified as alternative-specific based on each alternative's departure and arrival time. By using generic coefficients and variables associated with the departure period, arrival period, or duration, a parsimonious structure of the choice model is created, where the number of alternatives can be arbitrarily large depending on the chosen time unit scale, but the number of coefficients to estimate is limited to a reasonable number. Duration variables can be interpreted as "continuous shift" factors that parameterize the termination rate in such a way that if the coefficient multiplied by the variable is positive, this means the termination rate is getting lower and the whole distribution is shifted to the longer durations. Negative values work in the opposite direction, collapsing the distribution toward shorter durations.

In the CT-RAMP model structure, the tour-scheduling model is placed after destination choice and before mode choice. Thus, the destination of the tour and all related destination and origin-destination attributes are known and can be used as variables in the model estimation.

The choice alternatives are formulated as tour departure from home/arrival at home half-hour combinations (g, h), and the mode choice logsums and bias constants are related to multi-hour departure/arrival periods (s, t).Tour duration is calculated as the difference between the arrival and departure half-hours ($h - g$) and incorporates both the activity duration and travel time to and from the main tour activity, including intermediate stops.

The tour TOD choice utility has the following general form:

$$V_{gh} = V_g + V_h + D_{h-g} + \mu \ln\left(\sum_m V_{stm}\right) \qquad (9)$$

where:

V_g, V_h = departure and arrival time-specific components

D_{h-g} = duration-specific components

m = entire-tour modes (SOV, HOV, walk to transit, drive to transit, non-motorized)

V_{stm} = mode utility for the tour by mode m, leaving home in period s (containing half-hour h) and returning home in period t (containing g)

μ = mode choice logsum coefficient

For model estimation, the following practical rules can be used to set the alternative departure/arrival time combinations:

- Each reported/modeled departure/arrival time is rounded to the nearest whole half-hour. That is, the alternatives are 7:00 – 7:29, 7:30 – 7:59, 8:00 – 8:29, etc.
- Any times before 5:00 A.M. are shifted to 5:00 A.M., and any times after 1:00 A.M. are shifted to 1:00 A.M. This typically results in a shift for relatively few cases, and limits the number of half-hours in the model to 41.
- Every possible combination of the 41 departure half-hours with the 41 arrival half-hours (where the arrival half-hour is the same or later than the departure hour) is an alternative. This gives 41 × 42/2 = 861 choice alternatives.

The network simulations to obtain travel time and cost skims are implemented for three broad periods—A.M. Peak, Off-Peak, and P.M. Peak. Mode choice logsums are used for all relevant combinations of these aggregate time periods. The model could include more time of day periods for network simulation, ultimately approaching a resolution of dynamic traffic assignment. The tradeoff is the longer time it takes to create the skims and highway assignments at each travel time feedback loop.

The specification of the mandatory tour time of day choice models is shown in Table 29 to Table 31, respectively for work, university and school tours. Comparisons between modeled and observed distributions of tour departure and arrival times for work and school appear in Figure 15 to Figure 17. These models were calibrated to match the marginal distributions of mandatory tours by departure time, arrival time, and duration, for each tour purpose. The calibration targets were derived from the 2009 NHTS.

Table 29: Work Tour Time of Day Choice Model Estimation Results

Number of Observations:	3,154
Likelihood with constants only:	-17323
Final likelihood:	-16912
Rho-squared w.r.t zero:	0.199
Rho-squared w.r.t. constants:	0.024

Utility Terms	Coef.	t-Stat
Mode Choice Logsum	0.500	
Departure Time Constants		
Before 5:30 A.M.	-2.901	-4.19
5:30 A.M. to 6:00 A.M.	-1.708	-3.28
6:00 A.M. to 6:30 A.M.	-1.355	-3.44
6:30 A.M. to 7:00 A.M.	-0.728	-2.73
7:00 A.M. to 7:30 A.M.	-0.290	-2.00
7:30 A.M. to 8:00 A.M. (Reference)	0.000	
8:00 A.M. to 8:30 A.M.	-0.175	-1.23
8:30 A.M. to 9:00 A.M.	-0.358	-1.37
After 9:00 A.M.	-0.768	-1.99
Linear Shift for every 30 minutes after 9:30 A.M.	0.259	1.86
Squared Shift for every 30 minutes after 9:30 A.M.	-0.006	-3.55
Square Root Shift for every 30 minutes after 9:30 A.M.	-0.595	-3.83
Arrival Time Constants		
Linear Shift for every 30 minutes before 3 P.M.	-0.072	-0.45
Squared Shift for every 30 minutes before 3 P.M.	0.000	-0.03
Square Root Shift for every 30 minutes before 3 P.M.	0.138	0.72
Before 3:00 P.M.	0.493	0.76
3:00 P.M. to 3:30 P.M.	-0.071	-0.14
3:30 P.M. to 4:00 P.M.	-0.150	-0.39
4:00 P.M. to 4:30 P.M.	-0.135	-0.51
4:30 P.M. to 5:00 P.M.	-0.016	-0.11
5:00 P.M. to 5:30 P.M. (Reference)	0.000	
5:30 P.M. to 6:00 P.M.	-0.189	-1.30
6:00 P.M. to 6:30 P.M.	-0.540	-2.06
6:30 P.M. to 7:00 P.M.	-0.968	-2.51
After 7:00 P.M.	-1.054	-2.09
Linear Shift for every 30 minutes after 7:30 P.M.	-0.223	-0.98
Squared Shift for every 30 minutes after 7:30 P.M.	0.010	0.58
Square Root Shift for every 30 minutes after 7:30 P.M.	-0.193	-0.60
Duration Constants		
Linear Shift for every 30 minutes less than 8 hrs	0.269	1.83
Squared Shift for every 30 minutes less than 8 hrs	-0.023	-7.68
Square Root Shift for every 30 minutes less than 8 hrs	-0.697	-4.23
8 hours or less	-0.595	-1.42
8.5 hours	-0.057	-0.19
9 hours	-0.196	-1.36
9.5 hours	0.000	

Utility Terms	Coef.	t-Stat
10 hours	-0.093	-0.64
10.5 hours	-0.267	-1.02
11 hours or more	-0.505	-1.31
Linear Shift for every 30 minutes more than 11 hrs	0.261	1.05
Squared Shift for every 30 minutes more than 11 hrs	-0.044	-2.64
Square Root Shift for every 30 minutes more than 11 hrs	-0.559	-1.89
Low Income Household *(<=$29,999)*		
Departure Before 5 A.M. (Dummy)	-0.754	-2.58
Departure before 7:30 A.M. (Linear Shift)	-0.245	-4.96
Departure after 8 A.M. (Linear Shift)	0.033	2.49
Arrival after 12 A.M. (Dummy)	1.176	2.74
Duration< 9.5 hrs (Linear Shift)	0.023	1.80
Duration>9.5 hrs (Linear Shift)	-0.046	-1.72
Medium Income Household *($30,000 to $59,999)*		
Departure Before 5 A.M. (Dummy)	-0.754	-2.58
Departure before 7:30 A.M. (Linear Shift)	-0.133	-3.22
Departure after 8 A.M. (Linear Shift)	0.033	2.49
Duration< 9.5 hrs (Linear Shift)	0.023	1.80
Duration>9.5 hrs (Linear Shift)	-0.046	-1.72
High Income Household *(>= $100,000)*		
Departure before 7:30 A.M. (Linear Shift)	0.171	4.97
Departure after 8 A.M. (Linear Shift)	-0.037	-2.96
Household with Joint Travel		
Arrival before 5:00 P.M. (Linear Shift)	-0.042	-2.79
Arrival after 5:30 P.M. (Linear Shift)	-0.024	-1.18
Presence of Non-Working Adult in the Household		
Departure before 7:30 A.M. (Linear Shift)	-0.080	-2.17
Departure after 8 A.M. (Linear Shift)	-0.023	-1.31
Arrival before 5:00 P.M. (Linear Shift)	0.031	1.65
Arrival after 5:30 P.M. (Linear Shift)	0.044	1.98
Full Time Worker		
Departure after 10 A.M.	-0.332	-2.54
Duration < 9 hrs	-0.730	-4.17
Arrival before 3 P.M.	-0.884	-5.75
Part-Time Worker		
Departure before 7:30 A.M. (Linear Shift)	0.564	4.30
Departure before 7:30 A.M. (Squared Shift)	-0.095	-3.56
Duration< 9.5 hrs (Linear Shift)	-0.096	-5.36
University Student/Driving Age Student		
Departure after 8 A.M. (Linear Shift)	0.052	1.40
Duration< 9.5 hrs (Linear Shift)	-0.111	-1.11
Duration< 9.5 hrs (Squared Shift)	0.013	1.97
Female Worker		
Departure before 7:30 A.M. (Linear Shift)	0.149	4.99
Departure after 8 A.M. (Linear Shift)	-0.027	-2.34
Arrival after 5:30 P.M. (Linear Shift)	-0.017	-1.03

Utility Terms	Coef.	t-Stat
Female & Presence of Pre-School Child in the HH		
Departure before 7:30 A.M. (Linear Shift)	0.120	1.70
Arrival before 5:00 P.M. (Linear Shift)	0.013	0.53
Arrival after 5:30 P.M. (Linear Shift)	-0.067	-1.85
Age Group		
Age 16 to 18 yrs - Departure after 8 A.M. (Linear Shift)	0.137	3.53
Age 19 to 24 yrs - Departure before 7:30 A.M. (Linear Shift)	-0.179	-2.87
Age 19 to 24 yrs - Departure after 8 A.M. (Linear Shift)	0.148	7.42
Age 41 to 55 yrs - Departure before 7:30 A.M. (Linear Shift)	-0.111	-3.59
Age 55 to 64 yrs - Departure before 7:30 A.M. (Linear Shift)	-0.069	-1.71
Age 65+ yrs - Departure before 7:30 A.M. (Linear Shift)	0.116	1.48
Age 16 to 18 yrs - Duration> 9.5 hrs (Linear Shift)	-0.137	-0.65
Age 19 to 24 yrs - Duration< 9.5 hrs (Linear Shift)	0.092	3.51
Age 19 to 24 yrs - Duration> 9.5 hrs (Linear Shift)	-0.082	-1.41
Age 41 to 55 yrs -Duration< 9.5 hrs (Linear Shift)	-0.045	-3.69
Age 55 to 64 yrs - Duration< 9.5 hrs (Linear Shift)	-0.045	-2.90
Age 65+ yrs - Duration< 9.5 hrs (Linear Shift)	-0.128	-6.84
First Work Tour out of Two Mandatory Tours		
Second Tour is a Work Tour		
Departure before 7:30 A.M. (Linear Shift)	-0.140	-2.34
Departure after 8 A.M. (Linear Shift)	0.038	2.63
Duration< 9.5 hrs (Linear Shift)	-0.266	-16.01
Duration>9.5 hrs (Linear Shift)	-0.852	-3.10
Second Tour is a School Tour		
Departure before 7:30 A.M. (Linear Shift)	-0.250	-1.79
Departure after 8 A.M. (Linear Shift)	0.026	0.63
Duration< 9.5 hrs (Linear Shift)	-0.120	-2.87
Duration>9.5 hrs (Linear Shift)	-0.621	-1.67
Distance to Destination		
Departure before 7:30 A.M. (Linear Shift)	-0.014	-10.13
Departure after 8 A.M. (Linear Shift)	-0.002	-2.60
Arrival before 5:00 P.M. (Linear Shift)	0.004	5.25
Arrival after 5:30 P.M. (Linear Shift)	0.002	1.90
Employment Density at Destination		
Departure after 8 A.M. (Linear Shift)	-0.001	-3.01
Arrival before 5:00 P.M. (Linear Shift)	0.002	4.31
Arrival after 5:30 P.M. (Linear Shift)	0.001	2.36

Table 30: Time-of-Day Choice Model Estimation Results, University Tours

Number of Observations:	242		
Likelihood with constants only:	-1187	Rho-squared (0):	0.149
Final likelihood:	-1355	Rho-squared (constants):	0.142

Utility Terms	Coef.	t-Stat
Mode Choice Logsum	0.200	
Departure Time Constants		
Before 6:00 am	-5.750	-4.68
6:00 am to 6:30 am	-3.257	-3.80
6:30 am to 7:00 am	-2.358	-4.01
7:00 am to 7:30 am	-0.532	-1.69
7:30 am to 8:00 am (Reference)	0.000	
After 8:00 am	-0.347	-1.45
Linear Shift for every 30 minutes after 8:30 am	-0.162	-2.24
Arrival Time Constants		
Linear Shift for every 30 minutes before 11:00 am	0.060	0.43
Before 11:30 am	-0.386	-0.79
11:30 am to 12:00 pm	-0.508	-1.13
12:00 pm to 12:30 pm		
After 12:30 pm	-0.458	-1.24
Linear Shift for every 30 minutes after 1:00 pm	0.290	1.69
Squared Shift for every 30 minutes after 1:00 pm	-0.013	-3.05
Square Root Shift for every 30 minutes after 1:00 pm	-0.479	-1.18
Duration Constants		
Linear Shift for every 30 minutes under 2 hrs	-1.372	-2.94
Square Root Shift for every 30 minutes under 2 hrs	1.272	1.66
2.5 hours or less	-0.735	-1.51
3 hours	-0.157	-0.44
3.5 hours	0.059	0.19
4 hours	0.000	
4.5 hours	-0.180	-0.57
5 hours	-0.286	-0.81
5.5 hours or more	-0.369	-1.00
Linear Shift for every 30 minutes over 6.5 hrs	-0.146	-2.26
Low and Medium Income Household *(<=$59,999)*		
Departure after 8:00 am (Linear Shift)	0.031	0.70
Duration < 4 hrs (Linear Shift)	0.052	0.46
Duration > 4 hrs (Linear Shift)	0.032	0.53
High Income Household *(>= $100,000)*		
Departure before 7:30 am (Linear Shift)	-0.207	-0.77
Duration > 4 hrs (Linear Shift)	-0.076	-1.10
Age Group		
Age 16 to 24 yrs - Departure after 8 am (Linear Shift)	-0.045	-1.06
Age 16 to 24 yrs -Duration < 4 hrs (Linear Shift)	0.075	0.67
Age 55 to 64 yrs - Duration > 4 hrs (Linear Shift)	-0.183	-1.33
Age 65+ yrs - Duration > 4 hrs (Linear Shift)	-0.284	-1.42

Utility Terms	Coef.	t-Stat
Distance to Destination		
Departure before 7:30 am (Linear Shift)	-0.033	-2.25
Departure after 8:00 am (Linear Shift)	-0.001	-0.38
Arrival before 12:00 pm (Linear Shift)	0.046	2.67
Arrival after 12:30 pm (Linear Shift)	0.004	2.14
First University Tour of Two Mandatory Tours		
Second Tour is a Work Tour		
Departure after 8:00 am (Linear Shift)	-0.242	-2.80
Duration > 4 hrs (Linear Shift)	-0.264	-2.92
Second Tour is also a University Tour		
Duration < 4 hrs (Linear Shift)	-0.561	-3.81
Duration > 4 hrs (Linear Shift)	-0.710	-1.92

Terms that apply to non-available choices in model application were excluded from this table.

Table 31: Time of Day Choice Model Estimation Results for School Tours

Number of Observations:	1595		
Likelihood with constants only:	-6660	Rho-squared (zero):	0.381
Final likelihood:	-6622	Rho-squared (constants):	0.006

Utility Terms	Coef.	t-Stat
Mode Choice Logsum	0.100	
Departure Time Constants		
Before 6:30 A.M.	-1.671	-5.19
6:30 A.M. to 7:00 A.M.	0.273	1.46
7:00 A.M. to 7:30 A.M.	0.745	6.62
7:30 A.M. to 8:00 A.M. (Reference)	0.000	
8:00 A.M. to 8:30 A.M.	-0.873	-9.25
After 8:30 A.M.	-1.740	-11.91
Linear Shift for every 30 minutes after 9 A.M.	-0.118	-0.91
Square Root Shift for every 30 minutes after 9 A.M.	-1.954	-7.82
Arrival Time Constants		
Linear Shift for every 30 minutes before 2:30 P.M.	-0.080	-0.67
Squared Shift for every 30 minutes before 2:30 P.M.	-0.055	-4.48
Before 2:30 P.M.	-1.023	-8.80
2:30P.M. to 3:00 P.M. (Reference)	0.000	
3:00 P.M. to 3:30 P.M.	0.146	1.50
3:30 P.M. to 4:00 P.M.	-0.030	-0.22
4:00 P.M. to 4:30 P.M.	-0.275	-1.46
4:30 P.M. to 5:00 P.M.	-0.243	-1.07
After 5:00 P.M.	-0.152	-0.58
Linear Shift for every 30 minutes after 5:30 P.M.	-0.797	-8.34
Square Root Shift for every 30 minutes after 5:30 P.M.	0.728	3.36

Duration Constants		
Linear Shift for every 30 minutes under 6.5 hrs	0.097	1.28
6.5 hours or less	-0.153	-1.23
7 hours	0.000	
7.5 hours	-0.470	-4.48
8 hours	-0.779	-5.30
8.5 hours or more	-1.451	-7.20
Linear Shift for every 30 minutes over 8.5 hrs	0.626	1.43
Squared Shift for every 30 minutes over 8.5 hrs	-0.124	-2.54
Square Root Shift for every 30 minutes over 8.5 hrs	-0.801	-1.61
***Low Income Household** (<=$29,999)*		
Departure after 8:00 A.M. (Linear Shift)	0.157	2.76
Duration < 7 hrs (Linear Shift)	0.120	2.32
***High Income Household** (>= $100,000)*		
Departure before 7:30 A.M. (Linear Shift)	0.272	3.51
Duration < 7 hrs (Linear Shift)	0.107	3.04
All Adults are Full-Time Workers in the Household		
Departure before 7:30 A.M. (Linear Shift)	-0.212	-2.95
Departure after 8:00 A.M. (Linear Shift)	-0.126	-2.78
Arrival before 2:30 P.M. (Linear Shift)	0.165	3.13
Arrival after 3:00 P.M. (Linear Shift)	0.168	6.72
Driving Age Child		
Duration less than 7 hrs	-0.383	-1.59
Pre-driving Age Child		
Arrival before 2:00 P.M.	-1.061	-5.10
Age Group		
Age 0 to 5 yrs - Departure before 7:30 A.M. (Linear Shift)	1.094	7.82
Age 0 to 5 yrs - Departure after 8:00 A.M. (Linear Shift)	0.101	1.77
Age 6 to 12 yrs - Departure before 7:30 A.M. (Linear Shift)	0.836	9.43
Age 16 to 17 yrs- Departure after 8:00 A.M. (Linear Shift)	0.213	3.43
Age 0 to 5 yrs - Duration < 7 hrs (Linear Shift)	-0.399	-8.03
Age 0 to 5 yrs - Duration > 7 hrs (Linear Shift)	0.170	4.87
Age 6 to 12 yrs - Duration < 7 hrs (Linear Shift)	0.048	0.97
Age 6 to 12 yrs - Duration > 7 hrs (Linear Shift)	-0.058	-2.02
First School Tour of Two Mandatory Tours		
Second Tour is also a School Tour		
Departure before 7:30 A.M. (Linear Shift)	-0.538	-2.68
Departure after 8:00 A.M. (Linear Shift)	0.305	4.01
Duration < 7 hrs (Linear Shift)	-0.411	-6.05
Duration > 7 hrs (Linear Shift)	-0.242	-1.56
Second Tour is a Work Tour		
Duration > 7 hrs (Linear Shift)	-0.311	-1.64
Distance to Destination		
Departure before 7:30 A.M. (Linear Shift)	-0.010	-1.81
Arrival after 3:00 P.M. (Linear Shift)	0.012	5.62

Figure 15: Work Tour Departure and Arrival Times

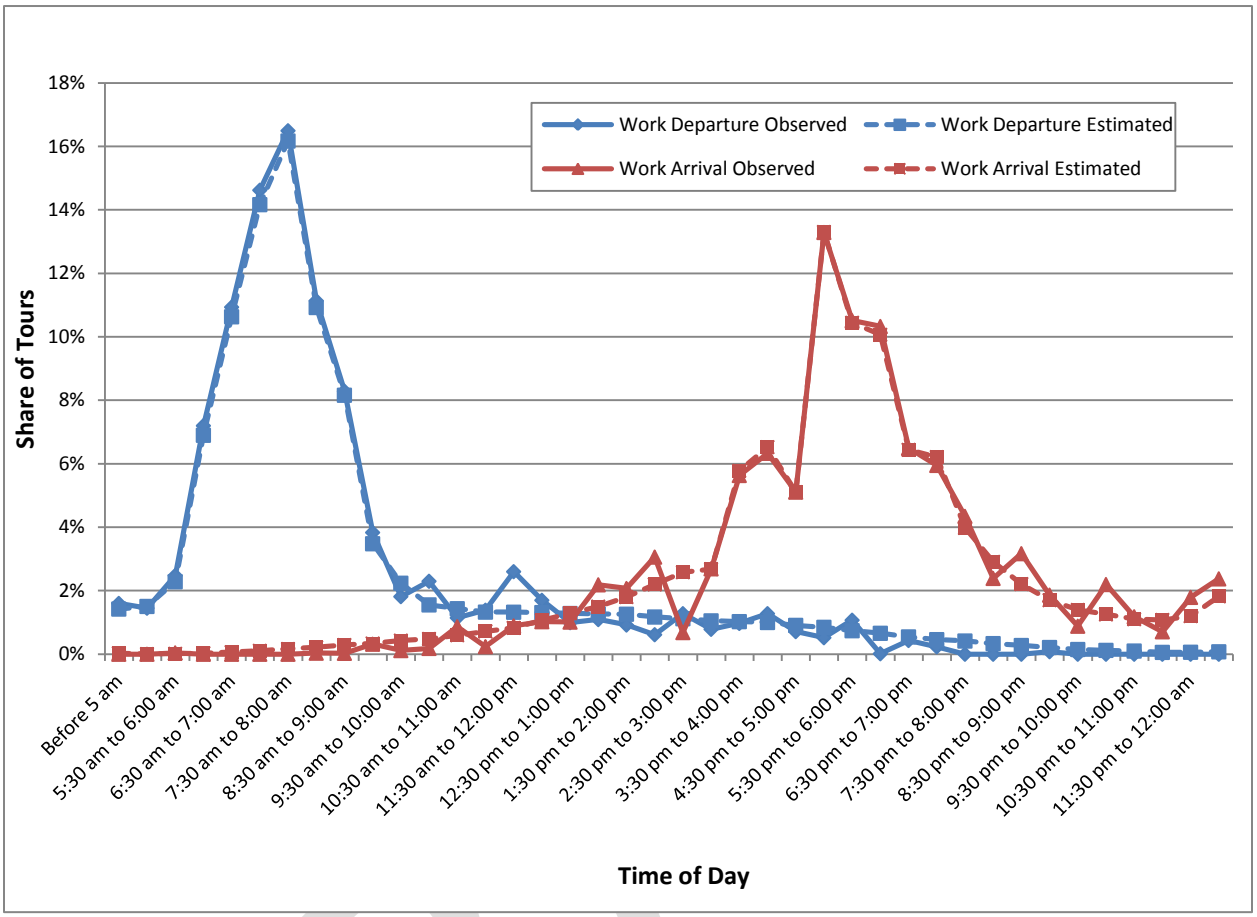


Figure 16: University Tour Departure and Arrival Times

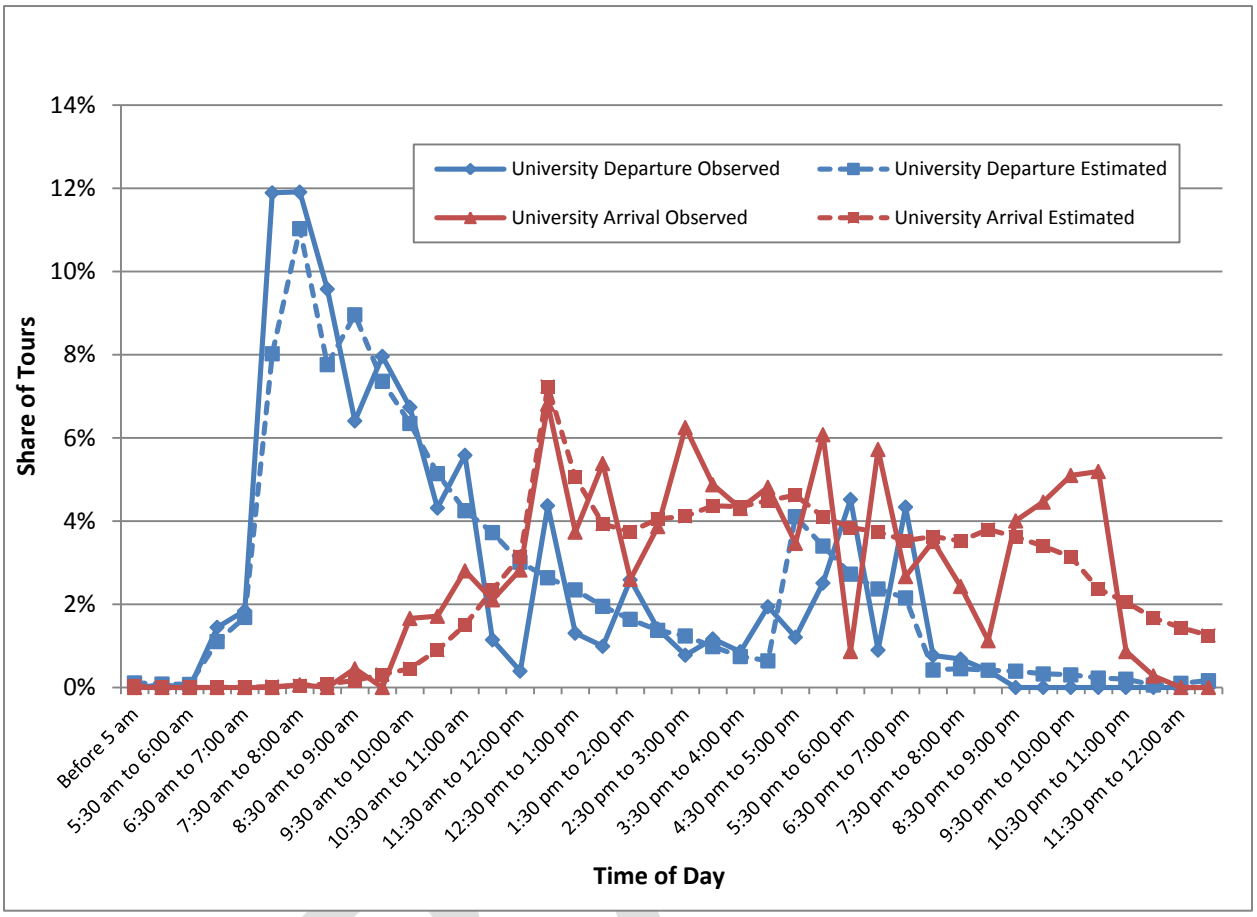
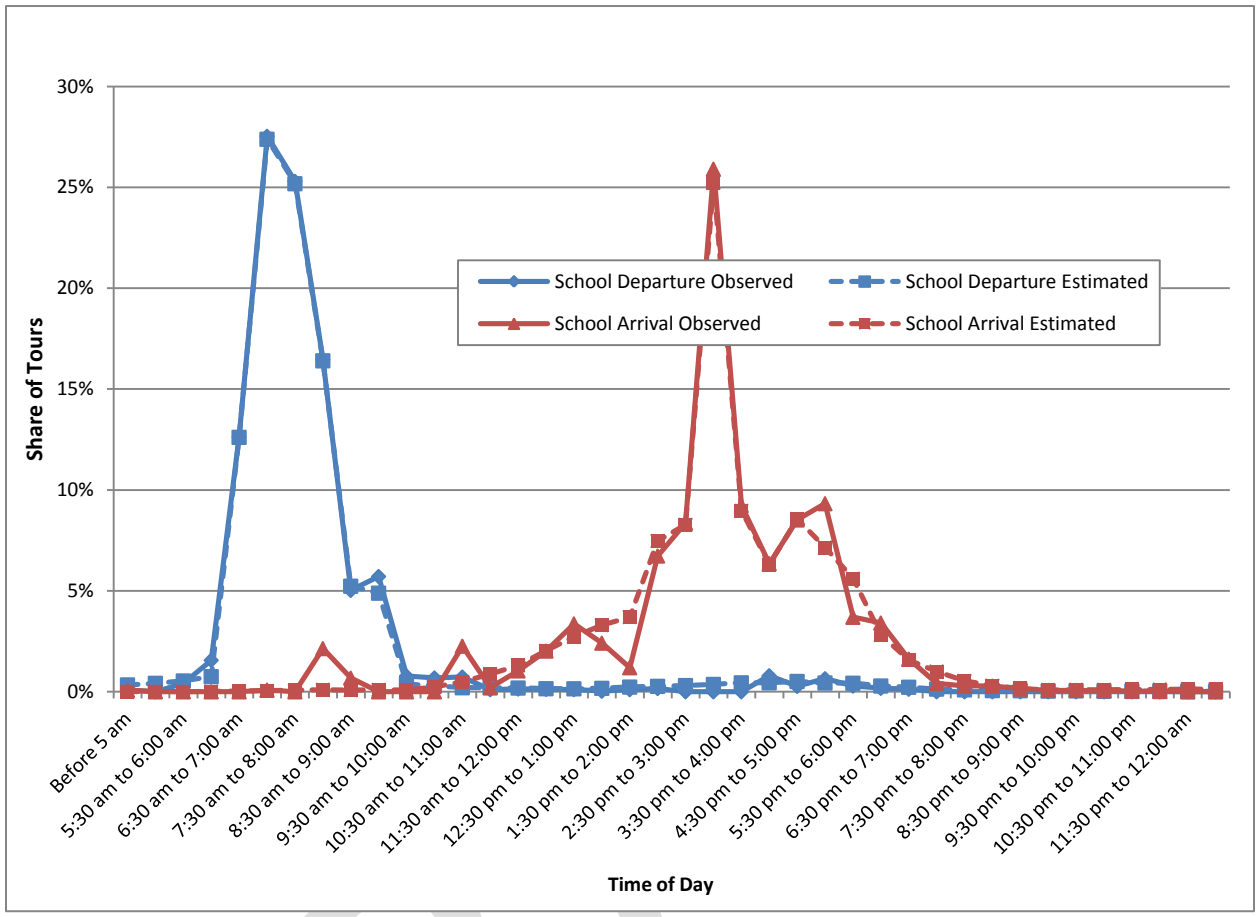


Figure 17: School Departure and Arrival Times



Model 4.3—Generation of Joint Household Tours

In the current CT-RAMP structure, joint travel for non-mandatory activities is modeled explicitly in the form of fully joint tours (where all members of the travel party travel together from the very beginning to the end and participate in the same activities along the way). Other types of joint travel like carpooling of workers and escorting children are not explicitly considered currently, though they are handled implicitly through shared-ride alternatives in mode choice.

An explicit model of joint travel constitutes one of the primary advantages of the CT-RAMP modeling paradigm. Each fully joint tour is considered a unit of modeling with a group-wise decision-making for the primary destination, mode, frequency and location of stops, etc. Formally, modeling joint activities involves two linked stages – see Figure 18:

- A tour generation stage that generates the number of joint tours by purpose/activity type made by the entire household. This is the joint tour frequency model.
- A tour participation stage at which the decision whether to participate or not in each joint tour is made for each household member and tour. This is the joint tour participation model. For

analytical convenience this model is broken into two sub-models. The first addresses travel party composition, and the second focuses on person participation choice.

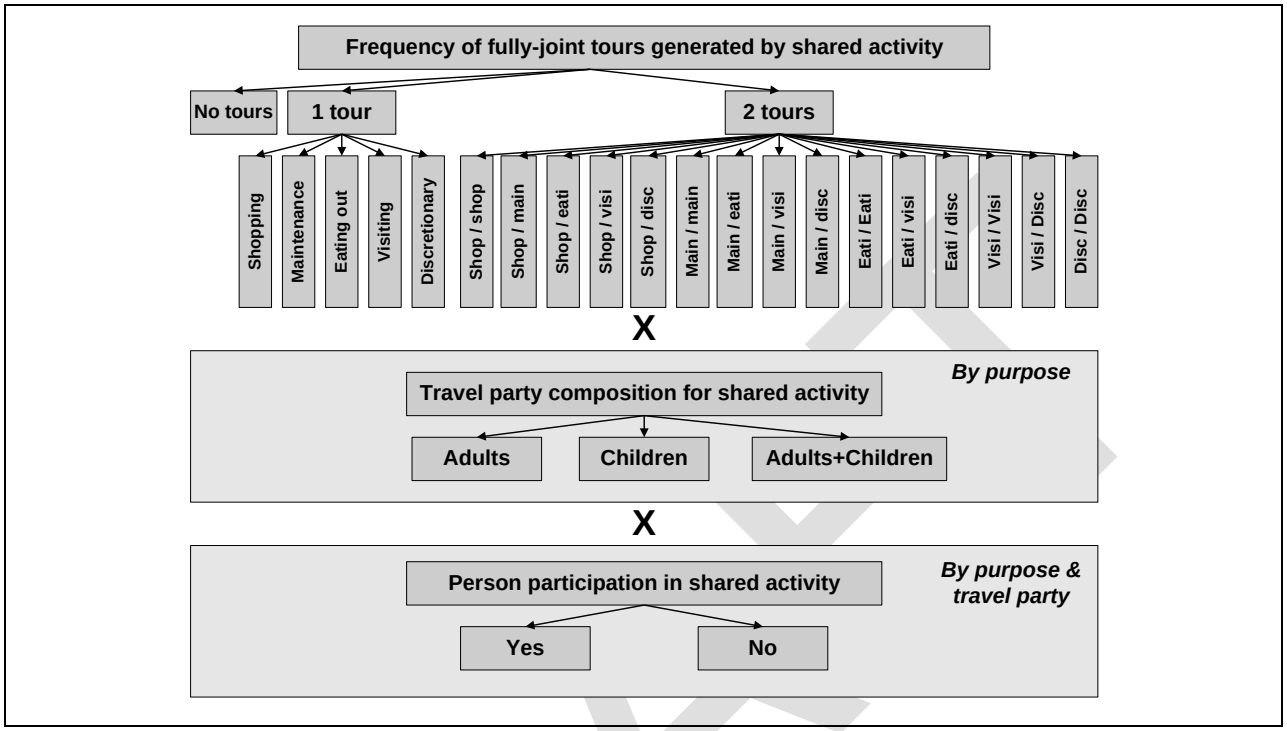


Figure 18: Model Structure for Joint Non-Mandatory Tours

Joint tour party composition is modeled for each tour. Travel party composition is defined in terms of person categories (e.g., adults and children) participating in each tour. Statistical analysis and model estimation has shown a strong linkage between trip purpose and typical party compositions. The essence of the joint party composition model is to narrow down the set of possible person participation choices modeled by the subsequent sub-model. Frequency choice and travel party composition models discussed above generally fall quite readily into the standard discrete choice structure. Regarding the person participation model, two alternative ways to formulate the choice model have been found (as shown in Figure 19). The first approach (shown on the left of Figure 19) constitutes entire-party choice. This approach is based on explicitly listing all possible person combinations for the travel party formation. The disadvantage of this approach is its complexity; in large households, it is not clear how to structure the alternatives, form a choice set, and estimate a model that is relatively easy to interpret. The second approach (shown on the right) is based on participation choice being modeled for each person sequentially. In this alternative approach, only a binary choice model is calibrated for each activity, party composition and person type. The model iterates through household members, and applies a binary choice to each to determine if the member participates. The model is constrained to only consider members with available time-windows overlapping with the generated joint tour. This method is used for modeling joint tour participation in CT-RAMP. The approach offers simplicity, but at

the cost of overlooking potential non-independent participation probabilities across household members. The joint tour frequency, composition, and participation models are described below.

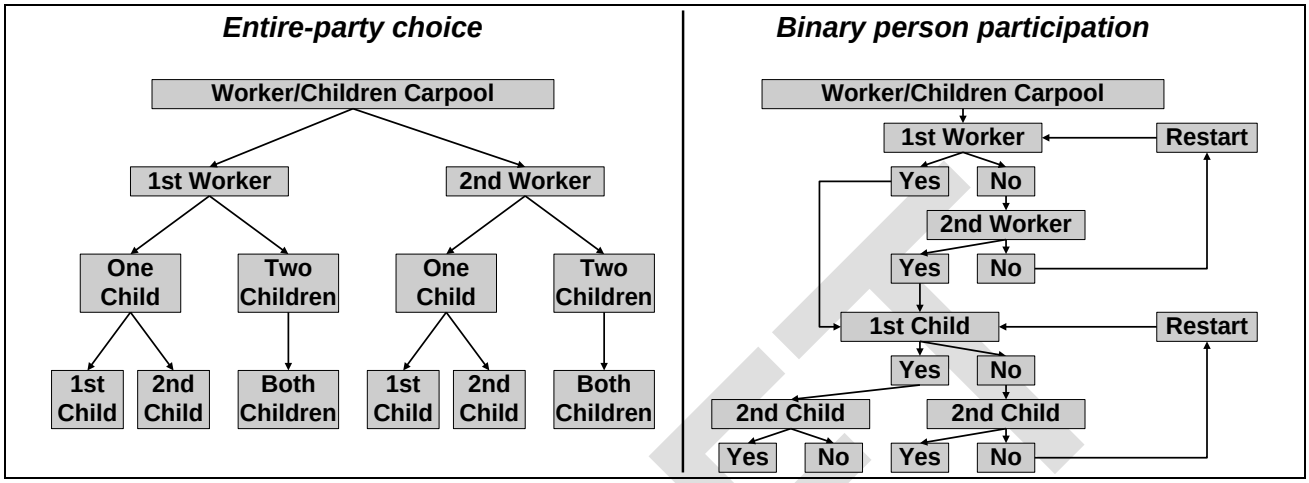


Figure 19: Travel Party Formation

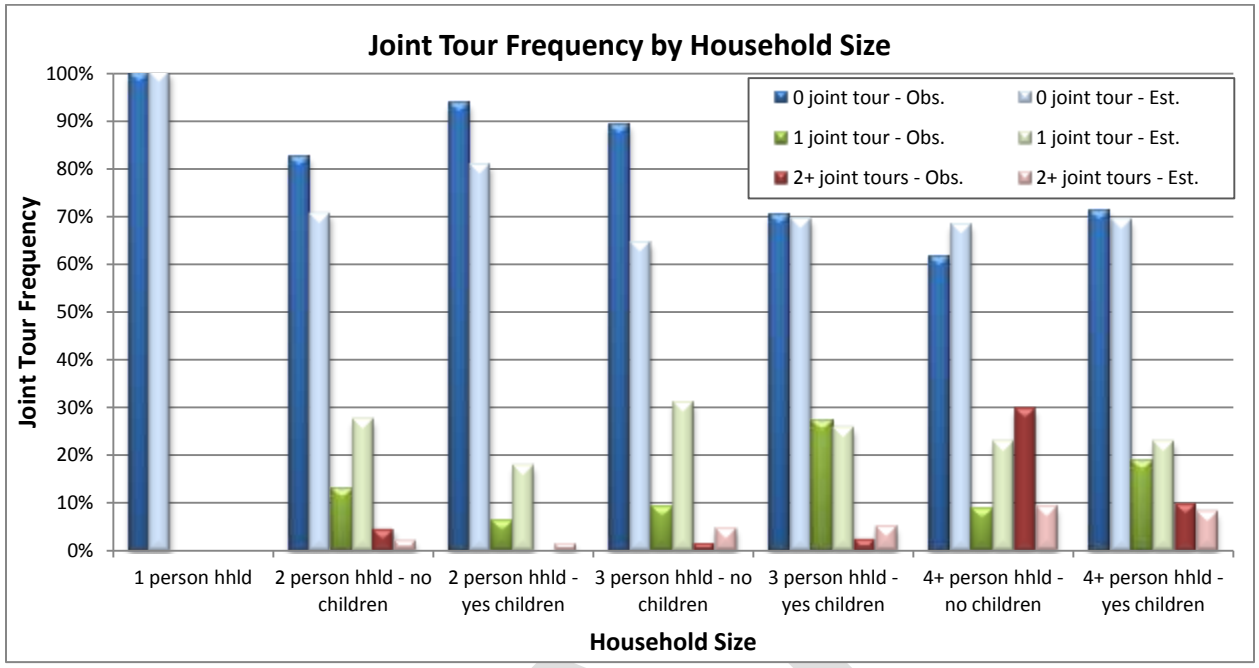
Model 4.3.1—Joint Tour Frequency

Number of Models: 1
Decision-Making Unit: Households
Model Form: Multinomial Logit
Alternatives: 21 (No tours, 1 tour segmented by purpose, 2 tours segmented by purpose)

Joint tour frequencies are generated by households, and include the number and purposes of the joint tours. Later models determine who in the household participates in the joint tour. The explanatory variables in the joint tour frequency model include household variables, accessibilities, and other urban form type variables. One of the most significant variables in the joint tour frequency model is the presence and size of overlapping time-windows, which represent the availability of household members to travel together after mandatory tours have been generated and scheduled. This formulation provides 'induced demand' effects on the generation and scheduling of joint tours; the frequency and duration of mandatory tours affect whether or not joint tours are generated.

The specification of the joint tour frequency model is shown in Table 32. This model was estimated jointly with the tour composition model; the goodness-of-fit statistics are shown in Table 33. The comparison of observed and estimated joint tour frequency by household size is shown in Figure 20. The joint tour frequency model was calibrated to match the distribution of households by number of joint tours and tour purpose(s), and the distribution of joint tours by household size and presence of children. The calibration targets were derived from the 2009 NHTS.

Figure 20: Joint Tour Frequency by Household Size



Model 4.3.2—Joint Tour Composition

Number of Models: 1
Decision-Making Unit: Joint Tour
Model Form: Multinomial Logit
Alternatives: 3 (adults only, children only, adults & children)

Joint tour party composition is modeled for each tour, and determines the person types that participate in the tour. The model is multinomial logit, and explanatory variables include the maximum time window overlaps across adults, children and adults or children after mandatory tours have been scheduled. Other variables include household structure, area type, and the purpose of the joint tour. The specification of the joint tour composition model is shown in Table 33. Comparison of observed and estimated joint tour composition is shown in Figure 21. This model was calibrated to match the distribution of joint tours by party composition and tour purpose. The calibration targets were derived from the 2009 NHTS.

Table 32: Joint Tour Frequency Model Estimation Results

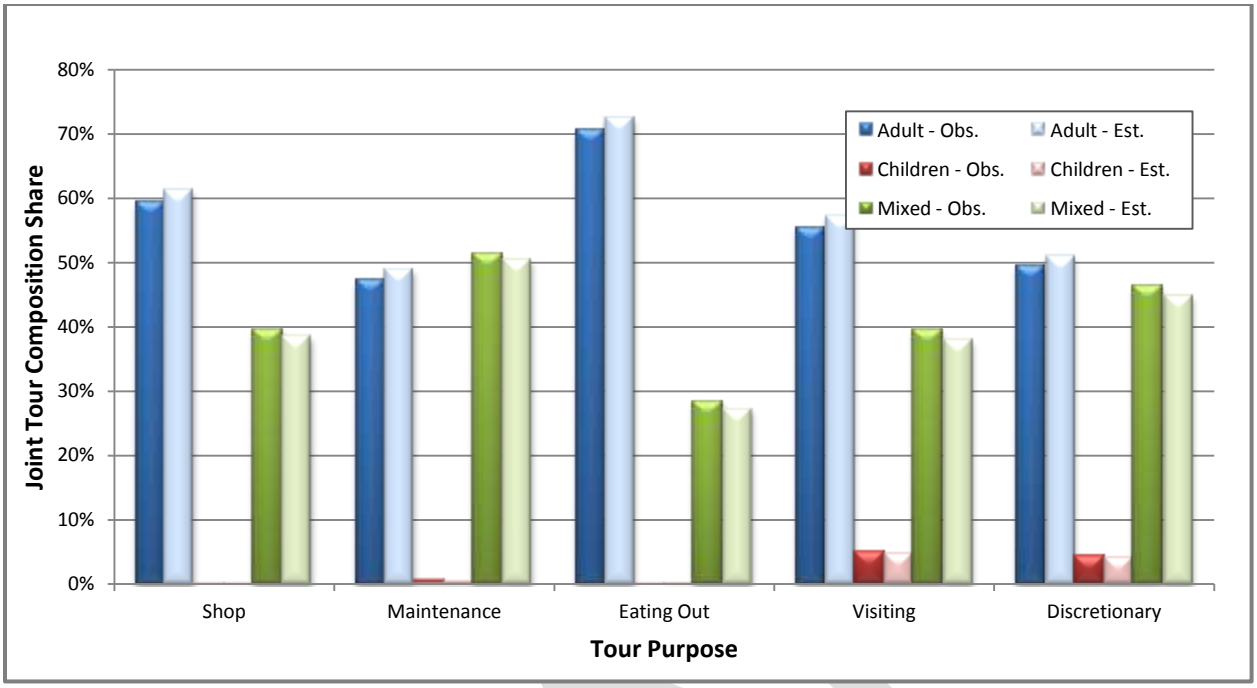
	Shopping		Maintenance		Eating Out		Visiting		Discretionary	
Utility Terms	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constants										
Purpose-Specific Constant	0.000		-1.477	-0.6	0.580	1.6	-1.004	-4.5	-1.120	-0.4
Two Tours Additional Combination Constants										
Shopping	-13.709	-2.0	-12.137	-3.5	-12.799	-3.7	-12.221	-3.5	-12.579	-3.6
Maintenance			-13.436	-10.7	-12.189	-9.9	-11.813	-9.6	-12.289	-10.3
Eating Out					-13.154	-10.0	-13.154	-10.0	-12.561	-10.1
Visiting							-13.154	-10.0	-12.372	-9.7
Discretionary									-13.235	-10.7
Household Composition - *Active Members only*										
Number of Full-Time Workers	0.099	0.9	0.000		-0.306	-1.7	0.000		0.000	
Number of Part-Time Workers	0.000		0.000		0.000		0.000		0.218	1.3
Number of University Students	0.000		0.000		-0.657	-1.4	0.000		-0.611	-1.8
Number of Non-Working Adults	0.394	2.3	0.323	1.6	0.000		0.000		0.000	
Number of Retirees	0.000		0.299	1.9	-0.392	-2.0	0.000		0.000	
Number of Driving Age School Childs	0.000		0.504	1.8	0.000		0.000		0.359	1.3
Number of Pre-driving Age School Childs	-0.313	-2.4	0.000		-0.251	-1.4	0.162	1.1	0.000	
Number of Pre-school Childs	-1.214	-3.7	-1.161	-3.4	-1.701	-4.2	-0.970	-2.7	-1.244	-3.7
Car Ownership										
Cars More than Workers			-0.336	-1.6						
Household Income										
$29,999 or Less					-1.282	-2.6			-0.353	-1.3
$30,000 to $59,999					-0.275	-1.0			-0.192	-0.9
$60,000 to $99,999										
$100,000 and more			-0.476	-2.3						
HOV Accessibilities by car ownership										
Accessibility			0.128	0.7					0.090	0.5
Accessibility,2 tours only	0.040	0.2								

Table 33: Joint Tour Composition Model Estimation Results

Number of Observations:	718
Likelihood, constants only:	-1785
Final Likelihood:	-1556
Rho-squared, zero:	0.4239
Rho-squared, constants:	0.1282

Utility Terms	Adults Only		Children Only		Mixed (Adults w/children)	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Constants						
Shopping			-5.375	-2.0	0.576	0.4
Maintenance			-5.145	-2.0	0.516	0.4
Eating Out			-4.098	-1.6	0.169	0.1
Visiting			-4.098	-1.6	0.078	0.1
Discretionary			-4.098	-1.6	0.856	0.7
Household Composition - *Active Members only*						
Number of Full-Time Workers	0.599	2.4				
Number of Part-Time Workers	1.114	3.4			0.522	1.8
Number of University Students	0.231	0.5				
Number of Non-Working Adults	0.341	1.0				
Number of Retirees	0.657	2.1				
Number of Driving Age School Children			0.580	1.8	0.217	0.7
Number of Pre-driving Age School Children			0.580	1.8	0.314	2.2
Number of Pre-school Children					0.898	3.0
Log of Window Overlaps						
Maximum Continuous Time Window Overlap	2.969	7.1	4.674	5.0	3.524	7.8
Car Ownership						
Zero Cars					-2.921	-1.3
Cars Less than Workers					-0.546	-1.0
Household Income						
$100,000 and more			-1.189	-1.4	-0.303	-1.0

Figure 21: Joint Tour Party Composition by Purpose



Model 4.3.3—Joint Tour Participation

Number of Models: 1
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: Yes and No

Joint tour participation is modeled for each person and each joint tour. If the person does not correspond to the composition of the tour determined in the joint tour composition model, they are ineligible to participate in the tour. Similarly, persons whose daily activity pattern type is home are excluded from participating. The model relies on a heuristic process to assure that the appropriate persons participate in the tour as per the composition model. The model follows the logic depicted in Figure 22. Explanatory variables include the person type of the decision-maker, the maximum pair-wise overlaps between the decision-maker and other household members of the same person type (adults or children), household and person variables, and urban form variables.

The specification of the joint tour participation model is shown in Table 34 and Table 35. This model was calibrated to match the distribution of joint tours by number of participants. The calibration targets were derived from the 2009 NHTS.

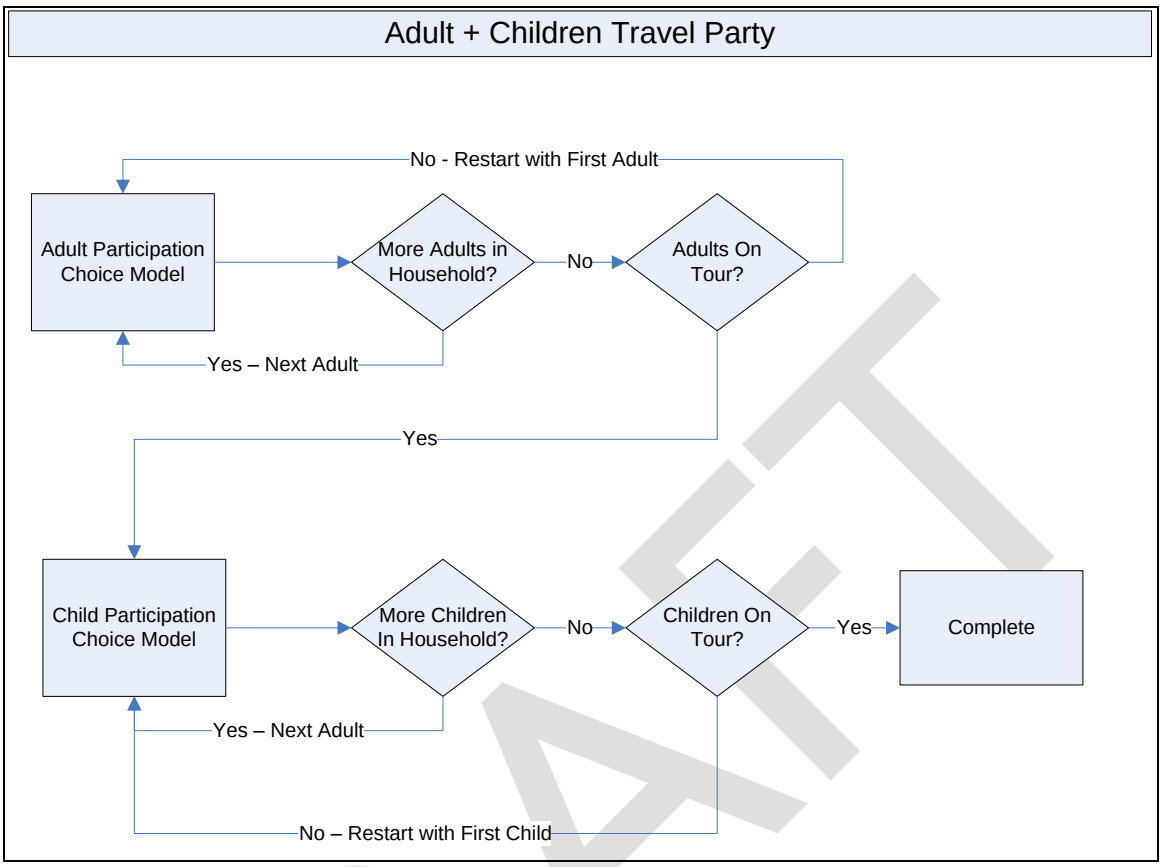


Figure 22: Application of the Person Participation Model

Table 34: Joint Tour Participation Model Estimation Results

Number of Observations:	1535
Likelihood, constants only:	-1007
Final Likelihood:	-806
Rho-squared, zero:	0.242
Rho-squared, constants:	0.199

Utility Terms	Adults Only		Children Only		Mixed	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Person Specific Constants						
Full-Time Worker	-0.845	-0.9			0.453	1.1
Part-Time Worker	-1.838	-1.7			1.263	2.2
University Student	-0.970	-1.0			1.562	2.5
Non-Working Adult	-0.758	-0.7			2.900	5.5
Retiree	1.197	0.9			1.043	1.1
Driving Age Child			-12.089	-1.3	-1.916	-2.3
Pre-driving Age Child			-16.170	-1.6	-1.916	-2.6

Utility Terms	Adults Only		Children Only		Mixed	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Pre-school Child			-16.170	-1.6	-0.934	-1.1
Car Ownership						
Cars Less than Workers/Adults	1.293	2.7				
Cars More than Workers/Adults					-0.391	-2.0
Zero Cars/Child					-1.547	-1.6
Household Income						
$29,999 or Less/ Adult	-0.681	-1.3				
$100,000 and more/ Adult					-0.203	-1.0
$100,000 and more/ Child					-0.742	-3.0
Number of Joint Tours for the Household						
Adult	-0.599	-2.6			-0.219	-1.4
Child			-0.314	-0.3	-0.242	-1.4
Competition						
# of Other Adults for Adult	-0.748	-3.0			-0.286	-2.1
# of other Children for Child			-2.306	-2.4	-0.472	-4.6
Maximum Continuous Window Overlap						
With Adults	1.634	4.5			0.057	0.3
With Child			10.703	2.2	1.617	4.7

Table 35: Joint Tour Participation Model - Tour Purpose Constants

Utility Terms	Maintenance		Eating Out		Visiting		Discretionary	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
Tour Purpose Constants								
Full-Time Worker			0.536	1.6				
Part-Time Worker	0.766	1.3	1.233	1.6	1.076	1.5	0.539	1.1
University Student								
Non-Working Adult	0.971	1.7			1.076	1.5		
Retiree					-1.930	-1.7	1.105	0.9
Driving Age Child			1.536	2.6	-1.335	-1.0	-1.151	-1.5
Pre-driving Age Child					1.553	1.4	0.799	2.6
Pre-school Child	-0.528	-1.3						

Model 4.3.4—Joint Tour Primary Destination Choice

Number of Models: 6 (shop, escort, maintenance, eat out, visit, discretionary)
Decision-Making Unit: Joint Tour
Model Form: Multinomial Logit
Alternatives: MAZs

The joint tour primary destination choice model determines the location of the tour primary destination. The destination is chosen for the tour and assigned to all tour participants. The model works at the MAZ level, and sampling of destination alternatives is implemented in order to reduce computation time. Explanatory variables include household and person characteristics, the tour purpose, logged size (i.e., attraction) variables, round-trip mode choice logsum, distance, and other variables. The mode choice logsum used is based on a logit averaged logsum of 'representative' time periods for non-mandatory tours, since the actual time period is not chosen until model 4.3.5. Logsums are computed for three representative combinations of outbound and inbound time period choices: AM Peak outbound & Midday inbound, Midday outbound and PM Peak inbound, and PM Peak outbound & Evening inbound. The joint tour models were estimated and calibrated jointly with the individual non-mandatory models (by tour purpose). The specification of these models and calibration results are shown in Table 40 and Table 41 below.

Model 4.3.5—Joint Tour Time of Day Choice

Number of Models: 6 (shop, escort, maintenance, eat out, visit, discretionary)
Decision-Making Unit: Joint Tour
Model Form: Multinomial Logit
Alternatives: 861 (combinations of tour departure and arrival half-hour periods)

After joint tours have been generated and assigned a primary location, the tour departure time from home and arrival time back at home is chosen simultaneously. The model is fully described under 4.1.2, above. However, a unique condition applies when applying the time-of-day choice model to joint tours. That is, the tour departure and arrival period combinations are restricted to only those available to all participants on the tour, after scheduling mandatory activities. Once the tour departure/arrival time combination is chosen, it is applied to all participants on the tour. The joint tour models were estimated and calibrated jointly with the individual non-mandatory models (by tour purpose). The specification of these models is shown in Table 43 through Table 46 below.

Model 4.4.1—Individual Non-Mandatory Tour Frequency

Number of Models: 8, one per person type
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: 197 alternatives, composed of 0-3 tours of each type of Non-mandatory activity (shopping, escort, maintenance, visit, eat out and discretionary)

The third tour frequency model generates all non-mandatory tours at the individual person level. There are six kinds of non-mandatory activities (shop, escort, other maintenance, eat out, visit, other discretionary), and potentially 0-3 tours generated for each purpose, for a total of 197 alternatives. No more than five non-mandatory tours per person are allowed, and certain infrequent combinations are excluded from the choice set. Utilities are a function of household attributes, person attributes, residual time windows, accessibilities and urban form. The specification of the non-mandatory tour frequency models is shown in Table 36 to Table 38. These models were calibrated to match the distribution of tours by tour purpose and person type, as shown in Table 39. The calibration targets were derived from the 2009 NHTS.

Table 36: Worker and University Non-Mandatory Tour Frequency Choice Model Specification

	Full-time worker	Part-time worker	University student
Number of observations	3,180	711	226
Likelihood with constants only	-4,973	-1,751	-414
Final likelihood	-4,570	-1,593	-367
ρ^2 w.r.t. zero	0.703	0.576	0.692
ρ^2 w.r.t. constants	0.081	0.090	0.114

Utility Terms	Full-time Worker		Part-time Worker		University Student	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Constant by tour frequency						
Number of non-mandatory tours =0						
Number of non-mandatory tours =1					-0.756	-1.35
Number of non-mandatory tours =2	1.091	6.75	1.085	4.15	-0.758	-0.80
Number of non-mandatory tours =3	1.983	7.14	1.577	3.75	-0.758	
Number of non-mandatory tours =4	2.939	7.01	2.837	4.70	-0.758	
Number of non-mandatory tours =5+	-999		2.837		-0.758	
Constant by tour purpose						
Escorting tour	-7.463	-3.17	-6.743	-2.00	-3.019	-2.39
Shopping tour	-7.832	-3.53	-2.898	-0.73	-2.021	-3.38
Maintenance tour	-5.502	-2.86	-7.280	-2.34	-2.085	-3.40
Eating out tour	-12.752	-3.32	-6.687	-1.15	-7.995	-1.27
Visiting	-3.404	-20.79	-4.338	-12.13	-3.956	-2.18
Discretionary	-3.415	-7.38	-3.114	-4.26	-10.279	-1.27

Utility Terms	Full-time Worker		Part-time Worker		University Student	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
More than 2 tours of same purpose						
Escorting tours	0.903	4.59	0.789	2.73	2.337	3.61
Shopping tours	-0.210	-0.87	-0.840	-2.17	-0.999	-1.17
Maintenance tours					-1.222	-1.04
Discretionary tours	-0.544	-2.02	-0.884	-2.48	-1.320	-1.19
For persons with mandatory DAP						
Number of non-mandatory tours =1						
Number of non-mandatory tours =2	-1.285	-6.90	-1.260	-5.56	-0.838	-1.72
Number of non-mandatory tours =3	-1.512	-5.11	-1.260		-2.788	-2.45
Number of non-mandatory tours =4	-3.499	-3.29	-2.043	-3.60	-2.788	
Number of non-mandatory tours =5+	-3.499		-2.043		-2.788	
Household income						
Escorting, income <$30K					0.260	0.58
Escorting, income $30K-$60K					0.260	
Escorting, income $60K-$100K						
Escorting, income $100K-$150K	-0.007	-0.06			-0.228	-0.41
Escorting, income >$150K	-0.080	-0.48	-0.171	-0.68	-0.228	-0.41
Shopping, income <$30K			-0.634	-1.78		
Shopping, income $30K-$60K			-0.304	-1.04		
Shopping, income $60K-$100K						
Shopping, income $100K-$150K	0.144	1.20	0.221	0.92	0.609	1.16
Shopping, income >$150K	0.144		0.221		0.612	0.71
Maintenance, income <$30K	0.138	0.69				
Maintenance, income $30K-$60K	0.070	0.42				
Maintenance, income $60K-$100K	0.0000					
Maintenance, income $100K-$150K	-0.060	-0.37			-0.528	-0.88
Maintenance, income >$150K	-0.535	-2.23			-0.528	
Eating out, income <$30K	-2.696	-2.65	-1.588	-2.03		
Eating out, income $30K-$60K	-0.128	-0.47	-0.520	-1.11		
Eating out, income $60K-$100K	0.0000					
Eating out, income $100K-$150K	0.0000				1.842	1.43
Eating out, income >$150K	0.815	3.38	0.725	1.66	1.842	
Visiting, income <$30K	-1.020	-2.23			0.546	0.72
Visiting, income $30K-$60K					0.555	0.79
Visiting, income $60K-$100K						
Visiting, income $100K-$150K					-0.468	-0.51
Visiting, income >$150K					-0.468	
Discretionary, income <$30K	-0.593	-2.04	-0.639	-1.70		
Discretionary, income $30K-$60K	-0.123	-0.65	-0.204	-0.74		
Discretionary, income $60K-$100K	0.0000		0.0000			
Discretionary, income $100K-$150K	0.077	0.47	0.272	1.19	0.902	1.83
Discretionary, income >$150K	0.235	1.27	0.272		0.902	

Utility Terms	Full-time Worker		Part-time Worker		University Student	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Gender						
Female, escorting tour	0.102	0.95	0.770	2.97	0.087	0.24
Female, shopping tour			0.611	2.50	0.992	2.08
Female, maintenance tour					0.708	1.42
Female, visiting			-0.440	-1.28	1.250	1.83
Household interactions						
Escorting						
Number of full-time workers	0.154	1.90	0.092	0.68	-0.158	-0.70
Number of part-time workers	-0.080	-0.54	-0.180	-0.79	-0.445	-1.20
Number of university students	0.237	1.41	0.400	1.01	0.449	1.32
Number of non-workers	-0.466	-2.90	-0.260	-0.78	-0.445	-1.20
Number of retirees	-0.500	-2.30			-0.860	-1.67
Number of driving age children	0.476	4.44	0.508	2.92		
Number of pre-driving children not at home	0.631	12.59	0.792	9.01	0.850	4.90
Number of pre-school children not at home	0.315	3.59	0.487	3.72	0.520	2.45
Shopping						
Number of full-time workers			-0.338	-2.02	-0.562	-1.92
Number of part-time workers			-0.338		-0.374	-0.75
Number of university students					-1.709	-1.65
Number of non-workers			-0.338		-0.252	-0.46
Number of retirees						
Number of driving age children	-0.074	-1.27				
Number of pre-driving age children	-0.074					
Maintenance						
Number of workers	-0.098	-1.24	-0.192	-1.42	-0.163	-0.65
Number of university students	-0.098				-0.577	-0.78
Number of non-workers	-0.098		-0.603	-1.62	-0.163	-0.65
Number of driving age children	0.094	1.76				
Number of pre-driving children	0.094					
Number of pre-school children	0.094					
Discretionary						
Number of university students					0.275	0.55
Number of driving age children	0.150	2.36	0.223	2.32		
Number of pre-driving children	0.150	2.36	0.223			
Number of pre-school children	-0.136	-1.10	-0.259	-1.31		
Eating out			-0.386	-1.32		
Number of full-time workers	-0.286	-1.97				
Number of part-time workers	-0.286					
Number of university students	-0.286					
Number of non-workers	-0.286					
Number of retirees	-0.286					
Number of pre-driving children	-0.071	-0.61				
Number of pre-school children	-0.071	-0.61				

Utility Terms	Full-time Worker		Part-time Worker		University Student	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Visiting						
Number of part-time workers			0.563	1.94		
Number of university students	-0.386	-1.89				
Number of non-workers	-0.386	-1.89				
Number of retirees	-0.386	-1.89	0.941	3.54		
Number of driving age children			0.194	1.40		
Number of pre-driving age children			0.194			
Car sufficiency						
No cars						
Number of non-mandatory tours =1						
Number of non-mandatory tours =2	-0.502	-0.89	-2.427	-2.20		
Number of non-mandatory tours >=3	-0.502	-0.89	-2.427			
Cars less than workers						
Number of non-mandatory tours =1						
Number of non-mandatory tours =2	-0.477	-1.53	-1.111	-2.34		
Number of non-mandatory tours >=3	-0.477		-1.111			
Cars more than workers						
Number of non-mandatory tours =1					0.320	0.68
Number of non-mandatory tours =2					0.320	
Number of non-mandatory tours >=3	0.011	0.04			0.320	
Escorting						
No cars	-0.974	-1.37	0.390	1.05		
Cars less than workers	0.518	2.31	-0.270	-1.48		
Cars more than workers						
Shopping						
Cars less than workers			0.917	2.41		
Cars more than workers			-0.475	-2.11		
Education						
College education						
Visiting tour	-0.479	-2.30				
Discretionary tour	0.473	3.53	0.371	1.86		
Less than high school						
Visiting tour	0.533	1.27				
Discretionary tour			-0.681	-0.89		
Accessibilities						
Escorting accessibility	0.264	1.62	0.204	0.87		
Shopping accessibility	0.364	2.30	0.042	0.15		
Maintenance accessibility	0.214	1.41	0.399	1.63		
Eating out accessibility	0.732	2.45	0.312	0.70		
Discretionary accessibility					0.632	1.03
Walk accessibility						
Escorting tour					0.025	0.21
Eating out tour					0.347	0.51
Visiting tour					0.043	0.24

Utility Terms	Full-time Worker		Part-time Worker		University Student	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Discretionary tour	0.036	0.72	0.078	0.99		
Work/school accessibility for persons with mandatory pattern						
Number of non-mandatory tours =1	0.314	3.55	0.479	2.10	0.760	2.29
Number of non-mandatory tours =2	0.548	3.03	0.770	2.58	0.760	
Number of non-mandatory tours >=3	0.548	3.03	0.872	2.37	0.760	
Usual work place is home						
Number of non-mandatory tours =1	0.422	1.79				
Number of non-mandatory tours =2	0.665	2.32				
Number of non-mandatory tours >=3	1.005	2.85				
Population density at home location						
Visiting tour			0.050	3.08		
Dwelling type - detached home						
Escorting tour	0.299	2.32	0.281	1.33		
Eating out tour			-0.122	-0.33		
Discretionary tour					-0.584	-1.37

Table 37: Non-Worker and Retiree Non-Mandatory Tour Frequency Choice Model Specification

	Non-Worker	Retiree
Number of observations	582	1,141
Likelihood with constants only	-1817.43	-3300.45
Final likelihood	-1676.32	-3283.80
ρ^2 w.r.t. zero	0.4045	0.4049
ρ^2 w.r.t. constants	0.0776	0.005

Utility Terms	Non-Worker		Retiree	
	Coef.	t-Stat	Coef.	t-Stat
Constant by tour frequency				
Number of non-mandatory tours =0	-0.1904	-0.24	-1.5783	-1.47
Number of non-mandatory tours =1	0.0000		0.0000	
Number of non-mandatory tours =2	0.0000		0.0000	
Number of non-mandatory tours =3	-0.5622	-2.79	-0.3002	-1.88
Number of non-mandatory tours =4	-0.9607	-2.74	-0.3002	
Number of non-mandatory tours =5+	-999		-999	
Constant by tour purpose				
Escorting tour	-6.3906	-2.19	-10.5002	-3.12
Shopping tour	-2.1117	-0.80	-5.4307	-3.16
Maintenance tour	-1.6380	-0.69	-4.2681	-2.97
Eating out tour	-4.6829	-3.47	-1.9035	-6.58
Visiting	-4.7069	-1.10	-4.2256	-1.69

Utility Terms	Non-Worker		Retiree	
	Coef.	t-Stat	Coef.	t-Stat
Discretionary	-5.7493	-1.71	-6.8970	-3.96
More than 2 tours of same purpose				
Escorting tours	1.5833	5.79	2.0805	5.73
Shopping tours	-0.7666	-2.88	-1.2721	-6.20
Maintenance tours	-0.6449	-2.29	-0.8517	-4.57
Discretionary tours	-0.8749	-1.98	-0.1133	-0.58
Household income				
Shopping, low income (<30K)	-0.3126	-1.67		
Shopping, medium income (30-60K)	-0.3126			
Shopping, medium income (60-100K)				
Shopping, high income (100-150K)			0.2909	1.78
Shopping, high income (>150K)			0.2909	
Maintenance, low income (<30K)			-0.3492	-2.97
Maintenance, medium income (30-60K)			-0.3492	
Maintenance, medium income (60-100K)				
Maintenance, high income (100-150K)	-0.2307	-1.06		
Maintenance, high income (>150K)	-0.2307			
Eating Out, low income (<30K)	-0.5484	-1.20	-1.3358	-4.26
Eating Out, medium income (30-60K)	-0.3580	-0.72	-0.5816	-2.45
Eating Out, medium income (60-100K)				
Eating Out, high income (100-150K)				
Eating Out, high income (>150K)	1.5359	3.56		
Visiting, low income (<30K)				
Visiting, medium income (30-60K)				
Visiting, medium income (60-100K)				
Visiting, high income (100-150K)	0.3139	0.88		
Visiting, high income (>150K)	0.3139		-1.6146	-1.58
Discretionary, low Income (<30K)	-0.4233	-1.72	-0.2020	-1.26
Discretionary, medium income (30-60K)	-0.4233			
Discretionary, medium income (60-100K)				
Discretionary, high income (100-150K)			0.1602	0.98
Discretionary, high income (>150K)			0.1602	
Gender				
Female, escorting tour	0.5115	2.33		
Female, shopping tour	0.3453	1.82	-0.1100	-0.91
Female, maintenance tour			-0.2449	-2.13
Female, eating out tour			-0.2451	-1.26
Female, visiting	0.4643	1.22		
Female, discretionary			-0.0780	-0.66
Household interactions				
Escorting				
Number of full-time workers	0.2407	1.62	-0.1531	-0.79
Number of part-time workers	0.1210	0.46	-0.1531	
Number of university students	0.3437	1.27		
Number of non-workers	-0.4871	-1.84	-0.1531	-0.79

Utility Terms	Non-Worker		Retiree	
	Coef.	t-Stat	Coef.	t-Stat
Number of retirees	0.3039	1.40		
Number of driving age school children	0.7440	4.36	0.4547	1.38
Number of pre-driving school children not at home	0.9082	9.43	0.7495	4.42
Number of pre-school children not at home	0.7481	7.39		
Shopping				
Number of non-workers	-0.3184	-1.20		
Number of retirees			-0.3556	-3.06
Maintenance				
Number of workers	0.1511	1.27		
Number of retirees			-0.2134	-1.99
Discretionary				
Number of school and pre-school children	0.1440	1.66		
Eating out				
Number of pre-driving school children	-0.2690	-1.39		
Number of pre-school children	-0.2690			
Visiting				
Number of retirees			-0.1703	-0.86
Number of pre-driving age children (SP,PS)	0.0928	0.67		
Households with only retirees and non-workers				
Escorting tour			-0.8345	-2.91
Shopping tour			0.2697	1.84
Eating out tour			0.1788	0.76
Discretionary tour			0.1204	0.84
Car sufficiency				
No cars				
Number of non-mandatory tours =1				
Number of non-mandatory tours =2	-0.5768	-1.58		
Number of non-mandatory tours >=3	-0.5768			
Cars less than workers				
Number of non-mandatory tours =1				
Number of non-mandatory tours =2	-0.5519	-0.57		
Number of non-mandatory tours >=3	-0.5519			
Escorting				
No cars	-0.8482	-1.48		
Cars less than workers				
Cars more than workers	0.2428	1.01		
Education				
College education				
Escorting tour			0.1896	1.02
Shopping tour	0.2522	1.40	0.1008	0.84
Maintenance tour	0.5068	2.87		
Eating out tour	0.8590	3.65		
Visiting tour	0.7077	1.97	0.3146	1.51
Discretionary tour	0.3391	1.06	0.3550	2.93

Utility Terms	Non-Worker		Retiree	
	Coef.	t-Stat	Coef.	t-Stat
Less than high school				
Escorting tour	0.1973	0.87	-0.9186	-1.79
Shopping tour	-0.3009	-1.09	-0.6426	-2.07
Maintenance tour			-0.6417	-2.14
Eating out tour	-0.9680	-1.94		
Visiting tour	-0.8165	-1.05		
Discretionary tour	-0.9874	-1.55	-0.5424	-1.61
Accessibilities				
Escorting accessibility	0.1994	1.02	0.5184	2.25
Shopping accessibility	0.0633	0.34	0.3052	2.50
Maintenance accessibility	0.0102	0.05	0.2808	2.46
Eating out accessibility	0.0000			
Visiting accessibility	0.1332	0.38	0.1222	0.59
Discretionary accessibility	0.2836	1.09	0.3990	3.02
Walk accessibility				
Eating out tour	0.2237	1.51		
Dwelling type - detached home				
Escorting tour	0.1495	0.87	0.3369	1.47
Eating out tour			-0.3271	-1.60
Discretionary tour			-0.1194	-1.00

Table 38: Children Non-Mandatory Tour Frequency Choice Model Specification

	Driving Age Child	Pre-Driving Age Child	Pre-School Child
Number of observations	285	1,102	569
Likelihood with constants only	-340	-1260	-1233
Final likelihood	-327	-1194	-1111
ρ^2 w.r.t. zero	0.76	0.78	0.60
ρ^2 w.r.t. constants	0.04	0.05	0.10

Utility Terms	Driving Age Child		Pre-Driving Age Child		Pre-School Child	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Constant by Tour Frequency						
Number of non-mandatory tours =0						
Number of non-mandatory tours =1	-1.0467	-1.46				
Number of non-mandatory tours =2	-1.2747	-0.80	0.0734	0.11	1.6723	4.31
Number of non-mandatory tours =3	-1.2747		0.0734		2.4044	3.11
Number of non-mandatory tours =4	-999		-999		4.8035	4.20
Number of non-mandatory tours =5+	-999		-999		-999	
Constant by tour purpose						
Escorting tour	-4.2078	-3.91	-11.5449	-1.91	-9.3585	-2.91

Utility Terms	Driving Age Child		Pre-Driving Age Child		Pre-School Child	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Shopping tour	-25.7696	-2.04	-17.9811	-2.34	-15.5285	-3.28
Maintenance tour	-5.2937	-0.69	-3.9966	-0.88	-6.9819	-1.93
Eating out tour	-27.8652	-1.41	-11.9893	-1.52	-3.2276	-5.46
Visiting	-2.1746	-2.82	-3.6720	-5.72	-4.7963	-9.70
Discretionary	-1.2022	-1.61	-2.3740	-0.68	-8.5943	-1.88
More than 2 tours of same purpose						
Escorting tours			0.6375	0.79	1.0152	3.37
Maintenance tours					-0.4714	-1.07
Discretionary tours	-0.6777	-0.97	-1.3768	-2.41	-1.1747	-2.26
For persons with mandatory DAP						
Number of non-mandatory tours =0			-0.9073	-1.67		
Number of non-mandatory tours =1	-2.0484	-2.16	-3.2999	-3.07	-1.775	-2.35
Number of non-mandatory tours =2	-2.0484		-3.2999		-1.775	
Number of non-mandatory tours =3	-2.0484		-3.2999		-1.775	
Number of non-mandatory tours =4	-2.0484		-3.2999		-1.775	
Household income						
Escorting, low income (<30K)	0.3707	0.36				
Escorting, medium income (30-60K)	0.3707					
Escorting, medium income (60-100K)						
Escorting, high income (100-150K)						
Escorting, high income (>150K)					-0.3290	-0.79
Shopping, low income (<30K)					-0.1204	-0.40
Shopping, medium income (30-60K)					0.0000	
Shopping, medium income (60-100K)						
Shopping, high income (100-150K)					0.4067	1.31
Shopping, high income (>150K)			0.4616	0.83	0.6540	1.56
Maintenance, low income (<30K)					0.5314	1.62
Maintenance, medium income (30-60K)					0.3992	1.26
Maintenance, medium income (60-100K)					0.0000	
Maintenance, high income (100-150K)			-0.1727	-0.58	-0.4070	-1.04
Maintenance, high income (>150K)	-0.6754	-0.65	-0.1727	-	-0.5562	-0.86
Eating Out, low income (<30K)					-1.695	-1.59
Eating Out, medium income (30-60K)						
Eating Out, medium income (60-100K)						
Eating Out, high income (100-150K)						
Eating Out, high income (>150K)			1.5516	3.24		
Visiting, low income (<30K)			-1.4377	-1.90		
Visiting, medium income (30-60K)			-0.5833	-1.15		
Visiting, medium income (60-100K)						
Visiting, high income (100-150K)	0.4310	0.74			0.1394	0.34
Visiting, high income (>150K)	0.4310		1.1100	2.57	0.6184	1.03
Discretionary, low income (<30K)	-0.9039	-1.48	-1.5275	-3.68	-1.5323	-3.42
Discretionary, medium income (30-60K)			-0.8207	-2.85	-0.5407	-1.74
Discretionary, medium income (60-100K)						

Utility Terms	Driving Age Child		Pre-Driving Age Child		Pre-School Child	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Discretionary, high income (100-150K)	0.3838	0.99				
Discretionary, high income (>150K)	0.5217	1.18	0.2576	0.99		
Gender						
Female, shopping tour	0.9536	1.56				
Household interactions						
Escorting						
Number of part-time workers					0.6322	3.68
Number of university students					0.7389	2.78
Number of non-workers					0.6322	3.68
Number of pre-driving children not at home	0.6772	1.69	0.4049	2.71	0.5762	6.35
Number of pre-school children not at home					0.5384	3.98
Shopping						
Number of workers and non-workers	-0.2018	-0.51				
Number of driving age children			0.2095	1.34		
Number of pre-driving age children	0.4796	2.11	0.2095			
Discretionary						
Number of full-time workers					-0.6727	-2.70
Number of part-time workers	0.4407	1.89				
Number of university students	0.5808	1.67				
Number of non-workers	0.4407	1.89				
Number of school and pre-school children			0.2187	2.51	0.3147	3.02
Eating out						
Number of part-time workers					-0.5894	-1.29
Number of non-workers					-0.5894	
Number of pre-driving age school children			0.3604	1.64	-0.7081	-2.03
Number of pre-school children			-1.5888	-1.63	-0.7081	
Visiting						
Number of driving age school children			0.4509	3.13		
Number of pre-driving age children (SP,PS)			0.4509		0.2651	1.75
Car sufficiency						
No cars						
Number of non-mandatory tours =1	-0.2385	-0.21	-0.9863	-1.56		
Number of non-mandatory tours =2	-0.2385		-0.9863			
Number of non-mandatory tours >=3	-0.2385		-0.9863			
Cars more than workers						
Number of non-mandatory tours =1	0.0388	0.12			0.6952	2.30
Number of non-mandatory tours =2	0.0388				0.6952	
Number of non-mandatory tours >=3	0.0388				0.6952	
Escorting						
No cars					-1.0637	-2.30
Cars less than workers					-1.0637	
Shopping						
No cars			-1.0265	-0.97		
Cars less than workers			-1.0265			

Utility Terms	Driving Age Child		Pre-Driving Age Child		Pre-School Child	
	Coef.	t-Stat	Coef.	t-Stat	Coef.	t-Stat
Cars more than workers			0.2305	0.61	0.4196	1.78
Maintenance						
Cars more than workers			0.6580	2.30		
Visiting						
Cars more than workers					0.5361	1.47
Discretionary						
Cars more than workers			0.0243	0.13		
Accessibilities						
Escorting accessibility			0.5917	1.41	0.3520	1.57
Shopping accessibility	1.6148	1.85	1.0369	1.91	0.8434	2.50
Maintenance accessibility	0.2615	0.44	0.1013	0.29	0.2777	0.97
Eating out accessibility	1.8894	1.26	0.6412	1.05		
Visiting accessibility						
Discretionary accessibility			0.0767	0.29	0.4620	1.31
Work/school accessibility for persons with mandatory pattern						
Number of non-mandatory tours =1			0.5143	2.13	0.1146	0.29
Number of non-mandatory tours =2	0.8484	0.86	1.2078	1.18	0.5810	0.67
Number of non-mandatory tours >=3	0.8484		1.2078		0.5810	
Population density at home location						
Visiting tour			0.0365	1.72		
Dwelling type - detached home						
Eating out tour					-0.8693	-1.79

Table 39: Individual Non-Mandatory Tour Frequency Calibration

Person Type and Tour Purpose	Number of Tours					
	Observed			Predicted		
	0	1	2+	0	1	2+
Escort Tours						
Full-time worker	90%	8%	2%	90%	8%	2%
Part-time worker	82%	12%	6%	82%	12%	6%
University student	95%	4%	1%	95%	4%	1%
Non-working adult	71%	19%	10%	72%	19%	10%
Non-working senior	93%	5%	1%	93%	5%	1%
Driving age student	97%	3%	0%	97%	3%	0%
Pre-driving student	99%	1%	0%	99%	1%	0%
Pre-school child	75%	16%	9%	74%	16%	9%
Total Escort	**88%**	**8%**	**3%**	**88%**	**8%**	**3%**
Shopping Tours						
Full-time worker	89%	9%	1%	89%	9%	1%
Part-time worker	71%	27%	2%	71%	27%	2%
University student	84%	15%	1%	84%	15%	1%
Non-working adult	59%	37%	4%	59%	37%	4%
Non-working senior	55%	42%	4%	55%	42%	4%
Driving age student	94%	5%	1%	94%	5%	1%
Pre-driving student	96%	4%	1%	96%	3%	1%
Pre-school child	98%	2%	1%	97%	2%	1%
Total Shopping	**81%**	**17%**	**2%**	**81%**	**17%**	**2%**
Maintenance Tours						
Full-time worker	90%	8%	2%	90%	8%	2%
Part-time worker	79%	17%	3%	79%	17%	3%
University student	87%	9%	4%	87%	9%	4%
Non-working adult	82%	17%	1%	83%	16%	1%
Non-working senior	65%	31%	5%	65%	31%	5%
Driving age student	99%	1%	0%	99%	1%	0%
Pre-driving student	98%	2%	0%	98%	2%	1%
Pre-school child	98%	2%	0%	97%	2%	1%
Total Maintenance	**87%**	**11%**	**2%**	**87%**	**11%**	**2%**
Eating Out Tours						
Full-time worker	92%	8%		92%	8%	
Part-time worker	91%	9%		91%	9%	
University student	89%	11%		89%	11%	
Non-working adult	91%	9%		91%	9%	
Non-working senior	91%	9%		91%	9%	
Driving age student	96%	4%		96%	4%	
Pre-driving student	96%	4%		96%	4%	
Pre-school child	96%	4%		97%	3%	

Total Eating Out	**92%**	**8%**		**92%**	**8%**	
Visiting Tours						
Full-time worker	95%	5%		95%	5%	
Part-time worker	91%	9%		91%	9%	
University student	88%	12%		88%	12%	
Non-working adult	91%	9%		91%	9%	
Non-working senior	94%	6%		94%	6%	
Driving age student	96%	4%		96%	4%	
Pre-driving student	97%	3%		97%	3%	
Pre-school child	94%	6%		94%	6%	
Total Visiting	**96%**	**4%**		**96%**	**4%**	
Discretionary Tours						
Full-time worker	90%	10%	0%	90%	10%	0%
Part-time worker	83%	14%	2%	83%	14%	2%
University student	86%	13%	1%	86%	13%	1%
Non-working adult	77%	20%	3%	77%	20%	3%
Non-working senior	76%	21%	3%	76%	21%	3%
Driving age student	81%	14%	5%	81%	14%	5%
Pre-driving student	88%	10%	2%	88%	10%	2%
Pre-school child	89%	10%	1%	88%	12%	0%
Total Discretionary	**85%**	**13%**	**2%**	**85%**	**13%**	**2%**

Model 4.4.2—Individual Non-Mandatory Tour Primary Destination Choice

Number of Models: 6, one per tour purpose
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: MAZs

The individual discretionary tour primary destination choice model determines the location of the tour primary destination. The model works at the MAZ level, and sampling of destination alternatives is implemented in order to reduce computation time. Explanatory variables include household and person characteristics, the tour purpose, logged size (i.e., attraction) variables, round-trip mode choice logsum, distance, and other variables. The mode choice logsum used is based on a logit averaged logsum of 'representative' time periods for individual non-mandatory tours, since the actual time period is not chosen until model 4.4.3. Logsums are computed for three representative combinations of outbound and inbound time period choices: AM Peak outbound & Midday inbound, Midday outbound and PM Peak inbound, and PM Peak outbound & Evening inbound.

The specification of the non-mandatory tour primary destination choice model is shown in Table 40 and Table 41. Comparisons between observed and modeled tour length frequency distributions are shown in Figure 23.

Table 40: Non-Mandatory Primary Destination Choice Model Specification

	Coefficients		
Utility Terms	**Shop**	**Escort**	**Maintenance**
Estimated terms			
Mode choice logsum	0.500	0.500	0.50000
Distance	-0.2558	-1.0334	-0.035327
Distance squared	-0.003099	0.022131	-0.007959
Distance cubed			
Distance logged	-0.229414		
Distance - Time Pressure(1)	0.029451		0.025736
Distance – Income < $30K		0.1574	
Distance – Age 16-24 yrs old			-0.503857
Distance – Age 56-64 years old		0.189508	
Distance – Age 65 and older		0.309310	
Non-Mandatory Accessibility	0.377323		
Size terms			
Retail employment	1.0000		1.0000
Professional and business services employment			0.8451
Personal services employment			2.4559
Federal government employment			0.7200
School enrollment, K thru 8		0.4370	
School enrollment, 9 thru 12		0.4370	
School enrollment, adult/vocational		0.4370	
School enrollment, college		0.4370	
Households		1.0000	
Calibrated terms(2)			
Distance	0.5816	-0.2321	0.2641
Distance squared	-0.1357	0.0733	-0.0396
Distance cubed	0.0090	-0.0027	0.0023
Distance logged	-1.3322	-0.0801	-1.4297
Distance 0-1 miles	-0.3477		-0.0214
Distance 1-2 miles	-0.2341		-0.1938
Distance 2-5 miles	-0.0208		
Maximum distance (miles)	10	20	8

(1) Time pressure is proportional to the ratio of available time windows and number of tours to schedule. A positive time pressure coefficient indicates that tour distance increases as time pressure decreases—longer tours result when there are fewer tours to schedule relative to available time.

(2) Additive terms that apply if tour distance is less than or equal to the maximum distance.

Table 41: Non-Mandatory Primary Destination Choice Model Specification

	Coefficients		
Utility Terms	**Eat Out**	**Visit**	**Discretionary**
Estimated terms			
Mode choice logsum	0.50000	0.40000	0.40000
Distance	0.094725	-0.082372	0.550021
Distance squared	-0.029121	-0.003052	-0.065311
Distance cubed	0.000648	0.000000	0.001720
Distance logged	-0.664601	-0.430261	-1.524852
Distance - Time Pressure(1)	0.027648		0.054074
Distance – Income < $30K		0.038684	
Size terms			
Retail employment			0.2230
Hotel employment			0.0345
Restaurant and bar employment	1.0000	0.1000	0.1391
Amusement services employment			0.0200
Religious activity employment			1.0000
Households	0.5512	0.3006	0.6546
Calibrated terms(2)			
Distance	-0.1900		0.2181
Distance squared	0.0333		-0.0523
Distance cubed	-0.0010		0.0027
Distance logged	-0.2569		-0.1883
Distance 0-1 miles	0.1074	1.0697	
Distance 1-2 miles		0.5699	
Maximum distance (miles)	10	10	10

(1) Time pressure is proportional to the ratio of available time windows and number of tours to schedule. A positive time pressure coefficient indicates that tour distance increases as time pressure decreases—longer tours result when there are fewer tours to schedule relative to available time.

(2) Additive terms that apply if tour distance is less than or equal to the maximum distance.

Table 42: Non-Mandatory Average Tour Length

Tour Purpose	Number of Observations	Observed	Estimated
Escort		4.8 mi	4.9 mi
Shopping		4.1 mi	4.1 mi
Maintenance		6.2 mi	5.9 mi
Eating Out		4.1 mi	4.0 mi
Visiting		8.9 mi	8.8 mi
Discretionary		3.8 mi	3.6 mi
At-Work Subtours		3.3 mi	3.2 mi

Figure 23: Escort Tour Length Frequency Distribution

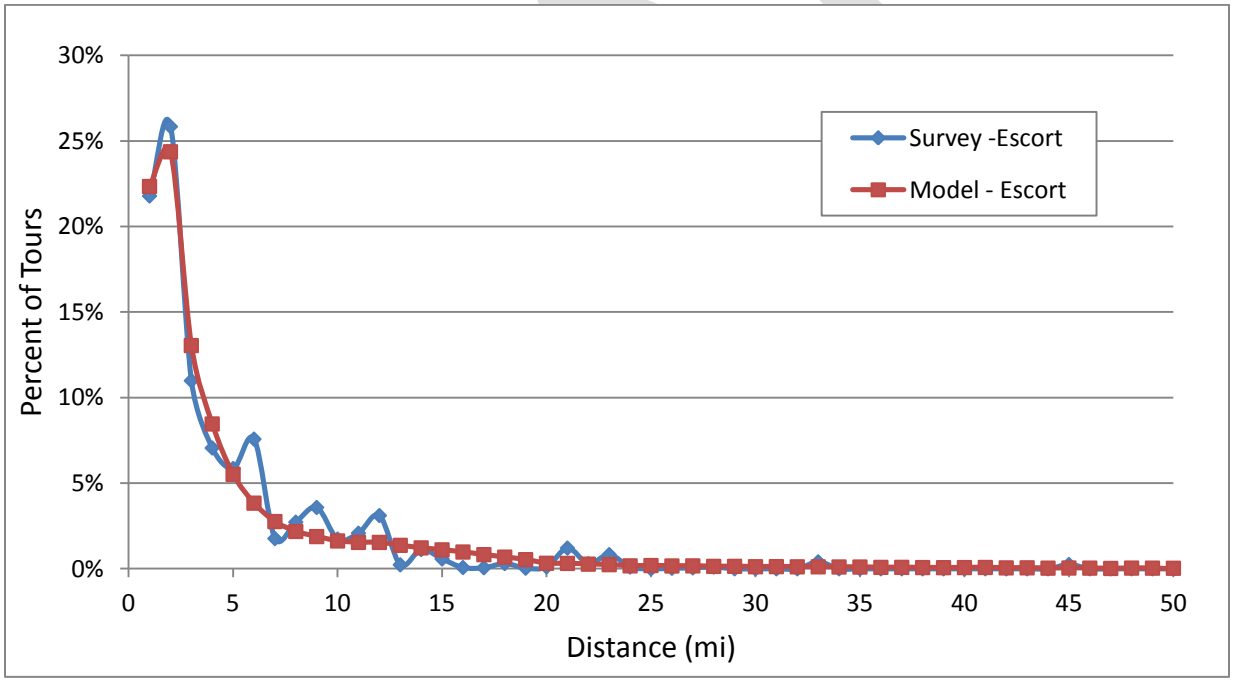


Figure 24: Shopping Tour Length Frequency Distribution

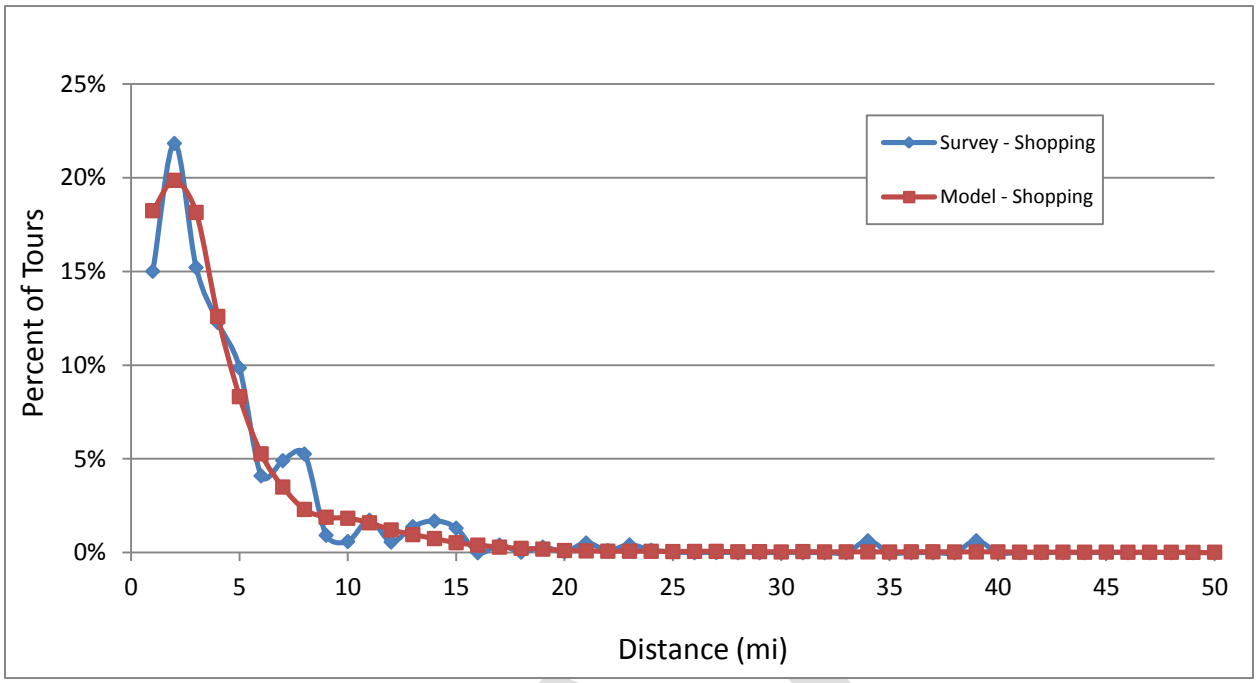


Figure 25: Maintenance Tour Length Frequency Distribution

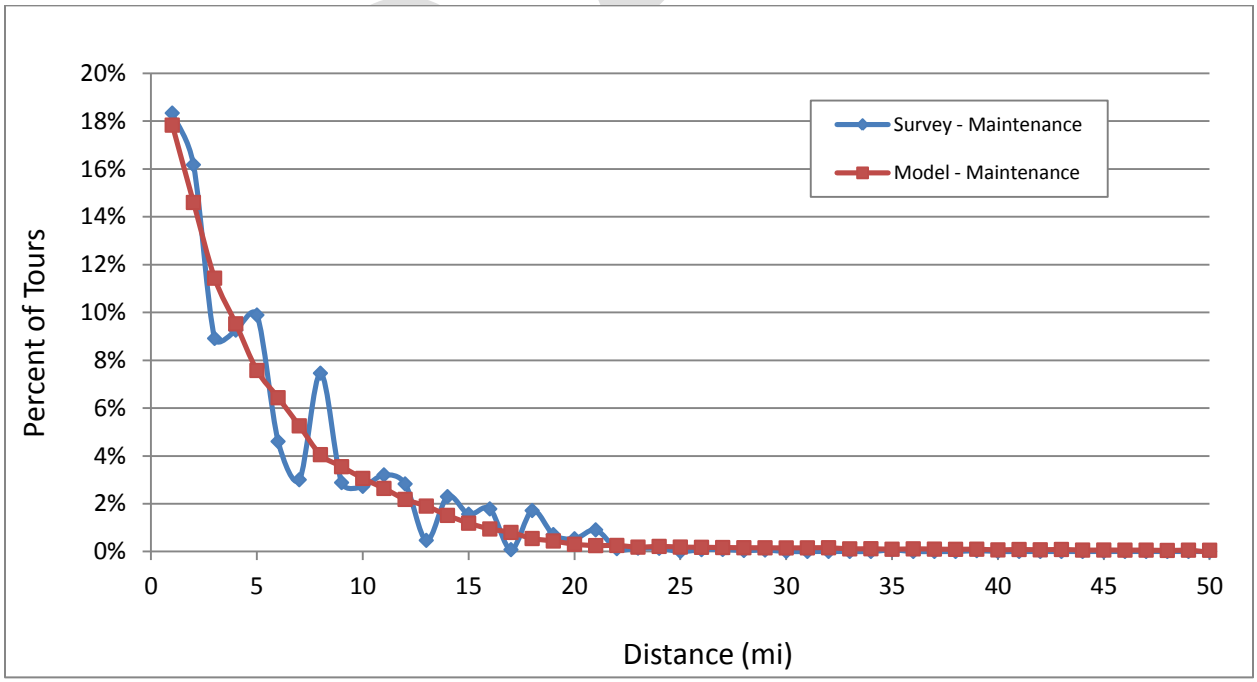


Figure 26: Eating Out Tour Length Frequency Distribution

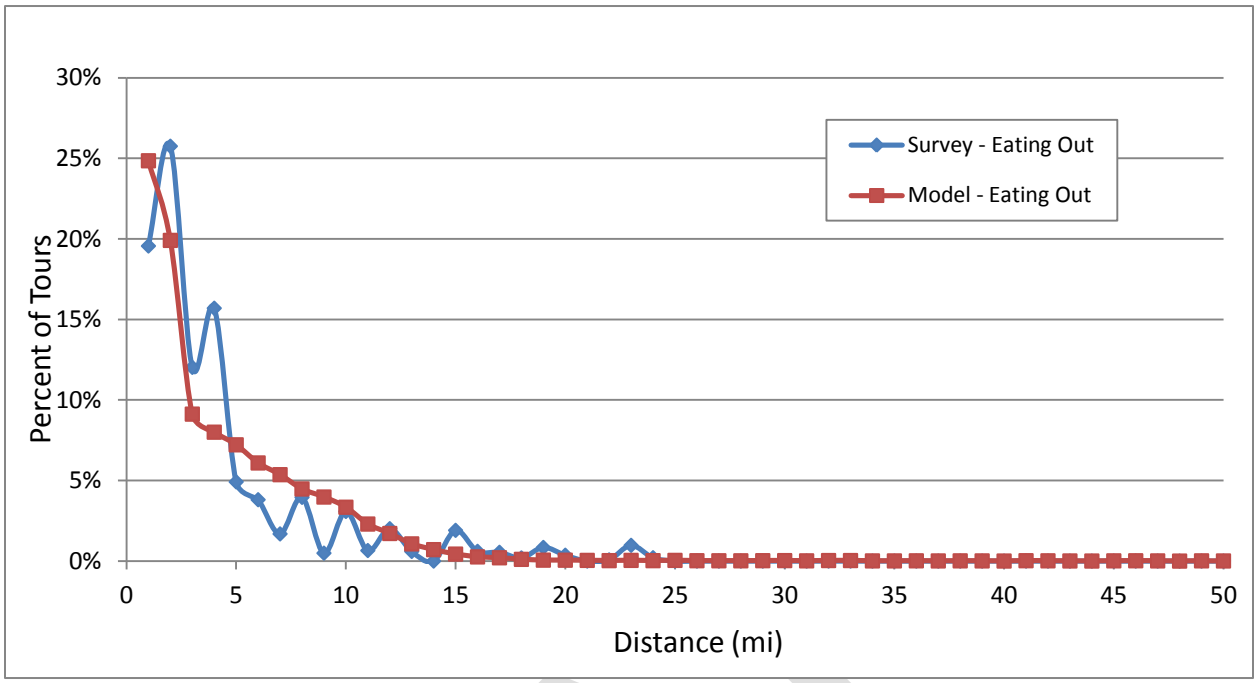


Figure 27: Visiting Tour Length Frequency Distribution

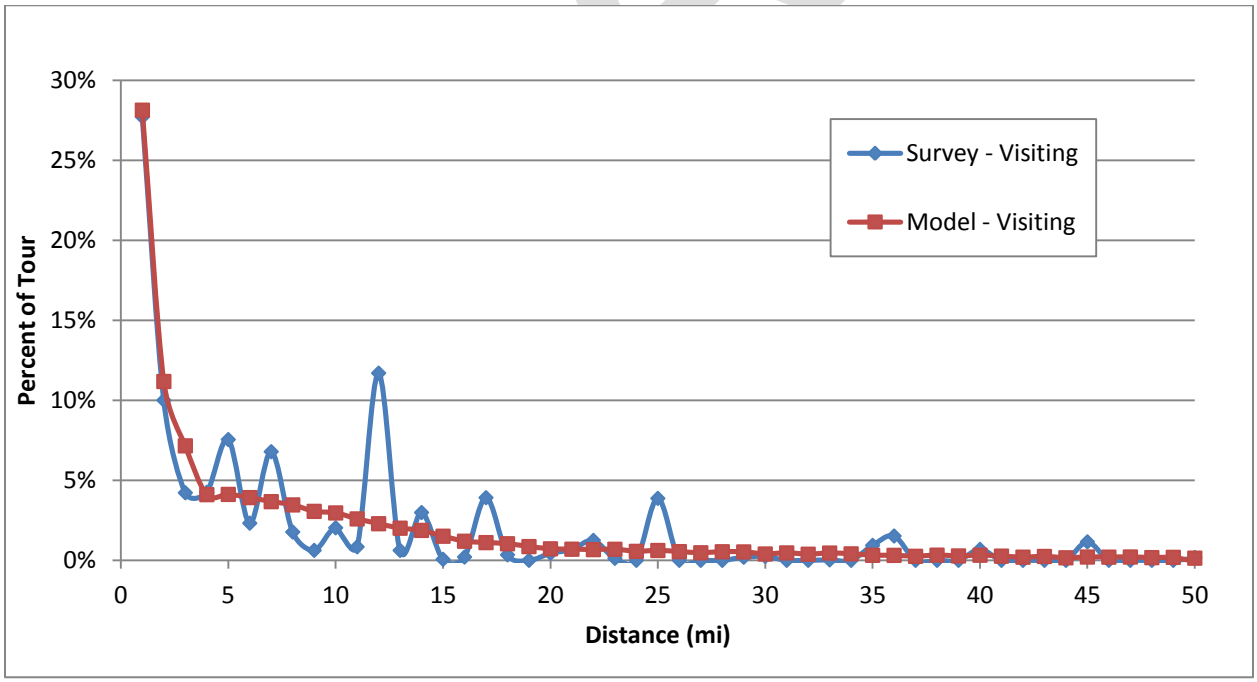


Figure 28: Discretionary Tour Length Frequency Distribution

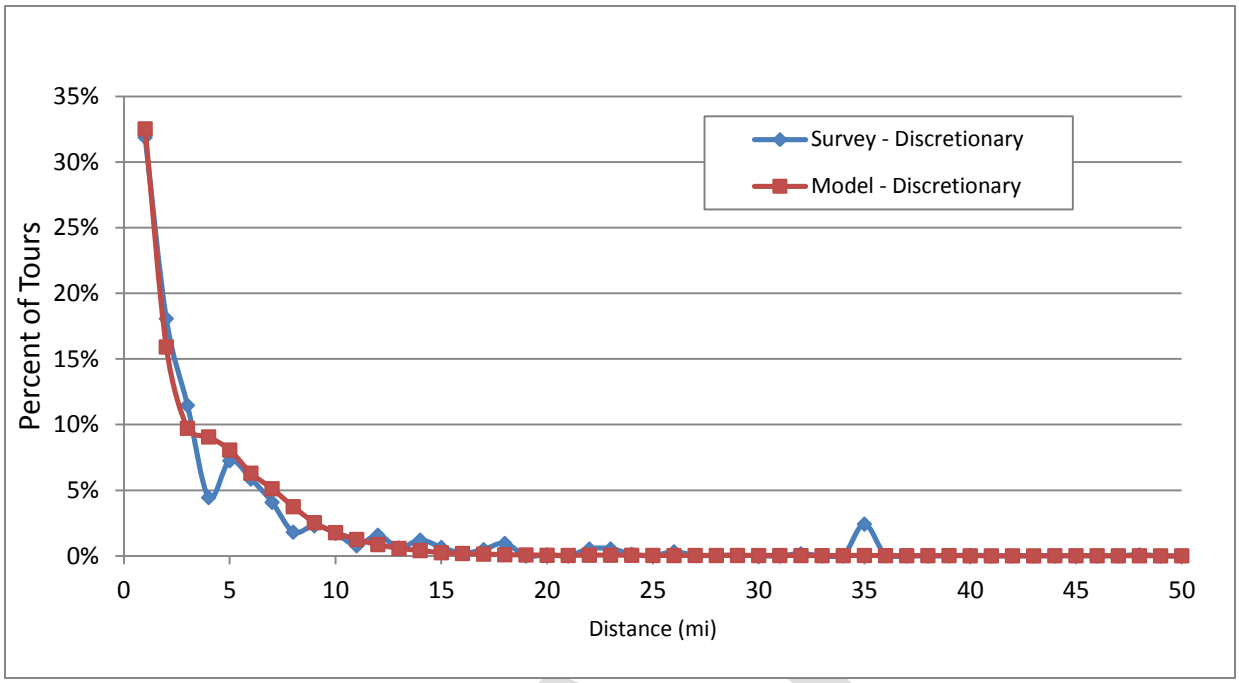
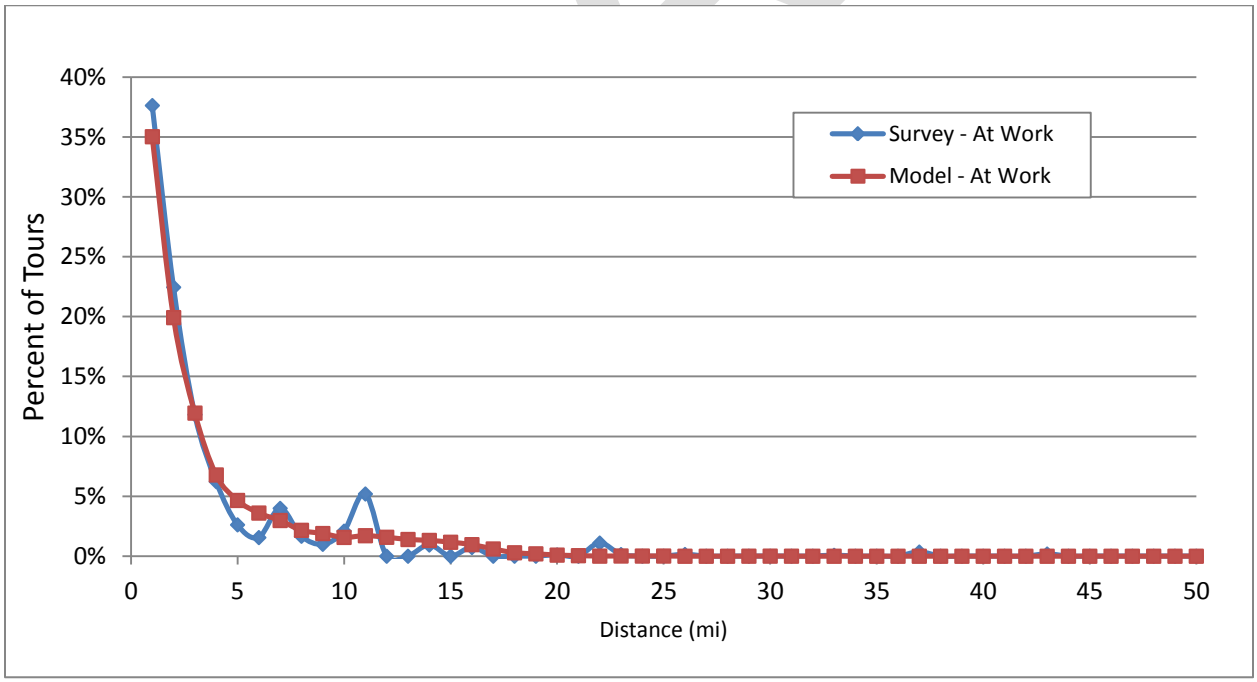


Figure 29: At-Work Subtours Tour Length Frequency Distribution



Model 4.4.3—Individual Non-Mandatory Tour Time of Day Choice

Number of Models:	6, one per non-mandatory tour purpose
Decision-Making Unit:	Persons
Model Form:	Multinomial Logit
Alternatives:	861 (combinations of tour departure and arrival half-hour periods)

After individual non-mandatory tours have been generated and assigned a primary location, the tour departure time from home and arrival time back at home is chosen simultaneously. The model is fully described under 4.1.2, above. The tour departure and arrival period combinations are restricted to only those available for each participant on the tour, after scheduling individual mandatory tours and joint tours.

The specification of the non-mandatory tour time of day choice model is shown in Table 43 thru Table 46. Comparisons between modeled and observed distributions of tour departure and arrival times appear in Figure 30 to Figure 35. The shopping and maintenance models were estimated jointly, such that all the person, household, and tour pattern effects are common to both purposes. Similarly, the visiting and discretionary tour models were estimated jointly. The non-mandatory tour time of day choice models were calibrated to match the marginal distributions of non-mandatory tours by departure time, arrival time and duration. The calibration targets were derived from the 2009 NHTS.

Table 43: Shopping and Maintenance Tour Time of Day Choice Model Specification

Number of Observations:	2084
Likelihood, constants only:	-10690
Final Likelihood:	-10316
Rho-squared, zero:	0.202
Rho-squared, constants:	0.035

Utility Term	Shopping		Maintenance	
	Coef.	t-Stat	Coef.	t-Stat
Mode Choice Logsum	0.500		0.500	
Departure Time Constants				
Linear Shift for every 30 minutes interval before 9:30 am	-0.491	-7.13		
Before 10:00 am	-0.376	-2.29		
10:00 am to 10:30 am	-0.100	-0.63		
10:30 am to 11:00 am	0.000			
11:00 am or After	-0.233	-1.49		
Linear Shift for every 30 minutes after 11:30 am	0.099	2.52		
Square Root Shift for every 30 minutes after 11:30 am	-0.554	-4.08		
Linear Shift for every 30 minutes interval before 7:30 am			-0.679	-7.57
Before 8:00 am			-0.300	-1.58
8:00 am to 8:30 am			-0.200	-1.09
8:30 am to 9:00 am			-0.103	-0.79
9:00 am to 9:30 am			-0.103	-0.79
9:30 am to 11:00 am			0.000	
11:00 am to 11:30 am			-0.142	-0.91
11:30 am to 6:30 pm			-0.430	-3.19
After 6:30 pm			-0.359	-1.30
Linear Shift for every 30 minutes after 6:30 pm			-0.729	-5.23
Arrival Time Constants				
Linear Shift for every 30 minutes interval before 10:30 am	-0.034	-0.47		
Before 11:30 am	-0.522	-2.31		
11:30 am to 1:30 pm	-0.431	-2.61		
1:30 pm to 2:00 pm (reference)	0.000			
2:00 pm to 5:00 pm	-0.078	-0.48		
5:00 pm to 6:30 pm	-0.592	-2.40		
6:30 pm to 8:30 pm	-1.066	-3.40		
After 8:30 pm	-1.642	-4.13		
Linear Shift for every 30 minutes interval after 9:00 pm	-0.524	-6.76		
Linear Shift for every 30 minutes interval before 9:30 am			-0.163	-2.26
Before 10:00 am			-0.438	-1.94
10:00 am to 11:00 am			-0.300	-1.62
11:00 am to 11:30 am			-0.161	-0.83
11:30 am to 12:00 pm			-0.054	-0.29
12:00 pm to 12:30 pm (Reference)			0.000	
12:30 pm to 4:30 pm			-0.140	-0.90
4:30 pm to 5:30 pm			-0.561	-2.77
After 5:30 pm			-1.102	-5.34
Linear Shift for every 30 minutes intervals after 6:00 pm			-0.146	-5.22

Utility Term	Shopping		Maintenance	
	Coef.	t-Stat	Coef.	t-Stat
Duration Constants				
0 hours	-0.589	-2.92	0.082	0.39
0.5 hours				
1 hours			-0.225	-2.22
1.5 hours	-0.460	-4.81	-0.225	-2.22
2 hours	-0.935	-7.60	-0.535	-3.99
2.5 hours or more	-1.611	-11.65	-0.847	-6.43
Linear Shift for every 30 minutes over 2.5 hours	-0.503	-10.30	-0.406	-11.29
Household Income				
Low Income (<=$29,999)				
Departure after 10:30 pm (Linear Shift)	-0.025	-2.01	-0.025	-2.01
Duration Shift for every 30 minutes over 1 hour	0.082	3.97	0.082	3.97
Medium Income ($30,000 to $59,999)				
Duration Shift for every 30 minutes over 1 hour	0.036	1.73	0.036	1.73
Household Size				
Duration Shift for every 30 minutes over 1 hour	0.008	1.26	0.008	1.26
Non-Working Adult				
Duration - 0 hours	-0.537	-1.39	-0.537	-1.39
Duration - 0.5 hours to 1 hour (Reference)	0.000		0.000	
Duration Shift for every 30 minutes over 1 hour	0.031	1.40	0.031	1.40
Female				
Duration - 0 hours	-0.747	-3.41	-0.747	-3.41
Duration - 0.5 hours to 1 hour (Reference)	0.000		0.000	
Duration Shift for every 30 minutes over 1 hour	0.072	4.14	0.072	4.14
Person Tour Pattern Specific Variables				
Number of Additional Individual Tours of Same Purpose				
Duration - 0 hours	0.296	1.83	0.296	1.83
Duration - 0.5 hours to 1 hour (Reference)				
Duration Shift for every 30 minutes over 1 hour	-0.091	-3.52	-0.091	-3.52
First Tours (of Same Purpose) out of Multiple Tours				
Departure after 10:30 pm (Linear Shift)	-0.158	-5.69	-0.158	-5.69
Joint Tours Variables				
Duration over 1 hour (Dummy)	0.905	6.04	0.905	6.04
Departure before 10:00 am (Linear Shift)	0.042	0.88	0.042	0.88
Departure after 10:30 pm (Linear Shift)	-0.027	-2.01	-0.027	-2.01
Kids on Joint Tour				
Duration - 0 hours	0.580	1.76	0.580	1.76
Duration - 0.5 hours to 1 hour (Reference)	0.000		0.000	
Duration Shift for every 30 minutes over 1 hour	-0.103	-2.33	-0.103	-2.33
Distance to Destination				
Duration - 0 hours	-0.270	-5.75	-0.270	-5.75
Duration - 0.5 hours to 1 hour (Reference)	0.000		0.000	
Duration Shift for every 30 minutes over 1 hour	0.009	11.05	0.009	11.05

Table 44: Escort Tour Time of Day Choice Model Specification

Number of Observations:	1341
Likelihood, constants only:	-5370
Final Likelihood:	-5015
Rho-squared, zero:	0.374
Rho-squared, constants:	0.066

Utility Terms	Coef.	t-Stat
Mode Choice Logsum	0.399	1.29
Departure Time Constants		
Linear Shift for every 30 minutes before 6:30 am	-1.419	-6.73
Before 7:00 am	-3.631	-8.13
7:00 am to 7:30 am	-1.164	-5.13
7:30 am to 8:00 am (Reference)	0.000	
8:00 am to 8:30 am	0.201	1.17
8:30 am to 9:00 am	-0.042	-0.16
After 9:00 am	-0.718	-2.18
Linear Shift for every 30 minutes after 9:30 am	0.205	3.42
1:30 pm to 2:00 pm	0.451	1.89
2:00 pm to 2:30 pm	0.734	2.59
2:30 pm to 3:00 pm	0.731	2.36
3:00 pm to 3:30 pm	1.236	3.65
After 3:30 pm	1.374	3.74
Linear Shift for every 30 minutes after 4:00 pm	0.121	2.01
Arrival Time Constants		
Before 7:00 am	3.706	6.71
7:00 am to 7:30 am	2.312	6.58
7:30 am to 8:00 am	1.139	5.45
8:00 am to 8:30 am (Reference)	0.000	
8:30 am to 9:00 am	-0.185	-1.03
After 9:00 am	-0.676	-2.47
Linear Shift for every 30 minutes after 9:30 am	-0.088	-1.53
2:00 pm to 2:30 pm	0.031	0.13
2:30pm to 3:00 pm	0.223	0.84
3:00 pm to 3:30 pm	-0.046	-0.14
After 3:30 pm	-0.722	-2.07
Linear Shift for every 30 minutes after 4:00 pm	-0.367	-6.19
Duration Constants		
0 hours	-0.485	-4.32
0.5 hours (Reference)	0.000	
1 hours	-0.898	-8.68
1.5 hours	-2.023	-10.22
2 hours	-2.480	-8.70

Utility Terms	Coef.	t-Stat
2.5 hours or more	-2.781	-7.34
***High Income** (>= $100,000)*		
Departure before 2:00 pm (Linear Shift)	0.046	1.87
School Child in Household with Mandatory Tour		
Departure after 8 am (Linear Shift)	-0.105	-1.22
Departure before 2:00 pm (Linear Shift)	0.262	2.28
Arrival before 8:00 am (Linear Shift)	0.606	4.91
Arrival after 8:30 am (Linear Shift)	-0.255	-3.28
Arrival before 3:00 pm (Linear Shift)	0.139	1.56
Arrival after 3:30 pm (Linear Shift)	-0.160	-5.11
Pre-School Child in Household with Mandatory Tour		
Departure before 7:30 am (Linear Shift)	0.442	1.29
Arrival before 8:00 am (Linear Shift)	0.510	2.10
Arrival after 8:30 am (Linear Shift)	0.137	3.23
Arrival before 3:00 pm (Linear Shift)	-0.254	-5.19
Arrival after 3:30 pm (Linear Shift)	-0.133	-3.04
Full-Time Worker Dummy		
Departure before 7:30 am (Linear Shift)	-0.164	-1.07
Arrival after 3:30 pm (Linear Shift)	0.110	3.70
Number of Non-Escorting Individual Tours		
Duration Shift for every 30 minutes over half an hour	-0.096	-1.72
First Escorting Tour of Multiple Escorting Tours		
Departure before 7:30 am (Linear Shift)	-0.132	-0.83
Departure after 8 am (Linear Shift)	-0.125	-2.37
Departure before 2:00 pm (Linear Shift)	-0.148	-1.81
Duration Constant - 0 hours	0.391	2.58
Duration - 0.5 hours (Reference)	0.000	
Duration Shift for every 30 minutes over half an hour	-0.206	-2.45
Distance to Destination		
Duration Constant - 0 hours	-0.162	-7.25
Duration - 0.5 hours (Reference)	0.000	
Duration Shift for every 30 minutes over half an hour	0.019	5.21

Table 45: Eating Out Tour Time of Day Choice Model Specification

Number of Observations:	260
Likelihood, constants only:	-1105
Final Likelihood:	-1190
Rho-squared, zero:	0.217
Rho-squared, constants:	0.077

Utility Terms	Coef.	t-Stat
Mode Choice Logsum	0.369	0.48
Departure Time Constants		
Before 7:30 am	-0.313	-0.37
Linear Shift for every 30 minutes before 10:30 am	-0.242	-2.06
10:30 am to 11:00 am	-0.246	-0.45
11:00 am to 11:30 am	0.835	1.77
11:30 am to 12:00 pm	0.891	1.84
12:00 pm to 12:30 pm	0.371	0.69
After 12:30 pm	-0.495	-0.81
Square Root Shift for every 30 minutes after 1:00 pm	-0.053	-0.17
Square Root Shift for every 30 minutes before 4 pm	-0.756	-2.25
Before 4:30 pm	-1.664	-2.26
4:30 pm to 5:00 pm	-1.604	-2.27
5:00 pm to 5:30 pm	-0.668	-1.52
5:30 pm to 6:30 pm (Reference)	0.000	
6:30 pm to 7:00 pm	-0.593	-1.43
7:00 pm to 7:30 pm	-0.638	-1.39
After 7:30 pm	-2.769	-3.77
Arrival Time Constants		
Before 12:00 pm	1.113	1.35
12:00 pm to 12:30 pm	1.136	1.48
12:30 pm to 1:00 pm	1.578	2.30
1:00 pm to 1:30 pm	1.852	2.89
1:30 pm to 2:00 pm	1.838	2.99
2:00 pm to 3:30 pm	1.477	2.76
3:30 pm to 5:00 pm	0.181	0.34
5:00 pm to 6:00 pm	0.251	0.56
6:00 pm to 7:30 pm	-0.030	-0.11
7:30 pm to 8:00 pm	0.000	
8:00 pm to 8:30 pm	-0.192	-0.61
8:30 pm to 9:00 pm	-0.210	-0.61
After 9:00 pm	-0.153	-0.42
Linear Shift for every 30 minutes after 9:30 pm	-0.477	-3.66
Duration Constants		
0 hours	0.421	0.53
0.5 hours	1.291	2.33
1 hours	0.922	2.48
1.5 hours	0.000	
2 hours	0.000	
2.5 hours	-0.571	-1.77
3 hours to 3.5 hours	-0.971	-2.65

Utility Terms	Coef.	t-Stat
4 hours or more	-1.639	-3.34
Household Income		
Low Income (<$30,000)		
Departure before 5:30 pm (Linear Shift)	-0.042	-0.42
Duration shorter than 1.5 hours (Linear Shift)	0.213	1.00
Medium Income ($30,000 to $59,999)		
Duration shorter than 1.5 hours (Linear Shift)	0.213	1.00
High Income (>= $100,000)		
Departure after 6:00 pm (Linear Shift)	0.068	0.54
Duration longer than 1.5 hours (Linear Shift)	-0.121	-1.26
Household Size		
Duration shorter than 1.5 hours (Linear Shift)	0.033	0.41
Worker or University Student with Mandatory Pattern		
Departure - Before 5:00 pm (Dummy)	-0.234	-0.50
Female		
Duration shorter than 1.5 hours (Linear Shift)	0.497	2.01
Duration longer than 1.5 hours (Linear Shift)	0.092	0.94
Time Pressure		
Departure before 5:30 pm (Linear Shift)	-0.069	-1.13
Joint Tours (Dummy)		
Departure Constant		
Departure between 11:00 am and 12:30 pm	-0.152	-0.34
Departure between 5:00 pm and 5:30 pm	0.163	0.20
Departure between 5:30 pm and 6:30 pm	-0.337	-0.40
Departure between 6:30 pm and 7:00 pm	0.245	0.26
Departure between 7:00 pm and 7:30 pm	-0.216	-0.22
Departure after 7:30 pm	0.268	0.24
Arrival Constant		
Arrival after 6:30 pm	-0.099	-0.21
Arrival before 12:00 pm	-0.887	-1.24
Duration Constant		
Duration 0 hours	-2.175	-1.71
Duration 0.5 hours	-1.327	-2.01
Duration 1 hours	-0.334	-0.76
Duration 2.5 hours	0.767	1.89
Duration 3 hours	0.459	0.94
Duration 3.5 hours	0.325	0.61
Children on Joint Tour		
Arrival before 7:30 pm (Linear Shift)	-0.120	-0.95
Duration longer than 1.5 hours (Linear Shift)	-0.180	-0.95
Distance		

Utility Terms	Coef.	t-Stat
Duration shorter than 1.5 hours (Linear Shift)	0.153	4.16
Duration longer than 1.5 hours (Linear Shift)	0.011	1.90

Table 46: Visiting and Discretionary Tour Time of Day Choice Model Specification

Number of Observations:	1,229
Likelihood, constants only:	-6207
Final Likelihood:	-6158
Rho-squared, zero:	0.140
Rho-squared, constants:	0.008

Utility Terms	Visiting		Discretionary	
	Coef.	t-Stat	Coef.	t-Stat
Mode Choice Logsum	0.500		0.500	
Departure Time Constants				
Linear Shift for every 30 minutes before 7:00 am			-0.468	-5.32
Linear Shift for every 30 minutes before 8:30 am	-0.468	-4.15		
Before 7:30 am	0.752	1.90	0.156	0.73
7:30 am to 9:00 am	0.752	1.90	0.630	4.60
9:00 am to 10:00 am	1.066	3.79	0.630	4.60
10:00 am to 12:30 pm	1.066	3.79		
Linear Shift for every 30 minutes before 4:00 pm			0.043	1.75
Linear Shift for every 30 minutes before 5:30 pm	-0.054	-1.33		
Before 4:30 pm	-0.499	-1.89	-0.336	-1.86
4:30 pm to 5:30 pm	-0.499	-1.89	-0.227	-1.35
5:30 pm to 6:00 pm	-0.499	-1.89	-0.224	-1.52
6:00 pm to 6:30 pm			-0.224	-1.52
6:30 pm to 7:00 pm	-0.190	-0.65		
7:00 pm to 7:30 pm	-0.211	-0.67	-1.046	-4.66
7:30 pm or Later	-0.849	-2.25	-1.685	-5.82
Linear Shift for every 30 minutes after 8 pm	-0.254	-1.59	-0.354	-2.25
Arrival Time Constants				
Linear Shift for every 30 minutes before 8:30 am			-0.130	-1.65
Linear Shift for every 30 minutes before 11:30 am	0.039	0.43		
Before 9:30 am	-0.230	-0.47	-0.573	-1.67
9:30 am to 12:00 pm	-0.230	-0.47	-0.532	-2.05
12:00 pm to 4:30 pm	0.186	0.57	-0.532	-2.05
4:30 pm to 7:30 pm	0.186	0.57	-0.421	-2.55
7:30 pm to 8:00 pm	0.027	0.07	-0.421	-2.55
8:00 pm to 8:30 pm	0.005	0.01	-0.421	-2.55
8:30 pm to 9:00 pm	-0.035	-0.10	-0.257	-1.38
9:00 pm to 9:30 pm	0.000		0.000	

Utility Terms	Visiting		Discretionary	
	Coef.	t-Stat	Coef.	t-Stat
9:30 pm to 10:00 pm	0.170	0.57	-0.839	-3.35
10:00 pm to 10:30 pm			-0.861	-3.45
10:30 pm to 11:00 pm	-0.376	-1.05	-0.861	-3.45
11:00 pm to 11:30 pm			-0.861	-3.45
11:30 pm to 12:00 pm	-1.708	-2.23	-0.861	-3.45
12:00 pm or Later	-1.626	-2.10	-0.861	-3.45
Linear Shift for every 30 minutes after 10:30 pm			-0.237	-1.94
Duration Constants				
0 hours	-1.956	-2.95	-2.190	-5.35
0.5 hours	0.110	0.34	-0.630	-2.65
1 hours	-0.093	-0.43	-0.137	-0.89
1.5 hours	-0.093	-0.43	0.000	
2 hours	0.000		-0.335	-2.93
2.5 hours	-0.219	-0.91	-0.651	-4.86
3 hours	-0.517	-1.96	-0.970	-6.06
3.5 hours or more	-0.675	-2.82	-1.263	-7.72
Linear Shift for every 30 minutes after 3.5 hours	-0.379	-6.75	-0.393	-9.11
Household Income				
Low Income (<$30,000)				
Departure before 6:30 pm (Linear Shift)	-0.050	-1.58	-0.050	-1.58
Duration Shift for every 30 minutes over 1.5 hours	0.071	2.39	0.071	2.39
Household Size *(Individual Tours Only)*				
Duration Shift for every 30 minutes over 1.5 hours	-0.014	-1.47	-0.014	-1.47
Person Type				
Non-Working Adult				
Duration Shift for every 30 minutes under 1.5 hours	-0.314	-1.78	-0.314	-1.78
Duration Shift for every 30 minutes over 1.5 hours	-0.145	-1.18	-0.145	-1.18
Retiree				
Duration Shift for every 30 minutes under 1.5 hours	-0.119	-0.92	-0.119	-0.92
Pre-driving Age Child				
Duration Shift for every 30 minutes under 1.5 hours	0.122	0.24	0.555	1.99
Duration Shift for every 30 minutes over 1.5 hours	0.202	3.09	0.025	0.44
Female				
Duration Shift for every 30 minutes over 1.5 hours	-0.028	-1.20	-0.028	-1.20
Time Pressure				
Duration Shift for every 30 minutes under 1.5 hours	0.032	0.61	0.032	0.61
Duration Shift for every 30 minutes over 1.5 hours	0.034	2.47	0.034	2.47
Duration Shift for every 30 minutes under 1.5 hours	-0.084	-0.77	-0.084	-0.77
Departure before 6:30 pm (Linear Shift)	-0.236	-3.77	-0.236	-3.77
Joint Tour Dummy				

Utility Terms	Visiting		Discretionary	
	Coef.	t-Stat	Coef.	t-Stat
Departure before 6:30 pm (Linear Shift)	0.094	3.44	0.094	3.44
Departure after 7:00 pm (Linear Shift)	-0.150	-1.18	-0.150	-1.18
3 or More Persons on the Joint Tour				
Departure before 6:30 pm (Linear Shift)	0.096	1.78	0.096	1.78
Kids on Joint Tour				
Arrival before 8:30 pm (Linear Shift)	-0.125	-3.50	-0.125	-3.50
Arrival after 9:00 pm (Linear Shift)	-0.225	-1.68	-0.225	-1.68
Distance to Destination				
Duration Shift for every 30 minutes under 1.5 hours	0.075	5.22	0.075	5.22
Duration Shift for every 30 minutes over 1.5 hours	0.009	7.81	0.009	7.81

Figure 30: Individual Escort Tour Departure and Arrival Times

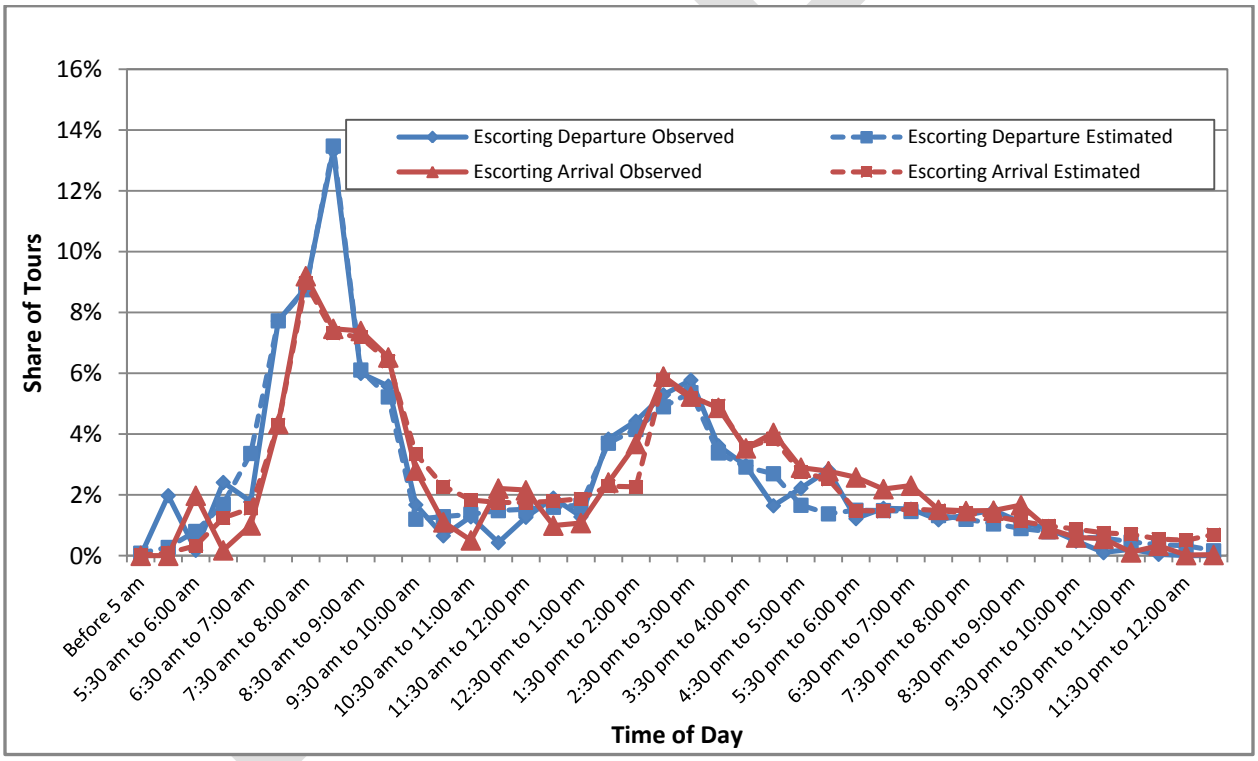


Figure 31: Individual Shopping Tour Departure and Arrival Times

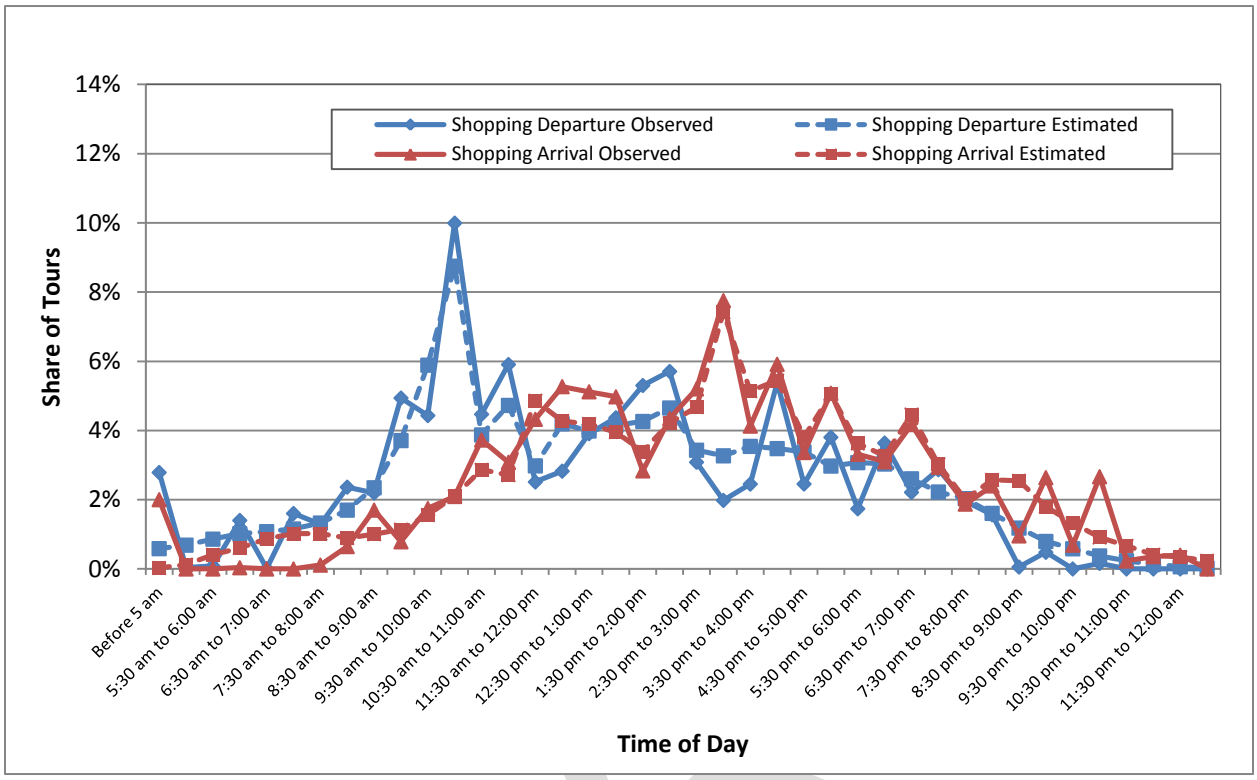


Figure 32: Individual Maintenance Tour Departure and Arrival Times

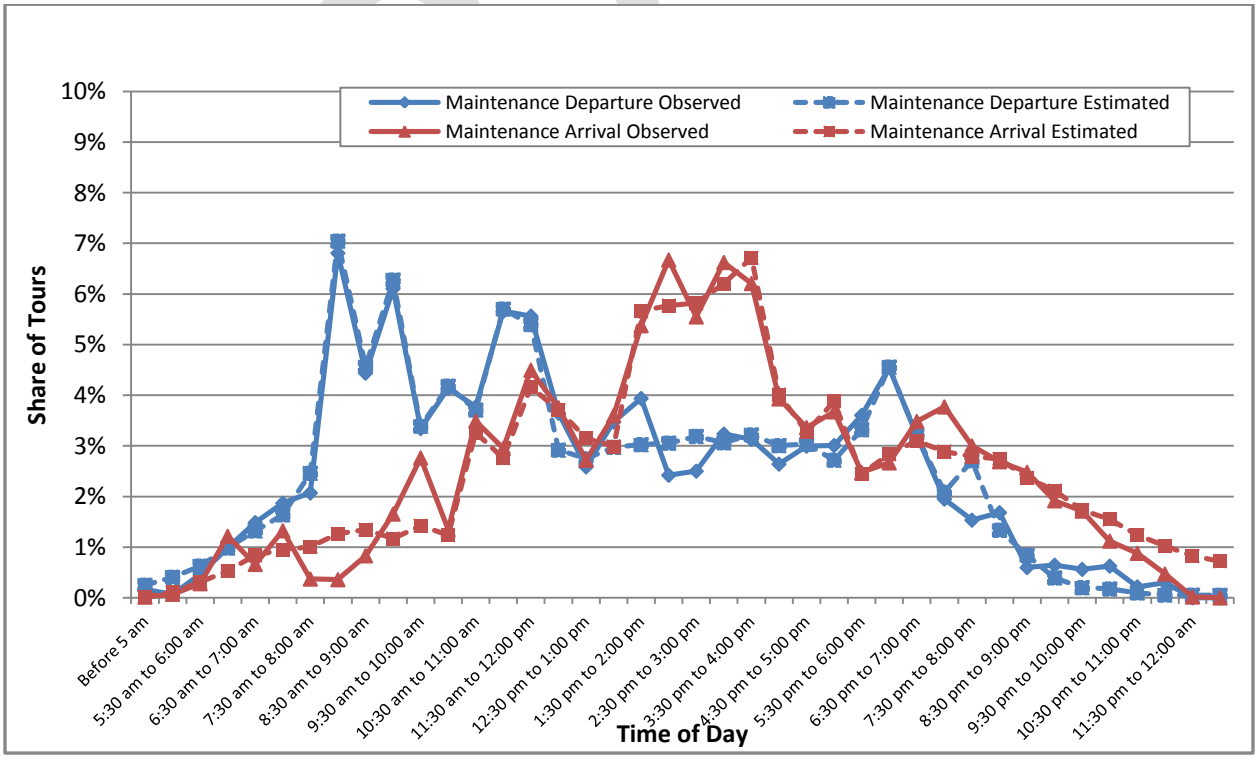


Figure 33: Individual Eating Out Tour Departure and Arrival Times

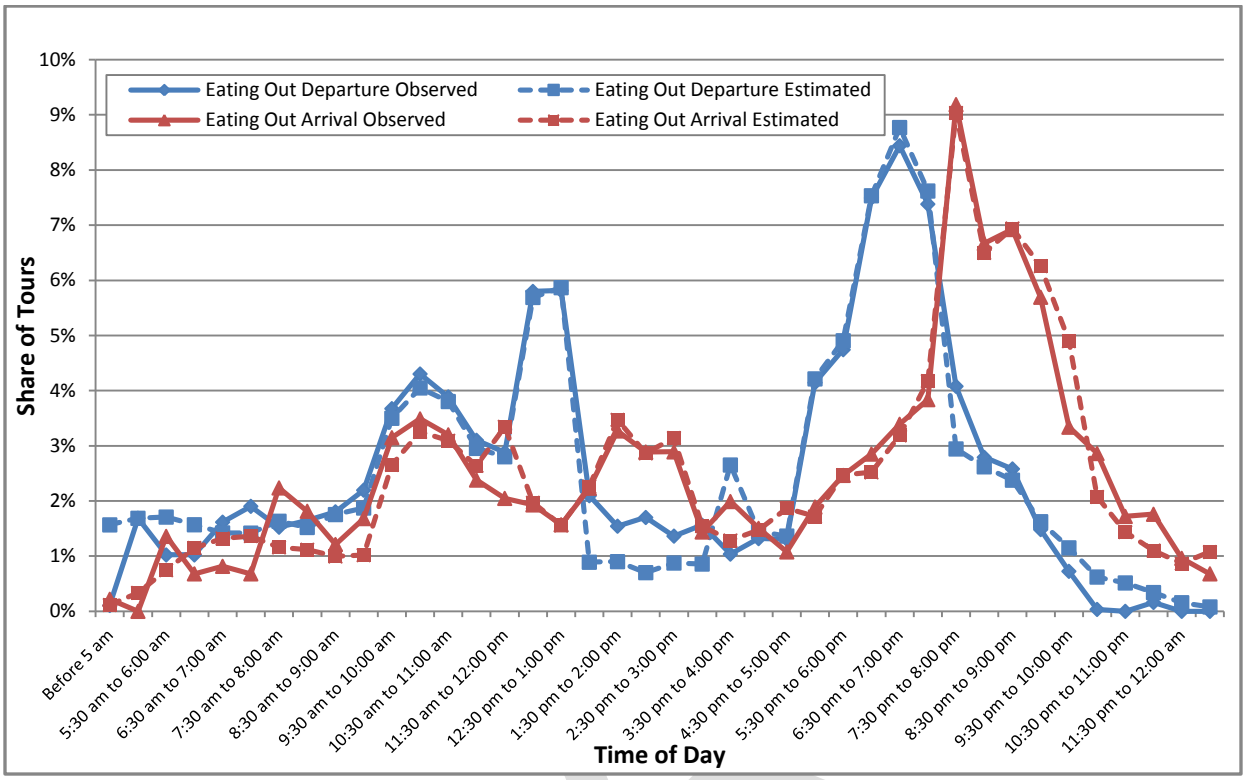


Figure 34: Individual Visiting Tour Departure and Arrival Times

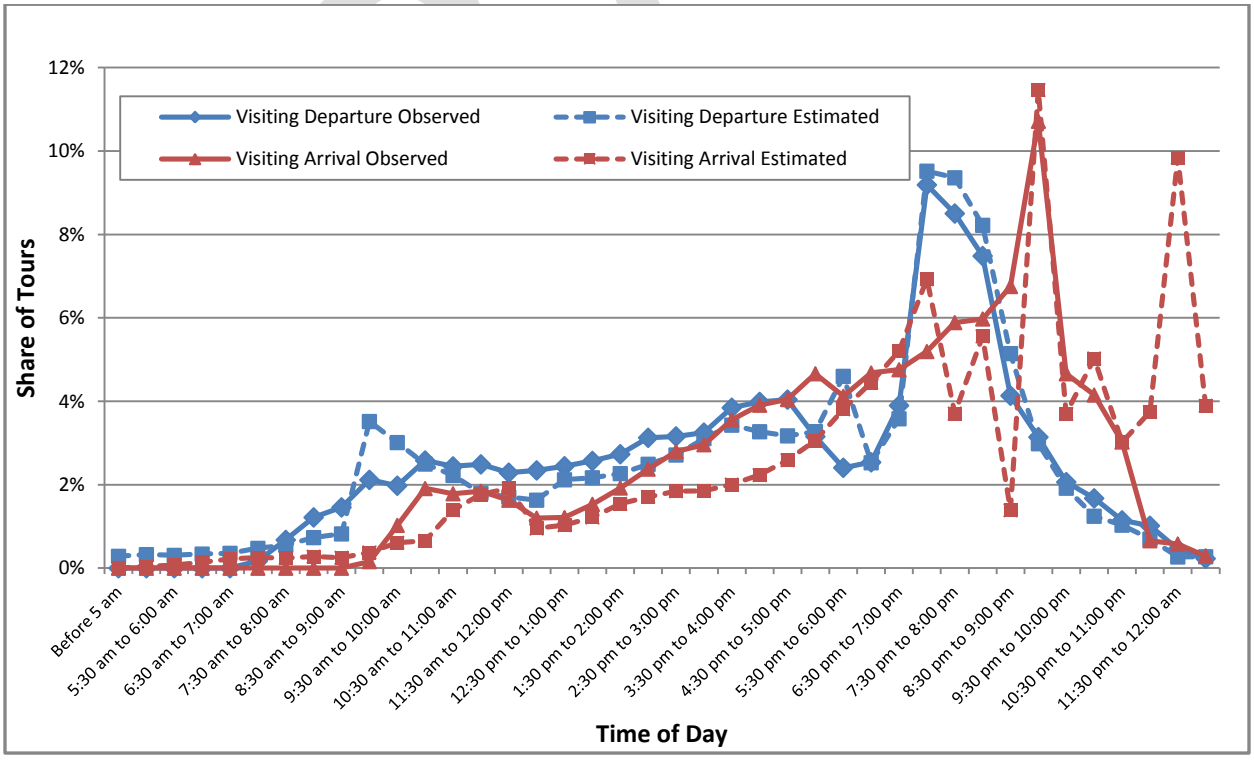
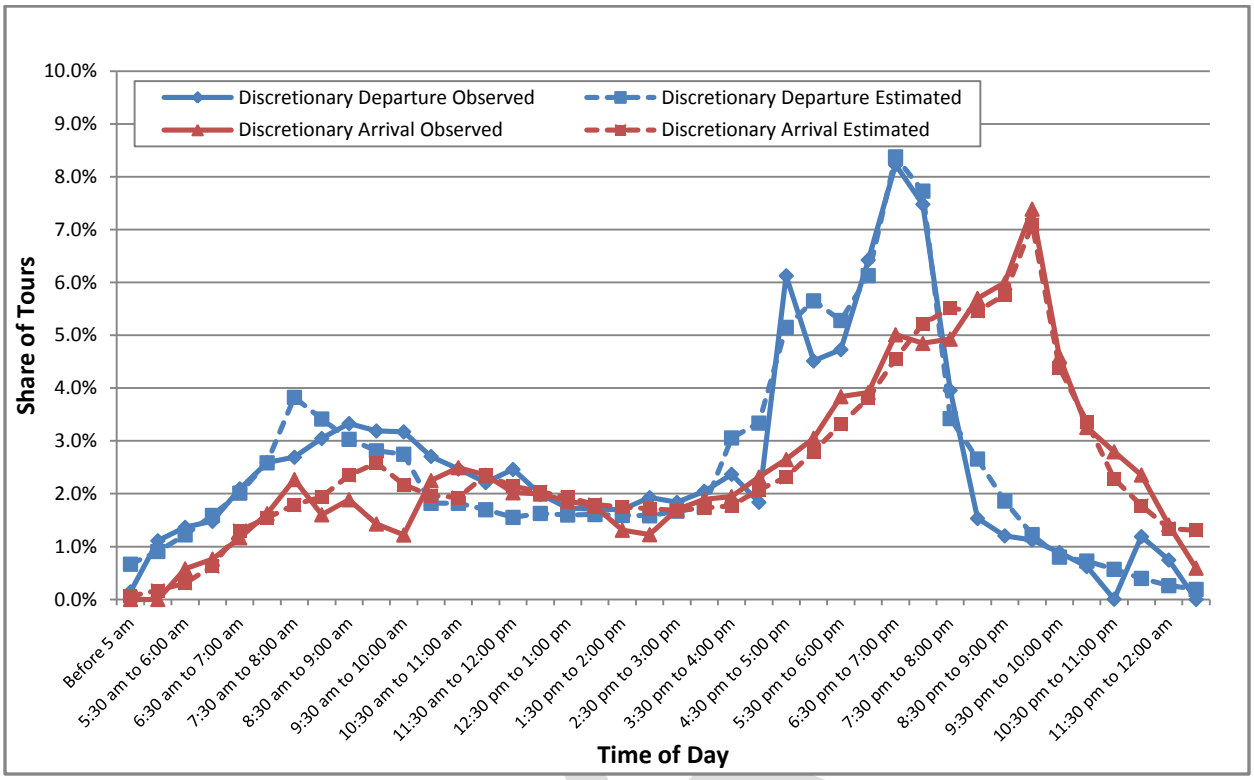


Figure 35: Individual Discretionary Tour Departure and Arrival Times



Model 4.5.1—At-Work Sub-Tour Frequency

Number of Models: 1
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: 9 (none, 1 eat out tour, 1 business tour, 1 other tour, 2 business tours, 2 other tours, 1 eat out & 1 business tour, 1+ eat out and 1+ other, 1+ business and 1+ other)

Work-based sub-tours are modeled last, and are relevant only for those persons who implement at least one work tour. The at-work tour frequency model predicts the number and purpose of tours that start at work. These underlying activities are mostly individual (e.g., business-related and eating-out purposes), but may include some household maintenance functions as well as person and household maintenance tasks. There are nine alternatives in the model, corresponding to the most frequently observed patterns of at-work sub-tours. Explanatory variables include household and person attributes, duration of the parent work tour, the number of joint and individual non-mandatory tours already generated in the day, and accessibility and urban form variables.

The specification of the at-work sub-tour frequency model is shown in Table 47. This model will be calibrated to match the distribution of persons by number of at-work tours and person type. The calibration targets were derived from the 2009 NHTS.

Table 47: At-Work Subtour Frequency Choice Model Specification

Number of Observations:	3,526
Likelihood, constants only:	-1,847
Final Likelihood:	-1,789
Rho-squared, zero:	0.778
Rho-squared, constants:	0.031

Utility Terms	Tour Purpose(s)	Coefficient	t-Stat
Constant	No at-work subtours	0.00	(ref.)
	1 eat tour	-3.73	-8.76
	1 work tour	-4.72	-10.72
	2 work tours	-8.36	-8.56
	1 other tour	-3.12	-7.53
	2+ other tours	-6.64	-7.14
	1 eat and 1 work tour	-7.96	-9.73
	1+ eat and 1+ other tours	-9.88	-7.31
	1+work and 1+ other tours	-9.01	-6.85
Full-time worker	Eat	0.69	2.59
	Work	1.10	2.44
	Other	0.65	2.31
Low income	Work	-0.51	-1.18
Medium high income	Eat	0.74	3.56
High income	Eat	1.01	5.12
	Other	0.59	3.86
Number of adults	Eat	-0.30	-2.79
	Other	-0.37	-3.32
Female, with pre-school children	Other	0.69	2.81
Non motorized work accessibility	Eat	0.06	1.72
Low employment density	Eat	-1.12	-2.19
High Mix density	Work	0.50	2.07
Total number of Eat tours in day	Eat	-0.58	-1.14
Total number of Other tours in the day	Other	-0.22	-1.23

Model 4.5.2—At-Work Sub-Tour Primary Destination Choice

Number of Models: 1
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: MAZs

The at-work sub-tour primary destination choice model determines the location of the tour primary destination. The model works at the MAZ level, and sampling of destination alternatives is implemented in order to reduce computation time. Explanatory variables include household and person characteristics, the tour purpose, logged size (i.e., attraction) variables, round-trip mode choice

logsum, distance, and other variables. Note that the mode choice logsum used is based a 'representative' time period for individual non-mandatory tours, which is currently off-peak, since the actual time period is not chosen until model 4.5.3. The model is constrained so that only destinations that allow for the sub-tour to be completed within the total available time window are chosen.

This model will be re-estimated using the 2009 NHTS data. The specification of the At-Work sub-tour primary destination choice model is shown in Table 48.

Table 48: At-Work Sub-Tour Destination Choice Model Specification

Utility Terms	Coefficient	t-Stat
Estimated terms		
Mode choice logsum	0.500	
Distance	-0.7058	-7.68
Distance squared	0.0150	6.59
Distance – full time worker	0.1190	1.38
Size terms		
Retail employment	0.1540	
Professional and business services employment	0.0290	
Restaurant and bar employment	0.3670	
Personal services, retail-based	0.0540	
School enrollment, K thru 8		
Calibrated terms[(2)]		
Distance	-0.5666	
Distancesquared	0.1300	
Distancecubed	-0.0047	
Distancelogged	-0.3494	
Maximum distance (miles)	20	

Model 4.5.3—At-Work Sub-Tour Time of Day Choice

Number of Models: 1
Decision-Making Unit: Persons
Model Form: Multinomial Logit
Alternatives: 861 (combinations of tour departure and arrival half-hour periods)

After at-work sub-tours have been generated and assigned a primary location, the tour departure time from workplace and arrival time back at the workplace is chosen simultaneously. The model is fully described under 3.1.2, above. The tour departure and arrival period combinations are restricted to only those available based on the time window of the parent work tour.

The specification of the at-work sub-tour time of day choice model is shown in Table 49. This model will be calibrated to match the marginal distributions of at-work sub-tours by departure time, arrival time and duration. The calibration targets were derived from the 2009 NHTS.

Table 49: At-Work Sub-Tour Time of Day Choice Model Specification

Number of Observations:	405
Likelihood, constants only:	-1,536
Final Likelihood:	-1,546
Rho-squared, zero:	0.266
Rho-squared, constants:	0.007

Utility Terms	Coefficient	t-Stat
Mode Choice Logsum	0.500	
Departure Time Constants		
Linear Shift for every 30 minutes before 11:00 am	-0.797	-6.74
11:30 am or Earlier	-2.022	-7.28
11:30 am to 12:00 pm	-0.465	-2.52
12:00 pm to 12:30 pm	0.000	
12:30 pm to 1:00 pm	-0.035	-0.17
1:00 pm or Later	-0.443	-1.63
Linear Shift for every 30 minutes after 1:30 pm	-0.186	-1.45
Arrival Time Constants		
11:30 am or Earlier	0.137	0.40
11:30 am to 12:00 pm	0.065	0.23
12:00 pm to 12:30 pm	-0.175	-0.86
12:30 pm to 1:00 pm	0.000	
1:00 pm to 1:30 pm	-0.696	-3.70
1:30 pm to 2:00 pm	-1.194	-4.85
2:00 pm or Later	-1.689	-5.35
Linear Shift for every 30 minutes after 2:30 pm	-0.418	-2.46
Square Root Shift for every 30 minutes after 2:30 pm	-0.112	-0.30
Duration Constants		
0 hours	-0.404	-1.08
0.5 hours	0.000	
1 hours	-0.008	-0.05
1.5 hours to 2 hours	-0.973	-4.16
2.5 hours or more	-2.505	-5.17
Household Income		
Low Income (<$30,000)		
Duration under 0.5 hours	0.792	1.22
Medium Income ($30,000 to $59,999)		
Duration under 0.5 hours	0.328	0.69
High Income (>= $100,000)		
Duration under 0.5 hours	-0.827	-1.94
Duration Shift for every 30 minutes over 0.5 hours	0.078	1.05
Distance to Destination		
Duration under 0.5 hours	-0.447	-3.28

Utility Terms	Coefficient	t-Stat
Duration Shift for every 30 minutes over 0.5 hours	0.019	4.23
Sub-tour Purpose		
Work-Related Sub-tour		
Departure Shift for every 30 minutes before 12:00 pm	-0.550	-5.31
Departure Shift for every 30 minutes after 12:30 pm	0.405	4.04
Duration Shift for every 30 minutes over 0.5 hours	0.427	5.29
Non-Eating Non-Mandatory Sub-tour		
Departure Shift for every 30 minutes before 12:00 pm	-0.475	-5.03
Departure Shift for every 30 minutes after 12:30 pm	0.305	3.45
Duration under 0.5 hours	0.460	1.28

Model 5.1—Tour Mode Choice Model

Number of Models: 6 (Work, University, K-12, Maintenance, Discretionary, At-Work)
Decision-Making Unit: Person
Model Form: Nested Logit
Alternatives: 26 (see Figure 36)

This model determines the "main tour mode" used to get from the origin to the primary destination. The tour-based modeling approach requires a reconsideration of the conventional mode choice structure. Instead of a single mode choice model pertinent to a four-step structure, in the CT-RAMP framework there are two different levels where the mode choice decision is modeled:

- The tour mode level (upper-level choice),
- The trip mode level (lower-level choice conditional upon the upper-level choice).

The tour mode level reflects the most important decisions that a traveler makes in terms of using a private car versus using public transit, non-motorized, or any other mode. Trip-level decisions correspond to details of the exact mode used for each trip. Modes for the SE Florida tour mode choice model are shown in Figure 36.

The tour mode choice model is distinguished by the following characteristics:

- Segmentation of the shared-ride mode by occupancy categories, which is essential for modeling specific HOV/HOT lanes and policies
- An explicit modeling of pay (toll) vs. free choices as highway sub-modes, which is essential for modeling highway pricing projects and policies
- Transit sub-modes that are characterized by their attractiveness, reliability, comfort, convenience, and other characteristics beyond travel time and cost
- Representation of transit access choices (walk, park-n-ride, kiss-n-ride)
- Explicit representation of walk and bike modes

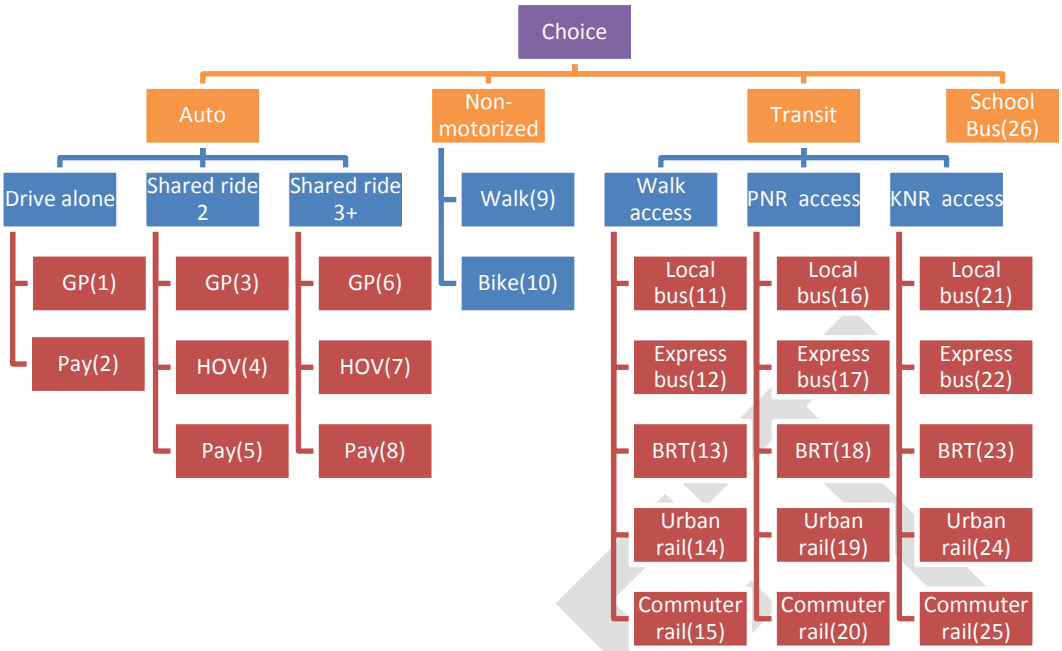


Figure 36: Tour Mode Choice Model Structure

The auto choices provide an opportunity for toll road and HOV lane choice as a path choice within the nesting structure. Implementation of these 'pre-route' choices requires separate free, pay and HOV skims to be provided as inputs to the model. As shown in Table 50, the free paths exclude all HOV, HOT and toll lanes, while the HOV paths exclude all pay lanes (tolls and HOT).The transit skims are segmented by local versus premium (express bus, BRT, urban rail, and commuter rail) modes. However, separate transit access points (TAPs) are coded for each premium mode, so that multiple premium mode paths are available for each MAZ-MAZ pair. The transit skims are built from TAP to TAP; the access & egress portions of the path are computed by the mode choice model.

The tour mode choice model is based on the round-trip level-of-service (LOS) between the tour anchor location (home for home-based tours and work for at-work sub-tours) and the tour primary destination. The model assumes that the same mode is used in the outbound and inbound directions. This assumption is later relaxed when trip modes are chosen. The tour mode is chosen based on LOS variables for both directions according to the time periods for the tour departure from the anchor and the arrival back at the anchor. This is one of the fundamental advantages of the tour-based approach. For example a commuter can have very attractive transit service in the A.M. peak period in the outbound direction, but if the return home time is in the midday or later at night, the commuter may prefer private auto due to lower off-peak transit service. Three sets of skims are used in SERPM 7.0—AM Peak Period, PM Peak Period, and Off-Peak. The off-peak skims are used to represent midday transit, while the transpose of the off-peak skims represent evening service.

The appropriate skim values for the tour mode choice are a function of the MAZ of the tour origin and MAZ of the tour primary destination. As described in the section on Treatment of Space, all transit level-of-service and certain non-motorized level of service (for MAZs within 1.5 miles of each other) are computed "on-the-fly" in mode choice. Transit access and egress times are specifically determined via detailed MAZ-to-TAP distances computed off model. Actual TAP-TAP pairs used for the MAZ-MAZ

pair, and therefore actual transit LOS, are based on a selection of the path with the best overall utility for each of five transit ride modes (local bus, express bus, bus rapid-transit, light-rail, and heavy rail).

Table 50: Skims Used in Tour Mode Choice

Mode	Skims
Drive-alone Non-Toll	All general purpose lanes available. HOV lanes, HOT lanes, and toll lanes unavailable.
Drive-alone Toll	All general purpose lanes and toll lanes are available. HOV lanes are unavailable. HOT lanes are available for the SOV toll rate.
Shared-2 Non-Toll, Non-HOV	All general purpose lanes available. HOV lanes, HOT lanes, and toll lanes unavailable.
Shared-2 Non-Toll, HOV	All general purpose lanes available. 2+ occupancy HOV lanes available. Toll lanes unavailable. HOT lanes where 2+ occupant vehicles go free are available.
Shared-2 Toll, HOV	All general purpose lanes available. 2+ occupancy HOV lanes and HOT lanes where 2+ occupant vehicles go free are available for free. Toll lanes and HOT lanes where 2-occupant vehicles are tolled are available at the 2-occupant toll rate.
Shared-3+ Non-Toll, Non-HOV	All general purpose lanes available. HOV lanes, HOT lanes, and toll lanes unavailable.
Shared-3+ Non-Toll, HOV	All general purpose lanes available. 2+ and 3+ occupancy HOV lanes available. Toll lanes unavailable. HOT lanes where 2+ or 3+ occupant vehicles go free are available.
Shared-3+ Toll, HOV	All general purpose lanes available. 2+ and 3+ occupancy HOV lanes and HOT lanes where 2 or 3+ occupant vehicles go free are available for free. Toll and HOT lanes where 3+ person carpools are tolled are available at the 3+ occupant toll rate.
Walk	Highway distance, excluding freeways. This is used for any MAZs separated by more than 1.5 miles. The walk time for MAZs less than 1.5 miles apart relies on the GIS-based walk distances.
Bike	Highway distance, excluding freeways. This is used for any MAZs separated by more than 1.5 miles. The bike time for MAZs less than 1.5 miles apart relies on the GIS-based bike distances.
Transit-Local	Local Bus TAP-to-TAP skims, including in-vehicle time, first wait time, transfer wait time, and fare.
Transit-Premium	Premium TAP-to-TAP skims, including in-vehicle time, first wait time, transfer wait time, and fare. These include local bus as a feeder mode, as well as express bus, bus rapid transit, light rail, and commuter rail. A premium mode designator is also included in the skim for each interchange, to identify which of the 4 premium ride-modes is used, based on the mode for which the greatest distance was travelled.

Tour modes are unavailable for various persons, or under certain conditions, as follows:

- Drive alone and PNR-Transit are not available to persons younger than 16 or to persons from zero car households
- School bus is available only for children older than 5 making School tours
- Pay modes are unavailable if no 'pay' route is used by the best pay path (inbound or outbound) for the MAZ pair
- HOV modes are unavailable if no HOV lanes are used by the best HOV path (inbound or outbound) for the MAZ pair
- Walk is unavailable if either the outbound or inbound walk time exceeds the maximum walk time (see Table 51)
- Bike is unavailable if the either the outbound or inbound bike time exceeds the maximum bike time (see Table 51)
- A transit mode is unavailable if the main ride mode is not observed in the best transit path for the mode
- The transit ride mode /access mode must be available both outbound and inbound for the mode to be available for the tour

The tour mode choice model contains a number of household and person attributes, including income, auto sufficiency, age, etc. Urban form variables are also important, particularly related to the choice of non-motorized modes. Various mode choice model parameters that are common to all tour purposes are shown in Table 51. The specification of the tour mode choice models is shown in Table 52 thru Table 54. These models were calibrated to match the share of tours by tour purpose, mode, car sufficiency and time period, and the number of transit tours by origin-destination district, when available. The calibration targets were derived from the 2009 NHTS and transit on-board surveys.

Table 51: Tour Mode Choice Model Parameters

Utility Term	Value
Auto operating cost, fuel	13.50 cents/mi
Auto operating cost, maintenance	6.30 cents/mi
Divisor for parking and toll cost sharing, SR2 tours	1.11
Divisor for parking and toll cost sharing, SR3+ tours	1.25
Maximum walk mode time	60 min
Maximum bike mode time	60 min
Maximum transit time (at-work sub-tours)	120 min
Drive access speed (for cost calculation)	35 mph
Terminal time	
Nesting coefficient, transit ride mode and auto mode	0.40
Nesting coefficient, transit access and auto occupancy	0.60

Table 52: Work Tour and At-Work Sub-Tour Mode Choice Model Specification

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
In vehicle time	-0.016		-0.032	
In vehicle time factor, express bus	0.90		0.90	
In vehicle time factor, BRT	0.90		0.90	
In vehicle time factor, light rail	0.85		0.85	
In vehicle time factor, commuter rail	0.75		0.75	
First wait time	-0.024	1.5	-0.048	1.5
Transfer wait time	-0.024	1.5	-0.048	1.5
Transfer penalty, PNR Transit	-0.240	15 min	-0.480	15 min
Walk access time	-0.030	1.9	-0.064	2.0
Walk egress time	-0.030	1.9	-0.064	2.0
Walk transfer time	-0.030	1.9	-0.064	2.0
Drive access time	-0.030	1.9	-0.064	2.0
Walk mode time	-0.059	3.7	-0.074	2.3
Bike mode time	-0.049	3.1	-0.074	2.3
Cost			-0.0020	$9.6
Household income < $30k	-0.00266	$3.6		
Household income $30k-$60k	-0.00118	$8.1		
Household income $60k - $100k	-0.00072	$13.3		
Household income > $100k	-0.00032	$30.0		
Short tour penalty[1], PNR Transit	1.0		1.0	
Short tour penalty[1], KNR Transit	1.0		1.0	
Origin MAZdwelling unit / employment mix density, non-motorized[2]	0.2101		0.2140	
Origin MAZ intersections, non-motorized[3]	0.0030			
Destination MAZ employment density, non-motorized[4]	0.0207			
Priced parking destination constant, drive transit	0.72	45 min	1.44	45 min
Age 16 to 24				
Shared-ride 2	-0.2139			
Shared-ride 3+	-1.7902			
Non-motorized	0.3032			
Transit	0.7947			
Age 41 to 55				
Shared-ride 2	-0.3064			
Shared-ride 3+	-0.4102			
Non-motorized	-0.1775			
Transit	-0.4230		-1.1666	

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
Age 56 to 64				
Shared-ride 2	-1.0296			
Shared-ride 3+	-0.8564			
Non-motorized	-0.6453			
Transit	-0.4499		-1.263	
Age 65 and older				
Shared-ride 2	-0.6711			
Shared-ride 3+	-1.4346			
Non-motorized	-1.4533			
Transit	-1.1231			
Female				
Shared-ride 2	0.5947			
Shared-ride 3+	0.8481			
Transit	0.1578			
Household size 2				
Shared-ride 2	1.0696			
Shared-ride 3+	-0.4673			
Household size 3				
Shared-ride 2	1.5802			
Shared-ride 3+	0.6546			
Household size 4+				
Shared-ride 2	1.6884			
Shared-ride 3+	1.4987			
Mode to work is Shared ride				
Drive alone			-0.8240	
Shared ride			2.4350	
Mode-Specific Constants				
Shared-Ride 2	-2.0836		-0.8750	
Shared-3+	-3.9470		-2.8110	
Walk	0.5215		-1.7990	
Bike	-3.8341		-3.0320	
Transit	-1.7080		-2.8470	
Express Bus	0.3200	-20 min	0.6400	-20 min
BRT	0.3200	-20 min	0.6400	-20 min
LRT	0.4800	-30 min	0.9600	-30 min
Commuter Rail	0.6400	-40 min	1.2800	-40 min
Drive Transit	-4.2364		n/a	
KNR Transit	0.3708		n/a	

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
Zero Car Household				
Shared-Ride 3+	2.1027		n/a	
Walk	1.4889		0.0000	
Bike	2.3922		n/a	
Walk-Transit	3.3550		-5.3651	
KNR-Transit	4.5907		n/a	
Auto Deficient Household(5)				
Shared-Ride 2	-0.0640		0.3104	
Shared-Ride 3+	1.8218		1.9881	
Walk	0.3012		2.1285	
Bike	0.9653		0.0000	
Walk-Transit	1.0077		0.1756	
PNR-Transit	3.8206		n/a	
KNR-Transit	3.1660		n/a	
Auto Sufficient Household(6)				
Shared-Ride 2	-0.2144		-0.2403	
Shared-Ride 3+	1.9592		1.3458	
Walk	-1.8831		2.3256	
Bike	-1.2979		-0.6346	
Walk-Transit	0.1141		0.5745	
PNR-Transit	3.5320		n/a	
KNR-Transit	2.3380		n/a	

(1) Short tour penalty: $-0.25 \times max[10 - distance\ to\ destination, 0]$
(2) Dwelling unit / employment mixed density: $(DU\ Den \times Emp\ Den)/(DU\ Den + Emp\ Den)$, where the densities are calculated over a 1/2 mile radius of the MAZ centroid
(3) Intersection density: total number of intersections within 1/2mile radius of the MAZ centroid
(4) Employment density: total employment density calculated over a 1/2mile radius of the MAZ centroid
(5) Auto deficient household: fewer adults than available cars
(6) Auto sufficient household: equal or more adults than available cars

Table 53: University and School Tour Mode Choice Model Specification

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
In vehicle time	-0.016		-0.010	
In vehicle time factor, express bus	0.90		0.90	
In vehicle time factor, BRT	0.90		0.90	
In vehicle time factor, light rail	0.85		0.85	
In vehicle time factor, commuter rail	0.75		0.75	
First wait time	-0.024	1.5	-0.015	1.5
Transfer wait time	-0.024	1.5	-0.015	1.5
Transfer penalty, PNR Transit	-0.240	15 min	-0.150	15 min
Walk access time	-0.035	2.2	-0.036	3.6
Walk egress time	-0.035	2.2	-0.036	2.0
Walk transfer time	-0.035	2.2	-0.036	2.0
Drive access time	-0.037	2.3	-0.016	1.6
Walk mode time	-0.064	4.0	-0.056	5.6
Bike mode time	-0.055	3.4	-0.083	8.3
Cost	-0.00126	$7.6		
Household income < $30k			-0.01084	$0.6
Household income $30k-$60k			-0.00450	$1.3
Household income $60k - $100k			-0.00313	$1.9
Household income > $100k			-0.00302	$2.0
Short tour penalty[1], PNR Transit	1.0		1.0	
Short tour penalty[1], KNR Transit	1.0		1.0	
Origin MAZdwelling unit / employment mix density, non-motorized[2]	0.1223			
Origin MAZ intersection density, non-motorized[3]	0.0091		0.0030	
Destination MAZ employment density, non-motorized[4]	0.0818			
Priced parking destination constant, drive transit	0.72	45 min	0.45	45 min
Age 1 to 5				
School bus			0.0000	
Non-motorized			-1.1622	
Transit			-6.5000	
Age 6 to 12				
School bus			1.4486	
Non-motorized			-0.5768	
Transit			-4.5987	

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
Age 13 to 15				
School bus			1.2965	
Non-motorized			0.6872	
Transit			-1.1834	
Age 16 to 24				
Transit	0.4612			
Female				
Shared-ride 2			0.3702	
Shared-ride 3+			0.3262	
Transit			0.6093	
Household size 2				
Shared-ride 2	1.8712			
Shared-ride 3+	1.8712			
Household size 3				
Shared-ride 2	1.8712		0.6681	
Shared-ride 3+	1.8712		0.6681	
Household size 4+				
Shared-ride 2	2.4263		0.4115	
Shared-ride 3+	2.4263		2.0972	
Mode-Specific Constants				
Shared-Ride 2	-2.5839		1.4700	
Shared-3+	-4.5926		-0.6200	
Walk	0.7559		4.1000	
Bike	-7.0855		-0.3800	
School bus			-0.6476	
Transit	1.6925		1.7700	
Express Bus	0.3200	-20 min	0.1996	-20 min
BRT	0.3200	-20 min	0.1996	-20 min
LRT	0.4800	-30 min	0.2994	-30 min
Commuter Rail	0.6400	-40 min	0.3991	-40 min
Drive Transit	-3.6716		-5.0400	
KNR Transit	0.0000		1.4700	
Zero Car Household				
Shared-Ride 3+	n/a		2.0993	
Walk	6.4453		3.3059	
Bike	n/a		0.0000	
Walk-Transit	2.2077		4.8660	
KNR-Transit	3.0520		1.6507	

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
School Bus			3.0020	
Auto Deficient Household[5]				
Shared-Ride 2	-0.3489		0.0956	
Shared-Ride 3+	1.4910		1.0936	
Walk	1.6921		0.6579	
Bike	3.2984		1.6980	
Walk-Transit	-0.5475		2.5162	
PNR-Transit	1.3433		6.6482	
KNR-Transit	1.4662		5.7772	
School Bus			1.4650	
Auto Sufficient Household[6]				
Shared-Ride 2	-0.3015		-1.6082	
Shared-Ride 3+	10343		-0.8676	
Walk	-2.7616		-3.1632	
Bike	2.2672		-1.5716	
Walk-Transit	-0.8393		-1.0982	
PNR-Transit	1.4843		3.0155	
KNR-Transit	1.3933		1.8082	
School Bus			-2.3698	

Footnotes – see Table 52.

Table 54: Maintenance and Discretionary Tour Mode Choice Model Specification

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
In vehicle time	-0.017		-0.015	
In vehicle time factor, express bus	0.90		0.90	
In vehicle time factor, BRT	0.90		0.90	
In vehicle time factor, light rail	0.85		0.85	
In vehicle time factor, commuter rail	0.75		0.75	
First wait time	-0.027	1.6	-0.023	1.5
Transfer wait time	-0.027	1.6	-0.023	1.5
Transfer penalty, PNR Transit	-0.255	15 min	-0.225	15 min
Walk access time	-0.024	1.4	-0.038	2.5
Walk egress time	-0.024	1.4	-0.038	2.5
Walk transfer time	-0.024	1.4	-0.038	2.5
Drive access time	-0.059	3.4	-0.017	1.1
Walk mode time	-0.074	4.3	-0.053	3.5
Bike mode time	-0.086	5.1	-0.099	6.6

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
Cost				
Household income < $30k	-0.00410	$2.5	-0.00370	$2.4
Household income $30k-$60k	-0.00180	$5.7	-0.00170	$5.3
Household income $60k - $100k	-0.00110	$9.3	-0.00100	$9.0
Household income > $100k	-0.00050	$20.4	-0.00040	$22.5
Short tour penalty[1], PNR Transit	1.0		1.0	
Short tour penalty[1], KNR Transit	1.0		1.0	
Origin MAZdwelling unit / employment mix density, non-motorized[2]	0.1456		0.1724	
Origin MAZ intersection density, non-motorized[3]			0.0057	
Priced parking destination constant, drive transit	0.765	45 min	0.675	45 min
Age 16 to 24				
Shared-ride 2			-0.5196	
Shared-ride 3+			-1.3163	
Non-motorized			-0.5557	
Transit	1.6211		1.0638	
Age 41 to 55				
Shared-ride 2	-0.8226		-1.0416	
Shared-ride 3+	-1.9355		-1.2104	
Non-motorized	-1.3415		-1.1497	
Transit	-1.3932		-0.4843	
Age 56 to 64				
Shared-ride 2	-0.9550		-0.8430	
Shared-ride 3+	-2.1678		-0.9650	
Non-motorized	-1.3422		-0.9781	
Transit	-1.4618		-1.0845	
Age 65 and older				
Shared-ride 2	-1.0622		-0.8944	
Shared-ride 3+	-2.1471		-1.1146	
Non-motorized	-2.3207		-1.6916	
Transit	-2.8650		-2.4983	
Female				
Shared-ride 2	0.3289		0.2620	
Shared-ride 3+	0.3426		0.2736	
Transit			-0.2331	

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
Household size 2				
Shared-ride 2			0.3530	
Shared-ride 3+	-1.6798		-0.9366	
Household size 3				
Shared-ride 2	0.4881		0.4127	
Shared-ride 3+	-1.3350		-0.7990	
Household size 4+				
Shared-ride 2	0.3082		0.7612	
Shared-ride 3+	0.5857		0.5781	
Mode-Specific Constants				
Shared-Ride 2	-0.1341		-0.5420	
Shared-3+	-1.5580		-1.6090	
Walk	2.9249		1.6746	
Bike	-3.0928		-2.3681	
Transit	-1.3766		0.9922	
Express Bus	0.3400	-20 min	0.3000	-20 min
BRT	0.3400	-20 min	0.3000	-20 min
LRT	0.5100	-30 min	0.4500	-30 min
Commuter Rail	0.6800	-40 min	0.6000	-40 min
Drive Transit	-5.7024		-5.1561	
KNR Transit	2.7480		0.8448	
Escort Tours				
Non-motorized	-1.2579			
Transit	-5.8388			
Joint Tours				
Zero Car Household				
Shared-Ride 3+	0.3151		0.0000	
Walk	0.7181		-0.0545	
Bike	0.5203		-1.9129	
Walk-Transit	-0.2565		-2.2143	
KNR-Transit	-1.3053		-6.5256	
Auto Deficient Household[5]				
Shared-Ride 2	0.0000		0.0000	
Shared-Ride 3+	-0.3972		-0.1838	
Walk	-3.4147		-2.8233	
Bike	-2.1551		-2.0856	
Walk-Transit	-3.1735		-3.4389	

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
PNR-Transit	-3.3489		-3.1331	
KNR-Transit	-3.5367		-3.3273	
Auto Sufficient Household[6]				
Shared-Ride 2	-0.7368		0.0000	
Shared-Ride 3+	0.5927		1.8242	
Walk	-4.2069		-0.7502	
Bike	-1.3491		-0.4147	
Walk-Transit	-3.7348		-2.3064	
PNR-Transit	-3.8025		-3.3648	
KNR-Transit	-5.0271		-3.5021	
Individual Tours				
Zero Car Household				
Shared-Ride 3+	1.4126		1.4712	
Walk	2.2064		0.0312	
Bike	1.8061		2.0006	
Walk-Transit	3.4758		3.0960	
KNR-Transit	1.6323		4.7775	
Auto Deficient Household[5]				
Shared-Ride 2	0.4671		-0.1273	
Shared-Ride 3+	1.5643		0.5652	
Walk	1.2404		0.4141	
Bike	2.6046		1.7458	
Walk-Transit	1.1419		-0.3732	
PNR-Transit	0.6200		2.3008	
KNR-Transit	0.6200		1.6310	
Auto Sufficient Household[6]				
Shared-Ride 2	0.0156		-0.0700	
Shared-Ride 3+	2.0132		1.3433	
Walk	-0.6665		-0.9512	
Bike	1.9844		1.2078	
Walk-Transit	-0.0486		-0.7378	
PNR-Transit	-0.4932		2.7431	
KNR-Transit	2.1963		1.2509	

Footnotes – see Table 52.

Table 55: Work Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	268,950	1,096,365	1,365,315	0	269,312	1,097,058	1,366,370
Shared 2	5,188	165,316	188,708	359,212	5,088	165,449	188,961	359,498
Shared 3+	2,982	62,710	85,332	151,025	3,011	62,790	85,479	151,279
Walk	4,301	17,845	3,481	25,627	4,546	18,264	3,683	26,493
Bike	1,871	446	3,289	5,606	1,917	552	3,442	5,911
Walk-Transit	30,957	30,495	13,450	74,902	30,928	31,420	13,547	75,896
PNR-Transit	0	3,491	12,348	15,839	0	3,362	12,403	15,765
KNR-Transit	931	3,077	2,536	6,544	1,004	3,312	2,569	6,884
School Bus	0	0	0	0	0	0	0	0
Total	46,230	552,330	1,405,510	2,004,070	46,493	554,460	1,407,143	2,008,095

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	57,269	1,140	2,152	60,560	55,524	1,054	2,027	58,605
Express Bus	6,697	2,432	764	9,893	3,683	2,348	522	6,553
Bus Rapid Transit	1,087	142	116	1,345	1,465	542	191	2,198
Urban Rail	8,762	9,164	2,558	20,484	14,410	9,172	3,111	26,693
Commuter Rail	1,087	2,961	955	5,003	813	2,649	1,034	4,496
Transit Total	74,902	15,839	6,544	97,284	75,896	15,765	6,884	98,545

Table 56: Work Tour Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	48.7%	78.0%	68.1%	0.0%	48.6%	78.0%	68.0%
Shared 2	11.2%	29.9%	13.4%	17.9%	10.9%	29.8%	13.4%	17.9%
Shared 3+	6.5%	11.4%	6.1%	7.5%	6.5%	11.3%	6.1%	7.5%
Walk	9.3%	3.2%	0.2%	1.3%	9.8%	3.3%	0.3%	1.3%
Bike	4.0%	0.1%	0.2%	0.3%	4.1%	0.1%	0.2%	0.3%
Walk-Transit	67.0%	5.5%	1.0%	3.7%	66.5%	5.7%	1.0%	3.8%
PNR-Transit	0.0%	0.6%	0.9%	0.8%	0.0%	0.6%	0.9%	0.8%
KNR-Transit	2.0%	0.6%	0.2%	0.3%	2.2%	0.6%	0.2%	0.3%
School Bus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	76.5%	7.2%	32.9%	62.3%	73.2%	6.7%	29.4%	59.5%
Express Bus	8.9%	15.4%	11.7%	10.2%	4.9%	14.9%	7.6%	6.6%
Bus Rapid Transit	1.5%	0.9%	1.8%	1.4%	1.9%	3.4%	2.8%	2.2%
Urban Rail	11.7%	57.9%	39.1%	21.1%	19.0%	58.2%	45.2%	27.1%
Commuter Rail	1.5%	18.7%	14.6%	5.1%	1.1%	16.8%	15.0%	4.6%
Transit Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 57: University Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	39,681	74,512	114,193	0	39,749	74,410	114,159
Shared 2	10	18,648	23,123	41,781	10	18,535	23,041	41,585
Shared 3+	10	15,483	19,113	34,607	0	15,635	19,127	34,762
Walk	4,417	7,881	2,197	14,496	3,432	8,440	2,378	14,250
Bike	2,484	718	220	3,422	2,990	692	201	3,884
Walk-Transit	3,616	5,855	2,166	11,637	4,084	5,700	2,127	11,912
PNR-Transit	0	316	660	977	0	401	712	1,114
KNR-Transit	73	556	388	1,017	70	472	341	883
School Bus	0	0	0	0	0	0	0	0
Total	10,610	89,140	122,380	222,130	10,587	89,624	122,338	222,549

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	8,815	210	435	9,460	9,192	311	371	9,875
Express Bus	742	3	18	764	472	151	90	712
Bus Rapid Transit	74	3	13	89	401	80	30	512
Urban Rail	1,879	503	379	2,762	1,766	432	281	2,479
Commuter Rail	127	258	172	556	80	140	110	331
Transit Total	11,637	977	1,017	13,631	11,912	1,114	883	13,909

Table 58: University Tour Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	44.5%	60.9%	51.4%	0.0%	44.4%	60.8%	51.3%
Shared 2	0.1%	20.9%	18.9%	18.8%	0.1%	20.7%	18.8%	18.7%
Shared 3+	0.1%	17.4%	15.6%	15.6%	0.0%	17.4%	15.6%	15.6%
Walk	41.6%	8.8%	1.8%	6.5%	32.4%	9.4%	1.9%	6.4%
Bike	23.4%	0.8%	0.2%	1.5%	28.2%	0.8%	0.2%	1.7%
Walk-Transit	34.1%	6.6%	1.8%	5.2%	38.6%	6.4%	1.7%	5.4%
PNR-Transit	0.0%	0.4%	0.5%	0.4%	0.0%	0.4%	0.6%	0.5%
KNR-Transit	0.7%	0.6%	0.3%	0.5%	0.7%	0.5%	0.3%	0.4%
School Bus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	75.8%	21.5%	42.8%	69.4%	77.2%	27.9%	42.0%	71.0%
Express Bus	6.4%	0.4%	1.8%	5.6%	4.0%	13.5%	10.2%	5.1%
Bus Rapid Transit	0.6%	0.3%	1.2%	0.7%	3.4%	7.2%	3.4%	3.7%
Urban Rail	16.1%	51.5%	37.3%	20.3%	14.8%	38.7%	31.8%	17.8%
Commuter Rail	1.1%	26.4%	16.9%	4.1%	0.7%	12.6%	12.5%	2.4%
Transit Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 59: School Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	0	16,180	16,180	0	432	16,227	16,658
Shared 2	759	27,910	114,041	142,710	773	27,938	114,410	143,121
Shared 3+	5,501	59,796	383,812	449,109	5,519	60,090	384,927	450,536
Walk	20,008	52,949	34,637	107,593	20,351	53,317	34,792	108,459
Bike	583	2,734	6,930	10,247	612	2,780	7,005	10,396
Walk-Transit	2,837	7,179	3,803	13,819	2,820	7,225	3,853	13,899
PNR-Transit	0	116	171	287	0	110	171	281
KNR-Transit	50	735	1,090	1,875	0	753	1,114	1,867
School Bus	11,993	61,571	121,476	195,041	11,821	61,616	121,676	195,113
Total	41,730	212,990	682,140	936,860	41,897	214,260	684,174	940,330

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	10,451	138	486	11,075	12,313	70	181	12,564
Express Bus	785	8	40	833	452	30	492	973
Bus Rapid Transit	177	2	22	201	271	40	201	512
Urban Rail	2,353	52	618	3,023	833	120	843	1,796
Commuter Rail	53	87	708	848	30	20	151	201
Transit Total	13,819	287	1,875	15,980	13,899	281	1,867	16,046

Table 60: School Tour Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	0.0%	2.4%	1.7%	0.0%	0.0%	2.4%	1.7%
Shared 2	1.8%	13.1%	16.7%	15.2%	1.8%	13.1%	16.7%	15.2%
Shared 3+	13.2%	28.1%	56.3%	47.9%	13.2%	28.1%	56.3%	47.9%
Walk	47.9%	24.9%	5.1%	11.5%	47.9%	24.9%	5.1%	11.5%
Bike	1.4%	1.3%	1.0%	1.1%	1.4%	1.3%	1.0%	1.1%
Walk-Transit	6.8%	3.4%	0.6%	1.5%	6.8%	3.4%	0.6%	1.5%
PNR-Transit	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
KNR-Transit	0.1%	0.3%	0.2%	0.2%	0.1%	0.3%	0.2%	0.2%
School Bus	28.7%	28.9%	17.8%	20.8%	28.7%	28.9%	17.8%	20.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	75.6%	48.1%	25.9%	69.3%	88.6%	25.0%	9.7%	78.3%
Express Bus	5.7%	2.7%	2.1%	5.2%	3.2%	10.7%	26.3%	6.1%
Bus Rapid Transit	1.3%	0.7%	1.2%	1.3%	1.9%	14.3%	10.8%	3.2%
Urban Rail	17.0%	18.1%	33.0%	18.9%	6.0%	42.9%	45.2%	11.2%
Commuter Rail	0.4%	30.4%	37.8%	5.3%	0.2%	7.1%	8.1%	1.3%
Transit Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 61: Maintenance Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	216,288	888,188	1,104,476	0	216,538	889,040	1,105,578
Shared 2	39,149	473,323	534,475	1,046,946	39,819	473,657	534,630	1,048,107
Shared 3+	46,195	228,384	323,359	597,938	47,205	228,133	323,161	598,499
Walk	105,854	103,341	172,018	381,213	105,479	101,927	169,503	376,909
Bike	961	4,766	15,263	20,990	973	4,807	15,173	20,953
Walk-Transit	24,535	17,017	9,918	51,470	24,747	16,708	9,784	51,239
PNR-Transit	0	1,088	1,539	2,627	0	0	0	0
KNR-Transit	1,106	1,083	929	3,119	1,134	1,004	863	3,000
School Bus	0	0	0	0	0	0	0	0
Total	217,800	1,045,290	1,945,690	3,208,780	219,357	1,042,773	1,942,155	3,204,285

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	41,139	843	1,675	43,657	43,301	0	1,606	44,907
Express Bus	3,788	116	452	4,356	973	0	90	1,064
Bus Rapid Transit	2,508	124	211	2,843	1,445	0	80	1,525
Urban Rail	3,784	979	417	5,180	4,977	0	853	5,830
Commuter Rail	250	565	365	1,180	542	0	371	913
Transit Total	51,470	2,627	3,119	57,216	51,239	0	3,000	54,240

Table 62: Maintenance Tour Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	20.7%	45.6%	34.4%	0.0%	20.8%	45.8%	34.5%
Shared 2	18.0%	45.3%	27.5%	32.6%	18.2%	45.4%	27.5%	32.7%
Shared 3+	21.2%	21.8%	16.6%	18.6%	21.5%	21.9%	16.6%	18.7%
Walk	48.6%	9.9%	8.8%	11.9%	48.1%	9.8%	8.7%	11.8%
Bike	0.4%	0.5%	0.8%	0.7%	0.4%	0.5%	0.8%	0.7%
Walk-Transit	11.3%	1.6%	0.5%	1.6%	11.3%	1.6%	0.5%	1.6%
PNR-Transit	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%
KNR-Transit	0.5%	0.1%	0.0%	0.1%	0.5%	0.1%	0.0%	0.1%
School Bus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	79.9%	32.1%	53.7%	76.3%	84.5%	0%	53.5%	82.8%
Express Bus	7.4%	4.4%	14.5%	7.6%	1.9%	0%	3.0%	2.0%
Bus Rapid Transit	4.9%	4.7%	6.8%	5.0%	2.8%	0%	2.7%	2.8%
Urban Rail	7.4%	37.3%	13.4%	9.1%	9.7%	0%	28.4%	10.7%
Commuter Rail	0.5%	21.5%	11.7%	2.1%	1.1%	0%	12.4%	1.7%
Transit Total	100.0%	100.0%	100.0%	100.0%	100.0%	0%	100.0%	100.0%

Table 63: Discretionary Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	93,630	357,340	450,970	0	93,838	358,705	452,543
Shared 2	22,921	207,278	239,166	469,364	23,281	207,536	239,949	470,767
Shared 3+	9,966	116,024	276,556	402,546	10,125	116,809	277,832	404,766
Walk	60,749	126,010	343,708	530,468	59,980	124,817	337,717	522,513
Bike	8,455	34,306	41,613	84,374	8,440	33,909	41,294	83,643
Walk-Transit	2,726	1,891	1,102	5,719	2,709	1,937	1,124	5,770
PNR-Transit	0	121	171	292	0	140	201	341
KNR-Transit	123	120	103	347	130	120	100	351
School Bus	0	0	0	0	0	0	0	0
Total	104,940	579,380	1,259,760	1,944,080	104,666	579,106	1,256,922	1,940,695

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	4,571	94	186	4,851	4,666	80	201	4,947
Express Bus	421	13	50	484	70	10	0	80
Bus Rapid Transit	279	14	23	316	100	40	0	140
Urban Rail	420	109	46	576	773	161	100	1,034
Commuter Rail	28	63	41	131	161	50	50	261
Transit Total	5,719	292	347	6,357	5,770	341	351	6,463

Table 64: Discretionary Tour Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	16.2%	28.4%	23.2%	0.0%	16.2%	28.5%	23.3%
Shared 2	21.8%	35.8%	19.0%	24.1%	22.2%	35.8%	19.1%	24.3%
Shared 3+	9.5%	20.0%	22.0%	20.7%	9.7%	20.2%	22.1%	20.9%
Walk	57.9%	21.7%	27.3%	27.3%	57.3%	21.6%	26.9%	26.9%
Bike	8.1%	5.9%	3.3%	4.3%	8.1%	5.9%	3.3%	4.3%
Walk-Transit	2.6%	0.3%	0.1%	0.3%	2.6%	0.3%	0.1%	0.3%
PNR-Transit	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KNR-Transit	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%
School Bus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	79.9%	32.1%	53.7%	76.3%	80.9%	23.5%	57.1%	76.6%
Express Bus	7.4%	4.4%	14.5%	7.6%	1.2%	2.9%	0.0%	1.2%
Bus Rapid Transit	4.9%	4.7%	6.8%	5.0%	1.7%	11.8%	0.0%	2.2%
Urban Rail	7.4%	37.3%	13.4%	9.1%	13.4%	47.1%	28.6%	16.0%
Commuter Rail	0.5%	21.5%	11.7%	2.1%	2.8%	14.7%	14.3%	4.0%
Transit Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 65: At-Work Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	10,613	110,683	121,296	0	10,045	108,439	118,485
Shared 2	0	11,924	29,776	41,700	0	11,651	28,510	40,161
Shared 3+	0	7,829	20,431	28,260	0	7,717	20,130	27,847
Walk	229	21,760	37,902	59,433	0	22,258	40,512	62,770
Bike	0	0	0	0	10	241	1,184	1,435
Walk-Transit	2,239	1,924	1,277	5,441	1,907	2,188	1,305	5,399
PNR-Transit	0	0	0	0	0	0	0	0
KNR-Transit	0	0	0	0	0	0	0	0
School Bus	0	0	0	0	0	0	0	0
Total	2,468	54,050	200,070	256,588	1,917	54,099	200,080	256,096

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	4,271	0	0	4,271	4,446	0	0	4,446
Express Bus	254	0	0	254	30	0	0	30
Bus Rapid Transit	96	0	0	96	151	0	0	151
Urban Rail	801	0	0	801	743	0	0	743
Commuter Rail	18	0	0	18	30	0	0	30
Transit Total	5,441	0	0	5,441	5,399	0	0	5,399

Table 66: At-Work Tour Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	19.6%	55.3%	47.4%	0.0%	18.6%	54.2%	46.3%
Shared 2	0.0%	22.1%	14.9%	16.3%	0.0%	21.5%	14.2%	15.7%
Shared 3+	0.0%	14.5%	10.2%	11.0%	0.0%	14.3%	10.1%	10.9%
Walk	11.4%	40.3%	18.9%	23.2%	0.0%	41.1%	20.2%	24.5%
Bike	0.0%	0.0%	0.0%	0.0%	0.5%	0.4%	0.6%	0.6%
Walk-Transit	88.6%	3.6%	0.6%	2.1%	99.5%	4.0%	0.7%	2.1%
PNR-Transit	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
KNR-Transit	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
School Bus	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	78.5%	0%	0%	78.5%	77.0%	0%	0%	68.8%
Express Bus	4.7%	0%	0%	4.7%	0.5%	0%	0%	0.5%
Bus Rapid Transit	1.8%	0%	0%	1.8%	2.6%	0%	0%	2.3%
Urban Rail	14.7%	0%	0%	14.7%	12.9%	0%	0%	11.5%
Commuter Rail	0.3%	0%	0%	0.3%	0.5%	0%	0%	0.5%
Transit Total	100.0%	0%	0%	100.0%	93.6%	0%	0%	83.5%

Table 67: All Tours by Tour Mode and Purpose

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0	629,162	2,543,269	3,172,431	0	629,914	2,543,880	3,173,794
Shared 2	68,025	904,398	1,129,290	2,101,713	68,971	904,765	1,129,502	2,103,238
Shared 3+	64,654	490,226	1,108,604	1,663,484	65,860	491,173	1,110,656	1,667,689
Walk	195,100	329,787	593,944	1,118,831	193,788	329,021	588,584	1,111,393
Bike	14,354	42,970	67,315	124,640	14,942	42,980	68,299	126,222
Walk-Transit	66,910	64,362	31,716	162,988	67,195	65,178	31,741	164,114
PNR-Transit	0	5,131	14,890	20,021	0	4,014	13,487	17,501
KNR-Transit	2,283	5,573	5,046	12,902	2,338	5,660	4,987	12,985
School Bus	11,993	61,571	121,476	195,041	11,821	61,616	121,676	195,113
Total	423,320	2,533,180	5,615,550	8,572,050	424,917	2,534,321	5,612,812	8,572,050

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	126,517	2,424	4,934	133,875	129,443	1,515	4,385	135,344
Express Bus	12,687	2,573	1,324	16,584	5,680	2,539	1,194	9,413
Bus Rapid Transit	4,221	284	385	4,890	3,833	702	502	5,038
Urban Rail	18,000	10,807	4,018	32,825	23,502	9,885	5,188	38,575
Commuter Rail	1,564	3,933	2,240	7,736	1,656	2,860	1,716	6,232
Transit Total	162,988	20,021	12,902	195,910	164,114	17,501	12,985	194,601

Table 68: Tour Mode Shares, Observed and Estimated

Tour Mode	Observed Tours				Estimated Tours			
	No Veh	Veh<Adult	Veh>=Adult	Total	No Veh	Veh<Adult	Veh>=Adult	Total
Drive-Alone	0.0%	24.8%	45.3%	37.0%	0.0%	24.9%	45.3%	37.0%
Shared 2	16.1%	35.7%	20.1%	24.5%	16.2%	35.7%	20.1%	24.5%
Shared 3+	15.3%	19.4%	19.7%	19.4%	15.5%	19.4%	19.8%	19.5%
Walk	46.1%	13.0%	10.6%	13.1%	45.6%	13.0%	10.5%	13.0%
Bike	3.4%	1.7%	1.2%	1.5%	3.5%	1.7%	1.2%	1.5%
Walk-Transit	15.8%	2.5%	0.6%	1.9%	15.8%	2.6%	0.6%	1.9%
PNR-Transit	0.0%	0.2%	0.3%	0.2%	0.0%	0.2%	0.2%	0.2%
KNR-Transit	0.5%	0.2%	0.1%	0.2%	0.6%	0.2%	0.1%	0.2%
School Bus	2.8%	2.4%	2.2%	2.3%	2.8%	2.4%	2.2%	2.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Transit Mode	Observed by Access Mode				Estimated by Access Mode			
	Walk	PNR	KNR	Total	Walk	PNR	KNR	Total
Local Bus	77.6%	12.1%	38.2%	68.3%	78.9%	8.7%	33.8%	69.5%
Express Bus	7.8%	12.8%	10.3%	8.5%	3.5%	14.5%	9.2%	4.8%
Bus Rapid Transit	2.6%	1.4%	3.0%	2.5%	2.3%	4.0%	3.9%	2.6%
Urban Rail	11.0%	54.0%	31.1%	16.8%	14.3%	56.5%	40.0%	19.8%
Commuter Rail	1.0%	19.6%	17.4%	3.9%	1.0%	16.3%	13.2%	3.2%
Transit Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Model 5.2—Intermediate Stop Frequency Model

Number of Models:	9 (By tour purpose plus one model for at-work subtours)
Decision-Making Unit:	Persons
Model Form:	Multinomial Logit
Alternatives:	16 (0-3 stops per direction)

The stop frequency choice model determines the number of intermediate stops on the way to/from the primary destination. The model incorporates the ability for more than one stop in each direction, up to a maximum of 3, for a total of 8 trips per tour (four on each tour leg). Thus, the total number of alternatives is 16, corresponding of 4 stop choices on the outbound leg combined with up 4 stop choices on the inbound leg. No intermediate stops are allowed on drive-transit tours to ensure that drivers who drive to transit pick up their cars at the end of the tour.

Stop frequency is based on a number of explanatory variables, including household and person attributes, the duration of the tour (with longer durations indicating the potential for more stop-making), the distance from the tour anchor to the primary destination (with intermediate stop-making positively correlated to tour distance), and accessibility and urban form variables. The specification of the intermediate stop frequency model is shown in Table 69 to Table 72. These models were calibrated to match the distribution of tours by number of stops by tour purpose by tour direction (outbound/inbound). Calibration targets and corresponding model estimates are shown in Table 73 and Table 74. The calibration targets were derived from the 2009 NHTS.

Once the number of intermediate stops is determined, each intermediate stop is assigned a purpose based on a frequency distribution created from observed data. The distribution is segmented by tour purpose, tour direction (outbound versus return) and person type. Work tours are also segmented by departure or arrival time period. Due to the small number of observations available in the NHTS dataset to develop these distributions, the stop purpose frequency distributions were borrowed from SANDAG. The stop purpose frequency distributions are given in Table 75 and Table 76.

Table 69: Intermediate Stop Frequency Model Specification -- Work, School, Shopping

	Tour Purpose		
	Work	**School**	**Shopping**
Number of observations	3266	1619	1362
Likelihood – Constants only	-4906	-1776	-2237
Final value of likelihood	-4773	-1596	-2022
Rho-Squared (0)	0.473	0.603	0.464
Rho-Squared (constant)	0.027	0.101	0.096

	Work		**School**		**Shopping**	
Explanatory Variable	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Constants						
outbound trip = 1	-1.748	-5.57	-5.541	-6.65	-1.863	-4.57
outbound trip = 2	-3.979	-7.51	-13.603	-8.59	-4.153	-6.20
outbound trip = 3	-6.068	-7.48	-18.069	-8.20	-6.586	-6.54
return trip = 1	-1.542	-7.13	-3.419	-5.77	-2.236	-8.12
return trip = 2	-3.426	-6.94	-8.514	-6.45	-4.640	-7.38
return trip = 3	-4.679	-6.18	-12.661	-6.07	-6.699	-7.03
total number of stops = 1	-0.355	-1.48	0.240	0.40	0.053	0.16
total number of stops = 2	0.900	1.84	1.263	1.20	0.427	0.87
for total number of stops = 3+	1.615	2.20	4.889	2.76	1.765	2.23
total number of stops = 4	2.696	2.70	8.038	3.10	3.516	3.16
total number of stops = 5	3.989	3.18	N/A	N/A	3.659	2.38
total number of stops = 6	5.005	3.17	N/A	N/A	7.127	3.93
Number of full-time workers other than traveler in household						
total number of stops = 1	-0.237	-3.47			-0.260	-2.58
total number of stops = 2+	-0.382	-4.75			-0.454	-3.58
Number of part-time workers						
total number of stops = 1	-0.323	-2.81				
total number of stops = 2	-0.446	-3.02				
for total number of stops = 3+	-0.465	-2.92				
Number of non-workers						
total number of stops = 1	-0.533	-4.07	-0.351	-2.20		
total number of stops = 2+	-0.851	-5.42	-0.285	-1.42		
Number of non-workers other than traveler in household						
total number of stops = 1					-0.301	-1.81
total number of stops = 2+					-1.226	-4.82
Number of children in household						
total number of stops = 1	0.171	4.00	-0.050	-0.64		
total number of stops = 2	0.331	6.14	0.386	4.92		
for total number of stops = 3+	0.351	5.93	1.102	7.19		
Traveler a full -time worker						
total number of stops = 1	-0.670	-4.04			0.000	
total number of stops = 2+	-1.249	-7.06			-0.222	-0.91

Explanatory Variable	Work		School		Shopping	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Traveler a preschool child						
total number of stops = 1			0.400	2.22		
total number of stops = 2			0.852	3.54		
for total number of stops = 3+			1.012	3.45		
Number of school tours per person						
total number of stops = 1+			0.478	1.44		
Number of shopping tours (individual + joint) per person						
total number of stops = 1+					-0.177	-0.97
Household income (<30K)						
total number of stops = 1+	-0.344	-2.38	-0.386	-1.97	-0.488	-2.72
Household income (30-100K)						
total number of stops = 1+	-0.135	-1.72			-0.198	-1.26
SOV Off peak trip distance to destination						
total number of stops = 1	0.090					
total number of stops = 2+	0.090					
SOV travel distance to usual school location						
total number of stops = 1			0.029	2.26		
total number of stops = 2			0.029	2.26		
total number of stops = 3			0.051	2.44		
total number of stops = 4+			0.079	2.14		
Tour duration						
total number of stops = 1	0.103	7.27	0.184	4.96	0.570	9.53
total number of stops = 2+	0.116	7.30	0.425	9.41	0.916	14.08
Tour mode is transit						
total number of stops = 1	-0.652	-3.24	-0.589	-1.28	-0.390	-1.21
total number of stops = 2+	-0.856	-3.60	-0.933	-1.49	-2.404	-4.98
Tour mode is school bus						
total number of stops = 1			-1.035	-3.99		
total number of stops = 2+			-1.035	-3.99		
Tour mode is non-motorized						
total number of stops = 1	-1.357	-3.41	-2.151	-5.07	0.000	
total number of stops = 2+	-1.471	-3.15	-3.441	-3.39	-1.592	-2.65
Joint tour indicator						
total number of stops = 1					0.172	0.64
total number of stops = 2+					0.172	0.64

Table 70: Intermediate Stop Frequency Model Specification -- Escorting, Maintenance, Discretionary

	Tour Purpose		
	Escorting	**Maintenance**	**Discretionary**
Number of Observations	1413	1360	1237
Likelihood – Constants only	-1506	-1893	-1291
Final value of likelihood	-1329	-1786	-1157
Rho-Squared (0)	0.661	0.526	0.663
Rho-Squared (constant)	0.117	0.056	0.104

	Escorting		**Maintenance**		**Discretionary**	
Utility Terms	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Constants						
outbound trip = 1	-5.774	-8.50	-5.843	-7.33	-6.628	-4.89
outbound trip = 2	-10.204	-9.59	-11.220	-7.44	-13.612	-5.17
outbound trip = 3	-14.464	-9.28	-16.256	-7.18	-20.665	-5.24
return trip = 1	-4.257	-9.99	-4.684	-6.57	-6.394	-5.01
return trip = 2	-9.739	-9.64	-10.142	-6.88	-12.930	-4.98
return trip = 3	-13.918	-9.24	-15.309	-6.88	-20.392	-5.21
total number of stops = 1	0.930	1.70	0.607	1.60	-0.425	-0.89
total number of stops = 2	3.346	4.58	4.032	4.70	4.618	3.25
for total number of stops = 3	7.212	5.96	8.366	5.25	10.667	3.93
total number of stops = 4	10.655	6.26	12.892	5.52	16.553	4.12
total number of stops = 5	14.937	6.49	17.433	5.62	23.605	4.43
total number of stops = 6	18.751	6.45	21.315	5.38	29.384	4.38
Number of full-time workers other than traveler in household						
total number of stops = 1			-0.350	-3.62		
total number of stops = 2+			-0.350	-3.62		
Number of part-time workers other than traveler in household						
total number of stops = 1+			-0.549	-2.92		
Number of children in household						
total number of stops = 1					0.230	3.98
total number of stops = 2					0.230	3.98
for total number of stops = 3+					0.230	3.98
Number of maintenance tours (individual + joint) per person						
total number of stops = 1			0.000			
total number of stops = 2+			-0.132	-1.13		
Number of other tours besides Maintenance tours per person						
total number of stops = 1+			0.010	0.12		
Number of other tours besides work and discretionary tours per person						
total number of stops = 1					0.000	
total number of stops = 2+					-0.114	-0.63

Utility Terms	Escorting		Maintenance		Discretionary	
	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Number of escorting tours per person						
total number of stops = 1	-0.148	-1.22				
total number of stops = 2+	-0.229	-1.35				
Number of tours made by other household members						
total number of stops = 3+	-0.081	-1.53				
Household income (<30K)						
total number of stops = 1+	-0.574	-2.59				
SOV Off peak trip distance to destination						
total number of stops = 1					-0.019	-1.47
total number of stops = 2+					0.005	0.38
SOV maintenance accessibility from home (destination accessibility terms 31-33)						
total number of stops = 1+			0.140	2.63		
SOV Discretionary Accessibility from Home (destination accessibility terms (40-42)						
total number of stops = 1+					0.186	2.14
Tour duration						
total number of stops = 1	0.989	10.41	0.241	7.38	0.547	9.74
total number of stops = 2+	1.346	13.15	0.374	11.61	0.666	11.14
Tour mode is transit						
total number of stops = 1					-0.851	-1.07
total number of stops = 2+					-0.851	-1.07
Tour mode is auto/taxi						
total number of stops = 1	1.939	4.78	0.857	3.76		
total number of stops = 2+	1.939	4.78				
Joint tour indicator						
total number of stops = 1	-0.399	-2.32	-0.225	-1.35	-0.206	-1.10
total number of stops = 2+	0.000		0.000		-0.555	-2.16

Table 71: Intermediate Stop Frequency Model Specification -- University, Eating, Visiting

	Tour Purpose		
	University	**Eating**	**Visiting**
Observations:	245	149	392
Likelihood – Constants only	-269.9	-85.4	-452.9
Final value of likelihood:	-298.8	-84.5	-469.1
Rho-Squared (0):	0.560	0.795	0.568
Rho-Squared (constant):	-0.107	0.011	-0.036

	University		**Eating**		**Visiting**	
Utility Terms	Coefficient	t-stat.	Coefficient	t-stat.	Coefficient	t-stat.
Constants						
outbound trip = 1+	-1.248	-2.88	-1.888	-1.58	-1.323	-4.00
return trip = 1+	-2.187	-8.23	-3.440	-5.85	-2.212	-10.80
total number of stops = 1+	-1.819	-4.55	-1.783	-1.55	-1.579	-4.67
Number of children in household						
total number of stops = 1+					0.032	0.39
Traveler a Non Worker						
total number of stops = 1+	1.152	1.17				
Traveler a non-traditional college student (age > 30)						
total number of stops = 1+	0.643	2.18				
Number of other tours besides eating out tours per person						
total number of stops = 1+			-0.890	-2.28		
Number of other tours besides visiting tours per person						
total number of stops = 1+					-0.511	-3.06
Household Income (<30K)						
total number of stops = 1+					-0.935	-1.97
SOV Off peak trip distance to destination						
total number of stops = 1					0.000	
total number of stops = 2+					0.029	2.22
Tour duration						
total number of stops = 1+	0.022	0.55	0.537	3.51	0.202	4.61
Tour mode is transit						
total number of stops = 1+	-0.523	-1.26			-0.244	-0.38
Tour mode is non-motorized						
total number of stops = 1+	-1.238	-1.52			-1.250	-1.99
Tour mode is auto/taxi						
total number of stops = 1			0			
total number of stops = 2+			-1.194	-2.00		
Joint tour indicator						
total number of stops = 1					0	
total number of stops = 2+					-1.045	-3.224

Table 72: Intermediate Stop Frequency Model Specification, At-Work Subtours

Number of Observations:	507
Likelihood, constants only:	-288.0
Final Likelihood:	-260.5
Rho-squared, zero:	0.815
Rho-squared, constants:	0.095

	At Work Sub Tour	
Utility Terms	Coefficient	t-statistic
Constants		
outbound trip = 1	-0.179	-0.17
outbound trip = 2+	-5.167	-3.25
return trip = 1	-3.050	-6.10
return trip = 2+	-4.713	-3.62
total number of stops = 1	-2.828	-2.40
total number of stops = 2	-0.089	-0.08
total number of stops = 3+	-0.522	-0.29
Number of children in household, 1+ stops	0.319	2.16
Traveler a full-time worker, 1+ stops	-0.845	-1.81
Household income (<30K), 1+ stops	-1.364	-1.27
Household income (30-100K), 1+ stops	-0.597	-1.95
Number of non-work tours per person, 2+ stops	-1.202	-1.19
Number of tours made by other household members, 2+ stops	-0.338	-1.83
At work sub tour purpose dummy, 1+ stops	0.668	1.96
Tour duration, 1+ stops	0.471	4.69

Table 73: Intermediate Stop Frequency by Tour Purpose, Observed

Target Stop Frequency Share	Purpose										
Stop Frequency	**Work**	**Univ.**	**School**	**Escort**	**Shop**	**Maint.**	**Eating Out**	**Visiting**	**Disc.**	**Work-Based**	**Total**
0 out, 0 in	52.57%	66.68%	73.64%	75.12%	52.35%	66.08%	73.64%	78.57%	87.64%	87.70%	**69.4%**
0 out, 1 in	13.92%	10.66%	15.64%	12.27%	12.04%	17.13%	4.80%	7.53%	3.44%	5.37%	**11.6%**
0 out, 2 in	6.32%	1.48%	2.91%	7.12%	3.57%	5.41%	2.41%	0.91%	0.74%	1.61%	**3.3%**
0 out, 3 in	0.73%	0.81%	1.89%	0.44%	1.31%	2.33%	3.98%	1.00%	0.22%	2.00%	**1.3%**
1 out, 0 in	9.25%	11.58%	2.24%	1.19%	11.98%	5.86%	10.16%	6.83%	3.00%	0.23%	**6.6%**
1 out, 1 in	7.10%	4.37%	1.19%	0.12%	4.43%	1.37%	1.24%	0.07%	1.18%	2.00%	**2.5%**
1 out, 2 in	3.20%	1.50%	0.32%	0.62%	1.05%	0.27%	0.23%	0.51%	0.04%	0.60%	**1.0%**
1 out, 3 in	0.24%	0.40%	0.20%	0.30%	0.47%	0.20%	0.37%	0.25%	1.00%	0.00%	**0.2%**
2 out, 0 in	3.19%	1.39%	0.31%	0.11%	6.19%	0.19%	1.57%	3.24%	0.39%	0.20%	**1.8%**
2 out, 1 in	1.16%	0.00%	0.65%	1.00%	4.44%	0.69%	0.56%	0.54%	0.70%	0.00%	**1.2%**
2 out, 2 in	0.84%	0.00%	0.62%	0.05%	0.37%	0.15%	0.32%	0.30%	0.17%	0.00%	**0.4%**
2 out, 3 in	0.17%	0.00%	0.00%	0.20%	0.24%	0.03%	0.63%	0.00%	0.20%	0.00%	**0.1%**
3 out, 0 in	0.87%	0.00%	0.38%	0.80%	0.84%	0.05%	0.08%	0.15%	0.18%	0.30%	**0.5%**
3 out, 1 in	0.37%	1.14%	0.01%	0.50%	0.10%	0.04%	0.00%	0.10%	0.20%	0.00%	**0.1%**
3 out, 2 in	0.07%	0.00%	0.00%	0.10%	0.10%	0.10%	0.00%	0.00%	0.80%	0.00%	**0.0%**
3 out, 3 in	0.00%	0.00%	0.00%	0.07%	0.50%	0.10%	0.00%	0.00%	0.10%	0.00%	**0.0%**

Table 74: Intermediate Stop Frequency by Tour Purpose, Estimated

Model Stop Frequency Share	Purpose										
Stop Frequency	**Work**	**Univ.**	**School**	**Escort**	**Shop**	**Maint.**	**Eating Out**	**Visiting**	**Disc.**	**Work-Based**	**Total**
0 out, 0 in	52.10%	67.51%	74.34%	75.37%	53.06%	65.78%	74.73%	83.52%	90.67%	90.89%	**67.6%**
0 out, 1 in	14.01%	10.62%	15.38%	12.38%	11.56%	17.44%	4.72%	5.89%	2.83%	4.20%	**11.5%**
0 out, 2 in	6.51%	1.39%	2.70%	6.96%	3.57%	5.30%	2.37%	0.66%	0.51%	1.17%	**4.0%**
0 out, 3 in	0.76%	0.92%	1.90%	0.43%	1.30%	2.30%	4.66%	0.89%	0.15%	1.40%	**1.3%**
1 out, 0 in	9.17%	12.03%	2.28%	1.16%	11.81%	6.00%	9.69%	5.13%	2.39%	0.16%	**6.5%**
1 out, 1 in	7.27%	4.55%	1.11%	0.13%	4.36%	1.40%	1.20%	0.04%	0.84%	1.45%	**3.0%**
1 out, 2 in	3.29%	1.43%	0.27%	0.63%	1.01%	0.30%	0.37%	0.35%	0.03%	0.39%	**1.1%**
1 out, 3 in	0.22%	0.00%	0.18%	0.28%	0.49%	0.20%	0.00%	0.23%	0.71%	0.00%	**0.3%**
2 out, 0 in	3.13%	1.54%	0.33%	0.12%	6.14%	0.20%	1.54%	2.51%	0.27%	0.15%	**2.0%**
2 out, 1 in	1.17%	0.00%	0.60%	0.91%	4.48%	0.59%	0.64%	0.37%	0.45%	0.00%	**1.3%**
2 out, 2 in	0.89%	0.00%	0.54%	0.04%	0.40%	0.16%	0.00%	0.25%	0.11%	0.00%	**0.4%**
2 out, 3 in	0.18%	0.00%	0.00%	0.16%	0.25%	0.01%	0.00%	0.00%	0.13%	0.00%	**0.1%**
3 out, 0 in	0.88%	0.00%	0.35%	0.77%	0.83%	0.05%	0.08%	0.09%	0.14%	0.19%	**0.5%**
3 out, 1 in	0.31%	0.00%	0.01%	0.49%	0.11%	0.04%	0.00%	0.07%	0.13%	0.00%	**0.2%**
3 out, 2 in	0.06%	0.00%	0.00%	0.09%	0.12%	0.09%	0.00%	0.00%	0.55%	0.00%	**0.1%**
3 out, 3 in	0.04%	0.00%	0.00%	0.06%	0.52%	0.12%	0.00%	0.00%	0.08%	0.00%	**0.1%**

Table 75: Stop Purpose Frequency Distribution, Outbound Tour Leg

Primary Purpose	Time	Person Type	Stop Purpose									
			Work	University	School	Escort	Shop	Other Maint.	Eating Out	Visiting	Other Disc.	Total
Work	Before 9 AM	FT Worker	19.8%	0.4%	0.0%	46.6%	8.3%	8.6%	9.3%	0.4%	6.6%	100.0%
Work	Before 9 AM	PT Worker	9.4%	0.0%	0.0%	65.7%	7.6%	7.0%	6.7%	0.9%	2.7%	100.0%
Work	Before 9 AM	University Student	6.7%	8.1%	0.0%	43.3%	0.5%	3.8%	15.3%	10.8%	11.5%	100.0%
Work	9 AM and Later	FT Worker	27.8%	0.8%	0.0%	17.2%	18.0%	19.3%	10.7%	1.6%	4.6%	100.0%
Work	9 AM and Later	PT Worker	44.2%	0.0%	0.0%	8.9%	10.5%	17.5%	10.2%	3.0%	5.7%	100.0%
Work	9 AM and Later	University Student	4.9%	8.6%	0.0%	39.2%	15.9%	15.7%	6.9%	7.3%	1.5%	100.0%
University	Any	FT Worker	52.6%	17.8%	0.0%	1.6%	16.0%	3.5%	2.8%	5.7%	0.0%	100.0%
University	Any	PT Worker	5.9%	94.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%
University	Any	University Student	10.9%	3.4%	0.0%	38.2%	13.6%	14.7%	9.4%	4.8%	5.0%	100.0%
School	Any	Driving Age Child	0.0%	0.0%	0.0%	54.8%	1.5%	10.0%	20.6%	7.3%	5.8%	100.0%
School	Any	Pre-Driving Child	0.0%	0.0%	0.0%	53.0%	2.5%	8.4%	11.2%	4.8%	20.1%	100.0%
School	Any	Preschool Child	0.0%	0.0%	0.0%	77.2%	0.7%	8.6%	2.3%	7.1%	4.1%	100.0%
Escort	Any	FT Worker	0.0%	0.0%	0.0%	55.0%	15.3%	8.4%	10.4%	4.9%	6.0%	100.0%
Escort	Any	PT Worker	0.0%	0.0%	0.0%	44.9%	19.4%	7.0%	16.7%	5.9%	6.1%	100.0%
Escort	Any	University Student	0.0%	0.0%	0.0%	50.9%	19.3%	15.8%	4.8%	5.8%	3.4%	100.0%
Escort	Any	Homemaker	0.0%	0.0%	0.0%	44.4%	21.6%	8.4%	10.8%	11.8%	3.0%	100.0%
Escort	Any	Retired	0.0%	0.0%	0.0%	37.0%	20.4%	19.2%	3.0%	6.8%	13.6%	100.0%
Escort	Any	Driving-age child	0.0%	0.0%	0.0%	58.6%	22.7%	0.0%	7.2%	11.5%	0.0%	100.0%
Escort	Any	Pre-driving child	0.0%	0.0%	0.0%	37.0%	18.3%	29.0%	6.4%	1.3%	8.0%	100.0%
Escort	Any	Preschool	0.0%	0.0%	0.0%	53.1%	6.4%	0.0%	13.1%	19.6%	7.8%	100.0%
Shop	Any	FT Worker	0.0%	0.0%	0.0%	10.2%	45.6%	22.6%	11.0%	6.0%	4.6%	100.0%
Shop	Any	PT Worker	0.0%	0.0%	0.0%	18.2%	29.1%	31.1%	10.8%	3.1%	7.7%	100.0%
Shop	Any	University Student	0.0%	0.0%	0.0%	13.0%	26.2%	36.0%	12.4%	6.0%	6.4%	100.0%
Shop	Any	Homemaker	0.0%	0.0%	0.0%	14.4%	33.6%	27.4%	12.2%	6.8%	5.6%	100.0%
Shop	Any	Retired	0.0%	0.0%	0.0%	5.8%	35.7%	41.8%	5.0%	4.7%	7.0%	100.0%
Shop	Any	Driving-age child	0.0%	0.0%	0.0%	7.6%	19.3%	29.8%	4.7%	13.0%	25.6%	100.0%
Shop	Any	Pre-driving child	0.0%	0.0%	0.0%	12.1%	14.2%	23.2%	29.1%	3.0%	18.4%	100.0%
Shop	Any	Preschool	0.0%	0.0%	0.0%	13.8%	29.2%	30.1%	18.7%	6.4%	1.8%	100.0%
Maintenance	Any	FT Worker	0.0%	0.0%	0.0%	20.1%	25.2%	36.6%	11.7%	3.2%	3.2%	100.0%
Maintenance	Any	PT Worker	0.0%	0.0%	0.0%	27.0%	25.9%	32.5%	10.9%	0.0%	3.7%	100.0%
Maintenance	Any	University Student	0.0%	0.0%	0.0%	48.9%	13.0%	16.7%	2.5%	15.0%	3.9%	100.0%

Primary Purpose	Time	Person Type	Stop Purpose									
			Work	University	School	Escort	Shop	Other Maint.	Eating Out	Visiting	Other Disc.	Total
Maintenance	Any	Homemaker	0.0%	0.0%	0.0%	27.9%	22.9%	34.4%	7.8%	3.9%	3.1%	100.0%
Maintenance	Any	Retired	0.0%	0.0%	0.0%	22.4%	13.9%	32.1%	9.8%	6.4%	15.4%	100.0%
Maintenance	Any	Driving-age child	0.0%	0.0%	0.0%	13.5%	0.0%	25.9%	8.3%	52.3%	0.0%	100.0%
Maintenance	Any	Pre-driving child	0.0%	0.0%	0.0%	19.1%	40.8%	34.4%	4.1%	0.8%	0.8%	100.0%
Maintenance	Any	Preschool	0.0%	0.0%	0.0%	14.3%	30.1%	46.4%	1.7%	2.9%	4.6%	100.0%
Eating Out	Any	FT Worker	0.0%	0.0%	0.0%	14.4%	28.3%	20.2%	3.6%	12.9%	20.6%	100.0%
Eating Out	Any	PT Worker	0.0%	0.0%	0.0%	16.9%	37.4%	17.9%	1.3%	13.5%	13.0%	100.0%
Eating Out	Any	University Student	0.0%	0.0%	0.0%	32.0%	8.5%	11.1%	0.0%	15.3%	33.1%	100.0%
Eating Out	Any	Homemaker	0.0%	0.0%	0.0%	20.1%	22.4%	26.9%	6.3%	8.2%	16.1%	100.0%
Eating Out	Any	Retired	0.0%	0.0%	0.0%	14.2%	23.7%	23.7%	3.4%	12.3%	22.7%	100.0%
Eating Out	Any	Driving-age child	0.0%	0.0%	0.0%	17.5%	28.9%	34.6%	0.0%	10.5%	8.5%	100.0%
Eating Out	Any	Pre-driving child	0.0%	0.0%	0.0%	12.4%	13.5%	13.5%	4.0%	4.8%	51.8%	100.0%
Eating Out	Any	Preschool	0.0%	0.0%	0.0%	5.5%	32.9%	16.5%	6.1%	0.0%	39.0%	100.0%
Visiting	Any	FT Worker	0.0%	0.0%	0.0%	18.6%	38.2%	14.4%	12.2%	12.6%	4.0%	100.0%
Visiting	Any	PT Worker	0.0%	0.0%	0.0%	17.5%	15.3%	16.7%	14.7%	18.3%	17.5%	100.0%
Visiting	Any	University Student	0.0%	0.0%	0.0%	0.0%	21.2%	9.1%	43.2%	23.4%	3.1%	100.0%
Visiting	Any	Homemaker	0.0%	0.0%	0.0%	31.1%	39.2%	14.9%	7.1%	5.8%	1.9%	100.0%
Visiting	Any	Retired	0.0%	0.0%	0.0%	12.0%	40.7%	20.3%	15.1%	10.2%	1.7%	100.0%
Visiting	Any	Driving-age child	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	41.5%	58.5%	100.0%
Visiting	Any	Pre-driving child	0.0%	0.0%	0.0%	32.2%	11.0%	5.0%	0.0%	37.8%	14.0%	100.0%
Visiting	Any	Preschool	0.0%	0.0%	0.0%	29.4%	0.0%	15.9%	0.0%	54.7%	0.0%	100.0%
Discretionary	Any	FT Worker	0.0%	0.0%	0.0%	23.6%	16.9%	14.3%	19.0%	9.3%	16.9%	100.0%
Discretionary	Any	PT Worker	0.0%	0.0%	0.0%	22.3%	20.8%	18.1%	19.3%	12.9%	6.6%	100.0%
Discretionary	Any	University Student	0.0%	0.0%	0.0%	13.5%	12.3%	6.1%	34.2%	12.3%	21.6%	100.0%
Discretionary	Any	Homemaker	0.0%	0.0%	0.0%	26.3%	29.5%	14.8%	8.8%	8.2%	12.4%	100.0%
Discretionary	Any	Retired	0.0%	0.0%	0.0%	22.5%	5.6%	38.9%	16.0%	9.1%	7.9%	100.0%
Discretionary	Any	Driving-age child	0.0%	0.0%	0.0%	31.1%	12.6%	5.1%	1.8%	14.2%	35.2%	100.0%
Discretionary	Any	Pre-driving child	0.0%	0.0%	0.0%	22.2%	11.2%	17.2%	17.3%	14.1%	18.0%	100.0%
Discretionary	Any	Preschool	0.0%	0.0%	0.0%	27.1%	10.8%	39.3%	14.6%	4.3%	3.9%	100.0%
Work-Based	All	All	20.6%	0.0%	0.0%	12.2%	16.6%	24.7%	24.1%	0.4%	1.4%	100.0%

Table 76: Stop Purpose Frequency Distribution, Return Tour Leg

Tour Purpose	Time	Person Type	Stop Purpose									
			Work	University	School	Escort	Shop	Other Maint.	Eating Out	Visiting	Other Disc.	Total
Work	Before 3 PM	PT Worker	9.7%	0.0%	0.0%	25.2%	21.1%	19.2%	15.9%	8.9%	0.0%	100.0%
Work	Before 3 PM	University Student	13.4%	0.0%	0.0%	32.9%	11.4%	21.2%	16.9%	4.2%	0.0%	100.0%
Work	3 PM and Later	FT Worker	15.1%	1.1%	0.0%	20.1%	28.0%	12.7%	10.3%	3.5%	9.2%	100.0%
Work	3 PM and Later	PT Worker	11.0%	0.0%	0.0%	24.3%	28.1%	13.0%	11.9%	3.6%	8.1%	100.0%
Work	3 PM and Later	University Student	5.8%	12.7%	0.0%	22.4%	26.9%	7.9%	7.2%	10.8%	6.3%	100.0%
University	Any	FT Worker	35.2%	3.2%	0.0%	3.2%	14.6%	11.4%	17.7%	2.8%	11.9%	100.0%
University	Any	PT Worker	0.0%	0.0%	0.0%	82.2%	17.8%	0.0%	0.0%	0.0%	0.0%	100.0%
University	Any	University Student	5.4%	2.5%	0.0%	19.4%	20.9%	17.9%	15.9%	6.7%	11.3%	100.0%
School	Any	Driving Age Child	0.0%	0.0%	0.0%	30.1%	11.7%	9.8%	16.9%	18.6%	12.9%	100.0%
School	Any	Pre-Driving Child	0.0%	0.0%	0.0%	16.6%	15.8%	14.7%	12.2%	13.3%	27.4%	100.0%
School	Any	Preschool Child	0.0%	0.0%	0.0%	38.0%	14.8%	8.9%	14.6%	10.2%	13.5%	100.0%
Escort	Any	FT Worker	0.0%	0.0%	0.0%	34.3%	23.5%	11.4%	22.2%	3.9%	4.7%	100.0%
Escort	Any	PT Worker	0.0%	0.0%	0.0%	24.0%	29.8%	12.8%	15.7%	4.5%	13.2%	100.0%
Escort	Any	University Student	0.0%	0.0%	0.0%	19.5%	31.9%	28.7%	2.0%	2.7%	15.2%	100.0%
Escort	Any	Homemaker	0.0%	0.0%	0.0%	28.0%	32.5%	16.9%	10.3%	5.0%	7.3%	100.0%
Escort	Any	Retired	0.0%	0.0%	0.0%	31.0%	31.7%	7.3%	11.1%	11.2%	7.7%	100.0%
Escort	Any	Driving-age child	0.0%	0.0%	0.0%	0.0%	48.9%	0.0%	14.8%	36.3%	0.0%	100.0%
Escort	Any	Pre-driving child	0.0%	0.0%	0.0%	18.8%	25.9%	12.9%	20.2%	6.0%	16.2%	100.0%
Escort	Any	Preschool	0.0%	0.0%	0.0%	41.3%	21.5%	11.8%	21.1%	1.9%	2.4%	100.0%
Shop	Any	FT Worker	0.0%	0.0%	0.0%	9.1%	52.6%	15.9%	15.2%	4.7%	2.5%	100.0%
Shop	Any	PT Worker	0.0%	0.0%	0.0%	10.4%	55.3%	15.6%	10.5%	3.7%	4.5%	100.0%
Shop	Any	University Student	0.0%	0.0%	0.0%	10.0%	43.0%	6.4%	34.4%	0.3%	5.9%	100.0%
Shop	Any	Homemaker	0.0%	0.0%	0.0%	11.0%	52.8%	15.8%	12.2%	5.9%	2.3%	100.0%
Shop	Any	Retired	0.0%	0.0%	0.0%	5.2%	54.9%	15.9%	12.3%	6.0%	5.7%	100.0%
Shop	Any	Driving-age child	0.0%	0.0%	0.0%	11.8%	70.7%	0.0%	4.1%	13.4%	0.0%	100.0%
Shop	Any	Pre-driving child	0.0%	0.0%	0.0%	1.5%	19.0%	25.6%	15.7%	17.9%	20.3%	100.0%
Shop	Any	Preschool	0.0%	0.0%	0.0%	20.6%	17.2%	22.0%	20.2%	15.8%	4.2%	100.0%
Maintenance	Any	FT Worker	0.0%	0.0%	0.0%	17.1%	36.4%	21.5%	15.9%	2.9%	6.2%	100.0%
Maintenance	Any	PT Worker	0.0%	0.0%	0.0%	22.8%	36.5%	17.0%	13.0%	4.1%	6.6%	100.0%
Maintenance	Any	University Student	0.0%	0.0%	0.0%	4.6%	34.5%	19.2%	29.8%	6.0%	5.9%	100.0%
Maintenance	Any	Homemaker	0.0%	0.0%	0.0%	17.0%	42.3%	15.8%	17.1%	6.4%	1.4%	100.0%
Maintenance	Any	Retired	0.0%	0.0%	0.0%	9.9%	39.1%	21.3%	24.1%	3.6%	2.0%	100.0%

Tour Purpose	Time	Person Type	Stop Purpose									
			Work	University	School	Escort	Shop	Other Maint.	Eating Out	Visiting	Other Disc.	Total
Maintenance	Any	Driving-age child	0.0%	0.0%	0.0%	3.1%	35.6%	7.5%	45.8%	3.1%	4.9%	100.0%
Maintenance	Any	Pre-driving child	0.0%	0.0%	0.0%	18.1%	25.5%	14.2%	31.3%	0.0%	10.9%	100.0%
Maintenance	Any	Preschool	0.0%	0.0%	0.0%	16.4%	24.9%	33.8%	5.3%	0.6%	19.0%	100.0%
Eating Out	Any	FT Worker	0.0%	0.0%	0.0%	10.6%	44.0%	11.2%	4.1%	12.8%	17.3%	100.0%
Eating Out	Any	PT Worker	0.0%	0.0%	0.0%	16.8%	33.1%	22.5%	2.3%	6.3%	19.0%	100.0%
Eating Out	Any	University Student	0.0%	0.0%	0.0%	16.5%	33.4%	10.4%	8.8%	13.5%	17.4%	100.0%
Eating Out	Any	Homemaker	0.0%	0.0%	0.0%	14.8%	54.7%	9.2%	5.6%	5.5%	10.2%	100.0%
Eating Out	Any	Retired	0.0%	0.0%	0.0%	16.6%	41.4%	16.9%	2.0%	16.6%	6.5%	100.0%
Eating Out	Any	Driving-age child	0.0%	0.0%	0.0%	19.5%	33.2%	11.4%	11.4%	0.0%	24.5%	100.0%
Eating Out	Any	Pre-driving child	0.0%	0.0%	0.0%	7.2%	35.6%	5.3%	1.9%	16.9%	33.1%	100.0%
Eating Out	Any	Preschool	0.0%	0.0%	0.0%	1.0%	28.6%	4.5%	11.7%	6.4%	47.8%	100.0%
Visiting	Any	FT Worker	0.0%	0.0%	0.0%	12.0%	28.6%	12.3%	19.0%	25.5%	2.6%	100.0%
Visiting	Any	PT Worker	0.0%	0.0%	0.0%	10.6%	12.2%	3.9%	55.3%	4.7%	13.3%	100.0%
Visiting	Any	University Student	0.0%	0.0%	0.0%	10.5%	27.4%	17.6%	0.0%	20.6%	23.9%	100.0%
Visiting	Any	Homemaker	0.0%	0.0%	0.0%	31.3%	32.6%	13.0%	6.2%	7.5%	9.4%	100.0%
Visiting	Any	Retired	0.0%	0.0%	0.0%	9.7%	33.8%	6.7%	15.6%	32.8%	1.4%	100.0%
Visiting	Any	Driving-age child	0.0%	0.0%	0.0%	0.0%	0.0%	36.8%	15.0%	48.2%	0.0%	100.0%
Visiting	Any	Pre-driving child	0.0%	0.0%	0.0%	5.8%	16.2%	8.5%	28.1%	12.5%	28.9%	100.0%
Visiting	Any	Preschool	0.0%	0.0%	0.0%	23.0%	2.8%	7.2%	23.0%	44.0%	0.0%	100.0%
Discretionary	Any	FT Worker	0.0%	0.0%	0.0%	10.8%	31.9%	13.2%	27.0%	11.2%	5.9%	100.0%
Discretionary	Any	PT Worker	0.0%	0.0%	0.0%	10.2%	34.6%	15.4%	18.1%	8.7%	13.0%	100.0%
Discretionary	Any	University Student	0.0%	0.0%	0.0%	11.6%	37.4%	12.4%	16.2%	3.3%	19.1%	100.0%
Discretionary	Any	Homemaker	0.0%	0.0%	0.0%	11.0%	38.9%	19.0%	19.0%	6.7%	5.4%	100.0%
Discretionary	Any	Retired	0.0%	0.0%	0.0%	11.1%	28.4%	18.6%	19.7%	11.1%	11.1%	100.0%
Discretionary	Any	Driving-age child	0.0%	0.0%	0.0%	27.7%	30.4%	5.7%	20.5%	15.7%	0.0%	100.0%
Discretionary	Any	Pre-driving child	0.0%	0.0%	0.0%	11.4%	20.4%	14.8%	29.1%	8.9%	15.4%	100.0%
Discretionary	Any	Preschool	0.0%	0.0%	0.0%	33.5%	13.3%	11.1%	28.2%	5.2%	8.7%	100.0%

Model 5.3—Intermediate Stop Location Choice Model

Number of Models:	2 (mandatory and non-mandatory tours)
Decision-Making Unit:	Person
Model Form:	Multinomial Logit
Alternatives:	MAZs

The stop location choice model predicts the location of stops other than the primary destination. The stop location model is structured as a multinomial logit model using MAZ attraction size variable and route deviation measure as impedance. The alternatives are sampled from the full set of MAZs, subject to availability of a zonal attraction size term, and utilizing the two-stage sampling procedure described under Work Location Choice models, above. The sampling mechanism is also based on accessibility between tour origin and primary destination, and is subject to certain rules based on tour mode. All destinations are available for auto tour modes, as long as there is a positive size term for the MAZ. Intermediate stops on walk tours must be within walking distance of both the tour origin and primary destination MAZs. Intermediate stops on bike tours must be within 12 miles of both the tour origin and primary destination MAZs. Intermediate stops on walk-transit tours must be within walking distance of the tour origin MAZ and boarding TAP, or within walking distance of the primary destination MAZ and alighting TAP. Intermediate stops on drive-transit tours must be within the drive-to-pnr distance of the boarding TAP, or within walking distance of the alighting TAP and primary destination TAP. The distance thresholds are user-defined, and currently specified as 0.75 miles for MAZ to TAP walk distance, 1.8 miles for MAZ to MAZ walk distance, and between 2 and 8 miles for MAZ to PNR lot distance depending on type of transit service and whether lot is formal or informal.

It is not straightforward to segment the model by purpose because the size (or attraction) variables are related to the purpose of the stop activity while the impedance variables are strongly related to the tour characteristics – primary tour purpose, primary mode used for the tour, etc. Therefore, two models were estimated, corresponding to mandatory and non-mandatory tours. On each of these models, the size variables are based on stop purpose while the utility variables are based on both stop and tour characteristics. Explanatory variables include trip mode choice logsum, deviation distance, distance from tour origin or tour destination, stop purpose, tour purpose and mode, household income, age, gender, and attraction variables including households, school enrollment and employment by industrial category.

The intermediate stop location choice model works by cycling through stops on tours. The LOS variables (including mode choice logsums and distance deviation) are calculated as the additional utility between the last location and the next known location on the tour. For example, the LOS variable for the first stop on the outbound direction of the tour is based on additional impedance between the tour origin and the tour primary destination. The LOS variable for the next outbound stop is based on the additional impedance between the previous stop and the tour primary destination. Stops on return tour legs work similarly, except that the location of the first stop is a function of the additional impedance between the tour primary destination and the tour origin. The next stop location is based on the additional impedance between the first stop on the return leg and the tour origin, and so on.

The mode choice logsums are calculated based on the trip mode choice model utilities, which are conditional upon the tour main mode. For drive alone, walk tours and bike tours, the logsums are the

mode choice utility of making half-tour by that single mode since no other trip modes are available for those tour modes. For transit tours, both transit and walk mode utilities are included in the logsum calculation.

The specification of the intermediate stop location choice models is shown in Table 77 to Table 79. Note that the size term for escort stops depends on the presence of children in the household, by grade level. In the case of children for multiple grade levels (for example both pre-school and elementary school children in the household), the corresponding size terms are combined.

The intermediate stop location models were calibrated to match the trip length frequency distribution of out-of-direction distance. Calibration results are shown in Figure 37 to Figure X. The calibration targets were derived from NHTS 2009.

Table 77: Intermediate Stop Location Model Specification

Number of Observations:	38,680
Likelihood, constants only:	-6560.3
Final Likelihood:	-3792.5
Rho-squared, zero:	0.416
Rho-squared, constants:	0.422

Utility Terms	Tour Purpose			
	Mandatory		Non-Mandatory	
	Coeff.	t-stat	Coeff.	t-stat
Trip mode choice logsum	1.3142		1.0066	
Distance Deviation				
Linear			-0.0615	
Log	-0.8397		-0.9405	
Square			-0.0002	
Distance Deviation				
Stop sequence				
Number of stops on the half-tour			0.0204	
2nd stop	-0.0618		-0.0315	
3rd stop	-0.0776		-0.0631	
Tour mode				
Walk & bike tours	0.0000		-1.0049	
Stop purpose				
Work	-0.1066		0.0637	
University	0.0843		0.0937	
Shopping	0.0000		-0.0227	
Maintenance	0.0292		0.0211	
Eating Out			0.0225	
Visiting			0.0686	
Discretionary	0.0727		0.0574	
Tour Purpose				
Work			0.0500	
School	0.1122		0.0186	
University	0.0259		0.0200	
Mandatory (inbound only)			0.0029	

Shopping		0.0268
Maintenance		0.0342
Discretionary		-0.0250
Visiting		0.0200
At-Work		0.0878
Person & household attributes		
Household income < $60K	0.0227	0.0363
Female	-0.0707	-0.0272
Age between 35 and 54 years old	-0.0895	-0.0102
Age over 54 years old	-0.0987	-0.0135
Distance Deviation -- Log		
Work stop purpose	1.0298	
Shopping stop purpose	-0.1994	
Visiting stop purpose	0.6522	
Distance Ratio*		
First outbound stop	-0.6487	-1.5160
First inbound stop	1.4972	1.8051
Mandatory tour purpose - outbound		-1.3255
Mandatory tour purpose - inbound	0.9173	-0.7034
Size	1.0000	1.0000

* *Distance between tour origin and stop divided by half-tour distance.*

Table 78: Intermediate Stop Location Model Size Coefficients

Size Term*	**Size Coefficient (t-Stat) by Stop Purpose**					
	Work	Shop	Maintenance	Eat Out	Visit	Discretionary
Total Employment	1.0000					
Retail		1.0000	1.0000	0.1378 (5.0)		0.0388 (8.6)
Professional and Business Services			0.0500 (n/a)			
Amusement Services						0.4737 (2.2)
Hotel Activity						0.0923 (4.9)
Restaurants and Bars		0.2147 (8.5)		1.0000	1.0000	0.1229 (6.4)
Personal Services and Retail Based			1.7259 (3.4)			
Religious Activity						1.0000
Federal Non-Military Activity			1.9857 (4.3)			
Health			1.9520 (4.6)			
Number of Households				0.0102 (3.3)	0.4952 (3.7)	0.0273 (12.2)

**Employment unless otherwise specified.*

Table 79: Intermediate Stop Location Size Coefficients, University and Escort Stops

Size Term*	Stop Purpose and Presence of Child in Household				
	University	Escort	Escort Pre-School Child	Escort Primary School Child	Escort High School Child
Education (Post Secondary)	1.0000		5.7072		
Education (Grades K-12)			5.7072		
Professional and Business Services			5.7072		
Religious Activity			5.7072		
Government			5.7072		
Health			5.7072		
Number of Households		1.0000	1.0000	1.0000	1.0000
Population			5.7072		
Enrollment Grades K-8				5.7072	
Enrollment Grades 9-12					5.7072

**Employment unless otherwise specified.*

Table 80: Average Out-of-Direction Distance, Observed and Estimated

Tour Purpose	Number of Observations	Observed	Estimated
Work		4.5 mi	4.4 mi
University		3.3 mi	3.1 mi
School		3.0 mi	3.2 mi
Escort		3.8 mi	3.6 mi
Shopping		4.7 mi	4.8 mi
Maintenance		3.8 mi	3.9 mi
Eating Out		3.1 mi	2.8 mi
Visiting		3.1 mi	2.9 mi
Discretionary		3.7 mi	3.6 mi
At-Work Subtours		5.3 mi	5.0 mi

Figure 37: Frequency Distribution of Stop Out-of-Direction Distance, Work Tours

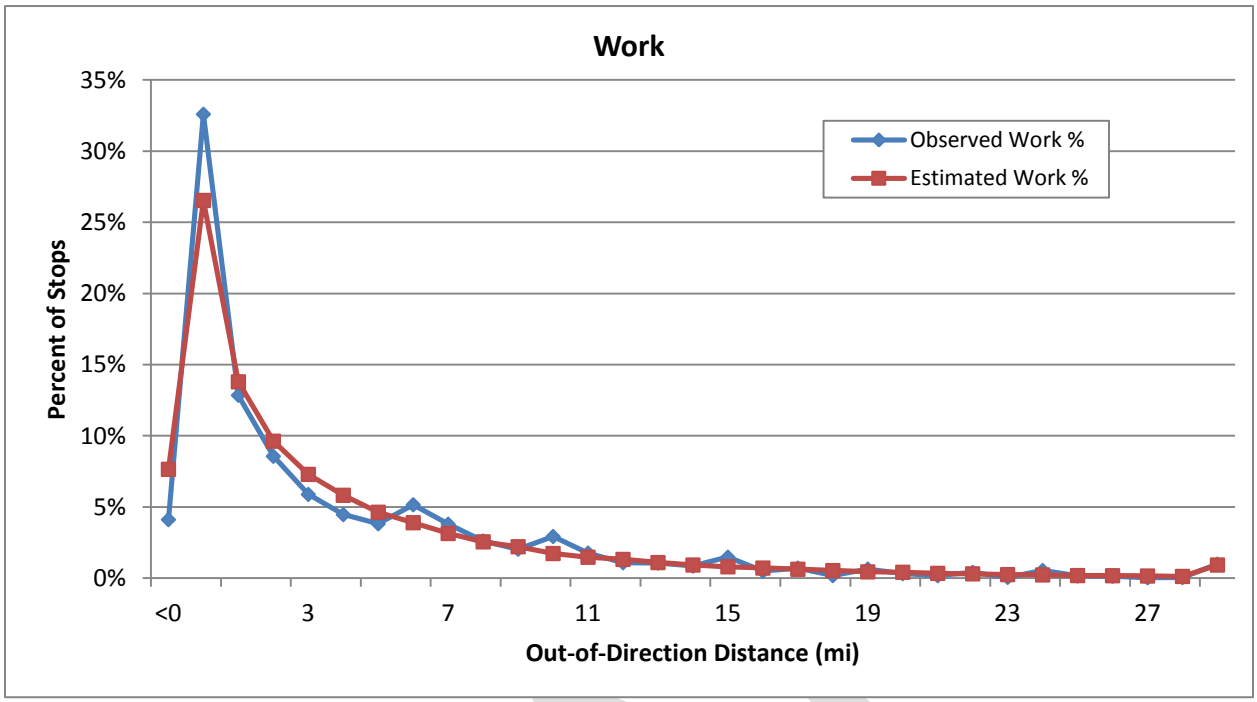


Figure 38: Frequency Distribution Stop Out-of-Direction Distance, University Tours

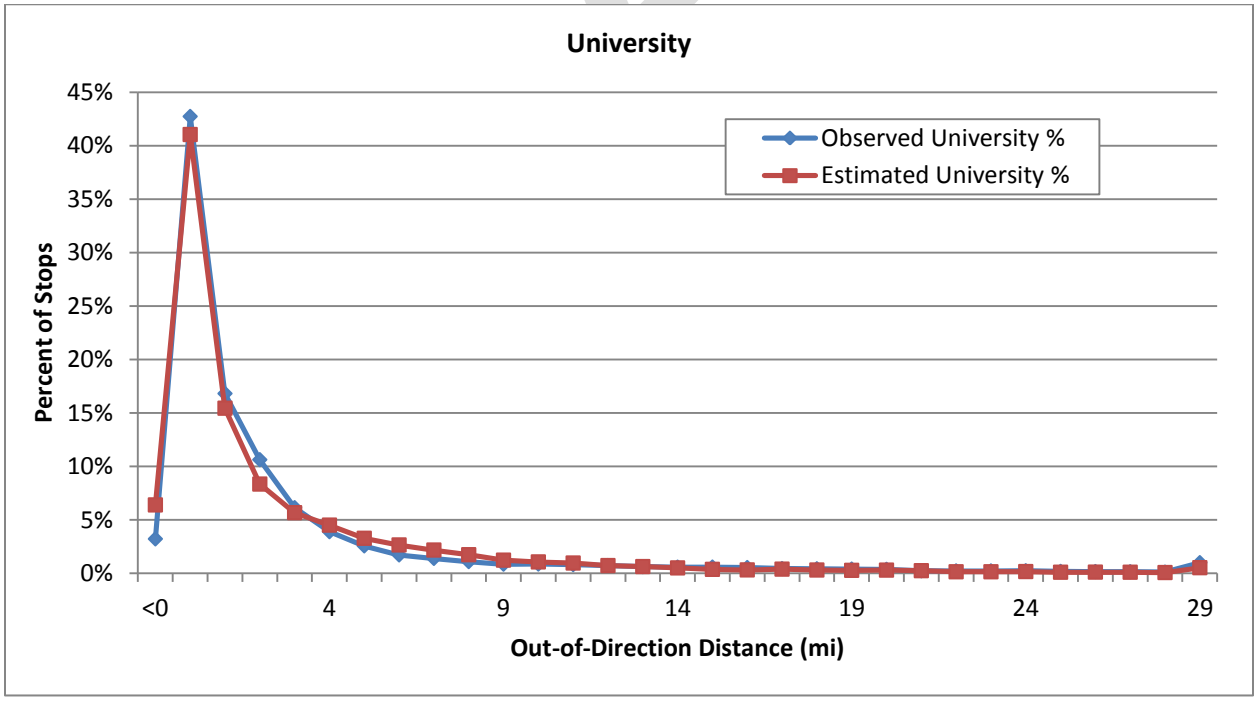


Figure 39: Frequency Distribution of Stop Out-of-Direction Distance, School Tours

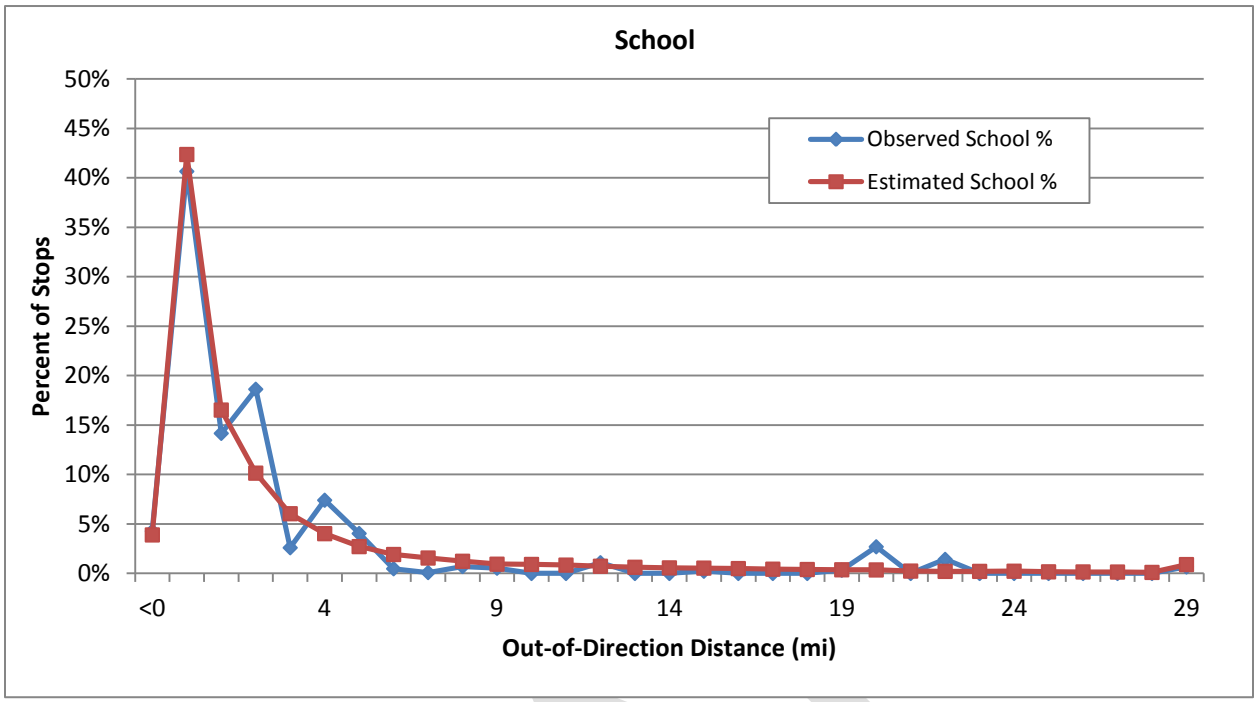


Figure 40: Frequency Distribution of Stop Out-of-Direction Distance, Escort Tours

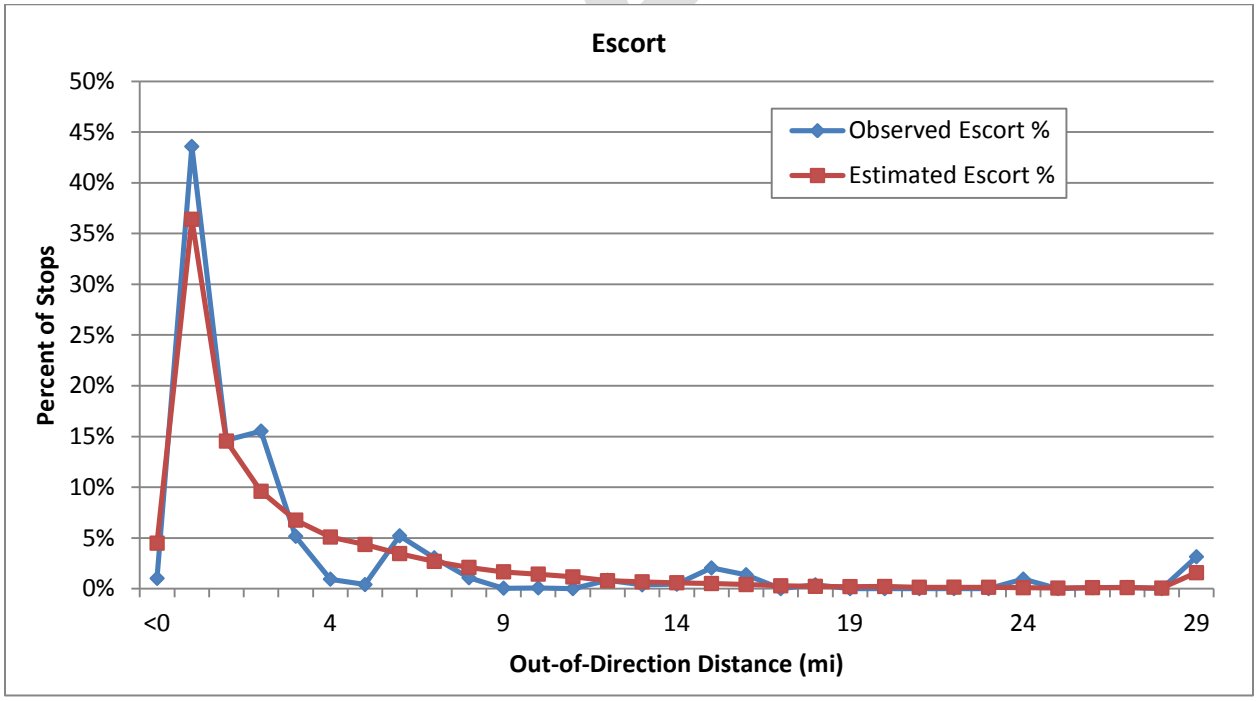


Figure 41: Frequency Distribution of Stop Out-of-Direction Distance, Shop Tours

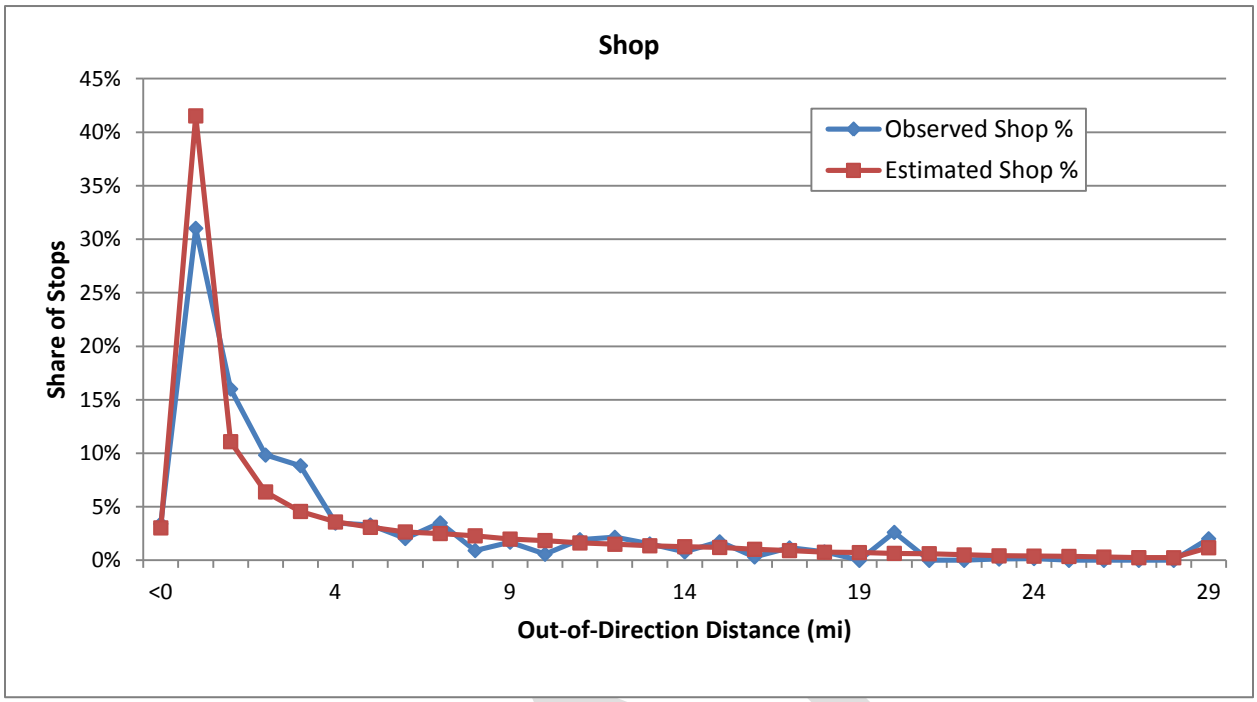


Figure 42: Frequency Distribution of Stop Out-of-Direction Distance, Maintenance Tours

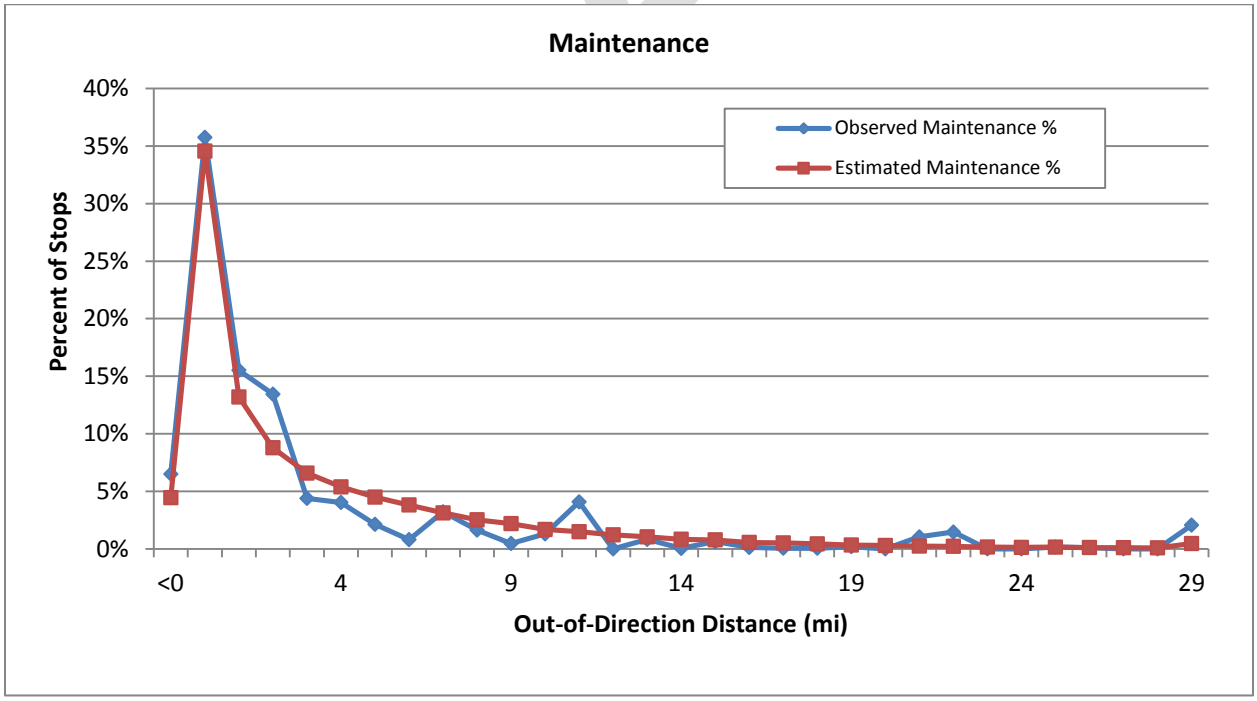


Figure 43: Frequency Distribution of Stop Out-of-Direction Distance, Eating Out Tours

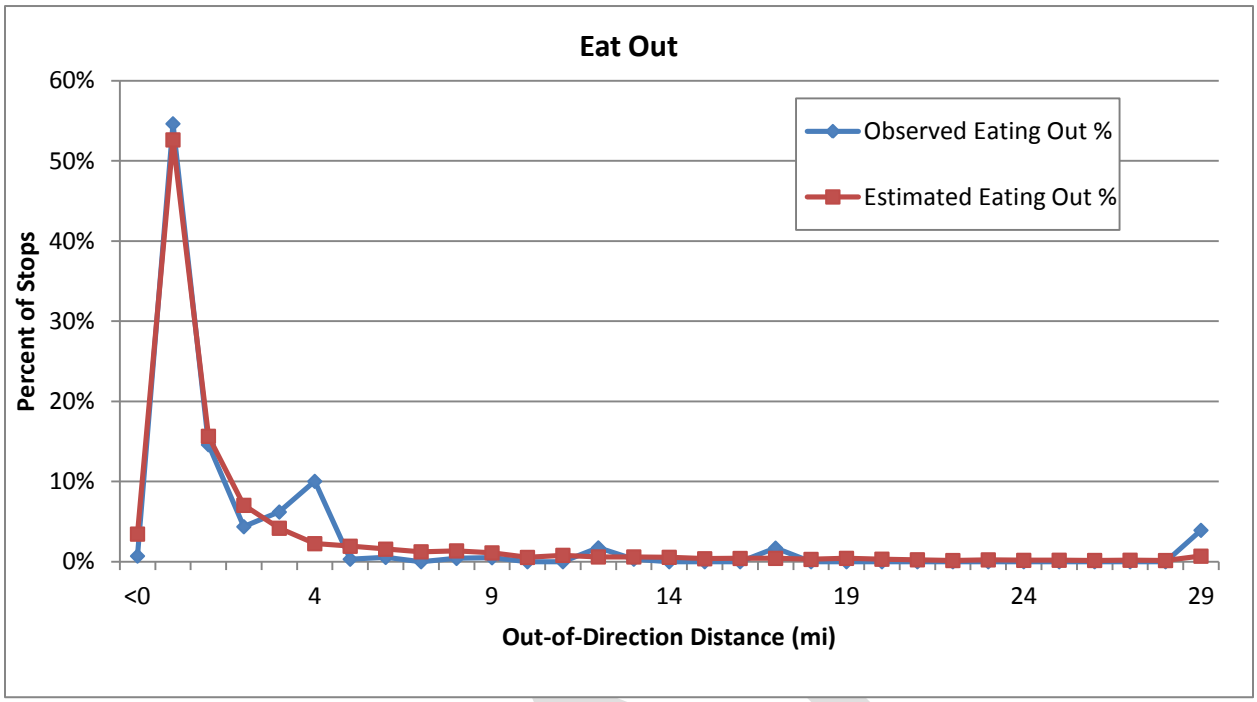


Figure 44: Frequency Distribution of Stop Out-of-Direction Distance, Visiting Tours

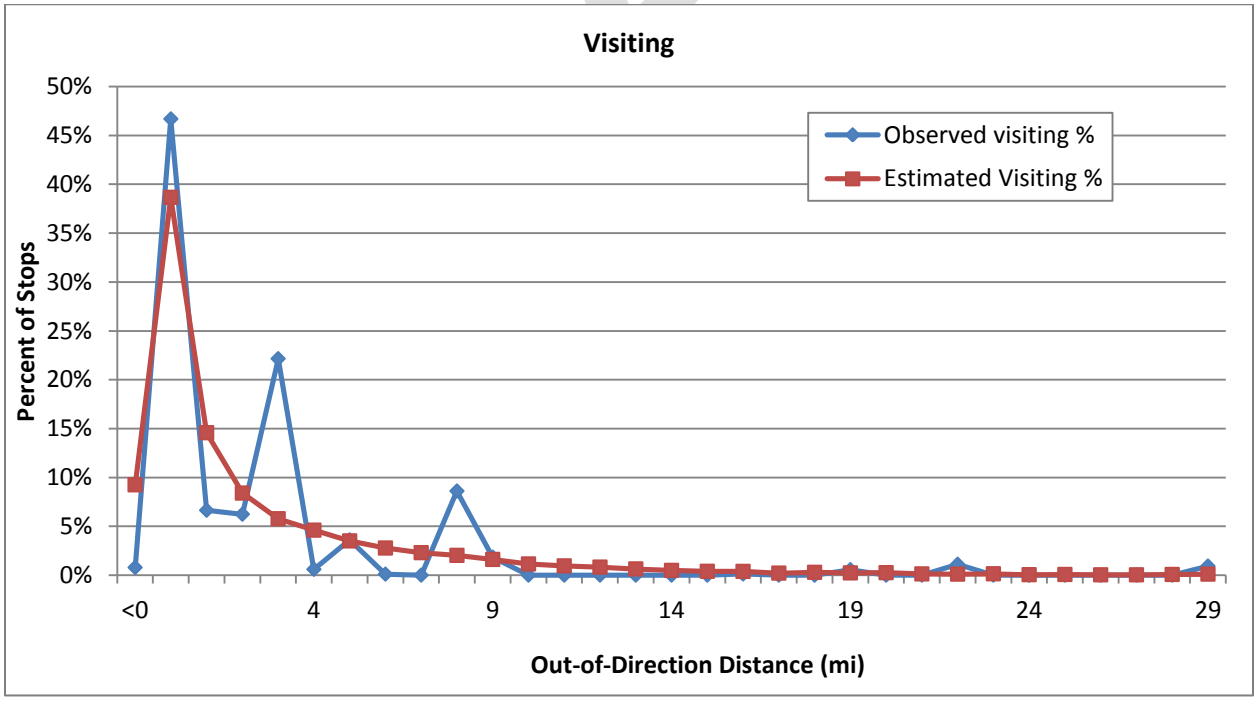


Figure 45: Frequency Distribution of Stop Out-of-Direction Distance, Discretionary Tours

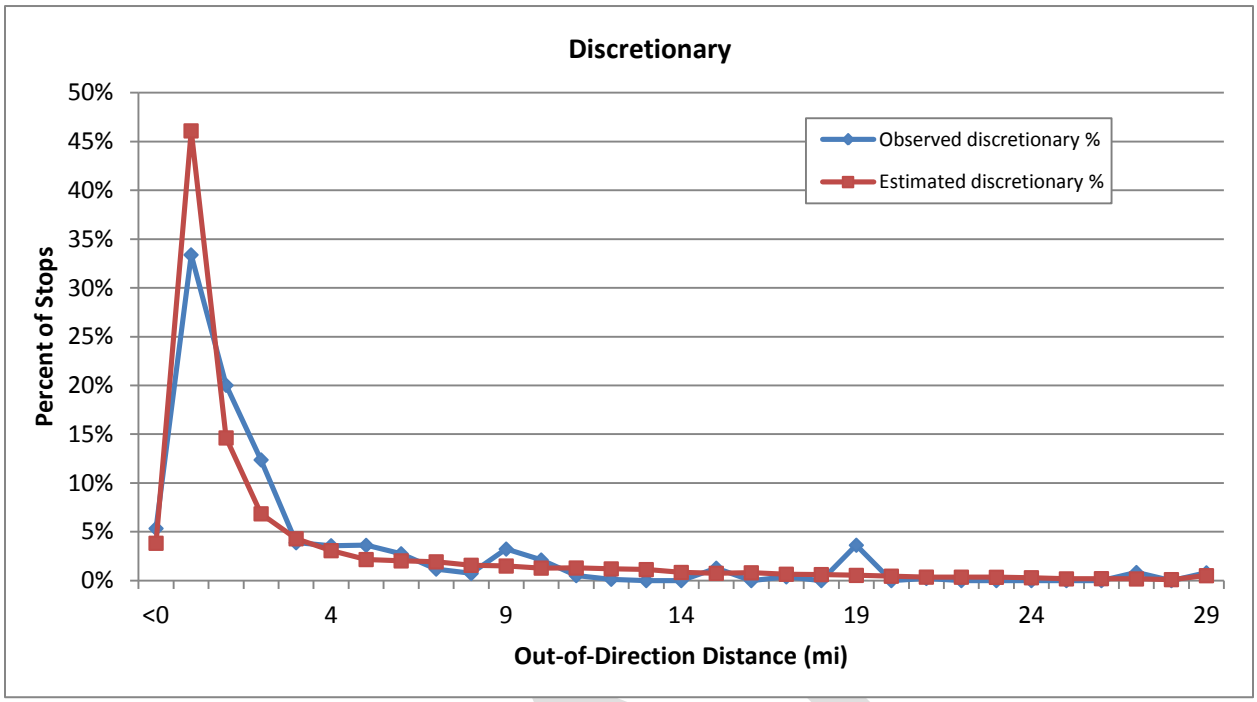
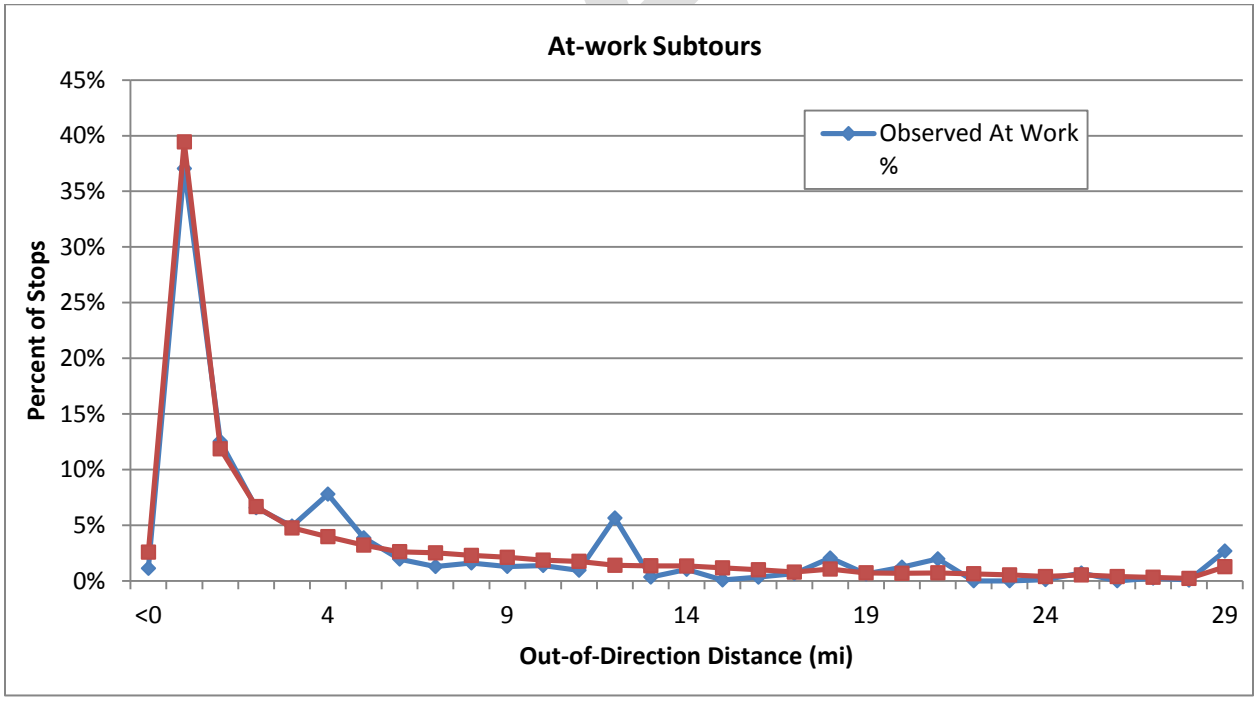


Figure 46: Frequency Distribution of Stop Out-of-Direction Distance, At-Work Subtours



Model 6.1—Trip Mode Choice Model

Number of Models:	6 (work, school, university, maintenance, discretionary, at-work)
Decision-Making Unit:	Person
Model Form:	Nested Logit
Alternatives:	26 (See Figure 36)

The trip mode choice model determines the mode for each trip along the tour. This model is a nested logit model, and is also referred to as a mode "switching" model because it predicts the likelihood of each trip mode conditioned by the chosen tour mode. The linkage between tour and trip levels is implemented through mode availability rules that establish the trip modes that are allowed for a given tour mode. The model can incorporate asymmetric mode combinations, but in reality, there is a great deal of symmetry between outbound and inbound modes used for the same tour. In particular, symmetry is enforced for drive-transit tours, by excluding intermediate stops from drive-transit tours.

The trip mode availability rules are shown in Table 81. Note that the trip modes are exactly the same as the modes in the tour mode choice model. However, every trip mode is not necessarily available for every tour mode. Trip mode availability depends on a hierarchy similar to that used for the definition of transit modes. The hierarchy is based on the following principles:

i. Pay trip modes are only available for pay tour modes (for example, drive-alone pay is only available at the trip mode level if drive-alone pay is selected as a tour mode).
ii. The auto occupancy of the tour mode is determined by the maximum occupancy across all auto trips that make up the tour. Therefore, the auto occupancy for the tour mode is the maximum auto occupancy for any trip on the tour.
iii. Transit tours can include auto shared-ride trips for particular legs. Therefore, 'casual carpool', wherein travelers share a ride to work and take transit back to the tour origin, is explicitly allowed in the tour/trip mode choice model structure.
iv. The walk mode is allowed for any trip on a tour except for drive-alone, wherein the driver must use the vehicle for all trips on the tour.
v. The transit mode of the tour is determined by the highest transit mode used for any trip in the tour according to the transit mode hierarchy as described in Table 50. As previously mentioned, free shared-ride modes are also available in transit tours, albeit with a low probability.

For the sake of parsimony, drive-transit modes are not included in Table 81. Because intermediate stops are not allowed on drive-transit tours, the availability rules simply follow the transit mode hierarchy.

The utility expression for each trip mode (i), given a tour mode (j) and the placement of the trip on tour (s) is specified as a linear function of level of service variables (such as time and cost), location specific measures, socio-economic (SE) characteristics, and alternate specific constants (δ, α, and λ):

$$U_{i|j,s} = \sum_k (\beta_k * Time_k) + \sum_l (\beta_l * Cost_l) + \sum_m (\beta_m * Location_m) + \sum_n (\beta_n * SE_n) + \delta_{i|j} + \alpha_s + \lambda_i$$

Where:

Time is an array of travel time variables, denoted by the index k. Travel time variables are typically disaggregated into in-vehicle and out-of-vehicle time, with out-of-vehicle time further disaggregated into walk time, initial wait time, and transfer wait time for the transit modes.

Cost is an array of travel cost variables, denoted by the index l. Travel cost is disaggregated into automobile operating costs, parking cost, tolls and transit fare. Costs are represented in 2009 dollars.

Location is an array of location-specific variables, denoted by the index m. Location variables are used to reflect zone-based characteristics such as the mix of residential and employment land uses.

SE is an array of socio-economic variables, denoted by the index n. SE variables include household size and gender. Note that variables such as auto ownership influence the choice of the ***tour mode***, and consequently are not explicitly included in the trip mode choice utility. These variables affect the trip mode choice probabilities indirectly, by virtue of the choice being conditional on the tour mode.

The trip mode choice model has three types of alternative specific constants (ASC):

i. Tour mode constants (δ): trip mode constants that are stratified by tour mode, where the mode equal to the tour mode is assumed as the reference (i.e., given zero constant).
ii. Mode sequence constants (α):constants applied to all trip modes other than the tour mode. They are stratified by the trip sequence within the tour -- first trip, last trip, or only trip (no stops on half-tour). These constants are referred to as "off-diagonal" constants because they are applied to all trip mode/tour mode combinations which would be off the main diagonal of a matrix of tour mode versus trip mode combinations. These constants capture the effect of the tour trip sequence on the likelihood of mode switching, as explained more fully below.
iii. Transit line-haul mode constants (λ): trip mode constants specifically for transit line-haul modes.

The tour mode constants (δ)help to determine the correct share of trips by mode for each tour mode. For example, drive alone (DA) trips may occur in DA tours and in shared-ride tours (SR2 and SR3+). To obtain the right share of DA trips across all tour modes and also within DA, SR2 and SR3+ tours, the utility for the DA trip mode includes one constant for DA trips in SR2 tours, and another constant for DA trips in SR3+ tours. The constant for DA trips in DA tours is assumed to be zero (i.e., it is the reference mode).Consider for example a tour that represents one or two parents dropping off a child at school. Since a DA trip in this type of tour is more likely if only one parent drops off the child (a SR2 tour) than if both parents do (a SR3+ tour), then the DA/SR2 constant is more positive than the DA/SR3+ constant.

The tour mode constants alone do not suffice to get the right shares of trips on tours, because the trip mode is also a function of where in the tour the trip occurs. In the escort tour example above, the tour mode constants cannot establish whether the DA trip is more likely to occur in the first or in the second trip of the SR tour. Hence the need for mode sequence constants. These sequence constants help determine the likelihood that a trip mode other than the tour mode is chosen, based on whether the trip occurs first in the half-tour, second in the half-tour (reference), or that it is the only trip in the half-tour. The mode sequence constants are stratified by tour mode. For example, if the mode of a work tour is SR2, and there is at least one outbound stop, the mode of the first trip is unlikely to be something other than SR2 (off-diagonal), because the data show that the first trip of a work tour is often

used to drop off a child at daycare. Therefore the off-diagonal constant for the first trip of SR2 tours is typically highly negative.

Figure 47 shows an example of a SR2 tour with two outbound trips and one return trip. In addition to relevant time, cost, location, and socio-economic components, the mode choice utility equations for trips 1, 2 and 3 will also contain the following constants:

Trip 1:

$Utility_{DA} = \ldots + Trip\ Mode\ Constant_{DA|SR2\ tour} + Off\text{-}Diagonal\ Constant_{first\ trip\ in\ SR2\ half\text{-}tour}$

$Utility_{SR2} = \ldots$ *(no additional constant)*

$Utility_{Walk} = \ldots + Trip\ Mode\ Constant_{Walk|SR2\ tour} + Off\text{-}Diagonal\ Constant_{first\ trip\ in\ SR2\ half\text{-}tour}$

Trip 2:

$Utility_{DA} = \ldots + Trip\ Mode\ Constant_{DA|SR2\ tour}$

$Utility_{SR2} = \ldots$ *(no additional constant)*

$Utility_{Walk} = \ldots + Trip\ Mode\ Constant_{Walk|SR2\ tour}$

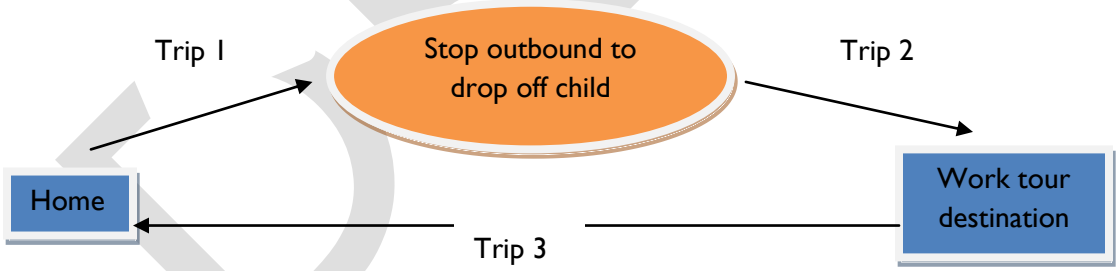
Trip 3:

$Utility_{DA} = \ldots + Trip\ Mode\ Constant_{DA|SR2} + Off\text{-}Diagonal\ Constant_{no\text{-}stops\ in\ SR2\ half\text{-}tour}$

$Utility_{SR2} = \ldots$ *(no additional constant)*

$Utility_{Walk} = \ldots + Trip\ Mode\ Constant_{Walk|SR2} + Off\text{-}Diagonal\ Constant_{no\text{-}stops\ in\ SR2\ half\text{-}tour}$

Figure 47:Trip Mode Switching Example – Shared Ride 2 Work Tour



The transit line-haul constants are applied to each transit trip mode in addition to the tour mode and off-diagonal constants. These line-haul constants are analogous to the transit mode specific constants used in trip-based models, and as such, are not stratified by tour mode or by any household or person attribute. The line-haul constant for local bus is assumed to be zero, so that the constants for the other transit modes measure the contribution of mode-specific un-included attributes to the trip mode utility relative to local bus.

The trip mode choice models explanatory variables include household and person variables, level-of-service between the trip origin and destination according to the time period for the tour leg, urban form

variables, and alternative-specific constants segmented by tour mode. Transit and non-motorized LOS are calculated "on-the-fly" using the TAP-TAP skims and the MAZ-TAP access links, as described under Tour Mode Choice, above. The specification of the trip mode choice models is shown in Table 82 to Table 84. These models were calibrated to match the share of trips by mode and tour purpose, and the number of transit trips by origin-destination district. The calibration targets were derived from the 2009 NHTS and transit on-board surveys.

Table 81: Trip Mode Availability Rules

Tour Mode	Trip Mode												
	Drive Alone		Shared Ride 2			Shared Ride 3+			Walk	Bike	Walk-Transit	PNR-Transit	KNR-Transit
	Non-Toll	Toll	Non-Toll, Non-HOV	Non-Toll, HOV	Toll, HOV	Non-Toll, Non-HOV	Non-Toll, HOV	Toll, HOV					
Drive Alone													
Non-Toll	Must	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot
Toll	Can	Can	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot
Shared Ride 2													
Non-Toll, Non-HOV	Can	Cannot	Can	Cannot	Cannot	Cannot	Cannot	Cannot	Can	Cannot	Cannot	Cannot	Cannot
Non-Toll, HOV	Can	Cannot	Can	Can	Cannot	Cannot	Cannot	Cannot	Can	Cannot	Cannot	Cannot	Cannot
Toll, HOV	Can	Can	Can	Can	Can	Cannot	Cannot	Cannot	Can	Cannot	Cannot	Cannot	Cannot
Shared Ride 3+													
Non-Toll, Non-HOV	Can	Cannot	Can	Cannot	Cannot	Can	Cannot	Cannot	Can	Cannot	Cannot	Cannot	Cannot
Non-Toll, HOV	Can	Cannot	Can	Can	Cannot	Can	Can	Cannot	Can	Cannot	Cannot	Cannot	Cannot
Toll, HOV	Can	Can	Can	Can	Can	Can	Can	Can	Can	Cannot	Cannot	Cannot	Cannot
Walk	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Must	Cannot	Cannot	Cannot	Cannot
Bike	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Can	Can	Cannot	Cannot	Cannot
Walk-Transit[2]	Cannot	Cannot	Can	Can	Cannot	Can	Can	Cannot	Can	Cannot	Can	Cannot	Cannot
PNR-Transit	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Must[3]	Cannot
KNR-Transit	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Cannot	Must

[2] For transit modes, any mode ranked higher on the modal hierarchy is unavailable as a trip mode on the tour. For example, if the tour mode is LRT, then local bus, express bus, bus-rapid transit, and LRT are available for any trip on the tour, but commuter rail is not available.

[3] Stops are not allowed on drive-transit (PNR or KNR) tours.

Table 82: Trip Mode Choice Model Specification, Work & At-Work Tours

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
In vehicle time	-0.0320		-0.0600	
In vehicle time factor, express bus	0.90		0.90	
In vehicle time factor, BRT	0.90		0.90	
In vehicle time factor, urban rail	0.85		0.85	
In vehicle time factor, commuter rail	0.75		0.75	
First wait time	-0.0480	1.5	-0.0900	1.5
Transfer wait time	-0.0480	1.5	-0.0900	1.5
Transfer penalty, PNR transit	-0.4800	15 min	-0.3000	5 min
Transfer penalty, non PNR transit	-0.0160	5 min	-0.3000	5 min
Walk access time	-0.0602	1.9	-0.1200	2.0
Walk egress time	-0.0602	1.9	-0.1200	2.0
Walk transfer time	-0.0602	1.9	-0.1200	2.0
Drive access time	-0.0602	1.9	-0.1200	2.0
Walk mode time	-0.1181	3.7	-0.1200	2.0
Bike mode time	-0.0986	3.1	-0.1200	2.0
Cost			-0.0380	$9.6
Household income < $30k	-0.00544	$3.6		
Household income $30k-$60k	-0.00224	$8.6		
Household income $60k - $100k	-0.00160	$12.0		
Household income > $100k	-0.00064	$30.0		
Origin MAZdwelling unit / employment mix density, non-motorized[2]	0.2252			
Origin MAZ intersections, non-motorized[3]				
Destination MAZ employment density, non-motorized[4]				
Destination MAZ employment density, drive to transit	0.0251			
Female				
Shared-ride 2	0.2743			
Shared-ride 3+	0.0718			
Transit	1.0624			
Non-Motorized	-1.1033			
Tour Mode Constant—Drive Alone				
Drive Alone GP	0.0000		0.0000	
Drive Alone Pay	0.0000		0.0000	
Tour Mode Constant—SR2 Tours				
Drive Alone GP	1.5448		-1.3059	
Drive Alone Pay	0.4529		-1.3059	

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
SR2 GP	0.0000		0.0000	
SR2 HOV	0.0000		0.0000	
SR2 Toll	0.0000		0.0000	
Walk	0.4741		0.0440	
Tour Mode Constant—SR3+ Tours				
Drive Alone GP	0.9456		-1.3730	
Drive Alone Pay	0.9456		-1.3730	
SR2 GP	-0.0855		-2.9267	
SR2 HOV	-0.0855		-2.9267	
SR2 Toll	-0.0855		-2.9267	
SR3+ GP	0.0000		0.0000	
SR3+ HOV	0.0000		0.0000	
SR3+ Toll	0.0000		0.0000	
Walk	-1.2482		-0.1175	
Tour Mode Constant—Walk Tours				
Walk	0.0000		0.0000	
Tour Mode Constant—Bike Tours				
Bike	0.0000		0.0000	
Tour Mode Constant—Walk Transit				
SR2 GP	-2.5357		n/a	
SR2 HOV	-2.5357		n/a	
SR2 Toll	-2.5357		n/a	
SR3+ GP	-4.5718		n/a	
SR3+ HOV	-4.5718		n/a	
SR3+ Toll	-4.5718		n/a	
Walk	0.2733		-5.000	
Walk Local	0.0000		0.0000	
Walk Express	0.0000		0.0000	
Walk BRT	0.0000		0.0000	
Walk Urban Rail	0.0000		0.0000	
Walk Commuter Rail	0.0000		0.0000	
Tour Mode Constant—PNR Transit			n/a	
Drive Alone GP	-0.1407			
Drive Alone Pay	-0.1407			
SR2 GP	-0.7501			
SR2 HOV	-0.7501			
SR2 Toll	-0.7501			
SR3+ GP	0.0000			

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
SR3+ HOV	0.0000			
SR3+ Toll	0.0000			
Walk	1.9559			
Walk Local	-0.4842			
Walk Express	-0.4842			
Walk BRT	-0.4842			
Walk Urban Rail	-0.4842			
Walk Commuter Rail	-0.4842			
PNR Local	0.0000			
PNR Express	0.0000			
PNR BRT	0.0000			
PNR Urban Rail	0.0000			
PNR Commuter Rail	0.0000			
Tour Mode Constant—KNR Transit			n/a	
SR2 GP	-0.4397			
SR2 HOV	-0.4397			
SR2 Toll	-0.4397			
SR3+ GP	-0.5291			
SR3+ HOV	-0.5291			
SR3+ Toll	-0.5291			
Walk	2.2190			
Walk Local	-0.3148			
Walk Express	-0.3148			
Walk BRT	-0.3148			
Walk Urban Rail	-0.3148			
Walk Commuter Rail	-0.3148			
PNR Local	0.0000			
PNR Express	0.0000			
PNR BRT	0.0000			
PNR Urban Rail	0.0000			
PNR Commuter Rail	0.0000			
Transit Line-Haul Constants				
Express Bus	0.3200	10 min		
BRT	0.3200	10 min	0.6400	11 min
LRT	0.4800	15 min	0.9600	16 min
Commuter Rail	0.6400	20 min	1.2800	21 min
Drive Transit	-4.2364		n/a	
KNR Transit	0.3708		n/a	

Utility Terms	Work Tours		At-Work Tours	
	Coef.	Ratio	Coef.	Ratio
HOV & Toll Constants				
Pay modes	0.0453	1.4 min	0.0000	
HOV modes	-0.0740	-2.3 min	0.6415	11 min
Off-Diagonal Mode Constants				
SR2 Tours				
First trip	-3.0147			
Last trip	-2.0599			
No stops	-3.2003		-1.4142	
SR3+ Tours				
First trip	-1.8752			
Last trip	-1.611			
No stops	-2.2614		-1.7313	
Walk to Transit Tours				
First trip	0.0000			
Last trip	0.0000			
No stops	-1.6562			
PNR to Transit Tours			n/a	
First trip	1.183			
Last trip	4.0169			
No stops	-9999			
KNR to Transit Tours			n/a	
First trip	1.183			
Last trip	4.0169			
No stops	0.0000			

Table 83: Trip Mode Choice Model Specification, University and School Tours

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
In vehicle time	-0.0334		-0.0200	
In vehicle time factor, express bus	0.90		0.90	
In vehicle time factor, BRT	0.90		0.90	
In vehicle time factor, urban rail	0.85		0.85	
In vehicle time factor, commuter rail	0.75		0.75	
First wait time	-0.0622	1.9	-0.0300	1.5
Transfer wait time	-0.0622	1.9	-0.0403	2.0
Transfer penalty, PNR transit	0.0000	0 min	-0.1920	10 min
Transfer penalty, non PNR transit	0.0060	0 min	-0.1920	10 min
Walk access time	-0.0622	1.9	-0.0900	4.5
Walk egress time	-0.0622	1.9	-0.0900	4.5

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
Walk transfer time	-0.0622	1.9	-0.0900	4.5
Drive access time	-0.0502	1.5	-0.0152	0.75
Walk mode time	-0.1783	5.3	-0.1248	6.2
Bike mode time	-0.1783	5.3	-0.1248	6.2
Cost	-0.00268	$7.5		
Household income < $30k			-0.0220	$0.5
Household income $30k-$60k			-0.0090	$1.3
Household income $60k - $100k			-0.0060	$2.0
Household income > $100k			-0.0060	$2.0
Age 1 to 5				
Non-motorized			-1.711	
Age 6 to 12				
Non-motorized			-0.7620	
Age 13 to 15				
Non-motorized			-0.3120	
Transit			-1.7430	
Female				
Shared-ride 2	-0.7308			
Shared-ride 3+	-1.1176			
Tour Mode Constant—Drive Alone				
Drive Alone GP	0.0000		0.0000	
Drive Alone Pay	0.0000		0.0000	
Tour Mode Constant—SR2 Tours				
Drive Alone GP	-0.4390		0.0196	
Drive Alone Pay	-0.4390		0.0196	
SR2 GP	0.0000		0.0000	
SR2 HOV	0.0000		0.0000	
SR2 Toll	0.0000		0.0000	
Walk	1.5461		4.6778	
Tour Mode Constant—SR3+ Tours				
Drive Alone GP	-0.9445		n/a	
Drive Alone Pay	-0.9445		n/a	
SR2 GP	-0.9707		1.1184	
SR2 HOV	-0.9707		1.1184	
SR2 Toll	-0.9707		1.1184	
SR3+ GP	0.0000		0.0000	
SR3+ HOV	0.0000		0.0000	
SR3+ Toll	0.0000		0.0000	

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
Walk	1.4641		3.3297	
Tour Mode Constant—Walk Tours				
Walk	0.0000		0.0000	
Tour Mode Constant—Bike Tours				
Bike	0.0000		0.0000	
Tour Mode Constant—Walk Transit				
SR2 GP	-4.0954		-2.7757	
SR2 HOV	-4.0954		-2.7757	
SR2 Toll	-4.0954		-2.7757	
SR3+ GP	-5.2505		-3.9969	
SR3+ HOV	-5.2505		-3.9969	
SR3+ Toll	-5.2505		-3.9969	
Walk	0.5732		0.4194	
Walk Local	0.0000		0.0000	
Walk Express	0.0000		0.0000	
Walk BRT	0.0000		0.0000	
Walk Urban Rail	0.0000		0.0000	
Walk Commuter Rail	0.0000		0.0000	
Tour Mode Constant—PNR Transit[1]				
Drive Alone GP	-2.2672		0.0000	
Drive Alone Pay	-2.2672		0.0000	
SR2 GP	-1.9560		0.0000	
SR2 HOV	-1.9560		0.0000	
SR2 Toll	-1.9560		0.0000	
SR3+ GP	-1.9626		0.0000	
SR3+ HOV	-1.9626		0.0000	
SR3+ Toll	-1.9626		0.0000	
Walk	n/a		-0.0532	
Walk Local	n/a		-0.0532	
Walk Express	n/a		-0.0532	
Walk BRT	n/a		-0.0532	
Walk Urban Rail	n/a		-0.0532	
Walk Commuter Rail	n/a		-0.0532	
PNR Local	0.0000		0.0000	
PNR Express	0.0000		0.0000	
PNR BRT	0.0000		0.0000	
PNR Urban Rail	0.0000		0.0000	
PNR Commuter Rail	0.0000		0.0000	

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
Tour Mode Constant—KNR Transit[1]				
SR2 GP	0.0000		0.6080	
SR2 HOV	0.0000		0.6080	
SR2 Toll	0.0000		0.6080	
SR3+ GP	0.0000		0.5653	
SR3+ HOV	0.2411		0.5653	
SR3+ Toll	0.2411		0.5653	
Walk	0.2411		0.1789	
Walk Local	0.1407		0.1789	
Walk Express	0.5731		0.1789	
Walk BRT	0.5731		0.1789	
Walk Urban Rail	0.5731		0.1789	
Walk Commuter Rail	0.5731		0.1789	
PNR Local	n/a		n/a	
PNR Express	n/a		n/a	
PNR BRT	n/a		n/a	
PNR Urban Rail	n/a		n/a	
PNR Commuter Rail	n/a		n/a	
Transit Line-Haul Constants				
Express Bus	0.3200	9 min	0.2000	10 min
BRT	0.3200	9 min	0.3000	15 min
LRT	0.4800	14 min	0.4000	20 min
Commuter Rail	0.6400	19 min	0.4000	20 min
HOV & Toll Constants				
Pay modes			0.0005	0 min
HOV modes			0.6549	33 min
Off-Diagonal Mode Constants				
SR2 Tours				
First trip	-1.2971		-2.5320	
Last trip	-0.7345		-4.0520	
No stops	-3.2105		-14.5540	
SR3+ Tours				
First trip	-1.7826		-3.9190	
Last trip	-1.1489		-3.6670	
No stops	-1.8930		-3.8660	
Walk to Transit Tours				
First trip	0.4204		0.9210	
Last trip	0.0000		1.5800	

Utility Terms	University Tours		School Tours	
	Coef.	Ratio	Coef.	Ratio
No stops	0.0000		-1.7060	
PNR to Transit Tours				
First trip	0.0000		-5.0000	
Last trip	0.0000		-5.0000	
No stops	-1.0002		0.0000	
KNR to Transit Tours				
First trip	0.0000		-5.0000	
Last trip	0.0000		-5.0000	
No stops	-1.0002		0.0000	

(1)Tour mode constants apply when auto trips are allowed in a PNR to Transit tour, or when walk trips are allowed in a KNR to Transit tour.

Table 84: Trip Mode Choice Model Specification, Maintenance & Discretionary Tours

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
In vehicle time	-0.0340		-0.0300	
In vehicle time factor, express bus	0.90		0.90	
In vehicle time factor, BRT	0.90		0.90	
In vehicle time factor, urban rail	0.85		0.85	
In vehicle time factor, commuter rail	0.75		0.75	
First wait time	-0.0510	1.5	-0.0450	1.5
Transfer wait time	-0.0590	1.7	-0.0550	1.8
Transfer penalty, PNR transit	0.0000	0 min	-0.1500	5 min
Transfer penalty, non PNR transit	0.0000	0 min	-0.1500	5 min
Walk access time	-0.0510	1.5	-0.0520	1.7
Walk egress time	-0.0510	1.5	-0.0520	1.7
Walk transfer time	-0.0510	1.5	-0.0520	1.7
Drive access time	-0.0510	1.5	-0.0450	1.5
Walk mode time	-0.1540	4.5	-0.2190	7.3
Bike mode time	-0.1540	4.5	-0.2190	7.3
Cost				
Household income < $30k	-0.0080	$2.5	-0.0070	$2.6
Household income $30k-$60k	-0.0040	$5.1	-0.0030	$6.0
Household income $60k - $100k	-0.0020	$10.2	-0.0020	$9.0
Household income > $100k	-0.0010	$20.4	-0.0008	$22.5
Origin MAZdwelling unit / employment mix density, non-motorized[(2)]				0.2750

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
Female				
Transit			-2.7360	
Household size 3				
Shared-ride 2	-0.4160		0.9580	
Shared-ride 3+	0.7920		0.6950	
Household size 4+				
Shared-ride 2	-0.4440		0.9580	
Shared-ride 3+	0.4240		0.6950	
Joint Tour				
Walk	-1.6690			
Joint Tour, if 2 participants				
Shared-ride 3+	-0.1100			
Escort Tour				
Walk	-1.2700			
Tour Mode Constant—Drive Alone				
Drive Alone GP	0.0000		0.0000	
Drive Alone Pay	0.0000		0.0000	
Tour Mode Constant—SR2 Tours				
Individual Tours				
Drive Alone GP	-0.7580		-0.5705	
Drive Alone Pay	-0.7580		-0.5705	
SR2 GP	0.0000		0.0000	
SR2 HOV	0.0000		0.0000	
SR2 Toll	0.0000		0.0000	
Walk	-1.9604		1.8565	
Joint Tours				
Drive Alone GP	-0.6505		-0.6861	
Drive Alone Pay	-0.6505		-0.6861	
SR2 GP	0.0000		0.0000	
SR2 HOV	0.0000		0.0000	
SR2 Toll	0.0000		0.0000	
Walk	-2.1152		1.8316	
Tour Mode Constant—SR3+ Tours				
Zero Car Household				
SR2 GP	-1.4690			
SR2 HOV	-1.4690			
SR2 Toll	-1.4690			

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
Car Deficient Household				
SR2 GP	-0.3240			
SR2 HOV	-0.3240			
SR2 Toll	-0.3240			
Individual Tours				
Drive Alone GP	-0.6570		-1.5976	
Drive Alone Pay	-0.6570		-1.5976	
SR2 GP	-0.0371		-1.2257	
SR2 HOV	-0.0371		-1.2257	
SR2 Toll	-0.0371		-1.2257	
SR3+ GP	0.0000		0.0000	
SR3+ HOV	0.0000		0.0000	
SR3+ Toll	0.0000		0.0000	
Walk	-1.3867		0.9156	
Joint Tours				
Drive Alone GP	-0.4474		-1.7264	
Drive Alone Pay	-0.4474		-1.7264	
SR2 GP	0.0070		-1.2312	
SR2 HOV	0.0070		-1.2312	
SR2 Toll	0.0070		-1.2312	
SR3+ GP	0.0000		0.0000	
SR3+ HOV	0.0000		0.0000	
SR3+ Toll	0.0000		0.0000	
Walk	-1.3413		0.9821	
Tour Mode Constant—Walk Tours				
Walk	0.0000		0.0000	
Tour Mode Constant—Bike Tours				
Bike	0.0000		0.0000	
Tour Mode Constant—Walk Transit				
Zero Car Households				
Walk	1.4240			
Individual Tours				
SR2 GP	-4.3150		-7.2954	
SR2 HOV	-4.3150		-7.2954	
SR2 Toll	-4.3150		-7.2954	
SR3+ GP	-4.7100		n/a	
SR3+ HOV	-4.7100		n/a	

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
SR3+ Toll	-4.7100		n/a	
Walk	2.8147		1.9442	
Walk Local	0.0000		0.0000	
Walk Express	0.0000		0.0000	
Walk BRT	0.0000		0.0000	
Walk Urban Rail	0.0000		0.0000	
Walk Commuter Rail	0.0000		0.0000	
Joint Tours				
SR2 GP	-3.4370		-7.2230	
SR2 HOV	-3.4370		-7.2230	
SR2 Toll	-3.4370		-7.2230	
SR3+ GP	-5.3702		n/a	
SR3+ HOV	-5.3702		n/a	
SR3+ Toll	-5.3702		n/a	
Walk	2.7719		1.8704	
Walk Local	0.0000		0.0000	
Walk Express	0.0000		0.0000	
Walk BRT	0.0000		0.0000	
Walk Urban Rail	0.0000		0.0000	
Walk Commuter Rail	0.0000		0.0000	
Tour Mode Constant—PNR Transit[1]				
Individual Tours				
Drive Alone GP	0.7378		0.6625	
Drive Alone Pay	0.7378		0.6625	
SR2 GP	0.5403		0.3222	
SR2 HOV	0.5403		0.3222	
SR2 Toll	0.5403		0.3222	
SR3+ GP	0.7378		0.3222	
SR3+ HOV	0.7378		0.3222	
SR3+ Toll	0.7378		0.3222	
Walk	0.0000		0.5149	
Walk Local	3.3193		0.9102	
Walk Express	3.3193		0.9102	
Walk BRT	3.3193		0.9102	
Walk Urban Rail	3.3193		0.9102	
Walk Commuter Rail	3.3193		0.9102	
PNR Local	0.0000		0.0000	

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
PNR Express	0.0000		0.0000	
PNR BRT	0.0000		0.0000	
PNR Urban Rail	0.0000		0.0000	
PNR Commuter Rail	0.0000		0.0000	
Joint Tours				
Drive Alone GP	0.0000		0.0000	
Drive Alone Pay	0.0000		0.0000	
SR2 GP	0.0000		0.0000	
SR2 HOV	0.0000		0.0000	
SR2 Toll	0.0000		0.0000	
SR3+ GP	0.0000		0.0000	
SR3+ HOV	0.0000		0.0000	
SR3+ Toll	0.0000		0.0000	
Walk	0.0000		0.0000	
Walk Local	0.0000		0.0000	
Walk Express	0.0000		0.0000	
Walk BRT	0.0000		0.0000	
Walk Urban Rail	0.0000		0.0000	
Walk Commuter Rail	0.0000		0.0000	
PNR Local	0.0000		0.0000	
PNR Express	0.0000		0.0000	
PNR BRT	0.0000		0.0000	
PNR Urban Rail	0.0000		0.0000	
PNR Commuter Rail	0.0000		0.0000	
Tour Mode Constant—KNR Transit[1]				
Individual Tours				
SR2 GP	0.8273		1.1577	
SR2 HOV	0.8273		1.1577	
SR2 Toll	0.8273		1.1577	
SR3+ GP	0.5532		0.9654	
SR3+ HOV	0.5532		0.9654	
SR3+ Toll	0.5532		0.9654	
Walk	0.9888		0.8376	
Walk Local	3.2537		1.1461	
Walk Express	3.2537		1.1461	
Walk BRT	3.2537		1.1461	
Walk Urban Rail	3.2537		1.1461	

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
Walk Commuter Rail	3.2537		1.1461	
PNR Local	n/a		n/a	
PNR Express	n/a		n/a	
PNR BRT	n/a		n/a	
PNR Urban Rail	n/a		n/a	
PNR Commuter Rail	n/a		n/a	
Joint Tours				
SR2 GP	1.9411		0.0000	
SR2 HOV	1.9411		0.0000	
SR2 Toll	1.9411		0.0000	
SR3+ GP	1.9411		0.0000	
SR3+ HOV	1.9411		0.0000	
SR3+ Toll	1.9411		0.0000	
Walk	1.9411		0.0000	
Walk Local	4.1001		0.0000	
Walk Express	4.1001		0.0000	
Walk BRT	4.1001		0.0000	
Walk Urban Rail	4.1001		0.0000	
Walk Commuter Rail	4.1001		0.0000	
PNR Local	n/a		n/a	
PNR Express	n/a		n/a	
PNR BRT	n/a		n/a	
PNR Urban Rail	n/a		n/a	
PNR Commuter Rail	n/a		n/a	
Transit Line-Haul Constants				
Express Bus	0.3400	10 min	0.3000	10 min
BRT	0.3400	10 min	0.3000	10 min
LRT	0.5100	15 min	0.4500	15 min
Commuter Rail	0.6800	20 min	0.6000	20 min
HOV & Toll Constants				
Individual Tours				
Pay modes	0.2767	8 min	-0.5127	-17 min
HOV modes	-0.0563	-2 min	0.0101	<1 min
Joint Tours				
Pay modes	-0.0001	<1 min	0.0003	<1 min
HOV modes	-0.0239	<1 min	0.0542	2 min
Off-Diagonal Mode Constants				

Utility Terms	Maintenance Tours		Discretionary Tours	
	Coef.	Ratio	Coef.	Ratio
SR2 Tours				
First trip	0.0000		0.8070	
Last trip	0.0000		0.0000	
No stops	0.0000		-3.2410	
SR3+ Tours				
First trip	0.0000		0.3970	
Last trip	0.0000		0.0000	
No stops	0.0000		-1.7730	
Walk to Transit Tours				
First trip	-1.4770		-3.0450	
Last trip	0.0000		0.0000	
No stops	-1.5218		-3.0600	
PNR to Transit Tours				
First trip	-5.0000		-5.0000	
Last trip	-5.0000		-5.0000	
No stops	0.0000		0.0000	
KNR to Transit Tours				
First trip	-5.0000		-5.0000	
Last trip	-5.0000		-5.0000	
No stops	0.0000		0.0000	

(1)Tour mode constants apply when auto trips are allowed in a PNR to Transit tour, or when walk trips are allowed in a KNR to Transit tour.

Table 85: Observed Trip Mode Switching Distribution, Work Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	3,635,764																					3,635,764
Shared 2	474,229	655,956		19,655																		1,149,840
Shared 3+	217,493	124,135	225,739	2,988																		570,354
Walk				53,505																		53,505
Bike					10,978																	10,978
Walk-Loc		7,202	3,863	11,392		108,689																131,146
Walk-Exp		472	258	1,636		1,552	10,363															14,281
Walk-BRT		93	51	324		307		2,051														2,827
Walk-UR		753	412	2,609		2,476			16,530													22,780
Walk-CR		93	51	324		307				2,051												2,827
PNR-Loc											1,948											1,948
PNR-Exp	894	733	20	587								3,858										6,092
PNR-BRT	53	44	1	35									230									363
PNR-UR	3,436	2,817	78	2,254										14,823								23,408
PNR-CR	1,127	924	26	739											4,862							7,677
KNR-Loc																3,896						3,896
KNR-Exp		444	12	162													1,067					1,686
KNR-BRT		66	2	24														158				250
KNR-UR		1,716	48	628															4,129			6,520
KNR-CR		648	18	237																1,560		2,463
School Bus																						-
Total	4,332,997	796,096	230,580	97,099	10,978	113,331	10,363	2,051	16,530	2,051	1,948	3,858	230	14,823	4,862	3,896	1,067	158	4,129	1,560	-	5,648,607

Table 86: Estimated Trip Mode Switching Distribution, Work Tours

Tour Mode	Trip Mode																				Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	3,949,410																					3,949,410
Shared 2	408,100	554,840		18,340																		981,280
Shared 3+	153,930	90,800	157,150	2,330																		404,210
Walk				57,090																		57,090
Bike					13,170																	13,170
Walk-Loc		6,680	2,920	14,260		94,250	3130	210	11200	360												133,010
Walk-Exp		530	210	880		1,970	4,920	30	860	40												9,440
Walk-BRT		160	120	330		320	40	2,320	320													3,610
Walk-UR		780	450	3,680		3,890	580	80	27,270	60												36,790
Walk-CR		160	100	250		540	50		90	1,060												2,250
PNR-Loc	360	510	20	210		50			10		1,370	100	10	80	30							2,750
PNR-Exp	1080	930	30	590		60	30		40		910	1,870	10	450	420							6,420
PNR-BRT	240	220	10	80		10		10	10		130	40	560	90	20							1420
PNR-UR	3,240	3,100	100	2,700		180	70	40	540		1630	200	80	12,340	650							24,870
PNR-CR	1,260	1570	60	690		30	10		10		870	270	10	470	2,210							7,460
KNR-Loc		1210	20	300		130	10		10							2,450	190	20	420	400		5,160
KNR-Exp		340		130		50	10		10							160	460	10	120	130		1,420
KNR-BRT		200	10	30		10			10							60	10	230	10	20		590
KNR-UR		1,810	30	790		140		50	220							500	130		4,460	390		8,520
KNR-CR		530	20	150		60	10		20	10						130	150		240	1,350		2,670
School Bus																						
Total	4,517,620	664,370	161,250	102,830	13,170	101,690	8,860	2,740	40,620	1,530	4,910	2,480	670	13,430	3,330	3,300	940	260	5,250	2,290		5,651,540

Table 87: Observed Trip Mode Switching Distribution, University Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	258,674																					258,674
Shared 2	25,635	94,837		7,439																		127,911
Shared 3+	5,234	26,453	48,107	4,046																		83,841
Walk				28,991																		28,991
Bike					6,844																	6,844
Walk-Loc						18,071																18,071
Walk-Exp							1,892															1,892
Walk-BRT								188														188
Walk-UR									4,792													4,792
Walk-CR										324												324
PNR-Loc											420											420
PNR-Exp			1									8										9
PNR-BRT			1										6									6
PNR-UR			167											1,116								1,283
PNR-CR			85												571							657
KNR-Loc																871						871
KNR-Exp			6														41					47
KNR-BRT			4															28				32
KNR-UR			126																842			968
KNR-CR			57																	381		437
School Bus																						
Total	289,542	121,290	48,555	40,477	6,844	18,071	1,892	188	4,792	324	420	8	6	1,116	571	871	41	28	842	381		536,257

Table 88: Estimated Trip Mode Switching Distribution, University Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	282,090																					282,090
Shared 2	21,130	76,530		5,140																		102,800
Shared 3+	5,260	27,730	48,830	4,070																		85,890
Walk				30,930																		30,930
Bike					8,610																	8,610
Walk-Loc		60	10	1,460		17,710	920	300	680	60												21,200
Walk-Exp				40		240	750	10	30													1,070
Walk-BRT				70		260	20	630														980
Walk-UR		10		290		720	70	30	3,060													4,180
Walk-CR				10		70				110												190
PNR-Loc	60	30	40								470	70	10	40	10							730
PNR-Exp	50	10									80	180		20	10							350
PNR-BRT	20		20								30		100	10	10							190
PNR-UR	110	50	70								160	80	10	570	30							1,080
PNR-CR	10	10	10								120	30			120							300
KNR-Loc		20	20	40		30			10							580	40	20	60	20		840
KNR-Exp			20			30										20	80	10	40	10		210
KNR-BRT			10			10										20		30	10			80
KNR-UR		30	70	20		40			20							80	10		390	30		690
KNR-CR		10	10													80	20		20	90		230
School Bus																						
Total	308,730	104,490	49,110	42,070	8,610	19,110	1,760	970	3,800	170	860	360	120	640	180	780	150	60	520	150		542,640

Table 89: Observed Trip Mode Switching Distribution, School Tours

Tour Mode	Trip Mode																				Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	34,013																					34,013
Shared 2	4,094	321,935		17,256																		343,285
Shared 3+	29,698	129,208	900,981	62,388																		1,122,275
Walk				215,187																		215,187
Bike					20,493																	20,493
Walk-Loc		548	429	2,515		21,591																25,083
Walk-Exp		32		518		173	1,160															1,883
Walk-BRT		7		117		39		262														425
Walk-UR		95		1,555		518			3,480													5,647
Walk-CR		2		35		12				79												128
PNR-Loc											331											331
PNR-Exp		4	1									11										16
PNR-BRT		1	0										3									4
PNR-UR		25	8											70								104
PNR-CR		42	14												118							174
KNR-Loc																1,167						1,167
KNR-Exp		19	6														54					80
KNR-BRT		11	3															30				44
KNR-UR		300	99																838			1,237
KNR-CR		343	113																	960		1,416
School Bus	2,758	48,643	59,627	23,105	8,125	24,627															339,820	506,706
Total	70,563	501,215	961,283	322,676	28,619	46,960	1,160	262	3,480	79	331	11	3	70	118	1,167	54	30	838	960	339,820	2,279,697

Table 90: Estimated Trip Mode Switching Distribution, School Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	41,660																					41,660
Shared 2		347,310		17,860																		365,170
Shared 3+		132,350	955,040	69,200																		1,156,590
Walk				222,300																		222,300
Bike					21,320																	21,320
Walk-Loc		460	210	4,170		21,970	510	140	320													27,780
Walk-Exp		20	10	140		180	660															1,010
Walk-BRT		40		90		130	20	340	20													640
Walk-UR		100	20	250		550	80	20	940													1,960
Walk-CR						50				10												60
PNR-Loc	40	60	10	10							120	10										250
PNR-Exp											20	40										60
PNR-BRT		10									30	10	40									90
PNR-UR	50	50	10								50	10		150	10							330
PNR-CR		10									30	10										50
KNR-Loc		50	10	30												290	10		20	10		420
KNR-Exp		220	30	10		10										470	250	20	60	60		1,130
KNR-BRT		60		10			10									220	20	100	30			450
KNR-UR		330	20	10		20										470	150	20	830	80		1,930
KNR-CR		30	30													140	10			140		350
School Bus																					388,860	388,860
Total	41,750	481,100	955,390	314,080	21,320	22,910	1,280	500	1,280	10	250	80	40	150	10	1,590	440	140	940	290	388,860	2,232,410

Table 91: Observed Trip Mode Switching Distribution, Maintenance Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm.Rail	School Bus	
Drive-Alone	2,805,567																					2,805,567
Shared 2	590,477	2,159,426		14,869																		2,764,772
Shared 3+	258,220	243,872	1,254,595	9,026																		1,765,713
Walk				765,993																		765,993
Bike					41,957																	41,957
Walk-Loc		1,432	6,638	9,833		84,945																102,848
Walk-Exp		753	477	1,699		1,070	5,471															9,470
Walk-BRT		498	316	1,125		708		3,622														6,270
Walk-UR		752	477	1,697		1,069			5,466													9,461
Walk-CR		50	32	112		71				362												626
PNR-Loc											1,685											1,685
PNR-Exp	60	61	29	48								93										291
PNR-BRT	64	65	31	51									99									311
PNR-UR	507	511	246	401										784								2,448
PNR-CR	292	294	142	231											452							1,412
KNR-Loc																3,350						3,350
KNR-Exp		393	189	185													362					1,129
KNR-BRT		184	89	86														169				528
KNR-UR		363	175	170															334			1,041
KNR-CR		318	153	149																292		912
School Bus																						
Total	3,655,188	2,408,972	1,263,587	805,675	41,957	87,863	5,471	3,622	5,466	362	1,685	93	99	784	452	3,350	362	169	334	292		8,285,783

Table 92: Estimated Trip Mode Switching Distribution, Maintenance Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	2,999,650																					2,999,650
Shared 2	659,470	2,087,750		15,720																		2,762,940
Shared 3+	270,530	205,650	1,044,200	8,790																		1,529,170
Walk				883,590																		883,590
Bike					49,010																	49,010
Walk-Loc		3,430	6,110	11,570		77,100	1,120	340	2,270	100												102,040
Walk-Exp		30	90	200		250	1,420	10	120	10												2,130
Walk-BRT		100	140	350		400	20	2,550	60													3,620
Walk-UR		280	370	1,260		1,700	80	40	7,910													11,640
Walk-CR		10	30	70		480	50			740												1,380
PNR-Loc																						
PNR-Exp																						
PNR-BRT																						
PNR-UR																						
PNR-CR																						
KNR-Loc		700	600	230		130			20							2,040	60	30	100	50		3,960
KNR-Exp		60	20	40		20										50	40		20	10		260
KNR-BRT																30		110	20			160
KNR-UR		430	150	160		20			10							270	30	50	920	20		2,060
KNR-CR		200	60	50		10			10							180			30	400		940
School Bus																						
Total	3,929,650	2,298,640	1,051,770	922,030	49,010	80,110	2,690	2,940	10,400	850						2,570	130	190	1,090	480		8,352,550

Table 93: Observed Trip Mode Switching Distribution, Discretionary Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	1,014,631																					1,014,631
Shared 2	101,217	975,412		4,769																		1,081,398
Shared 3+	65,539	156,548	833,793	8,271																		1,064,151
Walk				1,056,556																		1,056,556
Bike				952	169,886																	170,838
Walk-Loc		159	738	1,093		9,438																11,428
Walk-Exp		84	53	189		119	608															1,052
Walk-BRT		55	35	125		79		402														697
Walk-UR		84	53	189		119			607													1,051
Walk-CR		6	4	12		8				40												70
PNR-Loc											187											187
PNR-Exp	7	7	3	5								10										32
PNR-BRT	7	7	3	6									11									35
PNR-UR	56	57	27	45										87								272
PNR-CR	32	33	16	26											50							157
KNR-Loc																372						372
KNR-Exp		44	21	21													40					125
KNR-BRT		20	10	10														19				59
KNR-UR		40	19	19															37			116
KNR-CR		35	17	17																32		101
School Bus																						
Total	1,181,490	1,132,590	834,792	1,072,302	169,886	9,763	608	402	607	40	187	10	11	87	50	372	40	19	37	32		4,403,328

Table 94: Estimated Trip Mode Switching Distribution, Discretionary Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	1,025,140																					1,025,140
Shared 2	99,190	960,250		4,120																		1,063,560
Shared 3+	72,390	120,550	713,550	6,010																		912,500
Walk				1,158,670																		1,158,670
Bike					188,370																	188,370
Walk-Loc		280		1,730		8,370	160	60	80	10												10,690
Walk-Exp		30		20		30	80															160
Walk-BRT		30				30		150														210
Walk-UR		40		160		760	70		670													1,700
Walk-CR				60		40				280												380
PNR-Loc											140	10		10								160
PNR-Exp											10			10								20
PNR-BRT	50			20							20		20									110
PNR-UR	20	20	10	30							30	10	20	200	20							360
PNR-CR		10	10	10							10	20		10	40							110
KNR-Loc		100	50	30												230	10		50			470
KNR-Exp																						
KNR-BRT																						
KNR-UR		40	20													20			140			220
KNR-CR		10	20	30												20			20	40		140
School Bus																						
Total	1,196,790	1,081,360	713,660	1,170,890	188,370	9,230	310	210	750	290	210	40	40	230	60	270	10		210	40		4,362,970

Table 95: Observed Trip Mode Switching Distribution, Work-based Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm .Rail	School Bus	
Drive-Alone	1,025,140																					1,025,140
Shared 2	99,190	960,250		4,120																		1,063,560
Shared 3+	72,390	120,550	713,550	6,010																		912,500
Walk				1,158,670																		1,158,670
Bike					188,370																	188,370
Walk-Loc		280		1,730		8,370	160	60	80	10												10,690
Walk-Exp		30		20		30	80															160
Walk-BRT		30				30		150														210
Walk-UR		40		160		760	70		670													1,700
Walk-CR				60		40				280												380
PNR-Loc											140	10		10								160
PNR-Exp											10			10								20
PNR-BRT	50			20							20		20									110
PNR-UR	20	20	10	30							30	10	20	200	20							360
PNR-CR		10	10	10							10	20		10	40							110
KNR-Loc		100	50	30												230	10		50			470
KNR-Exp																						
KNR-BRT																						
KNR-UR		40	20													20			140			220
KNR-CR		10	20	30												20			20	40		140
School Bus																						
Total	1,196,790	1,081,360	713,660	1,170,890	188,370	9,230	310	210	750	290	210	40	40	230	60	270	10		210	40		4,362,970

Table 96: Estimated Trip Mode Switching Distribution, Work-based Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm. Rail	School Bus	
Drive-Alone	255,840																					255,840
Shared 2	4,380	80,340		990																		85,710
Shared 3+	760	7,400	50,810	1,210																		60,180
Walk				139,880																		139,880
Bike					3,200																	3,200
Walk-Loc				520		8,530	80	20	260	20												9,430
Walk-Exp						10	40		10													60
Walk-BRT				20		30		320														370
Walk-UR				30		260	10	10	1,270	10												1,590
Walk-CR				10		60																70
PNR-Loc																						
PNR-Exp																						
PNR-BRT																						
PNR-UR																						
PNR-CR																						
KNR-Loc																						
KNR-Exp																						
KNR-BRT																						
KNR-UR																						
KNR-CR																						
School Bus																						
Total	260,980	87,740	50,810	142,660	3,200	8,890	130	350	1,540	30												556,330

Table 97: Observed Trip Mode Switching Distribution, All Tours

Tour Mode	Trip Mode																				Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Com. Rail	School Bus	
Drive-Alone	8,005,735																					8,005,735
Shared 2	1,200,604	4,291,363		63,965																		5,555,932
Shared 3+	577,443	692,088	3,329,287	88,453																		4,687,271
Walk				2,237,287																		2,237,287
Bike				952	250,028																	250,980
Walk-Loc		9,341	11,668	24,833		251,276																297,118
Walk-Exp		1,443	845	4,401		3,254	22,275															32,218
Walk-BRT		654	402	1,691		1,133		6,717														10,598
Walk-UR		1,683	942	6,050		4,182			32,478													45,334
Walk-CR		151	86	484		398				2,892												4,010
PNR-Loc											4,903											4,903
PNR-Exp	992	829	56	659								4,129										6,665
PNR-BRT	125	117	37	91									353									723
PNR-UR	3,999	3,409	526	2,699										17,203								27,837
PNR-CR	1,452	1,293	282	996											6,069							10,093
KNR-Loc																10,063						10,063
KNR-Exp		962	237	390													1,764					3,353
KNR-BRT		283	108	121														442				955
KNR-UR		2,419	466	817															6,279			9,981
KNR-CR		1,345	358	403																3,239		5,345
School Bus	2,758	48,643	59,627	23,105	8,125	24,627															339,820	506,706
Total	9,793,108	5,056,024	3,404,928	2,457,398	258,153	284,870	22,275	6,717	32,478	2,892	4,903	4,129	353	17,203	6,069	10,063	1,764	442	6,279	3,239	339,820	21,713,107

Table 98: Estimated Trip Mode Switching Distribution, All Tours

Tour Mode	Trip Mode																					Total
						Walk Access					PNR Access					KNR Access						
	Drive-Alone	Shared 2P	Shared 3P+	Walk	Bike	Local	Exp	BRT	Urban Rail	Com. Rail	Local	Exp	BRT	Urban Rail	Comm Rail	Local	Exp	BRT	Urban Rail	Comm.Rail	School Bus	
Drive-Alone	8,553,790																					8,553,790
Shared 2	1,192,270	4,107,020		62,170																		5,361,460
Shared 3+	502,870	584,480	2,969,580	91,610																		4,148,540
Walk				2,492,460																		2,492,460
Bike					283,680																	283,680
Walk-Loc		10,910	9,250	33,710		227,930	5,920	1,070	14,810	550												304,150
Walk-Exp		610	310	1,280		2,680	7,870	50	1,020	50												13,870
Walk-BRT		330	260	860		1,170	100	6,310	400													9,430
Walk-UR		1,210	840	5,670		7,880	890	180	41,120	70												57,860
Walk-CR		170	130	400		1,240	100		90	2,200												4,330
PNR-Loc	460	600	70	220		50			10		2,100	190	20	130	40							3,890
PNR-Exp	1,130	940	30	590		60	30		40		1,020	2,090	10	480	430							6,850
PNR-BRT	310	230	30	100		10		10	10		210	50	720	100	30							1,810
PNR-UR	3,420	3,220	190	2,730		180	70	40	540		1,870	300	110	13,260	710							26,640
PNR-CR	1,270	1,600	80	700		30	10		10		1,030	330	10	480	2,370							7,920
KNR-Loc		2,080	700	630		290	10		40							5,590	310	70	650	480		10,850
KNR-Exp		620	70	180		110	10		10							700	830	40	240	210		3,020
KNR-BRT		260	20	40		20	10		10							330	30	470	70	20		1,280
KNR-UR		2,640	290	980		220		50	250							1,340	320	70	6,740	520		13,420
KNR-CR		780	140	230		70	10		30	10						550	180		310	2,020		4,330
School Bus																					388,860	388,860
Total	10,255,520	4,717,700	2,981,990	2,694,560	283,680	241,940	15,030	7,710	58,390	2,880	6,230	2,960	870	14,450	3,580	8,510	1,670	650	8,010	3,250	388,860	21,698,440

Model 6.2—Parking Location Choice

Number of Models: 1
Decision-Making Unit: Tours
Model Form: MultinomialLogit
Alternatives: MAZs within one mile of the destination MAZ

The parking location choice model determines where vehicles are parked at the terminal end of tours with a destination in parking-priced MAZs. Modeled parking priced areas include downtown Miami, Fort Lauderdale and West Palm Beach, as well as the Jackson Memorial Hospital area in Miami. Due to lack of observed disaggregate parking choice data in SE Florida, the SANDAG parking lot choice model was transferred 'as is' to SERPM 7.0. As shown in Table 99, the utility of parking lots is modeled as a tradeoff between parking cost and walking distance.

Table 99: Parking Location Choice Model Parameters

Explanatory Variables	Work Tours	Non-Work Tours
	Coefficient	Coefficient
Parking cost ($)	-0.72	-0.41
Walk distance (mi)	-8.59	-4.93

Base Year Model Validation

This section presents the highway and transit assignment results for the year 2010, with comparisons to observed data from the FDOT and MPO highway traffic count database and reported transit operator system boardings.

Highway Assignment

After the demand models have run, the trip lists output from the model are converted to trip matrices, segmented by mode and time period, combined with commercial, internal-external, and air passenger trips, and assigned to the five period-specific highway networks. Each time period's assignment is a multi-class static user equilibrium assignment with the following user classes: Drive Alone (free), Drive Alone (pay), Shared Ride 2 (free), Shared Ride 2 (pay), Shared Ride 3+ (free), Shared Ride 3+ (pay), Small Trucks, and Large Trucks. The solution to the traffic assignment problem is found using the Frank-Wolfe algorithm. The convergence criterion is a relative gap of 0.0001.

The highway assignment was validated against a count database comprised of data from Florida DOT Districts 4 and 6, Florida Turnpike Enterprise, and counts from multiple cities in the region provided by the Miami-Dade, Broward and Palm Beach MPOs. The database includes approximately 3,500 individual count observations. Each observations was split into two data points, one per direction, resulting in nearly 7,000 count data points available for comparison to the model output. The majority of counts are for total average daily traffic. Approximately 1/3 of the observations include time period counts.

The match between the modeled highway volumes and the observed traffic counts is detailed by Volume Group and Facility Type in Table 100 and Table 101, respectively.

The screenline and cutline validation is shown in Table X. The sceenline and cutline maps are shown in Figure 48 and Figure 49.

Table 100: Volume Group Validation

	Volume Group	Model RMSE	Recommended RMSE	Estimated Volume	Count Volume	Estimated To Count Ratio	Number of Observations
1	1- 5,000	89.8%	45 - 55%	6,033,560	4,924,685	1.23	1,589
2	5,000- 10,000	58.0%	35 - 45%	13,706,122	12,980,478	1.06	1,752
3	10,000- 20,000	34.0%	27 - 35%	30,582,228	31,185,063	0.98	2,110
4	20,000- 30,000	25.8%	24 - 27%	20,333,233	21,662,135	0.94	903
5	30,000- 40,000	23.6%	22 - 24%	5,870,490	5,964,127	0.98	176
6	40,000- 50,000	22.6%	20 - 22%	2,550,308	2,724,645	0.94	60
7	50,000- 60,000	23.1%	18 - 20%	1,135,892	1,212,303	0.94	22
8	60,000- 70,000	19.5%	17 - 18%	2,265,251	2,367,520	0.96	36
9	70,000- 80,000	19.8%	16 - 17%	4,025,391	4,093,369	0.98	54
10	80,000- 90,000	24.5%	15 - 16%	3,864,289	4,027,900	0.96	48
11	90,000-100,000	20.3%	14 - 15%	2,134,509	2,275,971	0.94	24
12	100,000-500,000	12.6%	LT 14 %	4,159,213	4,360,258	0.95	40
	All Groups	38.4%	32 - 39%	96,660,486	97,778,454	0.99	6,814

Table 101: Facility Type Validation

Facility Type	Model RMSE	Estimated Volume	Count Volume	Estimated To Count Ratio	Number of Observations
Freeways	20.1%	17,589,337	18,045,821	0.97	236
Uninterrupted Roadways	52.2%	1,598,488	1,419,154	1.13	187
High Speed Arterials	33.5%	51,895,244	52,101,667	1.00	3,667
Low Speed Collectors	58.8%	10,070,638	11,449,488	0.88	1,744
Ramps	61.5%	7,915,704	7,284,740	1.09	715
HOV Lanes	26.1%	1,770,406	1,721,433	1.03	82
Toll Roads	21.8%	5,820,669	5,732,702	1.02	178
HOT Lanes	23.6%	501,694	488,660	1.03	22
All Groups	38.4%	96,660,486	97,778,454	0.99	6,814

Table 102: Screenline Validation

No.	Screenline Location	Estimated Volume	Count Volume	Volume to Count Ratio	No. of Links	No. of Links with Count	Maximum Allowance
2	PB:EW Southern SL North of Clintmore Rd	505,422	427,240	1.18	24	24	0.12
3	PB:EW SL along N of Boynton Bch Blvd	516,135	477,834	1.08	28	28	0.11
4	PB:EW Middle SL along S of Forest Hill	585,482	582,665	1.00	48	46	0.10
5	PB:EW Northern SL along N of 45th St	379,343	382,749	0.99	32	32	0.13
6	PB:EW Northern SL along N of Donald Ross	250,052	261,682	0.96	26	26	0.15
7	PB:EW Ext SL @Martin County Line	164,037	157,150	1.04	18	18	0.19
8	PB:NS CL W of TPK from PGA-Beeline	84,809	75,436	1.12	6	6	0.29
9	PB:NS CL E of I95 from PGA-Northlake	130,762	133,198	0.98	10	8	0.21
10	PB:NS CL along TPK from SR704-SR822	163,370	161,617	1.01	8	8	0.19
11	PB:NS CL E of SR809 from SR704-Gun Club	174,174	190,285	0.92	14	14	0.18
12	PB:NS CL E of I95 from PB Lakes-Summitt	215,234	235,532	0.91	18	16	0.16
13	PB:NS CL along I95 from Lake IDA-Linton	111,308	114,945	0.97	8	8	0.23
14	PB:NS CL along TPK from Clintmore-SR806	81,733	96,125	0.85	6	6	0.28
15	PB:NS CL along I95 from SR794-SW18th	207,967	209,381	0.99	14	14	0.17
17	PB:NS CL by Heaven Hill Summitt-Gateway	203,497	243,734	0.83	20	20	0.16
18	PB:NS SL along Intra-Coastal Crossings	275,106	286,342	0.96	38	38	0.15
21	BO:EW Northern SL along Pompano Canal	695,505	642,010	1.08	33	31	0.10
22	BO:EW Middle SL along Oakland Park Blvd	992,547	967,780	1.03	48	48	0.08
23	BO:EW Southern SL along River Canal	859,024	815,025	1.05	42	38	0.09
24	BO:NS Western SL between I75 and TPK	572,701	643,228	0.89	41	38	0.10
25	BO:NS Middle SL along TPK	1,291,710	1,248,500	1.03	59	59	0.07
26	BO:NS Eastern SL along Intracostal Waterway	287,271	271,900	1.06	24	24	0.15
27	BO:EW SL BO/PB County Line	532,457	472,378	1.13	28	28	0.11
28	BO:EW SL BO/MD County Line	917,055	850,579	1.08	40	40	0.09
29	BO:Western Ext CL @ Collier County Line	19,446	19,400	1.00	2	2	0.47
32	BO:NS I-95 CL from Miami-Dade to I-595	383,317	390,705	0.98	22	22	0.13
33	BO:NS Western CL alng SR897 frm PB-SR816	406,085	419,800	0.97	38	34	0.12

No.	Screenline Location	Estimated Volume	Count Volume	Volume to Count Ratio	No. of Links	No. of Links with Count	Maximum Allowance
34	BO:NS I-95 CL from Palm Beach to I-595	910,623	972,215	0.94	48	48	0.08
42	MD:NS SL east of TPK	863,712	963,586	0.90	72	64	0.08
43	MD:EW SL south of I-75/Gratigny (SR 924)	960,209	1,037,384	0.93	58	54	0.08
44	MD:NS SL east of Palmeto Expwy (SR 826)	999,911	1,174,329	0.85	56	52	0.07
45	MD:EW SL south of SR934	920,260	887,580	1.04	52	44	0.08
46	MD:NS SL west of SR9/27th Avenue	1,148,072	1,057,107	1.09	76	64	0.08
47	MD:EW SL south of Dolphin Expwy (SR 836)	1,165,747	1,144,762	1.02	61	51	0.07
48	MD:EW CL along TPK ext and SR 826	711,107	685,171	1.04	36	30	0.10
49	MD:EW SL S of SR986/72ndSt & SnapperExpy	555,202	577,700	0.96	47	37	0.10
50	MD:NS SL west of I-95	1,255,531	1,085,225	1.16	88	60	0.08
51	MD:EW SL north of 152nd St (SR 992)	180,280	165,600	1.09	18	14	0.19
52	MD:NS Eastern SL along Intracostal Wway	434,346	388,763	1.12	18	18	0.13
53	MD:EW SL between 200th and 216th St	209,914	239,200	0.88	24	18	0.16

Figure 48: Screenline Locations

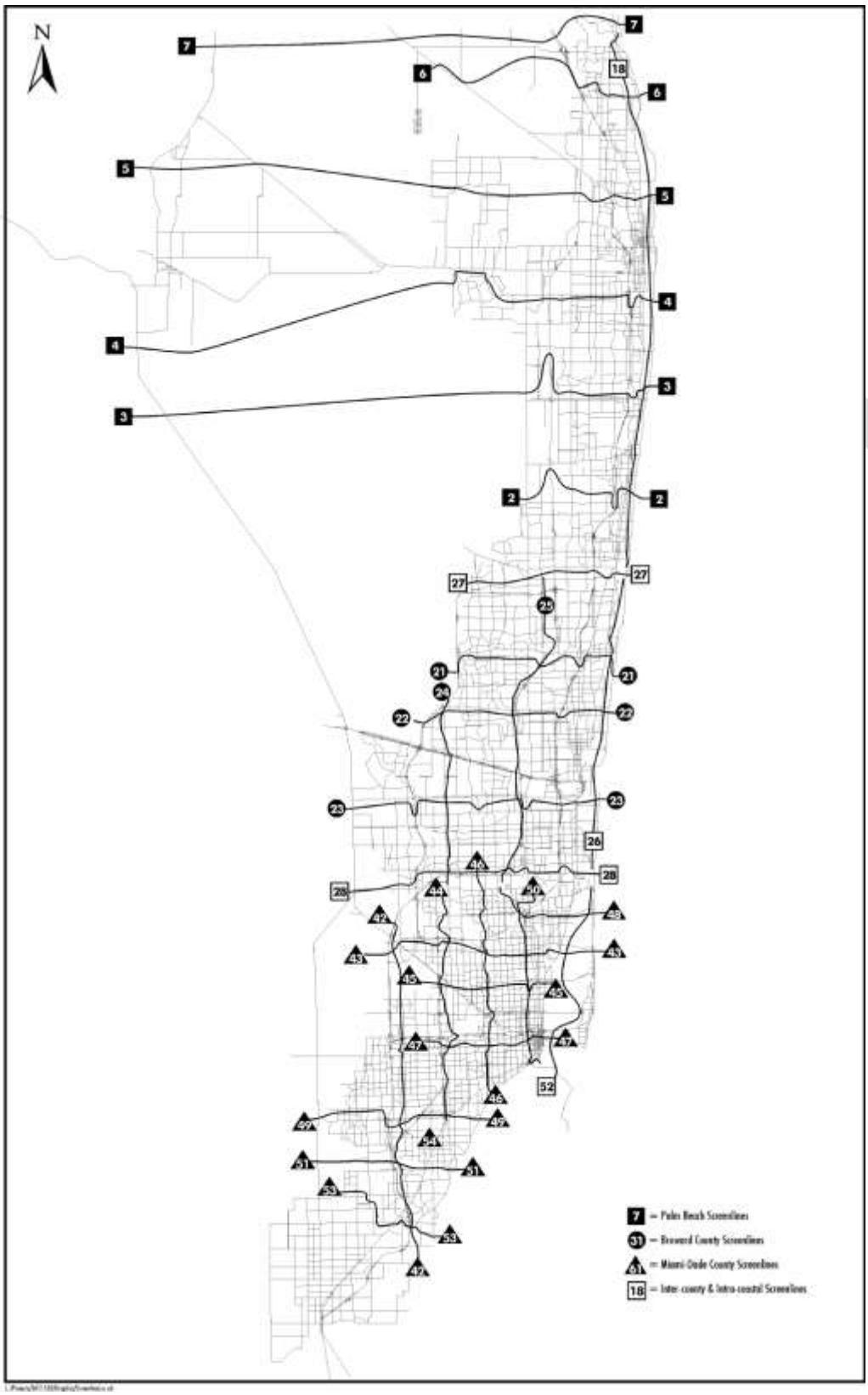
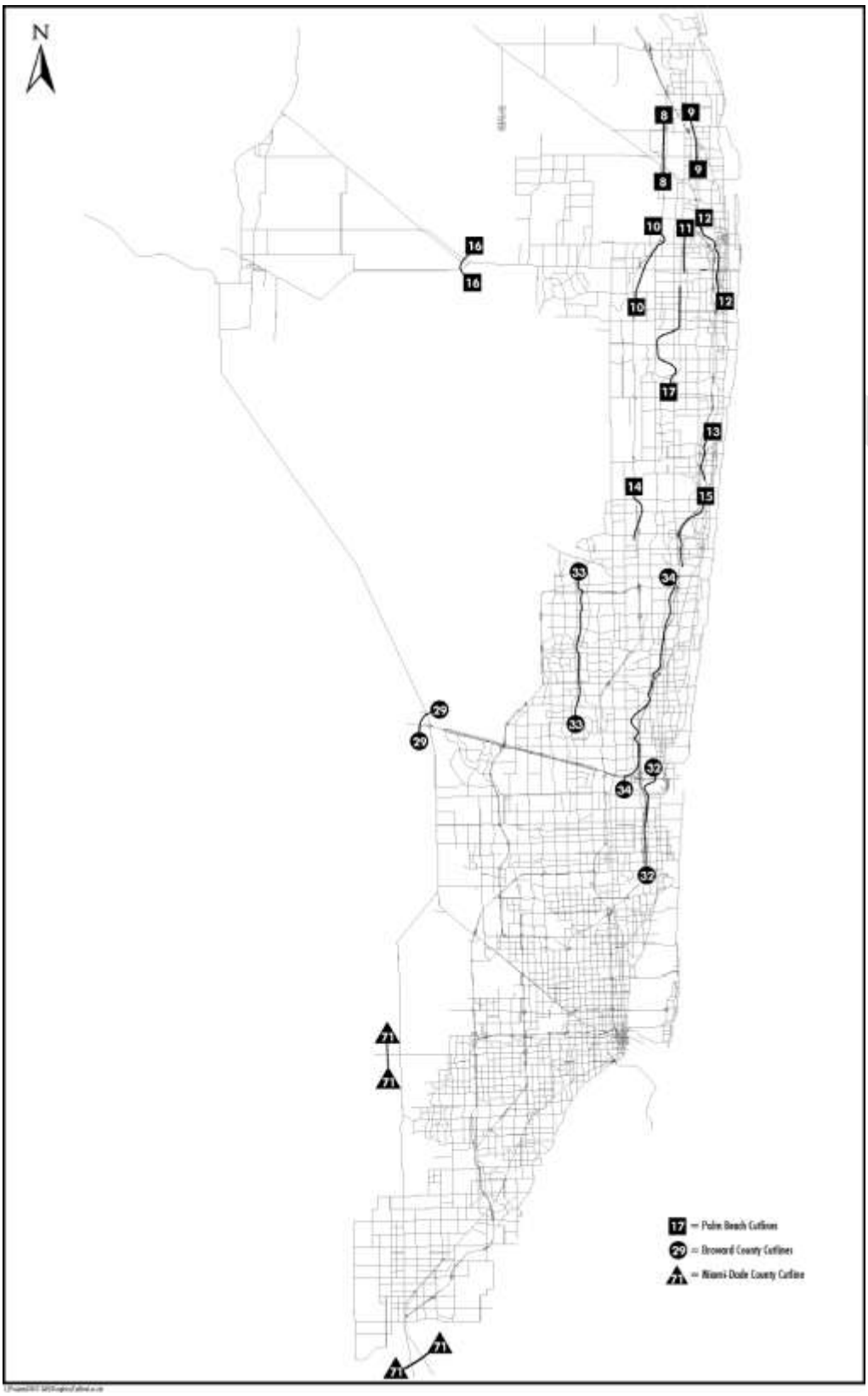


Figure 49: Cutline Locations



Transit Boardings Validation

Transit boardings by mode and operator are shown in Table 103.

Table 103: Transit Boardings Validation, Mode and Operator

Mode	Description	Observed Boardings	Estimated Boardings	Error
111	Tri-Rail	12,200		
121	Metrorail	57,880		
151/253	Inter-County Express Bus	1,413		
191/192	Trolleys/Shuttles			
242	BRT - MDT	11,640		
251	Express Bus - MDT	4,369		
252	I-95 Express Bus - MDT	2,497		
281	Metromover	26,300		
292	Local Bus - MDT	211,000		
351	Express Bus - BCT	3,365		
392	Local Bus - BCT	115,761		
492	Local Bus – Palm Tran	33,957		
	Total Transit Boardings	**481,670**		