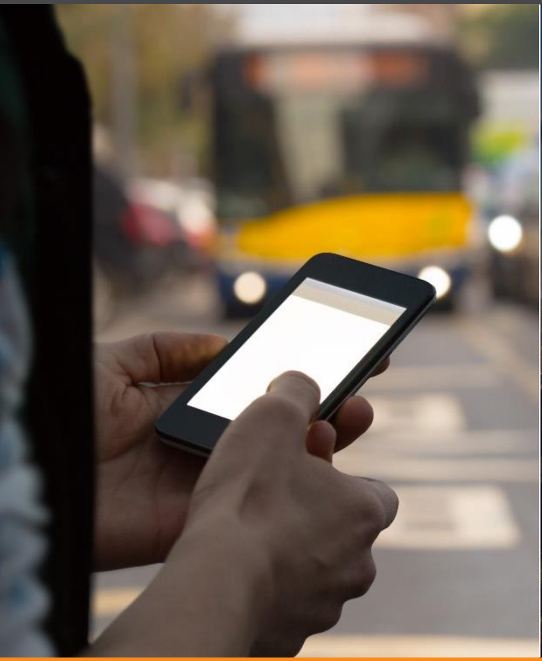
City of SeaTac and SeaTac Airport

AIRPORT MODEL DESIGN

March 6, 2024



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1.0 INTRODUCTION

The new City of SeaTac travel model is a local implementation of PSRC's SoundCast activity-based model. As part of the model development, a new Airport Model was developed to generate passengers' ground travel to/from the Seatle-Tacoma International (SEA) airport. The airport model development borrowed the framework from SANDAG's Airport Model which is in an ActivitySim framework, updated it with local data and requirements, and transfered mode choice parameters as seen fit from the current standalone SEA mode choice model.

The SEA airport generates ground-access travel for the people travelling to the airport for work, and air passengers travelling to/from the airport. The new airport model is responsible for generating the latter travel, passengers' ground-access travel, and worker's walk travel from offsite airport parking to the SEA airport terminal. The work travel to SEA airport (or offsite airport parking) is already included in the DaySim resident demand model. The new Airport model represents the last leg (to/from parking to Airport terminal) of their travel to the airport. The new disaggregate airport model replaced SoundCast's aggregate airport model. The new model in ActivitySim framework brings the following benefits:

- The disaggregate framework is capable of testing a wide set of application scenarios (see below for example applications).
- The SeaTac Airport Model framework allows for adding multiple access locations easier, more flexible, and more efficient. These enhancements will further expand the new model's ability to test airport access scenarios.
- PSRC is working on converting the SoundCast model to ActivitySim framework. The new SEA airport model in ActivitySim framework aligns with PSRC's future model development plans and therefore, should the new SeaTac model transitioned to PSRC's ActivitySim framework in future, the efforts spent here would be carried over with little additional effort.

With the new airport model, the agencies will be able to test the following policy sensitivities and model applications:

- Unified treatment of airport passenger travel demand within the overall regional travel model passenger demand
- Changes in forecasted airport enplanements
- Changes in land-use around airport and throughout the region
- Auto and transit investments
- Changes in parking options, price, and locations

- Changes in rental car costs and rental car center access
- Changes in curbside access locations
- Changes in ride-hail price and access locations
- Changes in employee offsite parking locations

2.0 MODEL DIMENSIONS

This chapter describes the primary travel dimensions of the new SEA Airport model including trip purpose, trip mode, treatment of time, and treatment of space.

2.1 TRIP PURPOSE

The airport model includes six trip purposes (see Table 1): four based on resident status (resident/visitor) of passengers and purpose of travel (business/personal), one for travel from outside the PSRC region (external), and one for employees from offsite employee parking to the SEA airport terminal (employee).

TABLE 1: AIRPORT MODEL PURPOSES

PURPOSE	DESCRIPTION
Resident business	Business travel made by residents of PSRC region
Resident personal	Personal travel made by residents of PSRC region
Visitor business	Business travel made by visitors to PSRC region
Visitor personal	Personal travel made by visitors to PSRC region
External	Travel made by travelers from outside PSRC region
Employee	Last leg of travel by airport employees; to/from offsite employee parking to the SEA airport

2.2 TRIP MODE

Figure 1 displays mode choice nesting structure and Table 2 lists trip modes available in the new airport model. In the table, the corresponding modes from the existing Sea-Tac mode choice model are also included for reference. The new airport model provides flexibility to add access locations (parking, ride hail, curb drop-off). Note that the Business Intelligence (BI) Airport Enplanement survey collected information only from a sample of departing passengers and did not collect full tours from trip origins to the airport. So, the modes of airport ground-access will be trip-based and symmetry will be assumed for the non-surveyed trips (arriving passengers). More details of the trip modes are provided in the section *Trip Mode Choice*.

Appendix A provides details of parameters transferred from the current NREL stand-alone SEA mode choice model[1].

FIGURE 1: NEW AIRPORT MODEL MODE CHOICE STRUCTURE

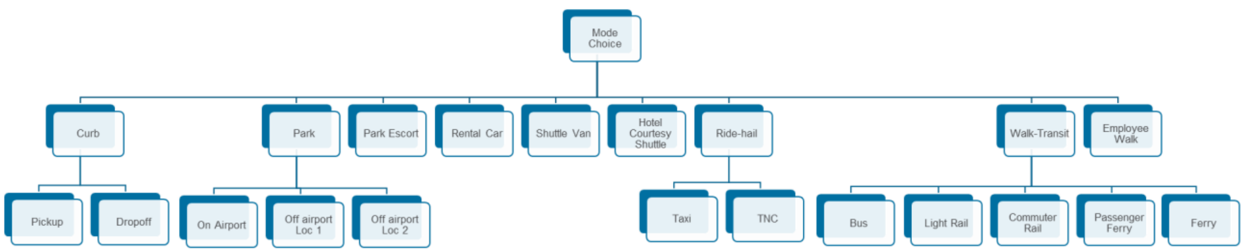


TABLE 2: TRIP ARRIVAL MODES

NEW MODES	DESCRIPTION	EXISTING MODE
Parking	Parking at airport. On-airport and off-airport parking locations are modeled as sub-mode. The locations are identified in Figure **.	On-airport parking and off-airport parking
Park and Escort	Park and escort	Dropped-off parking
Rental Car	Rental car	Rental Car
Shuttle Van	Shuttle van	Airport shuttle
Hotel Courtesy	Hotel curtesy shuttles	Hotel Shuttle
Ride-hail	TNCs (e.g., Uber, Lyft). Locations are modeled as sub-mode. The locations are identified in Figure **.	TNC
Curb drop-off	Curbside drop-off. Drop-off locations are modeled as sub-mode. The locations are identified in Figure **.	Dropped-off

[1] Documentation of the mode choice model was made available in "SEA-ATHENA- mode choice modeling notes -all combined 20230331.pdf".

NEW MODES	DESCRIPTION	EXISTING MODE
Walk local	Walk to local bus	Transit
Walk light rail	Walk to light rail	Transit
Walk commuter rail	Walk to commuter rail	Transit
Walk ferry	Walk to ferry	Transit
Walk ferry-passengers	Walk to ferry-passenger	Transit
Employee walk	Employee walk trips from parking to the terminal	

2.3 TREATMENT OF TIME

Every airport ground access trip will be allocated to a half-hour period and are aggregated to the 12 model time periods that exist in the current SeaTac model. The output trip matrices created by ActivitySim are then added to the existing trip matrices for each time period from the SoundCast model and then assigned to the network.

Feedback from the network back into the airport model uses only five representative time periods since the ActivitySim airport model is only constructed to have five input time periods in the skims. Table 3 shows the 12 time periods in the SoundCast model and the representative skim used for each time period in the airport model.

The evening time period was selected as 18to20 instead of 20to5 because SoundCast does not assign transit or produce transit skims for the 20to5 time period.

TABLE 3: TIME PERIODS FOR SKIMS (FIRST COLUMN) REFERENCED TO DEMAND HOURLY PERIODS

TIME PERIOD	START TIME	END TIME	LABEL
EA	5:00 a.m.	6:00 a.m.	5to6
	6:00 a.m.	7:00 a.m.	6to7
AM	7:00 a.m.	8:00 a.m.	7to8

TIME PERIOD	START TIME	END TIME	LABEL
	8:00 a.m.	9:00 a.m.	8to9
	9:00 a.m.	10:00 a.m.	9to10
Mid-Day	10:00 a.m.	2:00 p.m.	10to14
	2:00 p.m.	3:00 p.m.	14to15
	3:00 p.m.	4:00 p.m.	15to16
	4:00 p.m.	5:00 p.m.	16to17
PM	5:00 p.m.	6:00 p.m.	17to18
Evening	6:00 p.m.	8:00 p.m.	18to20
	8:00 p.m.	5:00 a.m.	20to5

2.4 TREATMENT OF SPACE

The SEA airport model uses a Transportation Analysis Zone (TAZ) spatial system where every trip end in the PSRC region is allocated to a TAZ. Table 4 presents key differences in 1-zone and 2-zone system implantations for the SEA airport model.

The new SeaTac model uses parcels as a secondary geography (primary geography in the resident demand model). However, using parcels as the primary geography in the airport model offers little benefits but adds more overhead in terms of model runtime and data disk space. A second geography, usually more detailed than TAZ, is key in accurately representing the level of service for active transportation and transit access/egress modes, see Table 4. However, a very small fraction of the airport passengers uses these modes to travel to/from the airport. Moreover, an all-street network with more network details than the planning network would be necessary to correctly represent the level of service at a parcel level. Based on these trade-offs, the team, in discussions with SEA airport staff, decided to implement the new Airport Model in a 1-zone system where all network level-of-service (skims) will be specified at the TAZ level. Note that the new SeaTac zone system was modified to add isolated zones for access locations (e.g., parking, ridehail, curb drop-off).

TABLE 4: COMPARISON OF 1-ZONE AND 2-ZONE IMPLEMENTATIONS

	1-ZONE	2-ZONE
Auto skims	TAZ	TAZ
Transit skims	TAZ	TAZ
Transit access/egress	TAZ	Parcel*
Active transportation	TAZ	Parcel*

*Requires all-street network to generate network level-of-service

Figure 2 shows the airport-specific zones added on the north side of the airport, showing a zone representing all north general parking lots, the consolidated rental car facility, and the employee off-site parking lot. The general parking location was selected as a representative facility while the rental car and employee parking zones were positioned to reflect their real-world locations.

Figure 3 shows the airport zones in the vicinity of the terminal, including passenger drop-off/pickup facilities, taxi/TNC/shuttle locations, general on-site and off-site parking near the terminal, and terminal entrances for passengers as well as employees. Each zone centroid was located at the position of the corresponding facility in the Port of Seattle model, and the centroid connectors were positioned to provide realistic connections to the surrounding roadway network. Finally, Figure 4 illustrates the southernmost off-site general parking facilities' representative zone.

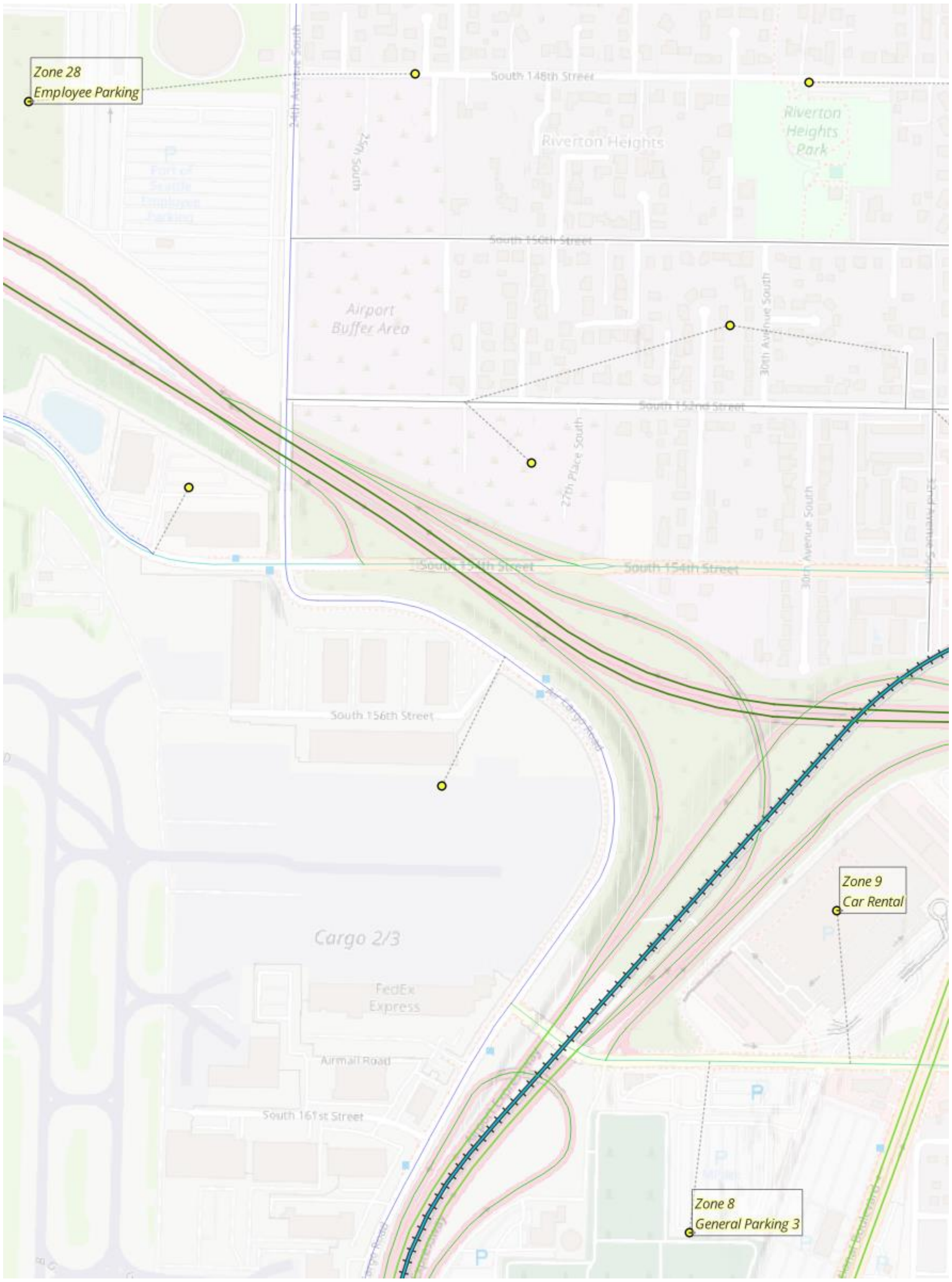


FIGURE 2: MAP OF NORTH AIRPORT ZONES

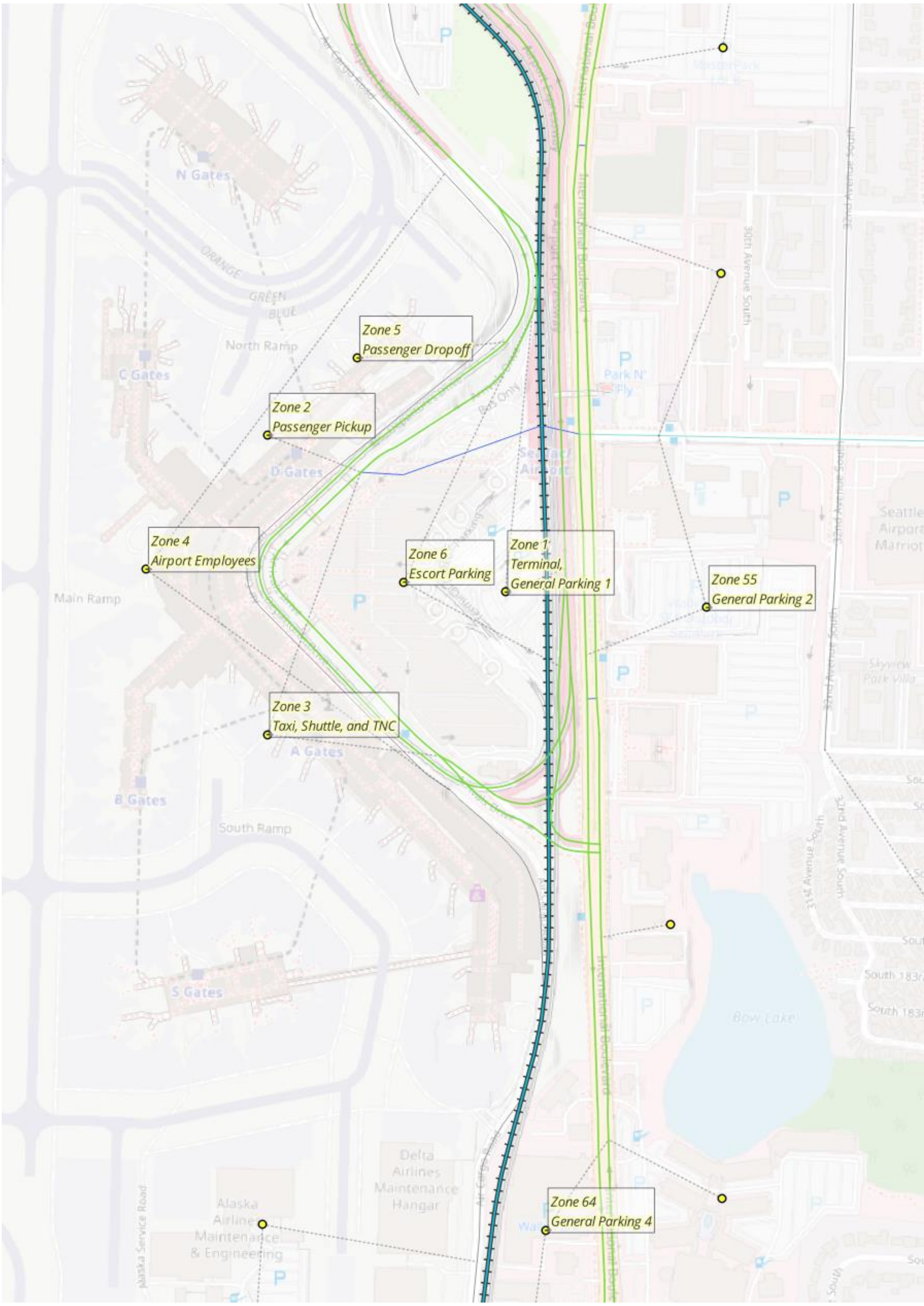


FIGURE 3: MAP OF TERMINAL AREA AIRPORT ZONES

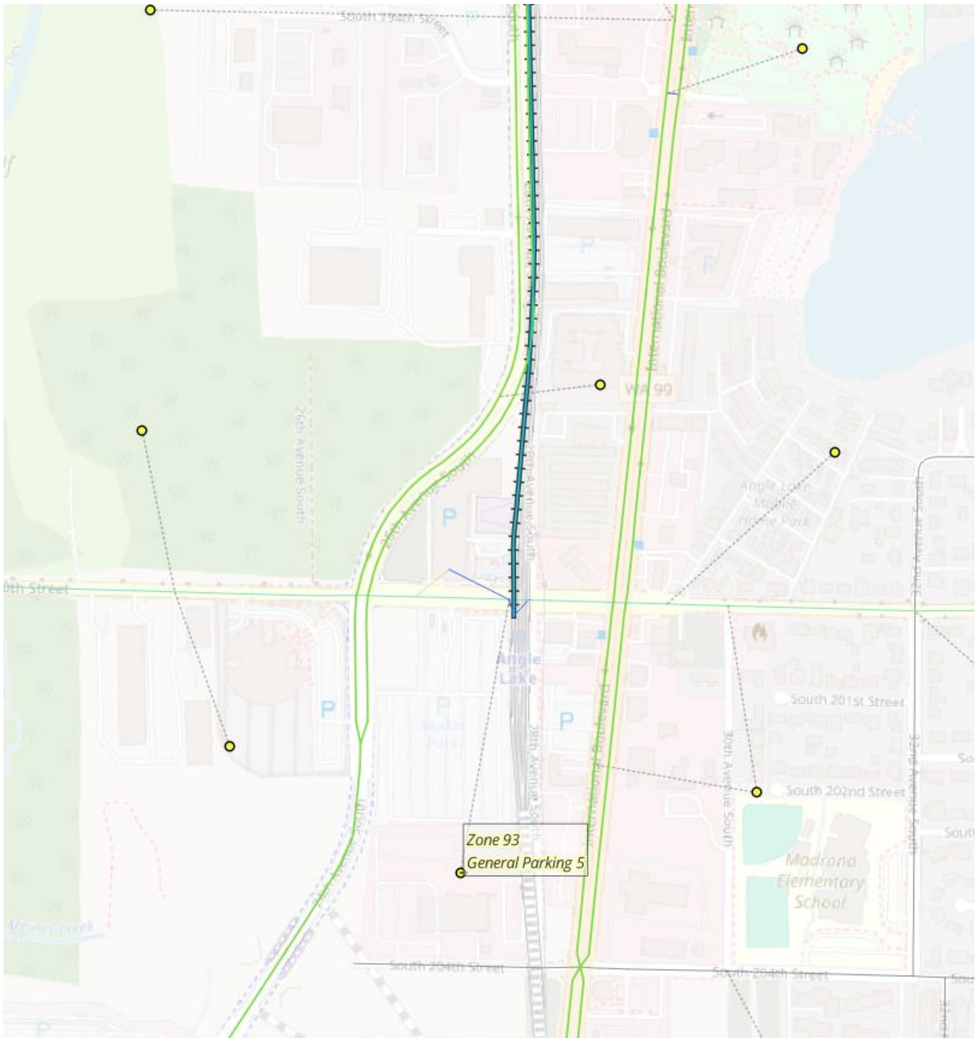


FIGURE 4: MAP OF SOUTH AIRPORT ZONES

3.0 MODEL DESIGN

This chapter describes the design of the SEA ground-access model. Figure 5 presents a schematic diagram of the airport model system. The model system consists of four components: model inputs, pre-processor, ActivitySim sub-models, and model outputs.

The airport model requires several **inputs** including airport data, distributions of enplanements and trips in various dimensions, land use data by TAZ, network level-of-service data by mode and time-period, and various model parameters.

The **pre-processor** step reads model inputs and generates necessary information for the ActivitySim model. The pre-processor includes three sub-steps: tour enumeration, scheduling probabilities, and ActivitySim pre-requisite. Tour enumeration calculates total airport trips and generates tours with the necessary attributes (e.g., purpose, party size, number of nights, and income). Scheduling probabilities produces trip scheduling distributions for each chooser segment[2]. ActivitySim pre-requisite builds synthetic population[3] and converts input land use data into format required in ActivitySim.

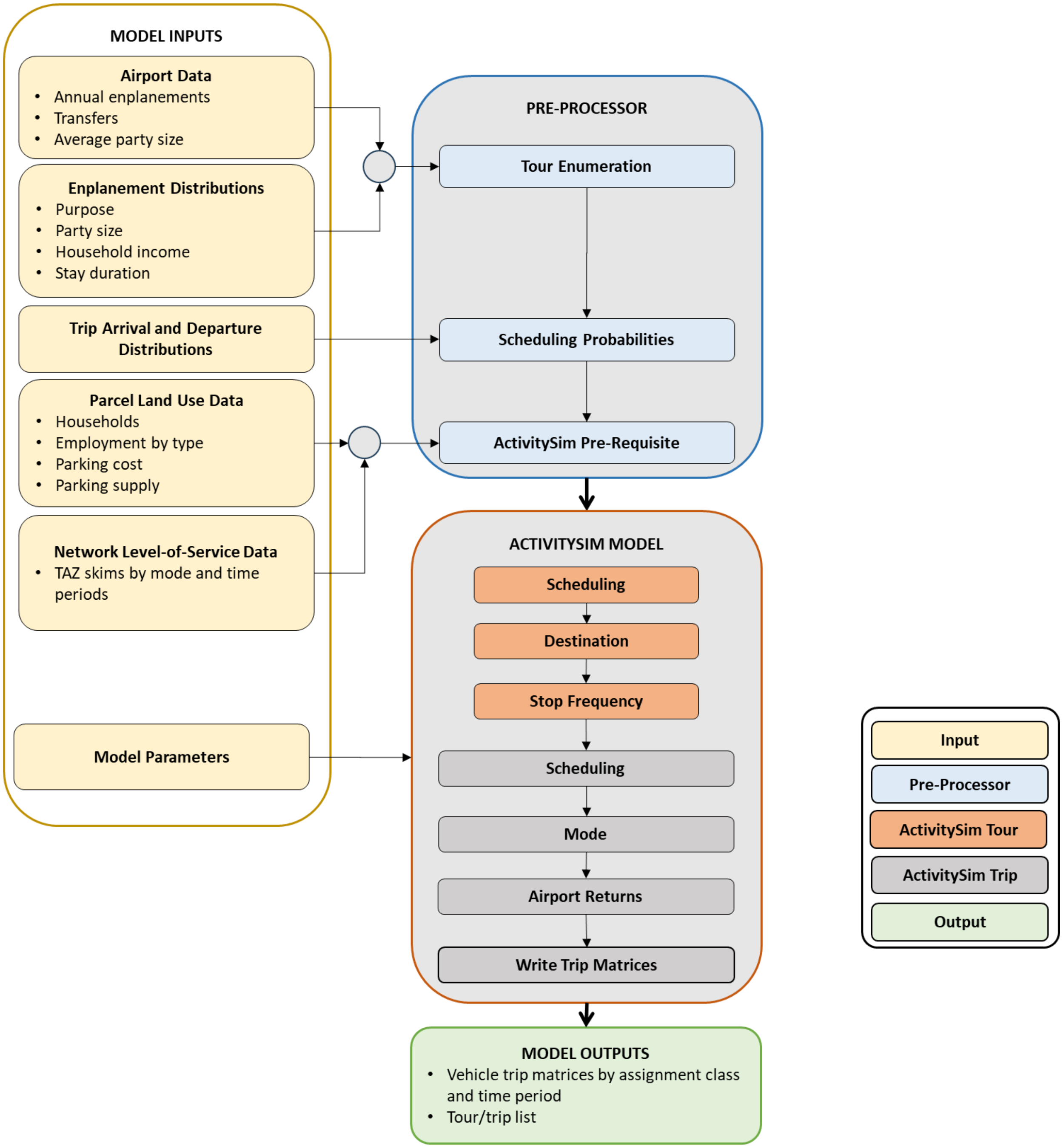
The **ActivitySim model** component runs necessary sub-models using the information generated by the pre-processor step, input level-of-service data, and other model parameters. First, the tour scheduling assigns start and end times to the tours generated in the pre-processing step. Next, non-airport ends of airport trips are chosen by the non-mandatory tour destination choice model. The stop frequency model then creates trips by generating tour legs. The trip scheduling model assigns depart times for each trip on a tour using tour scheduling times. The trip mode choice model determines arrival mode to the airport. The trips with mode as curbside drop-off or parked and escorted trips are generated with a return trip for the driver in the Airport Return step. The last step writes out trip matrices segmented by assignment class and time-period.

The **model outputs** consist of both aggregated (trip matrices) and disaggregate (tour/trip lists) travel records.

The following sections provide more details on the pre-processor and ActivitySim components. Model inputs and outputs are described in Chapter 4.0 Model Inputs and Outputs.

[2] Chooser segments are the trip purposes (except Employee) shown in Table 1
[3] Create a dummy file of one household per tour and one person per household.

FIGURE 5: AIRPORT GROUND-ACCESS MODEL SCHEMATIC DIAGRAM



3.1 PRE-PROCESSOR

A pre-processor enumerates airport trips and generates trip scheduling distributions for each chooser segment. The pre-processor uses the inputs as shown in Table 6 and Table 7 in Chapter 4.

Tour enumeration

The tour enumeration calculates total airport trips using the following formula and data from Section 4.1:

$$airport\ trips = \frac{(Enplanements - \ Connections)}{annualizationFactor * AveragePartySize} * 2$$

Half the tours are assigned to be arriving and the other half departing. Monte Carlo draws from the probability distributions in Section 4.1 assign each tour with a purpose, party size, number of nights, and income.

Employee trips from off-site employee parking are generated using workers auto travel to airport generated by the resident (DaySim) model. The Employee parking file contains, for each offsite parking lot, a share of workers which is expected to take public transit which is also tagged in the tour enumeration step of the pre-processor. Employee tours are expected to return so for each tour to the airport a corresponding tour is created from the airport to the off-site parking.

Scheduling probabilities

The airport model uses the scheduling distributions when enumerating airport tours to assign tour attributes. The scheduling probabilities are converted to ActivitySim format in the pre-processor. ActivitySim expects a dual tour departure and arrival probability to schedule the timing for the start of the tour and the return trip on the tour. However, for the airport model application, each tour will only have one trip (either going to or coming from the airport) so there is no dual scheduling probability. In order to match the ActivitySim format, departing trips (inbound) are assigned a tour start time of 1 and the observed probabilities are mapped to the end period in the distribution. Similarly, arriving passengers (outbound passengers) are assigned a tour start of the observed probability distribution with a tour end period of 48.

ActivitySim Prerequisites

The pre-processor also generates the necessary pre-requisites for ActivitySim which include a household, person, and land use file. The household and person file are generated by assuming there is one household per tour, and one person per household. Unique person and household IDs are assigned to match the unique tour IDs.

The land use file is an aggregation of the parcel land use data to TAZs and a re-assignment of the household income bins based on the synthetic population to match the size terms used in the airport model income bins.

The eight income bins used in the model are [0, $25k, $50k, $75k, $100k, $125k, $200k, $200k+] and are labeled a1, a2,…a8. (Keeping the labels generic allows for the ability to easily modify the income bins if desired.) Columns are added to the landuse table that count the number of households in the SoundCast synthetic population in each income bin. These household counts by income for each TAZ are used as size terms in the destination choice model.

Skim Conversion

The skims that come out of the SeaTac model are in hdf5 format whereas ActivitySim requires skims to be in omx format. Additionally, ActivitySim requires skims to have a specific naming convention that puts the time period they belong to at the end of the skim name. For example, the sov distance skim for the middle value-of-time group for the am time period would be named sov_incd2__AM (note the double underscore between the skim name and the time period).

The model preprocessor will convert the output SeaTac skim from hdf5 format to omx files. There is a files_to_time_period setting that exists in the preprocessing.yaml that maps the SoundCast skims to the ActivitySim time period. The current settings are described in the previous Treatment of Time section.

The preprocessor crucially also converts the units in the skims from 100's to 1's. For example, the SoundCast model skims will show a distance of 2 miles as 200 in the skim. Similarly, the cost skims are converted from cents to dollars. The ActivitySim airport model expects the distance skims to be in miles, the time skims in minutes, and the cost skims in dollars. The skim conversion process handles the unit conversion.

One special skim named DIST is also added to the mid-day omx output skim file. This distance skim represents the generic distance in a number of ActivitySim models and is simply a copy of the midday sov_inc2d skim from SoundCast.

The preprocessor will check the dimensions of the output omx skim matrices. If the number of TAZs in the landuse file does not match the matrix shape, the preprocessor will fail with an assertion error.

3.2 ACTIVITYSIM MODEL

This section describes each ActivitySim sub-model that is run to implement the airport model. The flowchart in Figure 5 illustrates the major steps.

Tour Scheduling

The tour scheduling model uses a probabilistic draw of the scheduling distribution prepared by the pre-processor. This model assigns start and end times to the tour. This is important because it will also serve as the schedule model for the final airport trips. In ActivitySim the trips are scheduled based on the tour schedule. If there is only one trip per leg on the tour (as is the case for airport trips) the trip is assigned the tour start/end time.

Non-Mandatory Tour Destination Choice

The destination choice model chooses the non-airport end of the airport trips. Each tour is set with an origin at the airport TAZ. The tour destination model of ActivitySim is used to choose the non-airport end of the trip. The utility equation includes the travel distance and the destination size terms[4]. The ActivitySim destination choice framework requires a mode choice logsum. A tour mode choice logsum with a value of zero for every destination is used as a work around to prevent ActivitySim from crashing since the airport model uses only distance as the measure of accessibility to the non-airport zone.

The destination choice model first samples alternatives and then chooses a destination. The sampling utility expressions calculator[5] (UEC) is the same as the destination choice UEC except for a sampling of alternatives correction factor applied in the destination choice UEC.

Stop Frequency

The stop frequency model is where the trip table is first created in the model flow. The pre-processor tags each tour with a direction of ‘inbound’ or ‘outbound’ according to whether the tour is by a departing or an arriving passenger. The stop frequency model generates the tour legs using the model specification. The model is specified so that inbound tours are tagged with zero outbound trips and -1 inbound trips (and the opposite for outbound tours: -1 outbound trips and 0 inbound trips). The 0 signifies that no intermediate stops are made; this leg of the tour will only have one trip. The -1 signifies that no trip is made at all on that leg. Using the -1 allows us to create ‘half-tours’ where only one leg of the tour is recorded as a trip.

Trip Scheduling

The trip scheduling model assigns departure times for each trip on a tour. ActivitySim typically requires trip scheduling probabilities but these are not used in this implementation since there is only one trip on any given tour leg. This means the trips will be assigned the tour scheduling

[4] A size term is quantitative factor/term in a utility function representing number of opportunities (e.g., employment, household, population) in a destination.
[5] UECs are spreadsheets containing python expressions to be evaluated by ActivitySim models.

times which were determined in the tour scheduling model. As a result, the trip scheduling probabilities file is just a dummy file.

Trip Mode Choice

The trip mode choice model determines the airport arrival mode. The arrival modes are shown in Table 5. The pre-processor in this step stores all values of skims from the trip origin to each of the access modes' destinations along with any associated costs. Costs include parking fees per day, access fees, fares, and rental car charges.

Employees are not fed into the trip mode choice model. Instead, if a transit share is specified in the employee park file, that percentage of employees will be assigned 'Walk Light Rail' mode in the pre-processor. Otherwise, employees are all assigned 'Walk' mode from the employee parking lot to the terminal.

Airport Returns

Airport trips where the party is dropped-off/picked-up curbside or parked and escorted are assumed to also have the driver make a return trip to the non-airport location. This procedure is done as a post-processing step after mode choice and before trip tables are written out.

The airport_returns.yaml ActivitySim configuration file specifies which trip modes will include a return trip. These trips records are flagged and duplicated. The duplicated trips swap the origin and destination of the original trip and are assigned a unique trip id. These trips are tagged with 'trip_num =2' so they are easily sorted in any additional processing (such as for writing trip matrices).

Write Trip Matrices

The write trip matrices step converts the vehicle trip lists into vehicle trip matrices segmented by vehicle class and time-period. Table 5 shows the vehicle classes that will be available in the matrices. The auto modes (SOV, HOV2, HOV3, and TNC) are segmented by value of time (VOT) bins. The VOT is either low, medium, or high based on the thresholds set in the model settings inputs (see Table 20).

No occupancy factor is used when creating these trip tables as each tour is associated with one household and one person. The party size is only determined by the attributed value from the pre-processor. Therefore, each record still represents one vehicle trip and the occupancy is determined by the party size and the mode.

TABLE 5: TRIP MATRICES CATEGORIES

CLASS	DESCRIPTION	CRITERIA
sov_inc1	Single occupant vehicle trips with low VOT	Party size = 1 and trip mode = Park location, rental car, return trips of curbside drop-off and park and escort.
sov_inc2	Single occupant vehicle trips with medium VOT	
sov_inc3	Single occupant vehicle trips with high VOT	
hov2_inc1	Shared ride 2 vehicle trips with low VOT	Party size = 2 and trip mode = Park location, rental car OR Party size =1 and first leg trip mode = park and escort, ridehail, taxi or curbside drop-off
hov2_inc2	Shared ride 2 vehicle trips with medium VOT	
hov2_inc3	Shared ride 2 vehicle trips with high VOT	
hov3_inc1	Shared ride 3+ vehicle trips with low VOT	Party size >= 3 and trip mode = Park location, rental car OR Party size >=2 and first leg trip mode = park and escort, ridehail, taxi or curbside drop-off
hov3_inc2	Shared ride 3+ vehicle trips with medium VOT	
hov3_inc3	Shared ride 3+ vehicle trips with high VOT	
tnc_inc1	Ridehail vehicle trips with low VOT	Party size >= 2 and trip mode = ridehail
tnc_inc2	Ridehail vehicle trips with medium VOT	
tnc_inc3	Ridehail vehicle trips with high VOT	
walk	Walk trips	Trip mode = walk
walk_transit	Walk to transit trips	Trip mode = walk to transit
drive_transit	Drive to transit trips	Trip mode = KNR, TNC access to transit

4.0 MODEL INPUTS AND OUTPUTS

This chapter describes inputs and outputs of the new SEA airport model.

4.1 MODEL INPUTS

The airport model inputs consist of configuration files (e.g., yaml), utility expression calculators (UECs), and other data in various formats (e.g., CSV, HDF5). The inputs can be grouped into the following categories: airport data, input distributions, land use data, network level-of-service data, and model parameters and settings.

Airport Data

These aggregate data (Table 6) are required in the pre-processing step to calculate total number of trips and are defined in the pre-processing configuration file (preprocessing.yaml).

TABLE 6: INPUT AIRPORT DATA

PARAMETER	DESCRIPTION	VALUE	SOURCE
num_enplanements	Number of annual enplanements	24,894,338	2018 annual enplanements and transfers by Airport's Business Intelligence (BI)[6]
avg_party_size	Average party size	1.7	BI Enplanement Passenger Survey (2014-2019)
annualization_factor	Annualization factor	365	
connecting	Annual transferring passengers	7,184,927	2018 annual enplanements and transfers by Airport's Business Intelligence (BI) divided by 2
airport_taz	Airport zone	1	Model zone system

[6] BI Data Shared on 09-28-23\Data from BI - Sea-Tac Model.xlsx

Input Distributions

The pre-processing step requires several distributions of enplanements and trips to develop disaggregate airport tours with various attributes. These input distribution are defined in the pre-processing configuration file (preprocessing.yaml). Table 7 presents the type of distribution and the data source that will be used to create that distribution for the SEA airport model. The format of these distributions are described in Table 8, Table 9, Table 10, Table 11, Table 12, Table 13, Table 14, and

LOT	TAZ	EMPLOYEE STALLS	SHARE TO TERMINAL	PUBLIC TRANSIT SHARE TO TERMINAL
General parking at terminal	1	1713	1	0
Airport employee off-site parking	28	4064	1	1

Table 16.

TABLE 7: AIRPORT MODEL INPUT FILES

PARAMETER	FILE NAME	DESCRIPTION	SOURCE
purpose_probs_input_fname	airport_purpose.csv	Probability distribution for trip purposes	BI Enplanement Passenger Survey (2014-2019)
party_size_probs_input_fname	airport_party.csv	Probability distribution for party size	BI Enplanement Passenger Survey (2014-2019)
nights_probs_input_fname	airport_nights.csv	Probability distribution for number of nights the trip lasts	BI Enplanement Passenger Survey (2014-2019)
income_probs_input_fname	airport_income.csv	Probability distribution for household income	BI Enplanement Passenger Survey (2014-2019)
arrival_sched_probs_fname	airport_arrival.csv	Probability distribution for	Flight Schedule Data (2018)

		arriving trip schedules	
departure_sched_probs_fname	airport_departure.csv	Probability distribution for departing trip schedules	Flight Schedule Data (2018)
employee_park_fname	airport_employee_park.csv	Distribution of parking stalls at employee parking lots and share of employees that travel to the terminal and share of employees that take transit.	SEA Airport
ext_station_probs_input_fname	InternalExternalDestination ChoiceAlternatives.csv	Distribution of external trips by external station	

TABLE 8: AIRPORT PURPOSE DISTRIBUTION (AIRPORT_PURPOSE.CSV)

FIELD	DESCRIPTION
Purpose	Purpose: 0 = Resident business 1 = Resident personal 2 = Visitor business 3 = Visitor personal 4 = External 5 = Employee
Percent	Distribution in trip purpose

FIGURE 6: GRAPH OF TRIP FREQUENCY BY PURPOSE

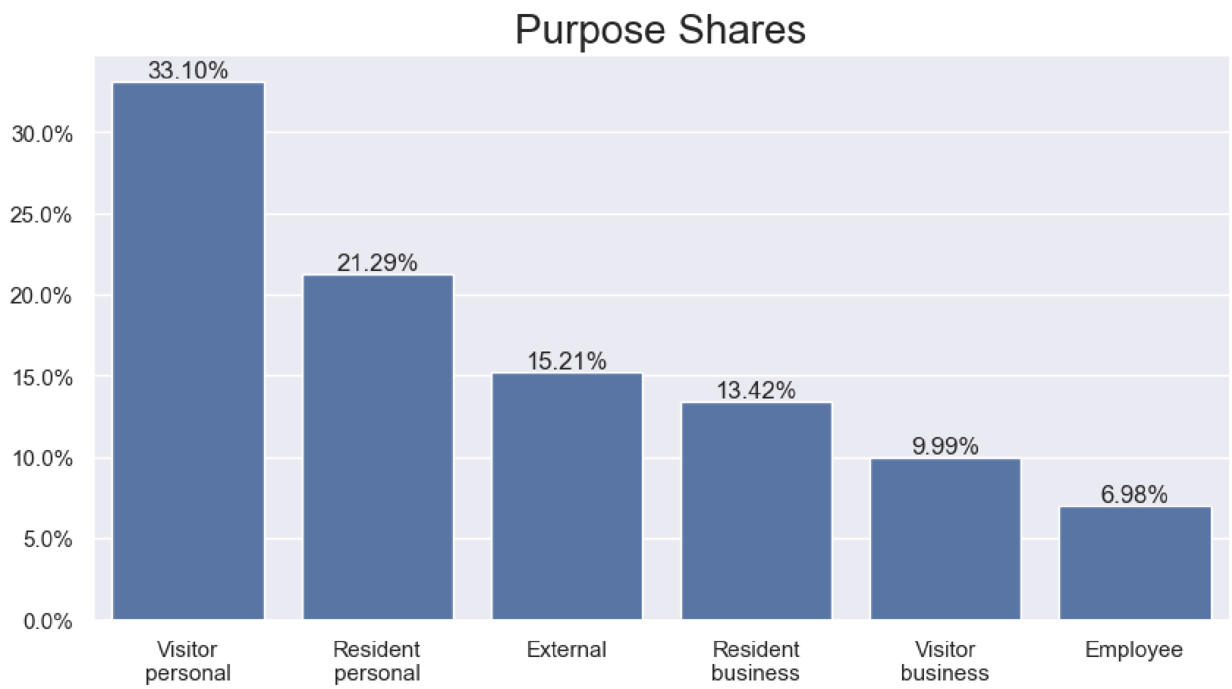


TABLE 9: AIRPORT PARTY SIZE DISTRIBUTION (AIRPORT_PARTY.CSV)

FIELD	DESCRIPTION
Party	Party size (1 through 5+)
purp0_perc	Distribution for resident business purpose
purp1_perc	Distribution for resident personal purpose
purp2_perc	Distribution for visitor business purpose
purp3_perc	Distribution for visitor business purpose
purp4_perc	Distribution for external purpose
purp5_perc	Distribution for employee purpose

FIGURE 7: GRAPH OF AIRPORT PARTIES BY PARTY SIZE

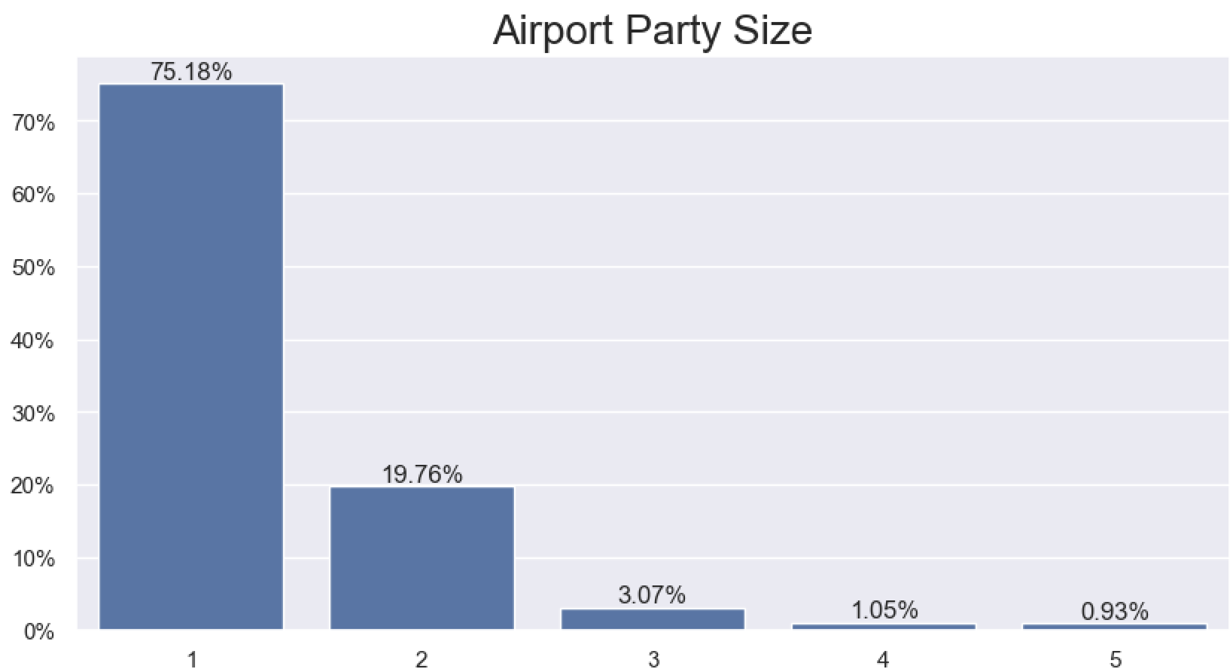


TABLE 10: AIRPORT STAY NIGHT DISTRIBUTION (AIRPORT_NIGHTS.CSV)

FIELD	DESCRIPTION
Nights	Number of nights stayed (0 through 14+)
purp0_perc	Distribution for resident business purpose
purp1_perc	Distribution for resident personal purpose
purp2_perc	Distribution for visitor business purpose
purp3_perc	Distribution for visitor business purpose
purp4_perc	Distribution for external purpose
purp5_perc	Distribution for employee purpose

The number of nights is broken down by purpose for the purposes of the model distribution, but Figure 8 shows the total number of nights across all purposes. The spike at 14 days is indicative of that bin containing all stays longer than 2 weeks.

FIGURE 8: GRAPH OF AIRPORT PARTIES BY NUMBER OF NIGHTS

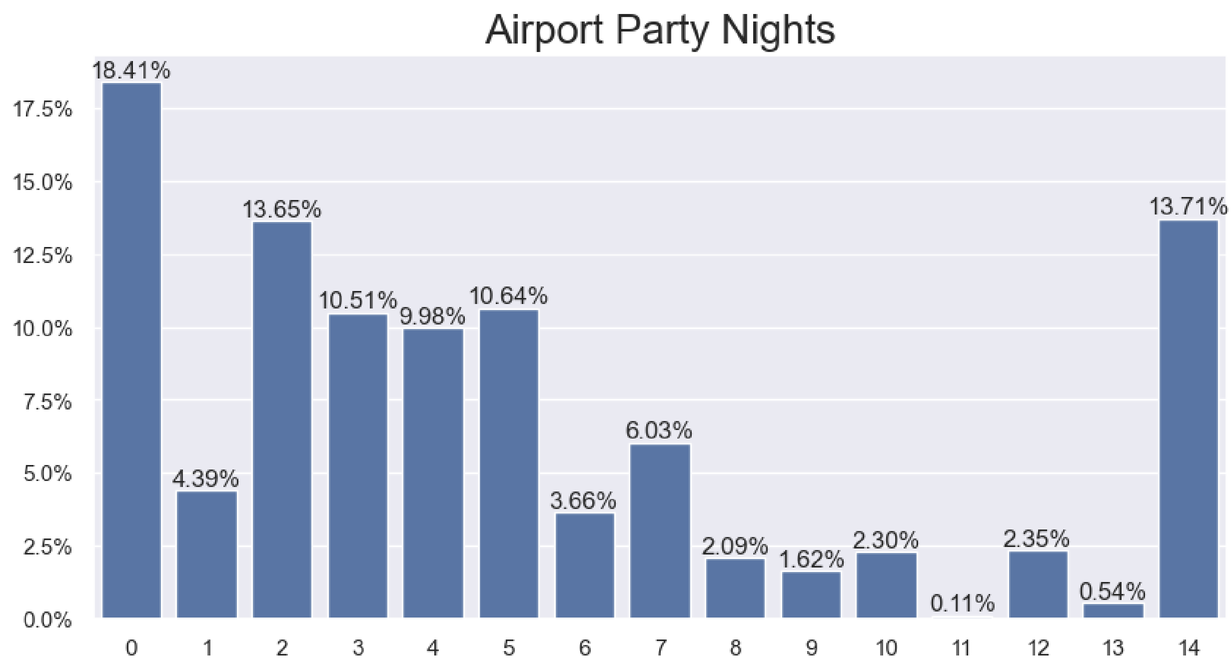


TABLE 11: AIRPORT INCOME DISTRIBUTION (AIRPORT_INCOME.CSV)

FIELD	DESCRIPTION
Income	Household income: 0 = Less than $25K 1 = $25K – $50K 2 = $50K – $75K 3 = $75K – $100K 4 = $100K – $125K 5 = $125K – $150K 6 = $150K – $200K 7 = $200K plus
purp0_perc	Distribution for resident business purpose
purp1_perc	Distribution for resident personal purpose

FIELD	DESCRIPTION
purp2_perc	Distribution for visitor business purpose
purp3_perc	Distribution for visitor business purpose
purp4_perc	Distribution for external purpose
purp5_perc	Distribution for employee purpose

FIGURE 9: GRAPH OF AIRPORT PARTIES BY INCOME

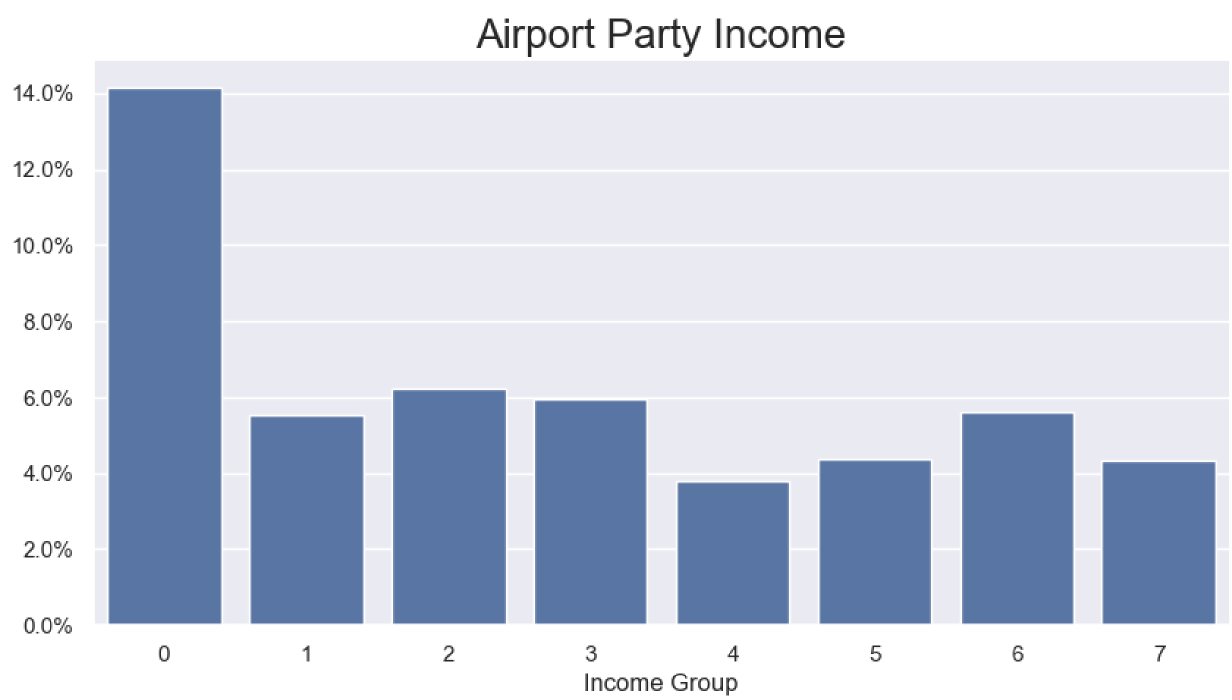


TABLE 12: AIRPORT ARRIVAL TIME BY PURPOSE DISTRIBUTION (AIRPORT_ARRIVAL.CSV)

FIELD	DESCRIPTION
Period	Arrival Period: Integer value corresponding to every 30 minute period starting with period 1 from 3:00 AM to 3:29

	AM and ending with period 48 starting at 2:30 AM and ending at 2:59 AM.
purp0_perc	Distribution for resident business purpose
purp1_perc	Distribution for resident personal purpose
purp2_perc	Distribution for visitor business purpose
purp3_perc	Distribution for visitor business purpose
purp4_perc	Distribution for external purpose
purp5_perc	Distribution for employee purpose

Since the BI Enplanement Passenger Survey only captured people departing on flights, the timing distribution from that survey was biased. Therefore data was sourced from flight departure and arrival times. Specifically, RSG was provided an excel workbook called "Flight schedule and vissim inputs processing v13 – Documentation.xlsx" that had the tables "Arr Term @Curb" and "Dep Orig@Curb". These two tables had data specified at the 5 minute increment level of arrival and departure times at the airport curb. The data was aggregated into ActivitySim's half-hour time bins. A gaussian KDE was then fit over the data to smooth out the distribution. The final table is normalized such that the probabilities of arriving at each bin sum to one. This can be seen in Figure 10 for arrival times and Figure 11 for departure times.

FIGURE 10: ARRIVAL TIME DISTRIBUTION

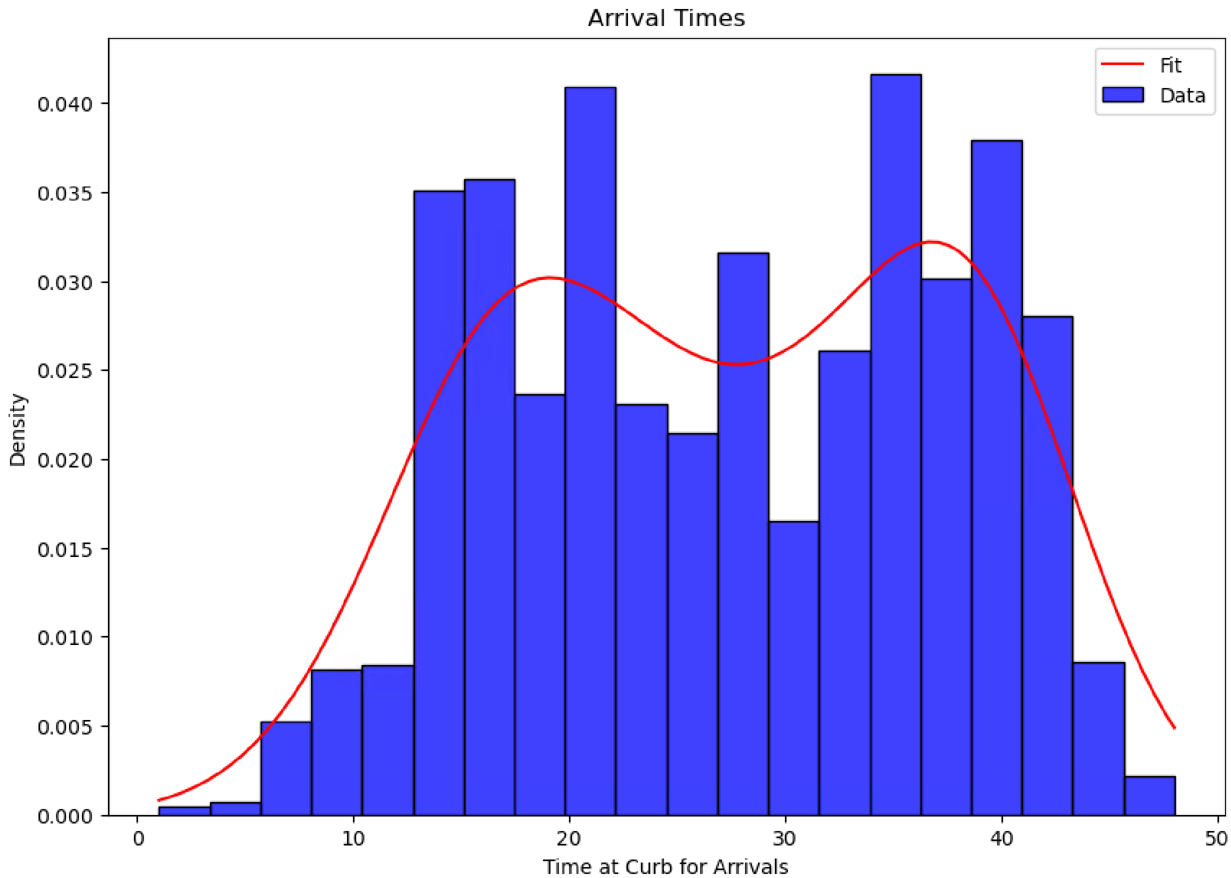


TABLE 13: AIRPORT DEPARTURE TIME BY PURPOSE DISTRIBUTION (AIRPORT_DEPARTURE.CSV)

FIELD	DESCRIPTION
Period	Departure Period: Integer value corresponding to every 30 minute period starting with period 1 from 3:00 AM to 3:29 AM and ending with period 48 starting at 2:30 AM and ending at 2:59 AM.
purp0_perc	Distribution for resident business purpose
purp1_perc	Distribution for resident personal purpose
purp2_perc	Distribution for visitor business purpose
purp3_perc	Distribution for visitor business purpose
purp4_perc	Distribution for external purpose
purp5_perc	Distribution for employee purpose

The airport departure time distribution is created similarly to the arrival time distribution where the departure times were converted to ActivitySim's 48 half-hour time periods and then smoothed with a gaussian fit to produce the output probabilities.

FIGURE 11: DEPARTURE TIME DISTRIBUTION

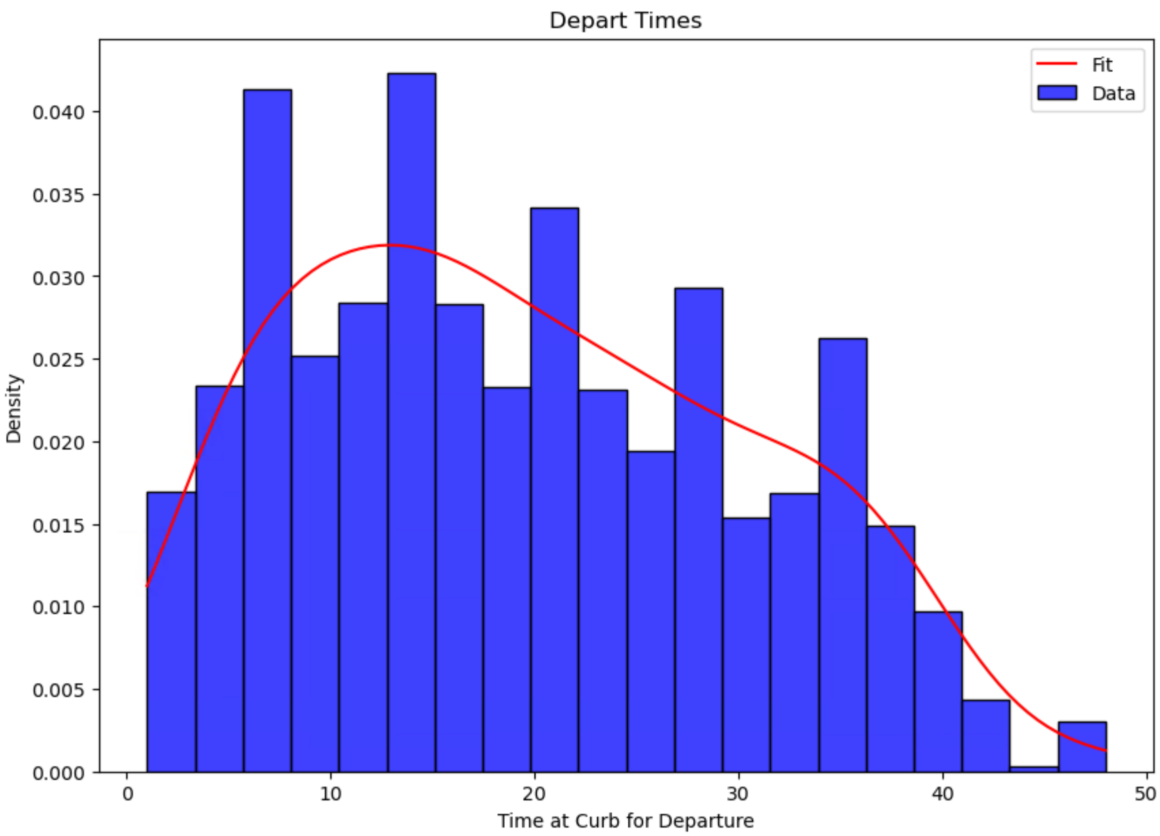


TABLE 14: AIRPORT EMPLOYEE PARK DISTRIBUTION (AIRPORT_EMPLOYEE_PARK.CSV)

FIELD	DESCRIPTION
Name	Parking location number
TAZ	Corresponding TAZ
Employee Stalls	Number of parking spaces
Share to Terminal	Share of parking spaces used by employees working at the airport
Public Transit Share to Terminal	Share of transit used by employee parking

There were only two airport employee parking locations designated in the model. The first parking location (TAZ 1) is the at-airport zone where the employees park at the terminal parking lot and walk into the airport. The number of employee stalls at this location came from 2019 employee parking data provided to RSG via email.

The second airport employee parking location (TAZ 28) is located north of the airport where employees will park their car at a large surface parking lot and take an employee shuttle into the terminal. The estimated number of employee stalls is calculated by taking the daily number of employee crew shuttle pickups with an assumed occupancy of 20 people. This number is in rough agreement with the number of spots in the lot and the expected fill level of that lot given the experiences of the SeaTac staff. All employees who park at this lot are assumed to take the shuttle as the walk is quite onerous (over a mile and crossing major roads). Employees that park in both locations are expected to all go to the terminal to work and not some other airport-related workplace location.

TABLE 15: AIRPORT EMPLOYEE PARKING DISTRIBUTION

LOT	TAZ	EMPLOYEE STALLS	SHARE TO TERMINAL	PUBLIC TRANSIT SHARE TO TERMINAL
General parking at terminal	1	1713	1	0
Airport employee off-site parking	28	4064	1	1

TABLE 16: AIRPORT EXTERNAL TRIPS DISTRIBUTION (INTERNALEXTERNALDESTINATIONCHOICEALTERNATIVES.CSV)

FIELD	DESCRIPTION
Alt	Alternative number
Taz	Associated taz id
Name	Name
tazOut	TAZ of the outbound trip
tazRet	TAZ of the inbound/return trip
Region	Region (1-4)
iePct	Internal-external percentage

Survey data whose non-airport endpoints fall outside the modeled region were tagged to the external station (aka gateway node) in the network nearest the trips' desire lines, with manual editing performed to ensure paths were consistent with expected routing to avoid large barriers such as mountains or large bodies of water. Once tagged to the corresponding stations, proportional shares of all external station usage were calculated separately for arriving and departing external trips. The total surveyed external arrivals and departures and their fractional distribution is shown in Table 17.

TABLE 17: EXTERNAL ARRIVAL/DEPARTURE DISTRIBUTIONS

EXTERNAL STATION	ARRIVALS	DEPARTURES	TOTAL	EXTERNAL ARRIVAL SHARE	EXTERNAL DEPARTURE SHARE
3733	47	96	143	26.9%	36.2%
3734	2	1	3	1.1%	0.4%
3739	36	55	91	20.6%	20.8%
3742	1	0	1	0.6%	0.0%
3744	61	65	126	34.9%	24.5%
3746	2	5	7	1.1%	1.9%
3747	5	10	15	2.9%	3.8%
3748	20	29	49	11.4%	10.9%
3749	1	4	5	0.6%	1.5%

Land Use and Synthetic Population Data

The airport model requires two land use inputs: household file and maz land use file. These inputs are defined in the pre-processing configuration file (preprocessing.yaml) with the parameter name shown under the column "PARAMETER" in Table 18. Note that these two files will not be direct inputs to the new SeaTac model system. The new SeaTac model system already takes these two as inputs but in a different format (HDF5) and in more geographic detail (parcel) than required. The pre-processor step of the airport model aggregates the input parcel level land use data to TAZ and writes to a CSV format. Also, it converts the input household file in HDF5 format to CSV file as needed by the airport model.

TABLE 18: INPUT LAND USE DATA FILES

PARAMETER	FILE NAME	DESCRIPTION	SOURCE
taz_output_fname	land_use.csv	TAZ land use file	SeaTac model / preprocessor
households_output_fname	airport_households.csv	Household file	Preprocessor
persons_output_fname	airport_persons.csv	Person file	Preprocessor
tours_output_fname	airport_tours.csv	Tour file	Preprocessor

The created TAZ land use file has the same columns that exist in the parcels_urbansim.txt parcel file used in the SoundCast model, just aggregated to TAZs instead of parcels. The only additional columns that are added are the count of households by income bin as described in the ActivitySim Prerequisites section above.

The household and person files read in by ActivitySim are simply the household id and home zone id for households. Similarly, the person file is simply the person id and the household id the person belongs to.

The meat of the information read in by ActivitySim exists in the tours file created by the preprocessor. Each tour represents a trip to or from the airport. The tours are attributed according to Table 19 below.

TABLE 19: AIRPORT MODEL INPUT TOUR TABLE COLUMNS

COLUMN NAME	DESCRIPTION	SOURCE
Tour_id	Unique tour ID	Numbered sequentially from 1 to the number of tours.
Person_id	Person ID	Map to person file
Household_id	Household ID	Map to household file
direction	Inbound or outbound (arriving to or departing from airport)	

Purpose	Tour purpose	Sampled from airport_purpose.csv
Party_size	Number of people traveling in the tour	Sampled from airport_party.csv
Nights	Number of nights the party is traveling for	Sampled from airport_nights.csv
Income	Income of the traveling household	Sampled from airport_income.csv
Purpose_id	Integer denoting the purpose	Simple mapping from purpose to integers
destination	Tour destination TAZ	Set to airport TAZ for inbound trips, 0 otherwise (overwritten by destination choice)
Origin	Tour origin TAZ	Set to airport TAZ for outbound trips, 0 otherwise (overwritten by destination choice)
Emp_trip_mode	Employee trip mode from parking lot to terminal	Sampled from airport_employee_park,csv
Tour_category	Category of the tour	Set to “non_mandatory” for all tours. This allows all tours to be selected by the non-mandatory tour destination model in ActivitySim.
Tour_type	Format is res_{purpose}_{income} for residents and vis_{purpose} for visitors	Derived from purpose fields
Mode_segment	Personal or business travel with the income segment appended	Derived from income and purpose_id fields

Network Level-of-Service Data

The network level-of-services (skims) are defined in the pre-processing configuration file (preprocessing.yaml). The model requires TAZ level skims by time-period (5) and mode (auto, transit). The new SeaTac model system already produces necessary skims. However, they are in HDF5 format. The pre-processor step will convert the HDF5 format into OMX as required in the airport model as discussed in the Pre-processor Skim Conversion section above.

Model Parameters and Settings

These include coefficients of statistically estimated models such as logit models and other assumptions. Initial parameters were borrowed from the SANDAG Airport Model. The team reviewed the current standalone SEA mode choice model[7] and transferred comparable parameters to the new airport model. Appendix A provides details on the transferred parameters. The parameters and settings are defined in *trip_mode_choice* configuration files (yaml) and utility files (csv).

Table 20 presents assumptions of the trip mode choice sub-model.

TABLE 20: MODEL PARAMETERS IN TRIP MODE CHOICE

PARAMETER	VALUE	DESCRIPTION
parkLocation1Taz	1	Parking location 1 zone id. -999 indicates not available.
parkLocation2Taz	55	Parking location 2 zone id. -999 indicates not available.
parkLocation3Taz	8	Parking location 3 zone id. -999 indicates not available.
parkLocation4Taz	64	Parking location 4 zone id. -999 indicates not available.
parkLocation5Taz	93	Parking location 5 zone id. -999 indicates not available.

[7] Documentation of the mode choice model was made available in “SEA-ATHENA- mode choice modeling notes -all combined 20230331.pdf”.

PARAMETER	VALUE	DESCRIPTION
parkEscortLocationTaz	6	Park and escort location zone id. -999 indicates not available.
rentalLocationTaz	9	Rental location zone id. -999 indicates not available.
terminal Taz	1	Airport terminal zone id
centralMobilityHubTaz	-999	Central mobility hub zone id
ridehailLocation1Taz	3	Ride hail pick-up/drop off location 1 zone id. -999 indicates not available.
ridehailLocation2Taz	-999	Ride hail pick-up/drop off location 2 zone id. -999 indicates not available.
transitTaz	1	-999 indicates not available.
curbLocation1Taz	5	Curb drop-off location 1 zone id. -999 indicates not available.
curbLocation2Taz	2	Curb drop-off location 2 zone id. -999 indicates not available.
curbLocation3Taz	-999	Curb drop-off location 3 zone id. -999 indicates not available.
curbLocation4Taz	-999	Curb drop-off location 4 zone id. -999 indicates not available.
curbLocation5Taz	-999	Curb drop-off location 5 zone id. -999 indicates not available.
shuttleVanTAZ	3	TAZ of shuttle van location
hotelCourtesyTAZ	3	TAZ of hotel courtesy shuttle location
parkLocation1AccessCost	0	Cost to get into parking location 1

PARAMETER	VALUE	DESCRIPTION
parkLocation1CostDay	$39.04	Daily cost in dollars for parking location 1
parkLocation1InVehicleTime	0	In vehicle time to get from parking location 1 to terminal
parkLocation1WalkTime	5 mins	Walk time to get from parking location 1 to terminal
parkLocation1WaitTime	0	Wait time to get from parking location 1 to terminal
parkLocation2AccessCost	0	Cost to get into parking location 2
parkLocation2CostDay	$25.62	Daily cost in dollars for parking location 2
parkLocation2InVehicleTime	3 mins	In vehicle time to get from parking location 2 to terminal
parkLocation2WalkTime	2 mins	Walk time to get from parking location 2 to terminal
parkLocation2WaitTime	3 mins	Wait time to get from parking location 2 to terminal
parkLocation3AccessCost	0	Cost to get into parking location 3
parkLocation3CostDay	$17.99	Daily cost in dollars for parking location 3
parkLocation3InVehicleTime	10 mins	In vehicle time to get from parking location 3 to terminal
parkLocation3WalkTime	2 mins	Walk time to get from parking location 3 to terminal
parkLocation3WaitTime	3 mins	Wait time to get from parking location 3 to terminal
parkLocation4AccessCost	0	Cost to get into parking location 4
parkLocation4CostDay	$17.99	Daily cost in dollars for parking location 4
parkLocation4InVehicleTime	10 mins	In vehicle time to get from parking location 4 to terminal
parkLocation4WalkTime	2 mins	Walk time to get from parking location 4 to terminal

PARAMETER	VALUE	DESCRIPTION
parkLocation4WaitTime	3 mins	Wait time to get from parking location 4 to terminal
parkLocation5AccessCost	0	Cost to get into parking location 5
parkLocation5CostDay	17.99	Daily cost in dollars for parking location 5
parkLocation5InVehicleTime	10 mins	In vehicle time to get from parking location 5 to terminal
parkLocation5WalkTime	2 mins	Walk time to get from parking location 5 to terminal
parkLocation5WaitTime	3 mins	Wait time to get from parking location 5 to terminal
parkEscortAccessCost	0	Cost to get into park escort location
parkEscortCostHour	$7.32	Hourly cost in dollars for park escort
parkEscortInVehicleTime	0	In vehicle time to get from park escort location to terminal
parkEscortWalkTime	5 mins	Walk time to get from park escort location to terminal
parkEscortWaitTime	0	Wait time to get from park escort location to terminal
rentalCarAccessCost	0	Cost to get into park escort location
rentalCostPerDay	$60.99	Hourly cost in dollars for park escort
rentalCarInVehicleTime	0	In vehicle time to get from park escort location to terminal
rentalCarWalkTime	0	Walk time to get from park escort location to terminal
rentalCarWaitTime	0	Wait time to get from park escort location to terminal

PARAMETER	VALUE	DESCRIPTION
ridehailCostInitial	$1.78	Access cost for ridehail service in dollars
ridehailCostPerMile	$1.08	Ridehail cost per mile in dollars
ridehailCostPerMinute	$0.19	Ridehail cost per minute in dollars
ridehailCostMinimum	$5.84	Minimum cost to use ridehail in dollars
ridehailWaitTime	4.1 mins	Wait time to access ridehail in minutes
ridehailLocation1AccessWalkTime	5 mins	Walk time to get to ridehail TAZ 1
ridehailLocation2AccessWalkTime	999	Walk time to get to ridehail TAZ 2
taxiCostInitial	$2.60	Access cost for taxi service in dollars
taxiCostPerMile	$2.70	Taxi cost per mile in dollars
taxiCostPerMinute	$0.50	Taxi cost per minute in dollars
taxiCostMinimum	0	Minimum cost to use taxi in dollars
taxiWaitTime	2 mins	Wait time to access taxi in minutes
taxiLocation1AccessWalkTime	5 mins	Walk time to get to Taxi TAZ 1
taxiLocation2AccessWalkTime	-999	Walk time to get to Taxi TAZ 2
curbLocation1InVehicleTime	0	In vehicle time to get from curb location 1 to terminal
curbLocation1WalkTime	5 min	Walk time to get from curb location 1 to terminal
curbLocation1WaitTime	0	Wait time to get from curb location 1 to terminal
curbLocation2InVehicleTime	0	In vehicle time to get from curb location 2 to terminal
curbLocation2WalkTime	5 min	Walk time to get from curb location 2 to terminal

PARAMETER	VALUE	DESCRIPTION
curbLocation2WaitTime	0	Wait time to get from curb location 2 to terminal
curbLocation3InVehicleTime	-999	In vehicle time to get from curb location 3 to terminal
curbLocation3WalkTime	-999	Walk time to get from curb location 3 to terminal
curbLocation3WaitTime	-999	Wait time to get from curb location 3 to terminal
curbLocation4InVehicleTime	-999	In vehicle time to get from curb location 4 to terminal
curbLocation4WalkTime	-999	Walk time to get from curb location 4 to terminal
curbLocation4WaitTime	-999	Wait time to get from curb location 4 to terminal
curbLocation5InVehicleTime	-999	In vehicle time to get from curb location 5 to terminal
curbLocation5WalkTime	-999	Walk time to get from curb location 5 to terminal
curbLocation5WaitTime	-999	Wait time to get from curb location 5 to terminal
hotelCourtesyWalkTime	5 mins	Walk time to get from hotel courtesy shuttle TAZ to terminal
hotelCourtesyWaitTime	10 mins	Wait time to board hotel courtesy shuttle
shuttleVanWalkTime	5 mins	Walk time to get from shuttle van TAZ to terminal
shuttleVanWaitTime	10 mins	Wait time to board shuttle van
vot_threshold_low	14.32	Max value of time for the lowest value of time bin. In dollars per hour.

PARAMETER	VALUE	DESCRIPTION
vot_threshold_med	26.64	Medium value of time bin is between the vot_threshold_low and this. High value of time bin is everything above this value.
costPerMile	0.5	Auto operating cost in dollars
eaperiod	11	ActivitySim bin denoting end of EA period. ActivitySim time bins start at 3:00 AM and increment in half hour intervals.
amperiod	17	ActivitySim bin denoting end of AM period
mdperiod	30	ActivitySim bin denoting end of MD period
pmperiod	37	ActivitySim bin denoting end of PM period
evperiod	48	ActivitySim bin denoting end of EV period
c_walk	1.7	Multiplier on in-vehicle transit time coefficient for walking
initial_wait_time_multiplier	1.5	Multiplier on initial wait time for boarding transit
transfer_wait_time_multiplier	2	Multiplier on transfer wait time for boarding transit
ivt_lrt_multiplier	0.75	Multiplier on in-vehicle transit time for light rail
ivt_crt_multiplier	0.65	Multiplier on in-vehicle transit time for commuter rail
ivt_frt_multiplier	0.6	Multiplier on in-vehicle transit time for ferry
ivt_fpt_multiplier	0.6	Multiplier on in-vehicle transit time for passenger ferry

4.2 MODEL OUTPUTS

The airport model produces two main outputs: airport tours and matrices. In addition, several intermediate outputs are generated. Table 21 lists the output file from the airport model. The households and person tables essentially the same as the input tables. The output tours table has the additional non-airport destination selected for the tour, but is otherwise not much changed. The trips table written out by the model contains the traveling party trips to or from the airport as well as the escorting vehicle trip home if applicable (as described in the Airport Returns section). Trip mode choice is the primary output contained in the trip table. OMX formatted matrices are then created from the final trips table to be included in assignment.

TABLE 21: MODEL OUTPUT FILES

TABLE	DESCRIPTION
households_airport.csv	Synthetic households
persons_airport.csv	Synthetic persons
tours_airport.csv	Airport tour records
Trips_airport.csv	Airport trip records
airporttrips_{tod}.omx	Vehicle trip matrices for assignment by 12 model time periods

Mode Choice Outputs

Modeled traveler mode choices include five general parking locations, the park-escort lot, curbside drop-off and pickup locations, hotel courtesy, shuttle van, taxi and ridehail operations, local bus and light rail stops, and the rental car facility. The employee model options are driving or walking (potentially from transit) only.

A variety of data sources were used to develop target distributions of trip mode choice for both employees and travelers. These included assumptions regarding average vehicle occupancy to convert vehicle trips to person-trips. The target data and assumed vehicle occupancies are shown for travelers in Table 22 and for employees in Table 23.

TABLE 22: TRAVELER MODE CHOICE TARGETS

TRIP MODE	DESCRIPTION	VEHICLE TRIPS TARGET	ASSERTED VEHICLE OCCUPANCY	PERSON TRIPS TARGET	PERSON TRIPS SHARE

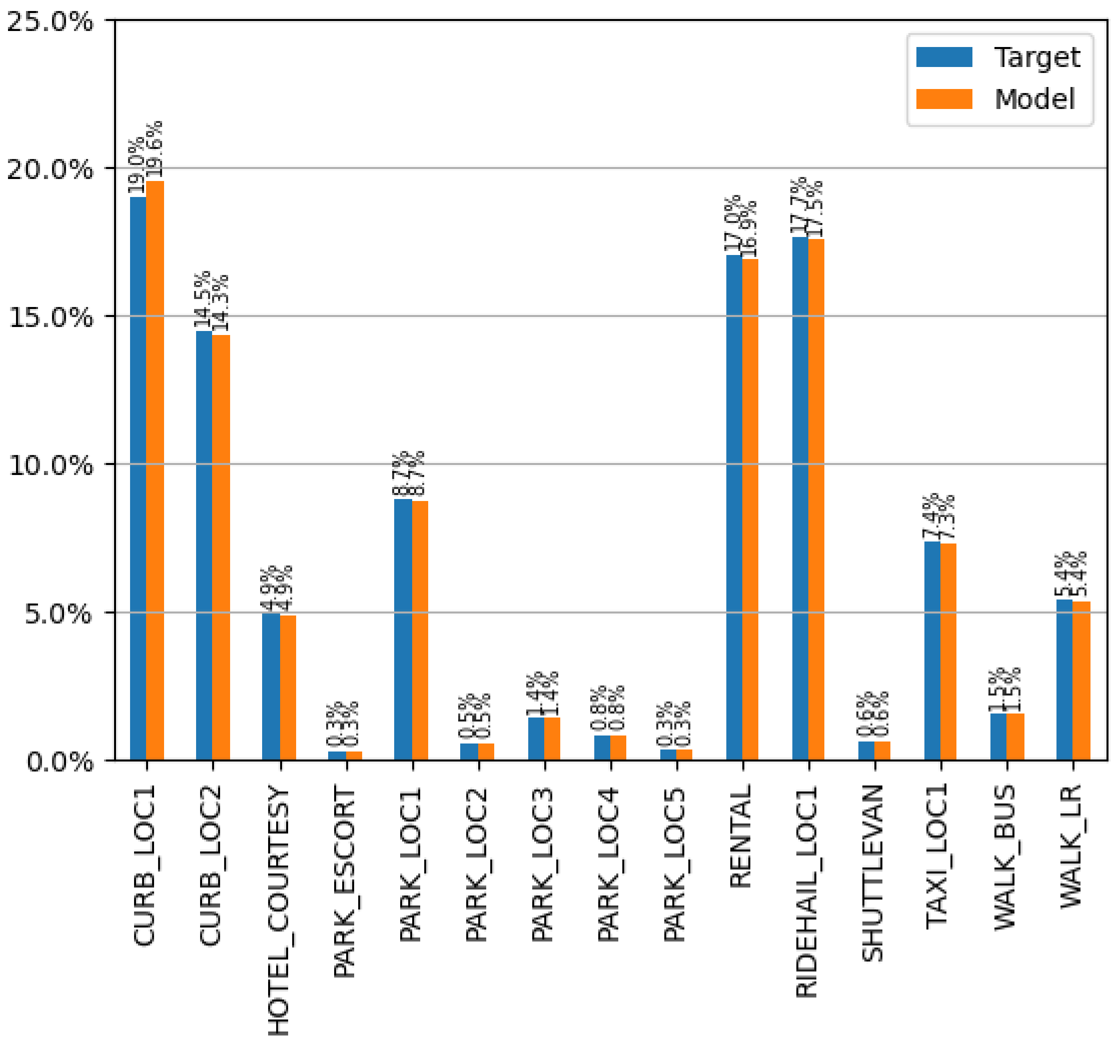
PARK_LOC1	Terminal paid parking	5,859	1.22	7,118	8.75%
PARK_LOC2	Terminal-vicinity paid parking	362	1.22	440	0.54%
PARK_LOC3	North airport paid parking	930	1.22	1,130	1.39%
PARK_LOC4	South airport paid parking	552	1.22	671	0.82%
PARK_LOC5	Angle Lake general parking	197	1.22	239	0.29%
PARK_ESCORT	Park and escort into terminal	181	1.22	220	0.27%
RENTAL	Rental car	13,862	1.00	13,862	17.04%
SHUTTLEVAN	Private shuttle and van services	404	1.22	491	0.60%
HOTEL_COURTESY	Hotel shuttles	3,284	1.22	3,990	4.90%
RIDEHAIL_LOC1	TNCs	13,682	1.05	14,367	17.66%
TAXI_LOC1	Taxi / Limo	5,698	1.05	5,983	7.35%
CURB_LOC1	Curbside drop-off	12,726	1.22	15,462	19.00%
CURB_LOC2	Curbside pick-up	9,687	1.22	11,770	14.47%
WALK_BUS	Walk access to/from bus	1,242.14	1.00	1,242	1.53%
WALK_LR	Walk access to/from light rail	4,380	1	4,380	5.38%

TABLE 23: EMPLOYEE MODE CHOICE TARGETS

TRIP MODE	DESCRIPTION	VEHICLE TRIPS TARGET	ASSERTED VEHICLE OCCUPANCY	PERSON TRIPS TARGET	PERSON TRIPS SHARE
WALK	Employee walk	1,713	1	1,713	29.65%
EMP_TRANSIT	Employee parking lot shuttle	203	20	4,064	70.35%

Calibration parameters were added to the mode choice model for each traveler mode, and a gradient descent search adjusted these parameters, iteratively modeling traveler mode choice while driving the resulting distribution close to the target shares. The resulting calibrated distribution and the target distribution are shown in Figure 12, indicating a close match.

FIGURE 12: MODELED VS. TARGET TRIP MODE CHOICE DISTRIBUTION

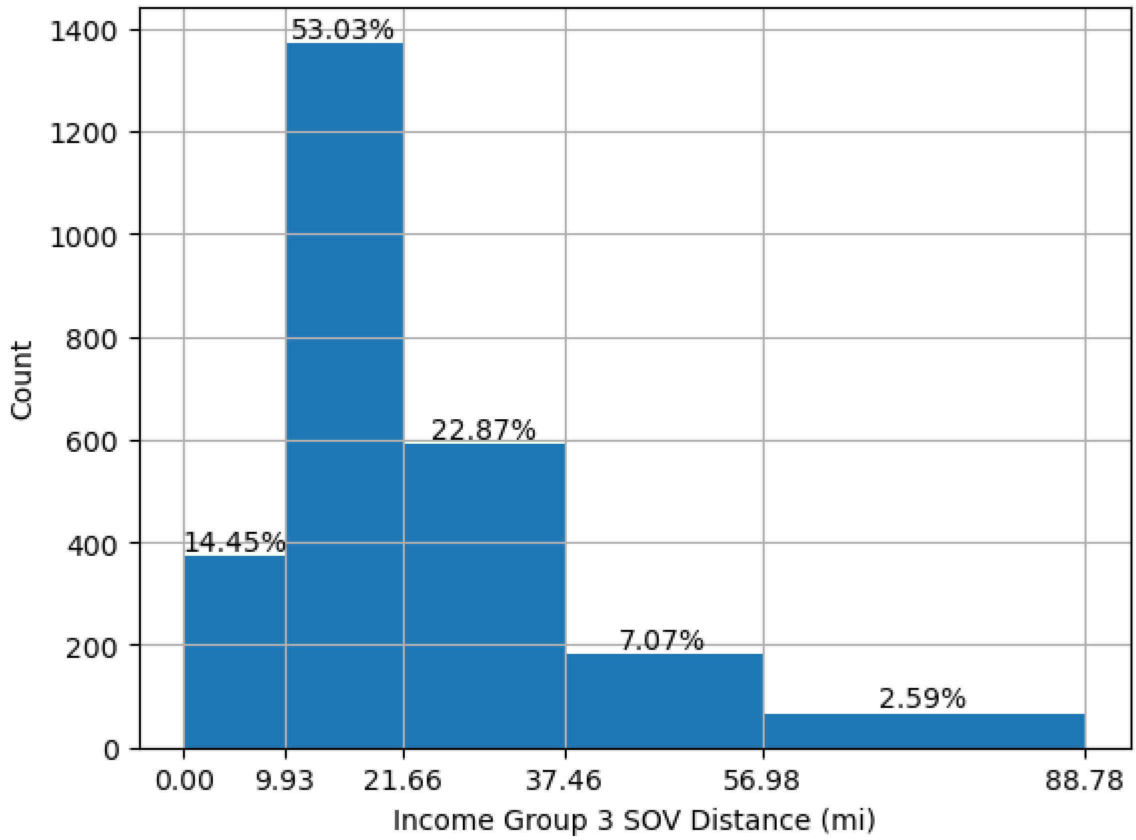


Destination Choice

Zone-level tour destination choice was calibrated according to target distance distributions obtained by mapping surveyed tours' start and end locations to zones and using the shortest route as observed by a household in the $75-100K income bracket traveling alone by car during the midday period.

The survey distance distribution was then split into five bins according to the Jenks natural breaks classification method. The resulting distance distribution and the corresponding bins' shares and bounds are shown in Figure 13.

FIGURE 13: JENKS-BINNED SURVEY DISTANCE DISTRIBUTION



Calibration coefficients for the Jenks-based distance bins were added to the existing non-mandatory tour destination choice model, and their values were adjusted using an iterative gradient-descent search to match the survey distribution. Figure 14 shows a comparison of the modeled and survey distance distributions in traditional density. Figure 15 additionally illustrates the cumulative distance densities for surveyed and modeled trips. Overall, the calibrated model closely reflects the target distance distribution, as shown in these three figures.

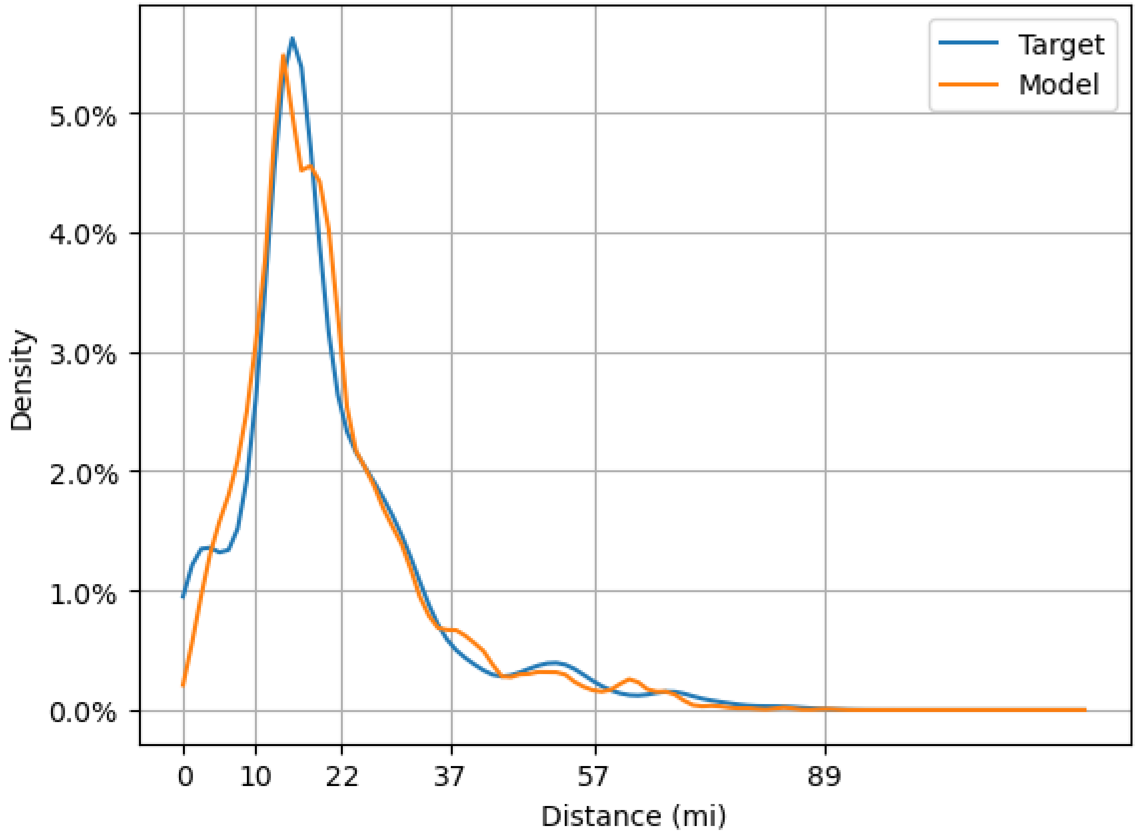


FIGURE 14: MODELED AND SURVEY DISTANCE DISTRIBUTIONS

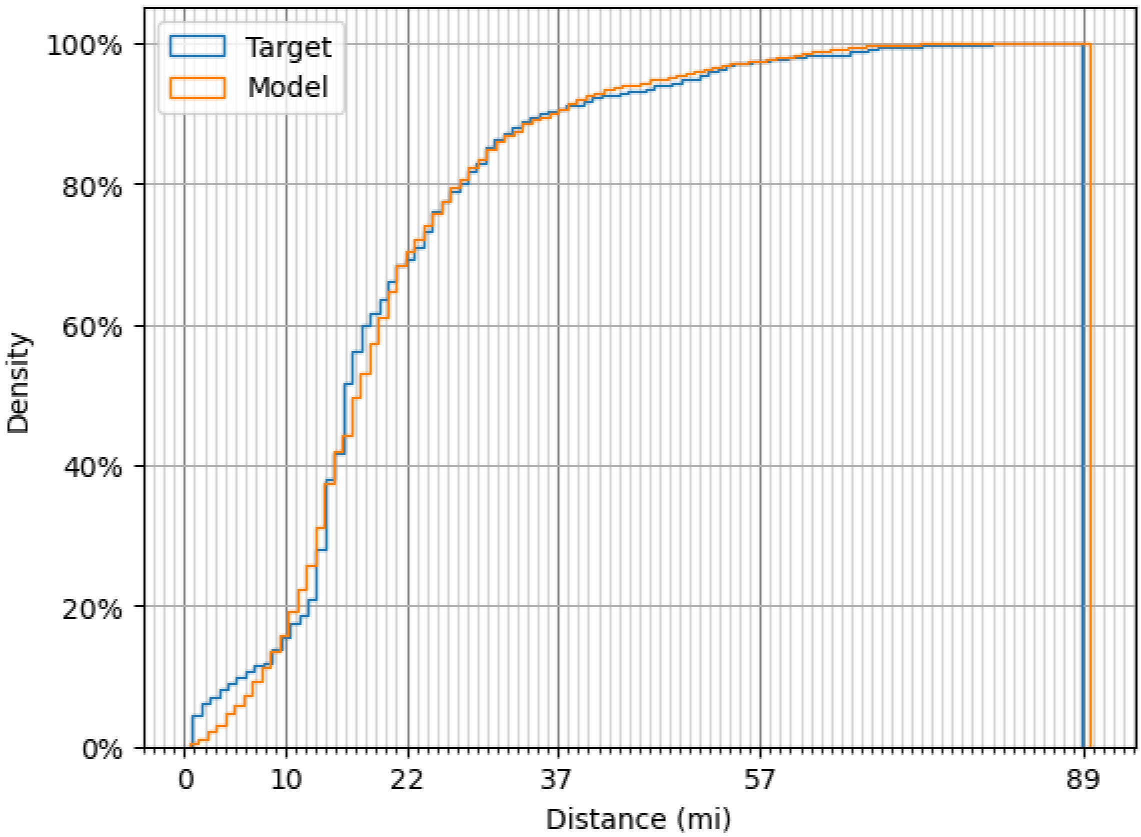


FIGURE 15: MODELED AND SURVEY DISTANCE CUMULATIVE DENSITIES

Output Matrices

The final step in the ActivitySim airport model is the output of final trip matrices. Each trip is associated with one of the 12 SoundCast time of day periods. Each period has auto mode demand segmented into drive alone, shared ride 2, and shared ride 3+ modes. The auto modes are additionally segmented into the three value of time bins. Transit demand matrices, specifically walk-to-transit, are output into their respective modes: bus, light rail, commercial rail, ferry, and passenger ferry.

Output matrices are then added to the resident and other special market models that exist as part of SoundCast. Total matrices are then assigned to the network to compare against validation statistics such as transit ridership and traffic counts. Please refer to the final calibration and validation portion for more information.

APPENDIX A. TRANSFER OF MODE CHOICE PARAMETERS

The NREL mode choice model includes separate mode choice structure and parameters for resident and visitor travelers. However, the new airport model in ActivitySim framework includes one mode choice structure for all travelers.

Figure 16 and Figure 17 show mode choice structure for NREL resident and visitor mode choice models, respectively. Table 24 and Table 25 present resident and visitor parameters in the NREL mode choice model and whether they were transferred to the new airport model. For the parameters that were not transferred, justification is provided under the column "DETAILS." Note that we considered only significant parameters, so non-significant parameters are excluded from the tables. Mode choice nesting structure of the new airport model is shown in Figure 1.

FIGURE 16: NREL RESIDENT MODE CHOICE STRUCTURE

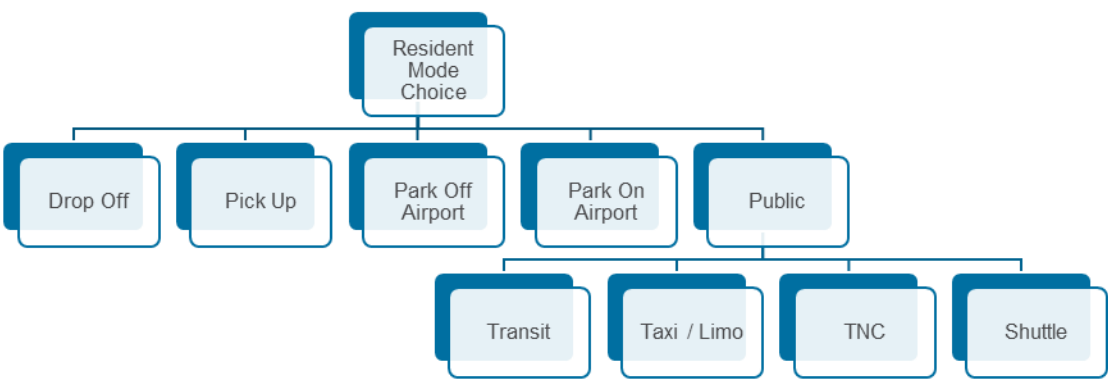


TABLE 24: RESIDENT MODE CHOICE MODEL PARAMETERS

PARAMETER	MODE	TRANSFERRED	DETAILS
Travel time	Generic	Yes	
Trave time business	Generic	Yes	
Cost	Generic	No	Instead, used cost parameters from SANDAG implementation as they are stratified by income and would provide more value.
Cost business	Generic	No	

PARAMETER	MODE	TRANSFERRED	DETAILS
Distance	Parking off airport	No	Used auto operating cost parameters (AOC) from SANDAG implementation. The AOC parameter would include the distance effect so no need to have a separate distance parameter.
	Parking on airport	No	
	Transit	No	
	Taxi or limo	No	
	Airport shuttle	No	
Age <= 35 years	Parking off airport	No	The variable is not in the new airport model so cannot use.
	TNC	No	
	Transit	No	
Household income <$50k	Parking off airport	Yes	
	Parking on airport	Yes	
	Transit	Yes	
Household income between $50k and $125k	Parking on airport	Yes	
Have bags?	Transit	No	The variable is not in the new airport model so cannot use.
Year 2017	TNC	No	Used Year 2018 parameter.
Year 2018	TNC	Yes	
Year 2019	TNC	No	Used Year 2018 parameter.
Year 2020	TNC	No	Used Year 2018 parameter.
Constants	TNC	Yes	

PARAMETER	MODE	TRANSFERRED	DETAILS
	Taxi or limo	Yes	
	Airport shuttle	Yes	
Lambda Public		No	Using a different nesting structure, used nesting parameters from SANDAG implementation.

FIGURE 17: NREL VISITOR MODE CHOICE STRUCTURE

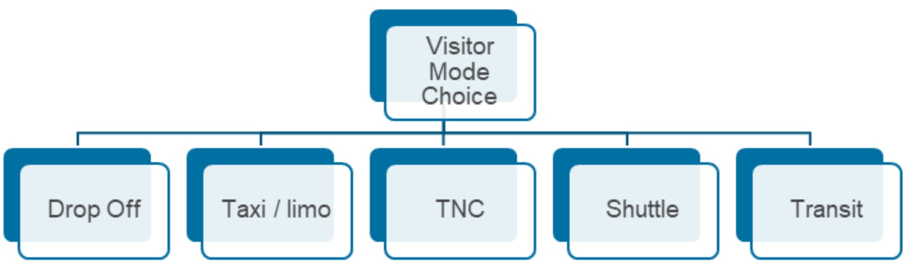


TABLE 25: VISITOR MODE CHOICE MODEL PARAMETERS

PARAMETER	MODE	TRANSFERRED	DETAILS
Travel time	Generic	Yes	
Trave time business	Generic	Yes	
Cost	Generic	No	Instead, used cost parameters from SANDAG implementation as they are stratified by income and would provide more value.
Cost business	Generic	No	
Distance driving	TNC	No	Used auto operating cost parameters (AOC) from SANDAG implementation. The AOC parameter would include the
	Transit	No	

PARAMETER	MODE	TRANSFERRED	DETAILS
			distance effect so need to have a separate distance parameter.
Age <= 35 years	Airport shuttle	No	The variable is not in the new airport model so cannot use.
Travelling alone	TNC	Yes	
	Airport Shuttle	Yes	
Household income <$50k	TNC	Yes	
Household income between $50k and $125k	TNC	Yes	
Have bags?	Transit	No	The variable is not in the new airport model so cannot use.
Year 2018	TNC	Yes	
Year 2019	TNC	No	Used Year 2018 parameter.
Constants	TNC	Yes	
	Taxi or limo	Yes	
	Transit	Yes	
	Airport shuttle	Yes	