12 Model Calibration and Validation

12.1 Observed Travel Data

Observed travel data is used for model development (estimation and calibration of statistical submodels) and for reasonableness checking and validation (comparisons of model estimates to observed data in the validation years). This section provides a description of the key observed travel datasets used for SACSIM19.

12.1.1 American Community Survey

Five-year ACS data from the Census Bureau is used as the source of demographic controls for the development of the 2016 representative population file for SACSIM19. In addition to the demographic profiles, the ACS reports commute statistics such as mode of commute. One-year samples average 1.5 percent of all households in the SACOG region. Three-year samples roll up three years of the ACS samples, and control or weight the totals to the end year of the three year sample cycle. SACSIM19 used 2016 five-year ACS data, using sampling from 2012, 2013, 2014, 2015, and 2016.

12.1.2 Household Travel Surveys

Household travel surveys (HTS) record the actual demographics, activity locations, and travel for all members of households for a known, structured sample of households within a region. HTSs are valuable for estimation of statistical models that form the basis of travel demand models like SACSIM19. HTSs are also valuable as sources of data for calibration of key submodels, to ensure that when applied, the submodels are reasonable representations of observed travel behavior. Two HTS's were used for SACSIM19: the 2000 SACOG Household Travel Survey, and the 2018 SACOG Household Travel Survey. Both HTSs were based on a structured sample of households in Sacramento, Sutter, Yolo, and Yuba Counties, and the western portions of El Dorado and Placer Counties.

- 2000 SACOG HTS. SACOG documented the survey and sample design, as well as initial results of the survey in Appendix C, "2000 Sacramento Area Travel Survey Final Report". A more detailed analysis of the 2000 HTS and extensive tabulations, are provided in Appendix H, "Pre-Census Travel Behavior Report: Analysis of the 2000 SACOG Household Travel Survey". The 2000 HTS was used to do the estimation of DAYSIM_1.7, which was later developed into DAYSIM_2.1, the version of DAYSIM used for SACSIM19.
- 2018 SACOG HTS. This was the first HTS implemented in the SACOG region using the smartphone as the primary data capture device for the survey. It was also the first HTS in the SACOG region that collected travel activities for multiple days, including weekend days. Detailed documentation of the survey and sample design, as well as initial results of the survey can be found in https://www.sacog.org/post/2018-sacog-regional-household-travel-survey. The 2018 HTS was finalized too late for use in re-estimation of SACSIM19, and its use was focused on calibration targets for selected DAYSIM_2.1 submodels, and reasonableness checking of SACSIM19 household-generated travel results.

12.1.3 Sacramento Regional Transit Airport Passenger Survey

In January and February 2002, a contractor for Sacramento Regional Transit surveyed air passengers at the Sacramento International Airport[40]. The goal of the survey was to elicit sufficient information from passengers to estimate a ground access mode choice model, and to sample enough passengers to enable using the sample database itself to apply the model using a sample enumeration approach. The survey sample included 777 departing passengers, which were pre-screened to include passengers traveling to the airport from somewhere in the Sacramento Regional Transit service area. This constitutes an approximately 1-in-10 sample of all departing passengers from the RT service area. The reasonableness of the survey as a basis for direct use using a sample enumeration approach was verified by comparison of the sample to aggregated totals from other random surveys of passengers taken in 1998 and 1999 with ground access trip origins within Sacramento, El Dorado, and Placer counties, which compares to the origin areas of the 2002 passenger surveys. By several key variables, such as ground access trip origin, whether the point of origin was a private residence, hotel, or business, and trip purpose, the 2002 sample matched very closely the near-universe sample taken in the 1999 passenger intercept survey.

The survey included both revealed and stated preference elements. The first questions related to the mode of travel actually taken to the airport on that day. Because very little transit service was present at the time of the survey, a set of stated-preference questions were asked related to transit service. A third set of questions elicited demographic information on the passenger.

12.1.4 On-Board Transit Surveys

To help validate SACSIM's transit ridership predictions, we referred to SACOG's 2013 Connect Card Survey, which surveyed nearly 17,000 transit riders in April 2013 as part of developing the Connect Card multi-agency fare card currently in use in the SACOG region. The survey gathered a rich set of demographic and travel behavior data from riders using Sacramento Regional Transit, Roseville Transit, Yuba-Sutter Transit, Yolobus, Folsom Stage Line, El Dorado Transit, and E-Tran (City of Elk Grove). Below we summarize some of the key metrics from the survey that we compared against modeled transit data outputs.

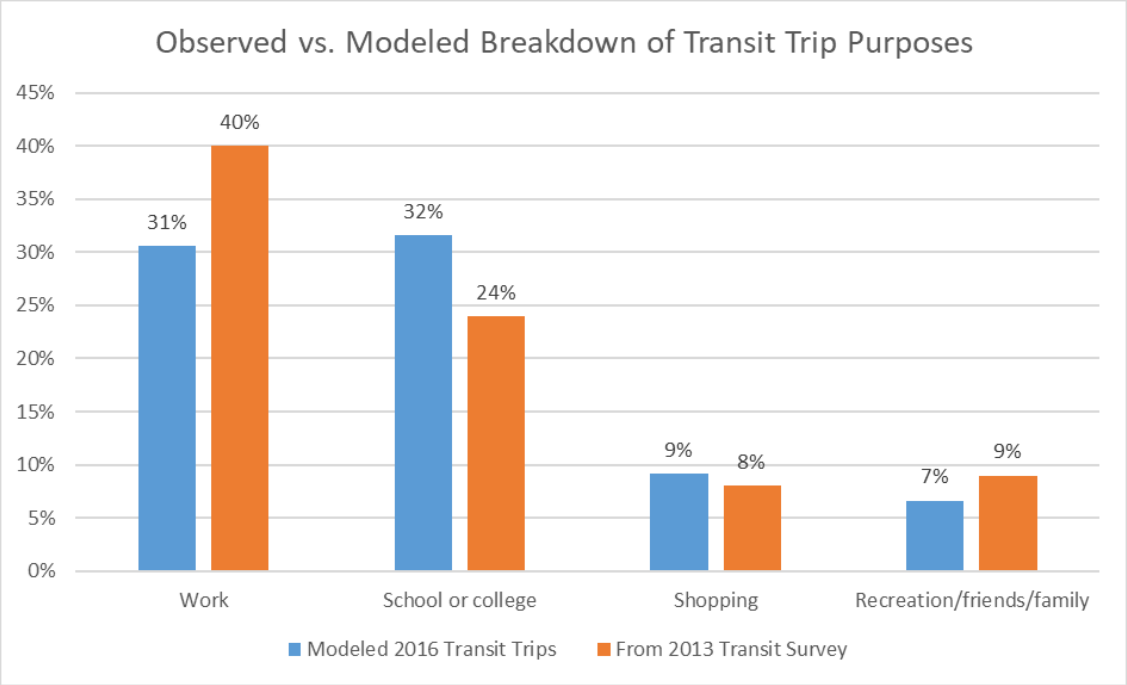
12.1.4.1 Trips by Purpose

Figure 12-1 breaks down transit trips by trip purpose, comparing the trip purpose shares of the model against those found in the 2013 Connect Card Survey. While other trip purposes are captured in the survey and by SACSIM, they are not included in the comparison because they do not have a shared, apples-to-apples definition between the two data sets. E.g., SACSIM has a "meal" trip purpose, but the survey does not. Conversely, the 2013 survey has a "medical appointment" trip purpose, but SACSIM does not.

[40] Parsons Brinckerhof Quade & Douglas, DKS Associates, and JD Franz Associates, "Methodology for Conducting the Passenger Survey at Sacramento International Airport in Support of the Downtown/Natomas/Airport Corridor Alternatives Analysis/Draft EIS Project", July 2002.

For purposes that were comparable, shown in Figure 12-1, SACSIM's modeled share of transit trips dedicated to each purpose is reasonably close to the observed share of trips dedicated to the same purpose. There is some discrepancy, e.g. 40% of observed transit trips were work trips, while only 31% of modeled transit trips were work trips, while for school trips SACSIM predicted that 32% of trips are school trips while observed data only indicated that 24% of trips are school trips. Both discrepancies are likely explained by the absence of Unitrans data in the 2013 Connect Card survey. Unitrans is the second most-used system in the SACOG region, so its riders' behaviors have a significant effect on regional aggregate numbers on rider behavior, and its riders are overwhelmingly UC Davis students. These two factors likely explain why the model data show both a lower share of work trips and higher share of student trips than the observed data.

Figure 12-1 Year 2013 Transit Trips by Purpose



12.1.4.2 Trips, Boardings, and Transfer Rates

Two distinct terms when measuring transit usage are "boardings" and "linked trips". A "linked trip" is the journey that a traveler makes from the trip origin to the trip destination, while a "boarding" occurs each time the traveler gets on a transit vehicle. E.g., if during a linked trip a traveler makes one transfer, that traveler made one linked trip but two boardings.

Table 12-1 below breaks down transfer habits for each transit agency, including how many transfers passengers made and the average boardings per trip. Considering all systems studied in the 2013 survey, the average passenger completed 1.78 boardings for every linked trip. This transfer rate is significantly higher than observed in prior on-board surveys, which ranged from 1.4 to 1.5. Important to note, and discussed in more detail in Section 12.3.4, is the absence of Unitrans data from the 2013 survey. Unitrans is the second busiest transit system in the SACOG region, and its

users are less likely to transfer because the system is oriented toward giving students a "one-seat" ride to the UC Davis campus. Therefore, the transfer rate from the 2013 survey is likely somewhat higher than the regional average after accounting for Unitrans riders.

Table 12-1 Year 2013 Transfer Rates by Service Type

Operator	Transit vehicles used to make trip					Boardings/Trip
	1	2	3	4	5	
RT	31%	61%	7%	2%	0%	1.80
Elk Grove	56%	30%	12%	2%	0%	1.60
El Dorado	89%	9%	2%	0%	0%	1.13
Folsom Stage Line	28%	48%	22%	2%	0%	1.98
Roseville	51%	37%	9%	2%	1%	1.65
Yolobus	42%	46%	10%	2%	0%	1.72
Yuba-Sutter	38%	51%	8%	3%	1%	1.79
All Systems	*33%*	*58%*	*7%*	*2%*	*0%*	*1.78*

12.1.5 Transit Boarding Counts

Year 2016 weekday passenger boardings by line were assembled for use in validation of the transit assignment,

12.1.6 Traffic Counts

Traffic counts are used for validation and reasonableness checking of the SACSIM19 highway vehicle assignments for the MTP/SCS base scenario year 2016. Historical count data for 2005, 2008, and 2012 from past model generations are also used for reasonableness checking and backcast validating. Year 2016 is the base year for SACSIM19 and for analysis of the 2020 Metropolitan Transportation Plan. SACSIM uses multiple sources for the traffic counts:

- Caltrans Performance Measurement System (PeMS): Average Spring or Fall, Tuesday – Thursday Daily average counts are used where sensors have been deemed healthy by PeMS sensor health monitor, observed percentage, and staff review.
- Caltrans Traffic Census Program including Traffic Columns: Annual Daily Traffic (AADT) and Truck Traffic: Annual Average Daily Truck Traffic. Reports provide average annual daily volumes and not typical weekday volumes, where provided "Peak Month" volumes were used.

- Processed counts provided by local agency staff in various forms, but generally as paper counts.
- Processed counts provided by a local traffic sensors, provided by local city traffic monitoring systems and readily available traffic count databases.
- Processed counts provided by a local traffic count vendor, with the permission of the clients that paid for the counts.
- Historic count data from permanent electronic count stations on the State Highway system, which were provided to SACOG in raw form by the Teal Data Center.
- Counts taken by count contractor for SACOG in Fall 2008.

In general, counts were used which met the following criteria:

- Counts were daily volumes broken down by direction of travel, or daily volumes broken down by direction of travel and hour.
- Counts were taken in Spring months (March, April, or May) or early Autumn months (September or October) of calendar year.
- Counts were taken during the mid-week weekdays (Tuesday, Wednesday or Thursday).

In some cases, counts were utilized by SACOG which did not meet these two criteria. The most common exceptions were non-directional daily counts, which were split 50/50 to get to direction of travel, or counts taken outside the desired seasonal windows and year, if there was some level of confidence that the count was a reasonably good representation of weekday volumes.

No peak hour counts were processed or utilized for SACSIM. The reasons for this have to do with the limitations of static or aggregate assignment of vehicle trips onto a regional network the size and extent of SACSIM. Table 12-2 provides a tabulation of the traffic counts assembled by county of the count location by year.

Table 12-2 Traffic Counts Collected by Year

	Year			
	2005	2008	2012	2016
Functional Class				
Freeway/HOV	189	241	191	371
Arterial/Expressway/Rural Highway	556	702	481	1,065
Other Surface Streets & Ramps	520	820	368	760
Total	1,265	1,763	1,040	2,196

Source: SACOG 2020.

12.1.7 Vehicle Miles Traveled

Estimates of VMT were extracted from the annual Highway Performance Monitory System data from the California Public Road Data[41] report, and adjusted for comparison to the SACSIM19 estimates VMT. Adjustments of the CPRD VMT estimates are needed for two reasons.

First, reported VMT is based on average annual daily traffic volumes (AADT) in the CPRD, while the SACSIM19 VMT estimates are typical weekday. The technical definition for "annual average" is the sum of daily volumes on a roadway for every day of the year, divided by the number of days in the year (365 or 366 for leap years). In practice, AADT volumes are rarely computed in this way, though—they are estimated from a limited number of counts, and adjusted for presumed seasonal variation, and for weekday/weekend variations. Spot comparisons of typical weekday volumes to AADT volumes show that on average, typical weekday volumes are about 5 percent higher than AADT volumes. In comparison, SACSIM "typical weekday" (discussed in greater detail in the "Introduction" of this report) is defined as mid-weekday (Tuesday through Thursday) in spring or fall months. In general, typical weekday is more focused on "workday" travel conditions. Since annual average includes weekends, holidays, and all seasons, the volumes tend to be lower on average than typical weekday. A global adjustment factor of 1.05 (i.e. a five percent increase) is used to convert from annual average to typical weekday and regional level.

Second, the CPRD reports provide printed tables which do not allow for tabulation of geography consistent with the SACSIM model area, which is all of Sacramento, Sutter, Yolo and Yuba Counties, and the non-Tahoe-Basin portions of El Dorado and Placer Counties. SACOG assumed the non-Tahoe-Basin portions of CPRD-reported VMT are 90 percent and 95 percent for El Dorado and Placer Counties, respectively.

[41] California Department of Transportation, *California Public Road Data*, published annually, http://www.dot.ca.gov/hq/tsip/hpms/datalibrary.php

12.1.8 Other Data Sources

For reasonableness checking and manual adjustments of free-flow speeds, available estimates of vehicle speed were utilized. For 2012 speeds, SACOG used INRIX average speed estimates by time of day and direction, average for the months of September and October. For 2016 speeds, SACOG used speed data provided through the Federal Highway Administration (FHWA) "National Performance Management Research Dataset" (NPMRDS). NPMRDS data are provided at 15-minute increments for all time periods and days; however, if raw data do not meet the reporting standards of the contractor to FHWA, data are not provided. In general, NPMRDS data coverage is very good for higher volume roadways, and very poor for lower volume roadways. SACOG processes the raw data for use in regional monitoring functions and the Congestion Management Program. The processed speeds are used for reasonableness checking of individual roadway segments and manual adjustments to free-flow speeds in the SACSIM19 highway network.