

# 1 Introduction

SACOG, as the designated Metropolitan Planning Organization (MPO) for the Sacramento region, has the primary responsibility for the development and maintenance of its travel demand forecasting methods and models. These models are used by agencies like SACOG for regional-scale policy analyses of land use and transportation plans, as well as for analyses of the effects of exogenous variables, like fuel prices and demographic change (e.g. aging of the population). The travel demand model currently used by SACOG is the Sacramento Activity-Based Travel Simulation Model, or “SACSIM”.

## 1.1 SACSIM Version

Versions of SACSIM are identified by the year the model code and data files are first utilized for a publicly released analysis. This report provides a detailed description of SACSIM19, which was developed and used for evaluation of the 2020 Metropolitan Transportation Plan/Sustainable Community Strategy (MTP/SCS). Table 1-1 lists the substantial changes and improvements made to SACSIM models since SACSIM15 was released.

Table 1-1 SACSIM15 to SACSIM19 Comparison

Feature	Used for...	SACSIM15	SACSIM19	Change in Modeling
<b>New generation DAYSIM with updated choice models and software structure</b>	Simulation of individual’s daily travel activities	Software constraints on number of skims allowed.	Re-estimated choice models; Fully object-originated programming; Shadow pricing to maintain supply/demand of work and school locations	Easy to use & add network skims by modes, VOT classes, time periods; better estimation / forecasting of travel patterns etc.
<b>Proximity buffering</b> (# of households, jobs, K12 enrollments, etc. within travel distance of each parcel)	Modeling attractiveness of parcels as destinations	-Simple radial buffers (¼ & ½ mile) -Unweighted (i.e. activities at far edge of buffer count same as near edges)	-Buffers based on network distance -Buffers decay weighted—closer activities count more	-Captures linearity of many activities clustered along major arterials -Captures accessibility “shadows” created by freeways, rivers, etc.
<b>Valuation of time (VOT)</b>	-Assessing trade-offs between cost of travel and time of travel -Useful for any model—but necessary to correctly model pricing	-Three levels of VOT, based on household (HH) income range -All members of high income HH have high VOT -All members of low income HH have low VOT	-Distributed VOT -VOT varies for all persons -Higher VOT more likely for high income HH.. -...but VOT mixes across HH income -Some high income have low VOT, some low income have high VOT	-Necessary for implementation of pricing -Necessary for fairly capturing equity impacts of pricing -Causes some trade-offs on shorter, slower routes and longer, faster routes
<b>Transit and Traffic Assignment Time Periods</b>	-Identify peak hour travel -Congestion levels, accessibility, boarding/alighting during peak hours of travel.	4 daily transit periods 4 daily traffic periods (AM,MD,PM,NT)	5 daily transit periods 9 daily traffic periods	-Better control over hourly diurnal flows.

<b>Feature</b>	<b>Used for...</b>	<b>SACSIM15</b>	<b>SACSIM19</b>	<b>Change in Modeling</b>
<b>Vehicle Equivalence on Traffic Assignment</b> (weighting trucks more heavily in estimates of congestion)	-Identifying congested segments and bottlenecks -Reflecting higher congestion impact of bigger trucks	No weighting of bigger trucks	-passenger vehicles =1 -smaller commercial vehicles = 1.5 -3+ axle commercial vehicles = 2.0	-Better practice—called out in last peer review -Overall higher congestion levels
<b>Transit sub-modes</b> (rail, commuter bus, standard fixed route bus)	-Reflecting preferences for different types of transit in mode choice	-Transit mode choice only accounts for mode of access (drive vs. walk) -All transit treated generically	-Continue to account for mode of access -Sub-modes allowed as part of mode choice (rail, commuter bus, fixed route bus)	Better balance of transit trips & boardings amongst the sub-modes
<b>Facility-based Pricing</b>	Modeling toll roads, high-occupancy/toll roads, express lanes	n/a	Full suite of options for modeling toll facilities with dynamic tolling and occupancy class exceptions. User settings for minima/maxima tolls, tolling periods, etc.	New functionality, allows for modeling the impact of tolling on travel behavior and on revenue
<b>Pay-As-You-Go Pricing</b> (PAYGO)	Modeling of mileage-based user fees	Limited to single-point auto-operating cost, inclusive of PAYGO. Fixed by time period, geography. Does not affect path-building.	PAYGO added as roadway network variable, captured in path-building and skims. Can vary by time period or geography.	Captures effects of PAYGO more realistically, and affects path-building and skims for auto modes.

Source: SACOG 2020.

## 1.2 Version History

SACSIM19 – Current

SACSIM15 – Released in 2016 as part of the 2016 MTP/SCS

SACSIM11 – Released in 2012 as part of the 2012 MTP/SCS

## 1.3 Public Access

The updated SACSIM modeling scripts and data files are made available for review and comment by local member agencies and the transportation consulting community in the following ways:

SACOG maintains a basic description of SACSIM on its website for the public at large to get a basic understanding of the model and its uses, and to connect members of the public to SACOG staff members that can provide additional information as needed. <https://www.sacog.org/modeling>

SACOG hosted a SACSIM19 users' conference in January 2019. The conference included a one-day session providing a general overview of the SACSIM19 model, directed at non-modeling planning professionals and representatives of community and advocate groups in the morning session, and a deeper dive into SACSIM19 model functionality for transportation planners and modelers in the afternoon session. Input from the attendees was solicited on the usefulness of the users' conference as a way of disseminating information on SACSIM19, and on user preferences for improvements to SACSIM19 moving forward. <https://www.sacog.org/pod/travel-demand-model-user-conference>

SACOG implemented a formal beta-test process, call for participants announced in November 2018, group starting in January 2019 and ending in March 2019. The beta-test process allowed for early access to the draft SACSIM19 for learning and testing purposes. Ten organizations and firms participated. The beta-test included a one-day training session on SACSIM19, technical support as needed, and bi-weekly teleconferences calls to check in on testing progress and to address questions or issues experienced by the beta testers. More information about beta testing can be found under <https://www.sacog.org/pod/travel-demand-model-beta-testing-group>.

SACOG scheduled an early release of the SACSIM19 MTP/SCS draft preferred scenario land use and transportation network files, data files, scripts, and executables to local agencies and their consultants, enabling them to review the MTP/SCS and provide a baseline for local project analyses. Agencies took advantage of this release of the draft MTP/SCS for projects such as the Placer Sacramento Gateway Plan and Caltrans Managed Lanes studies.

Modeling changes were presented to ARB staff in discussions related to the proposed technical methodology for assessment of greenhouse gases for implementation of SB 375, pursuant to Section 65080 of the Government Code.

## 1.4 Organization of the Report

The report is organized into 12 chapters with several Appendices.

### 1.4.1 Chapter 1 Introduction

Chapter 1 describes organization of the documentation, version history, and public access.

### 1.4.2 Chapter 2 Model Overview

Chapter 2 is oriented toward model users and provides information relevant to setting up and running the model such as hardware/software requirements, setting up model inputs, a review of model outputs, and troubleshooting common issues that arise when running the model.

### 1.4.3 Chapter 3 Model Structure

Chapter 3 describes the overall structure and flow of the SACSIM model, along with descriptions of each SACSIM submodel. The submodels include:

- *DAYSIM* is the person-day activity and travel simulator, which is the only true activity-based tour component of SACSIM. DAYSIM accounts for all travel by residents of the SACOG region for their travel within the region. The simulation is at person level, so the major outputs of DAYSIM relate to personal travel for work, school, social/recreational, and other non-work purposes. DAYSIM includes a set of *long-term choice* models at the highest level, and a larger set of *short-term choice* models at lower levels.
- *Airport ground access* to the Sacramento International Airport is modeled separately, at the traffic analysis zone (TAZ) level. This model is adapted from work done by the Sacramento Regional Transit District for its evaluation of the Downtown-Natomas-Airport transit corridor.
- *Commercial vehicle travel* is also modeled separately from resident travel and is modeled at the TAZ level. It includes all trips made for transportation of goods and services. This submodel was adapted from SACMET, and operates with conventional four-step trip generation, distribution, and assignment.
- *External trips* include both internal-external (trips made by region residents to points outside the region), external-internal (trips made by residents from outside the region to points within the region), and trips that pass through the region without stopping. These trips are fixed as exogenous, scenario variables. Only the portion of these trips that occur within the SACOG region are modeled.

Trips from all the submodels are aggregated to create conventional trip matrices which are assigned to the highway and transit networks. This process includes a *trip aggregator*, plus all the usual trip assignment programs.

SACSIM runs within an application shell, scripted in Citilabs® TP-Plus software. DAYSIM itself is a stand-alone program written in C#, and compiled to run within the SACSIM application. All trip aggregation, plus the non-DAYSIM components, are TP-Plus scripts.

### 1.4.4 Chapters 4 and 5 Land Use and Demographics

Chapters 4 and 5 cover key land use and demographic input data files required by SACSIM. Chapter 4 provides a description of the *parcel land use file*, which is the SACSIM equivalent of a zonal data

file in a conventional four-step model. In addition to descriptions of the key variables included in the file, Chapter 4 provides an overview of how the file is produced, starting from SACOG's land use model. Chapter 5 provides a description of the *representative population file*, which is a person-level representation of the region's household population. The population file is required to run activity-based tour models like SACSIM. The cumulative demographics (household size, workers, income distribution, age) of the representative population file reflect key demographic projections and forecast assumptions which underlie SACOG's travel demand forecasts. Chapter 5 provides an overview of how the population file is produced.

#### **1.4.5 Chapters 6, 7, and 8 Transportation Networks**

Chapters 6, 7, and 8 cover transportation network input files and assumptions. Chapter 6 provides a detailed description of the *highway network files* used by SACSIM. Highway networks are required for generating cost or level of service matrices (also called *skims*), which represent the level of accessibility of travel by automobile.

Chapter 7 describes SACSIM's transit network. By their nature, transit networks are more complicated than highway networks. First, more attributes need to be represented in transit networks, including stop locations, service frequencies, transfer locations, access points (e.g. park-and-ride lots), and hours of operation. Second, access to transit (i.e. how a traveler gets from his or her origin location to the first transit stop) is more difficult to characterize in computer models, and additional network features and coding are required to capture the options which can be used to access transit. Finally, transfers and fare policies vary among operators and passenger types, which results in a large variety of potential fares for each trip itinerary and person type. Together, these transit inputs allow creation of transit skims, which represent the level of transit access between TAZs.

Chapter 8 discusses SACSIM's bike and walk network, which is a subset of its highway network. It also discusses the method by which SACSIM takes advantage of its detailed, parcel-level land use data to estimate the distances of short trips (e.g. trips that start and end within the same TAZ, or between nearby TAZs) more accurately than can be done by the SACSIM highway network on its own.

#### **1.4.6 Chapter 9 Auto/Transit Cost and Pricing**

Large variations in fuel prices over the last several years have initiated a re-evaluation of fuel price and auto operating costs as it affects travel costs and behavior in travel demand models. Chapter 9 provides a SACOG-specific and California perspective on actual fuel prices and recent changes, and describes how fuel prices are represented in SACSIM. The chapter also explains how transit fares are represented in the model.

#### **1.4.7 Chapter 10 System Equilibration**

Chapter 10 describes the theoretical foundation behind and process by which SACSIM iterates in order to reach system equilibration and describes the relationships between the network

assignment and DAYSIM to determine person trip travel patterns and mode choices relating to congestion.

**1.4.8 Chapter 11 Sensitivity Tests**

Chapter 11 presents the results of several sensitivity tests applied to SACSIM, which test to see if the model's responses to changes in factors like fuel price, transit fare, income, land use density reasonably align with observed responses in travel behavior to changes in these factors. Chapter 11 also summarizes the results of a "random variation" test, which test to see how much variation there is in model outputs due to the probabilistic nature of many of its choice models.

**1.4.9 Chapter 12 Model Calibration, Validation and Reasonableness Check**

Chapter 12 describes the observed travel and transportation system data sources used for estimating, calibrating, validating, and reasonableness checking SACSIM along with a discussion on the quality and limitations of each source.