

SACOG Activity-Based Travel Forecasting Model

Featuring *DAYSIM*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

---

SACSIM/05

Activity-Based Travel Forecasting Model for SACOG

Featuring *DAYSIM*—the Person Day Activity and Travel Simulator

Technical Memo Number 9

**Household Auto Availability Model**

September 14, 2006—Draft 2

*Prepared for*

**Sacramento Area Council of Governments**

*Prepared by*

**John L. Bowman, Ph. D.**

Transportation Systems and Decision Sciences

28 Beals Street, Brookline, MA 02446 USA

+1-617-232-8189 [John\\_L\\_Bowman@alum.mit.edu](mailto:John_L_Bowman@alum.mit.edu) <http://JBowman.net>

***MARK BRADLEY***

*BRADLEY RESEARCH & CONSULTING*

524 Arroyo Ave., Santa Barbara, CA 93109, USA.

+1-805-564-3908 [mark\\_bradley@cox.net](mailto:mark_bradley@cox.net)

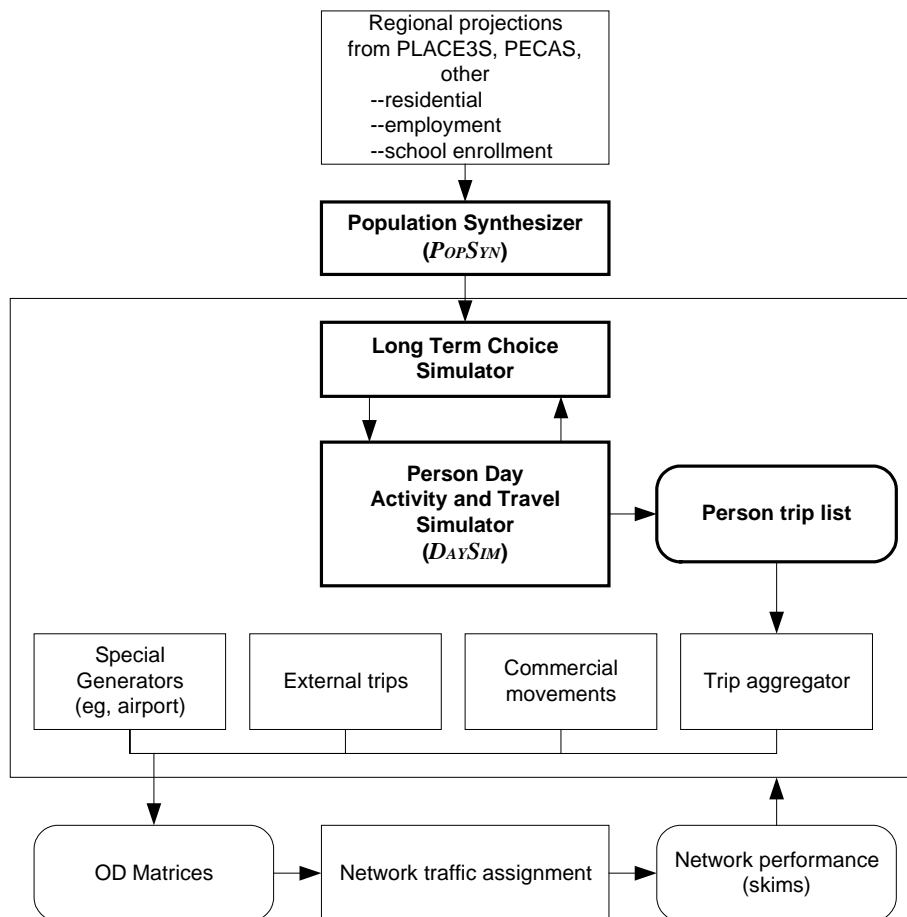
## Table of Contents

Table of Contents .....	2
Introduction .....	3
Auto availability model .....	5
Model application with estimation data .....	8
Appendix—Details of model application with estimation data .....	9

## Introduction

This is the ninth in a series of technical memos being produced according to a work program in which Mark A. Bradley and John L. Bowman are developing the activity-based demand model components of a new travel demand forecasting model system for the Sacramento Area Council of Governments (SACOG), depicted in **Figure 1**. For a description of the entire model system, see memo 1 in this series, entitled Model System Design.

**Figure 1: New SACOG Regional Travel Forecasting Model System**



The current memo presents the estimation results for the household auto availability model. It occurs within the Long Term Choice portion of the model system, occurring at model step 1.4, as highlighted in **Figure 2**. In this structure, it is assumed that the household's auto availability decision is made with full knowledge of all household members' usual work and school locations.

**Figure 2: DaySim models (numbered) within the program looping structure**

Begin

```
{Read run controls, model coefficients, TAZ data, LOS matrices,
      population controls, and Parcel data into memory}
{Draw a synthetic household sample if specified}
{Pre-calculate destination sampling probabilities}
{Pre-calculate (or read in) TAZ aggregate accessibility arrays}
{Open other input and output files}
{Main loop on households}
  {Loop on persons in HH}
    {Apply model 1.1 Work Location for workers}
    {Apply model 1.2 School Location for students}
    {Apply model 1.1 Work Location for students}
  {End loop on persons in HH}
  {Apply model 1.3 Household Auto Availability }
  {Loop on all persons within HH}
    {Apply model 2.1 Activity Pattern (0/1+ tours and 0/1+ stops)
      and model 2.2 Exact Number of Tours for 7 purposes}
    {Count total home-based tours and assign purposes}
    {Initialize tour and stop counters and time window for the person-day before looping on tours}
    {If there are tours, loop on home-based tours within person in tour priority sequence,
      with tour priority determined by purpose and person type}
    {Increment number of home-based tours simulated for tour purpose (including current)}
    {Apply model 3.1 Tour destination}
    {If work tour, apply model 3.2 Number and purpose of work-based sub-tours}
    {Loop on predicted work-based sub-tours and insert then tour array after current tour}
    {Apply model 3.3 Tour mode}
    {Apply model 3.4 Tour primary destination arrival and departure times}
    {Loop on tour halves (before and after primary activity)}
      {Apply model 4.1 Half tour stop frequency and purpose}
      {Loop on trips within home-based half tour (in reverse temporal order for 1st tour half)}
        {Increment number of stops simulated for stop purpose (including current)}
        {Apply model 4.2 Intermediate stop location}
        {Apply model 4.3 Trip mode}
        {Apply model 4.4 Intermediate stop departure time}
        {Update the remaining time window}
      {End loop on trips within half tour}
    {End loop on tour halves}
  {End loop on tours within person}
  {Write output records for person-day and all tours and trips}
{End loop on persons within household}
{End loop on Households}
{Close files}
{Create usual work location flow validation statistics}
```

End.

## Auto availability model

Throughout this document, the terms auto, vehicle and car are used interchangeably. They all refer to vehicles as defined and counted in the household survey used for model estimation. Auto availability refers to the number of vehicles owned, leased, or otherwise available for use by the household. Any person aged 16 or over is called a driver.

Table 1 shows the distribution of available autos by number of drivers among the households in the survey data used for model estimation. The number of autos is strongly correlated with the number of drivers.

**Table 1a: Frequency of households in estimation sample tabulated by number of household autos available and number of drivers in household**

		Number of household autos available									Total	
		0	1	2	3	4	5	6	7	8		9
Number of drivers in household	1	131	771	146	49	7	1	2				1107
	2	34	364	1315	339	78	34	7	2	3	4	2180
	3	5	44	161	195	56	18	3	1	2		485
	4	1	13	24	40	36	17	3	1			135
	5		1	11	1	6	5	1	1			26
	6		1		1	1	2	1				6
	7					1			1			2
	8							1				1
Total		171	1194	1657	625	185	77	18	6	5	4	3942

**Table 1b: Percentage of households in estimation sample tabulated by number of household autos available and number of drivers in household**

		Number of household autos available									Total	
		0	1	2	3	4	5	6	7	8		9
Number of drivers in household	1	3.3%	19.6%	3.7%	1.2%	.2%	.0%	.1%				28.1%
	2	.9%	9.2%	33.4%	8.6%	2.0%	.9%	.2%	.1%	.1%	.1%	55.3%
	3	.1%	1.1%	4.1%	4.9%	1.4%	.5%	.1%	.0%	.1%		12.3%
	4	.0%	.3%	.6%	1.0%	.9%	.4%	.1%	.0%			3.4%
	5		.0%	.3%	.0%	.2%	.1%	.0%	.0%			.7%
	6		.0%		.0%	.0%	.1%	.0%				.2%
	7					.0%			.0%			.1%
	8							.0%				.0%
Total		4.3%	30.3%	42.0%	15.9%	4.7%	2.0%	.5%	.2%	.1%	.1%	100%

The model is structured as a multinomial logit (MNL) with five available alternatives: 0, 1, 2, 3, and 4+. The 4+ aggregate category is used because very few of the 3942 households in the sample have five or more autos, and all but 12 of those have less than five drivers, so households with 4+ autos almost never have competition for autos within the household.

**Table 2** shows the results of model estimation, and a description of the model variables follows with a summary of the estimation results.

SACOG Activity-Based Travel Forecasting Model

Featuring *DAYSIM*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

**Table 2: Household Auto Availability Model**

Description	No car			1 car			2 cars			3 cars			4+ cars		
	ID	Coeff	T stat	ID	Coeff	T stat	ID	Coeff	T stat	ID	Coeff	T stat	ID	Coeff	T stat
1 driver in HH	1	-5.819	-5.6				2	-1.575	-10.1	3	-2.676	-12.9	4	-4.031	-10.4
2 drivers in HH	5	-6.830	-6.5	6	-1.772	-9.3				7	-1.375	-11.8	8	-2.100	-9.3
3 drivers in HH	9	-6.680	-5.7	10	-1.486	-5.3	11	-0.280	-1.3				12	-0.477	-1.9
4+ drivers in HH	13	-8.086	-5.3	14	-1.997	-4.6	15	-1.024	-3.0	16	-0.969	-2.8			
Cars per driver--nonfamily households	17	-0.469	-1.8	17	-0.469	-1.8	17	-0.469	-1.8	17	-0.469	-1.8	17	-0.469	-1.8
Dummy—at least as many cars as workers	18	0.578	4.9	18	0.578	4.9	18	0.578	4.9	18	0.578	4.9	18	0.578	4.9
part-time workers per driver	19			20						21	-0.325	-1.2	22	-0.382	-0.9
retired adults per driver	23			24	0.281	2.4				25	-0.338	-2.1	26	-0.560	-2.2
university students per driver	27			28	0.795	3.0				29	0.682	2.1	30		
driving age children per driver	31	2.281	1.9	32	1.234	2.1				33	-0.742	-1.4	34	-2.830	-3.8
home-based workers and students per driver	35	1.000	2.7	36	0.570	3.2				37			38	-0.211	-0.8
children under 5 per driver	39	-0.630	-0.9	40						41	-0.475	-1.6	42	-1.717	-2.8
Dummy--HH income under \$15,000 per year	43	2.217	8.7	44	0.547	3.0				45	-0.609	-1.9	46	-1.218	-2.2
Dummy--HH income \$50-75,000 per year	47	-1.419	-3.5	48	-1.138	-9.0				49	0.178	1.4	50	0.198	1.1
Dummy--HH income above \$75,000 per year	51	-1.600		52	-1.231	-6.6				53	0.310	2.2	54	0.435	2.2
Dummy--HH income not reported	55	-0.081	-0.2	56	-0.577	-3.6				57	0.168	0.9	58	-0.371	-1.2

	No car			Less cars than drivers		
Accessibility: Difference between logsums with full HH car availability and no HH car availability	59	-0.242	-3.3	60	-0.068	-3.1
--Mode choice logsum to work--fulltime workers						
--Mode choice logsum to work—other workers	61	-0.279	-1.9	61	-0.077	-2.0
--Mode choice logsum to school--students age 16+	63			64	-0.094	-1.9
--Driver's non-work mode-dest logsum	67	-0.250	-1.7	68		
Amount (mi) by which distance to nearest transit stop is less than ½ mile (capped at .25)	70	11.141	2.6	72	1.126	1.5
Amount (mi) by which distance to nearest transit stop is less than ¼ mile	69	5.244	3.3	71	1.338	1.7
Avg daily parking price (\$) within 1/2 mile of home	73	0.104	3.5	74	0.051	1.2
Natural log of commercial employment (food, retail, service, medical) within 1/2 mi of home	75	0.210	3.8	76	0.138	5.0
<b>Summary statistics</b>						
Number observed choices			3942			
Number of estimated parameters			64			
Log likelihood w coeffs=0			-6344			
Final Log likelihood			-3884			
Rho squared			0.388			
Adjusted rho squared			0.378			

**Number of drivers in household.** Rows 1-4 are alternative-specific constants by number of drivers. They capture much of the strong correlation between number of drivers and number of autos.

**Cars per driver (for nonfamilies).** The negative coefficient for this variable indicates that nonfamily households tend to have less cars per driver than do families.

**Cars greater than or equal to number of workers.** This captures the tendency to have at least one car for every worker in the household.

**Persons per driver by person type.** Rows 7-12 capture variations in car ownership rates depending on the type of persons in the household. For example, row 10 indicates that households are less likely to have a car for every high school driver than for other drivers in the household, and row 11 indicates that the same is true for workers who usually work at home.

**Income categories.** Rows 13-15 are alternative-specific dummy variables for income categories that capture a strong correlation between income and car ownership.

**Accessibility to work and school.** The variables in rows 17-19 are derived from mode choice logsums for workers and students in the household, traveling to their usual work and school locations. Row 17, for fulltime workers, is explained here, and rows 18 and 19 are analogous for other workers and students, respectively. The mode choice logsum for the work tour is calculated for each fulltime worker assuming the household has a car for every driver, and again assuming the household has no cars. The variable used in model estimation is the difference between these two logsums. Two separate coefficients are estimated, one associated with the 0 car alternative, and the other associated with all alternatives where drivers in the household must compete for cars. Both coefficients are negative, with the 0 car coefficient being larger in magnitude. The effect in the model is as follows: The difference variable is always positive, and when accessibility by car is much greater than by other modes, the difference variable is larger. When the difference is larger, the household is less likely to tolerate competition for cars among drivers, and even less likely to live without a car at all.

**Accessibility of nonwork activities.** This variable in row 20 is calculated and used like the work and school accessibility variables, with the following differences. Only one variable is used for the entire household, instead of one per driver. It is derived from non-work mode-destination logsums, so it represents accessibility in the neighborhood surrounding the residence for non-work activities. The pre-calculated aggregate mode-destination logsums for adults (with and without car available) are used for this purpose. Here, the effect is only statistically significant for the 0 car alternative. Inaccessibility by non-auto modes for nonwork activities slightly increases the tendency to have at least one car, but doesn't increase the tendency to have at least one car per driver.

**Accessibility to nearest transit stop.** Rows 21 and 22 capture increased tendency to live with less or no cars when the nearest transit stop is within a half mile. Row 21 captures this for distances less than  $\frac{1}{2}$  mile, with an increasing effect as the distance drops to  $\frac{1}{4}$  mile. Row 22 captures additional effect for distances less than  $\frac{1}{4}$  mile, with the effect also increasing as distance drops to 0.

**Parking prices in neighborhood.** Row 23 captures lower vehicle ownership rates among people living in neighborhoods where it costs money to park during the day, with ownership rates dropping as the price increases.

**Commercial employment in the neighborhood.** Similarly, row 24 captures correlation between vehicle ownership rates and commercial employment in the neighborhood, with ownership rates declining as commercial employment increases. The hypothesis is that people are more likely to live with less cars if they can get to commercial activities without one.

## Model application with estimation data

The appendix provides statistical results from applying the models on the estimation data, showing how well the model predicts the observed outcomes in the estimation data set. **Table 3** extracts from the appendix the modeled average auto ownership for various subsets of the sample households, and compares it to modeled auto ownership under four simple prediction scenarios. The results indicate that the model is sensitive to the policy scenarios, but the elasticity is very small. The most sensitive population segment by far is the lowest income group, and after that the elasticity is greater for households with one person, one driver, or no worker, than for other households.

**Table 3: Modeled average car ownership and elasticity for four scenarios**

Subset of households	Base case	Increase auto time by 10%		Reduce walk distance to transit by 10%		Increase auto cost by 10%		All other changes, plus reduce transit times and costs by 10%	
	Avg # cars	avg # cars	elast.	avg # cars	elast.	avg # cars	elast.	avg # cars	elast.
Aggregate	1.962	1.961	-0.01	1.958	-0.02	1.961	-0.01	1.953	-0.05
No kids	1.857	1.856	-0.01	1.853	-0.02	1.857	0.00	1.849	-0.04
With kids	2.272	2.271	0.00	2.268	-0.02	2.271	0.00	2.263	-0.04
HH size 1	1.127	1.126	-0.01	1.123	-0.04	1.127	0.00	1.117	<b>-0.09</b>
HH size 2	2.062	2.061	0.00	2.057	-0.02	2.061	0.00	2.055	-0.03
HH size 3	2.432	2.431	0.00	2.428	-0.02	2.431	0.00	2.423	-0.04
HH size 4	2.568	2.567	0.00	2.563	-0.02	2.567	0.00	2.558	-0.04
HH size 5	2.514	2.514	0.00	2.510	-0.02	2.514	0.00	2.506	-0.03
no worker	1.491	1.489	-0.01	1.484	-0.05	1.490	-0.01	1.480	<b>-0.07</b>
1 worker	1.758	1.757	-0.01	1.754	-0.02	1.757	-0.01	1.750	-0.05
2 workers	2.389	2.388	0.00	2.386	-0.01	2.388	0.00	2.383	-0.03
3 workers	3.123	3.121	-0.01	3.116	-0.02	3.122	0.00	3.108	-0.05
4 workers	3.805	3.803	-0.01	3.797	-0.02	3.803	-0.01	3.784	-0.06
no student	1.807	1.806	-0.01	1.803	-0.02	1.807	0.00	1.799	-0.04
1 student	2.188	2.187	0.00	2.184	-0.02	2.188	0.00	2.179	-0.04
2 students	2.352	2.351	0.00	2.348	-0.02	2.351	0.00	2.342	-0.04
3 students	2.405	2.404	0.00	2.400	-0.02	2.404	0.00	2.395	-0.04
no fulltime worker	1.526	1.524	-0.01	1.520	-0.04	1.525	-0.01	1.516	<b>-0.07</b>
1 fulltime worker	1.939	1.938	-0.01	1.935	-0.02	1.939	0.00	1.931	-0.04
2 fulltime workers	2.496	2.495	0.00	2.493	-0.01	2.495	0.00	2.489	-0.03
3 fulltime workers	3.372	3.371	0.00	3.366	-0.02	3.371	0.00	3.358	-0.04
HH income <\$15K	1.043	1.039	-0.04	1.033	-0.10	1.041	-0.02	1.022	<b>-0.20</b>
HH Income \$15-50K	1.724	1.723	-0.01	1.720	-0.02	1.724	0.00	1.716	-0.05
HH Income \$50-75K	2.306	2.305	0.00	2.303	-0.01	2.305	0.00	2.300	-0.03
HH Income \$75-100K	2.552	2.552	0.00	2.550	-0.01	2.552	0.00	2.547	-0.02
HH Income >\$100K	2.509	2.508	0.00	2.506	-0.01	2.508	0.00	2.504	-0.02
1 driver	1.134	1.133	-0.01	1.130	-0.04	1.134	0.00	1.125	<b>-0.08</b>
2 drivers	2.109	2.108	0.00	2.105	-0.02	2.108	0.00	2.103	-0.03
3 drivers	2.716	2.715	0.00	2.710	-0.02	2.716	0.00	2.703	-0.05
4 drivers	3.321	3.320	0.00	3.312	-0.03	3.320	0.00	3.301	-0.06

## Appendix—Details of model application with estimation data

This appendix provides statistical results from applying the models on the estimation data. Each table is in two parts. The first part reports the observed (No. chsn) and predicted (No. Pred) distributions of household auto availability for various subsets of the households (see column headings) under the base conditions used for model estimation. The estimated standard deviation of the observed choices (SD. Chsn) is also provided; it indicates the variation that would likely be observed (in No. chsn) if the estimation sample were redrawn repeatedly. If there are few stars, then the discrepancies between observed and predicted are small compared to the uncertainty in the sample itself.

The second part of each table reports the predicted average value of household auto availability for each subset of households.

Table for aKids (Presence of children)

	no kids	with kids	Total
No. Chsn	153.0	18.0	171.0
SD. Chsn	10.4	3.8	11.0
No Car	-	+	
No. Pred	152.7	18.3	171.0
No. Chsn	1008.0	186.0	1194.0
SD. Chsn	20.5	10.1	22.9
1 Car	+	-	
No. Pred	1014.4	179.6	1194.0
No. Chsn	1187.0	470.0	1657.0
SD. Chsn	23.3	14.2	27.3
2 Cars	-	+	
No. Pred	1181.8	475.2	1657.0
No. Chsn	413.0	212.0	625.0
SD. Chsn	17.7	12.2	21.6
3 Cars	-	+	
No. Pred	407.2	217.8	625.0
No. Chsn	186.0	109.0	295.0
SD. Chsn	12.3	8.7	15.1
4+ Cars	+	-	
No. Pred	190.8	104.2	295.0
No. Chsn	2947.0	995.0	3942.0
Total			
No. Pred	2947.0	995.0	3942.0
avg#carsx100	185.7	227.2	196.2

INFORMATION 571: root-Mean-Square-Error is 4.607  
 INFORMATION 572: number of \*\*stars\*\* in table is 0

# SACOG Activity-Based Travel Forecasting Model

Featuring *DaySim*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

Table for aHhsize (Household Size)

	1	2	3	4	5	6	7	8	9	10	Total
No. Chsn	125.0	31.0	7.0	7.0	1.0	.0	.0	.0	.0	.0	171.0
SD. Chsn	9.0	5.4	2.6	1.7	1.2	.7	.3	.1	.1	.4	11.0
No Car	-	+	+	**-	+	+					+
No. Pred	123.1	34.2	8.1	3.1	1.6	.5	.1	.0	.0	.2	171.0
No. Chsn	703.0	325.0	82.0	50.0	21.0	5.0	5.0	2.0	.0	1.0	1194.0
SD. Chsn	13.9	14.9	7.2	5.9	3.7	2.3	1.4	.9	.4	.6	22.9
1 Car	-	+	-	-	-	**+	*-	*-	+	-	
No. Pred	700.6	333.1	80.8	48.2	19.5	7.4	2.6	1.0	.2	.6	1194.0
No. Chsn	127.0	991.0	250.0	193.0	63.0	24.0	5.0	2.0	1.0	1.0	1657.0
SD. Chsn	10.4	19.6	11.0	9.3	5.2	3.4	1.8	1.2	.6	.7	27.3
2 Cars	+	-	+	+	-	-	+	+	*-	-	
No. Pred	131.3	975.5	254.1	201.3	61.4	23.2	6.5	2.8	.4	.6	1657.0
No. Chsn	45.0	248.0	175.0	110.0	26.0	17.0	2.0	2.0	.0	.0	625.0
SD. Chsn	6.4	14.5	10.2	8.5	4.7	3.1	1.6	1.2	.6	.5	21.6
3 Cars	-	+	-	-	*+	-	*+	+	+	+	
No. Pred	44.0	253.3	166.9	108.3	31.3	14.5	3.7	2.2	.5	.3	625.0
No. Chsn	8.0	99.0	66.0	76.0	27.0	12.0	4.0	2.0	1.0	.0	295.0
SD. Chsn	3.0	9.5	7.6	6.7	3.8	2.7	1.4	1.0	.7	.5	15.1
4+ Cars	+	-	+	-	-	+	-	-	-	+	
No. Pred	9.0	97.8	70.1	75.1	24.2	12.5	3.0	2.1	.9	.3	295.0
No. Chsn	1008.0	1694.0	580.0	436.0	138.0	58.0	16.0	8.0	2.0	2.0	3942.0
Total											
No. Pred	1008.0	1694.0	580.0	436.0	138.0	58.0	16.0	8.0	2.0	2.0	3942.0

avg#carsx100 | 112.7 206.2 243.2 256.8 251.4 266.2 254.9 281.5 331.9 202.3 196.2

INFORMATION 571: root-Mean-Square-Error is 1.933

INFORMATION 572: number of \*\*stars\*\* in table is 8

# SACOG Activity-Based Travel Forecasting Model

Featuring *DaySim*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

Table for aHHwork (number of workers in HH)

	0	1	2	3	4	5	Total
No. Chsn	113.0	51.0	7.0	.0	.0	.0	171.0
SD. Chsn	8.8	6.1	2.7	.8	.1	.2	11.0
No Car	+	-	+	*+			
No. Pred	115.7	46.0	8.4	.8	.0	.0	171.0
No. Chsn	559.0	527.0	99.0	7.0	1.0	1.0	1194.0
SD. Chsn	14.8	14.5	9.1	3.2	1.3	.7	22.9
1 Car	-	+	-	*+	+	-	
No. Pred	556.2	527.4	95.7	12.2	1.9	.7	1194.0
No. Chsn	403.0	480.0	729.0	40.0	3.0	2.0	1657.0
SD. Chsn	14.1	15.5	16.4	5.4	2.0	1.1	27.3
2 Cars	-	+	-	-	+	-	
No. Pred	401.8	482.5	727.8	38.6	4.8	1.5	1657.0
No. Chsn	96.0	152.0	279.0	92.0	6.0	.0	625.0
SD. Chsn	9.1	11.4	14.2	6.7	2.1	1.1	21.6
3 Cars	+	+	-	-	-	*+	
No. Pred	96.6	161.2	273.1	86.8	5.5	1.7	625.0
No. Chsn	30.0	65.0	114.0	56.0	26.0	4.0	295.0
SD. Chsn	5.4	7.2	10.1	5.9	2.7	1.3	15.1
4+ Cars	+	-	+	+	-	-	
No. Pred	30.8	57.9	122.9	56.6	23.8	3.1	295.0
No. Chsn	1201.0	1275.0	1228.0	195.0	36.0	7.0	3942.0
Total	1201.0	1275.0	1228.0	195.0	36.0	7.0	3942.0
No. Pred	1201.0	1275.0	1228.0	195.0	36.0	7.0	3942.0

avg#carsx100 | 149.1 175.8 238.9 312.3 380.5 328.8 196.2

INFORMATION 571: root-Mean-Square-Error is 2.933

INFORMATION 572: number of **\*\*stars\*\*** in table is 3

# SACOG Activity-Based Travel Forecasting Model

Featuring *DaySim*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

Table for aHHstud (number of students in HH)

	0	1	2	3	4	5	6	7	8	Total
No. Chsn	137.0	21.0	10.0	1.0	2.0	.0	.0	.0	.0	171.0
SD. Chsn	9.8	4.0	2.5	1.3	.8	.2	.2	.1	.4	11.0
No Car	+	+	-	+	*-				+	
No. Pred	138.0	21.9	7.9	2.1	.8	.0	.0	.0	.2	171.0
No. Chsn	922.0	171.0	67.0	26.0	6.0	.0	1.0	.0	1.0	1194.0
SD. Chsn	19.7	8.8	6.3	3.8	2.3	.8	.8	.6	.5	22.9
1 Car	+	-	+	-	*+	*+	-	+	*-	
No. Pred	924.8	165.7	67.7	24.1	9.1	1.1	.7	.4	.4	1194.0
No. Chsn	1097.0	297.0	183.0	56.0	18.0	3.0	3.0	.0	.0	1657.0
SD. Chsn	22.1	11.6	9.0	5.2	3.1	.8	1.0	.7	.5	27.3
2 Cars	-	+		+	+	**-	*-	+	+	
No. Pred	1088.8	303.4	183.0	58.8	18.9	1.2	1.9	.7	.4	1657.0
No. Chsn	321.0	160.0	96.0	34.0	12.0	.0	.0	2.0	.0	625.0
SD. Chsn	16.3	10.2	8.0	4.7	2.8	.6	1.0	.8	.3	21.6
3 Cars	+	-	-	-	-	+	*+	*-		
No. Pred	329.9	154.0	94.5	31.9	11.7	.4	1.5	1.0	.1	625.0
No. Chsn	146.0	70.0	48.0	20.0	9.0	.0	1.0	1.0	.0	295.0
SD. Chsn	10.9	7.4	5.8	3.6	2.1	.4	.8	.7	.1	15.1
4+ Cars	-	+	+	+	*-	+	-			
No. Pred	141.6	74.0	50.8	20.1	6.5	.2	.8	.9	.0	295.0
Total	2623.0	719.0	404.0	137.0	47.0	3.0	5.0	3.0	1.0	3942.0
No. Pred	2623.0	719.0	404.0	137.0	47.0	3.0	5.0	3.0	1.0	3942.0

avg#carsx100 | 180.7 218.8 235.2 240.5 237.7 193.3 257.9 301.6 132.9 196.2

INFORMATION 571: root-Mean-Square-Error is 1.537

INFORMATION 572: number of \*\*stars\*\* in table is 10

# SACOG Activity-Based Travel Forecasting Model

Featuring *DaySim*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

Table for aHHFTW (number of fulltime workers in HH)

	0	1	2	3	4	5	Total
No. Chsn	125.0	42.0	4.0	.0	.0	.0	171.0
SD. Chsn	9.2	5.7	2.1	.4	.0	.0	11.0
No Car	+	-	+	+			
No. Pred	126.2	40.1	4.6	.1	.0	.0	171.0
No. Chsn	653.0	481.0	56.0	3.0	.0	1.0	1194.0
SD. Chsn	15.9	14.4	7.6	1.9	.7	.3	22.9
1 Car	-	-	*+	+	+	***-	
No. Pred	646.1	478.1	65.1	4.1	.5	.1	1194.0
No. Chsn	479.0	631.0	524.0	22.0	1.0	.0	1657.0
SD. Chsn	15.5	16.9	14.4	3.4	1.2	.4	27.3
2 Cars	+	-	+	**-	+	+	
No. Pred	485.4	622.4	532.8	14.5	1.8	.2	1657.0
No. Chsn	124.0	208.0	268.0	23.0	2.0	.0	625.0
SD. Chsn	10.2	13.2	12.9	4.2	1.3	.4	21.6
3 Cars	-	*+	**-	*+	+	+	
No. Pred	122.5	229.7	239.5	30.9	2.1	.2	625.0
No. Chsn	39.0	101.0	111.0	36.0	8.0	.0	295.0
SD. Chsn	6.1	8.8	9.6	4.1	1.6	.5	15.1
4+ Cars	+	-	*+	-	-	+	
No. Pred	39.8	92.8	121.0	34.4	6.5	.5	295.0
No. Chsn	1420.0	1463.0	963.0	84.0	11.0	1.0	3942.0
Total							
No. Pred	1420.0	1463.0	963.0	84.0	11.0	1.0	3942.0

avg#carsx100 | 152.6 193.9 249.6 337.2 367.7 338.5 196.2

INFORMATION 571: root-Mean-Square-Error is 4.338

INFORMATION 572: number of \*\*stars\*\* in table is 11

# SACOG Activity-Based Travel Forecasting Model

Featuring *DaySim*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

Table for ainc6 (Household income categories)

	<15K	15-50K	50-75K	75-100K	100K+	re-fuse	Total
No. Chsn	92.0	55.0	8.0	.0	.0	16.0	171.0
SD. Chsn	7.3	6.8	2.7	.9	.9	3.6	11.0
No Car		-		+	+		
No. Pred	92.0	53.4	8.0	.8	.8	16.0	171.0
No. Chsn	181.0	662.0	176.0	31.0	22.0	122.0	1194.0
SD. Chsn	8.7	15.9	10.1	4.5	4.0	7.5	22.9
1 Car				-	+		
No. Pred	181.0	662.0	176.0	28.9	24.1	122.0	1194.0
No. Chsn	65.0	554.0	556.0	175.0	144.0	163.0	1657.0
SD. Chsn	6.4	16.6	15.0	8.5	7.6	8.6	27.3
2 Cars		+		+	-		
No. Pred	65.0	555.6	556.0	175.8	141.6	163.0	1657.0
No. Chsn	14.0	167.0	229.0	90.0	65.0	60.0	625.0
SD. Chsn	3.5	11.6	12.9	7.8	6.8	6.7	21.6
3 Cars				-	+		
No. Pred	14.0	167.0	229.0	89.1	65.9	60.0	625.0
No. Chsn	4.0	72.0	114.0	50.0	39.0	16.0	295.0
SD. Chsn	1.9	7.8	9.3	6.1	5.2	3.7	15.1
4+ Cars				+	-		
No. Pred	4.0	72.0	114.0	51.4	37.6	16.0	295.0
No. Chsn	356.0	1510.0	1083.0	346.0	270.0	377.0	3942.0
Total							
No. Pred	356.0	1510.0	1083.0	346.0	270.0	377.0	3942.0
avg#carsx100	104.3	172.4	230.6	255.2	250.9	186.0	196.2

INFORMATION 571: root-Mean-Square-Error is 1.228

INFORMATION 572: number of **\*\*stars\*\*** in table is 0

# SACOG Activity-Based Travel Forecasting Model

Featuring *DaySim*—the Person Day Simulator

Technical Memo No. 9: **Auto Availability Model**

Table for adriveage (number of driving age persons in HH)

	1	2	3	4	5	6	7	8	Total
No. Chsn	131.0	34.0	5.0	1.0	.0	.0	.0	.0	171.0
SD. Chsn	9.3	5.5	2.1	.9	.3	.2	.1	.0	11.0
No Car				-	+				
No. Pred	131.0	34.0	5.0	.8	.1	.0	.0	.0	171.0
No. Chsn	771.0	364.0	44.0	13.0	1.0	1.0	.0	.0	1194.0
SD. Chsn	14.6	16.2	6.0	3.0	1.5	.7	.4	.3	22.9
1 Car				-	*+	-	+	+	
No. Pred	771.0	364.0	44.0	11.4	2.8	.5	.1	.1	1194.0
No. Chsn	146.0	131.5	161.0	24.0	11.0	.0	.0	.0	1657.0
SD. Chsn	10.9	22.3	10.0	4.6	2.0	.9	.5	.4	27.3
2 Cars				+	**-	*+	+	+	
No. Pred	146.0	131.5	161.0	28.1	5.3	1.1	.3	.2	1657.0
No. Chsn	49.0	339.0	195.0	40.0	1.0	1.0	.0	.0	625.0
SD. Chsn	6.7	16.8	10.4	4.9	2.2	1.0	.6	.4	21.6
3 Cars				*-	**+	+	+	+	
No. Pred	49.0	339.0	195.0	33.4	6.4	1.4	.6	.2	625.0
No. Chsn	10.0	128.0	80.0	57.0	13.0	4.0	2.0	1.0	295.0
SD. Chsn	3.1	10.9	8.0	5.2	2.4	1.2	.7	.5	15.1
4+ Cars				+	-	-	*-	-	
No. Pred	10.0	128.0	80.0	61.3	11.4	2.9	.9	.5	295.0
Total	1107.0	2180.0	485.0	135.0	26.0	6.0	2.0	1.0	3942.0
No. Pred	1107.0	2180.0	485.0	135.0	26.0	6.0	2.0	1.0	3942.0

avg#carsx100 | 113.4 210.9 271.6 332.1 325.9 338.1 343.9 340.4 196.2

INFORMATION 571: root-Mean-Square-Error is 1.696

INFORMATION 572: number of \*\*stars\*\* in table is 8