Puget Sound Regional Council
PSRC

ACTIVITY-BASED MODEL
PHASE I FINAL REPORT

Activity Generator Model Estimation, Calibration & User Guide

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0 INTRODUCTION

The purpose of this document is to provide an overview of the estimation, calibration and validation of the new PSRC auto ownership and activity generation model components, and to provide details about the key model component input and outputs. A number of steps were involved in the estimation, calibration and validation of the model.

First, in Chapter 1, we describe the structure of the Activity Generator and document the estimation results for the various component models.

Next, in Chapter 2, we document the model calibration and validation stage. Although the synthetic population is produced by UrbanSim, it is a critical input to the auto ownership and activity generation models, so it was first evaluated to ensure that it matched key regional household and population distributions. Next, calibration targets were developed for the auto ownership and activity generator model components using the 2006 PSRC household survey data and 2000 Census data. Finally, the models were calibrated to match these targets.

This report concludes with Chapter 3, a User Guide section documenting the operation of the models and the content and formats of the model inputs and outputs.

1 ACTIVITY GENERATOR STRUCTURE & ESTIMATION RESULTS

1.1 STRUCTURE OF THE ACTIVITY GENERATOR

The PSRC Activity Generator is a stand-alone executable program, currently written in Delphi code. The Activity Generator is designed to replace the trip generation models in the current PSRC model implementation, with the results used as input to the current PSRC trip distribution, trip mode choice, and trip assignment models. As the other main product of this project, BB&C also prepared recommendations for a fully implemented activity-based model system, to be commissioned during Phase 2.

The structure of the Activity Generator program is as shown on the following page. It follows the main general structure of other activity-based model systems used in Sacramento, Denver, San Francisco and other regions, with models at the longer-term level, person-day level, tour level, and trip level. The main differences between those implementation and this one are:

- No synthetic population generator was used, and no models of usual work or school location were estimated. Rather, these outputs are being provided by the PSRC UrbanSim land use microsimulation model.
- No new time of day models were estimated for this Phase I implementation, as the existing PSRC trip-based time of day models will still be used.
- No new mode choice models were estimated. The existing PSRC trip mode choice models were coded, mainly for the purpose of calculating mode choice logsums to use as accessibility measures. The Activity Generator code does also apply those models to predict a chosen mode for each simulated trip, but it is not the intention that PSRC use that output – rather the EMME mode choice model implementation will still be used for the time being.
- Fairly simple destination choice models were estimated for this project, primarily for the purpose of calculating aggregate destination choice logsums to use as accessibility variables. However, there is one case where PSRC will use the output from the destination choice models in the EMME implementation. For cases of trips when neither trip end is home or the usual work location (NHB-Other), the output from the destination choice model will determine the production end of the trip, so that the attraction end can be determined using the current NHB-Other trip distribution model.

Schematic structure of the Activity Generator Program

- Read in and apply the commands in the user control file.
- Read in the file containing all estimated/calibrated model coefficients.
- Read in the zonal data file (currently provided as an ASCII file)
- Read in all auto and transit skim matrices from the EMME databanks.
- Calculate (or read) aggregate mode/destination logsums as accessibility variables.
- Set a random number seed for each person in the population, to allow synchronization of random draws across model runs.
- Loop on the households in the synthetic population file, reading in one at a time
    - Apply the auto ownership model for the household.
    - Loop on each person in the household
        - Apply the main Day Pattern Model, to predict 0 or 1+ tours and 0 or 1+ extra stops for all 7 activity purposes in the day
        - For each purpose with 1+ tours, apply the Exact Number of Tours model to predict 1, 2, 3 or 4 tours for the purpose in the day.
        - Loop on all tours (and subtours) for the person, in priority order
            - Apply the Destination Choice Models estimated for this project.
            - If a work tour, apply the Work-Based Subtour Frequency & Purpose model, and insert any subtours into the tour list.
            - Loop on half-tours
                - Apply the Intermediate Stop Frequency & Purpose model, and insert predicted stops into the tour
                - Loop on trips in the half tour
                    - If trip goes to an intermediate stop, apply the Stop Location model estimated for this project.
                    - Apply the existing PSRC trip mode choice model to predict the trip mode (not used by PSRC)
                    - Write trip record
            - Write tour record
        - Write person record
- End of program when all specified households have been simulated.

1.2 AGGREGATE ACCESSIBILITY MEASURES

For accessibility measures, the Activity Generator first calculates 24 different mode choice logsum O/D matrices, using the trip-based mode choice models documented in Chapter 8 of the September 2007 Cambridge Systematics Final Model Update Report to PSRC. All models use an average of the outbound and return level of service (even the non-home-based trips, since we use that to influence the frequency of work-based subtours leaving and returning to the workplace).

Table 1-1. Mode Choice Logsum Segmentation

Mode choice logsums	Segmentation	Level of service
HB Work	16, 4 cars/workers by 4 income	Transit- avg. of AM peak O-D and AM peak D-O Other – avg. of AM peak O-D and PM peak D-O
HB College	None	Transit- avg. of AM peak O-D and AM peak D-O Other– avg. of AM peak O-D and PM peak D-O
HB Grade School	None	All – avg. of AM peak O-D and Midday D-O
HB Other	5 cars/HH size	Transit- avg. of Midday O-D and Midday D-O Other – avg. of Midday O-D and Evening D-O
NHB	None	All – avg. of Midday O-D and Midday D-O

The mode choice logsums were used to estimate 10 trip-level destination choice models to use in calculating zone-level mode/destination accessibility logsums, with purpose correspondence and segmentation shown as in the table below.

Table 1-2. Destination Choice Logsum Segmentation

Destination choice model	Mode choice logsum	Segmentation
HB Work (usual workplace)	HB Work	16, 4 cars/workers by 4 income
HB Work (not usual workplace)	HB Work	16, 4 cars/workers by 4 income
HB College	HB College	None
HB School (K-12)	HB Grade school	None
HB Escort	HB Other	5 cars/HH size
HB Personal Business	HB Other	5 cars/HH size
HB Shopping	HB Other	5 cars/HH size
HB Meal	HB Other	5 cars/HH size
HB Social/Recreation	HB Other	5 cars/HH size
NHB	NHB	None

The estimation results for the 9 HB trip destination choice models are shown in Tables Table 1-3 and Table 1-4 below. The mode choice logsum parameters are significant and between 0 and 1 for every purpose except for School. (A negative parameter is estimated for School, but the model is applied with a parameter of 0). For the other 8 models, the lowest results are .221 for Work-usual workplace and .407 for Work-Other. For most other purposes, the logsum parameter is around 0.7. There is also a distance function linear, squared, cubed, and logarithmic terms. The logarithmic term is the strongest for each model.

Most other variables are land use effects and size variable functions. The size functions seem reasonable, with all types of employment included for both types of work destinations. School and college are predominantly related to education employment and university enrollment, respectively. Escort and social/recreation destinations are also mainly schools (education employment), and retail. Retail is the strongest attractor for personal business, and essentially the only attractor for shopping and eating out.

The Activity Generator code begins the simulation by applying these destination choice models to pre-calculate mode/destination accessibility logsums for each residence zone. The program can also be set to write out the values and to read them in from a previous run, although the run time is fast enough that reading them in does not provide a significant advantage. Also, it is desirable to re-calculate the logsums every time the program is run and the level of service changes, such as at the beginning of each global feedback iteration.

Table 1-3: Home based trip destination models by purpose (for use in calculating zonal accessibility mode/destination logsums)

File	Work-Usual		Work-Other		School		College	
Observations	5985		6661		5426		658	
Final log L	-30737.4		-34445.8		-17632.9		-2231.5	
Rho squared (0)	0.250		0.244		0.525		0.504	
Rho squared (const)	0.109		0.116		0.444		0.097	
O/D variables	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**
Mode choice logsum	0.221	5.2	0.407	10.3	-0.59	-1.2	0.779	6.6
Distance (miles)	-0.135	-11.5	-0.0866	-7.7	-0.55	-9.9	-0.23	-4.8
Distance squared	0.001	4.3	5.30E-04	2.3	0.0152	4.6	0.0035	3.1
Distance cubed	-2.60E-06	-1.7	-3.90E-07	-0.2	-2.10E-04	-3.2	-1.80E-05	-2.1
LN(distance+1)	-0.316	-5.0	-0.56	-9.6	-0.851	-7.9	0.208	0.9
Intrazonal dummy	0.387	4.1	0.378	4.3	-0.461	-8.0	-1.14	-2.9
Land use variables	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**
Intersections per square km	-1.70E-04	-0.2	4.40E-04	0.7	-0.0041	-3.6	-0.0055	-3.2
Mixed use index 6	-0.0329	-0.3	0.33	3.8	0.779	9.2	1.27	4.0
Hourly parking cost ($)	0.0450	5.1	0.0330	4.2	-0.0330	-1.4	-0.0830	-3.9
Area type 2- suburban large	0.0845	2.2	-0.0482	-1.3	-0.108	-1.9	-0.569	-4.6
Area type 3 - suburban small	0.238	4.5	-0.207	-4.0	-0.0178	-0.3	-1.01	-5.0
Area type 4- rural	0.484	6.4	-0.0425	-0.6	0.199	2.3	-0.753	-2.5
Size function	**Exp(Coef)**	**T-stat**	**Exp(Coef)**	**T-stat**	**Exp(Coef)**	**T-stat**	**Exp(Coef)**	**T-stat**
Retail employment	1	Cons	1	Cons	1	Cons	1	Cons
Government employment	1.747	3.6	2.071	6.9			26.576	2.3
FIRE employment	2.234	5.1	1.181	1.5			3.287	0.8
Education employment	3.421	6.8	2.945	7.9	37.338	28.7		
Manufacturing employment	2.514	6.0	2.552	8.9				
WCT employment	2.085	4.1	0.448	-3.7				
University enrolment							149.905	3.5
Resident HH	0.587	-6.1	0.313	-13.6	0.019	34.8	0.047	-1.5

Table 1-4. Home based trip destination models by purpose (for use in calculating zonal accessibility mode/destination logsums)

File	Escort		Pers.Bus		Shopping		Meal		Soc/Rec	
Observations	9173		7796		6288		3023		7175	
Final log L	-36532.4		-32124.6		-20699		-11860.6		-30118.6	
Rho squared (0)	0.418		0.398		0.519		0.427		0.387	
Rho squared (const)	0.367		0.337		0.419		0.32		0.324	
O/D variables	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**
Mode choice logsum	0.739	6.7	0.701	9.6	0.736	7.4	0.599	4.6	0.481	5.0
Distance (miles)	-0.257	-15.9	-0.194	-13.6	-0.139	-7.3	-0.183	-8.1	-0.214	-14.7
Distance squared	0.0044	8.1	0.0025	6.4	0.0014	2.3	0.0028	4.6	0.003	7.4
Distance cubed	-2.70E-05	-4.8	-1.10E-05	-3.3	-4.10E-06	-0.7	-1.30E-05	-2.6	-1.40E-05	-4.0
LN(distance+1)	-1.02	-20.4	-1.16	-23.5	-1.81	-31.2	-1.41	-18.4	-1.11	-22.8
Intrazonal dummy	-0.117	-2.5	-0.543	-10.4	-0.922	-15.6	-0.611	-7.0	-0.18	-3.5
Land use variables	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**
Intersections per square km	-0.0015	-1.9	-0.001	-1.3	-0.0072	-7.7	0.0036	3.0	-0.0089	-10.6
Mixed use index 6	0.481	6.7	-0.425	-4.6	0.339	3.7	0.229	1.6	0.454	5.7
Hourly parking cost ($)	-0.0570	-4.3	-0.0640	-5.1	-0.170	-10.7	-0.130	-7.1	-0.0620	-4.4
Area type 2-suburban large	0.0941	2.4	-0.0359	-0.9	0.194	4.0	0.0375	0.6	0.0202	0.5
Area type 3 - suburban small	0.0076	0.2	0.12	2.6	0.398	7.2	0.216	2.7	-0.255	-5.0
Area type 4- rural	0.0165	0.3	0.386	5.7	0.611	7.1	0.448	3.6	-0.119	-1.7
Size function	**Exp (Coef)**	**T-stat**	**Exp (Coef)**	**T-stat**	**Exp (Coef)**	**T-stat**	**Exp (Coef)**	**T-stat**	**Exp (Coef)**	**T-stat**
Retail employment	1	Cons	1	Cons	1	Cons	1	Con	1	Cons
Government empl.	0.388	-7.3	0.169	-12.4			0.057	13.4	0.490	-5.4
FIRE employment	0.170	-10.8	0.278	-12.6					0.228	-8.4
Education empl.	4.179	16.8	0.809	-1.4					2.622	7.9
Manufacturing emp										
WCT employment	0.408	-6.2								
Resident HH	0.587	-6.1	0.313	-13.6	0.019	34.8	0.047	21.1	0.864	-1.5

1.3 ESTIMATION RESULTS: AUTO OWNERSHIP MODEL

The auto ownership model predicts the number of motorized vehicles owned, leased, or otherwise belonging to fleet of vehicles possessed by the household. For this model, motorcycles, trucks, and vans are lumped together with cars as motorized vehicles. Vehicles are not assigned to specific members of the household.

The auto ownership model takes as given the household characteristics, as well as the regular work location information of all workers in the household. Therefore, it has available to it location-specific work accessibility information (home-to-work mode choice logsums; densities and aggregate logsums at the usual work location), as well as the accessibility information at the residential location (density and aggregate mode/ destination logsums).

The household and person data from the 2006 Household survey was processed and combined with the accessibility measures described above to create the estimation data set. There are 4746 households for estimation. The model is estimated to predict the probability of any household having 0, 1, 2, 3, or 4+ vehicles. The choice variable is tabulated against the number of driving age people in the household in Table 1-5 below. Note that the largest number/percent in each column is the one in which the number of vehicles equals the number of persons age 16+. Also note that most of the 0-vehicle households only have a single adult.

Table 1-5. HH Auto Ownership by HH Potential Drivers

Vehicles in the household * Household members age 16+ Crosstabulation

% within Household members age 16+

		Household members age 16+				
		one	two	three	four or more	Total
Vehicles in the household	none	11.6%	1.1%	.5%	1.4%	4.7%
	one	70.9%	15.0%	5.0%	2.9%	33.4%
	two	13.2%	59.9%	36.1%	15.8%	40.1%
	three	2.6%	18.1%	41.6%	33.8%	15.2%
	four or more	1.8%	5.8%	16.8%	46.0%	6.6%
Total		100.0%	100.0%	100.0%	100.0%	100.0%

The model estimation results are shown in the tables Table 1-6 and Table 1-7 below. The major influence on the number of vehicles is the number of potential drivers (people age 16+) in a household. Coefficients are estimated for each possible state of having more drivers than vehicles or more vehicles than drivers. As expected, and plotted in Figure 1-1 below, there is a strong disutility of having more drivers than vehicles, and somewhat less “disutility” of having more vehicles than drivers—presumably due to the cost of owning extra vehicles. After including these variables, the model can identify three additional constants for 0, 3 and 4+ vehicles. The additional constant for 0 vehicle households is strongly negative, even after accounting for the effect of fewer vehicles than drivers.

Table 1-6. Auto Ownership Model Estimation Statistics

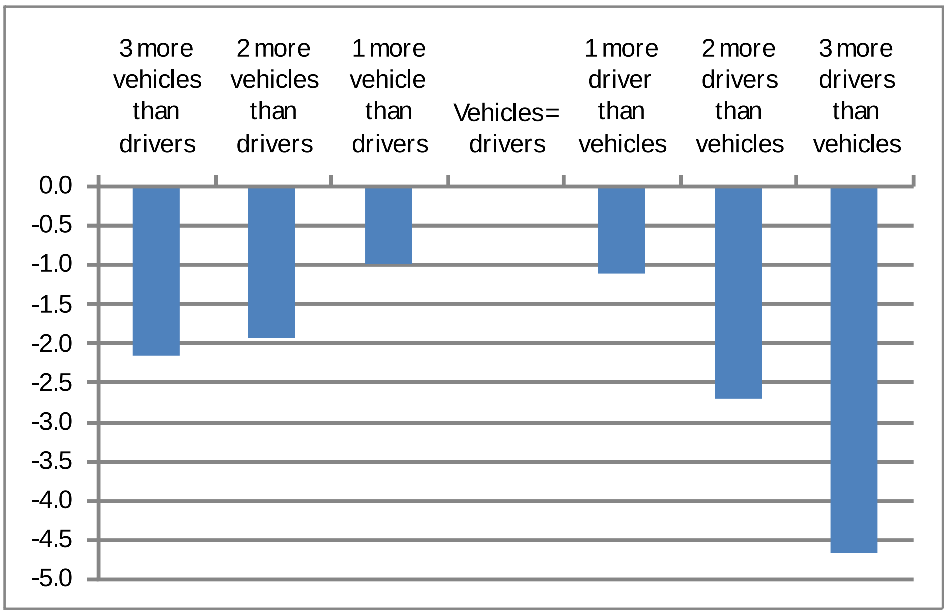
Observations	4746
Final log-likelihood	-4552.83
Rho-squared with respect to zero	0.404
Rho-squared with respect to constants	0.285

Table 1-7. Auto Ownership Model Estimation Results

Variable	Coefficient	T-stat.
Constant- 0 vehicles	-2.365	-9.1
Constant-3 vehicles	-0.518	-5.5
Constant- 4+ vehicles	-0.869	-4.5
Vehicles versus drivers		
3 more vehicles than drivers	-2.170	-5.3
2 more vehicles than drivers	-1.950	-7.7
1 more vehicle than drivers	-0.986	-8.2
1 more driver than vehicles	-1.124	-9.5
2 more drivers than vehicles	-2.707	-10.0
3 more drivers than vehicles	-4.684	-7.8
Non-linear function for additional vehicles		
HH income is below $30K	-1.200	-10.2
HH income is $60-90K	0.509	4.5
HH income is $90-120K	0.630	4.5
HH income is over $120K	1.102	7.2
HH income data is missing	0.393	3.0
Fraction of drivers employed	-0.567	-3.4
Fraction of drivers aged 16-19	-2.488	-4.5
Fraction of drivers aged 20-24	-1.140	-3.3
Fraction of drivers aged 25-29	-0.693	-3.0
HH children age 0-15 per driver	0.185	2.2
Residence zone mix use index 6	0.904	4.4
Residence zone intersections per sq.km	-0.00633	-2.8
Residence zone hourly parking cost ($)	-0.212	-4.8
Residence area type is 1- "metropolitan cities"	-0.395	-3.5
Residence area type is 3- "smaller suburban cities"	0.258	2.1
Residence area type is 4- "rural areas"	0.667	4.4
LN(longest commute distance in HH+1)	0.225	4.2
LN(2nd longest commute distance in HH +1)	0.300	4.2
1 worker in HH, worker has no usual workplace	0.879	4.6
2+ workers in HH, 2nd has no usual workplace	0.577	3.0

Other accessibility variables		
Each alternative - Avg. mode/destination logsum for home zone across 6 purposes	0.143	1.9
0 veh. – 1 worker in HH, 0 veh MC logsum minus 1 veh MC logsum	0.480	3.1
1 veh. – 2+ workers in HH, 1 veh MC logsum minus 2 veh MC logsum, longest commute	0.199	2.0
1 veh. – 2+ workers in HH, 1 veh MC logsum minus 2 veh MC logsum, 2nd longest com	0.285	2.5
0 veh. – 1 worker in HH, LN(longest commute distance in HH+1)	-0.340	-3.2
1 veh. – 2+ workers in HH, LN(longest commute distance in HH+1)	-0.348	-3.9
1 veh. – 2+ worker in HH, LN(2nd longest commute distance in HH+1)	-0.141	-1.1

Figure 1-1. Utility of vehicles versus persons aged 16+ in the household



The second group of variables in the table is specified so that a positive value favors a higher vehicle ownership. If this effect was linear, the variables would be multiplied by 0, 1, 2, 3, and 4 for the 5 alternatives. However, it is likely that each additional vehicle provides less marginal utility than the vehicles that the household already owns. To test this, after a fairly complete model was estimated using the linear assumption, models were estimated using several different decreasing functions, as shown in Figure 1-2 below. Each vehicle above 1 provides a fraction of the utility that the previous vehicle does, with the fractions ranging from 1.0 (linear) down to 0.5. Seven models were estimated which were identical except for this function. As shown in

Figure 1-3, the optimal model fit was achieved with the ratio 0.67, meaning each additional vehicle provides 2/3 as much utility. Using this approach, we can obtain some of the best features of both MNL and ordered logit.

The variables included in this non-linear function are as follows:

- Higher income households own more vehicles. This is true across all 5 income groups used (see Figure 1-4). A separate category for households with missing income data was included, and will be discarded in model application.
- The more drivers in the household who are employed, the more vehicles the household is likely to own.
- The more drivers in the household who are teenagers (age 16-19), the fewer vehicles the household is likely to own. This same effect is found for age groups 20-24 and 25-29, with the effect getting smaller by age. By age 30, most drivers who wish to have their own vehicle are likely to have one.
- The more children under age 16 in the household per driver, the more vehicles the household needs to own to chauffeur them around.
- People who live in areas with low mixed use tend to own more vehicles
- People who live in areas with higher street density/connectivity own fewer vehicles.
- People who live in areas with low parking availability own fewer vehicles, with hourly parking cost serving as a proxy for parking shortage, since few residents actually pay daily or hourly parking costs.
- The less “urban” the area type index (1-4), the more vehicles households tend to own.
- A number of other land use variables were tested as well, but dropped from the final model: Percent multifamily dwellings is significant, but is highly correlated to the mixed use index, and is less useful as a policy variable, so was removed. Retail intensity and fraction of land devoted to parks are both marginally significant only if the other land use variables are removed, indicating high correlations.
- The farther workers live from home, the more likely that they will own vehicles. The natural log of the commute distance is used, both to improve model fit and to minimize correlation with the home to work mode choice logsum. The logarithmic shape indicates a threshold-type effect—if a person already works a long distance from home, then another mile of commute distance will have little impact. The commute distance for the 2nd longest commute has a slightly stronger effect than the longest commute in the HH.
- If a worker in the household has no usual workplace recorded in the data, this also has a positive effect for having more vehicles. Without knowing why the data is missing, it is difficult to say whether this is a “nuisance” effect that can be done away with in application, or else a true behavioral effect for people who do not have a regular workplace, such as construction workers. If it is the latter, then that should be included as a possible outcome in the UrbanSim usual work location model.

The final accessibility variables in Table 1-7 are alternative-specific. Although the aggregate accessibility logsums were calculated primarily for use in estimating activity pattern models, they are also useful in estimating the vehicle ownership model. HB Accessibility logsums were calculated for different HH car ownership/HH worker or size segments, and the appropriate accessibility was assigned to each of the 5 alternatives depending on the number of workers or persons in the household. For aggregate mode/ destination accessibility from the home zone, an average was taken for the logsums across 6 purposes (all of the HB tour purposes except for school/college). The measures for the different purposes are too highly correlated to estimate all simultaneously, and estimation tests showed them to have comparable effects when each estimated separately, so a simple average is used. The more than adding vehicles to the HH increases the accessibility logsum from one alternative to the next, the more vehicles the HH is likely to own.

The mode choice logsums from home to work were found to only be significant for the 0 and 1 vehicle alternatives. The more that the work mode choice logsum increases going from 0 to 1 vehicle, the less likely the household is to own 0 vehicles. This effect was only found for 1-worker households, presumably because there are almost no two-worker households with 0 vehicles. For HH with two or more workers, the more that the work mode choice logsum increases going from 1 to2 vehicle for either worker, the less likely the household is to own only 1 vehicle. The effect is somewhat less for the longer commute, but significant for both.

In addition to the mode choice logsum, we also find additional effects related to the log of the commute distance. The longer the commute distance, the lower the probability of having 0 vehicles for 1 workers HH or 1 vehicle for 2+ worker HH. This last group of coefficients shows that accessibility to work mainly effects the choice of the "minimal" level of car ownership—0 vs. 1+ vehicles for 1-workers HH, and 1 vs. 2+ vehicles for 2+ worker HH.

Figure 1-2. Assumed shape of functions relating variables to different car ownership alternatives

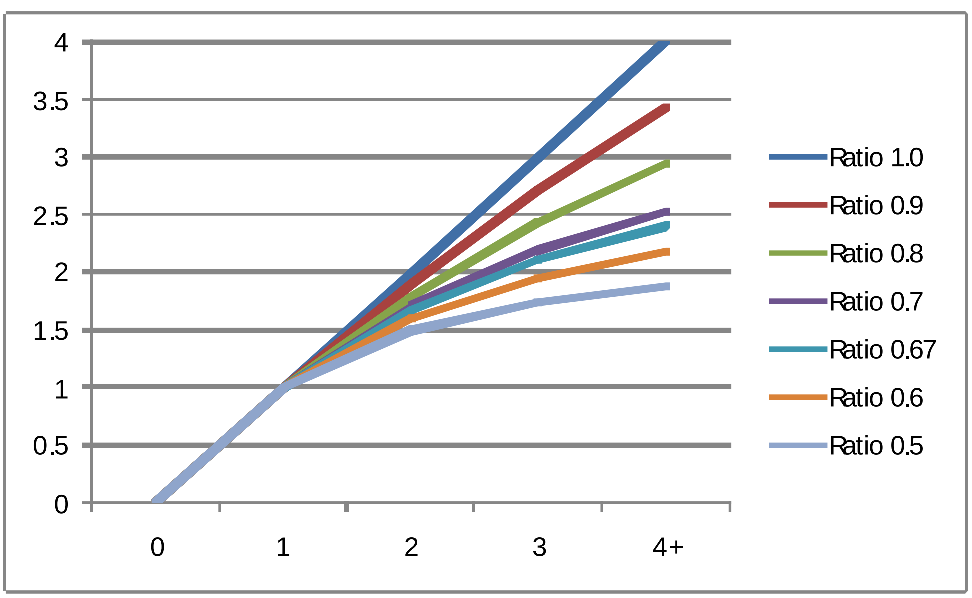


Figure 1-3. Resulting log-likelihood under each assumed function

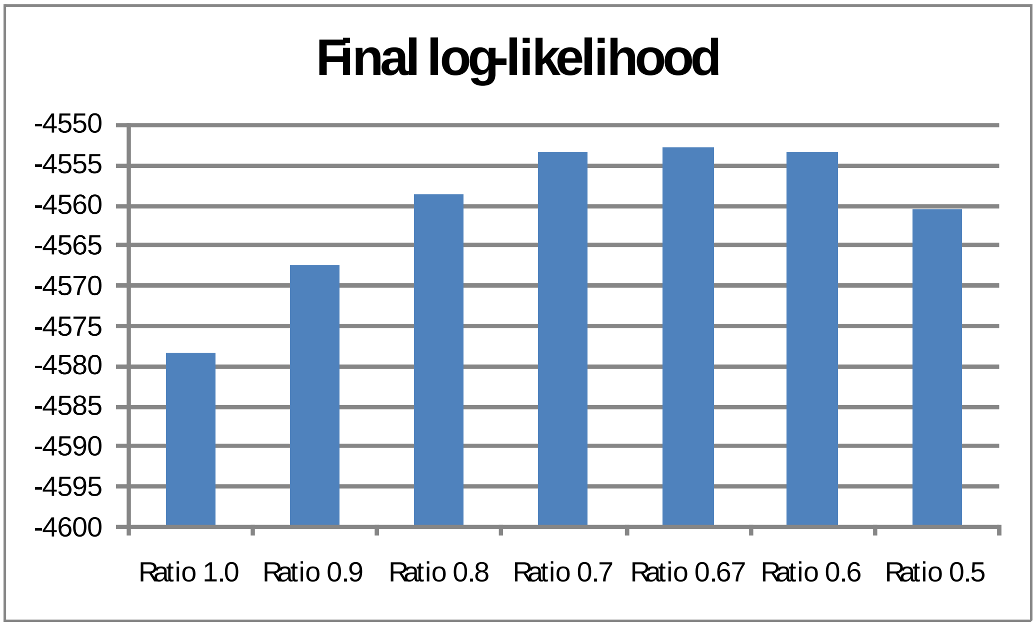


Figure 1-4. Estimated utility effects of income groups (positive value favors more vehicles)

1.4 ESTIMATION RESULTS: DAY PATTERN MODEL

This model is a variation on the Bowman and Ben-Akiva approach, and has been used in Sacramento and Denver. It jointly predicts the number of home-based tours a person undertakes during a day for seven purposes, and the occurrence of additional stops during the day for the same seven purposes. The seven purposes are work, school, serve passenger, personal business, shopping, meal, and social/recreational. The pattern choice is a function of many types of household and person characteristics, as well as land use and accessibility at the residence and, if relevant, the regular work location.

The person-day activity pattern model predicts the likelihood that ANY stops will be made during the day for a given purpose, at a level where the substitution between extra stops versus extra tours can be modeled directly. Then, the exact number and purpose of stops on each tour is predicted in Model 5 using any additional tour-level information. We feel that this approach provides a good balance between person-day-level and tour-level sensitivities. In particular the allocation of stops to particular tours can be sensitive to where, when and how each tour takes place (in future projects when tour-level models are added), and the exact total number of intermediate stops can also vary somewhat according to tour-level sensitivities, but only within limits, as each individual must complete at least one activity for each stop purpose predicted at the person-day level. One way to think of this is in the context of shopping stops. If person has easy access to a number of different stores during the day in the course of their travels, they may spread their shopping across multiple stops, and perhaps multiple tours. If they do not have good access to stores, they will be more likely to concentrate their shopping within fewer stops, but they still need to visit at least one store.

Day Pattern Model: Structure and Choice Alternatives

The model jointly predicts the following:

- 0 or 1+ home-based work tours in the person-day
- 0 or 1+ home-based school tours in the person-day
- 0 or 1+ home-based serve passenger tours in the person-day
- 0 or 1+ home-based personal business tours in the person-day
- 0 or 1+ home-based shopping tours in the person-day
- 0 or 1+ home-based meal tours in the person-day
- 0 or 1+ home-based social/recreation tours in the person-day
- 0 or 1+ work intermediate stops in the person-day
- 0 or 1+ school intermediate stops in the person-day
- 0 or 1+ serve passenger intermediate stops in the person-day
- 0 or 1+ personal business intermediate stops in the person-day
- 0 or 1+ shopping intermediate stops in the person-day

- 0 or 1+ meal intermediate stops in the person-day
- 0 or 1+ social/recreation intermediate stops in the person-day

The 0 versus 1+ distinction captured by this model represents most of the variance in the survey data. With the exception of work tours, over 80% of people make 0 tours for any given tour purpose, and over 80% make 0 stops for any given stop purpose. Very few people make more than one tour for a given purpose (less than 2% of the sample for any purpose except for Escort, for which paired tours are more common (e.g. a tour to drop a child at school and another to pick them up.) Less than 2% make two or most stops for any purpose, except for Escort, Shopping and Personal Business, for which about 5% of people make 2+ stops in the day.

If the model were to include every combination of the 14 binary choice variables, there would be 2^14, or 16,384 alternatives. As in the Sacramento and Denver models, it proved feasible to include only combinations that meet the following criteria:

- There can be no intermediate stop purpose with 1+ stops unless there is at least one tour purpose with 1+ tours. (There can be no stops without tours.)
- The maximum number of tour purposes with 1+ tours is 3.
- The maximum number of stop purposes with 1+ stops is 4.
- The maximum number of tour purposes and stop purposes with 1+ tour/stop is 5.
- There can be no intermediate work stops or school stops unless there are 1+ work tours and/or 1+ school tours.
- The pattern cannot include both intermediate work stops and school stops (if one is 1+, the other must be 0).

Following these rules, the number of alternatives is reduced to 2,080, while approximately 99% of the observed patterns in the household survey data are accommodated. An examination of the PSRC 2006 survey data shows that only 1.3% of cases do not fit within these limits. In estimation, we "compress" those few cases to fit within the modeled set of alternatives by deleting one or more tours or stops from the observed pattern.

In principle, every alternative is available for every case. In estimation, it is sometimes practical to make work tours/stops unavailable for non-workers and school tours/stops unavailable for non-students, although the survey data always contains a few cases that contradict such rules. A simple and practical approach is to make such alternatives effectively unavailable in estimation by fixing high negative constants for such person type/pattern combinations.

Table 1-8 through Table 1-13 contain the estimation results for the Day Pattern Model. Although all variables are estimated as part of a single large model, the utility components can be broken down into various groups:

- **Purpose-specific utility functions:** Shown in Table 1-8 and the left side of Table 1-9, these are utility functions that related to a tour OR a stop being made for a given purpose during the day. The more positive the coefficient, the more likely the person participates in an out-of-home activity of that type during the day. There are separate ASC's for tours and stops.

- **Utility functions for more tours or stops, regardless of purpose**: In the columns at the right of Table 1-10, a higher coefficient means that more tours or intermediate stops are made during the day, respectively. To be more accurate, it means that 1+ tours are made for more tour purposes or 1+ stops for more stop purposes, but, as explained earlier, 1+ means 1 in most cases.
- **Purpose interaction effects between tours and stops, tours and tours, and stops and stops:** Shown in Table 1-12, these parameters are typically negative, reflecting the fact that people can only go so many places and do so many things during the day, so if they make a tour or stop for one purpose, they are usually less likely to make a tour or a stop for any other purpose, all else equal. The interesting cases are the significantly positive ones. For instance, people who make work, school, or escort tours are more likely to also make intermediate escort stops during the day. To some extent, these interactions are also definitional, reflecting that way that the main tour purpose is specified. For example, people who make tours for personal business, shopping, meal and social/recreation are all less likely to make escort intermediate stops during the day. That is at least partly because if any of those particular tours had included an escort stop, then it would have been defined as an escort tour. So, any escort stops during the day would have had to have been made on some other type of tour—work, school or escort. Note that interaction terms for some purpose combinations in Table 1-12 have not been estimated. This is to avoid over-specification of the model, in combination with the residual constants. All of the interaction terms that can be estimated have been included.
- **Residual constants**: Finally, Table 1-13 contains the residual constants for each allowable number of tour purposes and stop purposes, relative to the base alternative of 0 tours and 0 stops (stay at home all day).
- **Model fit:** The model fit statistics for this model and most of the other estimated models are given in Table 1-15. For the Day Pattern model, the rho-squared with respect to constants is 0.1422, which seems quite good for a model with over 2000 alternatives.

Table 1-8. Day Activity Pattern Model Estimation Results (part 1)

Purpose-specific variables	Work		School		Escort		Pers.Bus.		Shopping	
	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st
ASC-Tour	1.071	11.0	-2.870	-10.2	-3.571	-19.2	-1.900	-13.5	-3.167	-11.7
ASC- Intermediate stop	2.263	3.4	6.646	16.7	-1.635	-5.8	0.761	3.1	0.149	0.4
Person Type										
Part-time worker	-1.316	-18.0	-1.108	-5.6	0.233	3.1	0.167	2.8	0.340	5.5
Non-worker age 65+	-4.924	-34.0	-20.000				0.273	4.4	0.091	1.3
Non-worker age 18-64	-4.542	-36.7	-20.000						0.213	3.2
College student	-2.474	-12.9	2.214	11.9	0.315	1.7				
K-12 student age 16+	-2.565	-15.9	2.677	16.7	0.798	6.2			-0.643	-4.2
Child age 5-15	-20.000		2.519	22.6	1.196	12.3	-0.607	-6.5	-1.354	-10.9
Child age 0-4	-20.000				1.774	17.9	-1.265	-10.8	-1.404	-10.9
Adult age group										
Age 18-25	-0.091	-0.9	-0.402	-2.6	-0.675	-5.7	-0.420	-4.1	-0.540	-4.8
Age 26-35	-0.262	-3.8			-0.223	-3.1	-0.216	-3.4		
Age 51-65	0.194	3.6	-0.617	-3.7	-0.180	-3.4	0.184	4.4		
Number of children										
Number of children age 0-4					0.323	6.2			-0.109	-2.4
Number of children age 5-15					0.477	14.6				
Number of children age 16+					-0.202	-3.1				
Household composition										
Only adult in HH, with children			-0.822	-2.3	1.478	10.4				
Work less than other adult, w/children			-0.321	-1.5	1.020	13.3				
Work more than other adult, w/children			-2.078	-8.2						
2+ adults, all work full time, w/children			-2.236	-8.2	1.075	14.8				
Only adult in HH, no children			-1.159	-6.4	-0.640	-7.2	0.297	6.2	0.170	3.0
Work less than other adult, no children										
Work more than other adult, no children			-1.732	-7.2	-0.384	-3.7				
2+ adults, all work full time, no children			-2.238	-8.7	-0.277	-3.0				

Table 1-9. Day Activity Pattern Model Estimation Results (part 1- continuation)

Purpose-specific variables	Work		School		Escort		Pers.Bus.		Shopping	
	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st
Household income										
HH income under $30K					-0.246	-3.2				
HH income $30-$60K					-0.267	-5.5				
HH income $90-120K			0.187	2.1						
HH income over $120K			0.357	3.9						
HH income missing			0.109	1.0	-0.166	-2.7				
Other variables										
No cars in HH	-0.183	-1.2			-0.906	-4.7			-0.403	-3.5
Car competition between HH adults	-0.059	-1.1			0.205	4.1			-0.054	-1.2
Usual workplace is home	-2.195	-10.3			-0.724	-2.4				
Proxy reporting	-0.220	-3.7			-0.125	-2.8	-0.346	-8.0	-0.291	-6.4
Second diary day	-0.130	-2.6	-0.157	-2.3	-0.079	-2.1	-0.140	-4.0	-0.197	-5.4
Land use and level of service										
Home zone fraction land in parks									-0.608	-2.4
Home-work zone mode choice logsum	0.097	3.2								
Home zone aggregate mode/dest logsum			0.182	6.3	0.049	3.2	-0.016	-2.6	0.017	2.9
Work zone NHB mode/dest logsum					0.005	2.1				
Work zone mixed use index 6	-1.117	-11.8								
Worker- no usual work zone	-1.078	-8.5								

Table 1-10. Day Activity Pattern Model Estimation Results (part 2)

Purpose-specific variables	Meal		Social /Rec		# Tour Purp		# Stop Pur		Stay Home	
	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st
ASC-Tour	-4.921	-18.7	-2.322	-28.1						
ASC- Intermediate stop	-1.794	-5.5	-0.103	-0.5						
Person Type										
Part-time worker			0.124	1.8	0.599	7.1			-0.888	-7.7
Non-worker age 65+			0.116	1.7					-0.957	-11.2
Non-worker age 18-64			0.098	1.5	0.452	5.4			-0.874	-11.2
College student					0.749	3.8			-1.021	-3.8
K-12 student age 16+			0.189	1.8	0.759	4.9			-0.365	-2.0
Child age 5-15	-0.431	-4.1	0.374	5.1	0.525	4.1			-0.458	-3.5
Child age 0-4	-0.553	-4.8	0.020	0.2					-1.196	-9.4
Adult age group										
Age 18-25							0.374	2.6		
Number of children										
Number of children age 0-4					-0.236	-3.8				
Number of children age 5-15	-0.121	-3.4			0.209	5.9				
Number of children age 16+					0.518	7.5				
Household composition										
Only adult in HH, with children					-0.384	-2.0				
Work less than other adult, w/children	-0.404	-5.0								
Work more than other adult, w/children										
2+ adults, all work full time, w/children	-0.167	-2.1								
Only adult in HH, no children	0.280	4.2	0.169	2.7	-0.150	-1.7				
Work less than other adult, no children			-0.304	-4.5						
Work more than other adult, no children										
2+ adults, all work full time, no children			-0.197	-2.9						

Table 1-11. Day Activity Pattern Model Estimation Results (part 2 - continuation)

Purpose-specific variables	Meal		Social /Rec		# Tour Purp		# Stop Pur		Stay Home	
	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st
Household income										
HH income under $30K	-0.280	-3.6	-0.489	-6.7						
HH income $30-$60K			-0.181	-3.9						
HH income $90-120K			0.110	2.3						
HH income over $120K	0.210	3.8								
HH income missing	-0.118	-1.8	0.001							
Other variables										
No cars in HH	-0.270	-1.9	-0.407	-2.9	-0.530	-2.6				
Car competition between HH adults	-0.135	-2.6	-0.176	-3.7	-0.158	-2.5			0.137	2.6
Usual workplace is home					0.754	2.7				
Proxy reporting	-0.144	-2.9	-0.230	-5.4					0.275	4.7
Second diary day	-0.067	-1.7	-0.096	-2.8					0.136	2.5
Land use and level of service										
Home zone fraction land in parks	-0.761	-2.6	0.842	3.7						
Home zone mixed use index 6					-0.278	-2.5				
Home zone intersections/sq.km			0.003	3.6	0.007	5.9				
Home zone aggregate mode/dest logsum	0.054	6.9			0.021	2.9				

Table 1-12. Day Activity Pattern Model Estimation Results (part 3)

Purpose combination variables	Tour+Tour		Stop+Stop		Tour+Stop	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Work + Work					-2.257	-3.6
Work + School	-2.044	-12.6			-10.000	
Work + Escort	-1.376	-16.0	-0.733	-6.6	0.849	10.6
Work + Per.Bus	-1.146	-14.2	-0.309	-3.1	-0.136	-2.0
Work + Shop	-1.089	-12.7	-0.474	-4.8	-0.309	-4.2
Work + Meal	-0.622	-6.8	0.428	4.4	-0.050	-0.6
Work + Soc/Rec	-0.659	-8.4	-0.775	-6.2		
School + Work					-1.314	-2.2
School + School					-7.473	-21.8
School + Escort	-1.457	-13.7	-0.349	-2.0	0.435	4.6
School + Per.Bus	-0.749	-6.5	-0.363	-1.7	-0.276	-2.9
School + Shop	-0.925	-6.2	-1.010	-3.2	-0.556	-4.7
School + Meal	-0.922	-6.0	0.499	2.6	-0.480	-4.2
School + Soc/Rec	-0.380	-3.8	-0.477	-2.4		
Escort + Escort					3.090	16.5
Escort + Per.Bus	0.001	0.0	-0.447	-5.3	0.476	7.2
Escort + Shop	-0.051	-0.6	-0.530	-6.2	0.200	3.0
Escort + Meal	-0.136	-1.2	-0.276	-3.0	0.550	7.1
Escort + Soc/Rec	0.012	0.1	-0.219	-2.5		
Per.Bus + Escort					-0.674	-7.1
Per Bus + Per Bus					0.291	2.1
Per Bus + Shop	-0.281	-3.2	-0.079	-1.0	0.104	1.6
Per Bus + Meal	0.045	0.4	-0.177	-2.2	-0.002	0.0
Per Bus + Soc/Rec	-0.108	-1.4	-0.704	-7.9		
Shop + Escort					-0.638	-6.1
Shop + Per Bus					0.425	6.1
Shop + Shop					1.014	3.7
Shop + Meal	0.018	0.2	-0.303	-3.7	-0.050	-0.6
Shop + Soc/Rec	0.058	0.7	-0.516	-5.9		
Meal + Escort					-0.590	-4.3
Meal + Per Bus					0.316	3.7
Meal + Shop					0.271	3.2
Meal + Meal					1.312	4.8
Soc/Rec + Escort						
Soc/Rec + Per Bus					-0.409	-5.2
Soc/Rec + Shop					0.072	1.1
Soc/Rec + Meal					0.140	2.2

Table 1-13. Day Activity Pattern Model Estimation Results (part 4)

Residual constants	Coeff	T-stat
1 tour purpose + 1 stop purpose	-2.385	-11.8
1 tour purpose + 2 stop purposes	-3.722	-10.7
1 tour purpose + 3+stop	-4.454	-9.8
2 tour purposes + 1 stop purpose	-2.252	-11.0
2 tour purposes + 2 stop	-3.678	-10.4
2 tour purposes + 3 stop	-4.142	-9.1
3 tour purposes + 1 stop purpose	-2.044	-8.8
3 tour purposes + 2 stop	-2.913	-7.7

Table 1-14. Distribution of Exact Number of Tour by Purpose, from Among those Making Tours

	Work		School		Escort		Per.Bu		Shop		Meal		Soc+Re	
Obs	8237	%	3533	%	3246	%	2752	%	2083	%	1085	%	3069	%
1 tour	7900	96.0	3469	98.	2294	71.	2451	89.	1944	93.	1034	95.	2790	90.
2 tours	326	3.9	61	1.7	707	21.	273	10.	122	6.0	49	4.5	252	8.2
3+ tours	11	0.1	3	0.1	189	5.8	28	1.0	17	0.8	2	0.2	27	0.9
4+ tours					47	1.4								

Table 1-15. Model Fit Statistics

	Main pattern model	Stop frequency model	Subtour freq model	Usual work / not model
Observations	21020	51402	5604	7630
Final log likelihood	-81474.48	-37885.17	-2299.82	-1492.88
Rho-squared (0)	0.4927	0.2476	0.5698	0.7177
Rho-squared	0.1422	0.1762	0.0647	0.0570

1.5 ESTIMATION RESULTS: EXACT NUMBER OF TOURS

This model fills in some of the "details" that are not predicted in the main pattern model. There are typically a small number of cases in the data where a person makes more than one tour for a given purpose during the day. This model predicts the distribution across such cases.

The cases used for estimation are of the same person-day records used in the main day pattern model, but screened out if they have 0 tours for the relevant tour purpose.

A very simple model specification is used to predict the exact number of tours for any given purpose, conditional on making 1+ tours for that purpose. For all purposes except Escort, it is a multinomial logit model with three alternatives:

1. The person makes 1 tour for the tour purpose.
2. The person makes 2 tours for the tour purpose.
3. The person makes 3 tours for the tour purpose
4. The person makes 4+ tours for the purpose (only included for Escort)

Because this model is only estimated and applied for cases where the person makes 1+ tours for the purpose, all three alternatives are always available. For all purposes except Escort, less than 1% of the observations make 3 tours for a purpose (see Table 1-14), so the model is for most intents and purposes a binary model between 1 and 2+. Only the constant and the accessibility logsum effect are estimated separately for the 2 and 3 tour alternatives, while the rest of the variables apply to both (2+ tours).

For Escort, a number of people make several tours during the day, so a 4th alternative is included.

The estimation results are shown in Table 1-16 and Table 1-17.

Table 1-16. Exact Number of Tour by Purpose Model Estimation Results (part 1)

	Work		School		Escort		Per.Bus.		Shop		Meal		Soc+Rec	
Observations	8237		3533		3246		2752		2083		1085		3069	
Final log likelihood	-1358.2		-316.7		-2355.5		-1002.3		-534.6		-199.6		-959.8	
Rho-squared(0)	0.850		0.918		0.477		0.669		0.766		0.833		0.715	
Rho-squared(constants)	0.067		0.047		0.096		0.039		0.049		0.068		0.062	
Person//HH variables	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**	**Coeff**	**T-stat**
Person Type														
Part-time worker													0.600	3.0
Non-worker age 18-64	-0.706	-1.4											0.568	3.6
College student	-1.474	-1.4												
K-12 student age 16+					1.182	3.6							0.776	2.3
Child age 5-15					1.278	6.2								
Child age 0-4					1.542	9.6								
Household composition														
Only adult, with children					0.945	3.4								
Work more than other, w/children					0.861	3.8								
Work less than other, w/ children					1.545	10.5								
All full time workers, w/children					0.909	4.7								
Only adult, no children											0.596	1.7		
Work less than other, no children	0.721	3.4			0.728	3.8								
All full time workers, no children							-0.935	-2.4						
Number of children age 5-15					0.294	4.9								
Household income														
HH income under $30K	0.760	3.7												
HH income over $120K													0.381	2.2
HH income missing	0.188	1.1											-0.224	-1.1
No cars in the HH	-0.570	-1.3												
Usual workplace is home									1.548	2.8	2.037	2.8		
Proxy reporting					-0.256	-2.5							-0.175	-1.2
Diary day 2	-0.139	-1.2			-0.112	-1.3					-0.441	-1.5	-0.190	-1.5

Table 1-17. Exact Number of Tour Estimation Results (part 2)

**** modeled as 0/1+ for higher priority purposes, and as exact # of tours for lower priority purposes**

	Work		School		Escort		Per.Bus.		Shop		Meal		Soc+Rec	
	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat	Coeff	T-stat
Other person/hh variables														
Home zone fraction in parks													0.990	1.2
Home zone intersections/sq.km													0.0099	3.2
Logsum variables														
Accssibility logsum- 2 tours	0.706	9.7	0.198	1.6	0.074	2.0	0.021	0.9	0.047	1.6	0.122	2.4	0.046	0.5
Accssibility logsum- 3 tours	1.094	3.4	2.943	2.6	0.122	1.9	0.021	const	0.122	1.7	0.137	0.6	0.052	0.2
Accssibility logsum- 4 tours					0.151	1.2								
Other tours in day														
Work tours (#)					-0.913	-7.1	-1.041	-4.8	-1.106	-3.6	-1.236	-2.8	-1.127	-6.2
School tours (#)					-1.853	-8.6	-0.875	-2.8	-0.819	-1.4	-0.839	-1.1	-1.077	-4.3
Escort tours (0/1+ or #)**													-0.146	-1.2
Per.bus tours (0/1+ or #)**			0.579	1.4	-0.319	-2.4					-0.449	-1.1	-0.172	-1.1
Shop tours (0/1+ or #)**							-0.459	-2.1			-0.575	-1.4	-0.439	-2.2
Meal tours (0/1+ or #)**							-0.371	-1.3	-0.729	-1.7			-0.924	-2.7
Social/recreation tours (0/1+)			-1.825	-2.5	-0.447	-3.7			-0.365	-1.4				
Other stops in day														
Work stops (0.1+)	0.634	4.6	0.933	1.2										
School stops (0.1+)														
Escort stops (0.1+)	0.379	2.6			0.172	2.0	-0.750	-2.2					-0.564	-1.9
Per.bus stops (0.1+)	0.285	2.1					0.526	4.2						
Shop stops (0.1+)	0.241	1.8			0.116	1.2			0.767	4.3				
Meal stops (0.1+)			0.867	2.3										
Constants														
2 Tours	-3.590	-33.6	-5.807	-5.2	-2.747	-6.4	-2.454	-5.5	-4.913	-3.7	-6.608	-3.9	-2.733	-4.3
3+ Tours	-7.115	-20.1	-35.67	-3.1	-4.591	-6.2	-4.330	-21.6	-10.44	-3.0	-10.32	-1.3	-4.997	-3.8
4+ Tours					-6.305	-4.4								

1.6 ESTIMATION RESULTS: NUMBER & PURPOSE OF WORK-BASED SUBTOURS

For any home-based work tours, this model predicts how many, if any, subtours are made that leave that destination and return to it during the day.

Cases for estimation

The cases used for estimation are all work tours with:

- A valid person-day activity pattern;
- Valid activity start and end time data for all activities in the person-day;
- At least one stop made for any purpose during the day. (Stops include all intermediate stops plus main activities on work-based subtours.)

The last restriction is used, because if the person did not make any extra stops for any purpose, then only the “quit” alternative is available, and there are no subtours.

Model structure and choice alternatives

This model uses an iterative stop/repeat structure, with eight possible alternatives: 1 (more) subtour for any of seven different activity purposes, or No (more) subtours, here called the “quit” alternative. When the model is applied the choice is repeated until the purpose of the third subtour or the quit alternative is chosen, whichever comes first. Three subtours is the limit because that is the maximum number observed in the data.

There are eight alternatives in the model:

1. Make a subtour for primary purpose work
2. Make a subtour for primary purpose school
3. Make a subtour for primary purpose serve passenger
4. Make a subtour for primary purpose personal business
5. Make a subtour for primary purpose shopping
6. Make a subtour for primary purpose meal
7. Make a subtour for primary purpose social/recreation
8. Make no (additional) subtours (“quit”)

The “quit” alternative is always available. The seven purpose-specific alternatives are only available if the person makes 1+ stops for that purpose during the day, as predicted by the main pattern model (Note that all locations on subtours, including the primary destination, are treated as stops in terms of the day pattern choice.)

Key explanatory and segmentation variables

A single model was estimated across all home-based work tours, with the results shown in Table 1-18. The variables tested included:

- A constant for each subtour purpose;
- “Quit” constants that vary depending on how many subtours are already predicted;

- Person attributes (age, gender, etc.);
- Household attributes (income, number of workers, auto, availability, etc.);
- Day-pattern types (e.g. persons with multiple work tours in a day);
- Accessibility from the work location for key purposes (e.g. meal and shopping) using aggregate mode/destination choice logsums for those purposes.

None of the person or household attribute variables were significant, and none were included in the final model. The accessibility variable was only important for the work subtour purpose. Intersection density was significant for the quit alternative.

Note that not all work tours go to the usual work destination. The explanatory power of this model will be improved when it can be applied conditional of the work tour destination, and thus is estimated based on the observed work activity location rather than the usual work location.

Table 1-18. Work-based Subtour Frequency/Purpose Estimation Results

Purpose-specific variables	Coeff	T-st
Work subtour- constant	-3.269	-6.2
Work subtour- Usual work zone acc.logsum	0.164	3.1
Work subtour- Full time worker	0.350	1.1
Work subtour- Income over $120K	0.437	2.3
Work subtour- Income missing	-0.496	-1.5
School subtour- constant	-20.0	Const
Escort subtour- constant	-3.965	-7.4
Escort subtour- Full time worker	0.521	1.0
Personal business subtour- constant	-2.786	-9.1
Personal business subtour- Full time worker	0.369	1.3
Shopping subtour- constant	-2.866	-14.1
Meal subtour- constant	-2.145	-6.7
Meal subtour- Full time worker	1.018	3.7
Meal subtour- Number of HB tours in day	0.697	2.3
Social/recreation subtour- constant	-2.698	-12.2
Quit- 1 subtour already made	1.229	8.6
Quit- 2 subtours already made	1.908	4.0
Quit- Number of home based tours in day	0.351	4.8
Quit- 2+ home-based work tours in day	0.909	4.1
Quit- Proxy reporting	0.107	1.0
Quit- Diary day 2	0.163	2.0
Quit- usual work zone NHB accessibility logsum	-0.0334	-4.5
Quit- usual work zone fraction in parkland	-1.686	-2.8
Quit- usual work zone none/missing	-2.089	-3.1

1.7 ESTIMATION RESULTS: NUMBER & PURPOSE OF INTERMEDIATE STOPS

For each half-tour (including half sub-tours), this model predicts how many, if any, intermediate stops are made on that half tour for each stop purpose.

Cases for estimation

The cases used for estimation will be all half tours, with:

- A valid person-day activity pattern;
- Valid activity start and end time data for all activities in the person-day;
- At least one stop made for any purpose during the day.

The last restriction is used, because if the person did not make any extra stops for any purpose, then only the “quit” alternative is available, and there are no intermediate stops on any half tour for that person day.

Model structure and choice alternatives

Similar to the subtour generation model above, this model uses an iterative stop/repeat structure, with eight possible alternatives: 1 (or more) stops on the half tour for any of seven different activity purposes, or No (more) stops, here called the ‘quit’ alternative. When the model is applied the choice is repeated until the purpose of the sixth stop or the quit alternative is chosen, whichever comes first. Six stops is specified as the limit because that captures well over 99% of the half tours in the PSRC estimation data set.

There are eight alternatives in the model:

1. Make a(nother) stop for primary purpose work
2. Make a(nother) stop for primary purpose school
3. Make a(nother) stop for primary purpose serve passenger
4. Make a(nother) stop for primary purpose personal business
5. Make a(nother) stop for primary purpose shopping
6. Make a(nother) stop for primary purpose meal
7. Make a(nother) stop for primary purpose social/recreation
8. Make no (additional) intermediate stops on the half tour (“quit”)

Alternative 8 is always available. The seven purpose-specific alternatives are only available if the person makes 1+ stops for that purpose during the day, as defined in the main pattern model. Note that stops are not “used up”—the pattern model reveals if there are any stops at all during the day for a given purpose, but not how many. In the majority of observed cases, there is only one stop made during the day for any purpose.

Key explanatory and segmentation variables

A single model was estimated for all half tours, regardless of tour purpose (although the tour purpose is an important variable within the model).The results are shown in Table 1-19 through Table 1-21. Variables tested include the following:

- A constant for each stop purpose, segmented by the main tour purpose
- "Quit" constants that vary depending on how many stops are already predicted on the half tour, different for the first and second half tours.
- Person attributes (age, gender, etc.).
- Household attributes (income, number of workers, auto, availability, etc.).
- Day-pattern types (e.g. persons with multiple work tours in a day).
- The number of times prior stops of the same purpose have already been made, on previous tours, on the previous half tour, and on the same half tour.

In future projects, it will be possible to expand this model to use more predicted information about the tour, including:

- Predicted tour destination, main mode and times of day.
- Accessibilities from the tour destination, using aggregate tour mode/destination choice logsums.
- Intermediate stop accessibility, using the aggregate auto intermediate stop logsum between the tour origin and destination.
- Time window effects: People will tend to make fewer stops if they have little time available or other tours to carry out during the day. It is known how much time is already "used" up by previously simulated tours and trips. It is also known how many tours still need to be simulated for the person day after the current tour, and so various types of "time pressure" variables can be specified.

Table 1-19. Intermediate Stop Frequency/Purpose Estimation Results (part 1)

Purpose-specific variables	Work		School		Escort		P.Bus.		Shop		Meal		S/Rec	
	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st
Constant	1.699	9.4	2.227	8.4	1.585	7.6	2.025	13.6	2.063	13.6	2.031	13.5	2.246	15.0
School tour														
Escort tour					-0.315	-4.0	-0.098	-1.8						
Personal business tour														
Shopping tour									0.525	6.1				
Meal tour											-1.263	-5.2		
Social/recreation tour							-0.312	-4.8						
Work-based tour							1.126	5.4	1.030	4.3	0.951	4.2		
Pattern variables														
Stops of same purpose, previous tours	-1.062	-6.4	-10.0	Const	-0.940	-15.8	-1.603	-27.4	-1.520	-24.5	-2.823	-20.7	-2.498	-19.9
Stops of same purpose, previous half-tour	-0.612	-7.2	-3.023	-10.3	-0.484	-11.5	-1.156	-22.3	-1.065	-18.1	-2.724	-21.8	-2.208	-20.8
Stops of same purpose, same half-tour	-0.648	-10.7	-3.707	-12.1	-0.740	-14.3	-0.970	-25.7	-0.953	-23.7	-3.100	-26.3	-2.036	-27.9
Tours of same purpose in the day	0.291	3.0			-0.052	-1.5			-0.220	-3.6	0.182	1.5	-0.121	-2.3
Stop number on first half tour					-0.334	-8.5								
Stop number on second half tour					-0.127	-4.0								
First half tour (from home)	-0.862	-9.9	-0.794	-3.8			-0.725	-14.6	-1.528	-30.1	-1.211	-19.5	-1.274	-20.3
Person Type														
Part-time worker							0.230	3.6	0.064	1.1				
Non-worker age 65+									0.114	1.9				
Non-worker age 18-64							0.351	6.4	0.241	4.5				
College student							0.229	1.5			0.511	2.2		
K-12 student age 16+			0.871	2.9					-0.278	-1.7	0.385	2.7		
Child age 5-15			1.043	4.5					-0.253	-2.2				
Child age 0-4			1.434	3.2	0.341	5.0								
Number of children														
Number of children age 0-4					0.082	2.1			-0.090	-1.9				
Number of children age 5-15					0.100	3.8					-0.081	-2.2	-0.104	-2.9
Number of children age 16+									-0.182	-3.2				

Table 1-20. Intermediate Stop Frequency/Purpose Estimation Results (part 2)

Purpose-specific variables	Work		School		Escort		P.Bus.		Shop		Meal		S/Rec	
	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st	Coeff	T-st
Household composition														
Only adult in HH, with children									-0.335	-2.2	-0.378	-1.7		
Work less than other adult, w/children							-0.315	-4.5						
Work more than other adult, w/children					-0.342	-4.4	-0.182	-2.4						
2+ adults, all work full time, w/children							-0.157	-2.2						
Only adult in HH, no children							-0.057	-1.2	-0.158	-3.1	-0.125	-1.8		
Work less than other adult, no children					0.441	4.4	-0.109	-1.6						
Household income														
HH income under $30K					0.308	3.6								
HH income $30-$60K					0.068	1.3								
HH income missing					0.063	0.9								
Other variables														
Work at home											0.850	2.3		
Proxy reporting							-0.133	-2.8	-0.099	-2.0				
Second diary day														
Land use and level of service														
Home zone aggregate mode/dest logsum					0.066	3.0								
Work zone NHB mode/dest logsum					0.0066	1.2								

Table 1-21. Intermediate Stop Frequency/Purpose Estimation Results (part 3)

Quit alternative	Coeff	T-stat
Outbound half tour – stop 2	-0.117	-2.9
Outbound half tour – stop 3	-0.497	-7.6
Outbound half tour – stop 4	-0.723	-7.3
Outbound half tour – stop 5	-0.742	-4.9
Outbound half tour – stop 6	-1.066	-4.5
Return half tour – stop 2	0.504	14.1
Return half tour – stop 3	0.692	13.5
Return half tour – stop 4	0.498	6.5
Return half tour – stop 5	0.304	2.6
Return half tour – stop 6	0.380	2.2
Outbound half of work tour	0.482	11.1
Outbound half of school tour	1.000	14.2
Outbound half of shopping tour	-0.337	-5.7
Outbound half of work-based subtour	2.677	14.0
Return half of work tour	-0.192	-4.8
Return half of school tour	-0.110	-1.9
Return half of escort tour	-0.237	-5.3
Return half of work-based subtour	2.309	13.0
Home zone aggregate logsum	0.0374	5.5
Number of tours in the day	0.529	34.5
Secondary tour in the day	-0.356	-11.4
Work tour- number of work-based	0.925	18.2

1.8 ESTIMATION RESULTS: WORK TOUR USUAL VERSUS OTHER WORKPLACE

For each work tour, it is important to know whether the destination is the usual workplace, which is already known, or else a different workplace, which must be predicted.

Cases for estimation

The observations are all work tours for which the destination is known and the worker has a valid out-of-home usual workplace.

Model structure and choice alternatives

The alternatives are (1) usual workplace, (2) other workplace. The utility for the other workplace alternative is set at 0, with all variables contributing to the usual workplace utility.

Key explanatory variables

The estimation results are shown in Table 1-22. Full time workers and those whose travel was reported by proxy were more likely to go to the usual workplace. Those high income workers, workers who made multiple work tours during the day, and workers who made more tours in total were less likely to go to the usual workplace.

Two types of accessibility variables are included: The more accessible the usual workplace (measured by the mode choice logsum), the more likely it is to be the destination. However, the more accessible the residence zone is to all work locations (measured by the non-usual work tour mode/destination logsum), the more likely the person is to visit other locations.

Table 1-22. Work Tour Usual versus Other Workplace Estimation Results

Purpose-specific variables	Coeff	T-st
Usual workplace- constant	4.463	5.1
Usual workplace- full time worker	0.498	3.8
Usual workplace- income over $120K	-0.390	-2.9
Usual workplace- income missing	0.084	0.5
Usual workplace- number of tours in the day	-0.272	-3.8
Usual workplace- primary tour of multiple work tours	-0.790	-3.7
Usual workplace- secondary tour of multiple work tours	-1.629	-9.3
Usual workplace- proxy reporting	0.251	1.9
Usual workplace- home to usual work mode choice logsum	0.107	1.6
Usual workplace- home zone aggregate logsum to other work dest.	-0.168	-1.6

2 MODEL CALIBRATION & VALIDATION

2.1 SYNTHETIC POPULATION

2.1.1 Description

The synthetic population used in the auto ownership and activity generator model components is based on Census PUMS data and is produced by Urbansim. The file contains a person-level records representing the entire population of the region, and includes both person and associated household attributes. The structure of this file is detailed in a following section of this document which describes the models' required input files and formats.

2.1.2 Validation

Prior to use in the auto ownership and activity generator model components, the synthetic population was validated against information from the Census and the household survey to demonstrate that this synthetic population matched key demographic distributions found the real population. The regional distribution of households along three key dimensions (persons per household (1, 2, 3 and 4+), workers per household (0, 1, 2 and 3+), and household income (up to $30K, $30 to $60K, $60 to $100K, and $100K+)) is explicitly controlled for in Urbansim for each forecast year. The synthetic population does not include group quarters residents. Only members of households are reflected in the synthetic population.

Table 2-1 through Table 2-5 summarize the validation of the synthetic population households against household targets developed as part of the household survey expansion process. The distribution of synthetic households by income category, size and number of workers matches the survey targets precisely, because these distributions are explicitly provided to the Urbansim synthetic population process. For other household attributes, such as lifecycle and residence location, there are some relatively minor discrepancies, such as the over-allocation of young 2+ adult households and households in Seattle.

Table 2-1. 2006 Household Income Synthetic Population Validation

	Survey Targets	Synthetic Pop	Diff	% Diff
$0 to below $30,000	347,930	347,911	-19	0%
$30,000 to below $60,000	396,887	396,857	-30	0%
$60,000 to below $100,000	338,562	337,938	-624	0%
$100,000 and above	294,049	294,047	-2	0%
Total	1,377,428	1,376,753	-675	0%

Table 2-2. 2006 Household Size Synthetic Population Validation

	Survey Targets	Synthetic Pop	Diff	% Diff
1- 1 person	403,750	403,524	-226	0%
2- 2 persons	474,001	473,833	-168	0%
3- 3 persons	197,275	197,327	52	0%
4- 4+ persons	302,402	302,069	-333	0%
Total	1,377,428	1,376,753	-675	0%

Table 2-3. 2006 Household Workers Synthetic Population Validation

	Survey Targets	Synthetic Pop	Diff	% Diff
1- No workers	304,728	304,404	-324	0%
2- 1 worker	567,163	566,688	-475	0%
3- 2 workers	426,926	427,031	105	0%
4- 3+ workers	78,611	78,630	19	0%
Total	1,377,428	1,376,753	-675	0%

Table 2-4. 2006 Household Lifecycle Synthetic Population Validation

	Survey Targets	Synthetic Pop	Diff	% Diff
1- Young children, 1-5	186,726	201,045	14,319	8%
2- School children, 6-17	260,998	255,059	-5,939	-2%
3- Young adult, 18-34	83,268	85,044	1,776	2%
4- Mid - adult, 35-64	219,941	202,204	-17,737	-8%
5- Older- adult, 65 +	100,316	116,200	15,884	16%
6- Young 2+ adult, 18-34	99,968	120,787	20,819	21%
7- Mid 2+ adult, 35-64	290,955	273,624	-17,331	-6%
8- Older 2+ adult, 65 +	135,256	122,790	-12,466	-9%
Total	1,377,428	1,376,753	-675	0%

Table 2-5. 2006 Household Residence District Synthetic Population Validation

	Survey Targets	Synthetic Pop	Diff	% Diff
Seattle	261,374	275,862	14,488	6%
Rest of King	484,670	473,450	-11,220	-2%
Snohomish	254,011	242,880	-11,131	-4%
Pierce	282,977	288,553	5,576	2%
Kitsap	94,396	96,008	1,612	2%
Total	1,377,428	1,376,753	-675	0%

While the expansion targets associated with the household survey were household-based, the synthetic population is person-based. No person-based distributions are used in the preparation of the synthetic population, and thus there can be some minor discrepancies between the expanded survey population and the synthetic population. Table 2-6 illustrates the differences in the distribution of persons by person type between the suvey targets and the synthetic population. These persontypes are key segmentations used in the activity generator models.

Table 2-6. 2006 Persons by Persontype

Persontype	Survey Targets	Synthetic Pop	Diff	% Diff
ft worker	1,320,858	1,344,286	23,428	2%
pt worker	288,284	239,030	-49,254	-17%
retired	299,615	314,554	14,939	5%
nonworker	460,318	453,439	-6,879	-1%
uinv.stud	90,739	113,392	22,653	25%
stud 16+	109,618	115,746	6,128	6%
stud.5-15	485,619	530,850	45,231	9%
under 5	212,077	224,565	12,488	6%
Total	3,267,128	3,335,862	68,734	2%

These regional household population estimates of approximately 3.3 million for the year 2006 are less than PSRC's published estimates of regional household population of approximately 3.45 million for the year 2006 and the Census Bureau's American Community Survey estimates of a regional household population of 3.45 million. This is because ACS population totals are inconsistent with the ACS household totals, due to the fact that the ACS uses different (and inconsistent) weighting factors to create household tables and population tables.

2.2 AUTO OWNERSHIP MODEL CALIBRATION

The auto ownership model predicts the number of motorized vehicles owned, leased, or otherwise belonging to fleet of vehicles possessed by the household. The auto ownership model takes as given the household characteristics, as well as the regular work location information of all workers in the household.

To calibrate the model, the alternative specific constants for each auto ownership level were adjusted. To validate the model, the estimated share of households in each auto ownership category was compared the observed shares of households along three primary dimensions: household potential drivers, household income and household residence district. The two primary sources for observed data were the 2000 Census and 2006 PSRC household survey.

Among the most important household attributes that influence the model are the relatiohship between the numbers of vehicles and the number of potential drivers. Potential drivers are identified as anyone aged 16 or older. Table 2-7 shows the observed and estimated shares of households by auto ownership level for each category of households by number of potential driver. The observed shares shown in Table 2-7 are derived from the PSRC household survey. Table 2-8 shows the estimated shares produced by the auto ownership model.

Table 2-9 shows the difference between the observed and estimated shares, and that for households with one or two potential drivers, the estimated share of households in each auto ownership category closely matches the observed share.

Table 2-7. Observed Shares of HH Auto Ownership by HH Potential Drivers

Potential Drivers	Number of Vehicles					
	0	*1*	*2*	*3*	*4+*	*Total*
1	19%	67%	10%	2%	1%	32%
2	2%	18%	57%	17%	6%	53%
3	1%	4%	33%	43%	19%	10%
4+	4%	6%	12%	31%	47%	4%
Total	7%	32%	37%	15%	8%	100%

Table 2-8. Estimated Shares of HH Auto Ownership by HH Potential Drivers

Potential Drivers	Number of Vehicles					
	0	*1*	*2*	*3*	*4+*	*Total*
1	18%	65%	13%	3%	1%	34%
2	2%	20%	57%	16%	5%	51%
3	2%	4%	29%	49%	15%	11%
4+	4%	3%	7%	27%	60%	4%
Total	7%	33%	37%	15%	7%	100%

Table 2-9. Difference in Shares of HH Auto Ownership by HH Potential Drivers

Potential Drivers	Number of Vehicles					
	0	*1*	*2*	*3*	*4+*	*Total*
1	-1%	-2%	3%	1%	0%	1%
2	0%	1%	0%	-2%	-1%	-2%
3	1%	0%	-3%	6%	-4%	1%
4+	0%	-3%	-5%	-4%	12%	0%
Total	0%	0%	0%	0%	0%	0%

Household income is also a significant household attribute affecting auto ownership levels. Table 2-10 through Table 2-12 show the observed and estimated shares of households by auto ownership level for each category of households income, and the difference between these shares. The observed shares shown in Table 2-10 are derived from the PSRC household survey. Table 2-12 shows that for all household income levels the estimated share of households in each auto ownership category closely matches the observed share.

Table 2-10. Observed Shares of HH Auto Ownership by HH Income

HH Income	Number of Vehicles					
	0	*1*	*2*	*3*	*4+*	*Total*
$0 - $30K	23%	53%	18%	4%	2%	25%
$30K - $60K	4%	43%	34%	14%	4%	29%
$60K - $100K	1%	18%	50%	21%	10%	25%
$100K +	1%	9%	49%	25%	16%	21%
Total	7%	32%	37%	15%	8%	100%

Table 2-11. Estimated Shares of HH Auto Ownership by HH Income

HH Income	Number of Vehicles					
	0	*1*	*2*	*3*	*4+*	*Total*
$0 - $30K	22%	54%	19%	4%	1%	25%
$30K - $60K	5%	41%	38%	12%	4%	29%
$60K - $100K	1%	19%	47%	22%	11%	25%
$100K +	0%	11%	46%	27%	16%	21%
Total	7%	33%	37%	15%	7%	100%

Table 2-12. Difference in Shares of HH Auto Ownership by HH Potential Drivers

HH Income	Number of Vehicles					
	0	*1*	*2*	*3*	*4+*	*Total*
$0 - $30K	-1%	1%	1%	0%	-1%	0%
$30K - $60K	1%	-2%	3%	-2%	0%	0%
$60K - $100K	0%	0%	-3%	1%	1%	0%
$100K +	0%	2%	-3%	2%	0%	0%
Total	0%	0%	0%	0%	0%	0%

2.3 ACTIVITY GENERATOR CALIBRATION

A primary goal of the calibration and validation effort is to ensure that the model is replicating key aspects of travel as captured in the household survey. An additional goal of the model was to ensure that the activity generator outputs, when integrated into the existing PSRC model system, will produce reasonable regional assignment results. In order to satisfy these goals, two sets of calibration targets were developed, and two calibration efforts completed.

The first set of activity generator calibration targets was based on the PSRC household survey and the ACS-based survey expansion weights. The activity generator is comprised of a number of component models that, for each person, predict the person's daily activity pattern, including the exact number of home-based tours by activity purpose, the number and purpose of work-based subtours, and the number and purpose of intermediate stops. Some of the first set of targets reflected the structure of these component models, while others provided overall measures of activity generator performance.

To calibrate the activity generator component models, the targets of tours by persontype, tour and stop combinations by persontype, exact numbers of tours and stops by purpose and persontype, exact number and purpose of workbased subtours by persontype, numbers of stops by tour purpose, and the exact numbers of tours and stops by persontype were prepared. The estimated results produced by the activity generator were then compared to these targets. The calibration and validation process primarily involved making adjustments to alternative specific constants and reviewing and revising estimated parameters to ensure reasonability and consistency.

Table 2-13 through Table 2-15 summarize overall activity generator model performance from the initial calibration. Table 2-13 demonstrates that the estimated total tours by tour purpose match the expanded survey within 2% and are within 8% of observed tours for all purposes. The overall 2% difference is consistent with the fact that the synthetic population exceeds the expanded survey population by 2% as well, as demonstrated in Table 2-6Table 2-6. Most estimated tour rates by purpose are within 5% of observed tour rates for all purposes, though the estimated shop tour rate is -9% relative to observed. The estimated tour rates by persontype also closely match the observed tour rates by persontype: with the exception of children less than 5 years old, all estimated tour rates by persontype are within 5% of observed.

Table 2-13. Tours By Purpose (No GPS Adjustment)

Purpose	Observed	Calibrated	Diff	% Diff
work	1,287,853	1,282,150	-5,703	0%
school	649,166	687,150	37,984	6%
escort	724,693	755,690	30,997	4%
pers.bus	442,015	448,450	6,435	1%
shop	320,245	296,700	-23,545	-7%
meal	153,121	161,540	8,419	5%
soc/rec	482,483	519,100	36,617	8%

workbased	101,177	109,210	8,033	8%
Total	4,160,753	4,259,990	99,237	2%

Table 2-14. Tour Rates by Purpose (No GPS Adjustment)

Purpose	Observed	Calibrated	Diff	% Diff
work	0.39	0.38	-0.01	-3%
school	0.20	0.21	0.01	4%
escort	0.22	0.23	0.00	2%
pers.bus	0.14	0.13	0.00	-1%
shop	0.10	0.09	-0.01	-9%
meal	0.05	0.05	0.00	3%
soc/rec	0.15	0.16	0.01	5%
workbased	0.03	0.03	0.00	6%
Total	1.27	1.28	0.00	0%

Table 2-15. Tour Rates by Persontype (No GPS Adjustment)

Persontype	Observed	Calibrated	Diff	% Diff
ft worker	1.29	1.29	0.01	1%
pt worker	1.58	1.52	-0.06	-4%
retired	0.98	1.03	0.05	5%
nonworker	1.24	1.24	0.01	1%
uinv.stud	1.45	1.42	-0.02	-2%
stud 16+	1.44	1.37	-0.07	-5%
stud.5-15	1.28	1.27	-0.01	-1%
under 5	1.11	1.22	0.11	10%
Total	1.27	1.28	0.00	0%

Table 2-16 through Table 2-18 summarize the estimated and observed trips and trip rates. While overall estimated trips are within 3% of observed, there is some greater variation by destination purpose, with meal trips (and trip rate) significantly underpredicted, and shopping trips (and trip rate) overpredicted. However, overall trip rates by person type look reasonable, with the estimated trip rates for all person less than 10% different than observed trip rates.

Table 2-16. Trips by Destination Purpose

Dest Purpose	Observed	Calibrated	Diff	% Diff
work	1,615,882	1,645,760	29,878	2%
school	691,148	738,750	47,602	7%
escort	1,387,431	1,515,000	127,569	9%
pers.bus	1,149,889	1,324,090	174,201	15%
shop	982,358	959,500	-22,858	-2%
meal	536,484	376,260	-160,224	-30%
soc/rec	846,365	911,760	65,395	8%
home	4,059,570	4,150,780	91,210	2%
Total	11,269,127	11,621,900	352,773	3%

Table 2-17. Trips Rates by Destination Purpose (No GPS Adjustment)

Dest Purpose	Observed	Calibrated	Diff	% Diff
work	0.49	0.49	0.00	0%
school	0.21	0.22	0.01	5%
escort	0.42	0.45	0.03	7%
pers.bus	0.35	0.40	0.04	13%
shop	0.30	0.29	-0.01	-4%
meal	0.16	0.11	-0.05	-31%
soc/rec	0.26	0.27	0.01	5%
home	1.24	1.24	0.00	0%
Total	3.45	3.48	0.03	1%

Table 2-18. Trip Rates by Persontype (No GPS Adjustment)

Persontype	Observed	Calibrated	Diff	% Diff
ft worker	3.51	3.58	0.07	2%
pt worker	4.46	4.35	-0.11	-3%
retired	2.76	2.96	0.20	7%
nonworker	3.54	3.54	0.00	0%
uinv.stud	3.84	3.66	-0.18	-5%
stud 16+	3.56	3.51	-0.05	-1%
stud.5-15	3.14	3.19	0.04	1%
under 5	2.95	3.18	0.23	8%
Total	3.45	3.48	0.03	1%

The second set of activity generator targets developed as part of the activity generator calibration process incorporated GPS-based adjustment factors. These factors, which were developed as part of the original PSRC household survey project, are intended to account for under-reporting of trips in the household survey. In typical household surveys there is no straightforward way of correcting for missing trips. However, for the PSRC survey, GPS units were placed in all household vehicles for a subsample of households, tracking time and space coordinates for the same days that the household members completed the travel diaries. By comparing the GPS and the household diary information, it was possible to identify missing trips and to get a more accurate representation of the actual number of trips undertaken by survey households.

However, the GPS-based information contains some inherent limitations. Most critically, the GPS information only provides information on missing vehicle trips, and only for households that own vehicles. Additionally, it is not possible to determine the purpose of these missing trips because they weren't reported in the household survey. In order to overcome some of these limitations, a binary logit model was developed that predicts the probability that a given type of trip was missing based on household and trip attributes, such as whether the trip started or ended at home, the trip length, and whether the data was collected on day 2 of the survey. This probability is converted into an adjustment factor that is then applied to the existing survey expansion factor. Further details describing he development of the logit model and GPS factors is documented in memo "Analysis of the Vehicle-Based GPS Data to Investigate Diary Non-Response" prepared by Mark Bradley on April 3, 2007.

In developing the GPS-based calibration targets as part of this activity generator effort, the GPS factors were capped at 3.0. In addition, transit trips, including school bus trips, were not adjusted because it was felt that it is less likely that travelers would forget to report transit trips. In addition, the calibration of the activity generator component models involves make adjustments at both the tour level and the stop level. A significant limitation of the GPS factors is that these factors are developed and applied at the trip level, and not at the tour level or stop level. In order to adjust the activity generator calibration, new tour level and stop level targets were developed by make assumptions about whether an individual trip was to a tour destination or to an intermediate stop destination, and adjusting the tour and stop targets accordingly.

A key goal of the activity generator model development project, and the GPS adjusted calibration, was to ensure that the activity generator outputs could be successfully integrated into the existing PSRC model system. PSRC established a process for translating activity generator-based outputs into the traditional trip-based model purposes, using information on the trip origin and destination purpose information. These trip-based purposes are shown in Table 2-19, and were the primary measure of the GPS-based calibration process.

As Table 2-19 illustrates, use of the GPS adjustment factors produced targets with significantly higher levels of trip-making. Table 2-16 showed a total of 11,269,127 daily trips without the use of the GPS adjustment factors, while the table below shows a total of 13,857,412 trips – an increase of over 23%. The final calibrated activity generator produced over 14 million trips, which was 2% above the GPS-adjusted target, and consistent with the fact that there are 2% more people in the synthetic population than in the expanded survey totals. For all PSRC triptypes the relative difference between the estimated and observed trips was 8% or less.

Table 2-19. GPS-adjusted Trips by PSRC Triptype

Persontype	No GPS Calibrated	GPS Observed	GPS Calibrated	GPS Diff	GPS % Diff
hb work	1,961,720	2,126,414	2,297,758	171,344	8%
hb school	900,380	1,090,231	1,178,810	88,579	8%
hb coll	234,430	138,499	150,254	11,755	8%
hb shop	834,100	1,109,079	1,099,857	-9,222	-1%
hb other	4,370,930	5,120,488	5,132,173	11,685	0%
nhb work	1,105,760	1,440,865	1,389,925	-50,940	-4%
nhb other	2,214,580	2,831,836	2,857,781	25,945	1%
Total	11,621,900	13,857,412	14,106,558	249,146	2%

In order to calibrate to these significantly higher trip totals, it was necessary to increase levels of tour-making and stop-making far beyond the rates implied by the expanded household survey. Table 2-20 through Table 2-22 illustrate the difference in tour rates and trip rates by purpose and persontype between the expanded household survey and the GPS-adjusted calibrated activity generator. Overall tour making was increased by 19% with notable increase in workbased, social/recreational, and school tours. This purposes seem consistent with the notion that the trips frequently under-reported include short trips, such as those to or from a workplace, and trips reported by a proxy, such as school trips. Tour rates were most significantly increase for young children, retired people, nonworkers and part time workers.

Table 2-20. Tour Rates by Purpose (GPS Adjusted)

Purpose	Observed	Calibrated	Diff	% Diff
work	0.39	0.45	0.06	14%
school	0.20	0.25	0.05	24%
escort	0.22	0.27	0.05	21%
pers.bus	0.14	0.16	0.02	18%
shop	0.10	0.12	0.02	18%
meal	0.05	0.05	0.01	11%
soc/rec	0.15	0.19	0.04	26%
workbased	0.03	0.04	0.01	31%
Total	1.27	1.52	0.24	19%

Table 2-21. Tour Rates by Persontype (GPS Adjusted)

Persontype	Observed	Calibrated	Diff	% Diff
ft worker	1.29	1.50	0.21	17%
pt worker	1.58	1.94	0.36	23%
retired	0.98	1.30	0.33	34%
nonworker	1.24	1.56	0.32	26%
uinv.stud	1.45	1.58	0.13	9%
stud 16+	1.44	1.61	0.17	12%
stud.5-15	1.28	1.47	0.19	15%
under 5	1.11	1.46	0.35	31%
Total	1.27	1.52	0.24	19%

The implied trip rates resulting from the GPS-adjusted calibration were approximately 23% higher than from the unadjusted calibration, with higher levels of shope, sociall / recreational, and escort trips. Again, young children, retired people, part-time workers and non-workers showed the greatest levels of increased tripmaking.

Table 2-22. Trip Rates by Destination Purpose (GPS Adjusted)

Dest Purpose	Observed	Calibrated	Diff	% Diff
Work	0.49	0.61	0.11	23%
School	0.21	0.26	0.05	24%
Escort	0.42	0.54	0.11	27%
Pers.bus	0.35	0.42	0.07	21%
Shop	0.30	0.40	0.09	31%
Meal	0.16	0.20	0.03	19%
Soc/Rec	0.26	0.33	0.07	27%
Home	1.24	1.48	0.24	19%
Total	3.45	4.23	0.78	23%

3 USER GUIDE

DaySim05 is a custom program written in the Delphi 2005 Pascal language for the Windows 32-bit platform that implements a set of core behavioral model components including the auto ownership model and all activity generator submodels, and is called from an MS-DOS command prompt. The most recent compiled version is named psactgen084.exe. The primary means of configuring the activity generator is through a control file that can be identified by the user when the program is called from a command prompt. If no control file is specified, the program looks for the default control file name ACTGEN.CTL. This file must be in the same directory as the executable, though using this control file it is possible to identify a separate directories where model inputs, outputs, other files are stored. In the following sections, ACTGEN.CTL is first described, followed by details describing other critical model inputs and outputs.

3.1 INPUT FILES

3.1.1 Actgen.ctl

The auto ownership model and activity generator models require a number of data inputs. Most critical is the aforementioned ACTGEN.CTL file, the control file that identifies other model inputs, outputs and contains important run parameters. ACTGEN.CTL is a space-delimited ASCII text file that can be edited with any standard text editing application.

Table 3-1 lists the parameters found in this control file, provides a brief description of each parameter, and where appropriate provides an example and/or comment for each parameter.

There are seven primary inputs to the model identified in ACTGEN.CTL:

- Coefficient file
- Zone data file
- Roadway and transit network skims
- Synthetic population
- Person-day file template
- Tour file template
- Trip file template

The format of the synthetic popualtion file is shown in Table 3-2, and the format of the zone data file is shown in Table 3-3. The contents of the coefficient file are not explicitly presented in this document due to the great number of coefficients used in the various model components. The model estimation documentation provides information on the coefficients used in each model component, and can be used to

guide any changes to these coefficients. The roadway and transit network information is listed in ACTGEN.CTL, and shown in

Table 3-1. The activity generator does not require that all required files be present in the run directory. Instead, separate locations can be identified for the synthetic population, network skim data, zone data, and outputs.

There are four primary outputs from the model identified in ACTGEN.CTL:

- Person-day file
- Tour file
- Trip file
- ASCII trip file

The first three files are all DBF format, and their structure and contents are described in Table 3-4, Table 3-5, and Table 3-6. The ASCII trip file is a similar to the trip file, but is in an ASCII format rather than a DBF format. ACTGEN.CTL includes “switch” parameters that allow users to determine which of these files should be produced. The ASCII trip file switch (AOUTSW) includes additional options. If set to 1, the output will include the same variables in the same order as the DBF trip file. If set to 2 or 3, the output will include more information on each record, related to the tour and pattern levels associated with each trip.

ACTGEN.CTL also includes additional parameters guiding the run which:

- Indicates whether logsums should be calculated, calculated and saved, or read from a previously saved file (AGGLGS);
- Identify the random number seed (RNSEED) for the run;
- Identify the household sampling rate (HHSRAT) which allows users to run the model using every nth household;
- Identify which household should be the first samples (HHSBEG); and
- Provide information on the reporting of the model run to the screen (SHOWID) and (WAITEX)

Table 3-1. ACTGEN.CTL Parameters

NAME	DESCRIPTION	EXAMPLE	COMMENT
RUNLAB	Run label		
RUNDIR	Run directory	z:\psrc\runpop\	
PRNTFN	Printfile name	actgen1.prn	
PRINTS	Print switch	2	1=less detail, 2=more detail
DEBUGS	Debug switch	0	0=no extra printing, 1=extra printing
COEFFI	Coefficient file	coeffs1.txt	Must be in run directory
ZONDIR	Zone data file directory	z:\psrc\2006los\	
ZONEFN	Zone data filename	taz2006.dat	
EMMDIR	EMME/2 data bank directory	z:\psrc\2006los\	
EBK1FN	EMME/2 databank 1 filename	bank1\emmebank	includes EMMDIR subdirectory name (if necessary)
EBK2FN	EMME/2 databank 2 filename	bank2\emmebank	includes EMMDIR

			subdirectory name (if necessary)
EBK3FN	EMME/2 databank 3 filename	bank3\emmebank	includes EMMDIR subdirectory name (if necessary)
AMDATM	AM drive alone Time matrix	1052	First digit refers to databank number identfied above, remaining digits refer to table number within the databank
AMS2TM	AM shared ride 2 Time matrix	1053	
AMS3TM	AM shared ride 3+ Time matrix	1054	
AMBKTM	AM bike Time matrix	1059	
AMWKTM	AM walk Time matrix	1060	
AMDADS	AM drive alone distance matrix	1061	
AMDAGT	AM drive alone generalized Time matrix	1062	
AMS2GT	AM shared ride 2 generalized Time matrix	1063	
AMS3GT	AM shared ride 3+ generalized Time matrix	1064	
MDDATM	MD drive alone Time matrix	2073	
MDS2TM	MD shared ride 2 Time matrix	2074	
MDS3TM	MD shared ride 3+ Time matrix	2075	
MDBKTM	MD bike Time matrix	2076	
MDWKTM	MD walk Time matrix	2077	
MDDADS	MD drive alone distance matrix	2078	
MDDAGT	MD drive alone generalized Time matrix	2079	
MDS2GT	MD shared ride 2 generalized Time matrix	2080	
MDS3GT	MD shared ride 3+ generalized Time matrix	2081	
PMDATM	PM drive alone Time matrix	3009	
PMS2TM	PM shared ride 2 Time matrix	3010	
PMS3TM	PM shared ride 3+ Time matrix	3011	
PMBKTM	PM bike Time matrix	3012	
PMWKTM	PM walk Time matrix	3013	
PMDADS	PM drive alone distance matrix	3014	
PMDAGT	PM drive alone generlized Time matrix	3015	
PMS2GT	PM shared ride 2 generlized Time matrix	3016	
PMS3GT	PM shared ride 3+ generlized Time matrix	3017	
EVDATM	EV drive alone Time matrix	3026	
EVS2TM	EV shared ride 2 Time matrix	3027	
EVS3TM	EV shared ride 3+ Time matrix	3028	
EVBKTM	EV bike Time matrix	3029	
EVWKTM	EV walk Time matrix	3030	
EVDADS	EV drive alone distance matrix	3031	
EVDAGT	EV drive alone generlized Time matrix	3032	
EVS2GT	EV shared ride 2 generlized Time matrix	3033	
EVS3GT	EV shared ride 3+ generlized Time matrix	3034	
NTDATM	NT drive alone Time matrix	3043	
NTS2TM	NT shared ride 2 Time matrix	3044	
NTS3TM	NT shared ride 3+ Time matrix	3045	
NTBKTM	NT bike Time matrix	3046	
NTWKTM	NT walk Time matrix	3047	

NTDADS	NT drive alone distance matrix	3048	
NTDAGT	NT drive alone generlized Time matrix	3049	
NTS2GT	NT shared ride 2 generlized Time matrix	3050	
NTS3GT	NT shared ride 3+ generlized Time matrix	3050	
AMWTFA	AM walk-transit fare matrix	1001	
AMWTIV	AM walk-transit in-vehicle Time matrix	1071	
AMWTWK	AM walk-transit walk Time matrix	1072	
AMWTWT	AM walk-transit wait Time matrix	1073	
AMWTXF	AM walk-transit transfer Time matrix	1074	
AMWTBD	AM walk-transit boarding Time matrix	1075	
AMWTNB	AM walk-transit number of boardings matrix	1076	
AMDTFA	AM drive-transit fare matrix	1002	
AMDTIV	AM drive-transit in-vehicle Time matrix	1078	
AMDTWK	AM drive-transit walk Time matrix	1079	
AMDTWT	AM drive-transit wait Time matrix	1080	
AMDTXF	AM drive-transit transfer Time matrix	1081	
AMDTBD	AM drive-transit boarding Time matrix	1082	
AMDTNB	AM drive-transit number of boardings matrix	1083	
MDWTFA	MD walk-transit fare matrix	2002	
MDWTIV	MD walk-transit in-vehicle Time matrix	2084	
MDWTWK	MD walk-transit walk Time matrix	2085	
MDWTWT	MD walk-transit wait Time matrix	2086	
MDWTXF	MD walk-transit transfer Time matrix	2087	
MDWTBD	MD walk-transit boarding Time matrix	2088	
MDWTNB	MD walk-transit number of boardings matrix	2089	
SAMDIR	Synthetic population directory	z:\psrc\runpop\	
SAMPFN	Synthetic population filename	synthpop.dbf	
OUTDIR	Output file directory	z:\psrc\runpop\	
POUTSW	Person-level file write switch	1	0=off, 1=on
TOUTSW	Tour level file write switch	1	0=off, 1=on
SOUTSW	Trip segment level file write switch	1	0=off, 1=on
POUTFN	Person-level output file Name	pout.dbf	DBF format
TOUTFN	Tour level output file Name	tout.dbf	DBF format
SOUTFN	Trip segment level file file Name	sout.dbf	DBF format
AOUTSW	ASCII output file write switch	3	0=off, 1=trip info, 2=trip+tour info, 3=trip+tour+pattern info
AOUTFN	ASCII output file Name	actgenout.txt	
AGGLGS	Aggregate logsum Switch	2	1=calc only, 2=calc & write, 3= read only
RNSEED	Seed for random number generator	12345	
HHSRAT	HH sample sampling ratio	1	Example: 10 = simulate every 10th household
HHSBEG	HH sampling - postion first hh to use	1	Example: 5 = start with 5th household
SHOWID	Show current household number on screen	0	0=off, 1=on
WAITEX	Wait at end of program	0	0=off, 1=on

3.1.2 Synthetic Population File

The synthetic population used by the activity generator is file of person records. In the base year 20006 used for model calibration, a full sample of 3,335,862 person records were included in this file. This file is produced by Urbansim. The fields contained in the synthetic population file are found in Table 3-2.

Table 3-2. Synthetic Population File Format

NAME	DESCRIPTION	COMMENTS
HHID	Household ID	Range = 1-1,579,146 (2006)
PNUM	Person sequence number within HH	Range = 1-17 (2006)
PERSONS	# persons in the household	Range = 1-17 (2006)
HINC	Household annual income ($)	Actual income, not income class, range = $-14,481 - $998,627. These incomes are in 2005 dollars for consistency with the PSRC household survey reported incomes, having been factored up from the 1999 dollars included in the PUMS data
RELATE	Relation to head of household (PUMS)	1 = Householder
		2 = Spouse
		3 = Child
		4 = Adopted
		5 = Stepchild
		6 = Sibling
		7 = Parent
		8 = Grandchild
		9 = Parent-in-law
		10 = Child-in-law
		11 = Other Relative
		12 = Siblin-in-law
		13 = Nephew / Niece
		14 = Grandparent
		15 = Aunt / Uncle
		16 = Cousin
		17 = Boarder
		18 = Housemate
		19 = Unmarried partner
		20 = Foster child
		21 = Other non-relative
SEX	Gender	1 = male
		2 = female
AGE	Age (years)	Range = 0-99
STUDENT	Person is a student (0/1)	0 = non-student
		1 = student
GRADE	Grade/level in school (PUMS)	0 = not attending school
		1 = Preschool
		2 = Kindergarten

		3 = Grade 1 to grade 4
		4 = Grade 5 to grade 8
		5 = Grade 9 to grade 12
		6 = College undergraduate
		7 = Graduate or professional school
WORKER	Person is a worker (0/1)	0 = non-worker
		1 = worker
HOURS	Hours worked per week	Range = 0 - 99
HTAZ	Residence zone	Range = 1 - 938
HPARCEL	Residence parcel ID	Range = 3 - 1,188,534 (2006)
UWTAZ	Usual work zone	Range = 1 - 938
UWPARCEL	Usual work parcel ID	Range = -1 – 1,500,000 (2006)
UWTYPE	Usual workplace type	0 = N/A
		1 = Work
		2 = Home
EXPFAC	Expansion factor	

3.1.3 Zone Data File

The zone data file contains one record for each travel analysis zone in the region information on households, population (including group quarters), employment, urban form and other attributes at the TAZ-level. The file is space-delimited, and there are currently 938 records in the zone data file. The contents of this file are described in Table 3-3.

Table 3-3. Zone Data File Format

NAME	DESCRIPTION
TAZ	Travel Analysis Zone
PCTMF	% of Households in Multifamily Unit
LIHH	# Low Income Households
LMIHH	# Low-Mid Income Households
UMIHH	# Mid-High Income Households
UIHH	# High Income Households
GQI	Institutional Group Quarters Residents
GQN	Non-Institutional Group Quarters Residents
TOTPOP	Total Population (HHPOP+GQI+GQN)
RETEMP	Retail Employment
FIREMP	FIRE Employment
GOVEMP	Government Employment
EDUEMP	Education Employment
WTCEMP	Wholesale, Communication, Transportation & Utility Employment
MANEMP	Manufacturing Employment
UNIENR	Full-time Equivalent College Students
DENTYPE	Density Factor
FAZ	Forecast Analysis Zone
AREATYPE	
TOTHH	Total Households
TOTEMP	Total Employment
PARKAREA	Ratio of urban parkland to total area in TAZ
RATNOMOT	ratio of non-motorized facilities (quarter mile buffer) to total area
RETINT	Retail (really commercial) intensity, a ration of total retail floor area to building footprint that includes parking area
MIXUIND6	a mix of land use index using six land use categories -1.0 is even use for all six, -0.0 all land use in one category
MIXUIND4	Same as above but only four land uses
INTPSQKM	the number of street intersections per square kilometer
UOFWASH	
SEATCBD	
PCOSTDAY	Average daily parking cost
PCOSTCOL	
PCOSTHR	Average hourly parking cost
EMPDENS	

3.1.4 Person-day Template File

The person-day template file, called PFILETEMPLATE.DBF is used to control the format of the person-day output file. It is a DBF format file with two records. The first record contains the field names as described in the person-day file section below. The second record contains the format of each field. Table 3-4 shows the fields currently included in this file.

3.1.5 Tour template File

The tour template file, called TFILETEMPLATE.DBF is used to control the format of the tour output file. It is a DBF format file with two records. The first record contains the field names as described in the tour file section below. The second record contains the format of each field. Table 3-5 shows the fields currently included in this file.

3.1.6 Trip Template File

The person-day template file, called PFILETEMPLATE.DBF is used to control the format of the person-day output file. It is a DBF format file with two records. The first record contains the field names as described in the person-day file section below. The second record contains the format of each field. Table 3-6 shows the fields currently included in this file.

3.2 OUTPUT FILES

The person, tour and trip level output files contain all of the variables predicted by DaySim, plus enough ID variables to cross-reference each other and the input data files in order to append more information if necessary.

3.2.1 Person-day File

The person-day file contains the same number of records as found in the input synthetic sample, unless households are sub-sampled within DaySim. Typically, the person-day file will contain one record for each person in the region. The filename is assigned by user in ACTGEN.CTL. Key person, household, and daily travel pattern information is contained in this file, as described in Table 3-4. The file structure is defined in PFILETEMPLATE.DBF, but any changes to the file template must be accompanied by changes to the activity generator code.

Table 3-4. Person-day File Format

NAME	DESCRIPTION	COMMENT
SAMPN	Household ID	
PERSN	Person sequence number within HH	
HHTAZ	Residence zone	
HHSIZE	Household Size	
HHWORK	Household # of workers	
HHCARS	Household vehicles	
HHINCOME	Household income	
UWTAZ	Usual work zone	
UWCEL	Usual work parcel (can be EMPTY for now)	
UWTYPE	Work at home	0 = NA 1 = work out of home 2 = work at home
NTOURS1	Number of work tours	
NTOURS2	Number of school tours	
NTOURS3	Number of escort tours	
NTOURS4	Number of personal business tours	
NTOURS5	Number of shopping tours	
NTOURS6	Number of meal tours	
NTOURS7	Number of social/recreation tours	
NSTOPS1	Number of work stops	
NSTOPS2	Number of school stops	
NSTOPS3	Number of escort stops	
NSTOPS4	Number of personal business stops	
NSTOPS5	Number of shopping stops	
NSTOPS6	Number of meal stops	
NSTOPS7	Number of social/recreation stops	
WBTOURS	Number of work-based subtours	
EXPFAC	Expansion factor (same as EXFAC x subsample rate)	
WORKER	Worker status	0 = nonworker 1 = worker
PERSTYPE	Person Type	1 = full-time worker 2 = part-time worker 3 = retired 4 = non-worker 5 = university student 6 = student 16+ 7 = student 5-15 8 = under 5

3.2.2 Tour File

The tour file is output by the activity generator. It contains one record for each tour that occurs in the region. Each tour is associated with a person and household, and is identified by a tour purpose, origin and destination TAZ, and subtour and intermediate stop information, as presented in Table 3-5.

Table 3-5. Tour File Format

NAME	DESCRIPTION	COMMENT
SAMPN	Household ID	
PERSN	Person sequence number within HH	
TOURNO	Tour sequence number within person day	
TOURPURP	Tour purpose	1 = Work
		2 = School
		3 = Escort
		4 = Personal Business
		5 = Shopping
		6 = Meal
		7 = Social / Recreational
PRNTTOUR	Work-based subtour "parent" work tour ID	0 = home-based TOURNO = "parent" tour
OTAZ	Origin TAZ	
DTAZ	Destination TAZ	Predicted, but not calibrated
MAINMODE	Tour main mode	Empty
TRIPSH1	# of trips in first half tour	
TRIPSH2	# of trips in second half tour	
SUBTOURS	# of subtours	
EXPFAC	Expansion factor	same as EXFAC x subsample rate

3.2.3 Trip File

The trip file is output by the activity generator. It contains one record for each trip that occurs in the region. Each tour is associated with a person and household, and is identified by a tour purpose, origin and destination TAZ, and subtour and intermediate stop information, as presented in Table 3-6.

Table 3-6. Trip File Format

NAME	DESCRIPTION	COMMENT
SAMPN	Household ID	
HHSIZE	Household Size	
HHWORK	Household # of workers	
HHCARS	Household vehicles	
HHINC	Household income	
PERSN	Person sequence number within HH	
PTYPE	Person Type	1 = full-time worker
		2 = part-time worker
		3 = retired
		4 = non-worker
		5 = university student
		6 = student 16+
		7 = student 5-15
		8 = under 5
TOURNO	Tour sequence number within person day	
TOURHALF	Tour half	1 = outbound
		2 = return
TRIPSH	Trips on tour half	
TRIPNO	Trip sequence number within half-tour	
OTAZ	Origin TAZ	
DTAZ	Destination TAZ	
MODE	Trip mode	EMPTY
OPURP	Trip origin activity purpose	1 = Work
		2 = School
		3 = Escort
		4 = Personal Business
		5 = Shopping
		6 = Meal
		7 = Social / Recreational
		8 = Home
DPURP	Trip destination activity purpose	1 = Work
		2 = School
		3 = Escort
		4 = Personal Business
		5 = Shopping
		6 = Meal
		7 = Social / Recreational

		8 = Home
TRAVTIME	*Trip door-to-door travel time*	EMPTY
TRAVDIST	*Trip door-to-door travel distance*	EMPTY
EXPFACT	Expansion factor	same as EXFAC x subsample rate

3.2.4 ASCII Trip File

Table 3-7. ASCII Trip File Format

Items written to ASCII file if AOUTSW > 0		
NAME	**FORMAT**	**DEFINITION**
sampn	I8	HH id
hhsize	I3	HH persons
hhwork	I3	HH workers
hhcars	I3	HH cars
hhincome	I8	HH income ($)
persn	I3	Person id
perstype	I2	Person type (1-8)
tourno	I2	Tour number in the day
tourhalf	I2	Tour half
ntrips	I2	Number of trips in half tour
tripno	I2	Trip number in half tour
otaz	I5	Trip origin TAZ
dtaz	I5	Trip destination TAZ
mode	I3	Trip mode
opurp	I2	Trip origin purpose
dpurp	I2	Trip destination purpose
travtime	F6.1	Trip OD SOV travel time (min)
travdist	F6.1	Trip OD SOV distance (miles)
expfact	F8.2	Expansion faction
Additional items added if AOUTSW > 1		
tourpurp	I2	Tour purpose
prnttour	I2	Tour parent tour number
totaz	I5	Tour origin TAZ
tdtaz	I5	Tour primary dest. TAZ
mainmode	I3	Tour main mode
tripsh1	I2	Trips in first half tour
tripsh2	I2	Trips in second half tour
subtours	I2	Tour number of subtours
Additional items added if AOUTSW > 2		
hhtaz	I5	HH residence TAZ
uwtaz	I5	Usual work TAZ
uwtype	I2	Usual work type
ntours1	I2	Number of work tours made

ntours2	I2	Number of school tours made
ntours3	I2	Number of escort tours made
ntours4	I2	Number of p.bus. tours made
ntours5	I2	Number of shop tours made
ntours6	I2	Number of meal tours made
ntours7	I2	Number of so/rec tours made
nstops1	I2	Number of work stops made
nstops2	I2	Number of school stops made
nstops3	I2	Number of escort stops made
nstops4	I2	Number of p.bus. stops made
nstops5	I2	Number of shop stops made
nstops6	I2	Number of meal stops made
nstops7	I2	Number of so/rec stops made
wbtours	I2	Number of work-based tours made

3.3 RUNNING THE ACTIVITY GENERATOR

3.3.1 From a DOS Prompt

The program is run from the DOS-type command line, using the command **DAYSIM05.EXE [control file name] [param1=x] [param2=y]** .... The control file name is the name of a text file containing various switch and file name settings. If nocontrol file name is given, the default name is ACTGEN.CTL, in the same directory as the executable.

The option parameters are the same control codes that are in the control file, and must be in the format CODE=argument, with no spaces, where CODE is the 6 letter control code as listed below, and argument is the text (filename or directory name) or integer value that is expected according to the code.

The following page shows example lines from a control file with all of the codes recognized by DaySim05. The default values for all of the controls are also shown.

All of the lines except for the italicized ones would be valid lines in a control file. The formatting rules for a control line are:

- A valid six letter code (can be any combination of upper and lower case)
- One or more spaces and/or equals signs
- The code argument – an integer or a file name or a directory name
- One or more spaces
- Any comment or blank (this is ignored by the program)

Only the RUNLAB argument with the run name can include spaces.

3.3.2 Prefixes

If a file name or directory name contains a question mark (?), this is replaced by the TP+ file name prefix. Currently, this is read as the first 4 characters in file TPPL.PRJ, but that can be changed by changing the appropriate controls.

3.3.3 Command line controls

Any control that can be put in the control file can also be put on the command line, using a = symbol and no spaces.

For example, the command

DAYSIM05.EXE run22.ctl HHSRAT=10 HHSBEG=3

will use only the 3rd out of every 10 households in the synthetic sample (and will multiply the expansion factors by 10 to adjust for the sampling rate).