San Francisco Travel Demand Forecasting Model Development

Mode Choice Models

Final Report

prepared for
San Francisco County Transportation Authority

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Overview

The mode choice models developed for the San Francisco Model determine the mode for tours, as well as all trips made as part of tours, and are the basis for the accessibility measure used in the tour destination choice models. Therefore, they are an integral link in the overall model structure, as shown in Figure 1. The models were estimated using only San Francisco residents surveyed as part of the 1990 MTC Bay Area Travel Survey (BATS).

The mode choice models differ from traditional "trip-based" mode choice models in that there are two distinct sets of mode choice models. The tour mode choice model determines the primary mode for the tour, while the trip mode choice models determine the mode for each individual trip made on that tour, based on the mode chosen for the tour. There is one of each model (tour and trip) for each tour purpose (Work, School, Other, and Work-Based).

Estimation Data

Several data sets were required for model estimation. The tour-based models were developed using the both the tours coded as part of tour generation model development, and the trips that make up each tour. The first step in developing both the tour models and the trip models involved coding modes for all observed trips in the BATS data. A detailed set of modes were utilized for this purpose.

Table 1 shows a tabulation of observed trips by mode for SF residents. This table reveals that there are a significant number of transit trips and non-motorized (walk) trips made by SF residents. It also shows that there are a number of transit trips made by more than one transit mode; i.e. local bus access to BART.

Table 2 shows these transit trips by mode of access and mode of egress. Note that there are almost no drive access or egress transit trips made by SF residents for transit modes other than Premium (CalTrain, Ferries, Express Bus) or BART. This is logical given the transit-rich environment in San Francisco which allows most residents walk-access to transit, and the relatively high cost and limited supply of parking.

Figure 1. San Francisco Model System

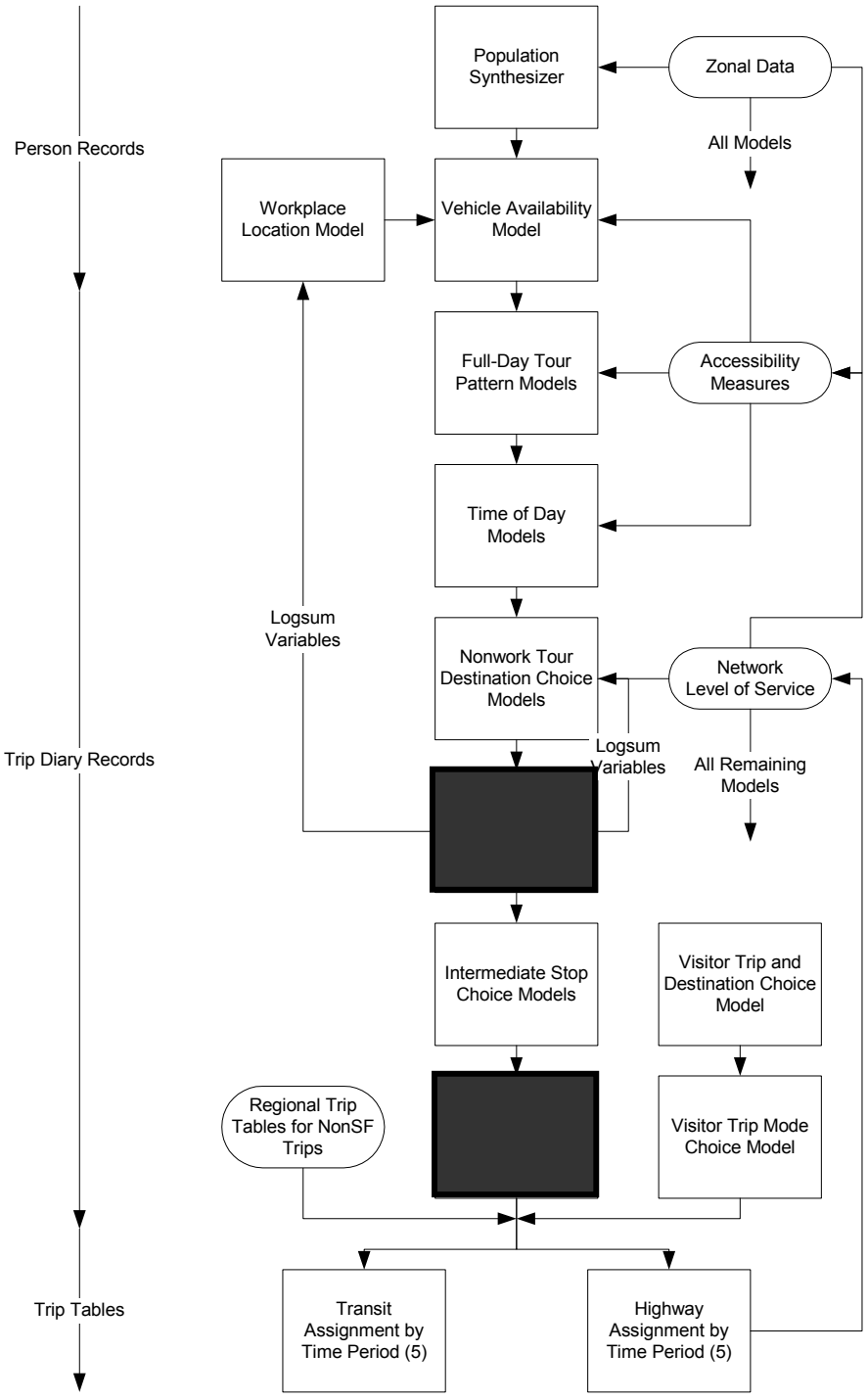

Table 1: Trips by Mode, SF Residents Only

Mode	Frequency	Percent
Walk	2005	18.40%
Bicycle	100	0.92%
Drive Alone	3773	34.62%
Drive (Occ=2)	1003	9.20%
Drive (Occ=3+)	338	3.10%
Auto Passenger (Occ=2)	832	7.64%
Auto Passenger (Occ=3+)	353	3.24%
Taxi	71	0.65%
School Bus	51	0.47%
Local Bus	1715	15.74%
MUNI Rail	250	2.29%
Premium*	42	0.39%
BART	138	1.27%
Local Bus to MUNI Rail	44	0.40%
MUNI Rail to Local Bus	44	0.40%
Local Bus/MUNI Rail to Premium	1	0.01%
Premium to Local Bus/MUNI Rail	13	0.12%
Local Bus/MUNI Rail to BART	52	0.48%
BART to Local Bus/MUNI Rail	61	0.56%
Other Modes	11	0.10%
TOTAL	10897	100.00%

* Premium transit refers to regional express transit servicing San Francisco, such as Caltrain, and AC Transit, Golden Gate Transit and SamTrans express bus routes

Table 2: Transit Trips by Tour Purpose, Mode, and Access/Egress Mode

Mode	Work	School	Other	Work-Based	Total
Local Bus					
Walk Access/Walk Egress	845	389	406	41	1681
Auto Access/Walk Egress	9	7	6	0	22
Walk Access/Auto Egress	6	3	3	0	12
Auto Access/Auto Egress	0	0	0	0	0
MUNI Rail					
Walk Access/Walk Egress	166	27	37	6	236
Auto Access/Walk Egress	7	2	0	0	9
Walk Access/Auto Egress	5	0	0	0	5
Auto Access/Auto Egress	0	0	0	0	0
Premium					
Walk Access/Walk Egress	24	0	9	0	33
Auto Access/Walk Egress	4	1	0	0	5
Walk Access/Auto Egress	3	0	1	0	4
Auto Access/Auto Egress	0	0	0	0	0
BART					
Walk Access/Walk Egress	57	20	14	7	98
Auto Access/Walk Egress	20	1	1	0	22
Walk Access/Auto Egress	16	0	1	0	17
Auto Access/Auto Egress	0	0	1	0	1
Local Bus to MUNI Rail					
Walk Access/Walk Egress	26	11	6	1	44
Auto Access/Walk Egress	0	0	0	0	0
Walk Access/Auto Egress	0	0	0	0	0
Auto Access/Auto Egress	0	0	0	0	0
MUNI Rail to Local Bus					
Walk Access/Walk Egress	27	11	5	1	44
Auto Access/Walk Egress	0	0	0	0	0
Walk Access/Auto Egress	0	0	0	0	0
Auto Access/Auto Egress	0	0	0	0	0
Local Bus/MUNI Rail to Premium					
Walk Access/Walk Egress	1	0	0	0	1
Auto Access/Walk Egress	0	0	0	0	0
Walk Access/Auto Egress	0	0	0	0	0
Auto Access/Auto Egress	0	0	0	0	0
Premium to Local Bus/MUNI Rail					
Walk Access/Walk Egress	10	1	2	0	13
Auto Access/Walk Egress	0	0	0	0	0
Walk Access/Auto Egress	0	0	0	0	0
Auto Access/Auto Egress	0	0	0	0	0
Local Bus/MUNI Rail to BART					
Walk Access/Walk Egress	40	5	4	0	49
Auto Access/Walk Egress	1	0	0	0	1
Walk Access/Auto Egress	2	0	0	0	2
Auto Access/Auto Egress	0	0	0	0	0
BART to Local Bus/MUNI Rail					
Walk Access/Walk Egress	36	6	8	0	50
Auto Access/Walk Egress	8	0	1	0	9
Walk Access/Auto Egress	2	0	0	0	2
Auto Access/Auto Egress	0	0	0	0	0
Total	1315	484	505	56	2360

Based on these data, the following modes were defined and coded for trip mode choice model estimation:

- Drive-Alone
- Shared-Ride 2
- Shared-Ride 3+
- Walk
- Bike
- Walk-Local-Walk (WLW)
- Walk-MUNI-Walk (WMW)
- Walk-Premium-Walk (WPW)
- Walk-Premium-Auto (WPA)
- Auto-Premium-Walk (APW)
- Walk-BART-Walk (WBW)
- Walk-BART-Auto (WBA)
- Auto-BART-Walk (ABW)

Note that each transit mode maintains the access and egress mode observed in the data, because the trip mode choice models are estimated using origin-destination trip records, as opposed to the traditional trip-based models which use production-attraction trip records. The modes are listed above in the following manner; access mode – transit mode – egress mode. An abbreviation code is also given for transit modes.

Additionally, a hierarchy of modes is utilized for the development of transit level-of-service matrices (i.e., skims) used in both model estimation and model application. This hierarchy allows certain modes to exist to allow transfers between modes. For example, when building Walk-BART-Walk skims, both local bus and MUNI metro modes are allowed to provide access to BART. Table 3 shows this mode hierarchy.

Table 3: Transit Mode Hierarchy

Transit Mode	Active Transit Modes
Local Bus	Local Bus
MUNI Metro	Local Bus, MUNI Metro
Express Bus	Local Bus, MUNI Metro, Express Bus
BART	Local Bus, MUNI Metro, BART

It is also necessary to define tour modes that are based on the combinations of modes used for trips on tours.

Table 4 shows a tabulation of the modes that were utilized for trips on all tours made by SF residents in the 1990 BATS data. The table has rows that are different combinations of active modes by tour, and lists active modes with a 1 in the cell for the mode. The number of tours and the frequency for each mode combination is given on the left. Combinations with less than 10 observed tours were omitted from the table. This table indicates that there are few cases where there are more than two modes utilized on the same tour, and that most tours utilize only one mode. Table 4 also indicates that most of the tours with more than one mode utilized for the tour include a walk trip and some other mode (mostly transit), or an auto-passenger trip combined with a transit trip.

Another way of looking at these data is given in Table 5, which shows the mode utilized for the first trip on tours made by SF residents, and the frequency of modes for all subsequent trips made on the tour (there are at least two trips made on each tour, one to the primary destination and a return to the origin). The table reinforces the data shown in Table 4, simply by viewing the diagonal of the table matrix.

Based on these data, tour modes were defined which allow the traveler to switch between modes where such behavior is most common. Tour modes were coded according to the following rules:

- **Auto Driver:** This mode describes tours that consist of trips primarily made by the driver of an automobile. If any trip on a tour was auto driver, the tour mode was coded as Auto Driver. All Auto Passenger trips on the tour were re-coded Auto Driver. Walk trips on Auto Driver tours were maintained. Transit trips on Auto Driver tours were re-coded as the appropriate drive-transit mode.
- **Auto Passenger:** This mode describes tours that consist of trips made entirely by passengers of automobiles. Walk trips on Auto Passenger tours were maintained.
- **Walk:** This mode describes tours that consist entirely of trips whose mode is walk.
- **Bike:** This mode describes tours that consist entirely of trips whose mode is either walk or bike.
- **Walk-Transit:** This mode describes tours that consist of trips made by transit passengers or combinations of transit and auto passengers. Walk trips on Walk-Transit tours were also maintained.
- **Drive-Transit:** This mode describes tours that consist of trips made by transit passengers where the access mode or egress mode is auto, or combinations of drive-transit, walk-transit, and Auto Passenger trips. Walk trips on Drive-Transit tours were maintained.

The tour mode definitions listed above allow the traveler to utilize walk as a mode for trips on any tour, and allow the traveler to switch between transit modes and auto-passenger modes for trips on transit tours. Table 6 shows the trip modes allowed for each type of tour mode.

Table 4: Active Modes for Tours, SF Residents Only

	Mode	Drv-1*	Drv-2*	Drv-3*	Pas-2*	Pas-3*	Walk	Bike	Taxi	Bus	Metro/CC	BART	OthRail	Ferry	Sch-B	Other
Freq.	Percent															
1078	27.6%	1														
166	4.3%		1													
276	7.1%	1	1													
57	1.5%			1												
38	1.0%	1		1												
38	1.0%		1	1												
36	0.9%	1	1	1												
197	5.1%				1											
66	1.7%					1										
39	1.0%				1	1										
662	17.0%						1									
93	2.4%	1					1									
22	0.6%	1	1				1									
32	0.8%				1		1									
13	0.3%					1	1									
37	0.9%							1								
12	0.3%								1							
252	6.5%									1						
42	1.1%				1					1						
12	0.3%					1				1						
407	10.4%						1			1						
12	0.3%	1					1			1						
55	1.4%				1		1			1						
22	0.6%					1	1			1						
15	0.4%						1		1	1						
26	0.7%										1					
58	1.5%						1				1					
47	1.2%						1			1	1					
21	0.5%						1					1				
44	1.1%						1			1		1				
11	0.3%				1		1			1		1				
13	0.3%														1	
3899	100.0%															

* Drv and Pas refer to whether the person was a driver or passenger in a vehicle and -1, -2, and -3+ refer to the total number of people in the vehicle.

Table 5: Tours by First Trip Mode and Subsequent Trip Modes, SF Residents Only

First Trip Mode	Total Tours	Subsequent trips by Mode					Total Subsequent Trips
		Driver	Passenger	Walk	Bike	Transit	
Driver	1849	3156	33	96	0	44	3329
		94.8%	1.0%	2.9%	0.0%	1.3%	100.0%
Passenger	433	19	538	51	0	97	705
		2.7%	76.3%	7.2%	0.0%	13.8%	100.0%
Walk	790	53	49	858	0	136	1096
		4.8%	4.5%	78.3%	0.0%	12.4%	100.0%
Bike	40	0	0	1	58	2	61
		0.0%	0.0%	1.6%	95.1%	3.3%	100.0%
Transit	1046	23	130	209	2	1115	1479
		1.6%	8.8%	14.1%	0.1%	75.4%	100.0%
Total	4158	3251	750	1215	60	1394	6670

Table 6: Trip Modes Allowed by Tour Mode

Trip Mode	Tour Mode					
	Driver	**Walk**	**Bike**	**Passenger**	**Walk-Transit**	**Drive-Transit**
Drive Alone	X					
Share-2	X			X	X	X
Share-3+	X			X	X	X
Walk	X	X	X	X	X	X
Bike			X	X	X	X
Walk-Local					X	X
Walk-MUNI					X	X
Walk-Premium					X	X
Walk-BART					X	X
Drive-Premium						X
Drive-BART						X

Tour Mode Choice Models

Estimation Dataset

The tour mode choice model estimation dataset contains one record for each tour, with household and person attributes appended. Additionally, the tour records included information on the tour purpose, departure and return times, origin and primary destination TAZ, tour mode, number of stops before and number of stops after the primary destination and all available land-use data for both the origin and the destination TAZ including parking cost, availability, and the Pedestrian Environment Factor (PEF) variables described in another chapter. To this file was appended the full range of level-of-service characteristics for each mode describing the trip from the tour origin to the primary destination and the return trip from the tour destination to the primary origin. The time-of-departure from the tour origin and the tour destination were used to append the skim data for the appropriate time period.

Note that tour-based model estimation differs from traditional trip-based model estimation in at least two distinct ways. First, the models go beyond the traditional assumption that all work travel occurs in the peak period and non-work travel occurs in the off-peak period. The SFCTA models use the actual time period that travel occurred, in an attempt to more accurately reflect the travel conditions and modes available during that time period. There are five distinct time periods modeled in the SFCTA models:

- Early A.M. (3:00 A.M. to 6:00 A.M.)
- A.M. Peak (6:00 A.M. to 9:00 A.M.)
- Midday (9:00 A.M. to 3:30 P.M.)
- PM Peak (3:30 P.M. to 6:30 P.M.)
- Evening. (6:30 P.M. to 3:00 A.M.)

Furthermore, the tour models include the round-trip travel characteristics for the tour; that is, they include outbound level-of-service to the primary destination and the return level-of-service back to the tour origin. The level-of-service characteristics for these legs of the tour are based on the tour origin TAZ and the tour primary destination TAZ; they do not include trips made to intermediate stops on the tour, since the location of these stops is not known when the tour mode choice model is applied.

Tour Mode Choice Estimation Results

Figure 2 shows the structure used in the model estimation. Tables 7 through 10 show the estimation results for the tour mode choice models. One model was estimated for each tour type, using only San Francisco residents from the survey data. The tables display 'traditional' level-of-service variables, such as in-vehicle time, first and second wait time

for transit, walk-access time, etc., as well as those variables that pertain to the tour chain type (number of stops), pedestrian environment factor variables, and household variables. The originally estimated alternative specific constants are given, as well as summary statistics describing goodness-of-fit. For each estimated coefficient, the standard error as well as the t-statistic (the coefficient value divided by the standard error) is given.

- Overall, level-of-service variable coefficient values for tours are very similar to values typically obtained in a trip-based model. This indicates that the average relative importance given to the various components of travel time and cost for a tour are not significantly different from those in a trip-based model. All of the coefficients are correctly signed, and are generally statistically-significant. Ratios of each component of travel time to in-vehicle time are also given, under Summary Statistics. These ratios also show that the coefficient values are reasonable when compared to the in-vehicle time coefficient. Finally, the implied value-of-time for each model is given.
- The in-vehicle time coefficients are generally lower for tour-based models than for trip-based models. This could be due to the inclusion of other variables not typically included in trip-based models, particularly the number of stops on the tour.
- The second wait coefficient for Work tours is significantly higher than the first wait coefficient. The first wait refers to the amount of time that a person waits at a stop for the first bus or train on a given trip. If a person transfers on transit in order to reach their destination, the second wait refers to the amount of time that a person waits for a bus or train at the transfer point. This reflects the relatively high transit level-of-service in San Francisco, particularly serving employment centers such as the financial district. Additionally, this relationship probably also reflects the large percentage of 'choice' transit riders in the Work tour market. The second wait coefficients for the other tour types are not as high as the first wait coefficient, indicating the presence of more 'captive' riders for non-work tours.
- It was possible to estimate a stepwise, or non-linear relationship, on walk time for Work-Based tours. This relationship indicates a much higher coefficient, or greater disutility, for walk time if the walk distance is greater than 1 mile. This relationship applies to both the walk mode and to walk-access to transit.
- The coefficient on bicycle time is generally significantly higher than the coefficient on walk mode time, indicating a relative disutility associated with the bicycle mode. This could be due to non-included variables such as topography from tour origin to destination, traffic interference, and perceived safety of bicycling.
- Attempts to estimate a parking cost coefficient for any of the tour or trip models were not successful, resulting in illogical coefficient signs or values. This is most likely due to the use of an *average* parking cost value for each TAZ, as opposed to the *actual* parking cost that the traveler paid or would have paid. The use of an average parking cost value tends to obscure the sensitivity of individuals to this important variable; i.e., some travelers (particularly for the work purpose) are provided parking for free, while others have partially subsidized parking paid for by their employers, and finally others pay full price, even within the same TAZ. As a result, the parking cost coefficient was preset to equal the out-of-pocket cost coefficient and is not given separately below.

- Similarly, it was not possible to estimate a coefficient on transit fare, for reasons that may be the same as those given above. The household survey does not identify the type of fare paid for the transit tour or trip, so the full-price fare was used for estimation. However, there are significant differences among fares paid, particularly by San Francisco residents (student fares, monthly passes, etc.). Therefore, the traditional assumption that the fare coefficient is equivalent to the out-of-pocket cost coefficient was utilized.
- There were very few observations choosing drive-transit for any purpose other than Work. Therefore, this mode was only estimated for Work Tours and Work Trips. Due to the relatively low number of observations, attempts to estimate a separate coefficient on drive time to transit were unsuccessful. Therefore, this coefficient was preset to twice the value of in-vehicle time. This is a reasonable value for drive-transit time and has been successfully used in other travel demand models. The value for the coefficient is given for those purposes where there is a drive-transit mode choice, but the Standard Error and t-statistic are not available.
- It was possible to stratify out-of-pocket cost for Work Tours and Other Tours by household income, probably due to the large number of observations for these tour purposes. The coefficients are correctly signed and behave well with respect to increasing household income (the value of the coefficient decreases in size with increasing household income). This means that the wealthier the traveler, the less sensitive the traveler is to out-of-pocket travel expenses such as gas, transit fare, and parking cost. For School Tours and Work-Based Tours, the out-of-pocket cost coefficient is generic across income groups.
- Attempts to estimate coefficients on the number of stops for each mode were generally successful. These coefficients are applied to the number of stops on the tour and are therefore continuous in application. The coefficient on the walk mode takes the greatest negative value for all of the tour types, indicating that the probability of choosing walk for tours with stops is lower than other modes, all other things being equal. The coefficient on stops for the transit mode is also negative for all tour purposes, indicating a lack of convenience associated with choosing transit when intermediate stops are required.
- Pedestrian Environment Factors (PEFs) were tested and included in the model specifications for Tours. The PEFs range between one and three, where one is considered "bad", and three is considered "good". All five PEFs (neighborhood vitality, safety, topology, safety, network connectivity, and ease of crossing) were tested using the APPLY function of ALOGIT for both the origin TAZ and primary destination TAZ of the tour, relating each PEF to a non-auto mode. Those factors with logical results were retained. None of the PEFs for the origin TAZ were logically signed or significant. Because there was little difference between a PEF of 1 or 2 in the APPLY results, the PEFs were included in model specifications as dummy variables, with 1 indicating a PEF of 1 or 2.The PEFs that were the most significant were generally associated with the walk mode, followed closely by walk-transit. Safety was not significant or reasonable for any of the models or modes. The coefficient on neighborhood vitality was significant for many of the models, indicating a strong relationship between non-auto modes and urban form in San Francisco. Network connectivity and topology were also significant to varying degrees.

- Household Type variables were tested by associating household characteristics with certain modes. The relationships that were tested include household size with the propensity to ride-share, and various age categories on driver and transit modes. The ride-share relationship was consistently significant, indicating a higher probability, likely due to a greater opportunity, to choose auto-passenger in larger households. Age variables were also reasonable, and reveal restrictions imposed (either legally or parentally) on travelers below certain age thresholds. These relationships were strongest with respect to transit, possibly due to real or perceived safety issues, or auto-driver, for obvious reasons.

- Two stratifications of alternative specific constants were tested; autos per household (0, 1, 2+), and autos per worker (autos=0, autos<workers, autos>=workers). The autos per worker constants were more significant and resulted in greater Rho-Squared estimates. The constants are reasonable, and indicate a higher probability to choose non-motorized modes where number of autos is 0 or less than number of workers. The constants shown in the tables are preliminary, estimated alternative-specific constants. They were later calibrated to match existing mode shares. It was not possible to use three market segments in the School tour model due to lack of sufficient number of observations in the autos=0 market. Therefore, this market was collapsed with autos<workers.

- Several different nesting structures were tested using the Work Tour estimation file, including attempts to group 'passenger' (auto and transit) alternatives together. A fairly traditional nesting structure was successfully estimated with a logical nesting coefficient. The structure nests auto modes together (Auto Driver and Auto Passenger), non-motorized modes (Walk and Bicycle) and Transit Modes (Walk-Access and Drive-Access). The nesting coefficient is 0.72. The nesting structure is shown in Figure 2.

Figure 2: Tour Mode Choice Model Nesting Structure

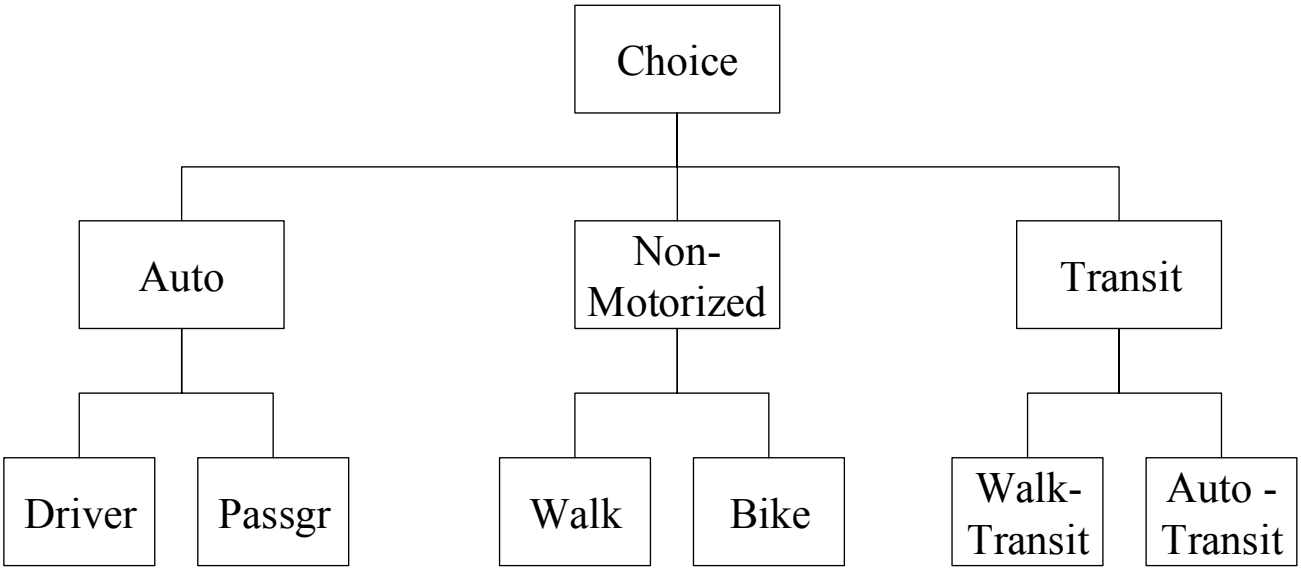

Table 7: Work Tour Mode Choice Model Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0134	0.0059	-2.28
First Wait	-0.0144	0.0149	-0.97
Second Wait	-0.0411	0.0105	-3.90
Drive Time	-0.0269	--	--
Walk Time	-0.0377	0.0042	-9.02
Walk Mode Time	-0.0377	0.0042	-9.02
Bike Mode Time	-0.0536	0.0135	-3.97
OPC, Income 0-30k	-0.0021	0.0010	-2.08
OPC, Income 30-60K	-0.0014	0.0009	-1.56
OPC, Income 60k+	-0.0012	0.0009	-1.29
Number of Stops			
Walk	-0.9387	0.2176	-4.31
Bike	-0.4748	0.2747	-1.73
Auto Passenger	-0.2109	0.1004	-2.10
Walk-Transit	-0.4576	0.0740	-6.18
Drive-Transit	-0.8646	0.3100	-2.79
Pedestrian Environment Factor - Walk Mode			
Destination Network Connectivity	-1.0697	0.3841	-2.79
Destination Vitality	-0.4945	0.4936	-1.00
Destination Topology	-0.9686	0.3096	-3.13
Pedestrian Environment Factor - Walk-Transit			
Destination Network Connectivity	-0.6019	0.1865	-3.23
Destination Vitality	-0.0675	0.2106	-0.32
Destination Topology	-0.6219	0.1707	-3.64
Household Type			
Auto Passenger - Household Size = 1	-0.0551	0.0068	-8.08
Alternative-Specific Constants			
Walk			
Autos=0	4.0410	0.3654	11.06
Autos<Workers	0.6369	0.3973	1.60
Autos>=Workers	0.7885	0.2851	2.77
Bike			
Autos=0	-0.5512	0.4929	-1.12
Autos<Workers	-2.4530	0.3947	-6.21
Autos>=Workers	-3.5788	0.4538	-7.89
Passenger- Auto			
Autos=0			
Autos<Workers	-1.5865	0.1653	-9.60
Autos>=Workers	-2.4635	0.1721	-14.32
Passenger-Transit Walk			
Autos=0	3.4869	0.2995	11.64
Autos<Workers	1.0983	0.1529	7.18
Autos>=Workers	0.1727	0.1383	1.25
Passenger-Transit Drive			
Autos=0	0.8286	0.5934	1.40
Autos<Workers	-0.4476	0.3911	-1.14
Autos>=Workers	-2.2822	0.5311	-4.30

Table 7. Work Tour Mode Choice Model Estimation Results (continued)

Summary Statistics	
Log-Likelihood at Convergence	-1360.87
Rho-Squared with respect to Zero	0.4664
Rho-Squared with respect to Constants	0.1638
First Wait/In-Vehicle Time	1.07
Second Wait/In-Vehicle Time	3.06
Walk Time/In-Vehicle Time	2.80
Walk Mode/In-Vehicle Time	2.80
Bike Mode/In-Vehicle Time	3.99
Value of Time, 0-30k	$3.83
Value of Time, 30-60k	$5.82
Value of Time, 60k+	$6.91

Table 8: School Tour Mode Choice Model Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0224	0.0090	-2.50
First Wait	-0.0757	0.0357	-2.12
Second Wait	-0.0336		
Out-of-Pocket Cost	-0.0065	0.0022	-2.91
Walk Time	-0.0622	0.0097	-6.43
Walk Mode Time	-0.0622	0.0097	-6.43
Bike Mode Time	-0.0344	0.0227	-1.51
Number of Stops			
Auto Driver/Passenger	0.2845	0.1524	1.87
Walk	-0.8328	0.4401	-1.89
Pedestrian Environment Factor - Bike Mode			
Destination Topology	-2.0253	1.3024	-1.56
Household Type			
Auto Driver, Age between 16 and 19 years old	-1.3813	0.6040	-2.29
Transit, Age less than or equal to 10 years old	-1.5548	0.3334	-4.66
Auto Passenger - Household Size less than 3 persons	-0.6359	0.5653	-1.12
Alternative-Specific Constants			
Driver			
Autos<Workers	-0.8279	0.8092	-1.02
Autos>=Workers	-0.8980	0.6653	-1.35
Bike			
Autos<Workers	-4.1638	1.4428	-2.89
Autos>=Workers	-5.0941	1.1890	-4.28
Passenger- Auto			
Autos<Workers	-3.7190	0.7773	-4.78
Autos>=Workers	-4.0416	0.7154	-5.65
Passenger-Transit Walk			
Autos<Workers	0.8233	0.5758	1.43
Autos>=Workers	-0.1347	0.5040	-0.27
Summary Statistics			
Log-Likelihood at Convergence	-266.36		
Rho-Squared with respect to Zero	0.5014		
Rho-Squared with respect to Constants	0.3076		
First Wait/In-Vehicle Time	3.38		
Second Wait/In-Vehicle Time	1.50		
Walk Time/In-Vehicle Time	2.77		
Walk Mode/In-Vehicle Time	2.77		
Bike Mode/In-Vehicle Time	1.53		
Value of Time	$3.83		

Table 9: Other Tour Mode Choice Model Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0175	0.0028	-6.31
First Wait *	-0.0438	--	--
Second Wait	-0.0372	0.0070	-5.29
Walk Time	-0.0334	0.0017	-19.60
Walk Mode Time	-0.0334	0.0017	-19.60
Bike Mode Time	-0.0422	0.0086	-4.92
OPC, Income 0-30k	-0.0033	0.0007	-5.06
OPC, Income 30-60K	-0.0023	0.0006	-4.16
OPC, Income 60k+	-0.0016	0.0007	-2.20
Number of Stops			
Walk	-1.0067	0.1057	-9.53
Bike	-0.3236	0.1948	-1.66
Walk-Transit	-0.3727	0.0518	-7.19
Pedestrian Environment Factor - Walk Mode			
Destination Vitality	-0.7269	0.1309	-5.55
Destination Topology	-0.2693	0.1328	-2.03
Pedestrian Environment Factor - Bike Mode			
Destination Vitality	-0.9118	0.4560	-2.00
Destination Topology	-0.7659	0.3886	-1.97
Pedestrian Environment Factor - Walk-Transit			
Destination Network Connectivity	-0.1040	0.0968	-1.07
Destination Vitality	-0.3440	0.1094	-3.15
Destination Topology	-0.0767	0.1023	-0.75
Household Type			
Auto Passenger - Age less than 16	1.3660	0.1651	8.27
Auto Passenger - Household Size equals 1	-0.4527	0.1891	-2.39
Alternative-Specific Constants			
Walk			
Autos=0	4.0552	0.4517	8.98
Autos<Workers	2.2526	0.1822	12.36
Autos>=Workers	1.7333	0.1534	11.30
Bike			
Autos=0			
Autos<Workers	-1.6076	0.4520	-3.56
Autos>=Workers	-2.8844	0.4571	-6.31
Passenger- Auto			
Autos=0	0.0356	0.4663	0.08
Autos<Workers	-1.4543	0.1240	-11.73
Autos>=Workers	-1.8731	0.0930	-20.15
Passenger-Transit Walk			
Autos=0	3.4311	0.4475	7.67
Autos<Workers	1.4904	0.1488	10.02
Autos>=Workers	0.5827	0.1393	4.18

Table 9: Other Tour Mode Choice Model Estimation Results (continued)

Summary Statistics	
Log-Likelihood at Convergence	-3359.05
Rho-Squared with respect to Zero	0.4121
Rho-Squared with respect to Constants	0.2099
First Wait/In-Vehicle Time	2.50
Second Wait/In-Vehicle Time	2.12
Walk Time/In-Vehicle Time	1.90
Walk Mode/In-Vehicle Time	1.90
Bike Mode/In-Vehicle Time	2.41
Value of Time, 0-30k	$3.19
Value of Time, 30-60k	$4.48
Value of Time, 60k+	$6.63

Table 10: Work-Based Tour Mode Choice Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0188	0.0241	-0.78
First Wait	-0.0281	--	--
Second Wait	-0.0252	0.0572	-0.44
Out-of-Pocket Cost	-0.0071	0.0065	-1.09
Bike Mode Time	-0.1554	0.1198	-1.30
Short Walk Time	-0.0276	0.0509	-0.54
Long Walk Time	-0.0967	0.0173	-5.58
Number of Stops			
Walk	-1.7794	0.5660	-3.14
Bike	-0.4858	0.8425	-0.58
Auto Passenger	-0.7252	0.6779	-1.07
Walk-Transit	-1.1810	0.6511	-1.81
Pedestrian Environment Factor - Walk Mode			
Destination Vitality	-0.5523	0.4818	-1.15
Pedestrian Environment Factor - Bike Mode			
Destination Topology	-1.0504	1.3057	-0.80
Alternative-Specific Constants			
Walk			
Autos<Workers	2.6928	1.1942	2.25
Autos>=Workers	1.9130	1.0817	1.77
Bike			
Autos<Workers	-1.2508	1.5138	-0.83
Autos>=Workers	-2.9455	1.6641	-1.77
Passenger- Auto			
Autos<Workers	-1.7535	0.8221	-2.13
Autos>=Workers	-3.0645	0.6033	-5.08
Passenger-Transit Walk			
Autos<Workers	0.3917	1.8580	0.21
Autos>=Workers	-0.6153	1.7404	-0.35
Summary Statistics			
Log-Likelihood at Convergence	-136.51		
Rho-Squared with respect to Zero	0.6430		
Rho-Squared with respect to Constants	0.3516		
First Wait/In-Vehicle Time	1.50		
Second Wait/In-Vehicle Time	1.34		
Short Walk Time/In-Vehicle Time	1.47		
Long Walk Time/In-Vehicle Time	5.16		
Bike Mode/In-Vehicle Time	8.29		
Value of Time	$1.59		

Trip Mode Choice Model

Estimation Data

The trip mode choice model estimation dataset contains one record for each trip in origin-destination format, with household and person attributes appended. The trip records also include all of the information about the tour described above, as well as land-use data for both the origin and the destination TAZ. To this file was appended the full range of level-of-service characteristics for each mode according to the trip departure time. See the Appendix for the trip mode choice estimation file variables and descriptions.

The trip mode choice models are applied to each intermediate stop on the tour, including the stop at the primary destination, and are conditional on the mode chosen for the tour, as explained above. The level-of-service characteristics consider only the trip origin and destination, not the level-of-service characteristics of the entire tour. The trip model alternative specific constants reflect the model structure, as they are stratified by tour mode. This structure makes it possible to calibrate the trip models by tour mode, ensuring the proper distribution of trips by both trip mode and tour mode.

Trip Mode Choice Estimation Results

Figure 3 shows the nesting structure used to estimate the trip mode choice models. Table 11 through Table 14 show the estimation results for the trip mode choice models. One model was estimated for each trip purpose, using only San Francisco residents from the survey data. The tables display 'traditional' level-of-service variables as well as those variables that pertain to the tour chain type (number of stops), pedestrian environment factor variables, and household variables. The originally estimated alternative-specific constants are given, as well as summary statistics describing goodness-of-fit. For each estimated coefficient, the standard error as well as the t-statistic (the coefficient value divided by the standard error) is given.

- The level-of-service coefficients (in-vehicle time, first wait time, transfer wait time, and out-of-pocket cost) all have the correct signs, are within reasonable ranges of value, and are significant. They are generally greater in absolute value than those estimated in the tour mode choice models, indicating higher elasticities with respect to time and cost for each trip mode given the tour mode. For example, persons would be more willing or able to switch between trip modes due to changes in service characteristics than between tour modes for relatively similar changes. This may be due to the presence of the autos per worker stratification in the tour models, which has a major influence on the choice of motorized versus non-motorized, or transit versus non-transit, modes of travel.
- Efforts to estimate parking cost or drive-transit time coefficients for trip mode choice models were not successful, likely due to the same reasons mentioned above pertaining

to tour mode choice model estimation. These coefficients were preset using the relationships also described above. To maintain consistency with the tour mode choice models, and due to data availability, the drive-transit mode was only allowed for intermediate stops made as part of Work Tours.

- The number of stops on a tour makes a significant contribution in determining the type of trip mode utilized for trips on the tour. These variables were formulated to affect the probability of choosing shared-ride, transit, or walk mode. They are logically negative and significant, indicating that drive-alone is preferred when stops are required, consistent with the tour mode choice model estimation.
- Pattern analysis of the sequence of trips by mode on tours revealed little consistent behavior among travelers. That is, it was not possible to determine when a certain trip mode was likely to occur on any given tour. For example, the data showed that persons were equally likely to utilize shared-ride trips as part of transit tours on trips both before and after the primary destination. Walk trips were also made at random throughout drive alone, shared-ride, and transit tours. Therefore, no 'trip sequence' coefficients were tested for the trip mode choice models.
- A variable was added to the Work trip mode choice model to account for the decreased probability of choosing the walk mode when the departure time is night. Convergence problems or illogical signs resulted when this variable was added to models for the other purposes.
- Household variables were added, as for the tour mode choice models, with similar results. Additionally, a variable was added to account for the low number of drive-alone trips among low income households in the Work trip mode choice model.
- Pedestrian Environment Factor variables were also successfully estimated for trip mode choice models, with the single exception of the School trip mode choice model. Interestingly, the degree of safety was found to be significant for walk and transit trips on Other and Work-Based tours.
- The alternative-specific constants shown in the tables are stratified by tour mode. As previously mentioned, this model structure allows calibration of alternative-specific constants to match observed trips by mode and tour mode.
- The nested model structure for trip mode choice is shown in Figure 3. The structure is consistent with that of the tour mode choice models; that is, auto alternatives are nested separately from transit. The access mode in the transit nests (walk vs. drive) is 'higher' in the nesting structure than are the transit sub-modes, indicating a higher elasticity between transit modes given the mode of access. The estimated nesting coefficient is 0.7011.

Figure 3: Trip Mode Choice Model Nesting Structure

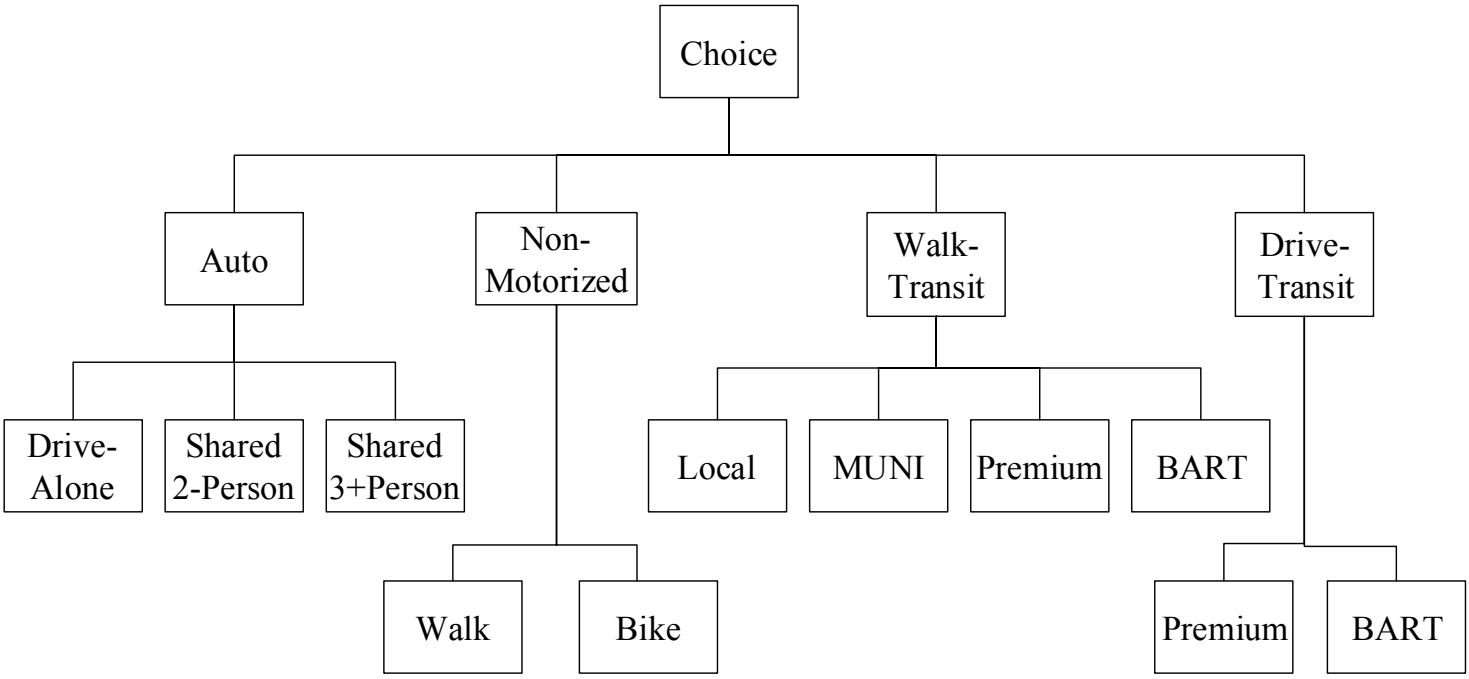

Table 11: Work Trip Mode Choice Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0220	0.0073	-3.01
First Wait	-0.0550	0.0215	-2.56
Second Wait	-0.0800	0.0129	-6.19
Drive-Transit Time		--	--
Out-of-Pocket Cost	-0.0077	0.0018	-4.38
Walk Time	-0.0877	0.0064	-13.78
Walk Mode Time	-0.0877	0.0064	-13.78
Bike Mode Time	-0.1156	0.0250	-4.62
Number of Stops			
Walk, Tour mode not walk	0.7083	0.0914	7.75
Shared-ride, Tour mode = transit	0.4585	0.0742	6.17
Walk Mode – Night	-0.5721	0.2657	-2.15
Household Variables			
Drive Alone-Low income	-0.4159	0.1920	-2.17
Shared-Ride 2, Household Size=1	-0.8003	0.2123	-3.77
Shared-Ride 3+, Household Size<=2	-1.5691	0.2122	-7.39
Pedestrian Environment Factor - Walk Mode			
Destination Network Connectivity	-0.4983	0.2084	-2.39
Destination Crossing	-0.6599	0.2508	-2.63
Destination Vitality	-0.7239	0.2572	-2.81
Destination Topology	-0.1334	0.2595	-0.51
Pedestrian Environment Factor - Transit			
Destination Network Connectivity	-0.3974	0.1721	-2.31
Destination Crossing	-0.7164	0.2133	-3.36
Destination Vitality	-0.1608	0.1820	-0.88
Alternative-Specific Constants			
Driver			
Shared-Ride 2	-1.5407	0.1010	-15.26
Shared-Ride 3+	-2.3020	0.1267	-18.17
Walk	-0.8890	0.3449	-2.58
Passenger			
Shared-Ride 3+	-1.2905	0.1833	-7.04
Walk	1.4914	0.3623	4.12
Bike	-1.0876	0.3273	-3.32
Walk-Transit			
Shared-Ride 3+	-1.1198	0.2395	-4.68
Walk	4.1943	0.3310	12.67
Walk-Local	4.9448	0.2741	18.04
Walk-Muni	4.2186	0.2769	15.23
Walk-Premium	3.1882	0.3708	8.60
Walk-BART	4.7910	0.3427	13.98
Drive-Transit			
Shared-Ride 3+	-0.6673	0.8209	-0.81
Walk	4.4489	0.8124	5.48
Walk-Local	4.0467	0.6634	6.10
Walk-Muni	3.4963	0.9216	3.79
Walk-Premium	2.4499	1.1922	2.05
Walk-BART	4.8443	0.7835	6.18
Drive-Premium	3.5757	0.8816	4.06
Drive-BART	5.6775	0.6581	8.63

Table 11: Work Trip Mode Choice Estimation Results (continued)

Summary Statistics	
Log-Likelihood at Convergence	-2266.79
Rho-Squared with respect to Zero	0.4157
Rho-Squared with respect to Constants	0.2573
First Wait/In-Vehicle Time	2.50
Second Wait/In-Vehicle Time	3.63
Walk Time/In-Vehicle Time	3.98
Walk Mode Time/In-Vehicle Time	3.98
Bike Mode Time/In-Vehicle Time	5.25
Value of Time	$1.70

Table 12: School Trip Mode Choice Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0271	0.0175	-1.55
First Wait	-0.0398	0.0351	-1.13
Second Wait	-0.0355	0.0232	-1.53
Out-of-Pocket Cost	-0.0118	0.0043	-2.76
Walk Time	-0.0642	0.0111	-5.79
Walk Mode Time	-0.0642	0.0111	-5.79
Bike Mode Time	-0.0481	0.0451	-1.07
Number of Stops			
Walk, Tour mode not walk	0.4713	0.0997	4.73
Shared-ride, Tour mode = transit	0.4592	0.0944	4.87
Household Variables			
Shared-Ride 2, Household Size=1	-1.3672	0.9746	-1.40
Shared-Ride 3+, Household Size<=2	-1.5114	0.4787	-3.16
Alternative-Specific Constants			
Driver			
Shared-Ride 2	-1.6256	0.3956	-4.11
Shared-Ride 3+	-3.1843	0.5783	-5.51
Walk	-1.9401	0.6707	-2.89
Passenger			
Shared-Ride 3+	-0.3411	0.1877	-1.82
Walk	-0.4185	0.4064	-1.03
Bike	-2.4959	0.6666	-3.74
Walk-Transit			
Shared-Ride 3+	0.4781	0.2664	1.79
Walk	2.1542	0.4224	5.10
Walk-Local	4.6869	0.4171	11.24
Walk-Muni	3.0762	0.4580	6.72
Walk-BART	4.4197	0.6855	6.45
Summary Statistics			
Log-Likelihood at Convergence	-594.34		
Rho-Squared with respect to Zero	0.4635		
Rho-Squared with respect to Constants	0.2480		
First Wait/In-Vehicle Time	1.47		
Second Wait/In-Vehicle Time	1.31		
Walk Time/In-Vehicle Time	2.37		
Walk Mode Time/In-Vehicle Time	2.37		
Bike Mode Time/In-Vehicle Time	1.78		
Value of Time	$1.38		

Table 13: Other Trip Mode Choice Estimation Results

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0279	0.0134	-2.08
First Wait	-0.0681	0.0354	-1.92
Second Wait	-0.1095	0.0258	-4.24
Out-of-Pocket Cost	-0.0067	0.0041	-1.65
Walk Time	-0.0974	0.0092	-10.60
Walk Mode Time	-0.0974	0.0092	-10.60
Bike Mode Time	-0.1311	0.0813	-1.61
Number of Stops			
Shared-ride	-0.2525	0.0437	-5.77
Transit	-0.5692	0.0847	-6.72
Household Variables			
Shared-Ride 2, Household Size=1	-0.5145	0.1984	-2.59
Shared-Ride 3+, Household Size<=2	-1.6935	0.1571	-10.78
Transit, age <= 10	-1.4158	0.7395	-1.91
Pedestrian Environment Factor-Walk Mode			
Crossing	-0.8856	0.3300	-2.68
Safety	-0.5407	0.2450	-2.21
Vitality	-1.1399	0.3422	-3.33
Pedestrian Environment Factor-Bike			
Vitality	-1.8661	1.3116	-1.42
Pedestrian Environment Factor-Transit			
Crossing	-1.4901	0.4609	-3.23
Vitality	-0.5547	0.3584	-1.55
Topology	-0.8986	0.3051	-2.95
Alternative-Specific Constants			
Driver			
Shared-Ride 2	-0.5860	0.1071	-5.47
Shared-Ride 3+	-0.9517	0.1195	-7.97
Walk	-0.2885	0.3503	-0.82
Passenger			
Shared-Ride 3+	-3.0934	0.8030	-3.85
Walk	0.0064	0.1215	0.05
Bike	0.3917	0.4350	0.90
Walk-Transit			
Shared-Ride 3+	-1.2715	0.5453	-2.33
Walk	5.5656	0.4967	11.20
Walk-Local	7.1595	0.6870	10.42
Walk-Muni	5.5714	0.6880	8.10
Walk-Premium	6.1305	0.8798	6.97
Walk-BART	6.8890	0.8880	7.76
Summary Statistics			
Log-Likelihood at Convergence	-1470.04		
Rho-Squared with respect to Zero	0.4403		
Rho-Squared with respect to Constants	0.3095		
First Wait/In-Vehicle Time	2.44		
Second Wait/In-Vehicle Time	3.92		
Walk Time/In-Vehicle Time	3.49		
Walk Mode Time/In-Vehicle Time	3.49		
Bike Mode Time/In-Vehicle Time	4.69		
Value of Time	$2.49		

Table 14: Work-Based Trip Mode Choice Model

Attribute	Coefficient	Standard Error	t-statistic
Level-of-Service Variable			
In-Vehicle Time	-0.0227	0.0181	-1.25
First Wait	-0.0340	--	--
Second Wait	-0.0325	0.0368	-0.88
Out-of-Pocket Cost	-0.0040	0.0051	-0.79
Walk Time	-0.0840	0.0079	-10.65
Walk Mode Time	-0.0840	0.0079	-10.65
Bike Mode Time	-0.1299	0.0540	-2.40
Number of Stops			
Walk	-0.8606	0.1168	-7.37
Transit	-0.4792	0.1769	-2.71
Pedestrian Environment Factor-Walk Mode			
Safety	-0.4243	0.2238	-1.90
Vitality	-0.6542	0.2389	-2.74
Topology	-0.7457	0.2644	-2.82
Pedestrian Environment Factor-Transit			
Safety	-0.4452	0.3626	-1.23
Vitality	-1.7720	0.5496	-3.22
Topology	-0.8730	0.4860	-1.80
Alternative-Specific Constants			
Drive			
Shared-Ride 2	-1.4030	0.2064	-6.80
Shared-Ride 3+	-3.1113	0.2745	-11.34
Walk	3.2944	0.2674	12.32
Bike	-2.5523	0.4853	-5.26
Walk-Local	-0.2190	0.5571	-0.39
Walk-Muni	-0.4839	0.6421	-0.75
Walk-BART	-0.3918	0.7583	-0.52
Summary Statistics			
Log-Likelihood at Convergence	-739.63		
Rho-Squared with respect to Zero	0.6115		
Rho-Squared with respect to Constants	0.2619		
First Wait/In-Vehicle Time	1.50		
Second Wait/In-Vehicle Time	1.43		
Walk Time/In-Vehicle Time	3.70		
Walk Mode Time/In-Vehicle Time	3.70		
Bike Mode Time/In-Vehicle Time	5.73		
Value of Time	$3.38		

Model Application

All of the models in this chapter were incorporated into two C++ programs:

- SFTOURMC.EXE, which is the combined tour destination choice/mode choice program
- SFTRIPMC.EXE, which is the trip mode choice program

There are two modes for the destination choice/tour mode choice program.

- Mode 1 is used to generate primary tour mode choices for work tours in the sample file.
- Mode 2 is used to determine the primary tour mode choices for all non-work tours in the sample file.

The combined tour destination choice/mode choice program is called 'SFTOURMC.EXE'. To run the program, type:

SFTOURMC *n*

at a DOS prompt, where *n* is 1 for workplace location mode, and 2 is mode/destination choice mode.

APPENDIX A. Work Tour Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0134
First Wait	-0.0144
Second Wait	-0.0411
Drive Time	-0.0269
Walk Time	-0.0377
Walk Mode Time	-0.0377
Bike Mode Time	-0.0536
OPC, Income 0-30k	-0.0021
OPC, Income 30-60K	-0.0014
OPC, Income 60k+	-0.0012
Parking Availability Index	-0.1340
Number of Stops	
Walk	-0.9387
Bike	-0.4748
Auto Passenger	-0.2109
Walk-Transit	-0.4576
Drive-Transit	-0.8646
Pedestrian Environment Factor - Walk Mode	
Destination Network Connectivity	-1.0697
Destination Vitality	-0.4945
Destination Topology	-0.9686
Pedestrian Environment Factor - Walk-Transit	
Destination Network Connectivity	-0.6019
Destination Vitality	-0.0675
Destination Topology	-0.6219
Household Type	
Auto Passenger - Household Size = 1	-0.7346
Alternative-Specific Constants	
Walk	
Autos=0	-0.0574
Autos<Workers	-0.9399
Autos>=Workers	-0.0278
Bike	
Autos=0	-4.5757
Autos<Workers	-3.7281
Autos>=Workers	-4.0583
Driver- Auto	
Autos=0	0.000
Autos<Workers	-1.9586
Autos>=Workers	-1.4759
Passenger- Auto	
Autos=0	-4.7469
Autos<Workers	-3.3009

Autos>=Workers	-3.3686
Passenger-Transit Walk	
Autos=0	-1.0929
Autos<Workers	-0.0375
Autos>=Workers	-0.5384
Passenger-Transit Drive	
Autos=0	0.0000
Autos<Workers	-0.7235
Autos>=Workers	-1.9293

Summary Statistics

Log-Likelihood at Convergence	-1360.87
Rho-Squared with respect to Zero	0.4664
Rho-Squared with respect to Constants	0.1638
First Wait/In-Vehicle Time	1.07
Second Wait/In-Vehicle Time	3.06
Walk Time/In-Vehicle Time	2.80
Walk Mode/In-Vehicle Time	2.80
Bike Mode/In-Vehicle Time	3.99
Value of Time, 0-30k	$3.83
Value of Time, 30-60k	$5.82
Value of Time, 60k+	$6.91

APPENDIX B. School Tour Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0224
First Wait	-0.0757
Second Wait *	-0.0336
Out-of-Pocket Cost	-0.0065
Walk Time	-0.0622
Walk Mode Time	-0.0622
Bike Mode Time	-0.0344
Parking Availability Index	-0.2240
Number of Stops	
Auto Driver/Passenger	0.2845
Walk	-0.8328
Pedestrian Environment Factor - Bike Mode	
Destination Topology	-2.0253
Household Type	
Auto Driver, Age between 16 and 19 years old	-1.3813
Transit, Age less than or equal to 10 years old	-1.5548
Auto Passenger - Household Size less than 3 persons	-0.6359
Alternative-Specific Constants	
Driver	
Autos<Workers	-1.5726
Autos>=Workers	-1.6064
Bike	
Autos<Workers	-6.5929
Autos>=Workers	-7.4809
Passenger- Auto	
Autos<Workers	-4.6702
Autos>=Workers	-7.8016
Passenger-Transit Walk	
Autos<Workers	0.3388
Autos>=Workers	-0.6041
Summary Statistics	
Log-Likelihood at Convergence	-266.36
Rho-Squared with respect to Zero	0.5014
Rho-Squared with respect to Constants	0.3076
First Wait/In-Vehicle Time	3.38
Second Wait/In-Vehicle Time	1.50
Walk Time/In-Vehicle Time	2.77
Walk Mode/In-Vehicle Time	2.77
Bike Mode/In-Vehicle Time	1.53
Value of Time	$3.83

APPENDIX C. Other Tour Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0175
First Wait *	-0.0438
Second Wait	-0.0372
Walk Time	-0.0334
Walk Mode Time	-0.0334
Bike Mode Time	-0.0422
OPC, Income 0-30k	-0.0033
OPC, Income 30-60K	-0.0023
OPC, Income 60k+	-0.0016
Parking Availability Index	-0.1750
Number of Stops	
Walk	-1.0067
Bike	-0.3236
Auto Passenger	-0.1662
Walk-Transit	-0.3727
Pedestrian Environment Factor - Walk Mode	
Destination Vitality	-0.7269
Destination Topology	-0.2693
Pedestrian Environment Factor - Bike Mode	
Destination Vitality	-0.9118
Destination Topology	-0.7659
Pedestrian Environment Factor - Walk-Transit	
Destination Network Connectivity	-0.0520
Destination Vitality	-0.1720
Destination Topology	-0.0384
Household Type	
Auto Passenger - Age less than 16	1.3660
Auto Passenger - Household Size equals 1	0.0000
Alternative-Specific Constants	
Drive	
Autos=0	0.0000
Autos<Workers	-2.3572
Autos>=Workers	-1.5497
Walk	
Autos=0	-0.1221
Autos<Workers	-0.1380
Autos>=Workers	-0.2707
Bike	
Autos=0	-3.7509
Autos<Workers	-3.8102
Autos>=Workers	-4.9340
Passenger- Auto	
Autos=0	-2.3432

Autos<Workers	-3.1020
Autos>=Workers	-2.0835
Passenger-Transit Walk	
Autos=0	-0.8484
Autos<Workers	-2.6292
Autos>=Workers	-2.7253
Summary Statistics	
Log-Likelihood at Convergence	-3359.05
Rho-Squared with respect to Zero	0.4121
Rho-Squared with respect to Constants	0.2099
First Wait/In-Vehicle Time	2.50
Second Wait/In-Vehicle Time	2.12
Walk Time/In-Vehicle Time	1.90
Walk Mode/In-Vehicle Time	1.90
Bike Mode/In-Vehicle Time	2.41
Value of Time, 0-30k	$3.19
Value of Time, 30-60k	$4.48
Value of Time, 60k+	$6.63

APPENDIX D. Work-Based Subtour Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0188
First Wait	-0.0281
Second Wait	-0.0252
Out-of-Pocket Cost	-0.0071
Bike Mode Time	-0.1554
Short Walk Time	-0.0276
Long Walk Time	-0.0967
Number of Stops	
Walk	-1.0067
Bike	-0.3236
Auto Passenger	-0.1662
Walk-Transit	-0.3727
Pedestrian Environment Factor - Walk Mode	
Destination Vitality	-0.7269
Destination Topology	-0.2693
Pedestrian Environment Factor - Bike Mode	
Destination Topology	-0.7659
Destination Vitality	-0.9118
Alternative-Specific Constants	
Drive	
Autos=0	0.0000
Autos<Workers	-5.3915
Autos>=Workers	-1.8858
Walk	
Autos=0	-1.5329
Autos<Workers	-1.5835
Autos>=Workers	-0.2133
Bike	
Autos=0	-0.6730
Autos<Workers	-0.0987
Autos>=Workers	-1.4033
Passenger- Auto	
Autos=0	-8.1702
Autos<Workers	-7.8884
Autos>=Workers	-6.4965
Passenger-Transit Walk	
Autos=0	-5.5137
Autos<Workers	-5.3968
Autos>=Workers	-3.6638
Summary Statistics	
Log-Likelihood at Convergence	-136.51
Rho-Squared with respect to Zero	0.6430

Rho-Squared with respect to Constants	0.3516
First Wait/In-Vehicle Time	1.50
Second Wait/In-Vehicle Time	1.34
Short Walk Time/In-Vehicle Time	1.47
Long Walk Time/In-Vehicle Time	5.16
Bike Mode/In-Vehicle Time	8.29
Value of Time	$1.59

APPENDIX E. Work Trip Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0220
First Wait	-0.0550
Second Wait	-0.0800
Drive-Transit Time	-0.0440
Out-of-Pocket Cost	-0.0077
Walk Time	-0.0877
Walk Mode Time	-0.0877
Bike Mode Time	-0.1156
Number of Stops	
Walk, Tour mode not walk	0.0000
Shared-ride, Tour mode = transit	0.0000
Walk Mode – Night	-0.5721
Household Variables	
Drive Alone-Low income	-0.4159
Shared-Ride 2, Household Size=1	-0.8003
Shared-Ride 3+, Household Size<=2	-1.5691
Pedestrian Environment Factor - Walk Mode	
Destination Network Connectivity	-0.4983
Destination Crossing	-0.6599
Destination Vitality	-0.7239
Destination Topology	-0.1334
Pedestrian Environment Factor - Transit	
Destination Network Connectivity	-0.1987
Destination Crossing	-0.3582
Destination Vitality	-0.0804
Alternative-Specific Constants	
Driver	
Drive Alone	-4.57015
Shared-Ride 2	-5.51849
Shared-Ride 3+	-6.00523
Walk	-1.55660
Passenger	
Shared-Ride 2	-5.94123
Shared-Ride 3+	-6.78484
Walk	-0.89724
Bike	0.00000
Walk-Transit	
Shared-Ride 2	-8.35004
Shared-Ride 3+	-8.96983
Walk	-0.11383
Walk-Local	-3.42692
Walk-Muni	-3.50694
Walk-Premium	0.00000
Walk-BART	-2.81380
Drive-Transit	
Shared-Ride 2	-6.73040
Shared-Ride 3+	-7.49054
Walk	-12.02491
Walk-Local	-3.38205
Walk-Muni	-3.66439

Walk-Premium	0.00000
Walk-BART	-0.65561
Drive-Premium	0.00000
Drive-BART	0.00000

Summary Statistics

Log-Likelihood at Convergence	-2266.79
Rho-Squared with respect to Zero	0.4157
Rho-Squared with respect to Constants	0.2573
First Wait/In-Vehicle Time	2.50
Second Wait/In-Vehicle Time	3.63
Walk Time/In-Vehicle Time	3.98
Walk Mode Time/In-Vehicle Time	3.98
Bike Mode Time/In-Vehicle Time	5.25
Value of Time	$1.70

APPENDIX F. School Trip Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0271
First Wait	-0.0398
Second Wait	-0.0355
Out-of-Pocket Cost	-0.0118
Walk Time	-0.0642
Walk Mode Time	-0.0642
Bike Mode Time	-0.0481
Number of Stops	
Walk, Tour mode not walk	0.0000
Shared-ride, Tour mode = transit	0.0000
Household Variables	
Shared-Ride 2, Household Size=1	-1.3672
Shared-Ride 3+, Household Size<=2	-1.5114
Alternative-Specific Constants	
Driver	
Shared-Ride 2	0.0000
Shared-Ride 3+	0.0000
Walk	0.0000
Passenger	
Shared-Ride 2	-1.94366
Shared-Ride 3+	-1.87656
Walk	-1.91966
Bike	-0.0000
Walk-Transit	
Shared-Ride 2	-2.57267
Shared-Ride 3+	-3.26921
Walk	-1.34417
Walk-Local	-0.60490
Walk-Muni	-0.13227
Walk-BART	-0.28140
Summary Statistics	
Log-Likelihood at Convergence	-594.34
Rho-Squared with respect to Zero	0.4635
Rho-Squared with respect to Constants	0.2480
First Wait/In-Vehicle Time	1.47
Second Wait/In-Vehicle Time	1.31
Walk Time/In-Vehicle Time	2.37
Walk Mode Time/In-Vehicle Time	2.37
Bike Mode Time/In-Vehicle Time	1.78
Value of Time	$1.38

APPENDIX G. Other Trip Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0279
First Wait	-0.0681
Second Wait	-0.1095
Out-of-Pocket Cost	-0.0067
Walk Time	-0.0974
Walk Mode Time	-0.0974
Bike Mode Time	-0.1311
Number of Stops	
Shared-ride	-0.2525
Transit	-0.5692
Household Variables	
Shared-Ride 2, Household Size=1	-0.5145
Shared-Ride 3+, Household Size<=2	-1.6935
Transit, age <= 10	-1.4158
Pedestrian Environment Factor-Walk Mode	
Crossing	-0.8856
Safety	-0.5407
Vitality	-1.1399
Pedestrian Environment Factor-Bike	
Vitality	-1.8661
Pedestrian Environment Factor-Transit	
Crossing	-0.7451
Vitality	-0.2774
Topology	-0.4493
Alternative-Specific Constants	
Driver	
Drive Alone	-6.02880
Shared-Ride 2	-6.13927
Shared-Ride 3+	--6.64931
Walk	-0.81141
Passenger	
Shared-Ride 2	-4.36446
Shared-Ride 3+	-5.93660
Walk	-1.85192
Bike	0.00000
Walk-Transit	
Shared-Ride 2	-13.57422
Shared-Ride 3+	-13.51556
Walk	-2.32576
Walk-Local	-5.63152
Walk-Muni	-2.00930
Walk-Premium	0.00000
Walk-BART	0.00000
Summary Statistics	
Log-Likelihood at Convergence	-1470.04
Rho-Squared with respect to Zero	0.4403
Rho-Squared with respect to Constants	0.3095
First Wait/In-Vehicle Time	2.44

Second Wait/In-Vehicle Time	3.92
Walk Time/In-Vehicle Time	3.49
Walk Mode Time/In-Vehicle Time	3.49
Bike Mode Time/In-Vehicle Time	4.69
Value of Time	$2.49

APPENDIX H. Work-Based Trip Mode Choice: Final Calibrated Model

Attribute	Coefficient
Level-of-Service Variable	
In-Vehicle Time	-0.0227
First Wait	-0.0340
Second Wait	-0.0325
Out-of-Pocket Cost	-0.0040
Walk Time	-0.0840
Walk Mode Time	-0.0840
Bike Mode Time	-0.1299
Number of Stops	
Walk	-0.8606
Transit	-0.4792
Pedestrian Environment Factor-Walk Mode	
Safety	-0.4243
Vitality	-0.6542
Topology	-0.7457
Pedestrian Environment Factor-Transit	
Safety	-0.2226
Vitality	-0.8860
Topology	-0.4365
Alternative-Specific Constants	
Drive	
Drive Alone	-2.72990
Shared-Ride 2	-3.90127
Shared-Ride 3+	-5.49592
Walk	-4.49371
Passenger	
Shared-Ride 2	-6.00783
Shared-Ride 3+	-7.00720
Walk	-1.48762
Bike	-8.41487
Walk-Transit	
Shared-Ride 2	-13.12694
Shared-Ride 3+	-13.19899
Walk	-2.93372
Walk-Local	-4.68414
Walk-Muni	--3.53815
Walk-BART	-3.13092
Summary Statistics	
Log-Likelihood at Convergence	-739.63
Rho-Squared with respect to Zero	0.6115
Rho-Squared with respect to Constants	0.2619
First Wait/In-Vehicle Time	1.50
Second Wait/In-Vehicle Time	1.43
Walk Time/In-Vehicle Time	3.70

Walk Mode Time/In-Vehicle Time	3.70
Bike Mode Time/In-Vehicle Time	5.73
Value of Time	$3.38

APPENDIX I. Files for Running the Mode Choice Models for the Base Year

HWYxx.MAT - The highway skim files by time period (EN, AM, MD, PM)

TRNyyyxx.MAT - The transit skim files by mode of access and egress (walk and auto) and time period (yyy = ATW,WTA,WTW, xx = EA, AM, MD, PM, EV)

TAZDATA.DAT - The zonal data file. 1738 records in space delimited format

SFSAMPzz.TXT – The sample file in space delimited format (zz = last two digits of year of interest)

ZONEEQUIV.DAT - The zonal equivalence file in space delimited format

NODES.TXT - The node file

SFTOURMC.CPP and SFTOURMC.EXE – the combined destination and mode choice code and executable files. It uses the output from the tour generation/time of day models plus the input files above. It creates TOURDC.OUT and TOURDC.RPT, which is a report file output.

SFISTOP.CPP and SFISTOP.EXE – the intermediate stop choice code and executable files. It uses the output from the trip mode choice model, plus the input files above to create TOURIS.OUT and TOURIS.RPT, which is a report file output.

APPENDIX J. Tour Mode Choice Estimation File Structure

Column	Variable	Description
1	HHID	Household ID
2	PERSID	Person ID
3	TOUR	Tour sequence number
4	OTAZ	Segment origin zone (model)
5	OTAZTOUR	Tour Origin TAZ
6	DTAZ	Segment destination zone (model)
7	DTAZTOUR	Tour Destination TAZ
8	TIME	Segment origin time period
9	ALAMODE	Mode definition for TP+ skims
10	DIARYDAY	Diary Day
11	DAYOFWK	Day of Week
12	RELTYPE	Relationship code
13	SEX	Sex (1male, 2female)
14	AGE	Age in years (5 - 99)
15	DRIVER	Drivers License (1yes, 2no)
16	ETHNIC	Ethnicity code (1 - 10)
17	EMPLOYED	Employment status code (1 - 9)
18	OCCUPTN	Occupation code (1 - 13)
19	BUSINESS	Business code (1 - 10)
20	WORKMTAZ	MTC TAZ of workplace
21	WORKSTAZ	SFCTA TAZ of workplace
22	WTAZ	Work TAZ
23	WORKGTYP	Geocode type of workplace
24	DISABLE	Has disability impacting transit use
25	HHDAYS	Travel diary days
26	HHSIZE	Number of persons in household
27	NAGEUND5	Number of persons age 0-4
28	NAGE511	Number of persons age 5-11
29	NAGE1217	Number of persons age 12-17
30	NAGE1824	Number of persons age 18-24
31	NAGE2534	Number of persons age 25-34
32	NAGE3549	Number of persons age 35-49
33	NAGE5064	Number of persons age 50-64
34	NAGE65UP	Number of persons age 65-99
35	NFULLTIM	Number of full time workers
36	NPARTTIM	Number of part time workers
37	NDRLIC	Number of licensed drivers
38	NSPOUSE	Number of parents/spouses
39	NCHILDR	Number of related children
40	NOTHREL	Number of other relatives
41	NNONREL	Number of non-relations
42	AUTOS	Number of automobiles
43	TRUCKS	Number of trucks
44	MCYCLES	Number of motorcycles
45	MOPEDS	Number of mopeds
46	BIKES	Number of bicycles

47	INCOME	Household income code
48	INCOME2	Imputed Household income
49	HOMEMTAZ	MTC TAZ of residence
50	HOMESTAZ	SFCTA TAZ of residence
51	HTAZ	Not Used
52	HOMEGTYP	Geocode type of residence
53	BUILDING	Type of building code (1 - 7)
54	YRSHOME	Number of years at current resid
55	TENURE	Tenure
56	TENURE2	Imputed Tenure (no code3)
57	TOUR2	Not Used
58	TPDTYPE	Tour primary destination purpose type
59	TPDPURP	Tour primary destination purpose
60	TMMODE	Main mode for tour
61	TODTIME	Tour Origin departure time
62	TDATIME	Tour Destination arrival time
63	TDDTIME	Tour Destination departure time
64	TOATIME	Tour Origin arrival time
65	TOMTAZ	Tour Origin MTC TAZ number
66	TOSTAZ	Tour Origin SFCTA TAZ number
67	TOGTYP	Tour Origin geocode type
68	TDMTAZ	Tour Destination MTC TAZ number
69	TDSTAZ	Tour Destination SFCTA TAZ number
70	TDGTYP	Tour Destination geocode type
71	TNSTOPSB	Tour Stops on way to destination
72	TNSTOPSA	Tour Stops on way from destination
73	SEG	Segment number within tour
74	SEGDIR	Segment direction within tour
75	SDPURP	Segment destination purpose
76	SOTIME	Segment origin departure time
77	SDTIME	Segment destination arrival time
78	SOMTAZ	Segment Origin MTC TAZ number
79	SOSTAZ	Segment Origin SFCTA TAZ number
80	SOGTYP	Segment Origin geocode type
81	SDMTAZ	Segment Destination MTC TAZ number
82	SDSTAZ	Segment Destination SFCTA TAZ number
83	SDGTYP	Segment Destination geocode type
84	SMMODE	Mode for Tour
85	SPARKTYP	Main parking type for segment
86	STICKTYP	Transit ticket type for segment
87	MODEDEF	Mode based on SMMODE and flags
88	PRIMMODE	Primary mode summary
89	TODEPART	Tour Origin Departure Time
90	TDDEPART	Tour Destination Departure Time
91	MODE01	Detailed Mode Segment 1
92	MODE02	Detailed Mode Segment 2
93	MODE03	Detailed Mode Segment 3
94	MODE04	Detailed Mode Segment 4
95	MODE05	Detailed Mode Segment 5
96	MODE06	Detailed Mode Segment 6

97	MODE07	Detailed Mode Segment 7
98	MODE08	Detailed Mode Segment 8
99	MODE09	Detailed Mode Segment 9
100	MODE10	Detailed Mode Segment 10
101	DIR01	Direction Segment 1
102	DIR02	Direction Segment 2
103	DIR03	Direction Segment 3
104	DIR04	Direction Segment 4
105	DIR05	Direction Segment 5
106	DIR06	Direction Segment 6
107	DIR07	Direction Segment 7
108	DIR08	Direction Segment 8
109	DIR09	Direction Segment 9
110	DIR10	Direction Segment 10
111	SMODE01	Collapsed Mode Segment 1
112	SMODE02	Collapsed Mode Segment 2
113	SMODE03	Collapsed Mode Segment 3
114	SMODE04	Collapsed Mode Segment 4
115	SMODE05	Collapsed Mode Segment 5
116	SMODE06	Collapsed Mode Segment 6
117	SMODE07	Collapsed Mode Segment 7
118	SMODE08	Collapsed Mode Segment 8
119	SMODE09	Collapsed Mode Segment 9
120	SMODE10	Collapsed Mode Segment 10
121	SMODE	Summarized Mode
122	TMODE	Tour Mode
123	TRANDEST	Not Used
124	TRANORIG	Not Used
125	PASSDEST	Not Used
126	PASSORIG	Not Used
127	TMODE2	Collapsed Tour Mode

Origin	Destination	Variable	Description
128	186	HHLDS	Households
129	187	POP	Population
130	188	EMPRES	Employed Residents
131	189	CIE	Cultural/Institutional/Educational Services Employment (SF*)
132	190	MED	Medical and Health Services Employment (SF)
133	191	MIPS	Management, Information, and Professional Services Employment (SF/Common**)
134	192	PDR	Production/Repair/Distribution Employment (SF/Common)
135	193	RETAIL	Retail/Entertainment Employment (SF/Common)
136	194	VISITOR	Visitor Lodging Employment (SF)
137	195	TOTALEMP	Total Employment
138	196	MTCTAZ	MTC TAZ Number
139	197	NETCON	PEF - Network Continuity / Integrity
140	198	CROSSING	PEF - Ease of Street Crossing
141	199	SAFETY	PEF - Perception of Safety and Personal Security
142	200	VITALITY	PEF - Urban Vitality
143	201	TOPOLOGY	PEF - Topological Barriers
144	202	AREATYPE	Area Type
145	203	SUPERDST	MTC 34 SuperDistrict

146	204	MTCEMP	MTC TAZ Total Employment
147	205	MTCPOP	MTC TAZ Total Population
148	206	HHINCQ1	Number of hhlds in income quartile 1
149	207	HHINCQ2	Number of hhlds in income quartile 2
150	208	HHINCQ3	Number of hhlds in income quartile 3
151	209	HHINCQ4	Number of hhlds in income quartile 4
152	210	AVGINCQ1	Average Household Income - Quartile 1
153	211	AVGINCQ2	Average Household Income - Quartile 2
154	212	AVGINCQ3	Average Household Income - Quartile 3
155	213	AVGINCQ4	Average Household Income - Quartile 4
156	214	AVGHHINC	Average Household Income - all hhlds
157	215	SHPOP62P	Share of Population 62 or older
158	216	COUNTY	County Number
159	217	TOTACRE	Total Area in Acres
160	218	RETEMP	Retail Employment (MTC***)
161	219	SEREMP	Service Employment (MTC)
162	220	OTHEMP	Other Employment (MTC)
163	221	AGREMP	Agricultural Employment (MTC)
164	222	MFGEMP	Manufacturing Employment (MTC)
165	223	TRDEMP	Trade Employment (MTC)
166	224	SFTAZ	SF TAZ Number (SF 1-756 and MTC 928-1899 (original MTC TAZ# + 800))
167	225	SERVICE	Service Employment (Common)
168	226	PKDISTNO	Parking District Number
169	227	PKDIST	Parking District Description
170	228	FREEPARK	Type of Parking Provided - % Free
171	229	SUBPARK	Type of Parking Provided - % Subsidized
172	230	PAIDPARK	Type of Parking Provided - % Paid
173	231	PPAYING	Percent Paying for Parking
174	232	PRKAVIND	Parking Availability Index
175	233	ONSTREET	Percentage of On-Street Parking
176	234	OFSTREET	Percentage of Off-Street Parking
177	235	PRKCSTWH	Hourly Parking Cost for Work Tours (dollars)
178	236	PRKCSTOH	Hourly Parking Cost for Other Tours (dollars)
179	237	POP0513	Number of persons in Zone between ages 5 and 13
180	238	HSENROLL	High School Enrolment
181	239	COLLFTE	Full-time College Enrolment
182	240	COLLPTE	Part-time College Enrolment
183	241	NOBLDGS	Number of School Buildings
184	242	BLDGAREA	School Building Floor Area (square footage)
185	243	SCHAREA	School Area (square footage)

LEVEL of SERVICE MATRICES: Origin to Primary Destination

Access Mode	**Walk**	**Auto**	
Primary Mode	**Transit**	**Transit**	
Local Bus In-Vehicle Time	244	255	
MUNI In-Vehicle Time	245	256	
Premium In-Vehicle Time	246	257	
BART In-Vehicle Time	247	258	
Access Time	248	259	(drive time)
Egress Time	249	260	(walk time)
First Wait Time	250	261	
Transfer Wait Time	251	262	
Distance	252	263	
Fare	253	264	
Boardings	254	265	

Variable	**Highway**
Drive Alone Time	266
Drive Alone Distance	267
Share 2 Time	268
Share 2 Distance	269
Share 3+ Time	270
Share 3+ Distance	271

PRIMARY DESTINATION TO ORIGIN

Access Mode	**Walk**	**Auto**	
Primary Mode	**Transit**	**Transit**	
Local Bus In-Vehicle Time	272	283	
MUNI In-Vehicle Time	273	284	
Premium In-Vehicle Time	274	285	
BART In-Vehicle Time	275	286	
Access Time	276	287	(walk time)
Egress Time	277	288	(drive time)
First Wait Time	278	289	
Transfer Wait Time	279	290	
Distance	280	291	
Fare	281	292	
Boardings	282	293	

Variable	**Hwy**
Drive Alone Time	294
Drive Alone Distance	295
Share 2 Time	296
Share 2 Distance	297
Share 3+ Time	298
Share 3+ Distance	299

APPENDIX K. Trip Mode Choice Estimation File Structure

Column	Variable	Description
1	HHID	Household ID
2	PERSID	Person ID
3	TOUR	Tour Number
4	DIARYDAY	Diary Day
5	SEG	Segment Number
6	TMODE	Not Used
7	TMODE2	Tour Mode
8	DAYOFWK	Day of Week
9	OTAZ	Trip Origin TAZ
10	OTAZTOUR	Tour Origin TAZ
11	DTAZ	Trip Destination TAZ
12	DTAZTOUR	Tour Destination TAZ
13	TIME	Not Used
14	ALAMODE	Detailed Trip Mode
15	RELTYPE	Relationship Type
16	SEX	Sex
17	AGE	Age
18	DRIVER	Licensed Driver
19	ETHNIC	Ethnicity
20	EMPLOYED	Employment Status
21	OCCUPTN	Occupation code
22	BUSINESS	Business Code
23	WORKMTAZ	MTC Work TAZ
24	WORKSTAZ	SFCTA Work TAZ
25	WTAZ	Not Used
26	WORKGTYP	Not Used
27	DISABLE	Disabled indicator
28	HHDAYS	Not Used
29	HHSIZE	Household Size
30	NAGEUND5	Number in HH under 5 yrs
31	NAGE511	Number in HH Age 5-11
32	NAGE1217	Number in HH Age 12-17
33	NAGE1824	Number in HH Age 18-24
34	NAGE2534	Number in HH Age 25-34
35	NAGE3549	Number in HH Age 35-49
36	NAGE5064	Number in HH Age 50-64
37	NAGE65UP	Number in HH Age 65+
38	NFULLTIM	Number Full-time Workers
39	NPARTTIM	Number Part-time Workers
40	NDRLIC	Number with Licenses
41	NSPOUSE	Number of Spouses
42	NCHILDR	Number of Children
43	NOTHREL	Number of Other Related Persons
44	NNONREL	Number of Non-Related Persons
45	AUTOS	Number of Autos
46	TRUCKS	Number of Trucks

47	MCYCLES	Number of Motorcycles
48	MOPEDS	Number of Mopeds
49	BIKES	Number of Bicycles
50	INCOME	Household Income
51	INCOME2	Household Income Category
52	HOMEMTAZ	MTC Home TAZ
53	HOMESTAZ	SFCTA Home TAZ
54	HTAZ	Not Used
55	HOMEGTYP	Home Type
56	BUILDING	Building Type
57	YRSHOME	Years in Home
58	TENURE	Tenure
59	TENURE2	Tenure Category
60	TOUR2	Not Used
61	TPDTYPE	Tour Primary Destination Type
62	TPDPURP	Tour Primary Purpose Type
63	TMMODE	Tour Main Mode
64	TODTIME	Tour Origin Departure Time
65	TDATIME	Tour Destination Arrival Time
66	TDDTIME	Tour Destination Departure Time
67	TOATIME	Tour Origin Arrival Time
68	TOMTAZ	Tour Origin MTC TAZ
69	TOSTAZ	Tour Origin SFCTA TAZ
70	TOGTYP	Not Used
71	TDMTAZ	Tour Destination MTC TAZ
72	TDSTAZ	Tour Destination SFCTA TAZ
73	TDGTYP	Not Used
74	TNSTOPSB	Number Stops Before Destination
75	TNSTOPSA	Number Stops After Destination
76	SEGDIR	Segment Direction
77	SDPURP	Segment Destination Purpose
78	SOTIME	Segment Origin Departure Time
79	SDTIME	Segment Destination Departure Time
80	SOMTAZ	Segment Origin MTC TAZ
81	SOSTAZ	Segment Origin SFCTA TAZ
82	SOGTYP	Not Used
83	SDMTAZ	Segment Destination MTC TAZ
84	SDSTAZ	Segment Destination SFCTA TAZ
85	SDGTYP	Not Used
86	SMMODE	Segment Mode
87	SPARKTYP	Segment Parking Type
88	STICKTYP	Segment Ticket Type
89	MODEDEF	Mode Definition Code
90	PRIMMODE	Trip Primary Mode
91	SDEPART	Departure Time for Trip

92	150	HHLDS	Households
93	151	POP	Population
94	152	EMPRES	Employed Residents
95	153	CIE	Cultural/Institutional/Educational Services Employment (SF*)
96	154	MED	Medical and Health Services Employment (SF)

97	155	MIPS	Management, Information, and Professional Services Employment (SF/Common**)
98	156	PDR	Production/Repair/Distribution Employment (SF/Common)
99	157	RETAIL	Retail/Entertainment Employment (SF/Common)
100	158	VISITOR	Visitor Lodging Employment (SF)
101	159	TOTALEMP	Total Employment
102	160	MTCTAZ	MTC TAZ Number
103	161	NETCON	PEF - Network Continuity / Integrity
104	162	CROSSING	PEF - Ease of Street Crossing
105	163	SAFETY	PEF - Perception of Safety and Personal Security
106	164	VITALITY	PEF - Urban Vitality
107	165	TOPOLOGY	PEF - Topological Barriers
108	166	AREATYPE	Area Type
109	167	SUPERDST	MTC 34 SuperDistrict
110	168	MTCEMP	MTC TAZ Total Employment
111	169	MTCPOP	MTC TAZ Total Population
112	170	HHINCQ1	Number of hhlds in income quartile 1
113	171	HHINCQ2	Number of hhlds in income quartile 2
114	172	HHINCQ3	Number of hhlds in income quartile 3
115	173	HHINCQ4	Number of hhlds in income quartile 4
116	174	AVGINCQ1	Average Household Income - Quartile 1
117	175	AVGINCQ2	Average Household Income - Quartile 2
118	176	AVGINCQ3	Average Household Income - Quartile 3
119	177	AVGINCQ4	Average Household Income - Quartile 4
120	178	AVGHHINC	Average Household Income - all hhlds
121	179	SHPOP62P	Share of Population 62 or older
122	180	COUNTY	County Number
123	181	TOTACRE	Total Area in Acres
124	182	RETEMP	Retail Employment (MTC***)
125	183	SEREMP	Service Employment (MTC)
126	184	OTHEMP	Other Employment (MTC)
127	185	AGREMP	Agricultural Employment (MTC)
128	186	MFGEMP	Manufacturing Employment (MTC)
129	187	TRDEMP	Trade Employment (MTC)
130	188	SERVICE	SF TAZ Number (SF 1-756 and MTC 928-1899 (original MTC TAZ# + 800))
131	189	PKDISTNO	Service Employment (Common)
132	190	PKDIST	Parking District Number
133	191	FREEPARK	Parking District Description
134	192	SUBPARK	Type of Parking Provided - % Free
135	193	PAIDPARK	Type of Parking Provided - % Subsidized
136	194	PPAYING	Type of Parking Provided - % Paid
137	195	PRKAVIND	Percent Paying for Parking
138	196	ONSTREET	Parking Availability Index
139	197	OFSTREET	Percentage of On-Street Parking
140	198	PRKCSTWH	Percentage of Off-Street Parking
141	199	PRKCSTOH	Hourly Parking Cost for Work Tours (dollars)
142	200	POP0513	Hourly Parking Cost for Other Tours (dollars)
143	201	HSENROLL	Number of persons in Zone between ages 5 and 13
144	202	COLLFTE	High School Enrolment
145	203	COLLPTE	Full-time College Enrolment
146	204	NOBLDGS	Part-time College Enrolment
147	205	BLDGAREA	Number of School Buildings
148	206	SCHAREA	School Building Floor Area (square footage)

149 207 MERGE School Area (square footage)

TRANSIT SKIMS

Access Mode Primary Mode Egress Mode	Walk Local Walk	Walk MUNI Walk	Walk BART Walk	Walk Premium Walk	Walk Premium Auto	Walk BART Auto
Local Bus In-Vehicle Time	208	216	225	235	245	255
MUNI Metro In-Vehicle Time		217	226	236	246	256
Premium In-Vehicle Time				237	247	
BART In-Vehicle Time			227			257
Access Time	209	218	228	238	248	258
Egress Time	210	219	229	239	249	259
First Wait Time	211	220	230	240	250	260
Transfer Wait Time	212	221	231	241	251	261
Distance	213	222	232	242	252	262
Fare	214	223	233	243	253	263
Boardings	215	224	234	244	254	264

AUTO SKIMS

Mode	Drive-Alone	Shared Ride 2	Shared Ride 3+
Time	265	267	269
Distance	266	268	270