

Local Area Transportation Characteristics for Households

BACKGROUND

The National Household Transportation Survey (NHTS), a survey of the U.S. Department of Transportation, is designed to assess the mobility of the American public (USDOT FHWA 2011). NHTS gathers data on daily personal travel, including information on household and demographic characteristics, employment status, vehicle ownership, trips taken, modal choice, and other related transportation data pertinent to US households. This survey is a continuation of the Nationwide Personal Transportation Survey (NPTS), which was conducted in 1969, 1977, 1983, 1990 and 1995; and the NHTS has been conducted in 2001 and in 2009. The 2009 NHTS collected travel data from a national sample of civilian, non-institutionalized population of the United States - 25,000 households in the national sample and separate samples from 20 add-on areas, which together provided data on 150,147 completed households.

While the NHTS is an excellent source of travel information for large geographic areas in the US, it has the difficulty of limited sample sizes for small area estimation. While statistically valid models relating such travel measures as person-trips, household-trips, person miles traveled and household miles traveled can and have been created for national and regional areas of the US (e.g., Scuderi and Clifton 2005, Pucher and Renne 2003), transferring the results of such models proves to be difficult based on the limited sample sizes of the small geographic areas. Such transferability studies often rely on other sources of more detailed information for the smaller geographic areas in order to estimate travel behavior.

In this study, the NHTS data are broken down into six geographical areas and urban/suburban/rural classifications to make estimates of several travel variables, based upon a set of household and demographic characteristics. These estimates are then transferred to individual census tracts using the household and demographic data for each of those census tracts. While these individual census tract estimates may have limited accuracy in some cases, they can be very beneficial to local governments, and other interested customers, who often do not have the budget and/or time for conducting their own surveys. Using these estimates can make economic sense for those agencies, even if the results are less accurate than if they conducted their own survey. Additionally NHTS has the advantage of using questions standardized across the geographic sample (with only small variations for the add-ons), which would not be possible when comparing local surveys with differing methodologies.

Henson and Goulias (2001) used the 2001 NHTS and local travel surveys by transferring a survey participant's daily travel schedules to different geographic locations by, connecting travel behavior and land use, urban form and accessibility. In this study, the NHTS participants were set into cluster models representing persons, land use and travel. These clusters were then compared to similar groupings from two local travel surveys – but their research indicated that people with different geographic areas do travel differently, even if they share the same socio-demographic characteristics. Wilmot and Stopher (2001) found that updating transferred values with local values from small surveys results in a better transferred model from the larger survey. Mohammadian et al. (2010) propose a technique to simulate

disaggregate and synthetic household travel survey data through spatial transferability of travel data. Bayesian modeling was used to create a 'synthetic' population for the State of New York (excluding Manhattan), which was then linked to travel estimates developed from the NHTS data. Stopher et al. (2005) used local survey data to supplement (through simulation) national data. In this study, distributions of travel characteristics were obtained from a nationwide sample, which were updated to a locality by using a small local sample and Bayesian updating. Long et al (2009) used small area estimation methods to produce reliable estimates of household travel characteristics at both the aggregated and disaggregated (household) level. Data were drawn from the 2001 NHTS and the CTPP.

The Federal Highway Administration (FHWA) contracted with researchers at Oak Ridge Laboratories to conduct work in this area of transferability to expand the usability of their NHTS data to small geographic areas – in particular, Census tracts. First utilizing the 1995 NPTS survey data, Reuscher et al. (2002) estimated local travel, which included vehicle trips (VT), vehicle miles of travel (VMT), person trips (PT), and person miles of travel (PMT). The three steps of research were used to obtain these estimates:

- 1) Classify the Census Tracts into homogenous groups. The census tracts were first split by income (very low, very high, and the rest), then split by area type (urban, suburban and rural), and then split by cluster analysis, based on income, employment rate and number of vehicles.
- 2) Use NPTS data to estimate driving characteristics for each of the clusters derived in the previous step.
- 3) With the classification and estimations from the above two steps, make travel estimates for any census tract derived from the tract's classification.

Census tracts without population or without vehicles were excluded from the analysis, as were the Manhattan census tracts.

In a subsequent study using 2001 NHTS data (Hu et al. 2007), the clustering approach fared poorly. Hu et al. tried to determine if the 2001 NHTS data had increased statistical noise – but that was not the case. They also thought that it may be due to a potential 'survey/firm' effect (different firms doing the surveys) – but that also was not the case. So – instead of utilizing the clustering by income and rural/urban/mega urban, the researchers reduced the breakouts to urban, suburban, rural, mega-urban and extreme poverty. Extreme poverty classified tracts with greater than 40% of the population being below poverty level. Mega-urban was defined by being densely populated with highly used transit; 19 cities were classified as mega-urban. Regressions were performed within each of these 'geo-economic clusters' - one regression for each parameter (PT, PMT, VT, and VMT) and geo-economic cluster. The tables below show the variables for these regressions.

Table 1. ORNL Regression Coefficients for PT and VT

	Extreme Poverty	Mega-Urban	Suburban	Urban	Rural
Total Daily <i>Person</i> Trips per Household					
Household Size	+	+	+	+	+
No. of Vehicles in Household	+	+	+	+	+
Percent Who Use Transit to Work	-				
Number of Workers per Household	+				
Household Life Cycle (2+ A, 1+ C)	+				
MSA size (250-499,000)	-				
Household Income		+			
Household Buying Power			+	+	+
R-SQUARED	0.4366	0.3913	0.3821	0.3923	0.3834
Total Daily <i>Vehicle</i> Trips per Household					
Household Size	-	+	+	+	+
No. of Vehicles in Household	+	+	+	+	+
Percent Who Use Transit to Work		-			
Number of Workers per Household	+		+	+	+
Household Life Cycle (2+ A, 1+ C)	+				
Household Income		+			
Household Buying Power	+		+	+	+
Census Divisions	+				
R-SQUARED	0.4645	0.3845	0.2811	0.3016	0.2836

*Households with two or more adults and one or more children

Source: Hu et al. 2007, Table 11. Significant Independent Variables to Estimate Household Travel Variables

Table 2. ORNL Regression Coefficients for PMT and VMT

	Extreme Poverty	Mega- Urban	Suburban	Urban	Rural
Total Daily <i>Person</i> Miles of Travel per Household					
Household Size	+	+	+	+	+
No. of Vehicles in Household	+	+	+	+	+
Life Cycle (2+ A, 1+ C)*	+			+	
Life Cycle (1A, 0C)					+
Household Buying Power			+		
Census division (East North Central)	+				
Home Ownership		+			
R-SQUARED	0.2125	0.1593	0.0934	0.1201	0.1204
Total Daily <i>Vehicle</i> Miles of Travel per Household					
Household Size	-	+	+	+	+
No. of Vehicles in Household	+	+	+	+	+
ACCRA Cost of Transportation Index	-				
No. of Workers	+				
Life Cycle (2+ A/1+ C; 1A/1C)*	+				
Life Cycle (2+ A, Retired)		-			
Census Region (Midwest)	+				
Census Region (South)					+
MSA size (250-499,000)	+				
Household Buying Power			+	+	
Home Ownership		+			
R-SQUARED	0.2622	0.2051	0.1028	0.1185	0.0994

*2+ A, 1+ C denotes households with two or more adults and one or more children

1A, 1+ C denotes households with one adult and more than one child

1A, 0C denotes households with one adult and no children

Source: Hu et al. 2007, Table 13. Significant Independent Variables for to Estimating Household PMT and VMT

For measuring success, each NHTS add-on was split into two samples. The four variables (PT, PMT, VT, VMT) were calculated for one of the two samples to create baselines for each add-on. The researchers then performed five different classification clusters / modeling on the second set of samples (Census division and MSA-sized base, MSA size-based, Census division-based, Census region-based and the above regressions). To determine which technique worked the best, the average baseline was compared to the calculated values of the variables by taking the percent difference from the baseline.

Table 3. ORNL Comparison of PT and VT Estimates

Number of <i>Person</i> Trips per Household (PT)							
Add-On Areas	Baseline Standards	Std Err %	% Difference from Baseline				
			C. Div & MSA Size-based	MSA Size-based	CENSUS Division-based	CENSUS Region-based	Re-gression-based
New York	9.91	1.16%	1.32%	9.61%	2.03%	5.29%	-6.52%
Wisconsin	9.90	1.13%	6.80%	5.86%	6.74%	7.67%	-4.98%
Texas	10.31	2.17%	7.94%	9.63%	8.69%	9.20%	-1.33%
Baltimore	9.10	1.48%	11.58%	14.45%	16.93%	14.93%	5.35%
Lancaster	10.26	2.67%	5.62%	9.51%	1.02%	3.13%	-2.18%
Des Moines	9.50	3.41%	15.19%	11.33%	13.97%	11.65%	2.75%
Kentucky	8.88	2.87%	9.95%	17.49%	14.14%	16.30%	2.44%
Hawaii	10.47	2.81%	-0.37%	6.72%	9.05%	10.75%	-3.68%
Oahu	10.79	2.54%	11.85%	9.92%	8.77%	10.47%	-5.90%
Mean Absolute Deviation			7.85%	10.50%	9.04%	9.93%	3.90%
Number of "Wins"			2	0	1	0	6
Number of <i>Vehicle</i> Trips per Household (VT)							
New York	4.54	1.76%	12.52%	36.61%	14.54%	22.46%	1.57%
Wisconsin	6.25	1.20%	5.96%	3.81%	4.50%	4.98%	-4.83%
Texas	6.68	2.05%	2.61%	-3.06%	3.16%	1.86%	-10.13%
Baltimore	5.30	1.86%	10.84%	8.98%	22.31%	22.49%	6.28%
Lancaster	6.37	3.00%	-0.23%	7.59%	-17.44%	-11.98%	-2.23%
Des Moines	6.30	3.33%	7.87%	4.49%	5.28%	4.09%	0.99%
Kentucky	5.80	3.07%	8.82%	13.38%	12.02%	12.40%	-2.59%
Hawaii	6.86	2.47%	-9.79%	-1.44%	-6.45%	-3.25%	-12.30%
Oahu	6.25	2.89%	4.34%	14.77%	4.65%	8.15%	-11.46%
Mean Absolute Deviation			7.00%	10.46%	10.04%	10.18%	5.82%
Number of "Wins"			2	2	0	1	4

Percentage difference in bold indicate the method that gives estimates closest to the baseline

Percentage difference in yellow highlight indicate the cluster-based approach gives estimates closest to the baseline

Source: Hu et al. 2007, Table 12. Comparing Baseline Standards to Various Trip-Frequency Estimates, Data from Nine 2001 NHTS Add-on Areas.

Table 4. ORNL Comparison of PMT and VMT Estimates

<i>Person Miles of Travel per Household (PT)</i>							
Add-On Areas	Baseline Standards	Std Err %	% Difference from Baseline				
			C. Div & MSA Size-based	MSA Size-based	CENSUS Division-based	CENSUS Region-based	Re-gression-based
New York	67.96	2.41%	6.36%	314.00%	8.14%	12.71%	-3.38%
Wisconsin	87.99	2.52%	6.82%	9.95%	3.23%	5.80%	-6.99%
Texas	100.12	3.89%	4.99%	-5.05%	6.63%	6.55%	-17.30%
Baltimore	75.71	2.70%	14.82%	8.02%	30.01%	32.59%	-3.61%
Lancaster	79.93	5.35%	8.93%	20.86%	-4.48%	-1.77%	5.71%
Des Moines	71.69	9.94%	25.82%	29.97%	38.05%	29.25%	11.86%
Kentucky	99.46	5.79%	7.93%	4.13%	7.68%	0.16%	-4.50%
Hawaii	68.04	7.36%	66.85%	79.17%	39.68%	43.77%	33.31%
Oahu	68.44	7.20%	68.03%	46.00%	42.29%	46.52%	-0.78%
Mean Absolute Deviation			22.39%	26.06%	20.02%	19.90%	9.72%
Number of "Wins"			1	0	1	2	6
<i>Vehicle Miles of Travel per Household (VT)</i>							
New York	38.78	2.54%	15.00%	51.48%	17.17%	26.03%	0.42%
Wisconsin	60.85	2.76%	4.74%	5.02%	1.10%	1.64%	-12.76%
Texas	68.12	4.44%	4.78%	-9.43%	6.62%	4.34%	-20.90%
Baltimore	52.88	2.93%	3.54%	1.08%	23.61%	27.30%	-9.41%
Lancaster	52.05	4.43%	8.44%	19.09%	-10.84%	-4.61%	5.31%
Des Moines	48.28	8.98%	19.12%	24.93%	30.64%	27.62%	12.21%
Kentucky	66.93	6.22%	9.25%	1.06%	7.56%	80.00%	-4.85%
Hawaii	44.49	4.14%	32.67%	74.73%	36.27%	41.76%	20.79%
Oahu	41.10	3.40%	57.62%	66.55%	50.26%	56.33%	-1.09%
Mean Absolute Deviation			17.24%	28.12%	20.45%	21.19%	9.75%
Number of "Wins"			0	1	1	3	4

Percentage difference in bold indicate the method that gives estimates closest to the baseline

Percentage difference in yellow highlight indicate the cluster-based approach gives estimates closest to the baseline

Source: Hu et al. 2007, Table 14. Comparison of Alternative PMT and VMT Estimates to Baseline Standards, Data from Nine 2001 NHTS Add-on Areas

This study uses similar methodology, utilizing multiple regression analysis, to estimate travel variables as a function of significant demographic and household characteristics. The following section gives details on the methodology.

METHODOLOGY

Census Region/Division Groups

The increased number of households sampled in the 2009 NHTS, a national sample of 25,000 and 125,000 'add-on', or oversampled, geographic areas, allows the sample to be divided up into six census region/division groups, and then subsetted into three urban groups, for a total of 18 separate categories. Each category is estimated separately. The geographic disaggregation was done to make more homogenous groupings of the households for the regression equations. The specific groupings were defined to keep an adequate sample size for estimation purposes. The census region/division groupings used were the following:

1. Northeast Region
2. Midwest Region
3. South Atlantic Division
4. East South Central Division and West South Central Division
5. Mountain Division
6. Pacific Division.

Development of Urbanicity Index

The 2009 NHTS includes the set of Census tract and block group variables known as the Claritas Variables that describe the characteristics of the areas where the NHTS were surveyed. The urban-rural continuum variable, contained within this set of Census tract and block group descriptors, describes the level of urban development within an area in terms of the population density in the geographic area itself and in the surrounding areas. This overall measure of population density is used in labeling Census block groups as: urban, suburban, second city, and town/country. Block groups where one or more households were surveyed are assigned to one of these groups. Households were not surveyed in all block groups and consequently, a complete urban-rural continuum dataset, using the Claritas Variable, for Census block groups cannot be extracted from the NHTS¹.

The present analysis requires all U.S. Census tracts to be labeled in terms of their urbanicity. If a complete urban-rural continuum dataset could be obtained for Census block groups, a dataset for tracts could be created by calculating the mean or median value assigned to block groups contained by a given

¹ Claritas data for all Census Tracts can be purchased, but that was not an option for this study. For complete information on the Claritas variables included in the 2009 NHTS, see: <http://nhts.ornl.gov/2009/pub/UsersGuideClaritas.pdf>

tract and assigning that value to the tract. Since a complete block group dataset cannot be obtained, a dataset cannot be created for tracts in this manner. For this reason, a new urbanicity measure was created and calculated for all tracts. This measure is based on the population density of a Census tract (converted to a centile score) and on whether the Census tract is in an urban area or urban region/division. The 2010 Census tract and urban boundaries were used in combination with 2010 Census information on population and land area². The following shows the assignment of Census tracts to the following categories: urban, suburban, and rural.

Table 5. Urbanicity Index: Count of 2010 Census Tracts by Category

Category	Census Tracts	With population density centile	Number of Tracts
Urban	In UAs	60 to 100	28,471
	In UCs	30 to 100	2,773
	Total (urban)		31,244
Suburban	In UAs	Greater than 0 and less than 60	18,464
	In UCs	Greater than 0 and less than 30	670
	Total (suburban)		19,134
Rural	Not in an UA or UC	N/A	22,153
	Total (rural)		22,153
No population (but land area)			208
Total			72,739

NOTES:

There are 318 Census tracts defined in the 2010 files with no land area. There are 208 tracts with land area but with no population in 2010.

Urbanized Areas (UAs) are areas with 50,000 or more people; Urban Region/divisions (UCs) are areas with at least 2,500 and less than 50,000 people. Census Tracts in UAs are defined as those with their centroid in an UA; Census Tracts in UCs are defined as those with their centroid in an UC.

Density centile was calculated by sorting Census Tracts with a population greater than 0 by their population density in ascending order and then assigning a score from 0 to 100 to each Census Tract according to this order. The Census tract with the smallest population density was assigned a score of 0 and the Census tract with the largest population density was assigned a score of 100.

² 2010 Census Tract boundaries obtained from National Historical Geographical Information System: <https://www.nhgis.org/>; 2010 urban boundaries obtained from the 2010 Census TIGER/Line Shapefiles: <http://www.census.gov/geo/www/tiger/tgrshp2010/tgrshp2010.html>. 2010 population and land area data obtained from the Census 2010 Census Tract Relationship File: <http://www.census.gov/geo/maps-data/data/relationship.html>

The number of NHTS households in each census region/division and urban group is given in the following table:

Table 6. Breakdown of NHTS Households by Census Region/Division and Urban Group

Census Region/Division	Urban	Suburban	Rural	Total
Northeast Region	6,371	5,463	8,857	20,691
Midwest Region	3,937	4,158	7,333	15,428
South Atlantic Division	10,760	18,629	26,650	56,039
East South Central & West South Central Divisions	8,677	6,338	11,555	26,570
Mountain Division	4,088	2,244	2,674	9,006
Pacific Division	13,803	3,641	4,967	22,411
Total	47,636	40,473	62,036	150,145

Mean and Confidence Intervals of Travel Variables

The objective of dividing the NHTS households into these 18 groups is to improve the accuracy and usefulness of the regression estimates. One way to assess the groupings is to look at the differences in means and confidence intervals for each travel variable. The means and confidence intervals are shown in Figures 1 through 4. Considerable variation can be observed, both across geographical divisions and between urban groups.

Figure 1. NHTS Person Miles Means and 95% Confidence Intervals

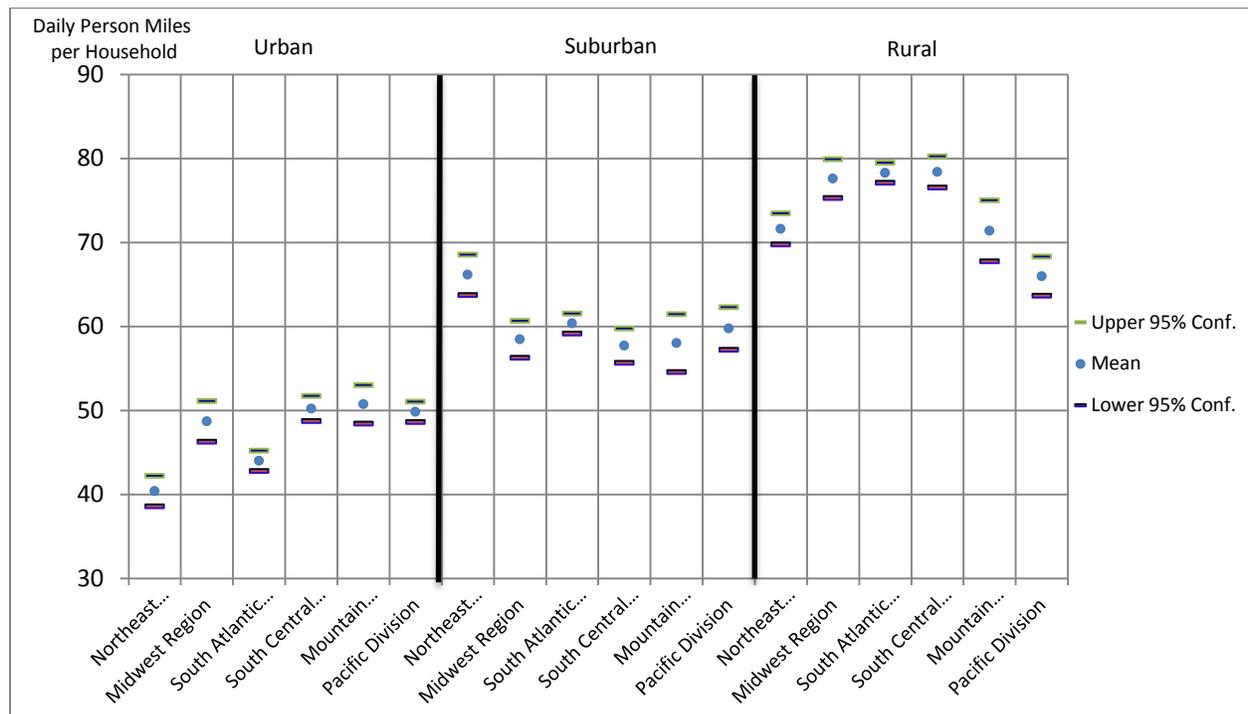


Figure 2. NHTS Person Trip Means and 95% Confidence Intervals

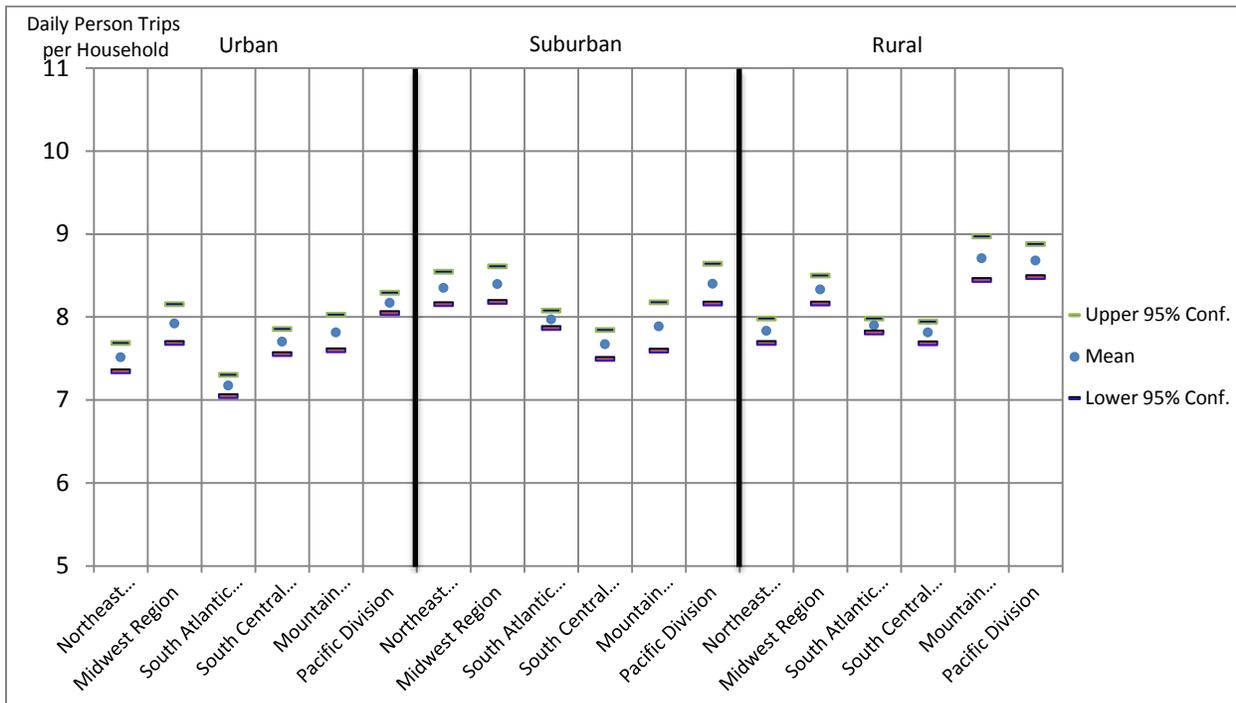


Figure 3. NHTS Vehicle Miles Means and 95% Confidence Intervals

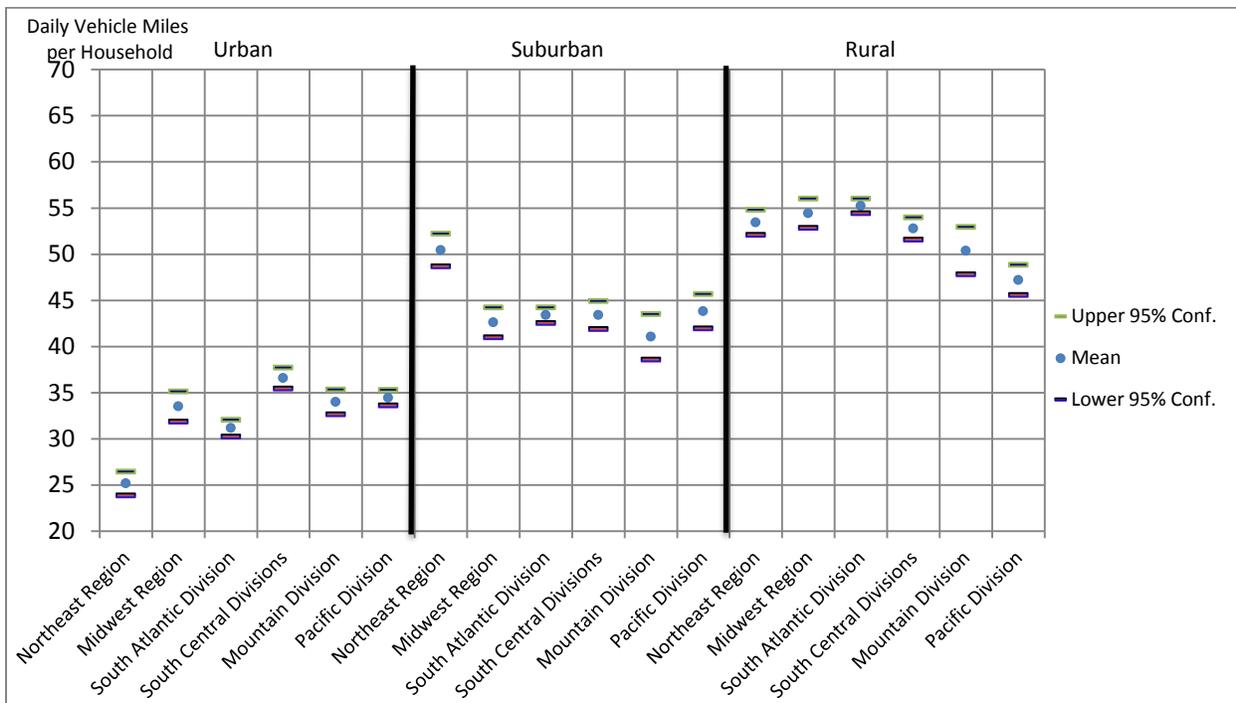
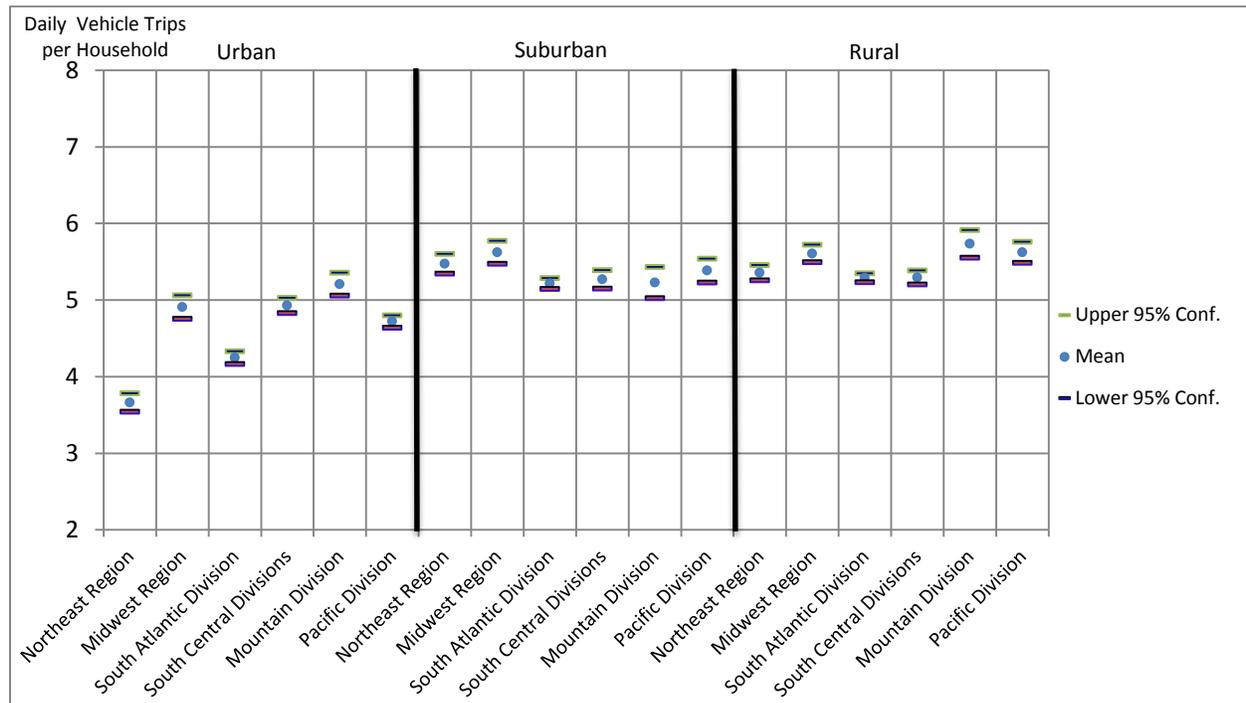


Figure 4. NHTS Vehicle Trip Means and 95% Confidence Intervals



Definition of Travel Variables and Exclusions of Certain Households

Certain NHTS households were excluded in the analysis. Only households with a weekday travel day were used, all weekend trips were excluded. This follows the methodology used in the previous 2001 NHTS Transferability Project (Hu et al. 2007) and is a common assumption in urban planning models. As in the previous study, all households in Manhattan, New York, were excluded, due to the unique travel patterns and relationships to household characteristics of that area. There were also several outliers identified in some household trip data. In order to reduce the distortions of those outliers, approximately 1 percent of the trips in the upper tail of each distribution were excluded.

Person trips include all trips, except that using an airplane mode. Vehicle trips include trips using cars, vans, SUVs, pickup trucks, other trucks, RVs, motorcycles, and light electric vehicles. It includes only trips taken by the driver of the vehicle. Household trips represent the sum of all trips taken by members of the household.

Four travel variables were estimated:

1. Total household person miles traveled, excluding outliers > 500 miles
2. Total household number of person trips, excluding outliers > 30 trips
3. Total household vehicle miles traveled, excluding outliers > 310 miles
4. Total household number of vehicle trips, excluding outliers > 20 trips

Explanatory Variables

The selection of explanatory variables to be used in the analysis relied partially on previous work in the 2001 NHTS Transferability Study (Hu et al. 2007). In addition other NHTS household variables were examined for potential inclusion. This examination also included the requirement that comparable data be available in the Census ACS public data tables at the census tract level. This became a significant constraint in developing the life-cycle household variables. The NHTS defined life-cycle variables do not have equivalent counterparts in the ACS data tables. As a result, alternative life-cycle variables were constructed that could be used with the available ACS data tables. The final set of explanatory variables used in the analysis includes:

1. Household income [**HH Income or Nat. Log (HH Income)**] This variable was converted from the household income categories in the NHTS data to a point estimate, using the mid-point of each category range. For the last category, household income above \$100,000, more detailed Census household income tables were used to derive a weighted average of \$147,500 for that category.³ The natural log of household income was also used in some cases to reflect the non-linear relationship sometimes observed between higher household income and trips taken. Household income is the best available proxy for household wealth, which is assumed to be the primary driver of discretionary travel expenditure.
2. Count of household vehicles [**Count of HH Vehicles**]
3. Number of members in household [**Count of HH Members**]
4. Homeowner (yes or no) [**Homeowner**]
5. Number of workers in household [**Number of Workers**]
6. Life-Cycle, 1 or more children in household, less than 18 years old [**Life Cycle (1+C<18)**]
7. Life-Cycle, 1 person household, less than 65 years old [**Life Cycle (1P hh<65)**]
8. Life-Cycle, 2 or more person household, all less than 65 years old [**Life Cycle (2+P hh, 0 65+)**]
9. Life-Cycle, 2 or more person household, at least one 65 or more years old [**Life Cycle (2+P hh, 1+65+)**]

³ U.S. Bureau of Census, Current Population Survey, Table HINC-01, Selected Characteristics of Households, by Total Money Income in 2009. http://www.census.gov/hhes/www/cpstables/032010/hhinc/new01_001.htm

REGRESSION ESTIMATION

The relationship between each dependent variable and the explanatory variables was estimated using multiple linear regression⁴.

Transportation variable (PT, VT, PMT, or VMT)	∝	HH Income or Nat. Log (HH Income) Count of HH Vehicles Count of HH Members Homeowner Number of Workers Life Cycle (1+C<18) Life Cycle (1P hh<65) Life Cycle (2+P hh, 0 65+) Life Cycle (2+P hh, 1+65+)
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The results of those regressions are shown in Appendix A. All of the coefficients are significant at a 5 percent confidence level. The choice of household income in linear or log form was determined by the variable giving the best fit (highest adjusted R² value). A comparison of the mean values for each category and the estimates using the regression equations are shown in Table 7. The regression equations use the mean values for each of the explanatory variables in the equation for that group. All regression estimates are within a 99% confidence interval of the mean values.

Due to the correlation between some of the explanatory variables, the impact of multicollinearity on the regression results was examined using principal components. The results of that analysis and the potential of using principal components as an alternative estimation technique are discussed below.

⁴ Example of SAS statement;

Table 7. Comparison NHTS Mean Values and Regression Estimates

Census Region/Division Category and Urban Group		Household Person Miles Traveled			Household Number of Person Trips			Household Vehicle Miles Traveled			Household Number of Vehicle Trips		
		Mean	Std. Error	Reg. Estimate	Mean	Std. Error	Reg. Estimate	Mean	Std. Error	Reg. Estimate	Mean	Std. Error	Reg. Estimate
Northeast Region	Urban	40.382	0.927	40.924	7.514	0.087	7.689	25.160	0.659	25.445	3.662	0.061	3.756
Northeast Region	Suburban	66.143	1.235	65.903	8.348	0.100	8.307	50.435	0.908	50.171	5.474	0.066	5.455
Northeast Region	Rural	71.611	0.951	72.419	7.832	0.075	7.930	53.434	0.692	54.404	5.357	0.051	5.443
Midwest Region	Urban	48.698	1.241	48.818	7.920	0.119	7.990	33.498	0.836	33.492	4.908	0.079	4.922
Midwest Region	Suburban	58.464	1.121	58.261	8.395	0.109	8.419	42.608	0.823	42.496	5.622	0.076	5.633
Midwest Region	Rural	77.603	1.185	79.131	8.328	0.086	8.425	54.419	0.810	55.312	5.607	0.058	5.637
South Atlantic Division	Urban	44.001	0.622	44.402	7.173	0.066	7.278	31.151	0.465	31.668	4.247	0.043	4.301
South Atlantic Division	Suburban	60.354	0.613	61.137	7.970	0.054	8.079	43.381	0.428	43.919	5.216	0.036	5.290
South Atlantic Division	Rural	78.291	0.610	79.008	7.895	0.043	7.957	55.207	0.411	55.847	5.290	0.029	5.335
South Central Divisions	Urban	50.228	0.758	50.825	7.702	0.077	7.816	36.584	0.580	37.009	4.929	0.051	5.034
South Central Divisions	Suburban	57.707	1.044	58.101	7.669	0.089	7.757	43.384	0.776	44.367	5.270	0.061	5.334
South Central Divisions	Rural	78.402	0.945	79.693	7.812	0.067	7.852	52.767	0.619	53.297	5.294	0.046	5.325
Mountain Division	Urban	50.724	1.174	51.216	7.811	0.109	7.811	33.980	0.690	34.839	5.208	0.076	5.208
Mountain Division	Suburban	58.023	1.759	58.904	7.886	0.149	7.980	41.044	1.256	41.044	5.227	0.105	5.287
Mountain Division	Rural	71.389	1.854	71.741	8.706	0.134	8.717	50.354	1.310	50.436	5.733	0.092	5.743
Pacific Division	Urban	49.833	0.626	50.080	8.168	0.062	8.233	34.449	0.437	34.696	4.718	0.041	4.763
Pacific Division	Suburban	59.751	1.295	58.873	8.400	0.123	8.500	43.810	0.949	43.050	5.383	0.080	5.425
Pacific Division	Rural	65.990	1.181	65.847	8.678	0.102	8.744	47.198	0.837	46.880	5.621	0.070	5.641

Principal Component Analysis

Several of the variables chosen to estimate household travel patterns measure similar concepts. For example, the presence or absence of persons 18 or younger in the household and the number of household members are means for describing the composition of a household. Because these two variables measure household composition in slightly different ways, both are included in the model. However, inclusion of both introduces multicollinearity into the model. The presence of multicollinearity is suspected given the relatively high degree of correlation between the independent variables (for an example, see Table 8).

Table 8. Correlation between Independent Variables (Excluding Life-cycle Indicators) for the Sample Used to Predict Person Miles in the Midwest Region, by Urban Group

Census Region/ Division	Urban Group	Variable	Household Income	Count of Household Vehicles	Count of Household Members	Number of Workers in Household	Homeowner	1+ child
Midwest	Urban	Household Income	1.00	0.39	0.15	0.36	0.56	0.22
	Suburban		1.00	0.44	0.29	0.42	0.54	0.24
	Rural		1.00	0.37	0.31	0.42	0.51	0.30
	Urban	Count of Household Vehicles	0.39	1.00	0.24	0.46	0.48	0.23
	Suburban		0.44	1.00	0.33	0.48	0.64	0.15
	Rural		0.37	1.00	0.33	0.44	0.49	0.24
	Urban	Count of Household Members	0.15	0.24	1.00	0.35	0.06	0.82
	Suburban		0.29	0.33	1.00	0.45	0.08	0.89
	Rural		0.31	0.33	1.00	0.45	0.19	0.85
	Urban	Number of Workers in Household	0.36	0.46	0.35	1.00	0.20	0.36
	Suburban		0.42	0.48	0.45	1.00	0.19	0.40
	Rural		0.42	0.44	0.45	1.00	0.30	0.41
	Urban	Homeowner (1=Yes; 0=No)	0.56	0.48	0.06	0.20	1.00	0.09
	Suburban		0.54	0.64	0.08	0.19	1.00	-0.03
	Rural		0.51	0.49	0.19	0.30	1.00	0.09
	Urban	1+ child <18 (1=Yes; 0=No)	0.22	0.23	0.82	0.36	0.09	1.00
	Suburban		0.24	0.15	0.89	0.40	-0.03	1.00
	Rural		0.30	0.24	0.85	0.41	0.09	1.00

NOTE: Pearson correlation used between continuous independent variables, polychoric correlation between binary and continuous independent variables, and tetrachoric correlation between binary independent variables. Homeowner and 1+ child <18 are binary variables; all other variables are continuous.

Multicollinearity decreases the reliability of the independent variables in predicting household travel by inflating the variance of the independent variables, which makes it difficult to assess whether a specific independent variable is statistically significant. To more accurately capture the effect of the independent variables, principle component analysis (PCA) was explored to collapse the explanatory variables into a smaller number of artificial variables called principal components (PCs) that are serially uncorrelated with one another. The PCs are then used in place of the independent variables to predict household travel.

The PCs were selected using the same independent variables and the same initial sample used to create the linear regression models for each Census region/division and urban group. The selection process was performed in SAS through proc factor, principle component analysis with varimax rotation and with a user-specified correlation matrix containing the Pearson correlation between continuous independent variables, polychoric correlation between binary and continuous independent variables, and tetrachoric correlation between binary independent variables. The life-cycle indicators were not included in the analysis. Inclusion of the life-cycle indicators requires forcing the correlation amongst the indicators to be zero (since the indicators are mutually exclusive). This causes the life-cycle indicators to load on separate PCs. Since each PC theoretically measures a distinct construct, the dispersion of the life-cycle indicators makes little theoretical sense. Theoretically, the life-cycle indicators ought to belong to the same PC, because they all measure the same construct (household life-cycle). Since this cannot occur when serially uncorrelated, the life-cycle indicators are excluded so as to produce interpretable PCs from the remaining independent variables.

In each Census region/division and urban group, 70 percent or more of the variation in the independent variables could be explained by two PCs. Household size and the presence of a child loaded strongly onto the first PC across all Census region/division and urban groups. Across all Census region/divisions and urban groups, only one variable loaded strongly onto the second PC and onto all subsequent and less significant PCs. Since more than one variable loaded strongly onto only the first PC, only the first PC was used in place of the independent variables it represented. The other PCs represented one of the independent variables that did not load onto the first PC and in representing only one of the independent variables, the other PCs provided no variable reduction advantage. The independent variables that loaded onto these PCs were used as regressors, in their original form, with the PC representing household size and the presence of a child to predict each household travel measure (vehicle miles traveled, person miles traveled, vehicle trips, and person trips). The results of these principle component regression (PCR) models were compared to the results from the linear regression models with all regressors in their original specification. There was no significant improvement in the fit of the models (in terms of the AIC, BIC, or adjusted R-squared) from using PCR. This was not unexpected because multicollinearity typically does not affect the fit of the model. Instead, multicollinearity affects the reliability of the predictors. Since the goal here is not to isolate the effect of individual regressors and separately measure the effects of each independent variable on household travel, linear regression models without PCs were selected after verifying that they otherwise fit the data as well as the models with PCs.

Validation

The linear regression models were evaluated for their prediction accuracy at the Census tract level. This was done by comparing the mean number of vehicle miles traveled, person miles traveled, vehicle trips, and person trips to the number calculated from the corresponding regression model. The non-public 2009 NHTS files were used to calculate the mean value of the four household travel variables in each Census tract. Predicted values were calculated using both the non-public 2009 NHTS files and the 2005-2009 American Community Survey (ACS) dataset. The 2005-2009 ACS dataset was used for evaluation rather than the 2007-2010 dataset, which was used to make travel estimates, because it uses the same statistical boundaries for Census tracts as the 2009 NHTS. This means that predicted household travel can be compared to the average estimated from households in the NHTS dataset that belong to the same Census tract⁵.

Household vehicle miles traveled, person miles traveled, vehicle trips, and person trips were predicted for each Census tract in two different ways:

- (1) By calculating the mean household values of each census tract for each independent variable⁶ from the NHTS dataset, and inserting them into the appropriate regression equation for that Census tract, and
- (2) By inserting the value extracted from the ACS dataset for each independent variable into the appropriate regression equation for each Census tract (see Table 9 for an example)⁷.

⁵ There are a few exceptions as a few Census tracts in the 2005-2009 ACS were defined by their 2010 statistical boundaries rather than their 2000 boundaries. Only Census tracts defined by their 2000 boundaries were evaluated for their prediction accuracy since the Census tract geographic identifiers in the non-public 2009 NHTS are based on the 2000 definitions.

⁶ The final household weight was in creating the linear regression models to predict household travel but was not used in calculating the mean household characteristics for a given Census tract since the final household weight was not intended to make households within a Census representative of the Census tract itself.

⁷ Census Tracts with a group quarters population were excluded because the number of workers per household could not be calculated, using the 2005-2009 ACS, without including workers living in group quarters (and hence not in a household) in the count of workers.

Table 9. Validation Process: Prediction of Person Miles Using American Community Survey Data (ACS)

Variable	Regression parameter	Value for Census Tract 19113000400 (from 2005-2009 ACS)	Col. (A) * (B)
	Col. (A)	Col. (B)	Col. (C)
Intercept	-18.5328	NA	-18.5328
Nat. Log (HH Income)	6.0875	4.0130	24.4292
Count of HH Vehicles	8.6363	1.8987	16.3979
Count of HH Members	6.5758	2.3644	15.5478
Number of Workers	11.2000	1.1856	13.2786
Life Cycle (1+C<18)	17.9354	0.3771	6.7638
Life Cycle (2+P hh, 1+65+)	9.5636	0.1784	1.7061
PMT			59.6

The predicted values were compared to the NHTS values in all Census tracts where at least eight or more households were surveyed for the NHTS. This size requirement, developed in conversations with some researchers of the previous NHTS study, provides greater confidence in representing a given Census tract. However, requiring more than eight households reduces the number of Census tracts that can be evaluated for their prediction accuracy. See Tables B1 to B4 in Appendix B for the count of Census tracts in each Census region/division and urban group that had eight or more households and the necessary data for making an accuracy assessment.

To aid in the assessment of the quality of the models For the Census tracts where a comparison could be made, the absolute percent error between the NHTS value and the predicted value in each Census tract was calculated and then compared to the median of these errors in each Census region/division and urban group to arrive at the median absolute percent error (MAPE) (see Tables B1 to B4 in Appendix B). The models for vehicle trips and person trips tend to predict better than the models for vehicle miles and person miles, as they show much smaller MAPEs across all Census region/divisions and urban groups. The MAPE tends to be larger in Census region/divisions and urban groups in all models where the medians for the independent variables from the NHTS dataset are significantly different from the medians from the ACS dataset for all Census tracts included in the evaluation (see the MAPE in Tables B5 to B8 in Appendix B). These differences in the median values are a major contributor to the larger MAPEs.

Travel Variable Estimates by Census Tract

After confirming that the models predict household travel well, estimates for the four household travel variables were made for all Census tracts in the U.S., with the exception of Census tracts in Manhattan⁸,

⁸ Census tracts in Manhattan were identified from the New York City Department of Urban Planning: (<http://www.nyc.gov/html/dcp/html/bytes/dwndistricts.shtml#cbt>) and were suppressed given the significant

using the 2007-2011 ACS. The 2007-2011 dataset was selected over ACS datasets in prior years, because it is the latest ACS release with the demographic and socio-economic data needed to make travel predictions at the Census tract level. The 2007-2011 dataset uses 2010 Census tract definitions rather than the 2000 definitions used in the 2009 NHTS. This difference precluded the 2007-2011 ACS dataset from being used to evaluate the prediction accuracy of the models but does not preclude the dataset from being used to make Census tract estimates of household travel. The models for predicting household travel were developed independently from Census tract boundaries and hence can be used for predicting household travel for any geographic entity within a Census region/division where the Census region/division id and urban group are known.

The urban group for all Census tracts in the 2007-2011 ACS dataset was identified per the method described in above section on the development of the urbanicity index using 2010 Census boundaries and population information⁹. A list of the data pulled from the 2007-2011 American Community Survey 5-year estimates data files can be found in Table 10. The ACS data were used to predict household travel. The estimates of household travel were evaluated non-spatially and spatially for reasonability. Spatial evaluation was performed first per the method below.

Table 10. Independent Variable Derivations from 2007-2011 American Community Survey

Variable	Formula (ACS Table ID + 'e' + Line Number)
Households	B11005e1
Independent Variables	
Household Income (Thousands \$)	B19013e1
Natural Log (Household Income)	Natural Log (B19013e1)
Count of Household Vehicles	B25046e1 / B11005e1
Count of Household Members	B11002e1 / B11005e1
Homeowner (0 to 1)	B25009e2 / B11005e1
Number of Workers	B08137e1 / B11005e1
Life Cycle (1+ child <18)	B11005e2 / B11005e1
Life Cycle (1 person household, <65)	B11007e8 / B11005e1
Life Cycle (2+ person household, 0 65+)	B11007e9 / B11005e1
Life Cycle (2+ person household, 1+ 65+)	B11007e4 / B11005e1

NOTE: Data pulled from summary flat files http://www2.census.gov/acs2011_5yr/summaryfile/

Spatial identification of unreliable estimates

difference in travel behavior between those living in Manhattan and those outside of Manhattan but still in the same Census region/division.

⁹ Per the U.S. Census Bureau, there are a few Census tracts in the 2005-2007 ACS with geo-identifiers that are different from the 2010 geographic definitions used for all other tracts. In a few instances, the geographic definitions remained the same but the numbering of the tract changed. In all other instances, both the geographic definitions and the numbering changed. For tracts that retained their geographic definitions but changed numbering, the new numbering was replaced with the numbering used in the 2010 geographic definitions. These tracts included: '36053940101' renumbered as '36053030101'; '36053940102' renumbered as '36053030102'; '36053940103' renumbered as '36053030103'; '36053940200'; renumbered as '36053030200'; '36053940300' renumbered as '36053030300'; '36053940401' renumbered as '36053030401'; '36053940403'; renumbered as '36053030403'; '36053940600' renumbered as '36053030600'; '36053940700' renumbered as '36053030402'; '36065940000'; renumbered as '36065024800'; '36065940100' renumbered as '36065024700'; '36065940200' renumbered as '36065024900'. For further information, see http://www.census.gov/acs/www/data_documentation/geography_notes/#centrct

Prior to testing for spatial reasonableness, estimates of household travel were examined, since the quality of the spatial analysis can be compromised by extreme values. Extreme estimates were defined as those less than the 1st percentile and greater than the 99th percentile of the NHTS mean value in a given Census region/division and urban group. No estimates were identified as extremes per these criteria.

Spatial reasonableness was examined by comparing household travel estimates for a Census tract to those of its neighbors. Neighboring tracts were defined as those that share an edge or a corner with the Census tract being evaluated for spatial reasonableness. If the household travel estimate for one or more of the four variables was significantly lower or higher than that of neighboring tracts, the significantly different estimate was considered spatially unreliable. This was performed by first using ArcGIS to identify the neighbors of each Census tract and then by calculating the Moran's I statistic for each Census tract in SAS.

The Moran's I statistic is a spatial statistic that tells how much a feature is similar or dissimilar to its neighbors. Features that are similar to their neighbors have large, positive Moran's I statistics. Features that are dissimilar to their neighbors have large, negative Moran's I statistics. Here, being dissimilar is used to mark spatially unreliable estimates as it is assumed that features near one another should exhibit similar travel patterns. The formula for the Moran's I statistic used to identify these dissimilar values can be found in figure 5.

Figure 5. Moran's I Statistic

$$I_i = \frac{(x_i - \bar{x})}{s^2} * \sum_j w_{ij}(x_j - \bar{x})$$

Where x_i is the target feature value, s^2 is the variance, w_{ij} is the weight for the target feature and neighbor pair, x_j is the neighbor value, and \bar{x} is the mean. The variance and the mean are calculated from the estimated values for the same Census region/division and urban group as the target feature.

As shown in the formula, the statistic involves the use of the overall mean (\bar{x}) in comparing a Census tract (x_i) to its neighbors (x_j). Since the models were developed specific to a Census region/division and urban group, the mean for the Census region/division and urban group were used in the formula rather than the overall mean. The Moran's I statistics were evaluated for statistical significance by calculating the z-score. Negative Moran's I statistics with statistically significant z-scores at the 99% confidence interval belong to estimates that are dissimilar from surrounding values. These estimates are marked as being spatially unreliable. Only a few estimates were marked as such and suppressed.

Non-spatial identification of outliers

After testing for spatial reasonableness, the estimates were evaluated further for non-spatial reasonableness by examining the distribution of the estimates. With the exception of vehicle miles traveled for five distinct Census tracts, all estimates for all variables were found to be within the range of values for the same travel variable used to create the regression model. The exceptions to this were resolved by suppressing the estimates for all household travel estimates within the bottom and top 0.5 percent of the distribution of the estimates. This tightened the range of the estimates and resulted in all estimates being within the range of values used to create the regression model (see Tables 11 through 14 for final counts and distribution of the estimates after completion of spatial and non-spatial reasonableness checks and see Appendix C for a description of the final dataset).

Table 11. Distribution of Person Mile Estimates

Census Region/ Division	Urban Group	Count of outliers		Distribution of person mile estimates after excluding outliers and tracts missing one or more travel estimates							
		Spatial	Bottom/ Top 0.5%	N	Mean	Standard deviation	Maximum	Q3	Median	Q1	Minimum
Northeast Region	Urban	4	66	6578	44.2	11.9	76.9	52.0	43.8	35.3	15.8
	Suburban	3	30	3090	70.7	15.3	120.5	81.0	70.2	59.7	25.1
	Rural	3	28	2820	76.7	9.7	105.6	82.8	75.7	69.8	53.1
Midwest Region	Urban	3	62	6159	52.9	9.4	79.6	58.9	52.9	47.0	23.2
	Suburban	2	44	4380	62.5	11.5	91.7	70.4	62.5	55.0	28.8
	Rural	15	58	5824	78.6	9.2	107.5	84.8	78.5	72.2	56.1
South Atlantic Division	Urban	5	42	4180	50.3	10.6	78.8	57.5	49.9	43.0	22.2
	Suburban	2	46	4552	66.5	13.9	100.6	76.7	66.3	56.3	29.4
	Rural	8	42	4228	83.4	11.4	117.7	90.6	82.6	75.3	55.0
East and West South Central Divisions	Urban	4	36	3702	53.3	10.0	82.1	60.0	52.6	46.1	27.9
	Suburban	2	32	3260	63.0	11.2	90.1	70.7	62.4	55.2	32.4
	Rural	25	50	5016	84.2	8.8	109.3	89.9	83.7	78.0	62.5
Mountain Division	Urban	1	24	2343	54.1	13.4	89.0	63.8	53.9	44.8	17.1
	Suburban	0	10	1085	69.4	13.7	100.0	79.0	69.9	61.0	27.6
	Rural	1	14	1546	74.0	14.4	119.2	83.1	72.5	63.3	40.3
Pacific Division	Urban	2	68	6886	59.0	10.6	87.8	66.7	59.1	51.6	24.6
	Suburban	5	16	1613	64.3	12.3	92.3	73.0	64.8	56.5	28.0
	Rural	1	18	1885	65.4	11.1	97.6	73.0	65.2	56.9	38.2

Table 12. Distribution of Person Trip Estimates

Census Region/ Division	Urban Group	Count of outliers		Distribution of person trip estimates after excluding outliers and tracts missing one or more travel estimates							
		Spatial	Bottom/ Top 0.5%	N	Mean	Standard deviation	Maximum	Q3	Median	Q1	Minimum
Northeast Region	Urban	3	66	6578	8.8	1.3	12.9	9.7	8.8	7.9	4.9
	Suburban	1	30	3090	9.0	1.2	12.0	9.9	9.0	8.2	4.8
	Rural	3	28	2820	8.8	0.9	11.6	9.4	8.8	8.2	6.4
Midwest Region	Urban	0	62	6159	9.0	1.5	13.5	9.9	9.0	8.1	4.7
	Suburban	1	44	4380	8.8	1.4	12.8	9.7	8.7	7.9	5.0
	Rural	4	58	5824	8.8	0.9	12.0	9.4	8.8	8.2	6.6
South Atlantic Division	Urban	3	42	4180	8.4	1.5	12.8	9.4	8.3	7.3	4.5
	Suburban	2	46	4552	8.9	1.5	12.8	10.0	8.9	7.9	5.1
	Rural	2	42	4228	8.5	1.0	11.9	9.1	8.5	7.8	6.1
East and West South Central Divisions	Urban	0	36	3702	8.9	1.5	13.0	9.9	8.8	7.9	5.1
	Suburban	1	32	3260	9.1	1.4	12.8	10.0	9.0	8.1	4.8
	Rural	0	50	5016	8.8	0.9	12.0	9.3	8.7	8.1	6.6
Mountain Division	Urban	0	24	2343	8.6	1.4	12.2	9.7	8.6	7.7	4.7
	Suburban	2	10	1085	9.0	1.8	13.9	10.3	9.0	7.7	4.5
	Rural	0	14	1546	9.3	1.3	13.6	10.2	9.2	8.3	5.8
Pacific Division	Urban	0	68	6886	9.8	1.8	14.7	11.0	9.8	8.5	4.8
	Suburban	3	16	1613	9.8	1.4	13.2	10.8	9.9	9.0	5.4
	Rural	0	18	1885	9.1	1.2	12.4	9.9	9.0	8.2	6.2

Table 13. Distribution of Vehicle Mile Estimates

Census Region/ Division	Urban Group	Count of outliers		Distribution of vehicle mile estimates after excluding outliers and tracts missing one or more travel estimates							
		Spatial	Bottom/ Top 0.5%	N	Mean	Standard deviation	Maximum	Q3	Median	Q1	Minimum
Northeast Region	Urban	4	66	6578	26.1	10.4	51.6	33.6	26.4	17.9	3.7
	Suburban	4	30	3090	52.9	11.2	87.9	60.4	52.7	45.3	20.1
	Rural	2	28	2820	55.9	7.2	76.2	60.6	55.2	50.8	37.8
Midwest Region	Urban	2	62	6159	34.4	7.8	53.8	39.6	34.9	29.3	10.1
	Suburban	0	44	4380	44.7	9.0	65.7	51.1	45.1	39.0	16.4
	Rural	7	58	5824	54.5	7.3	76.3	59.3	54.3	49.4	35.9
South Atlantic Division	Urban	3	42	4180	35.3	8.4	55.8	41.0	35.3	30.0	11.8
	Suburban	1	46	4552	46.8	10.2	71.9	54.3	46.8	39.5	18.2
	Rural	4	42	4228	57.4	8.4	82.2	62.9	57.0	51.4	36.1
East and West South Central Divisions	Urban	1	36	3702	37.6	7.6	59.4	42.5	37.3	32.4	16.8
	Suburban	0	32	3260	47.0	7.6	65.6	52.5	46.9	41.9	24.6
	Rural	3	50	5016	54.1	6.7	73.5	58.5	53.9	49.6	37.2
Mountain Division	Urban	0	24	2343	35.1	8.5	57.2	40.9	34.8	28.7	14.6
	Suburban	0	10	1085	46.9	10.0	68.8	54.0	47.5	40.7	16.9
	Rural	3	14	1546	51.5	10.7	84.6	58.7	50.6	43.6	26.2
Pacific Division	Urban	2	68	6886	40.4	8.0	60.7	46.3	40.4	35.0	14.7
	Suburban	1	16	1613	47.2	8.1	63.1	53.2	48.1	42.3	22.1
	Rural	0	18	1885	45.9	7.6	68.3	51.0	45.7	40.3	28.0

Table 14. Distribution of Vehicle Trip Estimates

Census Region/ Division	Urban Group	Count of outliers		Distribution of vehicle estimates after excluding outliers and tracts missing one or more travel estimates							
		Spatial	Bottom/ Top 0.5%	N	Mean	Standard deviation	Maximum	Q3	Median	Q1	Minimum
Northeast Region	Urban	0	66	6578	4.0	1.2	6.6	4.8	4.0	3.1	1.4
	Suburban	1	30	3090	5.7	0.8	7.6	6.3	5.8	5.2	3.0
	Rural	2	28	2820	5.9	0.6	7.5	6.3	5.8	5.4	4.1
Midwest Region	Urban	0	62	6159	5.2	1.0	7.8	5.9	5.3	4.6	2.0
	Suburban	0	44	4380	5.8	1.0	8.1	6.5	5.8	5.1	2.7
	Rural	1	58	5824	5.7	0.6	7.5	6.1	5.7	5.3	4.2
South Atlantic Division	Urban	1	42	4180	4.7	0.9	7.1	5.3	4.7	4.1	2.2
	Suburban	1	46	4552	5.6	0.9	8.0	6.3	5.6	5.0	3.1
	Rural	2	42	4228	5.5	0.6	7.3	5.9	5.4	5.0	3.9
East and West South Central Divisions	Urban	0	36	3702	5.4	0.9	7.7	6.0	5.4	4.8	2.8
	Suburban	1	32	3260	5.8	0.9	7.9	6.5	5.8	5.2	3.0
	Rural	1	50	5016	5.6	0.6	7.3	6.0	5.6	5.3	4.2
Mountain Division	Urban	0	24	2343	5.4	0.7	7.4	6.0	5.5	4.9	3.3
	Suburban	0	10	1085	5.9	1.1	8.5	6.7	5.9	5.1	2.7
	Rural	1	14	1546	6.1	0.7	8.1	6.6	6.1	5.6	4.1
Pacific Division	Urban	1	68	6886	5.4	1.0	7.9	6.1	5.4	4.8	2.3
	Suburban	2	16	1613	6.1	0.8	7.7	6.6	6.2	5.6	3.5
	Rural	0	18	1885	5.8	0.7	7.6	6.3	5.8	5.3	4.0

RESULTS, CHALLENGES, AND CONCLUSIONS

The resultant averages of the key transportation measures, by region and by urbanicity, provide assurance as to the quality of the regressions employed by comparing the results across the 18 categories. For example, as expected for the mean of person miles traveled (Table 11), the urban person miles are the lowest (as compared to suburban and rural) for each region; the order of mileage for each region is consistently urban lowest, then, suburban, and finally rural with the highest. The Northeast Region has the smallest urban person miles at an average of 44.2 miles. The Pacific Division, not surprising, has the longest urban person miles – at an average of 59.0, but not the longest average of rural (the Pacific Division had a rural average of 65.4). The longest rural person miles are in the East and West South Central Divisions, at an average of 84.2 miles, with a close second in the rural area of the South Atlantic Division, of 83.4 miles.

Since the results for passenger trips are represented by a count variable, the averages are not as dispersed as the person miles results (Table 12). The trips range from 8.4 (for South Atlantic urban) to 9.8 (Pacific urban and Pacific suburban). For the Midwest region, the urban trips are the highest (9.0); but, for the remaining regions, the suburban trips are the greatest. (For the Pacific Division, the suburban and urban numbers of trips are the same.)

Looking next to the results for the vehicle miles (Table 13), the lowest average mileage of 26.1 is again for the Northeast urban; the highest, 57.4 miles, is for the South Atlantic rural. For all but the Pacific Division, the average urban mileage is less than the suburban, which is, in turn, less than the rural mile averages. For the Pacific Division, the suburban vehicle mile average is greater than the rural.

Lastly, the vehicle trip estimates (Table 14) differ slightly from the person trips. The lowest average number of trips is for the urban area in the Northeast Region (4.0), whereas the highest vehicle trips average is for the Mountain rural and Pacific suburban (6.1). In all cases, urban areas have the lowest average number of vehicle trips, but in most regions/divisions, the number of suburban vehicle trips is higher than the number of rural trips. Only two rural areas were higher than the suburban areas, the Northeast Region and the Mountain Division.

Estimation by Census tract

Employing the results from the regression models, the next stage of research was undertaken – providing the estimates of PT, PMT, VT and VMT for each census tract. These estimates are made by transferring census tract information from the ACS (with the exception of Manhattan and the tracts suppressed for reasons above). Maps of the four travel variables are provided below in Figures 5 - 8:

Figure 5. Estimated Vehicle Miles per Census Tract

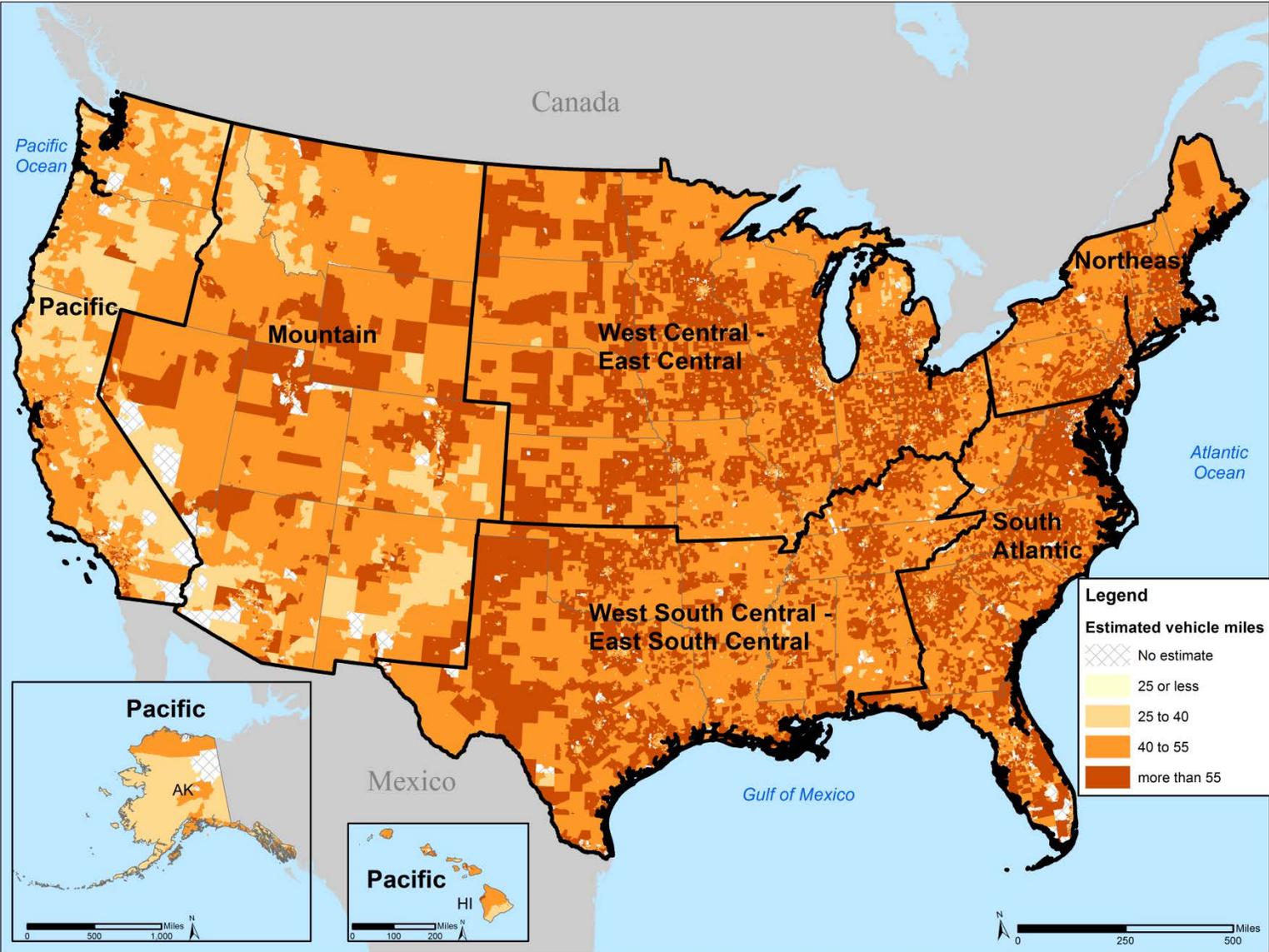


Figure 6. Estimated Person Miles per Census Tract

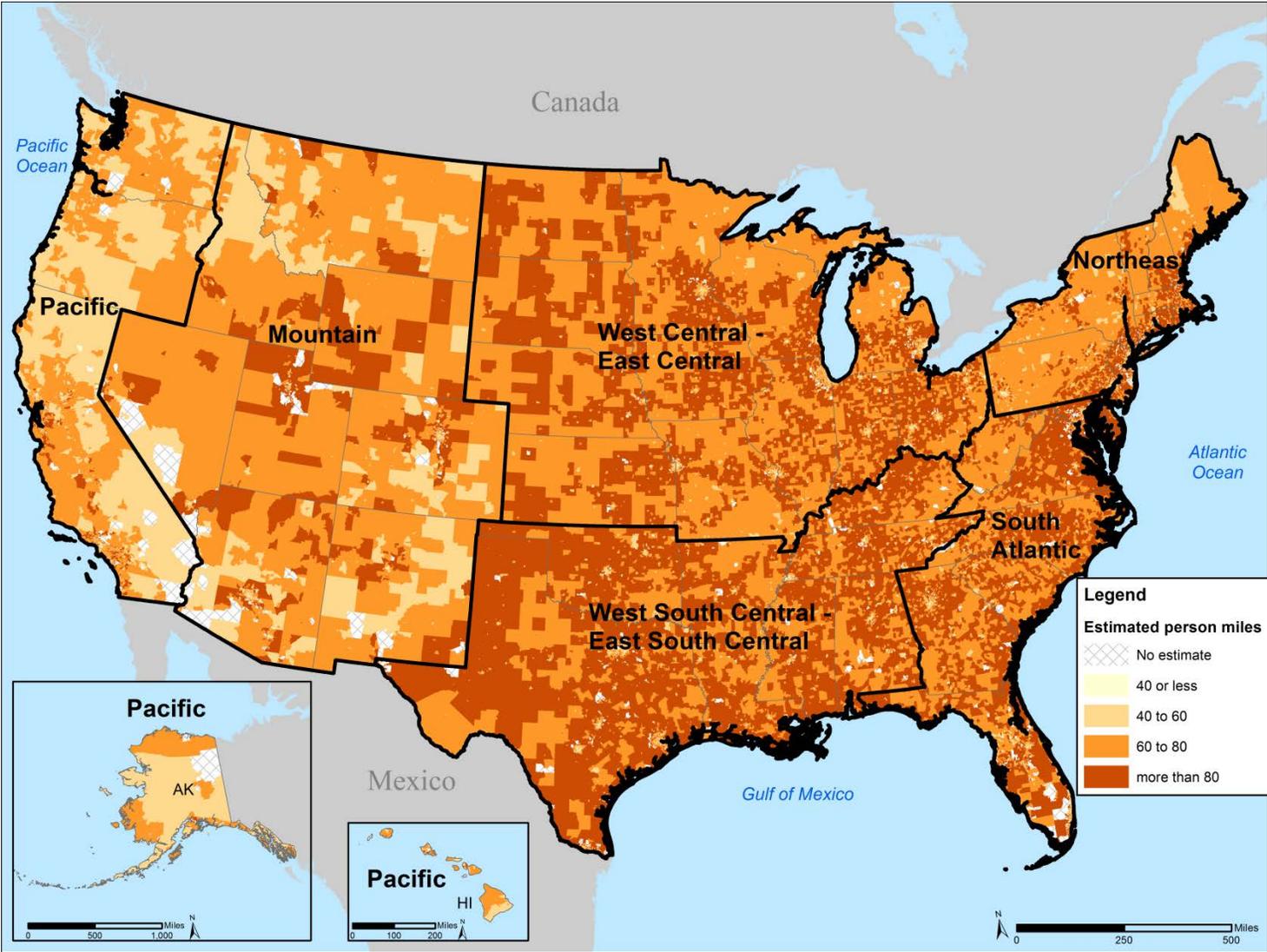


Figure 7. Estimated Vehicle Trips by Census Tract

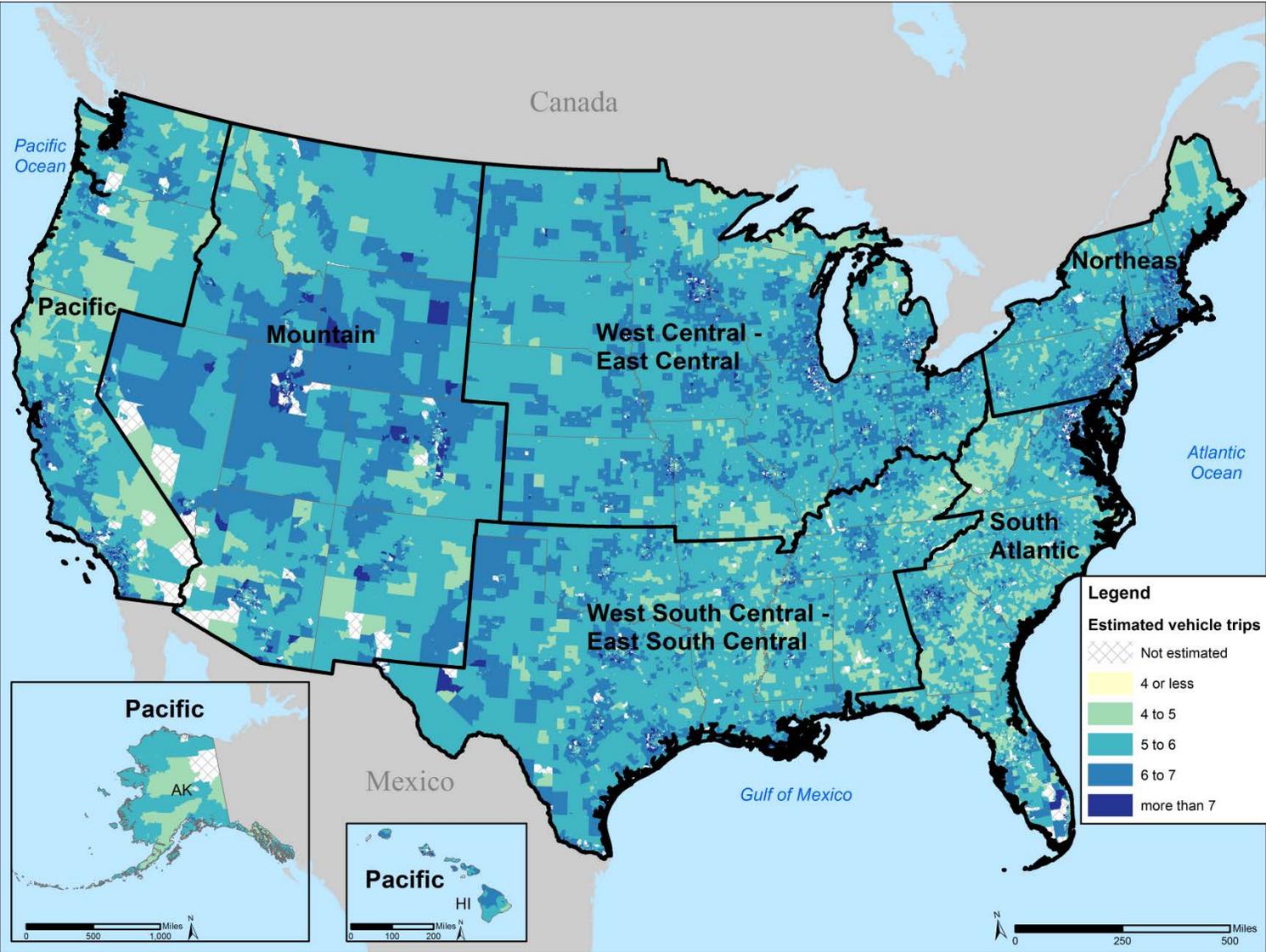
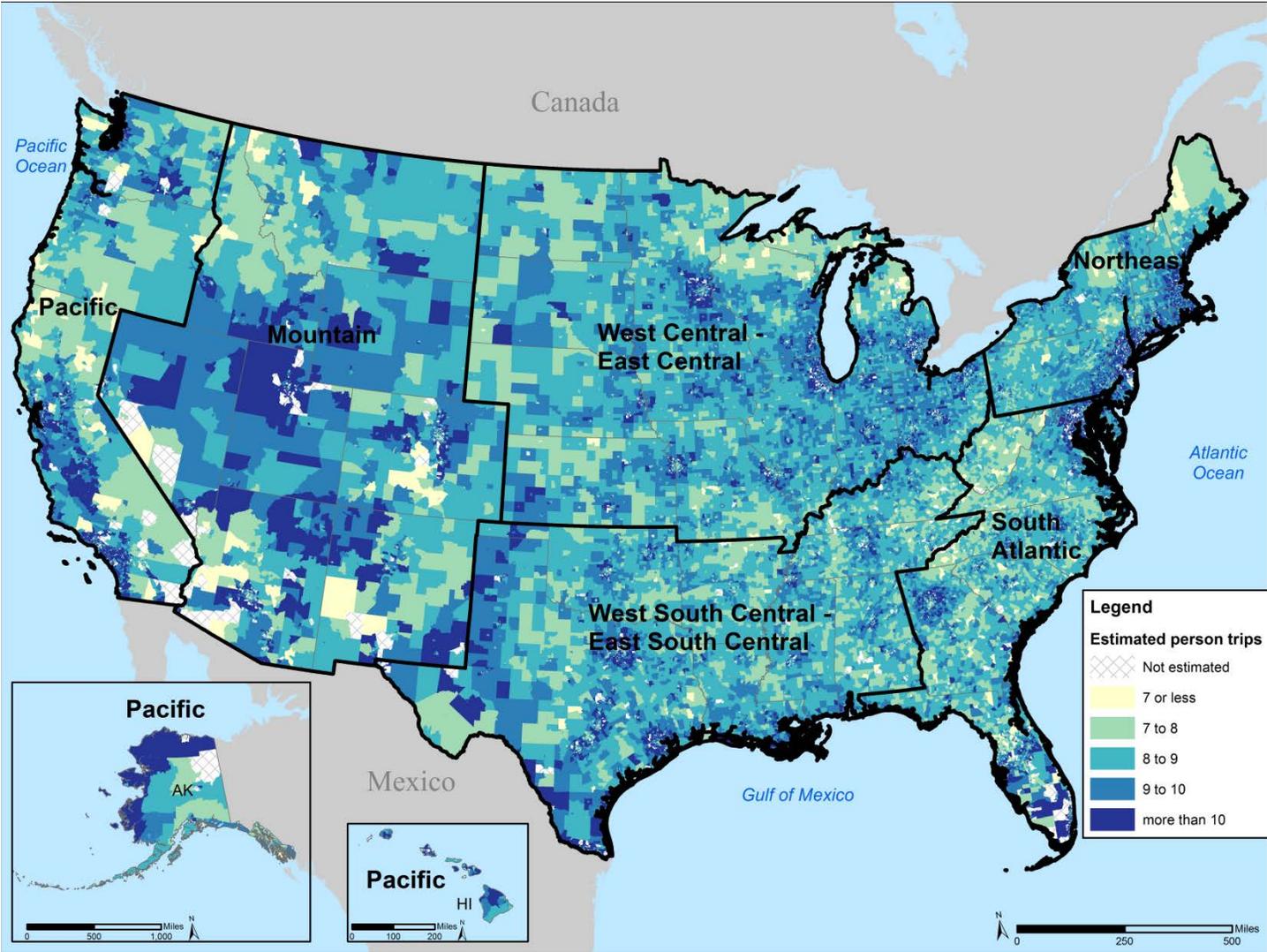


Figure 8. Estimated Person Trips by Census Tract



These estimates, by census tract, are available in state-by-state flat files, as well as in a SAS data file (the format of the SAS file is given in Appendix C). These files can be found on the BTS website: http://www.rita.dot.gov/bts/sites/rita.dot.gov/bts/files/subject_areas/national_household_travel_survey/index.html (under *NHTS 2009 Transferability Statistics* in the Detailed Data section).

Comments on Data

There are a few challenges associated with the data. The accuracy of the Census tract estimates could not be measured directly as there are no Census tract data to compare against the model results. Because the models explained only a limited amount of the variation in PT, PMT, VT, and VMT at the region level, the models are likely to explain even less at smaller geographies where statistical variability is expected to be higher. A limited comparison was made against NHTS data, where a reasonable number of households were sampled in a Census tract. These NHTS estimates proved similar to the estimates made by transferring the ACS data.

The ability to produce sub-national estimates is limited by the NHTS sample design. NHTS data are collected through random digit dialing (RDD) for a national sample and for select 'add-on' or oversampled geographic areas. The oversampled geographic areas are the areas where subnational level estimates can be best measured because of the larger sample size. The regions created here to estimate tract level PT, PMT, VT, and VMT include these oversampled geographic areas with areas covered by a much smaller sample. The characteristics of the areas with a smaller sample may be different from the oversampled areas and as such, the estimates of PT, PMT, VT, and VMT may be less accurate in these sparsely sampled areas.

The RDD design itself poses challenges in coverage and nonresponse bias. The response rate for the NHTS is relatively low (approximately 20 percent), which suggests the potential for nonresponse bias. This may be more extensive among demographic groups that are difficult to reach because they are highly mobile.

Finally, there are a few challenges associated with using the ACS data. ACS census tract level data are multi-year estimates. This adds variation to the data when changes occur over time.

Given these data challenges, however, the models still provide useful travel data, by census tract, that can be employed by planners and researchers alike.

It is recognized that transit accessibility and use impacts travel behavior, especially VMT. Future transferability projects could be improved by having GTFS (General Transit Feed Specification) for transit integrated with the project. This would help in getting more reliable results for census tracts in Chicago, San Francisco, Washington D.C, and other areas with higher transit usage.

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APPENDIX A. REGRESSION EQUATIONS

Table A1. Household Person Miles Traveled, Northeast Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-4.90389	-2.79	0.0053	-10.42098	-3.84	0.0001	-6.93912	-2.83	0.0046
HH Income (Thous. \$)	0.15254	6.85	<.0001	0.26662	10.39	<.0001	0.10389	4.98	<.0001
Nat. Log. (HH Income)									
Count of HH Vehicles	14.22240	14.18	<.0001	9.15699	7.63	<.0001	6.23972	7.39	<.0001
Count of HH Members				4.59441	3.93	<.0001	8.25954	7.78	<.0001
Homeowner							12.44722	5.54	<.0001
Number of Workers	12.14633	9.63	<.0001	18.82581	12.02	<.0001	19.49523	15.23	<.0001
Life Cycle (1+C <18)	11.82162	4.99	<.0001	23.44566	6.96	<.0001	17.81782	6.35	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	5.91647	2.39	0.0167				7.55948	3.23	0.0012
Life Cycle (2+P hh, 1+ 65+)	11.30437	4.21	<.0001						
Adj. R-Sq	0.2359			0.3016			0.2649		
F Value	198.21			297.06			301.48		
Obser. Used	3,834			3,428			5,837		

Table A2. Household Person Miles Traveled, Midwest Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-18.53276	-3.65	0.0003	-31.94327	-6.77	<.0001	-1.51671	-0.54	0.5899
HH Income (Thous. \$)							0.22119	7.30	<.0001
Nat. Log. (HH Income)	6.08751	4.13	<.0001	10.86391	7.93	<.0001			
Count of HH Vehicles	8.63627	6.48	<.0001	8.61841	7.16	<.0001	9.89173	10.04	<.0001
Count of HH Members	6.57575	6.09	<.0001	6.12712	5.10	<.0001	7.23071	5.11	<.0001
Homeowner									
Number of Workers	11.19997	6.29	<.0001	9.98903	6.35	<.0001	10.09978	6.23	<.0001
Life Cycle (1+C <18)	17.93537	4.74	<.0001	23.96875	7.02	<.0001	22.36621	6.33	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)							12.40232	3.27	0.0011
Life Cycle (2+P hh, 1+ 65+)	9.56362	2.59	0.0097	7.62373	2.70	0.0071	19.06278	4.76	<.0001
Adj. R-Sq	0.1901			0.2788			0.2178		
F Value	102.26			176.28			191.44		
Obser. Used	2,590			2,722			4,788		

Table A3. Household Person Miles Traveled, South Atlantic Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-14.26603	-6.22	<.0001	-27.64752	-11.22	<.0001	-20.69411	-8.75	<.0001
HH Income (Thous. \$)									
Nat. Log. (HH Income)	4.08374	5.89	<.0001	5.02763	7.00	<.0001	7.84196	11.74	<.0001
Count of HH Vehicles	8.65949	11.55	<.0001	6.58772	9.70	<.0001	7.20962	12.76	<.0001
Count of HH Members	6.10484	9.48	<.0001	11.36489	19.05	<.0001	9.15223	13.67	<.0001
Homeowner	4.89731	3.81	0.0001	12.96845	9.61	<.0001			
Number of Workers	12.11984	13.50	<.0001	14.90795	18.39	<.0001	20.73558	25.60	<.0001
Life Cycle (1+C <18)	4.13395	2.28	0.0228	21.83600	12.46	<.0001	23.78731	13.81	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	3.22884	2.09	0.0364				5.58823	2.93	0.0034
Life Cycle (2+P hh, 1+ 65+)							9.42649	4.73	<.0001
Adj. R-Sq	0.2323			0.2794			0.2404		
F Value	297.44			773.39			783.20		
Obser. Used	6,858			11,954			17,302		

Table A4. Household Person Miles Traveled, South Central Divisions

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-3.71181	-2.09	0.0363	-.01066	-0.00	0.9965	-4.48476	-1.20	0.2301
HH Income (Thous. \$)	0.14754	7.92	<.0001	0.10005	3.93	<.0001			
Nat. Log. (HH Income)							4.84099	4.21	<.0001
Count of HH Vehicles	7.43074	8.66	<.0001	5.52206	4.67	<.0001	9.03662	10.16	<.0001
Count of HH Members	6.26425	9.02		5.27392	4.52	<.0001	6.95034	6.79	<.0001
Homeowner				8.12363	3.44	0.0006	4.78322	2.08	0.0379
Number of Workers	14.64502	14.00	<.0001	18.56716	12.28	<.0001	14.83442	10.87	<.0001
Life Cycle (1+C <18)	8.91941	3.88	0.0001	11.09247	3.53	0.0004	17.10156	5.91	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)				5.45212	2.07	0.0381	14.42793	5.98	<.0001
Life Cycle (2+P hh, 1+ 65+)	9.10236	4.69	<.0001						
Adj. R-Sq	0.2115			0.1930			0.1873		
F Value	253.66			140.91			247.83		
Obser. Used	5,654			4,096			7,498		

Table A5. Household Person Miles Traveled, Mountain Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-4.30522	-1.82	0.687	-2.42860	-0.35	0.7274	-19.40760	-4.00	<.0001
HH Income (Thous. \$)	0.25992	8.62	<.0001				0.36084	7.92	<.0001
Nat. Log. (HH Income)				4.74469	2.35	0.0191			
Count of HH Vehicles				14.95240	8.00	<.0001			
Count of HH Members							14.49196	11.53	<.0001
Homeowner	23.90581	10.10	<.0001	-15.58373	-4.00	<.0001	24.36040	5.98	<.0001
Number of Workers	5.42787	3.39	0.0007	10.72817	4.28	<.0001	13.47898	5.47	<.0001
Life Cycle (1+C <18)	23.49604	8.13	<.0001	57.11182	12.99	<.0001			
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	19.98444	6.20	<.0001						
Life Cycle (2+P hh, 1+ 65+)	30.34287	8.56	<.0001	9.77042	2.17	0.0300			
Adj. R-Sq	0.2235			0.2439			0.2034		
F Value	128.64			78.75			117.20		
Obser. Used	2,662			1,447			1,821		

Table A6. Household Person Miles Traveled, Pacific Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-22.84603	-8.96	<.0001	-0.32442	-0.12	0.9072	-8.07112	-2.59	0.0096
HH Income (Thous. \$)				0.17093	6.68	<.0001	0.12915	4.99	<.0001
Nat. Log. (HH Income)	8.12967	11.70	<.0001						
Count of HH Vehicles	6.99802	11.52	<.0001	6.78767	5.98	<.0001	7.45839	7.15	<.0001
Count of HH Members	2.35964	3.76	0.0002				7.06326	7.18	<.0001
Homeowner							10.44439	4.16	<.0001
Number of Workers	14.66817	17.44	<.0001	14.83345	9.33	<.0001	16.17204	11.84	<.0001
Life Cycle (1+C <18)	15.39396	8.79	<.0001	31.29349	10.31	<.0001	9.61159	317	0.0015
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	4.65203	2.42	0.0156	7.28163	2.09	0.0363			
Life Cycle (2+P hh, 1+ 65+)	10.28514	5.04	<.0001	21.13945	5.73	<.0001			
Adj. R-Sq	0.2095			0.2414			0.2259		
F Value	344.03			128.21			159.18		
Obser. Used	9,061			2,399			3,253		

Table A7. Household Number of Person Trips, Northeast Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.84589	-2.97	0.0030	-0.61741	-1.65	0.0989	-0.09066	-0.33	0.7407
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.82447	10.02	<.0001	0.62762	6.13	<.0001	0.49320	6.21	<.0001
Count of HH Vehicles	0.50103	6.31	<.0001	0.60927	7.16	<.0001	0.50558	8.45	<.0001
Count of HH Members	1.20312	17.60	<.0001	0.77567	7.70	<.0001	0.55677	7.76	<.0001
Homeowner							0.34381	2.19	0.0287
Number of Workers	1.32314	12.94	<.0001	1.32394	11.79	<.0001	1.81108	20.62	<.0001
Life Cycle (1+C <18)	3.12092	14.13	<.0001	4.52392	18.91	<.0001	5.61503	28.22	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)				0.74446	2.55	0.0108			
Life Cycle (2+P hh, 1+ 65+)	0.69231	3.69	0.0002	1.40737	5.15	<.0001	1.49370	9.03	<.0001
Adj. R-Sq	0.4765			0.4818			0.4506		
F Value	579.65			455.86			686.22		
Obser. Used	3,816			3,426			5,850		

Table A8. Household Number of Person Trips, Midwest Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-1.40404	-3.71	0.0002	0.24217	1.10	0.2714	1.41369	7.35	<.0001
HH Income (Thous. \$)				0.01462	6.68	<.0001	0.02186	11.53	<.0001
Nat. Log. (HH Income)	0.71205	6.14	<.0001						
Count of HH Vehicles	0.20116	2.00	0.0455	0.32065	3.12	0.0018			
Count of HH Members	1.38873	17.12	<.0001	1.35458	13.64	<.0001	0.82884	10.77	<.0001
Homeowner	0.52661	2.57	0.0101	0.56040	2.75	0.0060	0.76233	4.28	<.0001
Number of Workers	1.79676	13.65	<.0001	1.51560	11.95	<.0001	1.42932	14.89	<.0001
Life Cycle (1+C <18)	4.46153	16.01	<.0001	3.63006	13.09	<.0001	4.63386	21.25	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)									
Life Cycle (2+P hh, 1+ 65+)	2.06594	7.50	<.0001	2.90201	12.62	<.0001	2.10460	10.56	<.0001
Adj. R-Sq	0.5230			0.5068			0.4215		
F Value	405.18			399.16			583.73		
Obser. Used	2,581			2,713			4,799		

Table A9. Household Number of Person Trips, South Atlantic Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.32390	-1.57	0.1174	-0.89222	-4.82	<.0001	0.05795	0.39	0.6997
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.46841	7.47	<.0001	0.62416	11.57	<.0001	0.55126	13.23	<.0001
Count of HH Vehicles	0.16473	2.42	0.0154	0.20644	4.04	<.0001	0.11733	3.31	0.0009
Count of HH Members	1.32925	23.48	<.0001	1.25278	27.13	<.0001	1.14865	30.46	<.0001
Homeowner	0.76755	6.57	<.0001	0.76187	7.44	<.0001			
Number of Workers	1.34154	16.69	<.0001	1.34255	21.21	<.0001	1.61837	31.61	<.0001
Life Cycle (1+C <18)	3.87228	23.28	<.0001	4.66524	34.60	<.0001	3.28367	30.12	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)									
Life Cycle (2+P hh, 1+ 65+)	0.42279	2.91	0.0037	0.98065	8.37	<.0001	1.26067	13.38	<.0001
Adj. R-Sq	0.4578			0.4690			0.3762		
F Value	827.35			1511.29			1750.84		
Obser. Used	6,853			11,970			17,412		

Table A10. Household Number of Person Trips, South Central Divisions

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.23305	-0.94	0.3493	0.56102	2.05	0.0400	0.52902	2.35	0.0190
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.48226	6.82	<.0001	0.27891	3.22	0.0013	0.46068	6.92	<.0001
Count of HH Vehicles	0.65458	8.93	<.0001	0.29566	3.30	0.0010	0.17237	3.28	0.0010
Count of HH Members	1.04587	17.54	<.0001	0.77073	9.60	<.0001	0.95417	13.69	<.0001
Homeowner				1.03325	5.81	<.0001			
Number of Workers	1.56111	17.35	<.0001	1.79764	15.89	<.0001	1.29593	15.88	<.0001
Life Cycle (1+C <18)	4.35704	22.52	<.0001	5.27548	22.86	<.0001	4.49126	25.14	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)							0.76208	3.97	<.0001
Life Cycle (2+P hh, 1+ 65+)	1.07076	6.57	<.0001	1.62816	7.49	<.0001	1.12207	5.57	<.0001
Adj. R-Sq	0.4432			0.4211			0.4063		
F Value	750.43			426.77			738.49		
Obser. Used	5,651			4,098			7,545		

Table A11. Household Number of Person Trips, Mountain Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	1.22651	6.22	<.0001	-0.09795	-0.32	0.7505	-0.91695	-1.75	0.0794
HH Income (Thous. \$)				0.02319	8.20	<.0001			
Nat. Log. (HH Income)							0.89309	6.42	<.0001
Count of HH Vehicles				0.88736	6.26	<.0001			
Count of HH Members	0.57181	5.73	<.0001	1.11439	8.30	<.0001	1.30364	12.93	<.0001
Homeowner	1.13807	6.68	<.0001						
Number of Workers	2.39878	19019	<.0001	0.65079	3.62	0.0003	1.52474	9.90	<.0001
Life Cycle (1+C <18)	3.13979	11.35	<.0001	4.70914	12.15	<.0001	3.36804	10.32	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	1.35440	4.93	<.0001						
Life Cycle (2+P hh, 1+ 65+)	2.49626	8.68	<.0001	3.15272	9.78	<.0001	1.29406	4.56	<.0001
Adj. R-Sq	0.4364			0.4502			0.4342		
F Value	373.06			199.54			281.15		
Observed	2,884			1,456			1,826		

Table A12. Household Number of Person Trips, Pacific Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.01104	-0.05	0.9582	-0.52982	-1.28	0.2001	0.01978	0.05	0.9609
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.53034	8.95	<.0001	1.10725	10.17	<.0001	0.56695	5.36	<.0001
Count of HH Vehicles	0.33626	6.52	<.0001				0.22771	2.68	0.0074
Count of HH Members	0.93716	20.86	<.0001				0.59190	6.63	<.0001
Homeowner	0.41928	3.84	<.0001				0.45391	2.22	0.0262
Number of Workers	1.56371	22.82	<.0001	1.53805	11.59	<.0001	1.63079	14.46	<.0001
Life Cycle (1+C <18)	4.82360	33.53	<.0001	6.59061	26.04	<.0001	3.76355	15.29	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)				1.44520	5.11	<.0001	1.07387	3.68	0.0003
Life Cycle (2+P hh, 1+ 65+)	0.87963	6.65	<.0001	2.77928	9.13	<.0001	2.42387	7.70	<.0001
Adj. R-Sq	0.4596			0.4335			0.3692		
F Value	1099.92			367.50			240.41		
Observed	9,046			2,396			3,274		

Table A13. Household Vehicle Miles Traveled, Northeast Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-6.86996	-6.44	<.0001	-10.56755	-4.76	<.0001	-4.65590	-2.72	0.0066
HH Income (Thous. \$)	0.08287	5.41	<.0001	0.20645	10.95	<.0001	0.08772	5.75	<.0001
Nat. Log. (HH Income)									
Count of HH Vehicles	17.50154	25.81	<.0001	10.26131	11.72	<.0001	6.55524	10.63	<.0001
Count of HH Members				2.86210	4.04	<.0001	3.57181	5.61	<.0001
Homeowner							9.20604	5.60	<.0001
Number of Workers	5.82215	7.08	<.0001	15.70948	13.62	<.0001	17.18424	18.35	<.0001
Life Cycle (1+C <18)									
Life Cycle (1P hh <65)				7.23785	2.70	0.0069			
Life Cycle (2+P hh, 0 65+)							7.96681	4.65	<.0001
Life Cycle (2+P hh, 1+ 65+)									
Adj. R-Sq	0.2922			0.3080			0.2675		
F Value	527.48			306.32			355.58		
Obser. Used	3,827			3,431			5,828		

Table A14. Household Vehicle Miles Traveled, Midwest Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-19.18071	-6.02	<.0001	-24.23894	-7.00	<.0001	-0.61707	-0.33	0.7450
HH Income (Thous. \$)							0.19803	9.49	<.0001
Nat. Log. (HH Income)	4.53490	4.78	<.0001	7.59239	7.55	<.0001			
Count of HH Vehicles	10.48334	12.14	<.0001	8.96073	10.21	<.0001	6.76393	10.15	<.0001
Count of HH Members	2.72159	4.89	<.0001	1.94928	2.21	0.0269			
Homeowner							5.28513	2.73	0.0063
Number of Workers	11.95444	10.37	<.0001	12.15805	10.54	<.0001	14.46571	13.49	<.0001
Life Cycle (1+C <18)				8.67894	3.47	0.0005	9.63198	5.06	
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)							7.77804	3.47	0.0005
Life Cycle (2+P hh, 1+ 65+)	6.26766	2.66	0.0079	5.61330	2.72	0.0066	8.68607	3.52	0.0004
Adj. R-Sq	0.2605			0.2903			0.2451		
F Value	183.24			186.37			222.37		
Obser. Used	2,588			2,720			4,773		

Table A15. Household Vehicle Miles Traveled, South Atlantic Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-9.78156	-6.14	<.0001	-20.85206	-12.04	<.0001	-16.40231	-10.42	<.0001
HH Income (Thous. \$)									
Nat. Log. (HH Income)	2.85873	5.50	<.0001	4.24703	8.40	<.0001	6.18434	13.77	<.0001
Count of HH Vehicles	11.70642	21.36	<.0001	8.13201	16.95	<.0001	7.86132	20.90	<.0001
Count of HH Members				3.17507	7.29	<.0001	3.16748	8.20	<.0001
Homeowner	2.44253	2.52	0.0118	10.92742	11.47	<.0001	4.65386	5.02	<.0001
Number of Workers	11.46791	17.10	<.0001	14.34610	24.43	<.0001	19.26313	37.13	<.0001
Life Cycle (1+C <18)				7.81305	6.34	<.0001	3.66921	3.29	0.0010
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	2.06335	2.02	0.0432	2.42967	2.31	0.0209			
Life Cycle (2+P hh, 1+ 65+)									
Adj. R-Sq	0.2535			0.2760			0.2680		
F Value	466.99			651.22			1055.17		
Obser. Used	6,861			11,938			17,281		

Table A16. Household Vehicle Miles Traveled, South Central Divisions

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-3.01622	-2.34	0.0195	1.36779	0.70	0.4833	2.28456	1.46	0.1452
HH Income (Thous. \$)	0.11057	7.89	<.0001	0.04989	2.67	0.0077	0.08266	5.29	<.0001
Nat. Log. (HH Income)									
Count of HH Vehicles	8.70204	13.56	<.0001	11.17887	12.96	<.0001	8.17316	14.72	<.0001
Count of HH Members	1.54016	3.74	0.0002						
Homeowner							7.97223	5.50	<.0001
Number of Workers	14.29586	18.16	<.0001	8.73603	7.59	<.0001	17.25116	20.02	<.0001
Life Cycle (1+C <18)				13.41715	6.67	<.0001	6.43454	4.30	<.0001
Life Cycle (1P hh <65)				6.05305	2.71	0.0067	5.38521	2.76	0.0058
Life Cycle (2+P hh, 0 65+)				12.50158	5.93	<.0001	6.78381	4.37	<.0001
Life Cycle (2+P hh, 1+ 65+)	3.64100	2.53	0.0114						
Adj. R-Sq	0.2294			0.1837			0.2257		
F Value	337.75			154.20			312.25		
Obser. Used	5,657			4,086			7,477		

Table A17. Household Vehicle Miles Traveled, Mountain Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-4.84096	-3.49	0.0005	-4.59235	-1.65	0.0997	-19.87899	-5.00	<.0001
HH Income (Thous. \$)	0.19498	10.88	<.0001				0.25934	8.40	<.0001
Nat. Log. (HH Income)									
Count of HH Vehicles	5.16680	7.41	<.0001	16.04391	13.43	<.0001	1.65341	2.08	0.0380
Count of HH Members							7.73185	8.87	<.0001
Homeowner	8.20199	5.84	<.0001				14.51037	4.94	<.0001
Number of Workers	7.65617	8.01	<.0001	6.47233	4.14	<.0001	17.04663	10.10	<.0001
Life Cycle (1+C <18)				32.87826	10.80	<.0001			
Life Cycle (1P hh <65)				7.82038	2.63	0.0086	11.09396	2.70	0.0070
Life Cycle (2+P hh, 0 65+)	8.35760	4.66	<.0001						
Life Cycle (2+P hh, 1+ 65+)	11.37603	5.30	<.0001						
Adj. R-Sq	0.2875			0.2480			0.2485		
F Value	179.98			132.35			101.75		
Obser. Used	2,662			1,594			1,829		

Table A18. Household Vehicle Miles Traveled, Pacific Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-20.33475	-12.53	<.0001	-14.41003	-4.03	<.0001	-1.53903	-0.72	0.4728
HH Income (Thous. \$)							0.11949	6.55	<.0001
Nat. Log. (HH Income)	6.71435	13.67	<.0001	5.27427	5.19	<.0001			
Count of HH Vehicles	7.63711	18.37	<.0001	2.66590	3.11	0.0019	6.26931	8.51	<.0001
Count of HH Members							3.24356	5.67	<.0001
Homeowner	2.71994	2.99	0.0028	7.32152	3.35	0.0008	4.49841	2.53	0.0113
Number of Workers	12.02393	21.66	<.0001	16.39064	14.09	<.0001	12.17018	12.57	<.0001
Life Cycle (1+C <18)	5.63397	5.94	<.0001	9.69012	4.38	<.0001			
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)				5.13820	2.03	0.0426			
Life Cycle (2+P hh, 1+ 65+)	3.41122	3.12	0.0018	10.49814	3.80	0.0001			
Adj. R-Sq	0.2462			0.2278			0.2016		
F Value	494.18			101.91			165.74		
Obser. Used	9,060			2,396			3,264		

Table A19. Household Number of Vehicle Trips, Northeast Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.66313	-3.31	0.0009	-1.65310	-6.49	<.0001	-1.02396	-5.13	<.0001
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.33738	5.19	<.0001	0.59534	7.96	<.0001	0.61957	10.68	<.0001
Count of HH Vehicles	1.93847	30.53	<.0001	0.87380	14.40	<.0001	0.55186	12.65	<.0001
Count of HH Members				0.52968	11.99	<.0001	0.16112	3.11	0.0019
Homeowner	0.35580	2.87	0.0041	1.00187	7.00	<.0001	0.64490	5.63	<.0001
Number of Workers	0.42257	5.80	<.0001	0.79548	10.05	<.0001	1.42602	22.19	<.0001
Life Cycle (1+C <18)	0.59515	4.53	<.0001				1.44103	9.92	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)									
Life Cycle (2+P hh, 1+ 65+)	0.33315	2.40	0.0163	0.50731	3.57	0.0004	0.80326	6.66	<.0001
Adj. R-Sq	0.3983			0.3938			0.3509		
F Value	423.38			373.19			454.00		
Obser. Used	3,830			3,439			5,866		

Table A20. Household Number of Vehicle Trips, Midwest Region

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-1.72506	-6.25	<.0001	-1.85189	-6.53	<.0001	1.29949	10.38	<.0001
HH Income (Thous. \$)							0.01510	10.75	<.0001
Nat. Log. (HH Income)	0.70221	8.26	<.0001	0.66274	7.53	<.0001			
Count of HH Vehicles	0.86441	11.70	<.0001	0.70326	9.19	<.0001	0.30531	6.81	<.0001
Count of HH Members	0.15307	2.62	0.0089	0.55573	10.57	<.0001			
Homeowner	0.76582	5.10	<.0001	0.79666	5.13	<.0001	0.65505	4.96	<.0001
Number of Workers	1.39714	14.45	<.0001	1.37442	14.28	<.0001	1.46809	20.57	<.0001
Life Cycle (1+C <18)	1.40195	6.84	<.0001				1.60507	12.99	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)									
Life Cycle (2+P hh, 1+ 65+)	1.60838	7.96	<.0001	1.24843	7.40	<.0001	1.13632	7.82	<.0001
Adj. R-Sq	0.4163			0.4073			0.3070		
F Value	264.83			314.07			355.79		
Obser. Used	2,590			2,734			4,806		

Table A21. Household Number of Vehicle Trips, South Atlantic Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.23425	-1.63	0.1040	-0.77587	-5.69	<.0001	0.11230	1.02	<.0001
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.18431	4.23	<.0001	0.50515	12.70	<.0001	0.42383	13.52	<.0001
Count of HH Vehicles	1.26723	26.72	<.0001	0.78640	20.88	<.0001	0.47983	18.23	<.0001
Count of HH Members	0.13750	3.50	0.0005	0.20773	6.19	<.0001	0.25972	9.53	<.0001
Homeowner	0.60390	7.43	<.0001	0.68862	9.11	<.0001	0.19854	3.04	0.0024
Number of Workers	1.11611	20.01	<.0001	1.14759	24.62	<.0001	1.50236	40.12	<.0001
Life Cycle (1+C <18)	0.67302	5.81	<.0001	1.78086	17.92	<.0001	0.54131	6.81	<.0001
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)									
Life Cycle (2+P hh, 1+ 65+)	0.45469	4.49	<.0001	0.50312	5.83	<.0001	0.47454	6.84	<.0001
Adj. R-Sq	0.3674			0.3377			0.2837		
F Value	571.40			876.13			988.52		
Obser. Used	6,877			12,013			17,452		

Table A22. Household Number of Vehicle Trips, South Central Divisions

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-0.88836	-4.96	<.0001	-0.71267	-3.18	0.0015	0.15958	0.96	0.3391
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.67469	12.56	<.0001	0.42893	6.83	<.0001	0.45838	8.97	<.0001
Count of HH Vehicles	0.86313	15.87	<.0001	0.78240	12.04	<.0001	0.49584	12.61	<.0001
Count of HH Members	0.12786	3.00	0.0027	0.14053	2.21	0.0272	0.22828	5.47	<.0001
Homeowner	0.35853	3.45	0.0006	1.00050	7.67	<.0001	0.33645	3.29	0.0010
Number of Workers	1.18915	18.37	<.0001	1.51422	18.40	<.0001	1.32624	22.28	<.0001
Life Cycle (1+C <18)	1.15433	8.28	<.0001	1.45215	8.66	<.0001	1.36769	10.57	<.0001
Life Cycle (1P hh <65)				0.49754	3.22	0.00130			
Life Cycle (2+P hh, 0 65+)									
Life Cycle (2+P hh, 1+ 65+)	0.37434	3.16	0.0016	0.72700	4.54	<.0001			
Adj. R-Sq	0.3480			0.3625			0.2938		
F Value	432.79			293.27			525.88		
Obser. Used	5,665			4,112			7,572		

Table A23. Household Number of Vehicle Trips, Mountain Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	1.03096	7.94	<.0001	-2.54403	-6.26	<.0001	-0.79473	-1.99	0.0464
HH Income (Thous. \$)									
Nat. Log. (HH Income)				0.87516	7.88	<.0001	1.01674	9.35	<.0001
Count of HH Vehicles	0.72474	10.99	<.0001	0.92633	8.63	<.0001			
Count of HH Members				0.46268	4.70	<.0001	0.38109	5.19	<.0001
Homeowner				0.42888	2.05	0.0409			
Number of Workers	1.86925	19.50	<.0001	0.57230	4.09	<.0001	1.30981	11.30	<.0001
Life Cycle (1+C <18)				1.62607	5.53	<.0001	0.91001	3.72	0.0002
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)	1.05868	5.88	<.0001						
Life Cycle (2+P hh, 1+ 65+)	1.45383	6.96	<.0001	1.64595	6.75	<.0001			
Adj. R-Sq	0.3363			0.3559			0.2675		
F Value	367.62			116.34			169.50		
Obser. Used	2,895			1,462			1,847		

Table A24. Household Number of Vehicle Trips, Pacific Division

	Urban			Suburban			Rural		
	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t	Parameter Estimate	t value	Pr> t
Intercept	-1.26220	-8.22	<.0001	-0.93007	-3.04	0.0024	-0.94625	-3.29	0.0010
HH Income (Thous. \$)									
Nat. Log. (HH Income)	0.60724	14.05	<.0001	0.99509	12.37	<.0001	0.70834	9.12	<.0001
Count of HH Vehicles	0.88442	23.41	<.0001				0.46105	7.42	<.0001
Count of HH Members	0.07045	2.15	0.0313				0.48858	10.24	<.0001
Homeowner	0.60889	7.65	<.0001				0.50116	3.41	0.0007
Number of Workers	1.15723	23.11	<.0001	1.44618	14.50	<.0001	0.95885	11.93	<.0001
Life Cycle (1+C <18)	1.33365	12.69	<.0001	1.52984	8.17	<.0001			
Life Cycle (1P hh <65)									
Life Cycle (2+P hh, 0 65+)				0.42489	2.02	0.0431			
Life Cycle (2+P hh, 1+ 65+)	0.66618	6.90	<.0001	0.93432	4.13	<.0001			
Adj. R-Sq	0.3561			0.2726			0.2511		
F Value	718.15			181.41			221.54		
Obser. Used	9,077			2,408			3,289		

APPENDIX B. VALIDATION RESULTS

Table B1. Validation Results for Person Miles

Census Region/ Division	Urban Group	Median Census Tract Value								
		Person miles								
		Number of Tracts	Mean percent of households with NHTS data	NHTS	NHTS Est.	MAPE NHTS vs. NHTS Est.	Percent difference NHTS est. v. NHTS	ACS Est.	MAPE NHTS vs. ACS Est.	Percent difference ACS est. v. NHTS
Northeast	Urban	38	0.53	57.1	46.0	15.0	-19.6	48.1	15.8	-15.8
	Suburban	67	0.69	60.0	64.5	15.6	7.4	72.6	16.2	21.0
	Rural	142	0.62	73.7	73.3	15.7	-0.5	79.2	18.3	7.4
Midwest	Urban	24	0.79	45.6	59.4	16.4	30.4	58.5	14.5	28.5
	Suburban	23	0.80	44.5	63.5	20.3	42.5	66.9	22.3	50.3
	Rural	30	0.74	65.3	90.7	23.4	39.0	91.3	25.0	39.8
South Atlantic	Urban	121	0.44	46.8	47.3	9.4	1.1	52.4	13.5	11.9
	Suburban	317	0.55	60.1	61.3	12.6	1.9	68.2	16.7	13.3
	Rural	445	0.55	73.7	77.7	14.6	5.5	86.8	20.6	17.8
East South Central and West South Central	Urban	79	0.31	62.8	58.8	12.5	-6.3	60.8	13.6	-3.1
	Suburban	79	0.31	76.5	73.2	16.7	-4.3	76.3	18.6	-0.2
	Rural	164	0.31	78.8	85.2	20.8	8.2	97.6	24.7	24.0
Mountain	Urban	53	0.39	44.2	53.5	15.5	21.2	52.5	20.1	19.0
	Suburban	46	0.45	56.7	57.4	11.1	1.1	65.3	9.6	15.0
	Rural	51	0.32	64.2	74.8	19.6	16.5	90.0	23.1	40.0
Pacific	Urban	110	0.50	55.8	53.9	9.9	-3.6	60.1	13.1	7.6
	Suburban	45	0.50	56.3	58.7	11.6	4.3	66.5	11.8	18.0
	Rural	45	0.38	71.6	64.5	16.0	-9.9	70.5	13.9	-1.6

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and predicted data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE. Percent difference is the difference between the median NHTS value for each Census region/division and urban group and the median predicted value.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B2. Validation Results for Person Trips

Census Region/ Division	Urban Group	Median Census Tract Value								
		Person trips								
		Number of Tracts	Mean percent of households with NHTS data	NHTS	NHTS Est.	MAPE NHTS vs. NHTS Est.	Percent difference NHTS est. v. NHTS	ACS Est.	MAPE NHTS vs. ACS Est.	Percent difference ACS est. v. NHTS
Northeast	Urban	38	0.53	7.8	7.6	0.6	-2.4	8.5	1.8	8.4
	Suburban	66	0.70	8.3	8.3	1.3	0.6	9.2	1.5	11.3
	Rural	143	0.62	8.4	8.2	1.0	-2.3	9.1	1.6	8.7
Midwest	Urban	22	0.79	8.8	9.0	0.7	2.4	9.5	1.7	8.3
	Suburban	23	0.80	8.4	8.7	0.5	2.8	8.9	1.0	5.8
	Rural	29	0.73	8.8	9.4	1.4	6.0	10.0	2.0	13.2
South Atlantic	Urban	118	0.45	7.4	7.0	1.0	-4.3	8.5	1.2	15.0
	Suburban	319	0.54	8.2	7.8	0.9	-4.2	8.9	1.3	8.7
	Rural	451	0.55	7.7	7.6	1.0	-1.8	8.7	1.4	12.7
East South Central and West South Central	Urban	79	0.32	7.9	8.4	1.1	6.7	9.6	1.6	22.0
	Suburban	79	0.31	9.0	9.1	1.0	1.1	10.5	1.4	17.0
	Rural	166	0.31	8.1	8.1	0.9	-0.9	9.9	1.7	22.4
Mountain	Urban	66	0.40	7.8	7.2	1.0	-7.4	8.6	2.1	10.1
	Suburban	46	0.46	8.3	8.3	1.1	0.3	9.0	1.3	8.7
	Rural	52	0.32	8.2	8.5	1.1	4.2	9.9	1.8	21.2
Pacific	Urban	106	0.50	8.4	8.1	1.1	-3.5	9.3	1.7	11.3
	Suburban	47	0.49	8.9	8.4	1.1	-6.4	9.9	1.3	11.1
	Rural	46	0.39	8.1	8.6	1.0	5.7	9.7	1.6	19.6

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and predicted data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE. Percent difference is the difference between the median NHTS value for each Census region/division and urban group and the median predicted value.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B3. Validation Results for Vehicle Miles

Census Region/ Division	Urban Group	Median Census Tract Value								
		Vehicle Miles								
		Number of Tracts	Mean percent of households with NHTS data	NHTS	NHTS Est.	MAPE NHTS vs. NHTS Est.	Percent difference NHTS est. v. NHTS	ACS Est.	MAPE NHTS vs. ACS Est.	Percent difference ACS est. v. NHTS
Northeast	Urban	39	0.54	29.2	32.8	7.4	12.3	32.0	8.0	9.7
	Suburban	65	0.71	48.1	50.6	13.3	5.1	54.3	10.7	13.0
	Rural	142	0.62	54.9	55.1	9.4	0.3	57.7	12.3	5.0
Midwest	Urban	24	0.79	36.3	43.3	11.0	19.2	39.6	10.1	9.0
	Suburban	23	0.80	36.8	45.3	13.2	23.0	48.7	12.1	32.4
	Rural	30	0.73	49.3	62.7	15.0	27.2	65.5	13.8	32.9
South Atlantic	Urban	121	0.44	35.5	36.1	7.5	1.7	38.0	8.0	7.2
	Suburban	317	0.54	42.7	46.2	8.9	8.3	49.3	11.9	15.4
	Rural	450	0.55	53.1	56.3	10.6	6.0	60.5	13.6	13.8
East South Central and West South Central	Urban	78	0.31	45.6	44.1	9.7	-3.3	45.1	10.3	-0.9
	Suburban	79	0.31	54.5	54.1	10.9	-0.7	56.0	11.2	2.8
	Rural	163	0.31	57.9	57.9	11.1	0.0	64.3	14.2	11.2
Mountain	Urban	54	0.38	30.0	34.7	8.1	15.8	34.0	9.9	13.3
	Suburban	52	0.49	42.4	41.7	10.3	-1.5	44.7	8.7	5.4
	Rural	51	0.32	50.7	51.4	11.3	1.3	63.5	15.8	25.1
Pacific	Urban	108	0.50	38.2	39.3	7.5	2.7	42.5	9.3	11.2
	Suburban	45	0.50	44.9	43.2	9.0	-3.8	49.8	9.4	10.8
	Rural	47	0.38	50.2	46.4	11.5	-7.6	51.2	13.9	1.9

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and predicted data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE. Percent difference is the difference between the median NHTS value for each Census region/division and urban group and the median predicted value.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B4. Validation Results for Vehicle Trips

Census Region/ Division	Urban Group	Median Census Tract Value								
		Vehicle Trips								
		Number of Tracts	Mean percent of households with NHTS data	NHTS	NHTS Est.	MAPE NHTS vs. NHTS Est.	Percent difference NHTS est. v. NHTS	ACS Est.	MAPE NHTS vs. ACS Est.	Percent difference ACS est. v. NHTS
Northeast	Urban	38	0.53	4.9	4.8	0.7	-1.2	4.7	0.7	-3.5
	Suburban	66	0.70	5.8	5.9	0.9	2.7	5.9	1.0	1.7
	Rural	143	0.62	5.7	5.7	0.6	0.8	6.0	1.0	6.2
Midwest	Urban	23	0.78	6.2	6.1	0.4	-2.1	5.9	0.7	-5.1
	Suburban	23	0.81	6.4	6.2	0.3	-2.8	6.2	0.7	-2.7
	Rural	30	0.75	6.3	6.3	0.9	-0.4	6.6	0.9	3.8
South Atlantic	Urban	120	0.44	5.2	4.9	0.6	-6.3	5.0	0.8	-2.8
	Suburban	321	0.55	5.8	5.6	0.7	-3.3	5.9	0.8	1.5
	Rural	452	0.55	5.3	5.3	0.7	1.2	5.7	0.8	7.5
East South Central and West South Central	Urban	82	0.32	5.9	6.1	0.7	3.0	6.2	1.0	6.1
	Suburban	80	0.31	6.2	6.7	0.9	6.8	6.9	1.0	10.8
	Rural	167	0.31	5.7	5.7	0.8	0.3	6.5	1.0	14.9
Mountain	Urban	65	0.40	5.1	4.8	0.8	-6.4	5.4	1.1	5.5
	Suburban	46	0.46	5.8	5.9	0.7	2.2	5.9	0.7	3.2
	Rural	52	0.32	5.5	6.0	0.7	9.1	6.7	1.0	22.0
Pacific	Urban	108	0.50	5.7	5.4	0.7	-5.5	5.7	1.0	-0.3
	Suburban	47	0.49	6.0	5.5	1.1	-7.9	6.3	1.0	5.8
	Rural	47	0.39	5.6	5.8	0.8	3.1	6.1	1.0	8.7

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and predicted data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE. Percent difference is the difference between the median NHTS value for each Census region/division and urban group and the median predicted value.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B5. Comparison of Means for Sample Used in Validating Models to Predict Person Miles

Census Region/ Division	Urban Group	Median Census Tract Value								
		Household Income (Thousands)			Count of Household Vehicles			Count of Household Members		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	47.5	50.9	35.1	1.7	1.6	10.9	2.2	2.4	14.0
	Suburban	67.5	75.8	17.8	2.0	1.9	13.3	2.5	2.6	9.8
	Rural	57.5	60.7	20.5	2.1	2.0	11.1	2.4	2.6	11.2
Midwest	Urban	47.5	52.8	16.3	2.1	1.8	15.8	2.4	2.4	7.9
	Suburban	67.5	55.1	12.7	2.2	1.9	12.0	2.4	2.4	8.8
	Rural	65.0	70.6	11.2	2.5	2.2	9.5	2.8	2.7	13.5
South Atlantic	Urban	47.5	52.2	15.6	1.9	1.7	13.1	2.2	2.5	15.0
	Suburban	57.5	58.3	19.2	2.1	1.9	11.2	2.3	2.5	11.5
	Rural	47.5	50.6	18.1	2.3	2.1	11.6	2.3	2.6	12.5
East South Central and West South Central	Urban	70.0	65.4	21.0	2.1	1.9	12.5	2.4	2.7	15.7
	Suburban	90.0	81.4	21.9	2.3	2.0	13.8	2.7	3.0	14.2
	Rural	72.5	69.0	19.0	2.2	2.1	10.7	2.5	2.9	16.5
Mountain	Urban	47.5	46.7	17.7	1.8	1.7	13.1	2.1	2.5	20.9
	Suburban	66.3	71.3	17.2	2.0	1.9	7.7	2.3	2.5	14.1
	Rural	65.0	66.0	14.9	2.2	2.0	12.1	2.4	2.8	12.7
Pacific	Urban	62.5	69.8	28.6	2.1	2.0	11.8	2.4	2.7	16.1
	Suburban	75.0	89.2	17.8	2.3	2.1	10.9	2.2	2.6	15.1
	Rural	72.5	83.3	19.0	2.5	2.2	9.6	2.5	2.8	10.4

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B5. Comparison of Means for Sample Used in Validating Models to Predict Person Miles (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		Number of Workers in Household			Homeowner (Percent)			1+ Child < 18 (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.8	0.7	15.8	0.9	1.2	25.8	0.2	0.3	43.8
	Suburban	0.9	0.8	15.5	1.0	1.3	25.7	0.2	0.4	71.8
	Rural	0.9	0.8	10.1	1.1	1.3	22.5	0.2	0.3	55.2
Midwest	Urban	0.9	0.7	22.3	1.2	1.3	19.4	0.2	0.3	52.9
	Suburban	0.9	0.8	16.5	1.1	1.2	12.9	0.2	0.3	69.2
	Rural	0.9	0.9	9.8	1.3	1.5	13.3	0.3	0.4	52.2
South Atlantic	Urban	0.9	0.7	22.9	0.9	1.2	37.5	0.1	0.3	84.2
	Suburban	0.9	0.8	16.1	0.9	1.2	28.0	0.2	0.3	75.5
	Rural	1.0	0.8	13.1	0.9	1.2	28.8	0.2	0.3	82.5
East South Central and West South Central	Urban	1.0	0.8	18.6	1.1	1.4	21.6	0.2	0.4	79.3
	Suburban	1.0	0.8	14.2	1.2	1.4	20.6	0.3	0.5	49.1
	Rural	1.0	0.9	11.7	1.0	1.4	33.3	0.2	0.4	85.6
Mountain	Urban	0.9	0.7	25.9	0.9	1.3	46.3	0.1	0.3	75.3
	Suburban	1.0	0.8	12.9	1.0	1.2	24.8	0.1	0.3	38.6
	Rural	0.9	0.9	9.7	1.1	1.3	33.0	0.2	0.4	48.4
Pacific	Urban	0.9	0.7	19.6	1.0	1.3	34.5	0.2	0.3	48.9
	Suburban	0.9	0.8	12.2	0.9	1.3	44.2	0.1	0.3	81.2
	Rural	0.9	0.8	13.4	1.0	1.3	25.5	0.2	0.4	57.7

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B5. Comparison of Means for Sample Used in Validating Models to Predict Person Miles (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		1 Person Household, <65 (Percent)			2+ Person Household, 0 65+ (Percent)			2+ Person household, 1+ 65+ (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.1	0.2	50.6	0.5	0.6	21.9	0.2	0.1	42.2
	Suburban	0.1	0.1	37.7	0.6	0.6	22.0	0.2	0.1	42.9
	Rural	0.1	0.1	38.5	0.6	0.6	22.0	0.2	0.2	41.8
Midwest	Urban	0.1	0.2	32.7	0.5	0.6	23.2	0.2	0.1	61.1
	Suburban	0.1	0.2	88.7	0.6	0.6	17.6	0.2	0.1	37.4
	Rural	0.1	0.1	42.2	0.7	0.7	15.6	0.2	0.1	32.8
South Atlantic	Urban	0.1	0.2	39.2	0.4	0.5	17.9	0.3	0.1	46.5
	Suburban	0.1	0.2	41.0	0.5	0.6	22.1	0.3	0.2	47.6
	Rural	0.1	0.1	46.7	0.5	0.6	22.4	0.3	0.2	46.0
East South Central and West South Central	Urban	0.1	0.1	44.9	0.6	0.6	19.6	0.3	0.1	53.2
	Suburban	0.0	0.1	42.8	0.7	0.7	11.2	0.2	0.1	50.7
	Rural	0.1	0.1	34.7	0.6	0.7	15.3	0.2	0.1	45.5
Mountain	Urban	0.1	0.2	39.7	0.4	0.5	33.9	0.3	0.1	52.6
	Suburban	0.1	0.1	42.7	0.5	0.6	20.0	0.3	0.2	40.6
	Rural	0.0	0.1	63.3	0.5	0.6	20.0	0.4	0.2	44.9
Pacific	Urban	0.1	0.1	48.5	0.5	0.6	24.3	0.3	0.2	47.8
	Suburban	0.1	0.1	35.2	0.4	0.6	26.9	0.3	0.2	40.3
	Rural	0.0	0.1	47.3	0.5	0.7	13.4	0.3	0.2	49.2

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B6. Comparison of Means for Sample Used in Validating Models to Predict Person Trips

Census Region/ Division	Urban Group	Median Census Tract Value								
		Household Income (Thousands)			Count of Household Vehicles			Count of Household Members		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	47.5	50.9	34.2	1.7	1.6	11.4	2.2	2.4	15.7
	Suburban	67.5	75.5	17.9	2.0	1.9	13.1	2.5	2.6	10.2
	Rural	57.5	60.8	20.4	2.2	2.0	10.4	2.4	2.5	11.1
Midwest	Urban	47.5	52.4	14.5	2.1	1.8	13.9	2.2	2.4	8.0
	Suburban	60.0	55.1	15.1	2.2	1.9	12.0	2.4	2.4	8.8
	Rural	67.5	69.9	13.4	2.6	2.2	9.1	2.6	2.7	14.3
South Atlantic	Urban	47.5	51.5	15.9	1.9	1.7	12.3	2.2	2.5	15.0
	Suburban	57.5	57.3	18.6	2.1	1.9	11.5	2.3	2.5	11.5
	Rural	47.5	50.6	19.2	2.3	2.1	11.6	2.3	2.6	12.5
East South Central and West South Central	Urban	70.0	66.6	22.8	2.1	1.9	12.2	2.4	2.7	16.3
	Suburban	90.0	80.5	21.4	2.3	2.0	13.8	2.6	3.0	12.8
	Rural	71.3	68.7	18.5	2.2	2.1	10.5	2.4	2.9	17.9
Mountain	Urban	50.0	48.4	19.8	1.8	1.6	12.4	2.1	2.5	20.9
	Suburban	67.5	71.3	16.4	2.0	1.9	6.9	2.3	2.5	14.5
	Rural	65.0	65.7	14.4	2.2	2.0	12.6	2.4	2.8	13.5
Pacific	Urban	62.5	69.8	28.6	2.1	2.0	10.6	2.4	2.6	16.4
	Suburban	77.5	89.2	16.4	2.3	2.1	11.2	2.3	2.6	13.5
	Rural	73.1	84.8	18.6	2.5	2.2	9.8	2.5	2.8	10.0

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B6. Comparison of Means for Sample Used in Validating Models to Predict Person Trips (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		Number of Workers in Household			Homeowner (Percent)			1+ Child < 18 (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.8	0.7	14.1	0.9	1.2	26.0	0.2	0.3	42.8
	Suburban	0.9	0.8	15.3	1.0	1.3	25.5	0.2	0.4	74.4
	Rural	0.9	0.8	10.1	1.1	1.3	22.5	0.2	0.3	54.7
Midwest	Urban	0.9	0.7	23.4	1.2	1.3	20.5	0.1	0.3	66.5
	Suburban	0.9	0.8	16.8	1.1	1.2	14.8	0.2	0.3	73.4
	Rural	0.9	0.9	10.0	1.3	1.5	13.5	0.3	0.4	73.6
South Atlantic	Urban	0.9	0.7	22.6	0.8	1.2	38.7	0.1	0.3	85.7
	Suburban	0.9	0.8	16.1	0.9	1.2	28.4	0.1	0.3	78.7
	Rural	1.0	0.8	13.4	0.9	1.2	28.9	0.2	0.3	82.8
East South Central and West South Central	Urban	1.0	0.8	18.6	1.1	1.4	24.4	0.1	0.4	83.4
	Suburban	1.0	0.8	14.2	1.2	1.4	22.3	0.3	0.5	70.7
	Rural	1.0	0.9	10.7	1.0	1.4	35.0	0.2	0.4	83.5
Mountain	Urban	0.9	0.7	24.6	0.9	1.3	44.5	0.1	0.3	71.4
	Suburban	1.0	0.8	12.9	1.0	1.2	25.6	0.1	0.3	43.7
	Rural	0.9	0.9	9.9	1.1	1.3	32.8	0.2	0.4	54.9
Pacific	Urban	0.9	0.7	18.4	1.0	1.3	34.0	0.2	0.3	50.6
	Suburban	0.9	0.8	12.2	0.9	1.3	40.0	0.2	0.3	78.5
	Rural	0.9	0.8	13.3	1.0	1.3	24.4	0.2	0.4	49.9

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B6. Comparison of Means for Sample Used in Validating Models to Predict Person Trips (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		1 Person Household, <65 (Percent)			2+ Person Household, 0 65+ (Percent)			2+ Person household, 1+ 65+ (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.1	0.2	50.0	0.5	0.6	20.4	0.2	0.1	42.2
	Suburban	0.1	0.1	38.9	0.5	0.6	22.4	0.3	0.1	42.9
	Rural	0.1	0.1	37.0	0.6	0.6	21.3	0.2	0.2	42.7
Midwest	Urban	0.1	0.2	34.1	0.5	0.6	28.1	0.2	0.1	59.0
	Suburban	0.1	0.2	92.7	0.5	0.6	15.7	0.2	0.1	42.7
	Rural	0.1	0.1	42.2	0.6	0.7	16.7	0.2	0.1	34.2
South Atlantic	Urban	0.1	0.2	39.3	0.4	0.5	17.8	0.3	0.1	45.8
	Suburban	0.1	0.2	42.4	0.5	0.6	22.1	0.3	0.2	47.5
	Rural	0.1	0.1	49.8	0.5	0.6	21.4	0.3	0.2	46.3
East South Central and West South Central	Urban	0.1	0.1	43.3	0.6	0.6	19.6	0.3	0.1	52.7
	Suburban	0.0	0.1	42.1	0.7	0.7	11.7	0.2	0.1	51.5
	Rural	0.1	0.1	34.7	0.6	0.7	16.7	0.2	0.1	44.6
Mountain	Urban	0.1	0.2	59.6	0.4	0.5	31.5	0.3	0.1	51.8
	Suburban	0.1	0.1	42.7	0.5	0.6	20.0	0.3	0.2	39.5
	Rural	0.0	0.1	63.3	0.5	0.6	22.8	0.3	0.2	45.1
Pacific	Urban	0.1	0.1	47.2	0.5	0.6	24.3	0.3	0.2	47.7
	Suburban	0.1	0.1	41.5	0.5	0.6	25.2	0.3	0.2	38.2
	Rural	0.0	0.1	42.7	0.5	0.7	13.0	0.3	0.2	47.8

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B7. Comparison of Means for Sample Used in Validating Models to Predict Vehicle Miles

Census Region/ Division	Urban Group	Median Census Tract Value								
		Household Income (Thousands)			Count of Household Vehicles			Count of Household Members		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	47.5	50.4	34.4	1.7	1.6	11.1	2.2	2.3	15.5
	Suburban	67.5	15.3	19.4	2.0	1.9	13.4	2.5	2.6	10.1
	Rural	57.5	13.4	20.5	2.2	2.0	11.1	2.4	2.5	11.2
Midwest	Urban	47.5	10.2	16.3	2.1	1.8	14.5	2.4	2.4	7.8
	Suburban	57.5	13.5	15.0	2.2	1.9	11.6	2.4	2.4	8.8
	Rural	67.5	12.6	12.8	2.5	2.2	8.9	2.8	2.7	13.6
South Atlantic	Urban	47.5	12.2	15.6	1.9	1.7	13.1	2.2	2.5	15.1
	Suburban	57.5	12.2	19.1	2.1	1.9	11.2	2.3	2.5	11.3
	Rural	47.5	11.8	18.6	2.3	2.1	11.9	2.4	2.6	12.6
East South Central and West South Central	Urban	68.8	12.2	20.0	2.0	1.9	13.4	2.4	2.7	16.4
	Suburban	90.0	8.7	21.9	2.3	2.0	13.8	2.8	3.0	12.2
	Rural	72.5	10.4	19.2	2.2	2.1	10.4	2.5	2.9	17.3
Mountain	Urban	47.5	10.4	18.2	1.8	1.6	13.1	2.1	2.5	20.5
	Suburban	66.3	9.2	18.0	2.0	1.9	7.7	2.3	2.5	14.5
	Rural	65.0	14.9	13.8	2.2	2.0	12.1	2.4	2.8	12.7
Pacific	Urban	62.5	15.1	28.6	2.1	2.0	10.6	2.4	2.7	16.4
	Suburban	77.5	12.2	16.4	2.3	2.1	10.9	2.2	2.6	14.3
	Rural	72.5	10.6	19.0	2.5	2.2	9.6	2.5	2.8	10.5

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B7. Comparison of Means for Sample Used in Validating Models to Predict Vehicle Miles (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		Number of Workers in Household			Homeowner (Percent)			1+ Child < 18 (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.8	0.7	15.1	0.9	1.2	25.8	0.2	0.3	52.8
	Suburban	0.9	0.8	15.0	1.0	1.3	25.3	0.2	0.4	64.6
	Rural	0.9	0.8	10.1	1.1	1.3	22.5	0.2	0.3	56.8
Midwest	Urban	0.9	0.7	22.3	1.2	1.3	19.4	0.2	0.3	51.4
	Suburban	0.9	0.8	16.5	1.1	1.2	12.9	0.2	0.3	73.4
	Rural	0.9	0.9	9.6	1.3	1.5	13.3	0.3	0.4	55.1
South Atlantic	Urban	0.9	0.7	22.9	0.9	1.2	37.5	0.1	0.3	81.8
	Suburban	0.9	0.8	16.3	0.9	1.2	28.4	0.2	0.3	75.3
	Rural	1.0	0.8	13.3	0.9	1.2	28.9	0.2	0.3	80.6
East South Central and West South Central	Urban	1.0	0.8	18.1	1.1	1.4	23.5	0.2	0.4	76.9
	Suburban	1.0	0.8	14.4	1.2	1.4	20.6	0.3	0.5	47.8
	Rural	1.0	0.9	11.8	1.0	1.4	34.4	0.2	0.4	79.8
Mountain	Urban	0.9	0.7	25.6	0.9	1.3	46.6	0.1	0.3	74.5
	Suburban	1.0	0.8	11.9	0.9	1.2	27.8	0.1	0.3	40.6
	Rural	0.9	0.9	10.2	1.1	1.3	32.6	0.2	0.4	48.4
Pacific	Urban	0.9	0.7	19.6	1.0	1.3	34.5	0.2	0.3	46.9
	Suburban	0.9	0.8	12.2	0.9	1.3	44.2	0.1	0.3	81.2
	Rural	0.9	0.8	13.4	1.0	1.3	25.5	0.2	0.4	49.0

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B7. Comparison of Means for Sample Used in Validating Models to Predict Vehicle Miles (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		1 Person Household, <65 (Percent)			2+ Person Household, 0 65+ (Percent)			2+ Person household, 1+ 65+ (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.1	0.2	50.6	0.5	0.6	20.8	0.2	0.1	41.0
	Suburban	0.1	0.1	37.7	0.5	0.6	22.0	0.3	0.1	42.5
	Rural	0.1	0.1	41.2	0.6	0.6	22.1	0.2	0.2	41.5
Midwest	Urban	0.1	0.2	38.3	0.5	0.6	23.2	0.2	0.1	61.1
	Suburban	0.1	0.2	90.6	0.5	0.6	15.7	0.2	0.1	41.8
	Rural	0.1	0.1	42.2	0.7	0.7	16.5	0.2	0.1	36.3
South Atlantic	Urban	0.1	0.2	41.9	0.4	0.5	17.9	0.3	0.1	46.5
	Suburban	0.1	0.2	41.9	0.5	0.6	21.9	0.3	0.2	47.8
	Rural	0.1	0.1	48.6	0.5	0.6	21.4	0.3	0.2	46.4
East South Central and West South Central	Urban	0.1	0.1	38.0	0.6	0.6	20.1	0.3	0.1	52.7
	Suburban	0.0	0.1	45.2	0.7	0.7	11.2	0.2	0.1	52.2
	Rural	0.1	0.1	34.8	0.6	0.7	15.1	0.2	0.1	45.2
Mountain	Urban	0.1	0.2	42.9	0.4	0.5	33.1	0.3	0.1	53.9
	Suburban	0.1	0.1	39.8	0.5	0.5	18.5	0.3	0.2	40.7
	Rural	0.0	0.1	63.3	0.5	0.6	20.0	0.4	0.2	43.6
Pacific	Urban	0.1	0.1	48.5	0.5	0.6	24.1	0.3	0.2	47.6
	Suburban	0.1	0.1	35.2	0.4	0.6	26.9	0.3	0.2	38.9
	Rural	0.0	0.1	42.7	0.5	0.7	14.3	0.3	0.2	47.0

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B8. Comparison of Means for Sample Used in Validating Models to Predict Vehicle Trips

Census Region/ Division	Urban Group	Median Census Tract Value								
		Household Income (Thousands)			Count of Household Vehicles			Count of Household Members		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	47.5	50.9	34.2	1.7	1.6	11.4	2.2	2.4	16.0
	Suburban	67.5	75.5	18.7	2.0	1.9	13.4	2.5	2.6	10.0
	Rural	57.5	60.8	20.4	2.1	2.0	10.4	2.4	2.5	11.1
Midwest	Urban	47.5	51.1	16.2	2.1	1.8	15.4	2.2	2.4	8.2
	Suburban	62.5	55.1	14.6	2.2	1.9	12.0	2.4	2.4	8.8
	Rural	67.5	69.3	13.5	2.5	2.2	9.5	2.8	2.7	13.6
South Atlantic	Urban	47.5	52.1	15.6	1.9	1.7	12.3	2.2	2.5	14.9
	Suburban	57.5	57.3	19.1	2.1	1.9	11.5	2.3	2.5	11.4
	Rural	47.5	50.6	19.0	2.3	2.1	11.6	2.4	2.6	12.5
East South Central and West South Central	Urban	68.8	66.2	21.4	2.1	1.9	13.1	2.4	2.7	16.4
	Suburban	90.0	81.4	21.6	2.3	2.0	13.4	2.7	3.0	12.3
	Rural	70.0	68.5	18.3	2.2	2.1	9.8	2.5	2.9	17.5
Mountain	Urban	50.0	48.6	19.5	1.7	1.7	12.0	2.1	2.5	20.9
	Suburban	67.5	71.3	16.4	2.0	1.9	6.9	2.3	2.5	14.5
	Rural	65.0	65.7	13.3	2.3	2.0	12.6	2.4	2.8	12.6
Pacific	Urban	62.5	69.8	28.3	2.1	2.0	11.3	2.4	2.7	16.2
	Suburban	77.5	89.2	16.4	2.3	2.1	11.2	2.3	2.6	13.5
	Rural	73.8	84.8	19.0	2.5	2.2	9.6	2.5	2.8	10.4

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B8. Comparison of Means for Sample Used in Validating Models to Predict Vehicle Trips (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		Number of Workers in Household			Homeowner (Percent)			1+ Child < 18 (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.8	0.7	14.1	0.9	1.2	27.9	0.2	0.3	42.8
	Suburban	0.9	0.8	15.3	1.0	1.3	25.8	0.2	0.4	73.6
	Rural	0.9	0.8	10.1	1.1	1.3	22.8	0.2	0.3	53.4
Midwest	Urban	0.9	0.7	22.5	1.2	1.3	19.8	0.1	0.3	64.5
	Suburban	0.9	0.8	16.7	1.1	1.2	14.8	0.2	0.3	73.4
	Rural	0.9	0.9	9.8	1.3	1.5	13.8	0.3	0.4	56.0
South Atlantic	Urban	0.9	0.7	22.6	0.8	1.2	35.3	0.1	0.3	83.7
	Suburban	0.9	0.8	16.1	0.9	1.2	27.7	0.2	0.3	75.6
	Rural	1.0	0.8	13.3	0.9	1.2	29.5	0.2	0.3	80.6
East South Central and West South Central	Urban	1.0	0.8	18.6	1.1	1.4	25.0	0.1	0.4	88.9
	Suburban	1.0	0.8	14.2	1.2	1.4	19.4	0.3	0.4	50.4
	Rural	1.0	0.9	11.0	1.0	1.4	34.4	0.2	0.4	84.7
Mountain	Urban	0.9	0.7	24.8	0.9	1.3	44.9	0.1	0.3	73.8
	Suburban	1.0	0.8	12.9	1.0	1.2	25.6	0.1	0.3	43.7
	Rural	0.9	0.9	9.9	1.1	1.3	32.5	0.2	0.4	49.5
Pacific	Urban	0.9	0.7	18.7	1.0	1.3	33.3	0.2	0.3	48.9
	Suburban	0.9	0.8	12.2	0.9	1.3	40.0	0.2	0.3	78.5
	Rural	0.9	0.8	13.6	1.0	1.3	25.5	0.2	0.4	49.0

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

Table B8. Comparison of Means for Sample Used in Validating Models to Predict Vehicle Trips (continued)

Census Region/ Division	Urban Group	Median Census Tract Value								
		1 Person Household, <65 (Percent)			2+ Person Household, 0 65+ (Percent)			2+ Person household, 1+ 65+ (Percent)		
		NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS	NHTS	ACS	MAPE ACS v. NHTS
Northeast	Urban	0.1	0.2	50.0	0.5	0.6	19.9	0.2	0.1	42.2
	Suburban	0.1	0.1	38.9	0.5	0.6	22.0	0.2	0.1	42.9
	Rural	0.1	0.1	38.5	0.6	0.6	21.3	0.2	0.2	43.0
Midwest	Urban	0.1	0.2	34.1	0.5	0.6	23.3	0.2	0.1	60.4
	Suburban	0.1	0.2	94.8	0.6	0.6	15.7	0.2	0.1	41.3
	Rural	0.1	0.1	42.2	0.7	0.7	15.6	0.2	0.1	36.3
South Atlantic	Urban	0.1	0.2	38.9	0.4	0.5	17.6	0.3	0.1	46.2
	Suburban	0.1	0.2	41.9	0.5	0.6	22.2	0.3	0.2	47.6
	Rural	0.1	0.1	49.7	0.5	0.6	21.2	0.3	0.2	46.3
East South Central and West South Central	Urban	0.1	0.1	40.6	0.6	0.6	20.1	0.3	0.1	52.9
	Suburban	0.0	0.1	39.3	0.7	0.7	11.5	0.2	0.1	50.8
	Rural	0.1	0.1	34.2	0.6	0.7	17.0	0.2	0.1	44.8
Mountain	Urban	0.1	0.2	60.5	0.4	0.5	32.5	0.3	0.1	52.1
	Suburban	0.1	0.1	42.7	0.5	0.6	20.0	0.3	0.2	39.5
	Rural	0.0	0.1	63.3	0.5	0.6	22.6	0.3	0.2	45.1
Pacific	Urban	0.1	0.1	48.5	0.5	0.6	24.3	0.3	0.2	47.7
	Suburban	0.1	0.1	41.5	0.5	0.6	25.2	0.3	0.2	38.2
	Rural	0.0	0.1	42.7	0.5	0.7	13.4	0.3	0.2	47.0

NOTE: MAPE = Median absolute percent error. Absolute percent difference between NHTS data value and ACS data value calculated for each Census tract. Median of differences for each Census region/division and urban group calculated to find the MAPE.

States included by Census Region: Northeast = NY (excluding Census tracts in Manhattan), VT; Midwest = IN, IA, NE, SD; South Atlantic = FL, GA, NC, SC, VA; East South Central and West South Central = AL, TN, TX; Mountain = AZ; Pacific = CA

APPENDIX C. SAS FILE INFORMATION

Table C1. Description of SAS File (n= 73,057)

Variable	Description	Formula	Length	Data Type
geoid	11-digit FIP identifier (state + county + tract)	2010 Census definitions	11	Character
cluster	Census Region/ Division 1=Northeast; 2=Midwest; 3=South Atlantic; 4=East South Central and West South Central; 5=Mountain; 6=Pacific	Census Regions and Divisions combined to form sample of sufficient size. See Table C2 for a list of states in each category.	8	Numeric
urban_group	Level of urbanicity 1=urban; 2=suburban; 3=rural	Calculated from population density centile and presence (or absence) in an urban area	8	Numeric
est_pmiles2007_11	Person Miles	Estimated from model using 2007-2011 American Community Survey 5-year estimate tract data	8	Numeric
est_ptrp2007_11	Person Trips	Estimated from model using 2007-2011 American Community Survey 5-year estimate tract data	8	Numeric
est_vmiles2007_11	Vehicle Miles	Estimated from model using 2007-2011 American Community Survey 5-year estimate tract data	8	Numeric
est_vtrp2007_11	Vehicle Trips	Estimated from model using 2007-2011 American Community Survey 5-year estimate tract data	8	Numeric
median_hh_inc2007_11	Household Income	B19013e1	8	Numeric
mean_hh_veh2007_11	Count of Household Vehicles	B25046e1 / B11005e1	8	Numeric
mean_hh_mem2007_11	Count of Household Members	B11002e1 / B11005e1	8	Numeric
pct_owner2007_11	Homeowner (Percent)	B25009e2 / B11005e1*100	8	Numeric
mean_hh_worker2007_11	Number of Workers	B08137e1 / B11005e1	8	Numeric
pct_lhcd2007_11	Life Cycle (1+ child <18) (Percent)	B11005e2 / B11005e1*100	8	Numeric
pct_lhd12007_11	Life Cycle (1 person household, <65) (Percent)	B11007e8 / B11005e1*100	8	Numeric
pct_lhd22007_11	Life Cycle (2+ person household, 0 65+) (Percent)	B11007e9 / B11005e1*100	8	Numeric

pct_lhd42007_11	Life Cycle (2+ person household, 1+ 65+) (Percent)	B11007e4 / B11005e1*100	8	Numeric
ptrp_1mem_0veh	Person trips assuming 1 person household with 0 vehicles available	Estimated from model using value of 1 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_1mem_1veh	Person trips assuming 1 person household with 1 vehicle available	Estimated from model using value of 1 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_1mem_2veh	Person trips assuming 1 person household with 2 vehicles available	Estimated from model using value of 1 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_1mem_3veh	Person trips assuming 1 person household with 3 vehicles available	Estimated from model using value of 1 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_1mem_4veh	Person trips assuming 1 person household with 4 or more vehicles available	Estimated from model using value of 1 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_2mem_0veh	Person trips assuming 2 person household with 0 vehicles available	Estimated from model using value of 2 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_2mem_1veh	Person trips assuming 2 person household with 1 vehicle available	Estimated from model using value of 2 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

ptrp_2mem_2veh	Person trips assuming 2 person household with 2 vehicles available	Estimated from model using value of 2 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_2mem_3veh	Person trips assuming 2 person household with 3 vehicles available	Estimated from model using value of 2 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_2mem_4veh	Person trips assuming 2 person household with 4 or more vehicles available	Estimated from model using value of 2 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_3mem_0veh	Person trips assuming 3 person household with 0 vehicles available	Estimated from model using value of 3 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_3mem_1veh	Person trips assuming 3 person household with 1 vehicle available	Estimated from model using value of 3 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_3mem_2veh	Person trips assuming 3 person household with 2 vehicles available	Estimated from model using value of 3 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_3mem_3veh	Person trips assuming 3 person household with 3 vehicles available	Estimated from model using value of 3 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

ptrp_3mem_4veh	Person trips assuming 3 person household with 4 or more vehicles available	Estimated from model using value of 3 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_4mem_0veh	Person trips assuming 4 person household with 0 vehicles available	Estimated from model using value of 4 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_4mem_1veh	Person trips assuming 4 person household with 1 vehicle available	Estimated from model using value of 4 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_4mem_2veh	Person trips assuming 4 person household with 2 vehicles available	Estimated from model using value of 4 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_4mem_3veh	Person trips assuming 4 person household with 3 vehicles available	Estimated from model using value of 4 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_4mem_4veh	Person trips assuming 4 person household with 4 or more vehicles available	Estimated from model using value of 4 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_5mem_0veh	Person trips assuming household with 5 or more persons and with 0 vehicles available	Estimated from model using value of 5 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

ptrp_5mem_1veh	Person trips assuming household with 5 or more persons and with 1 vehicle available	Estimated from model using value of 5 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_5mem_2veh	Person trips assuming household with 5 or more persons and with 2 vehicles available	Estimated from model using value of 5 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_5mem_3veh	Person trips assuming household with 5 or more persons and with 3 vehicles available	Estimated from model using value of 5 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
ptrp_5mem_4veh	Person trips assuming household with 5 or more persons and with 4 or more vehicles available	Estimated from model using value of 5 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_1mem_0veh	Person miles assuming 1 person household with 0 vehicles available	Estimated from model using value of 1 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_1mem_1veh	Person miles assuming 1 person household with 1 vehicle available	Estimated from model using value of 1 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_1mem_2veh	Person miles assuming 1 person household with 2 vehicles available	Estimated from model using value of 1 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

pmiles_1mem_3veh	Person miles assuming 1 person household with 3 vehicles available	Estimated from model using value of 1 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_1mem_4veh	Person miles assuming 1 person household with 4 or more vehicles available	Estimated from model using value of 1 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_2mem_0veh	Person miles assuming 2 person household with 0 vehicles available	Estimated from model using value of 2 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_2mem_1veh	Person miles assuming 2 person household with 1 vehicle available	Estimated from model using value of 2 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_2mem_2veh	Person miles assuming 2 person household with 2 vehicles available	Estimated from model using value of 2 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_2mem_3veh	Person miles assuming 2 person household with 3 vehicles available	Estimated from model using value of 2 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_2mem_4veh	Person miles assuming 2 person household with 4 or more vehicles available	Estimated from model using value of 2 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

pmiles_3mem_0veh	Person miles assuming 3 person household with 0 vehicles available	Estimated from model using value of 3 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_3mem_1veh	Person miles assuming 3 person household with 1 vehicle available	Estimated from model using value of 3 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_3mem_2veh	Person miles assuming 3 person household with 2 vehicles available	Estimated from model using value of 3 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_3mem_3veh	Person miles assuming 3 person household with 3 vehicles available	Estimated from model using value of 3 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_3mem_4veh	Person miles assuming 3 person household with 4 or more vehicles available	Estimated from model using value of 3 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_4mem_0veh	Person miles assuming 4 person household with 0 vehicles available	Estimated from model using value of 4 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_4mem_1veh	Person miles assuming 4 person household with 1 vehicle available	Estimated from model using value of 4 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

pmiles_4mem_2veh	Person miles assuming 4 person household with 2 vehicles available	Estimated from model using value of 4 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_4mem_3veh	Person miles assuming 4 person household with 3 vehicles available	Estimated from model using value of 4 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_4mem_4veh	Person miles assuming 4 person household with 4 or more vehicles available	Estimated from model using value of 4 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_5mem_0veh	Person miles assuming household with 5 or more persons and with 0 vehicles available	Estimated from model using value of 5 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_5mem_1veh	Person miles assuming household with 5 or more persons and with 1 vehicle available	Estimated from model using value of 5 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_5mem_2veh	Person miles assuming household with 5 or more persons and with 2 vehicles available	Estimated from model using value of 5 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
pmiles_5mem_3veh	Person miles assuming household with 5 or more persons and with 3 vehicles available	Estimated from model using value of 5 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

pmiles_5mem_4veh	Person miles assuming household with 5 or more persons and with 4 or more vehicles available	Estimated from model using value of 5 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_1mem_0veh	Vehicle trips assuming 1 person household with 0 vehicles available	Estimated from model using value of 1 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_1mem_1veh	Vehicle trips assuming 1 person household with 1 vehicle available	Estimated from model using value of 1 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_1mem_2veh	Vehicle trips assuming 1 person household with 2 vehicles available	Estimated from model using value of 1 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_1mem_3veh	Vehicle trips assuming 1 person household with 3 vehicles available	Estimated from model using value of 1 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_1mem_4veh	Vehicle trips assuming 1 person household with 4 or more vehicles available	Estimated from model using value of 1 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_2mem_0veh	Vehicle trips assuming 2 person household with 0 vehicles available	Estimated from model using value of 2 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vtrp_2mem_1veh	Vehicle trips assuming 2 person household with 1 vehicle available	Estimated from model using value of 2 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_2mem_2veh	Vehicle trips assuming 2 person household with 2 vehicles available	Estimated from model using value of 2 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_2mem_3veh	Vehicle trips assuming 2 person household with 3 vehicles available	Estimated from model using value of 2 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_2mem_4veh	Vehicle trips assuming 2 person household with 4 or more vehicles available	Estimated from model using value of 2 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_3mem_0veh	Vehicle trips assuming 3 person household with 0 vehicles available	Estimated from model using value of 3 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_3mem_1veh	Vehicle trips assuming 3 person household with 1 vehicle available	Estimated from model using value of 3 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_3mem_2veh	Vehicle trips assuming 3 person household with 2 vehicles available	Estimated from model using value of 3 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vtrp_3mem_3veh	Vehicle trips assuming 3 person household with 3 vehicles available	Estimated from model using value of 3 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_3mem_4veh	Vehicle trips assuming 3 person household with 4 or more vehicles available	Estimated from model using value of 3 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_4mem_0veh	Vehicle trips assuming 4 person household with 0 vehicles available	Estimated from model using value of 4 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_4mem_1veh	Vehicle trips assuming 4 person household with 1 vehicle available	Estimated from model using value of 4 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_4mem_2veh	Vehicle trips assuming 4 person household with 2 vehicles available	Estimated from model using value of 4 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_4mem_3veh	Vehicle trips assuming 4 person household with 3 vehicles available	Estimated from model using value of 4 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_4mem_4veh	Vehicle trips assuming 4 person household with 4 or more vehicles available	Estimated from model using value of 4 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vtrp_5mem_0veh	Vehicle trips assuming household with 5 or more persons and with 0 vehicles available	Estimated from model using value of 5 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_5mem_1veh	Vehicle trips assuming household with 5 or more persons and with 1 vehicle available	Estimated from model using value of 5 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_5mem_2veh	Vehicle trips assuming household with 5 or more persons and with 2 vehicles available	Estimated from model using value of 5 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_5mem_3veh	Vehicle trips assuming household with 5 or more persons and with 3 vehicles available	Estimated from model using value of 5 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vtrp_5mem_4veh	Vehicle trips assuming household with 5 or more persons and with 4 or more vehicles available	Estimated from model using value of 5 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_1mem_0veh	Vehicle miles assuming 1 person household with 0 vehicles available	Estimated from model using value of 1 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_1mem_1veh	Vehicle miles assuming 1 person household with 1 vehicle available	Estimated from model using value of 1 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vmiles_1mem_2veh	Vehicle miles assuming 1 person household with 2 vehicles available	Estimated from model using value of 1 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_1mem_3veh	Vehicle miles assuming 1 person household with 3 vehicles available	Estimated from model using value of 1 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_1mem_4veh	Vehicle miles assuming 1 person household with 4 or more vehicles available	Estimated from model using value of 1 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_2mem_0veh	Vehicle miles assuming 2 person household with 0 vehicles available	Estimated from model using value of 2 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_2mem_1veh	Vehicle miles assuming 2 person household with 1 vehicle available	Estimated from model using value of 2 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_2mem_2veh	Vehicle miles assuming 2 person household with 2 vehicles available	Estimated from model using value of 2 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_2mem_3veh	Vehicle miles assuming 2 person household with 3 vehicles available	Estimated from model using value of 2 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vmiles_2mem_4veh	Vehicle miles assuming 2 person household with 4 or more vehicles available	Estimated from model using value of 2 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_3mem_0veh	Vehicle miles assuming 3 person household with 0 vehicles available	Estimated from model using value of 3 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_3mem_1veh	Vehicle miles assuming 3 person household with 1 vehicle available	Estimated from model using value of 3 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_3mem_2veh	Vehicle miles assuming 3 person household with 2 vehicles available	Estimated from model using value of 3 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_3mem_3veh	Vehicle miles assuming 3 person household with 3 vehicles available	Estimated from model using value of 3 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_3mem_4veh	Vehicle miles assuming 3 person household with 4 or more vehicles available	Estimated from model using value of 3 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_4mem_0veh	Vehicle miles assuming 4 person household with 0 vehicles available	Estimated from model using value of 4 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vmiles_4mem_1veh	Vehicle miles assuming 4 person household with 1 vehicle available	Estimated from model using value of 4 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_4mem_2veh	Vehicle miles assuming 4 person household with 2 vehicles available	Estimated from model using value of 4 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_4mem_3veh	Vehicle miles assuming 4 person household with 3 vehicles available	Estimated from model using value of 4 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_4mem_4veh	Vehicle miles assuming 4 person household with 4 or more vehicles available	Estimated from model using value of 4 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_5mem_0veh	Vehicle miles assuming household with 5 or more persons and with 0 vehicles available	Estimated from model using value of 5 for household size, 0 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_5mem_1veh	Vehicle miles assuming household with 5 or more persons and with 1 vehicle available	Estimated from model using value of 5 for household size, 1 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_5mem_2veh	Vehicle miles assuming household with 5 or more persons and with 2 vehicles available	Estimated from model using value of 5 for household size, 2 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

vmiles_5mem_3veh	Vehicle miles assuming household with 5 or more persons and with 3 vehicles available	Estimated from model using value of 5 for household size, 3 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric
vmiles_5mem_4veh	Vehicle miles assuming household with 5 or more persons and with 4 or more vehicles available	Estimated from model using value of 5 for household size, 4 for vehicles available, and 2007-2011 American Community Survey 5-year estimate tract data for all other model parameters	8	Numeric

NOTE: There are 318 Census Tracts that were not assigned to a Census Region/Division or urban group. These are Census tracts with no land area. All data rounded to 2 decimal places. Household income; the count of household vehicles, household members, and workers; homeownership; and life cycle data pulled from the 2007-2011 American Community Survey 5-Year Estimates. Formula indicates the table number + 'e' + line number of data in summary flat files http://www2.census.gov/acs2011_5yr/summaryfile/

Table C2. Clusters Formed from Census Regions/Divisions by State

Cluster	Cluster Name	State FIP	Census Region/Division with State Names
1	Northeast		Northeast Region
			New England Division
		09	Connecticut
		23	Maine
		25	Massachusetts
		33	New Hampshire
		44	Rhode Island
		50	Vermont
			Middle Atlantic Division
		34	New Jersey
		36	New York
		42	Pennsylvania
2	Midwest		Midwest Region
			East North Central Division
		17	Illinois
		18	Indiana
		26	Michigan
		39	Ohio
		55	Wisconsin
			West North Central Division
		19	Iowa
		20	Kansas
		27	Minnesota
		29	Missouri
31	Nebraska		
38	North Dakota		

Cluster	Cluster Name	State FIP	Census Region/Division with State Names
		46	South Dakota
3	South Atlantic		South Region
			South Atlantic Division
		10	Delaware
		11	District of Columbia
		12	Florida
		13	Georgia
		24	Maryland
		37	North Carolina
		45	South Carolina
		51	Virginia
		54	West Virginia
4	East South Central and West South Central		East South Central Division
		01	Alabama
		21	Kentucky
		28	Mississippi
		47	Tennessee
			West South Central Division
		05	Arkansas
		22	Louisiana
		40	Oklahoma
48	Texas		
5	West		West Region
			Mountain Division
		04	Arizona
		08	Colorado
		16	Idaho
		30	Montana
		32	Nevada
		35	New Mexico
		49	Utah
56	Wyoming		
6	Pacific		Pacific Division
		02	Alaska
		06	California
		15	Hawaii
		41	Oregon
		53	Washington