

# **NHTS Add-on Data: Trip Generation Rates and Descriptive Analysis**

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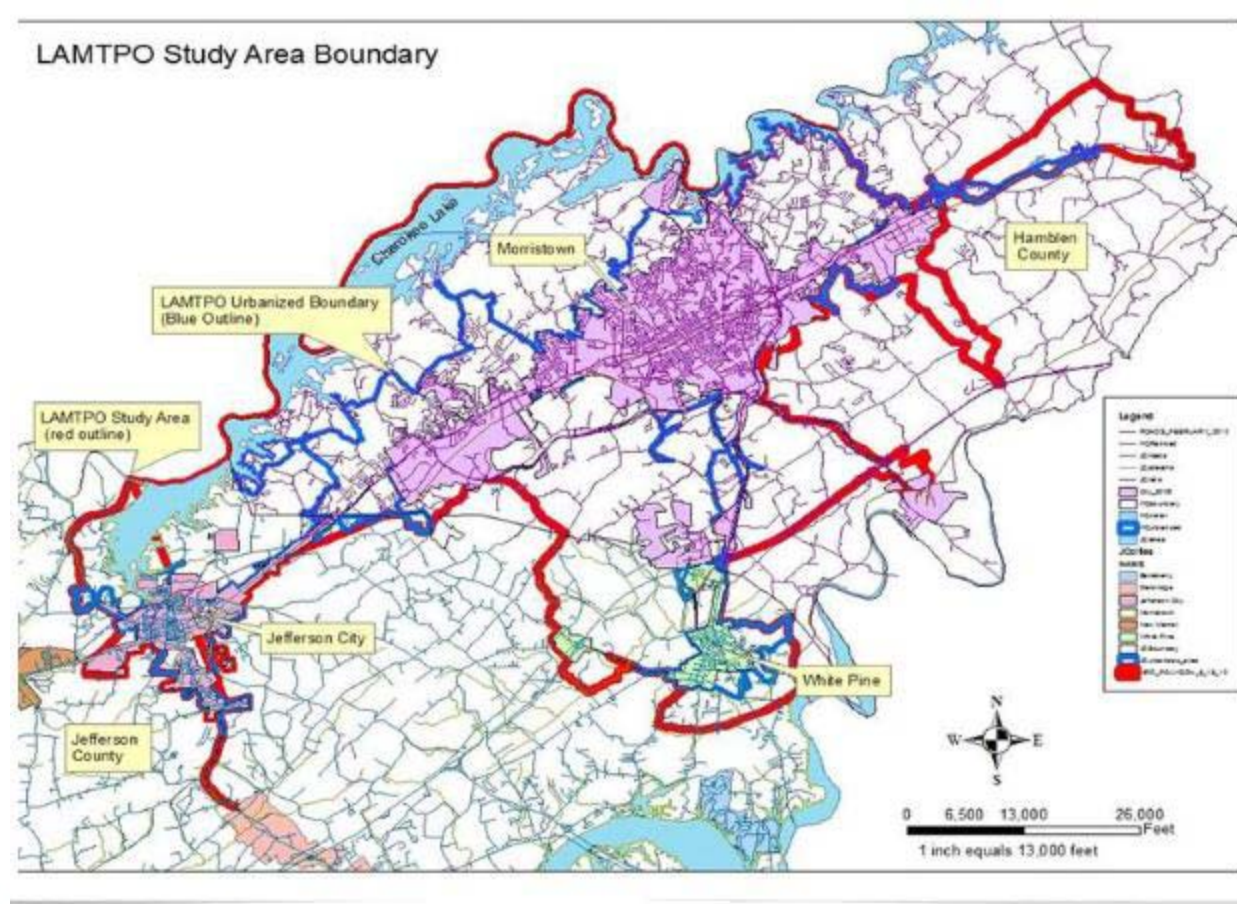
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# Agenda

- ❖ NHTS 2009 add-on sample (Tennessee)
  - Lakeway Area Metropolitan Transportation Planning Organization (LAMTPO) trip generation rates
  - Comparison with Lakeway household survey and NCHRP 365
- ❖ NHTS 2009 add-on sample (South Carolina)
  - Descriptive statistics of the add-on sample
  - Appalachian Council of Governments (APCOG) sample characteristics
  - Comparison of trip production rates with existing MPO models
- ❖ NHTS 2009 add-on sample (Maricopa Association of Governments)
  - Auto ownership model

# LAMTPO - Study Area



# NHTS 2009 – Tennessee Add-On

- ❖ TN add-on : 2,552 sampled households expanded to 2.4 million households
- ❖ 948 households in Non-MSA and MSA size less than 250,000 people – This sample is used to estimate the trip generation rates since this category is similar to the current study area
- ❖ LAMTPO study area – 948 households, 1996 persons surveyed, 6488 trips

# Lakeway Household Survey

- ❖ 498 households, 1103 Persons surveyed, 5490 'activities' reported
- ❖ The survey consisted of three files:
  1. Households – vehicles, workers, income, size
  2. Persons – age, gender, employment etc
  3. Activities – each record in the file describes the type of activity location (home, work, school, other) and purpose of the trip (12 categories such as activities a home, paid work etc.)
- ❖ The activities file needs to be recoded to obtain a trip file – 4402 trips.

# Cross Classification

- ❖ To obtain trip generation rates from the lakeway survey, various cross classification schemes were tried including number of workers, household income, household size and number of vehicles. The table below shows the number of households in the categories of the chosen cross classification scheme:

Number of Households					
	Household Size				
Number of Vehicles	1	2	3	4+	Grand Total
0	27	1	1	1	30
1	87	38	14	10	149
2+	39	136	65	79	319
Grand Total	153	175	80	90	498

# Lakeway Survey, NHTS 2009, Nashville MPO

## Trip Generation Rates - HBW

HBW – Trips Per Household					
	Household Size				
Number of Vehicles	1	2	3	4+	Weighted Average
0	N/A	N/A	N/A	N/A	0.17, 0.12
1	0.28, <i>0.25</i>	0.76, <i>1.24</i>	N/A	N/A	0.99, 0.82
2+	0.72, <i>0.83</i>	0.96, <i>0.74</i>	2.63, <i>1.68</i>	4.59, <i>1.81</i>	2.17, <i>1.27</i>
<b>Weighted Average</b>	0.34, <i>0.34</i>	0.91, <i>0.82</i>	2.76, <i>1.63</i>	4.58, <i>2.01</i>	1.69, <i>1.33</i>

**Note:** The first value in each cell is obtained from the household survey conducted in the LAMTPO area and the second value (*in red italics*) is obtained from the NHTS 2009

## Nashville Area MPO Trip Production Rates

HBW – Trips Per Household				
	Household Size			
Number of Vehicles	1	2	3	4+
0	0.29	0.75	0.75	1.00
1	1.00	1.18	1.50	1.75
2+	1.40	1.93	2.50	2.60

# Lakeway Survey, NHTS 2009, Nashville MPO

## Trip Generation Rates - HBO

HBW – Trips Per Household					
	Household Size				
Number of Vehicles	1	2	3	4+	Weighted Average
0	1.37, <i>1.20</i>	N/A	N/A	N/A	1.73, <i>1.77</i>
1	2.03, <i>1.56</i>	3.95, <i>2.23</i>	4.86, <i>N/A</i>	5.60, <i>N/A</i>	3.03, <i>2.65</i>
2+	1.72, <i>2.37</i>	4.21, <i>3.33</i>	4.77, <i>5.86</i>	5.89, <i>7.83</i>	4.44, <i>5.13</i>
<b>Weighted Average</b>	1.84, <i>1.65</i>	4.13, <i>3.16</i>	4.84, <i>5.93</i>	5.86, 8.06	3.85, <i>4.23</i>

**Note:** The first value in each cell is obtained from the household survey conducted in the LAMTPO area and the second value (*in red italics*) is obtained from the NHTS 2009

## Nashville Area MPO Trip Production Rates

HBO – Trips Per Household				
	Household Size			
Number of Vehicles	1	2	3	4+
0	1.00	1.50	4.50	5.90
1	1.95	2.50	4.65	7.00
2+	2.10	2.90	4.85	8.40



# Lakeway Survey, NHTS 2009, Nashville MPO

## Trip Generation Rates - NHB

NHB – Trips Per Household					
Number of Vehicles	Household Size				Weighted Average
	1	2	3	4+	
0	1.11, <i>0.46</i>	N/A	N/A	N/A	1.10, <i>0.79</i>
1	1.82, <i>0.81</i>	2.53, <i>1.66</i>	3.64, <i>N/A</i>	3.50, <i>N/A</i>	2.28, <i>1.38</i>
2+	1.59, <i>1.12</i>	3.45, <i>2.22</i>	4.82, <i>3.96</i>	5.34, <i>4.55</i>	3.78, <i>3.19</i>
<b>Weighted Average</b>	1.63, <i>0.80</i>	3.23, <i>2.11</i>	4.58, <i>4.60</i>	5.09, <i>4.60</i>	3.29, <i>2.54</i>

**Note:** The first value in each cell is obtained from the household survey conducted in the LAMTPO area and the second value (*in red italics*) is obtained from the NHTS 2009

## Nashville Area MPO Trip Production Rates

NHB – Trips Per Household				
Number of Vehicles	Household Size			
	1	2	3	4+
0	0.40	0.60	0.90	1.50
1	1.50	2.20	3.00	3.40
2+	1.60	2.42	3.40	5.00

# Lakeway Survey, NHTS 2009, Nashville MPO, NCHRP 365

## Trip Generation Rates – All Purposes

Comparison of trips from LAMTPO survey, NHTS 2009 and NCHRP 365

	Household Size				Weighted Average
	1	2	3	4+	
LAMTPO Survey	3.8	8.3	12.2	15.5	8.8
NHTS	2.9	6.3	11.5	15.2	8.1
NCHRP, 365	3.7	7.6	10.6	15.0	9.2

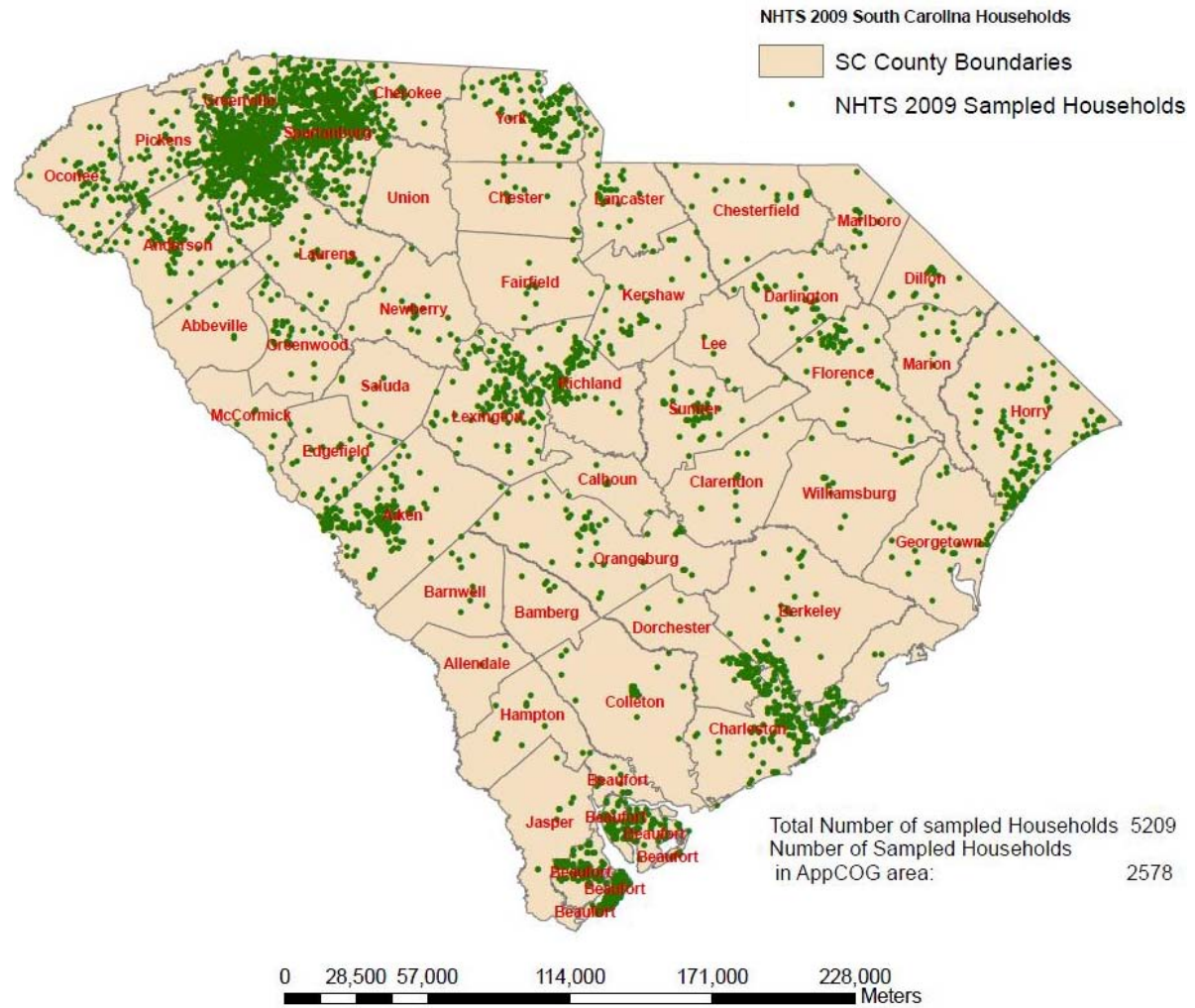
Note: NCHRP, 365 values corresponding to urban area size 50,000 - 199,999 are used

### Recommendation:

- ❖ Use NHTS 2009 (More recent, bigger sample, weighted to population and consistent with other similar sized MSA trips generation rates)

# NHTS 2009 – SC Add-On Sample

# NHTS 2009 – SC Add-On



# Sample Characteristics

Sub-Region	Number of Households Interviewed	Weighted Household Count	Number of Persons in the Households Interviewed	Weighted Person Count	Daily Trips Reported	Weighted Annual Daily Trips	Number of Vehicles (Weighted)	Number of Workers (Weighted)
<b>APCOG Area</b>								
Anderson	142	41,289	283	98,531	1,354	335,146,617	80,284	41,582
Cherokee	33	11,902	70	29,730	267	130,927,247	19,842	17,499
Greenville	1,234	404,370	2,455	1,054,318	11,622	578,508,505	796,330	534,532
Oconee	61	18,510	125	33,386	508	148,704,049	30,705	16,571
Pickens	78	30,020	159	79,648	723	159,911,995	64,563	42,504
Spartanburg	888	285,118	1,777	694,354	7,661	371,688,515	557,239	353,664
<b>Sub Total</b>	2,436	791,209	4,869	1,989,967	22,135	1,724,886,928	1,548,964	1,006,352
<b>Myrtle Beach area</b>								
Horry	123	38,119	244	78,613	1,067	227,785,660	65,273	35,175
Georgetown	33	14,464	69	51,394	274	67,156,958	25,936	17,546
<b>Sub Total</b>	156	52,583	313	130,007	1,341	294,942,618	91,209	52,721
Aiken	269	100,085	527	232,719	2,080	209,506,794	177,098	116,132
<b>Similar MPO's grouped together</b>								
Sumter	47	9,680	87	16,799	431	162,991,179	16,108	7,680
Florence	59	22,226	117	55,118	528	205,821,194	29,354	19,732
York	109	40,991	222	85,488	1,039	257,887,532	73,083	51,901
<b>Sub Total</b>	215	72,897	426	157,405	1,998	626,699,905	118,546	79,313
<b>Overall Statewide</b>	4,917	1,624,068	9,811	3,994,150	39,866	5,742,236,657	3,060,888	2,023,780

## Mode Split – Overall SC

Overall - Annual Estimate of Person Trips by Mode of Travel					
	n	High	Low	Est	%
Private Vehicle	34,324	5,115,544,340	4,776,589,798	4,946,067,069	89.4%
Transit	36	41,476,717	5,682,669	23,579,693	0.4%
Walk	2,605	422,012,920	328,237,658	375,125,289	6.8%
Other	821	222,901,060	153,014,565	187,957,813	3.4%

Commute - Annual Estimate of Person Trips by Mode of Travel					
	n	High	Low	Est	%
Private Vehicle	2,179	442,902,669	373,798,631	408,350,650	95.9%
Transit	8	11,823,581	945,570	6,384,576	1.5%
Walk	24	10,583,343	1,772,074	6,177,709	1.5%
Other	17	7,692,031	2,325,602	5,008,817	1.2%

Note1: Replicate weights are used to obtain the range (Jackknife method)

Note2: Confidence intervals – 95%

# Mode vs. Purpose

## Statewide

Trip Mode	Trip Purpose				
	HBW	HBO	NHB	Other	Total
Automobile (%)	96.2%	85.9%	93.1%	84.7%	89.4%
<i>sampled trips</i>	<i>3657</i>	<i>19002</i>	<i>11018</i>	<i>647</i>	<i>34324</i>
Bus (%)	1.5%	2.8%	1.3%	5.3%	2.2%
<i>sampled trips</i>	<i>12</i>	<i>261</i>	<i>101</i>	<i>11</i>	<i>385</i>
Taxi (%)		.0%	.0%	.0%	.0%
<i>sampled trips</i>	<i>0</i>	<i>1</i>	<i>7</i>	<i>3</i>	<i>11</i>
Ship (%)			.0%		.0%
<i>sampled trips</i>	<i>0</i>	<i>0</i>	<i>2</i>	<i>0</i>	<i>2</i>
Air (%)		.0%	.1%	.0%	.0%
<i>sampled trips</i>	<i>0</i>	<i>1</i>	<i>22</i>	<i>1</i>	<i>24</i>
Bicycle (%)	.4%	1.3%	.3%	1.7%	.9%
<i>sampled trips</i>	<i>7</i>	<i>187</i>	<i>21</i>	<i>9</i>	<i>224</i>
Walk (%)	1.1%	9.5%	4.5%	5.9%	6.8%
<i>sampled trips</i>	<i>44</i>	<i>2047</i>	<i>459</i>	<i>55</i>	<i>2605</i>
Other (%)	.7%	.6%	.6%	2.3%	.7%
<i>sampled trips</i>	<i>17</i>	<i>105</i>	<i>77</i>	<i>12</i>	<i>211</i>
Total (%)	100.0%	100.0%	100.0%	100.0%	100.0%
<i>sampled trips</i>	<i>3737</i>	<i>21604</i>	<i>11707</i>	<i>738</i>	<i>37786</i>

# Mode vs. Purpose

APCOG

Trip Mode	Trip Purpose				
	HBW	HBO	NHB	Other	Total
Automobile (%)	98.0%	86.7%	95.2%	92.2%	90.9%
<i>sampled trips</i>	<i>2222</i>	<i>11251</i>	<i>6468</i>	<i>374</i>	<i>20315</i>
Bus (%)	.1%	2.7%	1.2%	.3%	1.9%
<i>sampled trips</i>	<i>2</i>	<i>136</i>	<i>62</i>	<i>3</i>	<i>203</i>
Taxi (%)			.0%	.1%	.0%
<i>sampled trips</i>	<i>0</i>	<i>0</i>	<i>6</i>	<i>3</i>	<i>9</i>
Ship (%)			.0%		.0%
<i>sampled trips</i>	<i>0</i>	<i>0</i>	<i>2</i>	<i>0</i>	<i>2</i>
Air (%)		.0%	.2%		.1%
<i>sampled trips</i>	<i>0</i>	<i>1</i>	<i>12</i>	<i>0</i>	<i>13</i>
Bicycle (%)	.2%	.6%	.1%	1.8%	.4%
<i>sampled trips</i>	<i>3</i>	<i>68</i>	<i>5</i>	<i>5</i>	<i>81</i>
Walk (%)	1.1%	9.6%	2.8%	5.3%	6.3%
<i>sampled trips</i>	<i>27</i>	<i>1118</i>	<i>232</i>	<i>32</i>	<i>1409</i>
Other (%)	.5%	.5%	.4%	.4%	.5%
<i>sampled trips</i>	<i>9</i>	<i>57</i>	<i>34</i>	<i>3</i>	<i>103</i>
Total (%)	100.0%	100.0%	100.0%	100.0%	100.0%
<i>sampled trips</i>	<i>2263</i>	<i>12631</i>	<i>6821</i>	<i>420</i>	<i>22135</i>



# VMT – MWB (Statewide)

Vehicles Owned	Workers in the Household	VMT per Household (Mean)	VMT per Household (St. Dev)	MWB per Household (Mean)	MWB per Household (St. Dev)	Count of Sampled Households	Weighted Household counts
<b>Statewide Sample</b>							
0	0	6.23	20.19	0.99	1.96	153	50,793
0	1	12.65	13.05	1.36	3.34	20	5,108
0	2	18.16	6.56	1.94	0.64	3	462
0	3	58.28	12.63	4.25	2.36	2	256
1	0	27.36	49.53	0.35	1.10	814	267,886
1	1	46.49	89.45	0.37	1.20	357	124,845
1	2	57.36	73.61	1.05	2.09	28	9,693
1	3	44.55	33.12	1.83	0.45	3	246
2	0	44.75	63.01	0.29	1.06	1,149	377,087
2	1	56.24	60.83	0.57	2.56	1,294	440,517
2	2	77.75	85.43	0.73	2.05	951	304,833
2	3	106.28	85.83	0.62	0.98	143	42,344
<b>Overall</b>		56.21	75.54	0.51	1.72	4,917	1,624,068

Note: MWB – Miles walked/biked

# VMT – MWB (APCOG)

Vehicles Owned	Workers in the Household	VMT per Household (Mean)	VMT per Household (St. Dev)	MWB per Household (Mean)	MWB per Household (St. Dev)	Count of Sampled Households	Weighted Household counts
<b>APPCOG Sample</b>							
0	0	13.72	36.34	0.75	1.12	39	11,966
0	1	13.98	14.68	4.66	8.64	13	4,163
0	2	3.57	0.00	1.33	0.00	1	23
1	0	24.75	46.46	0.24	0.84	337	99,644
1	1	31.57	32.87	0.39	1.18	181	59,931
1	2	68.04	95.71	0.45	1.39	14	4,057
1	3	62.79	57.40	1.56	0.77	3	246
2	0	49.12	74.70	0.26	0.87	514	180,927
2	1	59.67	79.41	0.56	2.44	708	233,053
2	2	81.98	95.25	0.61	1.92	552	177,151
2	3	103.71	78.08	0.47	1.27	74	20,047
<b>Overall</b>		54.34	70.86	0.45	2.02	2,436	791,209

# VMT – MWB (APCOG)

	VMT per Household (Mean)	VMT per Household (St. Dev)	MWB per Household (Mean)	MWB per Household (St. Dev)
GPATS	54.96	90.54	0.61	3.14
SPATS	59.47	66.62	0.55	1.77
ANATS	56.80	84.62	0.27	1.00
Rural	62.21	90.54	0.42	2.17
Overall	54.34	70.86	0.45	2.02

# Trip Production Rates

# HBW Trip Production Rates

## HBW Trip Production Rates for APCOG Area

	HBW Trips Per Year	Daily HBW Trips	Surveyed HHs	Weighted HHs	Overall Trip Rates
<b>GPATS</b>	108,590,467	297,508	1021	174,904	1.701
<b>SPATS</b>	40,637,950	111,337	623	69,340	1.606
<b>ANATS</b>	19,492,262	53,403	73	47,159	1.132
<b>RURAL</b>	34,744,587	95,191	161	60,508	1.573
<b>TOTAL</b>	203,465,266	557,439	1878	351,912	1.584

Source: NHTS 2009

# NHTS vs. MPO Models

## After applying trip production rates from NHTS data

	HBW	HBO	NHB	Total trips	HH
<b>ANATS</b>	79,861	298,013	163,159	541,033	61,699
<b>GPATS</b>	268,188	1,053,766	590,873	1,912,827	197,887
<b>NewAPPCOG</b>	85,622	429,928	253,834	769,384	79,416
<b>SPATS</b>	125,231	574,288	292,922	992,441	98,672
<b>Total</b>	558,902	2,355,995	1,300,788	4,215,685	437,674
<b>Tot HH obtained from ACS 2005-2009 data</b>					

## From Current Individual MPO models

	HBW	HBO	NHB	Total trips	HH
<b>ANATS</b>	101,506	146,092	161,925	409,523	62,089
<b>GPATS</b>	302,925	665,195	538,625	1,506,745	180,482
<b>NewAPPCOG</b>	-	-	-	-	-
<b>SPATS</b>	219,064	264,164	270,921	754,148	116,986
<b>Total</b>	623,494	1,075,451	971,470	2,670,416	359,557

# NHTS vs. MPO Models

NHTS Trip Rates				
	HBW	HBO	NHB	Total
<b>ANATS</b>	1.29	4.83	2.64	8.77
<b>GPATS</b>	1.36	5.33	2.99	9.67
<b>NewAPPCOG</b>	1.08	5.41	3.20	9.69
<b>SPATS</b>	1.27	5.82	2.97	10.06
<b>Total</b>	1.28	5.38	2.97	9.63

Existing Model Trip Rates				
	HBW	HBO	NHB	Total
<b>ANATS</b>	1.63	2.35	2.61	6.60
<b>GPATS</b>	1.68	3.69	2.98	8.35
<b>NewAPPCOG</b>	-	-	-	-
<b>SPATS</b>	1.87	2.26	2.32	6.45
<b>Overall</b>	1.73	2.99	2.70	7.43

% Change				
	HBW	HBO	NHB	Total
<b>ANATS</b>	-21%	105%	1%	33%
<b>GPATS</b>	-19%	44%	0%	16%
<b>NewAPPCOG</b>	-	-	-	-
<b>SPATS</b>	-32%	158%	28%	56%
<b>Total</b>	-26%	80%	10%	30%

# NHTS vs. MPO Models

NHTS Trip Rates				
	HBW	HBO	NHB	Total
<b>ANATS</b>	1.29	4.83	2.64	8.77
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<b>Overall</b>	1.73	2.99	2.70	7.43

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<b>Total</b>	-26%	80%	10%	30%



# NHTS 2009 – MAG

# Auto Ownership Model

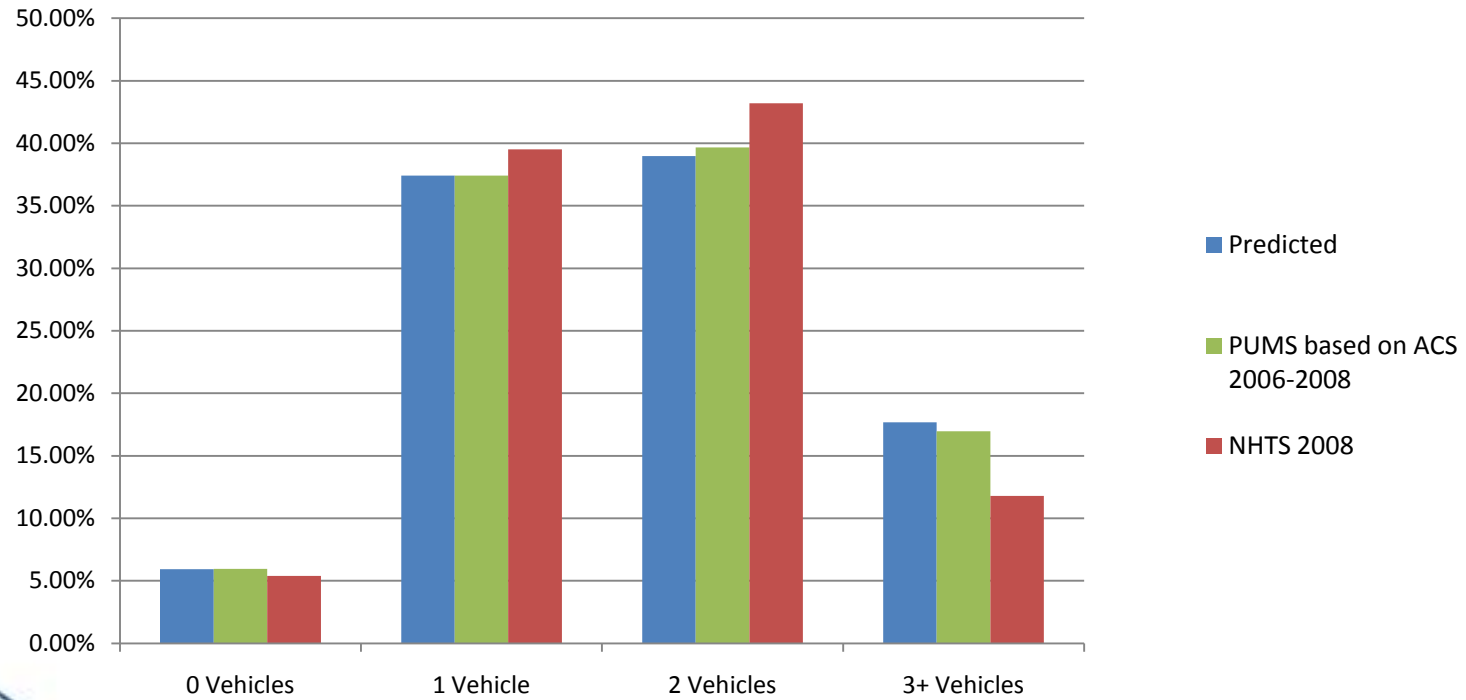
- ❖ Existing model : Multinomial logit
- ❖ Existing model dataset: 1989/1990 household survey
- ❖ Update dataset: NHTS 2009
  - Total number of households: 4,707
  - Number of households with valid income: 4,316
  - HH location falling within MAG TAZ boundary: 4,258
- ❖ Updated model: Multinomial logit model

# Final Model Specification

Auto Ownership model				
Variable	0 Vehicles	1 Vehicle	2 Vehicles	3+ Vehicles
Constant	-2.7404	1.6837	2.3022	0.0000
HHSIZE1				
HHSIZE2		0.9519		
HHSIZE3		0.9519		
HHSIZE4		0.9519		
Income QTL1	1.7077	0.7253	-0.7039	
Income QTL2	1.7077	0.7253		
Income QTL3				
Income QTL4			1.5098	2.6679
Income QTL5			1.5098	2.8229
HHWokers0	2.4813			
HHWorkers1				
HHWorkers2			1.5163	3.8167
HHWorkers3+			1.5163	4.4612
EMPDEN				-0.0482
HHDEN	0.0264			
REMP30T				-0.1629
HTYPE				-0.9998

# Calibration Result

## Predicted Vs. Observed Auto Ownership Shares



# Summary

- ❖ NHTS add-on data widely used in transportation planning process at various steps as illustrated here:
  - Trip generation rates
  - Auto ownership model
- ❖ Various sample characteristics and descriptive analysis can be derived such as
  - Mode split
  - VMT, PMT relationships

**Thank You**