

# Ver. 2.3 travel model, demographic sub-models: Household size, household income, and vehicle availability

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# Background

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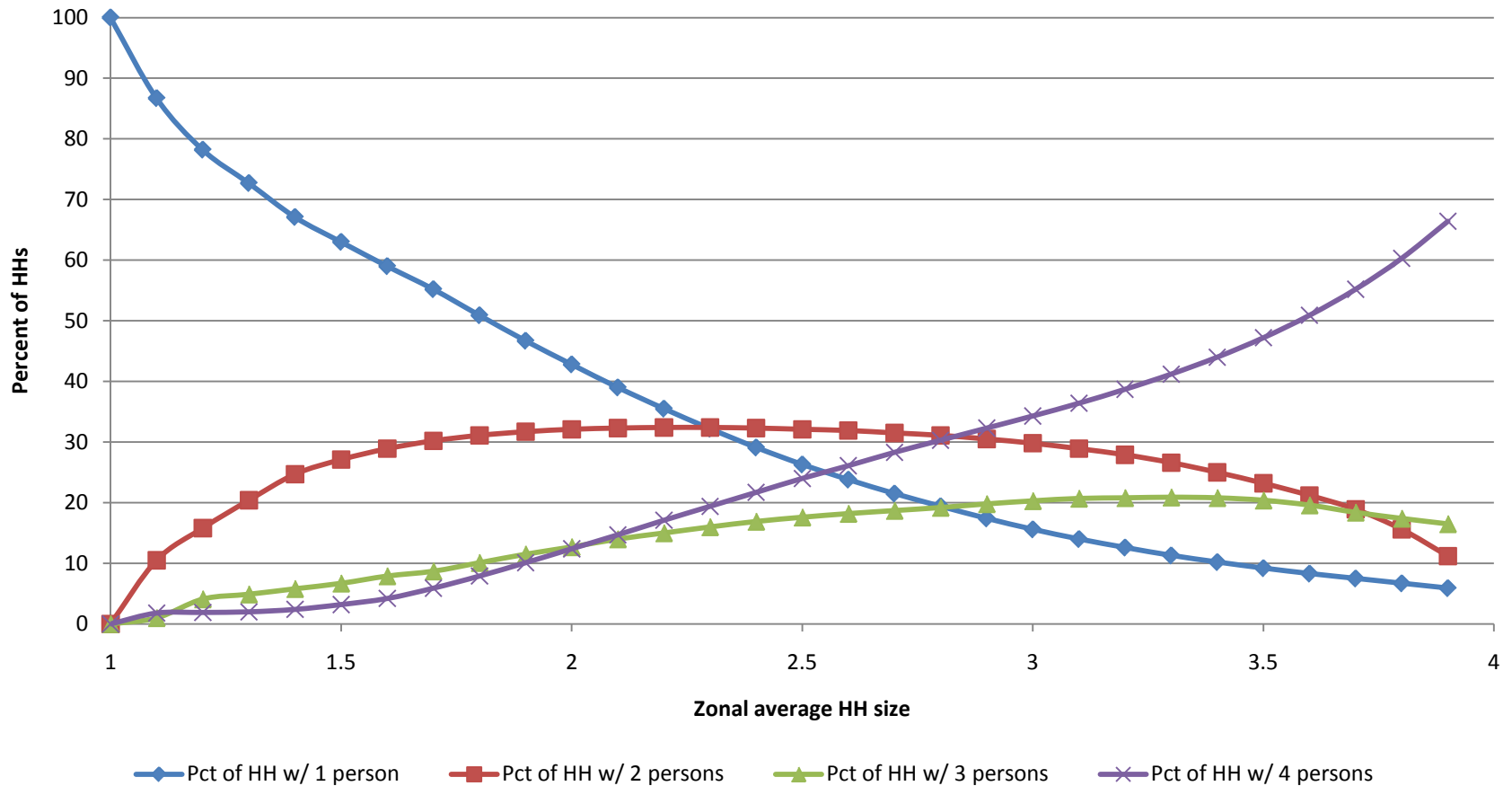
- Demographic Models are used prior to Trip Generation in order to allocate the households within each TAZ to a group by:
  - Household size
  - Household income
  - Vehicle availability
- Trip production rates are then developed for each group

# Household Size Model

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- Households are divided among size groups using “disaggregation curves” that were calibrated using zonal data from the 2000 Census (CTPP)
- The assumption is that specific proportions of integer household size groups within a zone can be specified based on an average household size
- Four size groups:
  - 1 person/hh
  - 2 persons/hh
  - 3 persons/hh
  - 4+ persons/hh

# Household Size Model



# Household Income Model

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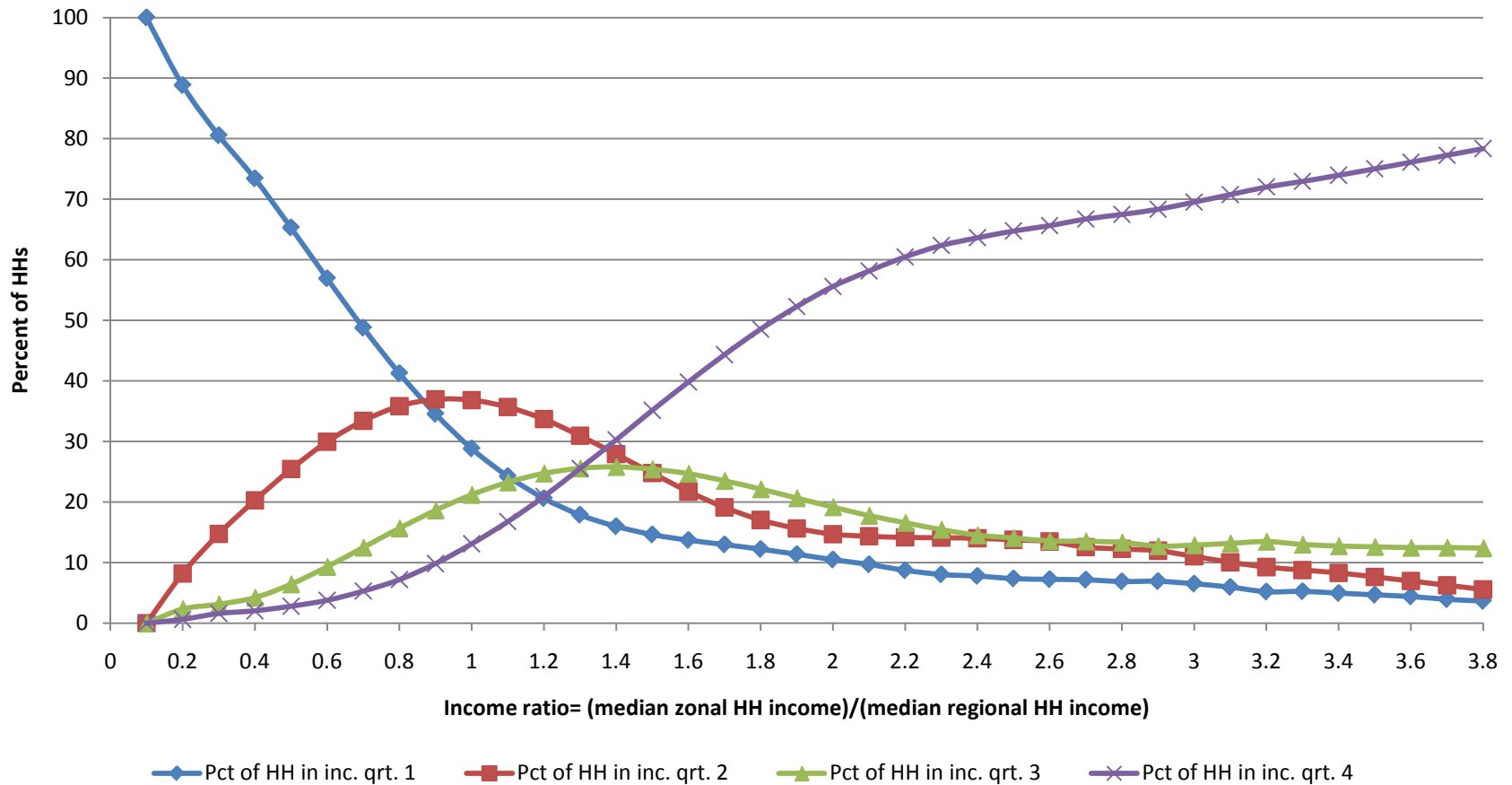
- Households are divided among income groups using another set of “disaggregation curves” that were calibrated using zonal data from the 2000 Census (CTPP)
- These disaggregation curves are related to the ratio of the zonal median income to the regional median income
- Four ranges that approximate quartiles:
  - <\$50,000
  - \$50,000-\$99,999
  - \$100,000-\$149,999
  - >\$150,000

# Household Income Model

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- ACS does not provide detailed enough data to re-estimate the curves, so 2000 CTPP ratios were adapted to the new zone system based on area proration
- The curves were adjusted because they overestimated the number of households in higher income groups when compared to the 2007 ACS

# Household Income Model



# Vehicle Availability Model

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- Apportions households among vehicle availability levels of 0, 1, 2, and 3+ vehicles
- Discrete choice model (multinomial logit) estimated at the TAZ level
- Estimated based on 2007/2008 HTS and “Pseudo” Round 8.0 land use forecast



# Vehicle Availability Model

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- Dependent variable:
  - Number of vehicles available to a household
    - 0, 1, 2, or 3+ vehicles
- Independent variables:
  - Household size
  - Household income
  - Area type
  - Employment within 45 minutes of “best” AM transit service
  - DC dummy

# Vehicle Availability Model: Estimated

Number of Vehicles				Variable	Coefficient	T- statistic
0	1	2	3+			
	X			Constant	0.848295	4.328
		X		Constant	-3.0131	-13.451
			X	Constant	-6.37966	-24.03
	X			Household Size	0.168815	2.536
		X		Household Size	1.344273	19.377
			X	Household Size	1.691119	23.174
	X			Income level 2	1.453173	14.516
		X		Income level 2	2.253346	19.364
			X	Income level 2	2.648328	18.332
	X			Income level 3	1.842613	11.916
		X		Income level 3	3.417672	20.697
			X	Income level 3	3.912204	21.023
	X			Income level 4	2.471859	8.376
		X		Income level 4	4.635946	15.449
			X	Income level 4	5.552037	17.737
	X			Employment w/in 45 min transit	-1.11E-06	-6.808
		X		Employment w/in 45 min transit	-1.95E-06	-10.677
			X	Employment w/in 45 min transit	-2.27E-06	-10.703
	X			Area type	0.237973	5.31
		X		Area type	0.519935	10.86
			X	Area type	0.828004	16.059
	X			DC dummy	-0.97983	-9.442
		X		DC dummy	-1.45223	-11.24
			X	DC dummy	-1.59873	-8.882

- All variables are statistically significant
- Adjusted pseudo- $R^2=0.269$

# Vehicle Availability Model: Adjusted

Number of Vehicles				Variable	Coefficient
0	1	2	3+		
	X			Constant	0.432532
		X		Constant	-3.641937
			X	Constant	-6.964056
	X			Household Size	0.168815
		X		Household Size	1.344273
			X	Household Size	1.691119
	X			Income level 2	1.453173
		X		Income level 2	2.253346
			X	Income level 2	2.648328
	X			Income level 3	1.842613
		X		Income level 3	3.417672
			X	Income level 3	3.912204
	X			Income level 4	2.471859
		X		Income level 4	4.635946
			X	Income level 4	5.552037
	X			Employment w/in 45 min transit	-1.11E-06
		X		Employment w/in 45 min transit	-1.95E-06
			X	Employment w/in 45 min transit	-2.27E-06
	X			Area type	0.237973
		X		Area type	0.519935
			X	Area type	0.828004
	X			DC dummy	-0.97983
		X		DC dummy	-1.45223
			X	DC dummy	-1.59873

- Constants adjusted to match ACS 2007 vehicle availability

# Household Size Model Validation

Estimated					
	1 Psn	2 Psns	3 Psns	4+ Psns	Total
HHs	664,559	723,464	392,846	558,997	2,339,865
Pct.	28.40%	30.92%	16.79%	23.89%	100.00%
Observed					
	1 Psn	2 Psns	3 Psns	4+ Psns	Total
HHs	649,305	713,509	385,435	575,731	2,323,980
Pct.	27.94%	30.70%	16.59%	24.77%	100.00%
Estimated/Observed Ratio					
	1 Psn	2 Psns	3 Psns	4+ Psns	Total
HHs	1.0235	1.0140	1.0192	0.9709	1.0068
Pct.	1.0165	1.0071	1.0123	0.9643	1.0000
Estimated- Observed					
	1 Psn	2 Psns	3 Psns	4+ Psns	Total
HHs	15,254	9,955	7,411	-16,734	15,885
Pct.	0.46%	0.22%	0.20%	-0.88%	0.00%

- Estimated number of households in each household size group is within 1% of the observed
- Note that the difference between the observed and estimated of 15,885 is due to Clarke County being omitted from the ACS observed trips

# Household Income Model Validation

Estimated					
	< 50.00k	50.00k- 99.99k	100.k- 149.99k	> 150.00k	Total
HHs	635,803	726,626	483,261	494,175	2,339,865
Pct.	27.17%	31.05%	20.65%	21.12%	100.00%
Observed					
	< 50.00k	50.00k- 99.99k	100.k- 149.99k	> 150.00k	Total
HHs	640,594	731,729	470,110	481,547	2,323,980
Pct.	27.56%	31.49%	20.23%	20.72%	100.00%
Estimated/Observed Ratio					
	< 50.00k	50.00k- 99.99k	100.k- 149.99k	> 150.00k	Total
HHs	0.9925	0.9930	1.0280	1.0262	1.0068
Pct.	0.9858	0.9863	1.0210	1.0193	1.0000
Estimated- Observed					
	< 50.00k	50.00k- 99.99k	100.k- 149.99k	> 150.00k	Total
HHs	-4,791	-5,103	13,151	12,628	15,885
Pct.	-0.39%	-0.43%	0.42%	0.40%	0.00%

- Estimated number of households in each household income group is within 1% of the observed

# Vehicle Availability Model Validation

Estimated					
	0 Vehs.	1 Veh.	2 Vehs.	3+ Vehs.	Total
HHs	197,911	734,183	877,105	530,667	2,339,865
Pct.	8.46%	31.38%	37.49%	22.68%	100.00%
Observed					
	0 Vehs.	1 Veh.	2 Vehs.	3+ Vehs.	Total
HHs	200,561	733,753	865,514	524,152	2,323,980
Pct.	8.63%	31.57%	37.24%	22.55%	100.00%
Estimated/Observed Ratio					
	0 Vehs.	1 Veh.	2 Vehs.	3+ Vehs.	Total
HHs	0.9868	1.0006	1.0134	1.0124	1.0068
Pct.	0.9801	0.9938	1.0065	1.0056	1.0000
Estimated- Observed					
	0 Vehs.	1 Veh.	2 Vehs.	3+ Vehs.	Total
HHs	-2,650	430	11,591	6,515	15,885
Pct.	-0.17%	-0.20%	0.24%	0.13%	0.00%

- Estimated number of households in each vehicle availability group is within 1% of the observed

# Conclusions

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- Household size demographic model estimated based on 2000 CTPP was retained without changes. It was validated on the 2007 ACS data and still fit well.
- Household income model estimated using the 2000 CTPP data was adjusted because the higher income levels were overestimated. It was also validated on the 2007 ACS data.
- Vehicle availability model was re-estimated using the 2007/2008 HTS and “Pseudo” Round 8.0 land use forecast. The constants were adjusted to better match the 2007 ACS data.