

HOUSEHOLD ENUMERATION FOR TRIP GENERATION

Chicago Area Transportation Modelers User Group
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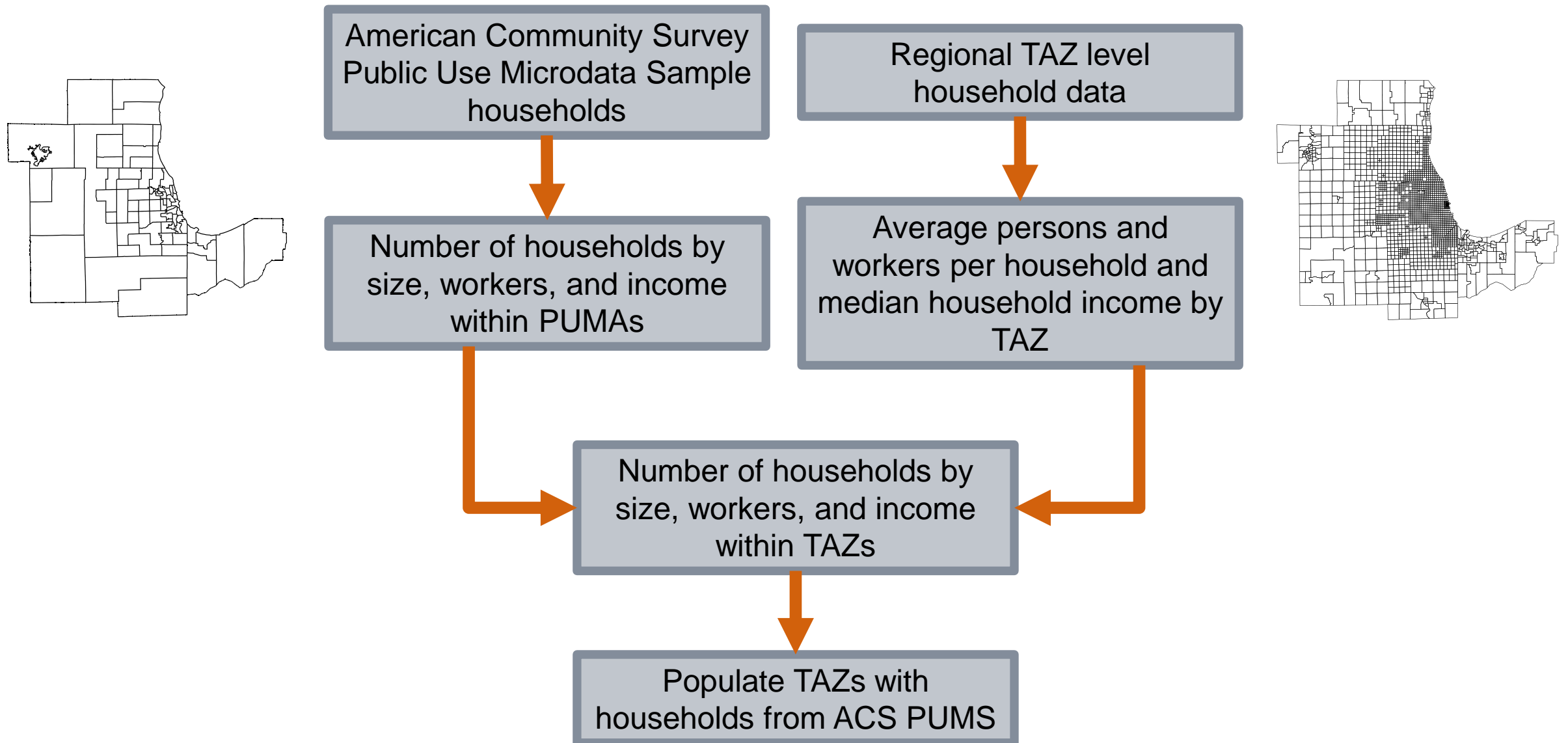
What Are Synthetic Populations?

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- A synthetic 100% sample of the population, enumerating every household and every person
- Prepared for small areas – TAZs, Blocks, Parcels
- Created from
 - ▣ A surveyed sample population that can be cross-classified by several household attributes within large areas – American Community Survey, National Household Travel Survey, Travel Tracker Survey
 - ▣ Population statistics (average household size, median income) by small areas – ACS or 2010 Census Summary Files, local land use/population data and forecasts

Typical Example

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General Methodology

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1. A desired TAZ level distribution of households is developed from a sample of surveyed households and TAZ household characteristics
 - a) Sample households provide a seed distribution – for example, number of households in cells defined by size, workers, and income at the geographic level of PUMAs created from ACS PUMS data
 - b) TAZ household control totals – for example, number of TAZ households in each size category
 - c) Seed distribution is manipulated to match TAZ control totals
2. TAZ is populated with households from a travel or other survey – random selection of households matching the desired distribution

Importance to Transportation Planning

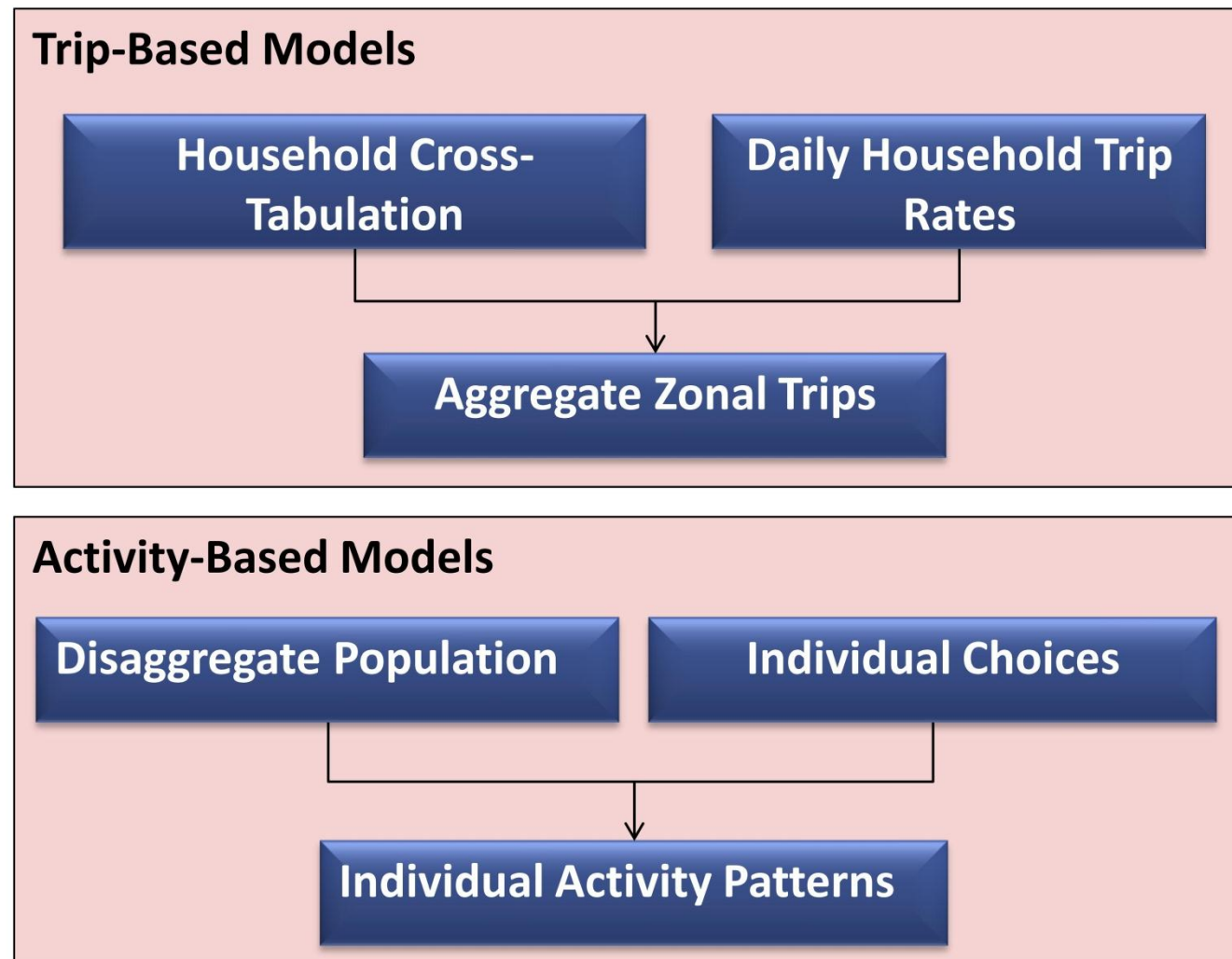
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- Travel surveys
 - ▣ Updating
 - ▣ Expansion of sample to universe
 - ▣ Evolution of population over time
- Provide inputs for four-step travel models
- Integral part of activity-based models

Trip-Based and Activity-Based Models

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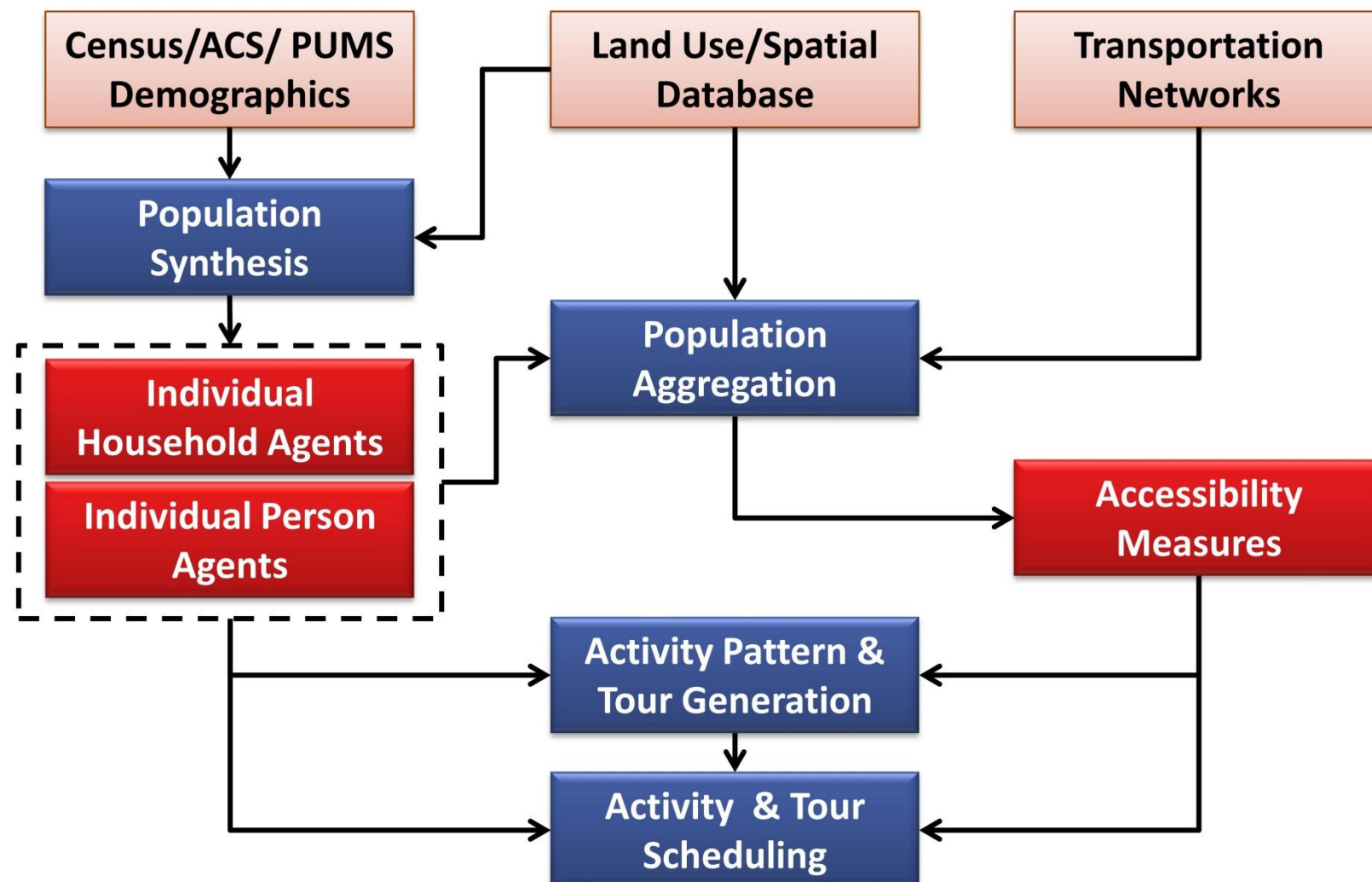
Aggregate vs. Disaggregate Travel Representation



Population Synthesis in Activity-Based Models

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Where does population synthesis fit in?



Enumerated Household Trip Generation

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- Replace household cross-classification and trip generation rates
- Generated trips are made by Travel Tracker Survey households that populate subzones for trip generation

Household Enumeration Trip Generation: Seed Tables

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1. Preliminary seed tables built from 2006-2010 ACS PUMS person and household files
 - a) Households cross-classified by adults, workers, children, household income quartile, and age of householder
 - b) 624 household type cells in table
 - c) Separate tables by place of residence: inner city, balance of Chicago and inner suburbs, mid-suburban, and outer suburbs
2. Final seed tables are adjusted (Iterative Proportional Fitting) to regional household control totals
 - a) Account for ACS multi-year averaging
 - b) Update to current year
 - c) Reconcile census and local data
 - d) Develop future forecast

Household Enumeration Trip Generation: TAZ Level Inputs

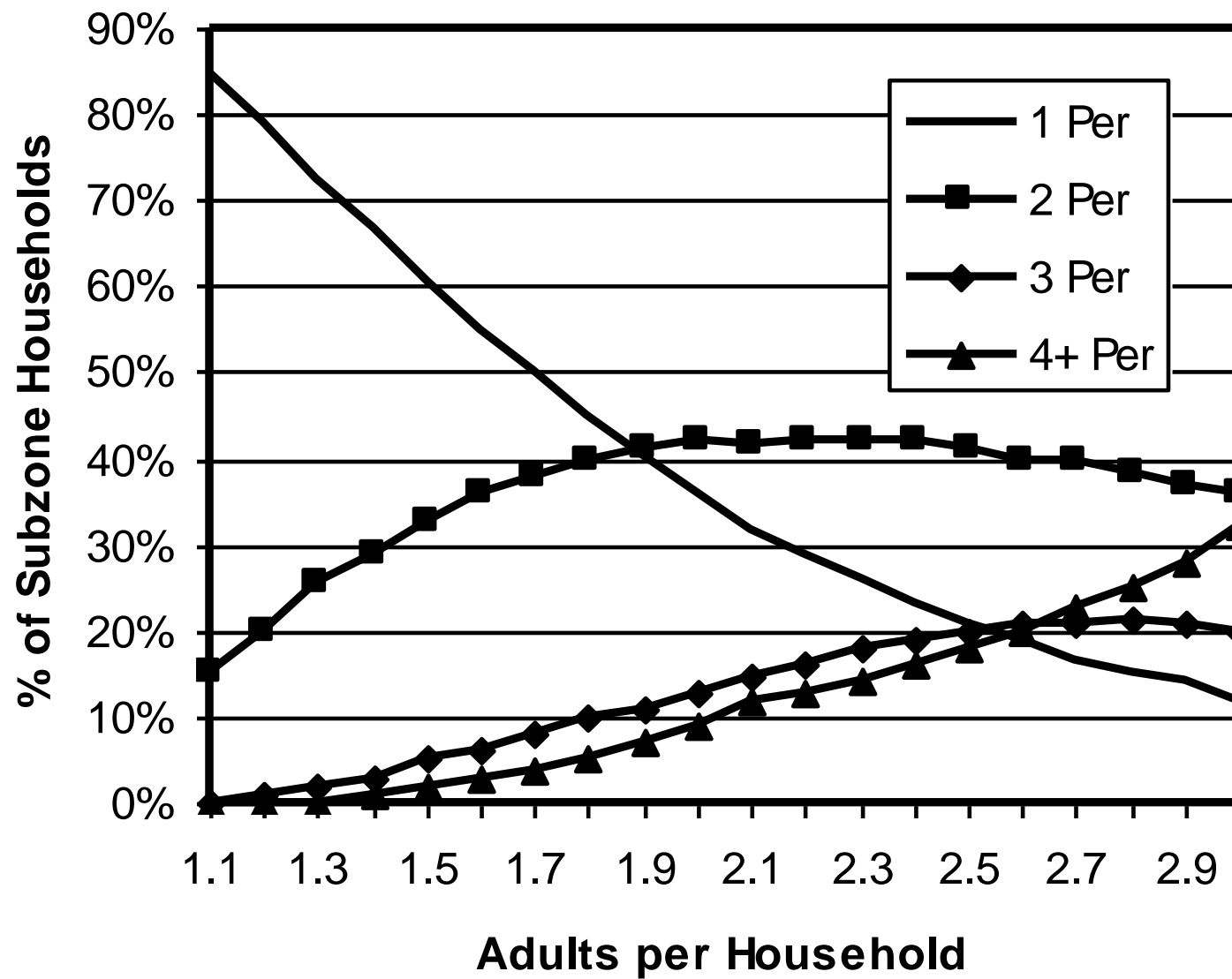
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- TAZ average household characteristics
 - ▣ Adults (driving age) per household
 - ▣ Workers per household
 - ▣ Children (0-15) per household
- Household income quartile index
(Average TAZ household income/median regional household income)
- Average age of householder index
(HHs with householder < 35 + 2*HHs with householder 35-64 + 3*HHs with householder > 64)

All Households

TAZ Averages/Indices to TAZ Control Totals

Inner Chicago



TAZ Household Type Distributions

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1. Select appropriate household seed table for TAZ
2. Manipulate household seed table to meet TAZ control totals using iterative proportional fitting
3. Result is distribution of households within TAZ for 624 household categories
4. Discretize TAZ household distributions
 - a) Cannot populate fractional households
 - b) Randomized rounding to integer values

Options for Populating TAZs

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1. Households from ACS PUMS to synthesize population without trip generation
 - a) Each TAZ has households in 624 types dimensioned by adults, workers, children, income quartile, age of householder
 - b) ACS PUMS households randomly selected to populate zone
 - c) Household's selection probability determined by its PUMS weight and number of comparable households
2. Households from Travel Tracker Survey to synthesize population and generate trips
 - a) Household vehicle availability sub-model first applied to households in TAZ household distribution
 - b) Each TAZ has households in 624 types dimensioned by adults, workers, children, vehicles in household, age of householder
 - c) Travel Tracker Survey households randomly selected to populate zone
 - d) Household's selection probability determined only by comparable households

Household Input Files to Populate TAZs

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- ACS PUMS – 175,710 households
 - ▣ Household PUMA
 - ▣ Household type 1 to 624
 - ▣ ACS PUMS household serial number
 - ▣ Match to all persons in household from ACS PUMS person file
 - ▣ ACS PUMS weight
- Travel Tracker Survey – 17,936 household travel weekdays
 - ▣ Household PUMA
 - ▣ Household type 1 to 624
 - ▣ Household serial number (sample number plus weekday code)
 - ▣ Match to all persons in household from Travel Tracker Survey
 - ▣ Trip ends

Random Household Selection

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Household file from ACS PUMS

- Randomly select same type household from PUMA
- No match: randomly select same type household from study area

Household file from Travel Tracker (Includes Trips)

- Randomly select same type household from PUMA
- No match: randomly select same type household from study area
- Still no match: randomly select household from small sample “odd” households

ACS Household Enumeration

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Enumerated Households/ACS Five Year Summary File

	Persons per Household				
	1	2	3	4 or more	Total
Chicago	0.94	1.15	1.07	1.09	1.05
Sub. Cook	1.00	1.00	1.00	0.94	0.98
DuPage	1.08	0.96	1.03	1.00	1.01
Kane	1.12	1.06	1.06	1.02	1.06
Lake	1.13	0.97	1.00	1.08	1.04
McHenry	1.25	0.94	0.96	1.09	1.05
Will	1.32	1.11	1.01	1.05	1.11

ACS Household Enumeration

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Enumerated Households/ACS Five Year Summary File

	Vehicles per Household					
	0	1	2	3	4 or more	Total
Chicago	1.02	1.04	1.10	1.03	1.00	1.05
Sub. Cook	0.98	1.00	0.98	0.96	0.91	0.98
DuPage	1.17	1.03	0.97	1.03	1.08	1.01
Kane	1.06	1.10	1.04	1.05	1.07	1.06
Lake	1.06	1.10	1.00	1.03	1.13	1.04
McHenry	1.27	1.20	1.01	0.97	0.96	1.05
Will	1.31	1.23	1.06	1.05	1.06	1.11

ACS Person Enumeration

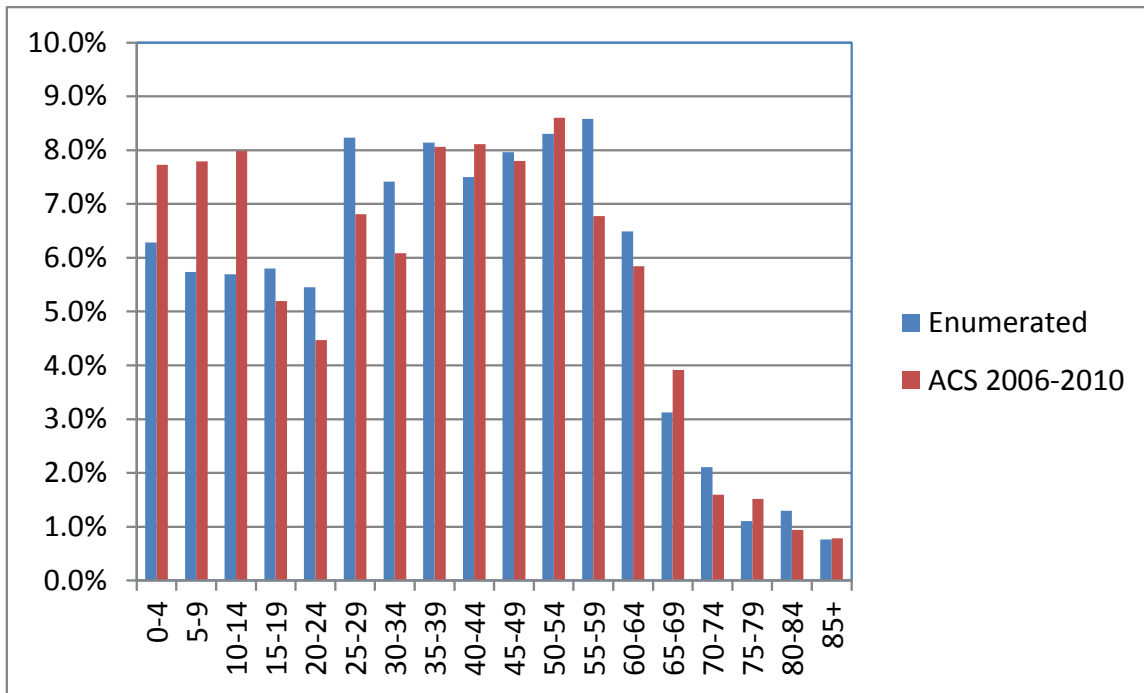
Persons with Advanced or Professional Degrees

	Enumerated Persons		ACS 2006-2010 Summary File	
	Male	Female	Male	Female
Chicago	108,036	124,842	108,681	123,847
Sub. Cook	109,684	110,482	109,329	111,010
DuPage	55,511	50,343	55,503	49,141
Kane	17,376	17,017	17,583	16,559
Lake	40,255	35,526	38,898	34,180
McHenry	10,032	10,395	10,212	10,070
Will	23,310	22,294	22,405	22,501

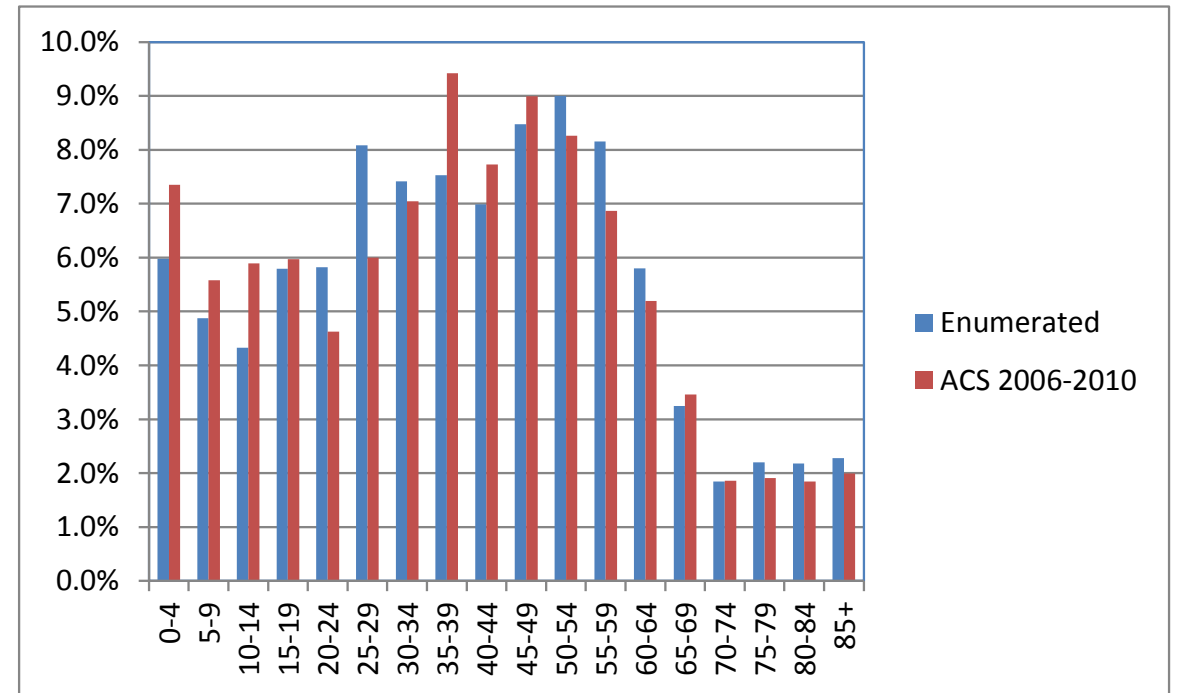
ACS Person Enumeration

Age Distribution of Oak Park Residents

Male



Female



Travel Tracker Survey Household Enumeration

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Enumerated Households/ACS Five Year Summary File

	Persons per Household				
	1	2	3	4 or more	Total
Chicago	0.94	1.15	1.04	1.09	1.05
Sub. Cook	1.00	1.00	1.00	0.93	0.98
DuPage	1.08	0.96	1.03	1.00	1.01
Kane	1.12	1.06	1.07	1.02	1.06
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Some Benefits

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- No need to estimate trip generation rates
- Automatic weighting of survey households within cross-classification cell
- Ability to evaluate different approaches for expanding surveys
- Track changes in region by updating the pool of households used to populate
- Location of special sub-populations

Questions?