

# An Overview of SimMobility Long-Term Simulator

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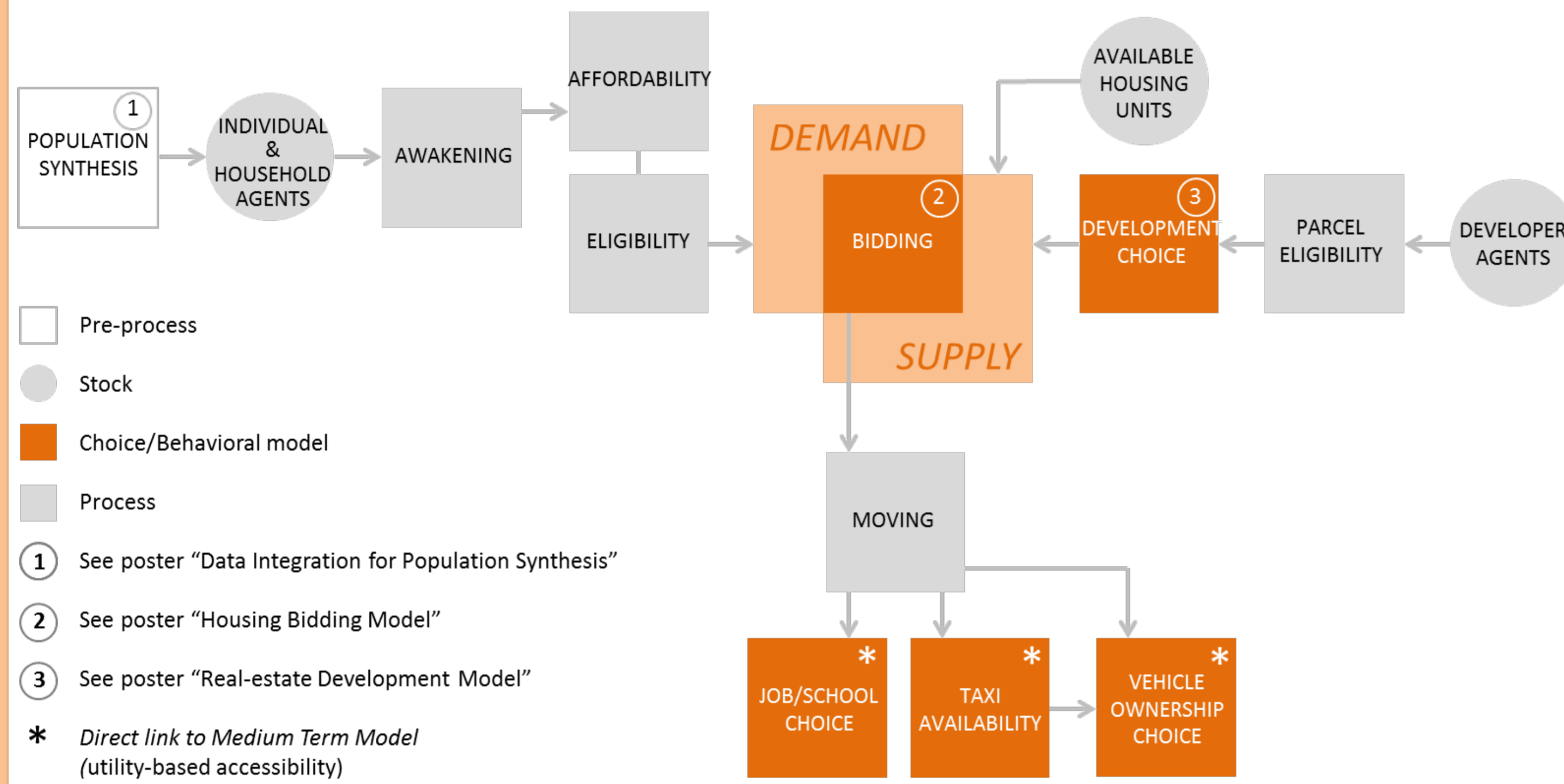
## 1 Long-term Simulator: Overview

### Objectives:

- Simulate the evolution of land and property development and use
- Predict location and vehicle ownership choices of households and firms

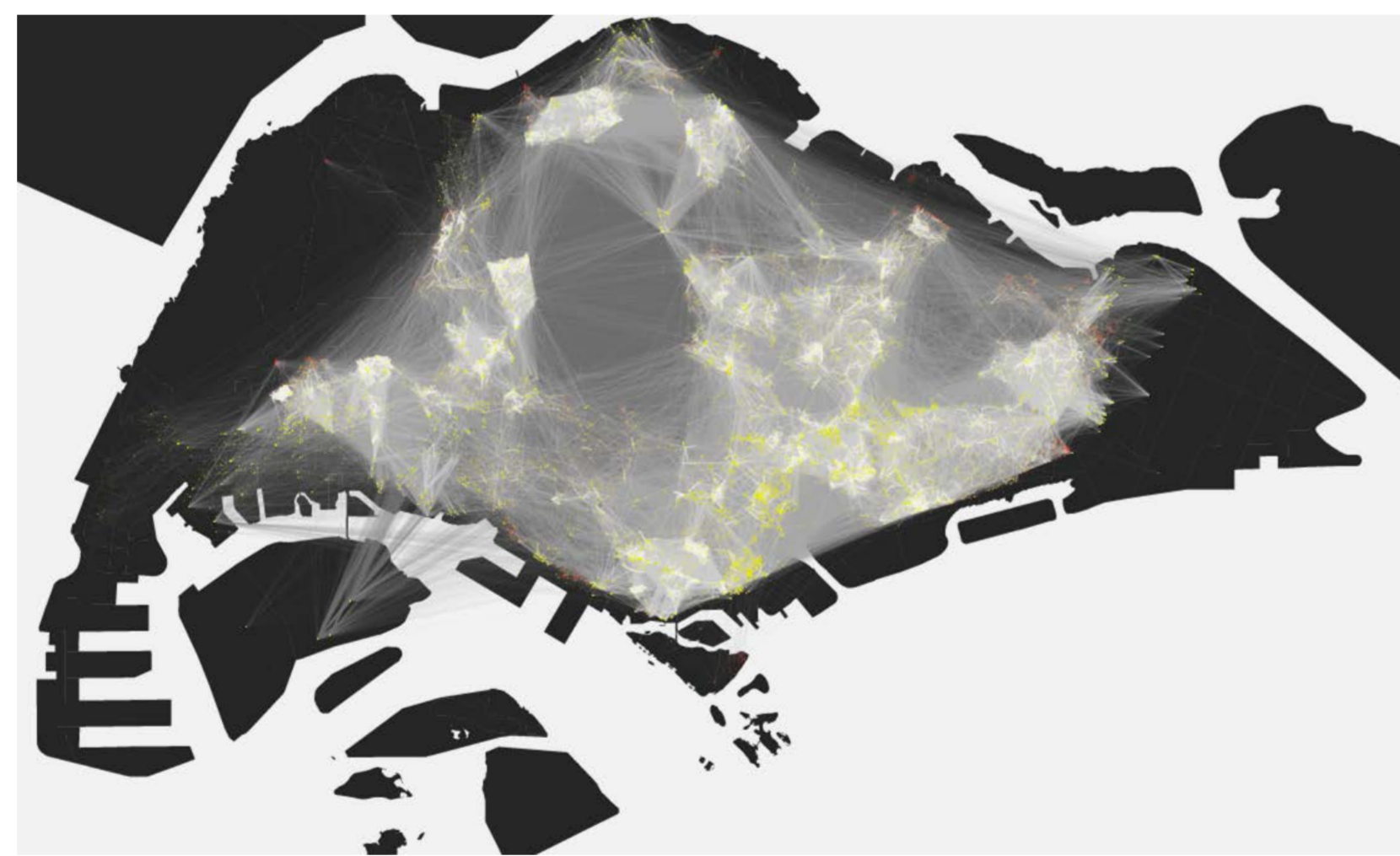
### Features:

- Draw on advanced behavioral and market theories and empirics
- Reflect varied situations and constraints
- Account for interactions among individuals and firms
- Interface with medium-term simulator via utility-based accessibility measures
- Consistently represent agents and their relevant attributes



## 2 Job and School Assignment

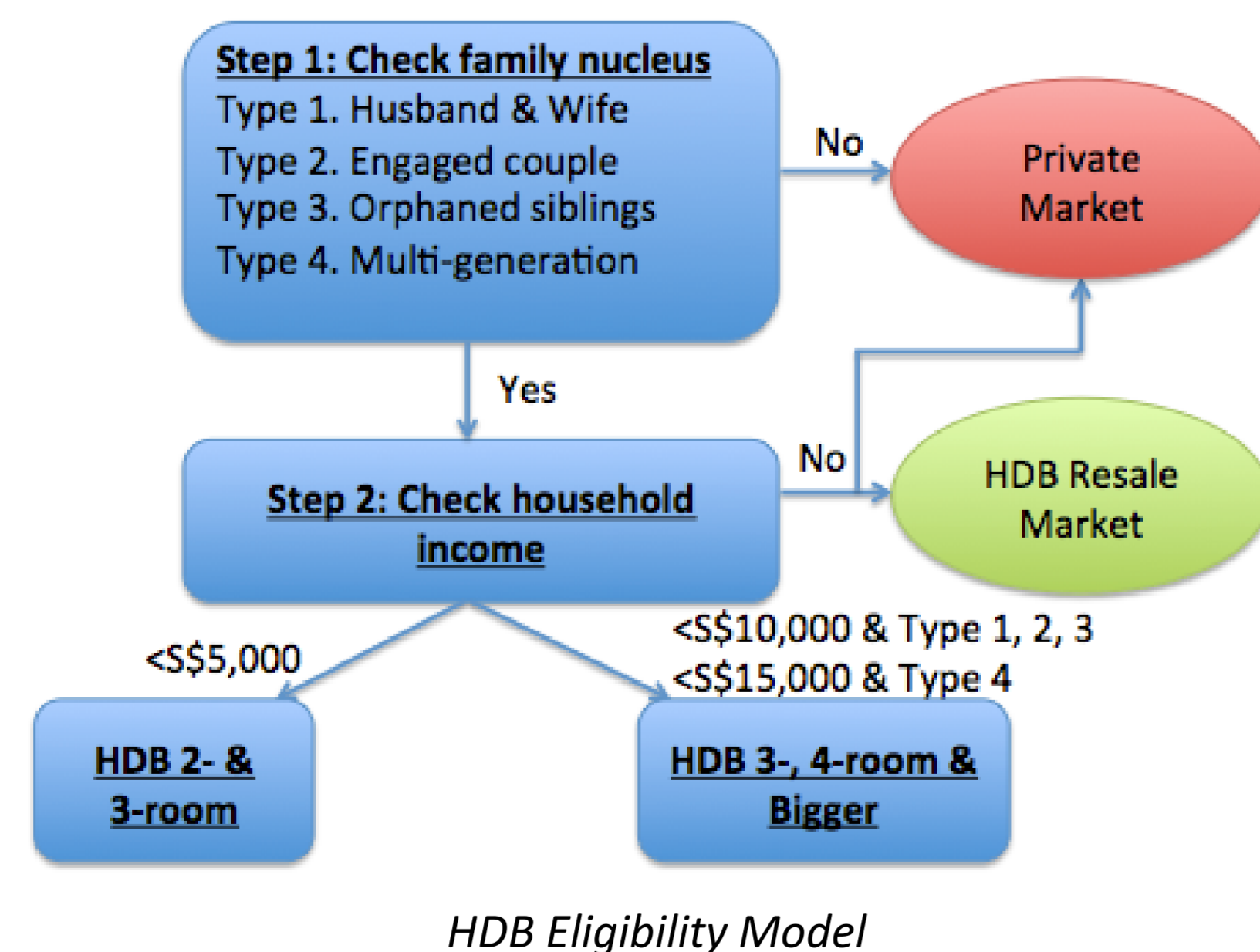
- Choice-based job and school assignment models
- Match jobs to workers based on mutual attributes like "occupation" and "industry sector"
- Account for characteristics of job locations such as job density and accessibility



Home-workplace links of workers in the wholesale and retail sectors

## 3 Housing Affordability and Eligibility

- Rule-based model accounting for public-private housing markets and housing policies
- Eligibility model: household eligibility to purchase a new HDB flat and type of flats
- Affordability model: estimate maximum housing unit prices affordable to households based on income and estimated savings



$$\text{maximum affordable housing unit price} = \text{max. mortgage} + \text{max. down payment}$$

$$\text{max. mortgage} = \text{pv}(\text{rate}, \text{nper}, \text{pmt})$$

$$\text{max. down payment} = \sum_{i=1}^n \text{Income}_i * (0.36 + \alpha_p)$$

- Returns present value of household's future cumulative income
- *rate*: interest rate per period
- *nper* – total number of payment periods
- *pmt* – the household monthly payment (cannot change over life of annuity).
- Returns est. available savings for down payment
- *i*: year of savings, starting from age of 20
- *Income<sub>i</sub>*—inflation-adjusted income for year *i*
- *α<sub>p</sub>*: proportion of savings for household type *p*

## 4 Taxi Availability and Vehicle Ownership

### Taxi Availability (i.e., HH being in "taxi business") Model

- ~ 28K Taxis in 2013
- Availability of taxi influences household car ownership decision
- Availability of taxi influences household mode choice decisions
  - Households with taxi available have higher taxi mode share (HITS 08 and 12)

- Some change in HH taxi availability preferences, 2008-12
  - Older households increasingly likely to be in taxi business
  - Richer HHs decreasingly likely to be in taxi business
  - Indian HHs decreasingly likely to be in taxi business

### Vehicle Ownership Model

- MRT proximity reduces HH ownership of 1 & 2+ vehicles
  - Effect strengthens for 2-vehicle choice
- Neighborhoods with higher automobile accessibility relative to transit: higher likelihood of owning 1 & 2 cars
  - Using simulation-based logsum accessibility (auto only, transit only) from SimMobility Medium Term

Household Taxi Availability Model	2008			2012		
	Beta	SE	t-value	Beta	SE	t-value
intercept	-8.49	0.36	-23.72	-7.45	0.36	-20.83
HDB 1-2 room	-0.71	0.44	-1.63			
age b/w 50-64 (1 person)	0.64	0.23	2.76	0.97	0.27	3.58
age b/w 50-64 (2+ persons)	1.10	0.27	4.14	1.46	0.28	5.13
age over 65 (1 person)	0.45	0.17	2.56			
age over 65 (2+ persons)	0.19	0.29	0.63			
age b/w 35-49 (1 person)	0.43	0.19	2.26			
age b/w 35-49 (2+ persons)	0.83	0.23	3.63			
Self-employed (1 person)	1.84	0.18	10.29			
Self-employed (2+ persons)	-0.08	0.42	-0.19			
Labor (1 person)	-0.60	0.33	-1.81	0.04	0.32	0.13
Professional (1 person)	-0.51	0.30	-1.67	0.13	0.26	0.52
Sales and service (1 person)	0.04	0.20	0.19	0.29	0.21	1.40
Machine operator (1 person)	5.80	0.25	23.03			
Machine operator (2+ persons)	4.97	0.37	13.30			
Household Inc. - low (<=3000\$)	0.24	0.18	1.37	0.06	0.22	0.28
Household Inc. - high (> 10000\$)	0.660	0.380	1.74	-1.35	0.48	-2.80
Indian	-0.289	0.317	-0.91	-0.72	0.40	-1.81
Malay	-0.934	0.240	-3.90	-0.81	0.29	-2.82

mu (variance scale) 1.071 0.055 19.512  
 Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
 Log-Likelihood: -978.42, R2: 0.4935

### Multinomial Logit Model of Household Vehicle Choice in 2008

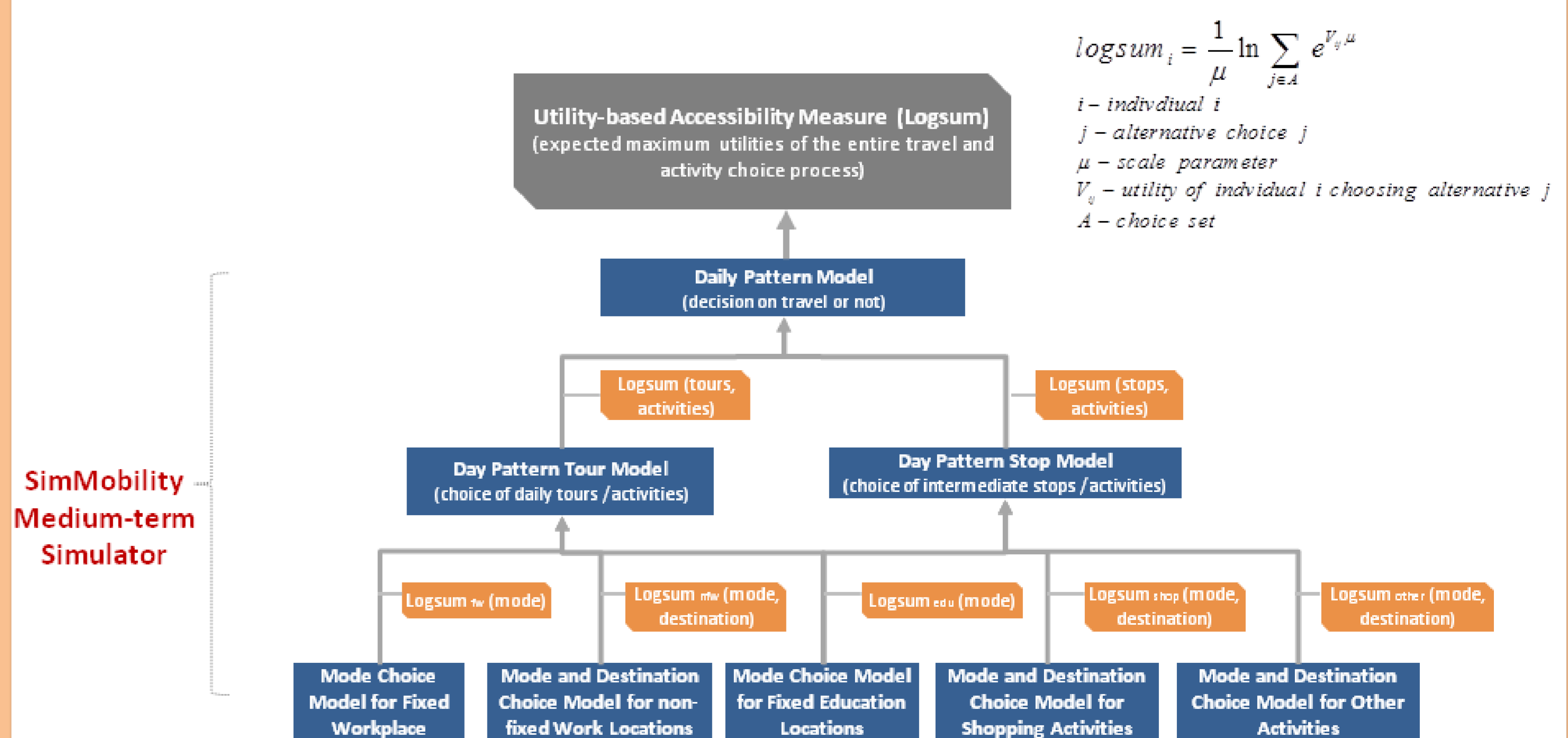
Variables	0 Veh. (base)		1 Vehicle		2 Vehicle	
	Beta	T-test	Beta	T-test	Beta	T-test
<b>Household Characteristics</b>						
HH Inc. 1*	0.87	7.02	0.969	1.76		
HH Inc. 2	2.24	18.07	2.79	5.55		
HH Inc. 3	2.78	21.79	4.20	8.69		
HH Inc. 4	3.14	19.85	5.47	11.09		
HH Inc. 5	3.70	21.13	6.70	13.65		
Malay	-0.44	-5.03	-0.56	-2.20		
Indian	-1.17	-12.61	-2.26	-7.47		
Other Races	-1.64	-9.42	-2.04	-5.37		
1 White Collar	-0.11	-1.52	-0.31	-2.02		
2+ White Collar	-0.16	-1.23	-0.43	-2.16		
1 Child HH	0.32	3.75	0.19	0.61		
2+ Child HH	0.55	3.26	0.47	1.40		
Elderly HH	-0.03	-0.71	0.40	4.93		
<b>Transport Characteristics</b>						
Motorcycle	-0.418	-3.64	-1.50	-3.14		
Taxi	-0.711	-2.98	-9.09	-0.30		
<500m Metro Station	-0.197	-2.70	-1.05	-6.61		
<1000m Metro Station	-0.220	-3.20	-0.93	-6.45		
<b>Meso-Level Built Environment Characteristics</b>						
Private Property	0.86	8.86	0.56	3.39		
Auto-Transit Accessibility **	4.71	19.91	4.45	9.00		
Constants	-3.25	-21.81	-6.41	-12.62		
Chosen Obs.	5644	2877	368			
% Obs.	63%	32%	5%			

Notes: n=8889 (excludes households with no income reported); Null Log-Likelihood: -9764.5; Final Log-Likelihood: -5101.0; LR Test: 9327; Rho-Square: 0.478. \* Household income in 2008 HITS data converted into 2012 \$\$. Inc. 1 (0,3000), Inc. 2 (3000, 5000), Inc. 3 (5000, 8000), Inc. 4 (8000, 10000), Inc. 5 (10000+). \*\* Estimated difference in accessibility car only – transit only, calculated for household member with highest income (Logsum estimated from Medium Term Model).

## 5 Utility-based Accessibility Measure

Activity-Based, Utility-based accessibility measure (Logsum):

- Based on behavioral theory and directly linked to measures of consumer surplus
- A rigorous means for inter-model behavioral consistency of agents
- Reflects scarcity of agents' time and money
- Reflects the ranges of activity characteristics, travel characteristics, and destination characteristics
- Reflects different preferences among agents



Logsum from Medium Term model: expected maximum utility to individual of choices available (modes, destinations, activities). Conditions the relative attractiveness of alternatives (housing, vehicle ownership, development parcels, etc.) in Long Term model

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