

SCAG ABM

Activity Generation and Allocation

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SCAG Modeling Task Force

Modeling and Forecasting

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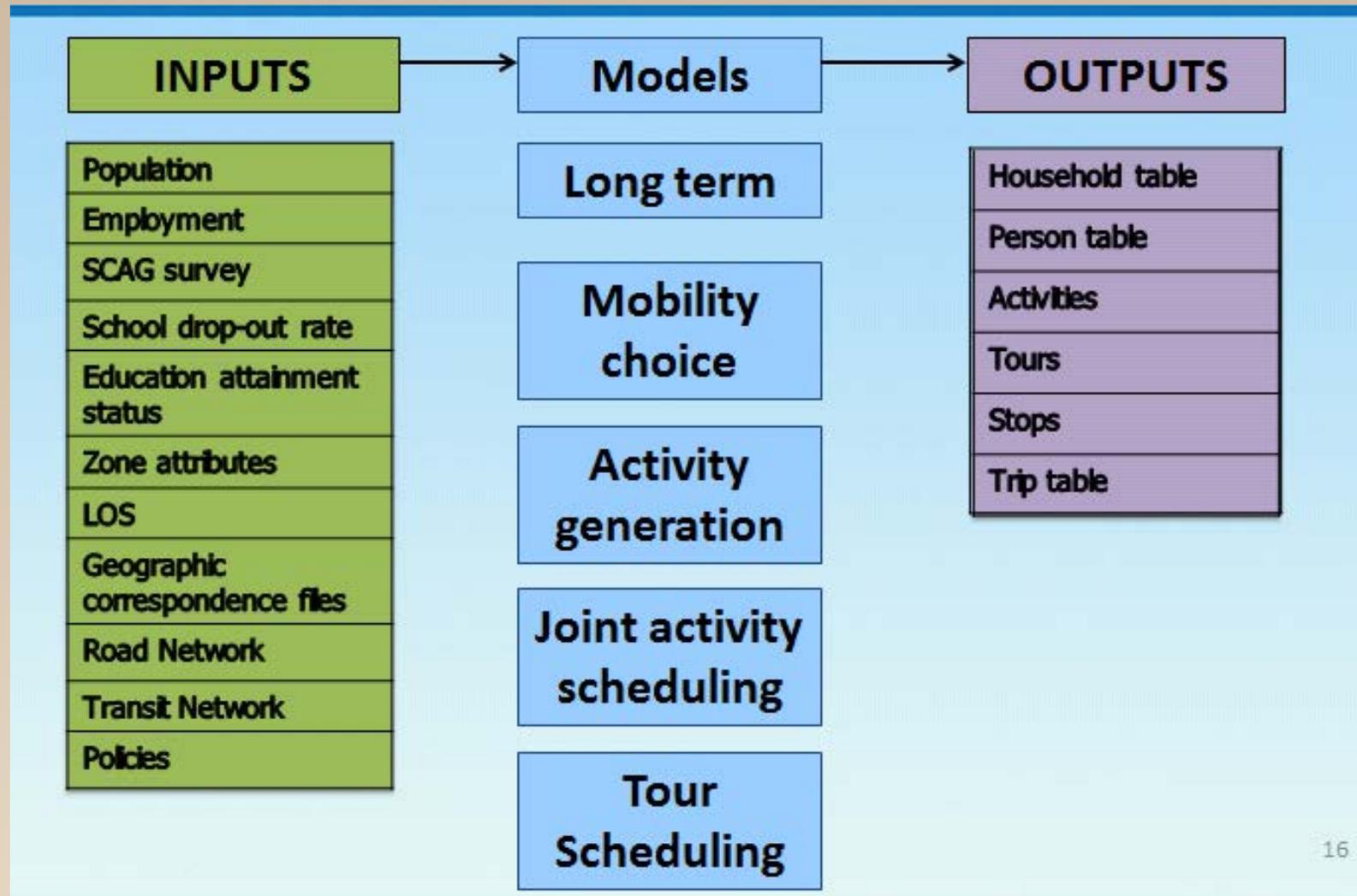
Outline

- **Update on Long-term Choice and Mobility Models**
- **Framework of Activity Generation Module**
- **Mandatory Activity Generation**

Background

- The activity-based approach views travel as a derived demand to pursue activities.
- Simulates the entire weekday travel pattern of each person in the SCAG region (18+ million):
 - derives travel from activity participation decisions
 - explicitly accounts for within household interactions
 - incorporates spatial and temporal constraints and influences when predicting activity participation and travel
 - operates on a detailed representation of the region's population, land use and transportation networks

Inputs & Output



SCAG Activity Based Model

1. Population Synthesis

2. Long-term Choices

2.0 Preschool Arrangement

2.1 Usual School Location

2.2 Work Arrangement

2.3 Usual Work Location

2.4 Work Scheduling Flexibility

3. Mobility Choices

3.1 Driver License

3.2 Auto Availability

4. Activity Generation-Allocation

Mandatory Activity Generation

Child Mandatory Activities

4.1.1 Frequency

4.1.2 Start/ End Time

4.1.3 Trip Mode

Adult Mandatory Activities

4.2.1 Frequency

4.2.2 Start/ End Time

4.2.3 Allocation of Dropoff/Pickup

Non-Mandatory Household Activity Generation

4.3.1 Out-of-Home Activity

4.3.2 Activity Duration

4.3.3 Out-of-home activity generation

4.3.4 Serve Passenger Activity Generation

5. Joint Activity Scheduling

5.1 Primary purpose

5.2 Location

5.3 Tour mode

5.4 Start time

5.5 Duration of intermediate stop

6. Tour and Trip Scheduling

Adult Mandatory Tour

6.1.1 Tour Mode

6.1.2 Intermediate stop

6.1.3 Distance to stop

6.1.4 Stop Location

6.1.5 Stop Duration

6.1.6 Departure, Return time period

Non-Mandatory Tour

6.2.1 Tour Frequency

6.2.2 Primary Purpose

6.2.3 Primary destination

6.2.4 Tour time window

6.2.5 Tour mode

6.2.6 Stop frequency

6.2.7 Distance to stop

6.2.8 Stop location

6.2.9 Stop duration

Market segmentation

Person type	Name
1	Worker
2	Working college student
3	Non-working college student
4	Working HS student
5	Non-working high school student
6	Adult non-worker
7	Children 6-15 years old
8	Children 0-5
9	Non-school kids 6-15

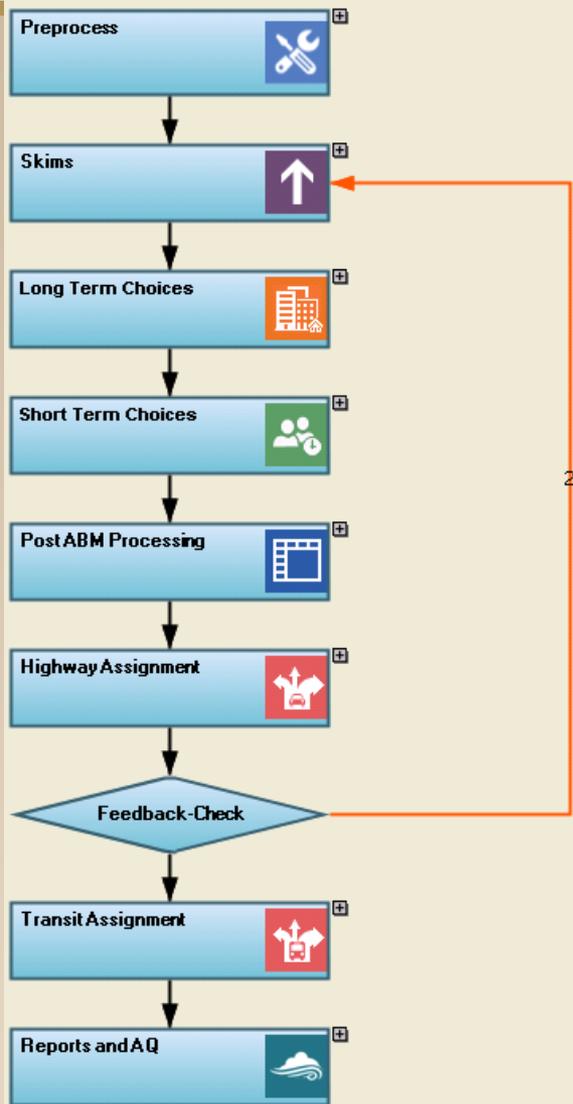
Segmentation

- Activity types:
 - **Work**
 - **School/College**
 - Escort
 - Shopping
 - Maintenance
 - Social
 - Entertainment
 - Visiting family and friend
 - Active recreation
 - Eating out
 - Work related
 - Other



Temporal resolution

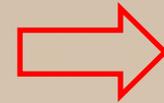
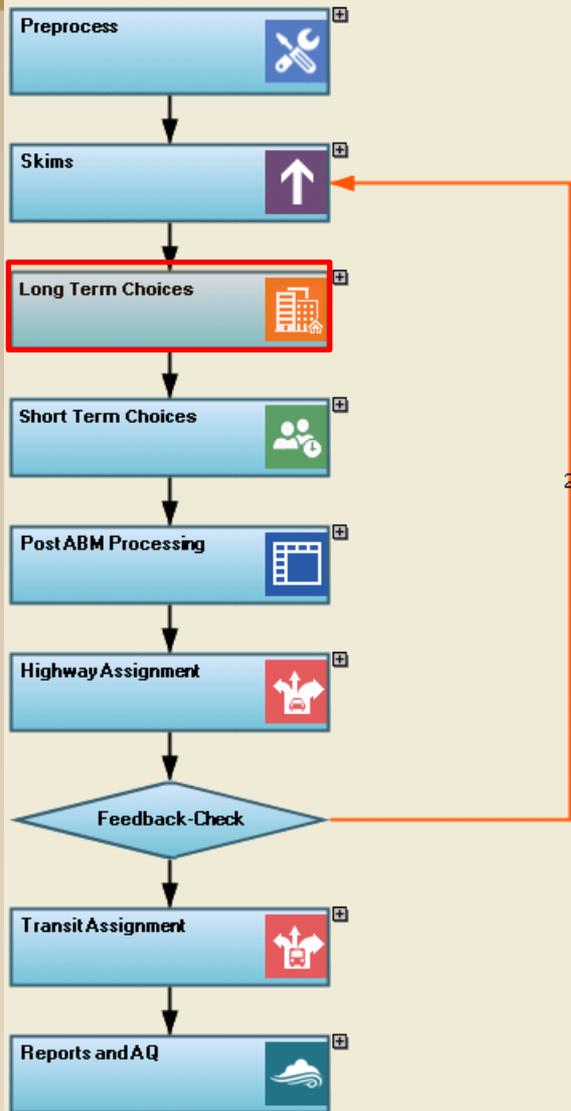
- Five time periods used for skimming and assignment
 - ✓ AM Peak (6:00 AM to 9:00 AM)
 - ✓ Midday (9:00 AM to 3:00 PM)
 - ✓ PM Peak (3:00 PM to 7:00 PM)
 - ✓ Evening (7:00 PM to 10:00 PM)
 - ✓ Night (10:00 PM to 6:00 AM)
- 15-minute and 30-minute resolution for scheduling primary activity of a tour, extended to continuous
- Continuous for scheduling all other activities



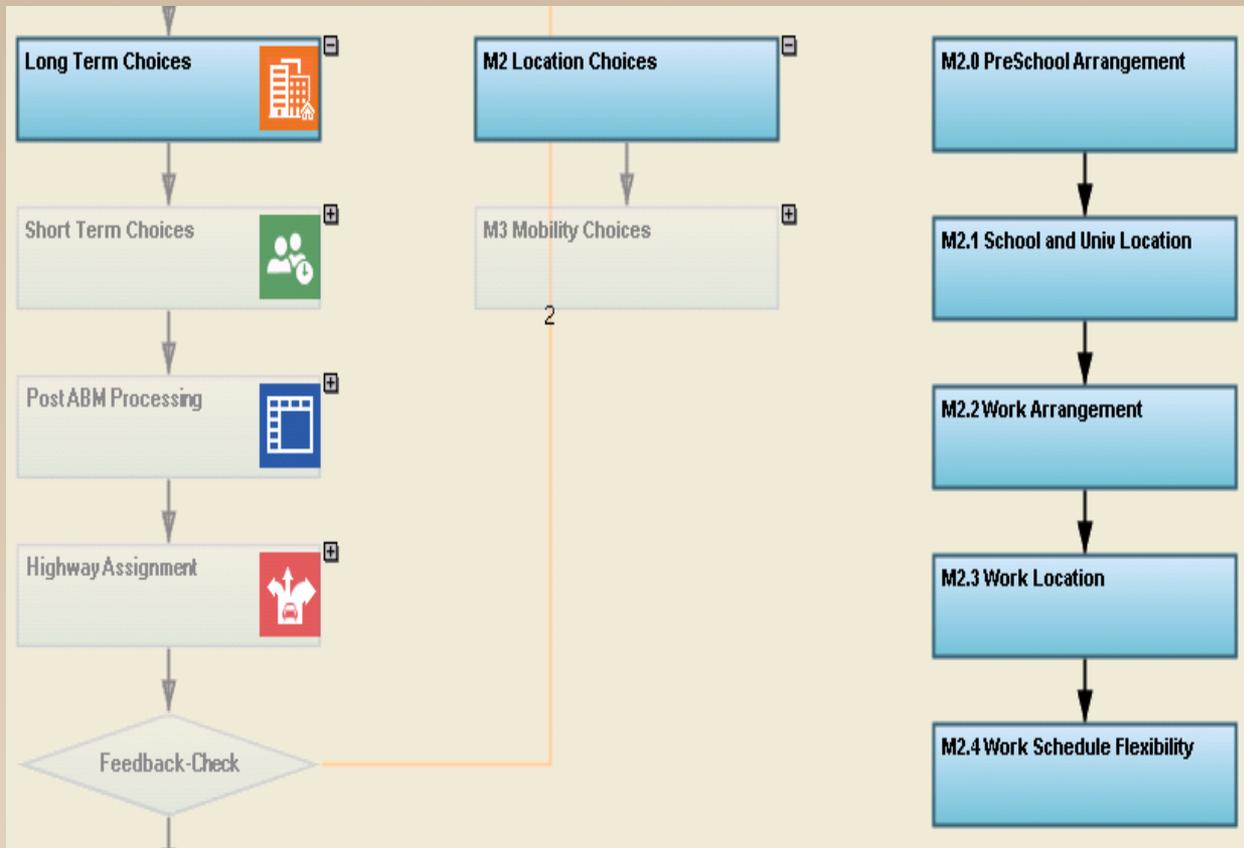
SCAG -ABM User Interface

- Built in new TransCAD 7.0

Long Term Choice Models



Location Choice



Workers

- 16 years old or older.
- SCAG region has about 7 million workers in 2012; 39% of total population of SCAG region.

Students

- About 5 million, 28% of total population
- Are categorized by 1) Preschool, 2) Grade K-8, 3) Grade 9-12, and 4) College/University

M2.0 Preschool arrangement

Step: M2 Location Choices - M2.0 PreSchool Arrangement in Scenario: Scenarios

PreSchool Arrangement

Model Type: Binary Logit

Apply To: Person+HH

Decision Variable: GoToPreSCH

Segment: PersonType = 8 and Age > 2

Additional Sources: SED Table

Utility

Source	Variable	Beta	Market Segment
Expression	[Person+HH].Age = 4	1.006	
Expression	[Person+HH].Age = 5	2.398	
Person+HH	Hnwork	-0.302	
Expression	[Person+HH].HHINC between	0.335	
Expression	[Person+HH].HHINC between	0.968	
Expression	[Person+HH].HHINC >= 1500	1.282	
	Constant	-0.426	

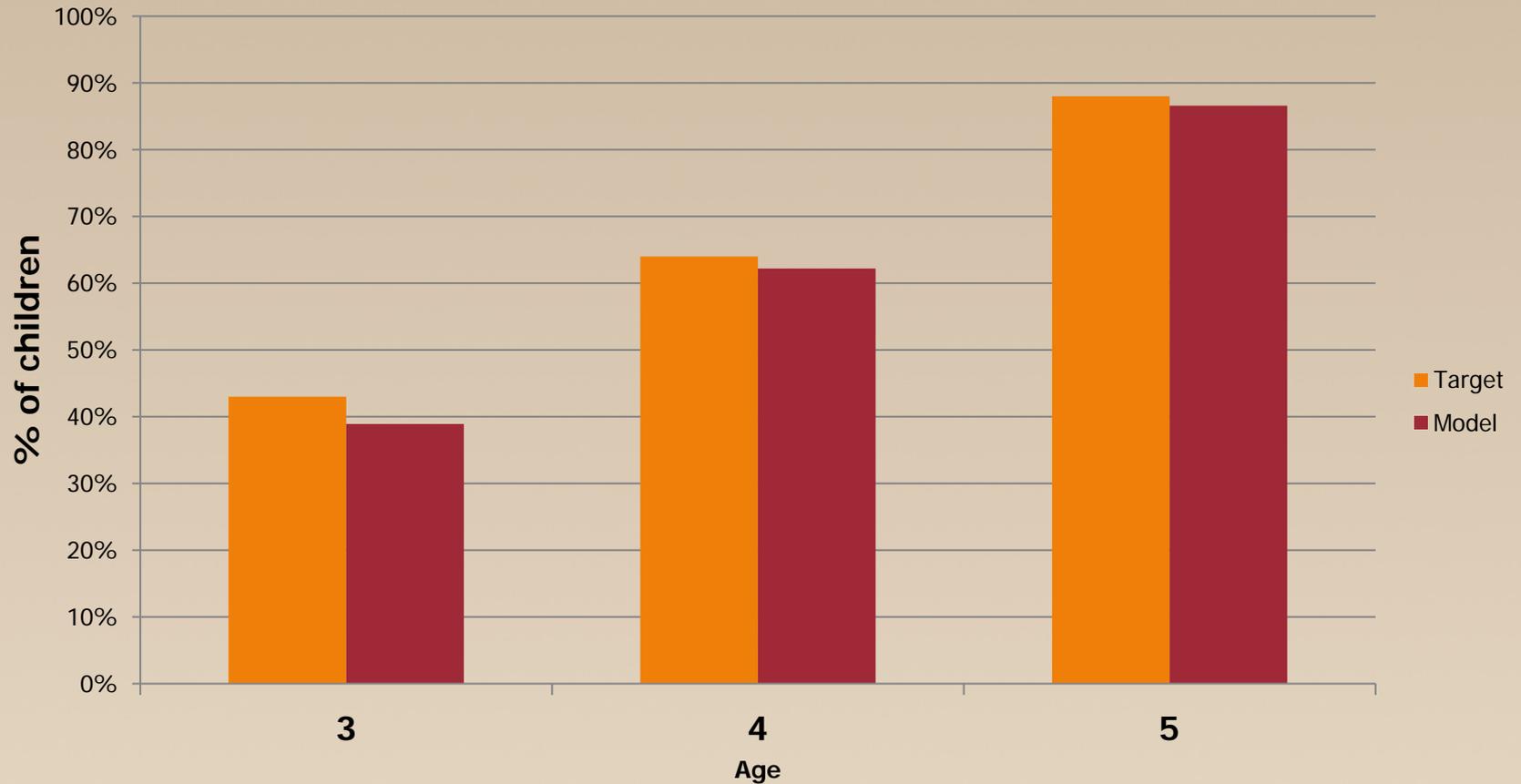
Filter

Default OK Apply Cancel Help

Model specification UI

For age < = 2, assumed not go to school

M 2.0 Preschool arrangement



M2.1 Usual School Location

2.1a Preschool Location Model – MNL

2.1b Usual School Location k-8 Rule based

2.1c Usual School Location 9-12 Rule based

2.1d University Location- MNL

M2.1 Usual School Location: K-12

Step: M2 Location Choices - M2.1 School and Univ Location in Scenario: Scenarios

- Runtime
 - Input
 - Long Term Choices
 - Location Choices
 - PreSchool Location
 - K to 8 School Location**
 - High School Location
 - University Location

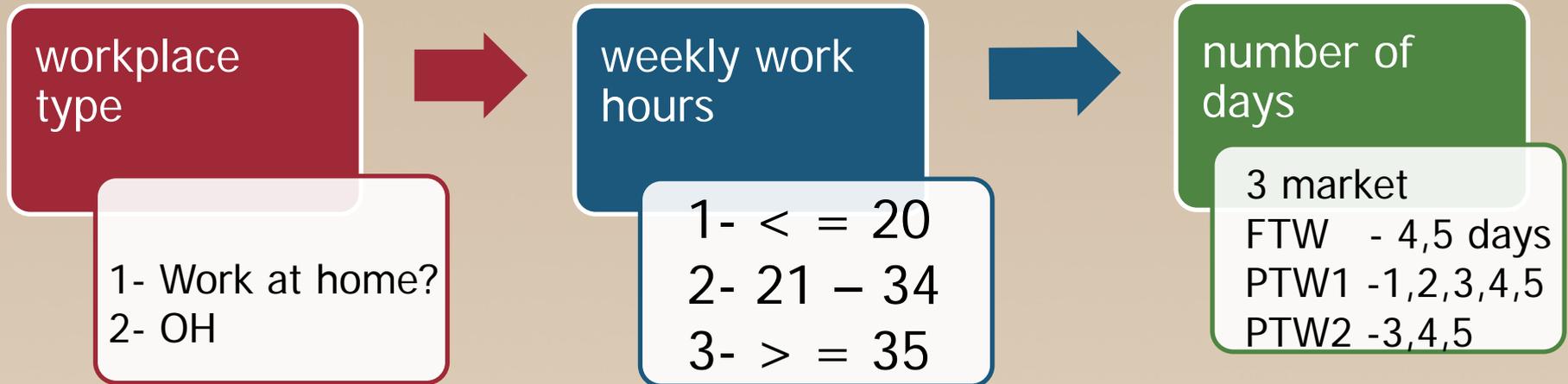
K to 8 School Location	
Model Type	Nearest TAZ
Decision Variable	STier2TAZID
Segment	PersonType = 7
Kto8 School SED Set	KT08 > 0

Step: M2 Location Choices - M2.1 School and Univ Location in Scenario: Scenarios

- Runtime
 - Input
 - Long Term Choices
 - Location Choices
 - PreSchool Location
 - K to 8 School Location
 - High School Location**
 - University Location

High School Location	
Model Type	Nearest TAZ
Decision Variable	STier2TAZID
Segment	PersonType = 4 or PersonType = 5
High School SED Set	[8T012] > 0

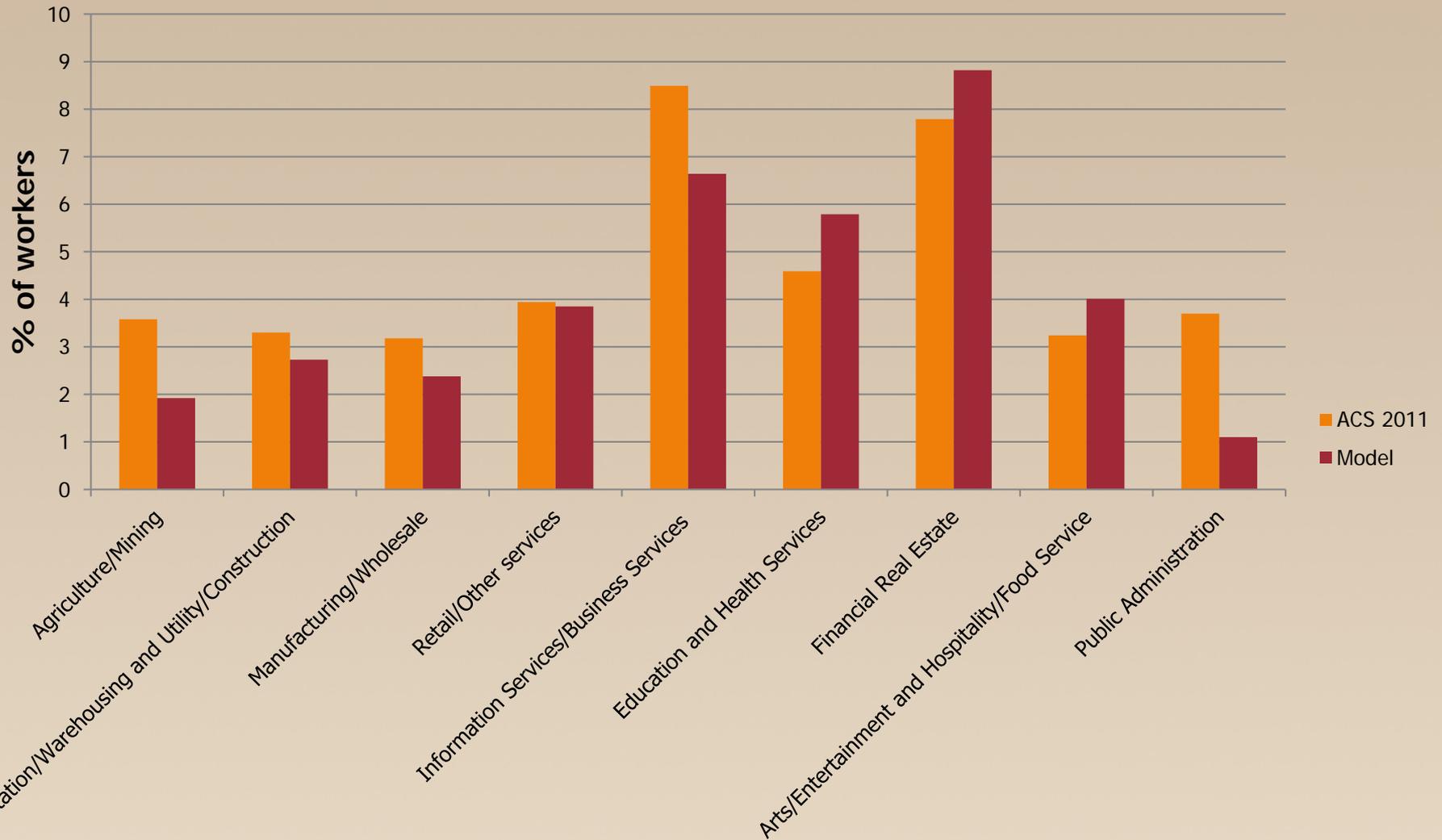
M2.2 Work Arrangement



M2.2.1 Work @ Home

	ACS 2011	Model
Age		
16-24	1.86%	3.67%
25-44	4.03%	4.07%
45-60	5.97%	5.87%
60+	9.39%	8.18%
Total	4.76%	4.97%

M2.2.1 Work @ Home



M2.2.2.1 Work Duration

Work Duration	Survey Analysis		Model Results				
	Survey Freq	Survey Share	Initial ASC	Initial Share	Final ASC	Final Share	Final Count
1-20 hrs	658,413	10.14%	-1.920	13.26%	-2.274	10.36%	667,106
21-34 hrs	449,275	6.92%	-2.391	9.86%	-2.829	7.07%	454,806
35+ hrs	5,383,803	82.94%		76.88%		82.57%	5,315,259
	6,491,491						6,437,171

- MNL with 3 alternatives: 0-20hrs, 21-34hrs, 35+ hrs

M2.2.2.2 Work Days

Wdays	HTS	Model
4	6.64	6.6
5	93.36	93.4

Segment 1:
Full time workers
(35 hrs/wk and more)

Wdays	HTS	Model
1	9.98	9.7
2	17.28	16.8
3	24.19	23.6
4	14.37	14
5	34.18	36

Segment 2:
Part time workers (1-20 hrs/wk)

Wdays	HTS	Model
3	18.01	17.8
4	34.05	33.5
5	47.94	48.7

Segment 3:
Part time workers (21-34 hrs/wk)

MNL on 3 Market Segments based on Work Duration

M.2.3 Work location

Utility

Utility + ↑ ↓ ⓧ 📄

Source	Variable	Beta	Market Segment
Transform Logsum Work Matri	TLS	-0.04435	
Expression	Log(1.0+[Transform Logsum W	-1.22677	
Expression	pow([Transform Logsum Work	6e-005	
Transform Logsum Work Matri	TLS	-0.02341	[Person+HH].Gender = 2
Expression	pow([Transform Logsum Work	0.0001	[Person+HH].Gender = 2
Expression	Log(1.0+[Transform Logsum W	-0.30275	[Person+HH].HHINC <= 3500
Transform Logsum Work Matri	TLS	0.0113	[Person+HH].HHINC > 10000
Expression	pow([Transform Logsum Work	7e-005	[Person+HH].HHINC > 10000
Transform Logsum Work Matri	TLS	0.01389	[Person+HH].WorkDuration =
Expression	Log(1.0+[Transform Logsum W	-0.77254	[Person+HH].WorkDuration =
Transform Logsum Work Matri	TLS	-0.00742	[Person+HH].GENDER=2 anc
Expression	Log(1.0+[Transform Logsum W	0.34006	[Person+HH].GENDER=2 anc
Expression	[AM SOV Skim].[NON-TOLL C	-999	

Include Existing Shadow Prices from SED Data

Default OK Apply Cancel Help

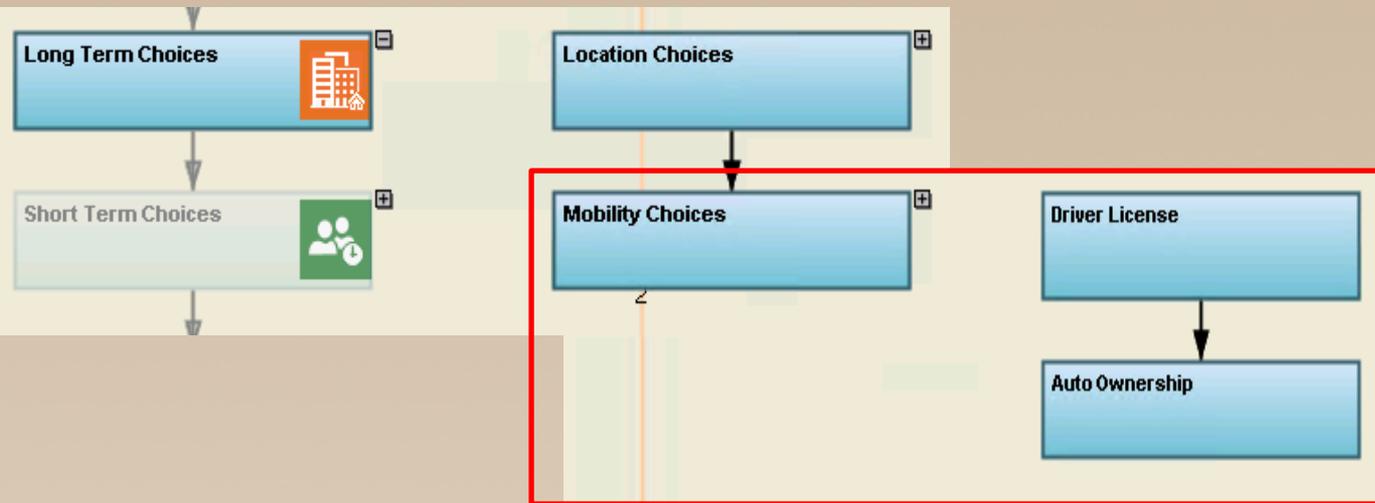
- Updating input files (skim and attraction rate)
- Re-estimate work location

M.2.4 Work Schedule Flexibility

WSCHED	HTS	Model
1	43.69	41.8
2	44.57	46
3	11.75	12.1

MNL with 3 alternatives: None, Moderate and High

Mobility Choice Models



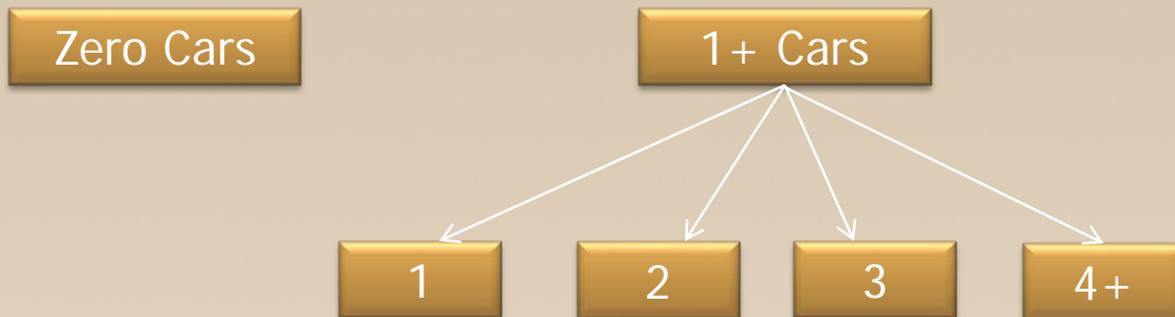
M.3.1 Drive License

Age	Yes	No	Percentage
16-18	708,401	170,602.00	80.6%
19-24	1,347,450	211,434.00	86.4%
25-29	1,116,940	159,182.00	87.5%
30-44	3,282,869	456,032.00	87.8%
45-60	3,371,269	438,643.00	88.5%
60-70	963,316	424,706.00	69.4%
70-80	355,602	452,071.00	44.0%
80+	192,438	289,123.00	40.0%
	11,338,285	2,601,793.00	81.3%

- Driver License
 - For Age ≥ 16 ,
 - Survey Share was 83.46%
 - Model Share was 81.0%

M.3.2 Auto Ownership

- Predicts number of household vehicles
- Nested Logit
- Households (HHs) with no licensed drivers should automatically be assigned 0 cars.



M.3.2 Auto Ownership

	0Cars	1Car	2Cars	3Cars	4+Cars	Total
ACS	7.65%	32.28%	37.22%	15.03%	7.81%	100.00%
HTS	7.56%	31.86%	38.88%	14.81%	6.89%	100.00%
(HTS) - Households have at least 1 license driver	3.53%	32.90%	40.79%	15.55%	7.23%	100.00%
Model*	11.8	30.8	33.2	14.9	9.2	100.00%

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4.1.2 Start/ End Time

4.1.3 Trip Mode

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4.2.1 Frequency

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4.2.3 Allocation of Dropoff/Pickup

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4.3.2 Activity Duration

4.3.3 Out-of-home activity generation

4.3.4 Serve Passenger Activity Generation

5. Joint Activity Scheduling

5.1 Primary purpose

5.2 Location

5.3 Tour mode

5.4 Start time

5.5 Duration of intermediate stop

6. Tour and Trip Scheduling

Adult Mandatory Tour

6.1.1 Tour Mode

6.1.2 Intermediate stop

6.1.3 Distance to stop

6.1.4 Stop Location

6.1.5 Stop Duration

6.1.6 Departure, Return time period

Non-Mandatory Tour

6.2.1 Tour Frequency

6.2.2 Primary Purpose

6.2.3 Primary destination

6.2.4 Tour time window

6.2.5 Tour mode

6.2.6 Stop frequency

6.2.7 Distance to stop

6.2.8 Stop location

6.2.9 Stop duration

Activity Generation Module

Activity Generation Module



- First step in the prediction of daily activity and travel
- Travel being viewed as a derivative of out-of-home activity participation and scheduling decisions
- Mandatory and non-mandatory activities
- The predictions from these models are used later in the model chain to form mandatory and non-mandatory tours, as well as to predict the frequency and purpose of intermediate travel stops on tours

	Model Number	Model Component	Model Structure
Children	4.1.1	Child Mandatory Activity Frequency	Monte Carlo
	4.1.2	Child Mandatory Activity Start/End Time	
		a. Start Time	HD
		b. End Time	HD
	4.1.3	Child School Mode	
Workers	4.2.1	Adult Mandatory Activity Frequency	
		a. Work Activity	BL
		b. School & University Activity	BL
	4.2.2	Adult Mandatory Activity Start/End Time	
		a. Work Activity	MNL
		b. College Activity	MNL
	4.2.3	Allocation of Escort Responsibilities	Rule based
All	4.3.1	Out-of-Home Activity Participation	BL
	4.3.2	NM activity time	Regression
	4.3.3	Out-of-Home Activity Generation	
		a. Household size =< 5	MDCEV
		b. Household size > 5	MDCEV
	4.3.4	Serve Passenger Activity Generation	BL
	4.3.5	Tour formation	

- Market segmentation
- Model components
- Model Structure

Mandatory Activities

Mandatory Activities

2

Non Mandatory Activities

Joint Activity Scheduling

Child School Activities

Adult Work-Univ Activites

Child School Mode

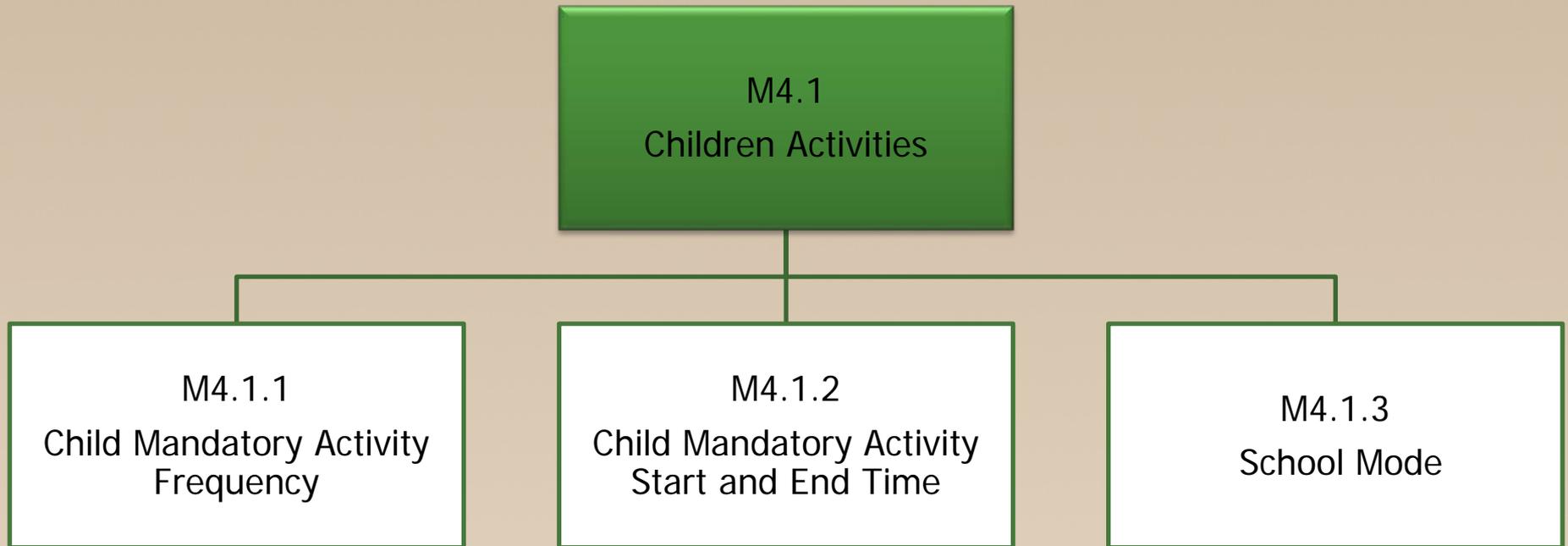
Crucial in shaping overall daily activity-travel pattern

Serves a peg around which other activities are scheduled

Key constrain on non-mandatory activity generation

Predicted before predicting non-mandatory activities

M4.1 Children Activities



M4.1.1 Child Mandatory Activity Frequency

Decision to attend school on a day

Monte Carlo simulation based on attendance rate of 0.85

All children 3 years and older

M4.1.2 School Start and End Time

- ❖ Predict children school start and end time
- ❖ Hazard Duration Models
 - Start time
 - End time
- ❖ Duration – calculated
- ❖ Choice alternative: Continues time
- ❖ Apply to: all children with non-zero activity frequency
- ❖ Age, grade level, household income and number of employed adults

M4.1.3 School Mode

Predict mode
to/from school

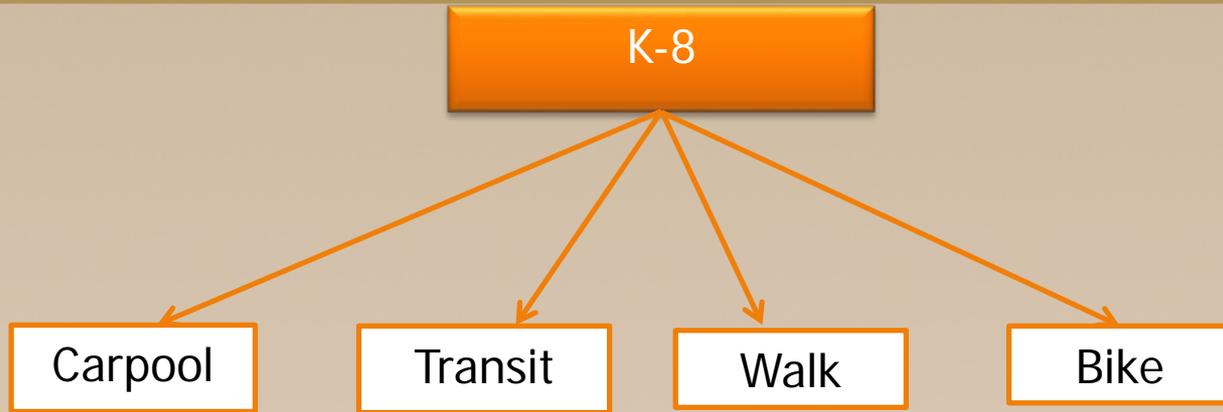
MNL

Two sub-models

K-8

9-12

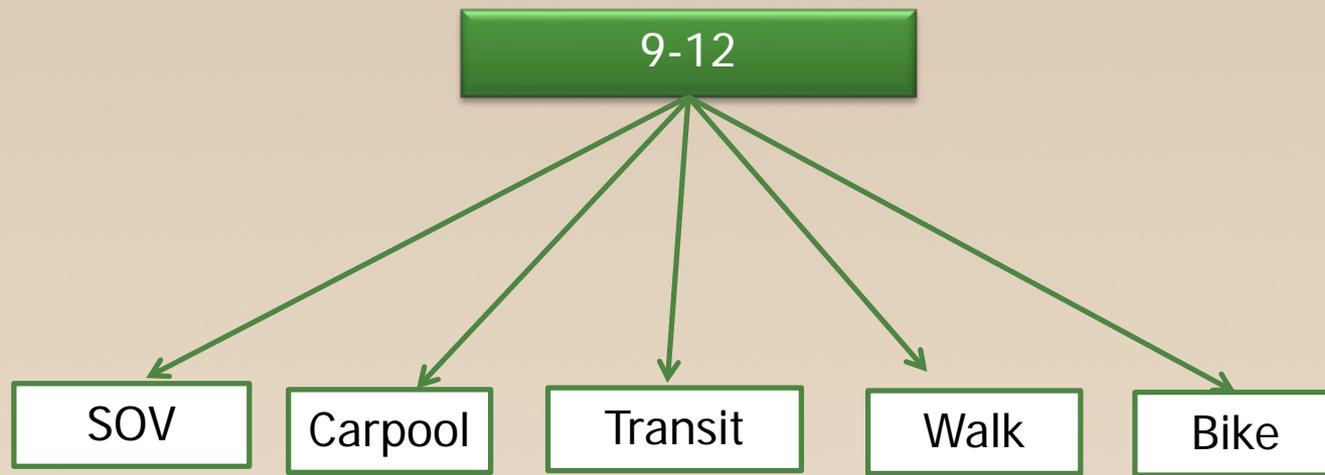
MNL with 4 alternatives



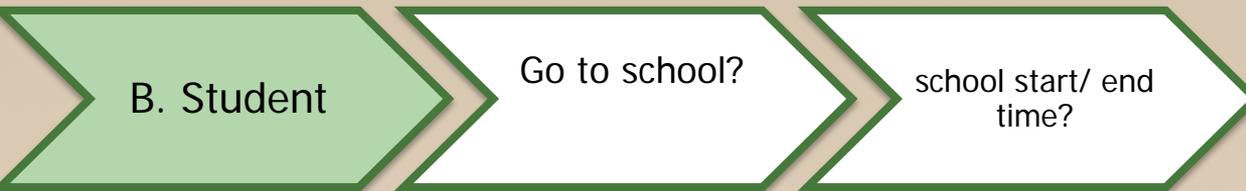
Step 1: Rule based "School Bus"

Step 2: MNL

MNL with 5 alternatives



M4.2 Adult Mandatory Activity



Decision tree

M4.2.1a Go to work

- Monte Carlo based on days of work from M2.2 for each market segment
- **Apply to:** Person.Pertype=1 who work outside of home

M4.2.1a Go to school

- ❑ Monte Carlo based on initial attendance rate=0.7
- ❑ **Apply to:** 'Individuals with Person.Pertype==2 and 3

M4.2.2a Work Start and End time

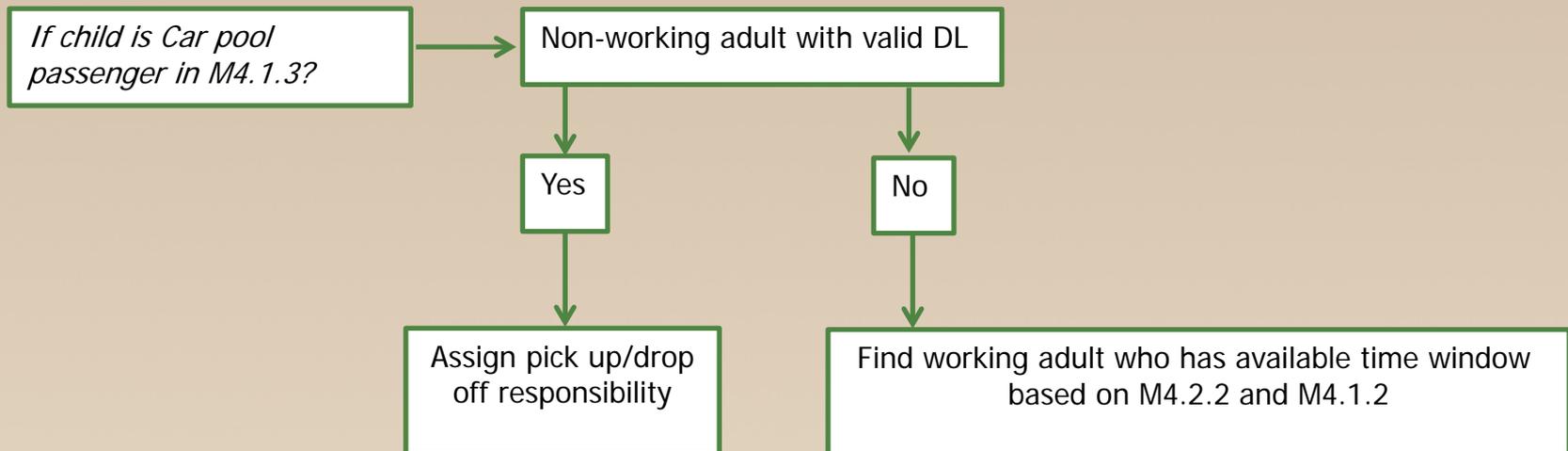
- Predict activity start time and end time at primary work place
- For all workers in a household who go to work on the given day
- Model structure: MNL
- Choice Alternatives: 48 bin (start from 3.00 am)
- Apply to: (Person.Pertype==1) who work outside of home
- Estimation data: SCAG HTS 2012

M4.2.2b College start and end time

- ❑ **Model structure:** MNL
- ❑ **Choice Alternatives:** 7 alternatives:
 - before 7.30
 - 7.30-8.29
 - 8.30-9.29
 - 9.30-10.29
 - 10.30-11.59
 - 12.00-3.59pm
 - 4pm-
- ❑ **Apply to:** All university students (Person.Pertype==2 and 3) who go to school on the day
- ❑ **Reference time:** 7.30-8.29

M.4.2.3 Escort responsibility

- Allocates children drop-off and pick up episodes to parents
- Rule based allocation



Thank You

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