

California Statewide Travel Demand Model (CSTDm)

Tier 2 Training

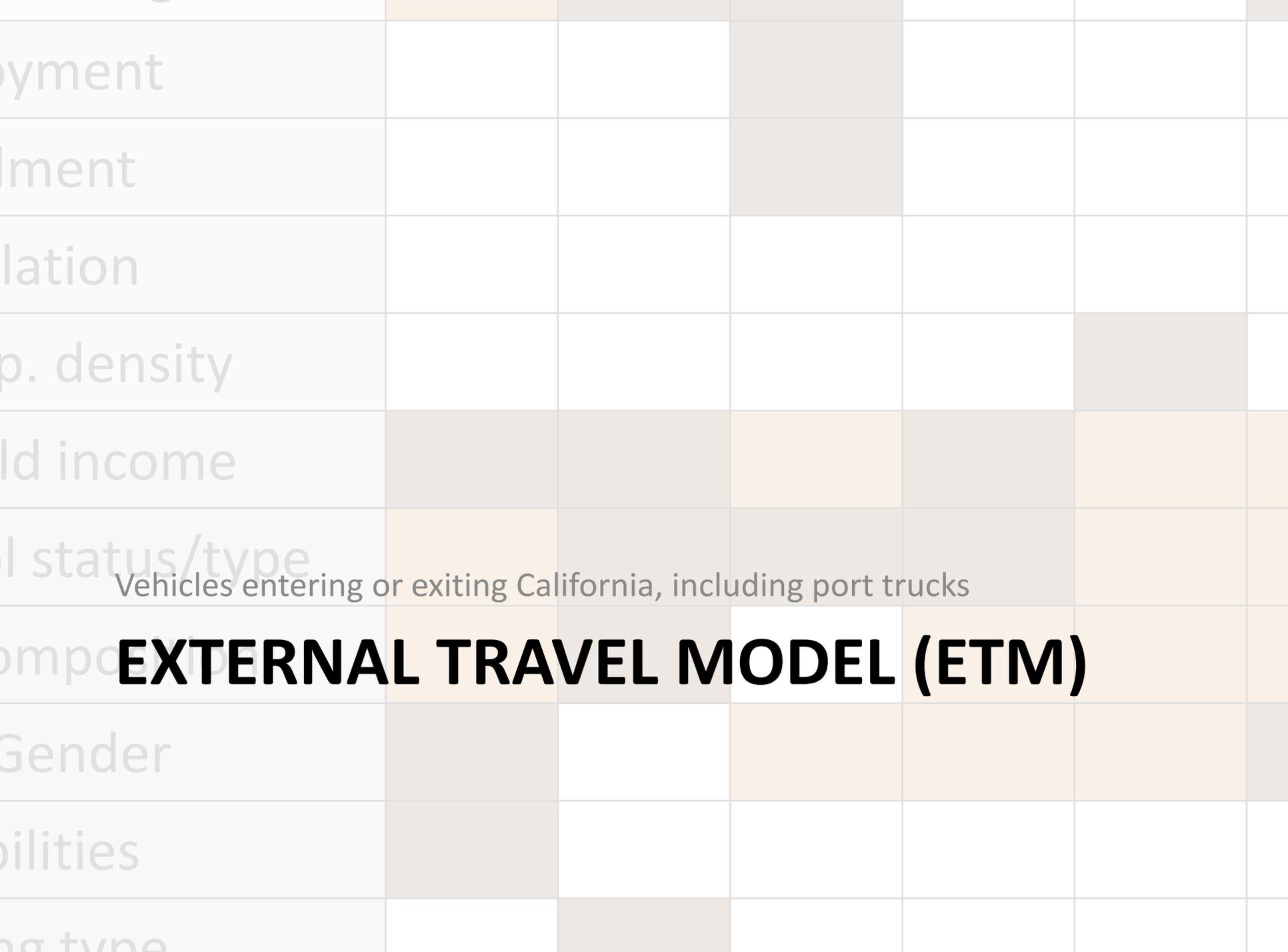
Unit 8

Model Structure

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8 March 2011



Payment

Employment

Population

Pop. density

World income

Marital status/type

Vehicles entering or exiting California, including port trucks

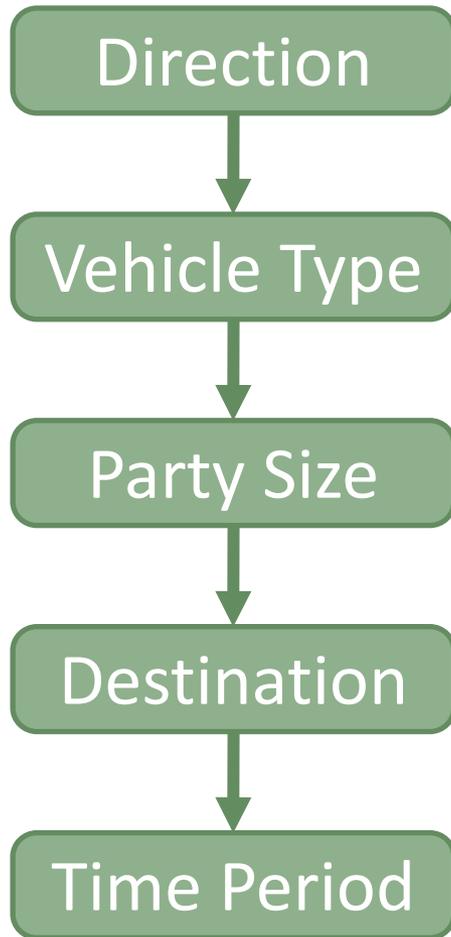
EXTERNAL TRAVEL MODEL (ETM)

Gender

Abilities

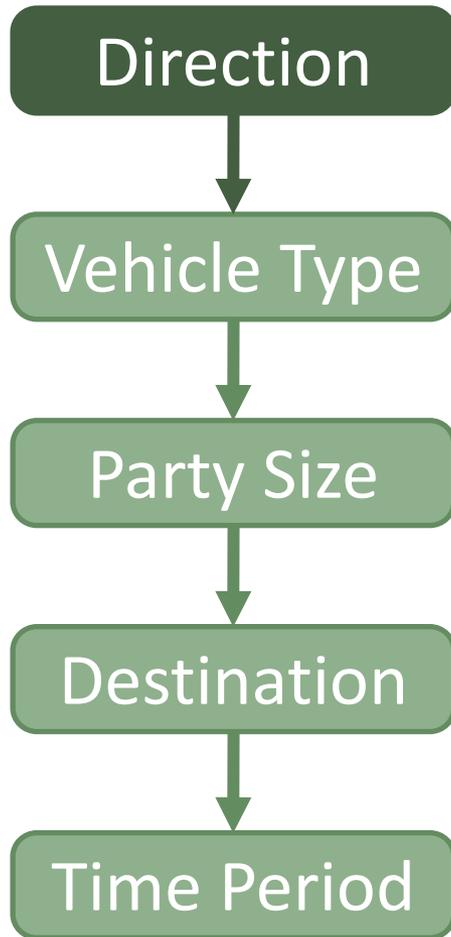
Age type

External Travel Model (ETM)



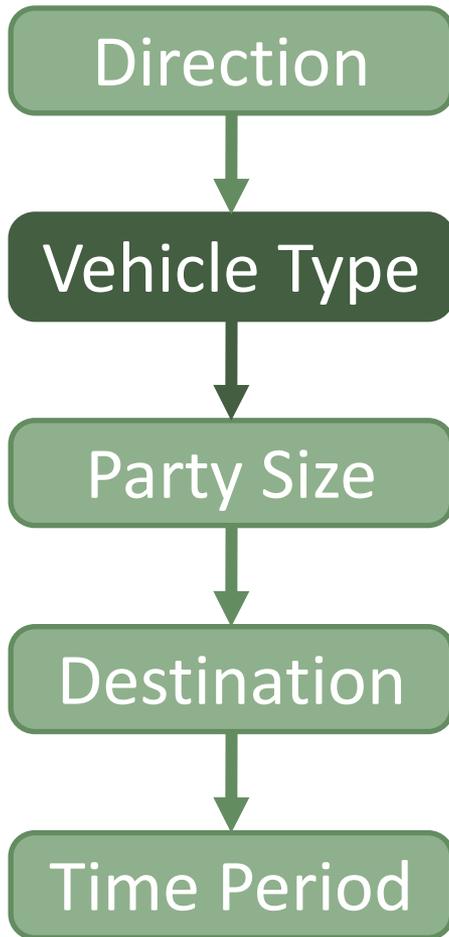
- Iterates through 48 external highway gates and 3 ports
- Total 24 hr bidirectional crossing volume is specified as an input for each gate
- Processes each external crossing individually
- Writes a standard trip list

ETM: Direction Choice



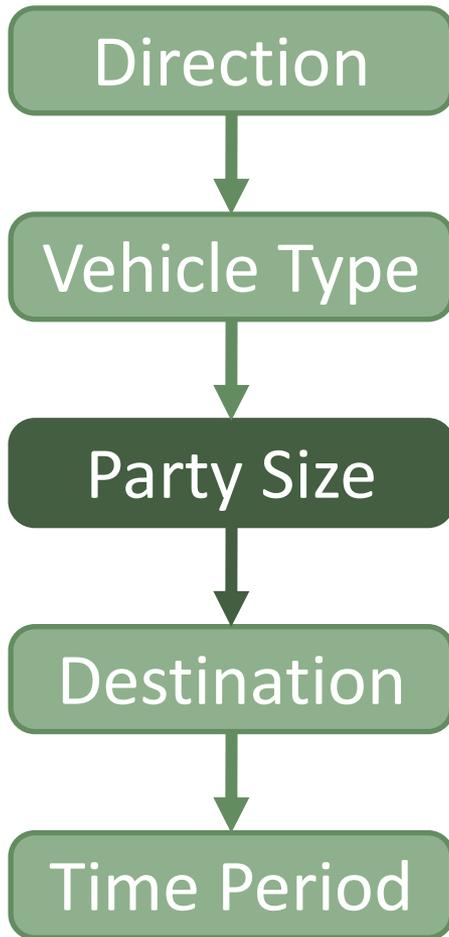
- Internal to External (I-E)
- External to Internal (E-I)
- External to External (E-E)
- I-E and E-I have even chance
- E-E only at key crossings:
 - Interstates, Mexico, Ports
 - Proportion specified by gate (based on FAF2)

ETM: Vehicle Type Choice

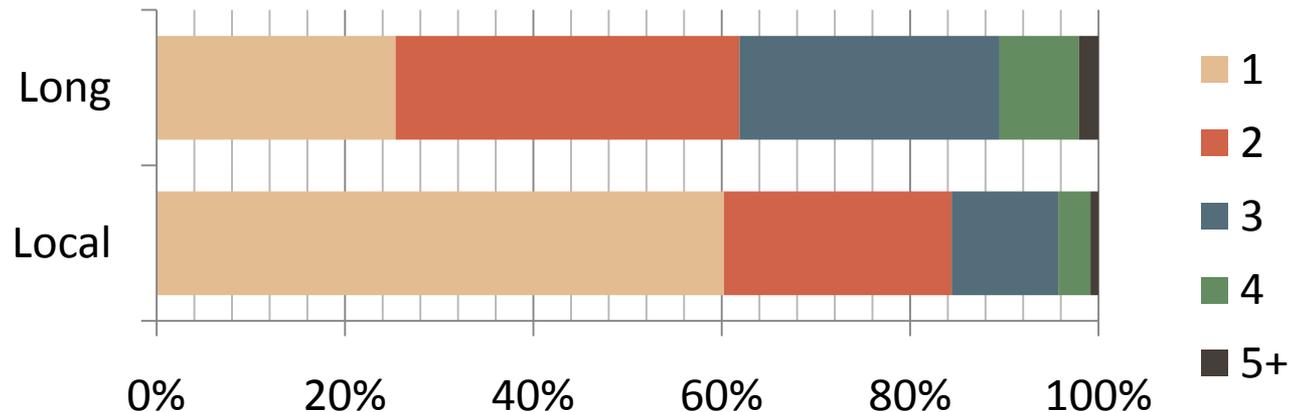


- Heavy, Medium, Car (x2)
 - Split based on observed counts
 - Ports only Heavy and Medium
- Car split into Local and Long
 - Local: live near border in area
 - Long: long distance travellers
 - Based on NHTS and counts
- E-E only Heavy

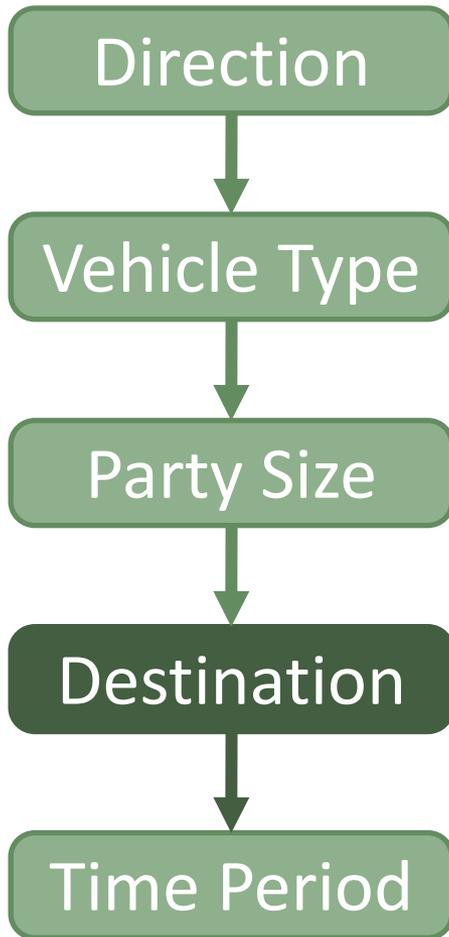
ETM: Party Size Choice



- Needed for consistency
 - Modes are SOV, HOV2, HOV3+
 - Trips are “person trips”
- Heavy and Medium: 1 trip
- Car based on surveys/NHTS

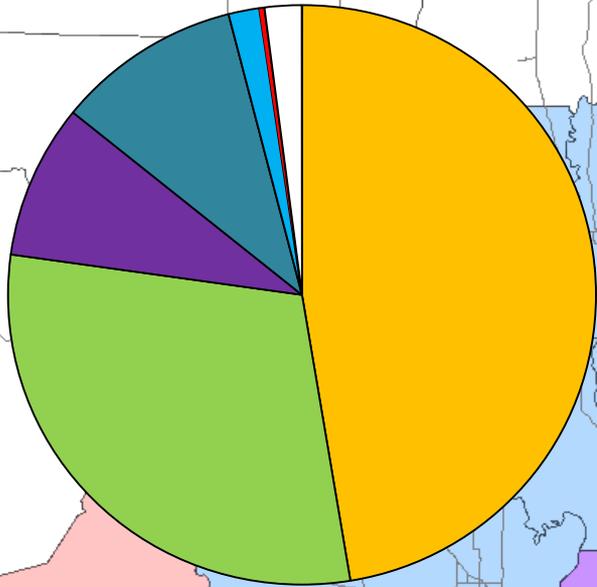


ETM: Destination Choice

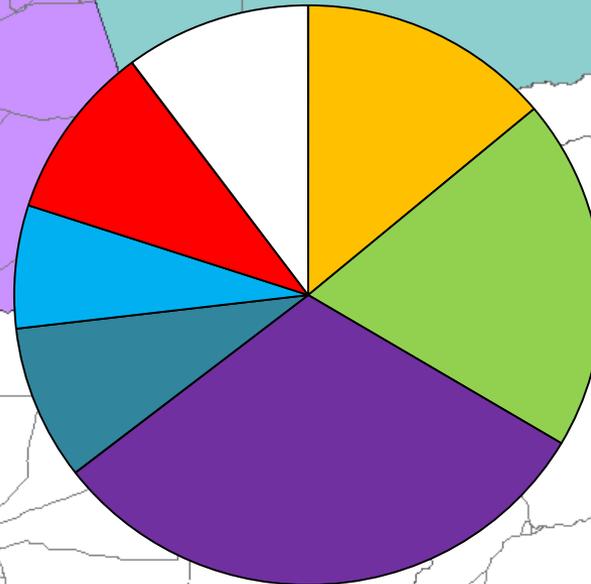


- Internal zone:
 - Logit destination choice model
 - Zonal attractiveness and distance
 - Calibrated with counts/FAF/NHTS
- Local and Long Distance Cars:
 - Total employment, retail employment, population
 - Local car much more sensitive to distance

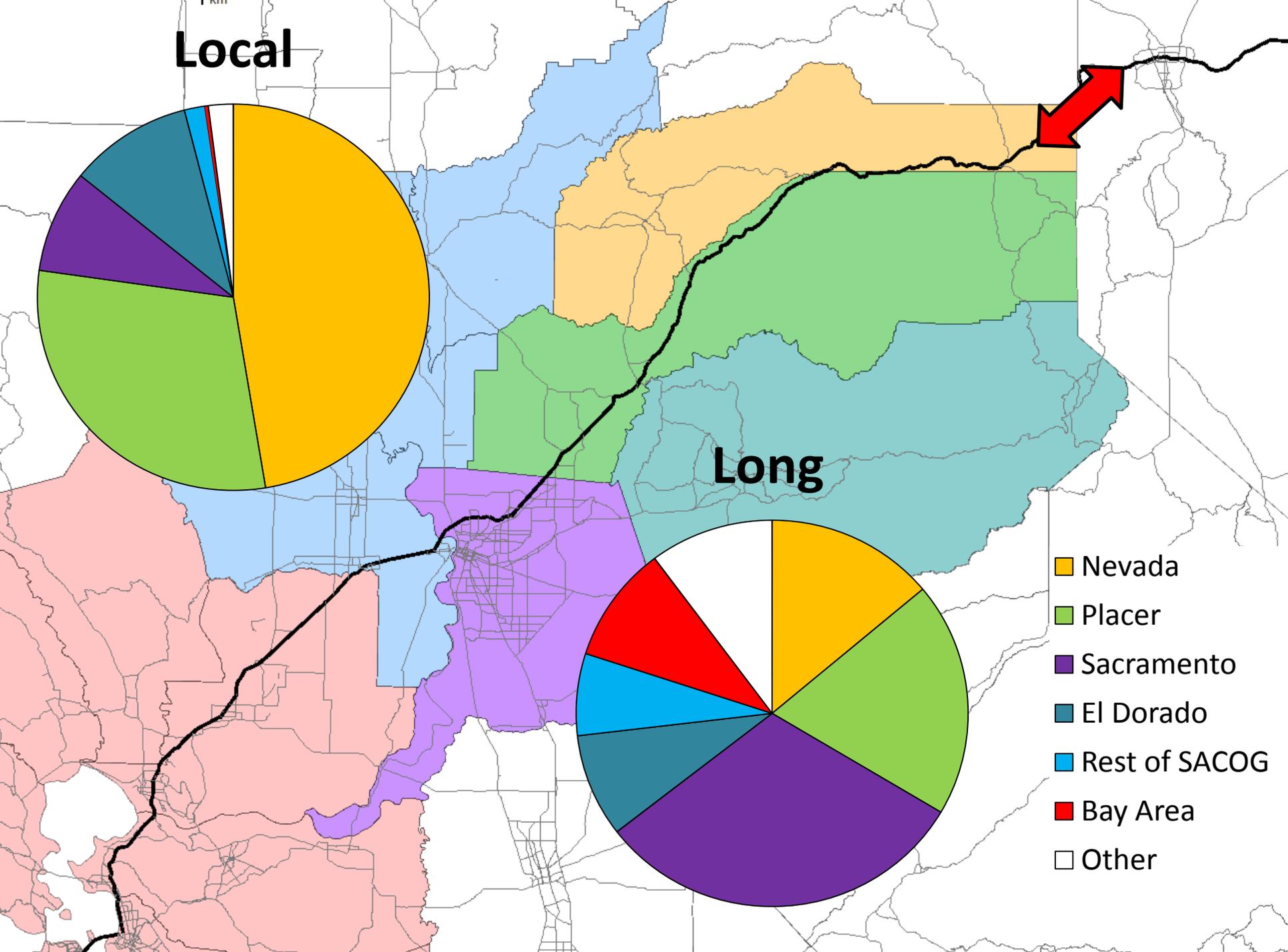
Local



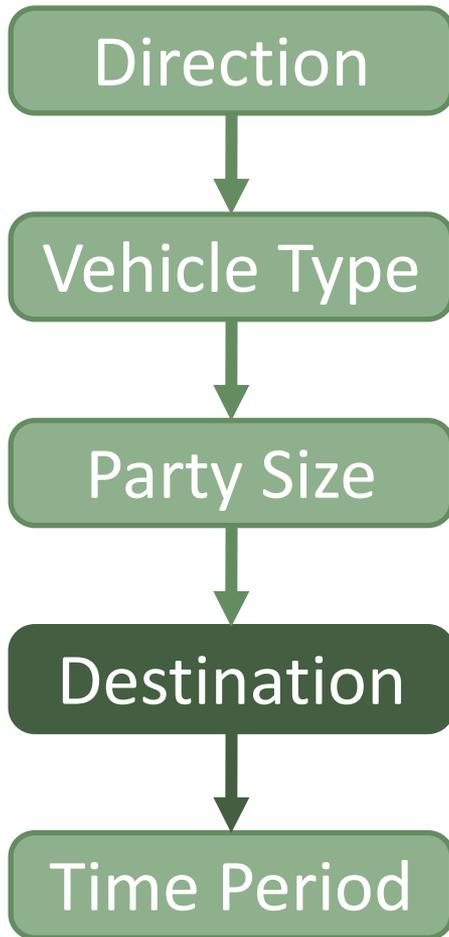
Long



- Nevada
- Placer
- Sacramento
- El Dorado
- Rest of SACOG
- Bay Area
- Other

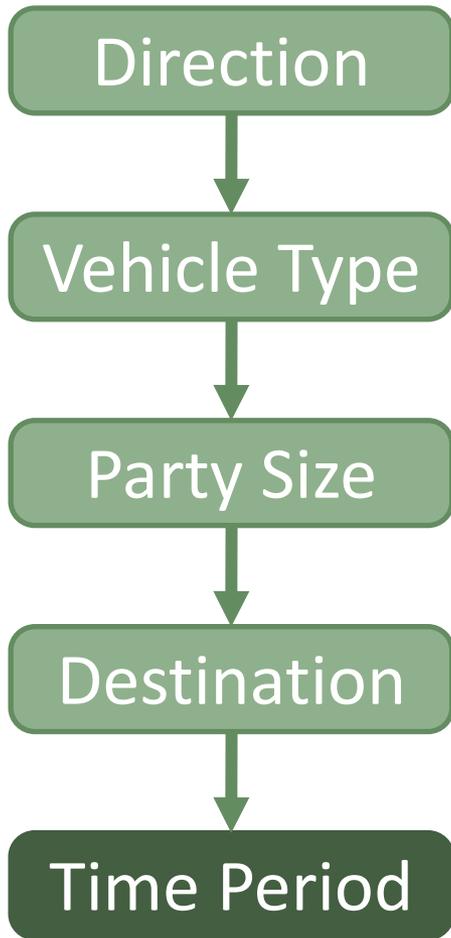


ETM: Destination Choice

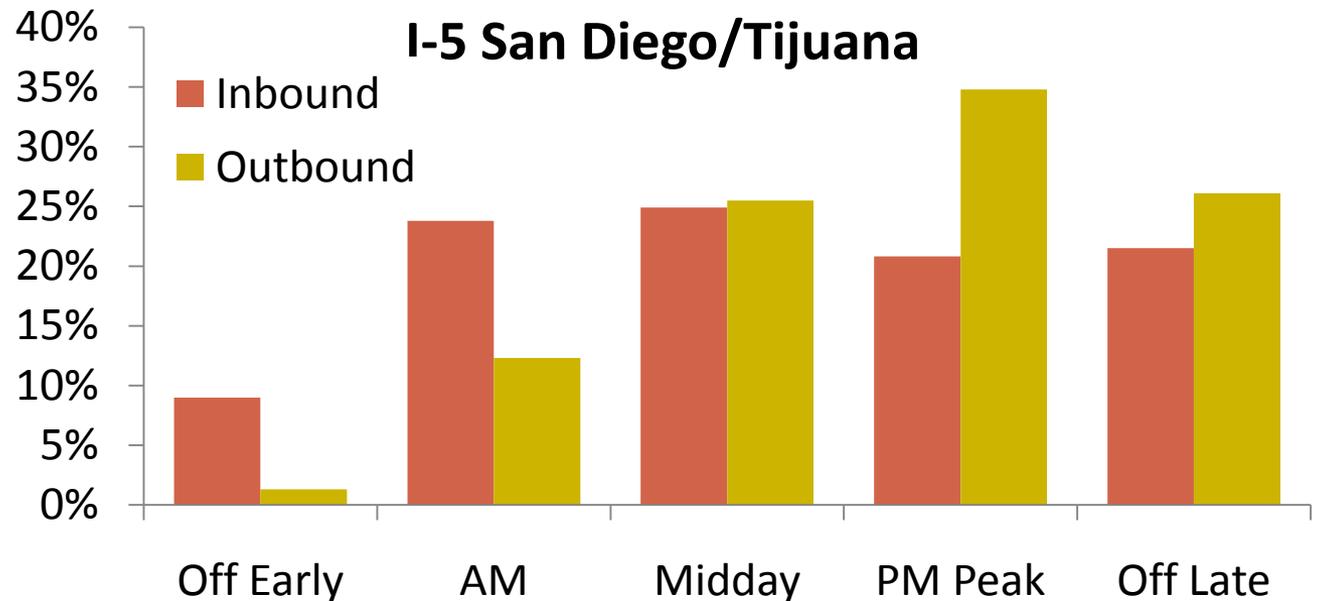


- Medium and Heavy:
 - Employment x 5 industry groups
 - Medium more sensitive to distance
- Through (E-E):
 - Proportions specified between key gateways
 - Based on FAF2

ETM: Time Period Choice



- Trip(s) assigned to time period
- Observed distribution by gate
- Specified for each direction



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lment

lation

p. density

ld income

l status/type

Commercial vehicles over 50 miles from their establishment

omposition

LONG DISTANCE COMMERCIAL

Gender

VEHICLE MODEL (LDCVM)

ilities

ng type

Long Distance

Commercial Vehicle Model (LDCVM)

- CalSIIM model produces commodity flows in dollars between TAZ
- 11 commodity types that travel by heavy truck
 - Agriculture (x3), Manufacturing (x5), Mining, Fuels and Scrap
- Flows converted to number of trucks
- Trucks assigned to specific time periods
- Individual trip records created

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lation

p. density

ld income

l status/type

Personal trips over 100 miles from home

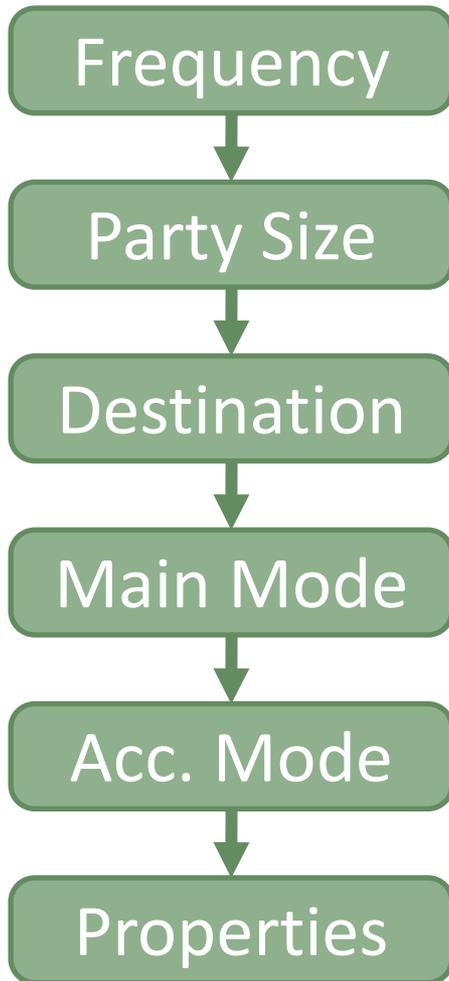
ompositiv **LONG DISTANCE PERSONAL TRAVEL**

Gends **MODEL (LDPTM)**

ilities

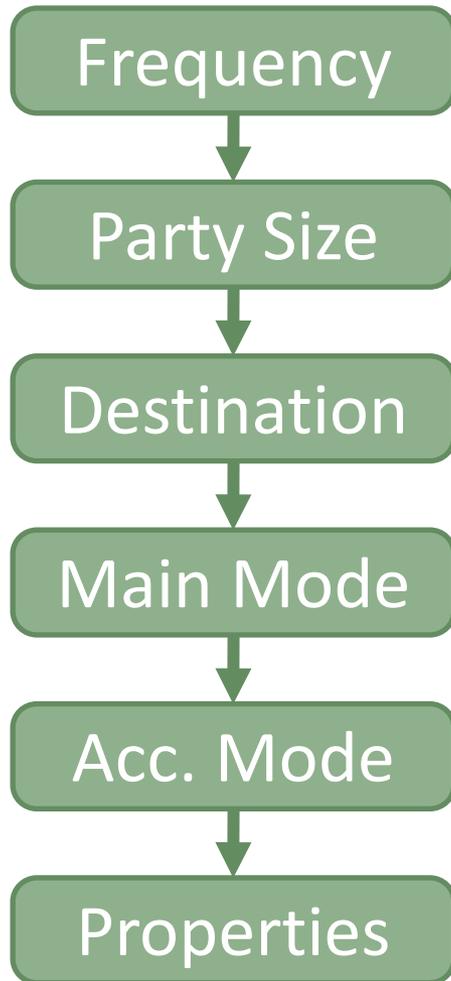
ng type

Long Distance Personal Travel Model (LDPTM)



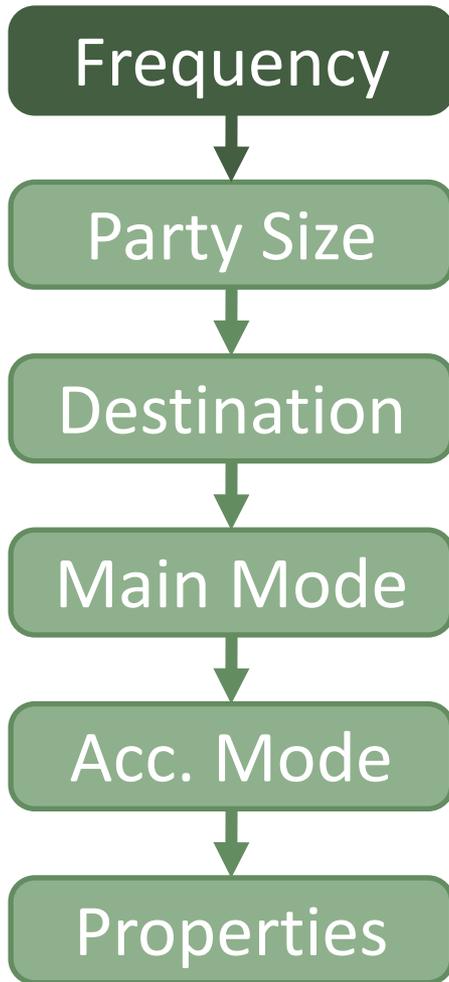
- Series of logit choice models
- Four travel purposes:
 - Business, Commute
 - Recreation, Other

Long Distance Personal Travel Model (LDPTM)



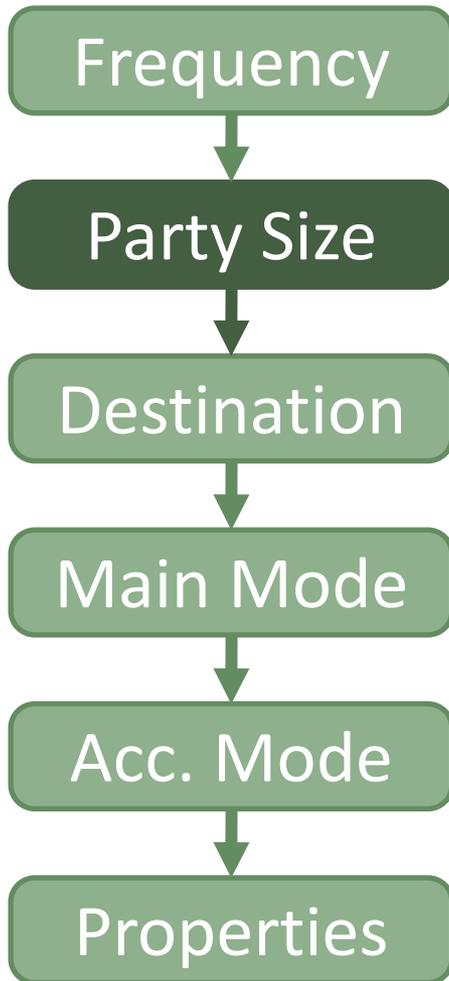
- Iterates through all persons
- Uses 99 household types, derived from the synthetic population
 - Size x4, number of workers x3
 - Income x3, number of cars x3

LDPTM: Trip Frequency



- Probability that a person will make 0, 1 or 2 trips
- Parameters vary by purpose
- Uses purpose-specific destination choice logsum
 - Measure of all of the choices available in the destination choice model

LDPTM: Party Size



- Choice to travel alone or in a group
- Parameters vary by two groups of purposes:
 - Business or commute
 - Recreation or other

Trip Frequency and Party Size sensitivities

Attribute	Trip Frequency				Party Size	
	Bus.	Comm.	Rec.	Other	B&C	R&O
Destination choice logsum	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	None	None
Local accessibility	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	None	None
Household size	None	None	Partial or limited	Reasonably comprehensive	Partial or limited	Reasonably comprehensive
Auto ownership	Partial or limited	Partial or limited	Partial or limited	Partial or limited	Partial or limited	None
Household income	Reasonably comprehensive	Reasonably comprehensive	Partial or limited	Partial or limited	Partial or limited	None
Number of workers	Reasonably comprehensive	Reasonably comprehensive	Partial or limited	Partial or limited	None	None

Reasonably comprehensive:



Partial or limited:



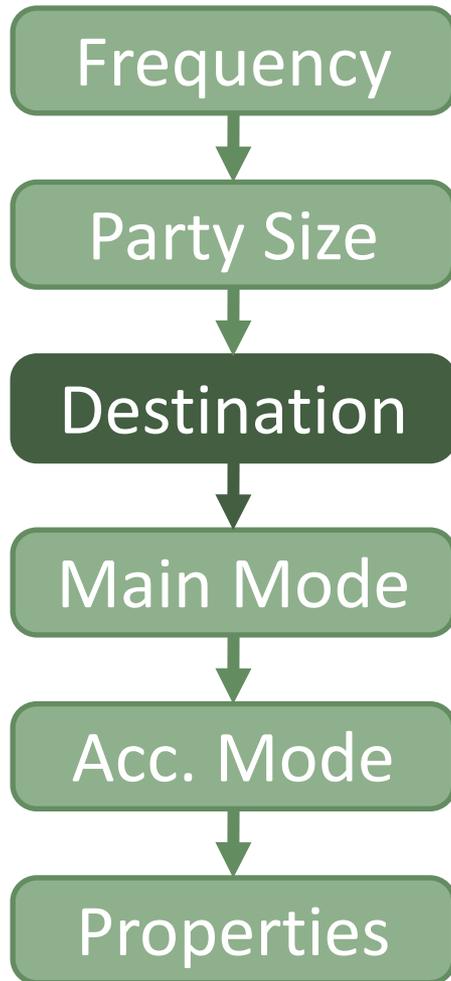
N/A:



None:



LDPTM: Destination Choice



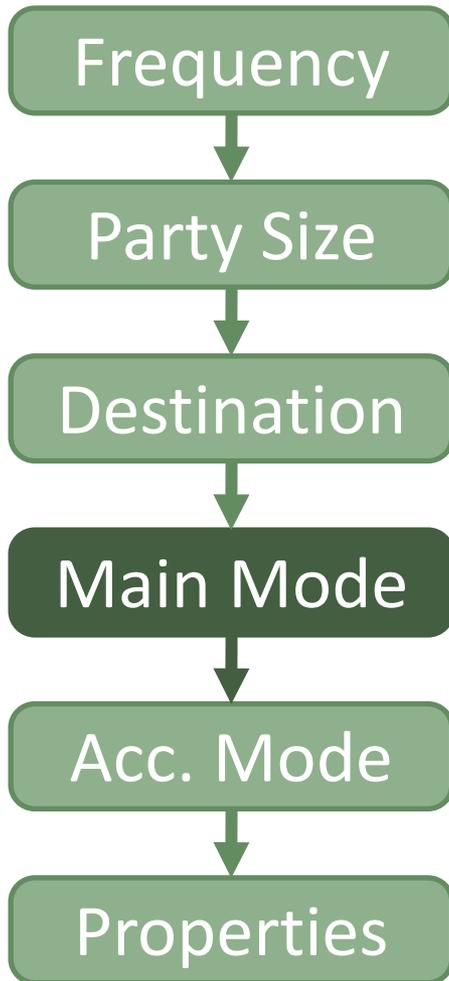
- Choice of specific destination
- Uses mode choice logsum by purpose
- Two groups of purposes:
 - Business / Commute
 - Recreation / Other
- Destination “size” terms vary by household income

Destination Choice sensitivities

Attribute	Size term		Destination
	Business / Commute	Recreation / Other	
Retail employment (by household income)	Reasonably comprehensive	Reasonably comprehensive	N/A
Service employment (by household income)	Reasonably comprehensive	Reasonably comprehensive	N/A
Other employment	Reasonably comprehensive	None	N/A
Number of households	None	Reasonably comprehensive	N/A
Size terms	N/A	N/A	Reasonably comprehensive
Mode choice logsum	N/A	N/A	Reasonably comprehensive
Destination density	N/A	N/A	Reasonably comprehensive

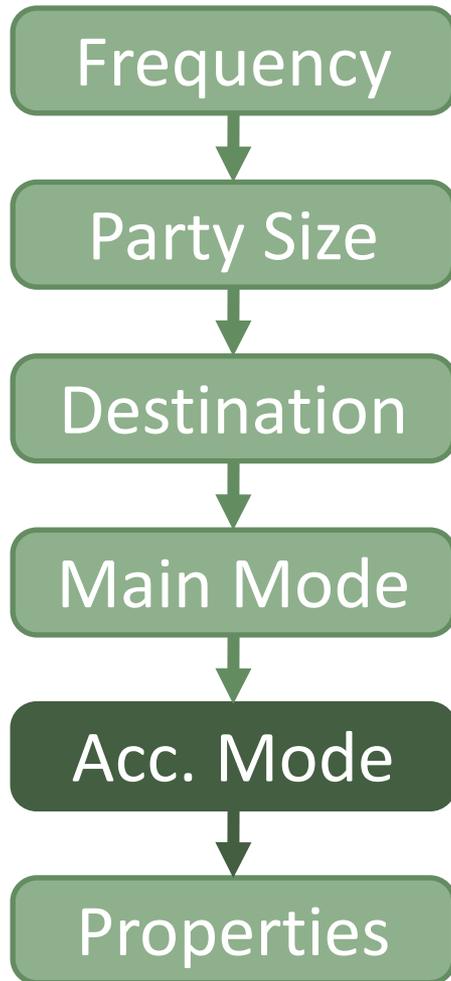
Reasonably comprehensive:  Partial or limited:  N/A:  None: 

LDPTM: Main Mode Choice



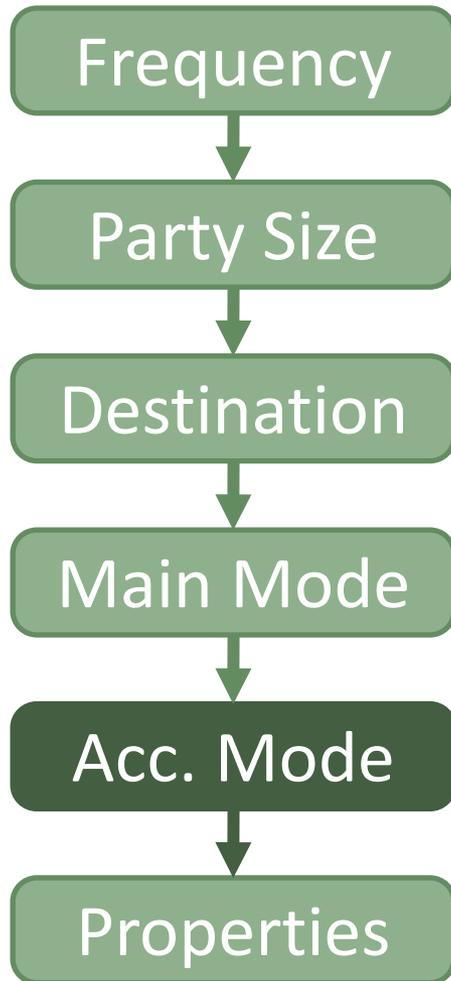
- Choice between main ('line haul') modes:
 - Auto, Air and Rail
- Two groups of purposes:
 - Business / Commute
 - Recreation / Other

LDPTM: Access/ Egress Mode Choice



- When main mode is rail or air
- Separate models for access and egress
- Two groups of purposes:
 - Business / Commute
 - Recreation / Other

LDPTM: Access/ Egress Mode Choice



- Six access/egress modes available:
 - Car and park
 - Rental car
 - Pick up / drop off
 - Taxi
 - Transit
 - Walk

Mode Choice sensitivities

Attribute	Main mode		Access / Egress mode	
	Business / Commute	Recreation / Other	Business / Commute	Recreation / Other
Money cost and travel time	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive
Headway	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive
Reliability	Reasonably comprehensive	Reasonably comprehensive	None	None
Access / Egress mode choice logsum	Reasonably comprehensive	Reasonably comprehensive	N/A	N/A
Main mode choice	N/A	N/A	Partial or limited	Partial or limited
Party size choice	Reasonably comprehensive	Reasonably comprehensive	None	None
Household size	Partial or limited	Partial or limited	Partial or limited	Partial or limited
Auto ownership	None	Partial or limited	Partial or limited	Partial or limited
Household income	Partial or limited	None	Partial or limited	Partial or limited

Reasonably comprehensive:



Partial or limited:



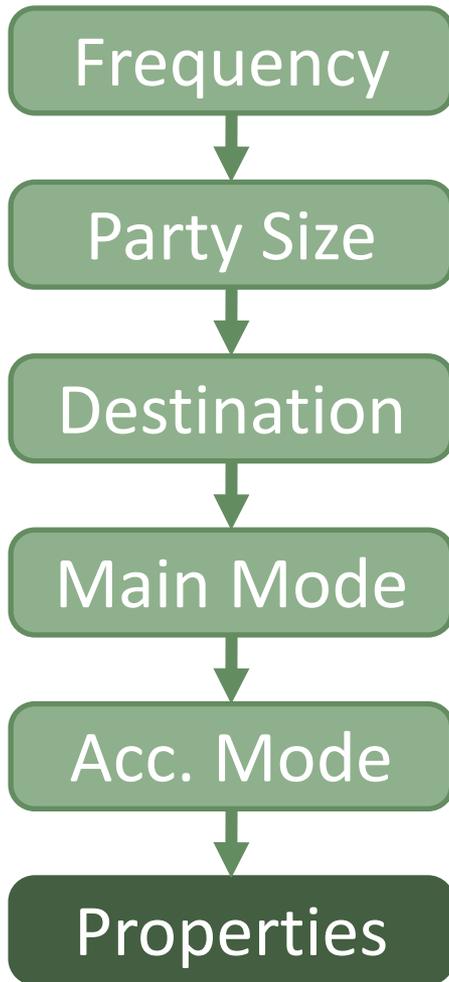
N/A:



None:

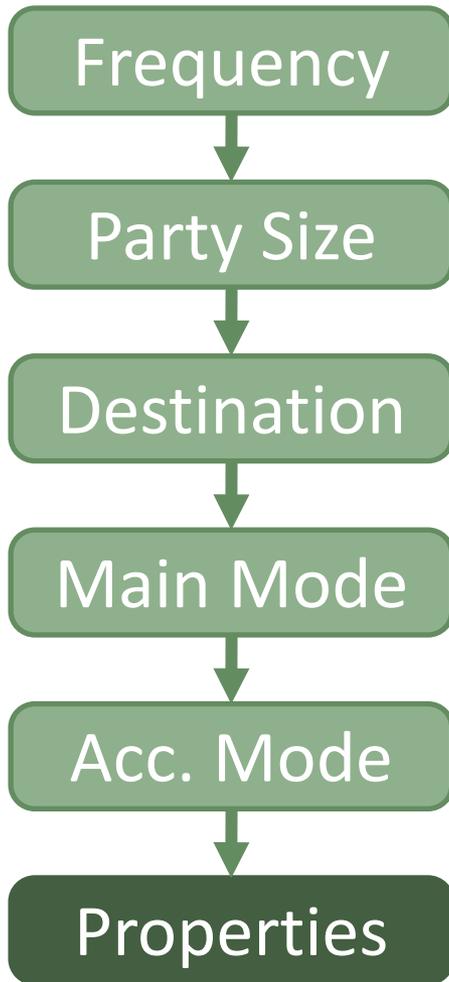


LDPTM: Trip Properties



- Trips produced by model need additional detail for CSTDM use
- Group auto travel: split into HOV2 and HOV3+
 - Observed occupancies by purpose

LDPTM: Trip Properties



- Direction:
 - Away from home or return home
 - Even split
- Time period:
 - Trips assigned a specific time period
 - By purpose and by direction
- Trips are written in standard trip list format

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p. density

ld income

l status/type

Commercial vehicles within 50 miles of their establishment

ompo

SHORT DISTANCE COMMERCIAL

Gender

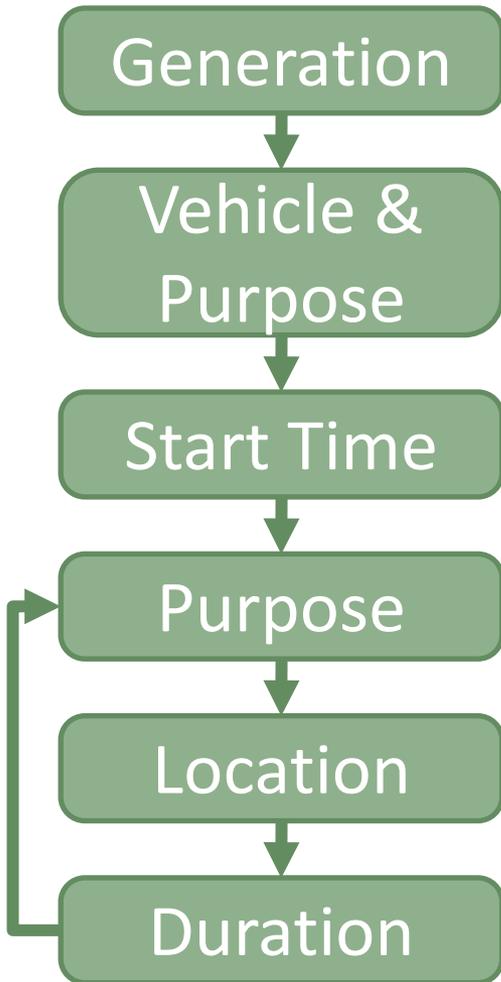
VEHICLE MODEL (SDCVM)

ilities

ng type

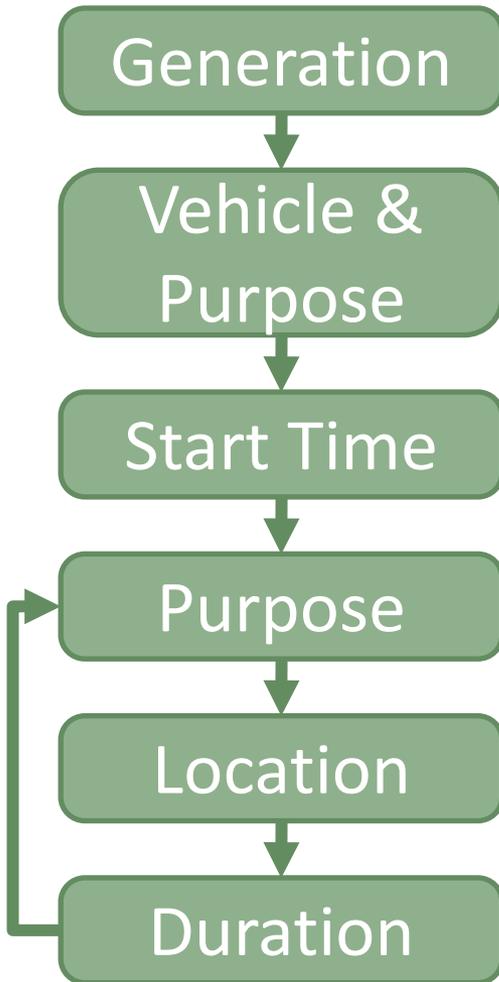
Short Distance

Commercial Vehicle Model (SDCVM)



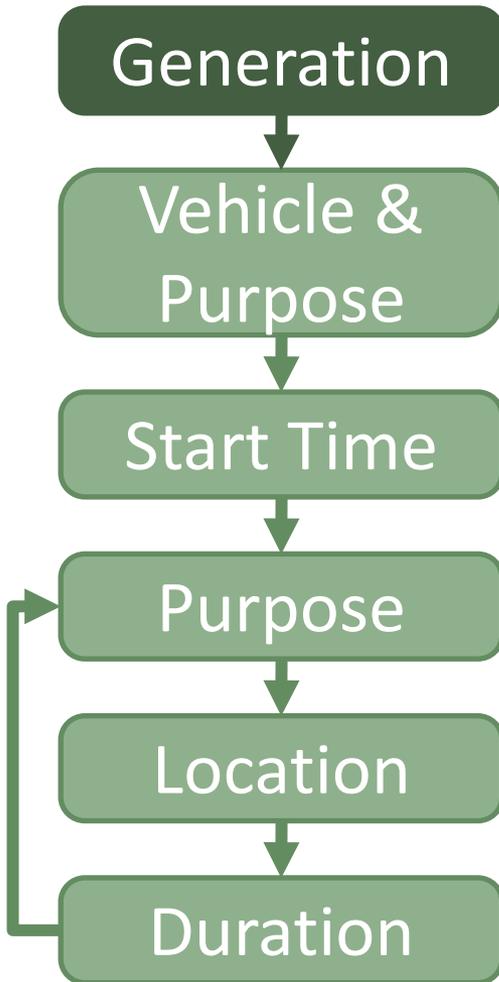
- Series of logit choice models, with continuous time distributions
- Tour starts generated by zone
- Each tour is then simulated
- Tours are “grown”
- Uses five “land use” types
 - Employment and population mix and density

Short Distance Commercial Vehicle Model (SDCVM)



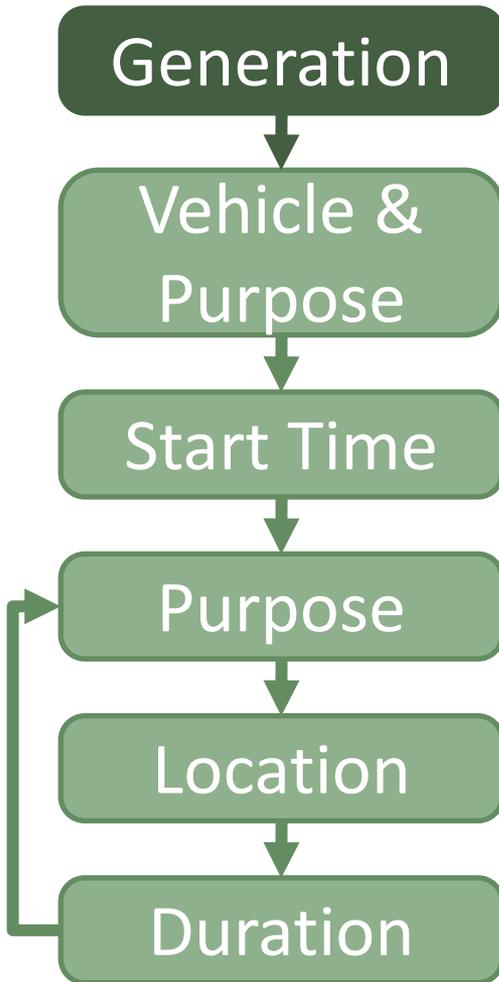
- Six industry groups:
 - Industrial and Agricultural
 - Wholesale
 - Retail
 - Service
 - Transportation
 - Fleet allocators
 - Coordinated fleet moving in mostly set patterns (e.g. postal, garbage)

SDCVM: Generation



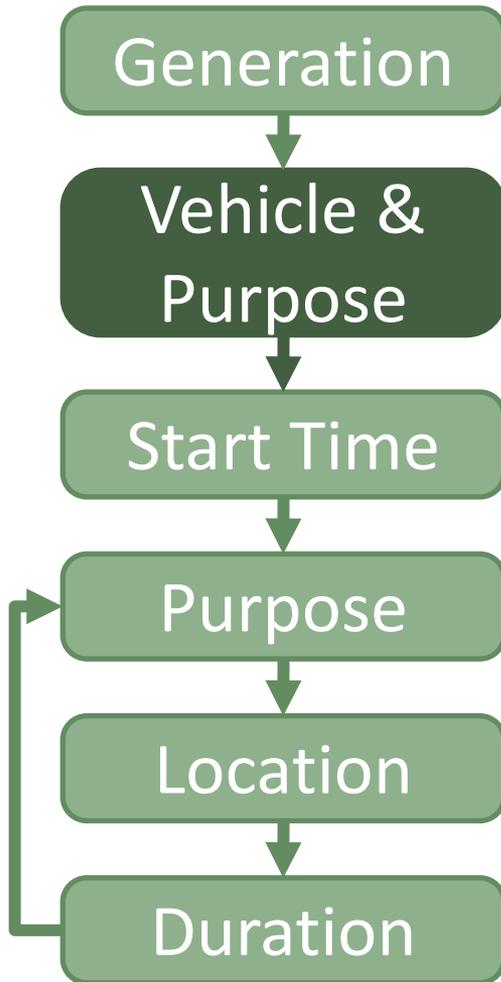
- Generation by zone, by industry and by time period
- Parameters vary by industry
- Three nested models

SDCVM: Generation



- Ship/No Ship
 - Overall decision to make trips
- Tours per employee
 - Rate of tour generation
- Tour start time of day
 - Five time periods
- Logsum from vehicle & purpose choice

SDCVM: Vehicle and Tour Purpose



- Combined choice of vehicle used and purpose of tour
- Four vehicle choices:
 - Light, Medium x2 and Heavy
- Three purposes:
 - Service, Goods and Other
- Parameters vary by industry
- Emp. & pop. accessibility by vehicle type

Generation, vehicle & tour sensitivities

Attribute	Ship / No Ship	Tours per employee	Start time period	Vehicle and purpose
Logsum from tours per employee	Partial or limited	N/A	N/A	N/A
Logsum from tour start time period	N/A	Reasonably comprehensive	N/A	N/A
Logsum from vehicle and tour purpose choice	N/A	N/A	Reasonably comprehensive	N/A
Zonal land use type	Reasonably comprehensive	Reasonably comprehensive	Partial or limited	Reasonably comprehensive
Type of employment in zone	Reasonably comprehensive	Reasonably comprehensive	Partial or limited	Reasonably comprehensive
Jobs within 30 minutes	None	Reasonably comprehensive	None	None
Employment accessibility	None	None	None	Reasonably comprehensive
Population accessibility	None	None	None	Reasonably comprehensive

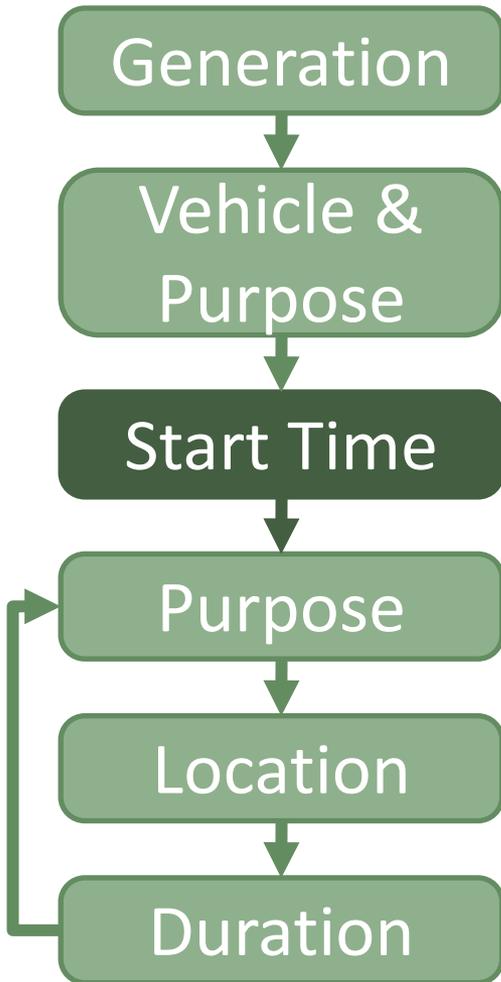
Reasonably comprehensive: 

Partial or limited: 

N/A: 

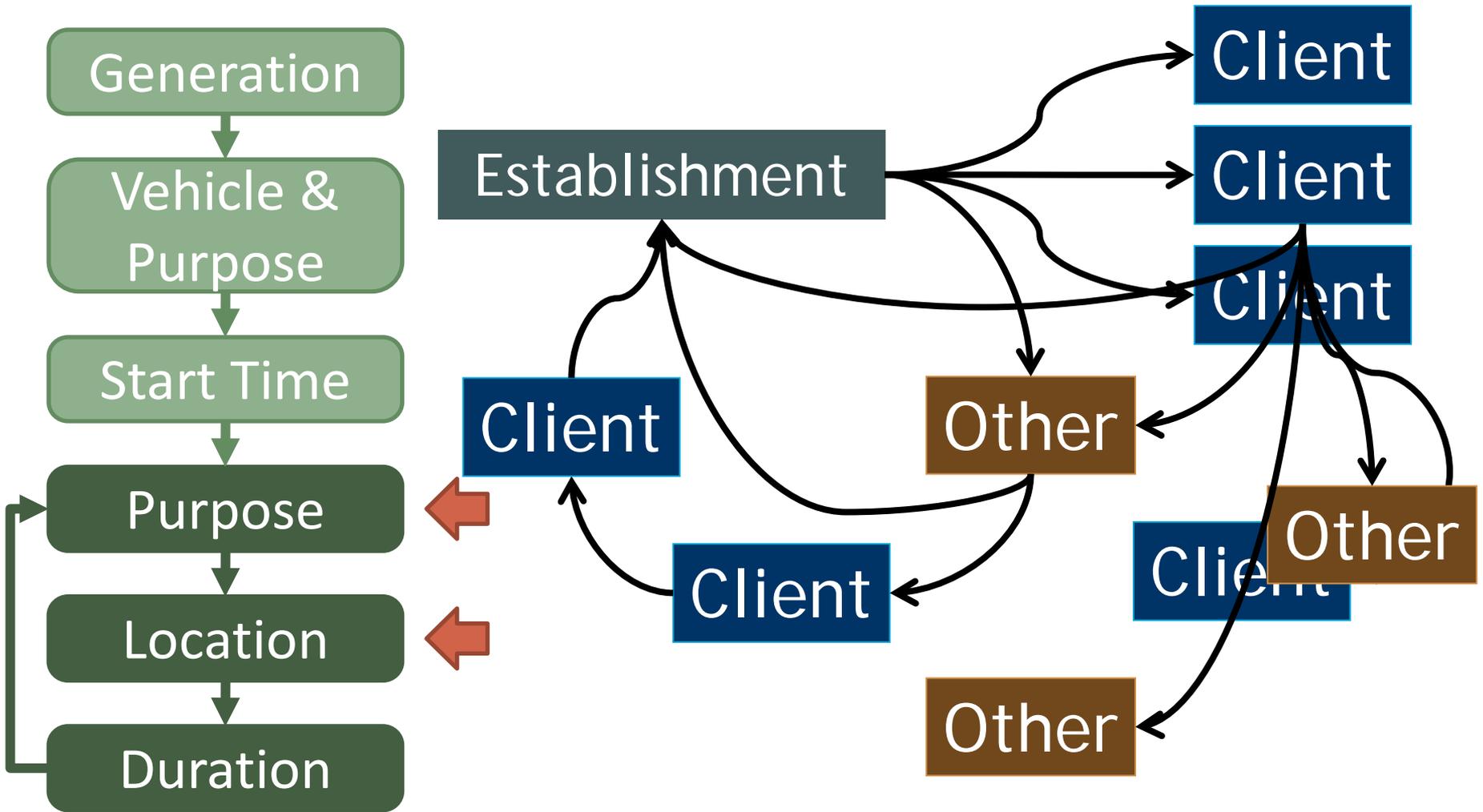
None: 

SDCVM: Specific start time

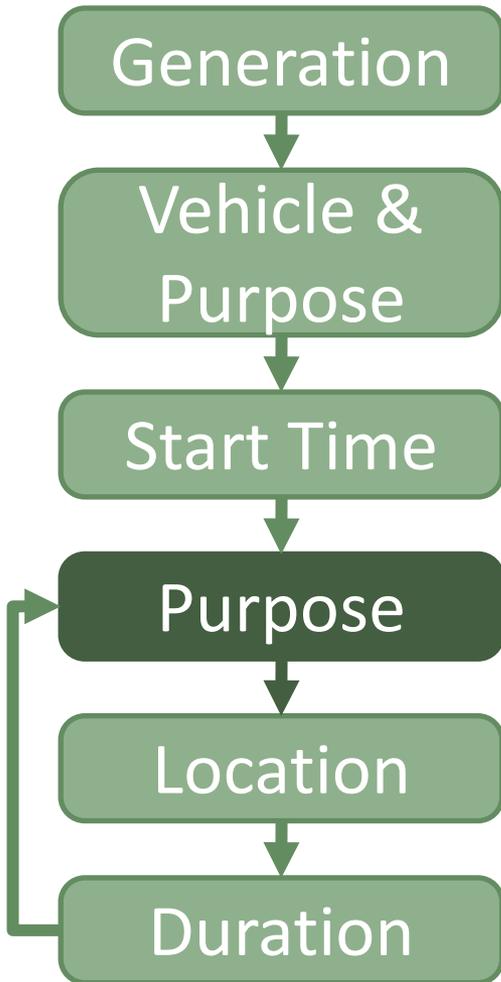


- Generation assigned tour to a time period
- Specific tour start time within period
- Monte Carlo process samples start time from distribution curve
- Curves vary by time period

SDCVM: Tour microsimulation

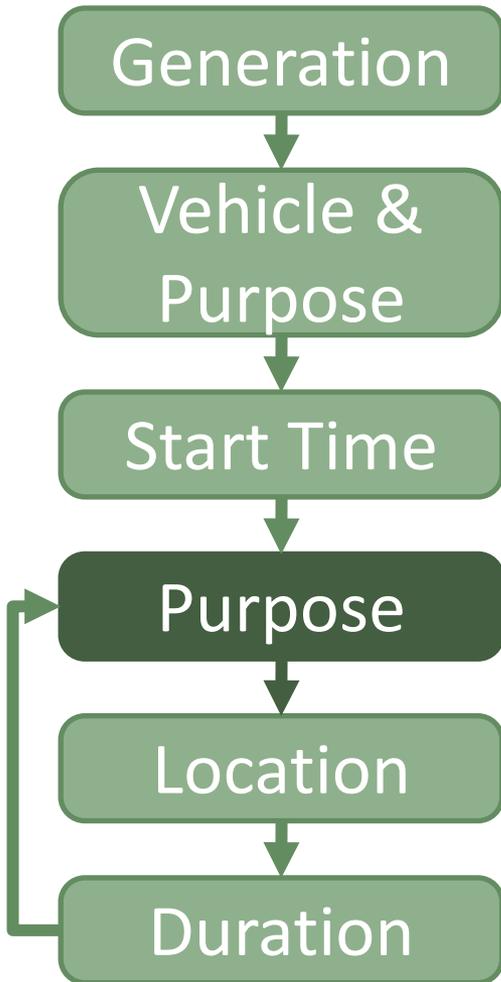


SDCVM: Next Stop Purpose



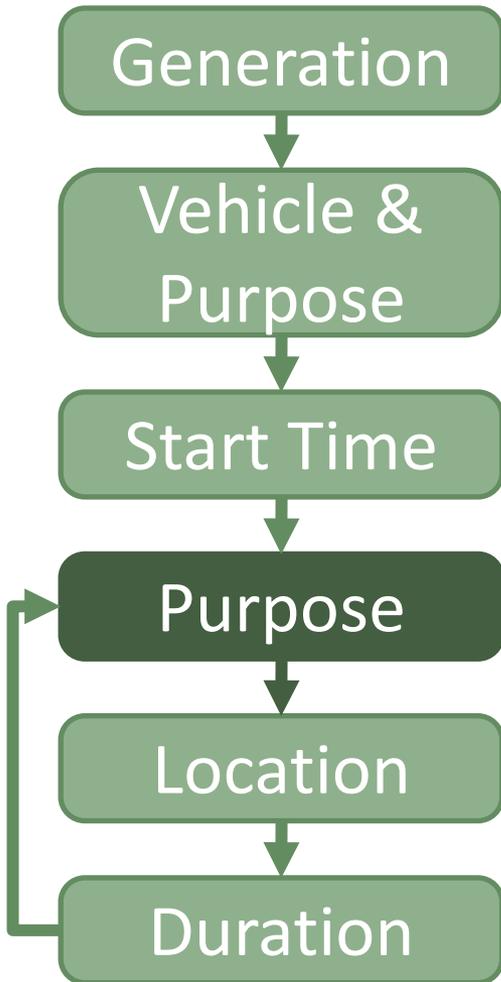
- Three purposes:
- “Business”:
 - Goods on Goods tours
 - Service on Service tours
 - Not available on Other tours
- Other
 - Always available
- Return to Establishment
 - Determines tour length

SDCVM: Next Stop Purpose



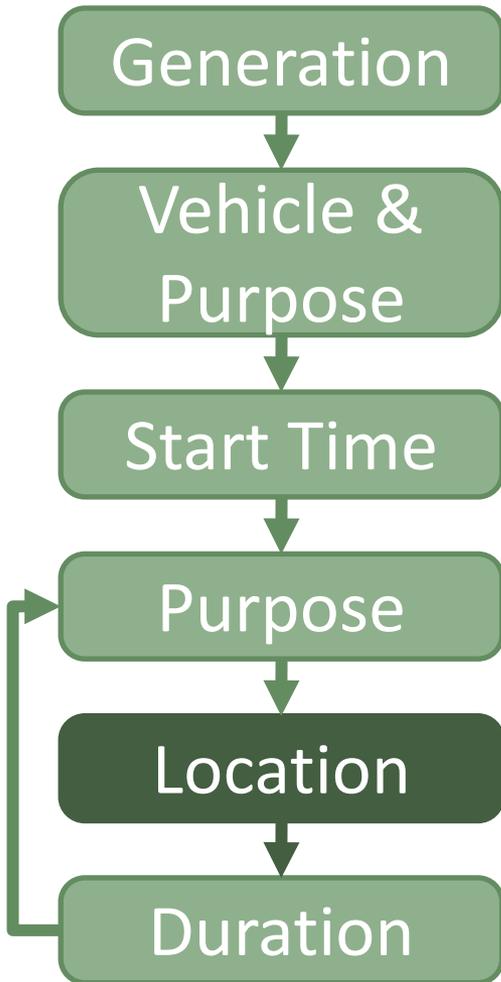
- 13 different segments
 - Combination of industry, tour purpose, vehicle type
 - e.g. Wholesale, Medium and Heavy vehicles on Goods tours
 - Parameters vary by segment

SDCVM: Next Stop Purpose



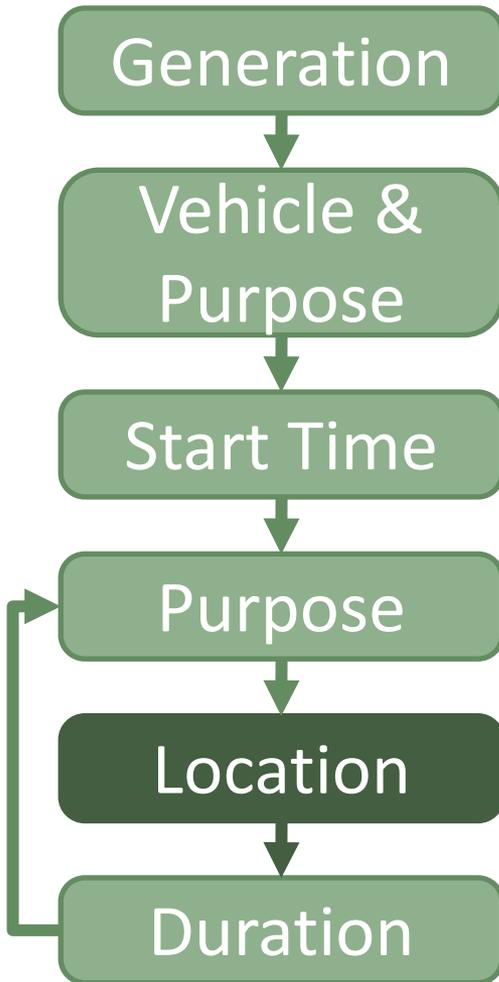
- Model takes into account:
 - Number of previous stops
 - Elapsed time (both travel and total)
 - Accessibility to employment
 - Return to establishment generalised travel cost

SDCVM: Next Stop Location



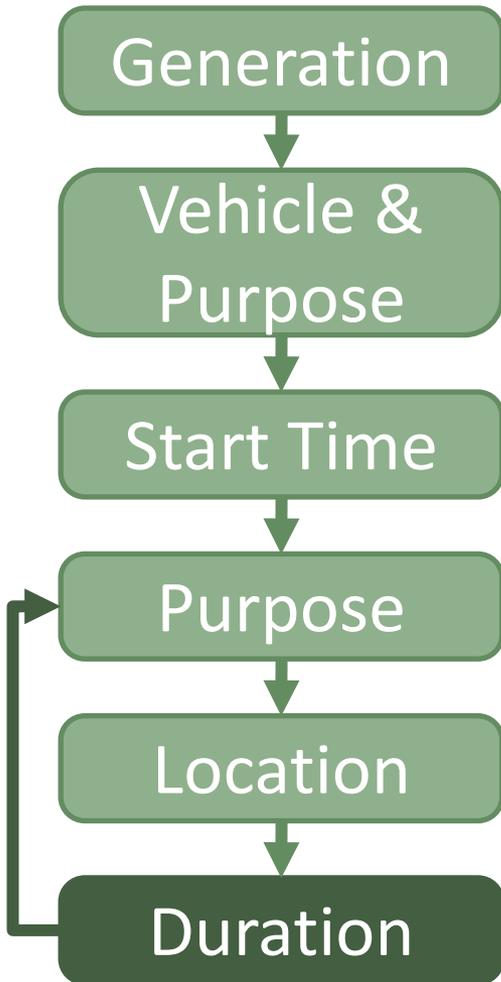
- Chooses specific location for next stop
- 12 segments based on industry, stop purpose and vehicle type
- Generalised travel cost:
 - Travel cost to destination
 - From destination back to establishment
 - Different costs for first trip

SDCVM: Next Stop Location



- Model also considers:
 - Employment x5 industry groups
 - Population and income
 - Accessibilities to pop. and emp.
 - Pop. and emp. densities
 - Land use
 - Geometry of tour

SDCVCM: Next Stop Duration



- Duration for each stop, in continuous time
- Monte Carlo process samples start time from distribution curve
- Curves vary by industry, vehicle size and stop purpose (19 segments)
- Trip written out to trip list

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p. density

ld income

l status/type

Personal trips within 100 miles of home

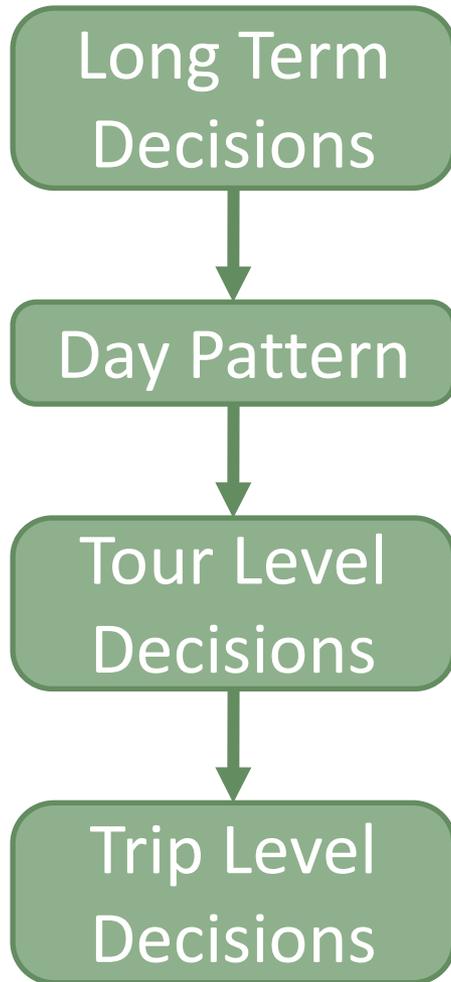
ompo **SHORT DISTANCE PERSONAL**

Gender **TRAVEL MODEL (SDPTM)**

ilities

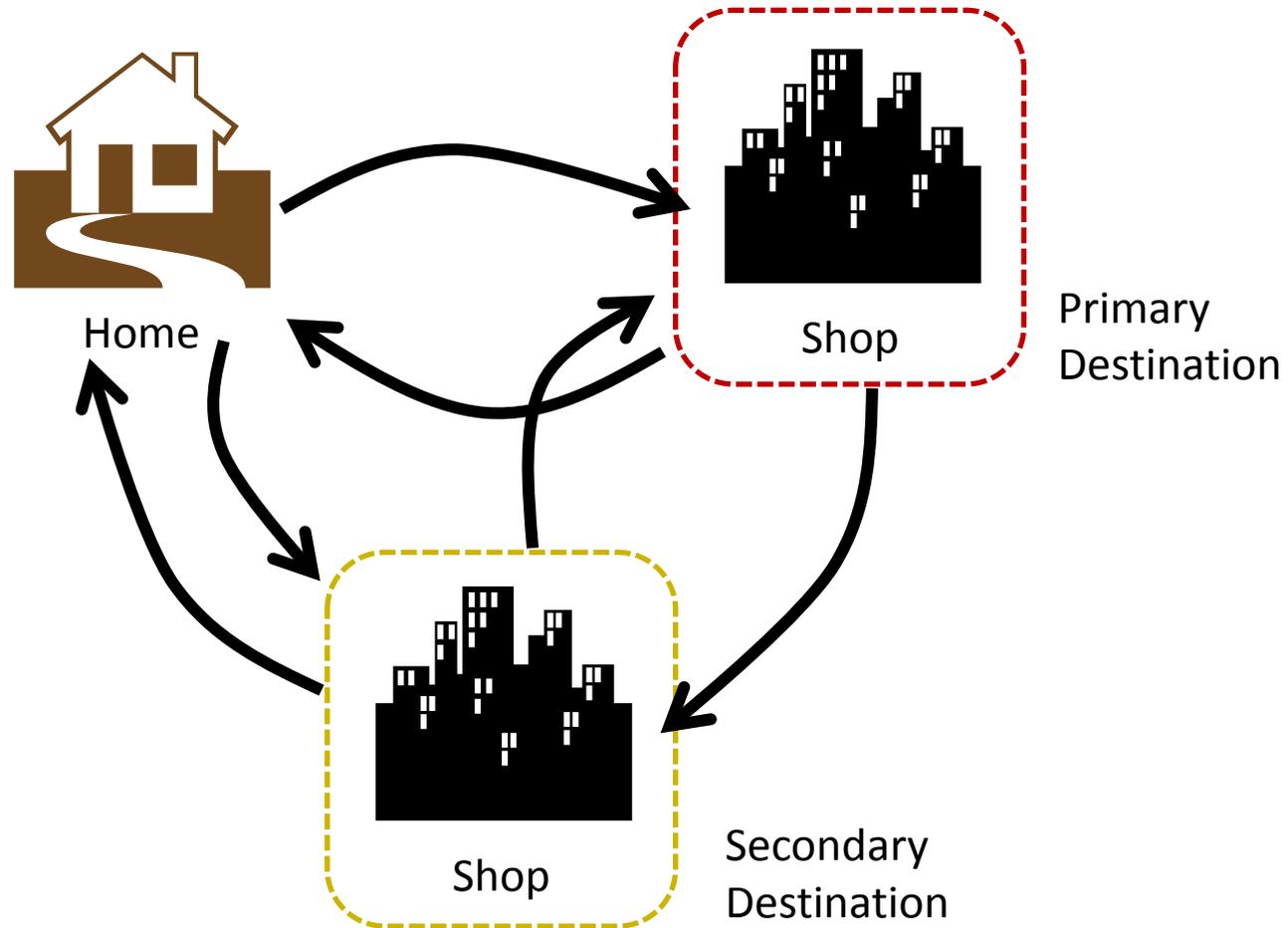
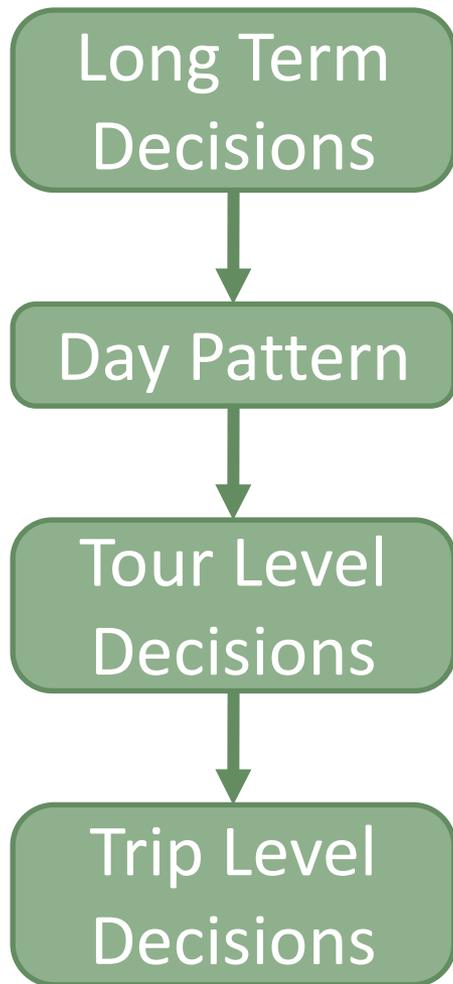
ng type

Short Distance Personal Travel Model (SDPTM)

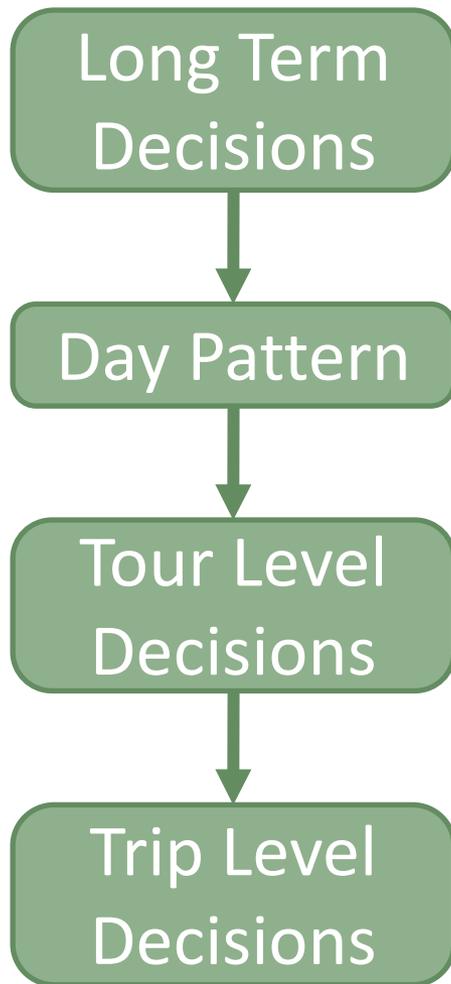


- Series of logit choice models
- Iterates through zones
 - Through people in zone
- Uses 8 activities / purposes
 - Work, School
 - Escort, Shop, Personal Business
 - Recreation, Eat, Social
- Estimated based on data set combining 4 travel surveys

Short Distance Personal Travel Model (SDPTM)

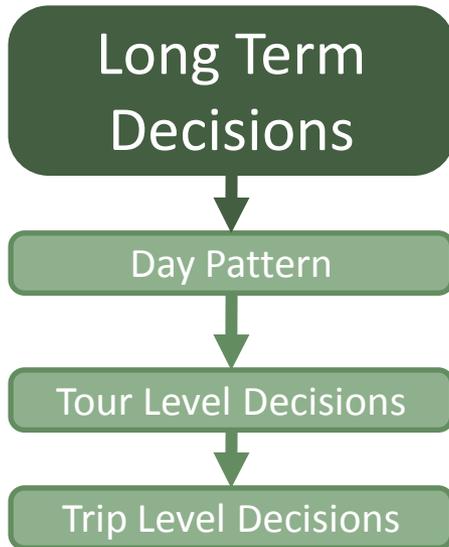


Short Distance Personal Travel Model (SDPTM)



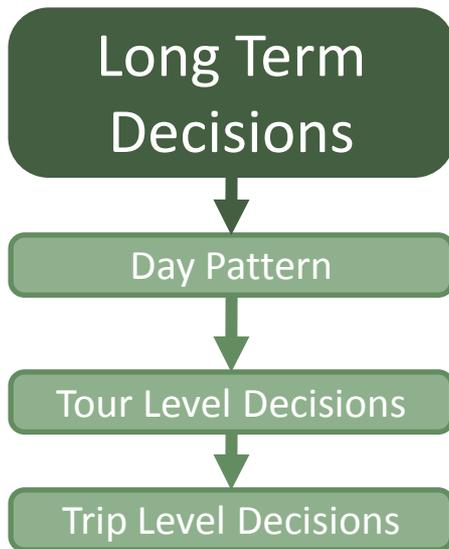
- 8 modes:
 - SOV
 - HOV 2 person
 - HOV 3+ person
 - School Bus
 - Drive Access Transit
 - Walk Access Transit
 - Bicycle
 - Walk

SDPTM: Long Term Decisions



- Long Term Decisions
- Made once for each person / household
- Auto ownership at household level
- Driver's license, work and school location at the person level

SDPTM: Long Term Decisions



- Simplified Mode Choice models
- Used only to create logsums for long term decisions
- Three auto ownership levels:
 - No autos
 - Insufficient (fewer than drivers)
 - Sufficient (as many or more)
- Represents full set of available modes

Mode choice sensitivities

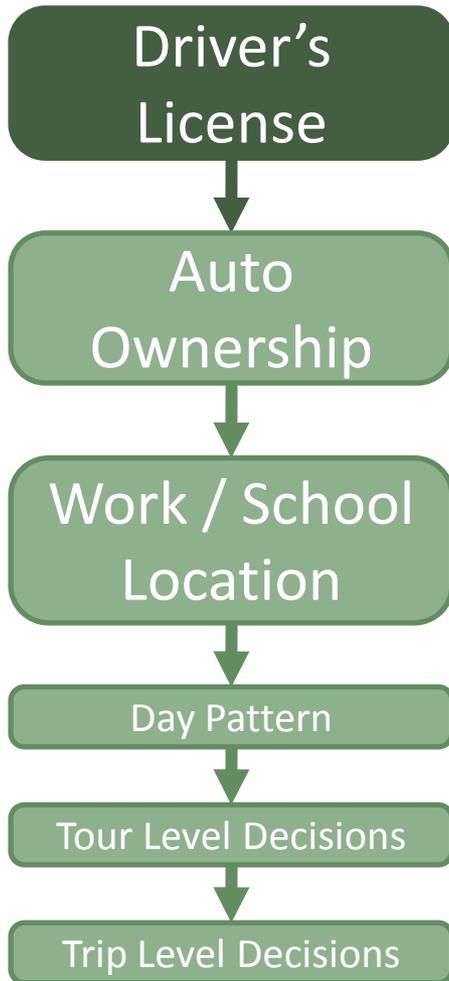
Attribute	Simplified		
	Work	K12	PSE
Travel time and cost	Uses AM-PM tour		
Auto ownership			
Household income			
Driver's license status			
Age			

Reasonably comprehensive: 

Partial or limited: 

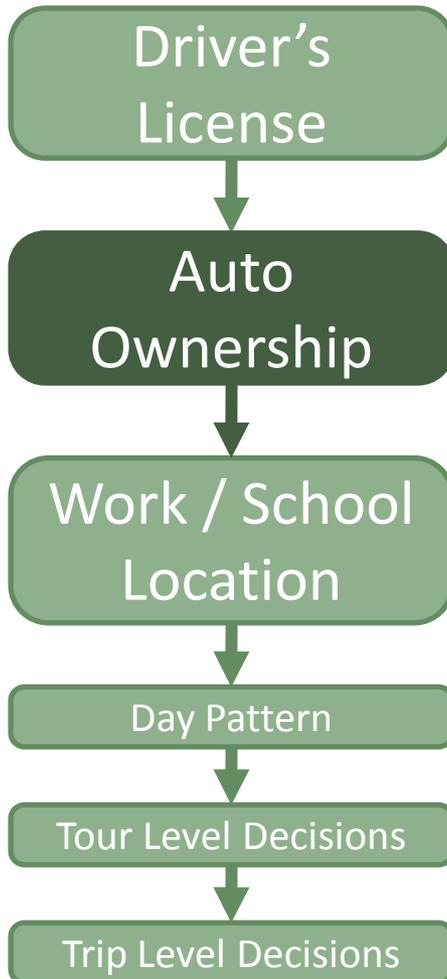
None: 

SDPTM: Driver's License



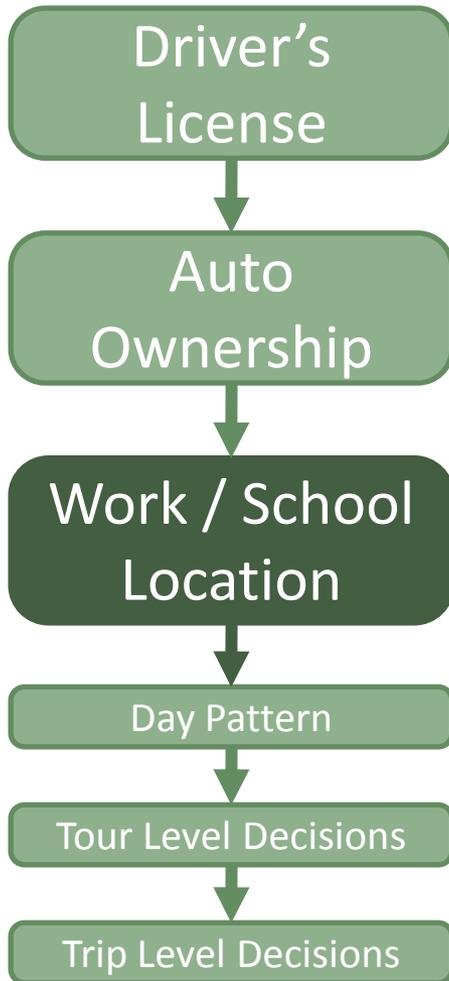
- Whether to hold license
- Made for all persons 16+
- Subsequent models can use licensed drivers to determine auto availability
- Includes simplified work mode choice logsums

SDPTM: Auto Ownership



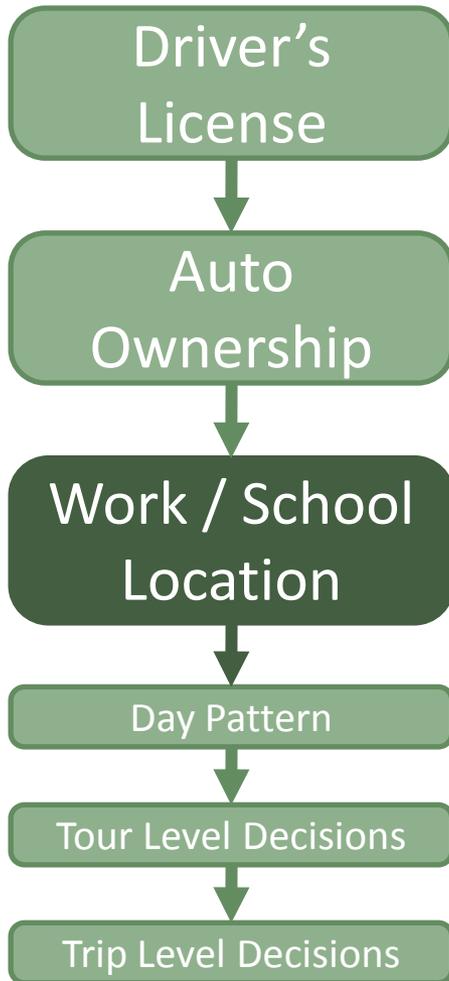
- Decision at household level
- Workers and PSE students use appropriate logsums
- Other adults use shopping destination choice logsums by transit and by SOV
- Additional household level destination choice logsums

SDPTM: Work Location



- Assigned for people with jobs
- Uses simplified mode choice logsums
- Considers round trip travel cost
- 9 occupation groups
- Workers only consider employment in their own occupation

SDPTM: School Location



- People enrolled at a school
- People can have both work and school locations assigned
- Uses simplified mode choice logsums
- Considers round trip travel cost
- 3 enrollment levels:
 - Grade school: K-8, 9-12
 - Post secondary education

Long Term Decision sensitivities

Attribute	Driver's License	Auto Own.	Destination		
			K12	PSE	Work
Simplified mode choice costs/logsums	Reasonably comprehensive				
Household income	Reasonably comprehensive	Reasonably comprehensive	None	None	Reasonably comprehensive
School level / Occupation	None	Partial or limited	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive
Work / school status	Partial or limited	Reasonably comprehensive	None	None	None
Age / Gender / Disabilities	Reasonably comprehensive	None	None	None	None
Household size / composition	Partial or limited	Reasonably comprehensive	None	None	None
Presence of children	None	Partial or limited	None	None	None
Housing type	None	Reasonably comprehensive	None	None	None
Number of drivers	None	Reasonably comprehensive	None	None	None
Auto ownership	N/A	N/A	Partial or limited	Reasonably comprehensive	Reasonably comprehensive
Employment by occupation	None	None	None	None	Reasonably comprehensive
Enrolment by level	None	None	Reasonably comprehensive	Reasonably comprehensive	None

Reasonably comprehensive:



Partial or limited:



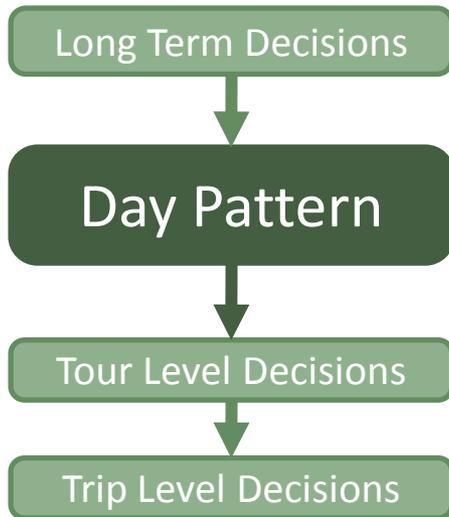
N/A:



None:



SDPTM: Day Pattern

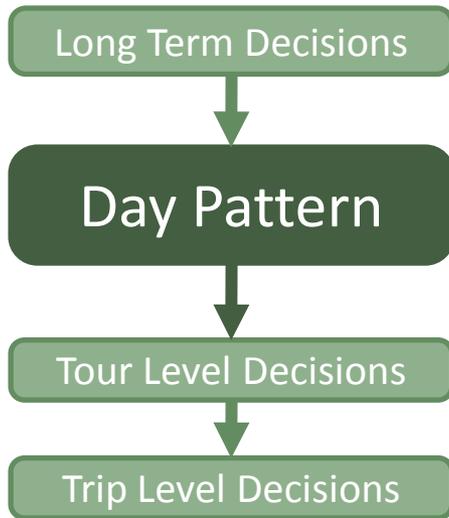


- Pattern of activities, and the tours of trips connecting them
- Example (9th most common):

O2W3T3W4O

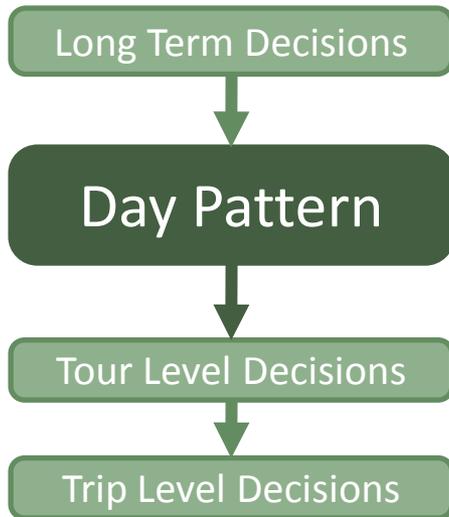
- Day starts at home (O)
- AM peak trip (2) to work (W)
- Midday (3) subtour to eat (T)
- PM return trip (4) to home (O)

SDPTM: Day Pattern



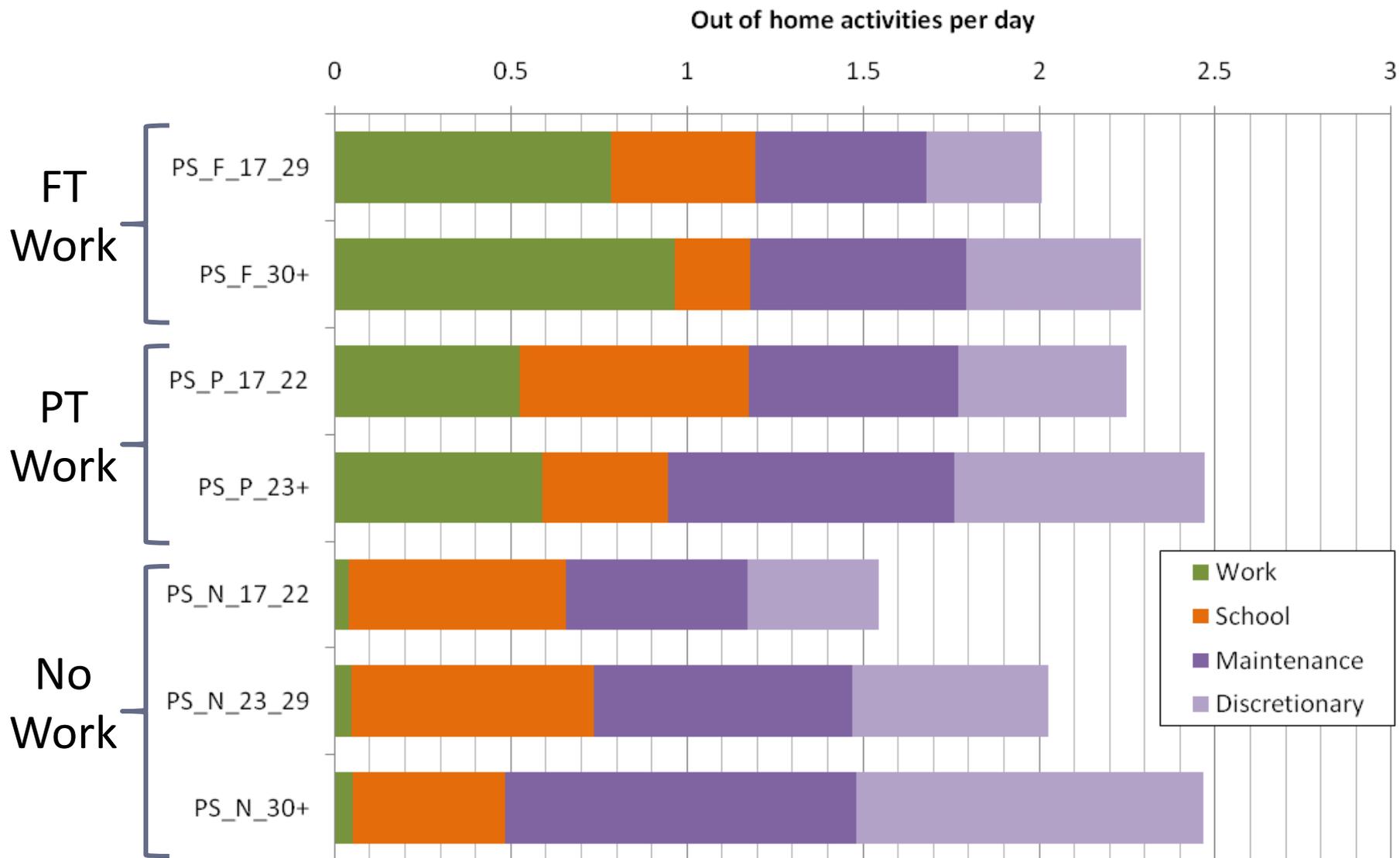
- Each person is assigned to a group based on personal and household characteristics
- Assigned a day pattern based on the observed frequency within the group

SDPTM: Day Pattern



- 103 different groups
 - usually 500 to 1000 observed day patterns per group
 - e.g. Grade school student 11 or older with no nonworking adults, HH income \$50-100K
 - e.g. Full time non blue collar worker without children in 2 person, 2 worker household with auto, income \$100-150K

PSE Day Patterns

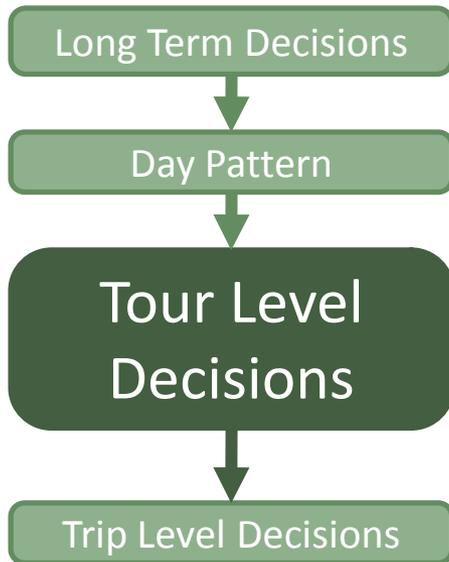


Day pattern sensitivities

Attribute	Children / Students			Adults / Workers			
	Pre	K-12	PSE	Work FT	Work PT	Adult Other	Senior
Work and school status							
Household income							
Age							
Household size							
Presence / number of children							
Gender							
Presence of nonworking adults							

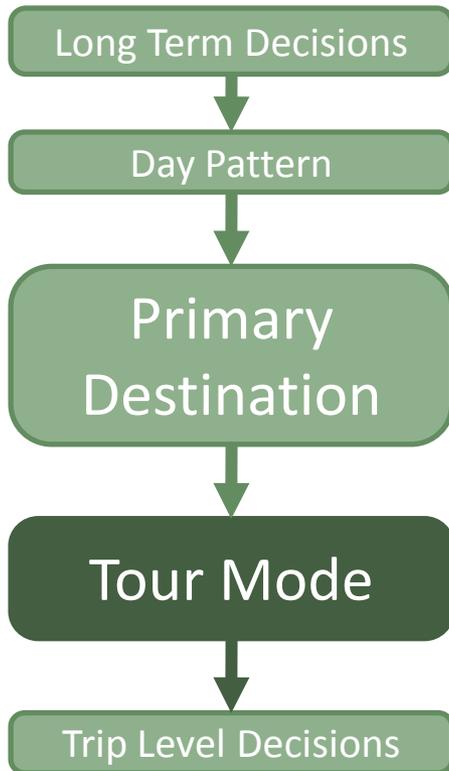
Reasonably comprehensive: Partial or limited: N/A: None:

SDPTM: Tour Level Decisions



- Tour primary destination and tour mode
- Work and School tours:
 - Primary destination uses long term decision choice
- Other tours:
 - Tour mode is chosen first

SDPTM: Work / School Mode



- Choice between 6 or 7 modes
 - SOV, HOV2, HOV3+
 - Walk, bicycle, walk access transit
 - Work: drive access transit
 - K-12 school: school bus
- Worker value of time varies by income
- Considers round trip travel costs (for specific time periods)

Mode choice sensitivities – Work/School

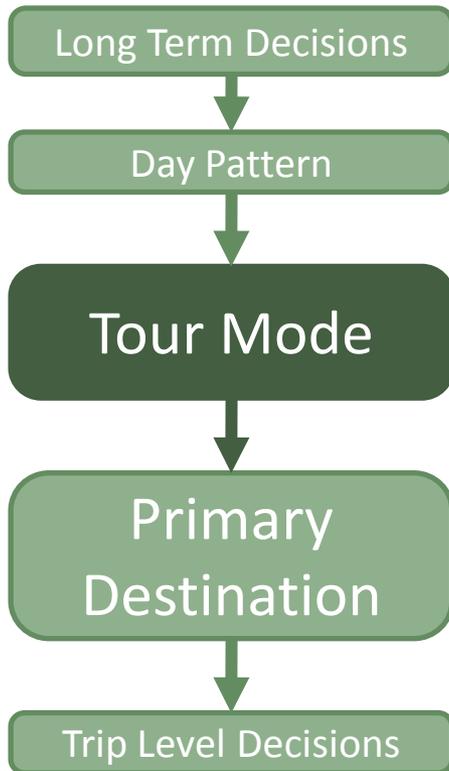
Attribute	Simplified			Full		
	Work	K12	PSE	Work	K12	PSE
Travel time and cost	Uses AM-PM tour			Uses specific tour times		
Auto ownership						
Household income						
Driver's license status						
Age						
Gender						
Occupation						
Work status						
# of stops on tour						
Tour time						
Household size						
Density at home/dest.						

Reasonably comprehensive: 

Partial or limited: 

None: 

SDPTM: Other Tour Mode



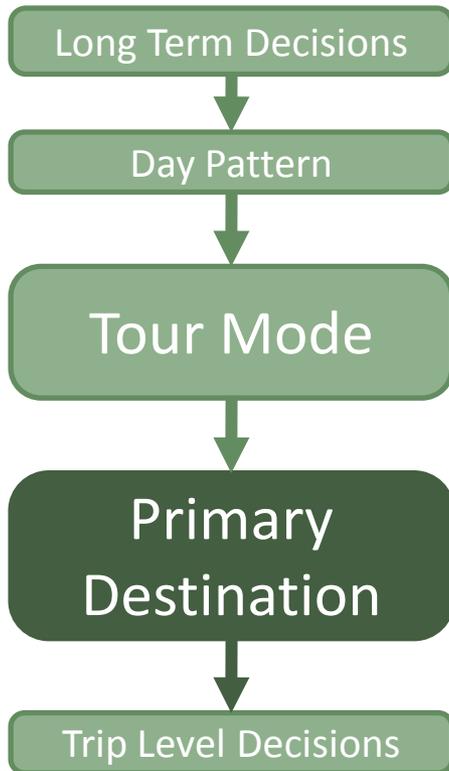
- Tour mode is chosen first
- Uses destination choice logsums
 - mode specific
 - purpose specific
 - tour time periods specific
 - e.g. SOV shop, outbound PM peak, return late offpeak
- Purpose-specific constants

Other Tour Mode choice sensitivities

Attribute	Other
Travel time and cost	Logsum
Auto ownership	
Household income	
Driver's license status	
Age	
Gender	
Work / school status	
# of stops on tour	
Tour purpose, time	
Household size	
Density at home/destination	

Reasonably comprehensive:  Partial or limited:  N/A:  None: 

SDPTM: Other Primary Destination



- Uses tour mode for travel costs
- Escort purpose split for households with and without children

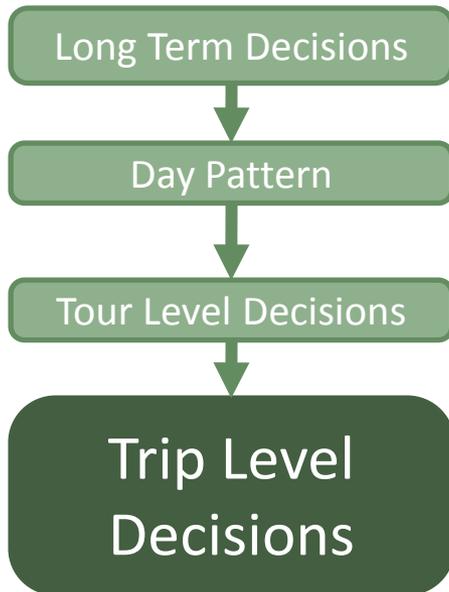
Other Destination sensitivities

Attribute	Size terms							Primary Destination
	Esc	Esc (kids)	Shop	PB	Eat	Rec	Soc	
Total employment	Included	Included	Included	Included	Included	Included	Included	N/A
Retail emp.	Included	N/A	Included	Included	N/A	Included	Included	N/A
Leisure/Hosp. emp.	Included	N/A	N/A	N/A	Included	Included	N/A	N/A
K-12 Enrolment	N/A	Included	N/A	N/A	N/A	N/A	N/A	N/A
Other types of emp.	Included	N/A	N/A	Included	N/A	N/A	N/A	N/A
# of Households	N/A	N/A	N/A	N/A	N/A	N/A	Included	N/A
Size terms	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Included
Travel cost to dest	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Included
Travel cost return	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Included

Included: 

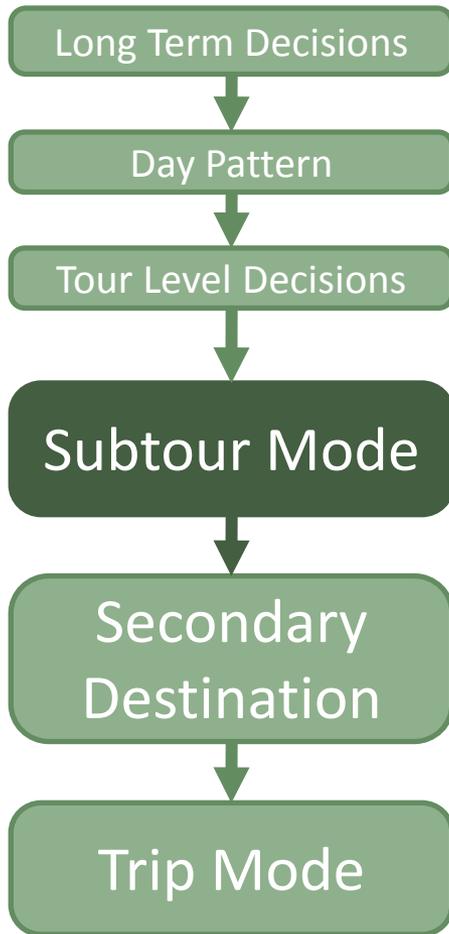
N/A: 

SDPTM: Trip Level Decisions



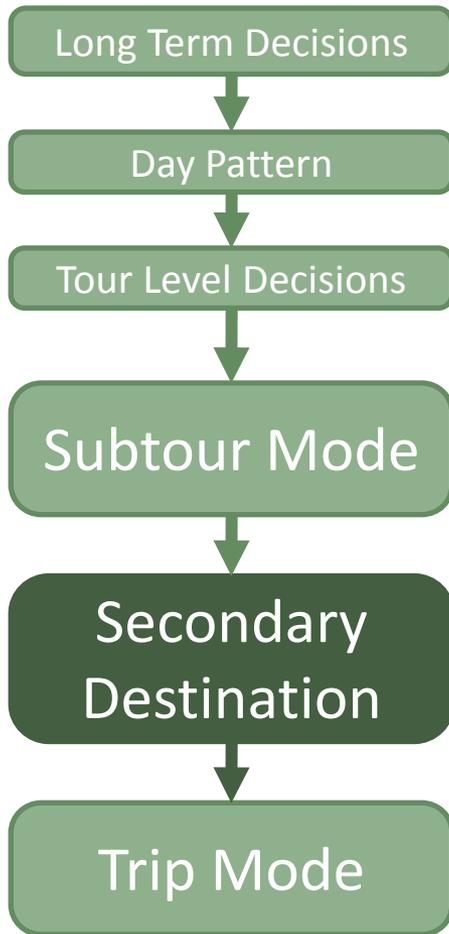
- Tour mode and primary destination have been chosen
- Additional secondary destinations need to be chosen, if they exist
- If subtour exists, subtour mode choice is made
- Trip modes chosen

SDPTM: Subtour Mode



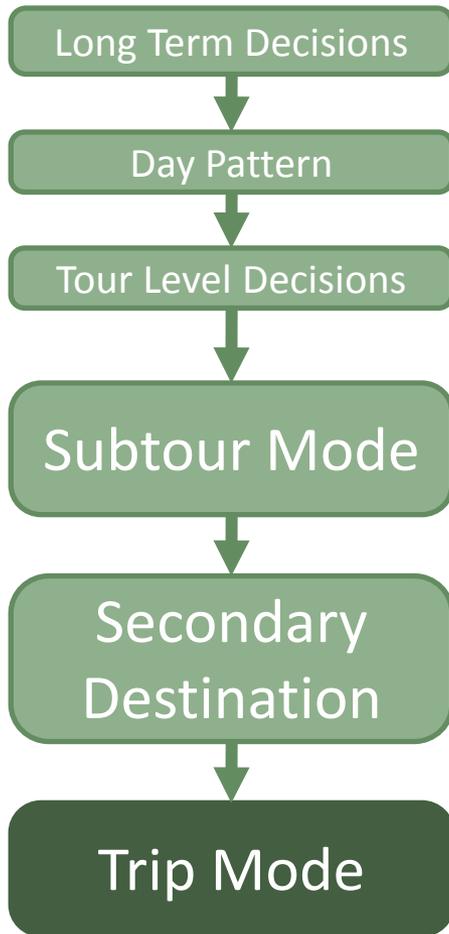
- If work or school based subtour, opportunity to change mode
- Binary choice between tour mode and walk

SDPTM: Secondary Destination



- Considers both travel cost to destination and to “ultimate”
 - Before primary destination or on subtour, the primary destination
 - After primary destination, home
- Uses same size terms and cost parameters as other primary destination choice
- Travel cost by tour mode

SDPTM: Trip Mode



- Drive access transit tours use rule-based mode assignment
- Trips on SOV and HOV2 can be made by HOV2 and HOV3
 - e.g. dropping child off at daycare
- Model permits these additional HOV trips to occur

Subtour / Trip Mode choice sensitivities

Attribute	Subtour	Trip mode (SOV/HOV)
Auto ownership		Reasonably comprehensive
Household income		Partial or limited
Gender		Reasonably comprehensive
Work / school status		Partial or limited
# of stops on tour/subtour	Reasonably comprehensive	Partial or limited
Tour purpose, time	Reasonably comprehensive	Reasonably comprehensive
Household size		Partial or limited
Density at home/dest.	Reasonably comprehensive	
Tour mode	Reasonably comprehensive	Reasonably comprehensive

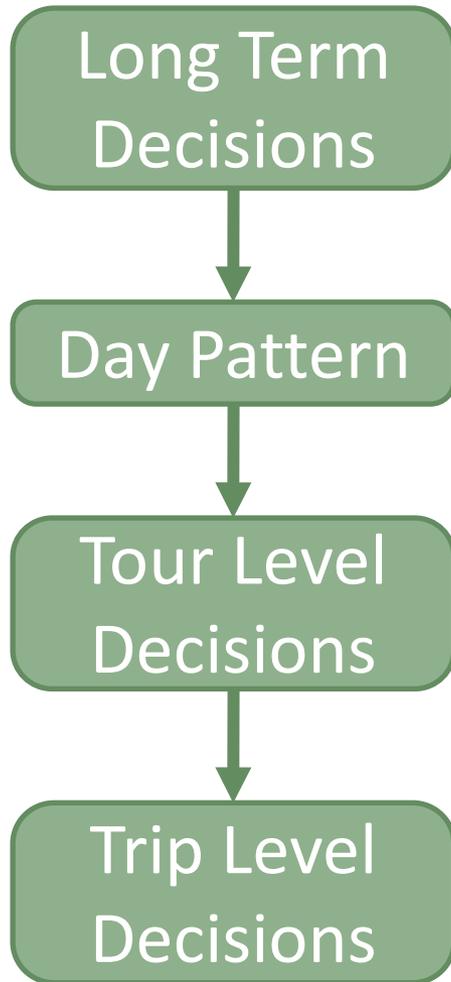
Reasonably comprehensive: 

Partial or limited: 

N/A: 

None: 

Short Distance Personal Travel Model (SDPTM)



- Trip lists output in standard .CSV file format
- Additional files containing
 - driver's license
 - auto ownership
 - work and school location

Overall direct input policy sensitivities

Attribute	DL	Auto Own	LTD Loc	Day Pat	Mode choice				Other Dest
					Work / School	Other	Subtour	Trip	
Travel times / costs									
Accessibilities / logsums									
Employment									
Enrolment									
Population									
Emp./Pop. density									
Household income									
Work/school status/type									
HH size/composition									
Age / Gender									
Disabilities									
Housing type									

Travel conditions

Land Use

Demographics

Reasonably comprehensive: Partial or limited: N/A: None:

Overall direct input policy sensitivities

Attribute	Drive Lic.	Auto Own.	LTD Loc.	Day Pat.	Mode choice				Other Dest.
					Work / School	Other	Subtour	Trip	
Travel times / costs					Reasonably comprehensive				Reasonably comprehensive
Accessibilities / logsums	Partial or limited	Reasonably comprehensive	Reasonably comprehensive			Reasonably comprehensive			Reasonably comprehensive
Employment			Reasonably comprehensive						Reasonably comprehensive
Enrolment			Reasonably comprehensive						Partial or limited
Population									Partial or limited
Emp./Pop. density					Reasonably comprehensive		Reasonably comprehensive		
Household income	Reasonably comprehensive	Reasonably comprehensive	Partial or limited	Reasonably comprehensive	Partial or limited	Partial or limited		Partial or limited	
Work/school status/type	Partial or limited	Reasonably comprehensive	Reasonably comprehensive	Reasonably comprehensive	Partial or limited	Partial or limited		Partial or limited	
HH size/composition	Partial or limited	Reasonably comprehensive		Partial or limited	Partial or limited	Partial or limited		Partial or limited	
Age / Gender	Reasonably comprehensive		Partial or limited	Partial or limited	Partial or limited	Reasonably comprehensive		Partial or limited	
Disabilities	Reasonably comprehensive								
Housing type		Reasonably comprehensive							

Reasonably comprehensive:  Partial or limited:  N/A:  None: 