

# Person Transport Component Of The TLUMIP Second Generation Model



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Third Oregon Symposium on  
Integrated Land Use and Transport  
Models

July 23-25, 2002



# Person Transport Model Considerations

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- **Develop models that address:**
  - Travel as a consequence of activities
  - Persons as the core unit of analysis
  - Travel time and cost across all modes
  - Disaggregate treatment of time

= Tour-Based Micro-Simulation Models!!



# Tour-Based Model Overview

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- What is a tour?
  - A series of trips beginning and ending at home or work (anchor locations)
  - Primary destination, intermediate stops
  - No more non-home-based trips!!
- Tour Purpose Classification - Hierarchical
  - Mandatory – Work, School
  - Maintenance – Shop, pickup/drop-off
  - Discretionary - Social/Recreational, Other

# Tour-Based Model Overview

**Work Tour with 3 trips**  
**No Linking!**



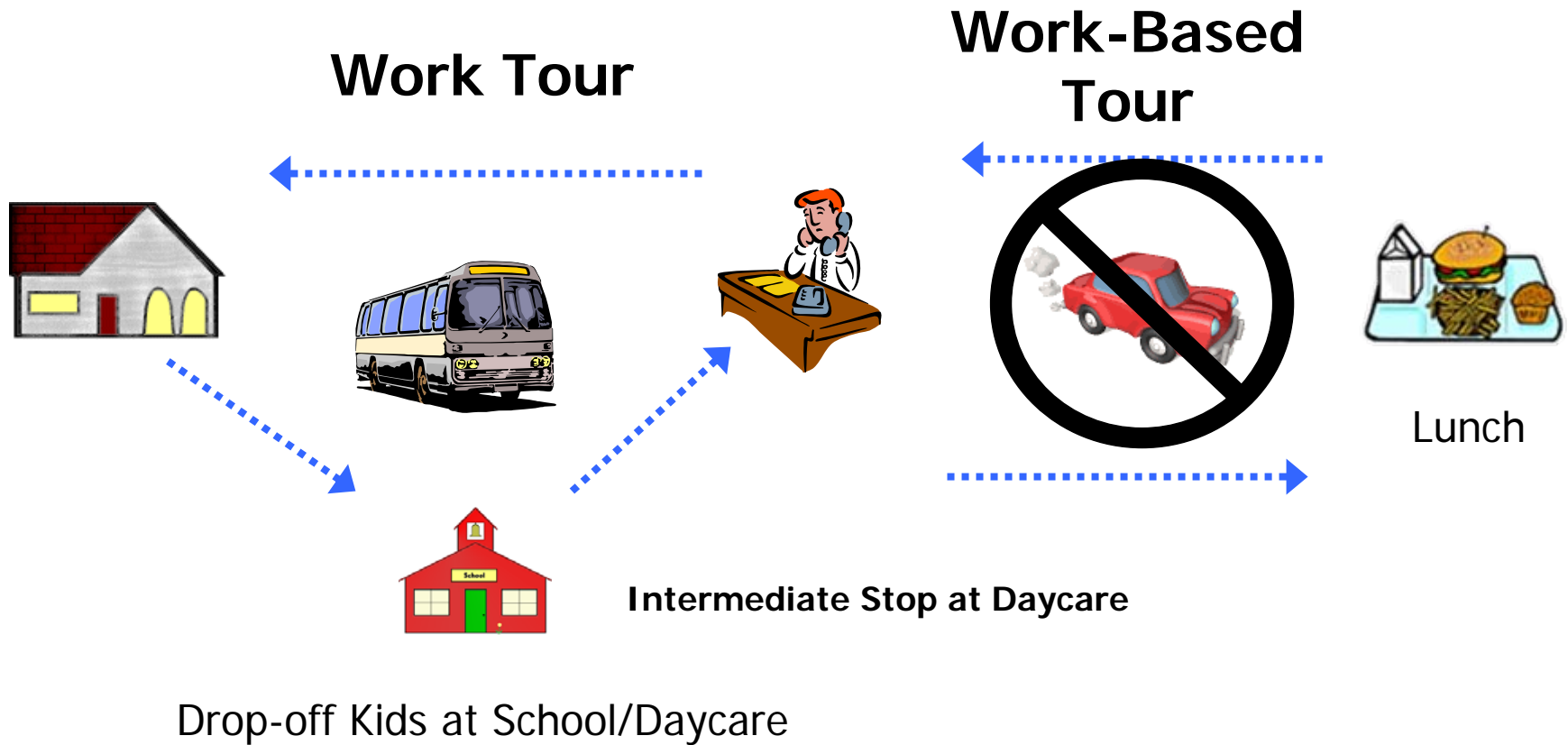
**Primary Destination**



**Intermediate Stop**

**Drop-off Kids at School/Daycare**

# Tour-Based Model Overview





# Tour-Based Model Overview

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- Why Tour Models?
  - More precise representation of travel
  - Greater behavioral realism (consistency)
  - More information available for analysis
  - Better able to address transportation demand management policies



# Tour-Based Model Overview

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- What is micro-simulation?
  - Synthetic sample drawn that represents actual population
  - Travel explicitly modeled for each person/household
  - Monte Carlo simulation instead of fractional probability aggregation
  - Variable results



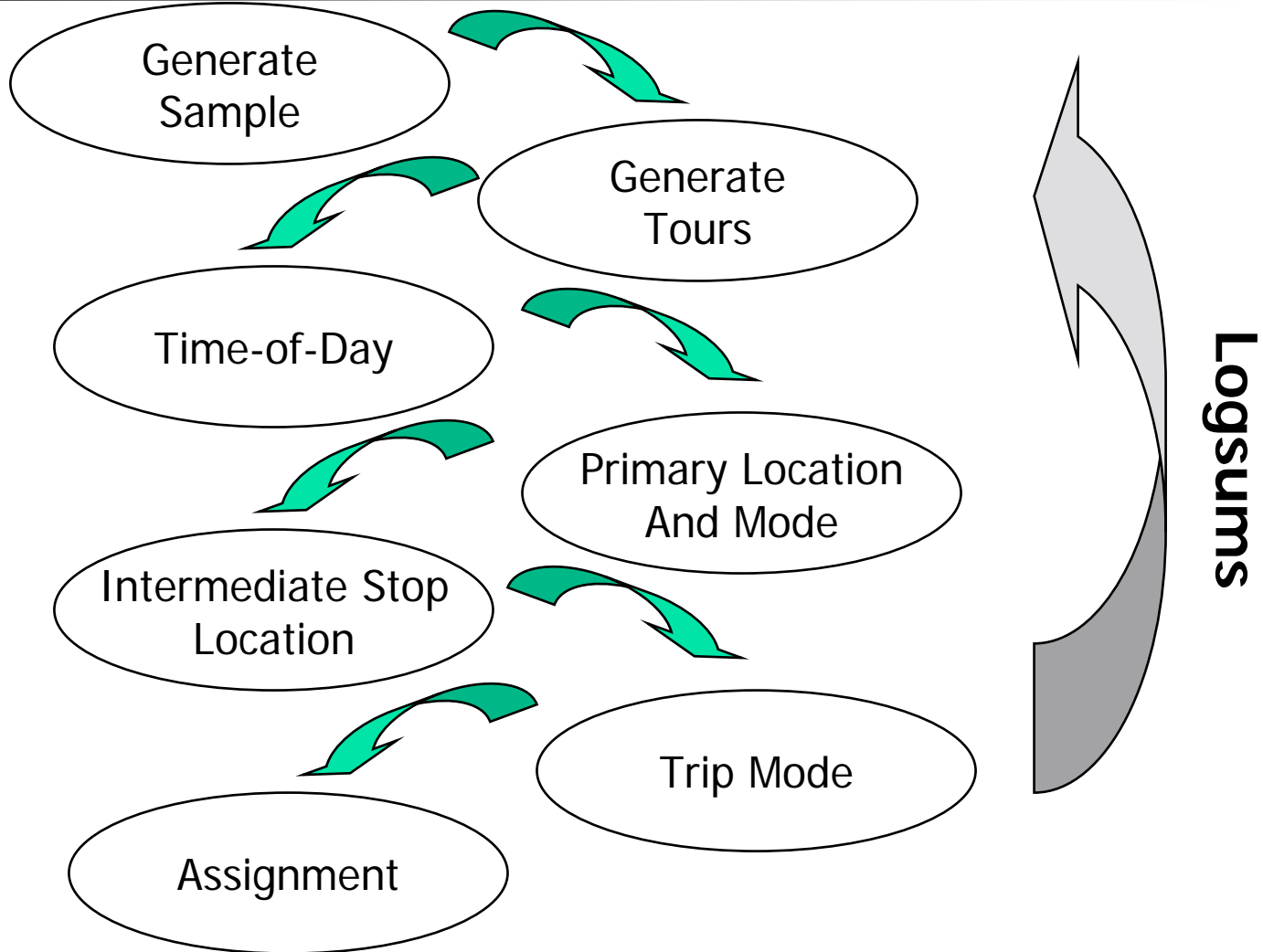
# Tour-Based Model Overview

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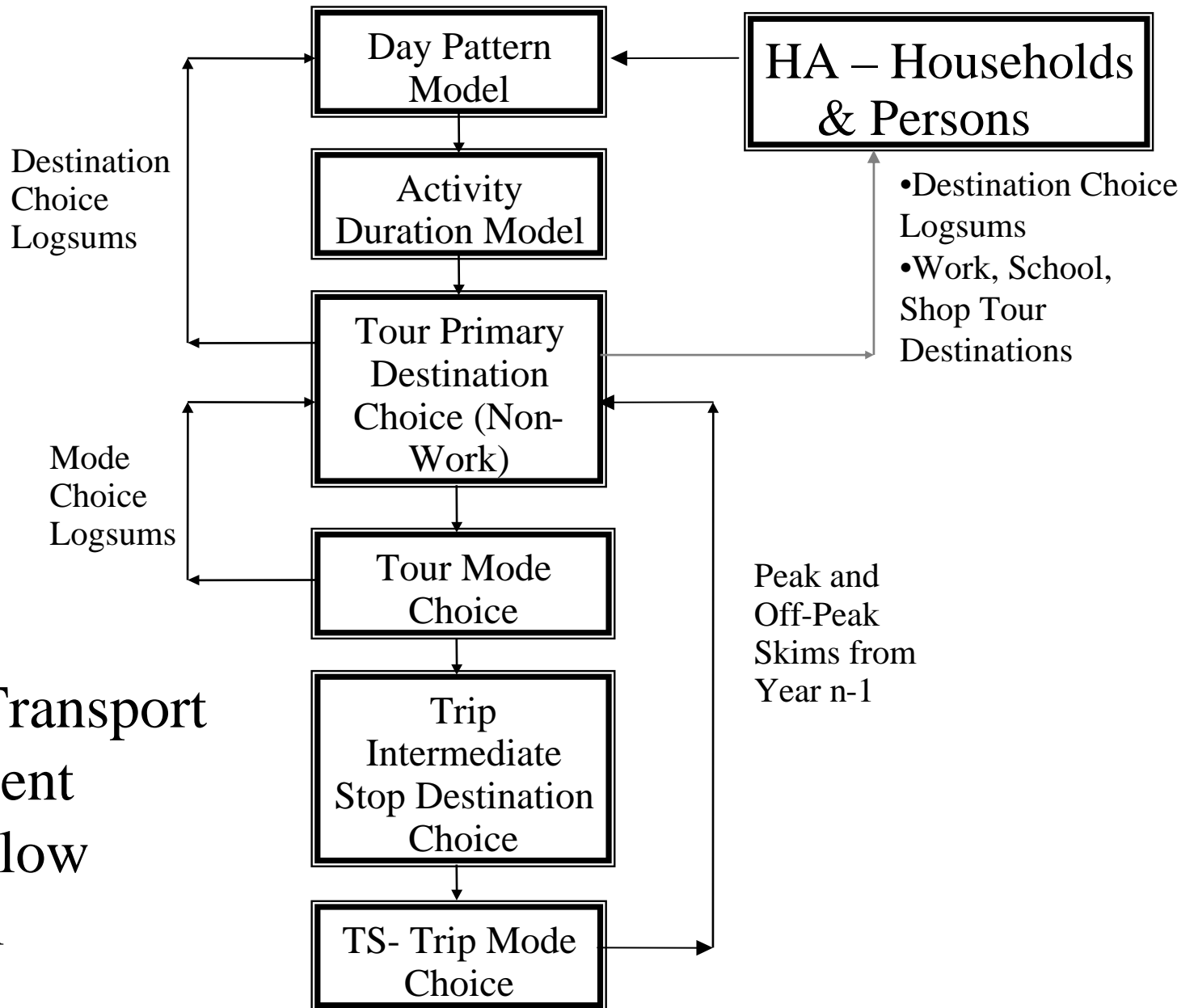
- Why Micro-simulation?
  - Computationally efficient for large numbers of market segments
  - Increased ability to include explanatory variables
  - Substantial reduction in aggregation error
  - Allows wide range of policy analysis: Lots of data!!



# Abstract Tour-Based Model Schematic



# Person Transport Component Model Flow Diagram





# Base-Year Synthetic Sample Generation

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- General Approach
  - Choose margins or control variables
  - Forecast distribution of households by each margin for each TAZ
  - Matrix balancing to forecast joint distribution, using PUMS as seed
  - Sample households from PUMS distribution according to balanced matrix frequencies



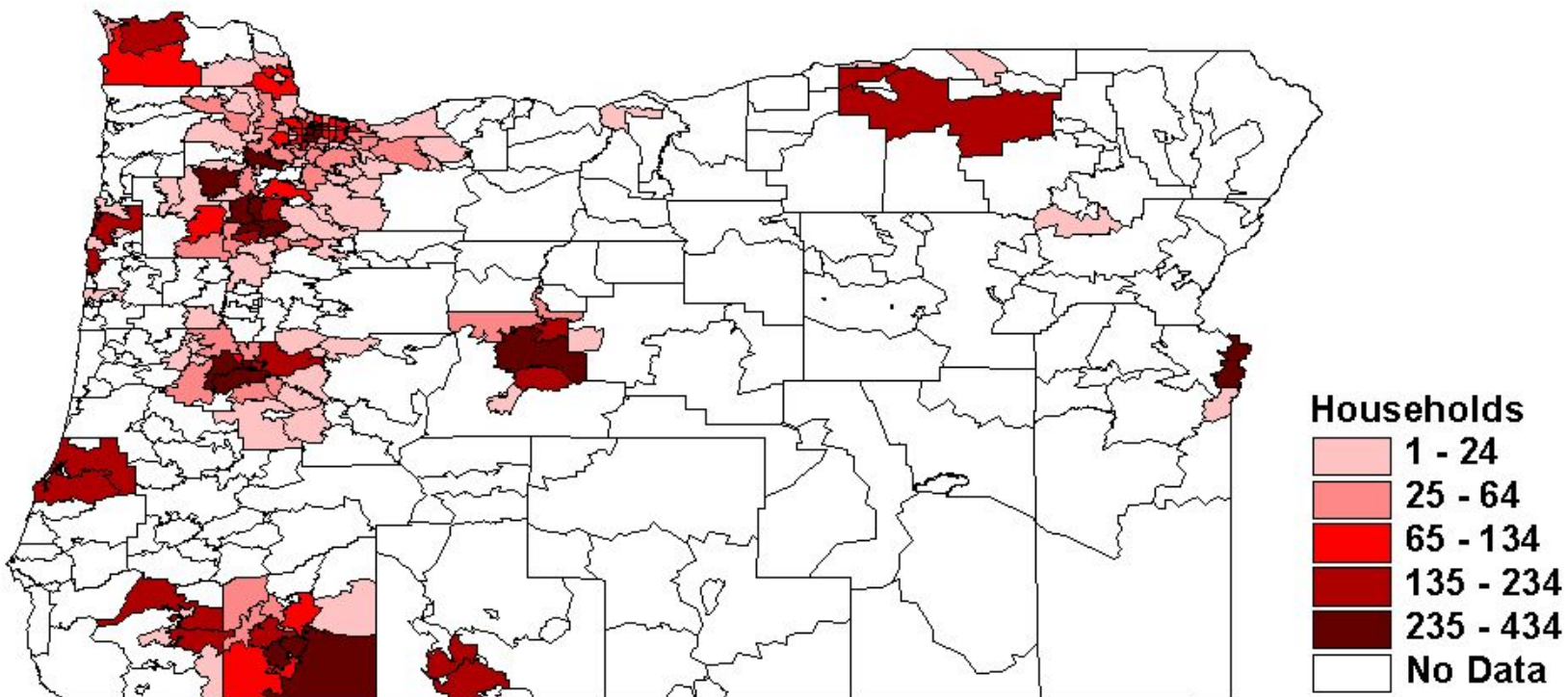
# Person Transport Model Estimation Data

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- 1994 Oregon Household Survey
  - 15,000 Households, 35,500 Persons in 4 MPOs and 11 Non-MPO Counties
  - Two-Day Activity-Based Diary Survey
  - 91,175 Tours, 1.3 Tours/Person/Day
  - 219,208 Trips, 3.0 Trips/Person/Day



# Oregon Household Survey Households



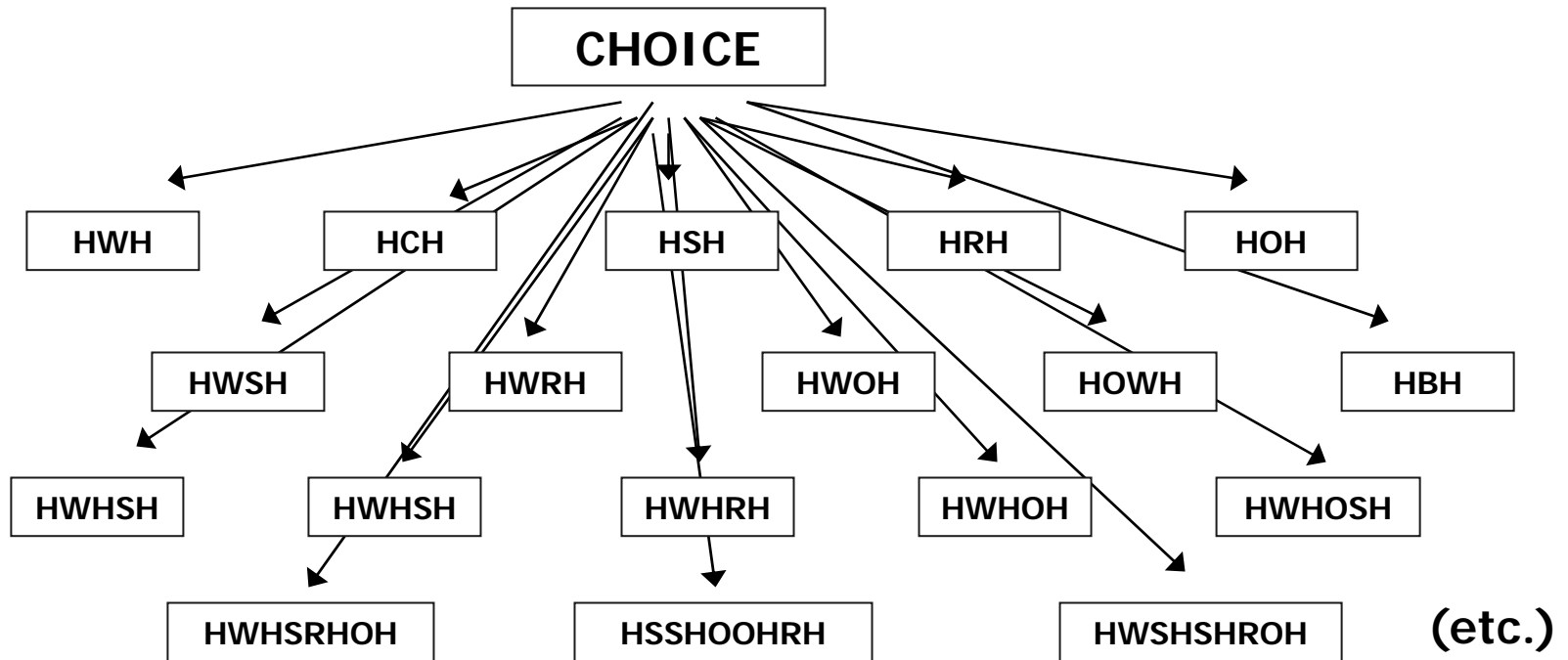


# Tour Generation

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- Day- Pattern Choice Model
  - Each out-of-home activity represented by a character
  - Characters form words that represent overall activity pattern
  - Each (available) observed pattern is a choice in multinomial logit model
- Advantage
  - No assumed hierarchy; sequence of activities/tours explicitly modeled; simple to apply

# Day-Pattern Choice Model



H = Home  
 W = Work  
 C = School  
 S = Shop  
 R = Social/Recreational  
 O = Other  
 B = Work w\Work-Based Tour

~ 3,000 Weekday Alternatives  
 ~ 1,000 Weekend Alternatives  
 (15,000 Households)



# Day-Pattern Model Estimation Results

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- Person Characteristics
  - Age, gender, work/school status
- Household Characteristics
  - Auto ownership, income
  - Household composition
  - Children by age, single parent
- Pattern/Tour Characteristics
  - Number of tours, tours by type, stops on tours, tour sequence, number of activities by type, etc.
- Destination Choice Logsums
  - Less accessible -> Less tours





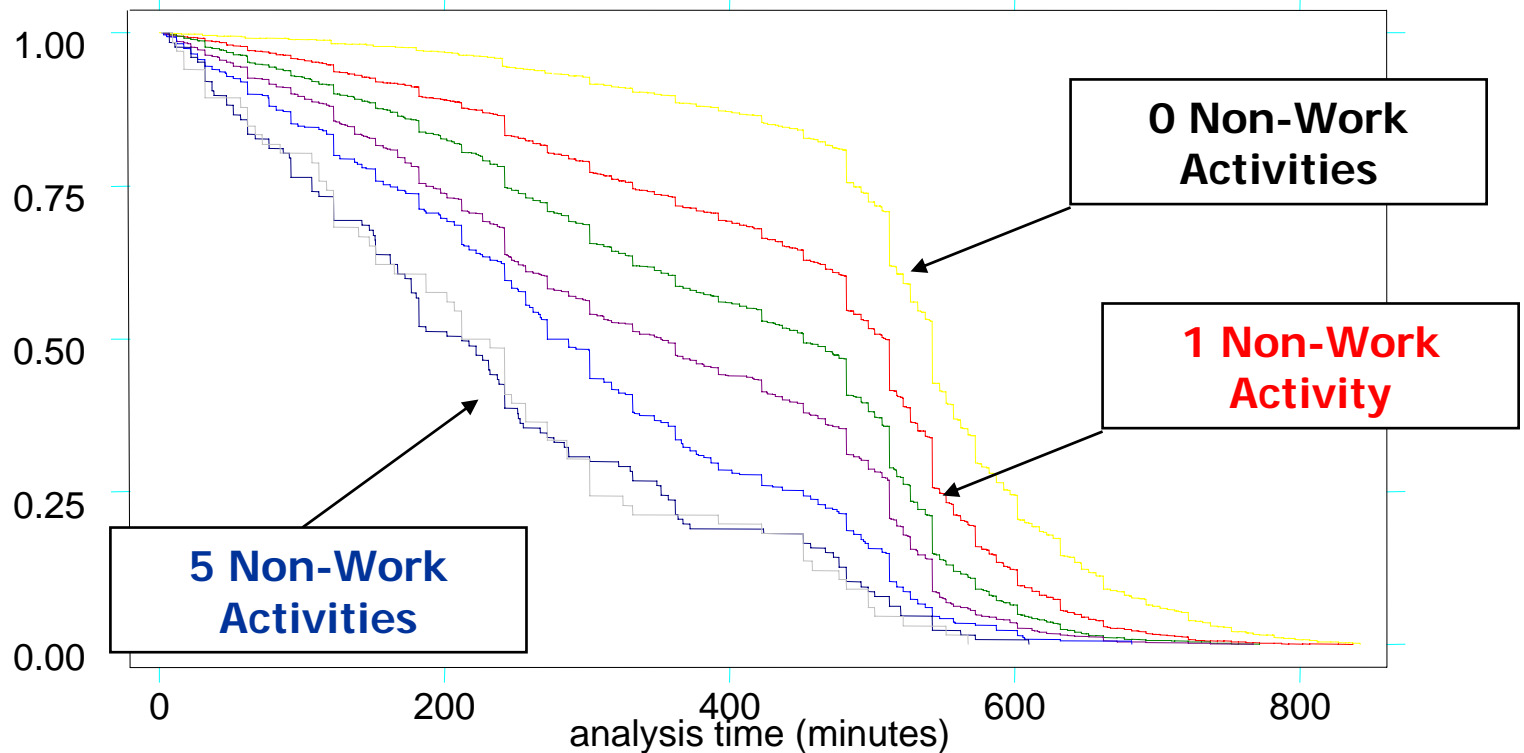
# Time-of-Day Models

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- Hazard-Based Duration Models
  - Borrowed from medical research ~ analysis of treatment effects (Survival Analysis)
  - Applied to each activity (in sequence) to determine duration *in minutes*
  - Allow a continuous representation of time
  - Baseline duration (survival function) and parameters modify that duration based on
    - household/person variables
    - day-pattern characteristics
    - tour characteristics
    - Activity sequence

# Time-of-Day Models

Work Activity Survival Estimates, by Total Non-Work Activities



$$S(t) = \exp\{-t^\lambda \exp[(-1/\sigma)(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n)]\}$$

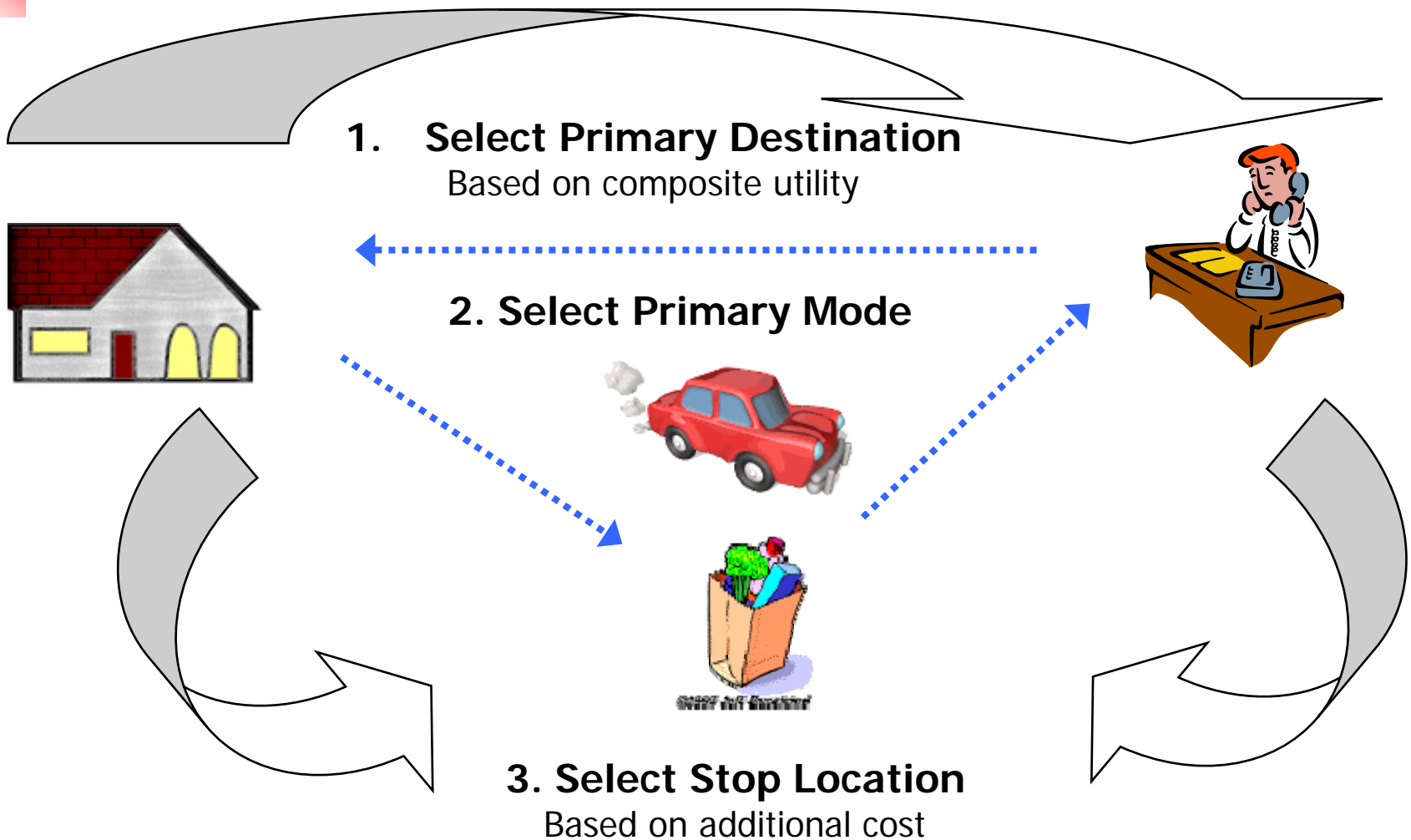


# Duration Model Estimation Results

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- One model each for
  - First, Intermediate At-Home activities
  - Work, School, Shop, Recreate, Other activities
- Variables include:
  - Household Composition, Socio-economic characteristics
  - Number of Tours, Stops
  - Activity Start Time
  - Gen3: accessibilities, congestion: peak-spreading!

# Tour Mode/Destination Choice



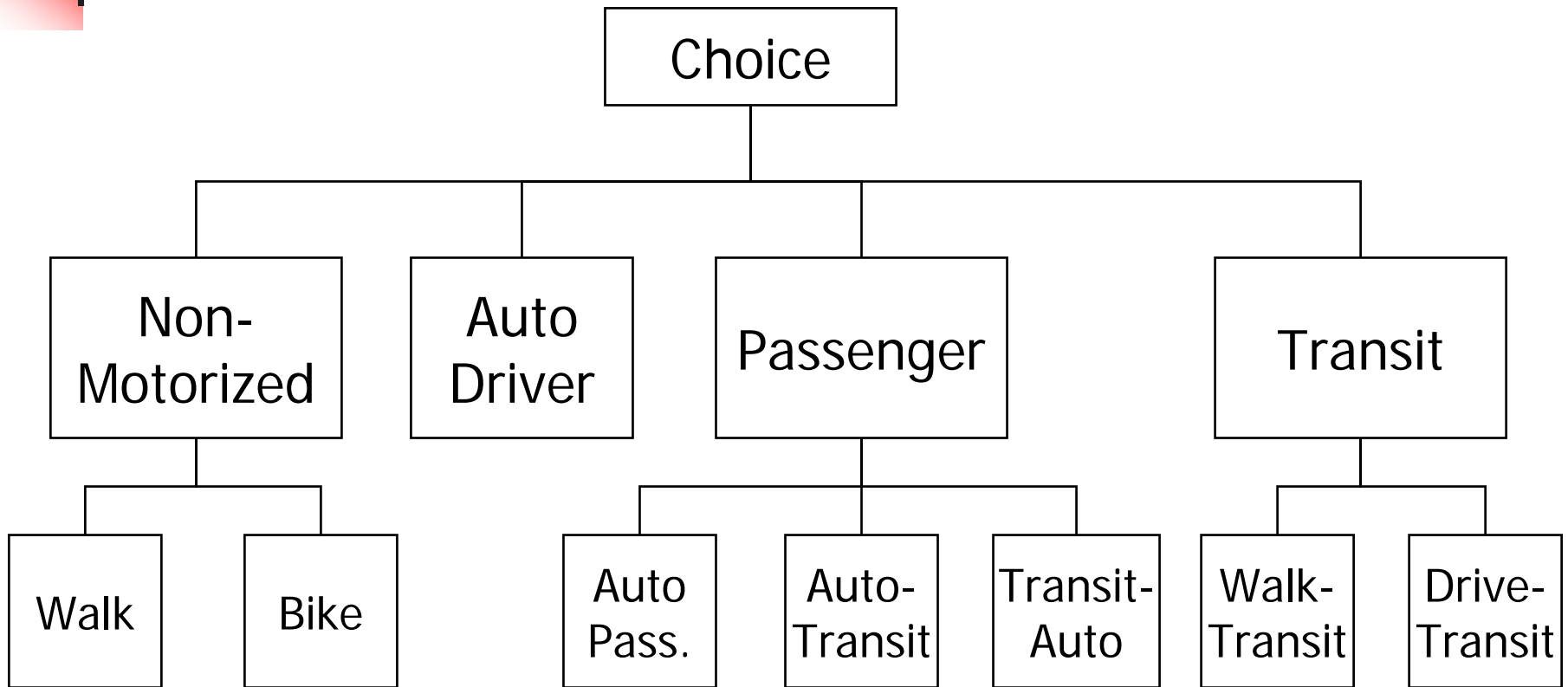


# Primary Destination Choice Models

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- Chooses primary activity location (TAZ) for each tour
- Place of residence, workplace determined by HA
- Full set of destinations considered (no sampling in application)
- Logit models with accessibilities represented by mode choice logsums

# Tour Mode Choice Model Nesting Structure





# Tour Mode Choice Estimation Results

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- Round-trip levels of service
- Person/Household characteristics
  - Cost coefficients stratified by household income
  - Household size directly related to passenger probability
- Alternative-specific constants stratified by:
  - Work tours: workers/autos
  - Other tours: household size/autos
- Number of stops on tour



# Tour Mode versus Trip Mode

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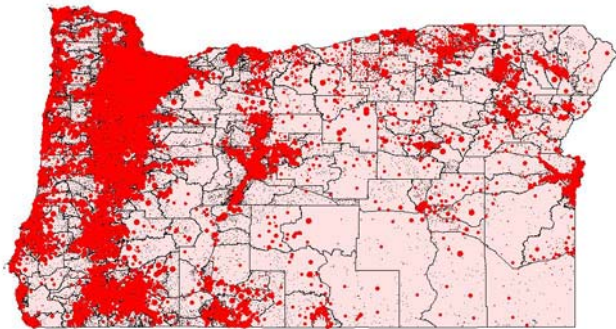
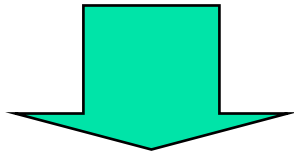
- Tour Mode Model
  - Logsum used for primary destination choice accessibility
  - Restricts selection set for mode of each trip
  - Used to select measure of accessibility for stop location destination choice
- Trip Mode Choice
  - Specific mode assigned for every leg of tour
  - Done on-the-fly in assignment (TS)



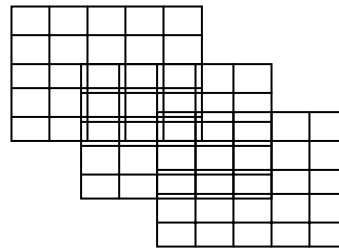
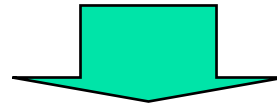
# Tour-Based Model Output

## Household Data, Person Data, Tour/Trip List

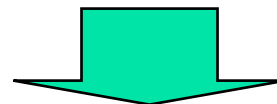
HID	PID	TID	PUR	MOD	SB	SA	OTAZ	DTAZ	S1TAZ	S2TAZ	TLOR	TLDS
1	1	1	2	1	0	1	943	987	0	964	1	3
1	1	2	1	2	1	0	943	731	856	0	3	3
1	2	1	4	1	0	0	943	952	0	0	1	2
1	3	1	2	4	1	1	943	565	698	982	1	2



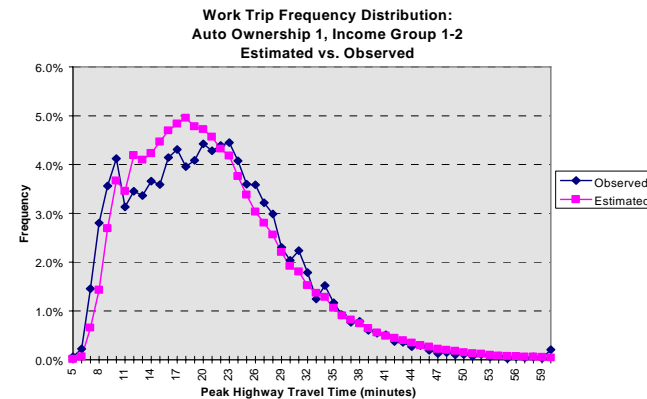
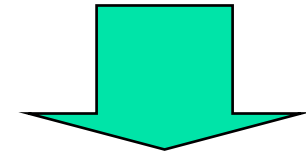
Maps, Graphics



Trip Tables/Lists



Assignment



Other Summaries



# Person Transport Application

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- Java Programming Language (OO)
- Communication to other components via common database (jDataStore)
- Run modes:
  - Market Segment Logsums
  - Individual Monte-Carlo Selections
- Reducing run-times through multi-threading and distributing



# Conclusions

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- PT Status
  - Models fully estimated
  - Model application code up and running
  - Need to add grid-cell/link selection
  - Beginning model calibration (cross-sectional base-year)
  - Reducing runtimes through distribution, optimization
- Further specification
  - Additional market segmentation
  - Congestion effects in duration models
  - Long-distance and open-ended tours