

Travel Demand Model Improvement Program

presented to
**Southern California Association of Governments
Peer Review Panel**

presented by
Cambridge Systematics, Inc.
with
Urban Analytics, Inc.

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Overview of the Model Improvement Program

- Current model improvements
 - Trip generation and auto ownership models
 - External trip models
 - Mode choice models
 - Trip assignment models
- Future model improvements
 - Trip distribution models
 - Freight models
 - Time-of-day models
 - Software evaluation and conversion
- Related modeling studies in the region
 - MTA destination choice models



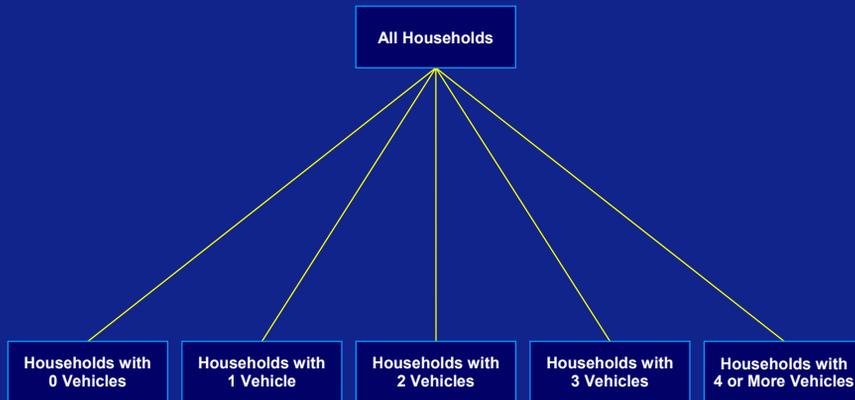
Trip Generation and Auto Ownership Models

Auto Ownership Model Overview

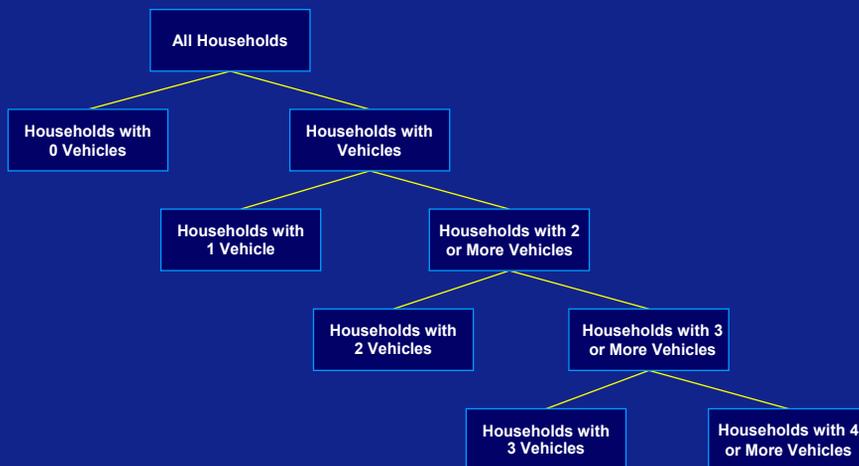
- Model structure options
 - Multivariate regression model – Linear function of explanatory household, person, zonal, and transportation system variables
 - Discrete choice models – Multinomial logit (MNL), ordered response logit (ORL), nested logit (NL) structures
- Model estimation
 - Use 2001 TCS data and 2000 Census data
- Model validation
 - Use 2000 Census SF3 estimates and PUMS data



Auto Ownership Model *Multinomial Logit Structure*

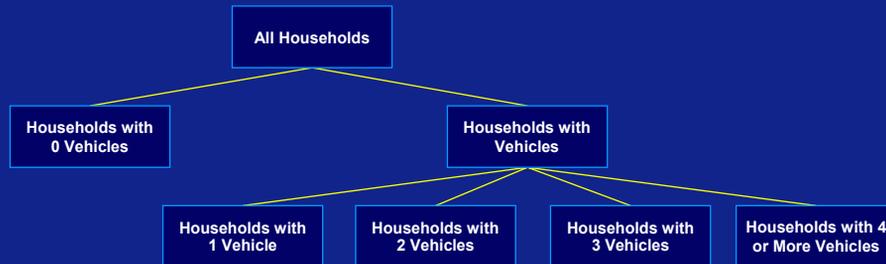


Auto Ownership Model *Ordered Response Logit Structure*



Auto Ownership Model

Nested Logit Structure



Trip Generation Model

Overview

- **Model estimation**
 - Estimate new trip production and attraction rates
 - Perform statistical tests to measure significance of differences between existing and new rates

- **Model structure options**
 - New variables like number of children under 18, household income level, age
 - **Alternative trip production model**
 - Logit-based trip frequency choice models

Trip Generation Model (continued)

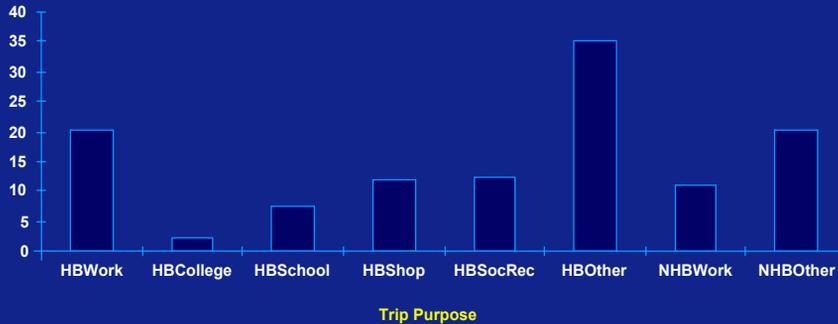
Overview

- Model implementation
 - Identify weaknesses and improve functionality
 - Determine desired interface and program features
 - Recode existing program with new input data

Trip Generation Model

Summary of Household Travel Survey

Survey Records (in Thousands)
(Unweighted)



120,544 Total Unweighted Trips by Purpose

External Trip Models

External Trip Model Overview

- Model estimation
 - Update with Regional Cordon Survey database and Caltrans' Statewide Transportation Model volumes
 - Use different friction factor curves by trip purpose
 - Apply Fratar process to forecast E-E trips
- Model Structure Options
 - Develop growth factors using population-based regression equations
 - Estimate external trips by type of facility
 - Derive external truck trips based on Caltrans' truck volumes, port-related truck trips, and air cargo trips from RADAM

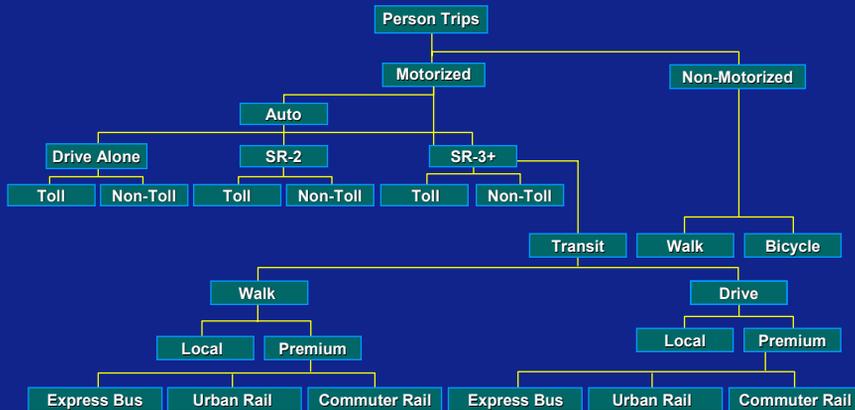
Mode Choice Models

Mode Choice Model Overview

- Model estimation
 - Re-estimate all five mode choice models
 - Introduce variables incrementally
 - Test alternative model forms
 - Test sensitivity for significant variables
- Model structures
 - Test nested logit structures
 - Introduce the Toll/Non-Toll alternative and represent METROLINK as a separate transit mode
- Model implementation
 - Update programming code

Mode Choice

Sample Nested Logit Structure



Mode Choice

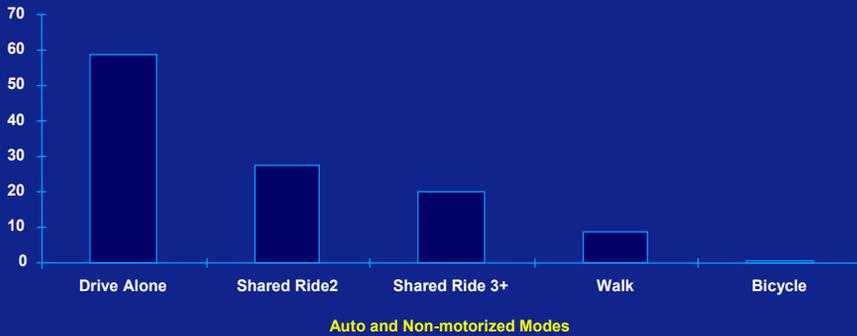
Testing

- Selection criteria
 - Variable coefficient's sign and magnitude
 - Variable coefficient's t-statistics
 - Model's rho-squared and log-likelihood statistics
 - Prediction success tables
 - Log-likelihood ratio tests
- Sensitivity tests
 - Aggregate level sensitivity tests
 - Repeated application of the model
 - Measuring model's elasticity of demand resulting from changes made to LOS variables
 - Comparison to observed data and other estimated models

Mode Choice

Summary of Household Travel Survey

Survey Records (in Thousands)
(Unweighted)



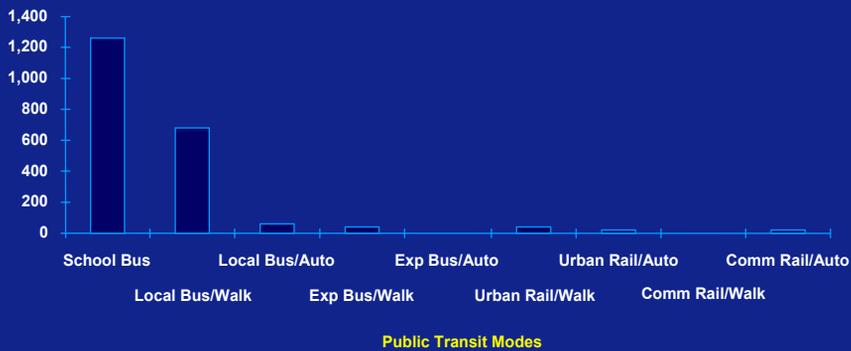
115,577 Auto and Non-motorized Unweighted Trips by Mode

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Mode Choice

Summary of Household Travel Survey (continued)

Survey Records
(Unweighted)



2,101 Public Transit Unweighted Trips by Mode

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Trip Assignment Model

Trip Assignment Model *Overview*

- Test alternative VDFs
 - Variations of standard BPR curve
 - Non-BPR functions
 - Conical and Akcelik functions
 - VDFs by facility type
- Re-validate model based on volumes, v/c ratios, and speeds by facility type
- Establish model validation standards at the beginning of this project

Trip Assignment Model Added Capabilities

- Multimodal assignment enhancement
 - Time-penalty factors for heavier trucks on freeways
 - Value of time factors by auto purpose or truck type
- Peak/off-peak network coding
 - Check auto and transit networks to reflect actual characteristics
 - Check truck-only lanes and truck-prohibited routes
- Passenger Car Equivalent (PCE) factors
 - Test different PCE factors to improve HDT model validation
- Peaking model
 - Update peaking factors based on new 2001 TCS data
 - Apply peak spreading for over-loaded links and corridors

Regional Household Travel Survey

Data Considerations for Model Input

Regional Household Travel Survey

Overview

The post Census household survey data will be the key inputs to the model improvement effort. Improvements to the survey database prior to model refinement will result in more valid models.

- Survey data weighting
- Usage of multiple survey sources
- Geocoding
- Incomplete households
- Trip purpose definitions
- Trip linking procedures
- Reported toll facility usage

Household Travel Survey Data Considerations

Survey Data Weighting

- The post-stratification weighting of the survey data used Year 2000 Census Summary File 2 data for population totals
- The newly available Year 2000 Census Transportation Planning Package (CTPP) data could be used to more accurately reflect households in the study region, because cross-classified variables are available

Household Travel Survey Data Considerations Usage of Multiple Survey Data Sources

Survey Data Source	Suitable for Trip Generation / Vehicle Availability / Time-of-Day Modeling	Suitable for Mode Choice Modeling
Base (Weekday; 24 hour; N=10,875)	✓	✓
RSA (Weekday; 24 hour; N=155)	✓	✓
Weekend (Fri/Sat or Sun/Mon; 48 hour; N=2,416)	Weekday trips only	Weekday only
Caltrans (Weekday; 24 hour; N=3,060)	✓	✓
Mode User Augment (Weekday; 24 hour; N=433) – Assumed to be Source="3" – Not in data dictionary	No	✓

Household Travel Survey Data Considerations Geocoding

Survey Data Source	Percent of Trip Ends That are Geocoded	Percent of Trip Ends Not Geocoded
Base (Weekday; 24 hour; N=10,875)	97%	3%
RSA (Weekday; 24 hour; N=155)	96%	4%
Weekend (Fri/Sat or Sun/Mon; 48 hour; N=2,416)	97%	3%
Caltrans (Weekday; 24 hour; N=3,060)	55%	45%
Mode User Augment (Weekday; 24 hour; N=433)	98%	2%

Household Travel Survey Data Considerations *Incomplete Households*

- Household survey records with four or more members were considered acceptable if one person's diary was missing.

Household Size	Complete	Missing One Diary
4	1,783	262
5	784	162
6	280	82
7	80	29
8	24	13
9	6	4

Household Travel Survey Data Considerations *Incomplete Households (continued)*

- Several options for dealing with incomplete households in developing models, particularly trip generation models
 - Use household data as is
 - Drop incomplete households for analysis
 - Impute number of missing trips
 - Simple factors based on completed households
 - Factors that consider household composition

Household Travel Survey Data Considerations ***Trip Purpose Definitions***

- In analyzing the survey results, NuStats relied on the reported primary activity only for identifying trip purposes
- Consideration of the other reported activities at the same location (up to four were recorded) and the place type of the location may improve the accuracy of trip purposes

Household Travel Survey Data Considerations ***Trip Linking Procedures***

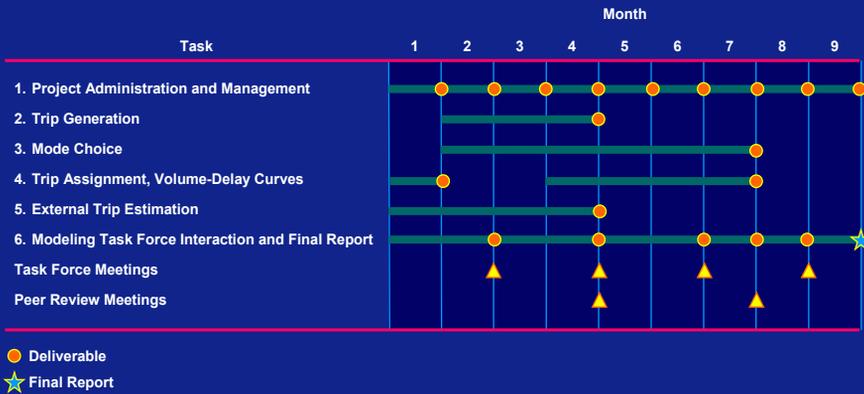
- NuStats and SCAG developed a procedure for identifying linked trips that were recorded in diaries as consecutive separate unlinked trips
- The procedure needs to be re-implemented so that submode information can be retained to allow us to properly classify the reported transit trips by access mode

Household Travel Survey Data Considerations ***Reported Toll Facility Usage***

- Survey respondents were asked whether they used a toll facility during the diary period, but toll usage was not tied to individual trips.
- The dataset does not include any information on the toll question.
- By analyzing people's travel patterns, it may be possible to identify the tolled trip and to designate these trips as such.
- Mode augment surveys may be more directly useable

Project Schedule

Project Schedule



Modeling Task Force and Peer Review

- **Modeling task force meetings**
 - **5 presentations on modeling progress and results**
 - Approach
 - Trip assignment and auto ownership
 - Trip generation and external trips
 - Mode choice
 - Model validation
- **Peer review panel meetings**
 - **3 presentations on modeling approach and results**
 - Approach
 - Trip assignment, trip generation and external trips
 - Mode choice and model validation

Final Report

- Outline of the final report will include
 - Executive summary
 - Trip generation (production, attraction, auto ownership)
 - Mode choice (by trip purpose)
 - Trip assignment (by vehicle class and time period)
 - External trip (E-I, I-E, and E-E) for autos and trucks
 - Model validation
 - Recommendations for future enhancements and data collection