Travel Model Developments: Review and Critique

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Outline

- Developments in Discrete Choice Models
- Developments in Activity Based Travel Demand Modeling
- Issues and Concerns
  - Art (Judgment) and Science (Statistics)
  - Technical Issues
  - Implementation Issues

Developments in Discrete Choice Models

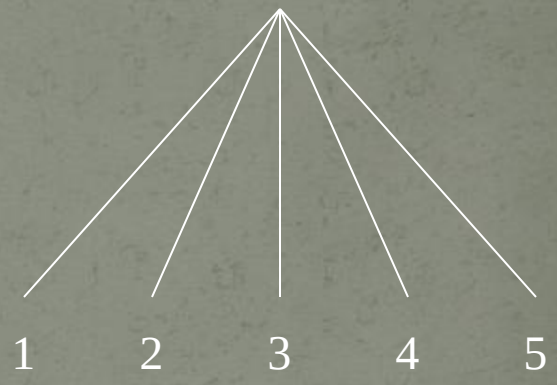
- Multinomial Logit Models (MNL)
- Nested Logit Models (NL)
- Generalized Extreme Value Models (GEV)
  - Paired Combinatorial Logit (PCL)
  - Cross-Correlated Logit (CCL)
  - Generalized Nested Logit (GNL)
  - Net GEV
- Mixed Logit Models
- Mixed Other Models

Choice of Models

- Theoretical Basis
- Behavioral Insight and Interpretation
- Examination of Complex Choices
- Examination of Complex Relationships

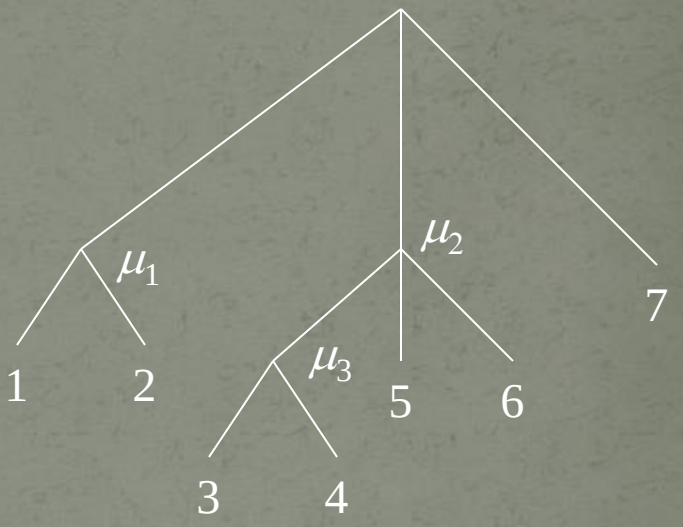
Multinomial Logit

- Advantages
  - Simple Mathematical Form
  - Unique Optimum
  - Easy to Estimate
  - Easy to add Alternatives
- Disadvantages
  - Constrained Substitution
  - Equal Cross Elasticity
  - Lacks Behavioral Reality

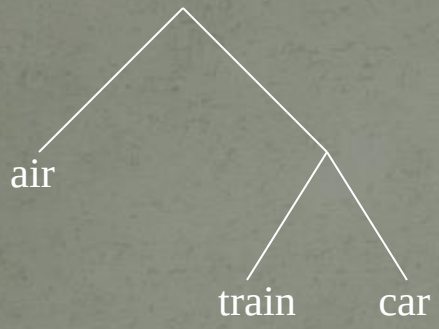


Nested Logit

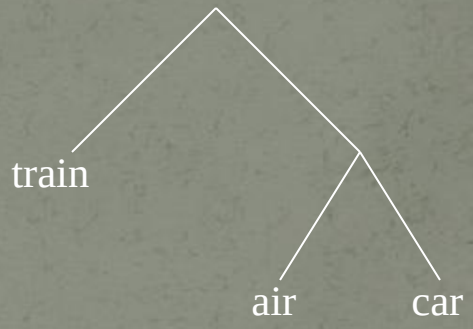
- Groups 'Common' Alternatives
- Advantages
  - Relatively Simple Form
  - Relatively Easy to Estimate
  - Different cross-elasticities between Alternatives in Different Groups
- Disadvantages
  - Increased Complexity
  - Estimate Substitution Parameters
  - Still Limits Substitution
  - Equal Cross-Elasticities within Groups



Nested Logit Example



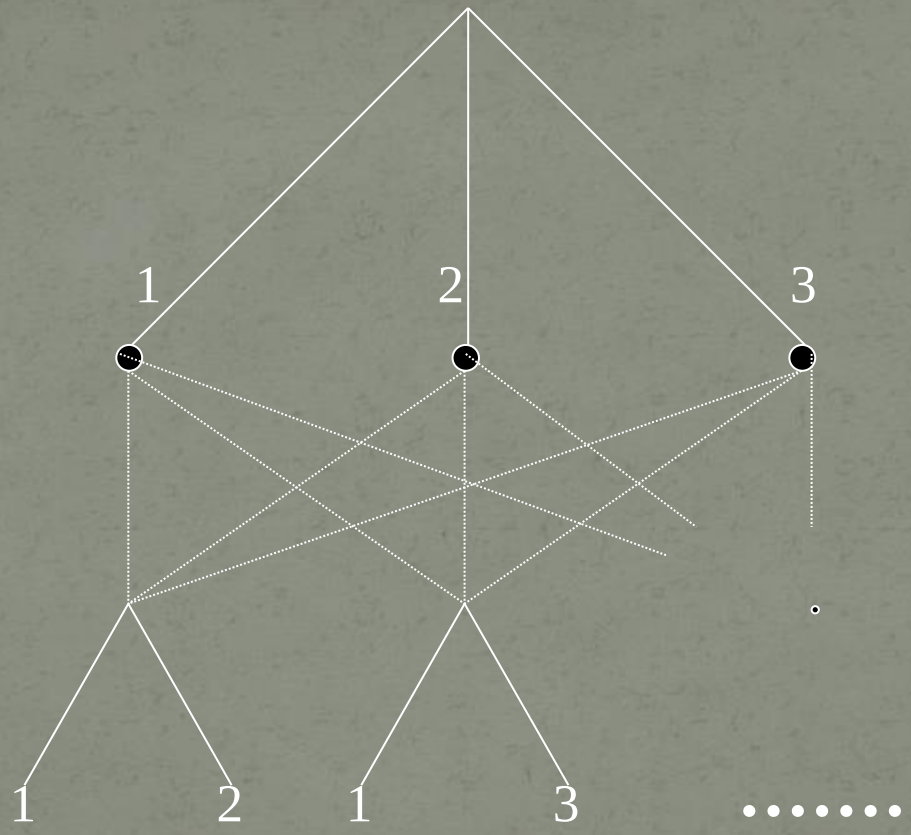
$LL(\beta_{NL1}) = -1917.4$



$LL(\beta_{NL2}) = -1914.5$

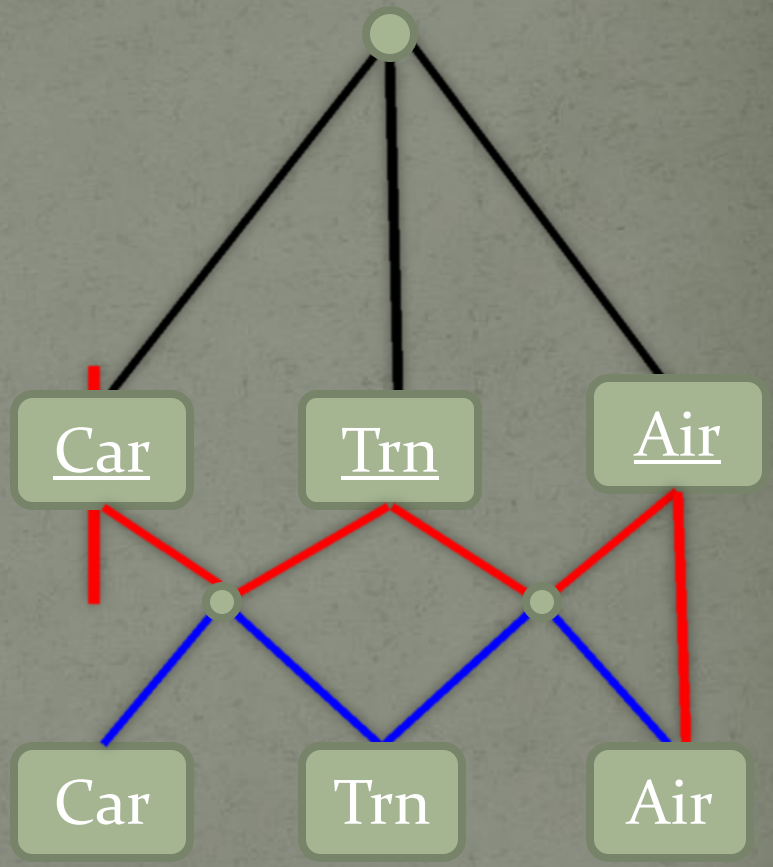
- There is Similarity between Air and Car and between Train and Car but not Air and Train.
- How can the Similar Pairs be placed in Same Next without Including Dissimilar Pairs?

Generalized Nested Logit

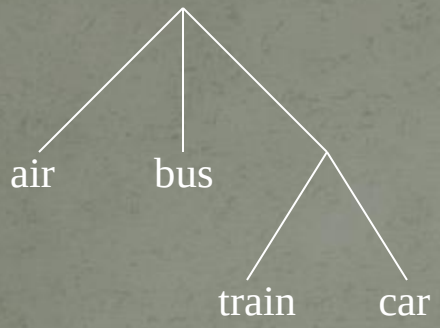


Generalized Nested Logit Applied to Air-Train-Car Example

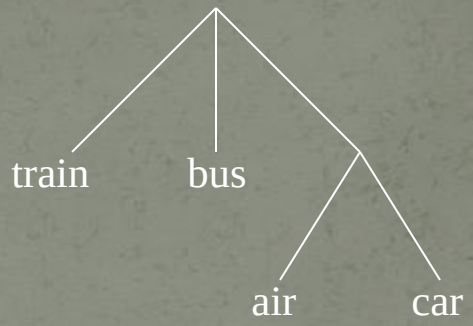
- Enables Overlapping Groups
- Advantages
  - More Flexible Substitution
- Disadvantages
  - Allocation and similarity parameters



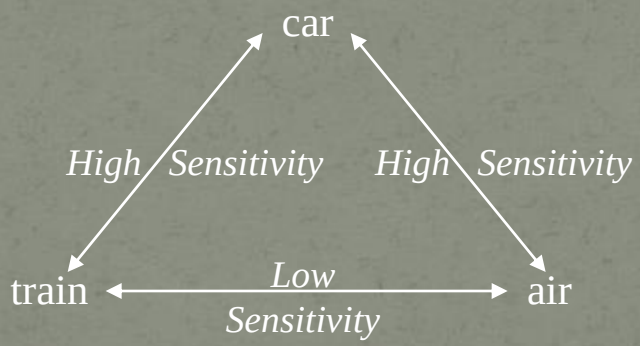
Generalized Nested Logit Applied to Nested Logit Example



$LL(\beta_{NL1}) = -1917.4$



$LL(\beta_{NL2}) = -1914.5$

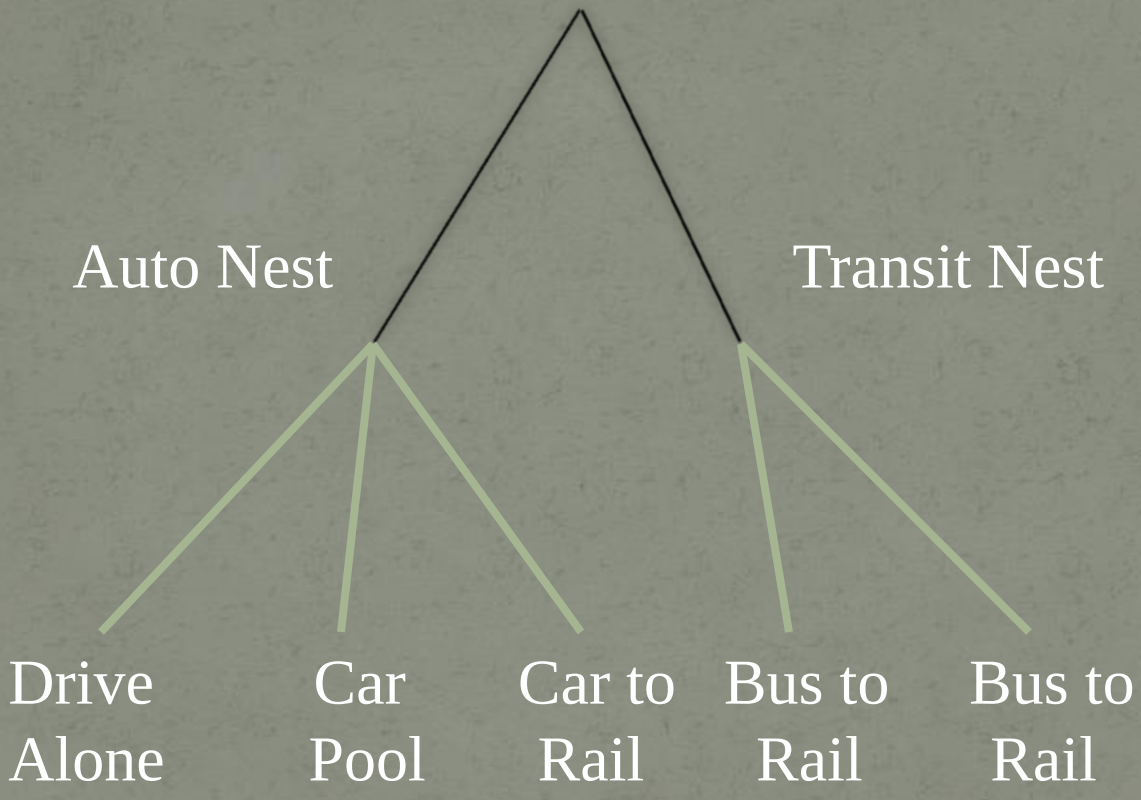


$LL(\beta_{GNL}) = -1903.9$

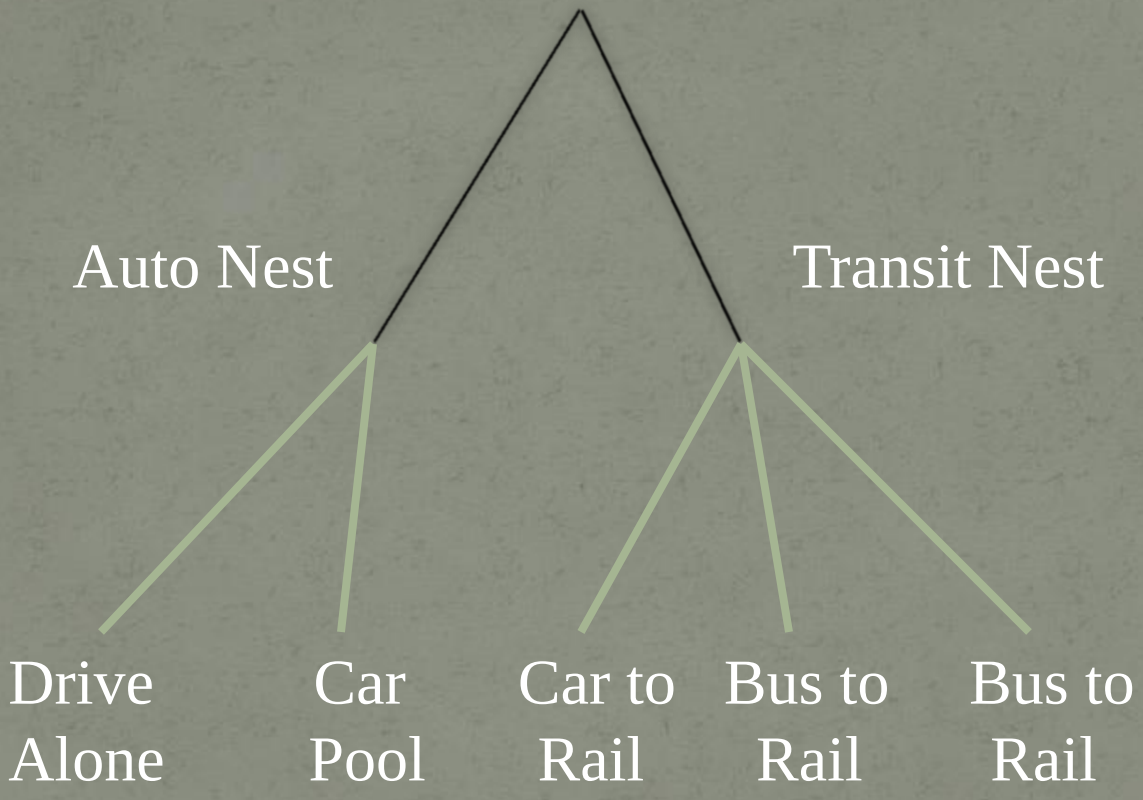
Recent TMIP Discussion

- Nested Logit Alternatives
  - Drive Alone
  - Car Pool
  - Car to Rail
  - Bus to Rail
  - Walk to Rail
  - Bus
- NL to Include Auto and Transit
- How to Include Car to Rail in Car Nest, Transit Nest or Both?

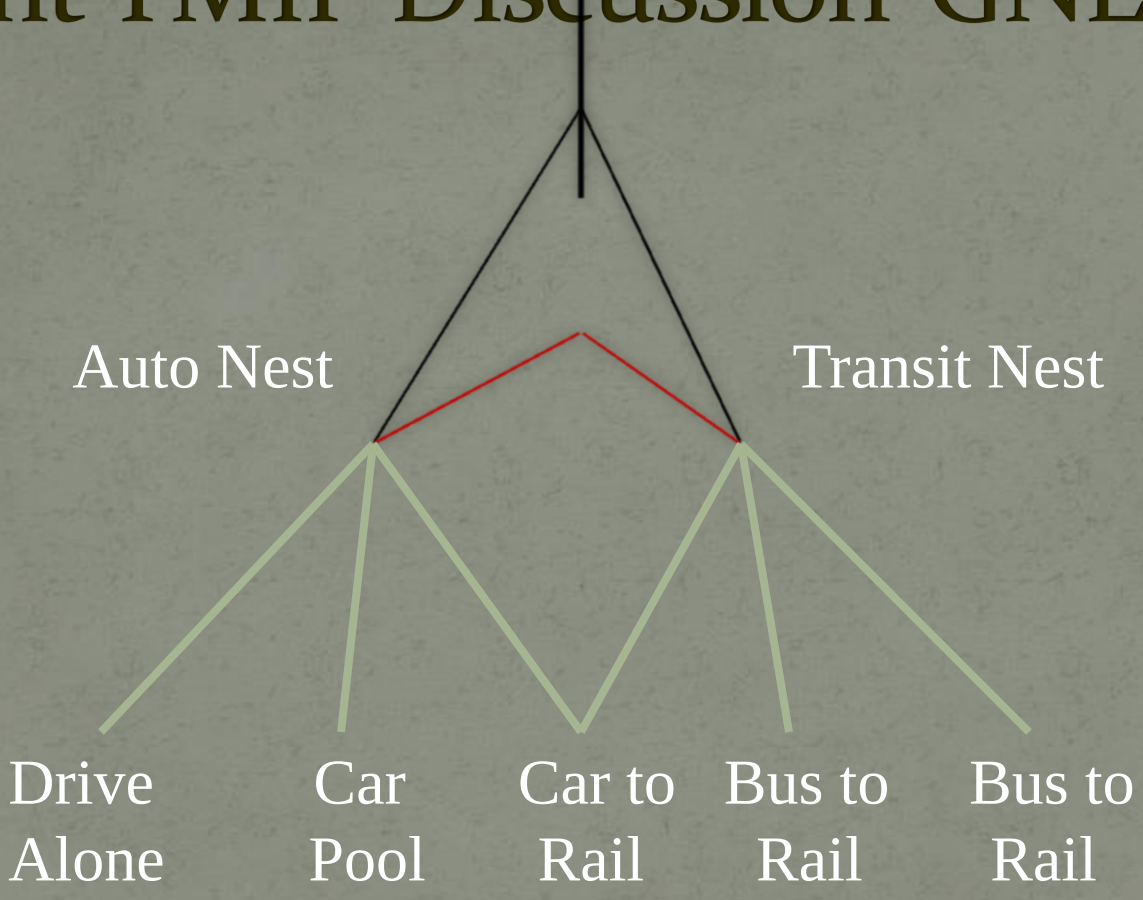
Recent TMIP Discussion-NL1



Recent TMIP Discussion-NL2



Recent TMIP Discussion-GNL



Current Developments

- Continued development of closed-form models
  - Variance parameterization
  - Covariance (similarity) parameterization
  - Net GEV
    - Formulates GEV for Multiple Levels
    - Provides Basis for Examining Different Structures
  - Can Estimate Repeated observation covariance
  - Simultaneous Use of Multiple Data Sources

Current Developments (continued)

- Development of hybrid models
  - Use error components (MXL) to represent differential variance for cases and/or alternatives and different error covariance among alternatives and repeated observations
  - Use error components (MXL) to Estimate Variability of Utility Parameters
  - Requires integration of logit model over additional error components

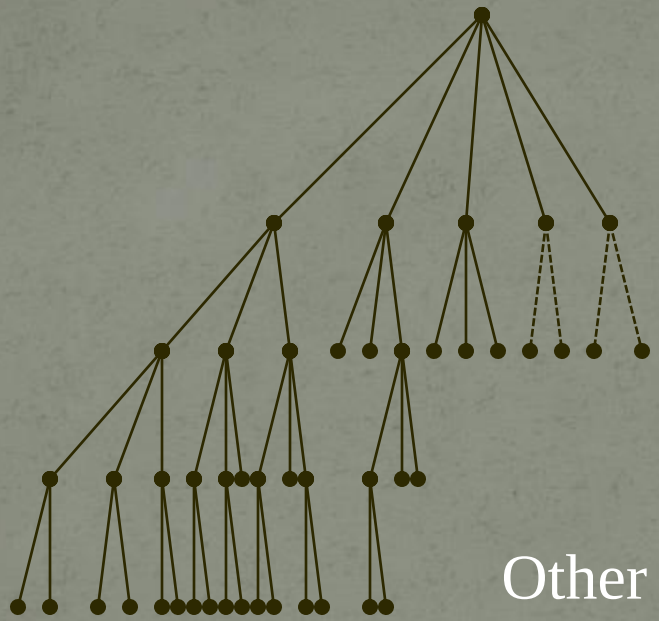
Overview of Choice Model Development

- Increased realism of model structures
- Estimation of Structural Elements
- Estimation of Complex Error Structures

Developments in Activity Based Models

- Group Stops into Tours
- Group Tours into Daily Travel
- Select Tour and Trip Modes
- Select Stop Location
- Distinct Models to Add:
  - Within HH Interactions
    - Joint Trips
    - Joint Stops
  - Time of Day for Tours and Stops
    - Conditional Linkages
    - Linking of Joint Travel and/or Stops

Complexity of Models
Single (3 Stop) Work Tour Example



Primary Stop Location

Arrive Work Time

Other Stop 1 Location

Other Stop 1Before/After/During

OS1 Time

OS2 Location

OS2 Sequence Position

OS2 Time

8 Levels & <u>Many</u> Alternatives for One (3 Stop)Tour!!!

‘Resolution’ to Complexity

- Approach to Estimation
  - Estimate Portions of Tree Sequentially
  - Use Logsums to Link Portions of the Tree
- Additional Complexity
  - Multiple Tours
  - Linkage between HH Members
  - Other
- Potentially Have Numerous Models to Link
- Problems: Inefficiency, Inadequate Data, Interpretation

Issues and Concerns: Judgment-1

- Utility Function Formulation
  - Selection of Variables
  - Variable, Power or Log Transform
  - Interaction between Variables
  - Inclusion of Constants
  - Alternative Specific Variables
  - Constraints on Parameter Values

Issues and Concerns: Judgment-2

- Model Structure Selection
  - MNL vs. NL vs. GNL vs. Other
  - Number of Levels
  - Number of Nests
  - Explore all Options of Selected Options
  - Constraints on Nest Parameters
  - Constraints on Allocation Parameters

Technical Issues

- Inclusion/Exclusion of Variables
  - Statistical Tests
  - Judgment
- Data Available to Estimate for Model
  - Sample Size Increases with Model Complexity
  - Constrain Parameters Across Portion of the Model
- Prediction
  - Aggregate vs. Disaggregate
  - Sample Based vs. Population Synthesis

Expected Superiority of Activity Based Models

- Pricing and Tolling Analysis
- Policies sensitive to time of day
  - Congestion-based Pricing
  - Highway and Transit Operations Enhancements
- Transportation Improvements in Urban Centers
- Impact of Transit-Oriented Development
- Transportation Project Analysis
- Induced travel.

Status of Activity Based Travel Model Adoption*

- Limited Adoption of Advanced Modeling Practice among Large Urban Regions
- Obstacles include:
  - Perceived Greater Complexity
  - Perceived to Require Significantly Greater Effort for Development and Implementation
  - Question Improvements in Forecasts vs. Existing Capabilities
  - Unavailability of 'Software'
  - Lack of Adequate Staff
  - Insufficient Funds

* TRB SR 288, **Metropolitan Travel Forecasting**