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

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?

LL(β_{NL1}) = -1917.4

LL(β_{NL2}) = -1914.5
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

Auto Nest

Drive Alone
Car Pool
Car to Rail
Bus to Rail
Bus to Rail

Transit Nest
Recent TMIP Discussion-NL2

Auto Nest

- Drive Alone
- Car Pool
- Car to Rail
- Bus to Rail
- Bus to Rail

Transit Nest
Recent TMIP Discussion-GNL

Travel Model Developments

ITM 2010
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
• 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

8 Levels & Many 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.
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