NCHRP Report 716
Travel Demand Forecasting
Parameters and Techniques

presented to
North Carolina Model Users Group Meeting

presented by
Cambridge Systematics, Inc.
John (Jay) Evans, P.E., AICP

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Presentation Outline

- Project Overview
- Analysis of NHTS Data
- Data from Existing MPO Models
- What’s in the Guidebook?
- Potential Applications
- Acknowledgments
Project Overview

Background

- 1978 – NCHRP Report 187
  » Quick Response Urban Travel Estimation Techniques and Transferable Parameters

- 1998 – NCHRP Report 365
  » Travel Estimation Techniques for Urban Planning

- 2012 – NCHRP Report 716
  » Travel Demand Forecasting; Parameters and Techniques
Project Overview

**Background (continued)**

- 1978 – NCHRP Report 187
  - Quick Response Urban Travel Estimation Techniques and Transferable Parameters

- 1998 – NCHRP Report 365
  - Travel Estimation Techniques for Urban Planning

- 2012 – NCHRP Report 716
  - Travel Demand Forecasting: Parameters and Techniques

Project Overview

**Project Panel, Staff, and Research Agency Team**

**NCHRP Staff for Project 8-61**
- Nanda Srinivasan, Sr. Pgm. Officer

**Project 8-61 Panel**
- Thomas Kane (Chair)
- Michael Bruff
- Ed Christopher
- Nathan Erlbaum
- Jerry Everett
- Bruce Griesenbeck
- Herbert Levinson
- Richard Pratt
- Bijan Sartipi
- Shuming Yan
- Kim Fisher (TRB Liaison)
- Ken Cervenka (DOT Liaison)

**Research Agency Team**
- Cambridge Systematics, Inc.
  - in association with
  - Vanasse Hangen Brustlin, Inc.
  - Martin/Alexiou/Bryson, PLLC
  - Gallop Corporation
  - Dr. Chandra R. Bhat
  - Shapiro Transportation Consulting, LLC

**Principal Investigator**
- Thomas Rossi
**Project Overview**

**Objectives**

- Revise and Update NCHRP Report 365
  - Current travel characteristics
  - Guidance on forecasting
    - Procedures
    - Applications

- Develop User-Friendly Guidebook
  - Range of approaches
    - Application of straightforward techniques
    - Optional use of default (transferable) parameters
  - References to more sophisticated techniques
  - Broad range of transportation planning issues

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**Analysis of NHTS Data**
Analysis of NHTS Data

**Process**

- Information developed for four variables of interest
  - Person trip production rates
    - Per household by trip purpose
  - Reported average trip durations
    - By mode and trip purpose
  - Time of day of travel distributions
    - By trip purpose
  - Vehicle occupancy
    - By trip purpose

- Variables selected based on potential for transferability

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Analysis of NHTS Data

**Classifications**

- Trip purposes used for data summaries
  - Home-based work
  - Home-based school
  - Home-based other
  - Nonhome based

- Urban area population classifications
### Analysis of NHTS Data
#### Sample Tabulations

**Table C.5 – Example Trip Production Tabulation**
*Home-Based Work Trip Rates*

<table>
<thead>
<tr>
<th>Autos</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3+</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>1.0</td>
<td>2.4</td>
<td>5.1</td>
<td>0.5</td>
</tr>
<tr>
<td>1</td>
<td>0.0</td>
<td>1.0</td>
<td>2.6</td>
<td>5.1</td>
<td>0.8</td>
</tr>
<tr>
<td>2</td>
<td>0.0</td>
<td>1.3</td>
<td>2.6</td>
<td>5.1</td>
<td>1.6</td>
</tr>
<tr>
<td>3+</td>
<td>0.0</td>
<td>1.3</td>
<td>2.6</td>
<td>5.1</td>
<td>2.3</td>
</tr>
<tr>
<td>Average</td>
<td>0.0</td>
<td>1.2</td>
<td>2.6</td>
<td>5.1</td>
<td>1.4</td>
</tr>
</tbody>
</table>

**Table C.10 – Example Trip Length Tabulation**
*Home-Based Work – Average Travel Time in Minutes*

<table>
<thead>
<tr>
<th>Urban Area Population</th>
<th>Auto</th>
<th>Transit</th>
<th>Nonmotorized</th>
<th>All Modes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater than 1 million with rail</td>
<td>29</td>
<td>55</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Greater than 1 million without rail</td>
<td>25</td>
<td>55</td>
<td>16</td>
<td>26</td>
</tr>
<tr>
<td>Between 500,000 and 1 million</td>
<td>22</td>
<td>55</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Less than 500,000</td>
<td>20</td>
<td>55</td>
<td>16</td>
<td>21</td>
</tr>
<tr>
<td>Not in urban area</td>
<td>24</td>
<td>55</td>
<td>16</td>
<td>24</td>
</tr>
<tr>
<td>All trips</td>
<td>24</td>
<td>55</td>
<td>16</td>
<td>25</td>
</tr>
</tbody>
</table>
Data from Existing MPO Models

Process

- Information from over 70 MPOs
  - Small, medium, large
  - Direct contact or publicly available reports
  - Information collected
    - Model parameters
      - Trip attraction rates
      - Friction factor parameters
      - Mode choice parameters
      - Volume-delay function parameters
      - ...
    - Model methods used
### Sample Tabulation

**Sample Gamma Function Gravity Model Parameters (Home-Based Work)**

<table>
<thead>
<tr>
<th>Model Type</th>
<th>( b )</th>
<th>( c )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large MPO 1</td>
<td>-0.503</td>
<td>-0.078</td>
</tr>
<tr>
<td>Large MPO 2</td>
<td>-1.650</td>
<td>-0.040</td>
</tr>
<tr>
<td>Large MPO 3</td>
<td>-0.156</td>
<td>-0.045</td>
</tr>
<tr>
<td>Medium MPO 1</td>
<td>-0.812</td>
<td>-0.037</td>
</tr>
<tr>
<td>Medium MPO 2</td>
<td>-0.388</td>
<td>-0.117</td>
</tr>
<tr>
<td>Medium MPO 3</td>
<td>-0.020</td>
<td>-0.123</td>
</tr>
<tr>
<td>Small MPO 1</td>
<td>-0.265</td>
<td>-0.040</td>
</tr>
</tbody>
</table>

Source: Table 4.5

### Sample Gamma Function Comparison (Home-Based Work)

#### Friction Factors as a Function of Time

- **Lightly Lined Lines**: Various models represented.
- **Legend**:
  - Large 1
  - Large 2
  - Large 3
  - Medium 1
  - Medium 2
  - Medium (a)
  - Small 1

Source: Figure 4.2
What is in the Guidebook?

What's in NCHRP Report 716?

- Chapter 1. Introduction
  - Purpose, objectives, and roadmap
  - Summary of modeling process
  - How parameters used

- Chapter 2. Planning Applications Context
  - Planning context affect on model
  - Examples from urban areas
Chapter 3. Development of Data

» Purposes
  • Model development
  • Model validation
  • Model application

» Considerations
  • Limitations of typical data
  • Primary and secondary data sources
  • Conversion of data from secondary sources
  • Network coding procedures
What's in NCHRP Report 716? (continued)

- **Chapter 4 subsections**
  - Vehicle Availability
  - Trip Generation
  - Trip Distribution
  - External Travel
  - Mode Choice
  - Automobile Occupancy
  - Time-of-Day Characteristics
  - Truck/Freight Modeling
  - Highway Assignment
  - Transit Assignment

Tables of transferable parameters are presented in Chapter 4. Longer tables are found in Appendix C and referred to in the text of Chapter 4 by table number (e.g., Table C.1).

What's in NCHRP Report 716? (continued)

- **Chapter 5. Model Validation Process**
  - Validation overview
    - Consistent with other sources
    - Appropriate out-references
    - Not duplication of existing references
  - Basic guidance
    - Focus on information in the guidebook
What’s in NCHRP Report 716? (continued)

- Chapter 6. Advanced Modeling Practices
  » Overview
  » Tour- and activity-based approaches
  » Traffic microsimulation

- Chapter 7. Case Study Application(s)
  » Two studies
    - Smaller urban area with little transit
    - Larger area with transit
  » Illustrate use of the information from Chapters 4 and 5
  » Draw on concepts presented guidebook
    - Similar to approach in NCHRP Report 365

Potential Applications
How do I use NCHRP Report 716?

- Describes key model components and approaches
- Provides reference options and examples
- Discusses best practices and implementation choices
- Helps with developing travel model components when no local data suitable for model estimation are available
- Supports checking the reasonableness of model components developed using local data

Use Case 1: GTown
- Large MPO
- Household travel survey
- Recalibrated model using this data
- Information from NCHRP Report 716 used to verify reasonableness

Use Case 2: Schultzville
- Small urban area
- Never had a model
- No area-specific travel survey
- Model structure from another small area
- NCHRP Report 716 used to inform
Gtown Model Reasonableness Checks

Trip Generation

**Trip production rates**
- Compares model rates to NHTS rates
- Considers reasons for differences

**Trip attraction rates**
- Compares model rates to MPO summary rates
- Considers implications of differences

Trip Distribution

**Average trip length**
- Compares model output to NHTS findings
- Discusses use of CTPP in reviewing HBW trip purpose

**Gamma function and friction factors**
- Compares model parameters to summarized MPOs
- Discusses implications of differences
Gtown Model Reasonableness Checks

Mode Choice
Reviews coefficients by trip purpose and implied value of time for model versus other MPOs

Automobile Occupancy
Compares average daily vehicle occupancy by trip purpose for model versus NHTS

Time of Day
Compares time of day distribution of auto trips for model versus NHTS

How do I use NCHRP Report 716?

Use Case 1: GTown
- Large MPO
- Household travel survey
- Recalibrated model using this data
- Information from NCHRP Report 716 used to verify reasonableness

Use Case 2: Schultzville
- Small urban area
- Never had a model
- No area-specific travel survey
- Model structure from another small area
- NCHRP Report 716 used to inform
Schultzville Model Development

- Zone and Highway Network Development
  - Highway network development
  - Transportation analysis zone definition

- Socioeconomic Data
  - Households
  - Employment

Schultzville Model Development (continued)

- Trip Generation
  - Trip production rates based on NHTS tables (Table C.5)
  - Trip attraction rates based on reference models (Table 4.4)

- Trip Distribution
  - Travel time inputs developed
  - Friction factors applied to achieve trip length distribution

- External Trips
  - Example uses a statewide model-derived trip table
Schultzville Model Development (continued)

Vehicle Occupancy
  » Convert person trips to vehicle trips (Table 4.16)
  » 1.10 for HBW; 1.72 for HBNW; 1.66 for NHB

Highway Assignment
  » Convert P-A to O-D
  » Used BPR parameters from Table 4.26
  » Equilibrium assignment
  » Review RMSE results

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- Tom Rossi, Cambridge Systematics, Inc.
- David Kurth, Cambridge Systematics, Inc.

Contact Information

Jay Evans, Principal
Cambridge Systematics, Inc.
4800 Hampden Lane, Suite 800
Bethesda, MD 20814
301-347-0100
jevans@camsys.com