County-Level Travel Demand Modeling Using TransCAD

for the 2002 Conference on Transportation Planning for Small and Medium-sized Communities by Rob Bostrom, P.E.

Division of Multimodal Programs
Presentation Overview

• Background
  – KYTC Modeling
  – Air Quality Issues

• County-level Modeling
  – Model Development
  – Use of Model
  – Issues

• Conclusion
KYTC Travel Demand Modeling Types

• Small Urban Area - 37 Areas/Cities in KY

• Air Quality County-level
  – 3 completed
  – Future counties based on new monitoring data

• MPO - 8 w/ models, 4 do their own modeling
  + 2 by consultant

• Special -
  – Sub-area models for special projects
  – Greater detail than full scale model

• Statewide - since 1975
Travel Demand Models: Small Urban
Travel Demand Models: MPO

- Evansville/Henderson
- Owensboro
- Louisville
- Cincinnati
- Huntington /Ashland
- Lexington
- Clarksville/Fort Campbell/Oak Grove MPO
Travel Demand Models: Statewide
Travel Demand Models: County-level

Scott County
Graves County
Marshall County
KYTC Travel Demand Model Usage

• Forecasting - especially new facilities
• Air Quality - VMT, speed forecasting, Mobile 5.0b/6.0 inputs
• Transportation Plans - used for MPO and small urban area needs analysis
• Corridor studies - I-66, I-69, Cincinnati-Dayton, and other major routes
• Special - CVM (Commercial Vehicle Monitoring) station optimization, User Cost Analysis, Detour Analysis
Statewide I-66 Study
Other Travel Model Related Activities

- Travel Model Contract
- NHTS Add-on Surveys
- New Software
- Model Users Group
- TAZ-UP / CTPP
- Research
- GIS Output for Public Meetings
Kentucky Travel Demand Model Users Group

- Seven years, meet 3 times/yr., annual workshop
- Next meeting- October 25, 2002
  - Modeling case studies
- Web: [http://www.kytc.state.ky.us/Multimodal/KyTraffic_MUG.htm](http://www.kytc.state.ky.us/Multimodal/KyTraffic_MUG.htm)
- Topics: software, freight, air quality, traffic simulation, forecasting, TRANSIMS, projects, data
- Participants: State, local, consultants, MPO, academic, FHWA
Overview of Air Quality Issues

• Potential nonattainment areas for ozone, carbon monoxide, & PM

• State Implementation Plan (SIP)
  – Emission Budgets (thresholds)
    • Mobile 6.0
      – Emission factor calculations (g/mi) use driving cycles (speed)
      – VMT provided from various sources
        » TDM models, post processors, & HPMS
    • Data needs: VMT & speed
  – Conformity - need to assess impact of transportation plan upon future VMT, use model to calculate emissions and compare to emission budgets in the SIP
Potential Ozone Nonattainment Areas
(8-hour period as of July 2000)

Statewide concern
Not just urban
Many RURAL areas
Kentucky Response

• VMT
  – County-level models for plan changes
  – Local data not available through HPMS for setting SIP emission budgets or conformity
  – Research on local VMT data

• Speed estimation
  – Need for setting SIP emission budgets and conformity determination

• Ramp - New Facility type
  – Need for setting emission budgets and conformity determination
  – Developed draft in-house ramp VMT %
VMT Research

- KTC Research Study
  - New local road traffic volume sample
  - Develop a process for estimating local road VMT
  - Future estimation at county-level failed
- Developed a means for forecasting future VMT in-house
  - Interstate & non-interstate breakdown
  - Based on trends in VMT per capita growth and projected population increase.
Speed Estimation

• Speeds needed for Mobile 6.0 emission factors
  – Need freeway and arterial for each county
    • Data not available
    • HPMS Analytical Package discontinued

• Development of speed estimation methodology
  – Speed Estimation Seminar - use HERS
  – Suggested NCHRP research study
  – Model post-processing
County-level Modeling

- Data Needs & Sources
- Model Development Highlights
- Uses to Date
- Issues
Data Needs and Sources

• Network
  – Kentucky’s Highway Information System
  – Kentucky’s Base GIS
  – Urban models

• Population data
  – Kentucky State Data Center (KSDC)
  – US Census Bureau
  – Area Development Districts (ADDs)
Data Needs and Sources

• Employment Data
  – Department of Employment Services (ES-202 data)
  – Area Development Districts (ADDs)
  – Harris Industrial Directory

• Travel data and model parameters
  – Statewide Model for external stations
  – NCHRP 365
  – NCHRP 187 trip rate table
Model Development

- 3-step model
  - Trip generation
  - Trip distribution
  - Trip assignment
- Develop Networks
  - & Zone System
- Develop Socioeconomic Data
- Develop Model Trip Tables
- Perform Base Model Calibration
- Perform Future Model Network Assignments
Develop Network and Zone System

- Used all non-local roads plus some selected locals
- Used GIS coverage from KYTC’s base GIS network
- Used KYTC’s HIS for network attributes
- Imported into TransCAD
- TAZ structure follows census blocks or block group boundaries
Marshall County TAZs
Current Socioeconomic Data

• Population data:
  – 2000 census county total
  – 1990 census block group data
  – If developed now, would use 2000 census data exclusively

• Employment:
  – by commercial, industrial & public employment
  – converted to retail-nonretail
Develop Model Trip Tables

- External to External trips (X-X) taken from KySTM
- External to Internal trips (X-I)
  - X-I = ADT minus X-X
  - NCHRP 365 methodology used to develop Ps& As for HBW, HBO and NHB trip purposes
Develop Model Trip Tables

• **Trip Generation** - used TransCAD’s QRM method to develop P/A’s for HBW, HBO and NHB trip purposes

• **Trip Production** - HBW - 16%, HBO, 61% & NHB - 23%

• **Trip Attraction**
  - QRM uses regression on SE variables (retail emp., non-retail emp. & DUs)
  - Attractions balanced to productions
TransCAD Trip Generation

### Dataview5 - Endpoints + final socioeconomic data

<table>
<thead>
<tr>
<th>ID</th>
<th>Z0_TA2POP</th>
<th>Z0_TA2HSH</th>
<th>Z0_INDEMP</th>
<th>Z0_COMEMP</th>
<th>Z0_PUBEMP</th>
<th>Z0_RETEMP</th>
<th>Z0_NRETEMP</th>
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<td>1771</td>
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<td>25</td>
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</table>

### QRM - Trip Generation and Balancing

- **Application**: Endpoints + final socioeconomic data
- **Using**: All Records

#### Production
- **Lookup Table**: FGQ0_TGP
- **Classify By**: None (use avg rates)
- **Total HH**: Z0_TA2HSH
- **Income**
  - HH Auto Ownership Split
  - 0 Autos: [value]
  - 1 Auto: [value]
  - 2 Auto: [value]
  - 3+ Auto: [value]

#### Attraction
- **Lookup Table**: ATF_TGP
- **Dwelling Units**: Z0_TA2HSH
- **Retail Emp**: Z0_RETEMP
- **Nonretail Emp**: Z0_NRETEMP

#### Balancing
- **Method**: Hold Productions
- **Use Special Zones**: [on/off]
- **Ex. Settings**
Develop Model Trip Tables

- Person trips converted to vehicle trips - NCHRP vehicle occupancy rates
- Trip Distribution
  - Gravity model gamma function
  - NCHRP 365 gamma function coefficients
Perform Base Model Calibration & Validation

• Traffic assignment using User Equilibrium
• Comparison of model volumes to ground counts
• Matrix estimation to improve results
• Final model volume & VMT
  – Summarized by FC
  – Compared to HPMS data
# Marshall County Calibration by Link

<table>
<thead>
<tr>
<th>Functional Class Code</th>
<th>Existing Traffic Volume</th>
<th>Initial Model Volume</th>
<th>Calibrated Model Volume</th>
<th>Ratio (Calibrated / Existing)</th>
<th>Total Links</th>
<th>Links w/ Counts</th>
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<tbody>
<tr>
<td>1</td>
<td>264,600</td>
<td>221,966</td>
<td>260,804</td>
<td>0.99</td>
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<td>2</td>
<td>1,075,770</td>
<td>1,458,415</td>
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<td>6</td>
<td>282,300</td>
<td>275,159</td>
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<td>52,848</td>
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<td>TOTAL</td>
<td>2,284,953</td>
<td>3,018,470</td>
<td>2,400,299</td>
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<td>467</td>
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# Marshall County Model Calibration by VMT

<table>
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<tr>
<th>Code</th>
<th>Description</th>
<th>1999 VMT Estimates</th>
<th>Ratio</th>
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<tbody>
<tr>
<td>1</td>
<td>Rural Interstate</td>
<td>319,131</td>
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<td>2</td>
<td>Rural Principal Arterial</td>
<td>491,942</td>
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<td>6</td>
<td>Rural Minor Arterial</td>
<td>103,002</td>
<td>0.91</td>
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<td>7</td>
<td>Rural Major Collector</td>
<td>166,747</td>
<td>1.04</td>
</tr>
<tr>
<td>8</td>
<td>Rural Minor Collector</td>
<td>45,643</td>
<td>1.26</td>
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<tr>
<td>9</td>
<td>Rural Local</td>
<td>138,703</td>
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<tr>
<td></td>
<td>Rural TAZ</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td><strong>Summary:</strong></td>
<td><strong>1,265,168</strong></td>
<td>1.11</td>
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<tr>
<td></td>
<td><strong>Summary of Common Links:</strong></td>
<td><strong>1,188,050</strong></td>
<td>1.01</td>
</tr>
</tbody>
</table>

*Note:*
- Code 1, 2, 6, 7, 8, 9 are specific rural functional classes.
- Code 9 represents the Rural TAZ (Traffic Analysis Zone).
- The table provides a comparison of 1999 VMT estimates from HPMS and model, along with the ratio of model estimates to HPMS estimates.
Perform Future Model Network Assignments

• Developed E + C network
  – KYTC’s Six-Year Plan

• Projected future SE data (2025)
  – County control totals based on HPMS
  – Growth allocated to zones manually based on local input
  – Interpolated for years between current year and year 2025

• Remaining future model development steps similar to current model
County-level Model Usage

- Scott County
  - Needed VMT for review of Fayette County/Scott County plan conformity
  - Needed interim forecast years: 2010 & 2020 in addition to plan year of 2025
County-level Modeling

Issues

• Accuracy
• State of practice at KYTC evolving
  – Lack of script
  – Post processing awkward
• AQ Changes
  – 8-hour standard
  – New monitoring results
Assessment of County-level Modeling

• Cost effective and quick - ~ $30-35K & 4 months
• Future models lack some accuracy due to use of matrix estimation
• Can be used for project development traffic forecasting (e.g. new bypasses)
Conclusion

• Thank you for your attention!
• Acknowledgements
  • WSA
  • Barry House
• Contacts:
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