The Best Practice Model in New York

TMIP NCDOT Panel
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Study Area

- 28 counties
- 3,586 Transportation Analysis Zones
- 4 time periods
- 8 trip purposes
- 10 modes
Highway Network

- Very large network
  - 52,794 links
  - 4,950 High-level facilities
  - 26,385 Arterials
  - 10,694 Centroid and external connectors
  - 10,765 Other
- Unidirectional / dualized coding
- Conflated the network geography
- GIS Network Developed in TransCAD Software
- SOV, HOV2, HOV3+, taxi, truck, other commercial
- Attributes include capacities, initial speeds, lanes, parking availability, truck restriction, signal spacing, Roadway Names, and functional class
GIS Street Base – TIGER (or LION)
Highway Network

Uni-directional coding & / Ramps
Link Attributes

<table>
<thead>
<tr>
<th>ID</th>
<th>FCLASS</th>
<th>DESIGN</th>
<th>MEDIAN</th>
<th>ACCESS</th>
<th>SIGNAL</th>
<th>DRIVEWAY</th>
<th>TURN</th>
<th>RAMPTYPE</th>
<th>AUTOTOLL</th>
<th>TRUKTOLL</th>
<th>TRUCK</th>
<th>TRUK_USG</th>
<th>SPECIAL</th>
<th>TOT_LANE</th>
<th>LANESAB</th>
<th>LANESBA</th>
<th>PARK</th>
<th>RESTRICT</th>
<th>SPDMOD</th>
<th>CAPMOD</th>
<th>ZONE</th>
<th>AREATYPE</th>
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<td>12</td>
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</tbody>
</table>
Transit Network

- Extremely detailed transit coding based on information from MTA and NJ Transit
- Developed in TransCAD 4.0
- Each route variation coded as a distinct route:
  - 100 NYC subway routes
  - 900 Commuter rail routes
  - 2,300 bus routes
  - 50 ferry routes
  - Includes sidewalk network in Manhattan
  - Walk access/egress links
  - Park - and - Ride
Highlights of NYBPM

- Micro-Simulation choice models
- Population synthesis and intra-household travel interactions
- Journey-based travel units modeled
- Non-motorized (pre-mode choice)
- Mode-Destination Choice (nested logit)
- Stop frequency and location sub-model
- Full multi-modal analysis / assignment
General Modeling Structure

- Journey Generation
- Mode & Destination
- Stop Freq & Location
- Time of Day
- Assignment
Journey Generation

- Mode & Destination
- Stop Freq & Location
- Time of Day
- Assignment

Synthetic Population

- Auto Ownership
- Journey Frequency

Seed PUMS

Socio-Economic Targets

LUM

Accessibility
Modeling Structure

**MDC**
- Journey Frequency
  - Pre-Mode Choice
    - Non-Motorized Destination
    - Motorized Destination
      - Motorized Mode
        - Attraction (Activity Size)
        - Impedance (Skims)

**Stops**
- Stop Frequency
  - Stop Location
    - Stop Density

**PAP / TOD**
- Journey TOD
  - Stop TOD
Journey Frequency Model

Intra-Household Interaction

Workers
Non-Workers
Children

School → University
School → University
School

Work → At Work
M → M
M → M
M → M

Individual Time-Space Constraint
Mandatory
Maintenance
Discretionary

Journey Frequency Model
Mode Choice to Work
Nested Structure

- Drive Alone
- Drive Alone
- Drive Alone
- Drive Alone
- Transit & Shared Ride
  - 2 Pass
  - 3 Pass
  - 4 Pass
  - Commuter Rail
  - Walk to Commuter Rail
  - Drive to Commuter Transit Rail
  - Walk to Transit Rail
  - Drive to Transit Rail
  - Taxi
  - Taxi
  - Taxi
## Mode Choice to Work: Mode Availability

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Modes Unavailable</th>
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<tbody>
<tr>
<td>No walk access to transit at origin</td>
<td>Walk to transit &amp; commuter rail</td>
</tr>
<tr>
<td>No walk access to transit at destination</td>
<td>Walk &amp; drive to transit &amp; commuter rail</td>
</tr>
<tr>
<td>Zero INV time in skim</td>
<td>Walk &amp; drive to transit &amp; commuter rail</td>
</tr>
<tr>
<td>No cars in household</td>
<td>Drive alone</td>
</tr>
</tbody>
</table>
Destination-Choice Model: Utility Components

- Attraction-size variable
- Mode-choice log-sum
- 3 River-crossing dummies
- Intra-county dummy
- Distance-based term
- 4 To-Manhattan dummies
- County-to-county k-factors
Route-Deviation Concept

Combined impedance: \( d_{ik} + d_{kj} \)

Absolute route deviation: \( d_{ik} + d_{kj} - d_{ij} \)

Relative route deviation: \( \frac{(d_{ik} + d_{kj} - d_{ij})}{d_{ij}} \)
Stop Frequency by Purpose

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No stops | Outbound | Return | Both
---|---|---|---
0% | | | |
10% | | | |
20% | | | |
30% | | | |
40% | | | |
50% | | | |
60% | | | |
70% | | | |
80% | | | |
90% | | | |

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Work-low, Work-med, Work-high, School, Univ, At work, Maint, Discr
Stop Frequency by Mode

- Drive alone
- Shared ride
- Transit
- Commuter rail
- Taxi
- School bus
- Other

- No stops
- Outbound
- Return
- Both
Stop Distribution by Duration

Activity duration, hours

- < 1 h
- 1-2 h
- 2-3 h
- 3-4 h
- 4-5 h
- > 5 h
Stop-Frequency Choice Model

Choice Alternatives

- 0 - No stops
- 1 - Outbound
- 2 - Return
- 3 - Both

Structural Dimensions

Journey Purpose

- Work
- School
- University
- Maintenance
- Discretionary
- At Work

Person Type

- Worker
- Child
- Non-Worker

Mode

- SOV, Taxi
- HOV
- Transit

Utility Components

Income

Car Sufficiency

Household Composition

Journey Distance

Other Journeys

Stop-Location (Density) Log-Sum
Stages of Calibration and Validation Sources

- **Disaggregate Calibration by Purpose**
  - Household Survey

- **Aggregate Calibration of Destination Choice**
  - Household Survey; PUMS

- **Aggregate Calibration of Mode Shares**
  - Household Survey; PUMS

- **Highway and Transit Assignment**
  - Traffic Counts; Screenline Database; MATRIX
MDC Calibration Framework

Mode Choice Calibration

Destination Choice Calibration

Application

Adjustment To Aggregate Targets

Distance Term Adjustment to Observed TLD

Intra County-Specific Adjustment

To-Manhattan Adjustment

OPTION: Adjustment to Traffic Counts
BPM Structure – “GUI” for User Documentation
Procedures for Estimating Congestion

Highway Networks

Transit Networks

Socio-Economic Data

Best Practice Model

PPAQ / PEQUEST

County Level Delays
- Person Hours
- Vehicle Hours

Congestion Maps
- Link Level
- Level-of-Service Analysis

Updated Traffic Data

Reviews:
- Agencies
- Public

- Person Hours
- Vehicle Hours

County Level Delays
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- Vehicle Hours

Congestion Maps
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How is BPM Better than Other Models

Comparison of BPM versus Traditional Model

- GIS Based
- Journey versus trip
- Microsimulation - looks at each household and each journey
- Walk Trips Separated
- Travel Interaction
  - Auto Availability
  - Family Interaction
  - Time constraints
Applications of BPM .. NYMTC’s Use

- Conformity Analysis
- Regional Transportation Plan
- Congestion Management Systems
- Testing Scenarios for emission reduction strategies
- Request for Data Manipulation and Runs from other agencies
Applications of BPM .. Projects

- Tappan Zee Bridge
- Gowanus Expressway
- Bronx Arterial Needs
- Bruckner Sheriden Expressway
- Long Island East Side Study
- Canal Area Transportation Study
- Lower Manhattan Development Corporation
- Southern Brooklyn Transportation Study
- Regional Freight Plan Study
- Hackensack Meadowland Development Corp.
Model Update

- Study of Post 9/11 Travel Pattern Changes
- New Set of Socioeconomic and Demographic Forecasts
- Collection of 2002 traffic and transit data
- Updated 2002 base year Model by January, 2004
What’s Next

- Overcome the current problems
  - Very Complex Model – 9 million households, 25 million paired journeys, 8 trip purposes, 4 time periods, 10 travel modes
  - Long Running Time – More than 100 hours for a single scenario run.
  - Hardware Needs - 2 GB RAM / Dual Processor / 1.5 Ghz / 80+ GB Hardrive
  - Software problems – TransCAD version changed
  - High turnover at consultant end
Status of On-Going Improvements

• Speed up the running time

  – Memory Handling
    • allocated the memory only once, using a flag to determine if the memory had already been allocated
    • memory could be allocated in one block
  
  – Input/Output
    • Remove messages (one per 33 million lines in the HAJ trip file) to the screen, reduced processing time from 22 minutes to 20 seconds
  
  – Parameter Passing
    • Passing information of a pointer to a structure rather than an entire structure (e.g., the memory used to call about 260,000 times of one function with 92 bytes could be reduced significantly by passing a pointer to the structure that only requires 4 bytes)
  
  – In-lining Function Calls
    • Very short functions that are called frequently can cause bottlenecks (function consists of just a few lines (e.g., Calling a function, which was being called between 300,000 to 600,000 times, was taking up 10% of the total program time. In-lining the function reduced it to 0.3% of the total program time)

  – Additional optimization
Model Improvements

- Better Highway - Transit Connection – Bus Preload on highways
- Improve transit models
- Integrate BPM with the Land Use Model
- Web Applications
  - Model output analysis
  - Model runs
- Distributed Process
- Better GUI
- More project applications