Triangle Regional Model v4

What it is, recent application, and future directions
Presentation Outline

1. TRM v4 – what it is: a description of the Triangle Regional Model
2. Recent applications of the model
3. Future directions for model development
TRM v4 – What it is

• An enhanced trip based four step model for the Triangle region of North Carolina
• Intended for use with:
  > Long range transportation plans
  > Air quality analysis
  > Project level forecasts
  > New Starts analysis
TRM v4 – by the Numbers

- Modeled area is 2,600 square miles
- Includes all of Wake, Orange and Durham counties and part of Chatham, Franklin, Granville, Johnston, and Harnett counties
- 2,317 internal TAZs and 72 external stations
- 2005 population 1,312,000
- 2005 employment 681,000
By the Numbers – cont’d

- Base year (2005) highway network has 10,800 links representing 3,700 miles of roadways
- 179 bus lines representing 1,800 route miles of transit service
Model Structure

A typical 4 step model with enhancements

- Household Stratification
- Trip Generation
- Trip Distribution
- Mode Choice
- Traffic Assignment

- Feedback to Trip Distribution
Market Segmentation

2 general vehicle types:
- passenger autos
- commercial vehicles

3 household member types:
- Working adult (worker)
- Non-working adult
- Child

4 income strata:
- Low income
- Medium low
- Medium high
- High
Market Segmentation (2)

5 Demographic Strata:

- Zero Car Household
- Low Income Household with One or More Cars
- Medium Income Household with Car less than Workers
- Medium Income Household with Car greater than or equal to Workers
- High Income Household with One or More Cars
Market Segmentation (3)

5 Trip Purposes (modeled fully):
- Home-based work
- Home-based shopping
- Home-based school
- Home-based other
- Non-home-based

**Note**: University trip table added to the model after trip distribution and modeled only for mode choice and traffic assignment

3 Times of Day:
- Morning peak (4 hours: 6:00 – 10:00 am)
- Evening peak (4 hours: 3:30 – 7:30 pm)
- Off-peak (16 hours: rest of the day)
What’s New in Trip Generation?

• Discrete choice Logit model replaces cross-classification model
• Trip frequency choice by trip purpose and household member type

Output are the probabilities of a household member making certain numbers of trips a day, for example:

P(0) = 20%, P(1) = 25%, P(2) = 40%, and P(3+) = 15%
P(total) always = 100%
Trip Generation: Example

The number of trips that person makes a day is:

\[
0 \times 20\% = 0 \\
+ 1 \times 25\% = 0.25 \\
+ 2 \times 40\% = 0.80 \\
+ 3.4 \times 15\% = 0.51 \\
\]

\[
\text{Total} = 1.56 \\
\]

Note: Assuming, from the survey, 3.4 is the average number of trips for the 3+ trip frequency category.

Then perform aggregation: Assuming a TAZ has 100 persons in the same SE category, then zonal daily trip subtotal for that category will be

\[
100 \times 1.56 = 156
\]
Non-Motorized Trip Model

Logit models used to distinguish non-motorized trips from motorized trips (yes or no)

Major factors:
- demographic strata
- Accessibility
- area type

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
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<tbody>
<tr>
<td>Str1dum</td>
<td>No Car Dummy, 1 if Car=0</td>
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<tr>
<td>Str2dum</td>
<td>Low Income Dummy, 1 if Inc&lt;=19999</td>
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<tr>
<td>Str3dum</td>
<td>Med. Inc and Less Car Dummy, 1 if 20000&lt;=Inc&lt;=49999 and Cars&lt;Workers</td>
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<td>Med Inc and More Car Dummy, 1 if 50000&lt;=Inc&lt;=99999 and Cars&gt;=Worker</td>
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<tr>
<td>Str5dum</td>
<td>High Income Dummy, 1 if Inc&gt;=100000</td>
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<td>EmpDis *</td>
<td>Employment Distance Access Measure</td>
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<tr>
<td>PopDis *</td>
<td>Population Distance Access Measure</td>
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<td>EmpPopDis</td>
<td>Emp + Pop Distance Access Measure</td>
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<td>SubUrban</td>
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<td>Rural</td>
<td>Low Density Dummy, 1 if Area Type = 3</td>
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</table>
What’s New in Trip Distribution?

Destination Choice Model vs. Gravity Model

- Disaggregate model
- Model individual trip behavior directly instead of simulating the aggregate attractiveness between zones using the gravity law
- Probabilistic vs. deterministic
- Zones compete with each other to be the destination of a trip
Mode Choice – New Features

Nested Logit Improvements

- 3-tier nest structure vs. 2-tier
- Disaggregate drive access into a nest of Park-n-Ride and Kiss-n-Ride
- Auto intercept
- Zero fare treatment
- Rail potential
Mode Choice – Nested Logit Model
Traffic Assignment

Multi-modal multi-class traffic assignment (MMA):

- SOV, HOV, & CV trips loaded onto network simultaneously

User equilibrium
By time of day:

- am peak, pm peak, and off-peak

Improved volume-delay functions

- Reduce computing time while keep the same quality
Feedback

Why feedback?
- Achieve travel time consistency among sequential modeling steps

New feedback strategy
- Old model: one feedback, HBW only
- New model: unlimited feedbacks, all purposes

Improved feedback technique
- Old model: direct feedback
- New model: successive averaging
Improvements Made by TRMSB

• Implemented successive averaging to replace naïve feedback
• Changed destination choice models from singly-constrained to doubly-constrained to address imbalanced trip distribution issue
• Automated the creation of walk access links and updating of zonal percentage within walking range of bus stops
• Recalibrated mode choice models using 2006 survey data
• Added kiss and ride at bus stops
Enhancements

- Air Quality analysis tool
- LRTP performance measures
Recent Application

- Forecasts for MPO Long Range Transportation Plans
  - 33 alternatives, 4 final preferred alternatives
- Air Quality Analysis for four AQ years
Recent Application
## LRTP Evaluation Measures

<table>
<thead>
<tr>
<th>Measures</th>
<th>Region</th>
<th>CAMPO</th>
<th>DCHC</th>
<th>Durham</th>
<th>Orange</th>
<th>Chatham</th>
<th>Wake</th>
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<td>1.10.4 Degree of congestion (V/C)</td>
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<td>3.90%</td>
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<td>1.10.5 Degree of congestion (V/C)</td>
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<td>8.70%</td>
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<td>2.50%</td>
<td>4.80%</td>
</tr>
</tbody>
</table>

## Mode Share Measures

### 2.1 Number Mode Choice - All Trips
Future Directions

• Developing v5
  > Incorporate new non-motorized model being developed by DCHC
  > New parking cost incorporated in model
  > Expanded model area & new models estimated using 2006 survey data

• Developing v6
  Will depend on the policies stakeholders want to test
Questions?