

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

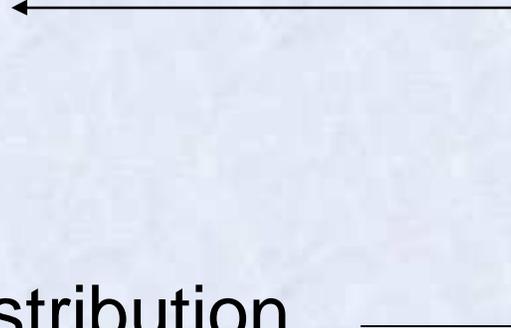
By the Numbers – cont'd

- 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
 $P(3+) = 15\%$

$P(\text{total})$ always = 100%

Trip Generation: Example

The number of trips that person makes a day is:

$$\begin{array}{r} 0 * 20\% = 0 \\ + 1 * 25\% = 0.25 \\ + 2 * 40\% = 0.80 \\ + 3.4 * 15\% = 0.51 \\ \hline 1.56 \end{array}$$

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 $100 * 1.56 = 156$

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

Variable	Description
Str1dum	No Car Dummy, 1 if Car=0
Str2dum	Low Income Dummy, 1 if Inc <=19999
Str3dum	Med. Inc and Less Car Dummy, 1 if 20000 <=Inc <=49999 and Cars < Workers
Str4dum	Med Inc and More Car Dummy, 1 if 50000 <=Inc <=99999 and Cars >= Worker
Str5dum	High Income Dummy, 1 if Inc >=100000
EmpDis *	Employment Distance Access Measure
PopDis *	Population Distance Access Measure
EPDis *	Emp + Pop Distance Access Measure
Urban	High Density Dummy, 1 if Area Type = 1
SubUrban	Medium Density Dummy, 1 if Area Type = 2
Rural	Low Density Dummy, 1 if Area Type = 3

What's New in Trip Distribution?

Destination Choice Model vs. Gravity Model

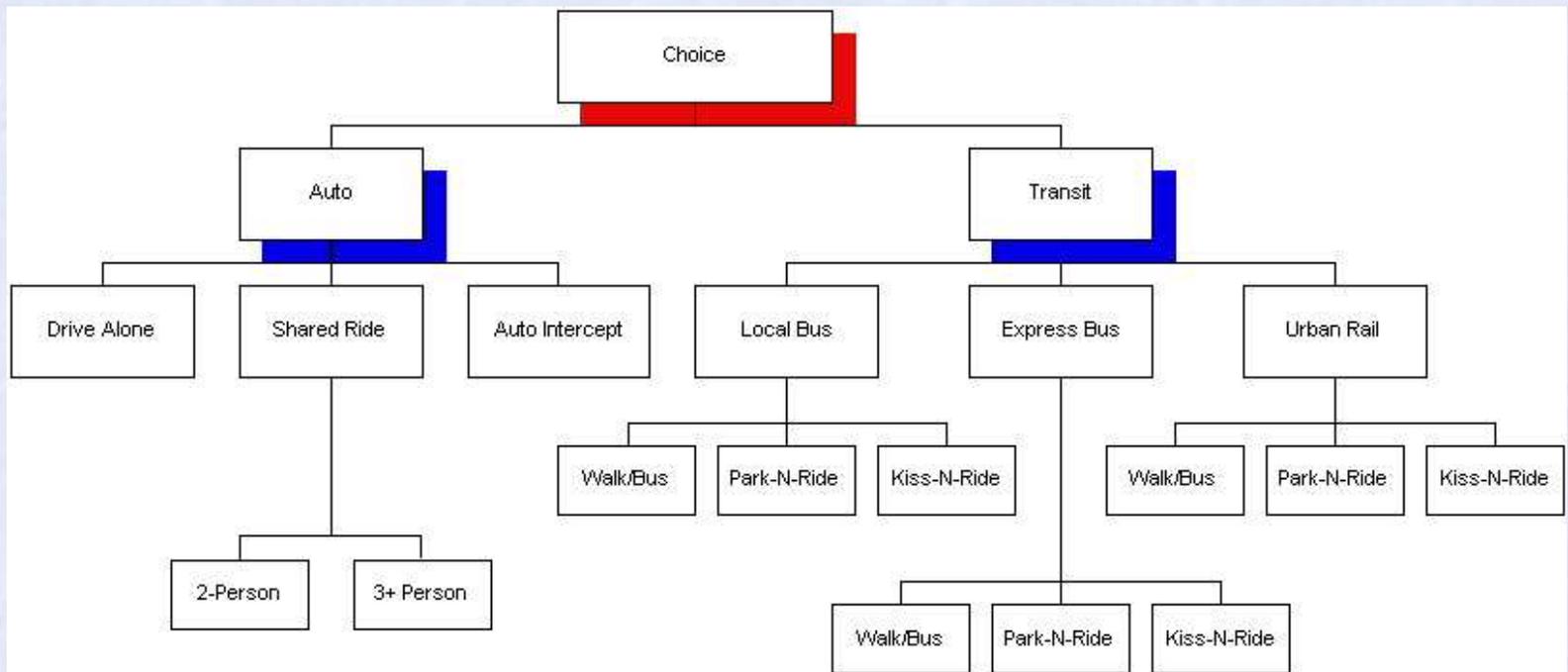
- Disaggregate model
- Model individual trip behavior directly instead of simulating the aggregate attractiveness between zones using the gravity law
- Probabilistic vs. deterministic
- Zones compete with each other to be the destination of a trip

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

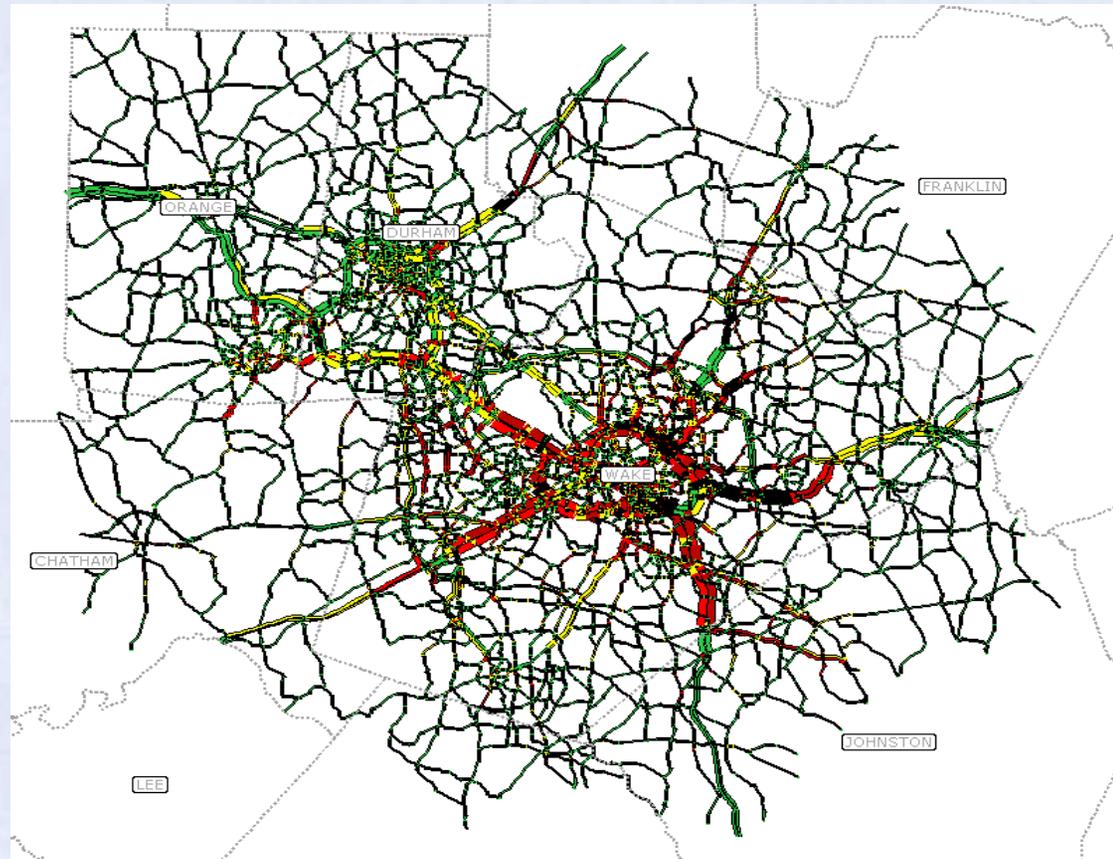
Enhancements

- 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





L RTP Evaluation Measures

TRM L RTP Evaluation Measures										
Measures	Region	CAMPO	DCHC	Durham	Orange	Chatham	Wake	Franklin	Granville	
1 Performance Measures										
1.1 Total VMT (daily)	73861276	51472776	17603017	12261173	6079557	2686489	43869737	1834195	1767175	
1.2 Total VHT (daily)	1826903	1317244	406044	279912	137828	60075	1148672	41185	38905	
1.3 Average Speed by Facility (miles/hour)										
1.3.1 - Freeway	59.2	57.8	60.6	59.5	64.1	-99	56.5	-99	65.2	
1.3.2 - Arterial	42.7	42.6	39.2	40.1	36.4	55.7	41.4	51.2	40.5	
1.3.3 - All Facility	46.9	45.5	49.5	49.3	51.8	48.7	44.8	47.3	51.5	
1.4 Peak Average Speed by Facility (miles/hour)										
1.4.1 - Freeway	56.8	54.8	59.1	57.7	63	-99	53.3	-99	62.8	
1.4.2 - Arterial	41.1	40.7	38.2	39.3	35.5	54.3	39.6	50.2	38.9	
1.4.3 - All Facility	45	43.4	48.1	47.9	50.6	47.2	42.7	46.3	48.9	
1.5 Average Travel Time - All	15.42	16.13	15.94	16.2	15.96	19.64	16.23	20.23	20.29	
1.6 Average Travel Time - Wo	21.93	23.21	22.45	22.4	22.12	28.26	22.96	31.99	30.23	
1.7 Peak Average Travel Time	17.52	18.43	18.28	18.54	18.18	22.34	18.55	23.25	23.69	
1.8 Hours of Delay (daily)	407045	323917	66791	46156	21110	7546	302327	4504	6444	
1.8.1 CV Hours of Delay (daily)	13336	10016	2865	2108	793	180	9561	99	185	
1.9 Percent of VMT experiencing congestion - All Day										
1.9.1 - Freeway	5.50%	7.70%	2.30%	2.90%	1.40%	-9900%	8.30%	-9900%	2%	
1.9.2 - Arterial	6.40%	7.60%	3%	2%	5.30%	0.50%	7.90%	1%	6%	
1.9.3 - All Facility	5.30%	6.50%	2.50%	2.60%	2.10%	0.90%	7.30%	0.80%	2.60%	
1.10. Percent of VMT experiencing congestion - Peak										
1.10.1 - Freeway	9%	12.40%	3.60%	4.50%	2.40%	-9900%	13.30%	-9900%	3.60%	
1.10.2 - Arterial	9.80%	11.60%	4.50%	2.90%	7.90%	0.90%	12.10%	1%	10.10%	
1.10.3 - All Facility	8.20%	10.20%	3.70%	3.90%	3.30%	1.50%	11.30%	1%	4.30%	
1.10.4 Degree of congestion (V/C	7.10%	8.80%	3.90%	2.90%	9.20%	0.50%	8.80%	0.20%	-9900%	
1.10.5 Degree of congestion (V/C	6.80%	8.70%	2.80%	2.70%	3.50%	0.50%	8.90%	2.50%	4.80%	
2 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?