



North Jersey Regional Transportation Model- Enhanced Transportation Modeling Overview May 19, 2008

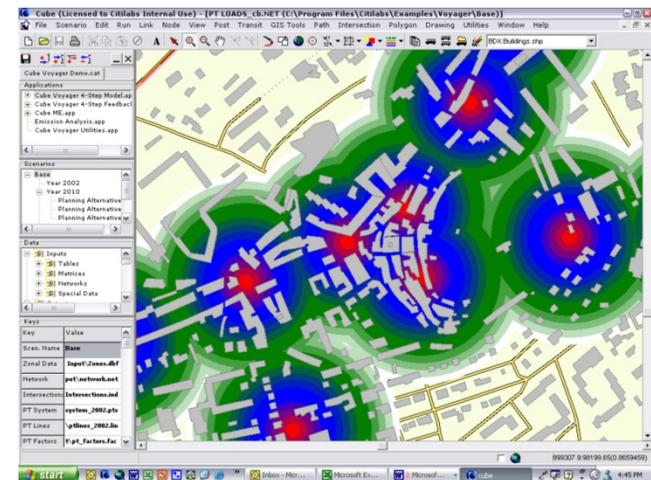
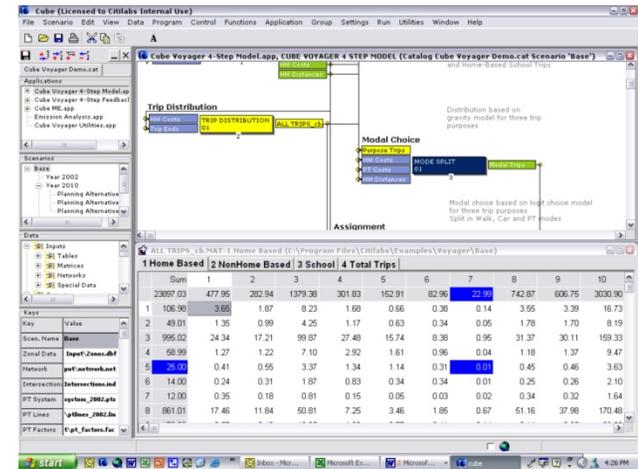
Instructors

David Schellinger, P.E.

Wade White, AICP

Agenda

- Transportation Planning and Modeling
- Typical Applications of Models
- Questions Put to Models
- The Model as but One Tool
- Data Driving the NJRTM-E
- Break
- Types and Varieties of Outputs
- Opportunities for Interagency Coordination

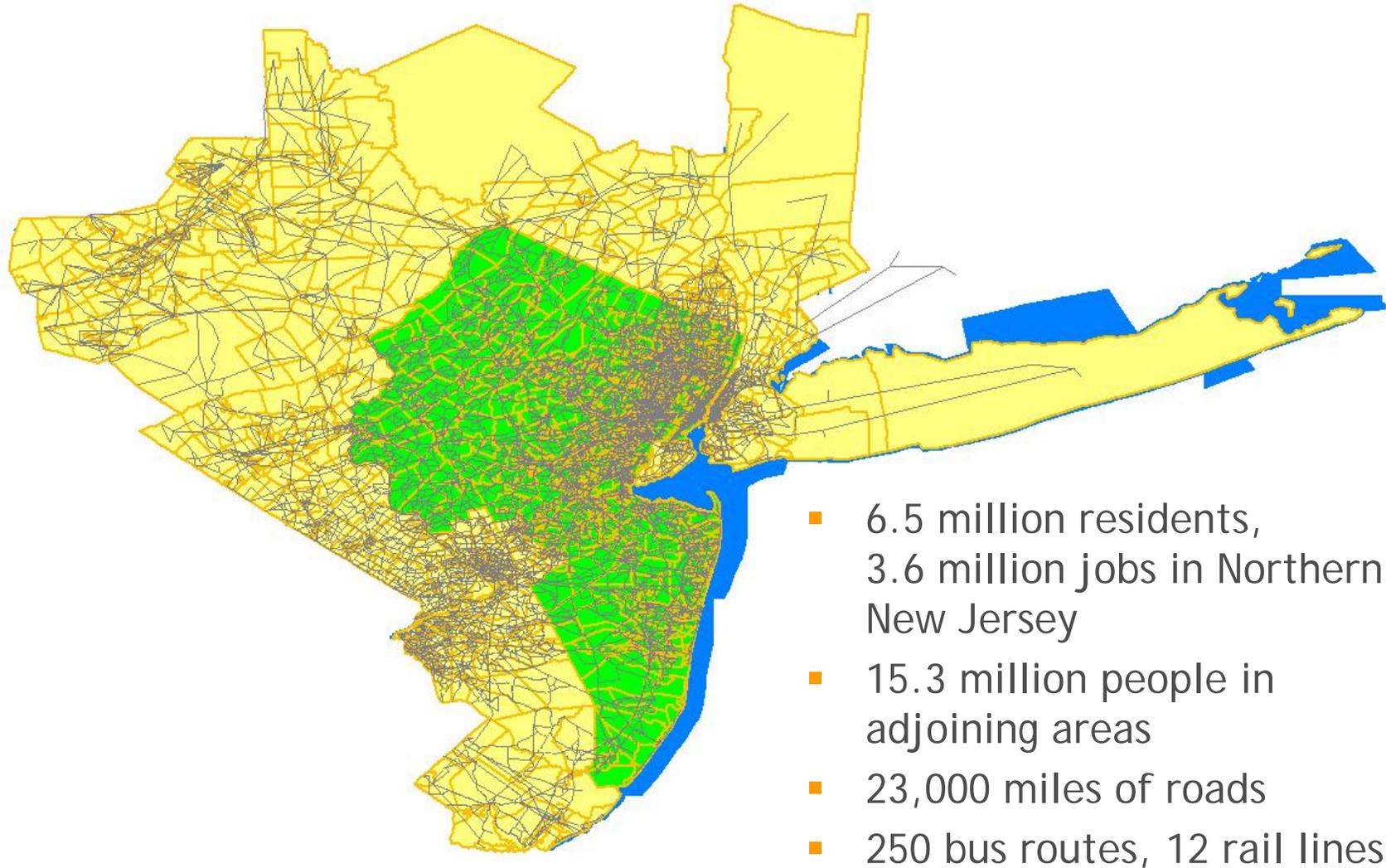


Transportation Planning and Modeling

How do they fit together?

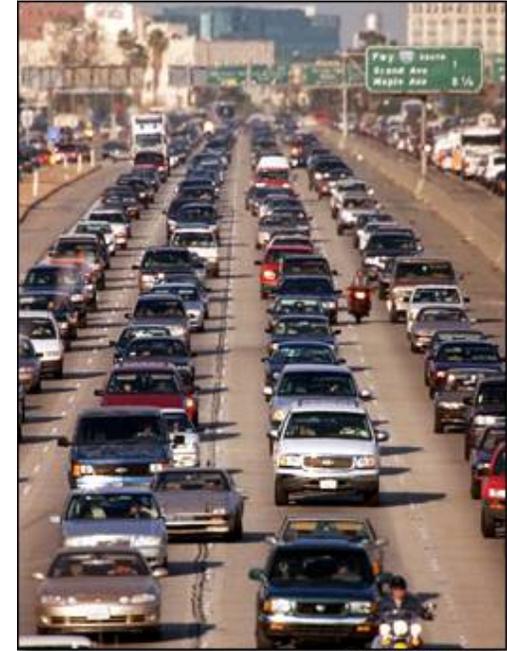
- Planning and Modeling are Inextricably Linked
 - “Good forecasting is the start of good planning”
- Quiz for the Audience- What is a Model?
- The “Right” Model Depends on the Questions Asked
- The Goal Today- Demystifying the NJRTM-E

NJTPA Region Study Area



Our Challenge - Overburdened Infrastructure

- There's Lots of Traffic Today
- Public Transit Capacity is Limited
- Travel Grows as the Region Grows
- Land Use Patterns Haven't Always Helped
- We Must Do Something
- **What Will be Effective?**

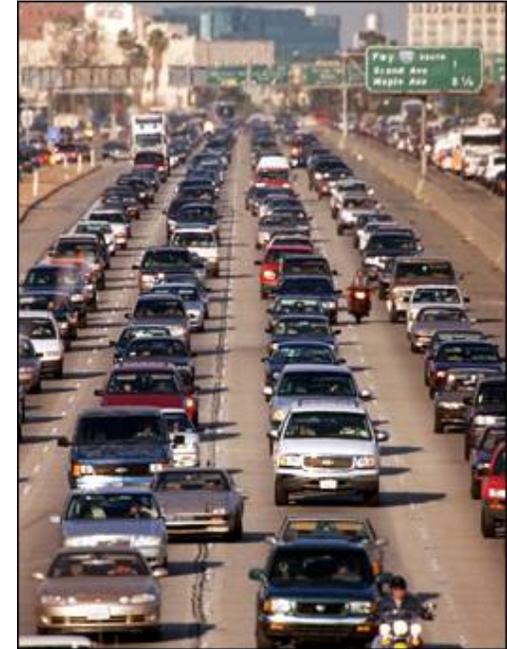


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What Do I Need to Know To Solve This Problem

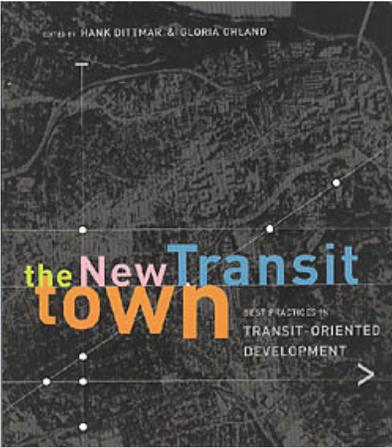
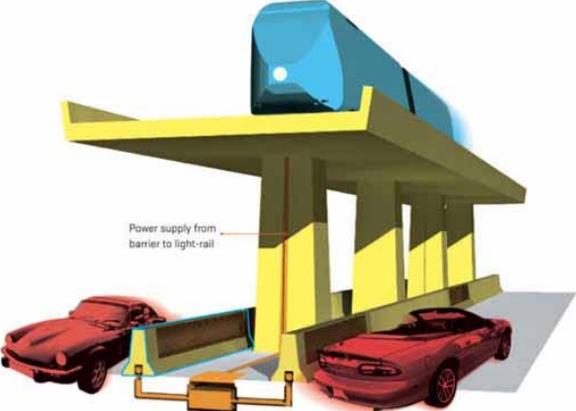
- How Big is the Problem?
- Where is All the Travel Coming From?
- Where is All the Travel Going To?
- How Will Travelers Respond to Different Solutions?
- How Long Would a Solution be Good For (return on investment)?
- Answer: LET'S STUDY IT!
 - Maybe Toll It
 - Maybe a BRT
 - Maybe Build/Upgrade a Rail
 - Maybe Upgrade a Parallel Facility



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Possibilities...



Man, I'm Going to Need a Lot of
Information. Where can I find it?

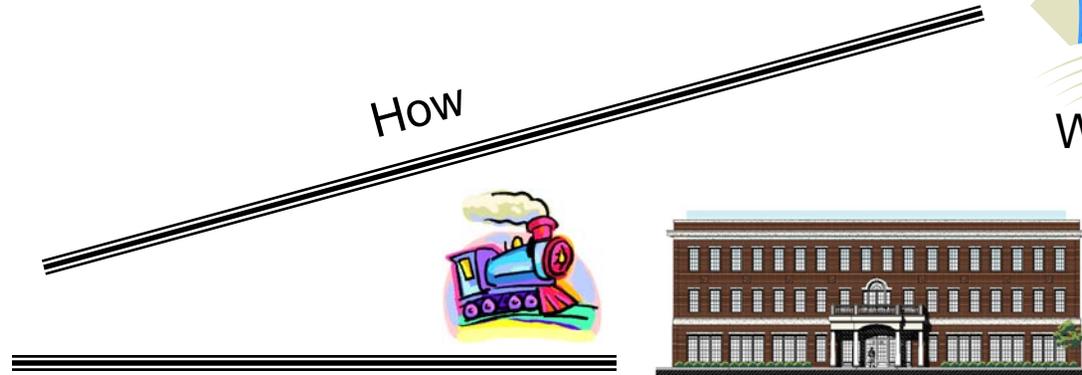
An Introduction to the NJRTM-E

The Basics

Who



How

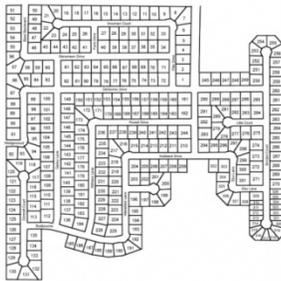


Where

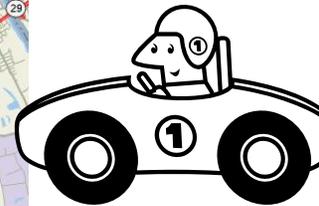
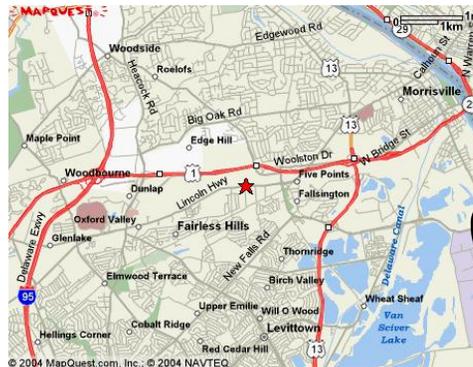


How

Why



Where



Where



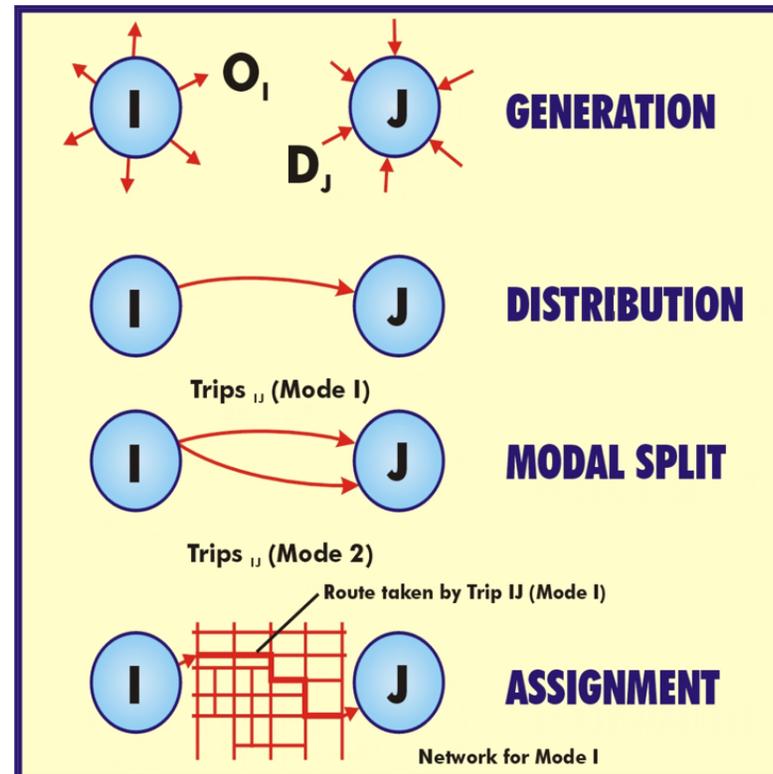
The Basics

- Trip Generation- Who and Why Should I Go
 - Considers the location of people and destination potential
 - Households, employment, land use, activity centers
- Trip Distribution- Where to Go
 - Considers the choices available to travelers and why they go to one vs. another
 - Where is it and how much does it cost me to go to one vs. another?
- Mode Choice- By What Means to Go
 - Considers the relative attractiveness of choices for various types of trip making
 - To go from home to work, should I drive, walk, take the bus, take the train, etc
- Assignment- By What Route to Go
 - Considers the best and alternate routes between the selected origin location and destination location now that I've selected a mode

The Basics

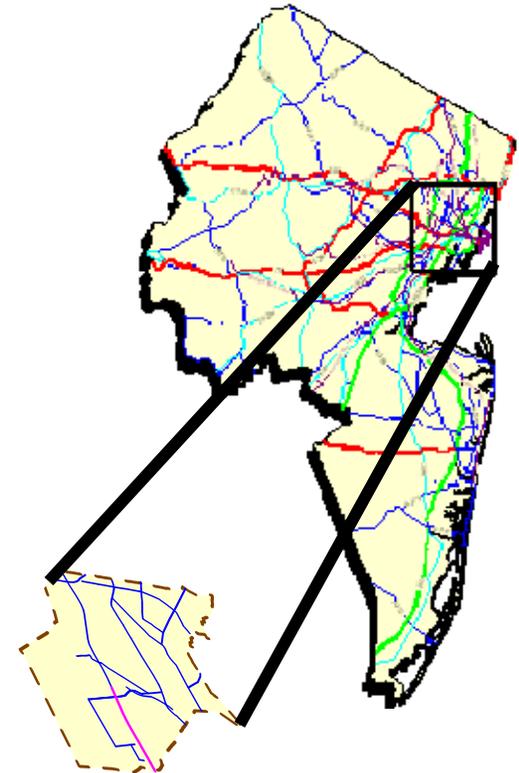
Saying it Differently (aka in Jargonese)

- I= origin or trip starting point, typically home
 - Maybe in Hackensack
- J=destination or trip ending point, typically a trip attractor (job, mall, etc)
 - Maybe in Newark

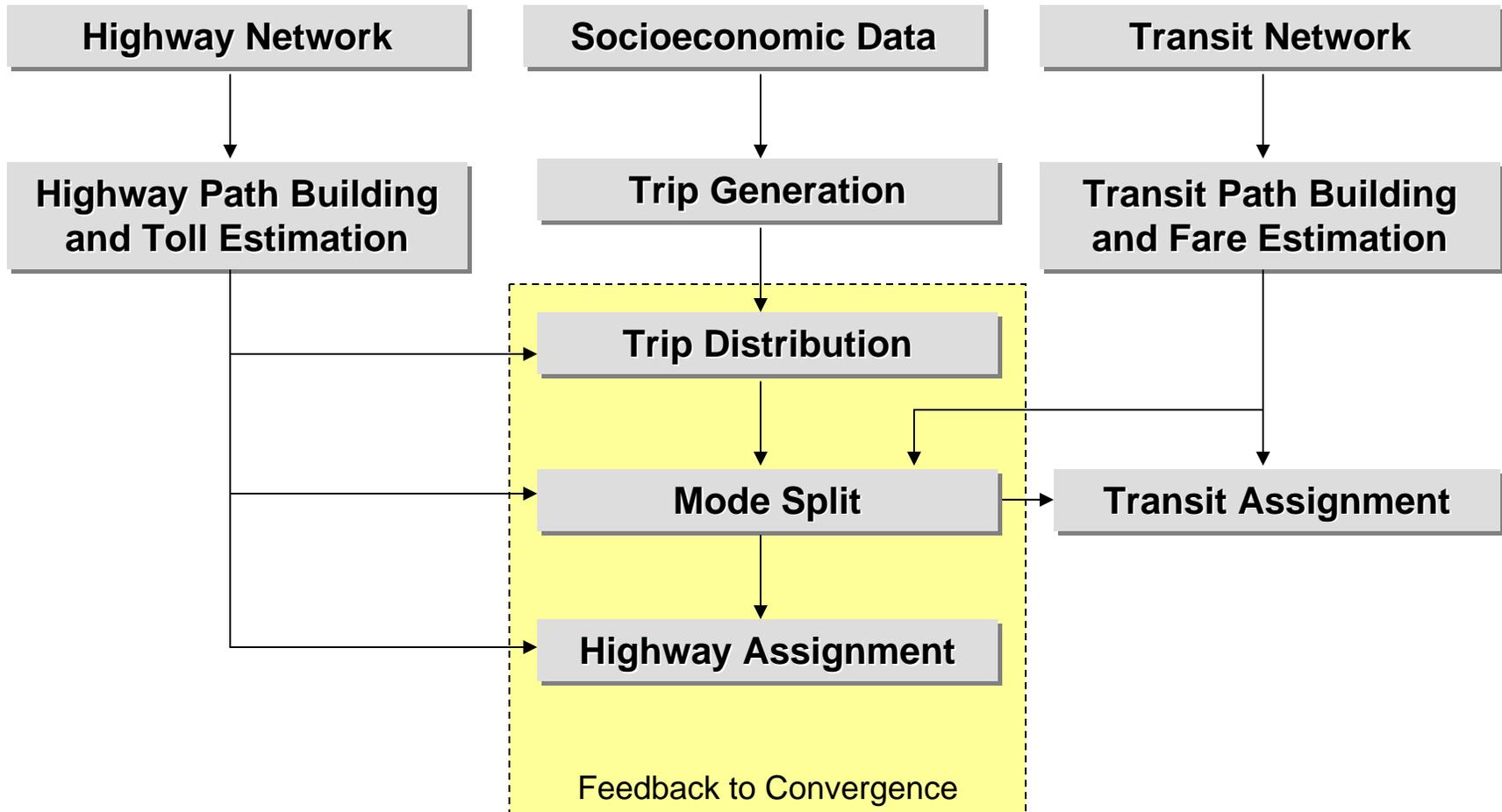


Traffic Analysis Zones

- A TAZ is a Unit of Geography Used to Forecast Trip Making
 - Should be consistent (nested inside) network boundaries
 - Should be consistent with model application
- Considerations
 - Fine Enough to Forecast Traffic
 - Course Enough to Get Data On
- Boundaries Typically Respect
 - Manmade Features (Roads, RR, etc)
 - Natural Features (Rivers, etc)
 - Political Features (census, city, county, state)

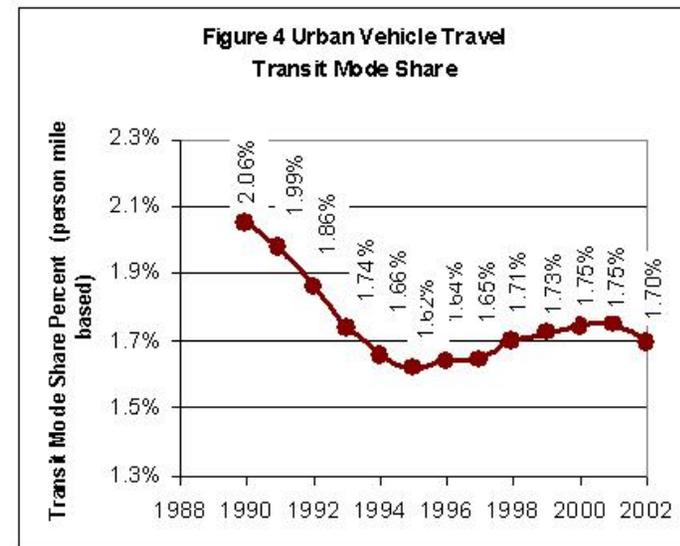
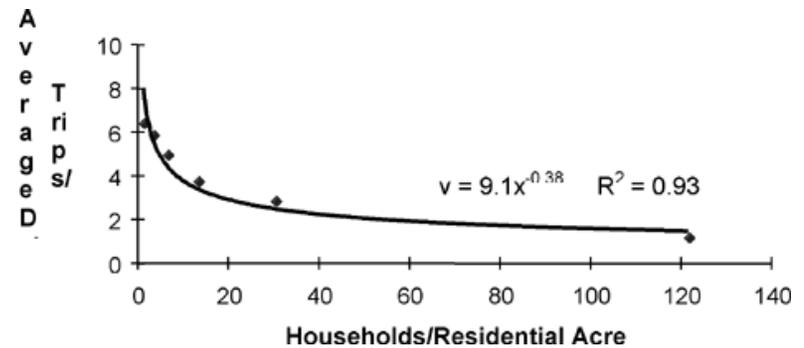


Standard Four-step Demand Forecasting Model



The Basic Elements

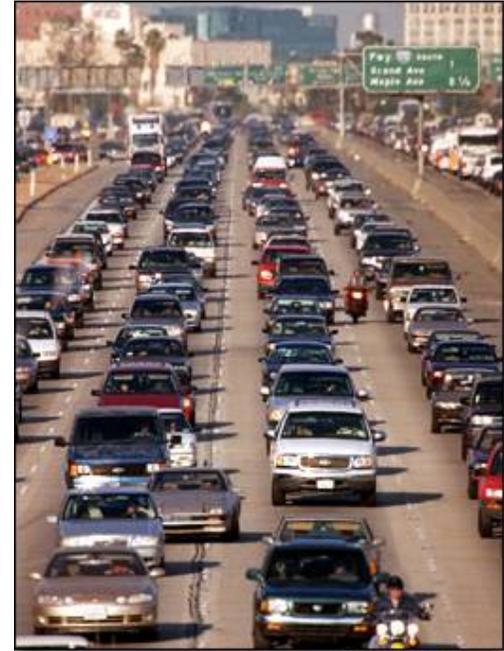
- Households and their Trip Making Behavior
- Employees and their Trip Making Behavior
- Locations of Households and Employees
- Travel Opportunities and Costs
- Transportation Infrastructure Available and its Capacity



NJRTM-E Specific Examples

- Who & Where are They- Zonal Data
- Where to Go- Trip Ends, Travel Time and Cost Matrices
- By What Means to Travel- Mode Choice Model, Costs and Congestion, Roadway Network, Transit Network
- Which Route to Take- Traffic Assignment, Transit Assignment, Feedback Loop

Now Let's Answer
Question 1: How Big is
the Problem?



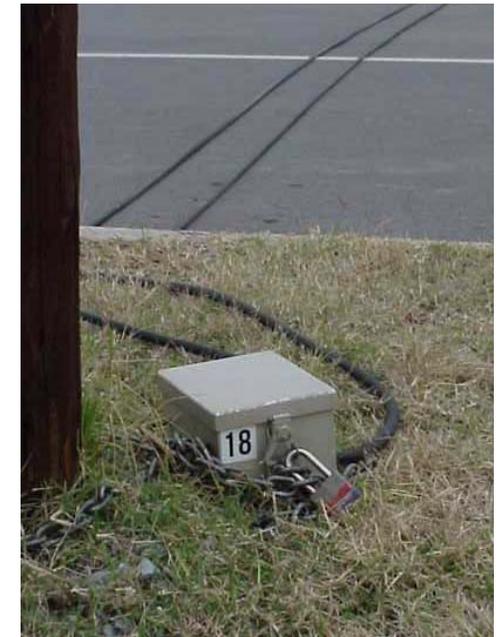
Reed Saxon / AP file



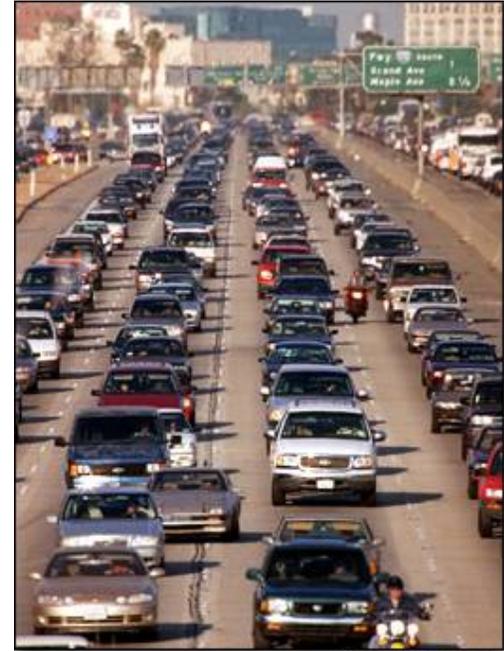
Sources of Understanding The Problem

- Observation
 - Traffic Counts
 - Origin/Destination Surveys
 - Transit Ridership Surveys
- User Opinion Surveys
- Newspaper Articles
- Field Review

Florio Rebuffs Plan for Toll Increase



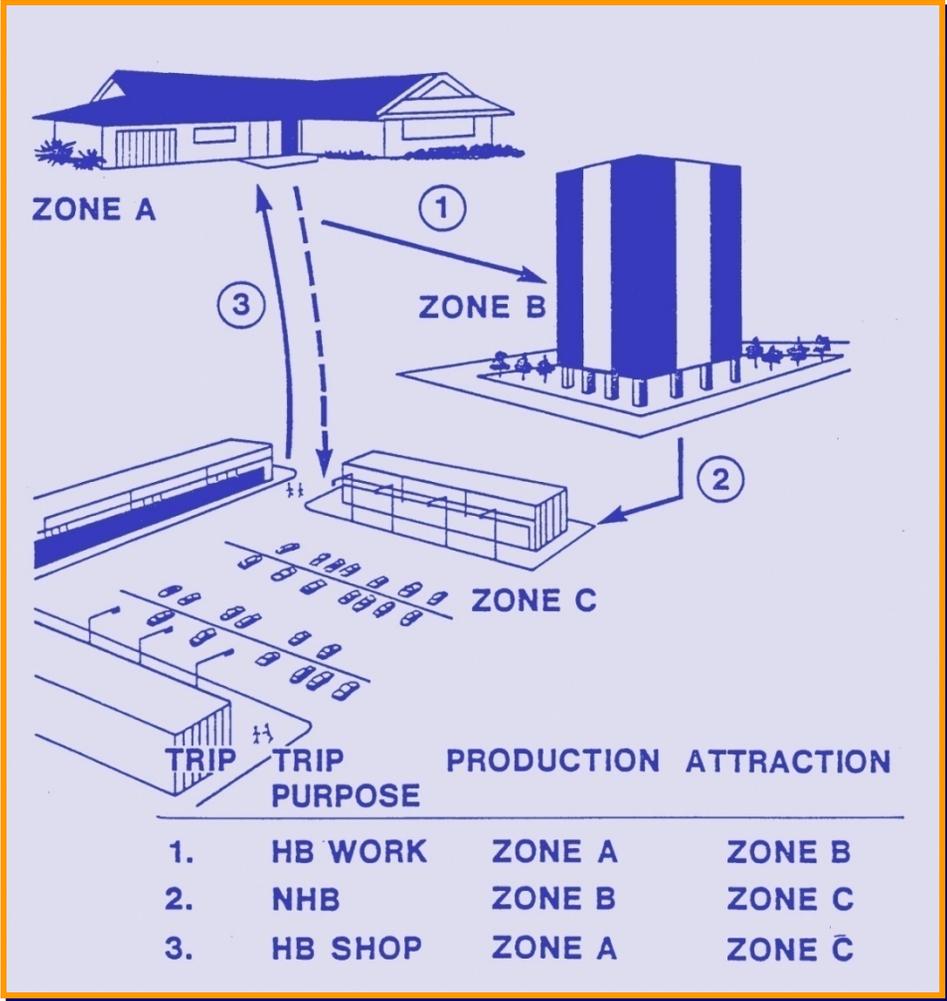
Now Let's Answer
Question 2: Where is
All the Travel Coming
From?



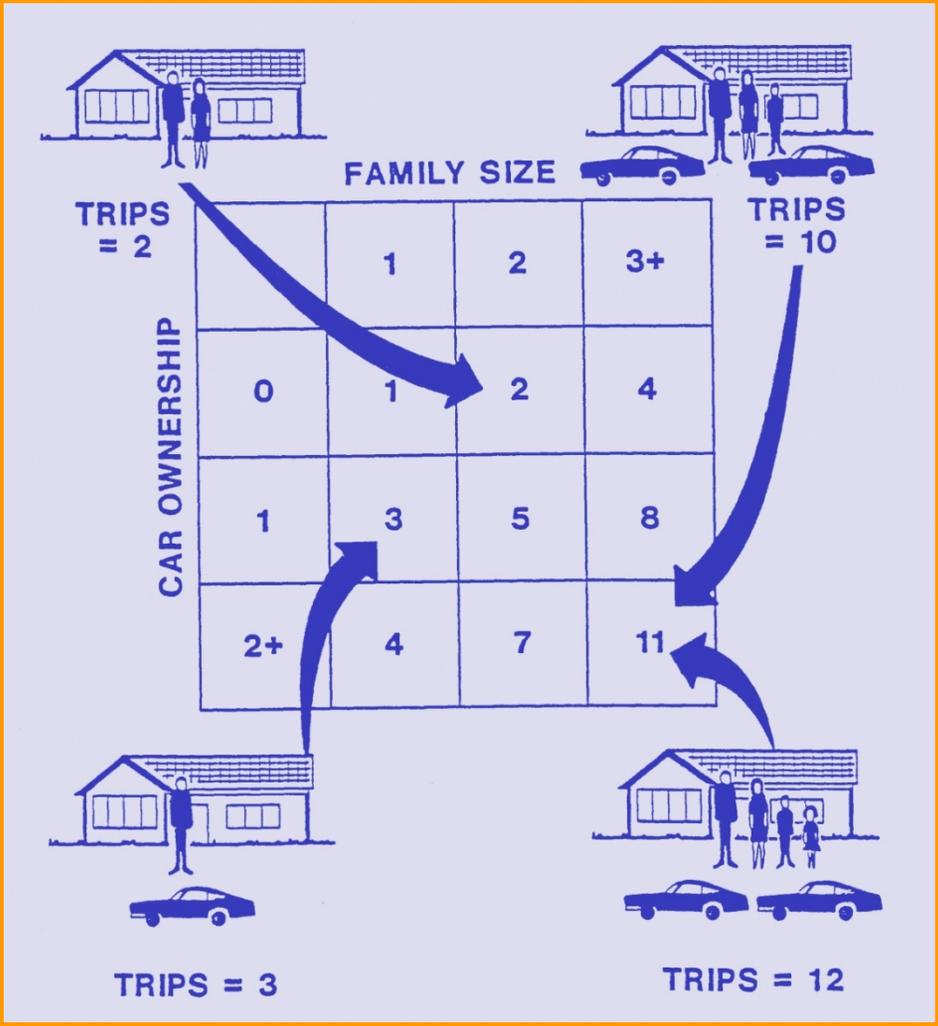
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Simple Trip Chain



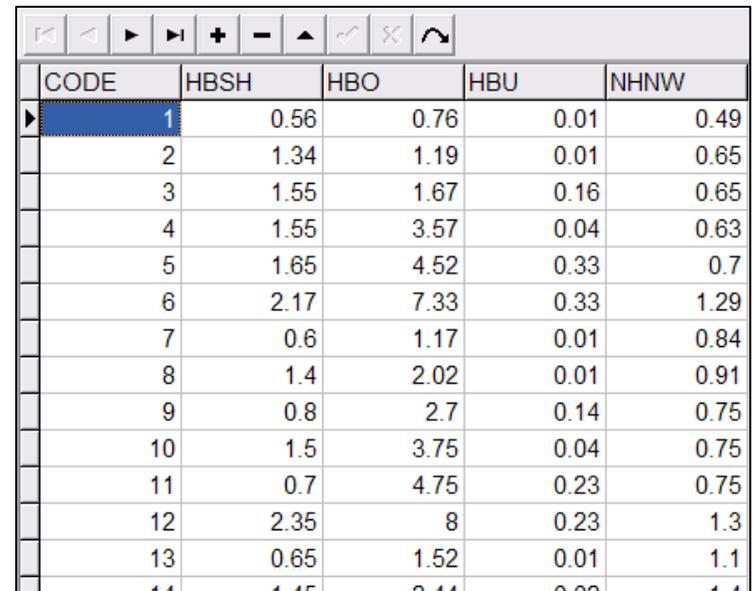
Simple Cross-Classification Technique



NJRTM-E Trip Generation

■ Cross-classification

- Household Lifecycle Groups (3)
 - With Retirees (at least 1)
 - With Children
 - Without Retirees or Children
- Household Income Groups (5)
 - 0-15K
 - 15-35K
 - 35-75K
 - 75-150K
 - 150k+
- Workers Per Household (4)
 - 0 Worker
 - 1 Worker
 - 2 Workers
 - 3+Workers
- Persons Per Household (6)
 - 1 to 6+ Persons



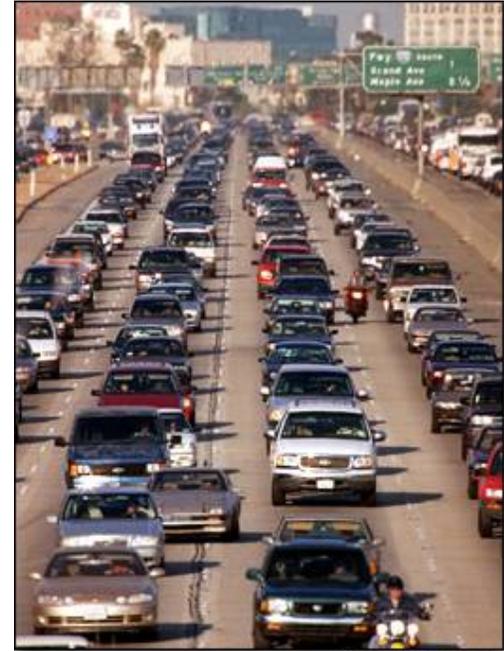
CODE	HBSH	HBO	HBU	NHNW
1	0.56	0.76	0.01	0.49
2	1.34	1.19	0.01	0.65
3	1.55	1.67	0.16	0.65
4	1.55	3.57	0.04	0.63
5	1.65	4.52	0.33	0.7
6	2.17	7.33	0.33	1.29
7	0.6	1.17	0.01	0.84
8	1.4	2.02	0.01	0.91
9	0.8	2.7	0.14	0.75
10	1.5	3.75	0.04	0.75
11	0.7	4.75	0.23	0.75
12	2.35	8	0.23	1.3
13	0.65	1.52	0.01	1.1
14	1.45	2.44	0.02	1.4

An example of NJRTM-E trip rates

NJRTM-E Trip Purposes

- Trips are Classified Based on Whether they are Oriented Toward Home or Work:
 - Home-Based Work Direct (from home to work)
 - Home-Based Work Strategic (e.g., drop off kids, pick up coffee on the way)
 - Home-Based Shopping
 - Home-Based Other (e.g., leisure, visit family)
 - Home-Based University
 - Work-Based Other (e.g., to lunch, shopping)
 - Non-Home Non-Work (all the rest - e.g., from a store to school)
 - Trucks

Now Let's Answer
Question 3: Where is
All the Travel Going
To?



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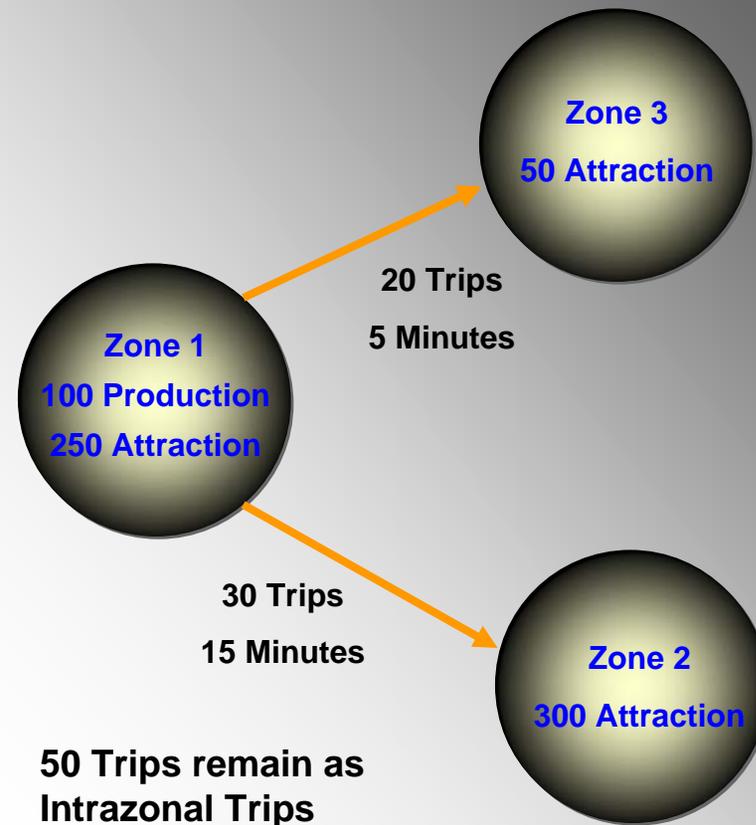


Trip Distribution Example

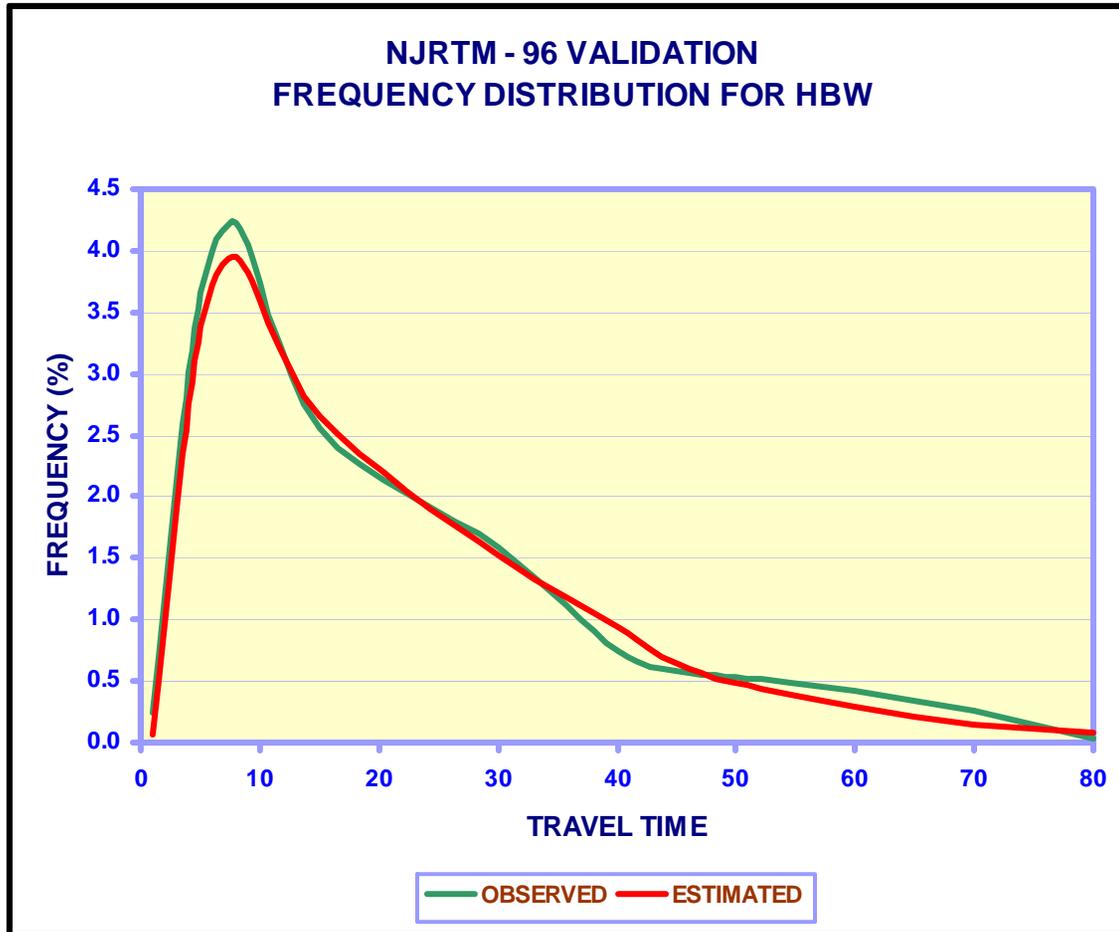
I. Trip Generation Estimates

Zone	Production	Attraction
1	100	250
2	200	300
3	300	50
Total	600	600

II. Trip Distribution (Zones)



Sample Trip Distribution

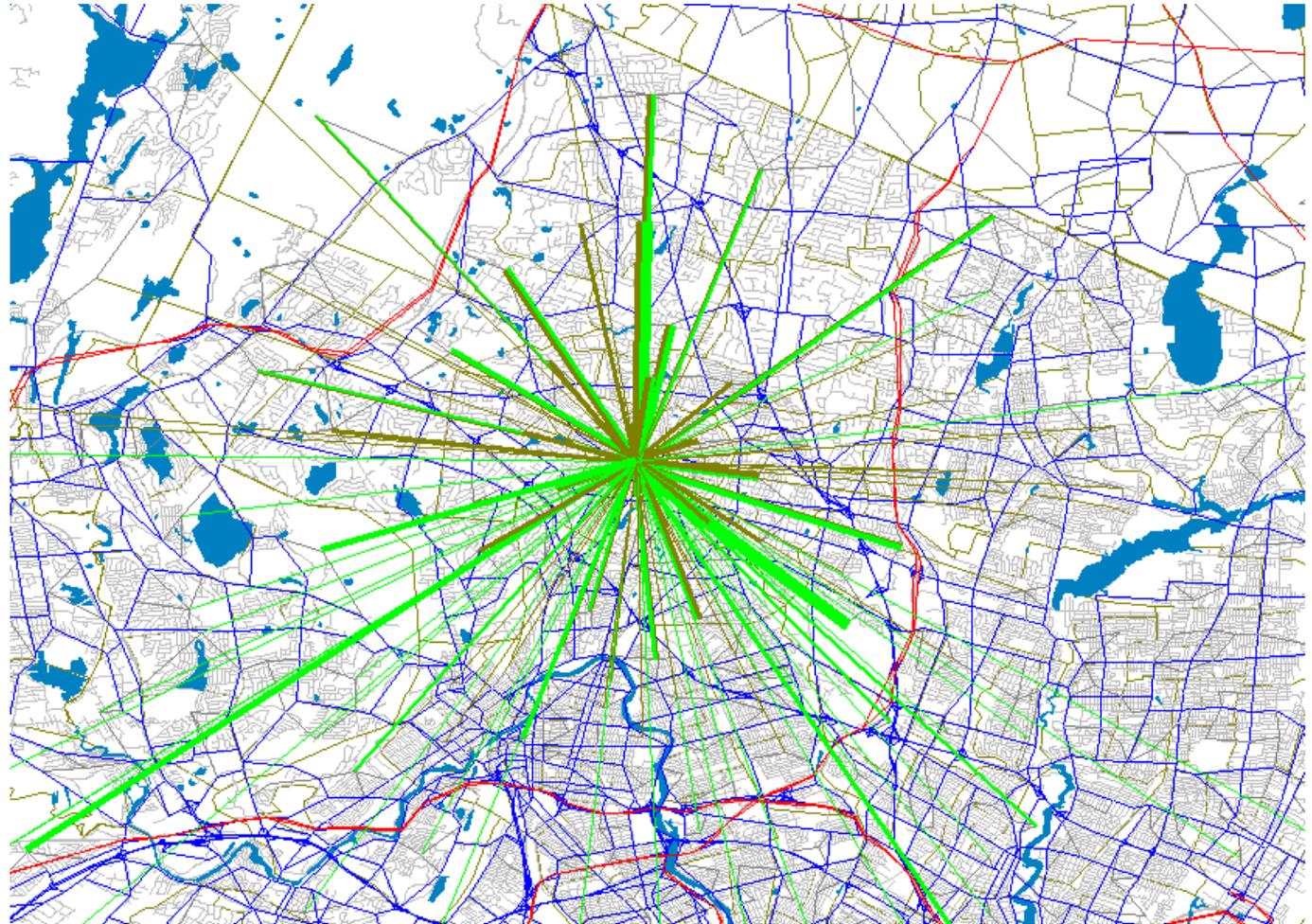


OBS. AVG. (min.)	EST. AVG. (min.)
22.3	23.1

Final model must replicate trips by time interval. This proves the model allocates trips properly

NJRTM-E Distribution

- Direction and Magnitude of Travel



Now Let's Answer
Question 4: How Will
Travelers Respond to
Different Solutions?

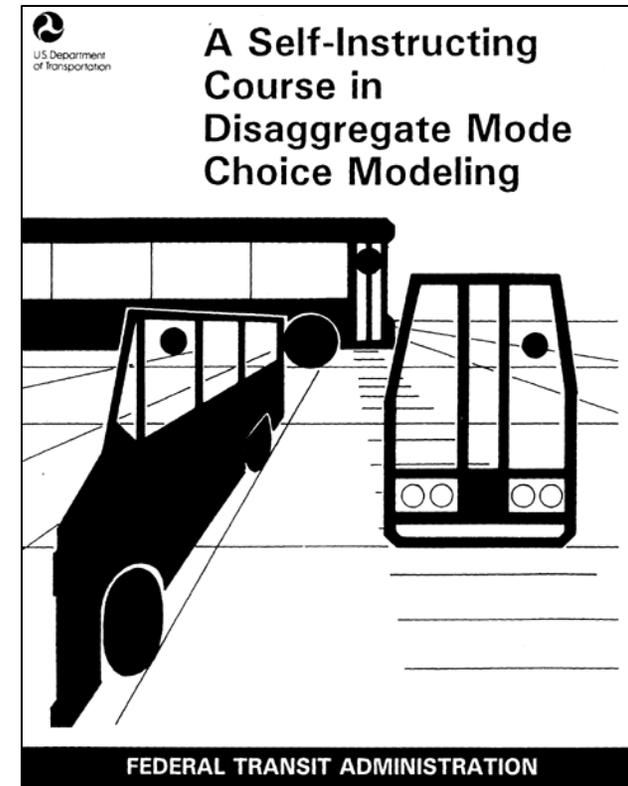


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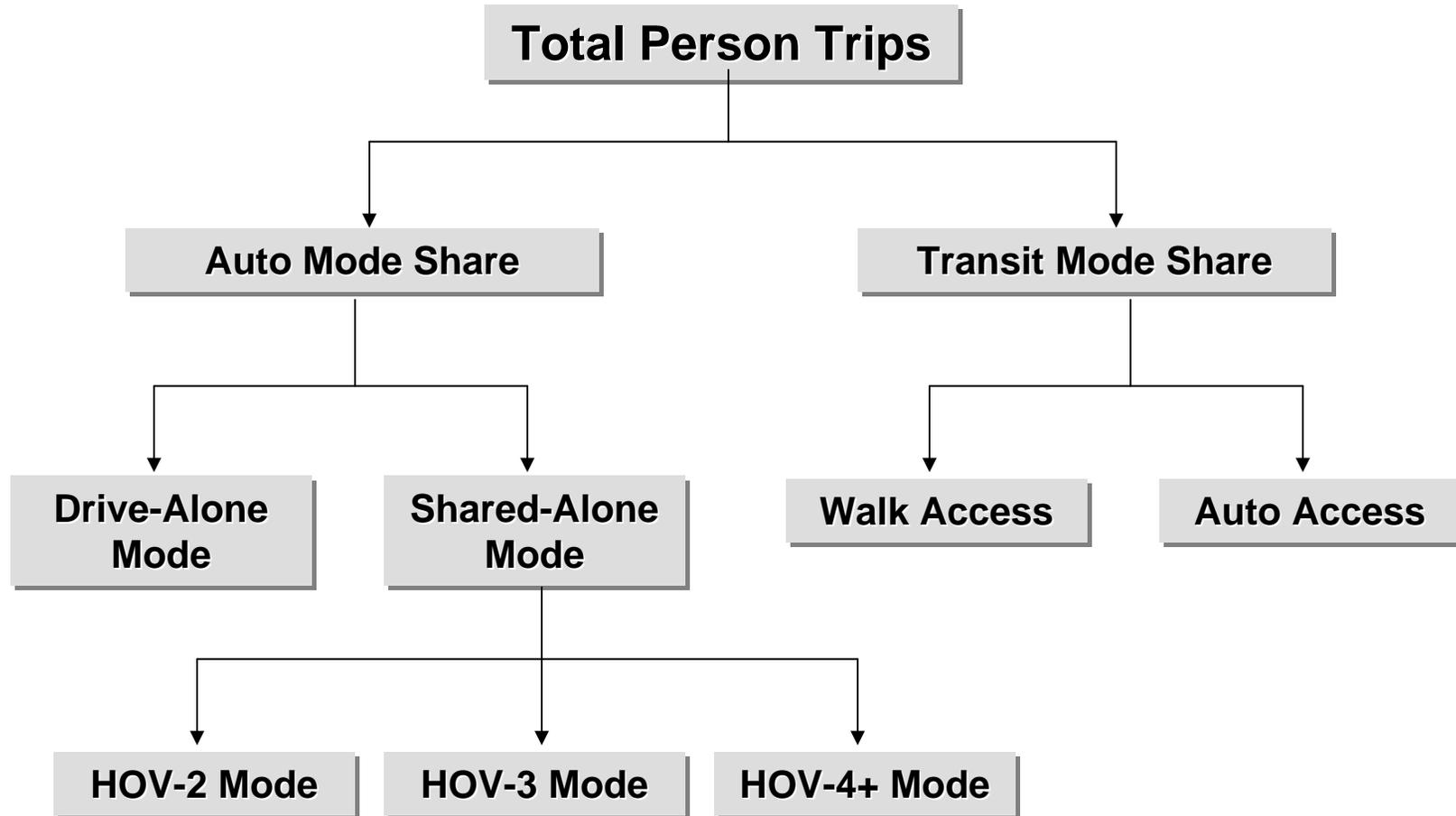


Mode Choice

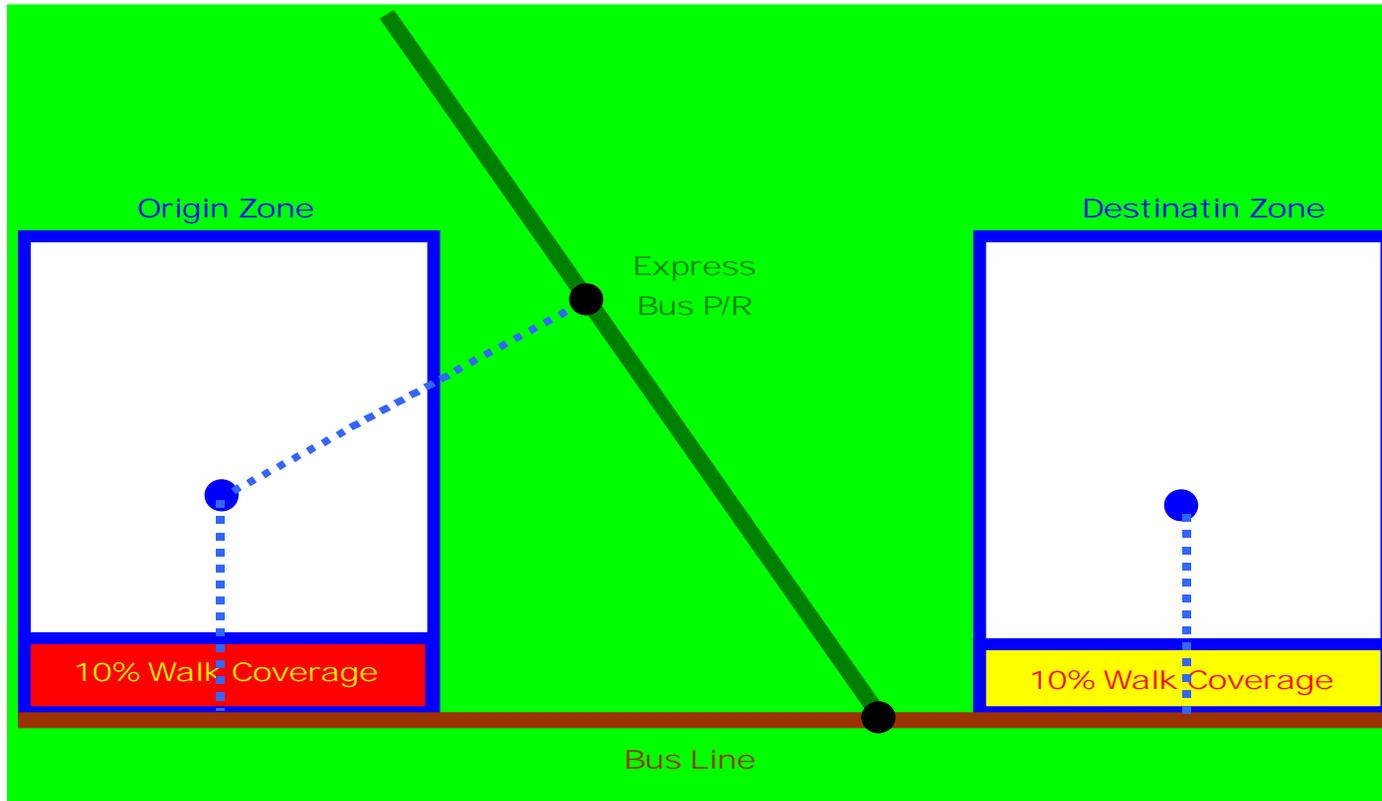
- Given the Available Modes to Get from Here to There, Which Ones are Travelers Likely to Use
- The Chance of a Mode Being Selected is a Function of:
 - Travel Time
 - Cost (Out of Pocket and Fixed)
 - Transfers
 - Walk Time
 - Wait Time
 - User Characteristics and Biases



Modes and Choices in NJRTM-E



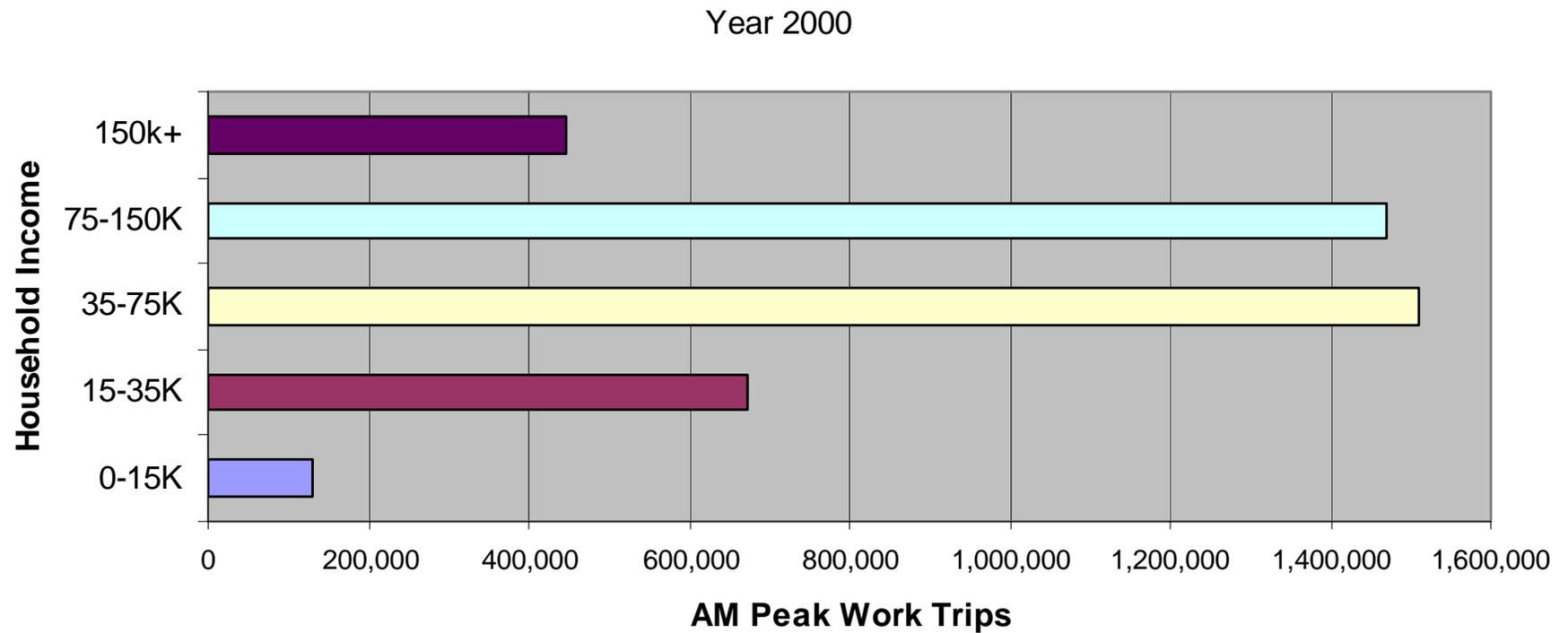
Mode Choice Market Segmentation Example



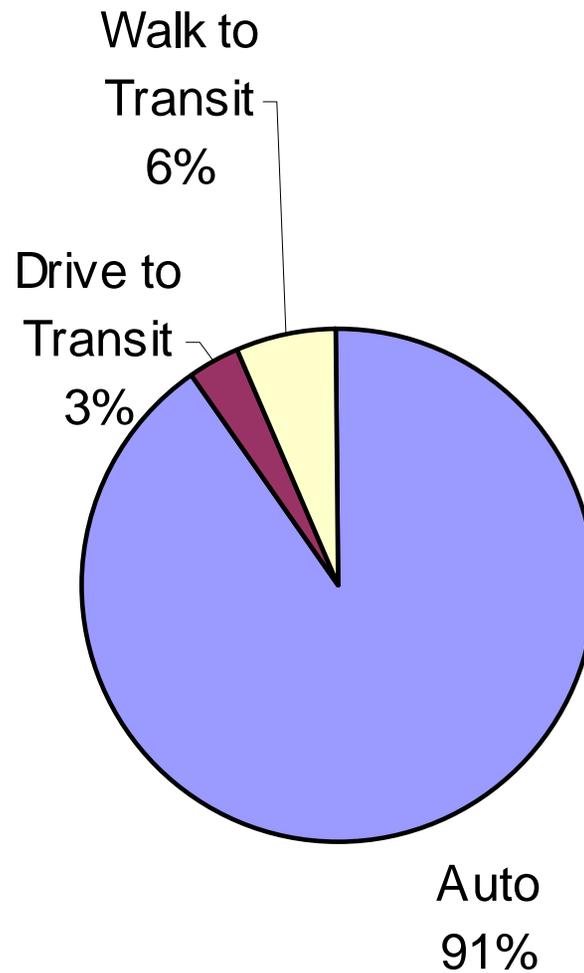
MARKET SEGMENT CALCULATIONS			COMPETING MODES AVAILABLE						
MARKET SEGMENT	PERCENTAGE ALLOCATION	TRIP ALLOCATION	TRANSIT MODES				AUTO MODES		
			LOCAL BUS		EXPRESS BUS		SOV	HOV2	HOV3
			WALK	DRIVE	WALK	DRIVE			
WALK - TRANSIT	1.0%	1	<input checked="" type="checkbox"/>						
DRIVE - TRANSIT	9.0%	9		<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
NO - TRANSIT	90.0%	90					<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

NJRTM-E Mode Choice

- 5 Income Classes for Work Trips



NJRTM-E Mode Choice- AM Peak

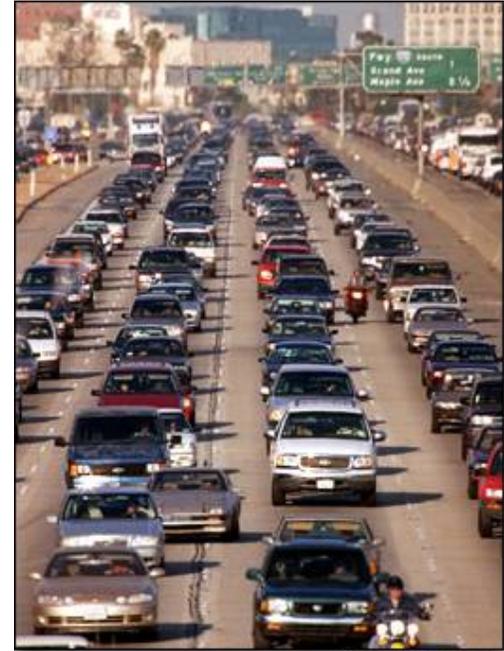


Let's Not Forget

- Trucks Can't Readily Change Modes
- Some People Don't Have a Car (captive)
- Some People Will Spend Anything to Save a Minute
- Some People Will Not Spend Anything to Save an Hour



Now Let's Answer
Question 4: How Will
Travelers Respond to
Different Solutions?



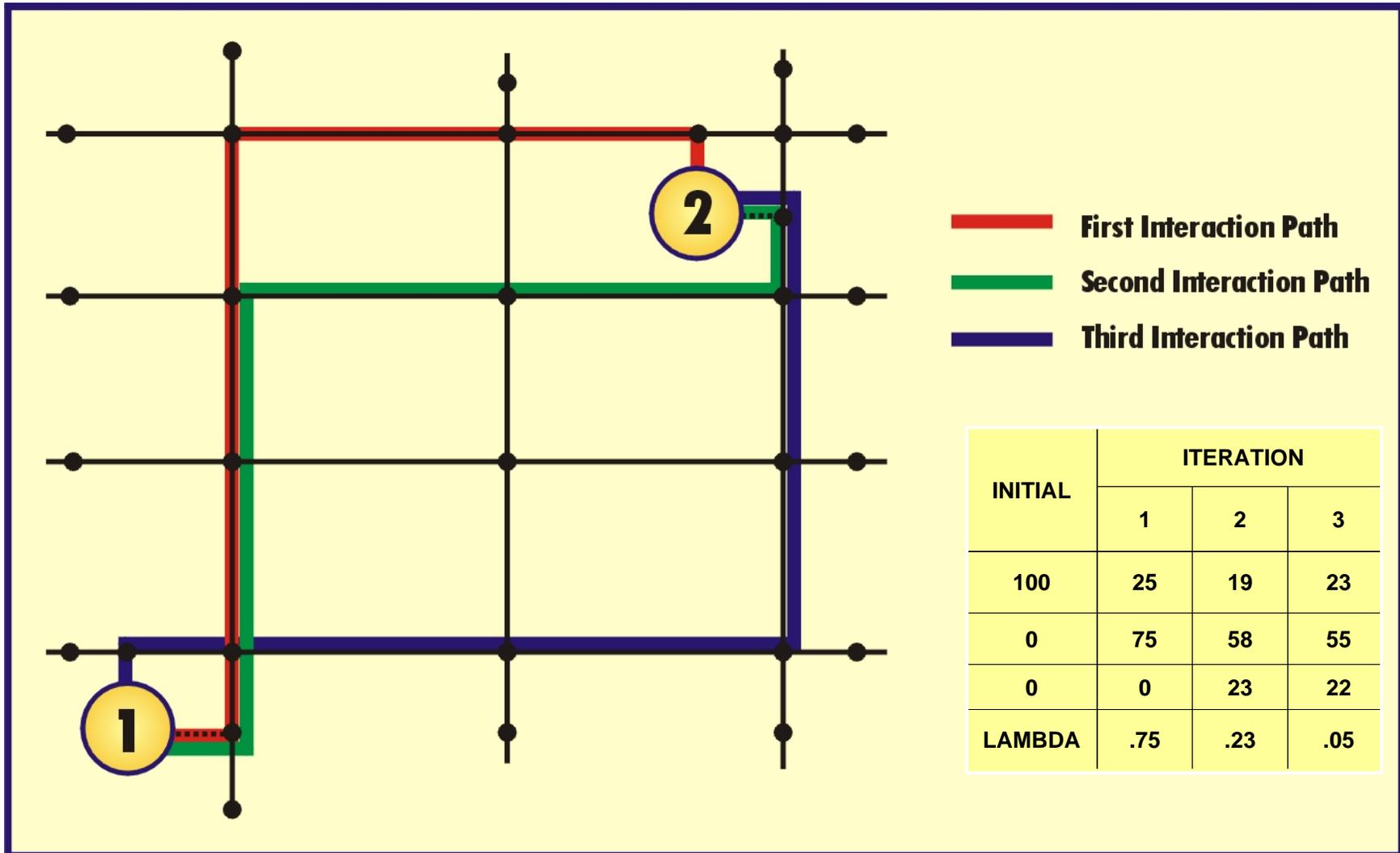
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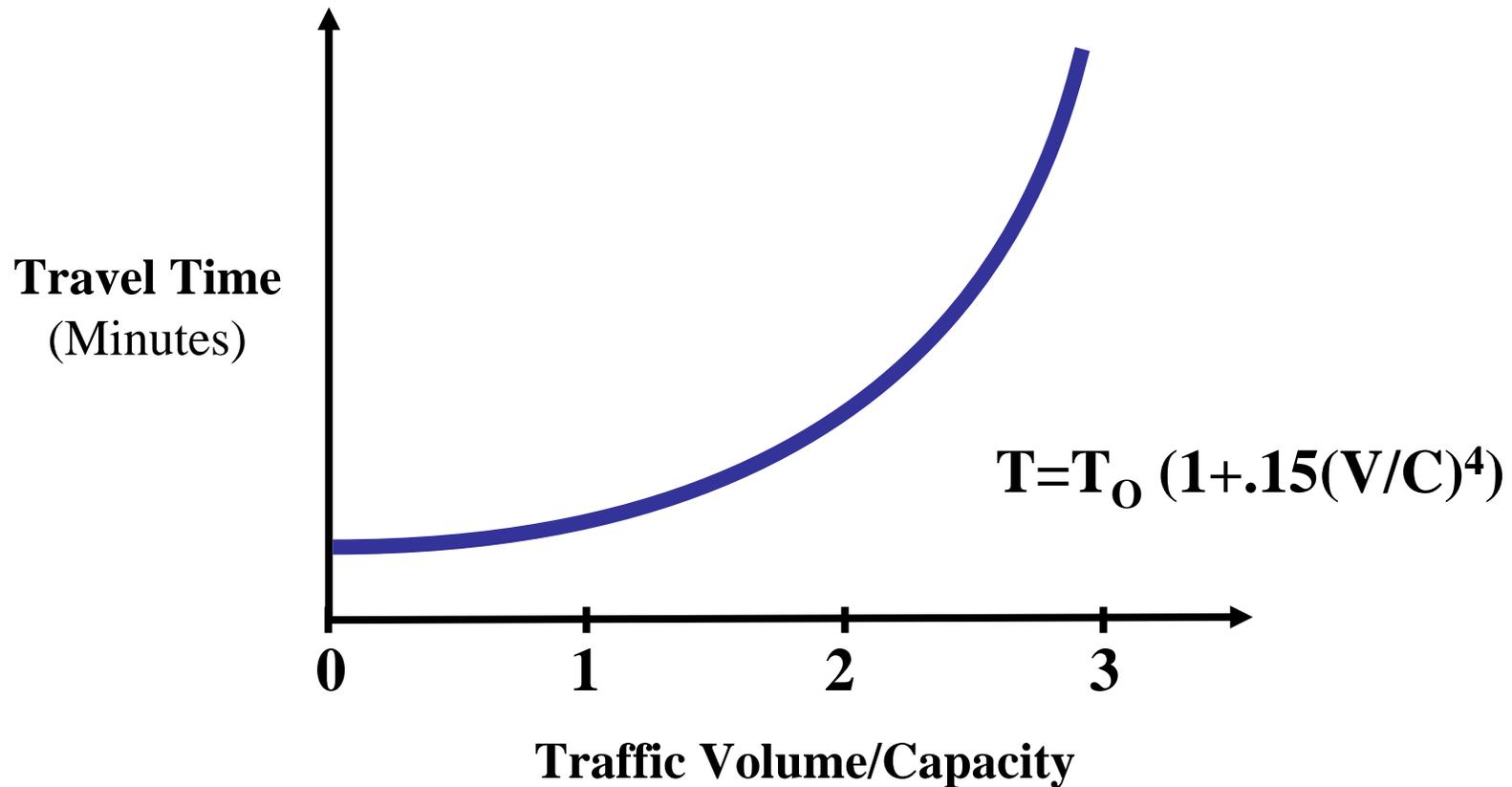
Assignment

- Given the Number of Trips by Mode have been Calculated, Assignment Puts those trips on Specific Routes (road, transit)
- Transit Assignment is a Function of the Best Choice
- Highway Assignment is a Function of the Best Choice
 - Travel Time
 - Toll Cost
 - Congestion

Equilibrium Assignment Process

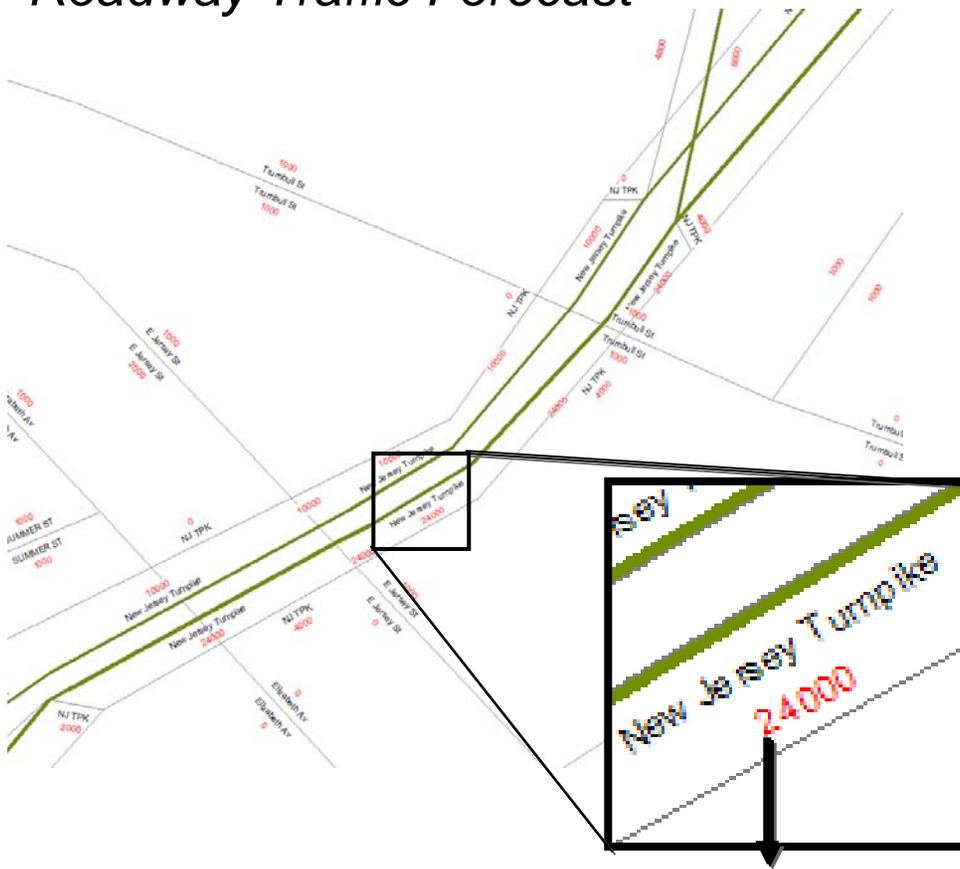


Capacity Restraint - Bureau of Public Roads Delay Calculation "BPR Formula"



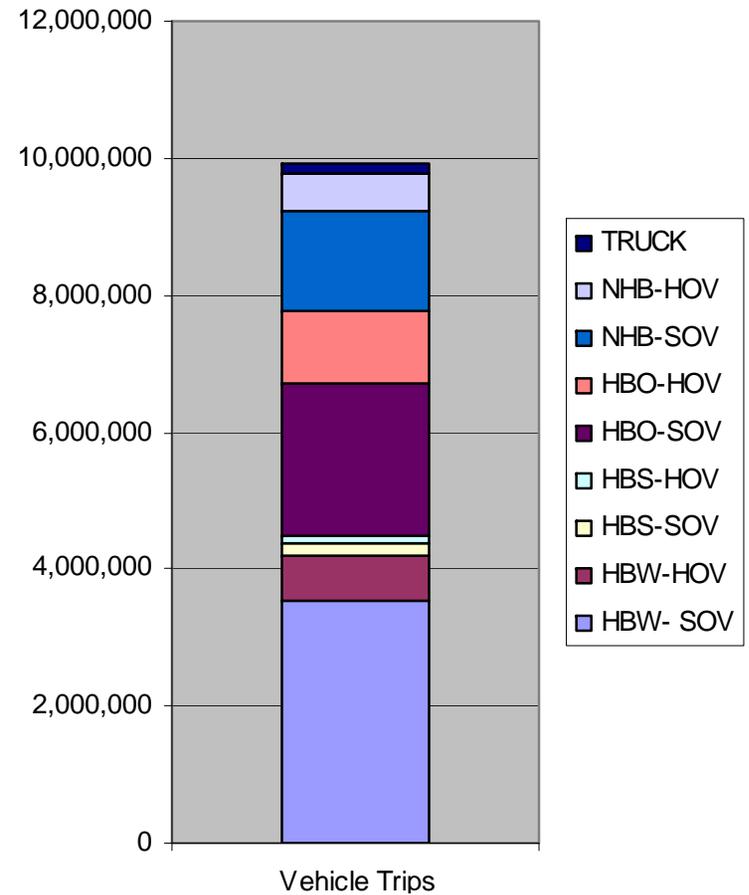
NJRTM-E Assignment

Roadway Traffic Forecast



24,000 vehicles in AM peak hour

AM Peak Vehicle Trips by Purpose Validation Year



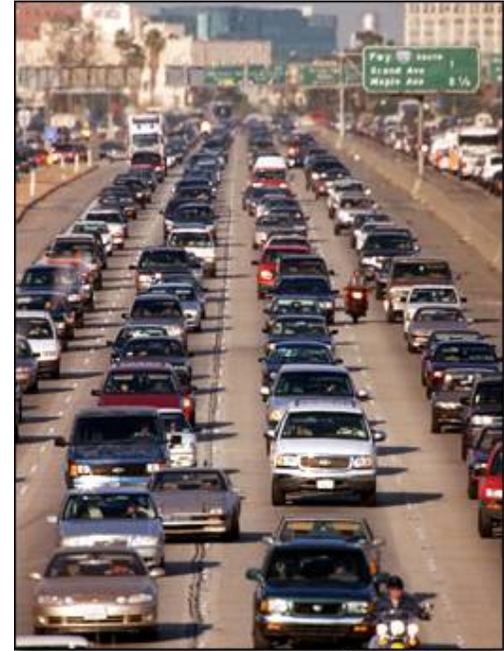
NJRTM-E Transit Assignment

- Results for Modes, Lines or Stops
- Information Available About
 - Ridership
 - Revenues
 - Passenger Miles of Travel
 - Vehicle Fleet Requirements

Train Ridership Comparison

	Base	Scenario 3A	Ratio
Bay Head	885	889	1.00
Pt Pleasant Beach	2,376	2,372	1.00
Manasquan	1,811	1,814	1.00
Spring Lake	1,867	1,872	1.00
Belmar	1,083	1,086	1.00
Bradley Beach	1,799	1,804	1.00
Asbury Park	1,784	1,786	1.00
Allenhurst	294	294	1.00
Elberon	1,246	1,245	1.00
SUBTOTAL	13,145	13,162	1.00
Long Branch	4,592	4,598	1.00
Little Silver	4,615	4,603	1.00
Red Bank	4,340	4,337	1.00
Middletown	6,953	6,967	1.00
Hazlet	4,661	4,696	1.01
Matawan	16,378	17,047	1.04
South Amboy	4,914	5,813	1.18
Perth Amboy	3,123	3,125	1.00
Woodbridge	3,550	3,556	1.00
Avenal	486	489	1.01
SUBTOTAL	53,612	55,231	1.03
GRAND TOTAL	66,757	68,393	1.02

Now Let's Answer
Question 5: How Long
Would a Solution be
Good For (return on
investment)?



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Solution

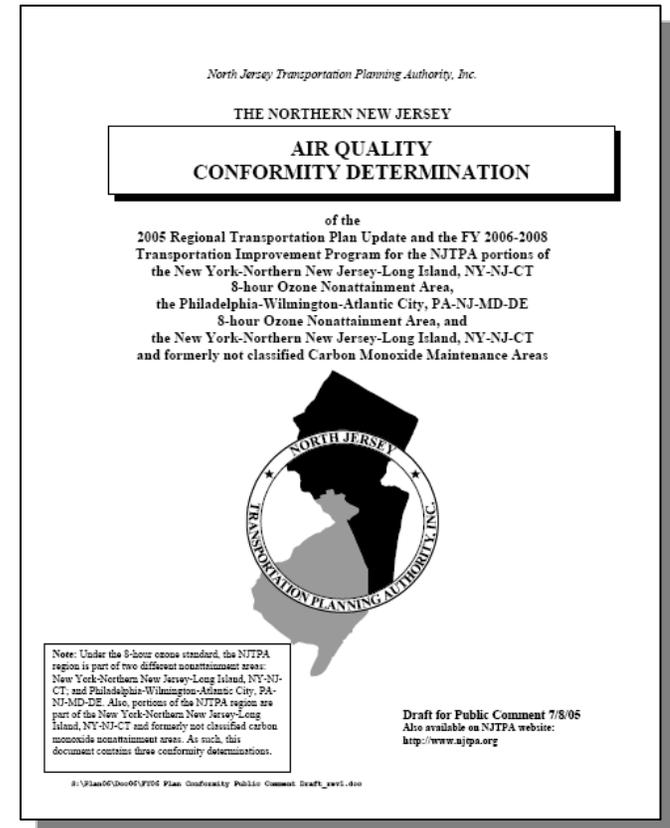
- Use the NJRTM-E
- Give it Forecasts of
 - Networks
 - Demographics
- Analyze Results to See if Solution Fits in 5 Years, 10 Years, 30 Years
- Does the Result Fit the Community's Vision?



Break

Typical Applications of the NJRTM-E

- Regional/State
 - Air Quality Analysis
 - Evaluation of Major Regional Projects
 - Impacts on “Neighbors”
 - Freight
 - Roadway Revenue Forecasts (Toll, Gas Tax, etc)
- Subarea and Local
 - Land Use Plans
 - Bypasses and Widening



Model Users

- Agencies
 - NJTPA
 - NJDOT
 - NJ Transit
- Subregions
 - Counties
 - Newark/Jersey City
- Other Agencies
 - In-state Authorities
 - Adjacent MPOs
- Consultants

Data Driving the NJRTM-E

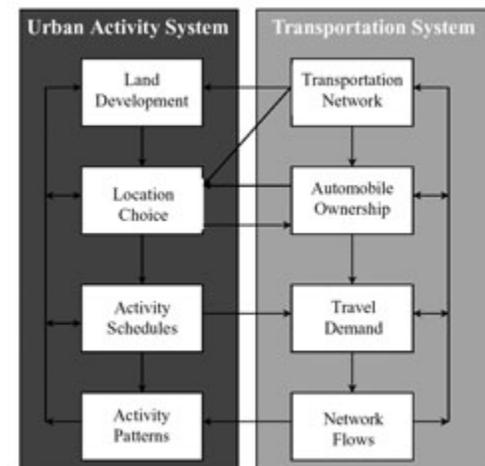
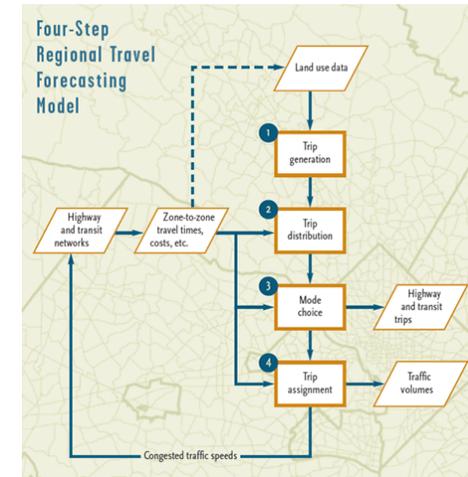
- Socio-economic
 - Households by Lifestyle, Income and Persons
 - Employment by Type
 - Truck Terminals
 - University Enrollment
 - Special Generators
 - Etc.
- Network
 - Facility Type
 - Lanes
 - Transit Services
 - Etc.
- Behavioral
 - Parameters, rates, coefficients, etc.

*Where's The Traffic
Coming From or
Going To?*

*How Will Travelers
Respond to Different
Solutions?*

Questions Put to Models

- Those They Can Answer
- Those They Can Only Partially Answer
- Those They Can Not Answer
- A Function of
 - How far out is the forecast
 - What degree of sensitivity to variables
 - Certainty of Independent variables
 - How much variation in variables and coefficients
 - Sometimes the model is the ONLY tool available for certain analyses



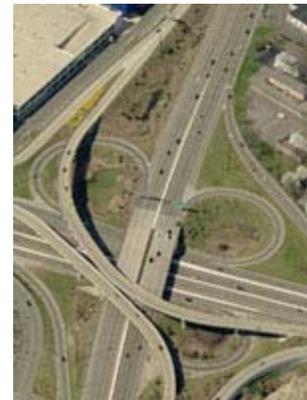
Using the Tool Appropriately

- Understanding the Character of a Macroscopic Model
- Understanding the Limitations of Each Type of Model
 - Trend- No behavior considerations
 - Macroscopic/Demand
 - Microscopic/Operational
- Understanding the Causes of Model “Error”
 - Averages
 - Specification
 - Cumulative and Offsetting
- Compensating for Errors and Unknowns
 - NCHRP Methods
 - Sensitivity Analysis
 - Hedging Your Bet on Error- What if?

Types of Demand Models

- Gaming/Visioning
- Direct Demand
- Simple Four-step
- Complex Four-step
- Complex Four-step with Feedback (NJRTM-E)
- Activity-based
- Integrated Transport/Land Use Models

TMIP
Travel Model Improvement Program



The NJRTM-E Model as One Tool in a Toolbox

- Long-Range Planning Tools (NJRTM-E)
- Short-Range Planning Tools (trend, pivot point, incremental)
- Operational Planning Tools (DYNASIM, CORSIM, SYNCRO)
- Tools to Communicate Alternatives' Concepts and Likely Outcomes



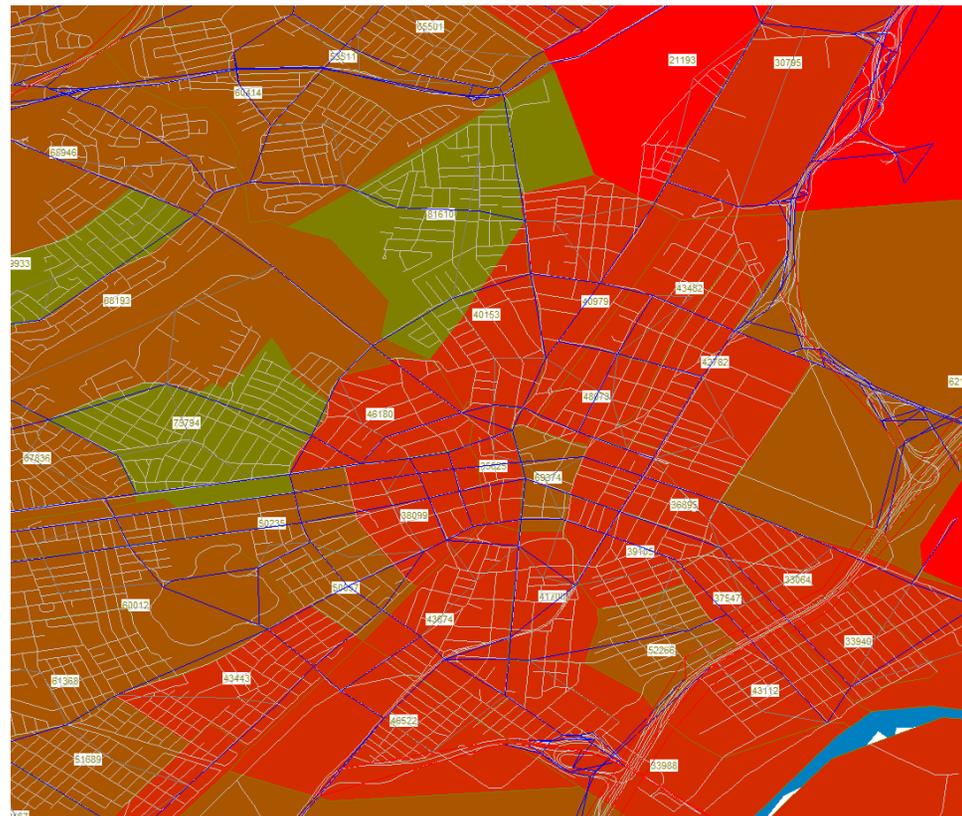
Types and Varieties of Outputs

- Translating Model Outputs to Meaningful Decision Making Results
- Summaries
 - Tabular
 - Graphical
 - Map

Summarizing Land Use Input/Outputs

- Thematic Maps
- Useful for Presenting Spatial Information that relates to a Specific Geography
 - Zones
 - Census Tracts
 - City/County Boundaries
- NJRTM-E Examples
 - Zonal Attributes
 - Trip Ends
 - Travel Time

*Where's The Traffic
Coming From or
Going To?*

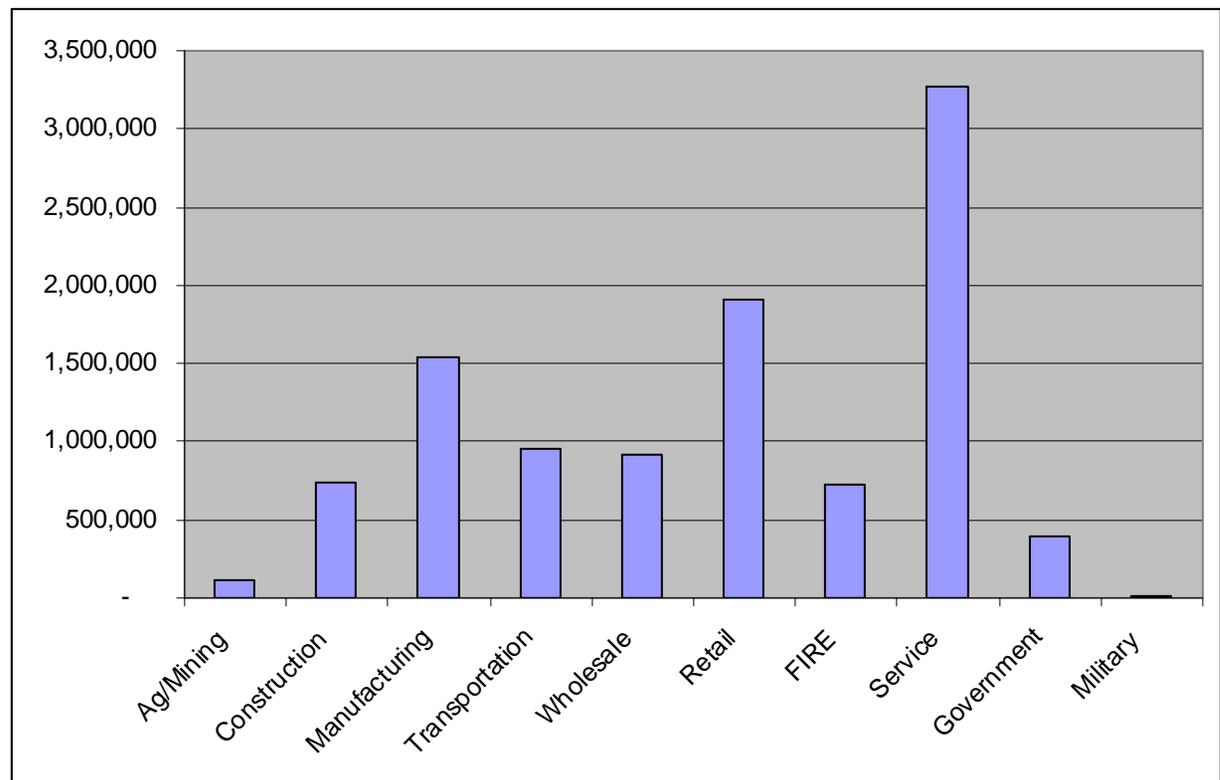
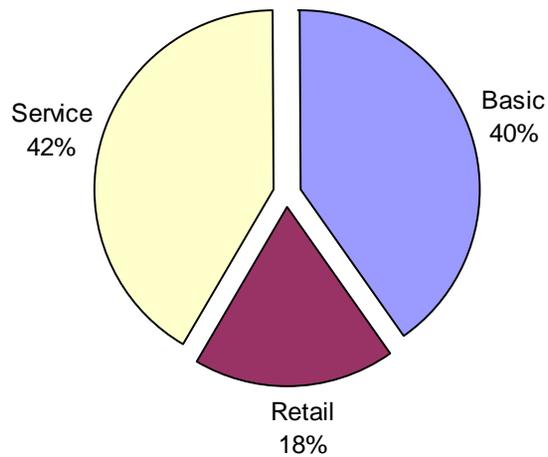


Income by Traffic Zone

Summarizing Land Use Inputs/Outputs

- Total Employment in the Year 2000

Where's The Traffic Coming From or Going To?



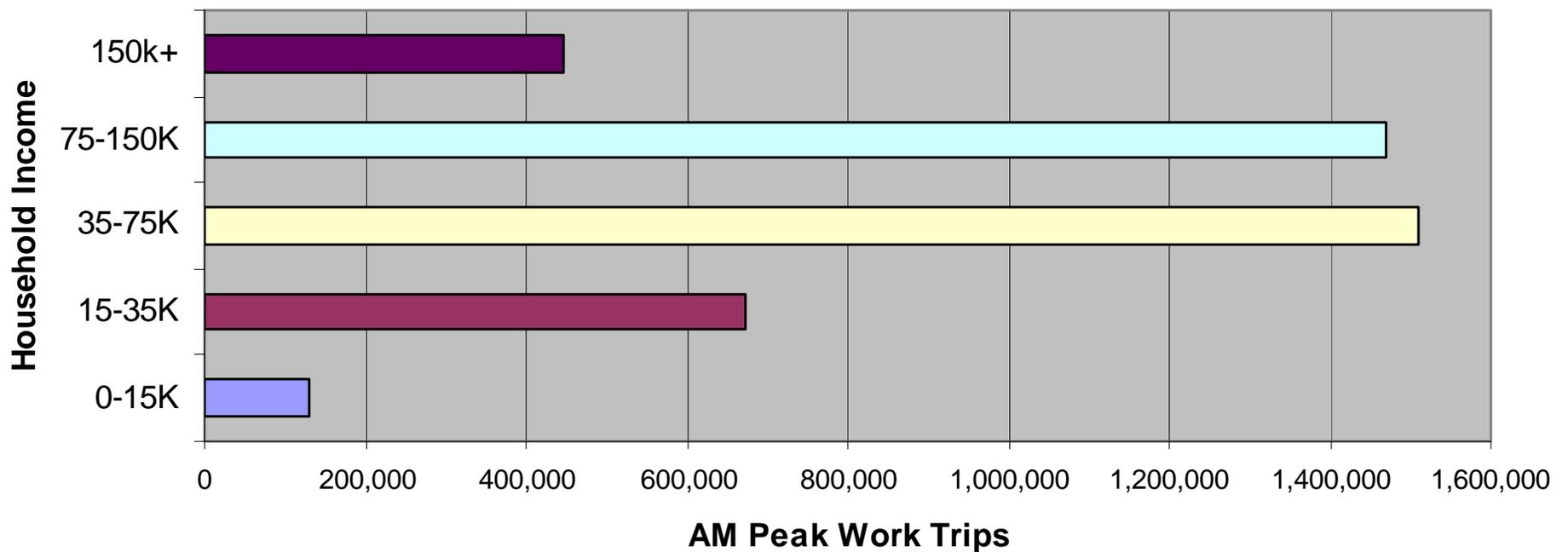
Summarizing Land Use Inputs/Outputs

- Histograms

- Great for Showing Shares, Trip Length and Other Frequency-type Data

Where's The Traffic Coming From or Going To?

Year 2000



Summarizing Land Use Inputs/Outputs

- Tables

- Easily Show Detailed Results and Can Make Subtle Data Differences Clearer

How Will Travelers Respond to Different Solutions?

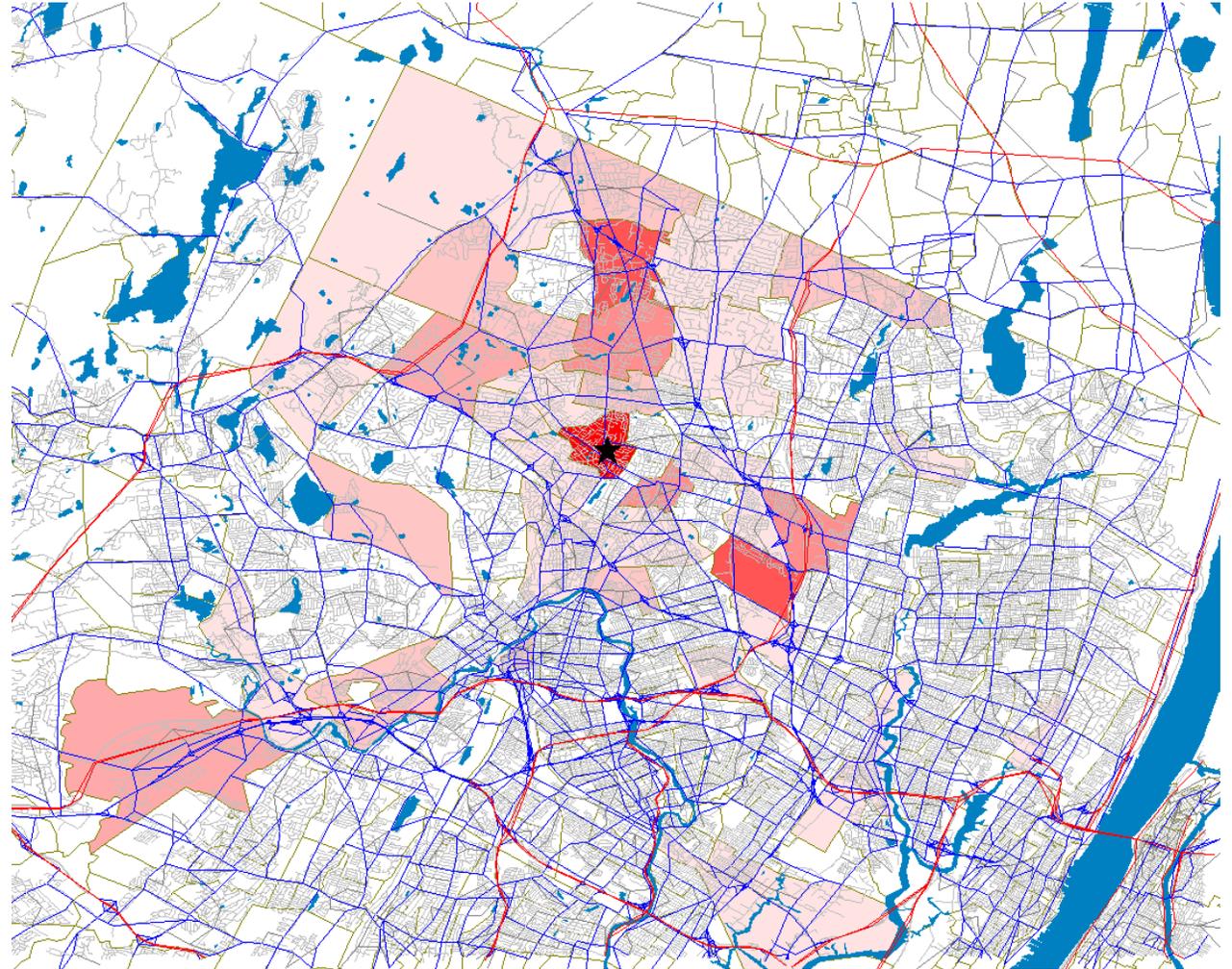
Transit Ridership Summary

Rail/Ferry Services	Observed	Estimated	Diff	% Diff
Main/Bergen/Port Jervis Line	22,380	26,192	3,812	17.0%
Pascack Valley Line	7,018	3,352	-3,666	-52.2%
Boonton Line	9,824	14,620	4,796	48.8%
Morris/Essex Line	40,250	30,904	-9,346	-23.2%
Raritan Valley Line	18,070	16,556	-1,514	-8.4%
North Jersey Coastline/Northeast Corridor Line	106,052	94,154	-11,898	-11.2%
Metro North Trips from West of Hudson Locations	5,248	3,224	-2,024	-38.6%
Total Rail Service	208,842	189,002	-19,840	-9.5%
PATH	500,532	519,082	18,550	3.7%
Newark City Subway Line	36,232	30,385	-5,847	-16.1%
Hudson-Bergen LRT	22,000	31,838	17,580	123.3%
NJ Ferry Service	23,097	14,838	-8,259	-35.8%
Total	790,703	785,145	-5,558	-0.7%

Presenting Trip Distribution Results

- Thematic Map

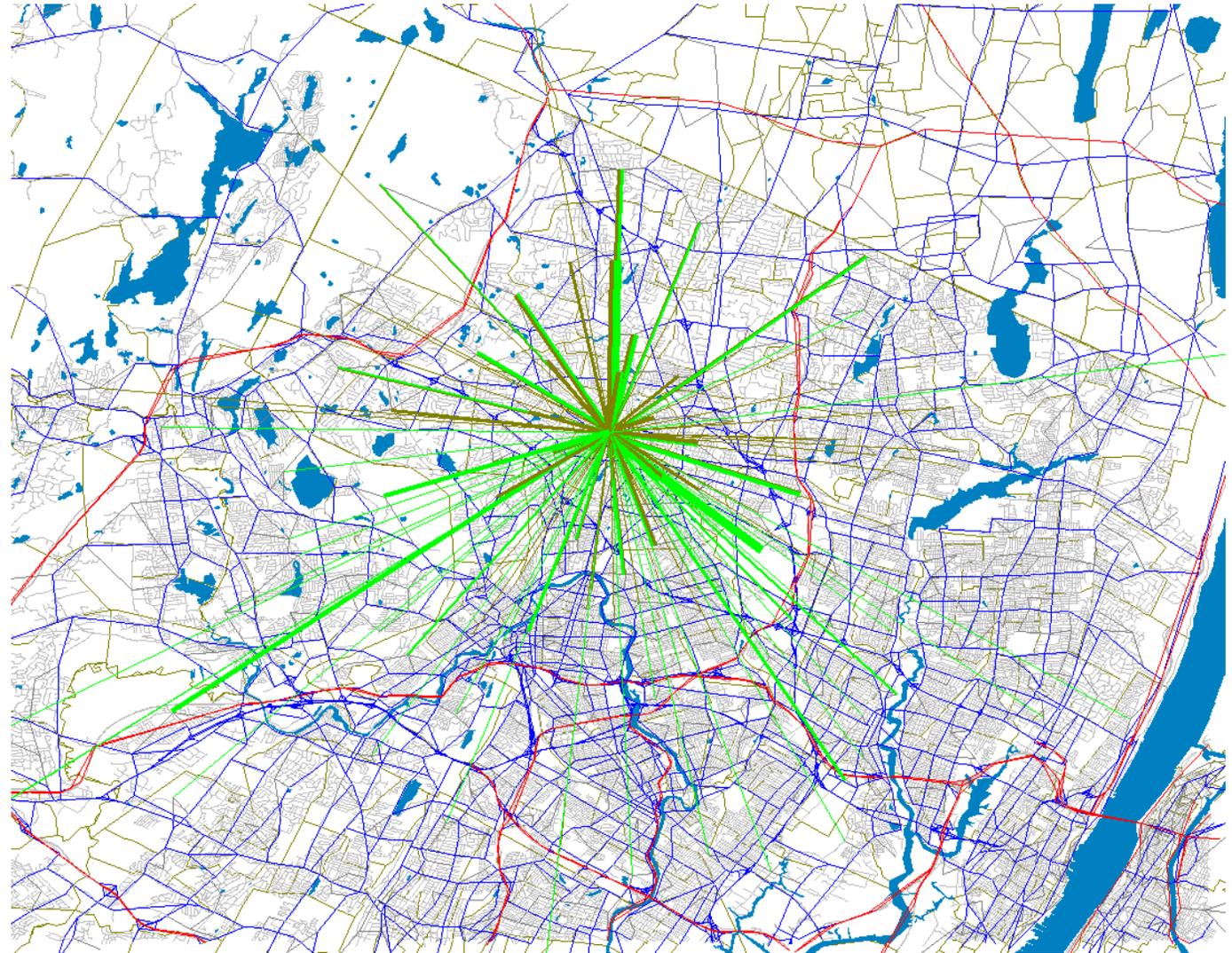
*How Will Travelers
Respond to Different
Solutions?*



Destinations, Color by Trips Attracted from a Zone

Presenting Trip Distribution Results

- Desire Lines



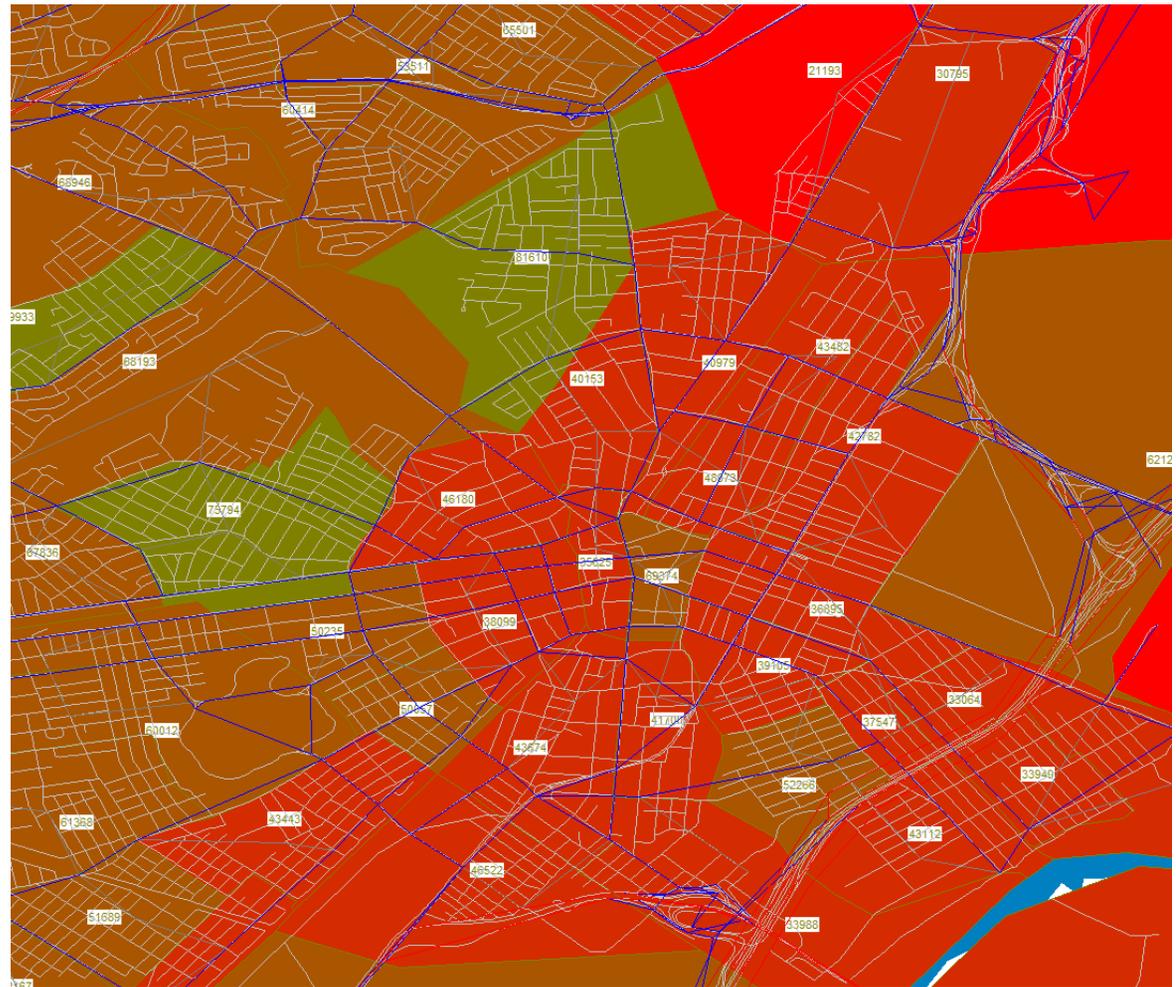
*Where's The
Traffic Coming
From or Going
To?*

Understanding Mode Choice Results

- Thematic Map of Low Income Households

Where's The Traffic Coming From or Going To?

How Will Travelers Respond to Different Solutions?

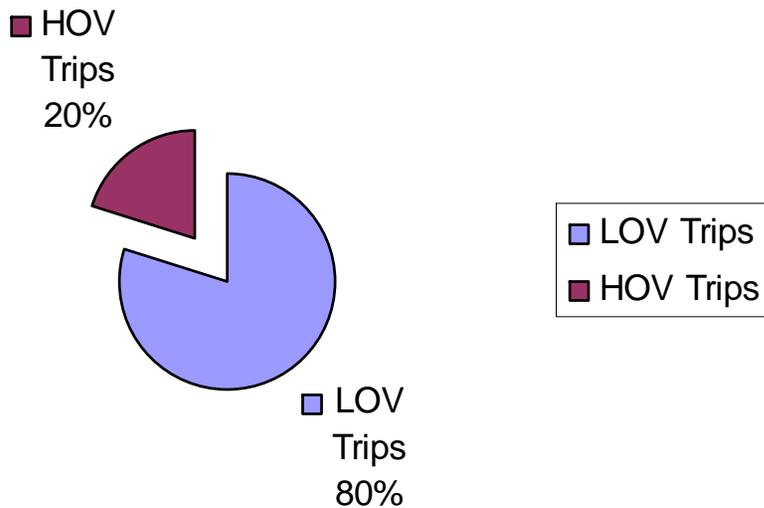


Income by Traffic Zone

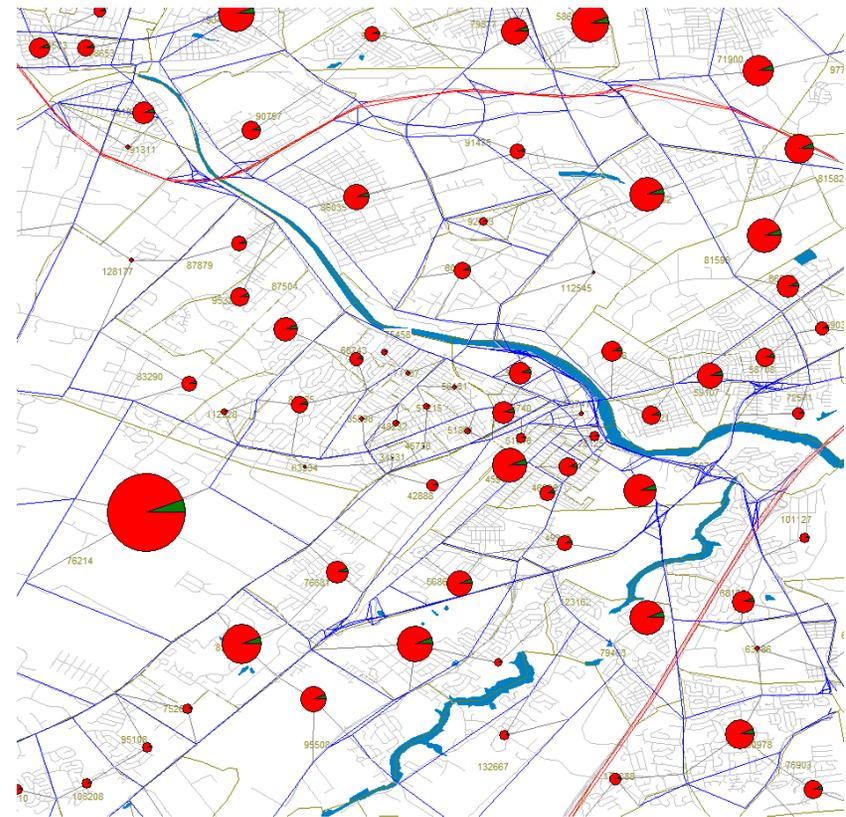
Understanding Mode Choice Results

- Pie Charts and Histograms

New Development



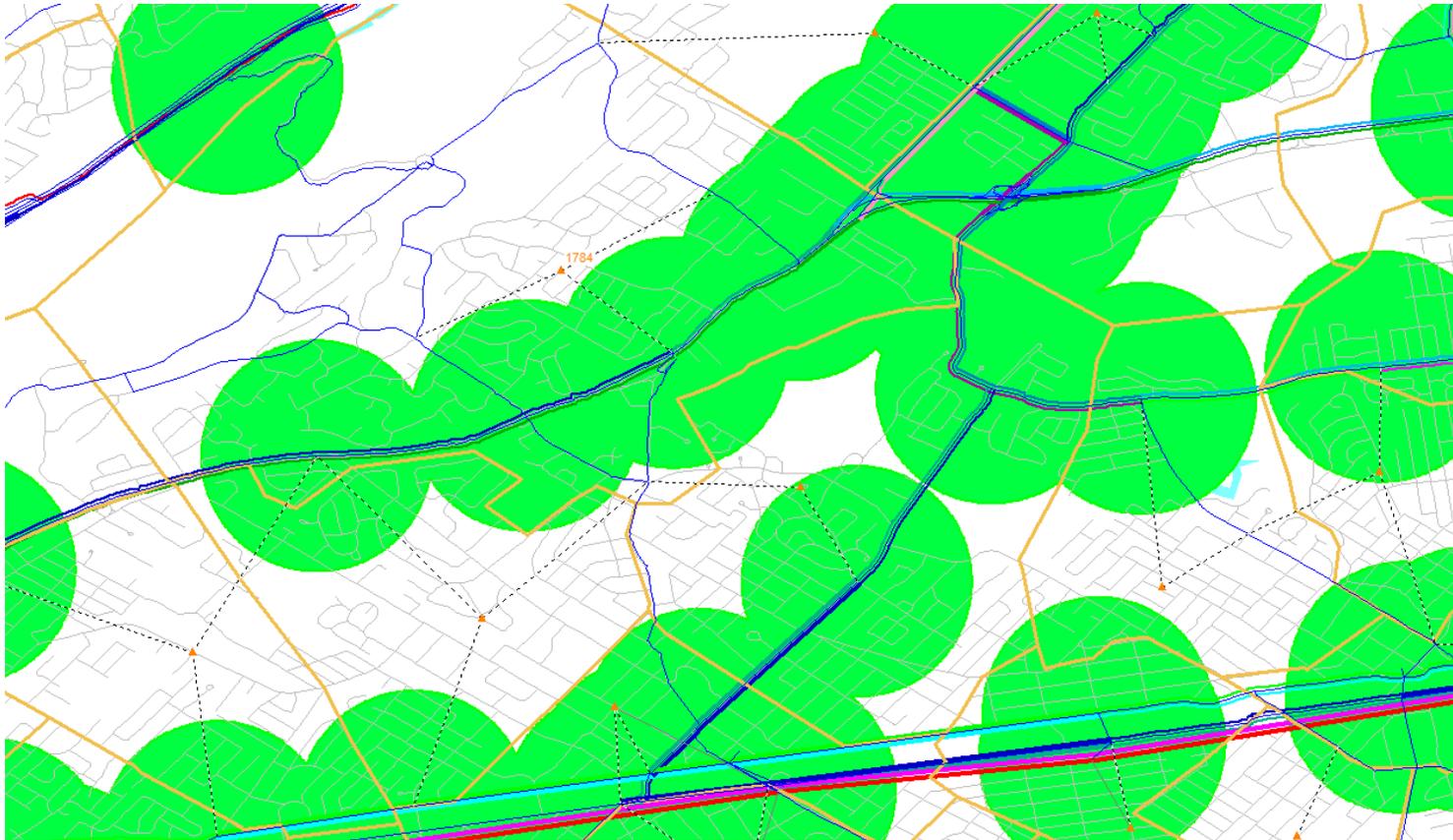
Work Trips Shares from a New Development



Trips by Purpose

Understanding Mode Choice Results

- Thematic Maps of Walk Buffer Areas Maps

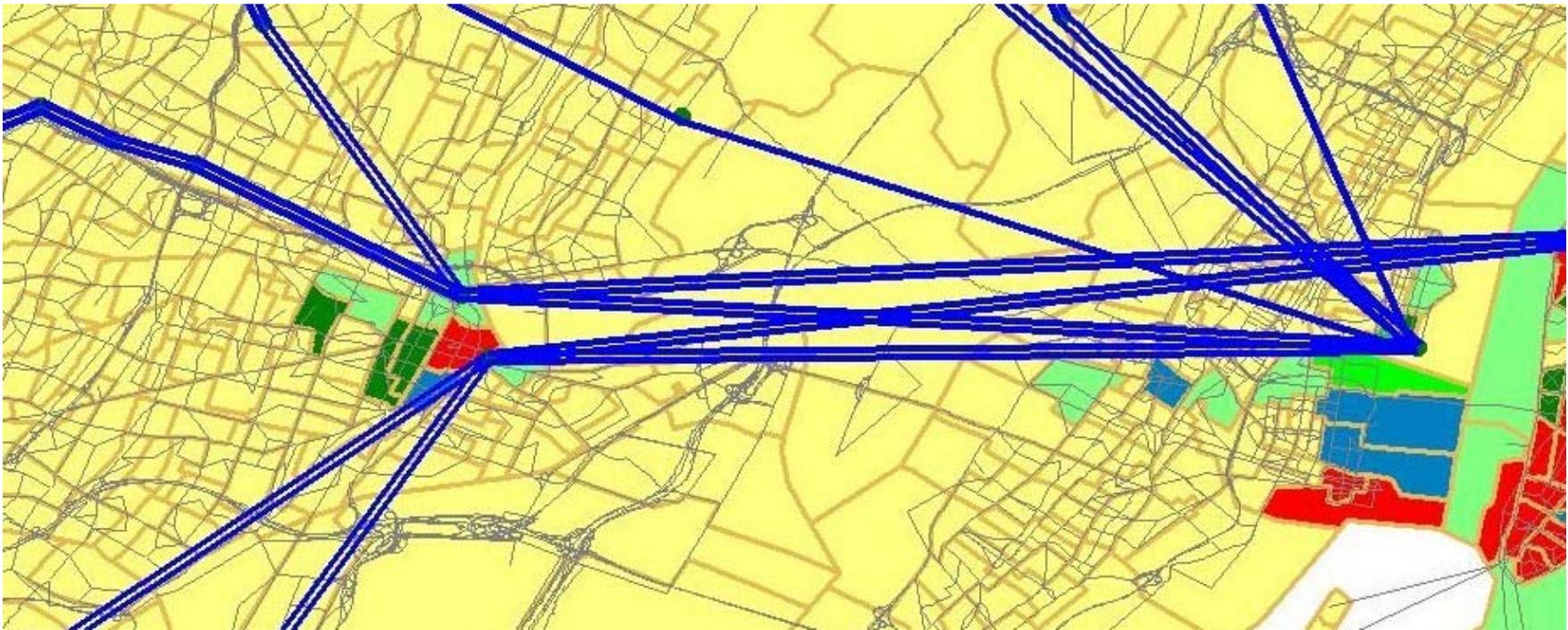


*Mountainside Twp.
(Zone 1784)*

Understanding Mode Choice Results

- Thematic Map of Trip Ends Served by Transit

How Will Travelers Respond to Different Solutions?



Example -Zones with Significant Commuter Rail Mode Trip Destinations

Understanding Mode Choice Results

- FTA SUMMIT Application
 - Convert Model Outputs to Summit-ready Inputs
 - Executes Fixed Trip Table Mode Choice for Work and Non-work Trips
 - Allows Mode Results to be Sent to SUMMIT Program for FTA Project Funding Requests

How Will Travelers Respond to Different Solutions?

Presenting Transit Assignment

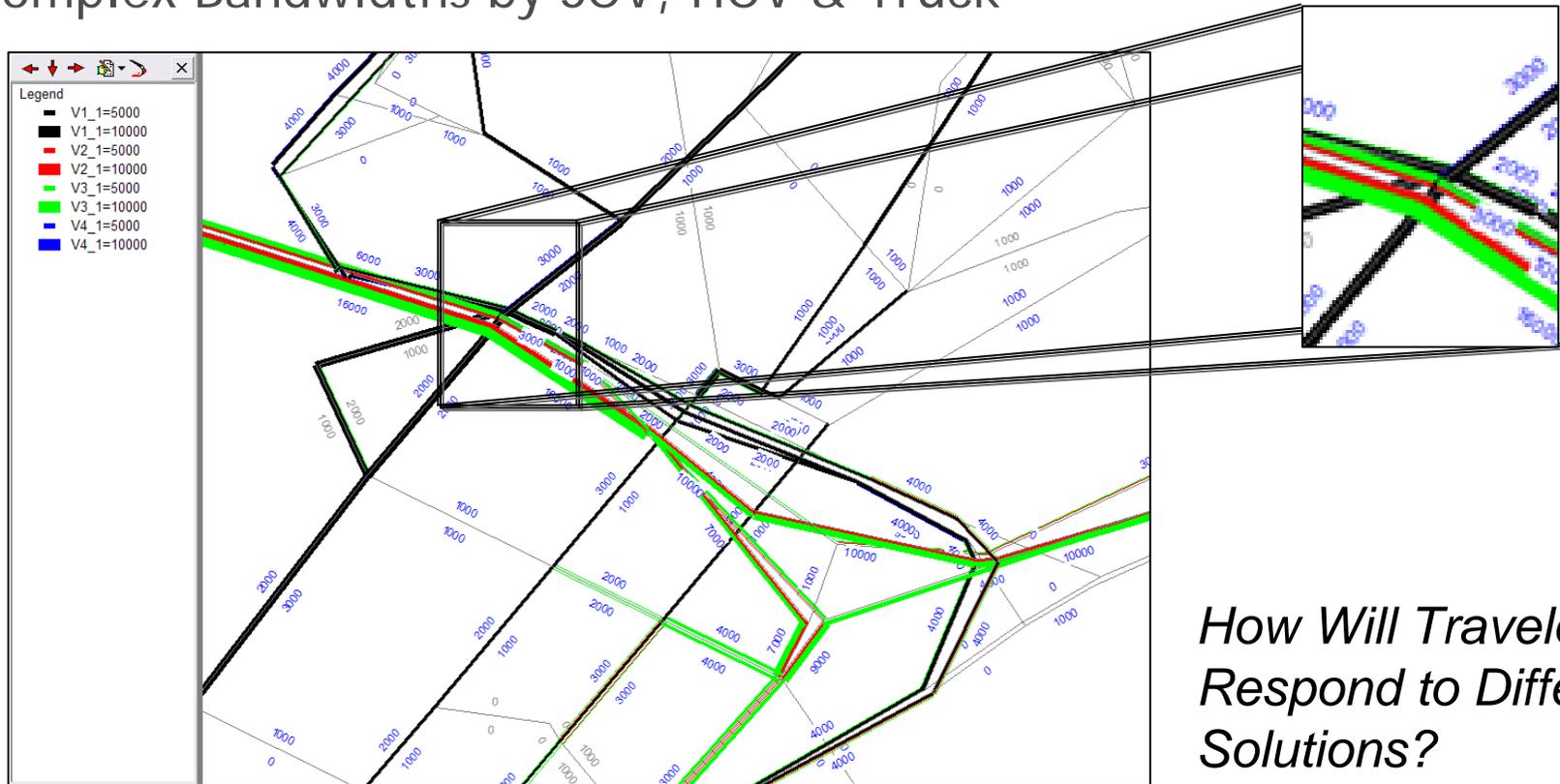
- Simple Tables of Ridership, Boardings, Passenger Miles and other statistics by line/mode/operator

Transit Ridership Summary

Rail/Ferry Services	Observed	Estimated	Diff	% Diff
Main/Bergen/Port Jervis Line	22,380	26,192	3,812	17.0%
Pascack Valley Line	7,018	3,352	-3,666	-52.2%
Boonton Line	9,824	14,620	4,796	48.8%
Morris/Essex Line	40,250	30,904	-9,346	-23.2%
Raritan Valley Line	18,070	16,556	-1,514	-8.4%
North Jersey Coastline/Northeast Corridor Line	106,052	94,154	-11,898	-11.2%
Metro North Trips from West of Hudson Locations	5,248	3,224	-2,024	-38.6%
Total Rail Service	208,842	189,002	-19,840	-9.5%
PATH	500,532	519,082	18,550	3.7%
Newark City Subway Line	36,232	30,385	-5,847	-16.1%
Hudson-Bergen LRT	22,000	31,838	17,580	123.3%
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Presenting Highway Assignment

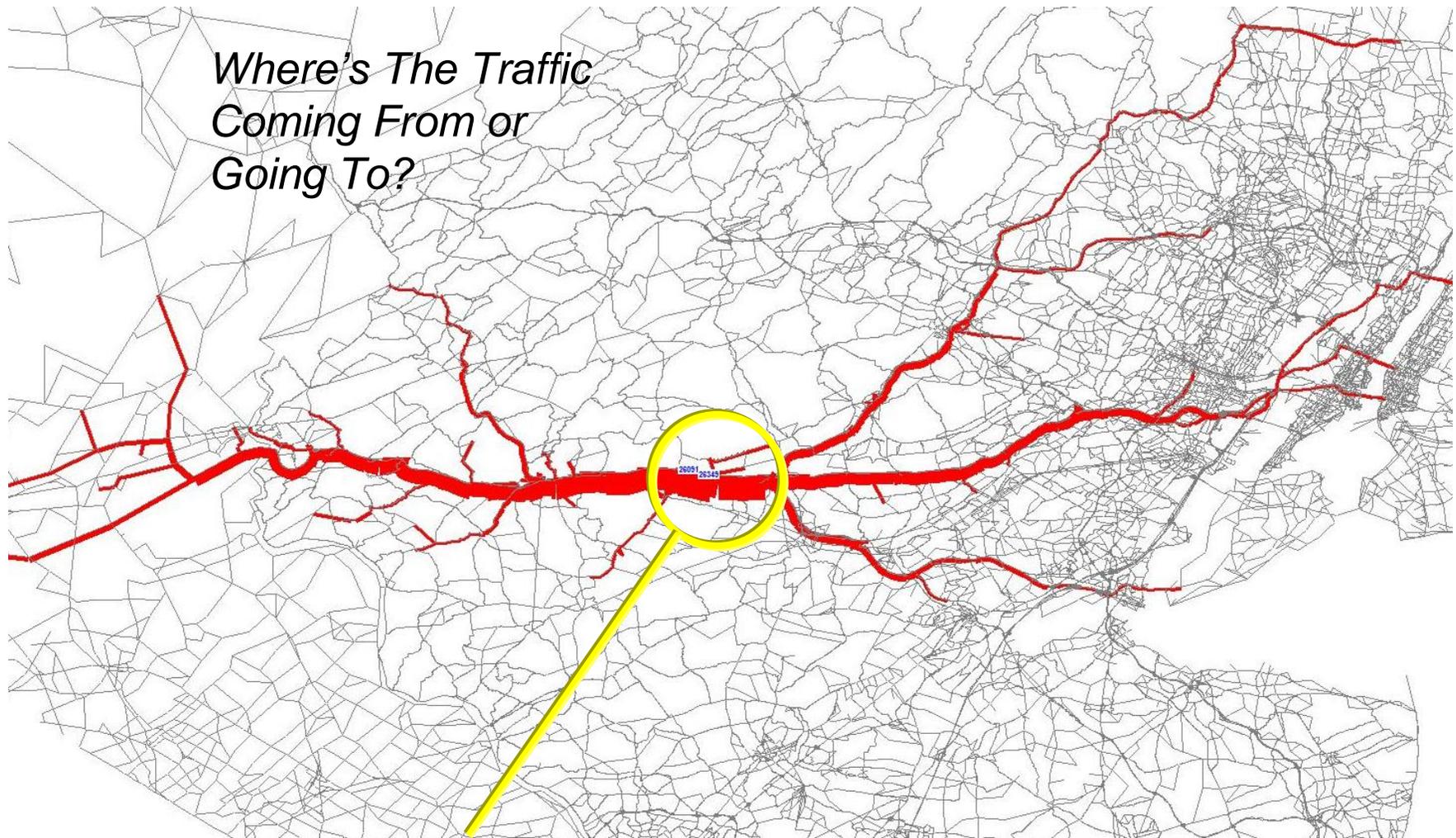
- Complex Bandwidths by SOV, HOV & Truck



Presenting Highway Assignment

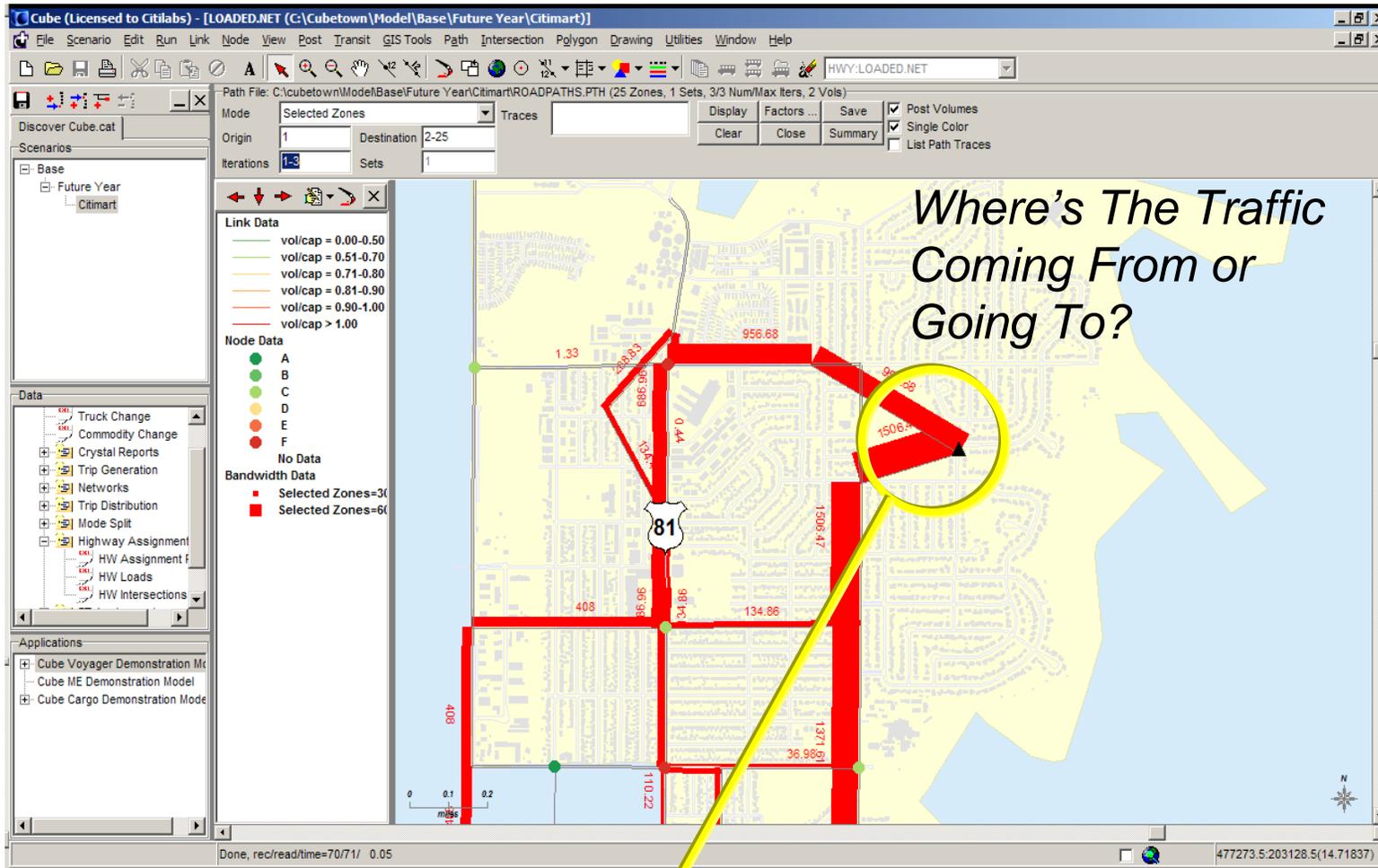
- Simple System-wide Indicator Tables
 - VMT
 - VHT
 - Hours of Delay
 - Lane Miles by FT, Congestion, Travel Speed, etc

Presenting Highway Assignment



Select-Link for I-78 Just West of I-287

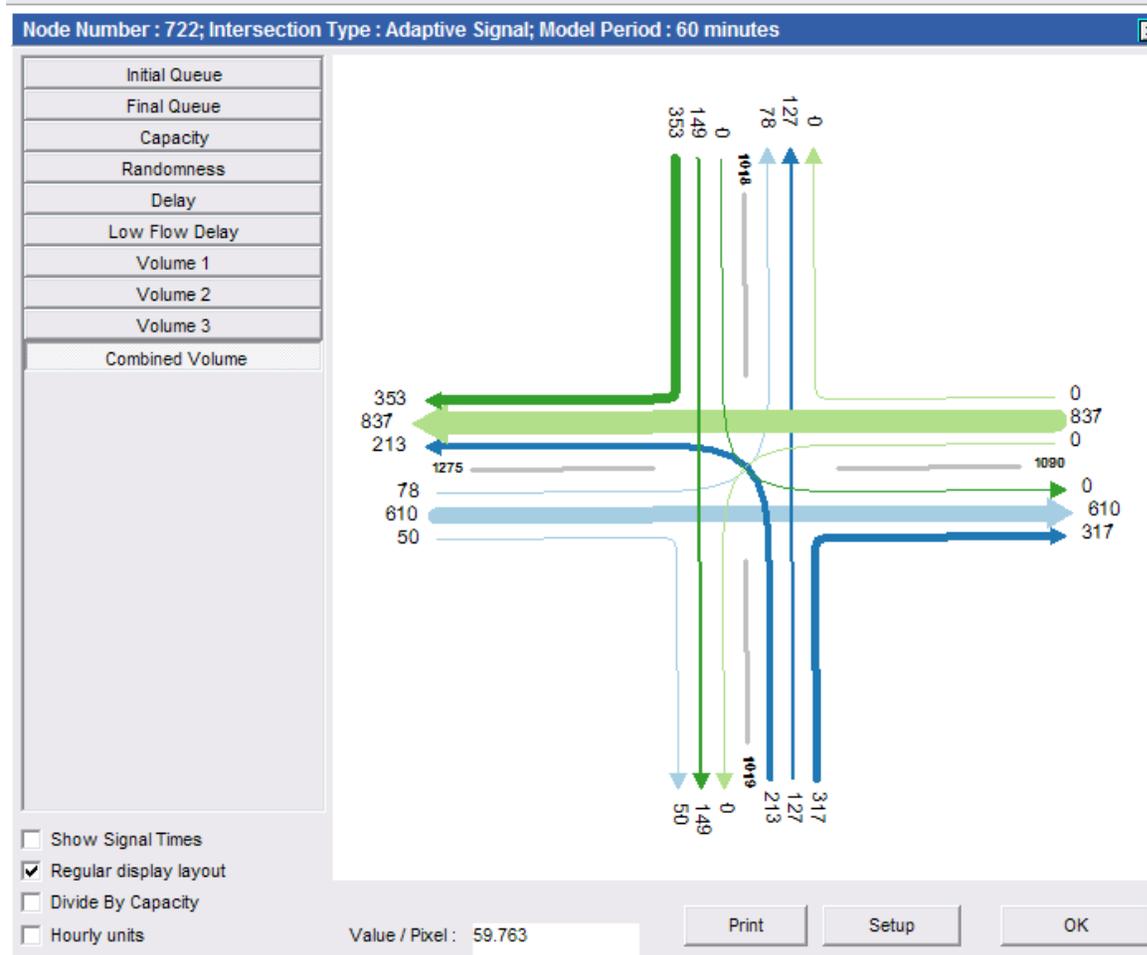
Presenting Highway Assignment



Example of a Select Zone Analysis, Useful for Development Impact Review

Presenting Highway Assignment

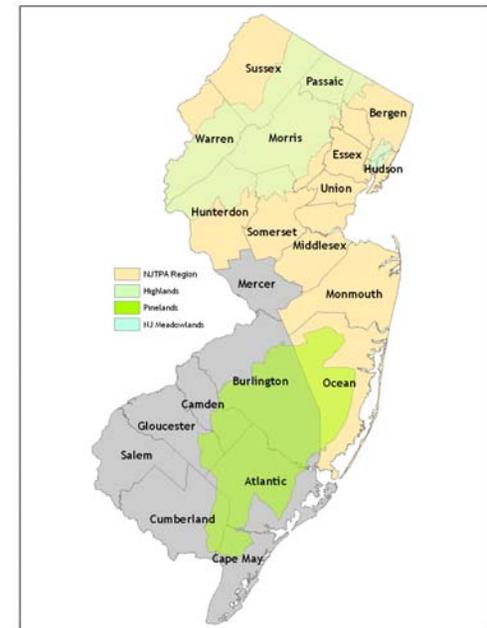
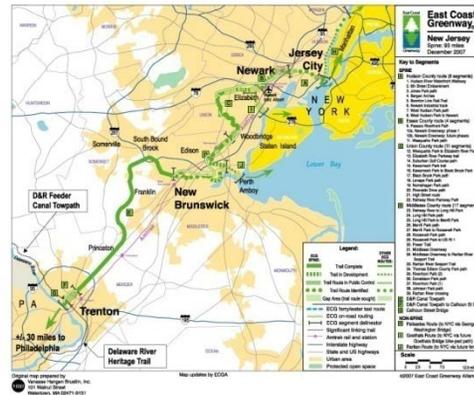
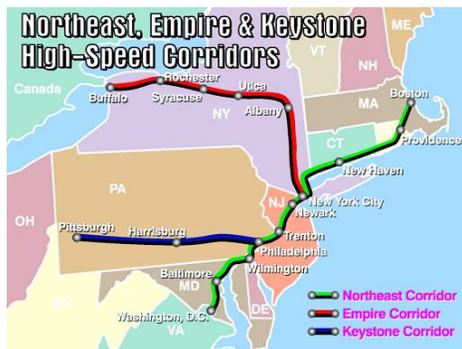
- Turning Movement Diagrams



Where's The Traffic Coming From or Going To?

Opportunities for Interagency Coordination

- Scheduled Model Updates
- Technical Coordination
- Users' Group
- Pooled Data Development Opportunities



Coordination

■ Benefits

- Use of common modeling methodology
 - Model Structure
 - Model Database
- Facilitates transfer of study products between agencies
- Maximizes Resources
- Facilitates Regulatory Approvals



Schedule

- Database Refinements & Minor Model Adjustments
 - Annual Process
 - Lead by Single Agency
 - Input from All Agencies, Subregions and Adjacent MPOs
 - Should not impact ongoing planning studies
- Major Model & Database Enhancements
 - Influenced by Process of the Update Element
 - Influenced by Federal Regulatory Requirements

Caveats

- The NJRTM-E Model Is A Tool
 - Based on Average Human Behavioral Characteristics and Responses and the Transport System's Characteristics
 - Remember, the AVERAGE family has 2.5 kids (none do)
 - For Every Average (mean), there is a standard deviation
 - The NJRTM-E is Built Upon the Most Recent AVAILABLE Data (some data are dated and some data are not available locally)
- Detailed Studies (FTA New Starts, Corridor Studies, Impact Assessment, etc) Should ALWAYS review the Model Data, Assumptions and Results and TAILOR the Tool to Fit the Conditions/Needs of the Study

Now it is Time for Q&A