Travel Forecasting for New Starts

Minneapolis, MN

June 15-16, 2006

Welcome!

- Purpose
- Approach
- Participants
- Logistics
- Agenda
- Overview of *Additional Project Benefits*

Purpose

- No surprises – for sponsors or for FTA
- Updates on FTA efforts since 2003
  - Capturing additional benefits of New Starts
  - Applying QC tests to forecasts
  - Vetting draft FTA guidance on forecasting

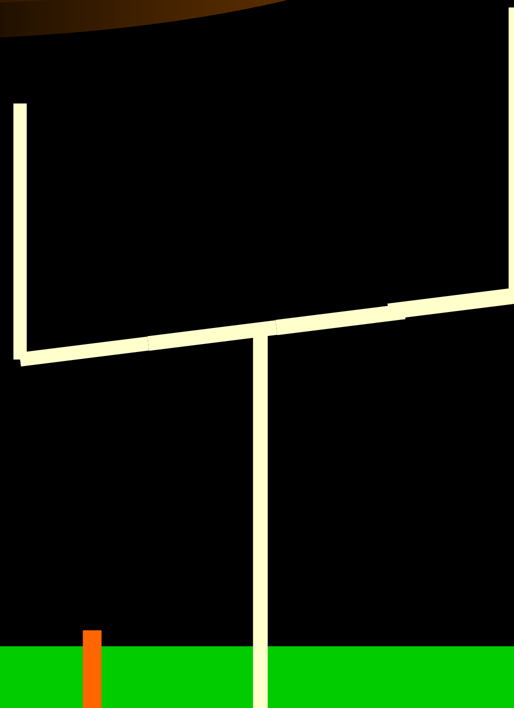
No Surprises!

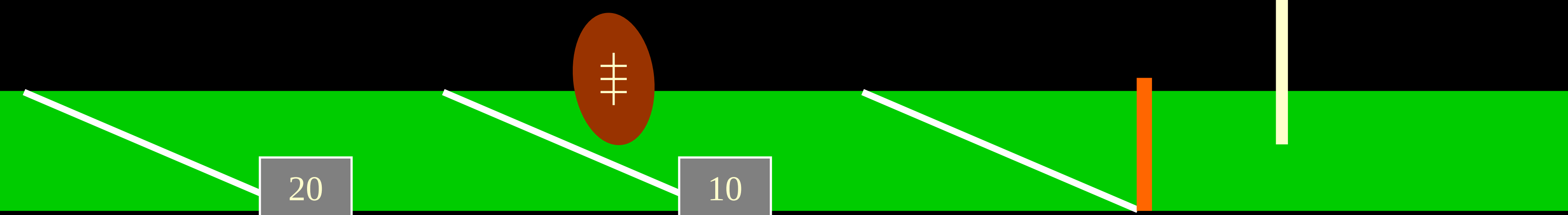
<u>Long-standing FTA principles</u>

- Respond to problems
- Compare against low-cost option
- Hold policies constant
- Find effective, cost-effective projects

<u>Recent improvements in FTA QC</u>

- Summit
- FTA staff reviews of forecasts
- Making the case for a project





Approach to This Workshop

- Early distribution of written materials
  - Think-pieces
  - Draft guidance
- Workshop
  - Summary presentations
  - Participant comments / questions
  - Wrap-up session on next steps
- Workshop summary

Participants

- Affiliation
- Experience with New Starts forecasting

Logistics

- Sessions
  - Summary presentations
  - Participant comments / questions / e-mails
- Schedule
  - Lunches provided
  - Scheduled breaks (Red Sox at Twins, 7:10pm tonight)
  - Schedule adherence (see above)
- Facilities

Agenda

- Capturing additional project benefits
  - Additional transit attributes
  - Congestion relief
  - Variable trip tables
  - Economic development

Agenda

- Quality control on forecasts
  - Predicted and actual ridership
  - Data library of on-board surveys
  - Aggregate CTPP-based model
  - Semi-independent forecasts
  - Additional QC tests
  - Summit 1.0 and 1.5

Agenda

- Quality control (continued)
  - Early service-quality analysis of alternatives
  - Dealing with uncertainties
  - Tracking performance of forecasters

Agenda

- Draft guidance
  - Properties of travel forecasting models
  - Calibration and validation
  - Methods for on-board surveys
  - Preservation of forecasts

Discussion-piece #1: “Allowances” in Benefits and Cost-Effectiveness

- New Starts ratings and project benefits
- Allowances for omissions in the CE ratings
  - Traveler value of time: work and non-work
  - Timing of costs and benefits
  - Multiplier for unmeasured congestion relief
  - Multiplier for 2^{nd}-order unmeasured benefits
- Perspective on the hunt for new benefits

2 – Benefits from Changes in Other Transit Attributes

- Motivations
- Unmeasured attributes of transit
- Representing unmeasured attributes
- Possible approaches for New Starts

Motivations

- Current FTA policy on “constants”
  - No differences across transit modes
  - Unless calibrated with existing local guideways
  - And calibrated constants must be “reasonable”
- Recent observations for guideways
  - Ks seem necessary in well-scrubbed models
  - BRT ridership impacts > service changes
- So, look to non-time/cost service attributes

Unmeasured Transit Attributes

Some unmeasured attributes for trips that include:

Use of guideway(s) and local bus	**Exclusive use of guideway(s)**	**Time spent on a guideway**
	Reliability of boarding time	Reliability of travel time
Comfort at stations	Comfort at stations	Vehicle amenities
Safety at stations	Safety at stations	Ride quality
	Visibility/awareness	Personal safety
	Learnability	
	Span of good service	

Where IVT_g and IVT_b represent in-vehicle time spent on guideways and local buses, respectively

Current Strategies

- Mode choice model
- Network coding and pathbuilding

- Challenges
  - Deriving transit-mode-specific parameters
  - Representing access markets and paths
  - Controlling multi-path pathbuilders

Current Strategies (1)

- Reliance on the mode choice model
  - Approach
    - Code network and build paths conventionally
    - Determine nature of the path (rail, bus, etc.)
    - Include constant specific to transit mode
    - Perhaps apply transit-mode-specific C(IVT)s
  - Common practice (esp. with path choice in nested models)
  - Different sensitivities for different markets
  - Problems with path/mode-choice consistency?

Current Strategies (2)

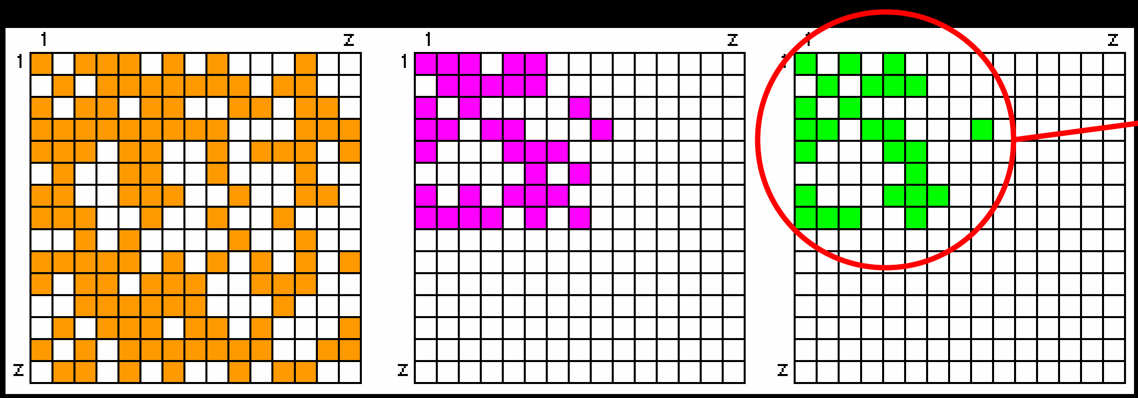
- Reliance on network coding
  - Approach
    - Represent fixed attributes as boarding times
    - Employ transit-mode-specific IVT weights
    - Build paths that recognize “unmeasured” attributes
    - Pass “smarter” impedances to mode choice
  - Better approach with multi-path path-builders?
  - Virtue of internal consistency
  - Risk to QC? Insensitive across travel markets?

Challenges - 1

- Determining mode-specific Ks and Cs
  - – Problems in estimation of mode choice models
    - General instability of parameter estimates
    - Even generic-transit Ks rarely survive calibration
  - – Problems in calibration of mode choice models
    - Absence of similar behavior (choice riders, park-ride)
    - Inadequate data on current transit ridership
    - Grossly erroneous person-trip tables from TG & TD
  - – Absence of consistent parameters nationally

Challenges - 1

Example: errors in the person-trip table and the transit network lead directly to errors in the computed calibration target and the calibrated value of K



I-J pairs with person-trips in segment "S"

I-J pairs with transit mode "M" connections

I-J pairs with transit-connected person-trips

Sum of the person-trips in these cells is the denominator of the target transit share calculation for this transit mode "M" serving this travel market "S"

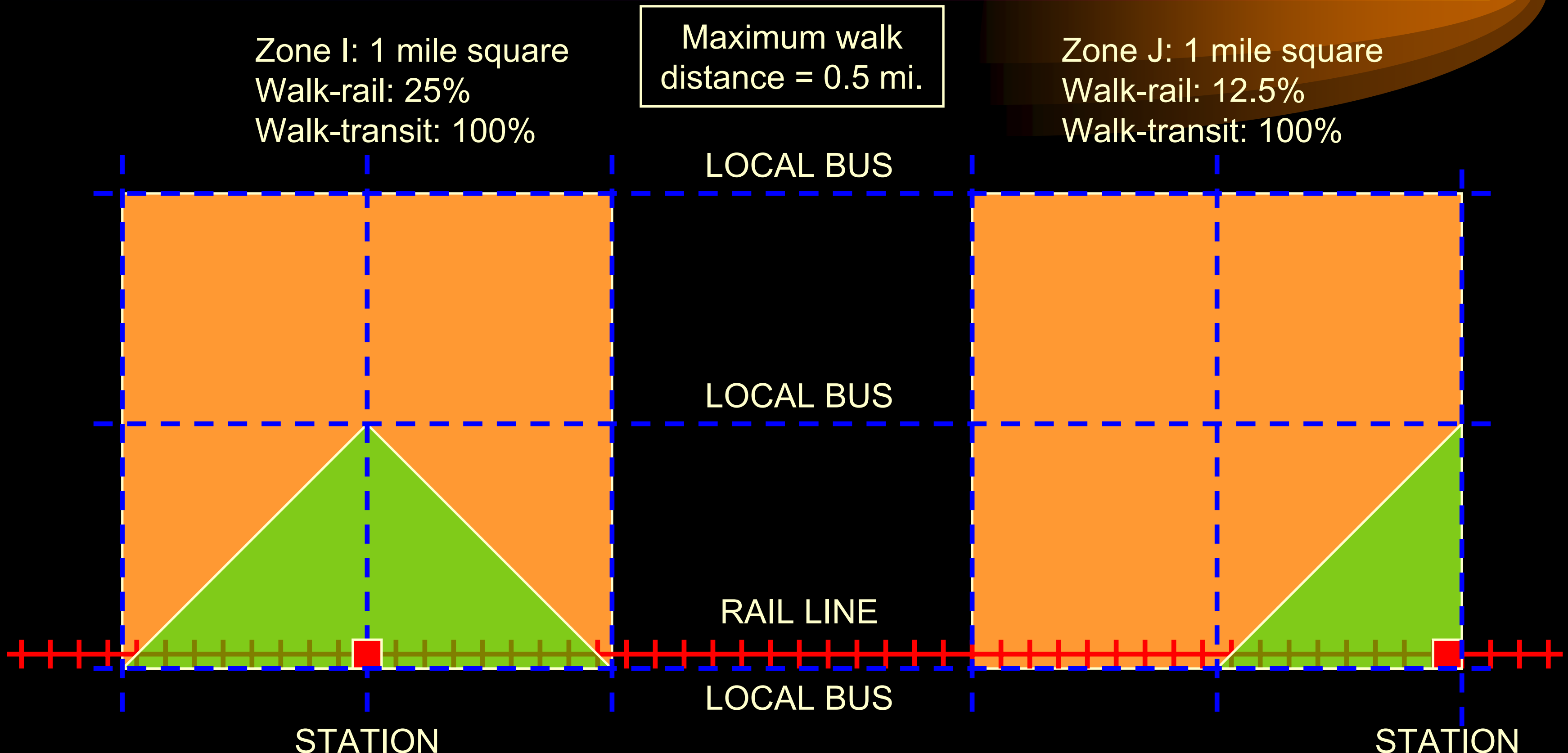
Challenges - 1

- Sources of error in person-trip tables
  - Demographic/socio-economic estimates
  - Highway speeds
  - Generation and distribution models
- Sources of error in transit connectivity
  - Walk-access coding rules
  - Drive-access coding rules
  - Path-building conventions

Challenges - 2

- Isolating trips with guideway-only paths
  - Zones typically larger than max-walk-distance
  - Parts of I and J may require bus connections
  - Options:
    - Zones sized to max-walk-distance,
    - Or access partitioning within zones, and separate path for access/line-haul market, and separate mode-choice calculation for each market
    - Or enumeration method for model application

Challenges – 2



What transit options are available to whom?

Challenges - 2

- Paths from I to J
  - Detailed
    - walk-rail-walk
    - walk-bus-rail-walk
    - walk-rail-bus-walk
    - walk-bus-walk
    - drive-rail-walk
    - drive-rail-bus-walk
  - Typical
    - walk-local-walk
    - walk-premium-walk
    - drive-transit-walk

- Markets from I to J
  - Detailed
    - 25 x 12.5 = 3.125%
    - 100 x 12.5 = 12.5%
    - 25 x 100 = 25%
    - 100 x 100 = 100%
    - 100 x 12.5 = 12.5%
    - 100 x 100 = 100%
  - Typical
    - 100 x 100 = 100%
    - 100 x 100 = 100%
    - 100 x 100 = 100%

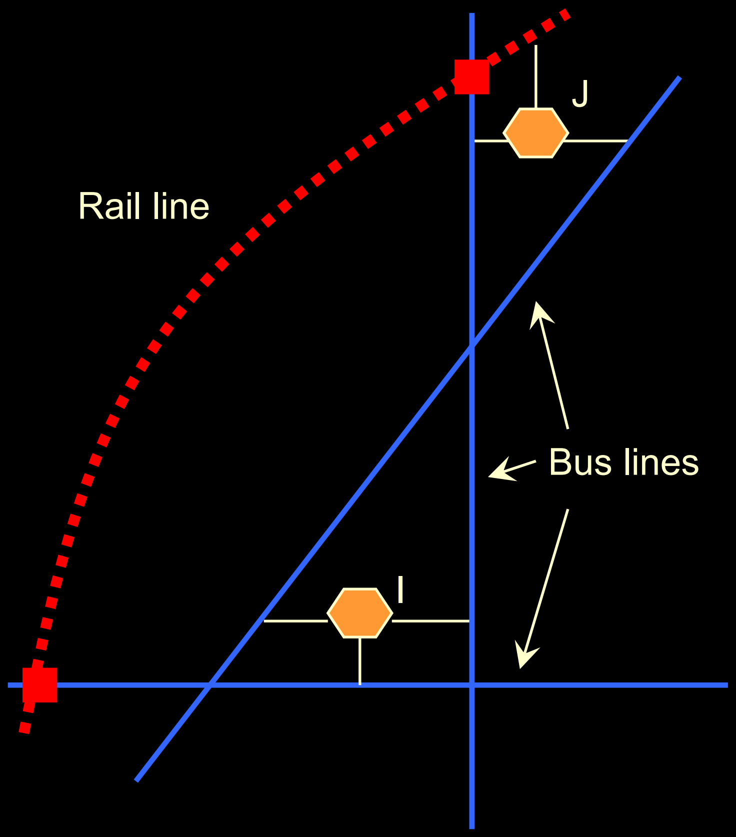
!

Challenges - 3

- Isolating guideways within multi-paths
  - I-J “path” may include many path options
  - I-J impedances may be probability weighted
  - Test of $IVT_{gdwy} > 0$ may be very misleading
  - Some trips from I to J use local-only paths
  - K_{gdwy} inappropriate for local-only component of trips from I to J

Challenges - 3

Challenges with multi-path pathbuilders



- Multiple paths from I to J
- Probability-weighted impedances
  - $IVT_{skim}(rail) = \%rail \times IVT_{path}(rail)$
  - $IVT_{skim}(bus) = \%bus1 \times IVT_{path}(bus1)$
    $+ \%bus2 \times IVT_{path}(bus2)$
- Questions: if IVT(rail) = 5
  - what is the actual rail time?
  - what is the %rail?
  - should a K(rail) apply in mode choice?

Possible Approaches for FTA

- Potential methods
  - Current policy: K=0 except from local data
  - K & C(IVT) determined by project attributes
- Potential applicability
  - Defaults for “new” New Starts
  - Caps for New Starts expansions
- Alternative implementation strategies

An Illustration

- K & C(ivt) determined by project attributes
  - Guideway-like characteristics
    - Reliability
    - Branding/visibility
    - Ride quality
    - Schedule-free service
    - Learnability
  - Span of service
  - Passenger amenities
    - Stations/stops
    - Vehicles

An Illustration (continued)

- Application rules for path characteristics:
  - Guideway only, drive-acc: full K
  - Guideway only, walk-acc: some % of K
  - Guideway & local bus: some % of K
  - Guideway IVT: less onerous C
- Relevant to build <u>and</u> baseline alternatives

An Illustration *(continued)*

- Implementation
  - Option 1: within mode choice models
    - Modification of local models for Ks and Cs
    - Higher user benefits → better cost-effectiveness
    - Higher ridership forecasts (big park/ride increase?)
  - Option 2: post-forecast computations
    - Isolation of new guideway trips
    - Calculation of benefits for those trips using Ks, Cs
    - Higher user benefits but same ridership forecasts

Next Steps

- Decision on Options 1 and 2 (or 3?)
- Testing of implications
- Effective in January 2007
  - Seems possible with Option 1
  - Challenge with Option 2

3 – Evaluation of Highway Congestion Relief Benefits

- Background
- Confirmation of problems
- Tests of alternative remedies

Bill Woodford, AECOM Consult

Background

- FTA recognizes that transit projects can reduce highway congestion and improve mobility for highway users.
- User benefits = transit + highway
- But, early experience showed unexplainable highway benefits (magnitude and geographic location)

Background

- Consequently:
  - FTA considers only transit-user benefits
  - Congestion-relief benefits not counted
  - Congressional direction to FTA and FHWA to conduct research on ways to credit congestion-relief benefits

    (2004 House appropriations)

Background

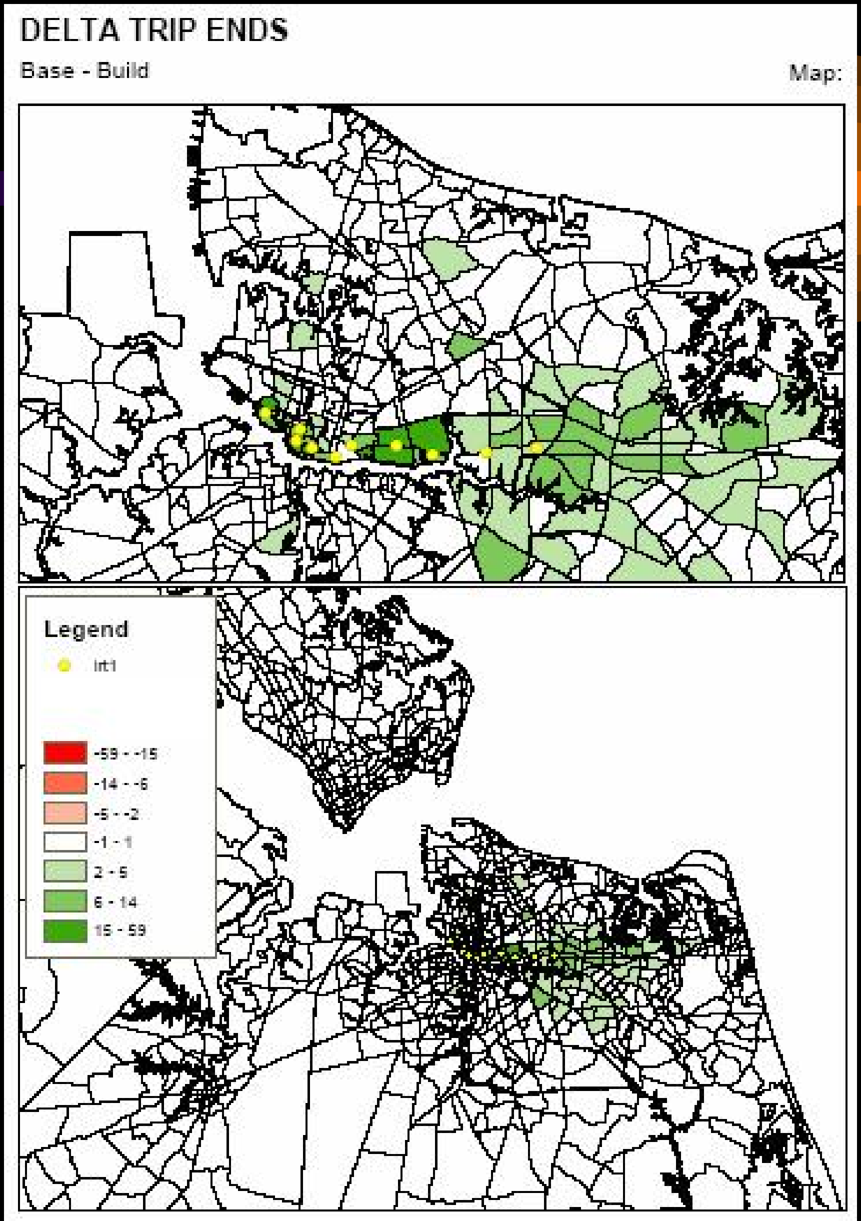
- Research approach
  - Confirm existence & magnitude of problem
  - Diagnose likely causes
  - Propose solutions
  - Prepare recommendations

Confirm Problem

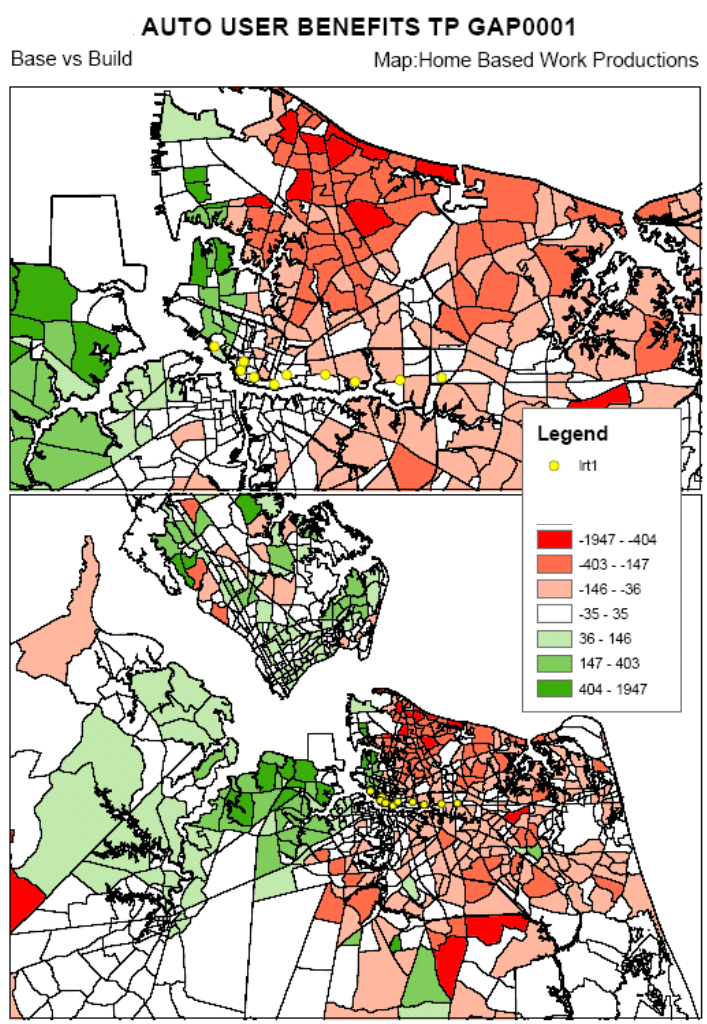
- Examine two test cases with “well-behaved” mode choice models and alternative definition
  – Case 1: Modest project with small change in vehicle trips
  – Case 2: Mega project with large ridership impacts
- Compute and map user benefits
- Analyze highway assignment results

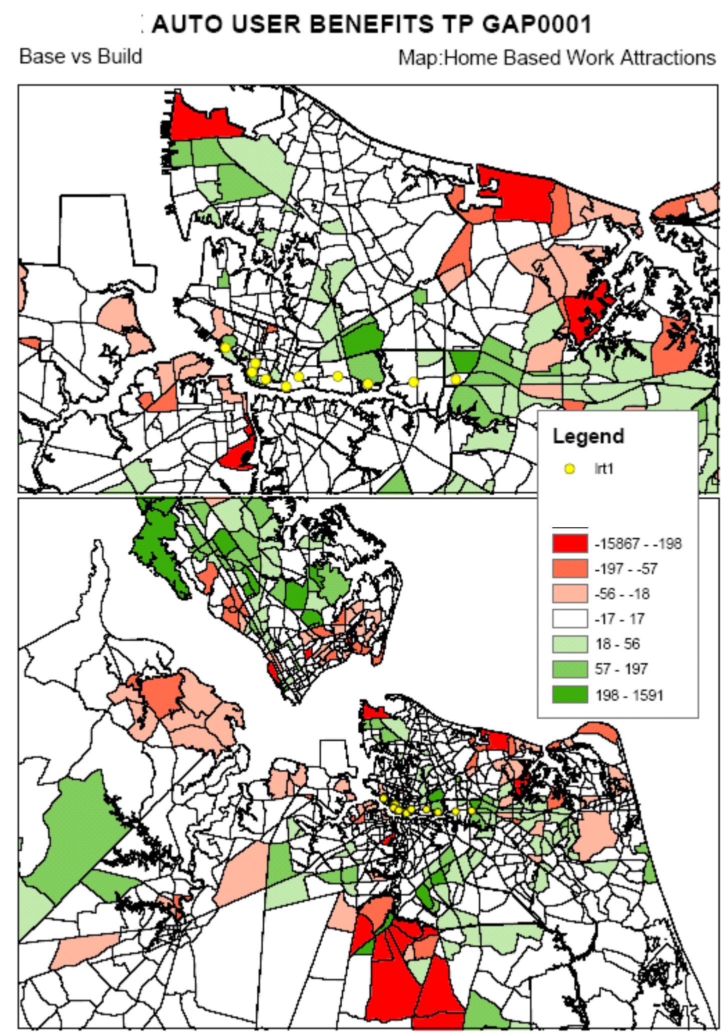
Case 1 – Change in Auto Vehicle Trips

Productions
+
Attractions

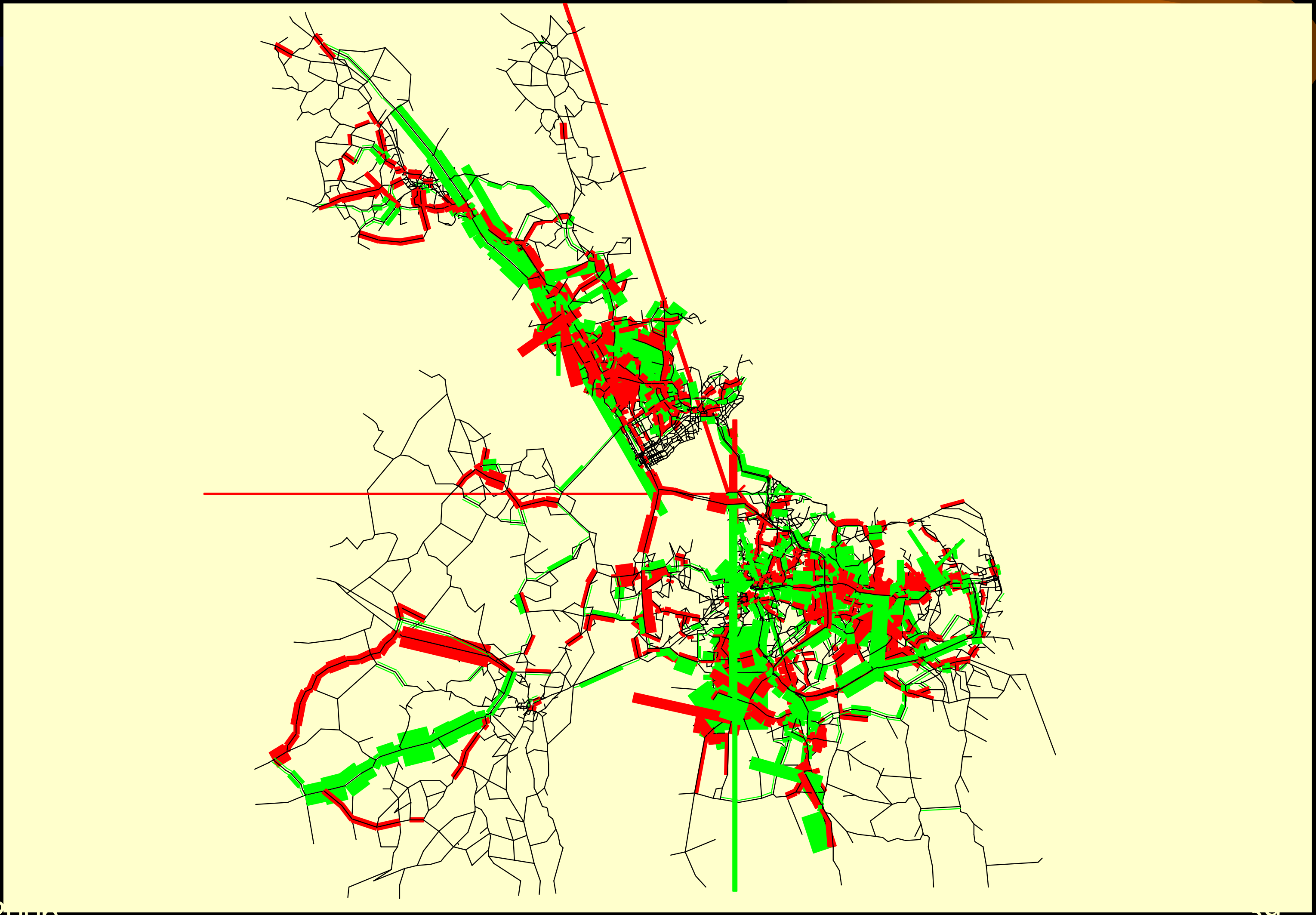


Case 1 – Auto User Benefits

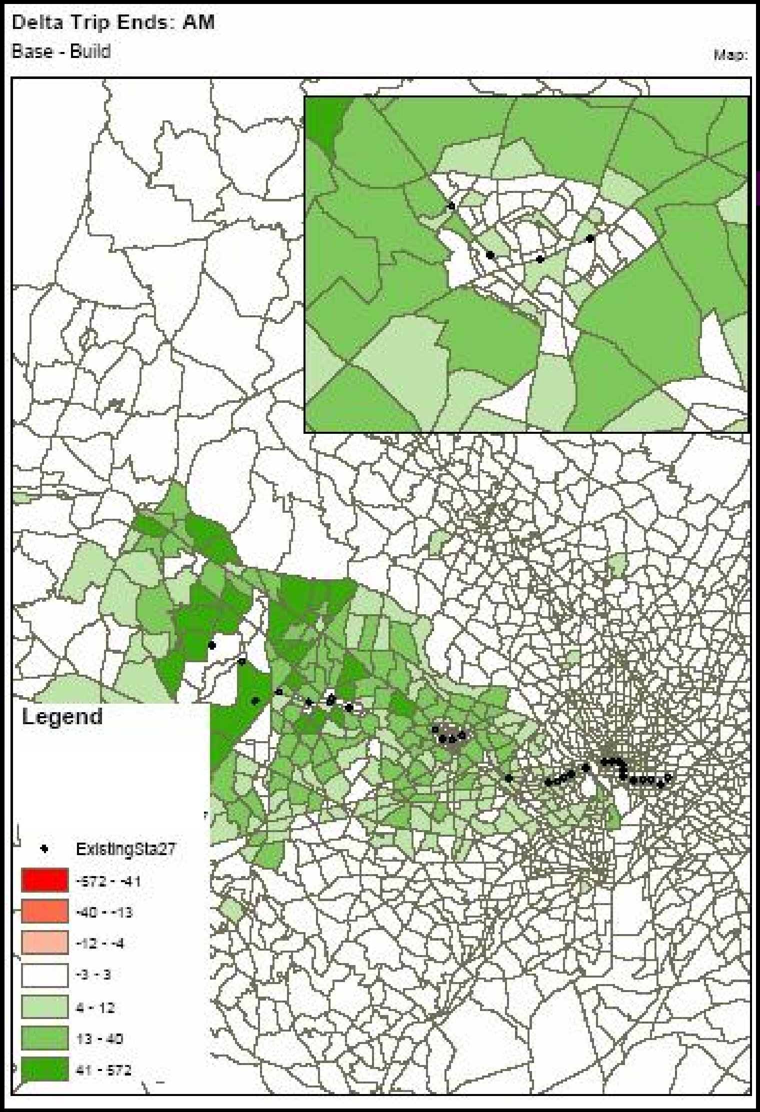




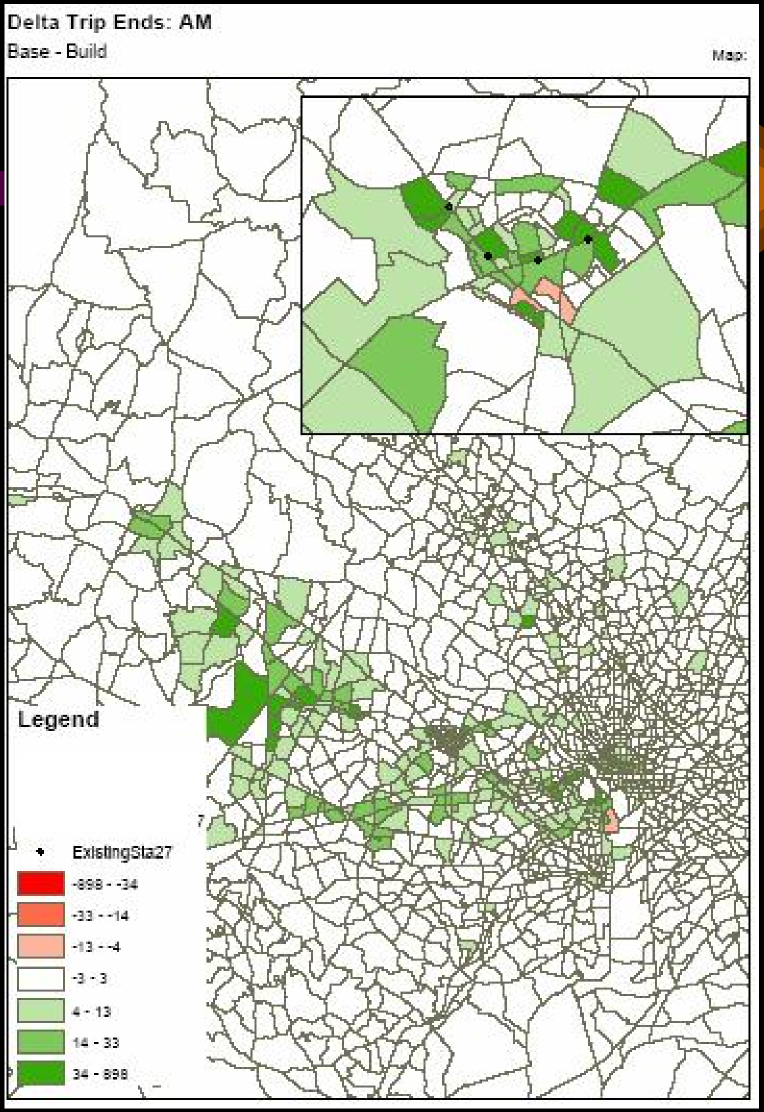
Case 1 – Change in Assigned VHT



Case 2 – Change in Auto Vehicle Trips

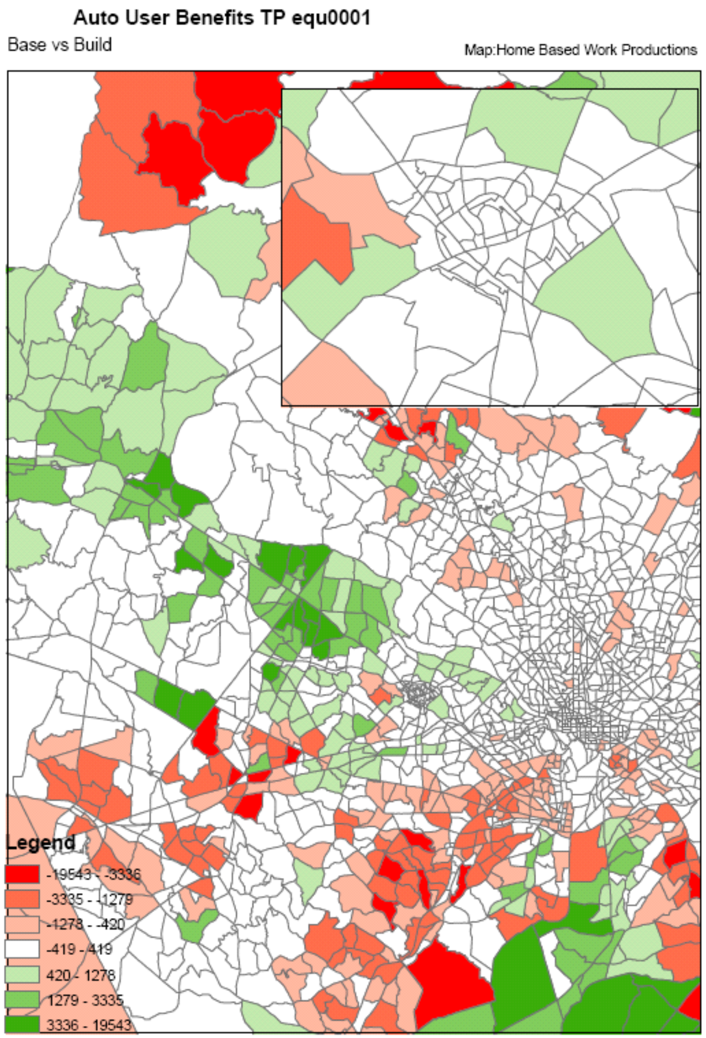


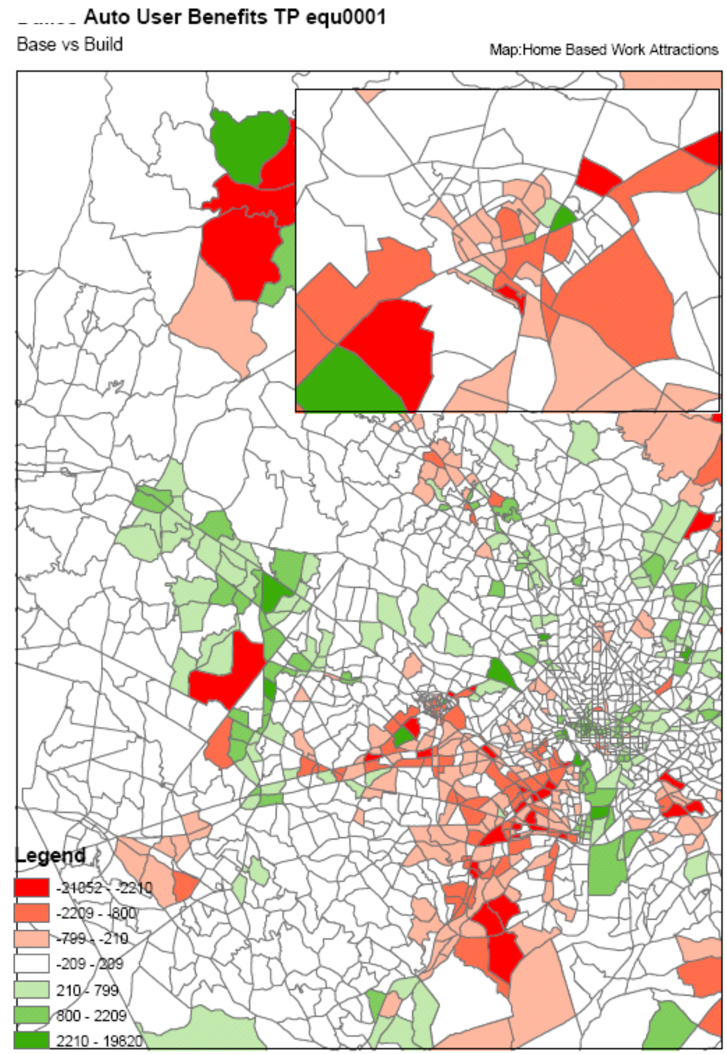
Productions



Attractions

Case 2 – Auto User Benefits





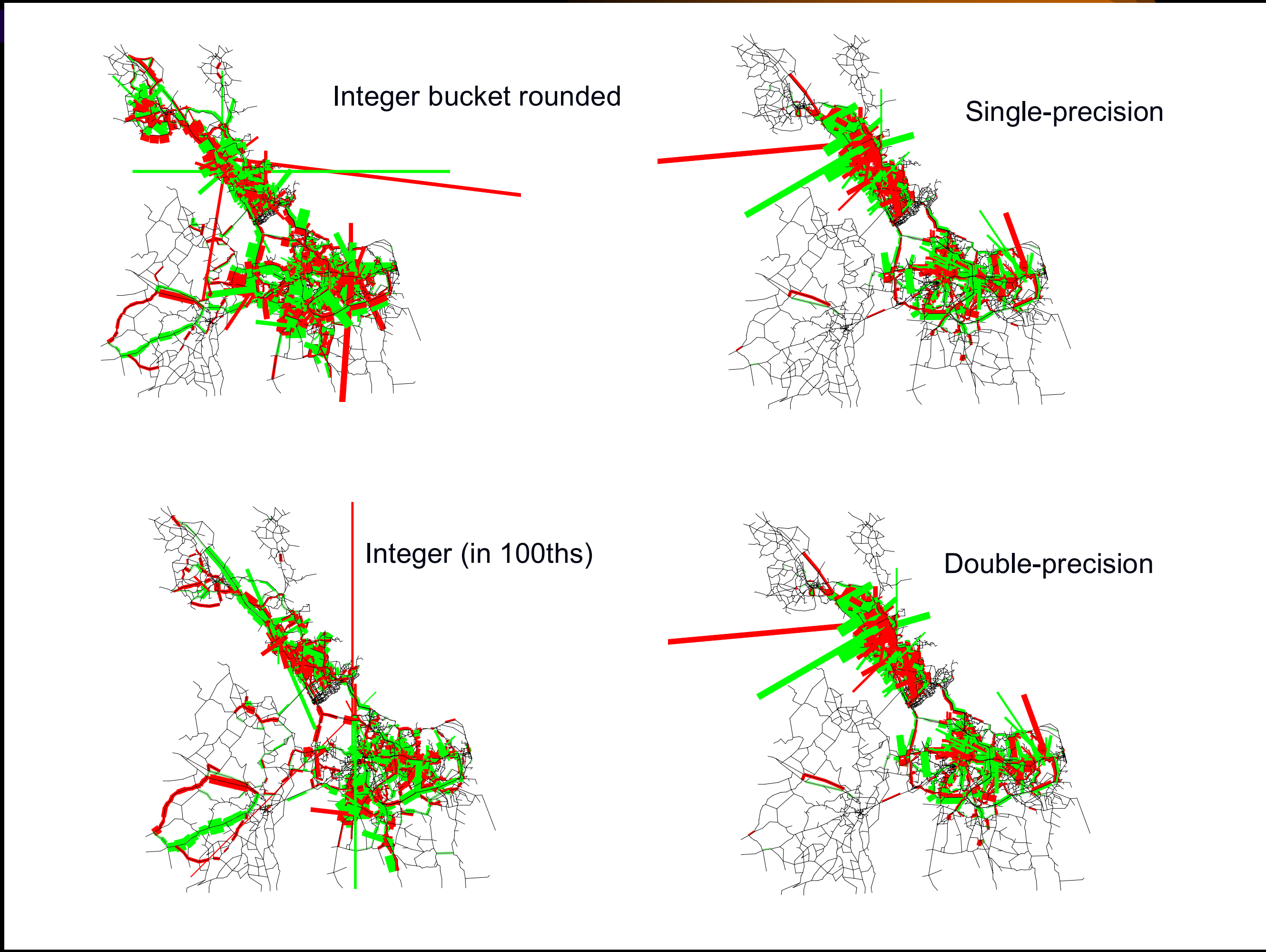
Case 2 – Change in Assigned VHT

Conclusions

- Auto User Benefits are unstable
- Magnitude of Auto User Benefits compared to Transit User Benefits sufficient to materially misstate cost-effectiveness
- Apparent cause is lack of assignment stability

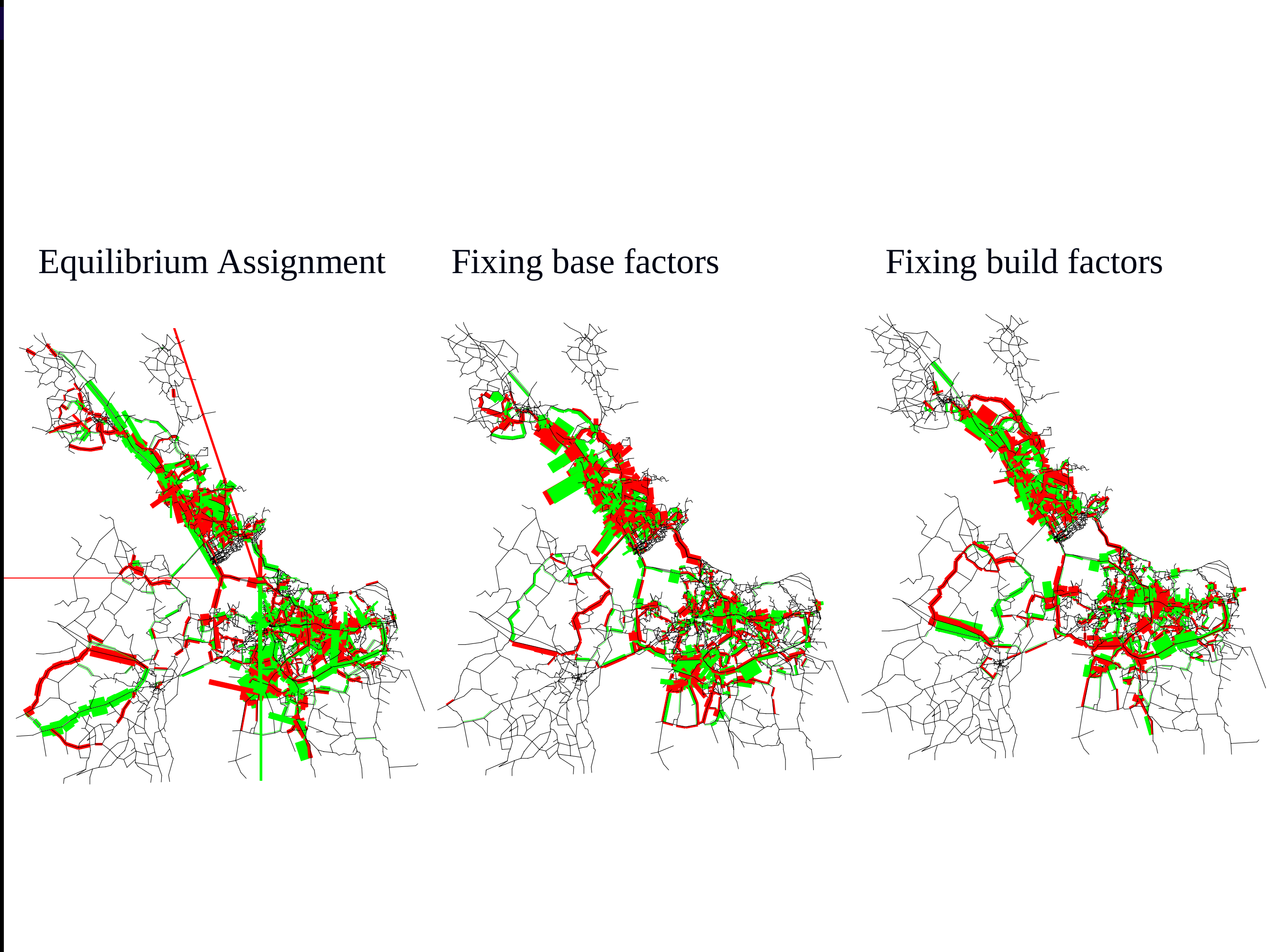
Assessment of Techniques to Improve Stability

- Trip table precision – bucket rounded integers appears to aggravate problem
- Real numbers do not, however, solve problem



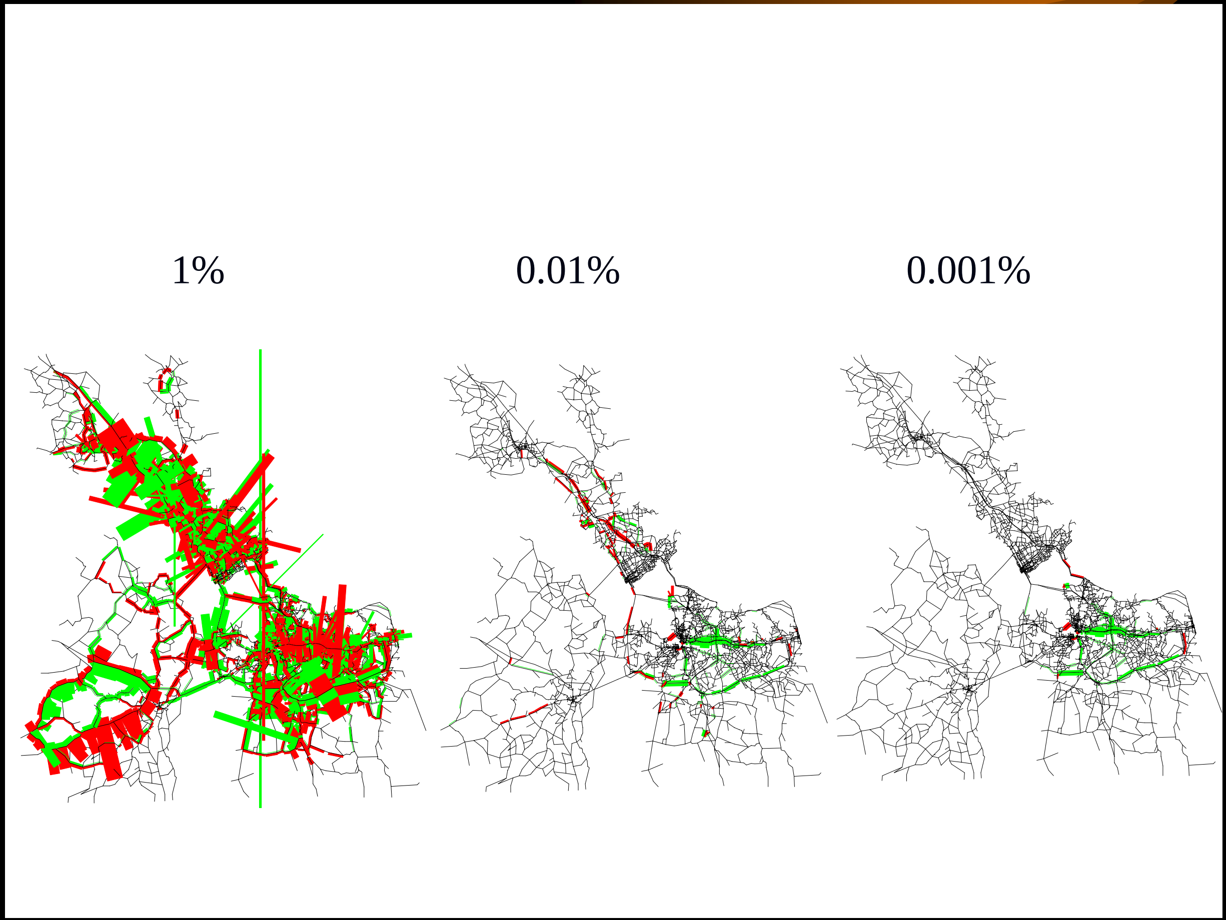
Assessment of Techniques to Improve Stability

- Fixed iteration shares do not appear to address problem



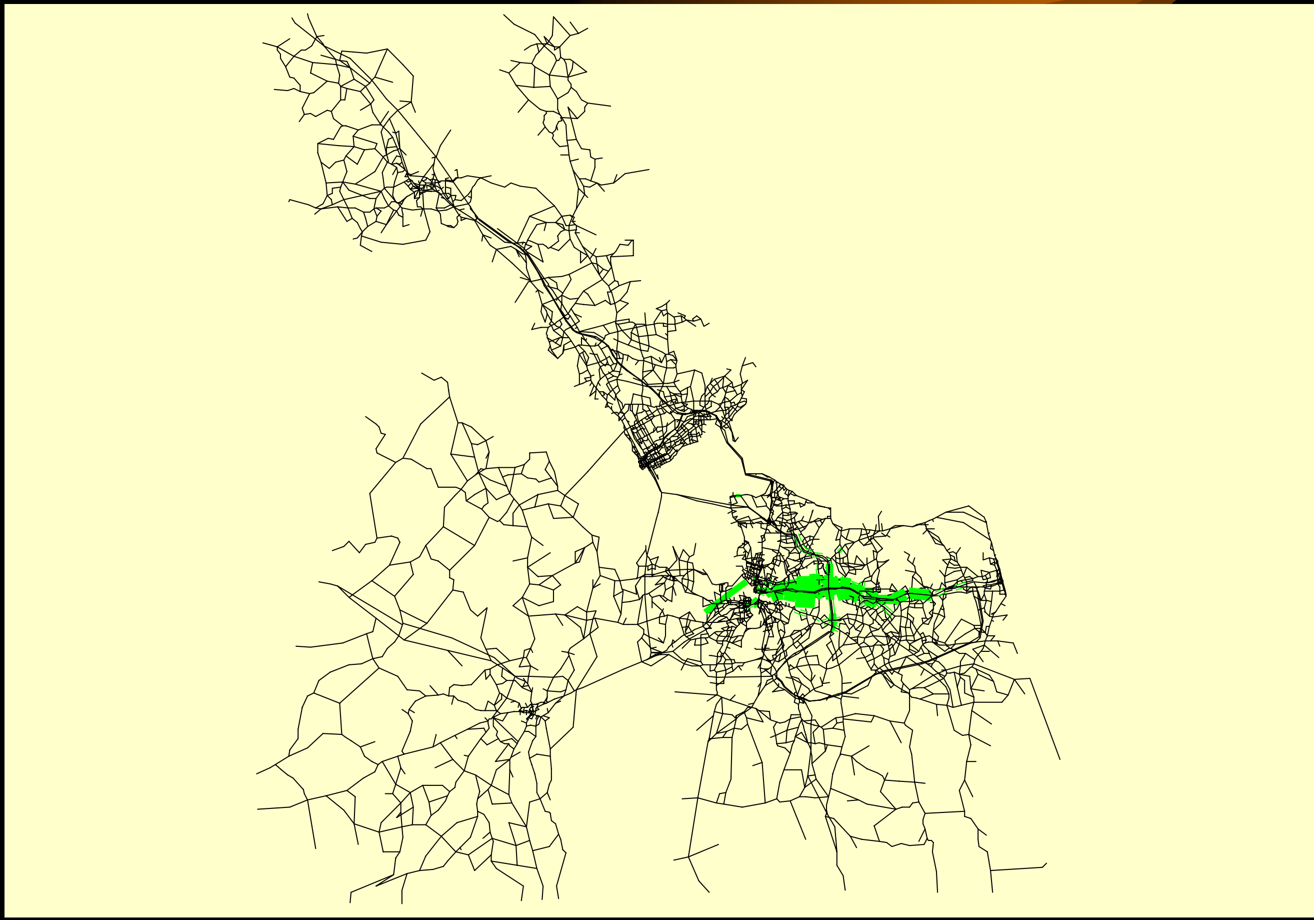
Assessment of Techniques to Improve Stability

- Tighter equilibrium closure criteria does improve link assignment stability… eventually



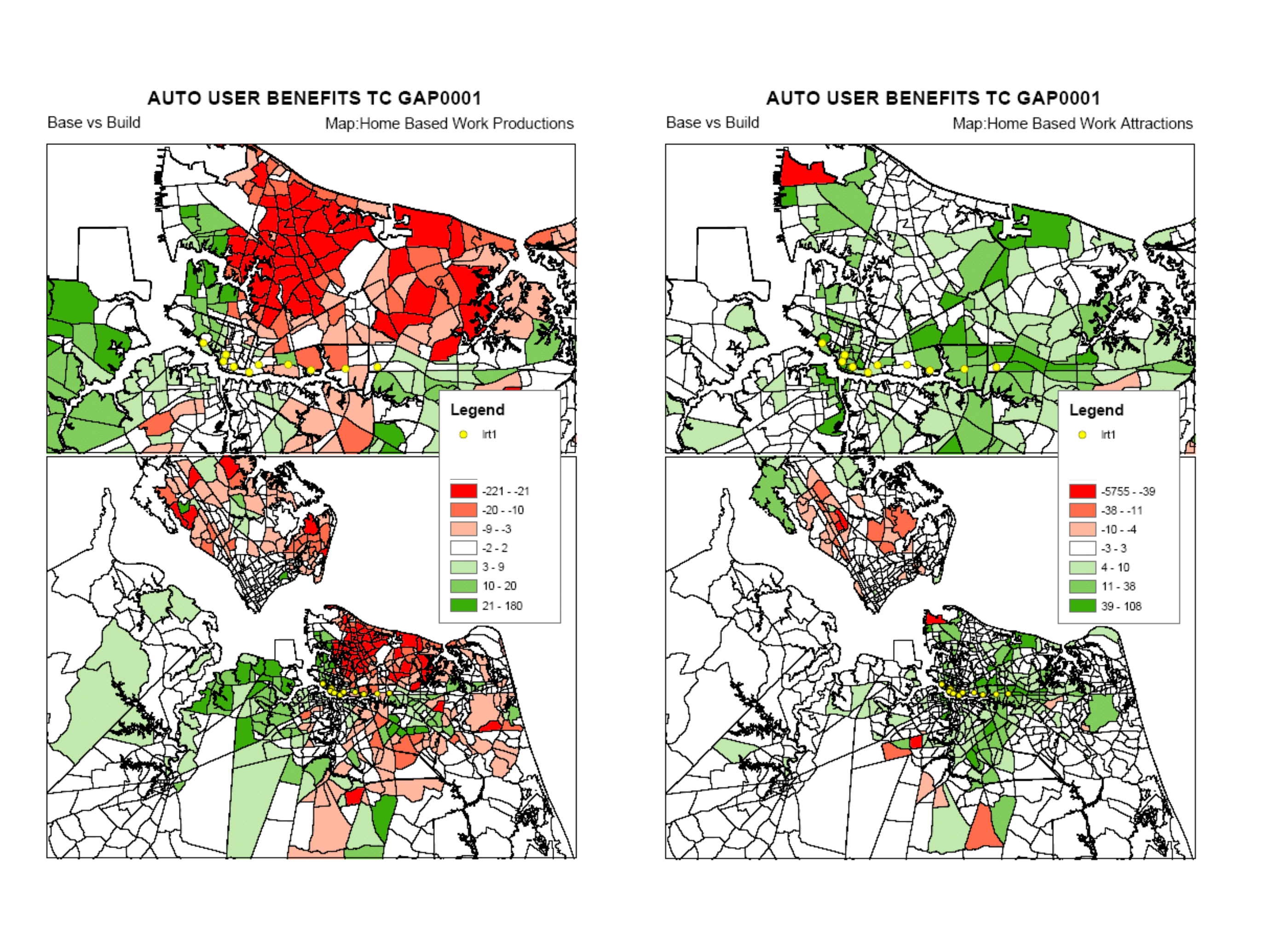
Assessment of Techniques to Improve Stability

- Incremental assignment rapidly generates a stable solution…
- But with substantially different User Benefit results than equilibrium assignment.



Relationship between Tighter Closure and User Benefits

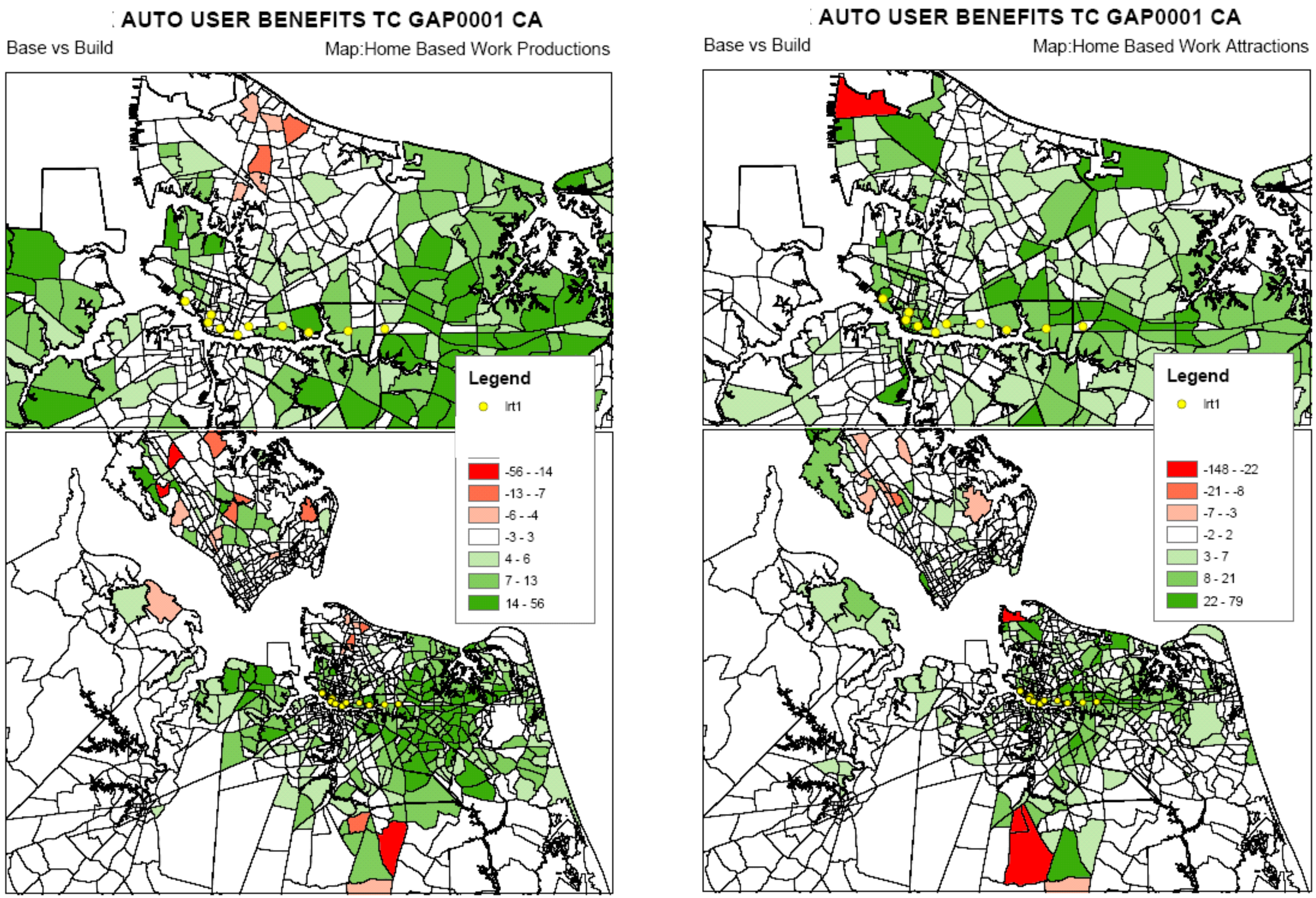
- Tighter closure necessary but not sufficient for meaningful User Benefits



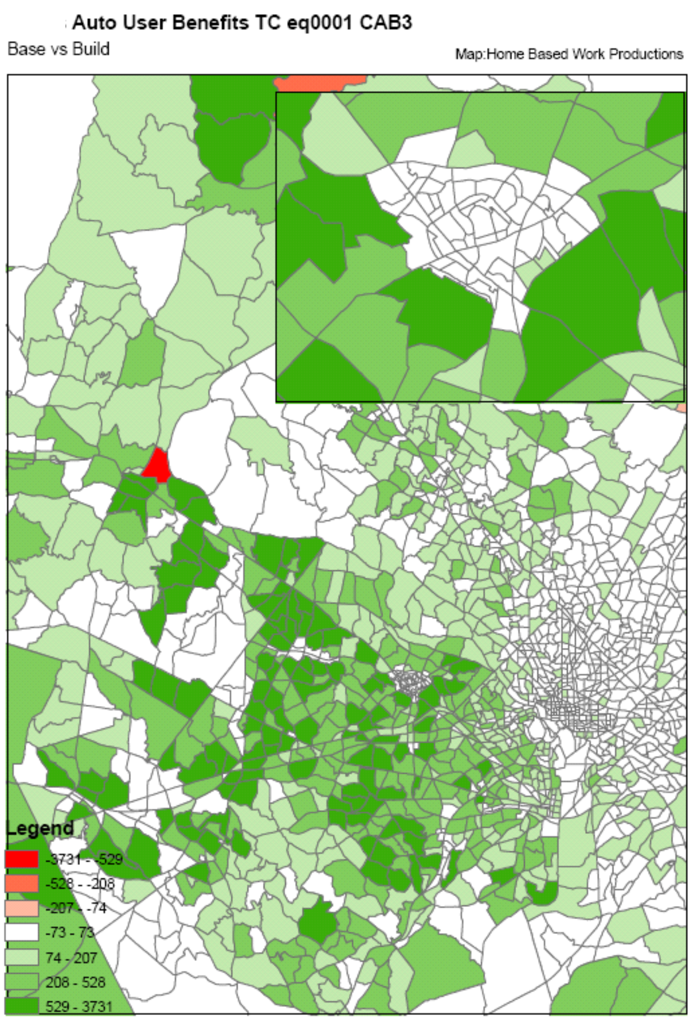
Relationship between Tighter Closure and User Benefits

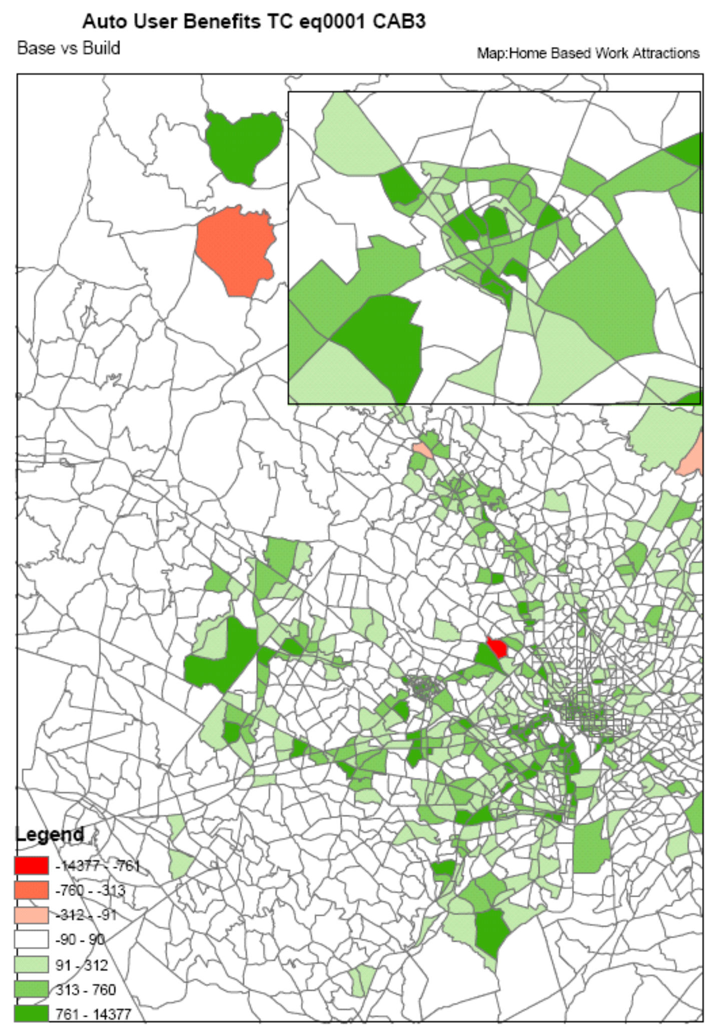
- Stabilized User Benefits requires:
  - Tighter closure
  - Consistent-across-the-board (CAB) evaluation of “best” transportation option:
    - Time vs. distance vs. cost
    - Path skimming, mode choice, assignment
  - Even so…
    - Widespread benefits
    - Substantial effort required to confirm reasonableness

Case 1 – Tighter Closure + CAB



Case 2 – Tighter Closure + CAB





Conclusions

- Highway assignment stability can be improved with existing equilibrium assignment techniques:
  - Extremely time consuming – 1000s of iterations
  - Very high degree of consistency required among different model components
  - Model revision/revalidation may be required

Conclusions

- Highway congestion benefits still not practical
  - May require modifications to highway assignment and mode choice procedures
  - Requires development of meaningful time/capacity estimates
  - Unclear how consistency can be achieved across metropolitan areas
  - Burdensome new Federal review for New Starts
- FTA: continue with transit benefits only

4 – Mobility Benefits from Variable Trip Tables

- Background
- An approach
- Barriers
- Conclusion

Background

- “Fixed” trip tables
  - Implications
    - TSM person-trip tables for all alternatives
    - Benefits from mode choice only
    - No benefits from rearranged travel patterns
  - Long-standing FTA policy
    - Unavailability of appropriate methods
    - Avoidance of another source of over-predictions
  - Reassessment

An Approach

- Simplest setting (for this task)
  - Logit for mode choice and destination choice
  - Logsum from mode choice → destination choice

$$\text{Prob(j given i)} = \frac{\exp(C_{ls} \times \text{logsum}_{ij}) \times \text{size}_j}{\text{sum}_j[\exp(C_{ls} \times \text{logsum}_{ij}) \times \text{size}_j]}$$

From mode choice; same term used in Summit to compute user benefits

An Approach

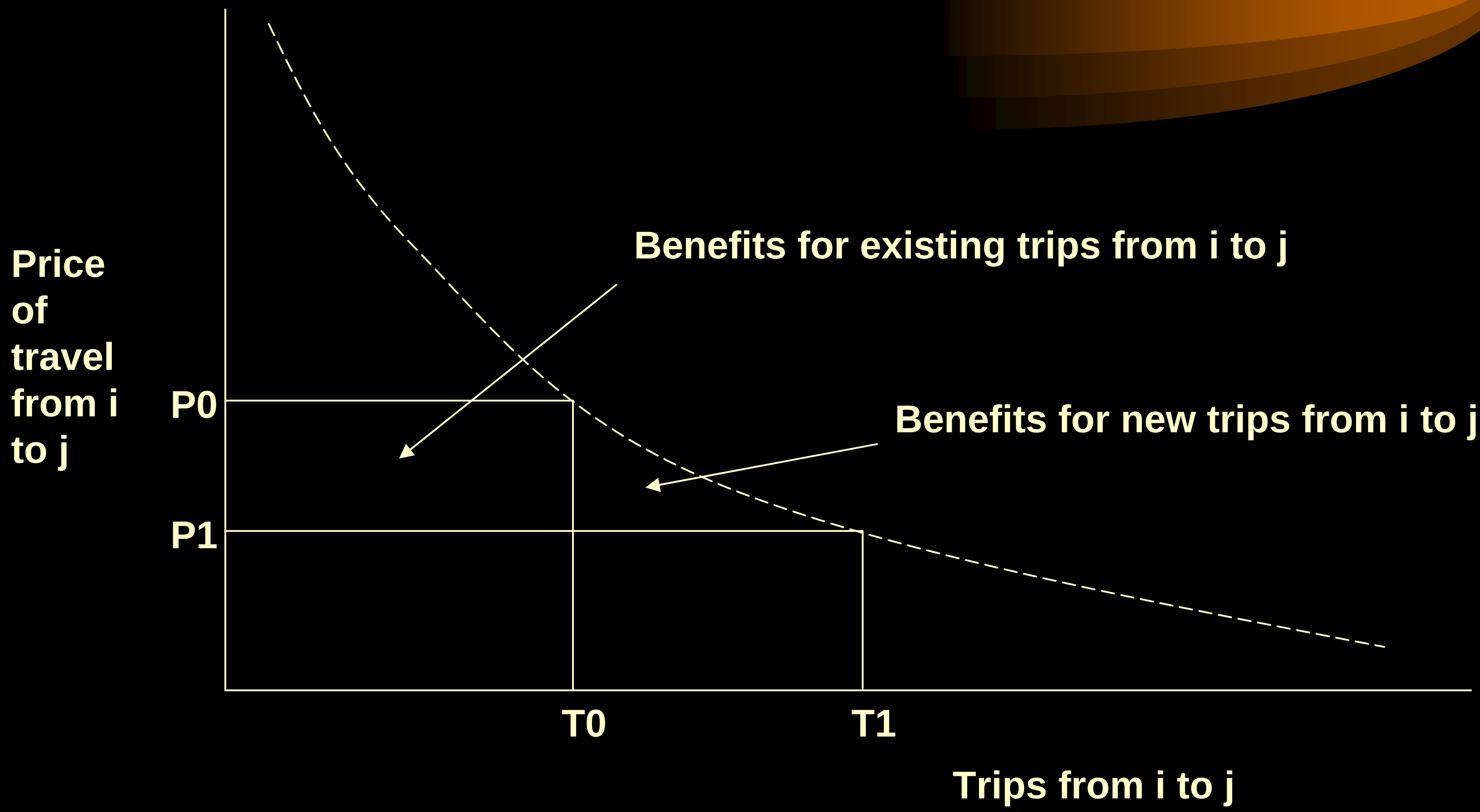
- Another logsum-based measure
  - Same principles as mode-choice logsum
  - Inclusive of benefits from mode choice <u>and</u> destination choice

(1) $\text{logsum}_i = \ln\{\text{sum}_j[\exp(C_{ls} \times \text{logsum}_{ij}) \times \text{size}_j]\}$

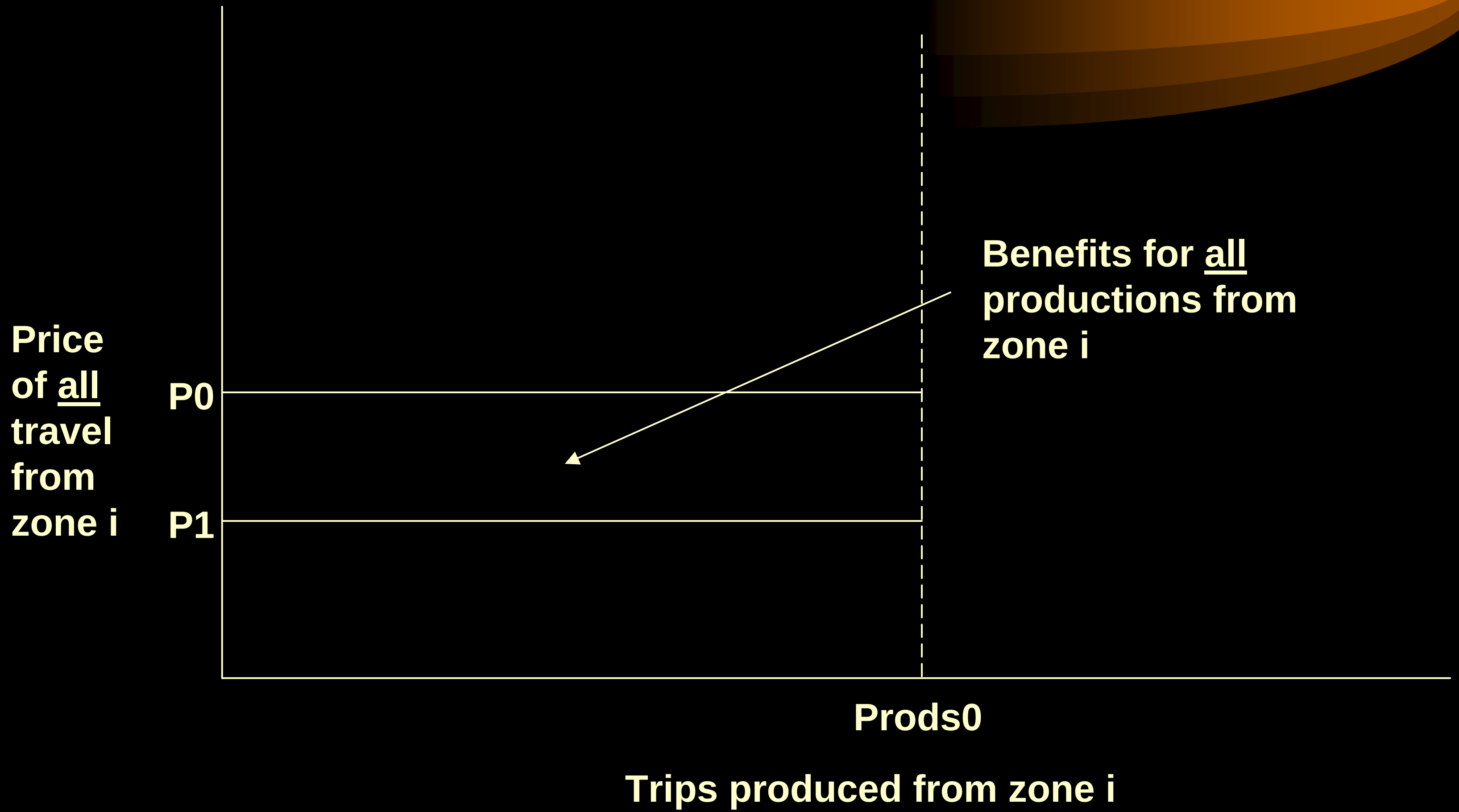
(2) Price of all travel from I = $\text{logsum}_i / (C_{ivt} \times C_{ls})$

(3) User benefits = $(\text{price}_{build} - \text{price}_{base}) \times \text{productions}_i \times (-1)$

An Approach


Price
of
travel
from i
to j
P0
P1
Benefits for existing trips from i to j
Benefits for new trips from i to j
T0
T1
Trips from i to j

An Approach


Benefits for all productions from zone i
Price of all travel from zone i
P0
P1
Prods0
Trips produced from zone i

An Approach

- Properties
  - Captures the benefits of any change
    - Any choice in the mode choice model
    - Any attribute of any choice
  - Isolates benefits by source
    - Changes in mode/access/path choices
    - Changes in destination choices

A 10-zone Test of the Approach

- Models
  - Binary logit mode choice
  - Logit trip distribution (“destination choice”)
    - Singly constrained (i.e., choice model only)
    - Doubly constrained (so column sums = attractions)
  - Linked with logsum variable
- Test: 20-minute (IVT) reduction for transit travel from zone 1 to zone 2

Test Measures

- Singly constrained trip distribution
  - Total user benefits from TD logsum
  - TD benefits = total benefits – MC benefits
- Doubly constrained trip distribution
  - Total user benefits from TD logsum (same)
  - MC benefits from Δ expenditures

Test Results (1)

Singly Constrained Destination-Choice Model

Zone	dPrice (mins)	UBtot (hrs)	UBmc (hrs)	UBtd (hrs)
1	0.00	0.0	0.0	0.0
2	-1.35	112.9	110.4	2.4
3	0.00	0.0	0.0	0.0
4	0.00	0.0	0.0	0.0
5	0.00	0.0	0.0	0.0
6	0.00	0.0	0.0	0.0
7	0.00	0.0	0.0	0.0
8	0.00	0.0	0.0	0.0
9	0.00	0.0	0.0	0.0
10	0.00	0.0	0.0	0.0
Total	---	112.9	110.4	2.4

2%!

Test Results (2)

Doubly Constrained Destination-Choice Model

Zone	dPrice (mins)	UBtot (hrs)	UBmc (hrs)	UBtd (hrs)
1	0.02	-2.0	1.1	-3.1
2	-1.66	138.3	108.0	30.3
3	0.01	-1.6	4.3	-5.9
4	0.02	-3.5	2.7	-6.2
5	0.02	-2.7	3.4	-6.1
6	0.02	-3.8	2.4	-6.3
7	0.02	-3.0	3.1	-6.2
8	0.02	-3.1	3.1	-6.2
9	0.02	-3.1	3.1	-6.2
10	0.02	-2.5	3.6	-6.1
Total	---	112.9	134.9	-22.0

Observations on the Test

- Singly constrained destination choice
  - Internally consistent results for MC and TD
  - Meaningful UBmc and UBtd
- Doubly constrained destination choice
  - Consistent results with TD prices
  - Inconsistent results with MC prices
  - So, MC-level expenditure calculations for changes in person-trip tables → meaningless

Barriers and Tentative Conclusion

- Narrow set of conditions for success
  - Logit trip distribution models
  - Logsum from mode choice
- General absence of these conditions
- Apparently small contribution from TD
- Trade-off with added model complexity
- Conclusion(?): low priority for FTA

5 – Mobility Benefits from Variable Trip Ends

- Motivations
- Risks of double-counting
- Location benefits
- Barriers and conclusions

Motivations

- "Economic development benefits"
  - Often-cited goal for New Starts projects
  - Absent from FTA's rating process
    - Fixed trip tables → no land-use changes
    - Land use rating considers setting, not impacts
- Recent interest at FTA and in Congress in "economic development"

Risks of Double Counting

- Research conclusion:

  Development impacts are the consequence of accessibility improvements

- New Starts ratings criteria capture well the impacts on mobility/accessibility
- So, many possible measures of economic development impacts would double-count the same benefits

Location Benefits

- Two possibilities
  - Benefits from shifts in location choices of households and businesses (analogous to changes in destination choices)
  - Benefits from reduced expenditures on travel because of more focused development (from outlying suburb to urban core)

Problems

- Absence of an established state of the practice in land-use forecasting
- Difficulties in differentiating policy-driven impacts from project-caused impacts
- Potentially overwhelming magnitude of reductions in overall travel → no help in differentiating proposed projects
- Opportunities for manipulation

Status

- No promising avenues toward valuing benefits of development consequences
- FTA has no current plans for further pursuit of ways to quantify benefits of revised locational choices as an increment beyond direct mobility benefits

6 – Predicted and Actual Ridership on New Starts Projects

- Phase I: overview
- Phase II: case studies
- Conclusions

Phase I

- Selection criteria for projects
  - Full Funding Grant Agreement
  - Not included in the Pickrell report
  - Open to service (21 projects)
  - Forecast of guideway ridership (19 projects)

Phase I

- Assessment of post-1990 projects (FTA):
  - Exceeded AA forecast: 3 of 19
  - At least 80% of AA forecast: 3 of 19
  - At least 70% of AA forecast: 4 of 19
- Assessment of pre-1990 projects (Pickrell):
  - Exceeded AA forecast: 0 of 10
  - At least 80% of AA forecast: 0 of 10
  - At least 70% of AA forecast: 1 of 10

Update on the 1990 Projects

- Update on pre-1990 projects
  - Ridership now close to forecast: 2 of 10
  - Ridership growing but ways to go: 2 of 10
  - Ridership largely unchanged: 3 of 10
  - Ridership has declined: 3 of 10

Phase I

- Conclusions
  - Risk is higher for starter projects
  - Risk is higher with less-common modes
    - Downtown circulators
    - Bus guideways
  - Travel forecasting usually ends with the conclusion of Alternatives Analysis

Phase II

- Approach
  - Detailed review of 7 of the 19 projects
  - Reliance on available documentation
  - “Forensic” analysis
  - Two “successful” forecasts
  - Five “less successful” forecasts

Phase II

- Conclusions
  - Forensic analysis nearly impossible with current data sources
  - Experience matters, but not always
  - Offsetting errors help “successful” forecasts
    - Underestimated population/employment growth
    - Underestimate guideway share of transit trips

Phase II

- Conclusions (continued)
  - "Less success" has many sources
    - Overestimated population/employment growth
    - Unanticipated changes in travel patterns
    - Overstated service levels, understated fares
    - Post-forecast changes in project scope

Overall Conclusions

- Forecast accuracy <u>may</u> be improving.
- Models cause only some of the problems.
- There is still a long way to go.
- We need more information if we are to learn more from future projects.

"Hey, we're only humble travel forecasters ……… …… and we have much to be humble about."

7 – Data Library

- Motivations and application
- Assembled datasets
- Early insights

Motivations

- Learn from 30 years of New Starts experience
- Understand travel patterns of rail projects
- Improve planning, forecasting, and as a result, decision-making

Approach

- Collect available on-board survey datasets
- Develop common tabulations regarding
  – Characteristics of the transit rider,
  – Geography of the trips
  – Characteristics of the trips by trip purposes
- Distribute the information where it may be useful - Available on CD

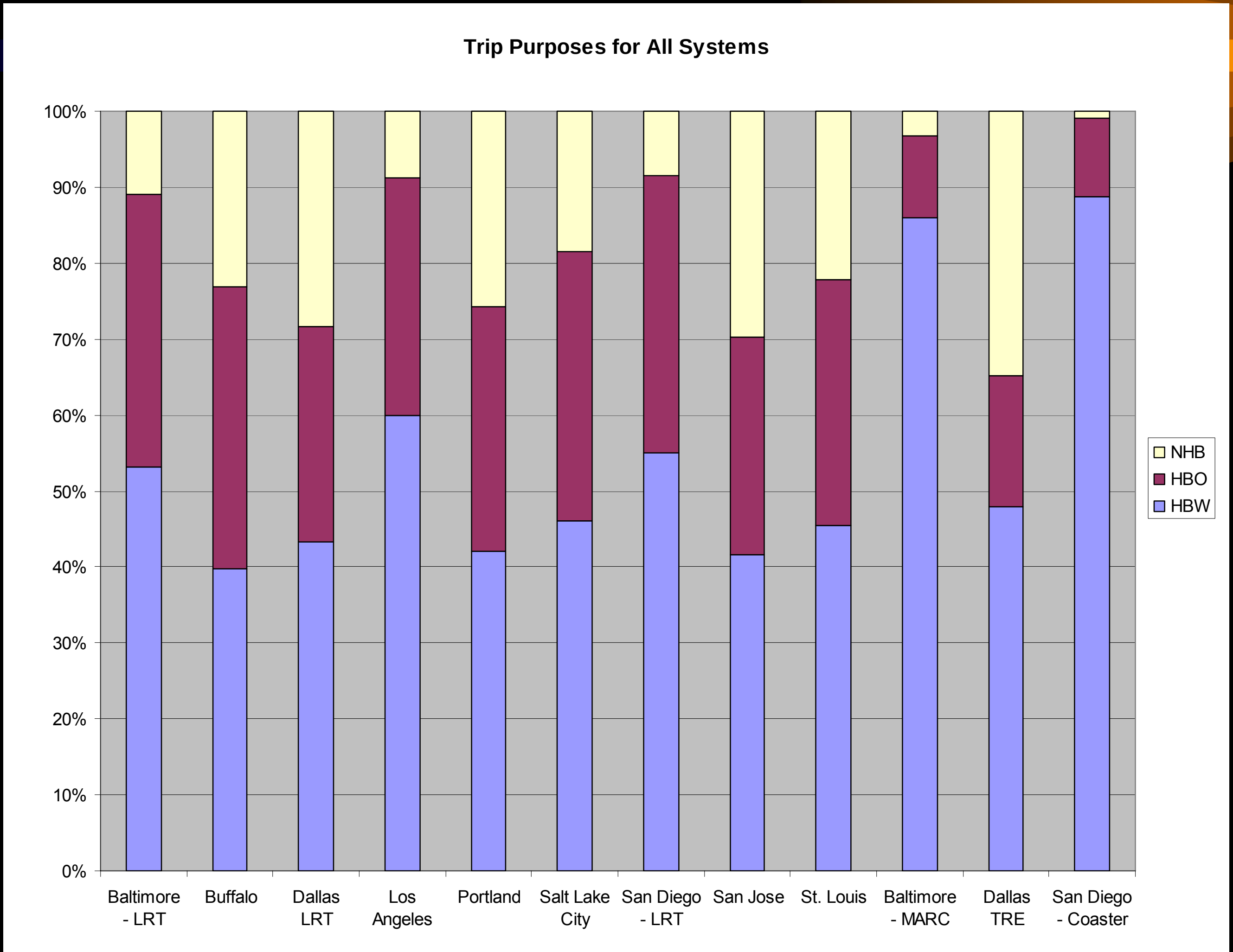
Use of the Data Library

- Understand likely travel patterns of proposed projects
- Provide precedent for project characteristics and forecasting results
- Bolster “case” for proposed projects
- Beware of data problems

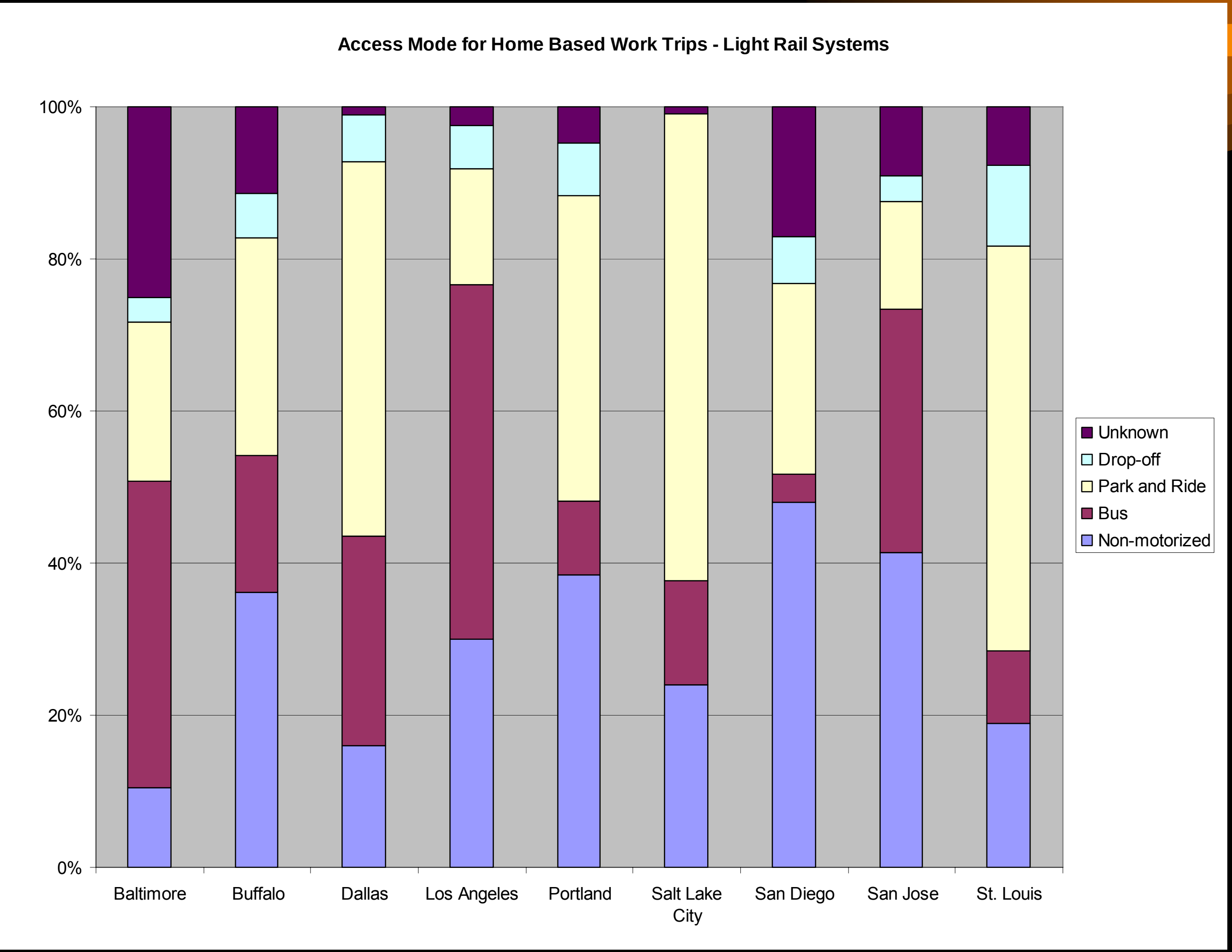
Datasets

- Baltimore Light Rail & MARC Commuter Rail
- Buffalo Metro Rail
- Dallas Light Rail and TRE Commuter Rail
- Los Angeles Metro Rail (Blue and Green lines)
- Portland MAX Light Rail
- Salt Lake City TRAX
- San Diego Trolley and Coaster Commuter Rail
- San Jose Light Rail
- St. Louis Metrolink

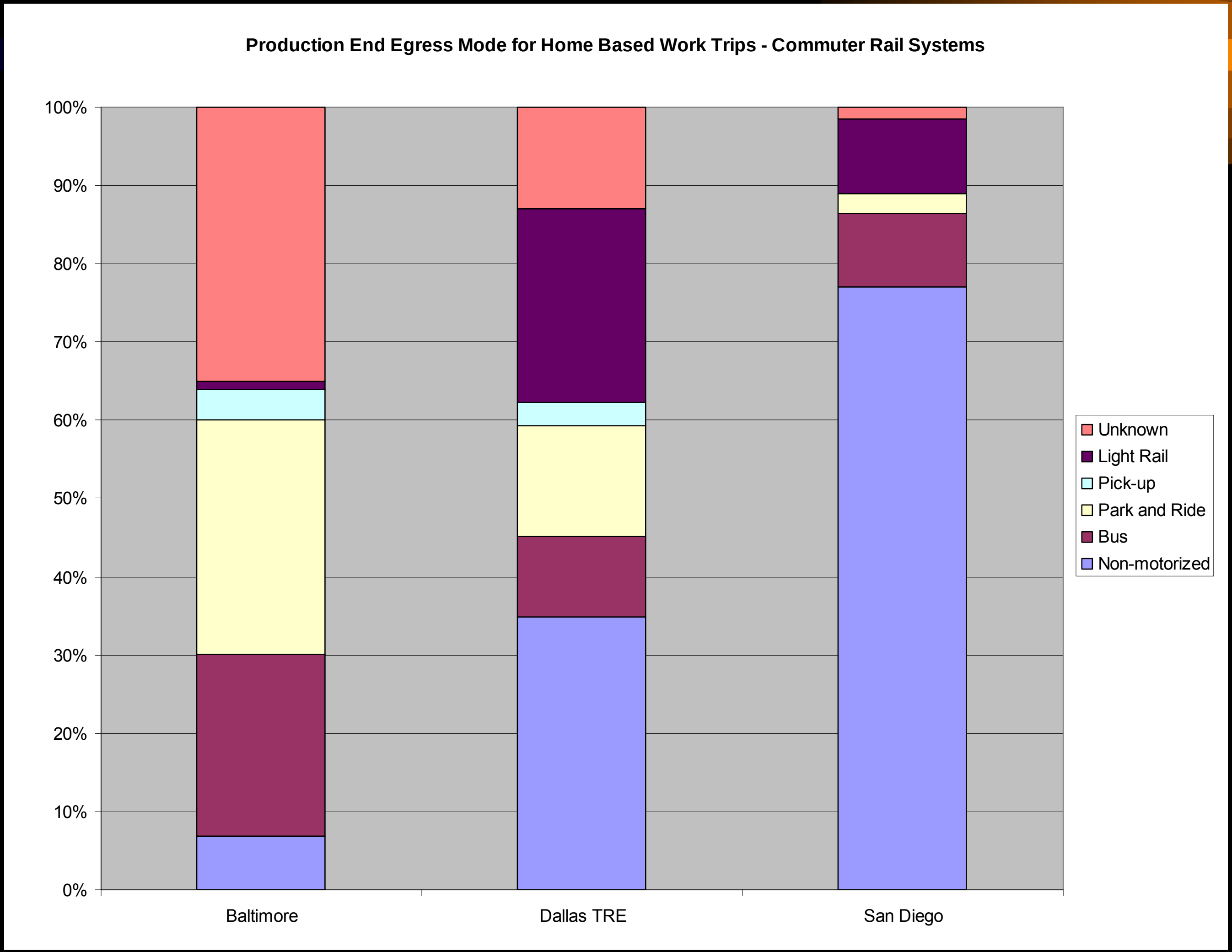
Early Insights – Trip Purposes



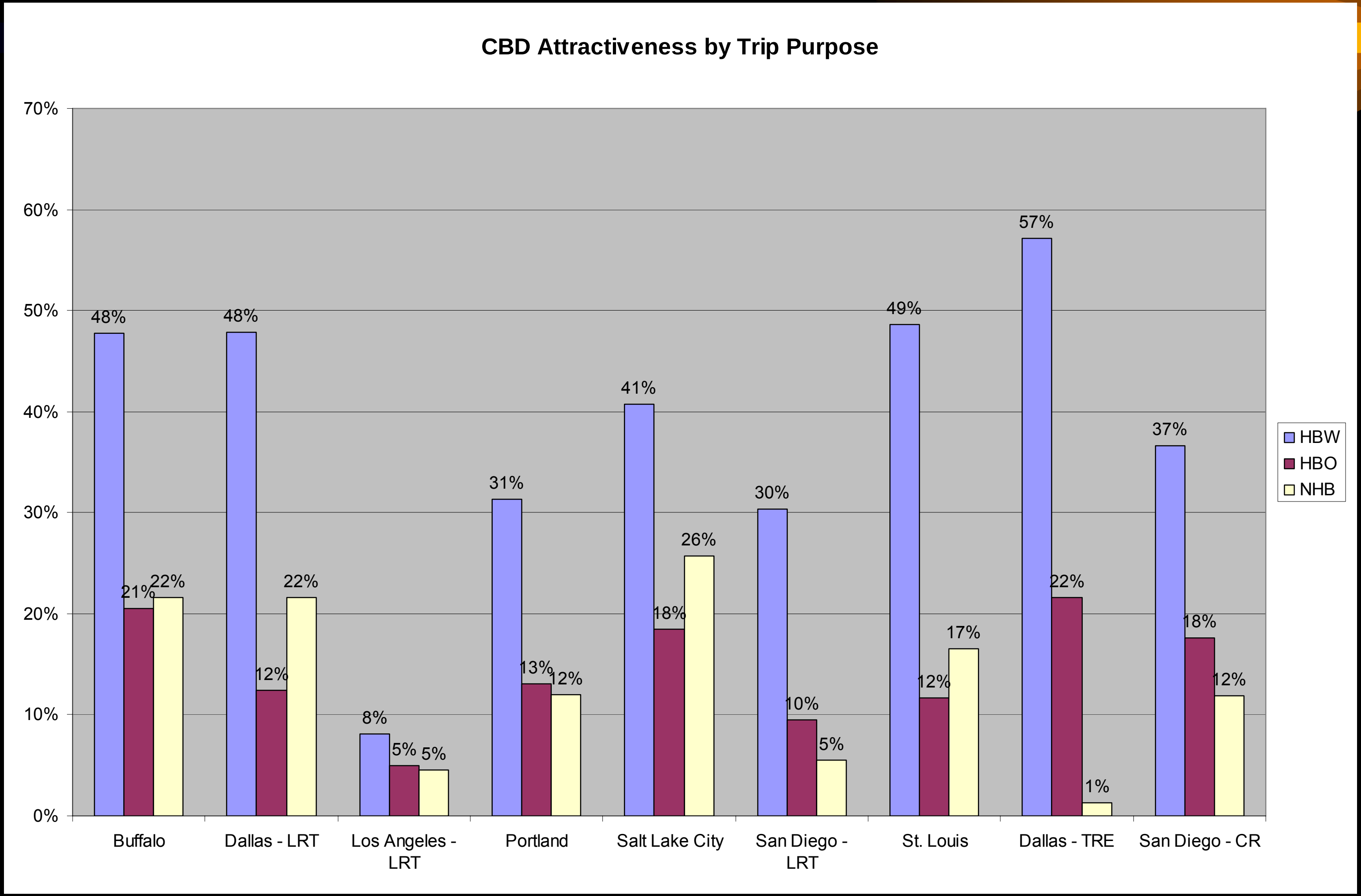
Early Insights – Access Mode



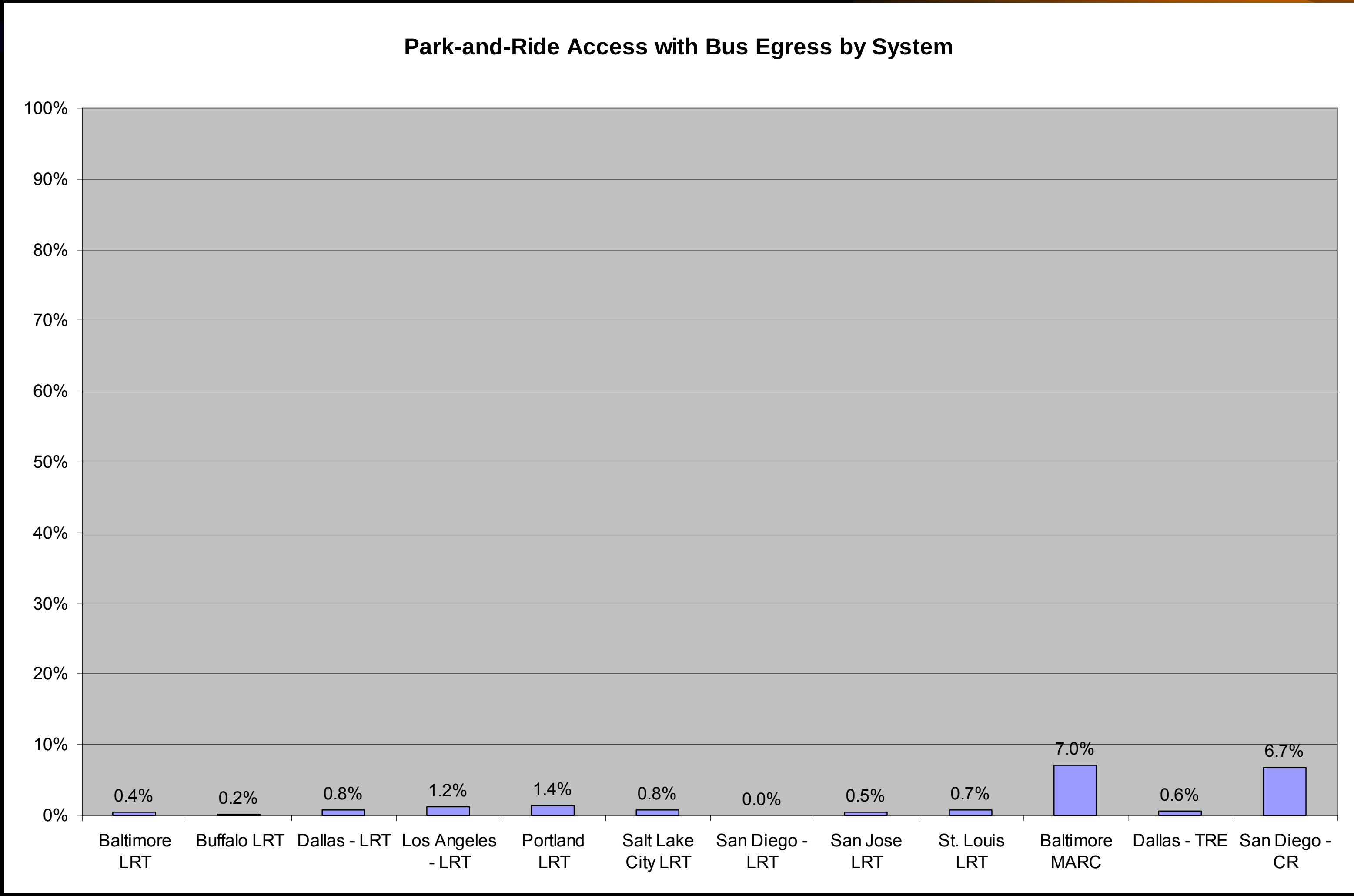
Early Insights – Egress Mode



Early Insights – CBD Attractiveness



Early Insights – Unusual Markets



Implementation

- Big picture quality control
  - Consistency with observed travel patterns
  - Precedents for unexpected characteristics
  - Basis for explaining deviations from past experience -- What's different?
- Help FTA and project sponsors evaluate forecasts in the context of past experience

8 – CTPP-based Aggregate Model

- Background and approach
- Light rail model
- Commuter rail model

Bill Woodford, AECOM Consult

Background

- New generation of rail projects offers opportunity to understand markets outside very largest metropolitan areas
- FTA and project sponsors require procedures to apply these insights to new projects:
  - Relatively simple, robust approach
  - Transferable using consistently available data

Overview

- Aggregate Rail Ridership Forecasting (AARF) Model
  - Relates:
    - Y2000 CTPP JTW
    - ~Y2000 station locations / NTD service quality
  - To:
    - NTD ~Y2000 rail ridership
- Purpose: Supplement conventional models with:
  - Understanding of potential markets
  - Insights into reasonableness of forecasts

Data for the LRT Model

- Excluded very largest metro areas
- Ridership reported in 2000 NTD, or more survey on an expanded system

System & year	Trips		System & year	Trips
Baltimore 2000	27,415		Sacramento 2000	29,102
Buffalo 2000	23,155		Salt Lake City 2002:	33,615
Cleveland 2000	14,062		San Diego 2000:	83,474
Dallas 2000	37,682		San Jose 2001	30,295
Denver 2001	31,423		St. Louis 2002:	37,281
Portland 2000:	73,562			

Data for the Commuter Rail Model

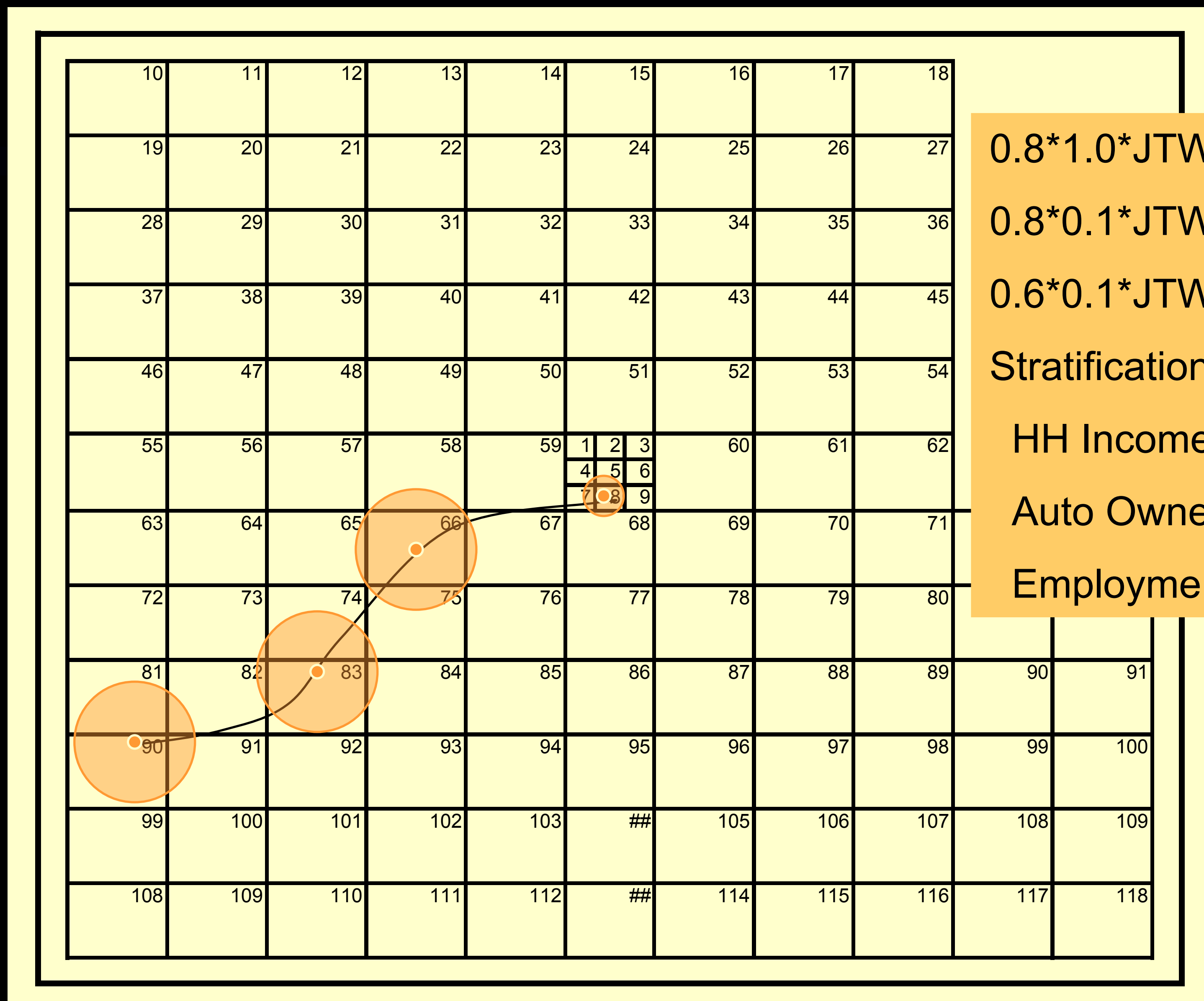
- Included all but the very largest metro areas
- Year 2000 NTD (APTA for ACE)

System	Trips		System	Trips
Baltimore-DC MARC	20,851		San Francisco Peninsula	30,616
Dallas-Ft. Worth TRE	4,229		San Jose ACE	3,500
LA Metrolink:	26,300		Seattle Sounder	1,120
Miami Tri-Rail	7,381		DC VRE	8,057
San Diego Coaster	4,327			

Level of Service Variables

- LRT
  - None used (similar LOS across country)
- Commuter rail
  - Speed (NTD vehicle miles/vehicle hours)
  - Train miles per direction route mile
  - Connection to rail distributor (only Seattle has none)

CTPP JTW Selection



0.8*1.0*JTW(90 to 8)

0.8*0.1*JTW(90-to-7)

0.6*0.1*JTW(81-to-7)

Stratifications:

- HH Income (Part I)
- Auto Ownership (III)
- Employment Density (II)

Calibration Approach

- Tests of alternative model forms
  - Home-end / work end JTW station radii
  - Purpose segmentations
  - Access mode segmentations
- Criteria
  - “Reasonable” coefficient values
  - Higher r-squared values

LRT Model

Weekday Unlinked
Drive Access to Work
Rail Trips= 0.030 * CTPP PNR 6 -to-1 Mile JTW Flows (<50K Den) +
0.202 * CTPP PNR 6 -to-1 Mile JTW Flows (>50K Den)

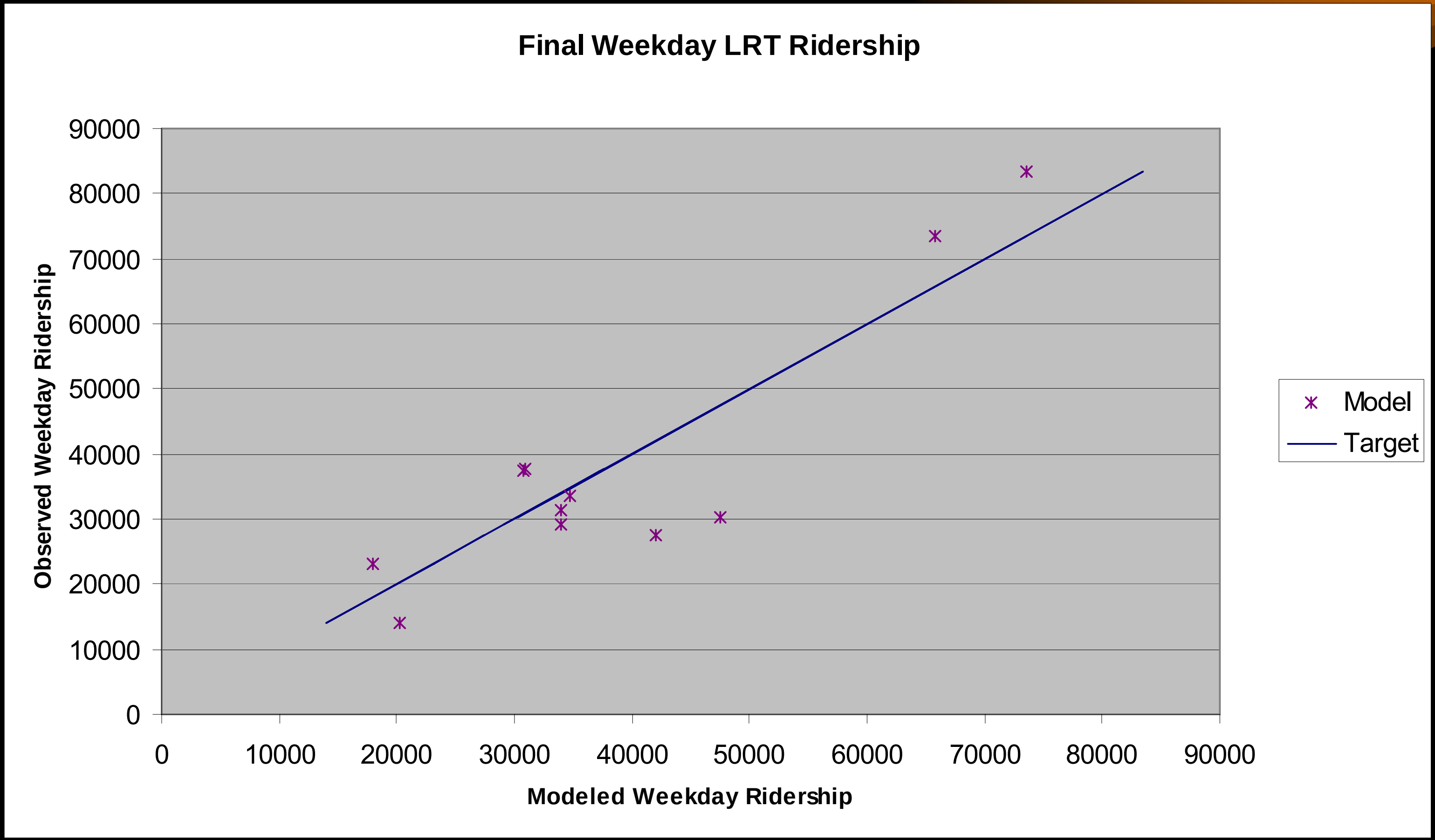
Weekday Unlinked Other
(Non-Drive Access to Work)
Rail Trips= 0.395 * CTPP 2 -to-1 Mile JTW Flows (<50K Den) +
0.445 * CTPP 2 -to-1 Mile JTW Flows (>50K Den)

Total Weekday Unlinked
Rail Trips= Weekday Unlinked Drive Access to Work Rail Trips +
Weekday Unlinked Other Rail Trips

LRT Model
Predicted vs. Observed

City	Observed Weekday Unlinked Trips	Drive Access Work Rail Trips	Other Rail Trips	Total Rail Trips	Percentage Error
Baltimore	27,415	13,336	28,704	42,040	53.3%
Buffalo	23,155	4,168	13,753	17,921	-22.6%
Cleveland	14,062	7,088	13,098	20,187	43.6%
Dallas	37,682	9,866	21,050	30,916	-18.0%
Denver	31,423	12,474	21,454	33,928	8.0%
Portland	73,562	13,320	52,431	65,751	-10.6%
Sacramento	29,102	8,539	25,389	33,928	16.6%
Salt Lake City	33,615	8,272	26,525	34,797	3.5%
San Diego	83,474	13,019	60,468	73,487	-12.0%
San Jose	30,295	9,338	38,168	47,506	56.8%
St. Louis	37,381	10,182	20,547	30,729	-17.8%

LRT Model
Predicted vs. Observed



Commuter Rail Model

Commuter Rail Weekday
Unlinked Trips =Nominal Ridership x Demand Adjustment Factor

Nominal Ridership=

0.069*High Income CTPP Flows within 6 miles of a PNR station at the home end and 1 mile of any station at the work end of the trip +

0.041*Medium Income CTPP Flows within 6 miles of a PNR station at the home end and 1 mile of any station at the work end of the trip +

0.151*Low Income CTPP Flows within 2 miles of any station at the home end and 1 mile of any station at the work end of the trip

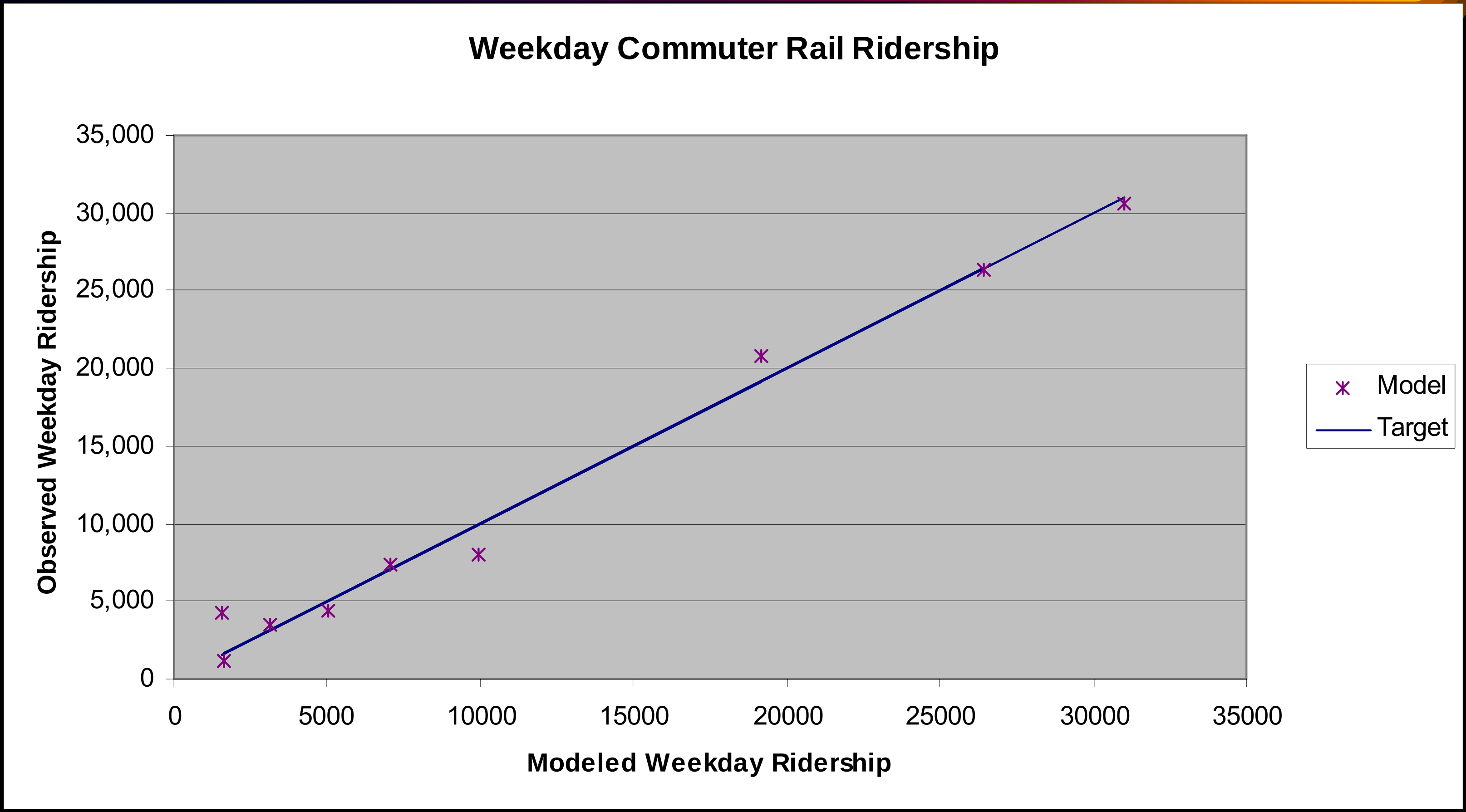
Demand Adjustment Factor=

(1+0.3*Percent Deviation in Average System Speed) x
(1+0.3*Percent Deviation in Train Miles per Mile) x Rail Connection Index

Commuter Rail Model Predicted vs. Observed

City	Observed Ridership	Modeled Ridership	Percent Difference
Baltimore	20,851	19,145	-8.2%
Dallas	4,229	1,586	-62.5%
Los Angeles	26,300	26,450	0.6%
Miami	7,381	7,061	-4.3%
San Diego	4,327	5,017	15.9%
San Francisco	30,616	31,032	1.4%
San Jose	3,500	3,127	-10.7%
Seattle	1,120	1,642	46.6%
Virginia	8,057	9,972	23.8%

Commuter Rail Model Predicted vs. Observed



Next Steps

- FTA testing through 2006
- Beginning in 2007
  - AARF forecasts part of QC tests
  - Documented in requests for entry to PE

9 – Semi-independent Forecasts

- Motivations
- Strategy and detailed approach
- Implementation

Motivations

- Experience over the past four years
  - Closer scrutiny of predicted deltas
    - Build versus baseline
    - New transit trips and user benefits
    - Better understanding of the project
  - Previously unknown model "properties"
    - Transit pathbuilding
    - Mode choice
  - Inadequacy of fixed "cap" on user benefits

Motivations

- Deltas highlight areas for attention
  - Better understanding, or
  - Problems for correction
- So, “quality control” forecasts
  - Generated by project sponsor
  - Compared against sponsor’s forecast
  - Used to solidify explanation of sponsor’s forecast, or to revise it

Strategy

- "Quality-control" forecast
  - Prepared for the build alternative
  - Grounded in the "sponsor's" forecast for the baseline alternative
  - Based on standardized methods
    - "Best" transit paths
    - Incremental mode choice model
  - Not a replacement for sponsor's forecast

Strategy

- Local conditions vs. national consistency
  - Local conditions
    - Grasped by sponsor's models
    - Reflected in the baseline forecast
  - National consistency
    - Simplified methods
    - Transparent properties

Details

- Best transit paths
  - Separately for walk-access & drive-access
  - Properties
    - No “favoring” of path types
    - Minimization of multi-path effects
    - Preservation of combined-headway effects
  - Dependence on local pathbuilder software
    - Straightforward with older all-or-nothing algorithms
    - Probably less so with multi-path algorithms

Details: Pathbuilding Weights

Impedance Weights for Path Selection

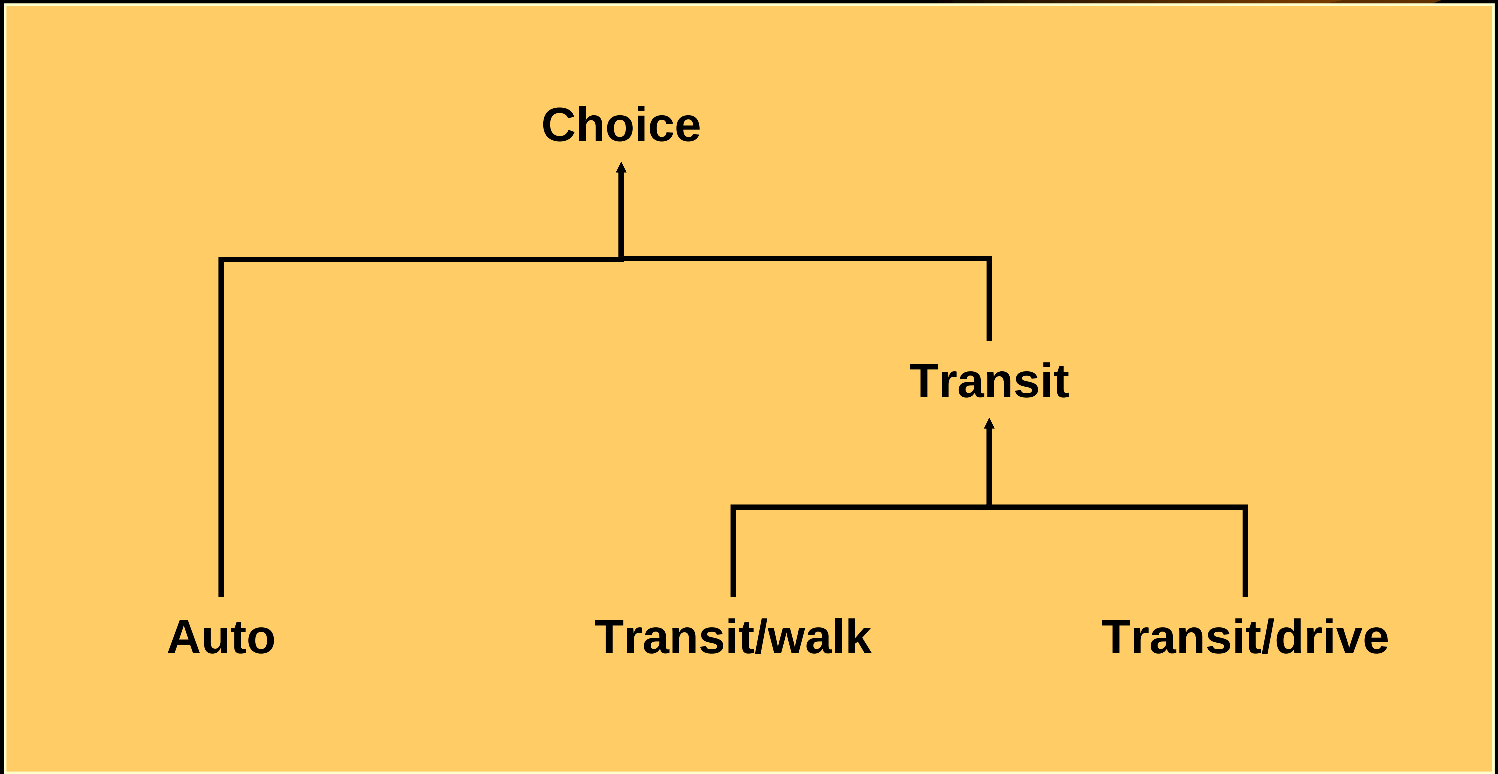
Impedance	Units	Weight
In-vehicle time for (most) transit modes	Minutes	1.0
In-vehicle time for commuter rail	Minutes	0.8
All out-of-vehicle time	Minutes	2.0
Drive-access time	Minutes	2.0
Transfers	Number	5.0
Fare (cents) (peak / off-peak)	Cents	0.15 / 0.075

--- --- --- Subject to revision --- --- ---

Details: Mode Choice Model

- Incremental logit
  - Focuses only on transit service changes
  - Considers small set of alternatives
  - Uses coefficients from mid-range of national experience

Details: Incremental Mode Choice Model



Details: Mode Choice Coefficients

Coefficients in the Mode Choice Model

Variables		Coefficients		
Attribute	**Units**	**HBW**	**HBO**	**NHB**
IVT for (most) transit modes	Minutes	-0.020	-0.010	-0.020
IVT for commuter rail	Minutes	-0.016	-0.008	-0.016
All out-of-vehicle time	Minutes	-0.040	-0.020	-0.040
Drive-access time	Minutes	-0.040	-0.020	-0.040
Transfers	Number	-0.100	-0.050	-0.100
Fare (cents)	Cents	-0.003	-0.0015	-0.0015
Guideway flag(s)	0/1	TBD	TBD	TBD
Transit-access logsum	Utiles	0.6	0.6	0.6

--- --- --- Subject to revision --- --- ---

Details: Mechanics

- Development of “best” transit paths
  - Walk and drive access
  - Baseline and build alternatives
- Aggregation of sponsor forecasts
  - Preserving trip purposes, market segments
  - Transit trips by (1) walk and (2) drive access
  - Baseline and build alternatives
- Application of the incremental MC model

Implementation

- Testing through 2006
- Function in Summit version 1.5
- Effective January 2007
  - Projects requesting entry into PE
  - Projects in PE(?)

10 – Other Quality-Control Tests

- Motivations
- Strategy
- Two new QC tests
- Implementation

Motivation

- Recent experience
  - Unknown properties of models
  - Inconsistencies between alternatives
- Existing QC tests
  - Deltas in district-level trip tables, benefits
  - Thematic maps of benefits
  - Benefits by change in transit availability

Motivation

- Gaps in existing QC tests
  - Causes of benefits unclear
    - In-vehicle, walk, wait, or transfer time?
    - Fares?
    - Constants and mode-choice nesting structure?
  - Role of the project unclear
    - Introduction of transit guideway?
    - Other transit changes in the build alternative?

Motivation

- Findings for one recent proposed project
  - Tests
    - 80% of benefits from Δwait + Δtransfer times
    - 70% of benefits on zone-to-zone paths that did not include the proposed guideway
  - Analysis
    - Benefits generated by large-scale improvements in bus headways (only) in the build alternative to foster bus access to the new guideway

Strategy

- Parallel with semi-independent forecasts
  - Best walk-access and drive-access paths
  - Incremental mode choice
- Additional tests
  - Benefits from each service attribute
  - Benefits for paths involving new guideway
- Potential application in sponsor’s models

Test 1: Causes of Benefits

- Isolation of deltas: “partial” forecasts

$$\exp(w + x + y + z)$$
$$= \exp(w) \times \exp(x) \times \exp(y) \times \exp(z) \quad \text{[complete]}$$
$$= 1.0 \times \exp(x) \times \exp(y) \times \exp(z) \quad \text{[partial \#1]}$$
$$= \exp(w) \times 1.0 \times \exp(y) \times \exp(z) \quad \text{[partial \#2]}$$
$$= \exp(w) \times \exp(x) \times 1.0 \times \exp(z) \quad \text{[partial \#3]}$$
$$= \exp(w) \times \exp(x) \times \exp(z) \times 1.0 \quad \text{[partial \#4]}$$

where w, x, y, and z are b(Δ service variable)

Test 2: Role of the Project

- Benefits related to project if:
  - Build IVT(gdwy) > Base IVT(gdwy) = 0
  - Build IVT(gdwy) > Base IVT(gdwy) > 0
- Benefits not related to project if:
  - Build IVT(gdwy) = 0
  - Build IVT(gdwy) = Base IVT(gdwy)
  - Build IVT(gdwy) < Base IVT(gdwy) [?!]

Some Details

- Multi-path transit pathbuilders
  - Various ways of identifying families of paths
  - Probabilities for individual paths
  - Probability-weighted attributes
- Implications
  - Test 1 probably unaffected
  - Test 2 may not be possible with multi-paths

Implementation

- Testing through 2006
- Function in Summit version 1.5
- Effective January 2007
  - Projects requesting entry into PE
  - Projects in PE(?)
- *Ad hoc testing already in use at FTA when needed*

11 – Summit Update

- Spreadsheet example
- Software versions

Spreadsheet example

- Prototypical mode choice model
- Extraction of information for Summit
- Summit calculations
  - Trips by change in transit availability
  - Price change for “non-transit”
  - Price changes for transit (by availability)
  - Capping
  - Price changes for all travel (by transit availability)
  - User benefits: total, transit, and auto

Summit Version 1.0

- Updates from version 0.99x
  - Full i/o compatibility with software packages
  - Options for transfer of mode choice results
    - Special binary file (as with 0.99x)
    - Matrix file format of local software package
  - Additional reporting
    - Capping effects
    - Playback of input records
- Projected: September 2006

Summit Version 1.5

- Updates from Version 1.0
  - Semi-independent forecasts
  - New quality-control tests
    - Sources of benefits
    - Role of the project