Activity-Based Modeling: National Experience

presented to
Panel on Activity-Based Models

presented by
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Presentation Topics

- Applications of Activity-Based Models From:
  - San Francisco
  - New York
  - Sacramento
  - Atlanta

- A few “lessons learned” and ongoing work

- Thoughts on Activity-Based Modeling in Florida
Tour-Based Model Output

Household Data, Person Data, Tour/ Trip List

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<th>TID</th>
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<th>MOD</th>
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Maps, Graphics

Trip Tables

Assignment

Other Summaries
Transit New Starts Application: Muni Central Subway

- 1.4 miles connecting South of Market to Chinatown
- Third Street LRT 7.1 mile surface line (IOS = Baseline)
Muni Central Subway

Third Street Alternative

Headways:

• 5 min. peak
• 10 min. off-peak
• 12 min. night
Mode Choice Models

Trip Mode Choice Model Nesting Structure

Choice

Auto
- Drive-Alone
- Shared 2-Person
- Shared 3+Person

Non-Motorized
- Walk
- Bike

Walk-Transit
- Local
- MUNI
- Premium
- BART

Drive-Transit
- Premium
- BART
Careful Model Validation…

Year 2000 Transit Routes in Project Corridor
Work Tour Destination-Based User Benefit
SF Model

Hours of User Benefit
- < -100
- -100 - -25
- -25 - -5
- -5 - 5
- 5 - 25
- 25 - 100
- > 100

3rd St IOS+NCS
Market Segmentation

- There is no limit on “market segmentation” in a micro-simulation model in the same way that there is in an aggregate trip-based model.
- Used auto sufficiency stratification in tour and trip mode choice models
  - Autos=0, autos< workers, autos>=[workers

Fixed trip table constraint – “level playing field”

- Tour models have more integration across model components – vehicle, pattern, destination choice, mode choice.
- Only tour & trip mode allowed to vary for purposes of New Starts analysis: no trip asymmetry.
Another (non-New Starts) Transit Application: Sacramento State BRT Project

- Activity-based model used to simulate campus arrivals and departures by ½ hour time periods
- Parking lots fill up -> park further from destination
- Choice of BRT or walk from lot to destination
• The tour-based model tracks time in 1/2 hour periods

• Conventional models do not have this level of detail

• Parking constraints and policies affect transit ridership
Conclusions

- Simulation-based forecasting can capture dynamics that traditional aggregate models miss

- Sometimes model enhancements are required for ‘special market’ analysis (true with trip-based models too)
  - Split up Sacramento State University parcel into smaller, sub-parcel units
  - Used university-provided information to allocate origins and destinations to sub-parcels
  - Developed a sub-model that trades-off between walking and riding the BRT shuttle
  - Adjustments to population synthesizer required to get the SSU students living in on-campus GQ households
SF Mobility Study – Why?

- Bay Area is 2\textsuperscript{nd} most congested region in the nation (Texas Transportation Institute)
- Average peak period trip to Downtown SF is twice as long as off-peak trip
- San Francisco sacrificed over $2 billion to congestion in 2005
- 4.6 million daily trips are made to/from/within San Francisco
  - Peak transit mode share to Downtown just over 40%
  - About half of all trips made by regional travelers

Source: SFCTA, Spring 2006 LOS Monitoring
SFMTA, Spring 2007 AVL Monitoring Results
High share of peak period trips to the focus area from within San Francisco

Strong South Bay reverse commute (auto-dominated)

High share of non-commute travel during peak hours
WHERE would the toll be?

Congested Streets in SF Downtown
Cordon Gateway with Parking Pricing
Double Ring Northeast Cordon

Congested Transit Segment (travel speed below 8 mph)
Congested Auto Segment (highway speed below 30 mph, road speed below 10 mph)
**WHO?**

<table>
<thead>
<tr>
<th>Type of Driver/ Group</th>
<th>Level of Discount</th>
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<tbody>
<tr>
<td>Taxi, Transit</td>
<td>FREE</td>
</tr>
<tr>
<td>Commercial Vehicles, Shuttles</td>
<td>FLEET</td>
</tr>
<tr>
<td>Rental Cars &amp; Carsharing</td>
<td>FLEET</td>
</tr>
<tr>
<td>Toll-payer ‘Fee’-bate</td>
<td>$1 off</td>
</tr>
<tr>
<td>Low-Income (Lifeline Value)</td>
<td>50% off</td>
</tr>
<tr>
<td>Disabled Drivers</td>
<td>50% off</td>
</tr>
<tr>
<td>Zone Residents</td>
<td>50% off</td>
</tr>
<tr>
<td>Low-Emission Vehicles</td>
<td>-</td>
</tr>
<tr>
<td>HOV/Carpool</td>
<td>-</td>
</tr>
</tbody>
</table>

Helps minimize administrative impacts for businesses, and keeps industry moving.

Would require documentation of inability to take transit.

May be accompanied by investment in Means-Based Fare Assistance Program.
Model Enhancements to Support Pricing

- Model extended to entire 9-county Bay Area
- Re-structuring of certain model components
- Pay sub-options added to mode choice
- Additional peak-spreading model with 30 minute resolution
- Distributed values-of-time
- Logic for different users (area pricing, pass-thru trips, discounts)
Estimated distributed values-of-time (mixed logit) from SP data
SF Mobility Study – Model Analysis

- Microscopic nature allows us to use many types of model output to feed multiple parts of the pricing feasibility analysis
  - Toll Policy: What is the best shape, size, and toll-structure?
  - Revenue Generation: How many transactions? Can test various discount policies (bridge toll-payers, residents of cordon, low-income, maximum tolls etc).
  - Equity Analysis: Travel patterns of low-income HHs, zero-car HHs
  - Congestion Mitigation: Transit and Auto Speeds, Vehicles Hours of Delay
  - Effective Revenue Reinvestment: Responsiveness to various transit packages.
A good toll policy:
- Obtains mobility objective AND
- Does not have significant dis-benefits

Many policies had major pros AND major cons and were thrown out
SCENARIO COMPARISON

Percent Difference in PM Volume

- "Southern Gateway"
  - A lot of benefit, but...
“Southern Gateway”

- A lot of benefit, but...
- ...not in the focus area
Percent Difference in PM Volume

❖ Is somewhere in the middle just right?
Lower-income households would likely gain more access to the Focus Area with congestion pricing.

Additional benefits are likely through discounts, other program investments.

Daily Travel to/from Focus Area by Mode for Households with Income under $50K

- **Northeast Cordon**
  - Auto: 15%
  - Transit: 45%
  - Other: 40%

- **Gateway**
  - Auto: 17%
  - Transit: 43%
  - Other: 40%

- **Downtown Cordon**
  - Auto: 14%
  - Transit: 45%
  - Other: 40%

- **2015 Base**
  - Auto: 20%
  - Transit: 38%
  - Other: 42%

- **2005**
  - Auto: 21%
  - Transit: 38%
  - Other: 41%

- **5% more travel among low-income households with reinvestment of revenues**

- **No significant change in travel for low-income households in the future**
Diurnal Distribution of Toll vs. Non-Toll Trips  
2030 HOV2HOT Scenario
A few visualizations from the Atlanta Activity-Based Model
Tracing of Activities/Tours

Person id: 1018897 type: Full-time worker

Home

- mandatory
- non-mandatory
Persons Not At Home By TAZ and Hour
Time Spent Traveling by Income & Person Type

- Low income time spent traveling
- Med income time spent traveling
- High income time spent traveling
- Very high income time spent traveling
A few lessons learned…

- Staff development and training is a requirement
- A model development plan is essential
- A local champion ensures success
- Quality data is important
- More models equals more calibration (but many models look better “out of the box”
...and future directions

- Intra-household interactions and explicit ridesharing
- Spatial and temporal detail
- Special markets (university students, long-distance travel, special events, visitor travel, seasonal patterns)
- Better integration of supply and demand
- Advancements in data processing and visualization of outputs
- Integration with land-use models and long-term choices
Issues to consider

- What policies are of interest in Florida and what sorts of model features does this imply?

- What are current staff capabilities and what are training needs to move into ABM?

- What computing facilities exist, and what level of investment is required?

- What data exists to support ABM and what other data might be useful to collect and/or assemble?

- What is the right balance between innovation and standardization?
Tracing of Activities/Tours

Person id= 5238355 type= University student

- mandatory
- non-mandatory
Mode Share by Person Type
Persons By TAZ and Hour (Daytime Population)
Mean Delay Peak Period Travel

- Full-time worker
  - female
  - male
- Part-time worker
  - female
  - male
- Non-worker
  - female
  - male
- Retired
  - female
  - male
- University student
  - female
  - male
- Student of driving age
  - female
  - male
- Student of non-driving age
  - female
  - male
- Child too young for school
  - female
  - male

mean delay (min)