LACMTA Bike Model – Update to MTF

Review of Bicycle Model Development Progress

presented to
SCAG Modeling Task Force

presented by
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March 25, 2015

Overview

• Bike Model Status Report
  » Big Picture and Progress to Date
    • Policy Sensitivity
    • Multiple Geographic Scales
    • 3-Step Developmental Approach

• Bike Data Collection Plan
  » Why Collect Bike Data?
  » What Kind of Data?
Bike Model Status Report

Big Picture: Multiple Geographic Scales

- Highway, Transit, Mode Choice level
  » TAZ {Census Tracts}
  » “Traditional” network

- Bike Skims/Paths
  » Census Blocks
  » TeleAtlas Network
    * Very fine level
    * Includes all Collectors
Big Picture: 3-Step Development Approach

- Prototype Case and Sensitivity Tests {Done}
  » Model Specifications/Assertions
  » Spreadsheet implementation – The “Math”

- Small Area Test Case {In Progress}
  » Santa Monica Implementation
    • All “Rows and Columns” to/from Santa Monica
  » Software Validation

- Full Model Application
  » Full Implementation
    • All TAZs in all Counties
  » Model Validation

Refined Geographic Scale – Existing Bike Network
### Ability to Answer Policy Questions

<table>
<thead>
<tr>
<th>Policy Issue</th>
<th>Capable of Addressing Issue</th>
<th>Case 1</th>
<th>Case 2</th>
<th>LA</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mode Choice</td>
<td>Route Choice</td>
<td>Mode Choice</td>
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<tr>
<td>Intra, Inter-zonal</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No intra-zonal</td>
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<tr>
<td>Bicycle to transit</td>
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<tr>
<td>Bike sharing</td>
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<td>Bicycle parking</td>
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<td>N/A</td>
<td>No</td>
<td>N/A</td>
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<tr>
<td>Recreational</td>
<td>No</td>
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</table>

### Modeling Element Overview

<table>
<thead>
<tr>
<th>Trip Purposes</th>
<th>Utilitarian</th>
<th>Recreation</th>
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<tbody>
<tr>
<td></td>
<td>Auto</td>
<td>Transit</td>
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<tr>
<td></td>
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<td>Walk Access</td>
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<td>Home-Based Work</td>
<td></td>
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<td>Home-Based Recreation-</td>
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<tr>
<td>Biking @ Destination</td>
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<tr>
<td>Home-Based Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-Home-Based</td>
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</tr>
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</table>
Path Choice /Mode Choice Integration

Five path themes are used to generate distinct and representative paths, including:

- Minimum distance (MD)
- Minimum turns (MT)
- Minimum stress (MS)
- Preferred facilities (PF)
- Preferred trails (PT)

Path building parameters include weights on 10 variables:

- 2 for Roadway Types (major vs. minor)
- 5 for Treatment of Bicycle Facilities (no treatment, bike route, bike lane, cycle track and bike trail)
- 1 for Slope Effect
- 2 for Turn Penalty.

Recreational Bicycle Model

Quantity of Recreational Bicycling

- Refinement of Phase I Model: Two-stage, discrete choice and regression model on Synthetic Population
  - Propensity Logit Model
  - Frequency (regression) Model
  - Mileage (BMT) Calculation

Allocation of Recreational Bicycling BMT

- Network element’s potential for recreational bicycling
  - F (urban form, roadway facility characteristics, and more)
- Total Recreational BMT on bicycle network
Recreational Modeling Process

Output #1: Individuals making recreational bike trips
- Binary Logit Model – predicts whether any recreational trip is made

Output #2: Amount of recreational bicycling per individual
- Linear Regression Model – predicts amount of recreational bicycling (BMT)

Output #3: Recreational bicycling (BMT) by facility
- Allocation - Allocation of recreational bicycling BMT to network

Santa Monica Implementation

- Bike Facilities
Santa Monica Implementation

Path Building
  » Block 1461 to TAZ 3088 (Ocean Park)

Santa Monica 20 Year Plan Bike Model Test

Network Coding
  » Added 38 new links
  » Updated about 1300 links with modified bike facility class
  » Recalculated utility cost
  » Conversion from ArcGIS to CUBE

Base Year and Future Year Model Run
  » Built about 16 million bike paths
  » Aggregated block to block utility to intra-zonal utility (from 8 million interchanges to 2268)
  » Aggregated block to zone utility to short inter-zonal utility (from 3 million interchanges to 26455)
Why Collect Bike Data? (Modeling and Other Purposes)

- Model Development/Validation/Application
- Planning Projects
- Safety Issues (Collision Data)
- Before and After Studies
- Trend Analysis
- Maintenance
- Other Needs

Data Collected in Other Cities Uses a Wide Variety of Technologies, Similar to Those Planned for LA County

While Bike Data in LA County Is Insufficient, It's No Worse than in Most Large Cities

Similar Problems and Concerns:
  - Most existing data is site specific, not subject to extrapolation to a larger geographic area
  - All count technologies are subject to error, and the use of short term counts extrapolated over time is especially prone to error
  - Until recently, there has been little guidance regarding best practices

Even Cities Known for Their High Bike Usage – Such as Portland, Oregon – Are Struggling to Identify the Best Data Collection Practices
What Kind of Bike Data?

- **Bike Travel Demand**
  - Bike Counts on Bike Network
  - Bike User Surveys
  - GPS Tracking

- **Bike Travel Supply**
  - The Current Database is Ready for Current Model Development Tasks
  - Bike Infrastructure (Network Attributes)
  - Bike Programs

Overview

- **Long Term Plan Goal**
  - Implement a Permanent and On-going System of Bike Data Collection
  - Use Automated Counters to Allow Continuous Data Collection and Reporting
  - Expand Data Collection Plan to Include Pedestrian Data

- **Short Term Plan Objectives**
  - Focus on Data Necessary for Model Calibration and Model Validation
  - Begin Purchase and Implementation of Automated Counters
  - Supplement with Video Bike Counts and Emerging Technologies to Increase Coverage
  - Include Behavioral Surveys for Model Calibration
  - Some Pedestrian Data Will Be Collected as a Byproduct of Bike Plan
Behavioral Data Collection Methods

- Survey: Web-based
  - Respondents use personal computer
  - Intercept bicyclists use tablet
- Route choice: Smartphone with GPS device supplement
  - Streetlight Data – customize CycleTracks, clean data
  - Distribute GPS devices (~200 to 300 respondents)

Data Collection Methods

- Counting Technology
  - In-street inductive loop counting, a combined infrared/inductive loop technology for counting on bike paths, and an infrared pedestrian counter
Short Term Plan: Evaluation Criteria

- Count Locations Will Be Chosen to Satisfy a Wide Range of Evaluation Criteria
  - Urban Fabric: A Combination of Socioeconomic and Land Use Density Measures
  - Transit Usage: Access to a Mix of Transit Modes, Including Local Bus, Rapid Bus and Rail
  - Highway Facility Type: Arterial, Collector and Local
  - Bike Treatment Type: Trail, Lane, Route or Untreated
  - Dominant Bike Usage: Utilitarian or Recreational
  - Safety/Collision Data: Focus on Locations with Clusters of Bike Collisions
  - Supplement Existing Data Sources: Focus on Locations that Lack Existing Data
  - Model Concerns: Use Initial Application of Bike Model to Identify Anomalous Results

Urban Fabric: Combination of Land Use Density and Household Income

- Income Displayed Thematically by Color:
  - Blue = Low Income
  - Green = Medium
  - Red = High Income
- Density Displayed by Shading:
  - Lighter Shades Represent Lower Density
  - Darker Shades Represent Higher Density
- Identify Clusters of Similar Urban Fabric for Bike Counts
Current Status of Bike Data in LA County

- Very Few Existing Bike Counts in LA County (Except in Santa Monica)
- Most Existing Counts are Only for a Few Hours on a Single Day

Questions and Comments
End

Modeling Framework for Utilitarian Trips

- Intrazonal trips
- Interzonal trips
- Bicycle access to transit trips

Mode Choice-Route Choice

- Trip Generation (SCAG)
- Trip Distribution (MTA/SCAG)
- Mode Choice with Enhanced Nonmotorized Nest

Motorized Trips by Auto and Transit
Bike (and Walk) trips
Bike access to transit
Assignment
Bike Route Choice

Enhanced Mode Choice and New Route Choice
Path Choice /Mode Choice Integration

- **Logsum Aggregation/Disaggregation - TAZ to SB**

\[ T_{ij} = T_{ij} \times \frac{\exp(l_{ij} + \ln(size_{ij}))}{\sum_{p,q} \exp(l_{pq} + \ln(size_{pq}))} \]

\[ size_{ij} = 1.0 \times POP_i + 1.0 \times POP_j + 2.0 \times EMP_i + 2.0 \times EMP_j \]

» \( l_{ij} \) should be “symmetrized” for Mode Choice

- Intra-zonals cost averaged before logit averaging
- Inter-zonals cost averaged \((S+S)\)/2 after logit averaging

Path Choice /Mode Choice Integration

- **Modal Utility Function for bike modes**

» Literature review – identified key variables in bike mode utility

- Literature on bike access to transit is thin
- Coefficient values
  - Based on odds ratios &/or equivalent minutes

» Key Variables

- Route choice logsum
- Densities
- Bike parking (by parking type, as % with access to)
- Bike share program – literature is thin
  - Extent of system (described by variable with min/max 0/1)
  - Access to system
- Others - % 0-veh households, % education land area
Path Choice /Mode Choice Integration

- Logsum Calculations
  - Use MNL logsums, rather than CNL
    • Overlap across paths is not considered
    • Each of 5 paths is considered to be unique in logsum calculation
      ♦ There are always 5 alternatives in the logsum, regardless of the degree of overlap across the alternatives
  - Non-uniform utility functions
    • Each alternative uses its respective path-building weights in the utility function (rather than a unified utility function across paths)
    • Alternative constants
      ♦ Due to unevenness in utility by path type, constants are calibrated for each path type alternative to ensure each impacts logsum appropriately (on average).

Santa Monica Implementation

- Study Area
### Santa Monica Implementation

**Recreational Bike Travel Demand**

- **Number of Recreational Bikers** who are Residents of TAZ

![Map of Santa Monica with bike travel demand data]

- **Weekly Bike Trips**
  - Less Than 100
  - 100-150
  - 150-200
  - Greater Than 200

More Bike Facility Types

<table>
<thead>
<tr>
<th>Bike Facility</th>
<th>Coefficient</th>
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<tbody>
<tr>
<td>No Treatment</td>
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<tr>
<td>Bike Route</td>
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<tr>
<td>Sharrows</td>
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<tr>
<td>Sharrows-Climbing</td>
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<tr>
<td>Bike Lane</td>
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<tr>
<td>Buffered Bike Lane</td>
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<td>Greenway</td>
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<tr>
<td>Cycle Track</td>
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<tr>
<td>Bike Path</td>
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