Travel demand forecasting (modeling)

Define “travel demand”
- Resulted from a desire to participate in activities distributed in space
- Dimensions of travel demand
  - Travel distance (origins)
  - Time of day (departure time), speed
  - Mode choice
  - Route choice
  - Whether to take the trip or not

Dimensions of travel demand in four-step models
- The quantity (trip rates) by type
- The origins and the destinations
- The mode
- The route

The four step model

- Estimating the kinds of trips generated
- Trip generation
- Trip distribution
- Mode split
- Trip assignment
- Overall system performance

Dimensions of travel demand in four-step models
- The quantity (trip rates) by type
- The origins and the destinations
  - Trip generation
  - Trip distribution
- The mode
  - Mode choice
- The route
  - Route choice
- Social-economic and demographics
  - HBO productions and attractions
  - Nick productions and attractions
  - Trip generation
  - Trip distribution
  - Mode split
  - Trip assignment
terminology

- Trip: a movement in time and space connecting an origin and a destination
- Trip generation: estimation of number of trips by purpose produced by or attracted to a TAZ (traffic analysis zones)
- Trip end: the beginning or the end of a trip
- Trip production: the home end of a HB trip or the beginning end of a NHB trip
- Trip attraction: the non-home end of a HB trip or the end of a NHB trip
- Home-based (HB) trip: one end is home
- Non-home-based (NHB) trip: neither end is home

Counting productions and attractions

Preparing the output (dependent variable) – trip rates

- From household travel surveys
Table 2. Trip rates by age, gender and purpose, 1990.

<table>
<thead>
<tr>
<th>Age cohort</th>
<th>Trips/person</th>
<th>Work trips/person</th>
<th>New work trips/person</th>
</tr>
</thead>
<tbody>
<tr>
<td>All</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>20-39</td>
<td>2.26</td>
<td>2.46</td>
<td>2.50</td>
</tr>
<tr>
<td>40-59</td>
<td>2.00</td>
<td>2.20</td>
<td>2.40</td>
</tr>
<tr>
<td>60-64</td>
<td>1.60</td>
<td>1.77</td>
<td>1.85</td>
</tr>
<tr>
<td>65+</td>
<td>1.20</td>
<td>1.43</td>
<td>1.65</td>
</tr>
</tbody>
</table>

Figure 5. Trip Generation by Mode and Purpose for Household Employment Residence.

Figure 6. Comparison of Two-Parameter Models in Different Stages.

Figure 7. Repeated-inside based work trips (for 2-day period).


Trip generation models – 2 kinds

- Cross-classification models
- Regression models

Cross-classification model - production

<table>
<thead>
<tr>
<th>Income range</th>
<th>NBW person trips per household</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Household size</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>$50,000-$99,999</td>
<td>0.33</td>
</tr>
<tr>
<td>$100,000-$199,999</td>
<td>0.49</td>
</tr>
<tr>
<td>$200,000-$299,999</td>
<td>0.76</td>
</tr>
<tr>
<td>$300,000-$499,999</td>
<td>1.09</td>
</tr>
<tr>
<td>$500,000+</td>
<td>1.81</td>
</tr>
</tbody>
</table>

Cross-classification models - attraction

<table>
<thead>
<tr>
<th>Income range</th>
<th>NBW person trips</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Attractions per employee</td>
</tr>
<tr>
<td></td>
<td>basic</td>
</tr>
<tr>
<td>$50,000-$99,999</td>
<td>1.00</td>
</tr>
<tr>
<td>$100,000-$199,999</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Estimates developed from the 1999 Austin, Texas Household travel survey

Regression models

- The simplest: Linear regression

Linear Regression models

One example assuming that the number of trips generated by household $i$ is a function of the number of people in that household and number of cars available:

$$Y_i = \beta_0 + \beta H_i + \beta A_i + \epsilon_i$$
Sample linear regression models

- A zonal average model for home-based trips per household:
  - \( T_i = 1.29 + 1.66HH_i + 1.83CH_i + 1.44AA_i + 0.651x_i \)
  - where \( T_i \) = the average number of person trips per household in zone \( i \)
  - \( HH_i \) = the average household size in zone \( i \)
  - \( CH_i \) = the average number of children under 5 in zone \( i \)
  - \( AA_i \) = the average number of autos per household in zone \( i \)
  - \( W_i \) = the average number of workers per household in zone \( i \)

- A household model for home-based trips:
  - \( Th = 1.29 + 1.66HH + 1.83CH + 1.44AA + 0.651x \)
  - where \( Th \) = the number of person trips per household
  - \( HH \) = the size of household
  - \( CH \) = the number of children under 5 in household
  - \( AA \) = the number of autos available to household
  - \( x \) = the number of workers in household

Travel Model Development and Refinement: Trip Generation Final Report
Corporate Author: DTI Associates, Puget Sound Regional Council

The following trip generation equation (which is estimating Productions) has been suggested for use in a regional model:

\[
P = 0.65HH + 0.095AA + 24.3\text{ADULT} + 0.23\text{CHILD}
\]

Where:
- \( P \) = number of trips produced per household
- \( HH \) = number of people per household
- \( AA \) = number of autos per household
- \( ADULT \) = number of adults in the household
- \( CHILD \) = number of children in the household

Critique this model. Are the magnitude and signs of the coefficients reasonable?

A few assumptions behind the trip generation model

- Trip as unit of analysis
- Trip generation as a function of socioeconomic and demographic factors

Counting productions and attractions

<table>
<thead>
<tr>
<th></th>
<th>HBO</th>
<th>HGW</th>
<th>NIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAZ 1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TAZ 2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TAZ 3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>TAZ 4</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

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