Urban Transportation Planning
MIT Course 1.252j/11.380j
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Quantitative Methods

- From road counts to …
- The 4-Step Model
- Critique
- Integration of the analytical chain
- New Trends
From road counts … to a Light Rail
From road counts...

- ... to origin-destination matrices:
  - By using heuristic methods to obtain an o-d matrix
  - Or by conducting surveys among drivers
  - Or even by updating an old o-d matrix

- Why an o-d matrix?
  - To assign that o-d matrix under “what if”
    - To test closing a street or other tactical short term measures
    - To analyze the impact of a New Light Rail

- ... Then why use a 4-step model?
From vehicle counts to traffic models

- Highway Capacity Manual:
  - Hand-calculations ➔ HCS
- Macroscopic Models:
  - Representation of Platoons
- Microscopic Models
  - Individual vehicles are analyzed

Data availability + Computer power
We could use Lafayette counts...

Saturation flows anyone??
Using Lafayette counts...
Using Lafayette counts...
Using Lafayette counts... Oops!

Screenshots courtesy of McTrans, used with permission.
Microscopic Traffic Models

- From research tools (MITSIM for the Big Dig) towards daily practice
- Commercial packages:
  - VISSIM
  - Aimsun
  - CORSIM – Traf-Netsim
  - Paramics
  - TransModeller
  - Dynasim
- And many others ………..
Microscopic models...
Microscopic Simulation: Example of Req’d Data

Acceptable Gaps (from Pte.Deusto)

Unacceptable Gaps (from Pte.Deusto)
Using street assignments to save a plaza

F. Salvucci and M. Murga
4-Step Models: The 4 Basic Questions

1. How many trips are generated and attracted at any given location?

2. How many trips go from a given location to all other locations?

3. Which transport mode will be chosen to go from that location to each destination?

4. Which road will be taken for car trips and which train line for transit trips?
4-Step Planning Model

Land-Use Scenarios: eg. New developments

Socio-economic data

Transport Scenarios: eg. New transit line

Policy Scenarios: eg. New parking scheme

Generation

Distribution

Modal Split

Assignment

Started in the 50’s to build the Interstate

Then, predict and accommodate

The basic approach remains unchanged today
4-Step Models: **Three Building Blocks**

1. **Travel Network**: road network, transit system, with all its parameters (speeds, frequencies, costs...)

2. **Socio-economic data**: number of dwellings, jobs, shops, household profiles: age, size, income..

3. **Logic of Behavioral Patterns**: Observed or revealed behavior from travel home surveys, road counts, transit passenger surveys, in terms of trip purpose, time of day, choices made, travelers reactions to system changes, etc.
Data of the road system: posted speed, speeds during peak hours, capacity, traffic regulation…

Data of the transit system: Routes, stops, commercial speeds, service frequencies…
Block 1: Network Model: Roads, Streets, Transit
Block 1: the road network
Block 1: Network Model: *Using the road*
Block 1: Walking Isochrones from North Station

<table>
<thead>
<tr>
<th>Walking Times from North Station</th>
<th>ISOCYRONEs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 5 mins</td>
<td>Red</td>
</tr>
<tr>
<td>5 to 10</td>
<td>Orange</td>
</tr>
<tr>
<td>15 to 20</td>
<td>Green</td>
</tr>
<tr>
<td>20 to 25</td>
<td>Blue</td>
</tr>
<tr>
<td>25 to 30</td>
<td>Purple</td>
</tr>
<tr>
<td>30 to 35</td>
<td>Pink</td>
</tr>
<tr>
<td>35 to 40</td>
<td>Cyan</td>
</tr>
<tr>
<td>GT 40 mins</td>
<td>Gray</td>
</tr>
<tr>
<td>Other</td>
<td>Gray</td>
</tr>
</tbody>
</table>
Block 1: Network Model: *The Bus system*
Block 1: Network Model: *Using Transit*
Block 2: *Data, data, data*...

- What do you know about the area beyond a quick 3-D tour with Google Earth?
- What is the density of residences?
- What about jobs?
- Have you checked the Census data?
- Do they have lots of parking?
Block 2: Residential Density

Massachusetts Institute of Technology

Residential Density

- 0 to 2489 (158)
- 2490 to 4899 (42)
- 4900 to 6999 (8)
- 7000 to 9599 (9)
- 9600 to 11899 (3)
- 11900 to 13999 (1)
- 14000 to 16999 (3)
- 17000 to 100000 (1)

Kilometers

People per Square Mile
Block 2: Distribution of jobs, hospitals, airports, etc.
Block 3: Behavioral Patterns

- How many trips per person per day?
- Which are the most important trip purposes?
- How do they vary along the day?
- Why some people choose transit?
- Why others are captive to the car?
- How do they react to price increases of transit fares, parking, tolls...?