The Trouble with Intercity Travel
Demand Models

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Presentation Outline

- Definitions
- Characteristics of a typical intercity model
- Issues
- Research needs
Definitions

“Intercity” models generally are applied within a reasonably well defined travel corridor.

A major policy application of these models almost always involves analysis of the introduction of a new mode of travel (and/or significant upgrades of existing services).

Lack of progress in intercity models

- Relatively few intercity travel corridors
- Lack of “natural home” for modeling efforts
  - Lack of institutional memory
  - Reinvention of wheels
- Private/public sector roles
- Lack of data
- Lack of investment in model development
### Typical Model Structure

- Pop, Emp, etc.
- Transport Network
- Total Demand \((T_{ij})\)
- Mode Choice \((P_{mij})\)
- O-D Trips by Mode

\[ T_{ij} = \alpha \left( \prod_k S_{ik}^{\beta_k} \right) \left( \prod_k S_{jk}^{\gamma_k} \right) \text{LOS}_{ij}^{\phi} \]

\[ P_{mij} = \exp(V_{mij}) / \sum_{m'} \exp(V_{m'ij}) \]

(or nested logit)

### Total (Direct) Demand Model

- “Unconstrained” function of socio-economics:
  \[ (T_{ij} / E_t) = \alpha (E_i^{\beta-1})(E_j^{\gamma}) \text{LOS}_{ij}^{\phi} \]
  - Constant elasticity (Cobb-Douglas)
  - Very aggregate, limited explanatory variables
  - “Feedback” to urban activity levels?
  - Nature of induced demand term
  - Induced demand on “old” modes:
  \[ I_{ij} = \alpha (E_i^{\beta})(E_j^{\gamma})(\text{LOS}_{ijr}^{\phi} - \text{LOS}_{ijb}^{\phi}) \]
  \[ I_{ij} = P_{mij}I_{ij} \]
Modeling Intercity Mode Choice

\[
P_{m|r} = \frac{e^{V_{m|r}/\mu}}{\sum_{m'} e^{V_{m'|r}/\mu}}
\]

\[
I_r = \log \left( \sum_{m'} e^{V_{m'|r}/\mu} \right)
\]

\[
P_a = \frac{e^{V_a}}{e^{V_a} + \mu I_r}
\]

\[
P_r = 1 - P_a
\]

Mode Choice Modeling Issues

- Selection of nesting structure
- Market segmentation
- Limited explanatory variables
  - Socio-economics
  - Level of service
- Common-carrier access-egress ***
- Modeling new modes ***
Common Carrier Access-Egress

- Access-egress typically a significant component of total travel time; can often nullify speed advantage of line-haul mode
- Proper treatment of access/egress sub-mode choice critical, especially at “non-home” end where one’s personal car is not available

New Travel Mode

- Revealed preference (RP) data does not exist for a new mode of travel
- Must use stated preference (SP) survey methods to “observe” new mode choices
- Developing mode “constant” or “bias” terms particularly challenging

\[ V_{\text{new}} = \alpha_{\text{new}} + \beta X_{\text{new}} \]

\[ \alpha_{\text{new}} = ??? \]
Data Collection Issues

- Choice-based sampling typically required
  - Access to private-sector common carrier passengers often difficult to obtain
  - Intercepting intercity auto trips difficult
  - Sampling frames difficult to define adequately
- SP-based surveys challenging
  - Expensive
  - Complicated
  - Small sample sizes
  - Sample selection / sampling frame issues
  - Bias potential when describing new modes
  - “Last trip”

Aggregation Issues

- Intercity models are typically extremely aggregate relative to best-practice urban models; aggregation issues exist wrt:
  - Space (large zones)
  - Time (24-hour models typical)
  - Market segments (very broad categories used)
  - Socio-economic effects
  - Modes (esp. access/egress representations)
Selected Other Issues

- Highway congestion
- Through traffic
- Non-resident travel
- ....

Some Suggestions

- Improve data collection methods
  - Better treatment of “new modes” within SP surveys
- Improve model disaggregation
  - More detailed representation wrt space, time, trip purposes, traveller socio-economics
- Improve treatment of access/egress modes
  - Clearly addressable with conventional nested model
- Improve model structure
  - Theoretical consistent treatment of trip “generation/distribution”
  - Improved market segmentation methods
- Improve model specification
  - Level of service, socio-economics, “travel generators”
Suggestions, cont’d

- Need for basic research to develop & test new methods
- Need for new data collection
- Need for new model designs

Outside the context of specific projects

Role of statewide models to replace / complement / incorporate intercity models ????