Modeling Commercial Vehicles in Alberta

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Context

- Province of Alberta
  - 255K sq mi / 4.4 million people
- Alberta Spatial Economic and Transport Model
  - Land use and transportation model system
  - 3 to 4 year model development project
Five travel demand models

- **SDPTM**: Activity-based model, PATLAS framework
- **LDPTM**: Tour-based party model
- **ETM**: Microsimulation

### Context Table

<table>
<thead>
<tr>
<th>Where</th>
<th>Personal</th>
<th>Commercial</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Short</strong></td>
<td>Short Distance Personal Travel Model (SDPTM)</td>
<td>Short Distance Commercial Vehicle Model (SDCVM)</td>
</tr>
<tr>
<td>within province (&lt;80 km)</td>
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<tr>
<td><strong>Long</strong></td>
<td>Long Distance Personal Travel Model (LDPTM)</td>
<td>Long Distance Commercial Vehicle Model (SDCVM)</td>
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<td>within province (&gt;80 km)</td>
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<tr>
<td><strong>External</strong></td>
<td></td>
<td>External Travel Model (ETM)</td>
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<tr>
<td>entering and/or exiting province</td>
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</table>
Context

**Short Distance Commercial Vehicle Model**
- Under 80 km (50 miles)
- Urban focus
- First mile / last mile
- Goods and services
- Tour-based microsimulation

**Long Distance Commercial Vehicle Model**
- Over 80 km (50 miles)
- Long-haul goods focus
- Microsimulation from economic flows
PECAS spatial economic model

**AA:** allocates economic flows – who is buying/selling, how much, of what commodities, from where

**SD:** microsimulation of land development process
Short distance commercial vehicle model
Urban, shorter distance travel
Tour-based microsimulation
Commercial vehicles
Commercial vehicles

- Pizza delivery
- Real estate agent
- Personal trainer
- Landscaper
- Plumber
- Florist
- Home care aide

Image credit: by prvideotv from Pixabay
Trucks?

San Diego

Calgary

Share of VMT

Heavy  Medium  Light
SDCVM structure

- 6 industry groups
  - Industrial, Wholesale, Transport, Retail, Service, Fleet Allocator
SDCVM structure

- 6 industry groups
- 5 generic land use categories
  - Low density, residential, industrial, retail/commercial, employment node
SDCVM structure

- 6 industry groups
- 5 generic land use categories
- 4 vehicle classes
  - Light, Medium <8.8 ton, Medium >8.8 ton, Heavy
SDCVM structure

- 6 industry groups
- 5 generic land use categories
- 4 vehicle classes
- 3 tour purposes
  - Goods, Service, Other
SDCVM structure

- 6 industry groups
- 5 generic land use categories
- 4 vehicle classes
- 3 tour purposes
- 2 phases
  - Aggregate generation, disaggregate tour simulation
Tour start generation

- Aggregate generation of tour starts at zonal level
- By industry, vehicle type, purpose, time of day
- Nested logit structure
- Logsums from lower levels (including accessibility) passed up to higher levels
Tour start generation

Ship or no ship

Tours per employee
Tour start generation

Ship or no ship

Tours per employee

Start time period

AM  PM  Early  Mid  Late
Tour start generation

Ship or no ship

Tours per employee

Start time period

Vehicle & purpose

Ship or no ship

Tours per employee

Start time period

Vehicle & purpose
Tour microsimulation

- Microsimulation of each commercial vehicle tour
- ‘Growing’ tour structure
Growing tours
Growing tours

Establishment → Stop
Growing tours
Growing tours
Growing tours

Establishment → Stop → Stop
Growing tours

- Establishment
- Stop
- Stop
- Stop
- Stop
- Stop
Growing tours
Growing tours
Growing tours
Tour microsimulation

- Poisson sampling of aggregate generation
- Already know:
  - Industry
  - Vehicle type
  - Tour purpose (goods, service, other)
  - Departure time period
Tour exact start time

- Establish specific start time
- Sampling observed distributions by industry and time period
- Model considers time as continuous
Next stop purpose

- Segments of industry, purpose, vehicle
- Logit choice of:
  - Goods/service (based on tour purpose)
  - Other
  - Return to establishment
- Establishes purpose, also tour length
Next stop location

- Segments of industry, purpose, vehicle
- Choice of destination zone
- Includes
  - Travel to zone
  - Return to establishment travel
  - Accessibility at zone
Stop duration

- Keep clock up to date
- Know travel time from skims
- Sampling observed distributions by industry, purpose, vehicle type
When return to establishment chosen as purpose

Last trip made

Move on to next tour
Other implementations

- SANDAG
  - Commercial Travel Model
  - Split service industry into service and government/office
  - Added toll route choice model after next stop location
LDCVM

- Long distance commercial vehicle model
- Longer distance (>80 km) flows
- Freight focus
  - Services in long distance personal travel model (business travel)
- Uses PECAS AA output
PECAS spatial economic model

- **AA**: Allocates economic flows
  - By “activity” (industry)
  - By land use zone – origin and destination
Commodity flows to loads

- Commodity flows (SCTG) by land use zone in dollars
- Converted into equivalent vehicle loads by load factors
- Origin and destination TAZ assigned based on employment
- Individual loads sampled to represent typical weekday
Mode choice models

- Nontruck shipments allocated by commodity and distance
  - Air, rail, pipeline
  - Notional treatment
  - Based on FAF

- Vehicle type choice
  - Commodity and distance – clusters
  - Based on VIUS
Vehicle type choice clusters

Cluster 0: (SCTG 11, 12 - sand and gravel)

Cluster 2: (SCTG 34 - machinery)
Trip details

- Time of day
- Empty return trucks
- Can postprocess into multiple matrices

Commodity flows by $ value
Green • – external
Red • – internal long distance
Truck Percentage Alternative Scenario – 2038
Long Distance Travel Percentage Alt Scenario – 2038
Conclusions

- Practical approach to the complexities of urban commercial movements
- Commercial vehicles – more than trucks and freight
Thanks!

ANY QUESTIONS?