Introduction of PTRM Tour-Based Freight Model

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Overview

- Overview of PTRM (Piedmont Triad Regional Model)
- Tour-Based Freight Model
Four Step Model

1. **TRIP GENERATION**
   (How many trips?)

2. **MODE CHOICE**
   (By what mode?)

3. **TRIP DISTRIBUTION**
   (Where do they go?)

4. **TRAFFIC ASSIGNMENT**
   (By what route?)

Feedback Loop
PTRM Model Overview

Area Coverage

- 4 Whole Counties & 5 Partial Counties
- 4 MPOs
- 1,932 Zones (TAZs)
- 2,352 Sq Mi
Network Coverage – Highway Network

- 21,428 links (Freeway, arterials, two-lane highway, collector, local road)
- 2017 BASE & Future Scenario networks
- Various attributes
Network Coverage – Transit Routes

- Local bus routes (GTA, HiTran, Link, WSTA)
- PART Express Routes
Socio-Economic Data

- Population, Household
- Employment by type
- K-12 students, University Students
- Avg Income, # HH Autos, ...
Forecast Traffic Flow & TransCAD v8.0
Tour-Based Freight Model
Needs of Tour-based Freight Model

- The information of freight movement
- Limitations in modeling the complexities of freight traffic
- Transportation systems emissions
- Analysis of the impacts of development
How the model addresses the Needs

- Behavioral Improvements
- Market Segmentation Scope
- Geographic Scope
Model System - Freight Model within PTRM
Firm Synthesis Model

- **Firm Synthesis**
  - `firm_sim_scale_employees`
  - Scales synthetic firms to employee forecasts

- **Simulate Commodity**
  - `firm_sim_scot`
  - Simulates production commodities for firms based on probability thresholds

- **Synthetic Firms**
  - `RegionalFirms`
  - List of business establishments in the model region, with location by TAZ and County, industry by NAICS and PTRM categories, production commodity by NAICS and SCTG, and size by employees and size category
# Outputs – Firm Synthesis

## Table 5: List of Business Establishments Output by the Firm Synthesis Model

<table>
<thead>
<tr>
<th>BusID</th>
<th>FAFZone</th>
<th>FIPS</th>
<th>NAII</th>
<th>NAICS6io</th>
<th>Industry10</th>
<th>Industry7</th>
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<tbody>
<tr>
<td>1</td>
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<td>541850</td>
<td>541800</td>
<td>Other Services</td>
<td>SER</td>
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<td>2</td>
<td>372</td>
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<td>238160</td>
<td>233411</td>
<td>Construction</td>
<td>IND</td>
</tr>
<tr>
<td>3</td>
<td>372</td>
<td>37081</td>
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<td>233411</td>
<td>Construction</td>
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<td>541200</td>
<td>Other Services</td>
<td>SER</td>
</tr>
<tr>
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<td>372</td>
<td>37081</td>
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<td>372</td>
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<td>441000</td>
<td>Retail</td>
<td>HWY</td>
</tr>
<tr>
<td>8</td>
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<td>37081</td>
<td>722110</td>
<td>722110</td>
<td>Hotel &amp; Real Estate</td>
<td>HWY</td>
</tr>
<tr>
<td>9</td>
<td>372</td>
<td>37081</td>
<td>541213</td>
<td>541200</td>
<td>Other Services</td>
<td>SER</td>
</tr>
<tr>
<td>10</td>
<td>372</td>
<td>37081</td>
<td>445120</td>
<td>445000</td>
<td>Retail</td>
<td>HWY</td>
</tr>
</tbody>
</table>

1-10 of 100 rows | 1-8 of 12 columns | Previous | 1 | 2 | 3 | 4 | 5 | 6 | ... | 10 | Next

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BusID</td>
<td>Unique business identifier (created in the model)</td>
</tr>
<tr>
<td>FAFZone</td>
<td>FAF Zone that the business is located in</td>
</tr>
<tr>
<td>FIPS</td>
<td>FIPS code for the county that the business is located in</td>
</tr>
<tr>
<td>TAZ</td>
<td>PTRM TAZ that the business is located in</td>
</tr>
<tr>
<td>NAICS6</td>
<td>6 digit NAICS industrial code for the business</td>
</tr>
<tr>
<td>NAICS6io</td>
<td>6 digit BEA NAICS code for the business</td>
</tr>
<tr>
<td>Industry10</td>
<td>Employment category for the Ohio GES</td>
</tr>
<tr>
<td>Industry7</td>
<td>PTRM employment category</td>
</tr>
<tr>
<td>Industry5</td>
<td>Summarized Ohio employment categories</td>
</tr>
<tr>
<td>Employees</td>
<td>Number of employees</td>
</tr>
<tr>
<td>esizecat</td>
<td>Employment size category</td>
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<tr>
<td>SCTG</td>
<td>Production commodity (SCTG categories)</td>
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</table>
Firm Synthesis Model
# Outputs – Freight Demand Model

## Table 10: List of Annual Shipments Output by the Freight Demand Model

<table>
<thead>
<tr>
<th>BusID.Seller</th>
<th>BusID.Buyer</th>
<th>TAZ.Port</th>
<th>Shipment</th>
<th>Movement.Type</th>
<th>Mode</th>
<th>Shipment.Weight</th>
</tr>
</thead>
<tbody>
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<td>4.988590e+01</td>
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<tr>
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<td></td>
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<tr>
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<tr>
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<td></td>
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<td>Truck</td>
<td>1 II</td>
<td></td>
<td>7.249474e+03</td>
</tr>
</tbody>
</table>

**Field** | **Description**
--- | ---
BusID.Seller | Unique business identifier (created in the model) for the seller
BusID.Buyer | Unique business identifier (created in the model) for the buyer
TAZ.Port | ZIP code for the port of entry to the region (either an intermodal facility or an external station)
Movement.Type | Movement type for the shipment (e.g., external to internal)
Mode | Mode of the shipment (truck, rail, or air)
Shipment.Weight | Shipment weight in pounds
Shipment.Size | Shipment size category
NumShipments | Number of shipments annually
Channel | Distribution channel
DistID | Distribution facility identifier

1-10 of 100 rows | 1-7 of 11 columns | Previous | 1 | 2 | 3 | 4 | 5 | 6 | ... | 10 | Next
Commercial Vehicle Touring Model
## Outputs – CVTM

### Table 20: List of Commercial Vehicle Tours and Trips Output by the CVTM

<table>
<thead>
<tr>
<th>Bu...</th>
<th>Vehicle</th>
<th>Tou...</th>
<th>TripID</th>
<th>Schedul...</th>
<th>O...</th>
<th>D...</th>
<th>Activity</th>
<th>MAMDe...</th>
<th>MAM/</th>
</tr>
</thead>
<tbody>
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<td>&lt;int&gt;</td>
<td>&lt;ord&gt;</td>
<td>&lt;int&gt;</td>
<td>&lt;int&gt;</td>
<td>&lt;int&gt;</td>
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<td>&lt;fctr&gt;</td>
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<td>m</td>
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<td>1</td>
<td>1</td>
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<td>1</td>
<td>622</td>
<td>713</td>
<td>Service</td>
<td>878.00</td>
<td>8E</td>
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<td>Light</td>
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<td>1</td>
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<td>Light</td>
<td>26627</td>
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<td>575</td>
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<td>11C</td>
</tr>
<tr>
<td>6</td>
<td>Light</td>
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<td>1</td>
<td>1</td>
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<td>Service</td>
<td>646.94</td>
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<td>Light</td>
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<td>2</td>
<td>1</td>
<td>590</td>
<td>603</td>
<td>Service</td>
<td>653.00</td>
<td>6E</td>
</tr>
<tr>
<td>6</td>
<td>Light</td>
<td>45838</td>
<td>3</td>
<td>1</td>
<td>603</td>
<td>1</td>
<td>Return</td>
<td>735.57</td>
<td>7E</td>
</tr>
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<td>12</td>
<td>Light</td>
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<td>Service</td>
<td>638.48</td>
<td>6E</td>
</tr>
</tbody>
</table>

Field | Description
--- | ---
BuID | Unique business identifier (created in the model)
Vehicle | Vehicle type (light, medium, heavy)
TourID | Tour identification number
TripID | Trip identifier (order within the tour)
Scheduled | Flag to denote that the stop at the end of the trip was scheduled (vs. an intermediate stop)
OTAZ | Origin PTM TAZ
DTAZ | Destination PTM TAZ
Activity | Activity at the stop location at the end of the trip
MAMDepart | Departure time of the trip (minutes after midnight)
MAMA arrive | Arrival time of the trip (minutes after midnight)
TravelTime | Travel time of the trip (minutes)
Distance | Distance of the trip (miles)
StopDuration | Stop duration for the activity at the end of the trip
Freight Truck Touring Model

- Simulate Daily Shipment Sample
  - Simulate_den
  - Predicts a single day of shipments between trading partners

- Simulate Vehicles
  - Simulate_vehicles
  - Chooses appropriate vehicle for transporting shipments in region

- Extract Non-Peddling Shipments
  - Simulate_nonpeddlingships
  - Selects specific types of shipments to be placed on one-stop tours

- Extract Peddling Shipments
  - Simulate_peddlingships
  - Selects specific types of shipments to be placed on one-stop tours

- Simulate Stop Duration
  - Simulate_stopduration
  - Simulate freight pickup/delivery stop durations for all shipments

- Simulate Peddling Stops Clustering
  - Simulate_stopclustering
  - Divides stops into spatially co-located groups by hierarchical clustering

- Simulate Peddling Tours Sequence
  - Simulate_tours
  - Organizes clustered stops into efficient sequence

- Simulate Non-Peddling Tours
  - Simulate_nonpeddlingtours
  - Constructs trips from non-peddling stops

- Simulate Arrival/Departure Times
  - Simulate_scheduletrips
  - Calculates trip durations to determine trip schedule

- Simulate Intermediate Stops
  - Simulate_intermediate
  - Predict intermediate stops and durations

Trips
- Choose
  - List of tour and trips planned with sequence of stops, complete schedule of arrivals and departures and travel times, and vehicles to be used for each tour
Peddling – FTTM

Internal-to-External Freight Movements

External-to-Internal Freight Movements
Freight Truck Touring Model

- Simulate Daily Shipment Sample
- Extract Non-Pedaling Shipments
- Extract Peddling Shipments
- Simulate Stop Duration
- Simulate Pedding Stops Clustering
- Simulate Pedding Tours Sequence
- Simulate Non-Pedding Tours
- Simulate Arrival/Departure Times
- Simulate Intermediate Stops
- List of tour and trips planned with sequence of stops, complete schedule of arrivals and departures and travel times, and vehicles to be used for each tour.

Piedmont Triad Regional Model (PTRM)

- Firm Synthesis
- Synthentic Firms
- Commercial Vehicle Rounting Model
- Freight Demand Model
- Shipments
- Freight Truck Touring Model
- Truck Trip Lists
- 1 Truck Trip Tables
- Assignments Regional Network

Passenger Vehicle Trip Tables
## Outputs – FTTM

### Table 23: List of Freight Truck Tours and Trips Output by the FTTM

<table>
<thead>
<tr>
<th>DistID</th>
<th>Peddl...</th>
<th>Tou...</th>
<th>TripID</th>
<th>TAZ.Anc...</th>
<th>Vehicle</th>
<th>Scheduled</th>
<th>NintStops</th>
<th>TAZ.Origin</th>
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</thead>
<tbody>
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<td>10</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>4281</td>
<td>Heavy</td>
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<td>0</td>
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<tr>
<td>10</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4281</td>
<td>Heavy</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
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<tr>
<td>10</td>
<td>1</td>
<td>2</td>
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<td>1</td>
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<td>3</td>
<td>3</td>
<td>1</td>
<td>4281</td>
<td>Heavy</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

- **Field**: Unique identifier for the distribution center facility where the tour starts.
- **Peddl...**: Flag to identify whether the tour is a peddling tour, i.e., it begins at a distribution center and includes one or more stops.
- **Tou...**: Tour identification number.
- **TripID**: Trip identifier (order within the tour).
- **TAZ.Anc...**: Anchor PTRM TAZ where the tour starts and ends.
- **Vehicle**: Vehicle type (light, medium, heavy).
- **Scheduled**: Flag to denote that the stop at the end of the trip was scheduled (vs. an intermediate stop).
- **NintStops**: Number of intermediate stops during the tour.
- **TAZ.Origin**: Origin PTRM TAZ.
- **TAZ.Destination**: Destination PTRM TAZ.
- **Activity**: Activity at the stop location at the end of the trip.
- **ShipmentWeight**: Shipment weight delivered or picked up at the stop.
- **StopDuration**: Stop duration for the activity at the end of the trip.
- **TravelTime**: Travel time of the trip (minutes).
- **Distance**: Distance of the trip (miles).
- **MMIVTime**: Arrival time of the trip (minutes after midnight).
- **MMIVDepart**: Departure time of the trip (minutes after midnight).
- **Movement.Type**: Movement type (e.g., internal to internal) for the trip.
- **Externalization**: PTRM TAZ code for external station used by the trip.
- **Direction**: Direction group for the external station.
Tour-based Freight Model: Dashboard