O-D + Waypoint Data

Complementary datasets informing model development

Chris Wichman
Transportation Solutions Advisor
AirSage
Agenda

• About AirSage
• Data Sources
• O-D + Waypoint for Model Development
• Q&A
An Analogy Attempt

Data Providers

Data Sources

Data Products
About AirSage

- The Location Data Pioneer

- Founded 20+ years ago
  - 2000: Began with Wireless Carrier data
  - 2012: Began working with Connected Vehicle (CV) Data
  - 2017: Transitioned to GPS data from Location Based Services (LBS) (i.e. mobile phone apps)

- What differentiates us?
  - We are not a Black Box provider.
    No synthetic input. No modeled output.
Data Sources
Data Sources - Mobile Devices

Mobile Apps → User Opt-in → Mobile App Ping → Location Data
Data Sources - Mobile Devices

Mobile App Ping

Wireless Carrier Ping

5-15 M

1000 M
Data Sources - Connected Vehicles

• GPS coordinates and associated attributes of connected vehicle movement (speed, heading, timestamp)

• Anonymized vehicle IDs to protect personally identifiable information

• Reporting rate between 3 to 15 seconds

• Available in near real-time (NRT) with a latency of <60 seconds in most cases

• Sourced from Original Equipment Manufacturers (OEMs), Fleets, and Telematics Service Providers (TSPs)
Raw Waypoint Attributes

- Vehicle ID
- Epoch time
- GPS coordinates (lat/lon)
- Heading
- Speed

Example data:

```
vehicle_id,time_epoch,latitude,longitude,heading_angle,speed_value
001f6970118475f3d8366d71b6ee56f0c,1650467155126,33.8244926,-84.3564529,257.48,0.0
00127940eda0a5b238ef101fd7fbf7a5,1650502391486,33.97528076171875,-84.09214782714844,189.52,0
001f6970118475f3d8366d71b6ee56f0c,1650459901764,33.812461299999995,-84.3739969,13.15,"
00127940eda0a5b238ef101fd7fbf7a5,1650456146319,33.9757484,-84.0922757,15.55,"
001f6970118475f3d8366d71b6ee56f0c,1650485702273,33.7175799,-84.3980194,210.97,120.7005
001f6970118475f3d8366d71b6ee56f0c,1650459421768,33.812461299999995,-84.3739969,13.15,"
001f6970118475f3d8366d71b6ee56f0c,1650485180206,33.7741714,-84.38310849999999,185.58,0.0
```
## Data Sources Overview

<table>
<thead>
<tr>
<th>Data Source</th>
<th>Movement Captured</th>
<th>Location Accuracy</th>
<th>Sampling Rate</th>
<th>Full Trip O-D</th>
<th>Full Trip Trajectory</th>
<th>Persistent Identifier</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile Device (LBS)</td>
<td>People</td>
<td>High</td>
<td>Variable</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Connected Vehicle (CV)</td>
<td>Vehicles</td>
<td>High</td>
<td>Very High</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
O-D + Waypoint
O-D + Waypoint for Model Development

AirSage’s model development stack:

1. Origin-Destination Trip Matrices
1. CV Trip Waypoints
1. CV Trip Summaries
### Origin-Destination Trip Matrices

What is the frequency of origins or destinations of trips between each zone by trip purpose?

<table>
<thead>
<tr>
<th>month</th>
<th>origin_zone</th>
<th>destination_zone</th>
<th>home_zone</th>
<th>aggregation</th>
<th>time_of_day</th>
<th>purpose</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>202203</td>
<td>219604</td>
<td>193778</td>
<td>219604</td>
<td>Mon_Tue_Wed_Thu</td>
<td>H07:H08</td>
<td>HO</td>
<td>23.7</td>
</tr>
<tr>
<td>202203</td>
<td>206934</td>
<td>213228</td>
<td>206934</td>
<td>Mon_Tue_Wed_Thu</td>
<td>H10:H11</td>
<td>HO</td>
<td>5.6</td>
</tr>
<tr>
<td>202203</td>
<td>206873</td>
<td>202006</td>
<td>211466</td>
<td>Mon_Tue_Wed_Thu</td>
<td>H12:H13</td>
<td>OW</td>
<td>5</td>
</tr>
<tr>
<td>202203</td>
<td>221975</td>
<td>190143</td>
<td>221975</td>
<td>Fri</td>
<td>H11:H12</td>
<td>HO</td>
<td>5</td>
</tr>
<tr>
<td>202203</td>
<td>197085</td>
<td>224995</td>
<td>190929</td>
<td>Mon_Tue_Wed_Thu</td>
<td>H15:H16</td>
<td>OO</td>
<td>10</td>
</tr>
</tbody>
</table>

Note: Output schema presented for demonstration purposes only
O-D + Waypoint for Model Development

Origin-Destination Trip Matrices

- Sourced from Mobile Device (LBS) data
  - Presents person movement
  - Persistent ID to determine trip purpose

- Applicability
  - Base year model development
  - Trip generation
  - Trip distribution
  - Survey cross-validation
  - Survey fusion

Trip Purpose by Time of Day
Connected Vehicle (CV) Trip Waypoints

What are the actual observed route choices between Origin-Destination pairs?

<table>
<thead>
<tr>
<th>trip_id</th>
<th>index</th>
<th>lat</th>
<th>lon</th>
<th>heading</th>
<th>speed</th>
<th>time</th>
<th>Route</th>
<th>Dir</th>
<th>FromMeasure</th>
<th>ToMeasure</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>555</td>
<td>33.509246</td>
<td>-112.044334</td>
<td>198</td>
<td>49</td>
<td>3/10/2022 9:44:02</td>
<td>L_83</td>
<td>SB</td>
<td>11.43</td>
<td>11.43</td>
</tr>
<tr>
<td>5</td>
<td>556</td>
<td>33.52381</td>
<td>-112.044336</td>
<td>198</td>
<td>51</td>
<td>3/10/2022 9:44:05</td>
<td>L_83</td>
<td>SB</td>
<td>11.42</td>
<td>11.42</td>
</tr>
<tr>
<td>5</td>
<td>557</td>
<td>33.538374</td>
<td>-112.044338</td>
<td>196</td>
<td>52</td>
<td>3/10/2022 9:44:08</td>
<td>L_83</td>
<td>SB</td>
<td>11.41</td>
<td>11.41</td>
</tr>
<tr>
<td>5</td>
<td>558</td>
<td>33.552938</td>
<td>-112.04434</td>
<td>194</td>
<td>54</td>
<td>3/10/2022 9:44:11</td>
<td>L_83</td>
<td>SB</td>
<td>11.36</td>
<td>11.36</td>
</tr>
<tr>
<td>5</td>
<td>559</td>
<td>33.567502</td>
<td>-112.044342</td>
<td>194</td>
<td>54</td>
<td>3/10/2022 9:44:14</td>
<td>L_83</td>
<td>SB</td>
<td>11.33</td>
<td>11.33</td>
</tr>
</tbody>
</table>

Note: Output schema presented for demonstration purposes only
**O-D + Waypoint for Model Development**

**Connected Vehicle (CV) Trip Waypoints**

- Sourced from Connected Vehicle (CV) data
  - Presents vehicle movement
  - Limited insight into trip purpose
  - Visibility of full vehicle trajectory

- Applicability
  - Base year model development
  - Network assignment
  - Link level speeds
  - Congestion/delay
## Connected Vehicle (CV) Trip Summaries

What are the actual observed travel times, and trip distances between Origin-Destination pairs?

<table>
<thead>
<tr>
<th>trip_id</th>
<th>fromLat</th>
<th>fromLon</th>
<th>fromTime</th>
<th>origin_zone</th>
<th>toLat</th>
<th>toLon</th>
<th>toTime</th>
<th>dest_zone</th>
<th>trip_time</th>
<th>trip_distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>33.46637</td>
<td>-112.032</td>
<td>3/10/2022 10:16:03</td>
<td>225343</td>
<td>33.523</td>
<td>-112.067</td>
<td>3/10/2022 10:33:33</td>
<td>207910</td>
<td>00:17:30</td>
<td>5.8032</td>
</tr>
<tr>
<td>3</td>
<td>33.48597</td>
<td>-111.910</td>
<td>3/10/2022 08:14:13</td>
<td>222002</td>
<td>33.545</td>
<td>-112.197</td>
<td>3/10/2022 08:56:33</td>
<td>205218</td>
<td>00:42:30</td>
<td>21.813</td>
</tr>
</tbody>
</table>

Note: Output schema presented for demonstration purposes only
Connected Vehicle (CV) Trip Summaries

- Sourced from Connected Vehicle (CV) data
  - Presents vehicle movement
  - Limited insight into trip purpose
  - Summary of full vehicle trips

- Applicability
  - Trip length distribution
    - Observed trip times (hr/min/sec)
    - Observed trip distance (miles)

Image Credits: Batista et al
Deliverable stack ideally-suited for travel demand model development

Leverage the strengths of each data source

Calibrate and validate against observations rather than heavily processed or modeled output
Questions?
Turn to the most powerful Insights to Build a Better Future

Chris Wichman
Transportation Solutions Advisor
cwichman@airsage.com
Thank you!

transportation@airsage.com | 404.809.2499