SoundCast and Daysim

Trips and Households, Excel Summary Sheets, EMME network measures, Benefit Cost Outputs

Land use attributes
Households & Individuals

SoundCast

DaySim
Travel demand simulator

Trips

Traffic conditions

Network assignment

Predictions
SoundCast creates...

a list of households and trips that looks like our household survey for the entire region!
<table>
<thead>
<tr>
<th>Model Steps</th>
<th>Choice Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population Synthesizer</td>
<td>Who is traveling?</td>
</tr>
<tr>
<td>Day Pattern</td>
<td>How much do people travel?</td>
</tr>
<tr>
<td>Destination Choice</td>
<td>Where do people go?</td>
</tr>
<tr>
<td>Mode Choice</td>
<td>What mode do people use?</td>
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<td>What time do people travel at?</td>
</tr>
<tr>
<td>Route Assignment</td>
<td>What paths do trips use?</td>
</tr>
</tbody>
</table>
Model Steps Compared to 4K – About People

- **Population Synthesizer**
  Who is traveling?

- **Day Pattern**
  How much do **people** travel?

- **Destination Choice**
  Where do people go?

- **Mode Choice**
  What mode do people use?

- **Time Choice**
  What time do people travel at?

- **Route Assignment**
  What paths do **trips** use?

- **Trip Generation**
  How many **trips** are there?

- **Trip Distribution**
  Where do the trips go?

- **Mode Choice**
  What mode do the trips use?

- **Time Choice**
  What time do trips occur?

- **Route Assignment**
  What paths do **trips** use?
How does it work?

- **Population Synthesizer**
  - Who is traveling?

- **Day Pattern**
  - How much do people travel?

- **Destination Choice**
  - Where do people go?

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  - What mode do people use?

- **Time Choice**
  - What time do people travel at?

- **Route Assignment**
  - What paths do trips use?
Geography: Parcels

Activity Units: Sim People
Population Synthesizer: who is traveling?

Example Household:
Adult – 29 years
Full Time worker
Male

Child – 3 years
Pre-school student
Male

Household Income - $32,000
They live at one of these parcels.
How does it work?

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- **Route Assignment**
  What paths do trips use?
How much do people travel?: Day Pattern

Adult –
1. Drops child off at school
2. Goes to work
3. Picks child up
4. Goes home

Child –
1. Goes to school
2. Goes home
How does it work?

Population Synthesizer
Who is traveling?

Day Pattern
How much do people travel?

Destination Choice
Where do people go?

Mode Choice
What mode do people use?

Time Choice
What time do people travel at?

Route Assignment
What paths do trips use?
Destination Choice at a parcel level

Adult –
1. Drops child off at school parcel
2. Goes to work parcel
3. Picks Child up at school parcel
4. Goes to Parcel Home

Child –
1. Goes to school
2. Goes to home parcel Hc
How does it work?

- Population Synthesizer: Who is traveling?
- Day Pattern: How much do people travel?
- Destination Choice: Where do people go?
- Mode Choice: What mode do people use?
- Time Choice: What time do people travel at?
- Route Assignment: What paths do trips use?
### What do mode do people use on their trips?

<table>
<thead>
<tr>
<th>Adult’s Trips</th>
<th>Most Likely</th>
<th>Maybe?</th>
<th>Probably Not!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drop off Child</td>
<td><img src="image" alt="Car" /></td>
<td><img src="image" alt="Bus" /></td>
<td><img src="image" alt="Bike" /></td>
</tr>
<tr>
<td>Go to Work</td>
<td><img src="image" alt="Car" /></td>
<td><img src="image" alt="Bus" /></td>
<td><img src="image" alt="Car" /></td>
</tr>
<tr>
<td>Pick up Child</td>
<td><img src="image" alt="Car" /></td>
<td><img src="image" alt="Bus" /></td>
<td><img src="image" alt="Bike" /></td>
</tr>
<tr>
<td>Go home</td>
<td><img src="image" alt="Car" /></td>
<td><img src="image" alt="Bus" /></td>
<td><img src="image" alt="Bus" /></td>
</tr>
</tbody>
</table>
How does it work?

Population Synthesizer
Who is traveling?

Day Pattern
How much do people travel?

Destination Choice
Where do people go?

Mode Choice
What mode do people use?

Time Choice
What time do people travel at?

Route Assignment
What paths do trips use?
Time Choice: When do people travel?

<table>
<thead>
<tr>
<th>3 AM</th>
<th>7 AM</th>
<th>12 PM</th>
<th>5 PM</th>
<th>10 PM</th>
<th>3 AM</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORK</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Adult</td>
</tr>
<tr>
<td></td>
<td>SCHOOL</td>
<td></td>
<td></td>
<td></td>
<td>Child</td>
</tr>
</tbody>
</table>
How does it work?

- Population Synthesizer
  Who is traveling?
- Day Pattern
  How much do people travel?
- Destination Choice
  Where do people go?
- Mode Choice
  What mode do people use?
- Time Choice
  What time do people travel at?
- Route Assignment
  What paths do trips use?
Route Assignment: What does it do?

Places cars, trucks and buses on the network

AM Peak Period Auto Volumes

AM Peak Period Transit Volumes
Sum of the Choices Makes a Picture of Travel
Where are people age 10-20 at 1 pm?
They're at school.
Sum of the Choices
Reminder: Levels of Transportation Modeling

- **Time**
  - Daily
  - Hour
  - Minute
  - Second

- **Size**
  - Statewide
  - Regional
  - City
  - Corridor / Neighborhood
  - Facility / Street
What is the model sensitive at this level?

- Number of Retail Jobs in a Parcel
- Cost of Parking in nearby parcels
- Amount of Congestion on I-5
- Travel Time on Light Rail Lines
- Household Income
- Person Gender and Age
- Number of Students in a Household
What can’t the model answer at this level?

- Traffic incidents and non-recurring delay
- Volumes on collectors
- How sidewalks make people walk more
- Car-sharing
- Person education level
- Person race
Average Commute Time by Mode

Average Commute Time (minutes)

<table>
<thead>
<tr>
<th>Mode</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOV</td>
<td>28</td>
</tr>
<tr>
<td>HOV</td>
<td>28</td>
</tr>
<tr>
<td>Transit</td>
<td>56</td>
</tr>
<tr>
<td>Walk</td>
<td>18</td>
</tr>
</tbody>
</table>
When are people traveling?
Geographically based outputs

Measuring Accessibility: Aggregate Logsums (Base 2010)

Home-based Tour Transit Mode Share By Residence
What if autonomous vehicles increase roadway capacity, reduce travel times, and reduce parking costs?
Powerful for comparison

Change in speed on the Tacoma Narrows if toll were removed

Red means slower without toll, and green means faster without
Person Miles Walked

- With Tolls: 1,750,000
- Without Tolls: 1,400,000
More technical look at SoundCast
Python Controller Scripts

- Python scripts control the “arrows” in the model structure
  - Set run iterations, convergence, process flow
  - Initializes directories, projects, banks
  - Controls demand models
  - Transfers data from demand model to Emme for assignment and skimming
  - Tests for convergence
  - Summarizes model results
Input Configuration

- Runs are managed by an “input configuration” file
- Switch on/off model processes like:
  - Basic directory setups
  - Use seed trips, run assignment only
  - Run specific sub-models like truck and external trips
- Holds variables and assumptions
  - Values that might change across analyses and important to quickly validate later
<table>
<thead>
<tr>
<th>Purposes</th>
<th>Modes</th>
<th>Time Resolution</th>
<th>Geographic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work</td>
<td>SOV</td>
<td>Choice Models</td>
<td>Parcel Land Use</td>
</tr>
<tr>
<td>School/College</td>
<td>HOV2</td>
<td>30 minutes</td>
<td>4000 zones for skimming and assignment</td>
</tr>
<tr>
<td>Personal</td>
<td>HOV3+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>Transit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shopping</td>
<td>Walk</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meals</td>
<td>Bike</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social/Rec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Escort</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Daysim Model Structure

Long Term
- Usual School and Work Locations
- Usual Travel Methods
- Auto Ownership

Day
- Day Patterns and Tours

Tour

Tour/Trip
- Destination
- Mode
- Schedule
Long-term choices

- Usual School Location
- Auto Ownership
- Transit Pass Ownership
- Pay to Park at Workplace
- Usual Work Location
- Trip/Stop
- Tour
- Day
- Long term
Daily choices

- Long term
- Day
  - Tour
  - Trip/Stop
- Destination, Mode, Arrival and Departure Times (5-6 time periods in day)
  - Intermediate Stop Generation
    - Stop Location
    - Trip Mode
    - Trip Arrival or Departure Time (10-minute time periods)
### Populating Trip Tables

<table>
<thead>
<tr>
<th>ID</th>
<th>Time</th>
<th>Mode</th>
<th>Origin Zone</th>
<th>Destination Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>567 SOV</td>
<td></td>
<td>123</td>
<td>456</td>
</tr>
<tr>
<td>2</td>
<td>890 Walk</td>
<td></td>
<td>789</td>
<td>1011</td>
</tr>
</tbody>
</table>

By Mode, Time

<table>
<thead>
<tr>
<th>D</th>
<th></th>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>O</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>...</td>
<td>3700</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
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<tr>
<td>...</td>
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<td>3700</td>
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</tr>
</tbody>
</table>
Overview

Assignment/Skimming Process

• 12 Time Periods
• 21 User Classes
• Run Auto Assignment for each Time Period
• Transit (assigned) for 5 Time Periods, skimmed for 2
• Skim for Time and Cost for all Time Periods
• Skim for Distance for Two Time Periods
• Run almost everything in Parallel
Emme Prep
- Create 12 TOD Banks
- Create 12 TOD Projects
- Import Networks

Emme Assignments & Skimming
- Define Matrices
- Import Trips
- Run Highway Assignments
- Skim for Time/Distance/Cost
- Transit Assignment
- Transit Skims
- Check Skim Convergence
- Export Skims to HDF5

Seed Trips

Demand Models
- Daysim
- Trucks
- External, GQs, SGs
if vot < 15:
    vot_category=1
elif vot < 25:
    vot_category=2
else:
    vot_category=3
Overview

Assignment/Skimming Process

• 12 Time Periods
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• Run Auto Assignment for each Time Period
• Transit for 5 Time Periods
• Skim for Time and Cost for all Time Periods
• Skim for Distance for Two Time Periods
• Run almost everything in Parallel
Assignment Details

• Emme Path-Traffic Assignment
  – Closing Criteria 0.0001 relative gap
  – Thinking about relaxing closing criteria in early iterations to speed up run time.

• Extended Transit Assignment
  – Performs a frequency-based transit assignment using optimal strategies
Convergence Test

Relative Trip-Weighted Average
Absolute Skim Change
By John Gibb, Of DKS:

\[
\frac{\sum_{ij} q|t_a - t_i|}{\sum_{ij} qt_a}
\]

\( q = \) demand (trip table)
\( t_a = \) cumulative average skim travel time
\( t_i = \) this iteration travel time
When do we stop?

Configurable parameters:

A list of travel time skims sent in for comparison

STOP_THRESHOLD = 0.025
DaySim Software and Hardware

**Software**
- Programmed in C#, Visual Studio, Microsoft .Net platform
- Two levels of distributed processing for faster runs
  - Distribution of households across different processors on a single machine.
  - Higher level distribution of households to different physical or virtual machines.
- Inputs and outputs are integrated with any travel modeling package
- Same code used for model estimation and application

**Hardware**
- Runs on 64-bit Windows systems
- Expected minimum configuration:
  - Single box with 4+ processing cores (more cores will reduce run times)
  - 8 GB RAM (16 GB if using more than 1,500 zones)
In addition to the usual “application mode,” which generates simulated travel, there is an “estimation mode” that produces new coefficients from survey data.