101 Transportation Modeling
Explaining the Mystery of the Black Box

WHAT IS A TRANSPORTATION MODEL?
- A set of mathematical relationships to represent (model) the choices people make when traveling. These choices include how many trips to make, where to, and what modes. Travel demand is the combined effect of thousands of individuals making these choices.
- A tool to help planners study the impacts of alternate transportation scenarios, such as new highways, bus route changes, or parking restrictions on future travel demand, in order to make informed policy decisions.

WHY ARE MODELS IMPORTANT?
- Federal law requires Metropolitan Planning Organizations (MPOs), including Thurston Regional Planning Council, to address at least a 20-year planning horizon, including short- and long-range strategies, to develop an integrated intermodal transportation system.
- Models provide a multimodal evaluation of the transportation, socioeconomic, environmental, and financial impacts of a transportation project.
- Model estimations help policy makers prioritize how millions of transportation dollars will be spent to ensure taxpayer dollars are used wisely.
- Utilizing the best tools available helps ensure high-quality transportation services at a reasonable cost with minimal environmental impact.

WHAT CAN OUR TRANSPORTATION MODEL DO?
- Forecast the number of trips on the region’s road, transit and trail networks.
- Project long-range traffic growth patterns by area and roadway network.
- Highlight the traffic impacts of new land use developments.
- Estimate air quality based on Vehicle Miles Traveled (VMT).
- Evaluate the effectiveness of various transportation project scenarios.
- Test policy implications of travel mode choice (Travel Demand Management).
- Help local jurisdiction find ways to mitigate current and future traffic capacity constraints.

HOW DO WE KNOW THE MODEL WORKS?
- The model is adjusted to match the results of several regional travel behavior surveys as closely as possible. Surveys and data sources include:
  - 2013 South Sound Travel Survey.
  - Puget Sound Regional Council’s transportation model for Pierce County.
  - Regional traffic count data for vehicles.
  - Automated passenger count (APC) data for transit trips.

MODEL LIMITATIONS
- The model is a statistical estimation of regional travel behavior. As such, it should only be used for general planning purposes.

WHAT’S NEW IN THE MODEL
The updated Greater Thurston Region (GTR) four-step travel demand model was released in 2015. The updated model:
- Contains an enhanced non-motorized network of trails and bicycle lanes.
- Models new or enhanced travel modes, such as carpool and vanpool and trips involving park and ride lots.
- Improves travel demand estimates at key border crossing by adding 177 transportation analysis zones (TAZs) in Pierce, Grays Harbor, Lewis, and Mason Counties.
- Models travel patterns in greater detail within Thurston County, expanding to 778 transportation analysis zones from 588 (in 1995).
- Is better coordinated with the Puget Sound Regional Council’s travel demand model.
- Contains the ability to model household travel behavior based on income.
- Contains a truck module.
- Will allow modeling of more travel demand management factors, including parking prices, or anticipated effects of new policies on telework.

TAZs and Model Network
How our roads, trails, and bus routes are represented in the model

Transportation Analysis Zone (TAZ): Geographic area ranging in size from a few blocks to several square miles. TAZs are the primary unit of analysis in the travel demand model. TAZs are characterized by their land use, including number of households, employment, environmental constraints, and parking costs.

TAZ Centroid: Node at the center of each TAZ and the start and end point of all trips to and from that zone.

Centroid Connectors: Connect TAZs with the transportation network.

Nodes: Points where links meet. Some nodes represent intersections and may have defined turning restrictions.

Network Link: Connected links that represent the region’s streets, transit lines, bike lanes, and multiuse trails. Each link contains data on length, travel speed, lanes and allowable modes of transportation.
The Greater Thurston County Model is built using the EMME modeling platform. The four-step modeling process is explained below:

1. **Trip Generation:** How many trips will be made?
   - Trip generation is the first step in travel forecasting. There are two components to trip generation: trip production and trip attraction.
   - Trip production calculates how many trips start at each TAZ. Trip production is based on household characteristics, including the household size, income, and the number of school-aged children.

2. **Trip Distribution:** Where do people go?
   - Trips have a beginning (origin) and an end (destination). Trip distribution is used to represent the process of where people choose to go (Destination Choice).
   - Two major factors affect trip distributions:
     - Trip purpose (home to work, shopping, school (K-12 and college/university), or other, and non-home based).
     - Proximity of potential destinations (including travel time and cost).

3. **Mode Choice:** What method is used for travel?
   - Mode choice is the process by which the model estimates how individuals will get to their destination. The model includes seven possible modes: Drive Alone, Carpool, Vanpool, Transit, Park and Ride, School Bus, Bike and Walk. The model evaluates the attractiveness of each mode to determine its relative usage. Three factors affect mode choice:
     - Household characteristics, including income, and vehicle ownership.
     - The accessibility and cost of travel between points, including:
       - Transit availability, travel time and cost.
       - Vehicle travel time and cost, including traffic delays, operating and parking costs.
       - Walk and bike travel time.
     - Land use characteristics or development patterns at the destination:
       - Employment density within a certain transit travel time.
       - Employment density within a certain walk distance.

4. **Trip Assignment:** What routes will be used?
   - After trips have been generated, trip distribution determined and mode choice selected, the trip must be assigned to a specific road, transit route, or trail. This process is called Trip Assignment and it is the most data intensive and time consuming step. The model calculates the quickest route between each origin and destination, then performs several iterations of complex calculations to account for the trip start time and network capacity until an optimal equilibrium is reached. The modeler or planner can then observe the number of trips on a stretch of road for a given time of day.