Travel Model Improvement Program Exploratory Modeling and Analysis Tool (TMIP-EMAT)

Understanding Forecasting Risk in Transportation Forecasting

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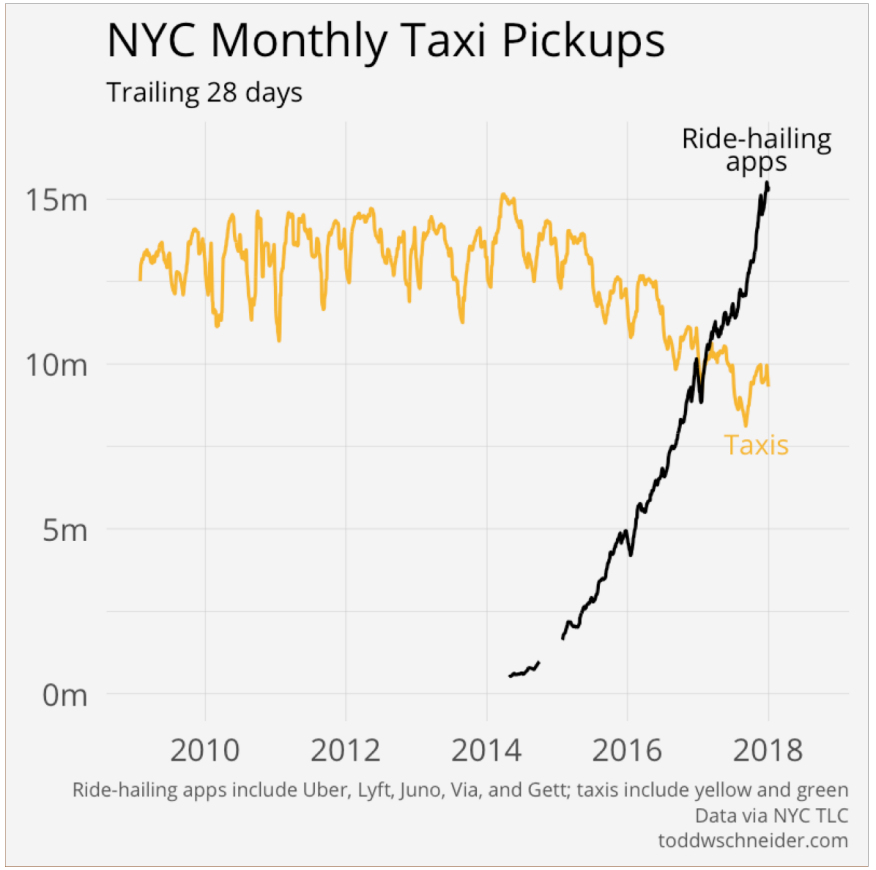
Deep Uncertainty in Transportation Planning

- Historically, most transportation demand forecasts have **ignored uncertainty**, or examined it in a cursory manner …
  although travel behaviors are complex they
  were relatively stable and predictable

- Disruptive technologies can and are changing transportation:
  - Transportation Network Companies (Uber, Lyft, etc.) have already decimated traditional taxis
  - Self-Driving Cars are on the horizon



https://www.reddit.com/r/dataisbeautiful/comments/84df5z/ridehailing_apps_are_now_65_bigger_than_taxis_in/

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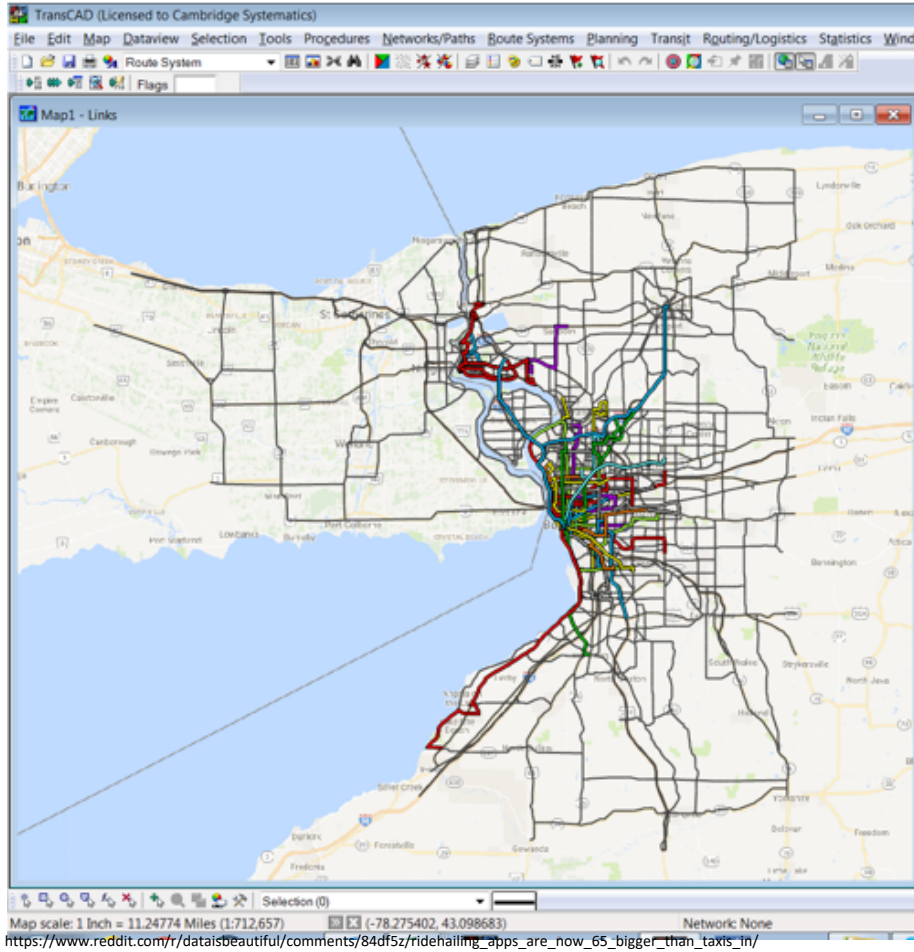
Demand Modeling in Transportation Planning

- In the United States, the federal government mandates MPO's must have and maintain a travel demand model (TDM)
- There are a few different basic types of TDM, but nearly every MPO has some level of customization of local details
- These models are used for prediction, probably inappropriately

very few resources are devoted to validating TDMs after-the-fact



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Our Goal: Nudge the Process toward DMDU

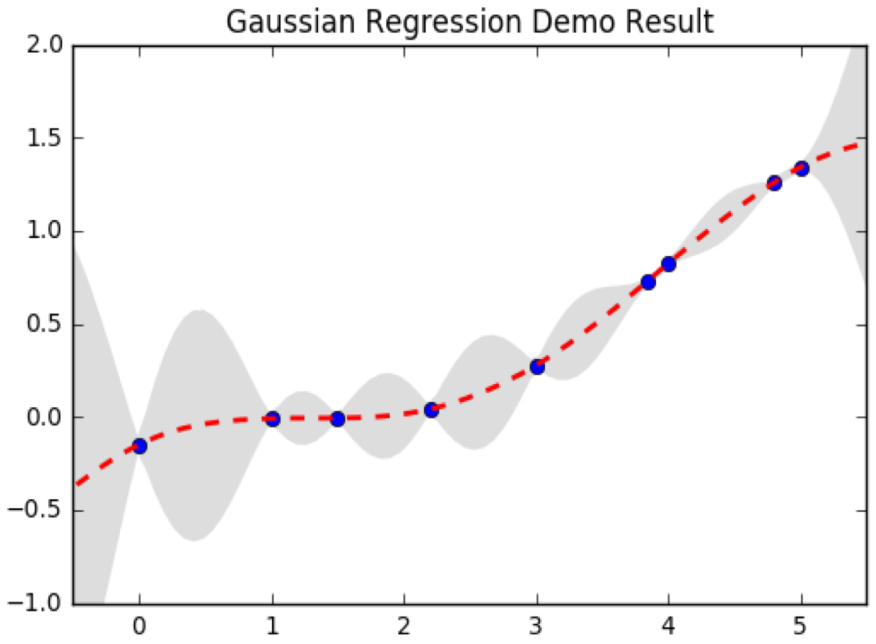
- Provide **additional tools** to transportation planners and modelers to start thinking about uncertainty and robustness
- Tools need to be **ready-to-use** and **easy** for a transportation planner to work with
- We provide examples and prototypes within the transportation planning context to guide users
- Don’t reinvent the wheel, just attach the wheel to our existing apparatus

An Obstacle: Computational Speed

- Travel demand forecasting models are generally slow: it is typical to take hours to days to generate a single scenario forecast
- Solution: The development and use of meta-models can be automated and nearly transparent to the modeling end-user.

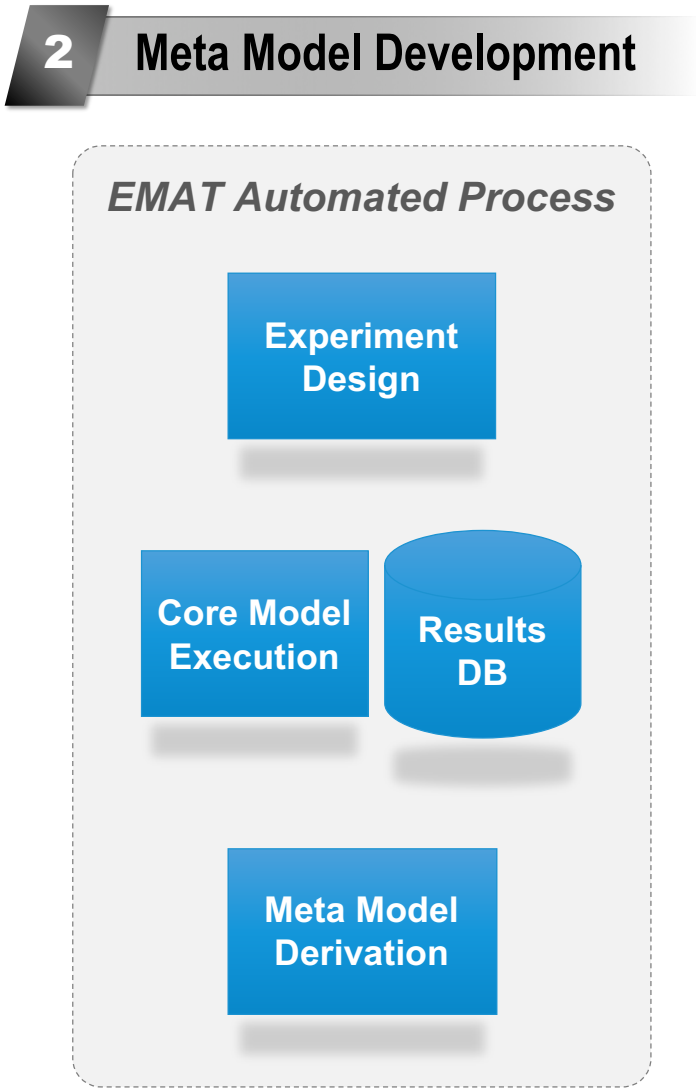
A Solution:
Automatic Meta-Model Development

- Although every travel forecasting model is unique, most of these models are similar.
- **Gaussian Process Regression** meta-models, using an anisotropic RBF kernel, have been seen to provide a good fit across a number of travel forecasting applications and performance measures, even without careful tuning of hyper-parameters.



Many Steps can be Automated:

- Experimental Design
- Core Model runs
- Persistent Storage of Core Model Results
- Meta-Model Fitting on Experiments

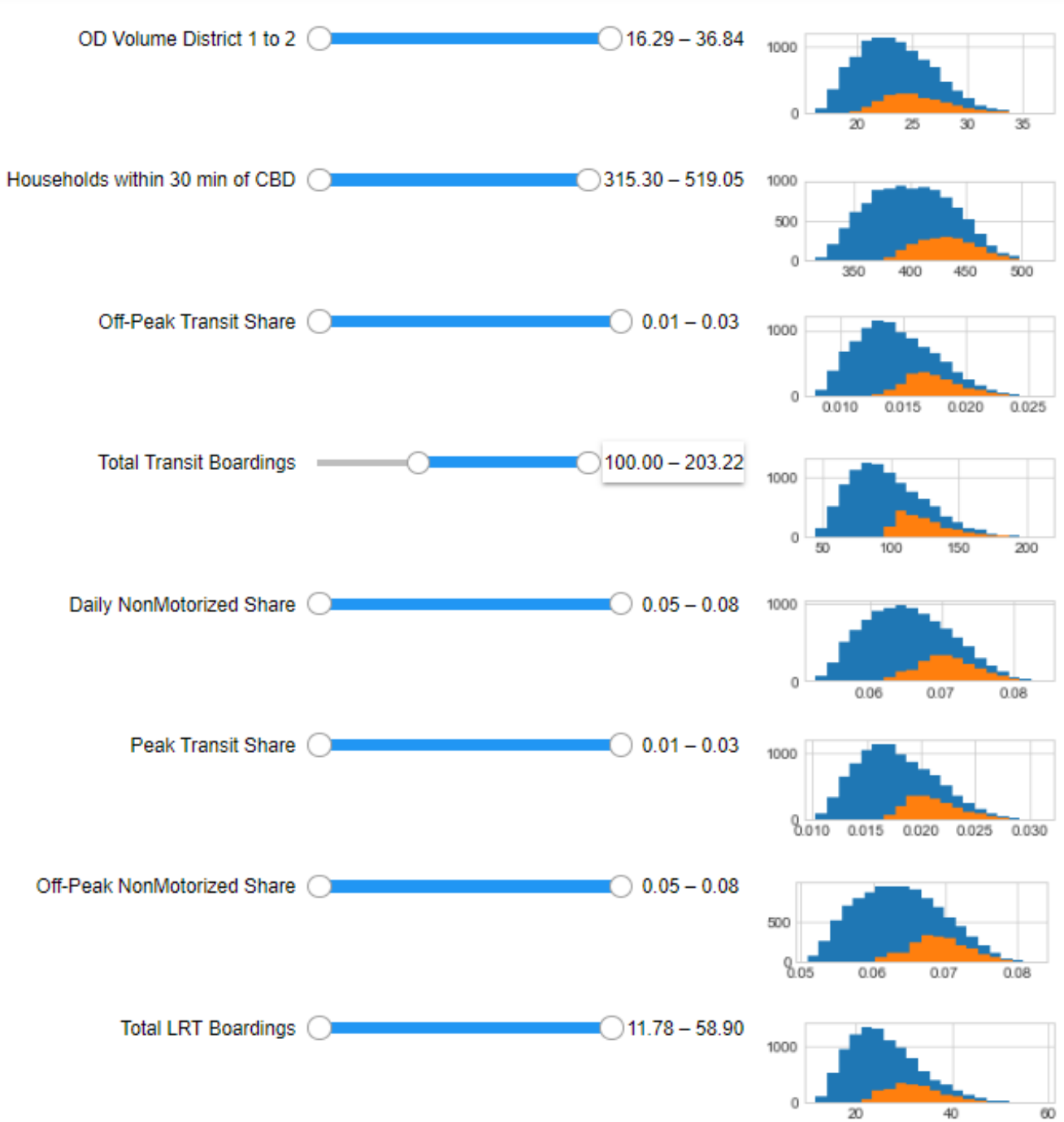


Prototype Demonstration Model

- To demonstrate the capabilities of EMA for transportation planning, the TMIP-EMAT tool has been connected to the Buffalo-Niagara regional forecasting model
- The TDM is a trip-based model that requires just a couple of hours to complete a model run

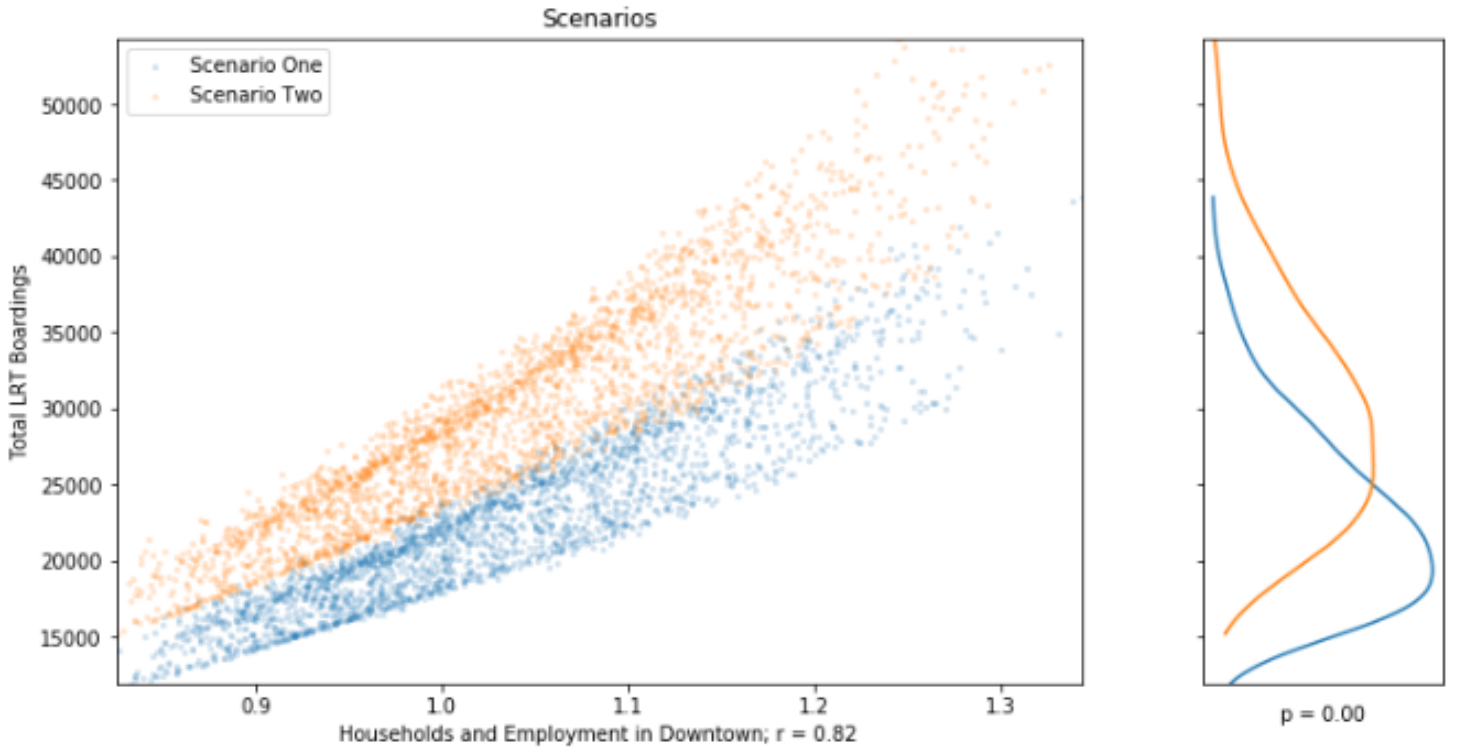
Exploration and Visualization

- The meta-model can be used to generate visualizations for both “shallow” and “deep” uncertainty



Build-No Build Analysis

- An easy-to-digest visualization that shows the impact of one risk factor on one performance measure, both with and without a particular policy or investment



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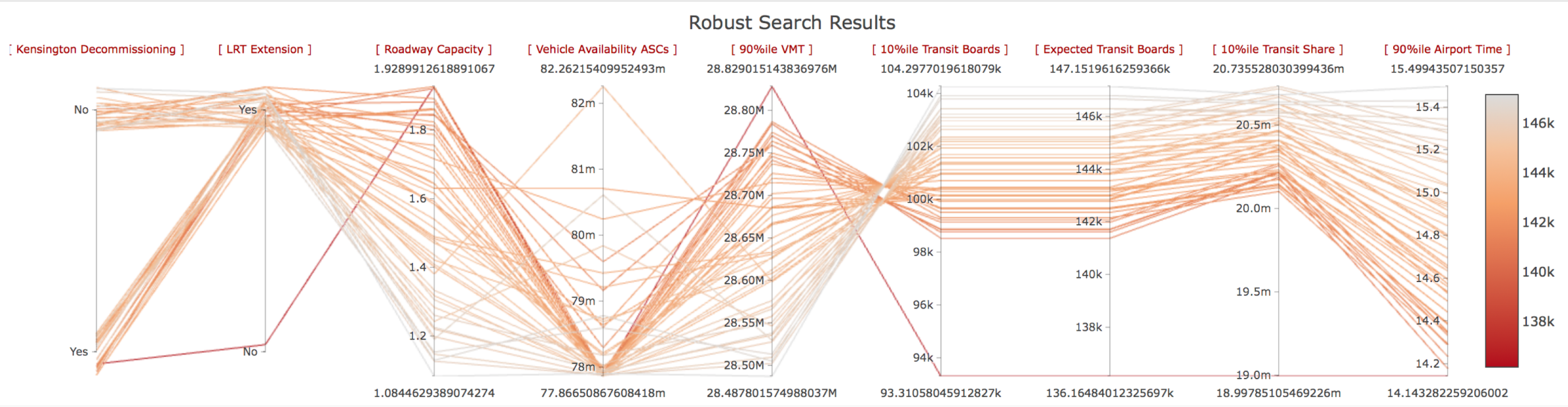
Robust Search and other EMA Methods

- By connecting the meta-model to the EMA Workbench, a broad suite of EMA tools is made available
- We will provide walk-throughs and examples to step through the process within a transportation-specific context



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Managing Expectations

- TMIP-EMAT can only be used to examine questions for which the underlying model has relevant sensitivities.
  - e.g., you can't study the impact of taxes on flying cars if flying cars are not present in the underlying simulation model
- We don't magically make the underlying model more accurate
- It will still be a fair bit of work for both the computers and the humans to use these tools

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