# Disparate Impact and Disproportionate Burden (DI/DB) Policy for Long-Range Transportation Plan (LRTP)

## Part 1: Quantifying Uncertainty

May 2, 2019

John Gliebe

Boston Region Metropolitan Planning Organization

# Outline

- What we are doing and why
- Uncertainty in forecasting
- Quantifying uncertainty for the DI/DB Policy
- Findings

# Background

- MPO staff developing LRTP DI/DB Policy
  - Applies to major infrastructure projects in LRTP as a group → analyze for *Destination 2040*
  - Could the build scenario adversely affect minority and/or low-income populations?
  - 2018: 3 working group mtgs, 1 public workshop
    - Set of metrics to measure impacts
    - Account for uncertainty in travel model forecasts
    - Need to be confident in predictions

# Potential Metrics

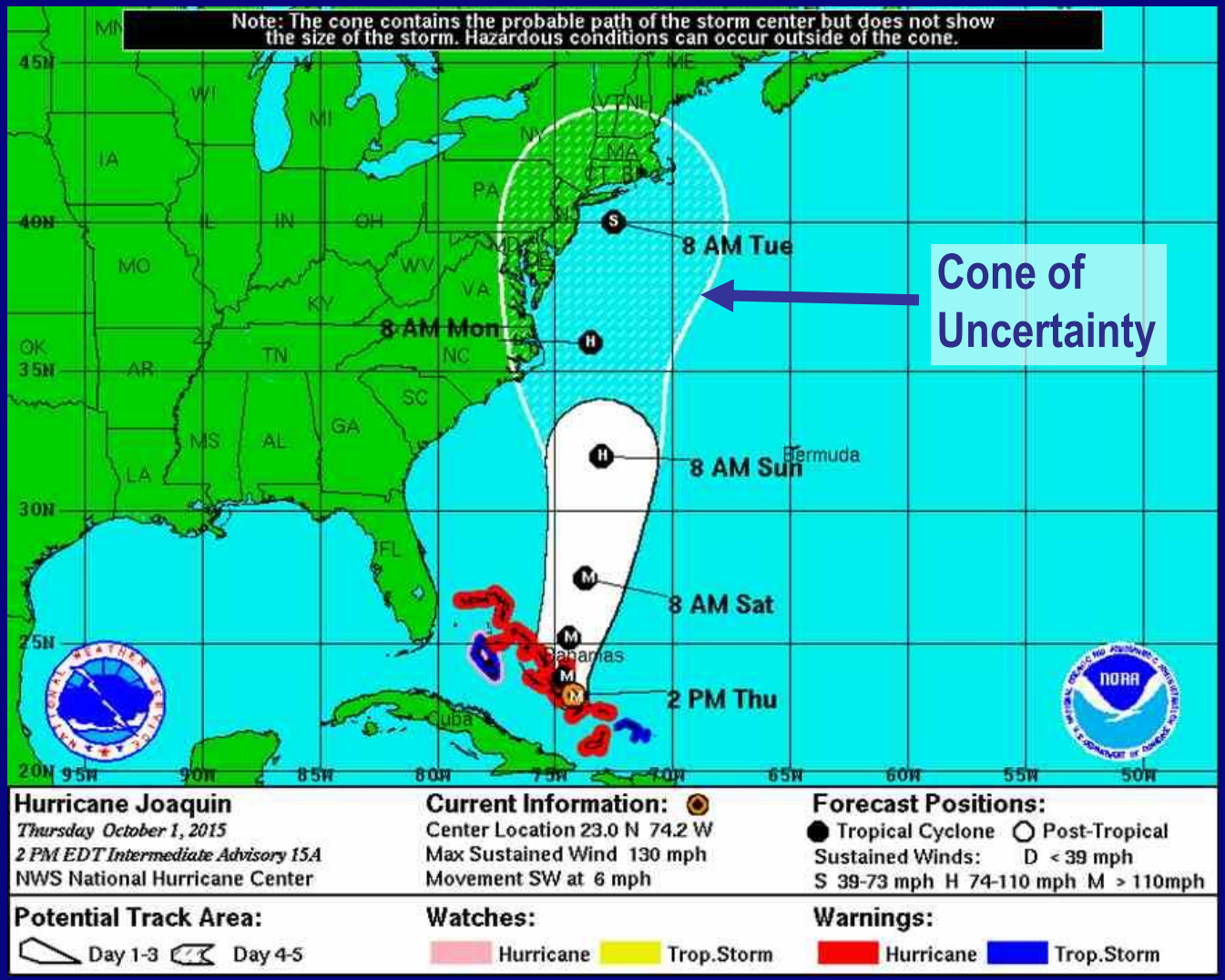
- Accessibility (highway and transit)
  - Jobs
  - Retail amenities
  - Healthcare facilities
  - Higher education
- Mobility (highway and transit)
  - Average travel time
- Environmental (highway)
  - Congested VMT
  - Carbon monoxide

# Why Study Uncertainty?

***Does the difference between no-build and build scenarios exceed the statistical error in the regional forecasting model?***

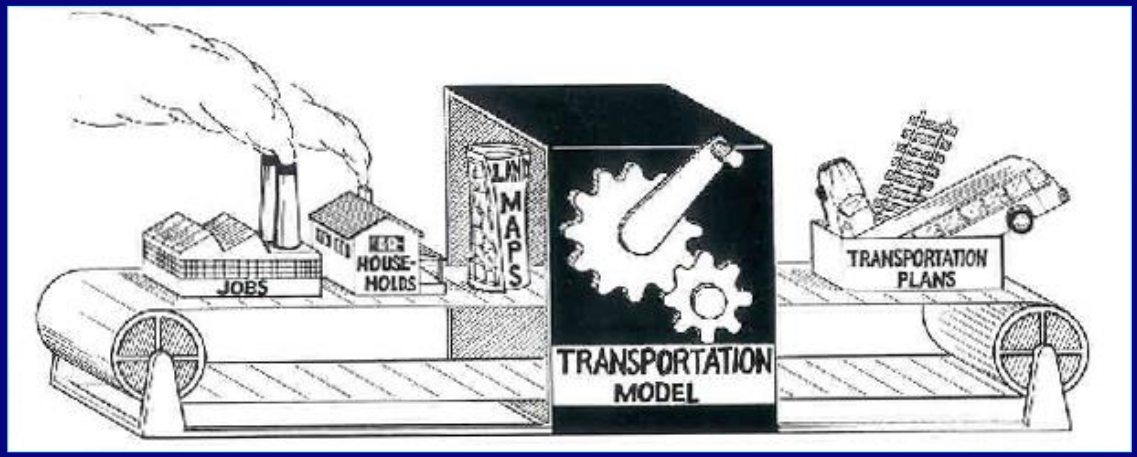
**"It's tough to make predictions, especially about the future." — Yogi Berra**

# Uncertainty in Forecasting



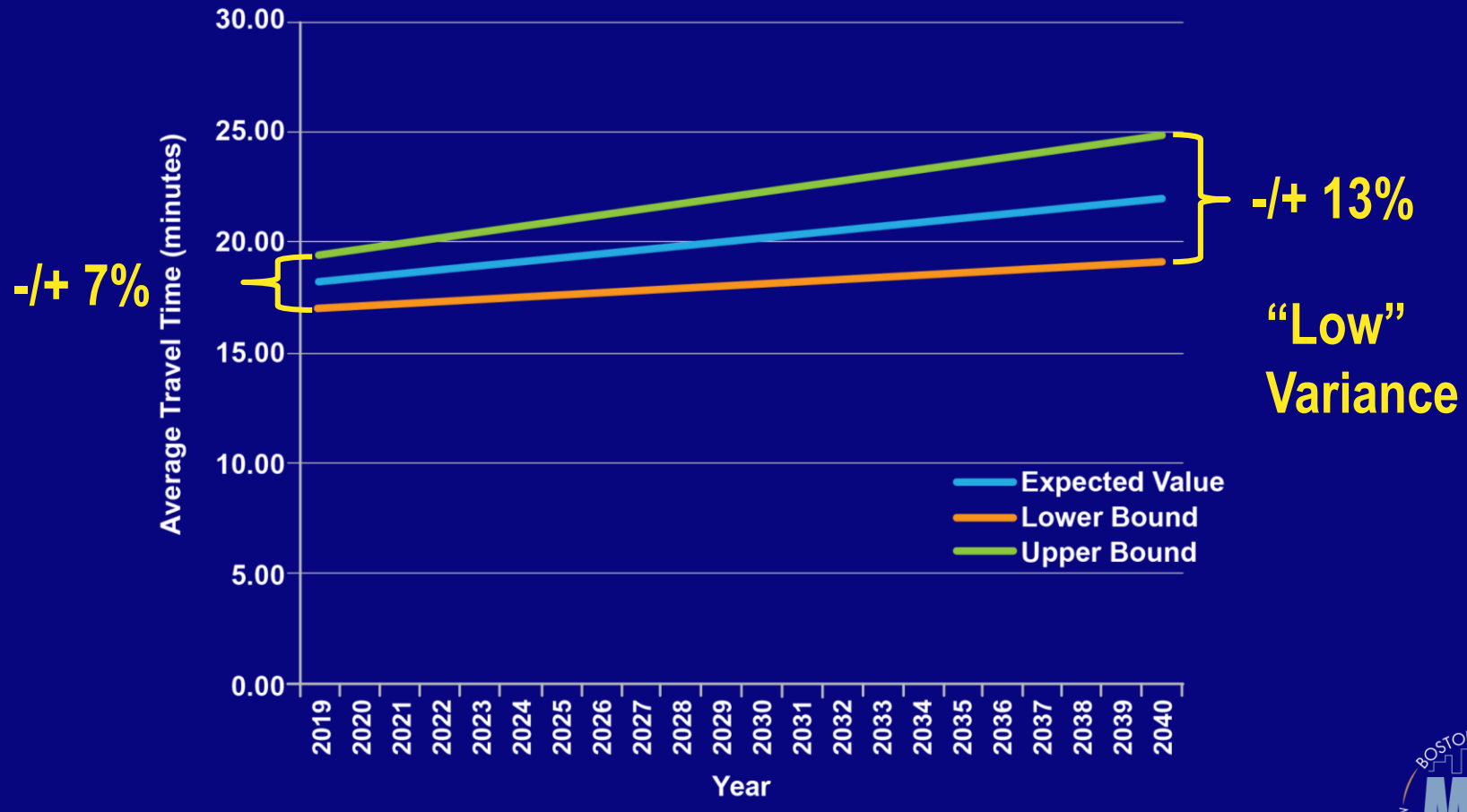
# Sources of Uncertainty in Regional Travel Forecasting

- Forecasting human behavior!
- Projecting to the future! (2040)
- CTPS's travel model is a complex assembly of data inputs, assumed behaviors, statistical relationships, and algorithms



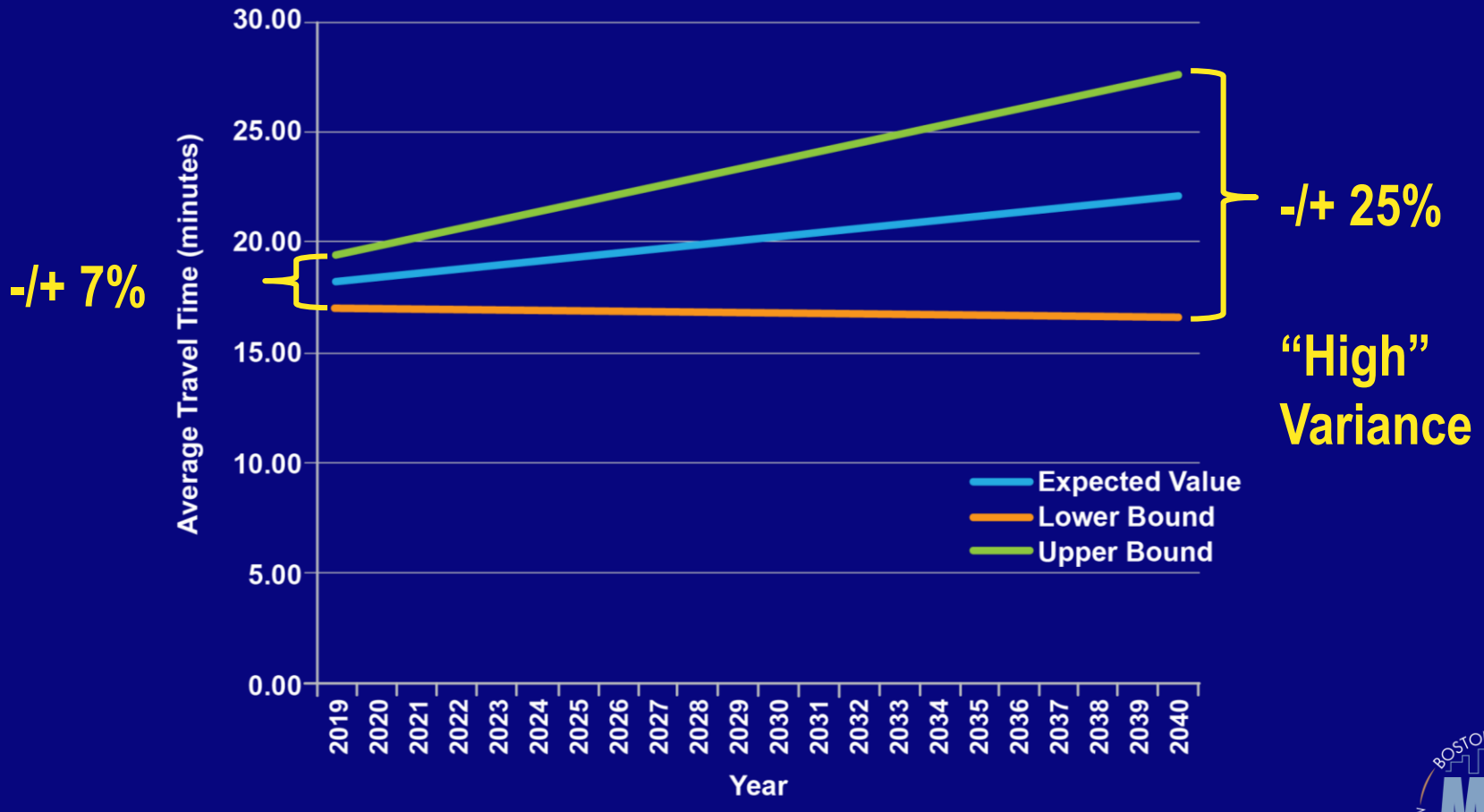
# Effect of Uncertainty on Metrics

## Relatively "Low" Variance



# Effect of Uncertainty on Metrics

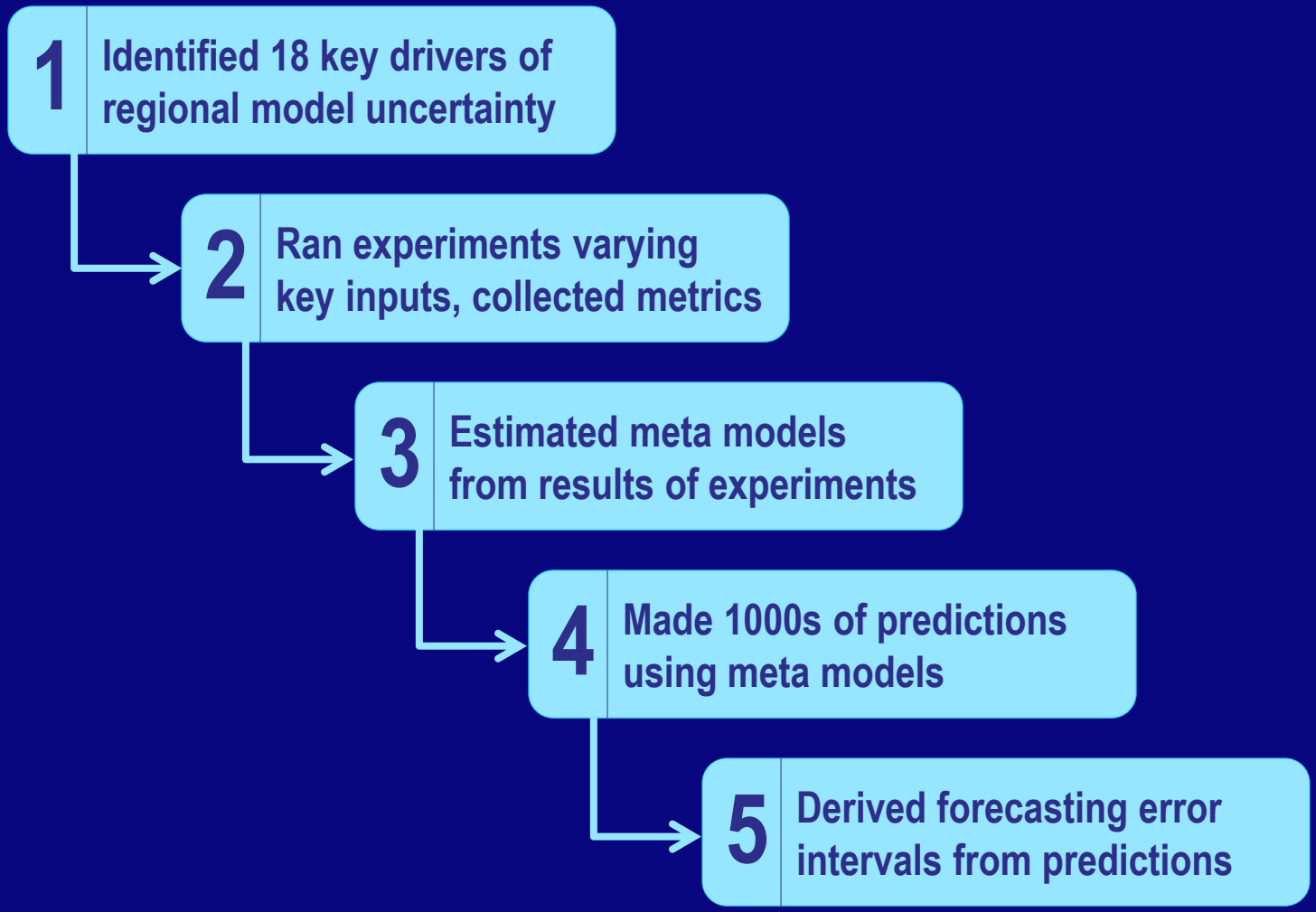
## Relatively "High" Variance



# Approach to Quantifying Uncertainty

- **Objective:** estimate a forecasting error interval for each metric
- **How?** Test the regional model's sensitivity…
  - Identify primary sources of uncertainty, vary them, and see how model outputs change
  - Develop a set of meta models that can test many combinations of inputs *quickly* to generate a distribution of outcomes

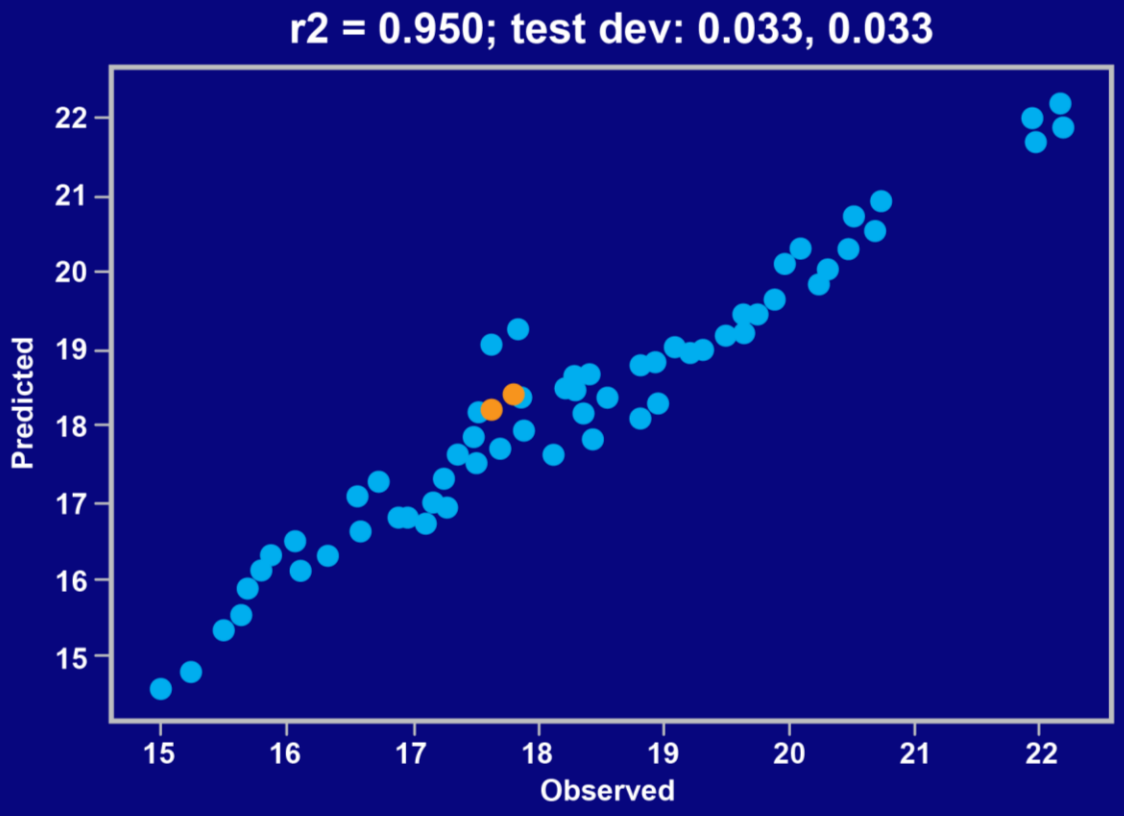
# Steps


1
Identified 18 key drivers of regional model uncertainty
2
Ran experiments varying key inputs, collected metrics
3
Estimated meta models from results of experiments
4
Made 1000s of predictions using meta models
5
Derived forecasting error intervals from predictions

# Example of Estimated Meta Model

## Average Highway Travel Time

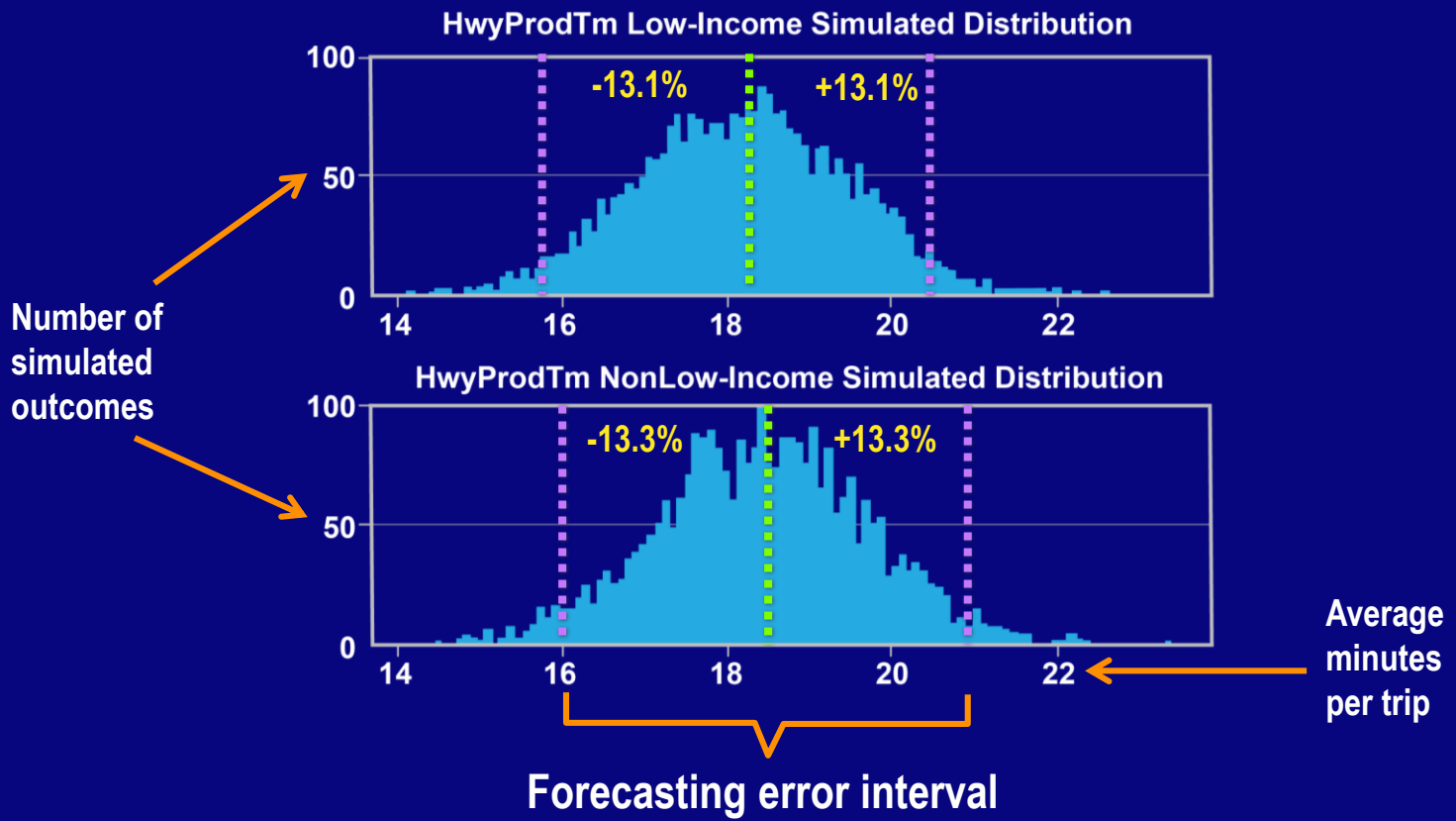
### Low-Income and Non-Low-Income



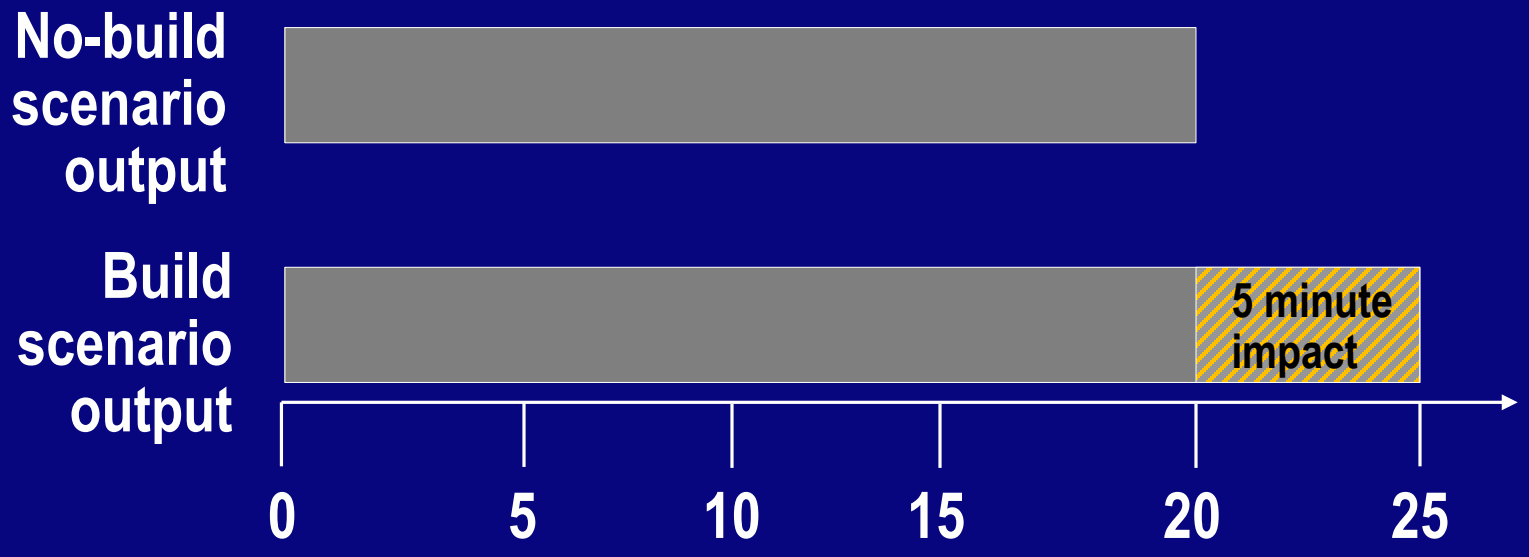
# Example of Simulated Predictions

## Average Highway Travel Time

### Low-Income and Non-Low-Income



# Hypothetical: Travel Time for Minority Population




15 percent (forecasting error) X 20 minutes = 3 minutes

Is 5 minutes > 3 minutes?

Yes. Projected impact.

# Findings (1 of 2)

- Results vary by mode and population group
- **Not all metrics are useful** for determining whether build scenarios have statistically significant impacts—too much uncertainty
- **Highway accessibility metrics** have wide forecasting error intervals—high uncertainty
  - Broad network coverage beyond the MPO
  - Future job locations

# Findings (2 of 2)

- **Transit access metrics**—low uncertainty
  - Calculation is limited by transit network coverage and walkability
- **Mobility metrics** (average highway and transit travel times)—low uncertainty
- **Environmental metrics** (local exposure to congested VMT and carbon monoxide)—low uncertainty

# Summary

- Importance of accounting for model uncertainty in the DI/DB policy
- Staff study quantified uncertainty for proposed metrics
  - Determined some might not be suitable
  - Produced forecasting error intervals to be "plugged" into policy analysis framework

# Questions?

# RESERVE SLIDES

# 18 key inputs (drivers of uncertainty)

1. Auto operating costs
2. Transit fares
3. Toll costs
4. Value of time
5. Household sizes
6. Job locations
7. Transit mode bias
8. Walk/bike mode bias
9. Trip length sensitivity
10. Transit wait/walk sensitivity
11. Transit service frequency
12. Park-and-ride lot supply
13. Roadway capacities
14. Congestion-delay sensitivity
15. Peak spreading factors
16. Work trip generation
17. Non-work trip generation
18. Truck trip generation

BOSTON REGION MPO METROPOLITAN PLANNING ORGANIZATION