Reliability Measures: Which Statistics Will Actually Help Manage our Roadways?

Why travel time reliability?

- Agencies monitor congestion levels on freeways
- Travel time useful statistic
- Used for:
  - operational decisions
  - mode choice model inputs
  - effectiveness of high occupancy toll lanes
  - freeway system performance monitoring
  - congestion mitigation measurement
- Average travel time is not enough
Topics

- Existing reliability statistics
- SR 520 results
- Recommended statistics
- Ongoing research

Proposed Reliability Statistics

Planning Time Index = \( \frac{95\text{th percentile } TT}{\text{Free Flow } TT} \)

Buffer Index (%) = \( \left( \frac{95\text{th percentile } TT - \text{Average } TT}{\text{Average } TT} \right) \times 100\% \)

TT Variability = \( \frac{\text{Standard Deviation of } TT}{\text{Average } TT} \)

Source: TTI, Cambridge

Source: CalTrans
Skewed Distribution

SR 520 Seattle section

SR 520 Redmond section
**Proposed Reliability Statistics**

\[ UI_r = \begin{cases} \frac{\lambda^{\text{var}} \ln(\lambda^{\text{var}})}{L_r} & \lambda^{\text{var}} > 1 \\ \frac{\lambda^{\text{var}}}{L_r} & \text{otherwise} \end{cases} \]

\[ \lambda^{\text{var}} = \frac{TT90 - TT50}{TT50 - TT10} \quad \text{where } TT10 < TT50 < TT90 \]

\[ \lambda^{\text{var}} = \frac{TT90 - TT10}{TT50} \]

Source: Van Lint, et al

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**WSDOT Data**

[Map showing various locations in Seattle area like University of Washington, Kirkland, Redmond, Microsoft, etc.]

[Map showing various highways like I-5, I-405, SR 520, I-520, and intersections]
SR 520 WB - Seattle section

SR 520 EB – Seattle section
Recommended Reliability Statistics

- More than one definition of TT reliability
- Median is a better central tendency statistic
- Variation in TT requires:
  - 80th percentile
  - 90th percentile
  - 95th percentile

Reliability Analysis

Graph showing travel time (seconds) from 15:00 to 19:45 with different lines representing incidents removed - median, incidents removed - 80%, incidents removed - 95%, all days - median, all days - 80%, and all days - 95%.
Ongoing Work

- SR-520 data expanded to other corridors
- Impacts to TT reliability due to:
  - Traffic volume regimes
  - Incidents
  - Weather

Traffic Regime

- Uses maximum speed and minimum volume from any loop detector in corridor
- Testing boundaries and effects
Incidents and Accidents

- WSDOT Incident Response Tracking System (WITS) data
  - Max incident length
  - Max closure length (if lane closed)
- WA State Patrol (WSP) data
  - Crash
  - Severity
- Expansion on data
  - Rubbernecking
  - Time and Queue Extended

Weather Variables

- Uses NOAA National Weather Service data from the airport
  - Presence of Rain, Heavy Rain, Wind, Snow / Ice
  - Amount of Rain in last hour, last 2 hours, last 4 hours
  - Wind Speed
Ongoing Work

- **Major Goal**: Develop statistical relationships between highway improvements and travel time reliability
- Better understand impacts of variables on travel time reliability
- Expand statistics to transit TT reliability

Thank you

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