Apples to Apples: Measuring the Performance of Transit and Roadways Equivalently

Reuben Juster
Faculty Research Assistant
CATT Works

Source: Amazon
CATT Works

• Under CATT

• Transportation Engineering/Analytics

• FRAs, GRAs, undergrads
The Tale of Two Modes

The Four Oh Five
SFVmedia

WMATA Rail
ARLnow
Performance Measurement

1. Goal (Qualitative)
2. Objective (Quantitative)
3. Performance Measures (Unit)
4. Performance Target (Range)
Why Measure Performance?

- Regulation (Love Canal, Buffalo News)
- Problem Identification (I-35W Collapse, Wikimedia)
- Transparency (Enron, Wikipedia)
- Prioritization (Momofuku Milkbar, NY Daily News)
- Justification (Intercounty Connector, FHWA)
The Problem
The Ideal

The Dan Ryan Branch and Expressway, Wikipedia
Apples (Highway Performance Measures)

• Percentile-based
• Travel Time Index
• Planning Time Index
• Cumulative Distribution Function
• Enabled by Probe Data
• Required by MAP-21
Oranges (New York)

NYC Transit
OTP (Terminal) - 1 Line

Monthly Comparison

<table>
<thead>
<tr>
<th></th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>YTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 Actual</td>
<td>74.3%</td>
<td>73.2%</td>
<td>76.4%</td>
<td>81.4%</td>
<td>78.5%</td>
<td>77.7%</td>
<td>76.5%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>77.4%</td>
</tr>
<tr>
<td>2015 Actual</td>
<td>74.2%</td>
<td>70.7%</td>
<td>74.9%</td>
<td>77.4%</td>
<td>78.7%</td>
<td>80.7%</td>
<td>73.4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>78.4%</td>
</tr>
<tr>
<td>2015 Target</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Subways weekday Terminal OTP evaluates performance based on schedule/service plan in effect, includes all delays.

Percentage of trains that start their journey at their first station within 5 minutes of the schedule and have not skipped any scheduled stations.
Blood Orange (Boston, MBTA)

Passengers Waits

- 87% < Headway (Goal: 90%*)
- 97% < Big Gap (Goal: 98%*)
- 100% < 2X Headway (Goal: 100%*)

Passenger Travel Time

- 96% delayed < 3 min. (Goal: TBD)
- 100% delayed < 6 min. (Goal: TBD)

Comparison to range for each metric over prior 6 months (red bar is worse, dark grey is worse than median, light grey is better)

* Goals are tentative, may be changes

Headway Performance (measured at Park Street)

- Early AM
- AM Peak
- Midday
- PM Peak
- Eve
- Night

Running Time Performance by Segment

Southbound
- Back Bay
- Kenmore
- South Station
- Stony Brook

Northbound
- JFK/UMass
- Faneuil Hall
- North Station
- South Station
- Back Bay
- Kenmore
- South Station
- Stony Brook

Highlighted times are 10% higher than the medians for the period

1. The standard for a big gap is either 1.5 times or 3 minutes greater than the scheduled headway, whichever is later.
2. Passenger travel time is based on average passenger demand rates per period. i.e.: 10000 passenger demand at the peak is a standard rate of 6000/hr or 100/hr, which are further divided by availability. The rate is multiplied by the headway of a train to get the number of people boarding that train. If the total is more than 2 minutes more than normal, below any two points, the passengers on that train are considered delayed. It does not account for people not being able to board a train due to crowding.
3. Weighted average headway accounts for the fact that fewer people end up experiencing a short headway than a long headway, since fewer passengers arrive between trains.
How about comparing the modes apples to apples?
Study Location
Study Data

- VPP for highways
- In House Virginia Railway Express (VRE) Data
Study Results (Congestion)

AM (5:00 AM to 9:00 AM)

PM (3:00 PM to 8:00 PM)
Study Results (Reliability)

AM (5:00 AM to 9:00 AM)

PM (3:00 PM to 8:00 PM)
### Study Results

<table>
<thead>
<tr>
<th>Performance Measure (Time Period)</th>
<th>Traditional Peak Periods (7-9AM, 4-6 PM)</th>
<th>VRE Service (5-9 AM, 3-8 PM)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I-95/ I-395</td>
<td>I-66</td>
</tr>
<tr>
<td>TTI (AM)</td>
<td>1.39</td>
<td>1.64</td>
</tr>
<tr>
<td>TTI (PM)</td>
<td>1.13</td>
<td>1.23</td>
</tr>
<tr>
<td>PTI (AM)</td>
<td>2.11</td>
<td>2.69</td>
</tr>
<tr>
<td>PTI (PM)</td>
<td>1.69</td>
<td>2.07</td>
</tr>
</tbody>
</table>

Average Results of Freeway Corridors During Traditional Peak Periods and VRE Service
The Ultimate Goal

Cumulative Distribution Function
Choose Your Commute

This map shows the median arrival times at various Northern Virginia destinations if you leave by car or VRE from Union Station after 5pm.

- To Broad Run: Leave at 5:05 PM. To Fredericksburg: Leave at 5:15 PM.
- Rippon: 6:10 PM. 5:34 PM.
- Broad Run: 6:06 PM. 6:21 PM.
- Burke Center: 5:43 PM. 5:49 PM.
- Backlick Road: 5:27 PM. 5:37 PM.
- Franconia/Springfield: 5:35 PM. 5:34 PM.
- Fredericksburg: 6:50 PM. 6:47 PM.

Bumper to bumper

Catching up on sleep
Closing Remarks

- Open data?
- Transparency
- Multimodal View
- Need Tools
- Path based
- MAP-21
- TRB
- Linkedin Report

Focmap.org
Questions