Traffic Matters for Everyone’s Daily Life

Sources:
How Do We Measure Traffic Performance?

**Somerset, Bellevue, WA**

**Wednesday**

Clear

<table>
<thead>
<tr>
<th>Time</th>
<th>Temperature</th>
<th>Precipitation</th>
<th>Wind</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 AM</td>
<td>64°F</td>
<td>10%</td>
<td>7 mph</td>
</tr>
<tr>
<td>3 AM</td>
<td>60°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 AM</td>
<td>59°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 AM</td>
<td>59°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 PM</td>
<td>71°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 PM</td>
<td>79°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6 PM</td>
<td>81°F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9 PM</td>
<td>74°F</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Current Air Quality** 10 PM PDT Sep 2

- **25 NowCast AQI**
- **PM2.5**

**Forecast**

- **Today**: Good
- **Tomorrow**: Good
How Do We Measure Traffic Performance?

22 min (14 mi)
Fastest route, the usual traffic

Smart Transportation Applications & Research
How Do We Measure Traffic Performance?

• Level of Services (LOS)?
  • It is based on density which is very hard to measure
  • Cannot be used for roadway network at this point

How Do We Measure Traffic Performance?
Traffic Performance Score (TPS)

• We introduce TPS for performance measurement from traffic system service provider’s perspective.

• It can be used at segment, corridor, or network levels.

• Using only one score

0 (Jam congestion) ← TPS → 100 (Network-wide free-flow travel)
Traffic Performance Score (TPS) at time $t$ is calculated as

$$TPS_t = \frac{\sum_{i=1}^{n} V_t^i \cdot Q_t^i \cdot L^i}{\sum_{i=1}^{n} V_f^i \cdot Q_t^i \cdot L^i} \times 100\%$$

Where $V_t^i$ and $Q_t^i$ represent the speed and volume of each road segment $i$ at time $t$. $L^i$ is the length of $i$-th detector's covered road segment. $V_f^i$ is the free flow speed.

The unit of speed is mile per hour (mph), and the unit of covered distance is mile.
TPS Website for the Greater Seattle Area Network

Our TPS Website is open for public access. Website URL: http://tps.uwstarlab.org/

Traffic Performance Score in the Greater Seattle Area

To view more information, please select on the left navigation panel. Enjoy! 😊

Select a date:

2020/05/05

Segment-based TPS on Animated Map

Please use Chrome for best visualization quality.
TPS Website Data Sources

• Data collected from more than 10,000 inductive loop detectors deployed on freeways.
• Cover main freeways include: I-5, I-90, I-99, I-167, I-405, and SR-520.
• Credit to WSDOT for streaming the raw data to users.
TPS for Traffic Performance Assessment

Selected Dates from 2020-05-18 to 2020-05-17:

Traffic Performance Score (%)
Impact of COVID-19

- **Responses to COVID-19**
  - **March 6**: Major tech companies ask Seattle employees to work from home. [link]
  - **March 9**: UW suspends on-site classes and finals. [link]
  - **March 13**: Gov. Inslee announces statewide school closures, expansion of limits on large gatherings. [link]
  - **March 16**: Gov. Inslee announces statewide shutdown of restaurants, bars and expanded social gathering limits. [link]
  - **March 23**: Gov. Inslee announces "Stay Home, Stay Healthy" order. [link]
  - **April 2**: Gov. Inslee extends "Stay Home, Stay Healthy" through May 4. [link]
  - **June 8**: The state required public-facing employees to wear masks.
  - **June 26**: The state requirement was extended to everyone in public places.
  - **July 7**: Statewide mask order strengthened; businesses require customers to wear face coverings

How Did the Countermeasures Impact TPS?

Daily Rush Hour TPS on Weekdays of Freeway GP Lanes

A: Tech company office shut down on March 6;
B: UW cancelled onsite classes on March 9;
C: Statewide school closure on March 13;
D: Restaurants shutdown on March 16;
E: “Stay Home, Stay Healthy” on March 23;
F: “Stay Home” order extended on April 2.
VMT Reduced by the Six Events?

A: Tech company office shut down on March 6;
B: UW cancelled onsite classes on March 9;
C: Statewide school closure on March 13;
D: Restaurants shutdown on March 16;
E: “Stay Home, Stay Healthy” on March 23;
F: “Stay Home” order extended on April 2.
VMT Reduced by the Six Events?

• Let’s revisit the weekly VMT change w.r.t. the immediate past week

Weekly VMT Change w.r.t. the Past Week

[Bar chart showing weekly VMT change with percentages ranging from -30.00% to 30.00%.]
Baseline: averaged VMT on each day of the week from Jan. 19 to Feb. 22, 2020.

New Norm? (~8% down)

VMT Changes w.r.t. Baseline
Measuring Fundamental Trips

• Considering all the trips after the “stay home” order are fundamental trips to support basic functions of our society.

• How many percent of the regular day trips are in this category?
  • We identify the fundamental trips as the trips occurred during the week with the minimum VMT.
  • We selected the VMT in the week from March 30 to April 5 as the minimum VMT.
Measuring Fundamental Trips

Percentage of Fundamental Trips in Regular Day Trips

- Normal VMT
- Fundamental VMT
- Ratio (Fundamental/Normal)

VMT

0 2,000,000 4,000,000 6,000,000 8,000,000 10,000,000 12,000,000 14,000,000 16,000,000 18,000,000

Mon Tue Wed Thu Fri Sat Sun
Volume Distribution over Road Segments

- During COVID-19, the network-wide volume in the traffic system reduced.

- Road segments in the Greater Seattle area may serve for different type of trips.

- During the pandemic, volume pattern changes of some segments have been observed.
Segment Ranking based on Volume per Lane

• Segments’ rank **increased:**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Rank before COVID-19</th>
<th>Rank from 05-10 to 05-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-405, SB, Milepost 24-26</td>
<td>16</td>
<td>6</td>
</tr>
<tr>
<td>I-5, NB, Milepost 161-163</td>
<td>17</td>
<td>3</td>
</tr>
<tr>
<td>I-5, SB, Milepost 171-173</td>
<td>19</td>
<td>13</td>
</tr>
<tr>
<td>I-405, SB, Milepost 26-28</td>
<td>26</td>
<td>15</td>
</tr>
</tbody>
</table>

• Segments’ rank **decreased:**

<table>
<thead>
<tr>
<th>Segment</th>
<th>Rank before COVID-19</th>
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</tr>
</thead>
<tbody>
<tr>
<td>I-5, SB, Milepost 163-161</td>
<td>9</td>
<td>32</td>
</tr>
<tr>
<td>I-405, SB, Milepost 0-2</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>I-5, NB, Milepost 167-169</td>
<td>13</td>
<td>29</td>
</tr>
<tr>
<td>I-5, SB, Milepost 157-159</td>
<td>23</td>
<td>47</td>
</tr>
</tbody>
</table>
More Speeding Vehicles?

• Since there are less vehicles traveling on roads during COVID-19, we consider speeding will be more than regular days.

• However, based on our analysis, the speeding rate during COVID-19 on major freeways did not increase.
• According to the one-minute interval loop detector data, speeding rate also decreased!
New Norm before the End of COVID-19?

- Freeway volumes are also roughly 8% lower.
New Norm before the End of COVID-19?

- VMT had been steadily bouncing back with the reopening process until late June, 2020.
New Norm before the End of COVID-19?

• TPS is consistently above 90 percent since March.
New Norm before the End of COVID-19?

- Green House Gas is roughly 9% lower.
TPS Can Be Used for Other Analyses

• How do roadway closures affect network traffic performance?
• How does rain or snow impact roadway travel?
• How does a new transportation policy or gas price influence VMT?
• How does sports events impact traffic over the roadway network?
• How does traffic respond to deployment of new technologies?
Covering Only Freeway Is Not Enough

- Urban traffic has obviously different patterns, comparing to freeway traffic.
Urban Street TPS

• We are developing TPS for urban streets with Seattle DOT

• Data source: Sensys data
  • Magnetic sensors at intersections
  • Provide lane-wise data at 45 intersections in the City of Seattle
  • Data parameters:
    • Volume and occupancy
    • Infra-red speed based on volume and occupancy
Spatial-Temporal Traffic Patterns

Spatial: traffic (volume) at intersections

Temporal: traffic (volume) of each lane
Urban Street TPS

- **Urban street TPS**
  \[ TPS_t = \frac{\sum_{i=1}^{n} V_t^i \cdot Q_t^i \cdot L_t^i}{\sum_{i=1}^{n} V_f^i \cdot Q_t^i \cdot L_t^i} \times 100\% \]

  - \(V\): speed, \(Q\): volume, \(L\): length of road segment, \(V_f\): free-flow speed

- **Urban TPS reflects**
  - Network-wide urban traffic performance
  - Short-term and long-term traffic patterns
Regional TPS Website Is Desirable

A more comprehensive TPS for the whole Puget Sound region is highly desirable

- to capture interactions between freeway and urban streets
- to balance capacity loading
- to optimize network-wide system control
Summary

• TPS is a simple yet effective method for quantifying traffic performance using existing traffic data.

• The TPS website developed by the UW STAR Lab is proven useful for evaluating COVID-19 impacts on network and segment traffic.

• COVID-19 has significantly affected VMT in the central Puget Sound area. The biggest drop is 64% on March 28.

• Trips to maintain life needs are around 50% of trips made on a regular day.

• No evidence showing increased level of speeding during home stay period.
You Are Welcome to Get Involved

• If your city is interested to be part of the TPS Score Website, please contact us at
  
  Email: yinhai@uw.edu
  Phone: (206) 616-2696

• Your comments and feedback on our online tool and methodology are also greatly appreciated!
Acknowledgement

• We appreciate the support from PacTrans and STAR Lab.
• We appreciate WSDOT and SDOT for data support.
• This website is developed by the Artificial Intelligence group of the STAR Lab.
  • Group member: Zhiyong Cui, Meixin Zhu, Pengfei Wang, Yang Zhou, Qianxia Cao, Shuo Wang, and Cole Kopca

For questions or comments, please email yinhai@uw.edu.