Lecture 4
(Chapter 9)

Speed, Travel Time
and Delay Studies
Speed Studies

- Some speed related terms
  - TMS and SMS (discussed previously)
    \[ \bar{S} = \frac{\sum n_i S_i}{N} \]
  - Standard deviation
    \[ \sigma = \sqrt{\frac{\sum (S_i - \bar{S})^2}{N-1}} = \sqrt{\frac{\sum S_i^2 - N\bar{S}^2}{N-1}} \]
  - 85th percentile speed
  - Median speed
  - Pace
Travel Time Studies

- Evaluate new signal timing improvement
- Travel time field techniques
  - Floating car
  - Maximum car
  - Average car
- GPS technology

Delay Studies

- Delay: the most commonly used performance measures
- Types of Intersection Delays
  - Stopped delay
  - Total delay (control delay)
  - Time in queue delay

Delay Studies

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Field Delay Studies

- Direct measurement of time in queue delay (path trace)
  - \( \text{delay} = (\text{time to exit stop line}) - (\text{time to join queue}) \)

- Queue sample
  \[
  T_Q = \left( \frac{\sum V_{V_i}}{V_T} \right)
  \]

Field Delay Studies - Example

<table>
<thead>
<tr>
<th>Clock Time</th>
<th>Number of vehicles in queue</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;10 sec</td>
</tr>
<tr>
<td>5:00 PM</td>
<td>4</td>
</tr>
<tr>
<td>5:01 PM</td>
<td>3</td>
</tr>
<tr>
<td>5:02 PM</td>
<td>3</td>
</tr>
<tr>
<td>5:03 PM</td>
<td>3</td>
</tr>
<tr>
<td>5:04 PM</td>
<td>3</td>
</tr>
<tr>
<td>5:05 PM</td>
<td>3</td>
</tr>
<tr>
<td>5:06 PM</td>
<td>3</td>
</tr>
<tr>
<td>5:07 PM</td>
<td>3</td>
</tr>
</tbody>
</table>

Total vehicle count going through the intersection is 120 vehs
Field Delay Studies

- Adjustment to account for deceleration and acceleration
  - 0.9 adjustment for error
    \[ T_v = \left( \sum_i \frac{V_i}{V_T} \right) \times 0.9 \]
  - Correction factor (CF) in Table 9.6, which would need FFS and \( V_{SLC} \)
    \[ V_{SLC} = \frac{V_{STOP}}{N_C N_L} \]

Field Delay Studies

- Final control delay
  \[ d = T_Q + (FVS \times CF) \]
  \[ FVS = \frac{V_{STOP}}{V_T} \]

Volume and Delay Data Collection Devices