Traffic Engineering - Lecture 2: Traffic Studies

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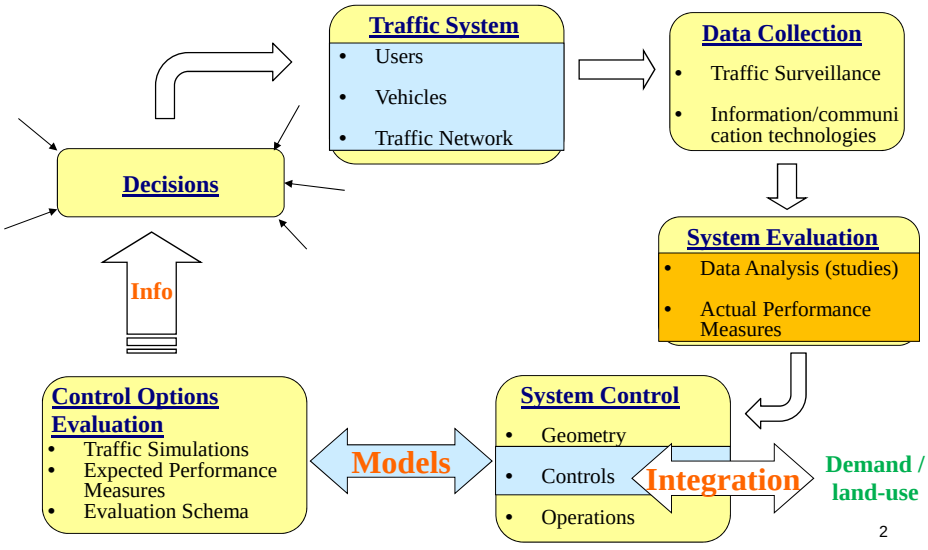
Course Syllabus

WHAT?
WHY?
HOW?



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Data Collection

- Main data fields
  - Classified Traffic volume: number of vehicles crossing a specific point during a specific time interval (per vehicle type).
  - Vehicles Speed: Travelling speeds and spot speeds.
- A wide variety of Surveillance Technologies
  - Intrusive Technologies such as;
    - Pneumatic tubes

    - Inductive Loop detector

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Data Collection

- A wide variety of Surveillance Technologies
  - Extrusive technologies, such as;
    - Traffic Counts (Manual or Automatic Counters)
    - Microwave Sensors (Such as Remote Traffic Microwave Sensor RTMS, and Doppler radar)
    - Infrared Radars
    - Traffic video cameras

http://mac-it-happens.com/products/radar.php

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Traffic Studies

- What?
  - Speed Studies
  - Volume Studies
  - Travel Time and Delay Studies
  - Parking Studies
  - Accidents Studies
  - …
- Why?
  - Assessment of current traffic conditions
  - Estimate actual performance measures
- How??

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Speed Studies

- Mean Speeds
  - Example:
    - Section 100 m length
    - Test Vehicle Travel times: 7 sec, 10 sec, 5 sec, 8 sec
    - Average Speed ????

Average time= =(7+10+5+8)/4=7.5 sec
Average speed=100/7.5=13.33 m/sec

OR

Travel Speeds are 14.28, 10, 20, 12.5
Average speed=
(14.28+10+20+12.5)/4=14.2 m/sec

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Speed Studies

- Mean Speeds
  - Time Mean Speed (TMS)

    TMS = [SUM(d/t_i)]/n

  - Space Mean Speed (SMS)

    SMS = [(n)(d)/SUM(t_i)]

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Spot Speed Studies

- What?
  - Collecting data on vehicles' instantaneous speeds on a given highway stretch.
- Why?
  - To estimate the distribution of speeds of vehicles in a stream of traffic, which is crucial for:
    - Operational Management/control (speed zones, passing/no passing zones, speed limits…etc).
    - Geometrical Design
    - Safety Analysis
    - Evaluations (Before/After Studies)
    - …

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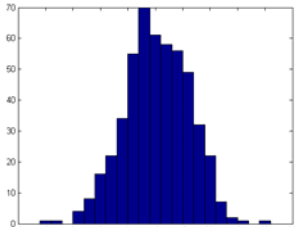
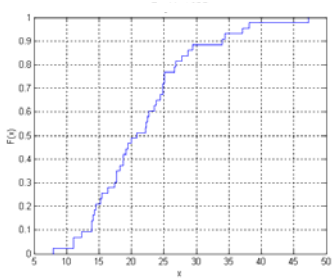
Spot Speed Studies

- How? Statistical Analysis
  - Graphical Representation:



Histogram: Frequency or relative frequency plot per class



Cumulative Relative Frequency Diagram: A plot of the fraction of observations smaller than or equal to a given threshold versus the threshold value.

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Spot Speed Studies

- How? Statistical Analysis
  - Numerical Summaries:
    - Mean= Sum of Speeds/Number

Formally:

$$\text{Mean} = \frac{\sum frequency * mid-class\ speed}{\sum frequency}$$

→ for theoretical purposes, the mean is the most important numerical measure (a crucial modeling parameter).

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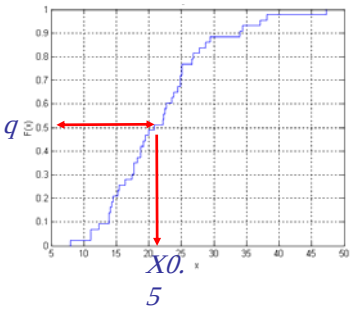
Spot Speed Studies

- How? Statistical Analysis
  - Numerical Summaries:
    - Median: 50th percentile speed

→ it is a resistance measure (relatively not affected by outliers). Useful for practical applications.



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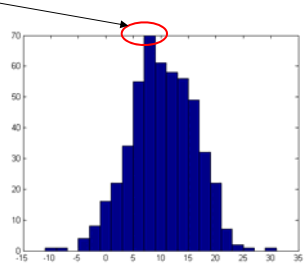
Spot Speed Studies

- How? Statistical Analysis
  - Numerical Summaries:
    - Mode: Speed with Highest Frequency

→ not unique but has the most practical significance. Not affected by outliers.



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Spot Speed Studies

- How? Sample definitions & performance measures
  - Free Flow Speed: Average vehicles speed under free flow conditions (low traffic volume conditions).
  - Design Speed: 95th Percentile Speed is used as the maximum safe speed for the design of the roadway elements.
  - Speed Limit: 85th Percentile speed is usually posted as the roadway speed limit.
  - Speed Index: the average (mean) speed divided by the free flow speed

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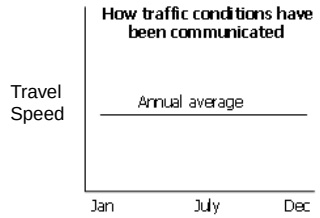
Spot Speed Studies

- How? Reliability Analysis (for speeds or travel times)



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Spot Speed Studies

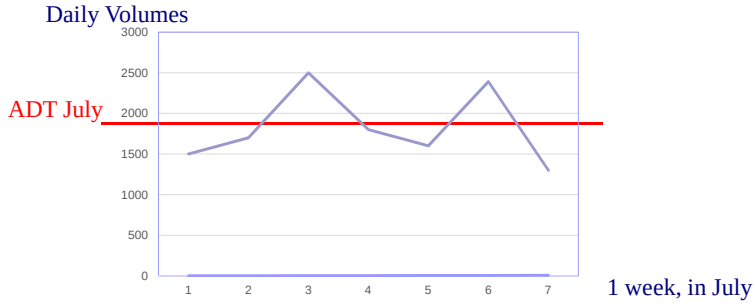
- How? Reliability Analysis (for speeds or travel times)
  - Planning Speed Index= 95th Percentile Speed/Free Flow Speed
  - Buffer Index= (95th Percentile Speed-Average Speed)/Average Speed

Volume Studies

- What?
  - Collecting data on the number of vehicles or pedestrians crossing a specific point at a specific time interval.
- Why?
  - To estimate traffic volume characteristics, which are crucial for demand/capacity analysis (and hence, most traffic-related applications).

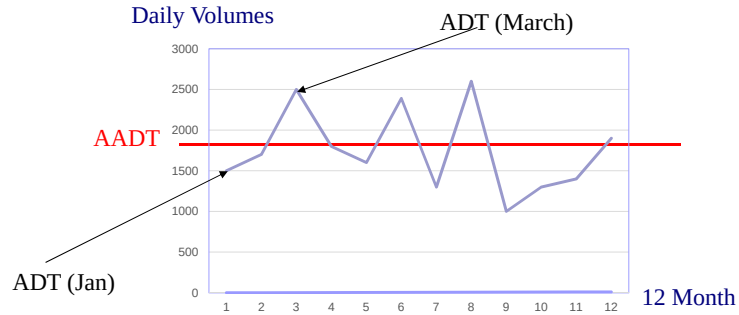
Volume Studies

- How?
  - Daily Rates
    1. Average Daily Traffic (ADT):



Volume Studies

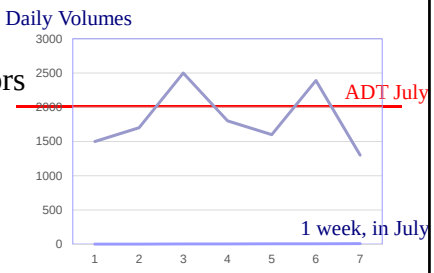
- How?
  - Daily Rates
    2. Average Annual Daily Traffic (AADT):



Volume Studies

- How?
  - Daily Rates – Expansion Factors
    1. **Daily Expansion Factor =**

$$\frac{\text{ADT for a week in a specific month}}{\text{Daily Volume for a specific day}}$$



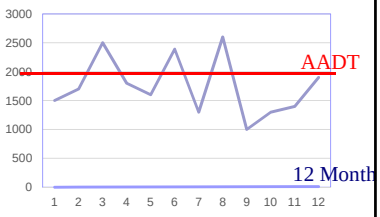
For Example;
Daily Expansion Factor for Day 1
=2000/1500=1.33

→ Why do need these factors??

Volume Studies

- How?
  - Daily Rates – Expansion Factors
    2. **Monthly Expansion Factor=**

$$\frac{\text{AADT}}{\text{ADT of a specific month}}$$

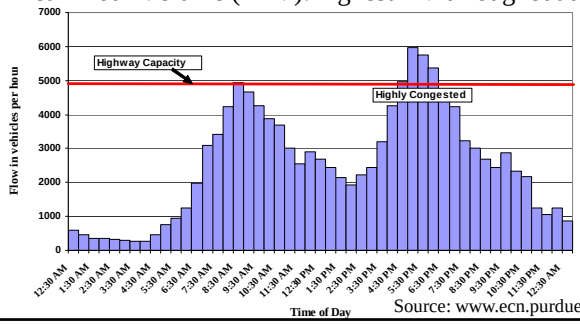


For Example;
Monthly Expansion Factor for
August= 2000/2600= 0.76

→ Why do need these factors??

Volume Studies

- How?
  - Hourly Rates
    1. Hourly Volume (HV): number of cars traveling a roadway section per hour.
    2. Peak Hour Volume (PHV): highest HV throughout the day.



Source: www.ecn.purdue.edu/~darcy

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Volume Studies

- How?
  - Hourly Rates- Peak Hour Factor

$$PHF = \frac{PHV}{4 \cdot \max 15\text{-}\ \min volume}$$

- Example:

$$PHF = \frac{4200}{4 \cdot 1200} = 0.875$$

Time Interval	Volume in time interval
5:00 – 5:15	1000
5:15 – 5:30	1100
5:30 – 5:45	1200
5:45 – 6:00	900
Total	= 4200 vph

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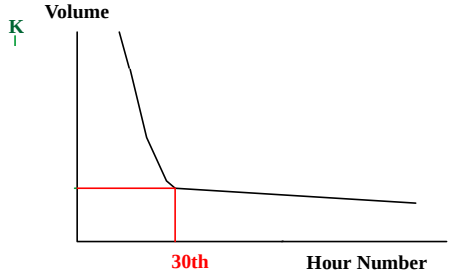
Volume Studies

- How?
  - Hourly Rates
    3. Daily Design Hourly Volume (DDHV): Volume exceeded only in 29 hour of the year.

$$\text{K-factor} = \frac{DDHV}{AADT}$$

→ 8-12% for urban facilities,
→ 12-18% for rural ones



Descending order of hourly volumes for entire year

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