

Lab 10

Freeway Detector Data & Greensheild's Model (1)

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Announcements

- ▶ Report 3 grade statistics:

Mean	Max	Min	Median
3.45(86%)	4.00	0.69	3.68(92%)

- ▶ Report 4 due on Apr. 24.
- ▶ Last meeting date is Apr. 25.

Objectives

- ▶ Look up detector maps and get familiar with real detector data
- ▶ Calculate the density, flow, and speed from detector data
- ▶ Learn R package “ggplot2” for generating nice plots
- ▶ Fit Greenshield's Models (flow-speed)

Detector Map

► Open “MNDOT All Detector Report”

Minnesota Department of Transportation - All Detector Report 2015

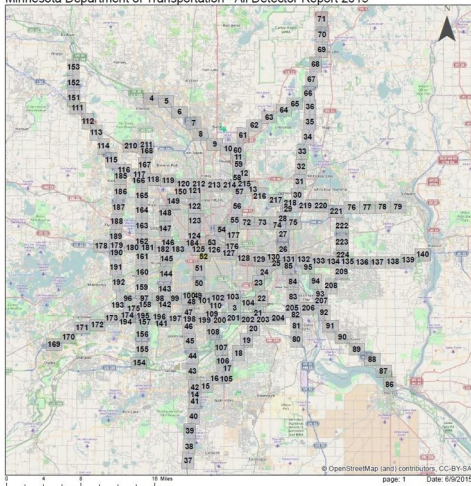


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PDF version of ADR:

* click on page number on map to navigate to that page
 * or click on roadway in table of contents to navigate to the beginning of a roadway

Figure: MnDOT Detector Map

Detector Locations

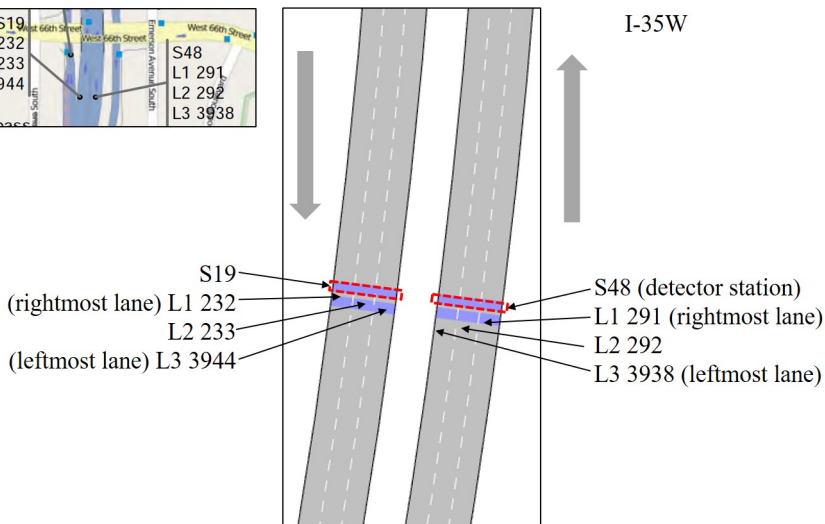


Figure: How to get the location of a detector

MnDOT Data Extraction Tool

The screenshot shows the MnDOT Data Extraction Tool interface. The main window is titled "DataExtract" and contains several sections:

- Available Sensors:** A list of sensors with checkboxes. The selected sensor is "5103 I-94 EB on of Tunnel".
- Selected Sensors:** A list of selected sensors, currently showing "5103 I-94 EB on of Tunnel".
- Calendar:** A calendar for October 2017, showing dates from 1 to 31.
- Settings Panel:**
 - Start:** A text input field.
 - End:** A text input field.
 - Smoothing:** A dropdown menu set to "5 minutes".
 - File Location:** A text input field with the path "C:\Users\jweah\22\Desktop\32011 Lab\Lab08 DetectorData" and a "Browse..." button.
 - File Name:** A text input field.
 - File Format:** A dropdown menu set to "Detector File".
 - Export:** A section with a checked "Values" checkbox and several unchecked checkboxes: "Sum", "Average", "Time Median", "Day Median", and "Sample".
 - Time ranges in:** A dropdown menu set to "Columns".

Figure: How to get the location of a detector¹

¹<http://data.dot.state.mn.us/datatools/>

Detector Data

- ▶ Direct data:
 - ▶ Occupancy [%]: How much the detector was “on”
Eg. “In the last hour, the detector had an occupancy of 10%”
 - ▶ Volume [veh/ln/time]: How many vehicles in a given time
Eg. “We measured a volume of 1500 veh/hr”
- ▶ Derived data:
 - ▶ Density [veh/ln/mi]: How many vehicles per lane per mile
Eg. “This road has a jam density of 196 veh/ln/mi”
 - ▶ Flow [veh/ln/hr]: How many vehicles per hour

Equations

- ▶ Density:

$$k = \frac{O}{L + d} = \frac{O}{100} \left(\frac{5280}{16 + 6} \right)$$

where O is occupancy,
 L is average length of vehicles (feet),
 d is average length of detector (feet)

- ▶ Flow:

$$q = 3600 \times \frac{Vol}{T}$$

- ▶ Speed:

$$v = \frac{q}{k}$$

R package - ggplot2

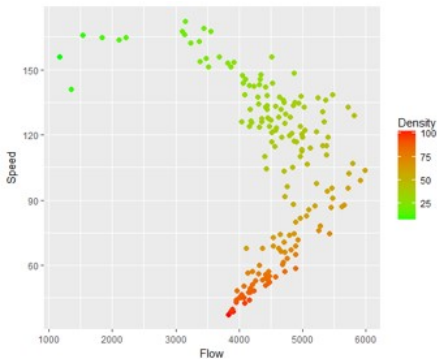
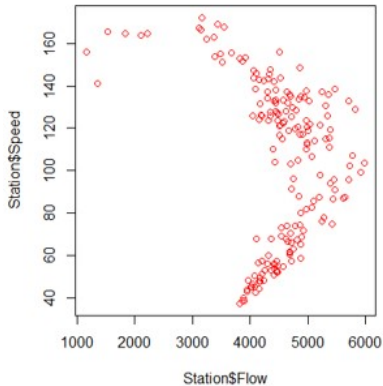


Figure: Flow-speed plot using default device Figure: Flow-speed plot using ggplot2

Using ggplot2

Read “ggplot2-cheatsheet”.

`ggplot(data = <DATA>) + <GEOM_FUNCTION>(aes(<MAPPING>))`

↓
Dataset

↓
Indicate what you want to build

<GEOM_FUNCTION>

If you want a scatterplot, use “**geom_point()**”
Other options: `geom_abline()`, `geom_hline()`,
`geom_vline()`, `geom_area()`, `geom_density()`,
`geom_dotplot()`, `geom_histogram()`, `geom_qq()`,.....

`aes(<MAPPING>)`

If you choose to build a scatterplot, you need to determine the values of x and y, and provide the data related to x and y.

↓
About `aes()`. Anything you want to visualize should be included in `aes()`.

Figure: ggplot2 usage

Greenshield's Model

$$u = u_f(1 - k/k_j)$$

$$q = u_f(k - k^2/k_j)$$

$$q = k_j(u - u^2/u_f)$$

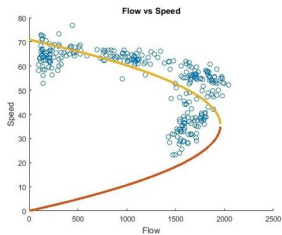
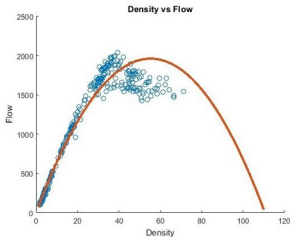
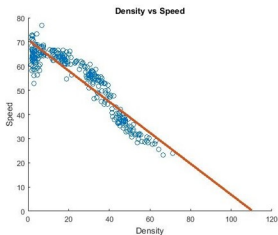


Figure: Greenshield's Model