Lab 10
Freeway Detector Data & Greensheild's Model (1)

Yufeng Zhang
zhan4879@umn.edu

CEGE-3201: Transportation Engineering

April 11, 2019

University of Minnesota

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"

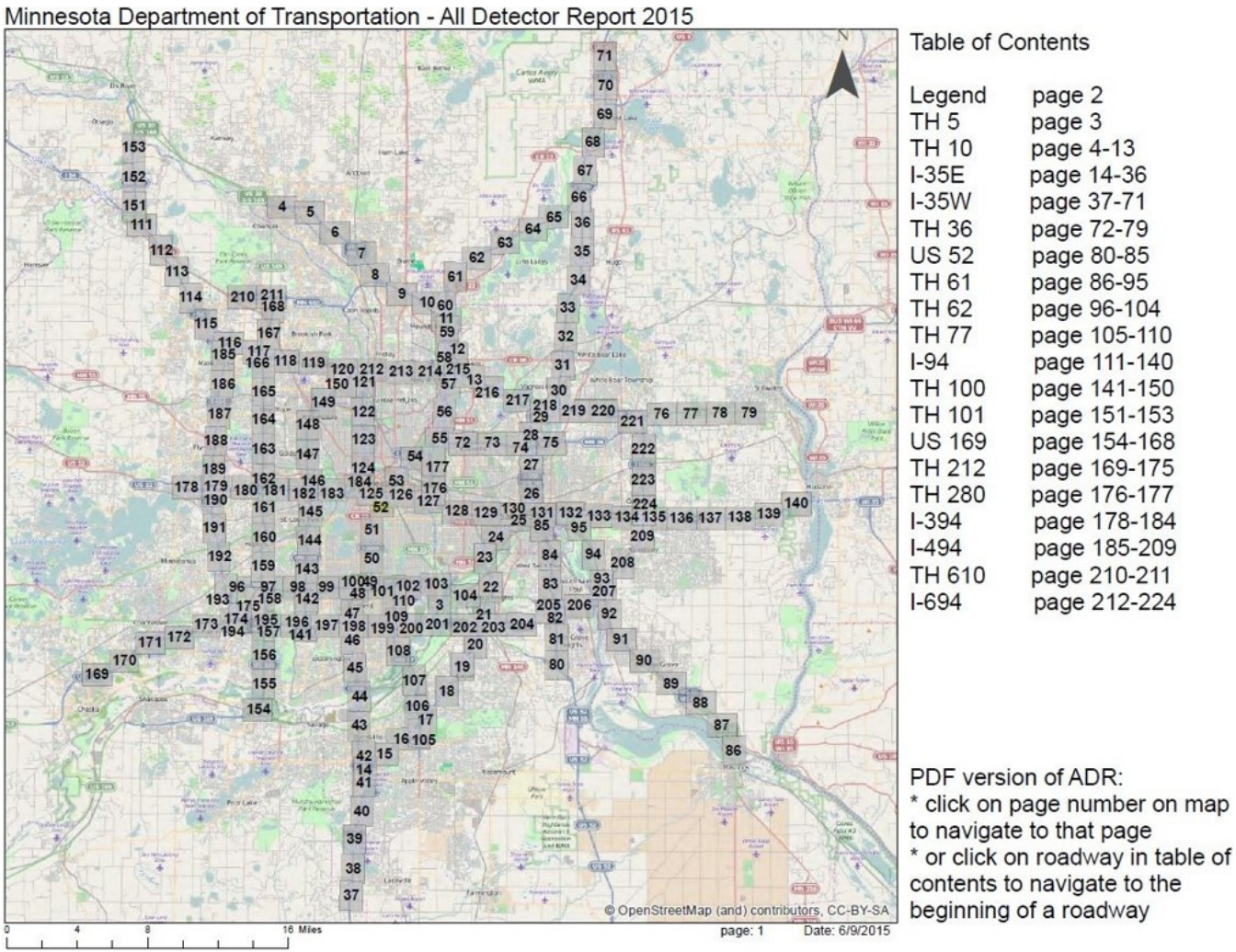


Figure: MnDOT Detector Map

Detector Locations

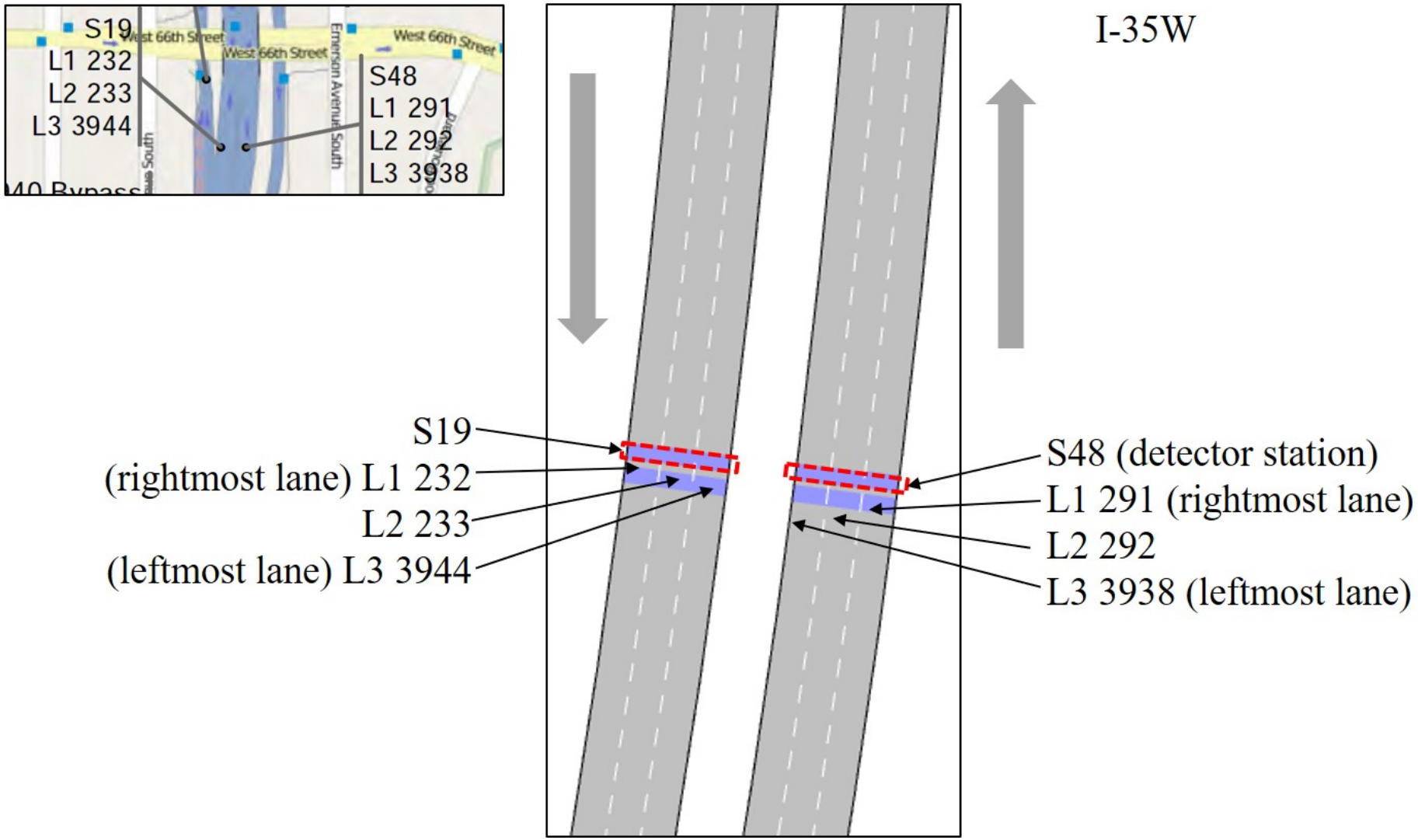


Figure: How to get the location of a detector

MnDOT Data Extraction Tool

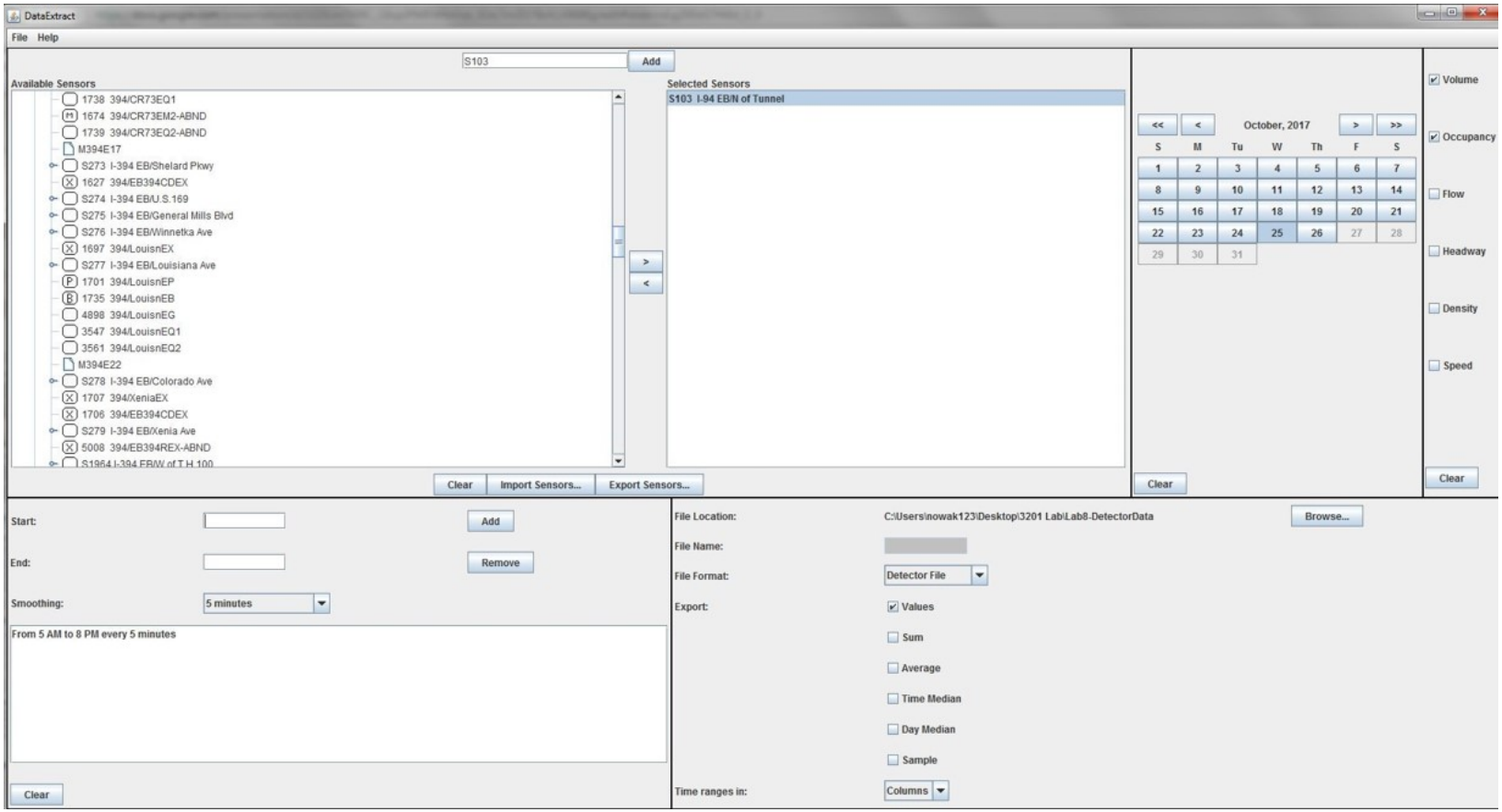


Figure: How to get the location of a detector[1]

[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:

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

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 pacakge - ggplot2

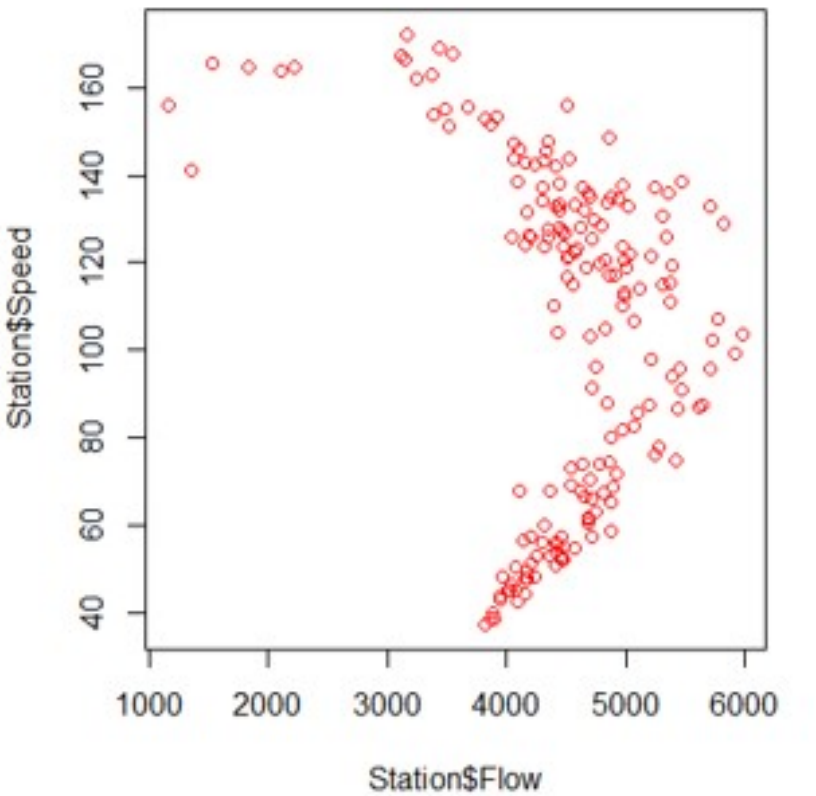


Figure: Flow-speed plot using default device

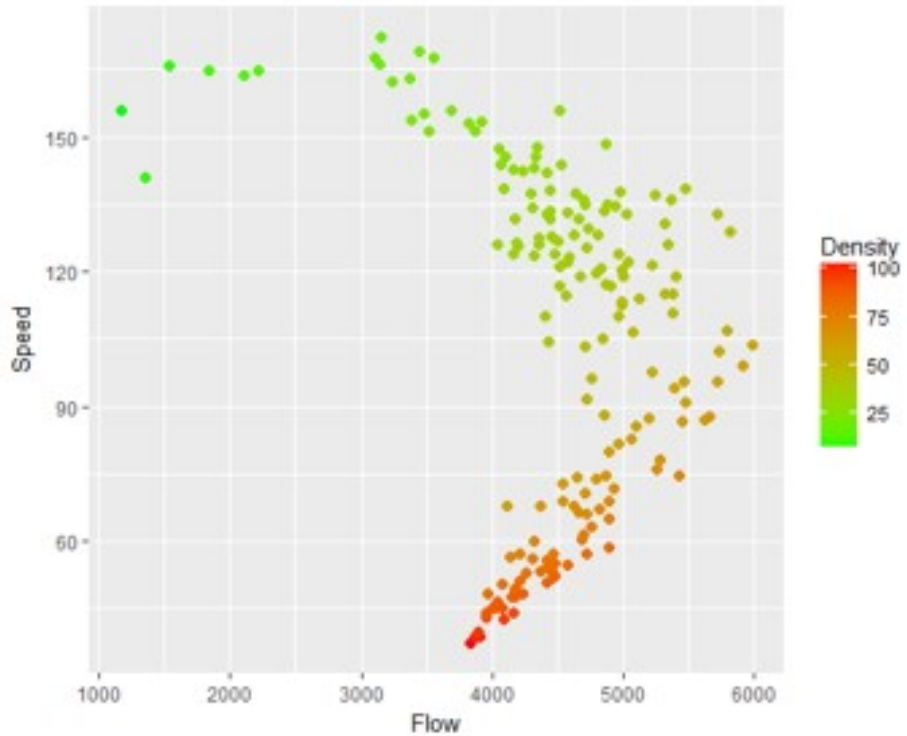


Figure: Flow-speed plot using ggplot2

Using ggplot2

Read "ggplot2-cheatsheet".

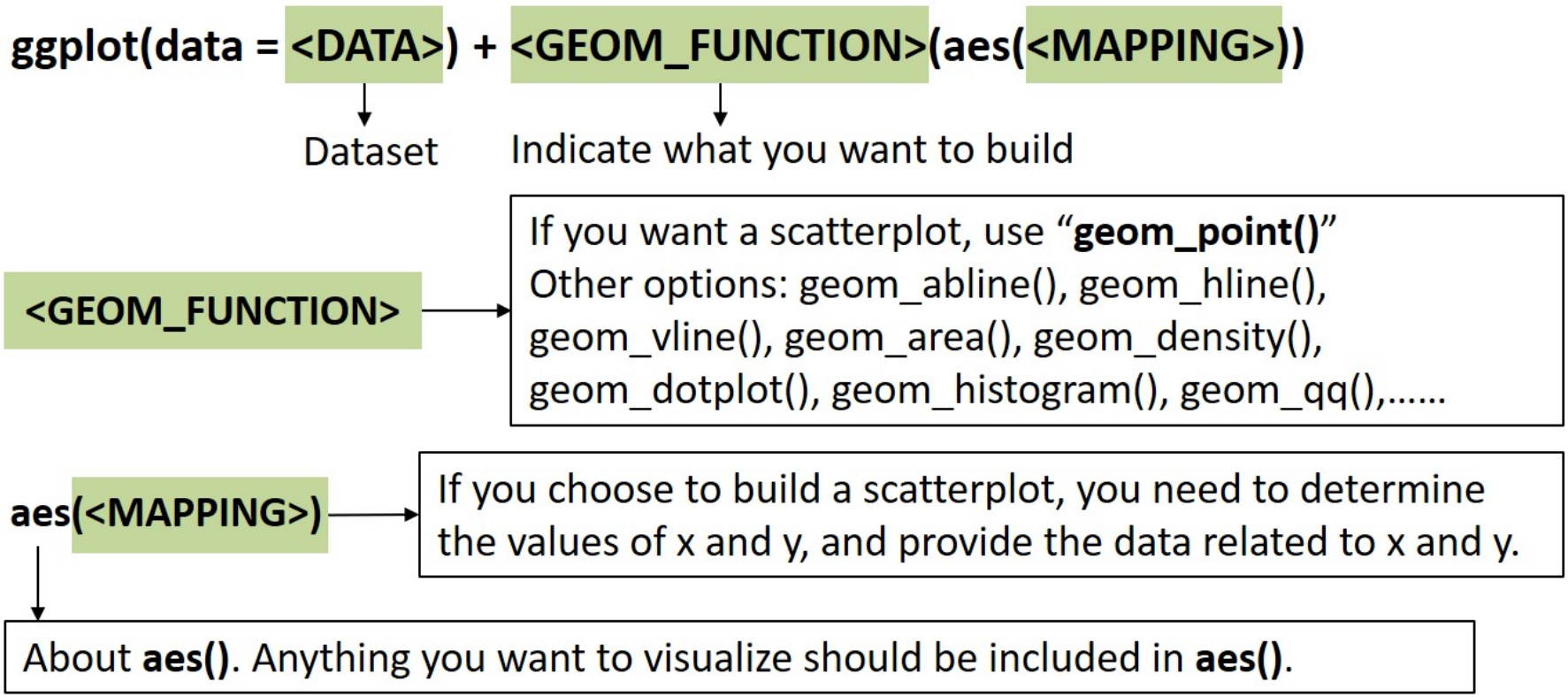


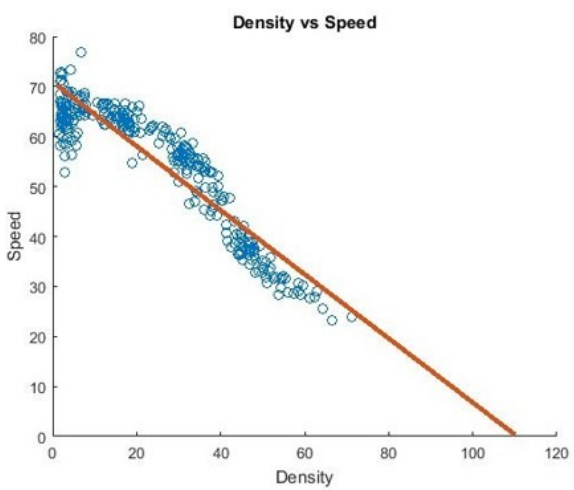
Figure: ggplot2 usage

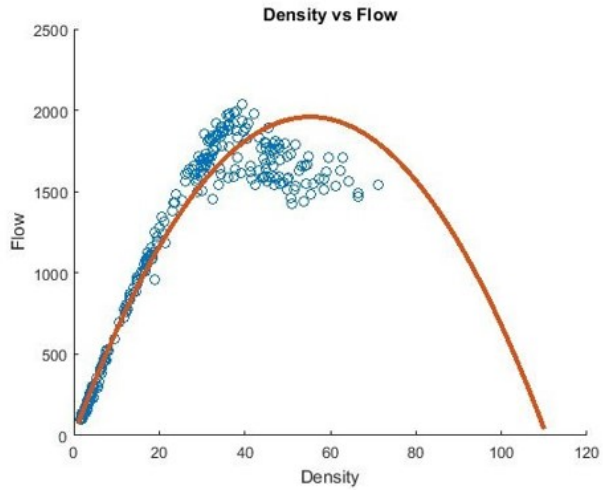
Greenshield's Model

$$u = u_f(1 - {}^{k}/_{k_j})$$

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

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





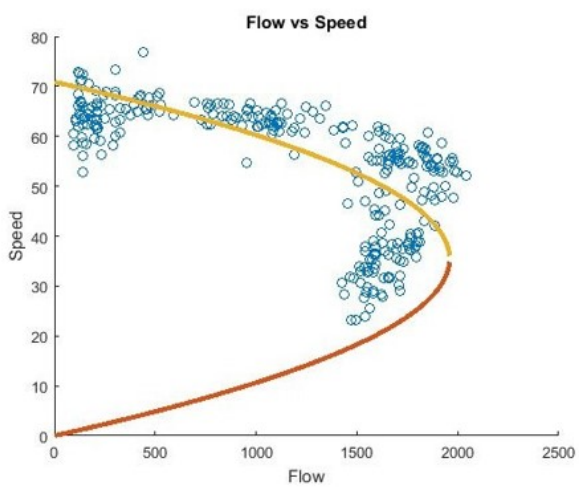


Figure: Greenshield's Model