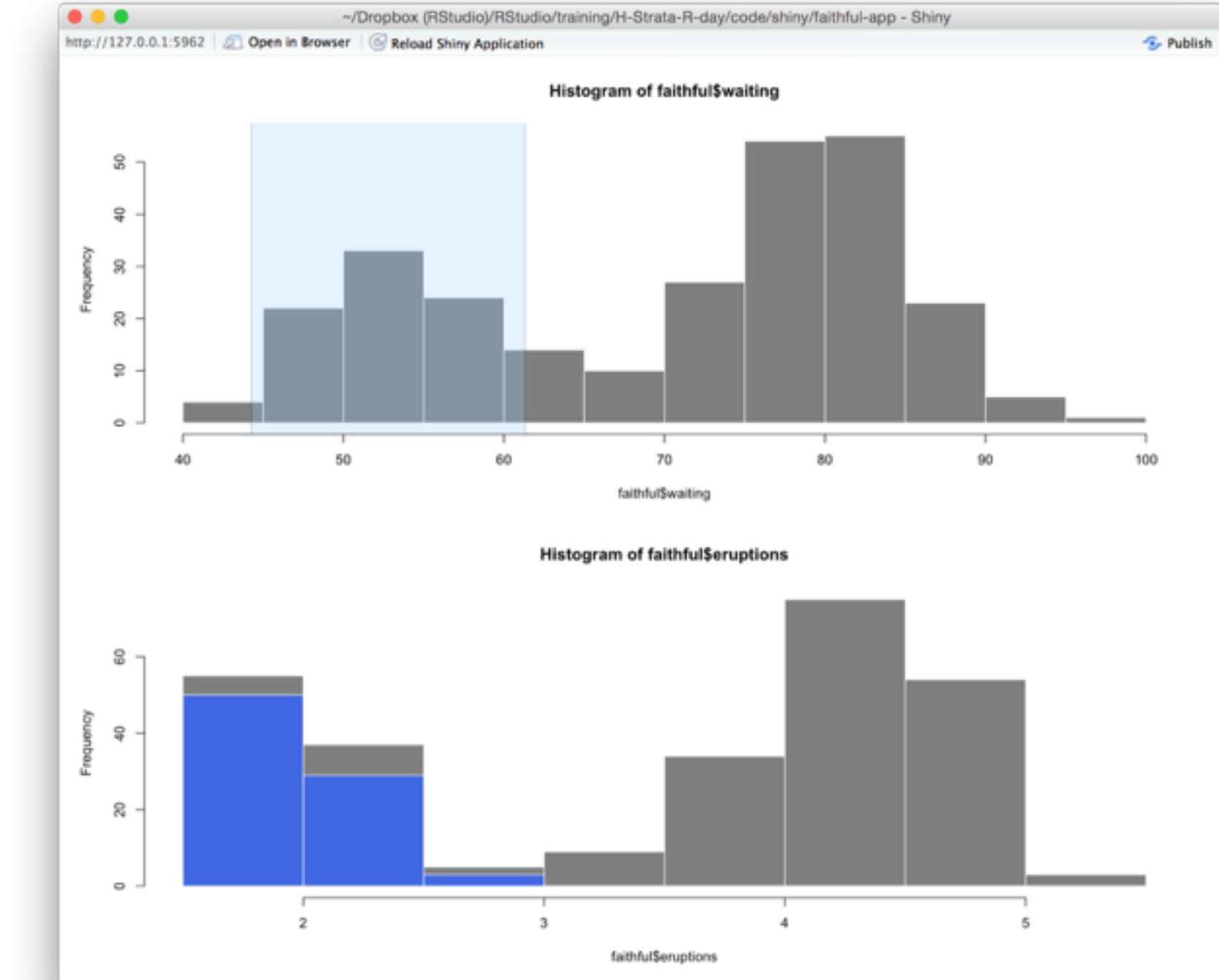


# Interactive Data Visualizations in R

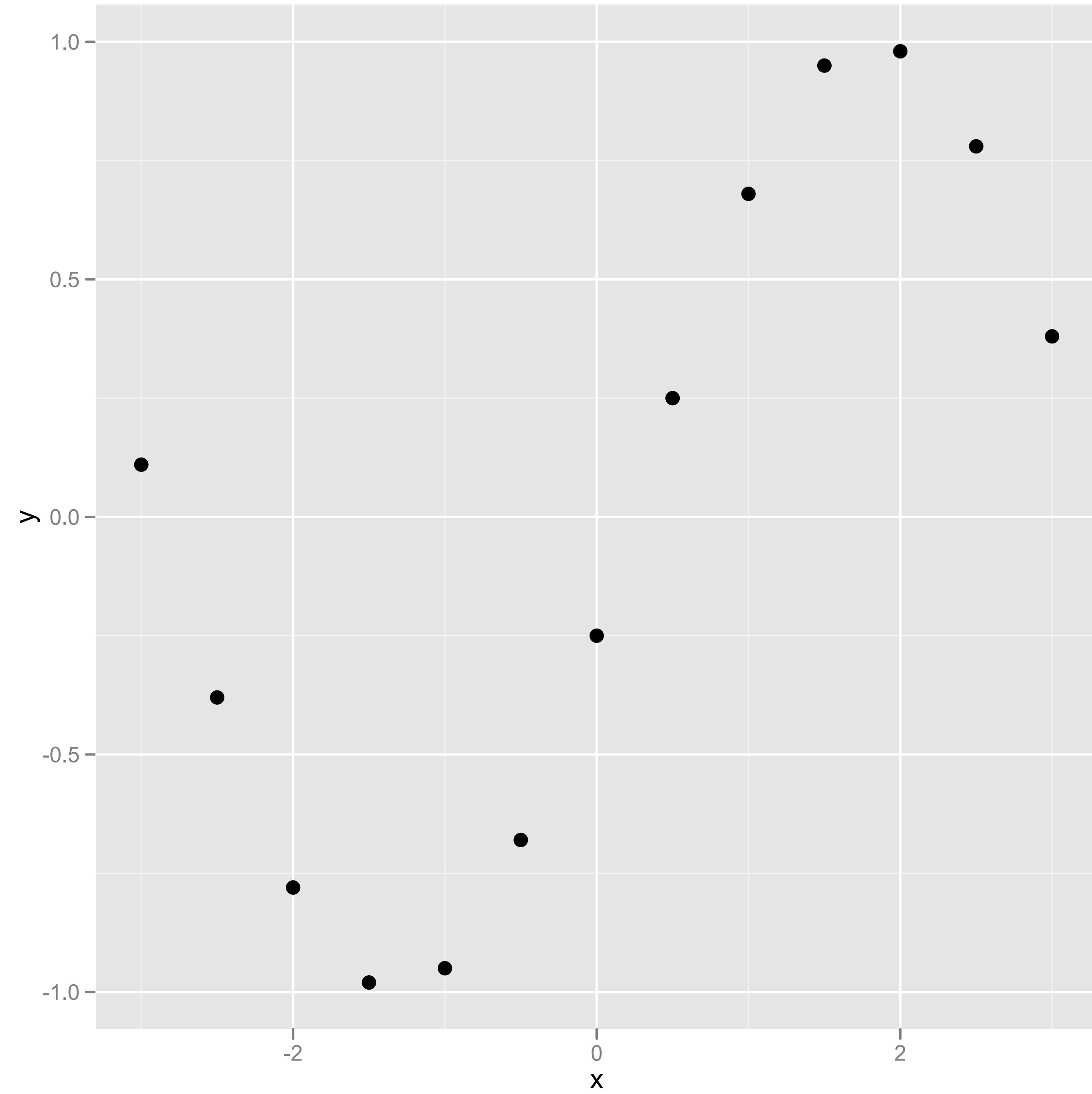
## with Shiny and ggplot2



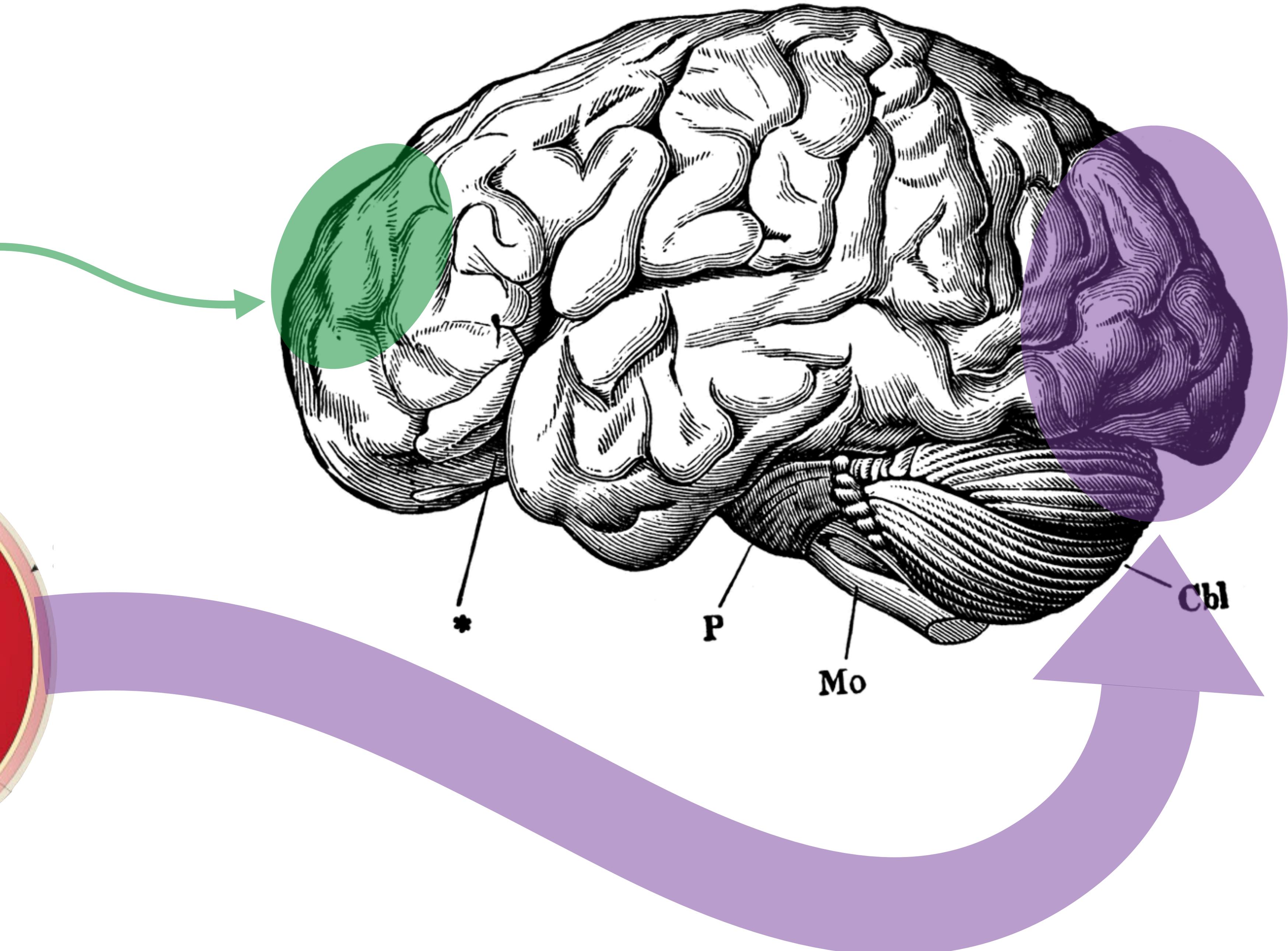
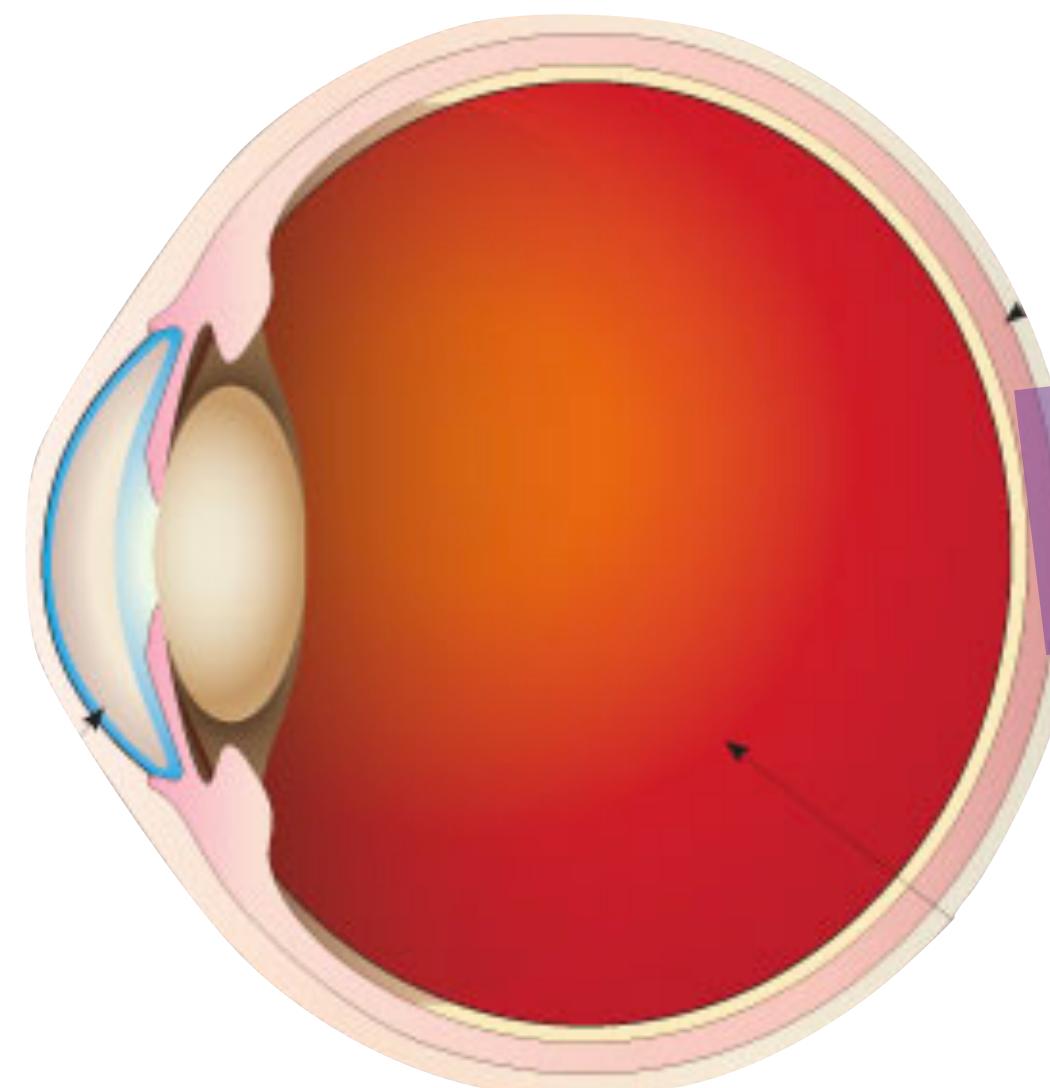
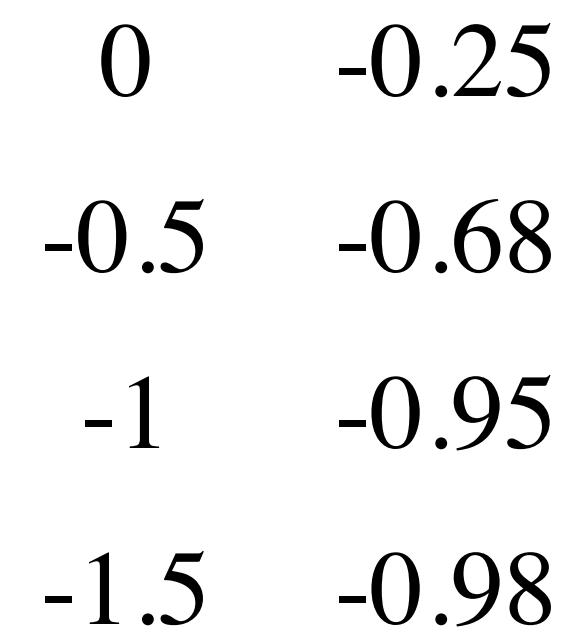
# Garrett Grolemund

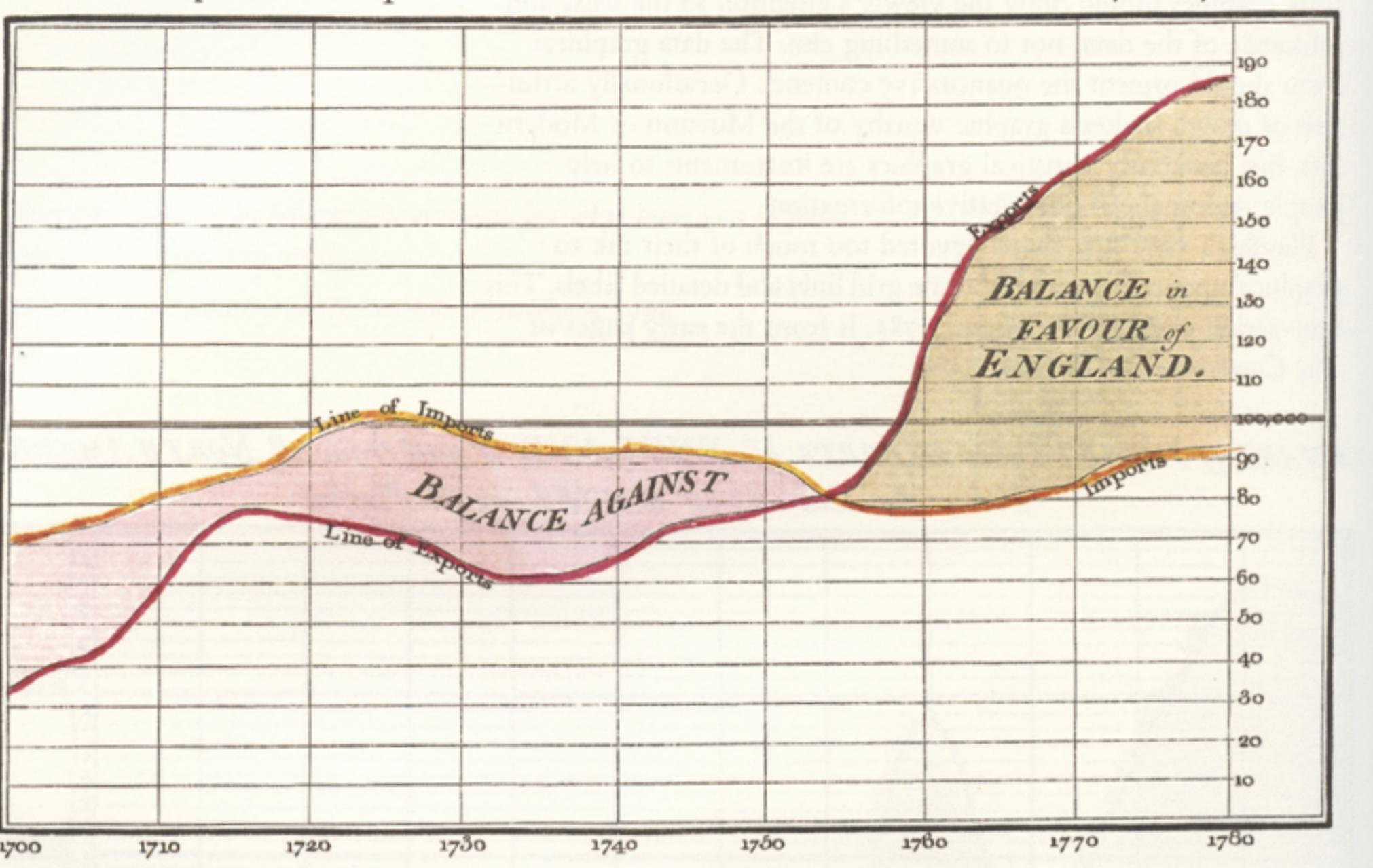
Data Scientist and Master Instructor  
February 2016  
Email: [garrett@rstudio.com](mailto:garrett@rstudio.com)

x	y
0	-0.25
-0.5	-0.68
-1	-0.95
-1.5	-0.98
-2.5	-0.38
0.5	0.25
2	0.98
1.5	0.95
3	0.38
1	0.68
2.5	0.78
-3	0.11
-2	-0.78



<b>x</b>	<b>y</b>
0	-0.25
-0.5	-0.68
-1	-0.95
-1.5	-0.98
-2.5	-0.38
0.5	0.25
2	0.98
1.5	0.95
3	0.38
1	0.68
2.5	0.78
-3	0.11
-2	-0.78





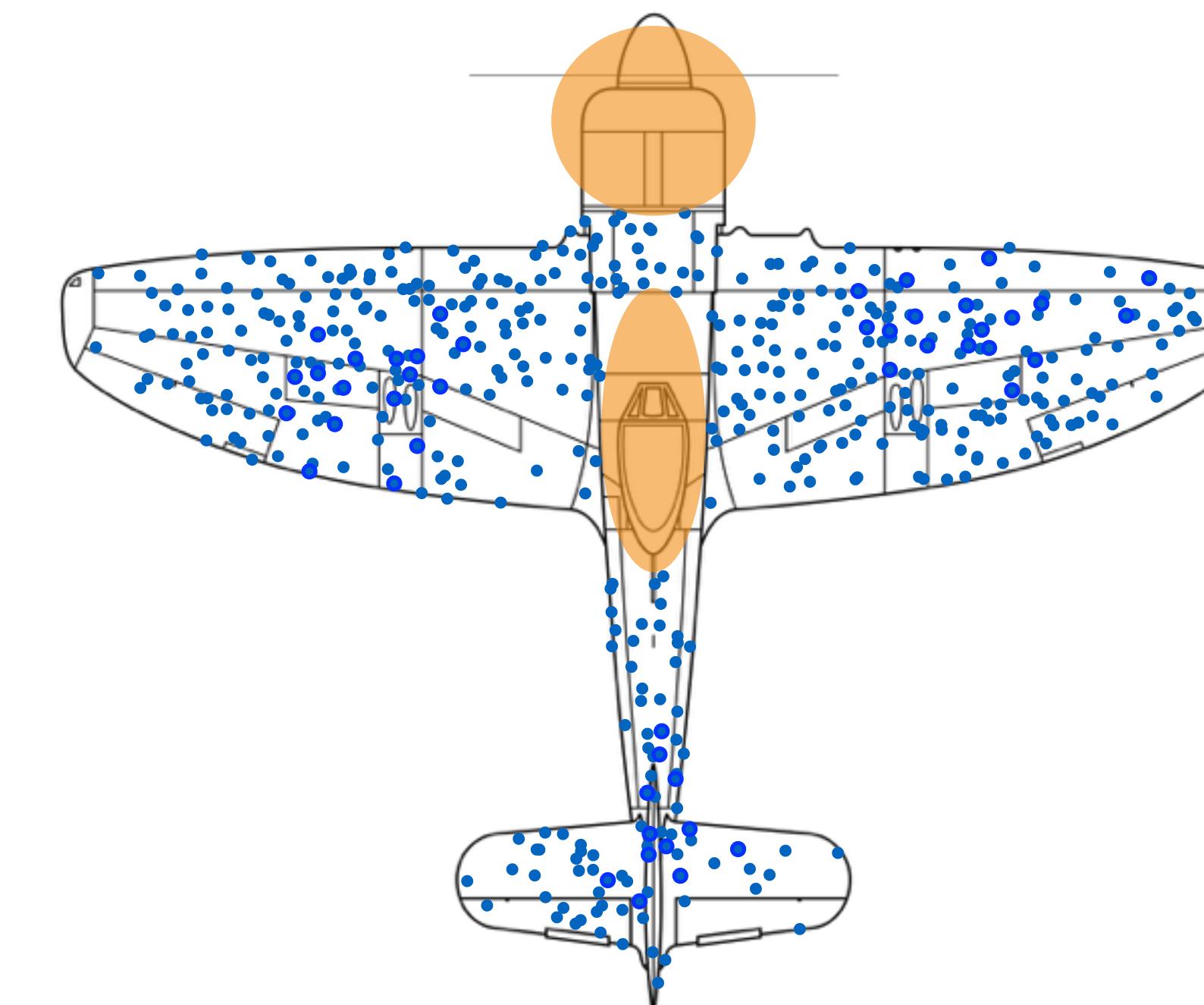
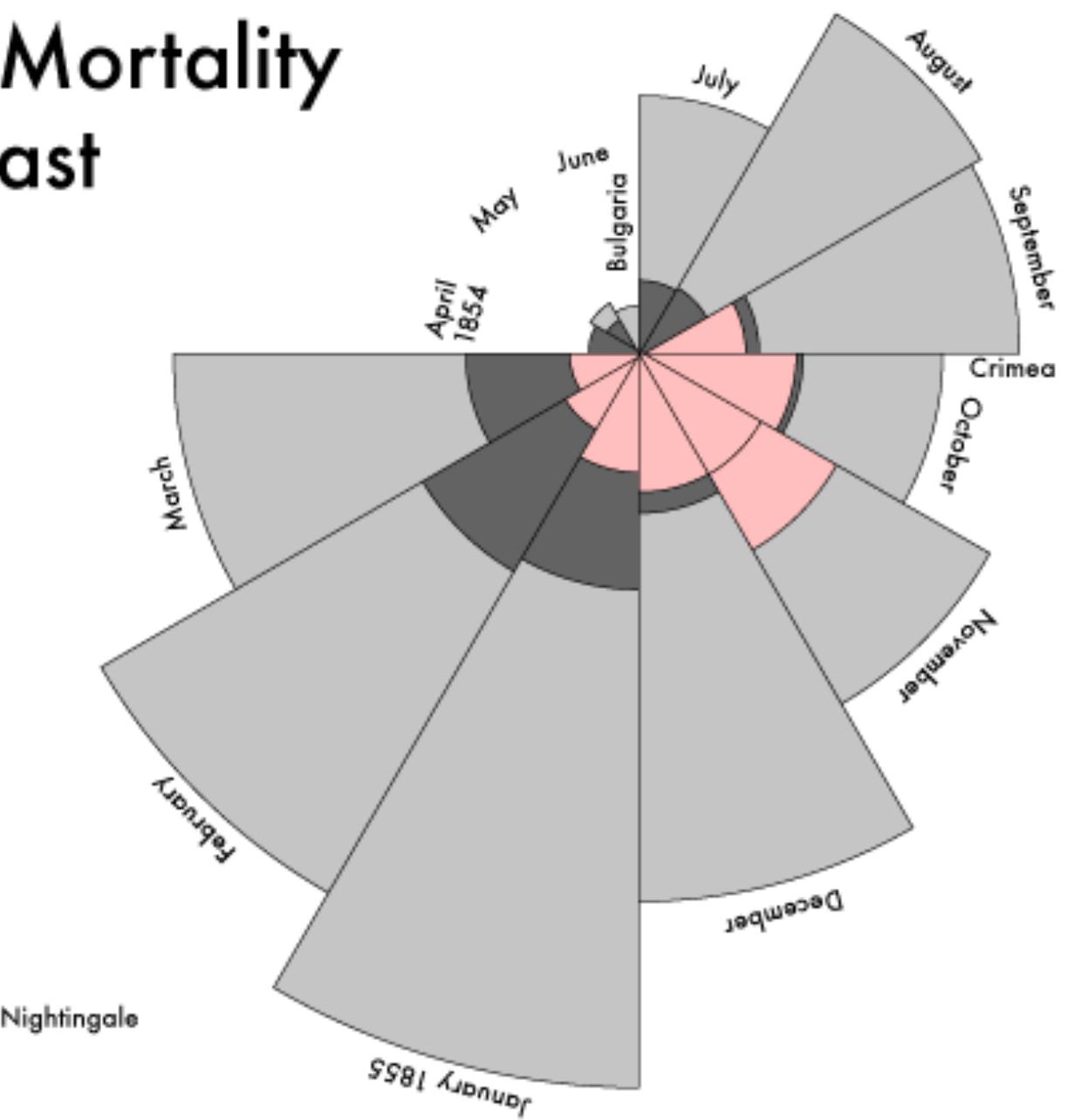
The Bottom line is divided into Years, the Right hand line into £10,000 each.  
Published as the Act directs, 1<sup>st</sup> May 1786, by W<sup>m</sup> Playfair  
Nestle sculpt 352, Strand, London.

## Diagram of the Causes of Mortality in the Army in the East

- Preventable or Mitigable Zymotic disease
- Wounds
- All other causes

The black line across November 1854 marks the boundary of the deaths from all other causes during that month. In October 1854, the black coincides with the red.

Florence Nightingale  
1856



A picture is not merely worth  
a 1,000 words, it is much  
more likely to be scrutinized  
than words are to be read.

– John Tukey

# But what if you could...

Zoom?

Pan?

Brush?

Highlight points?

Remove points?

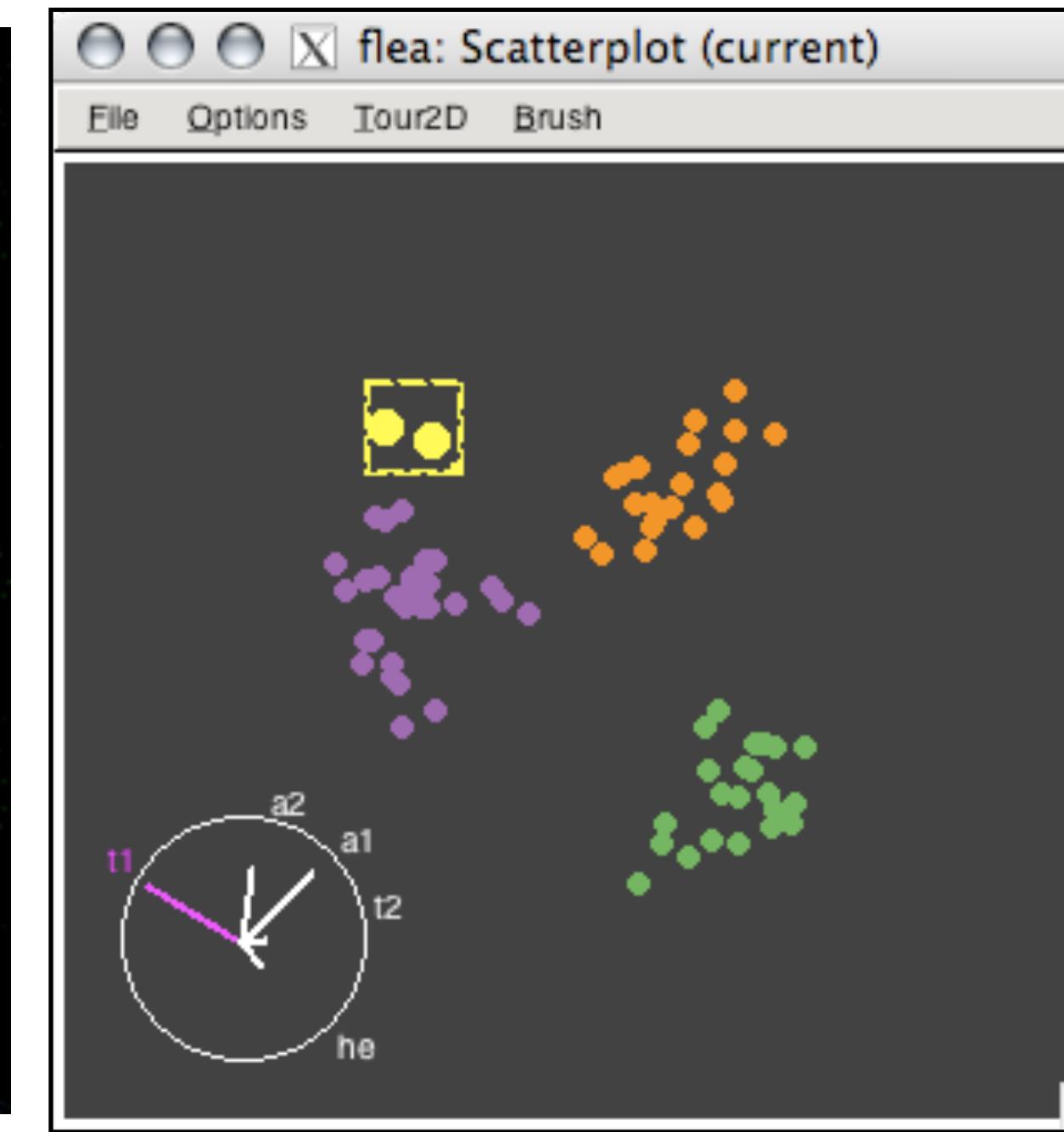
Add points?

# Interactive Graphics

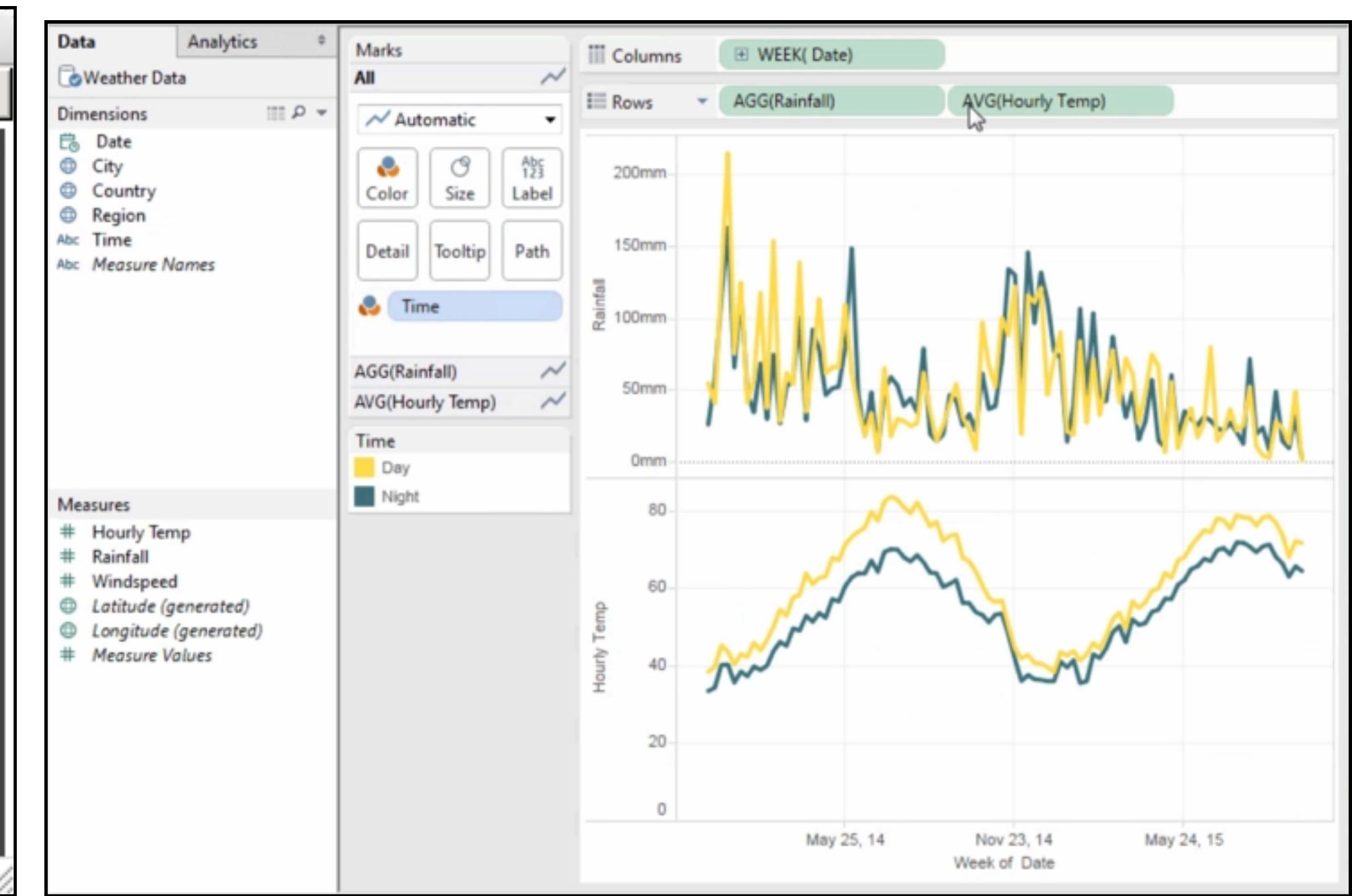
1972  
PRIM-9



2008  
GGobi



2016  
Tableau, JMP, etc.



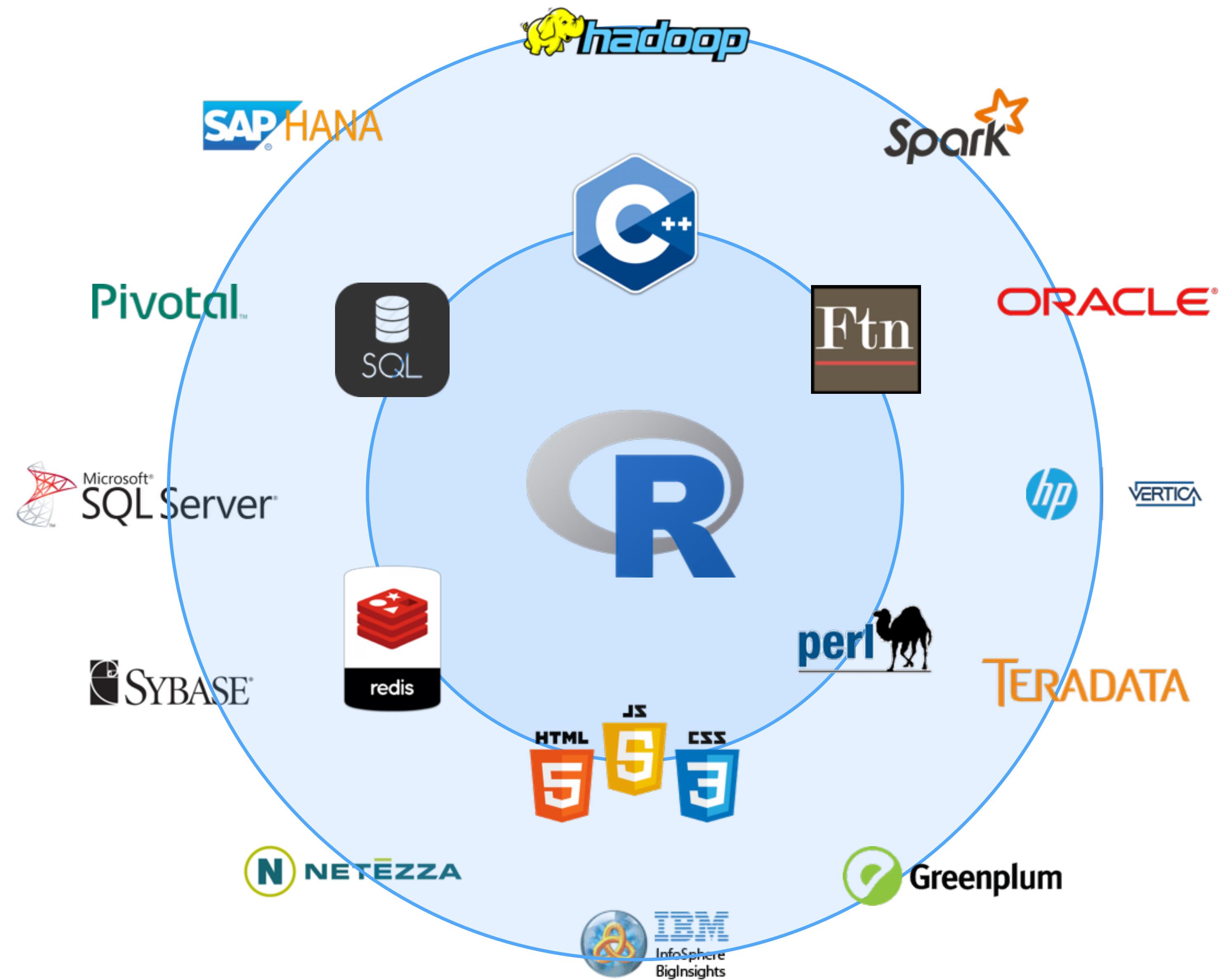
# Outline

- 1. A little technical background**
  - a. R
  - b. ggplot2
  - c. shiny
- 2. Interactive Visualizations with Shiny**
- 3. Possibilities**

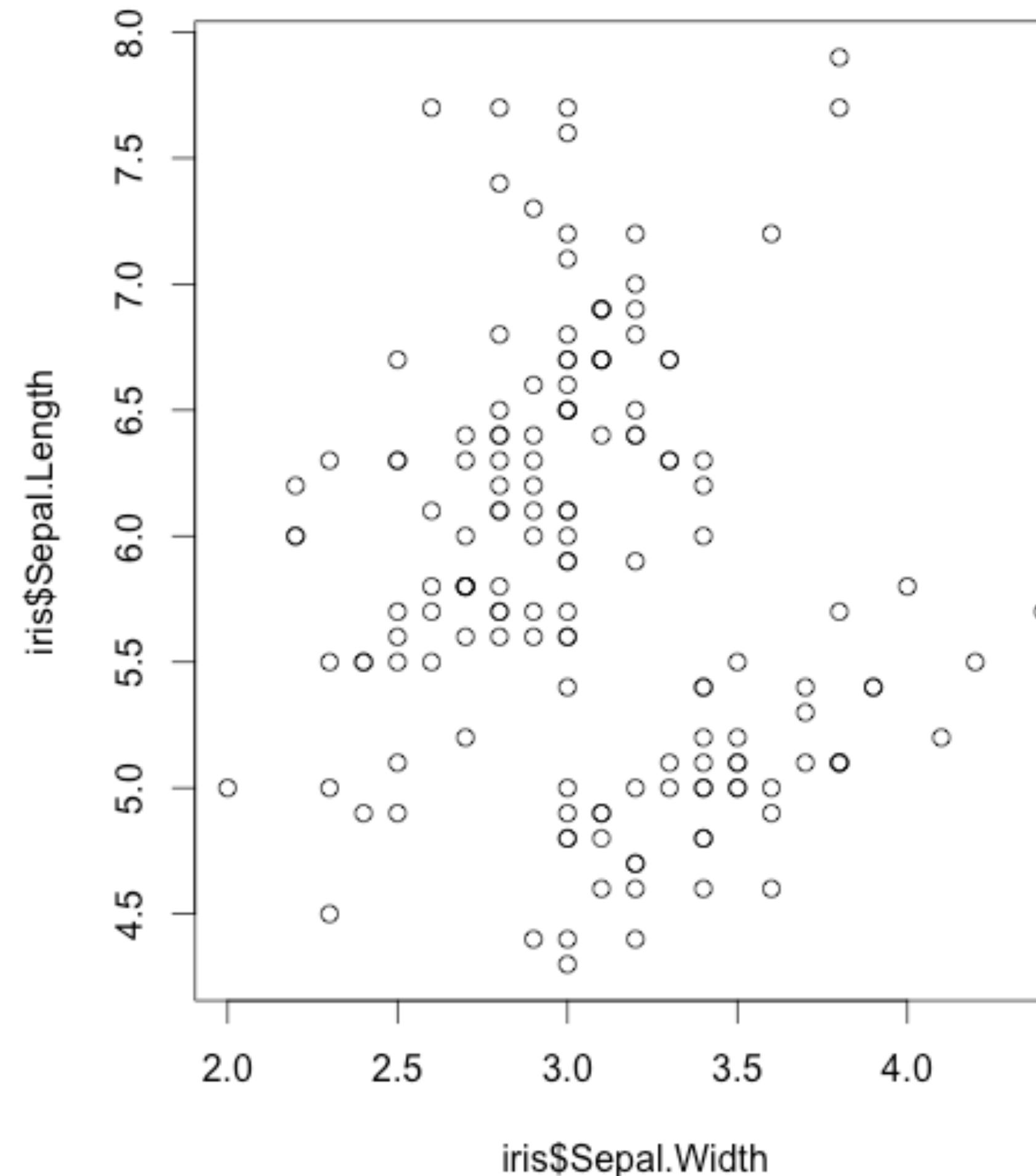
R

An **open source**  
**scripting language** that is  
very useful for analyzing data.





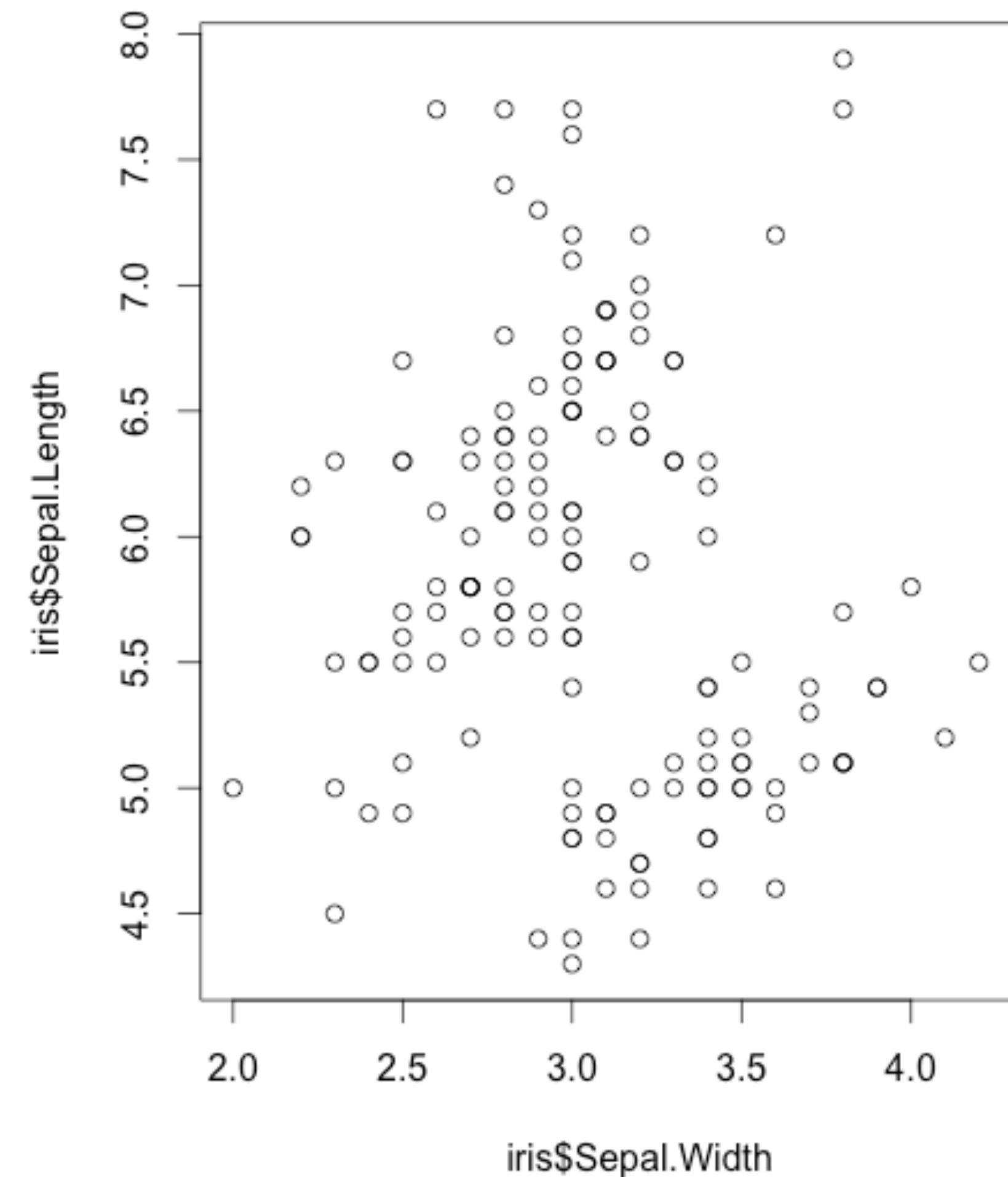
# plot



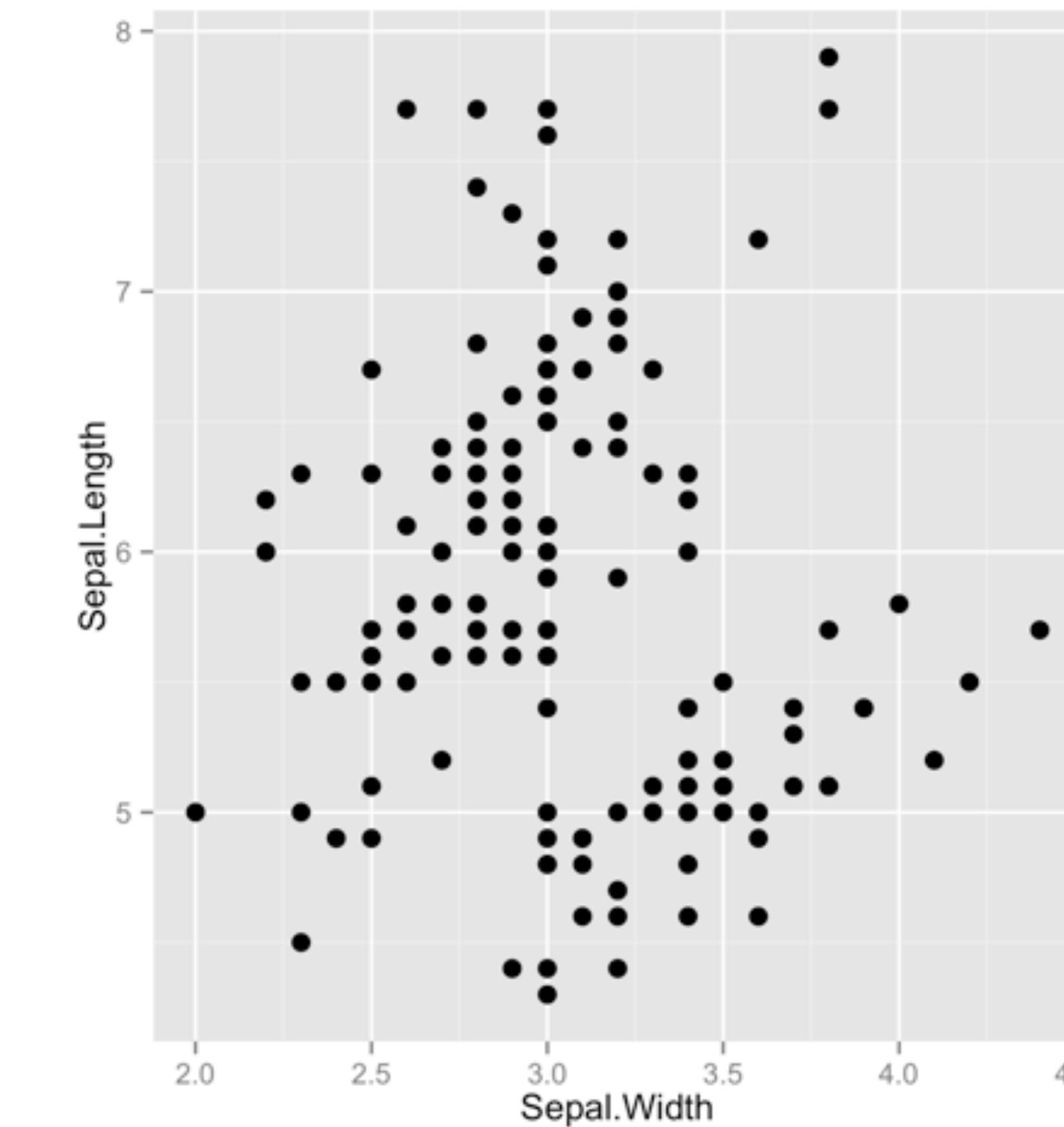
```
plot(iris$Sepal.Length,  
     iris$Sepal.Width)
```

- R's basic plot method
- simple
- customizable

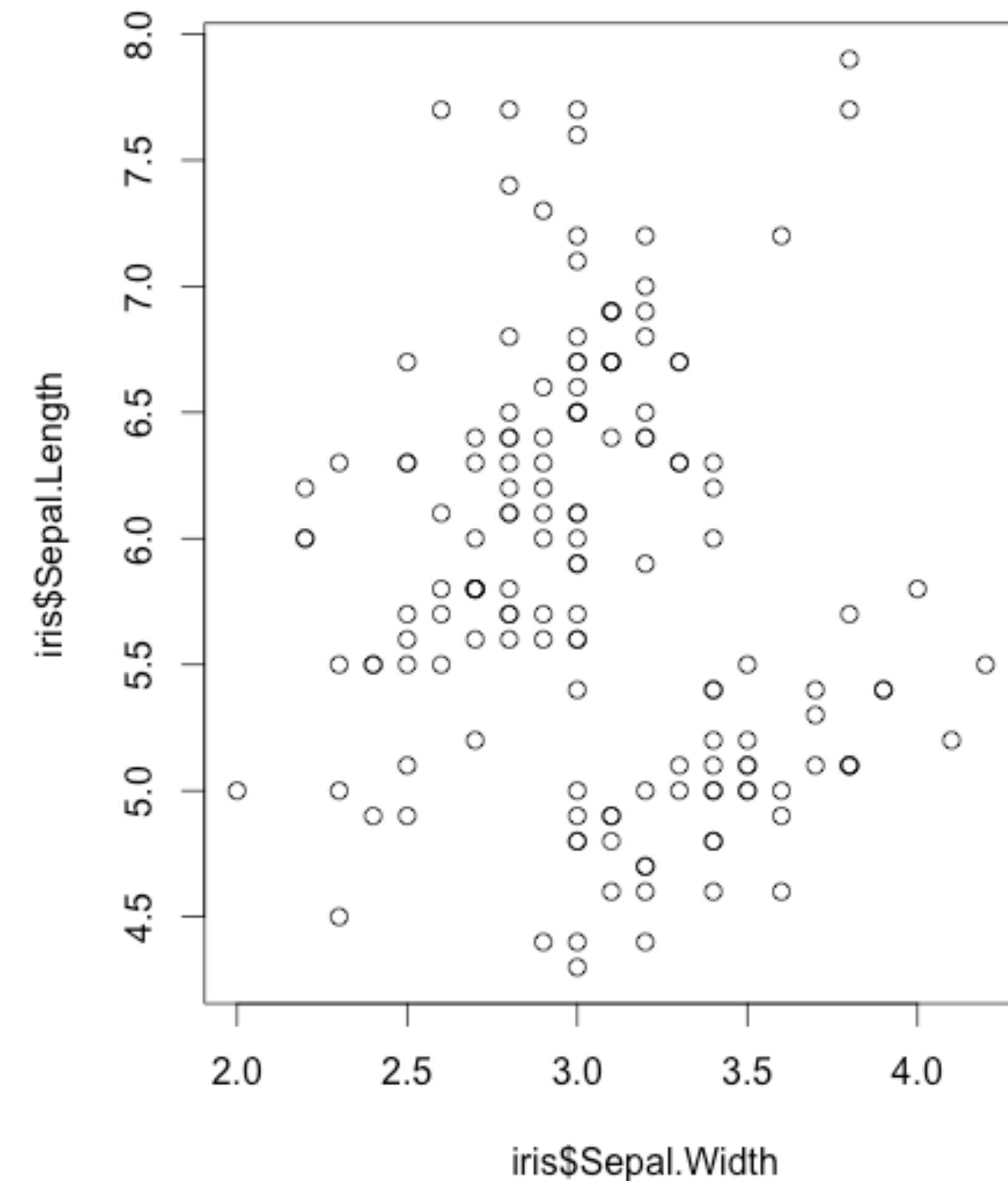
# plot



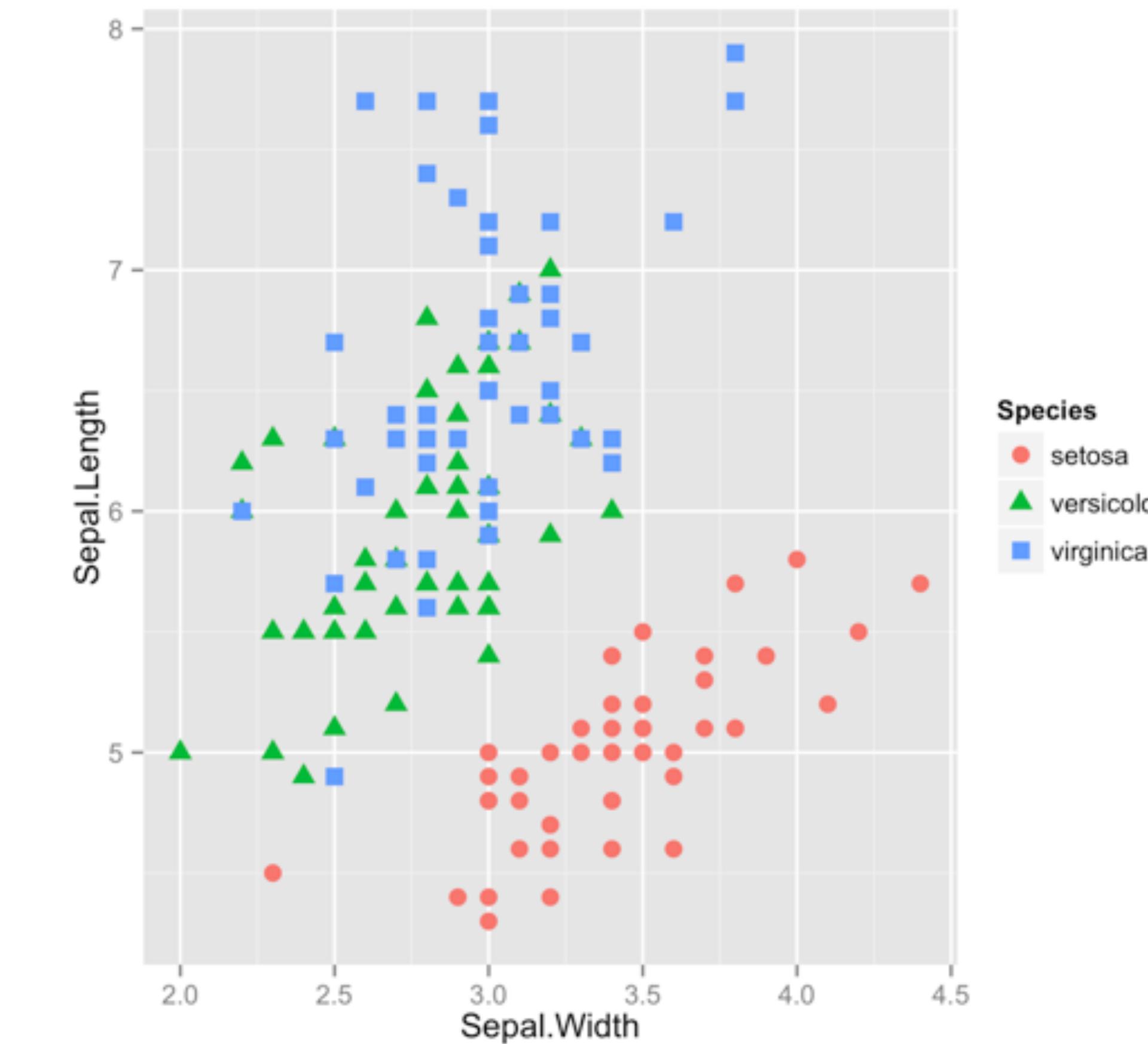
# ggplot2



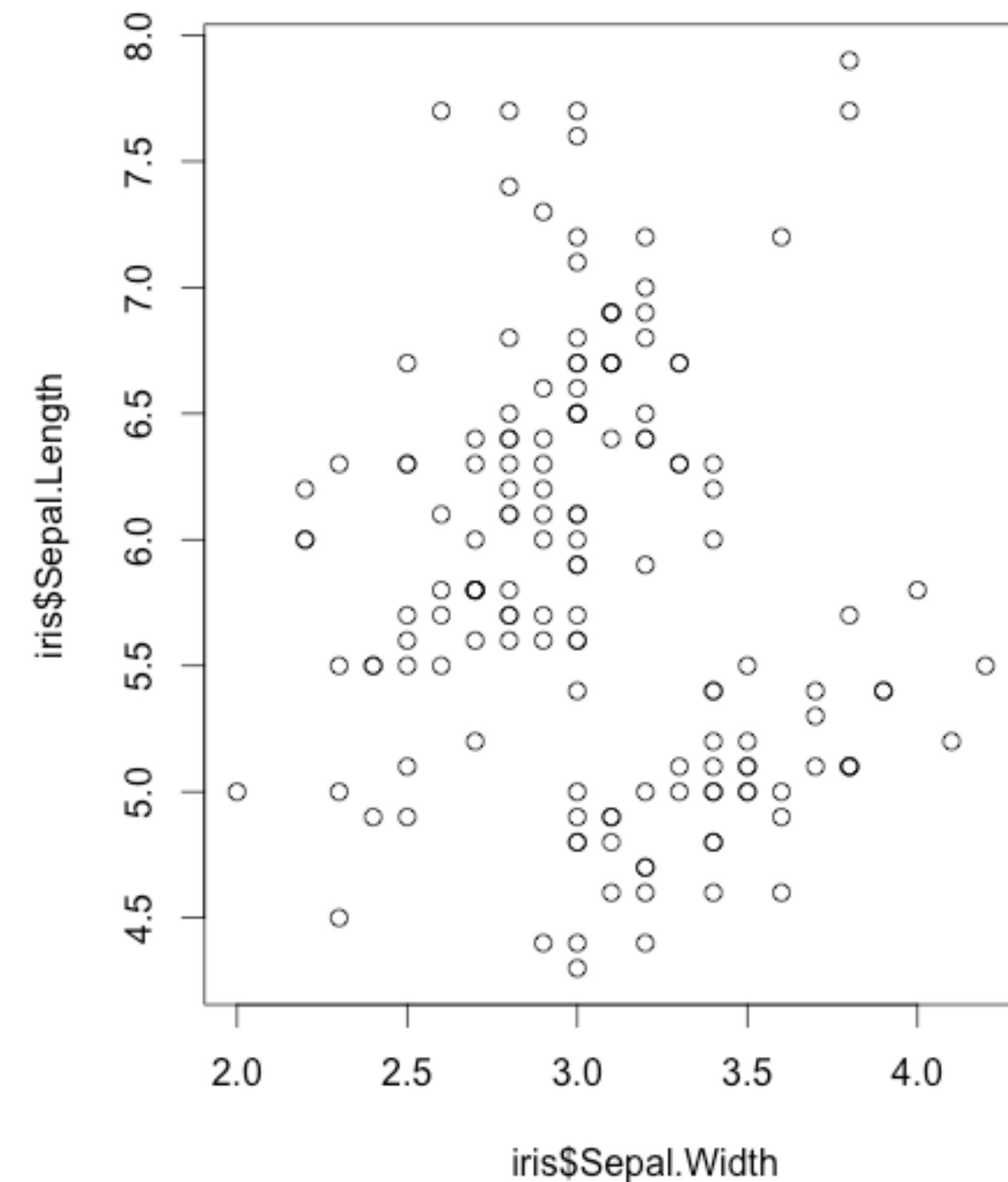
# plot



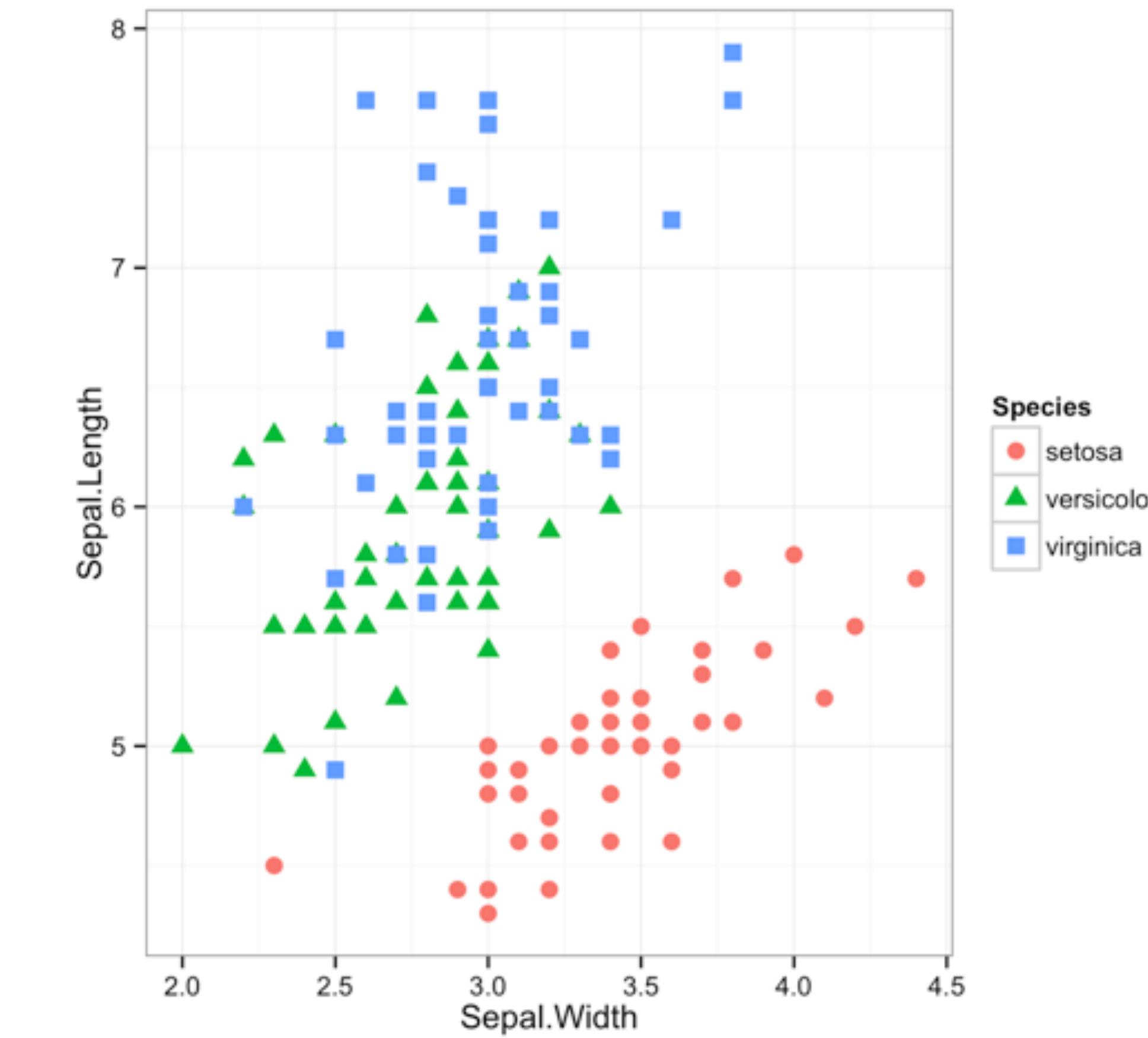
# ggplot2



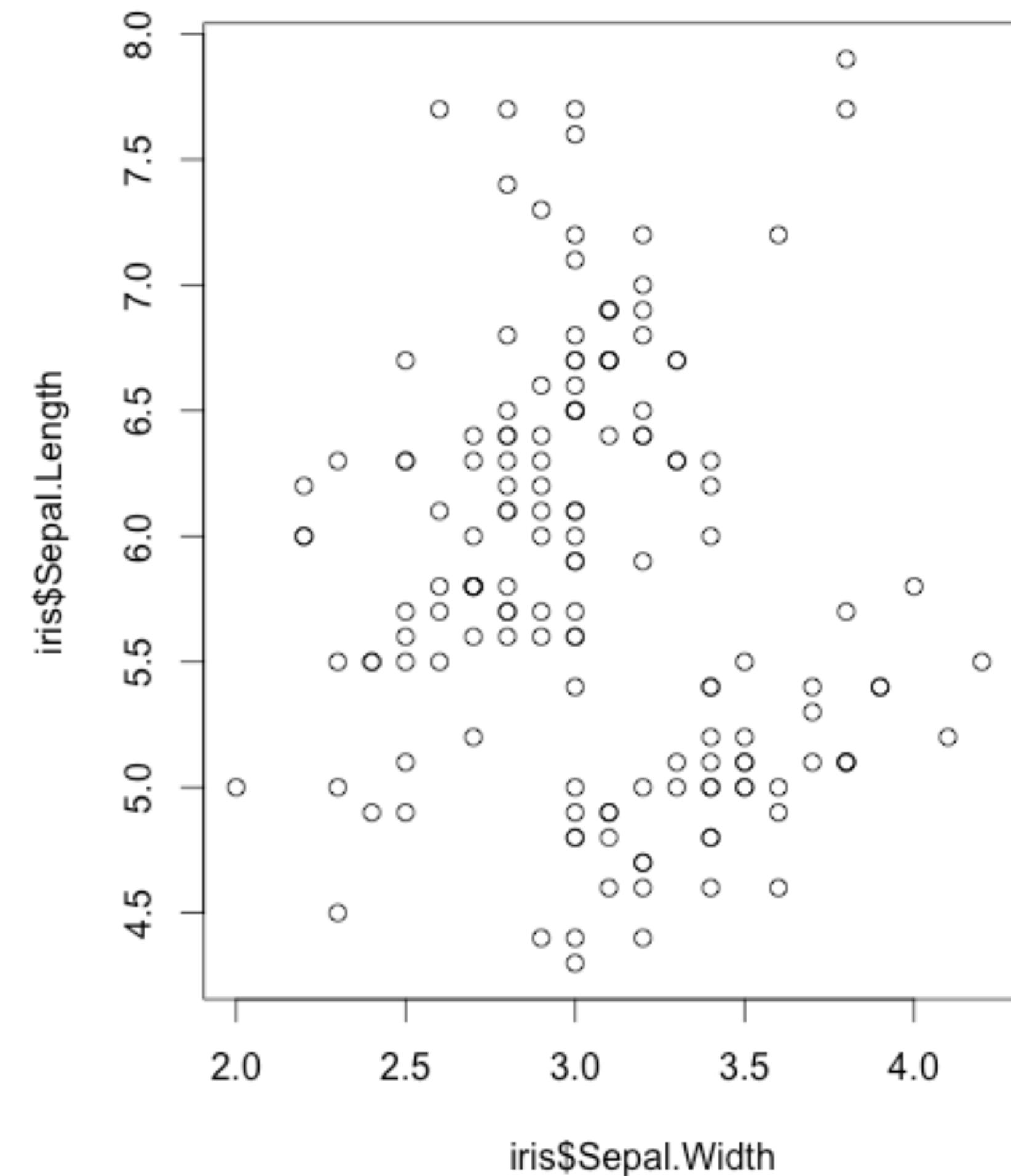
# plot



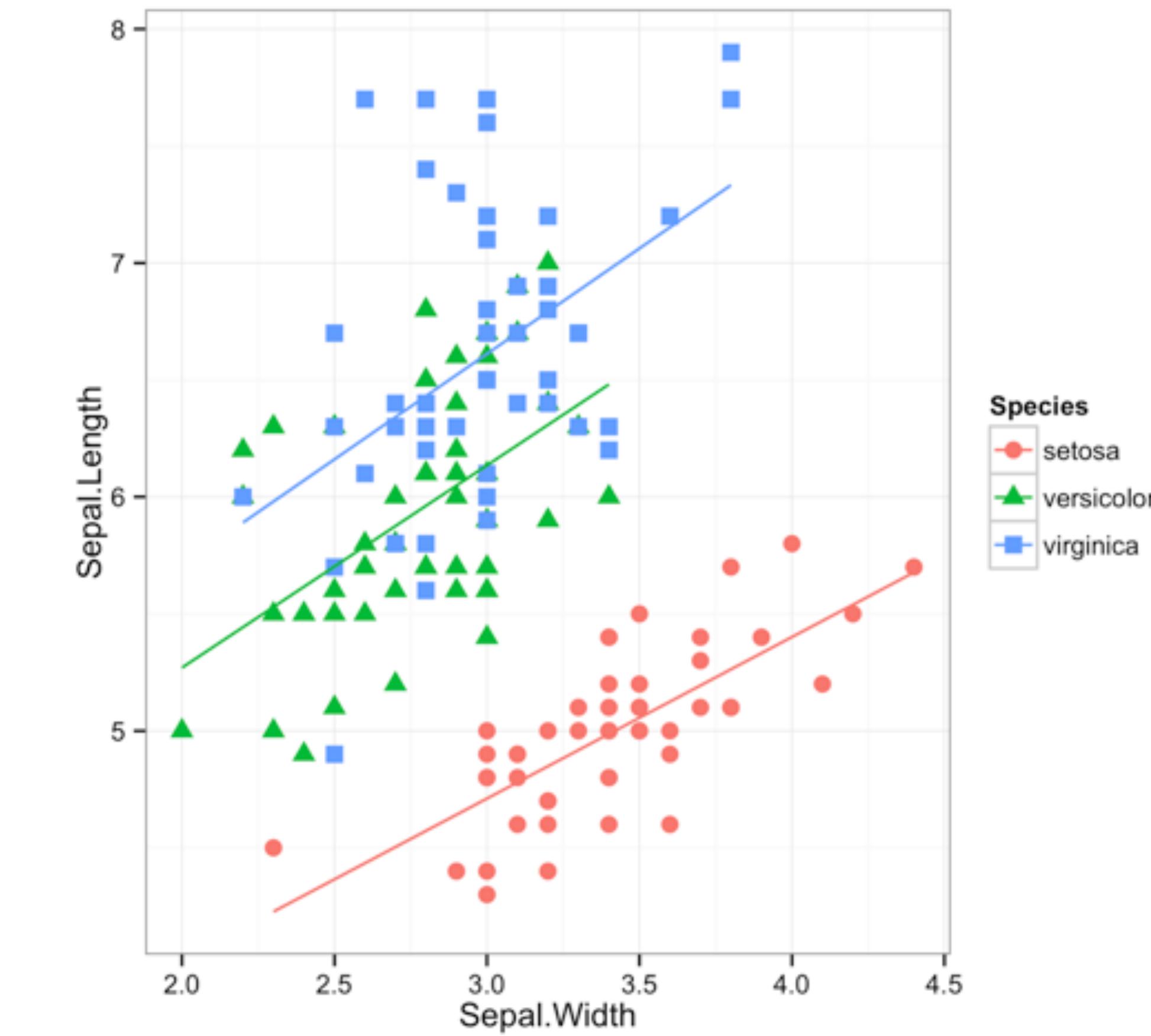
# ggplot2



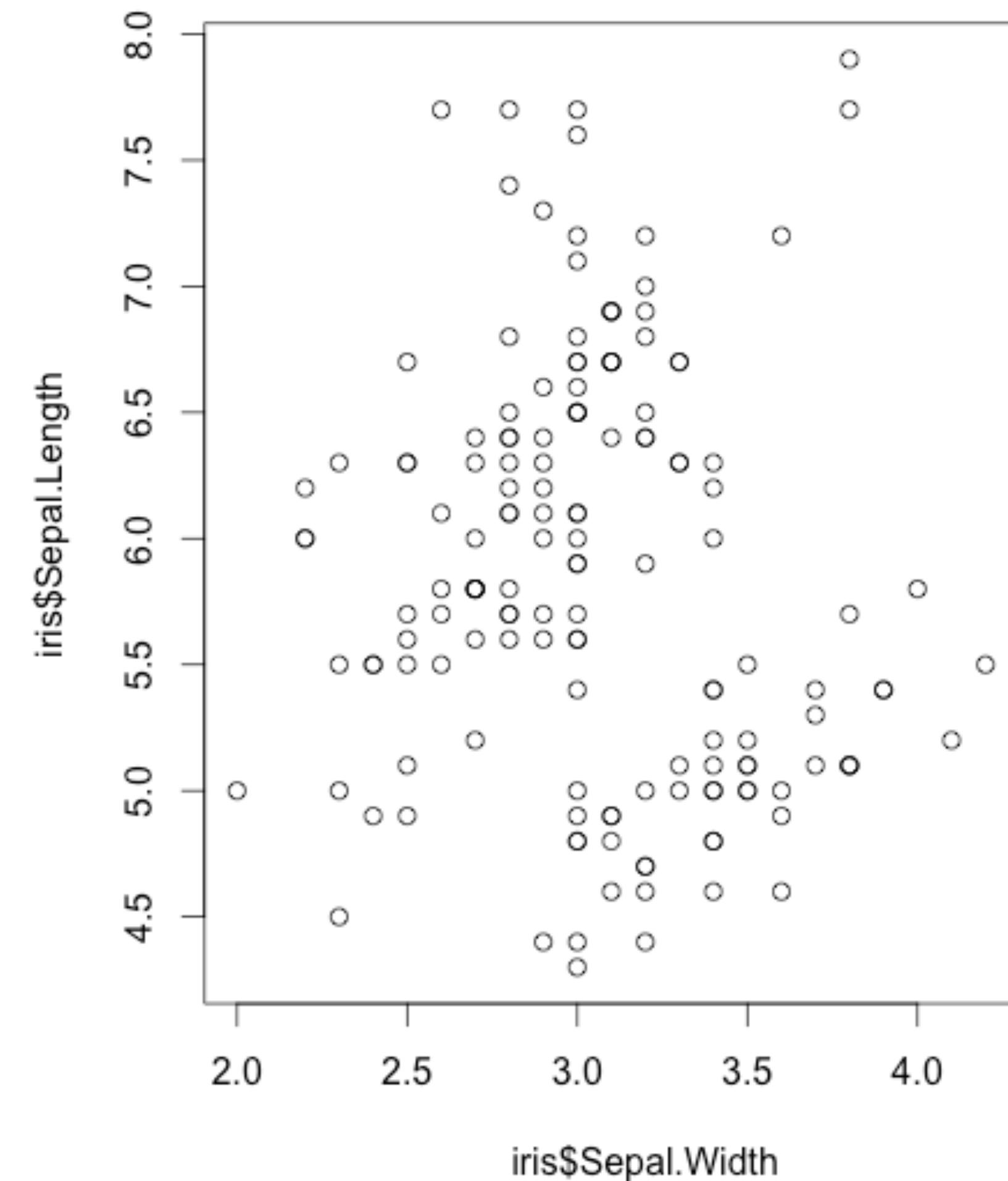
# plot



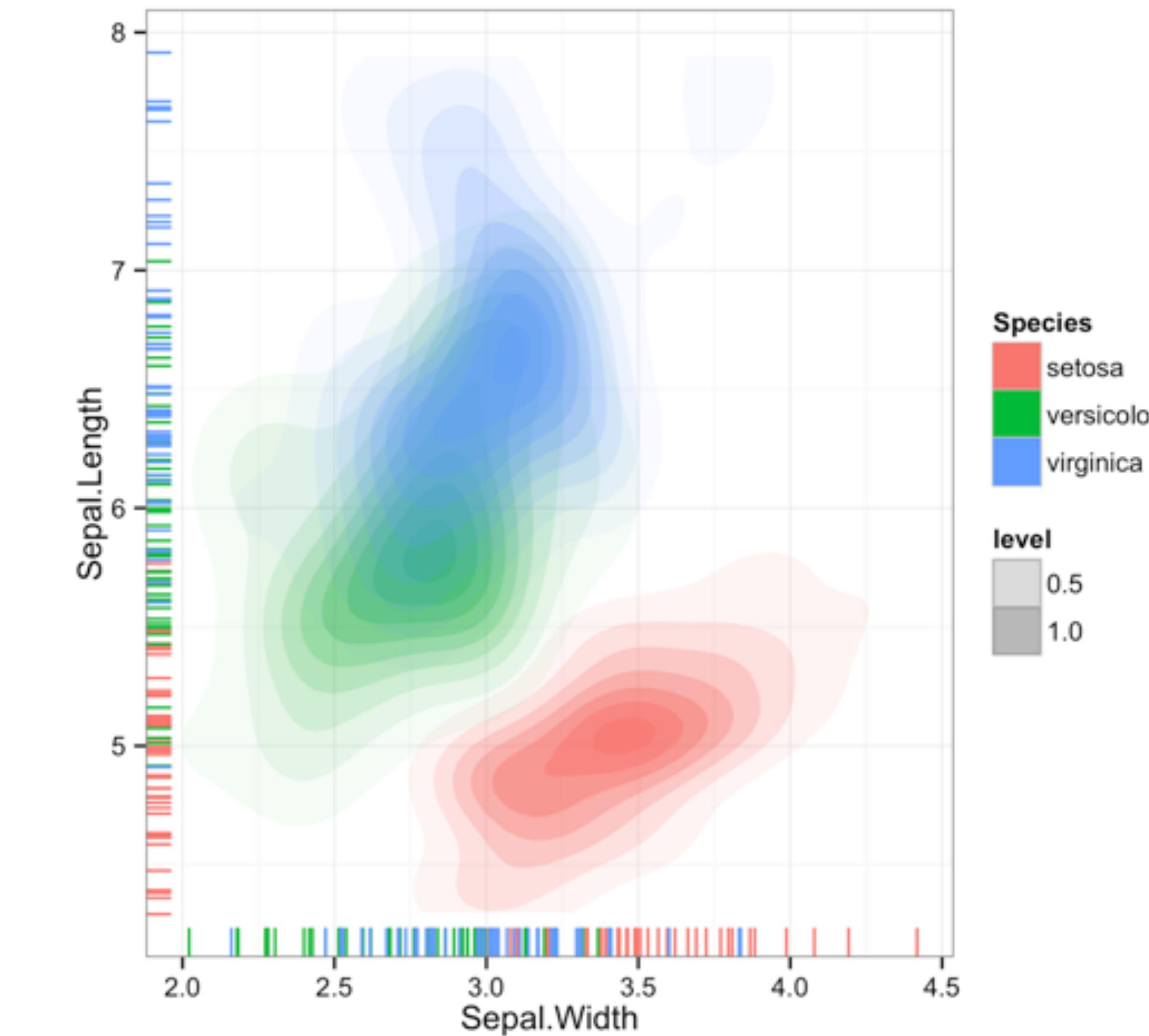
# ggplot2



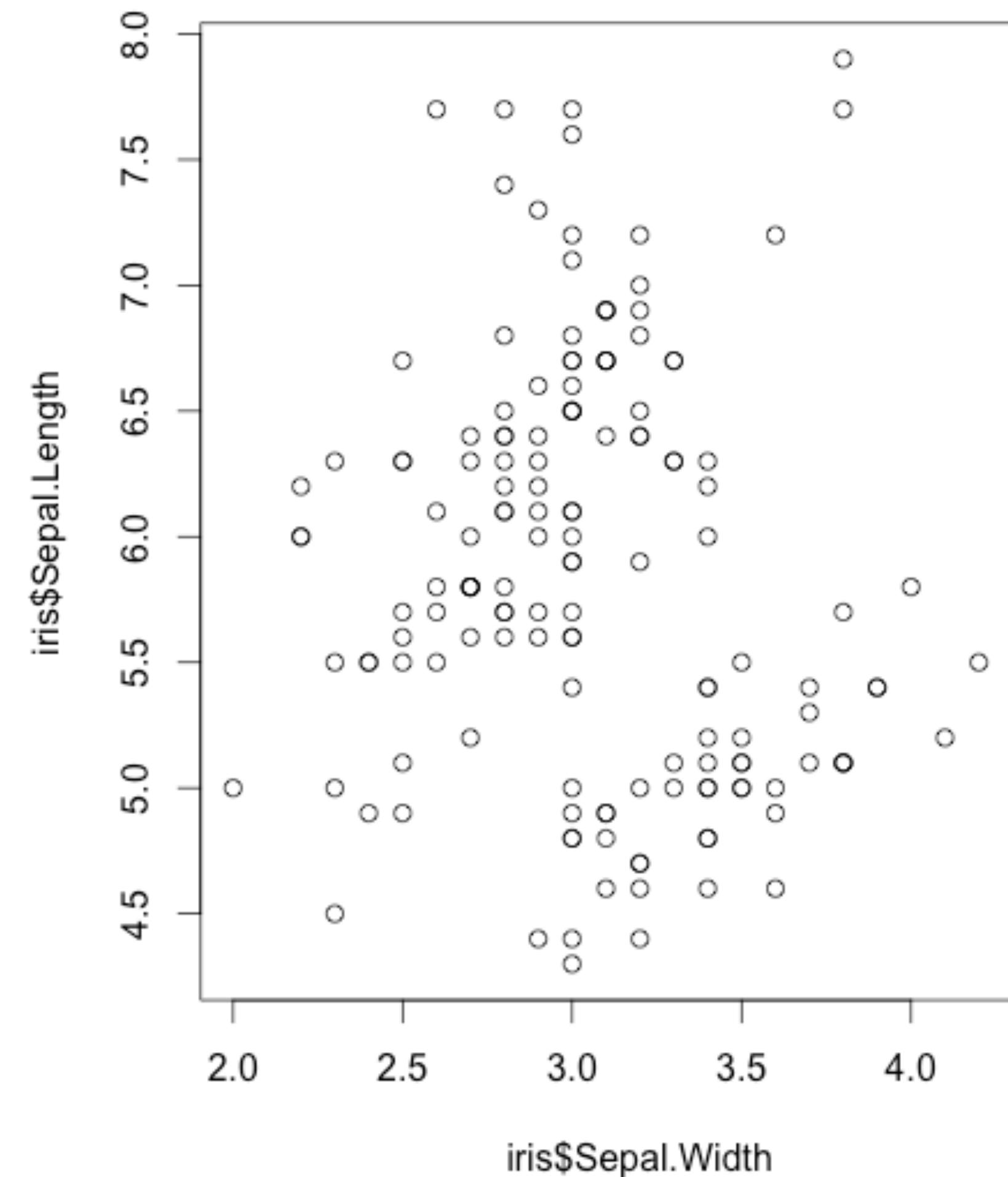
# plot



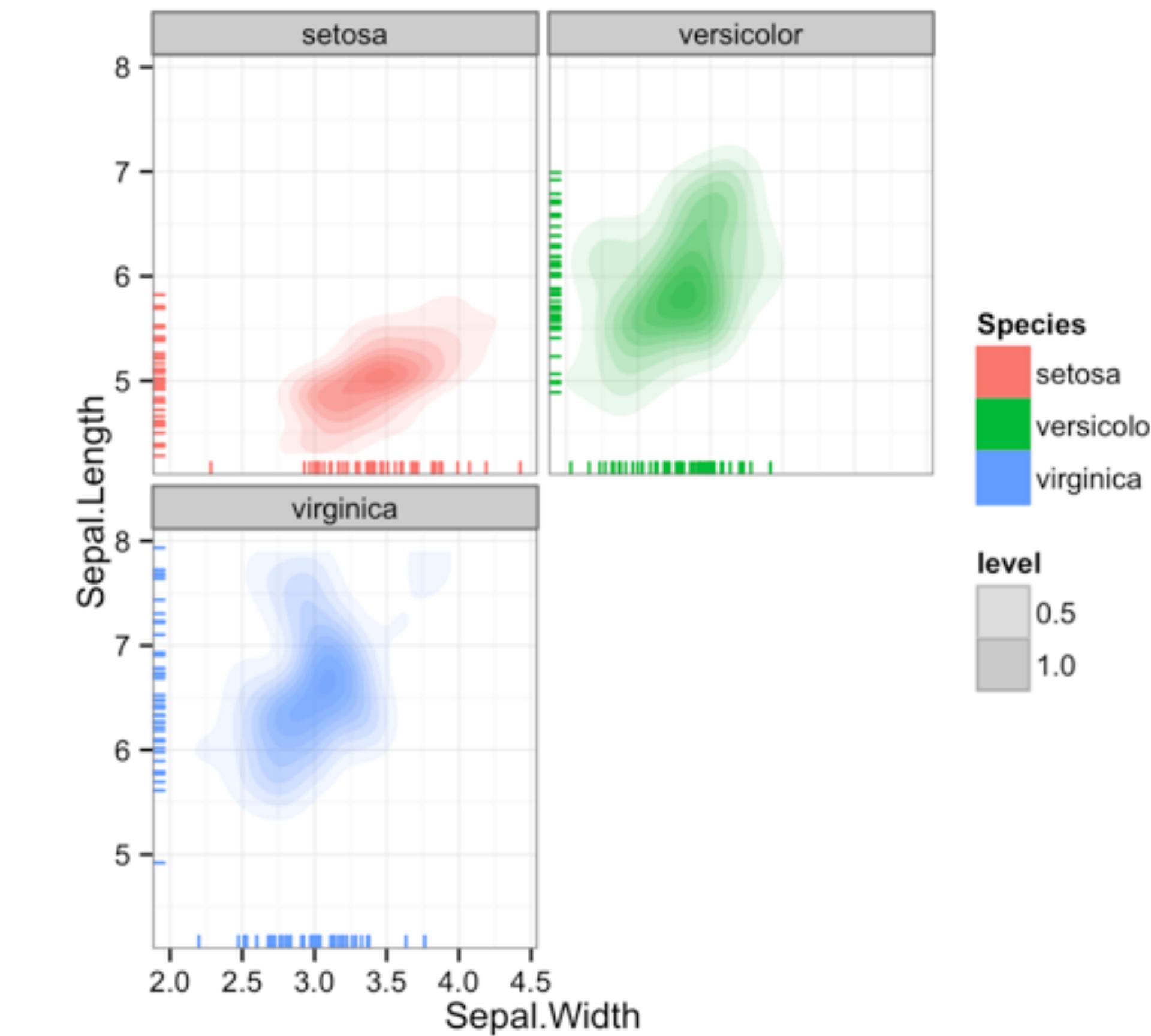
# ggplot2



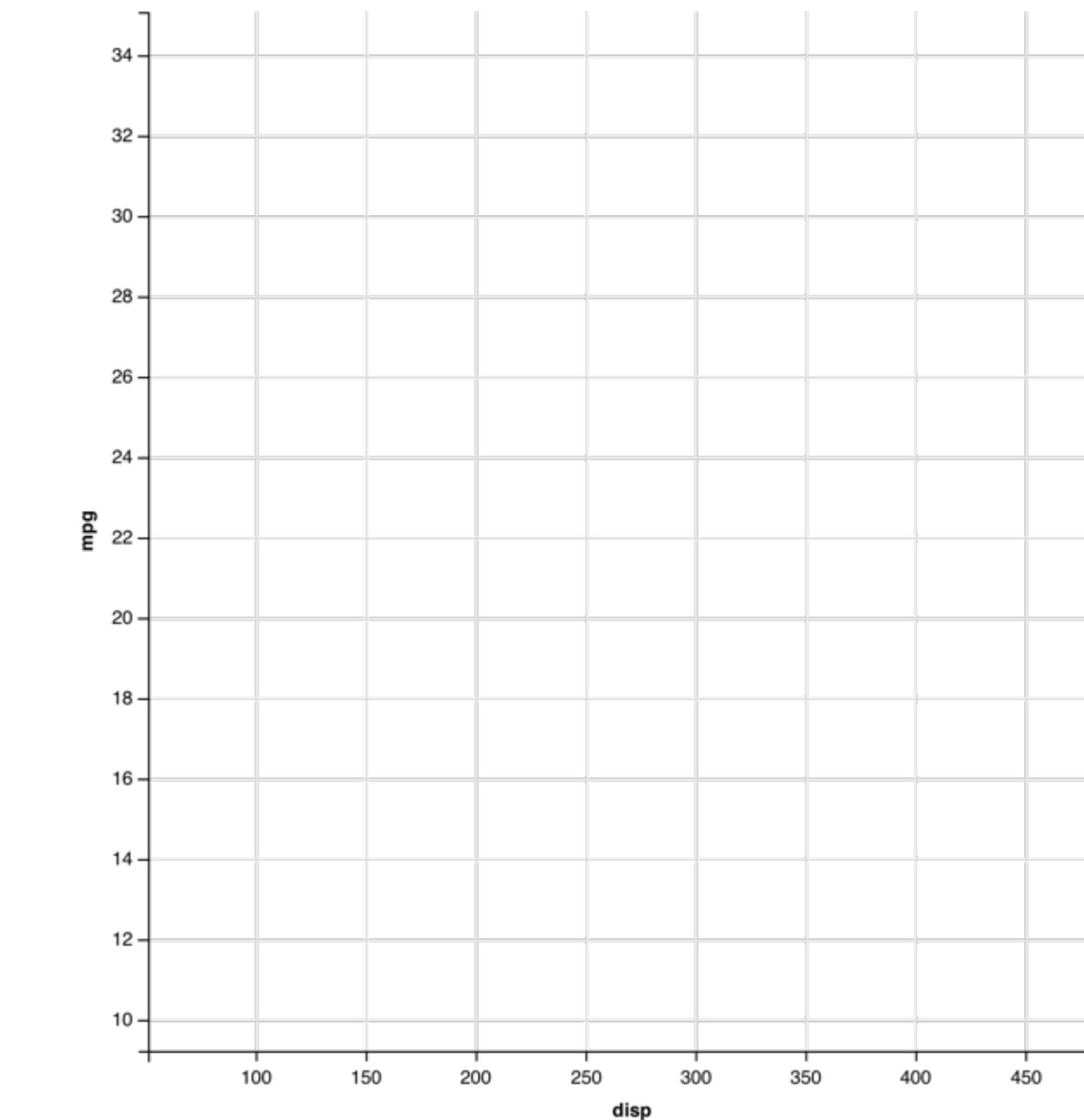
# plot



# ggplot2



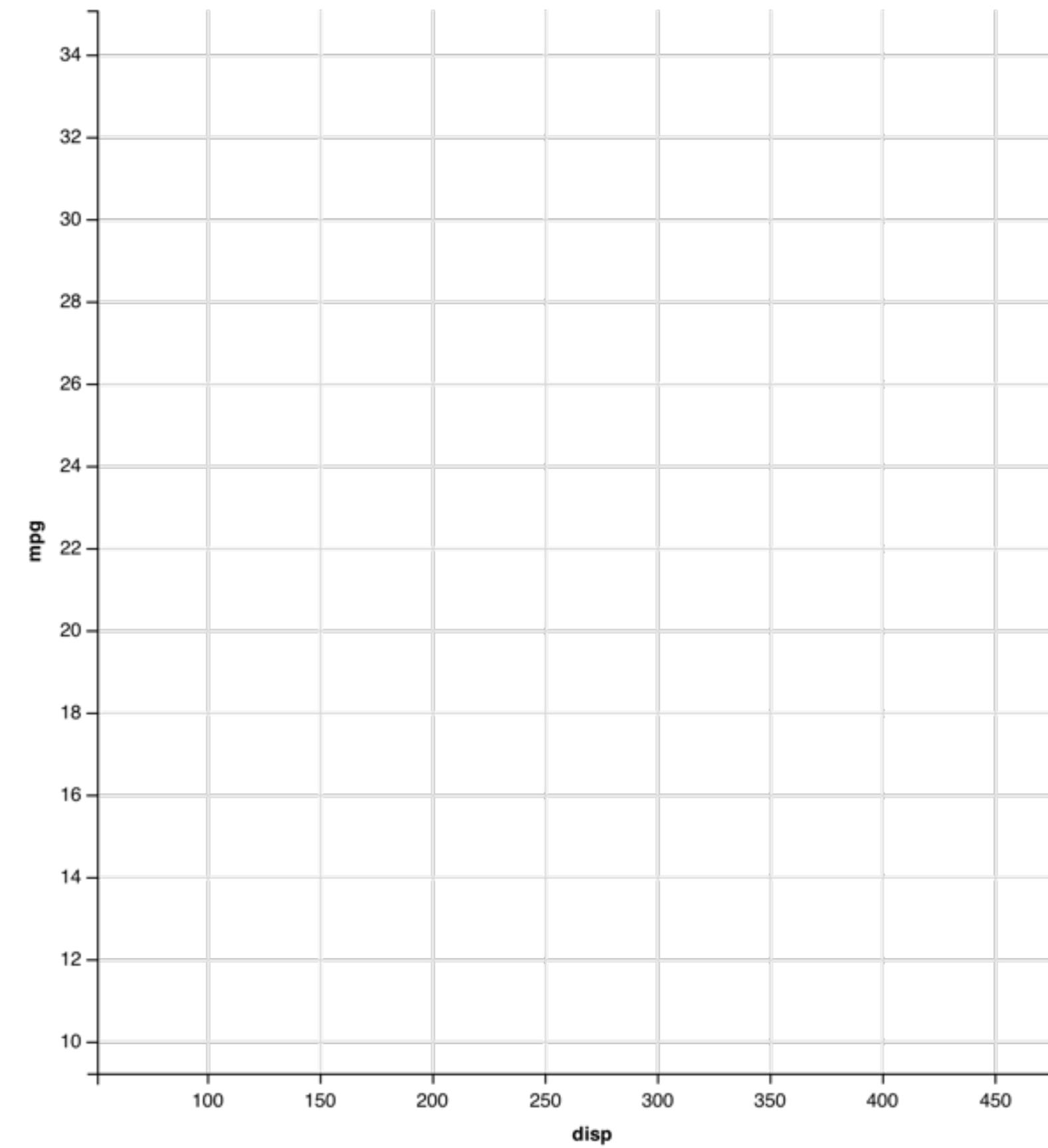
mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1

**data****geom****coordinate  
system**

# properties

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1

fill



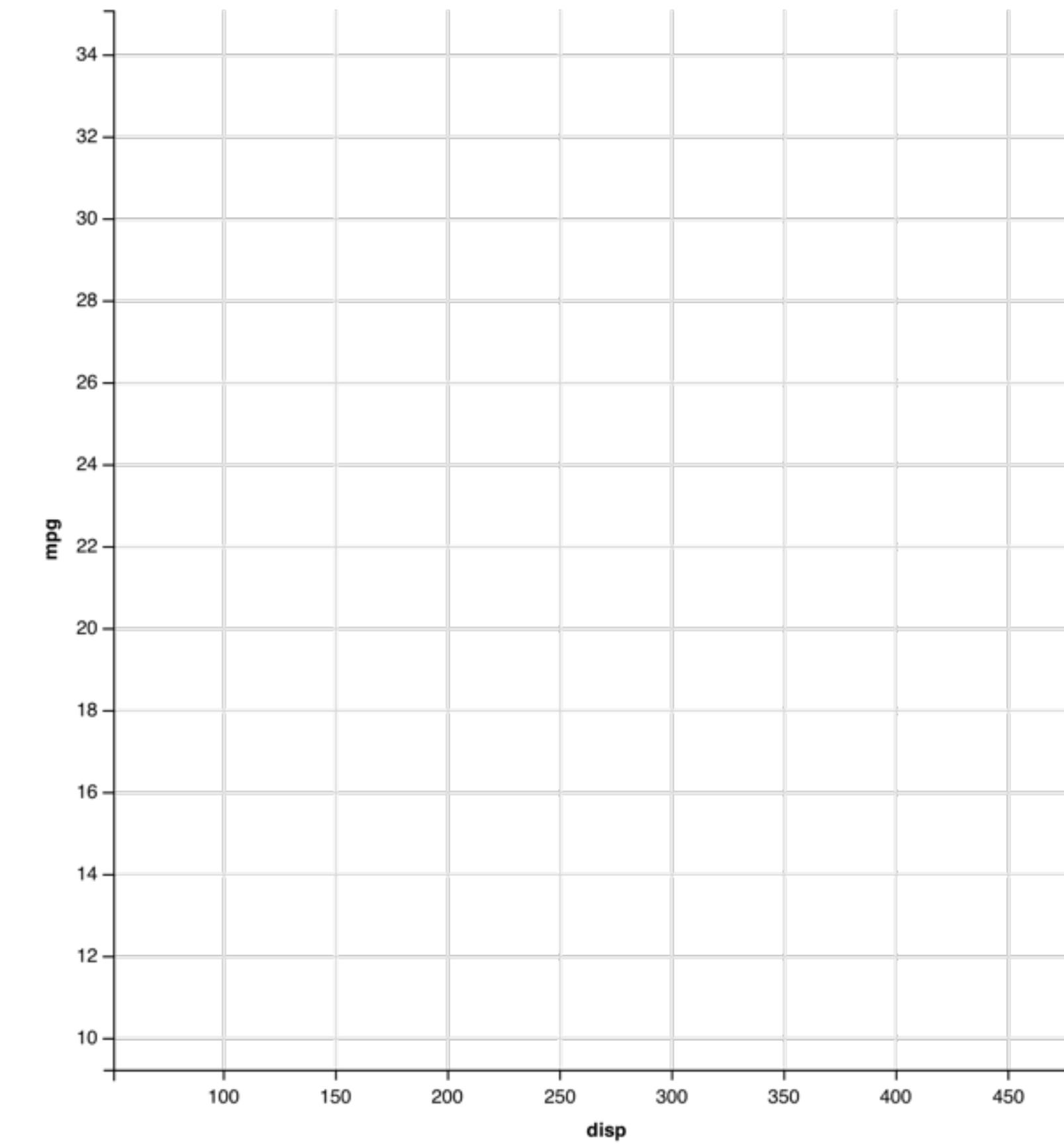
**data**

**geom**

**coordinate  
system**

# properties

mpg	cyl	disp	hp
21.0	6 +	160.0	2
21.0	6 +	160.0	2
22.8	4 ●	108.0	1
21.4	6 +	258.0	2
18.7	8 ♦	360.0	3
18.1	6 +	225.0	2
14.3	8 ♦	360.0	5
24.4	4 ●	146.7	1
22.8	4 ●	140.8	1
19.2	6 +	167.6	2
17.8	6 +	167.6	2
16.4	8 ♦	275.8	3
17.3	8 ♦	275.8	3
15.2	8 ♦	275.8	3
10.4	8 ♦	472.0	4
10.4	8 ♦	460.0	4
14.7	8 ♦	440.0	4
32.4	4 ●	78.7	1
30.4	4 ●	75.7	1
33.9	4 ●	71.1	1



# data

# geom

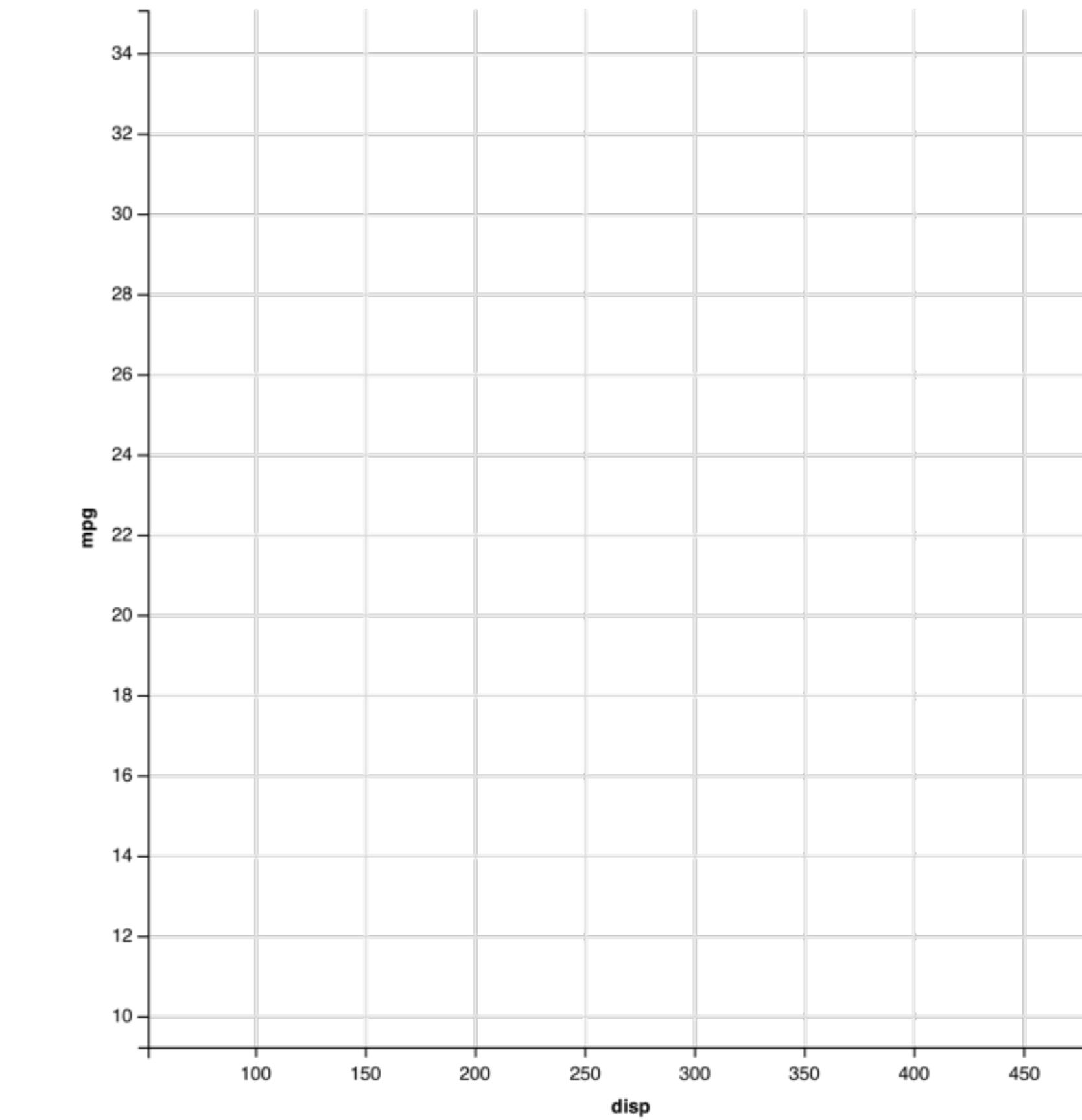
# coordinate system

## properties

	shape	x	fill
mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1

**data**

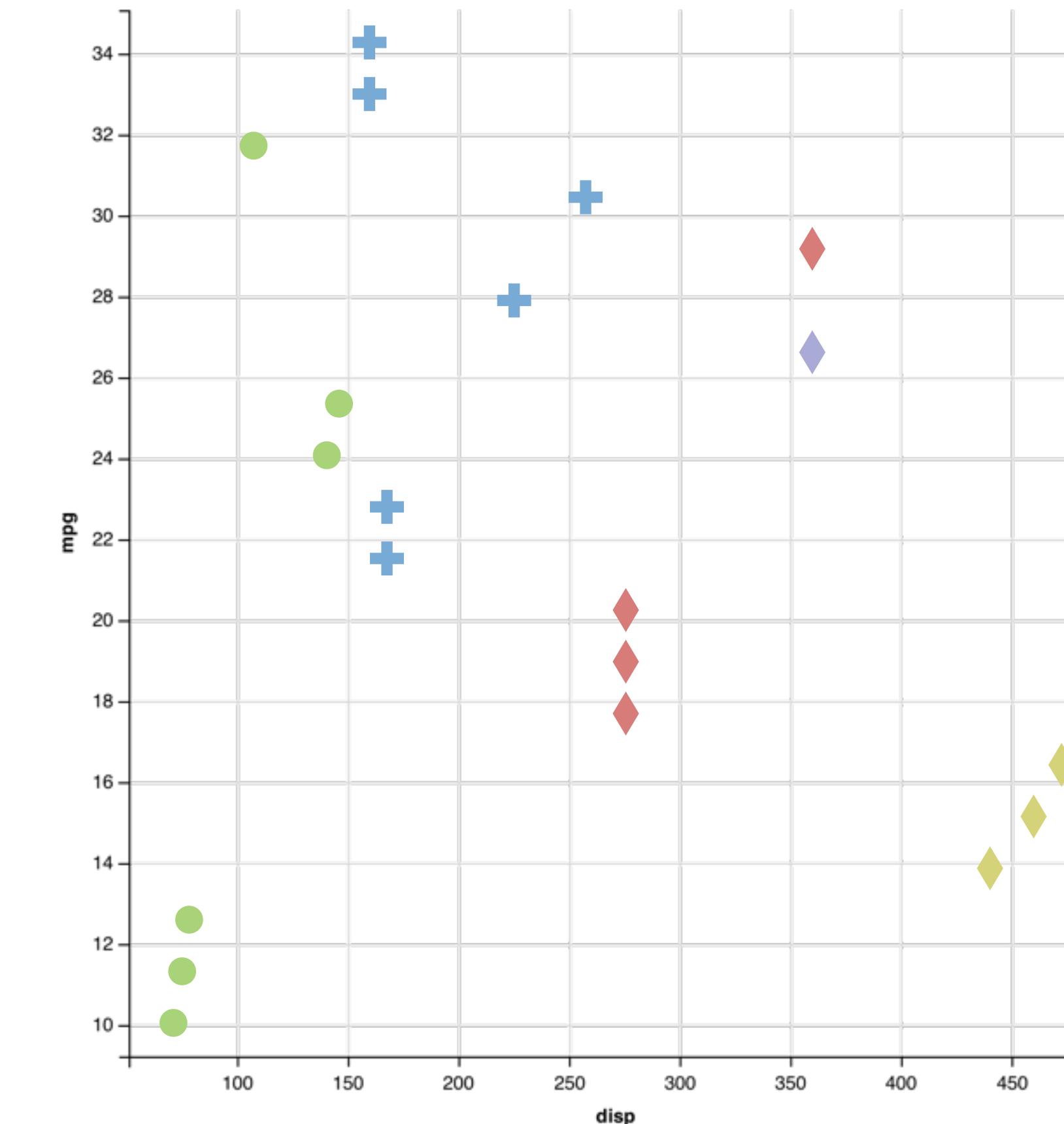
**geom**



**coordinate  
system**

## properties

y	shape	x	fill
mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1



**data**

**geom**

**coordinate  
system**

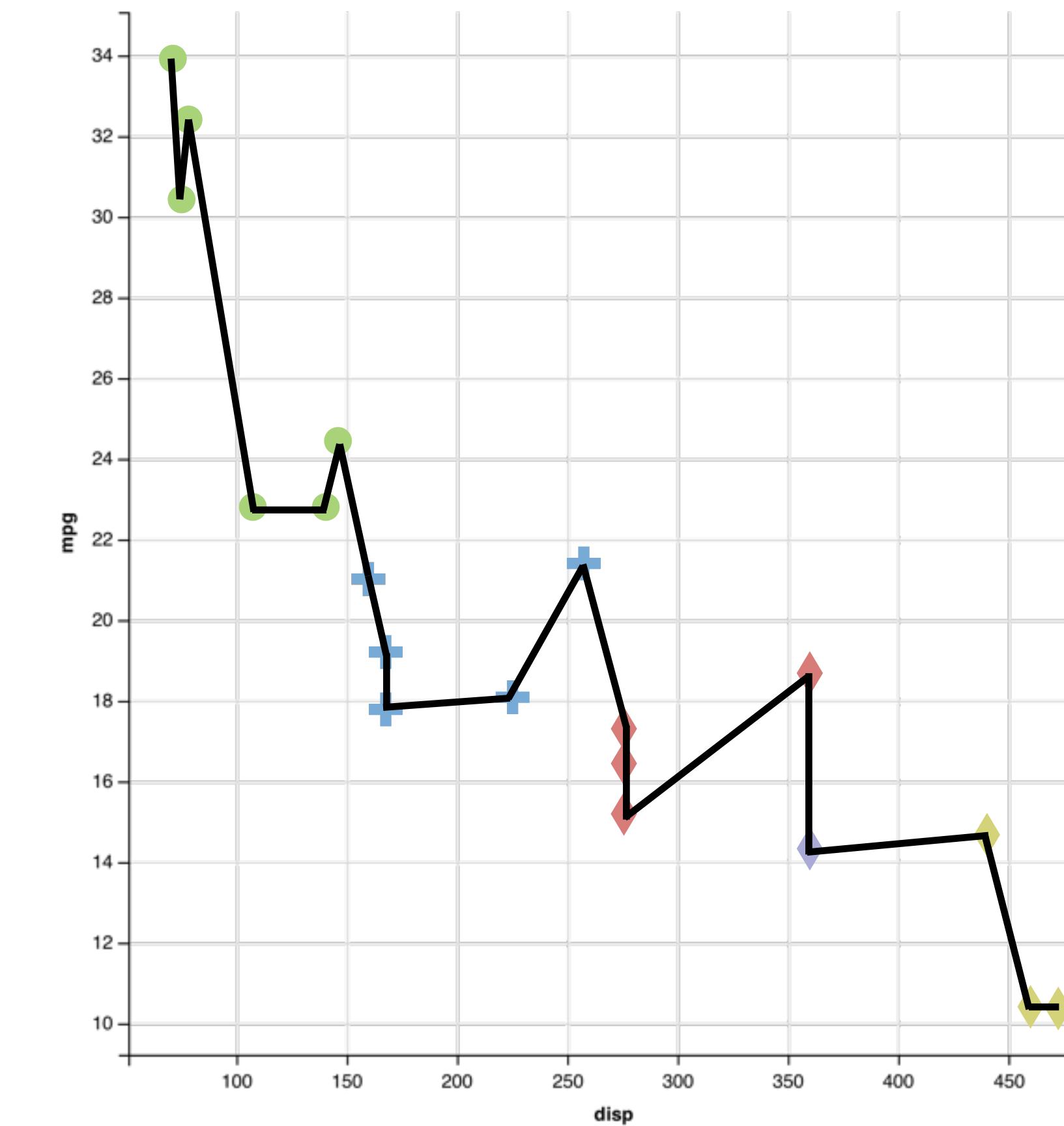
## properties

	y	shape	x	fill
	mpg	cyl	disp	hp
21.0	6	160.0	2	
21.0	6	160.0	2	
22.8	4	108.0	1	
21.4	6	258.0	2	
18.7	8	360.0	3	
18.1	6	225.0	2	
14.3	8	360.0	5	
24.4	4	146.7	1	
22.8	4	140.8	1	
19.2	6	167.6	2	
17.8	6	167.6	2	
16.4	8	275.8	3	
17.3	8	275.8	3	
15.2	8	275.8	3	
10.4	8	472.0	4	
10.4	8	460.0	4	
14.7	8	440.0	4	
32.4	4	78.7	1	
30.4	4	75.7	1	
33.9	4	71.1	1	

**data**

**geom**  
points  
lines

**coordinate**  
**system**



# properties

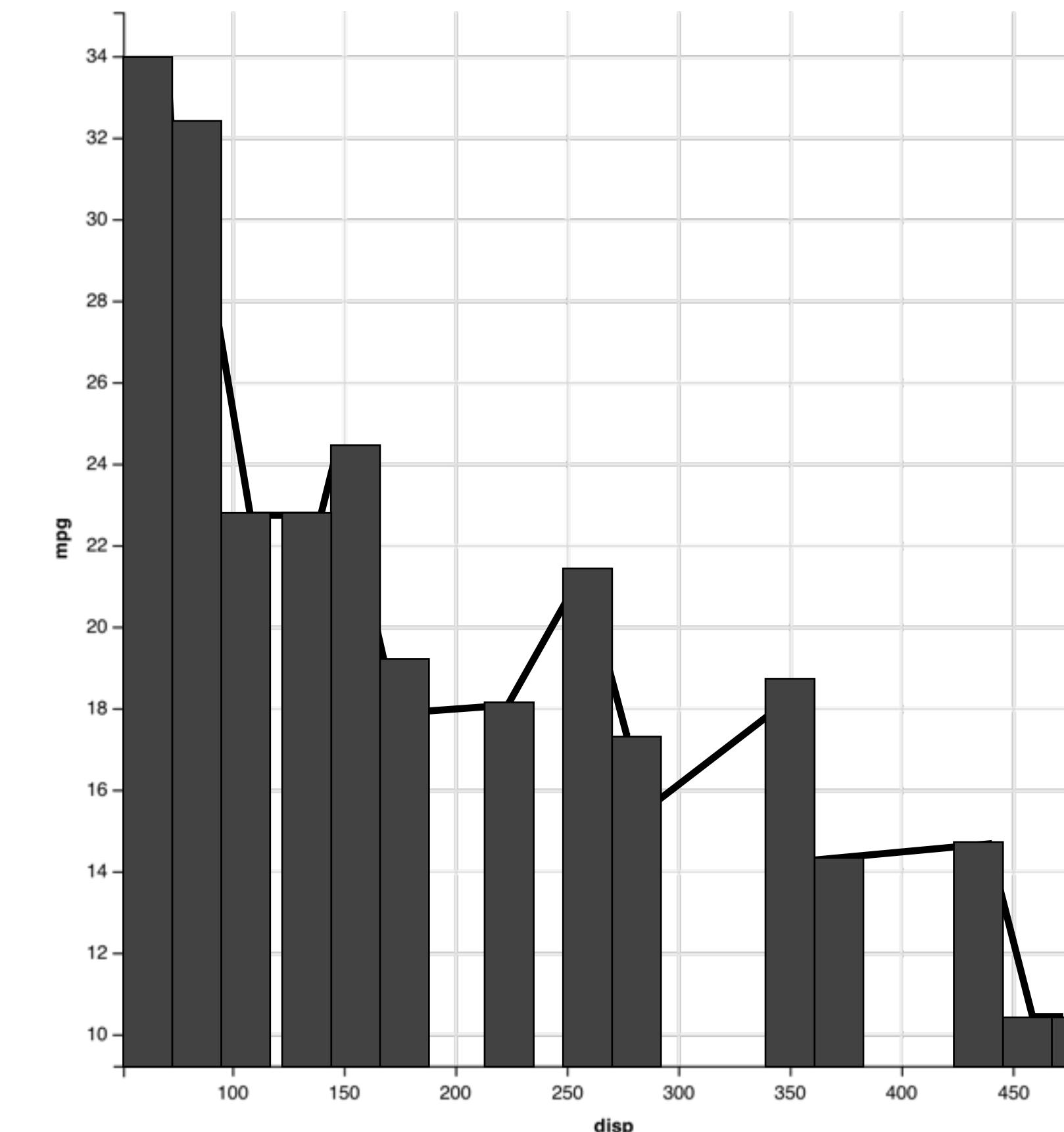
Y  
↑ ↓  
X  
↑ ↓

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1

**data**

**geom**  
points  
lines  
bars

**coordinate**  
**system**

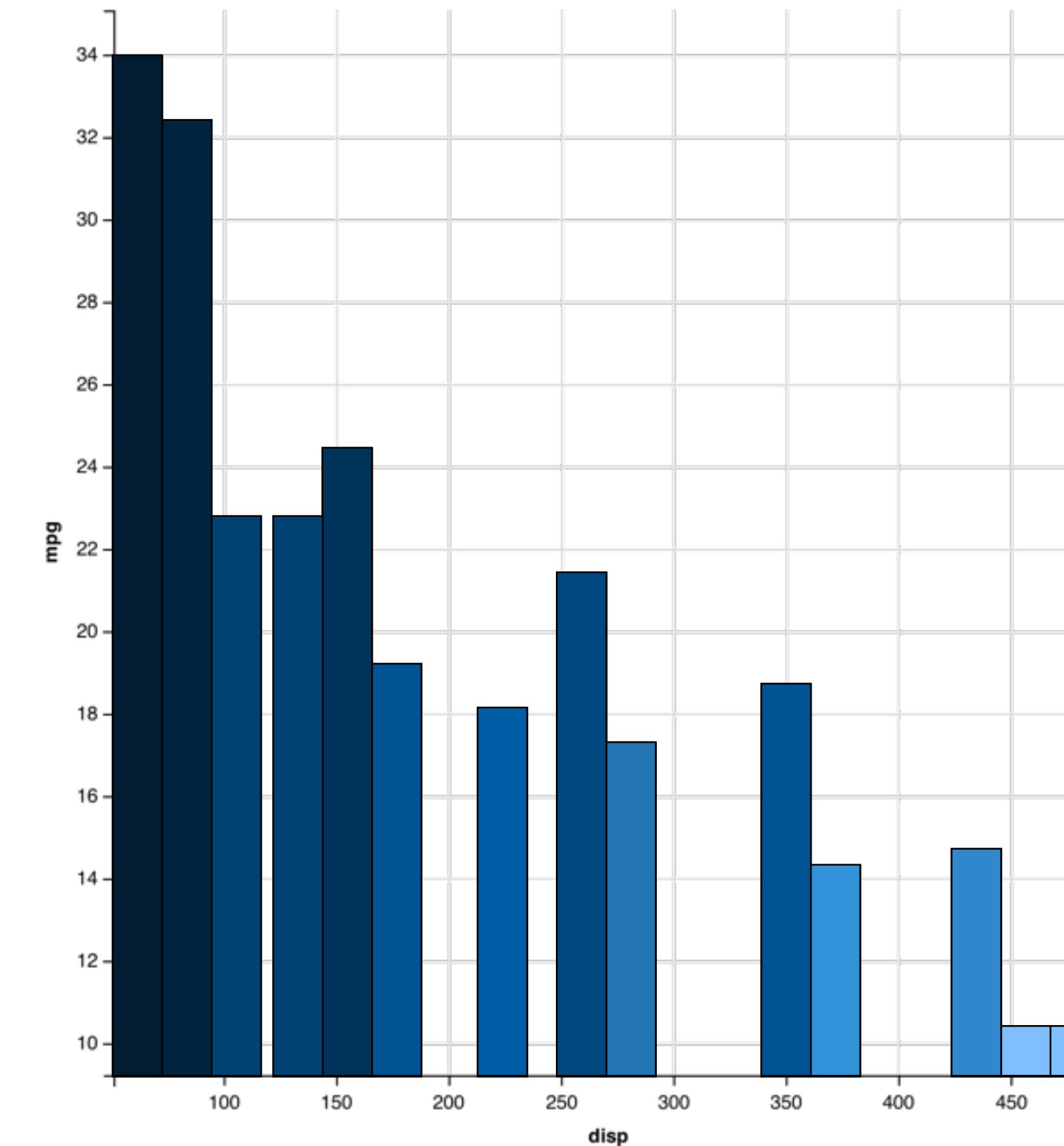


# properties

Y  
↑ ↓

fill  
↑ ↓

mpg	cyl	disp	hp
21.0	6	160.0	2
21.0	6	160.0	2
22.8	4	108.0	1
21.4	6	258.0	2
18.7	8	360.0	3
18.1	6	225.0	2
14.3	8	360.0	5
24.4	4	146.7	1
22.8	4	140.8	1
19.2	6	167.6	2
17.8	6	167.6	2
16.4	8	275.8	3
17.3	8	275.8	3
15.2	8	275.8	3
10.4	8	472.0	4
10.4	8	460.0	4
14.7	8	440.0	4
32.4	4	78.7	1
30.4	4	75.7	1
33.9	4	71.1	1

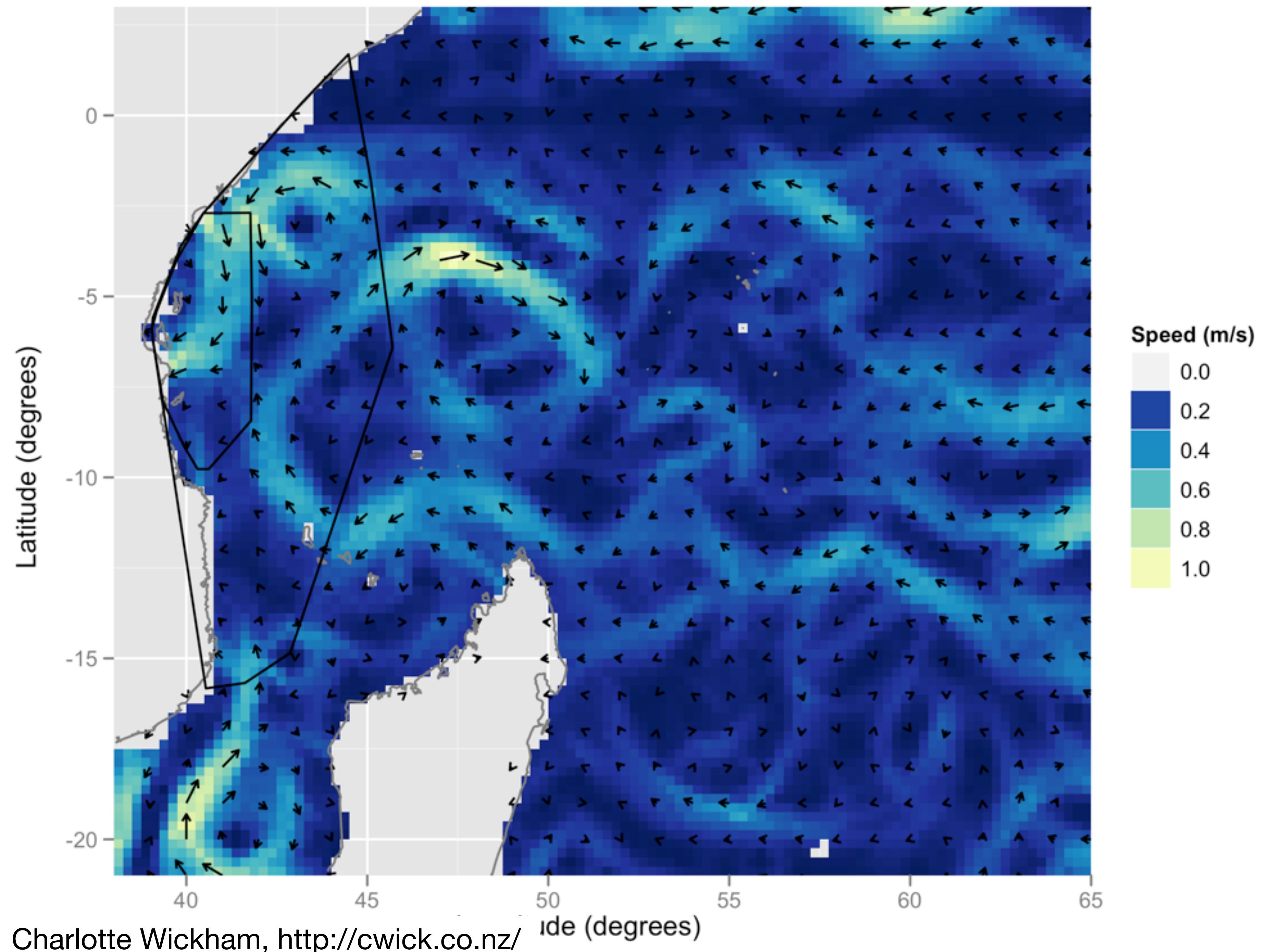


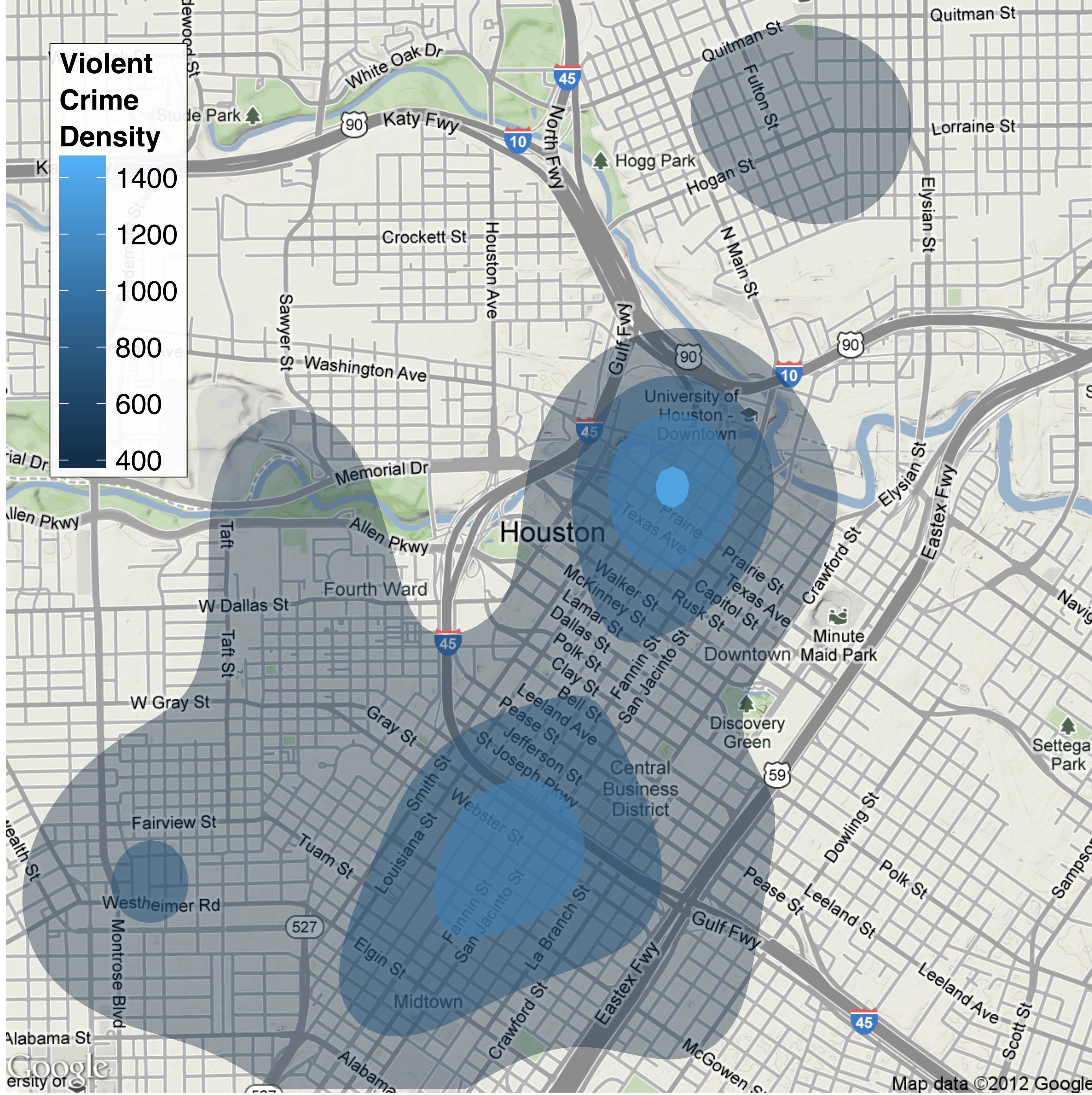
**data**

**geom**

points  
lines  
bars

**coordinate  
system**





# London Cycle Hire Journeys

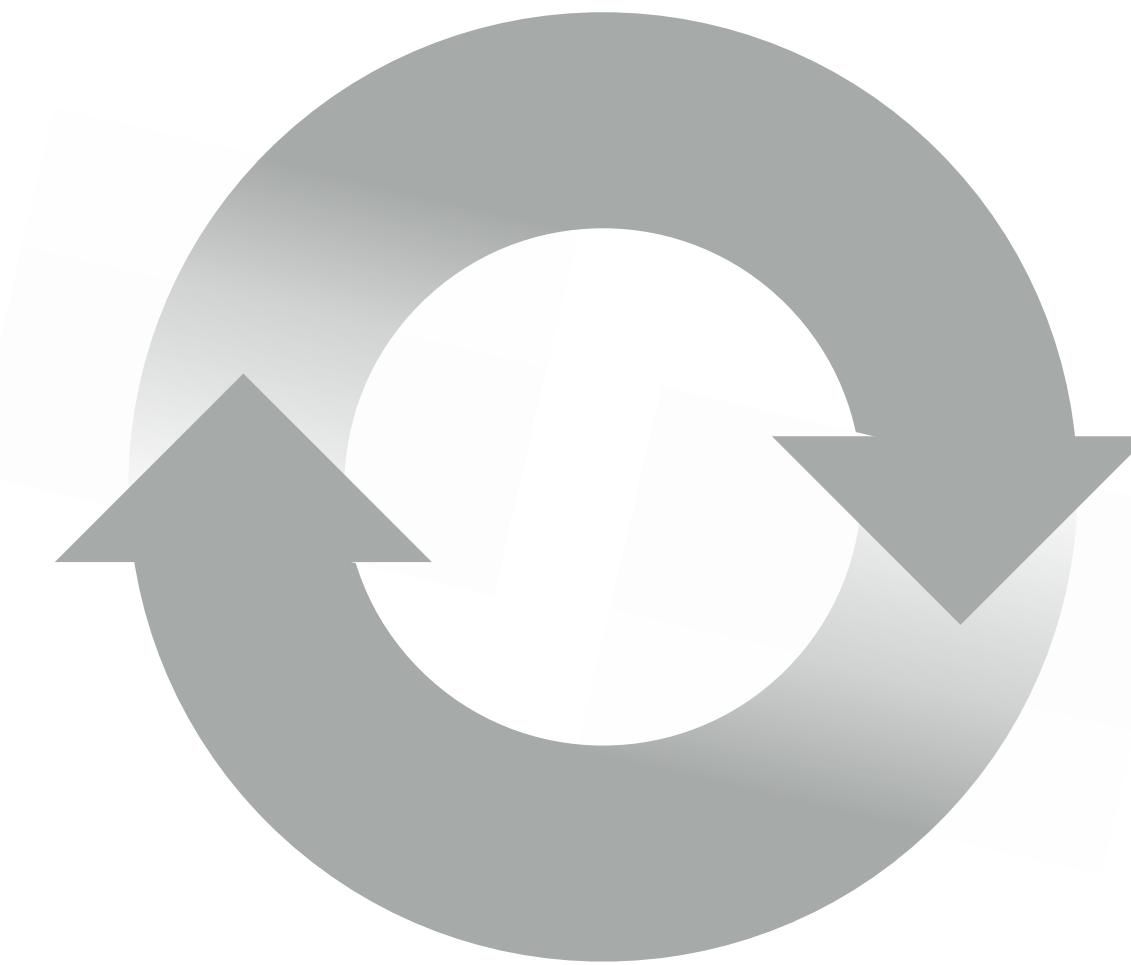
Thicker, yellower lines mean more journeys



James Cheshire, <http://bit.ly/xqHhAs>

Shiny

# Shiny



Web based  
User Interface

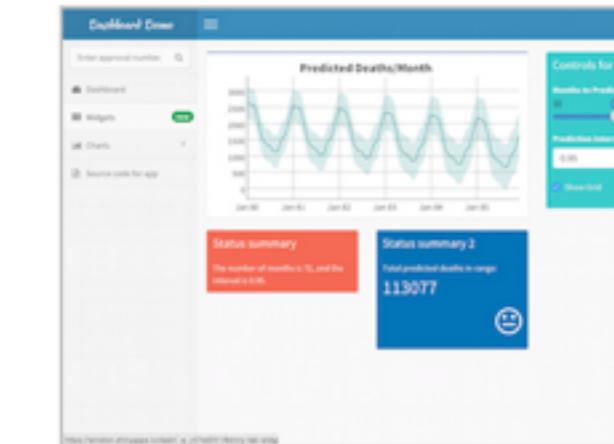
Reactive  
Programming

# demo

# Shiny Showcase

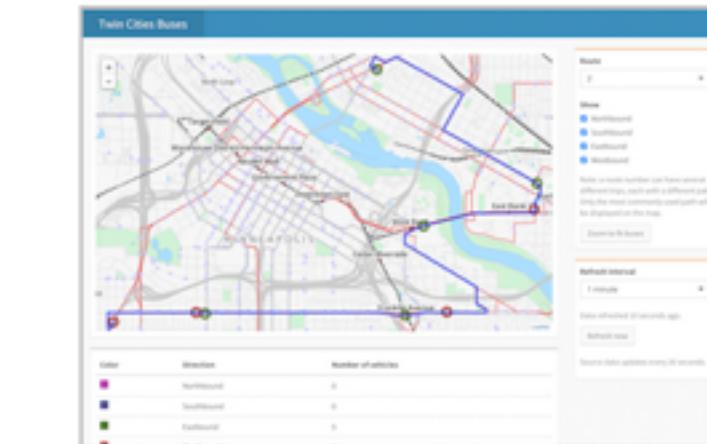
[www.rstudio.com/products/shiny/shiny-user-showcase/](http://www.rstudio.com/products/shiny/shiny-user-showcase/)

## Shiny Apps for the Enterprise



Shiny Dashboard Demo

A dashboard built with Shiny.



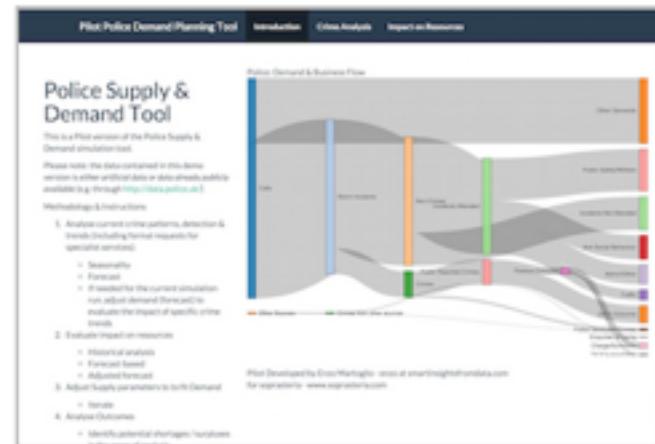
Location tracker

Track locations over time with streaming data.



Download monitor

Streaming download rates visualized as a bubble chart.



Supply and Demand

Forecast demand to plan resource allocation.

## Industry Specific Shiny Apps



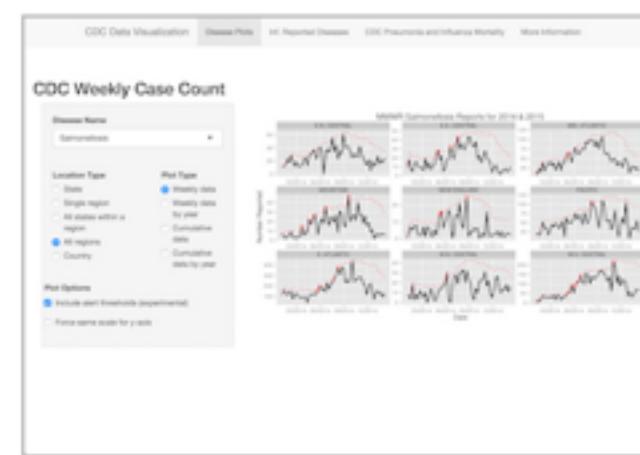
Economic Dashboard

Economic forecasting with macroeconomic indicators.



ER Optimization

An app that models patient flow.



CDC Disease Monitor

Alert thresholds and automatic weekly updates.



Ebola Model

An epidemiological simulation.



Pharmacometrics: some Shiny applications



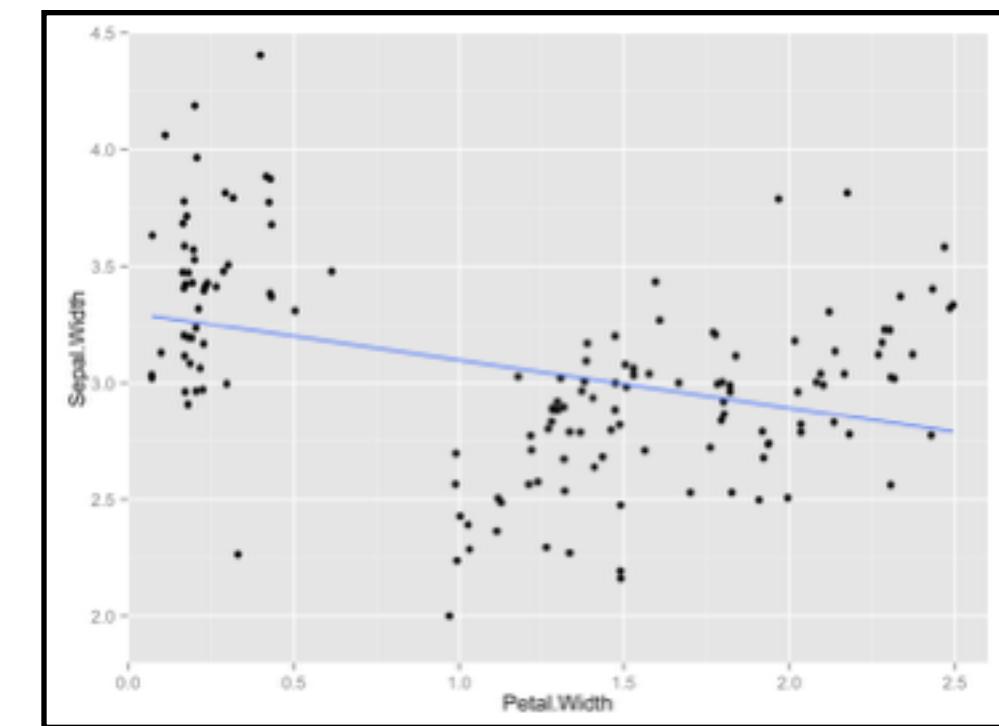
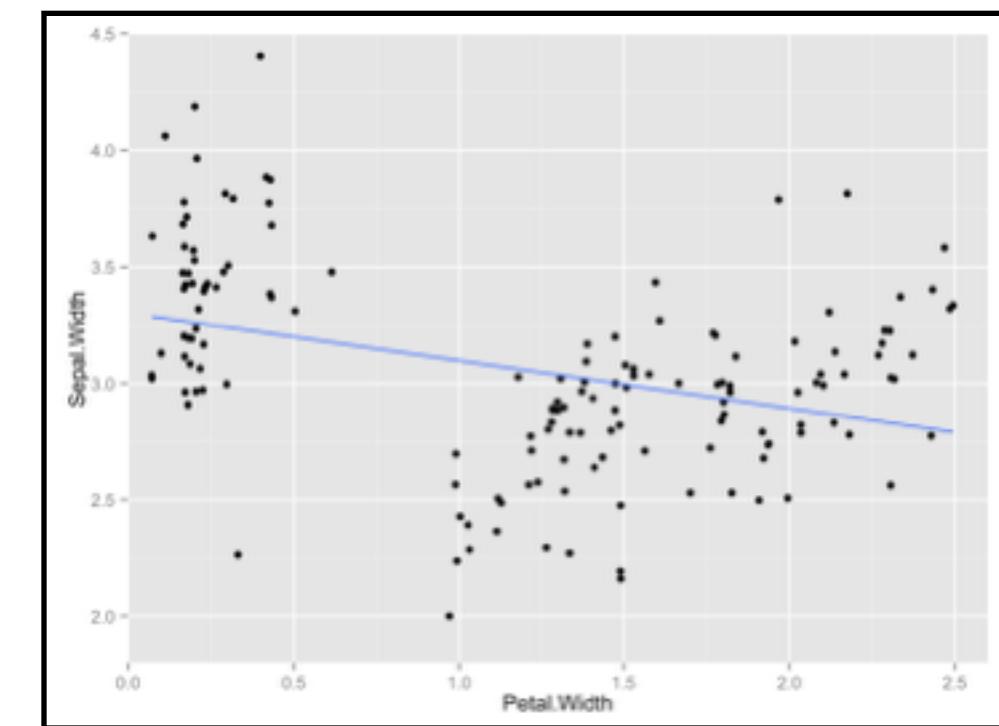
Introduction to pharmacokinetics modelling



Lake Erie Biological Station - Western Basin Trawl Survey

# Interactive visualizations

Plots and images can be both  
outputs *and* inputs.



# plotOutput()

To collect input values, add **click**, **dblclick**, **hover**, or **brush** arguments.

```
plotOutput(..., click = "myclick")
```

stores  
value as

```
input$myclick
```

# plotOutput()

Location of mouse click  
(in x and y coordinates)

Location of double click  
(in x and y coordinates)

Location of stationary  
mouse (in x and y)

Bounding coordinates of  
brush box (in x and y)

```
plotOutput(...,  
          click = "click",  
          dblclick = "dblclick",  
          hover = "hover",  
          brush = "brushed")
```

# nearPoints()

Returns a data frame of points near a click.

data frame to return subset  
of (should match plot)

click input  
object

x variable in plot  
(not needed with ggplot2)

```
nearPoints(mtcars, input$click, xvar = input$xVar,  
          yvar = "mpg", maxpoints = 1)
```

y variable in plot  
(not needed with ggplot2)

number of points to return

# brushedPoints()

Returns a data frame of points near a click.

data frame to return subset  
of (should match plot)

brush input  
object

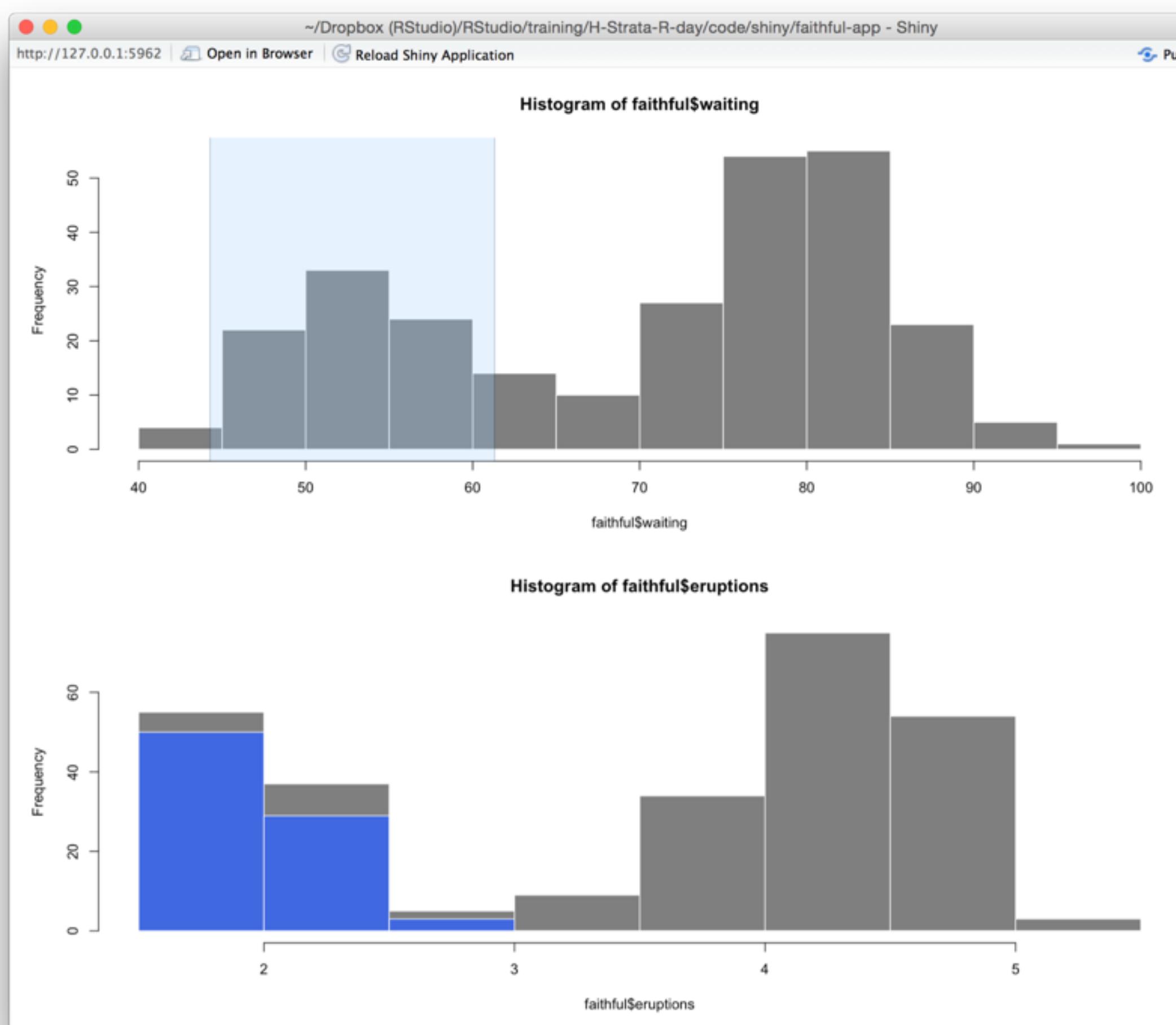
```
brushedPoints(mtcars, input$brush,  
              xvar = input$xvar, yvar = "mpg")
```

x variable in plot  
(not needed with ggplot2)

y variable in plot  
(not needed with ggplot2)

# Ideas

# demos



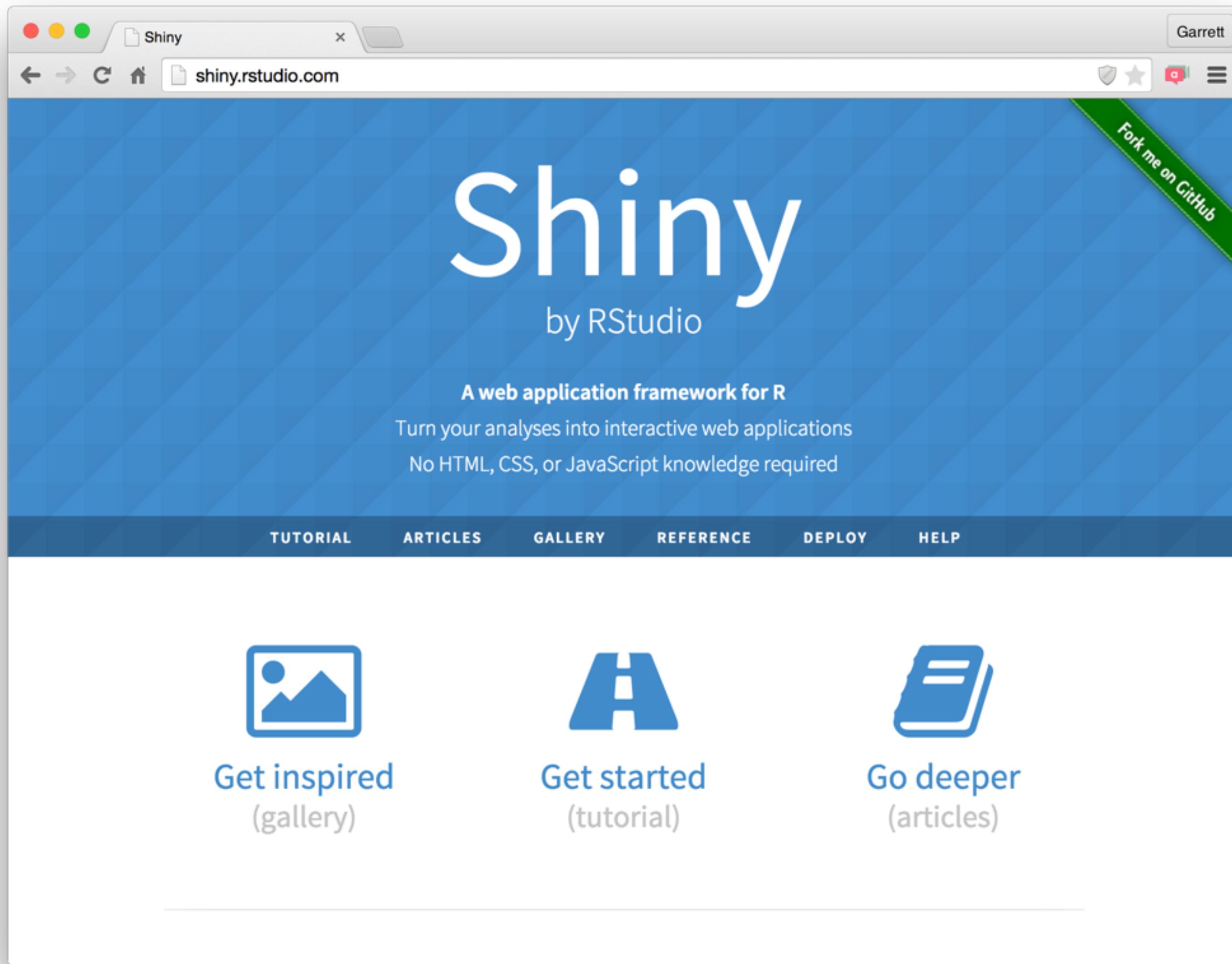
take away

R and Shiny provide an easy way to write your own, custom interactive visualizations.

This is a language for building tools, not just tools themselves.

# The Shiny Development Center

[shiny.rstudio.com](http://shiny.rstudio.com)



# Learn more

## [shiny.rstudio.com/articles](http://shiny.rstudio.com/articles)

**Interactive plots**

Create interactive plots with base and ggplot2 graphics

[Interactive plots](#)

[Selecting rows of data](#)

[Interactive plots - advanced](#)

Shiny - Articles

Shiny by RStudio

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**OVERVIEW**

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**ARTICLES** ARTICLES

**GALLERY**

**REFERENCE**

**DEPLOY**

**HELP**

**Articles**

**The basics**

If you've been through the [tutorial](#) and need a refresher, these articles are a good place to start. They describe the lay of the land.

- [The basic parts of a Shiny app](#)
- [How to build a Shiny app](#)
- [How to launch a Shiny app](#)
- [How to get help](#)
- [The Shiny cheat sheet](#)
- [Single-file Shiny apps](#)
- [App formats and launching methods](#)
- [Persistent data storage in Shiny apps](#)

**Extend Shiny**

These packages provide advanced features that can enhance your Shiny apps.

- [shinythemes](#) - CSS themes ready to use with Shiny
- [shinydashboard](#) - Shiny powered dashboards
- [htmlwidgets](#) - A framework for embedding JavaScript visualizations into R. Ready to use examples include:
- [leaflet](#) - Geo-spatial mapping ([article](#))
- [dygraphs](#) - Time series charting ([article](#))
- [MetricGraphics](#) - Scatterplots and line charts with D3
- [networkD3](#) - Graph data visualization with D3
- [DataTables](#) - Tabular data display ([article](#))
- [threejs](#) - 3D scatterplots and globes
- [rCharts](#) - Multiple JavaScript charting libraries
- [d3heatmap](#) - Heatmaps ([article](#))
- [diagrammeR](#) - Graph and flowchart diagrams ([article](#))

**Layouts and UI**

These articles explain how to control the layout, user-interface, and general appearance of your Shiny apps.

- [Application layout guide](#)
- [Display modes](#)
- [Tabs](#)
- [Customize your UI with HTML](#)
- [Build your entire UI with HTML](#)
- [Build a dynamic UI that reacts to user input](#)
- [Shiny HTML Tags Glossary](#)
- [Progress indicators](#)

**Deploying apps**

These articles describe the different ways to share your Shiny apps with users.

- [Getting started with shinyapps.io](#)
- [Setting up custom domains with shinyapps.io](#)
- [Scaling and Performance Tuning with shinyapps.io](#)
- [Share data across sessions with shinyapps.io](#)
- [Migrating shinyapps.io authentication](#)
- [Introduction to Shiny Server](#)
- [Save your app as a function](#)
- [Sharing apps to run locally](#)

**Interactive documents**

These articles explain how to add Shiny components to R Markdown reports.

- [Introduction to R Markdown](#)
- [Introduction to interactive documents](#)
- [R Markdown integration in the RStudio IDE](#)
- [The R Markdown Cheat sheet](#)

**Widgets**

These articles describe Shiny's pre-built widgets and provide ideas on how to use them. (See also [Lesson 3](#) in the tutorial, and the Widgets section in the [gallery](#).)

- [Using Action Buttons](#)
- [Using sliders](#)
- [Help users download data from your app](#)
- [Using selective input](#)

**Outputs**

These articles show you how to create and use different output objects, the parts of your app that display results and react to user input.

- [Render images in a Shiny app](#)
- [How to use DataTables in a Shiny App](#)

**Reactive programming**

These articles describe reactivity from a conceptual level. Understanding reactivity will help you build apps that are more efficient, robust, and correct.

- [Reactivity: An overview](#)
- [Stop reactions with isolate\(\)](#)
- [Execution scheduling](#)
- [How to understand reactivity in R](#)

**Customizing Shiny**

These articles suggest ways to create custom Shiny widgets, layouts and outputs; or to combine Shiny with other web technologies.

- [Style your apps with CSS](#)
- [Build custom input objects](#)
- [Build custom output objects](#)
- [Add Google Analytics to a Shiny app](#)

**Shiny Server Pro**

Here are some of the unique things you can do when you deploy your apps with Shiny Server Pro

- [How to create User Privileges](#)
- [Allow different libraries for different apps](#)

**Upgrade notes**

Notes for upgrading to particular versions of Shiny

- [Upgrade notes for Shiny 0.11](#)
- [Upgrade notes for Shiny 0.12](#)

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Slides and code available at  
[github.com/garrettgman/CSP2016](https://github.com/garrettgman/CSP2016)

# See Also

# htmlwidgets

Use htmlwidgets in:

- RStudio viewer pane
- R Markdown files
- Shiny Apps

[www.htmlwidgets.org](http://www.htmlwidgets.org)

