Getting Started with R Graphics

Clay Ford

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Graphics in R

R has powerful graphical facilities

- Easily produce standard statistical graphs
- Allows you to create new types of graphs
- Create publication quality graphs
- Many packages provide powerful plotting functions
- Lots of free reference material available

Producing graphics in R not always easy

- Need to know the right function and how to set its arguments
- Arguments are not always intuitive
- Data sometimes need to be in certain format or shape
- Error messages not always helpful

It's OK. Everyone struggles with R Graphics from time to time. Google can help you.

Workshop Plan

Follow along in R Studio as we learn about the following:

- R's plotting framework
- How to do common graphs
- ggplot2 package
- Examples of package-specific plotting functions

R graphics framework

R graphics are created with three kinds of functions:

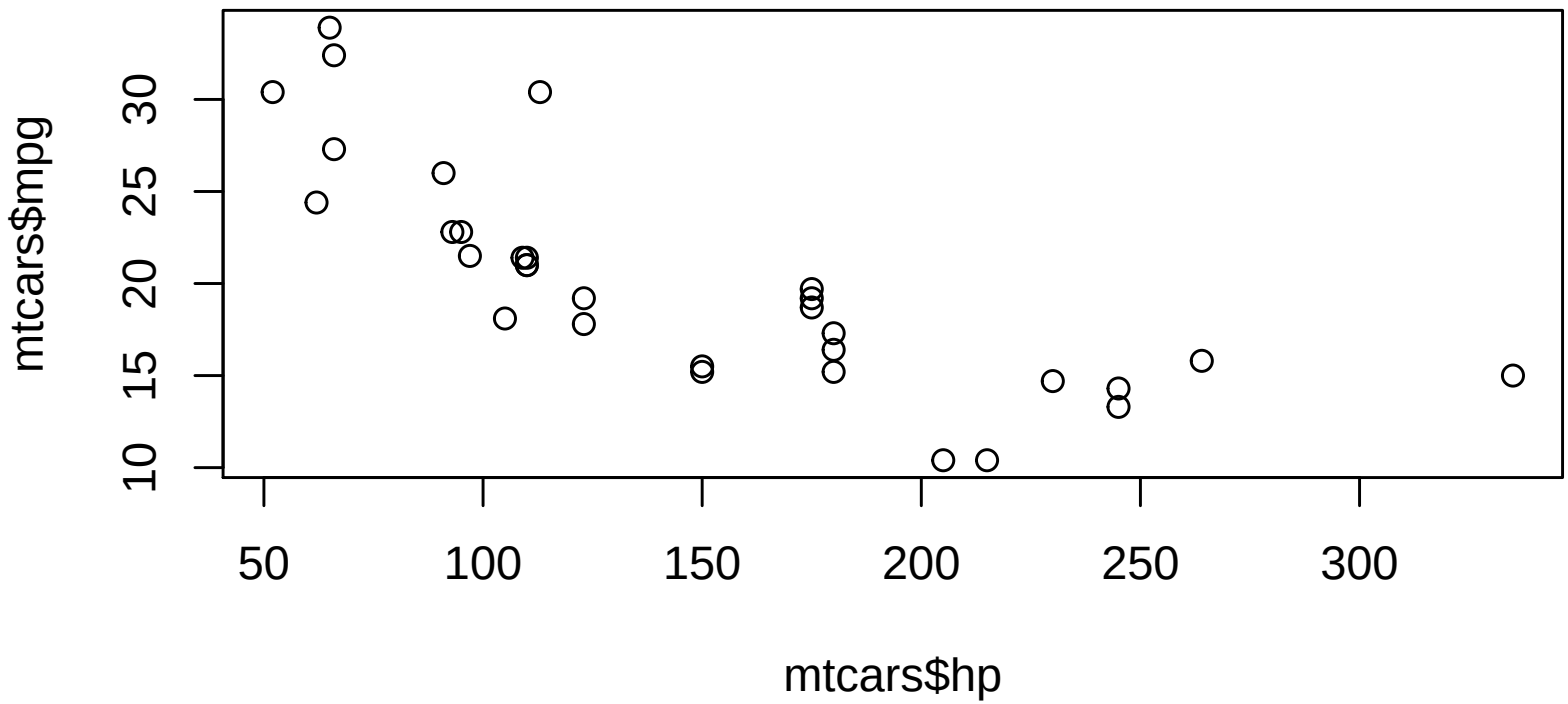
- **High-level functions**: create a graphic
- **Low-level functions**: add to an existing graphic
- **Interactive functions**: add or extract information from a graph, typically with a mouse

All functions have arguments that specify how they work.

In addition R has separate **graphical parameters** that apply to the display of graphics.

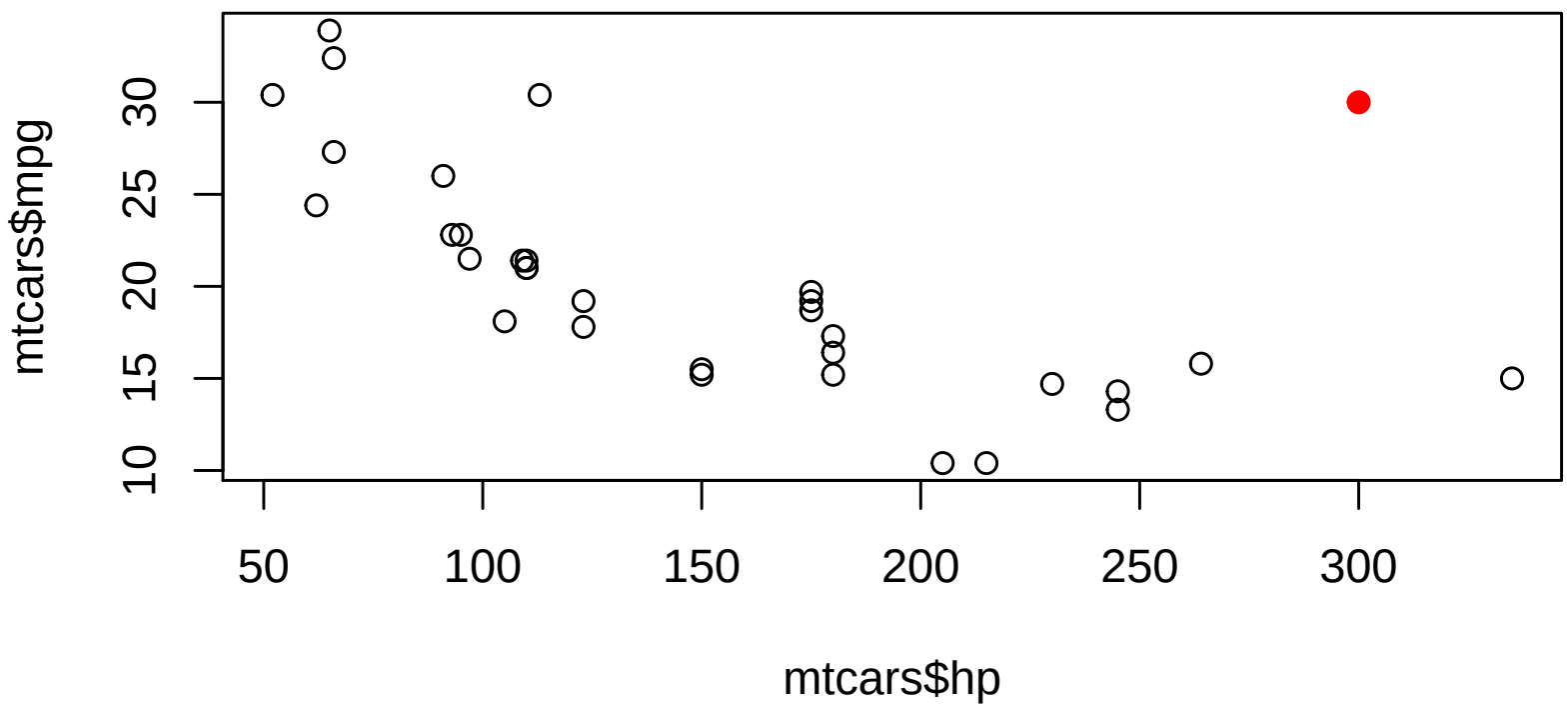
High-level function example

```
plot(x = mtcars$hp, y = mtcars$mpg)
```



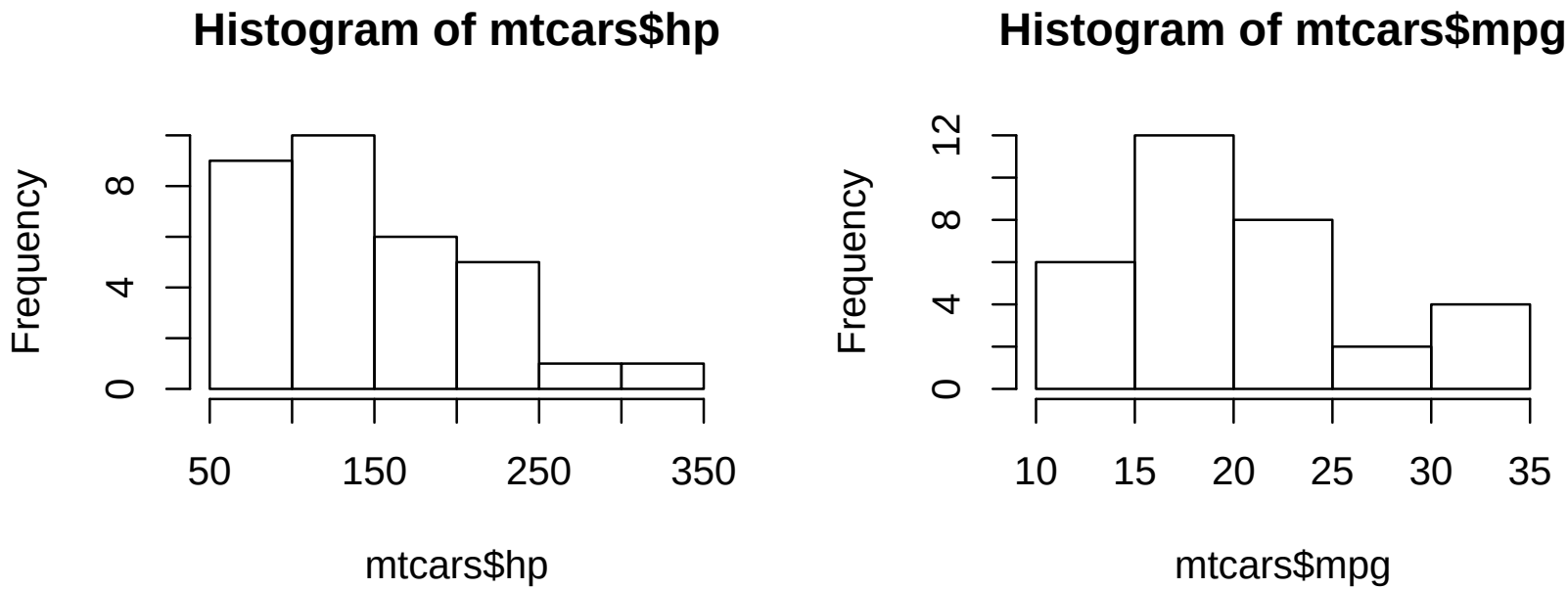
Low-level function example

```
plot(x = mtcars$hp, y = mtcars$mpg)
points(x = 300, y = 30, pch = 19, col = "red")
```



Graphical Parameters example

```
par(mfrow=c(1,2))
hist(mtcars$hp); hist(mtcars$mpg)
```



Let's go to R!

ggplot2

- Popular graphing package that implements Leland Wilkinson's *Grammar of Graphics* (2005)
- Features consistent coding
- Works in a layered fashion, first showing raw data and then adding layers of annotations and summaries
- Provides very nice default theme
- Handles legends beautifully

ggplot2 - the components

- Data and aesthetic mappings (**data** and **aes**)
- Geometric objects represent what you see on plot (**geoms**)
- Statistical transformations summarize data (**stats**)
- Scales that map values from data to the graph (**scale**)
- A coordinate system (**coord**)
- A faceting specification that describes how to lay out data (**facet**)

basic ggplot structure

Specify data and aesthetics

`ggplot(data, aes(x=, y=, color=, shape=, size=)) +`

Specify geometric shapes

`geom_xxxxx() +`

Specify statistical, scale or coordinate changes

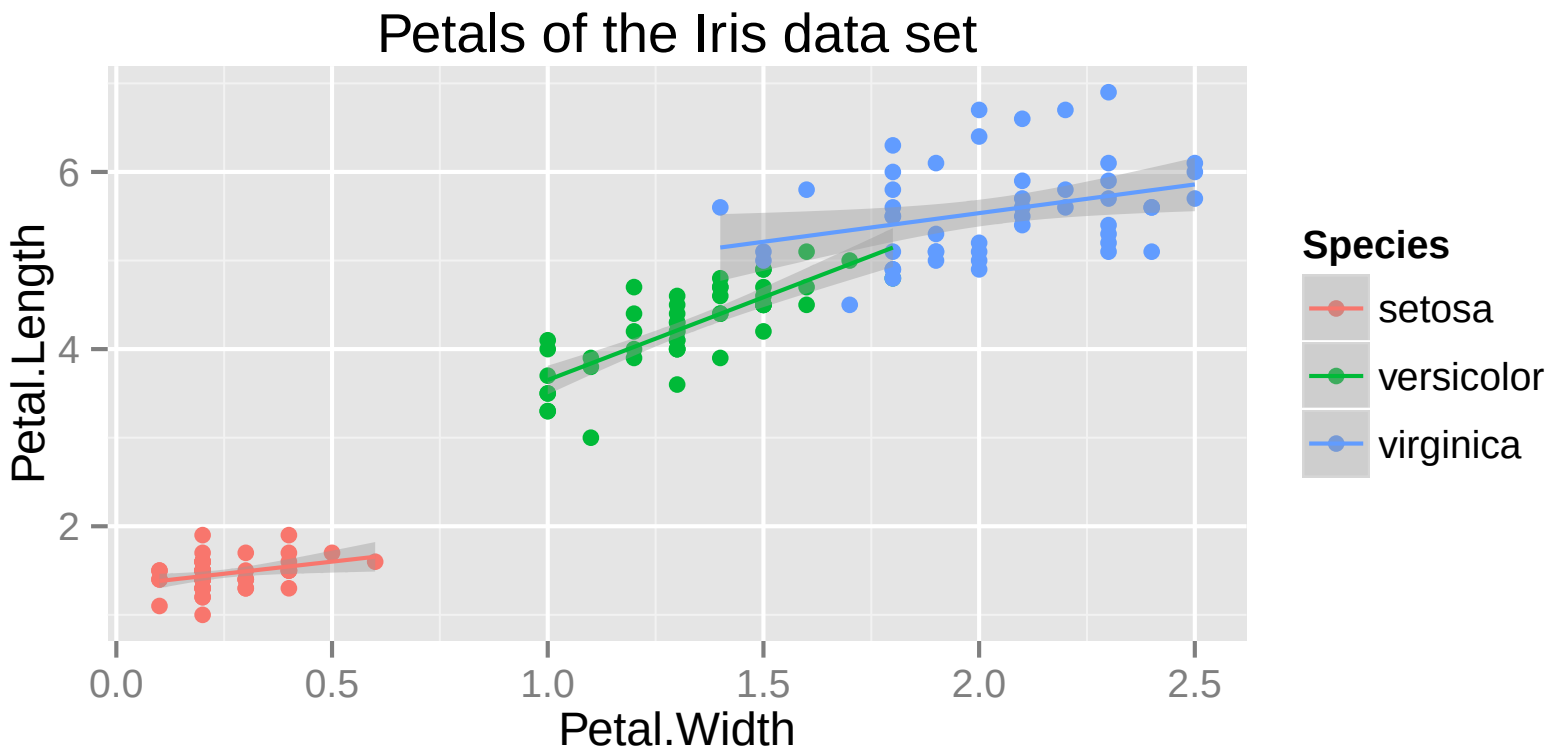
`stat_xxxx() +` or `scale_xxxx() +` or `coord_xxxx() +`

Specify how to layout multiple graphs

`facet_xxxx()`

ggplot example

```
library(ggplot2)
ggplot(iris, aes(x = Petal.Width, y = Petal.Length,
                 color=Species)) +
  geom_point() +
  geom_smooth(method="lm") +
  ggtitle("Petals of the Iris data set")
```



ggplot - the catch

- Data must be a data frame
- Data must be in *long* format, which could mean reshaping data
- The package is young and still evolving (ie, code that works today may not work in the future)
- Consistent interface, yes, but still many arguments to keep track of

Let's go to R...

References

- Chang, W. (2013), *R Graphics Cookbook*, O'Reilly.
- Murrell, P. (2005), *R Graphics*, Chapman and Hall.
- Wickham, H. (2010), "A Layered Grammar of Graphics", *Journal of Computational and Graphical Statistics*, Volume 19, Number 1, Pages 3–28: `http://vita.had.co.nz/papers/layered-grammar.pdf`
- Wickham, H. (2009), *ggplot2: Elegant Graphics for Data Analysis*, Springer.
- A complete list of R Graphics functions with individual help pages: library(help = "graphics")
- Intro to R Graphics: `http://cran.r-project.org/doc/manuals/R-intro.html#Graphics`

some web sites

CRAN Task View (all Graphics packages)
`http://cran.r-project.org/web/views/Graphics.html`
Cookbook for R: Graphs
`http://www.cookbook-r.com/Graphs/`
ggplot2 wiki
`https://github.com/hadley/ggplot2/wiki`
Quick-R: Basic Graphs
`http://www.statmethods.net/graphs/index.html`
R Tips: Graphs and tables
`https://www.zoology.ubc.ca/~schluter/R/display/`
R Graph Catalog
`http://shinyapps.stat.ubc.ca/r-graph-catalog/`

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