Visualization for Data Science in R

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Data Matters 2022
https://www.angelazoss.com/RVis-2Day/

Try right now:
Open RStudio
Try running “library(tidyverse)”
Tell me about any errors

Schedule, Day 1

Session	Topics	Duration
Session 1	Visualization and data science Intro, setup, basic ggplot2 syntax	9:30 a.m. – 10:35 a.m.
Morning break		10:35 a.m. – 10:50 a.m.
Session 2	Trying more charts	10:50 a.m. – 11:55 a.m.
Lunch		11:55 a.m. – 1:10 p.m.
Session 3	Customizing plots, saving charts out	1:10 p.m. – 2:15 p.m.
Afternoon break		2:15 p.m. – 2:30 p.m.
Session 4	Plot inheritance, advanced examples	2:30 p.m. – 3:35 p.m.
Q&A		3:35 p.m. – 3:40 p.m.

Schedule, Day 2

Session	Topics	Duration
Session 1	ggplot2 review, advanced techniques	9:30 a.m. – 10:35 a.m.
Morning break		10:35 a.m. – 10:50 a.m.
Session 2	Simple interactive plots	10:50 a.m. – 11:55 a.m.
Lunch		11:55 a.m. – 1:10 p.m.
Session 3	Intro to Shiny	1:10 p.m. – 2:15 p.m.
Afternoon break		2:15 p.m. – 2:30 p.m.
Session 4	Shiny examples and practice	2:30 p.m. – 3:35 p.m.
Q&A		3:35 p.m. – 3:40 p.m.

Set up environment

- R
- RStudio
- packages

Packages:

- **tidyverse**
- **readxl**
- **markdown**
- **knitr**
- **shiny**
- **plotly**
- DT
- crosstalk
- flexdashboard
- maps
- mapproj
- sf

Visualization for Data Science

Why visualize in R?

- Quickly explore data
- Save time switching to another tool
- Use charts to inspire new analyses and vice versa
- Reproducibility

Why care about reproducibility?

- Open science makes review easier
- Increasingly a requirement
- Saves you a lot of time trying to figure out what you did last time!

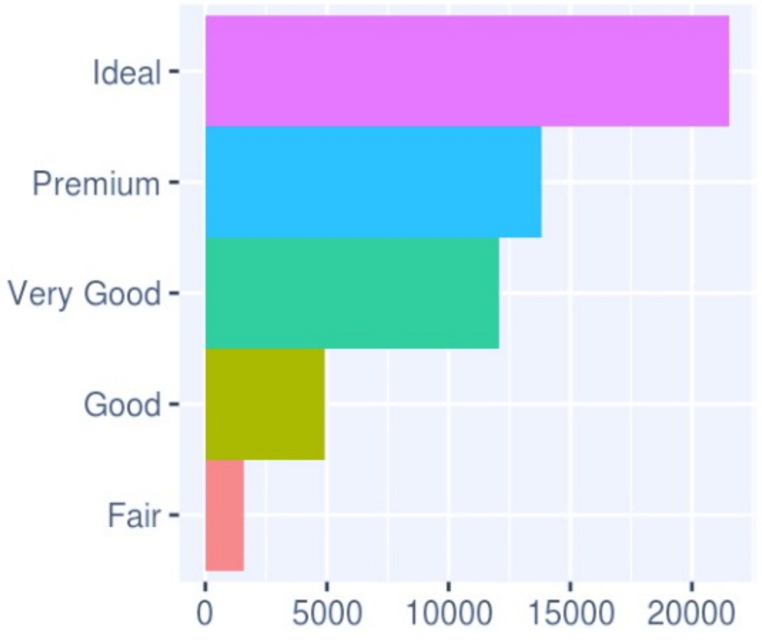
“Your closest collaborator is ***you*** *six months ago, but you don’t reply to emails.”*

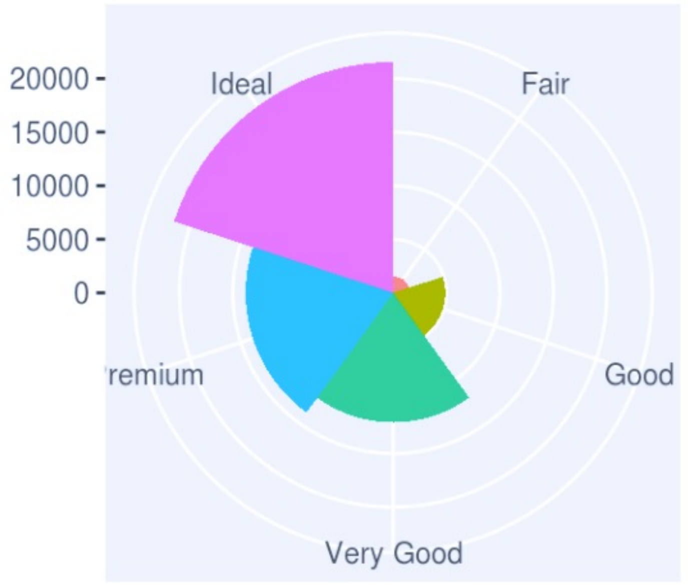
- Mark Holder

ggplot2

What is ggplot2?

an R package designed to create plots based on a theory of the grammar of graphics.





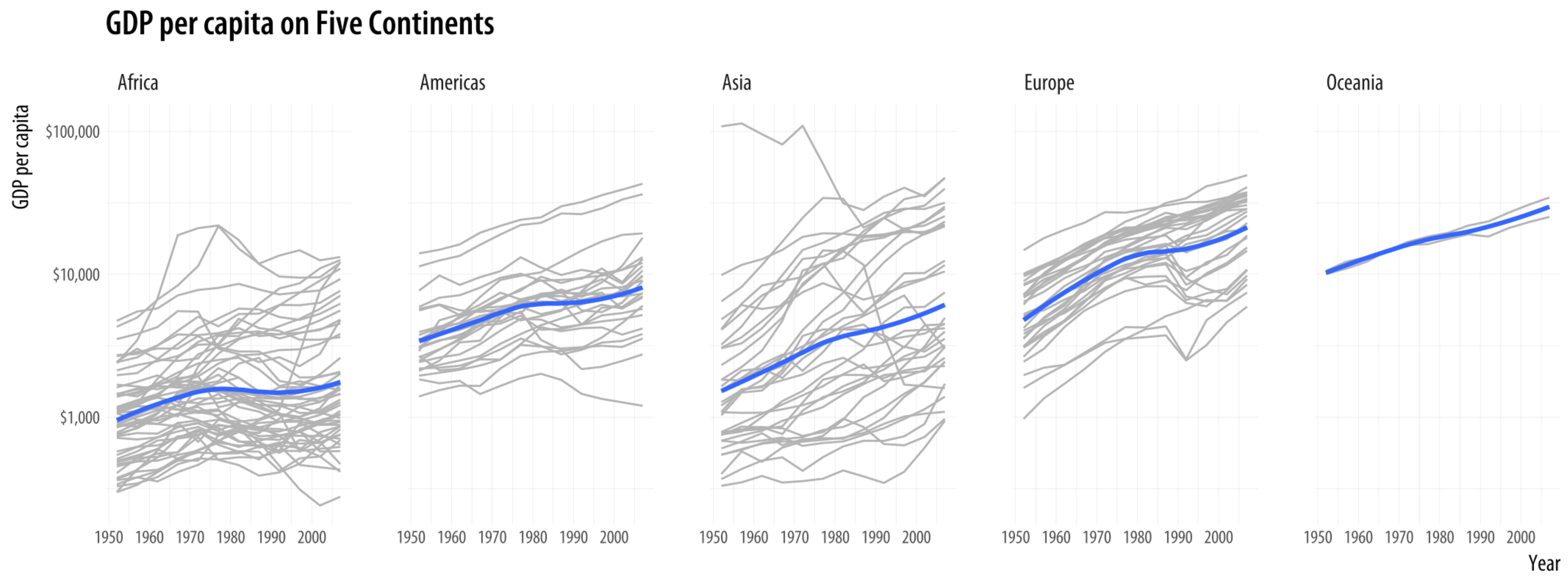
http://r4ds.had.co.nz/data-visualisation.html

Grammar of graphics

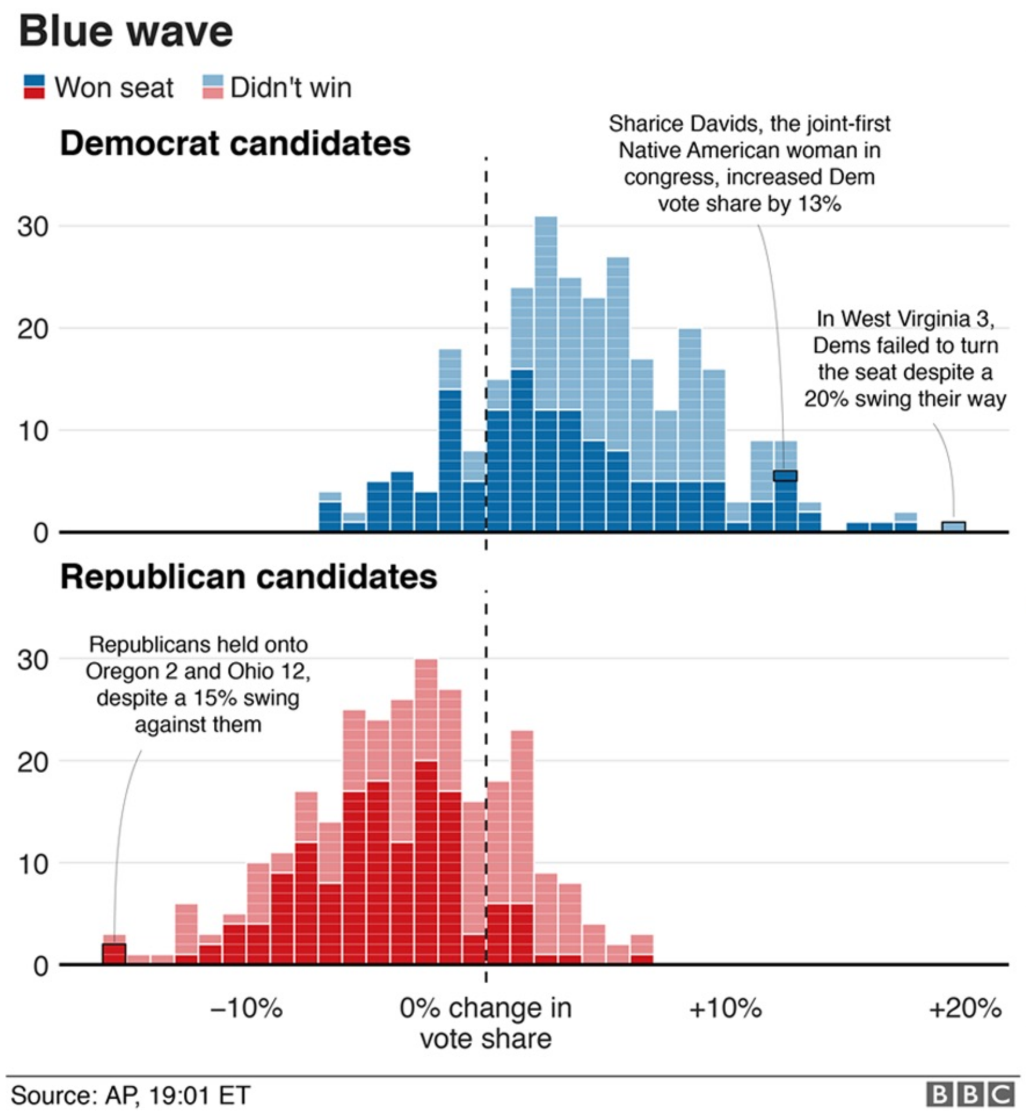
1. DATA: a set of data operations that create variables from datasets
2. TRANS: variable transformations (e.g., rank)
3. SCALE: scale transformations (e.g., log)
4. COORD: a coordinate system (e.g., polar)
5. ELEMENT: graphs (e.g., points) and their aesthetic attributes (e.g., color)
6. GUIDE: one or more guides (axes, legends, etc.).

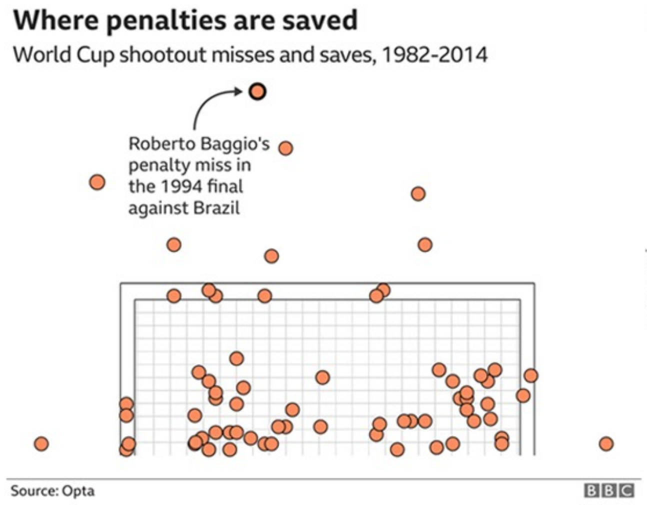
Wilkinson, Leland. (2005). *The grammar of graphics (2nd ed)*. New York: Springer.

ggplot2 examples

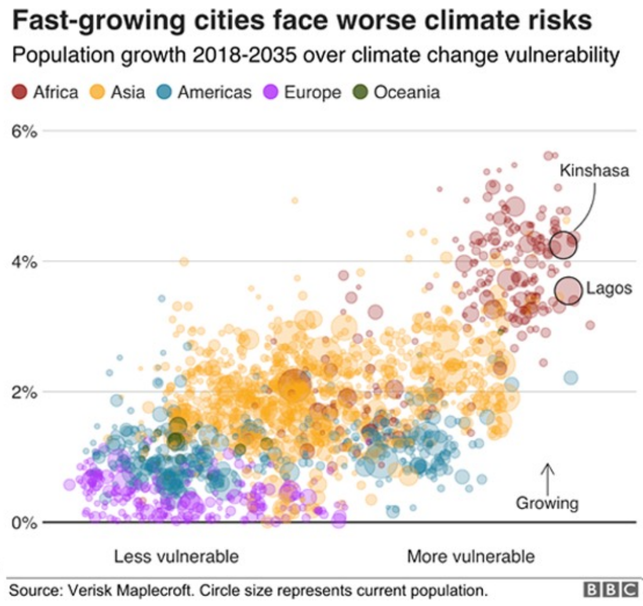


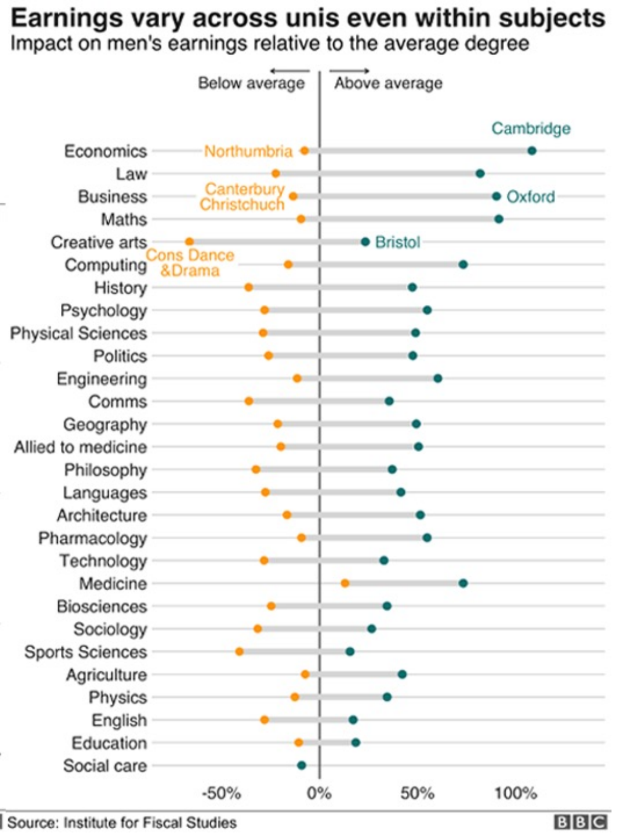
http://socviz.co/groupfacettx.html



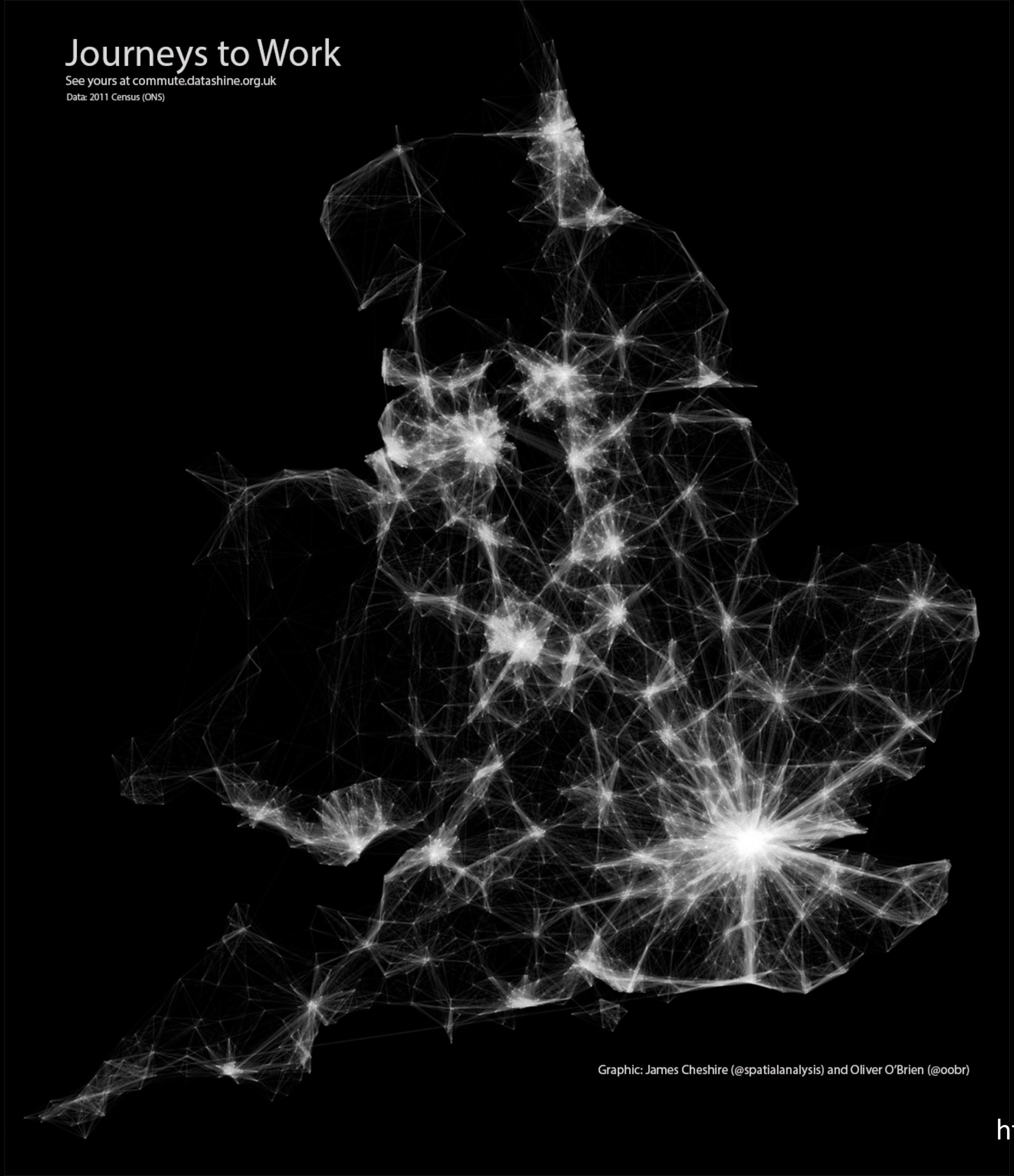


MPs rejected Theresa May's deal by 230 votes
For
Con (196)
202
Lab 3, Ind 3
Against
Con rebels (118)
Labour (248)
432
SNP 35, Lib Dem 11, DUP 10, Plaid 4, Green 1, Ind 5
Source: Commons Votes Services. Excludes 'tellers', the Speaker and deputies
BBC

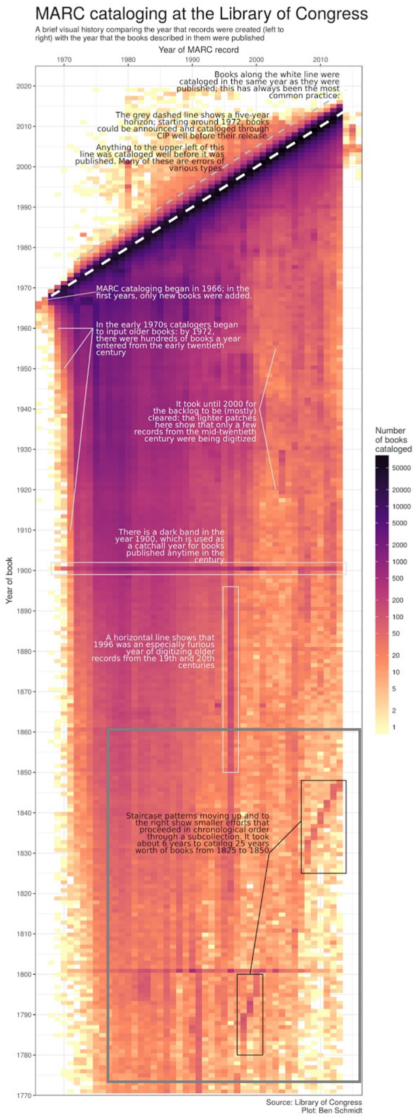




https://bbc.github.io/rcookbook/


Journeys to Work
See yours at commute.datashine.org.uk
Data: 2011 Census (ONS)
Graphic: James Cheshire (@spatialanalysis) and Oliver O'Brien (@oobr)

http://spatial.ly/2015/03/mapping-flows/


MARC cataloging at the Library of Congress

A brief visual history comparing the year that records were created (left to right) with the year that the books described in them were published

Books along the white line were cataloged in the same year as they were published; this has always been the most common practice.

The grey dashed line shows a five-year horizon; starting around 1972, books could be announced and cataloged through CIP well before their release.

Anything to the upper left of this line was cataloged well before it was published. Many of these are errors of various types.

MARC cataloging began in 1966; in the first years, only new books were added.

In the early 1970s catalogers began to input older books: by 1972, there were hundreds of books a year entered from the early twentieth century

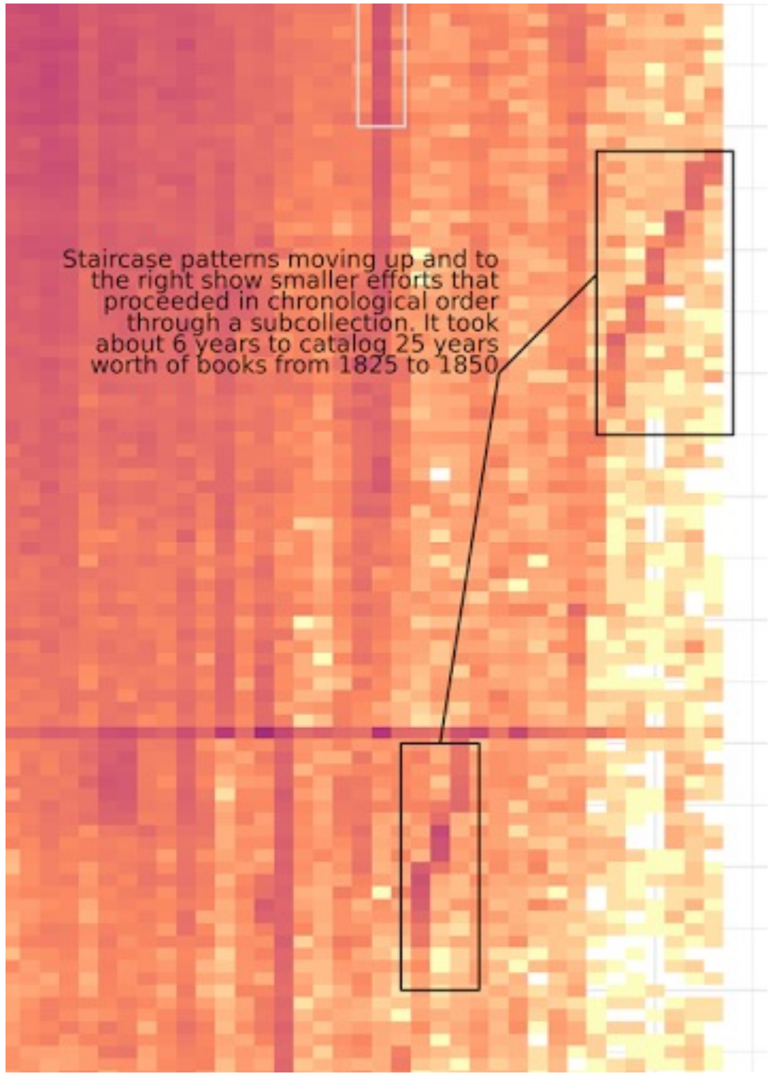
It took until 2000 for the backlog to be (mostly) cleared: the lighter patches here show that only a few records from the mid-twentieth century were being digitized

There is a dark band in the year 1900, which is used as a catchall year for books published anytime in the century

A horizontal line shows that 1996 was an especially furious year of digitizing older records from the 19th and 20th centuries

Staircase patterns moving up and to the right show smaller efforts that proceeded in chronological order through a subcollection. It took about 6 years to catalog 25 years worth of books from 1825 to 1850

Source: Library of Congress
Plot: Ben Schmidt


Staircase patterns moving up and to the right show smaller efforts that proceeded in chronological order through a subcollection. It took about 6 years to catalog 25 years worth of books from 1825 to 1850

http://sappingattention.blogspot.com/2017/05/a-brief-visual-history-of-marc.html

Why ggplot2 instead of base R?

- nice defaults
- easy faceting
- (arguably) more natural syntax
- can switch chart types more easily

“Why I use ggplot2”, David Robinson
http://varianceexplained.org/r/why-I-use-ggplot2/

R vs. Excel, Tableau, etc.

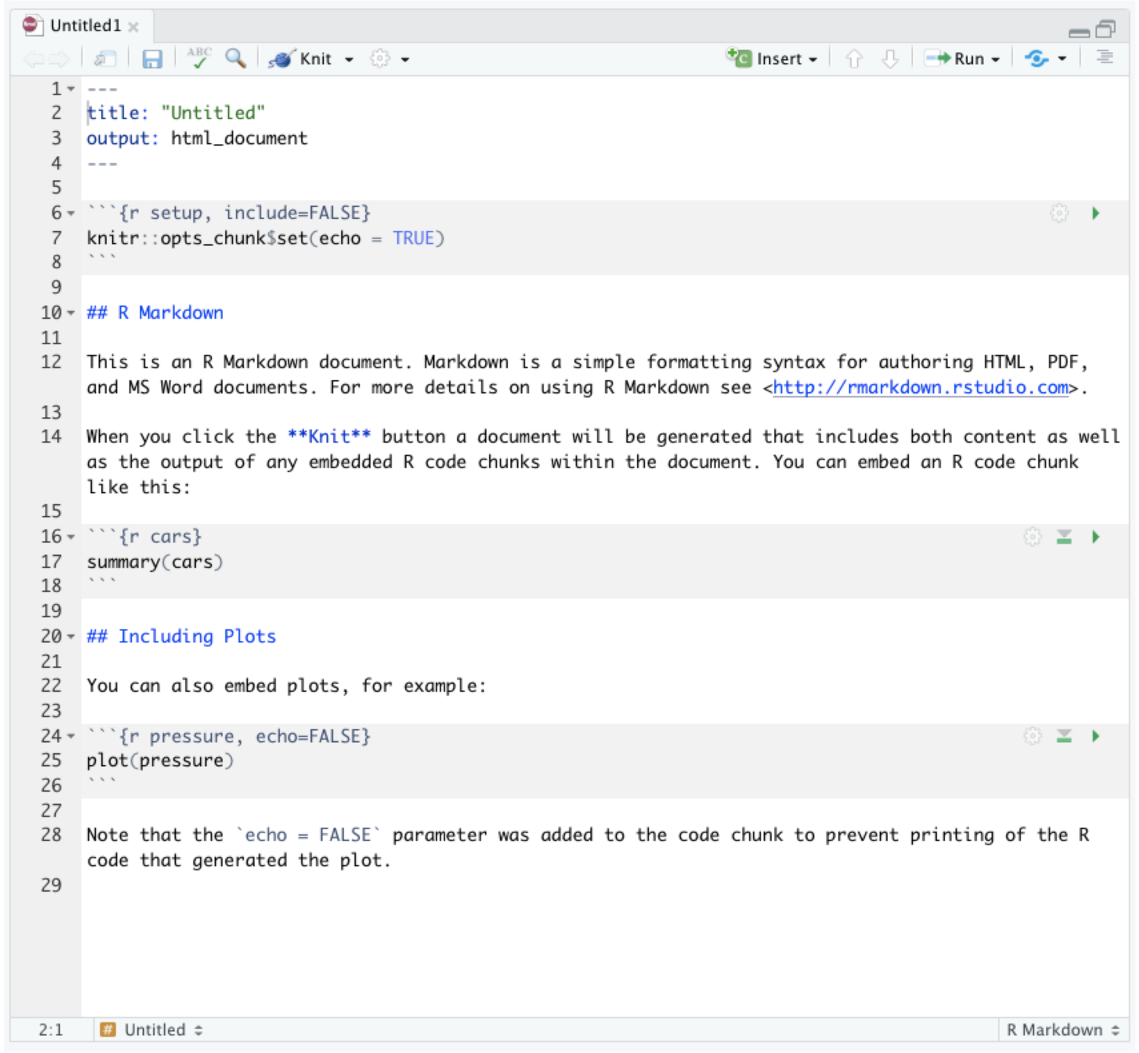
Questions to ask:

- Are you already using R? Why switch?
- Are you going to have to share this process or reproduce it? Try R!
- Is it a quick project, or will others work on it? Maybe Excel is fine.
- Do you need to try a bunch of charts quickly, build interactive components, etc.? Tableau might be more powerful and faster.

Working in RStudio

R Markdown files

- Blend "normal" text (using Markdown syntax for formatting) with code chunks and their output
- Can be compiled ("knit") into other formats (HTML, Word, PDF)
- Similar to Jupyter Notebooks for Python
- NB: The next generation of R Markdown is [Quarto]



~~~
---
title: "Untitled"
output: html_document
---

```{r setup, include=FALSE}
knitr::opts_chunk$set(echo = TRUE)
```

## R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF,
and MS Word documents. For more details on using R Markdown see <http://rmarkdown.rstudio.com>.

When you click the **Knit** button a document will be generated that includes both content as well
as the output of any embedded R code chunks within the document. You can embed an R code chunk
like this:

```{r cars}
summary(cars)
```

## Including Plots

You can also embed plots, for example:

```{r pressure, echo=FALSE}
plot(pressure)
```

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R
code that generated the plot.
~~~

Why R Markdown?

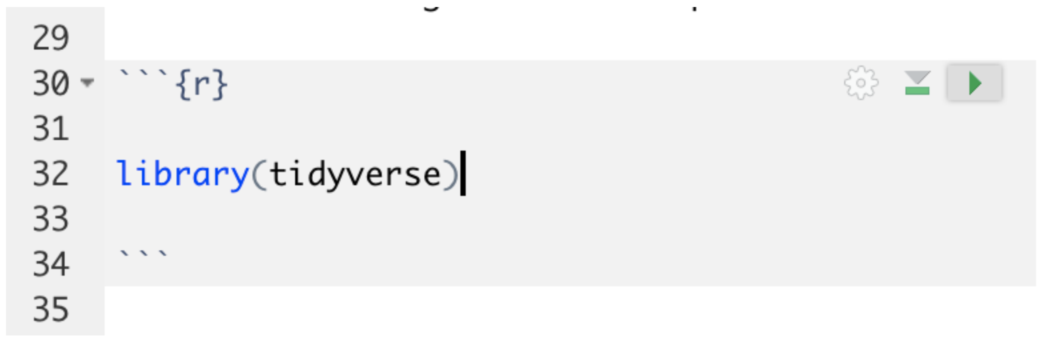
- Plots show up inline
- Easier to incorporate explanatory text and materials
- Like to be able to easily run one chunk at a time

Caution: Running things out of order can mean your code won’t work again later. Clear your environment often and run code chunks in order to be safe.

R Markdown test

- File → New File → R Markdown
- Click OK to accept defaults
- Type inside the first few lines to edit the YAML header (edit title, add author, etc.)
- Add a new R code chunk at the end of the file using Insert → R
- Type some R code inside the code chunk:

  library(tidyverse)
- Run the new code chunk



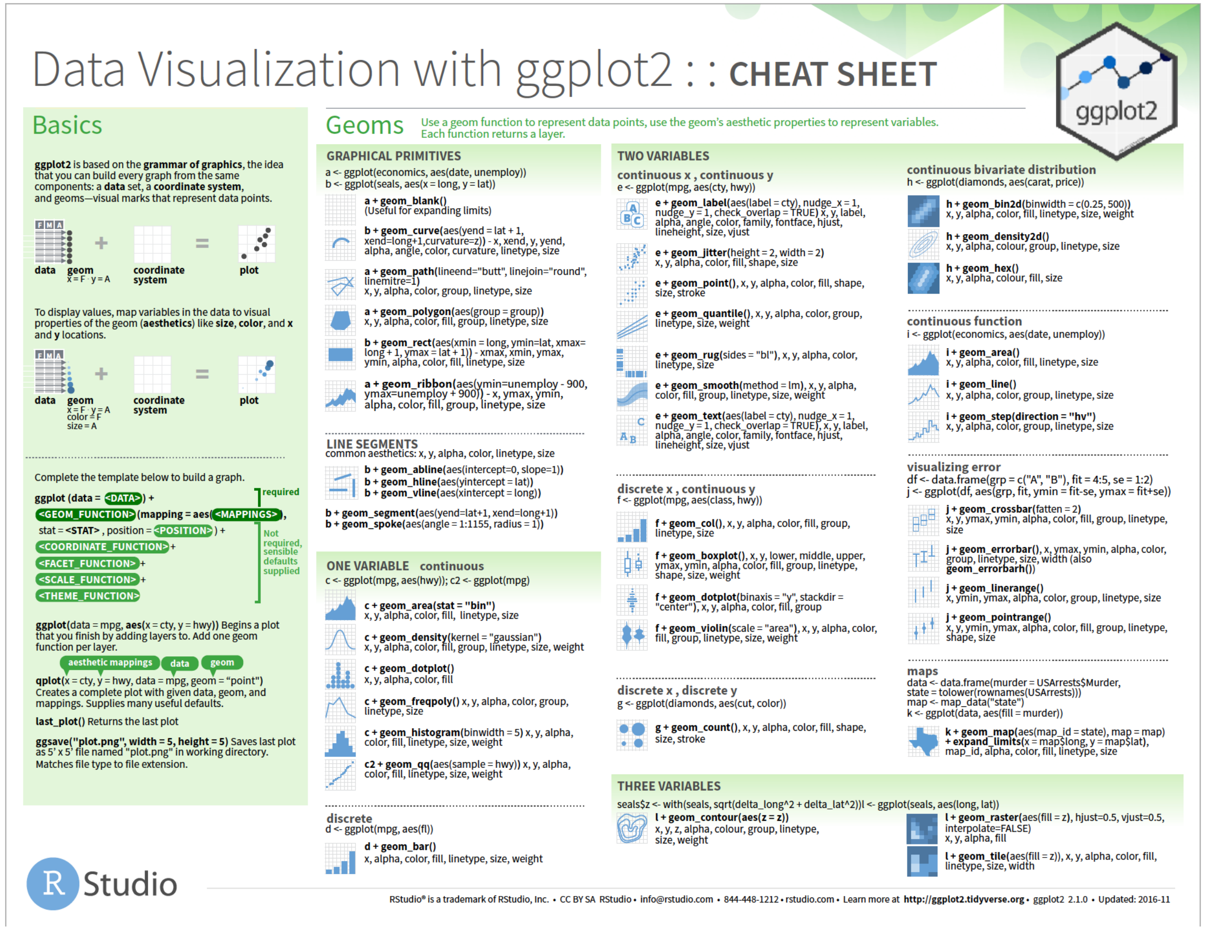
~~~
```{r}

library(tidyverse)

```
~~~

ggplot2 Cheat Sheet

Help →

Cheatsheets →

Data Visualization with ggplot2



Data Visualization with ggplot2 : : CHEAT SHEET

Basics

ggplot2 is based on the **grammar of graphics**, the idea that you can build every graph from the same components: a **data** set, a **coordinate system**, and geoms—visual marks that represent data points.

To display values, map variables in the data to visual properties of the geom (**aesthetics**) like **size**, **color**, and **x** and **y** locations.

Complete the template below to build a graph.

```
ggplot (data = <DATA>) +                                   required
<GEOM_FUNCTION>(mapping = aes(<MAPPINGS>),
 stat = <STAT> , position = <POSITION>) +                  Not
<COORDINATE_FUNCTION> +                                    required,
<FACET_FUNCTION> +                                         sensible
<SCALE_FUNCTION> +                                         defaults
<THEME_FUNCTION>                                           supplied
```

ggplot(data = mpg, **aes**(x = cty, y = hwy)) Begins a plot that you finish by adding layers to. Add one geom function per layer.

aesthetic mappings · data · geom

qplot(x = cty, y = hwy, data = mpg, geom = "point") Creates a complete plot with given data, geom, and mappings. Supplies many useful defaults.

last_plot() Returns the last plot

ggsave("plot.png", width = 5, height = 5) Saves last plot as 5' x 5' file named "plot.png" in working directory. Matches file type to file extension.

Geoms

Use a geom function to represent data points, use the geom's aesthetic properties to represent variables. Each function returns a layer.

GRAPHICAL PRIMITIVES

a <- ggplot(economics, aes(date, unemploy))
b <- ggplot(seals, aes(x = long, y = lat))

a + geom_blank()
(Useful for expanding limits)

b + geom_curve(aes(yend = lat + 1, xend=long+1,curvature=z)) - x, xend, y, yend, alpha, angle, color, curvature, linetype, size

a + geom_path(lineend="butt", linejoin="round", linemitre=1)
x, y, alpha, color, group, linetype, size

a + geom_polygon(aes(group = group))
x, y, alpha, color, fill, group, linetype, size

b + geom_rect(aes(xmin = long, ymin=lat, xmax= long + 1, ymax = lat + 1)) - xmax, xmin, ymax, ymin, alpha, color, fill, linetype, size

a + geom_ribbon(aes(ymin=unemploy - 900, ymax=unemploy + 900)) - x, ymax, ymin, alpha, color, fill, group, linetype, size

LINE SEGMENTS
common aesthetics: x, y, alpha, color, linetype, size

b + geom_abline(aes(intercept=0, slope=1))
b + geom_hline(aes(yintercept = lat))
b + geom_vline(aes(xintercept = long))

b + geom_segment(aes(yend=lat+1, xend=long+1))
b + geom_spoke(aes(angle = 1:1155, radius = 1))

ONE VARIABLE continuous
c <- ggplot(mpg, aes(hwy)); c2 <- ggplot(mpg)

c + geom_area(stat = "bin")
x, y, alpha, color, fill, linetype, size

c + geom_density(kernel = "gaussian")
x, y, alpha, color, fill, group, linetype, size, weight

c + geom_dotplot()
x, y, alpha, color, fill

c + geom_freqpoly() x, y, alpha, color, group, linetype, size

c + geom_histogram(binwidth = 5) x, y, alpha, color, fill, linetype, size, weight

c2 + geom_qq(aes(sample = hwy)) x, y, alpha, color, fill, linetype, size, weight

discrete
d <- ggplot(mpg, aes(fl))

d + geom_bar()
x, alpha, color, fill, linetype, size, weight

TWO VARIABLES

continuous x , continuous y
e <- ggplot(mpg, aes(cty, hwy))

e + geom_label(aes(label = cty), nudge_x = 1, nudge_y = 1, check_overlap = TRUE) x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

e + geom_jitter(height = 2, width = 2)
x, y, alpha, color, fill, shape, size

e + geom_point(), x, y, alpha, color, fill, shape, size, stroke

e + geom_quantile(), x, y, alpha, color, group, linetype, size, weight

e + geom_rug(sides = "bl"), x, y, alpha, color, linetype, size

e + geom_smooth(method = lm), x, y, alpha, color, fill, group, linetype, size, weight

e + geom_text(aes(label = cty), nudge_x = 1, nudge_y = 1, check_overlap = TRUE), x, y, label, alpha, angle, color, family, fontface, hjust, lineheight, size, vjust

discrete x , continuous y
f <- ggplot(mpg, aes(class, hwy))

f + geom_col(), x, y, alpha, color, fill, group, linetype, size

f + geom_boxplot(), x, y, lower, middle, upper, ymax, ymin, alpha, color, fill, group, linetype, shape, size, weight

f + geom_dotplot(binaxis = "y", stackdir = "center"), x, y, alpha, color, fill, group

f + geom_violin(scale = "area"), x, y, alpha, color, fill, group, linetype, size, weight

discrete x , discrete y
g <- ggplot(diamonds, aes(cut, color))

g + geom_count(), x, y, alpha, color, fill, shape, size, stroke

continuous bivariate distribution
h <- ggplot(diamonds, aes(carat, price))

h + geom_bin2d(binwidth = c(0.25, 500))
x, y, alpha, color, fill, linetype, size, weight

h + geom_density2d()
x, y, alpha, colour, group, linetype, size

h + geom_hex()
x, y, alpha, colour, fill, size

continuous function
i <- ggplot(economics, aes(date, unemploy))

i + geom_area()
x, y, alpha, color, fill, linetype, size

i + geom_line()
x, y, alpha, color, group, linetype, size

i + geom_step(direction = "hv")
x, y, alpha, color, group, linetype, size

visualizing error
df <- data.frame(grp = c("A", "B"), fit = 4:5, se = 1:2)
j <- ggplot(df, aes(grp, fit, ymin = fit-se, ymax = fit+se))

j + geom_crossbar(fatten = 2)
x, y, ymax, ymin, alpha, color, fill, group, linetype, size

j + geom_errorbar(), x, ymax, ymin, alpha, color, group, linetype, size, width (also **geom_errorbarh()**)

j + geom_linerange()
x, ymin, ymax, alpha, color, group, linetype, size

j + geom_pointrange()
x, y, ymin, ymax, alpha, color, fill, group, linetype, shape, size

maps
data <- data.frame(murder = USArrests$Murder,
state = tolower(rownames(USArrests)))
map <- map_data("state")
k <- ggplot(data, aes(fill = murder))

k + geom_map(aes(map_id = state), map = map)
+ expand_limits(x = map$long, y = map$lat),
map_id, alpha, color, fill, linetype, size

THREE VARIABLES
seals$z <- with(seals, sqrt(delta_long^2 + delta_lat^2))l <- ggplot(seals, aes(long, lat))

l + geom_contour(aes(z = z))
x, y, z, alpha, colour, group, linetype, size, weight

l + geom_raster(aes(fill = z), hjust=0.5, vjust=0.5, interpolate=FALSE)
x, y, alpha, fill

l + geom_tile(aes(fill = z)), x, y, alpha, color, fill, linetype, size, width

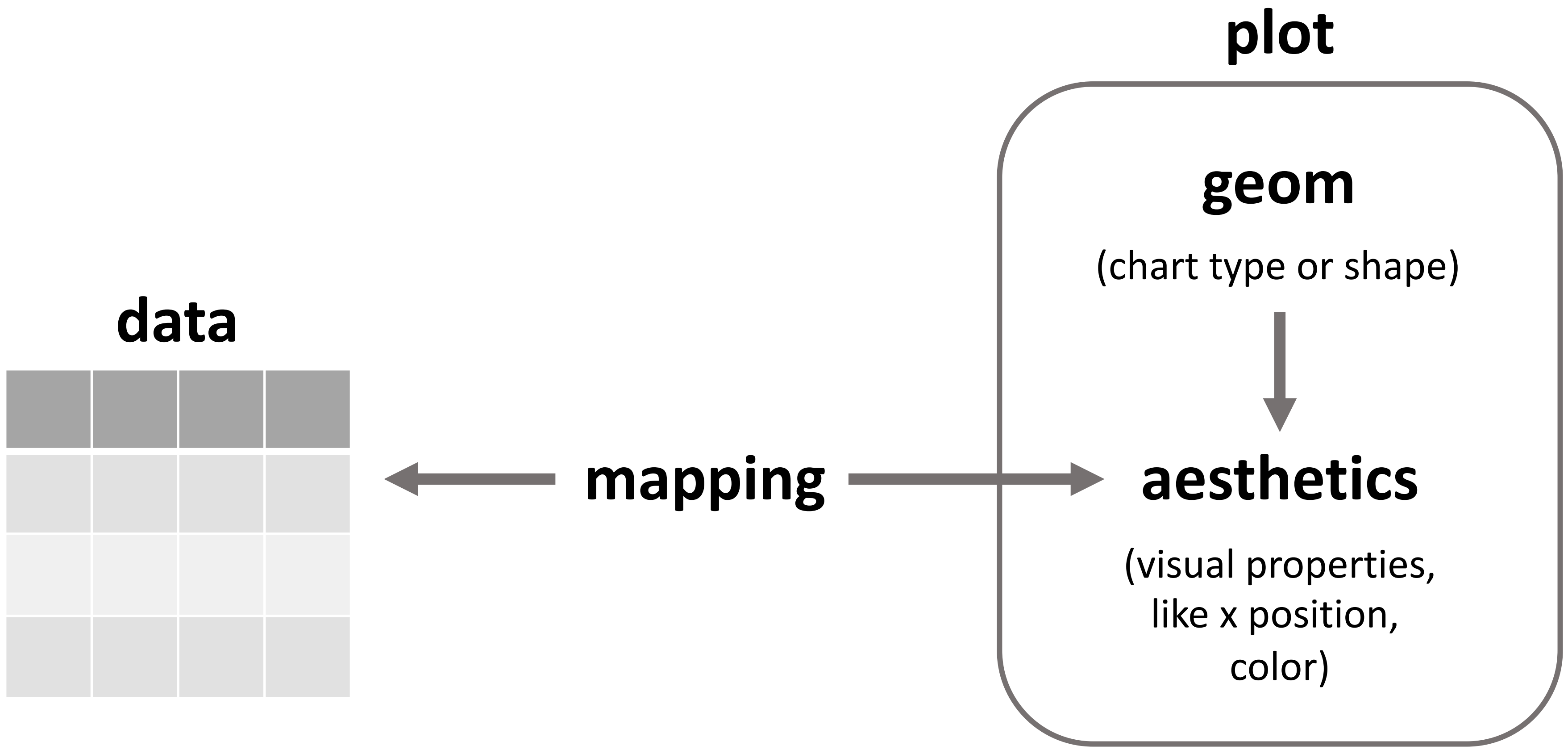
RStudio

RStudio® is a trademark of RStudio, Inc. • CC BY SA RStudio • info@rstudio.com • 844-448-1212 • rstudio.com • Learn more at **http://ggplot2.tidyverse.org** • ggplot2 2.1.0 • Updated: 2016-11

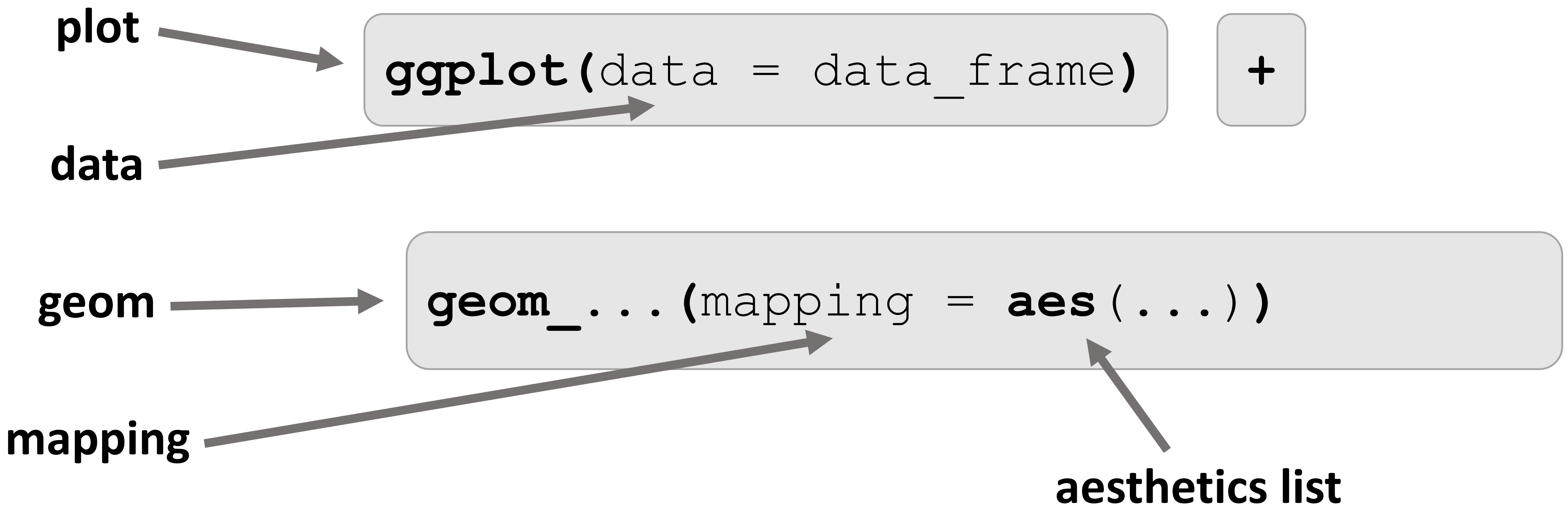
https://www.rstudio.com/resources/cheatsheets/#ggplot2

ggplot2: making a basic plot

Basic elements in any ggplot2 visualization



Template for a simple plot



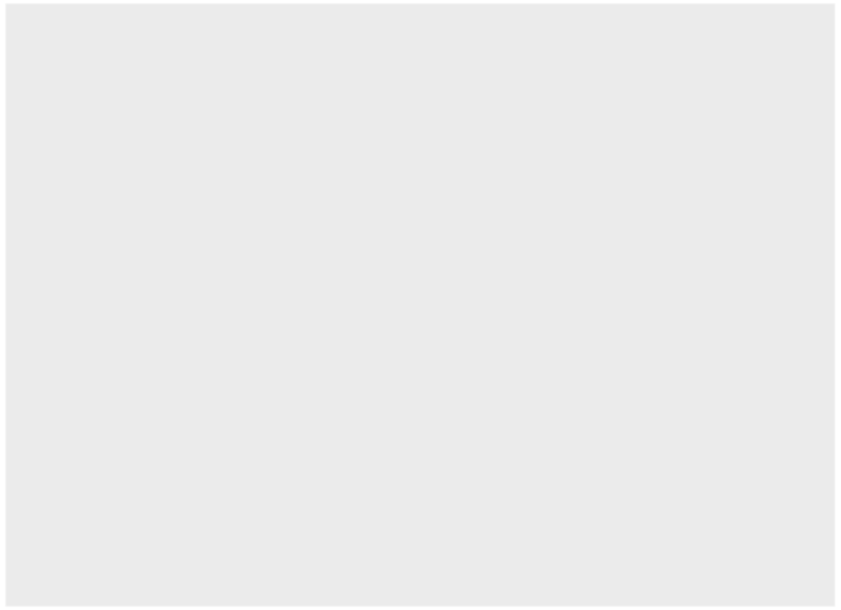
```
ggplot(data = data_frame)  +

geom_...(mapping = aes(...))
```

1. Set the data

"iris"

Petal.Width	Petal.Length	Species
0.3	1.4	setosa
1.3	4.0	versicolor
2.1	5.7	virginica

```
ggplot(data=iris)
```



2. Choose a shape layer

"iris"

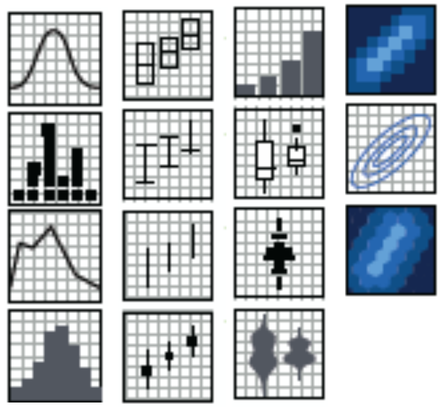
Petal.Width	Petal.Length	Species
0.3	1.4	setosa
1.3	4.0	versicolor
2.1	5.7	virginica

```
ggplot(data=iris) +
 geom_point()
```

```
Error: geom_point requires
the following missing
aesthetics: x and y
```

Types of geoms

- geom_bar()
- geom_point()
- geom_histogram()
- geom_map()
- etc.



http://bit.ly/ggplot2-cheatsheet

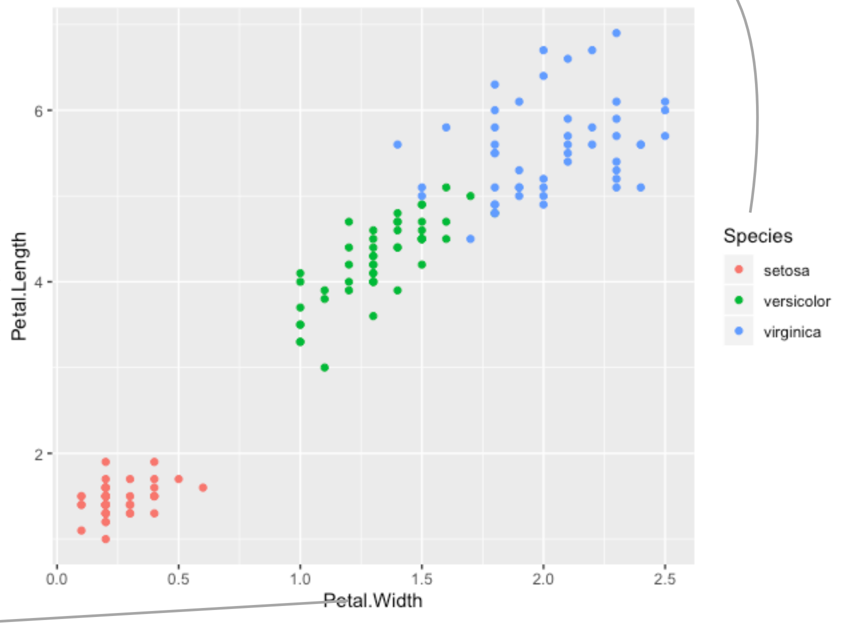
3. Map variables to aesthetics

"iris"

Petal.Width	Petal.Length	Species
0.3	1.4	setosa
1.3	4.0	versicolor
2.1	5.7	virginica

x position   y position   color

```
ggplot(data=iris) +
  geom_point(
     mapping=aes(x=Petal.Width,
                            y=Petal.Length,
                            color=Species))
```

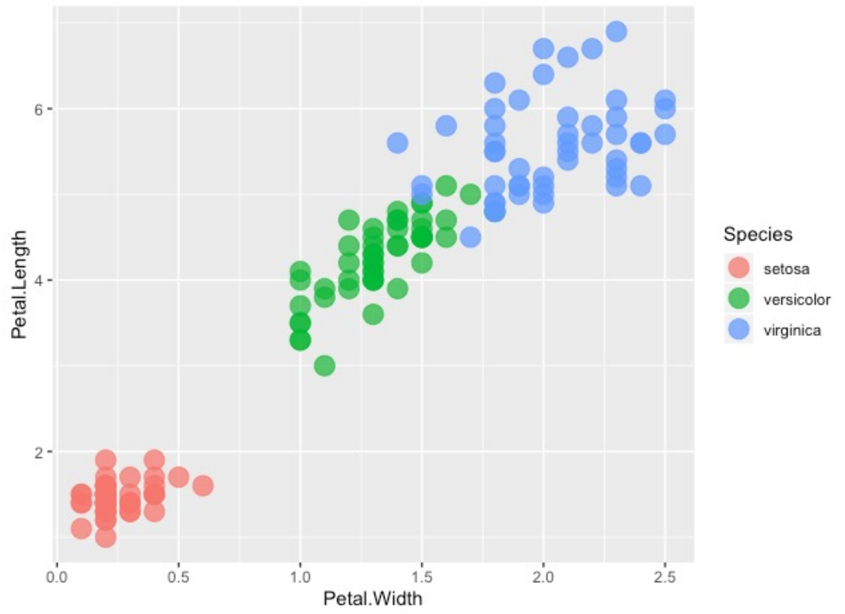


4. Add non-variable adjustments

"iris"

Petal.Width	Petal.Length	Species
0.3	1.4	setosa
1.3	4.0	versicolor
2.1	5.7	virginica

```
ggplot(data=iris) +
  geom_point(
     mapping=aes(x=Petal.Width,
                         y=Petal.Length,
                         color=Species),
     size=5, alpha=.75)
```



Debugging code

- Start simple
- If you see an error:
    - read error message for hints
    - check for problems with spelling/punctuation marks
- Get code to run without errors
- Check result to see if it makes sense

- Add a small change
- Get code to run without errors
- Check result to see if it makes sense
- etc.

Morning Break

Exercise 1: Inclusiveness Index

https://belonging.berkeley.edu/inclusivenessindex

Get workshop files

URL: https://github.com/amzoss/RVis-2Day

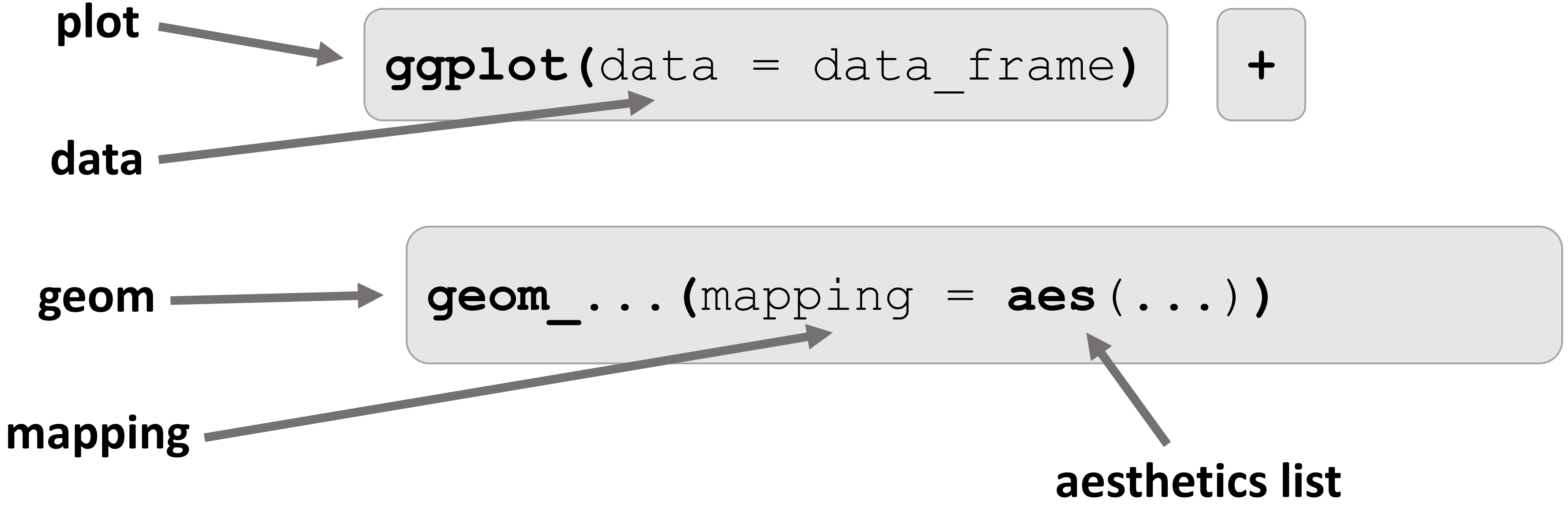
On GitHub:

- Click green “Code” button and select “Download ZIP”
- Unzip files on your laptop
  - Windows: Double-click, then look for “Extract Files” at the top
  - Mac: Double-click

In RStudio:

- Project → New project…
- Existing directory
- Select unzipped folder
- Create Project

Template for a simple plot

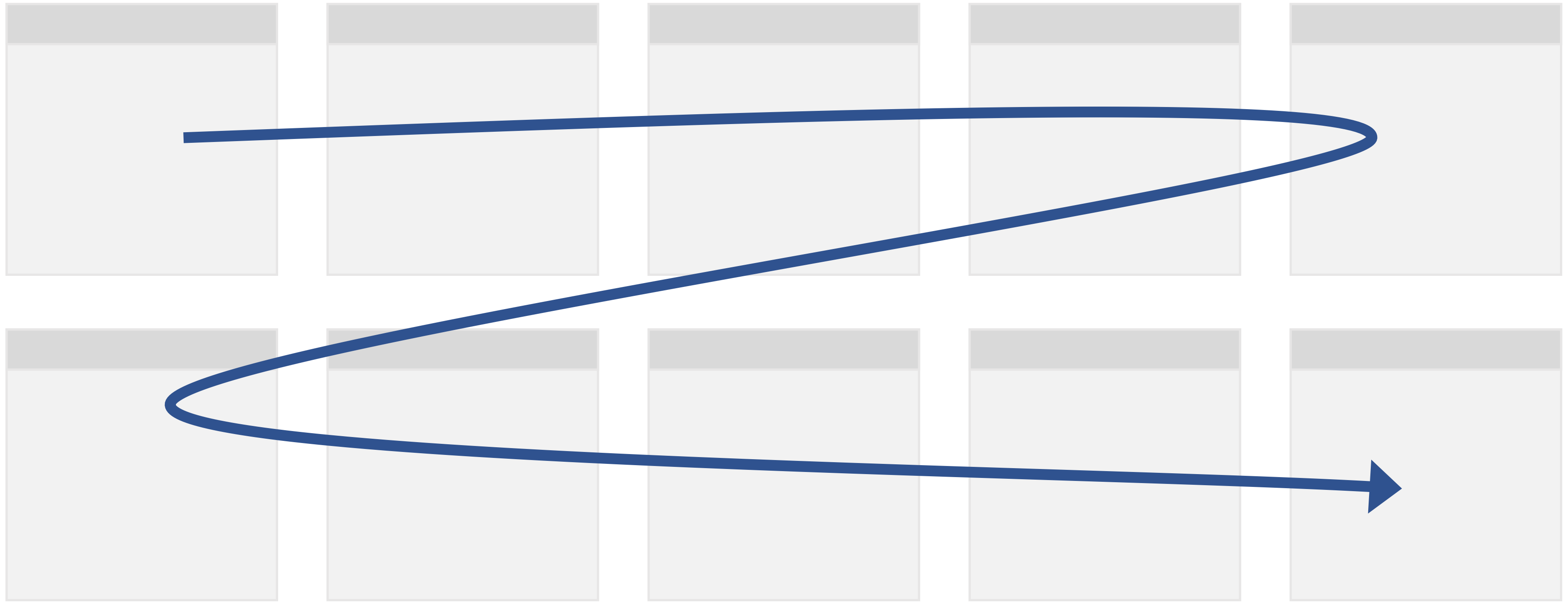


```
ggplot(data = data_frame)  +

geom_...(mapping = aes(...))
```

Creating repeated charts

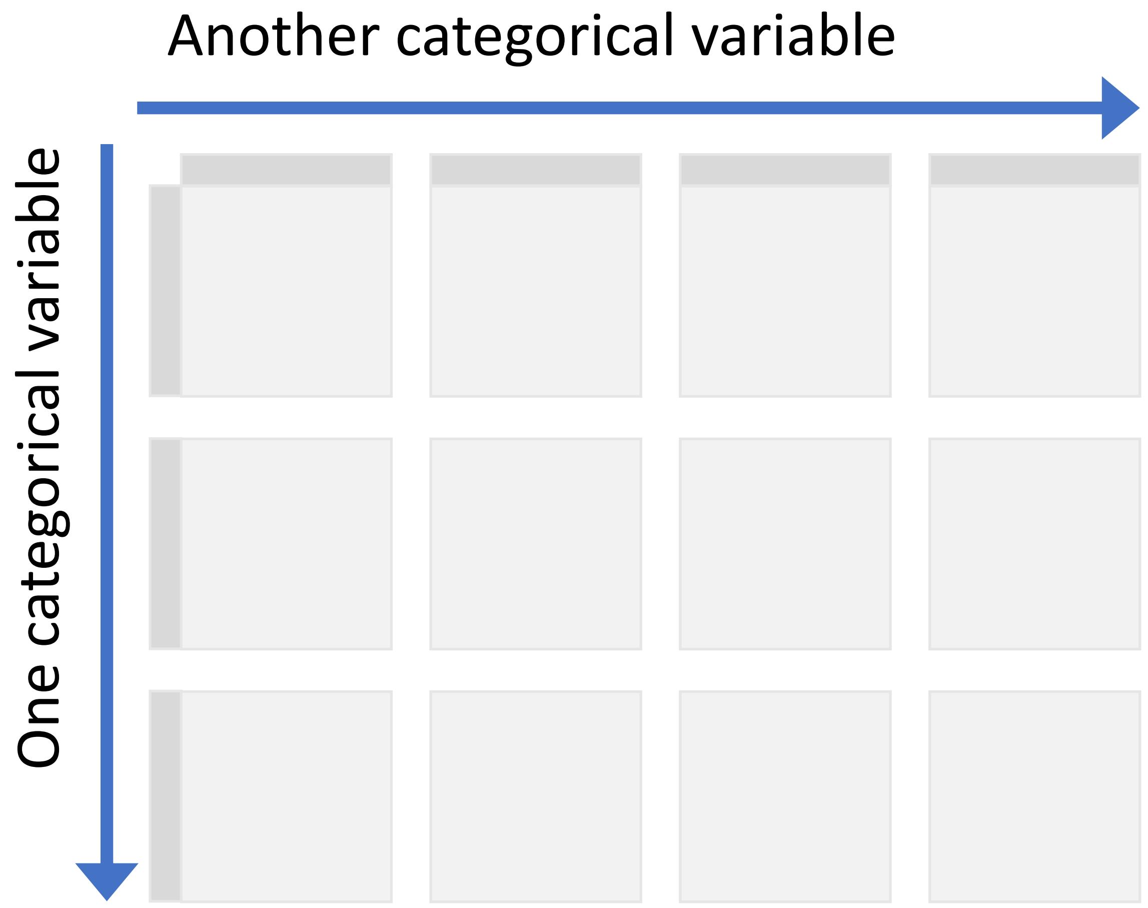
facet_wrap()

```
+ facet_wrap(vars(variable))
```



facet_grid()

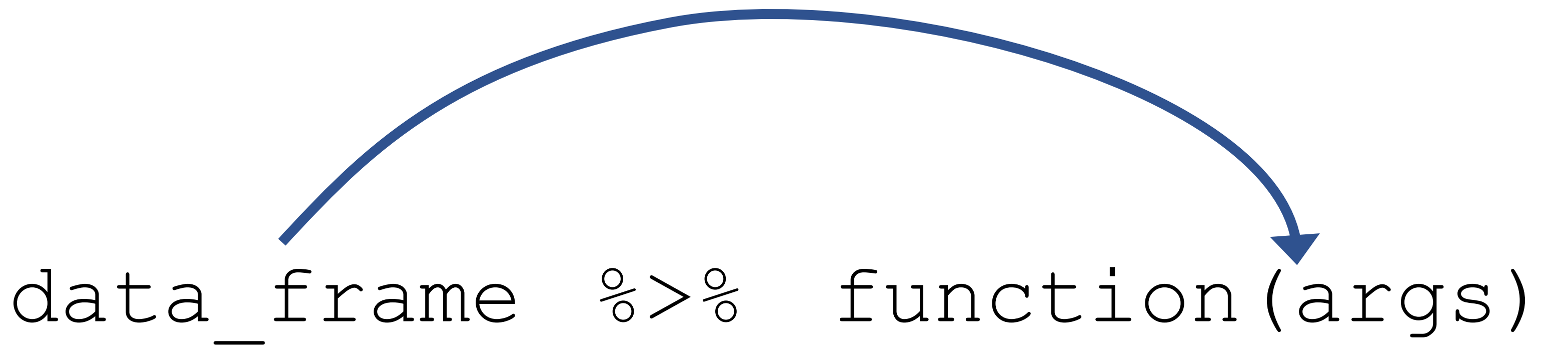
```
+ facet_grid(rows=vars(yvar,
             cols=vars(xvar))
```



Helpful data manipulation

Note: about %>%

- Loads automatically with tidyverse
- Used throughout tidyverse (except for ggplot2)
- Pushes data from the left into the function on the right



```
data_frame  %>%  function(args)
```

filter

Select a subset of rows

```
data %>% dplyr::filter(name == "John")
```

same as

```
dplyr::filter(data, name == "John")
```

https://www.rstudio.com/resources/cheatsheets/#dplyr

select

Select a subset of columns (many options!)

```
data %>% dplyr::select(id, name, age)
```

```
data %>% dplyr::select(-count)
```

https://www.rstudio.com/resources/cheatsheets/#dplyr

drop_na

Remove rows with NA values, either in any column or in specified columns

```
data %>% drop_na()
```

```
data %>% drop_na(age)
```

https://www.rstudio.com/resources/cheatsheets/ (Data Import with Tidyr Cheatsheet)

count

Take a dataset, group it by one or more variables, and count the number of rows grouped. Count will be stored in a variable called “n”.

```
data %>% count(sex)
```

```
data %>% count(sex, marital_status)
```

sex	**n**
m	23
f	45

sex	**marital_status**	**n**
m	married	18
m	unmarried	5
f	married	31
f	unmarried	14

https://www.rstudio.com/resources/cheatsheets/ (Data Transformation Cheatsheet)

Lunch

Exercise 2: Customizing charts

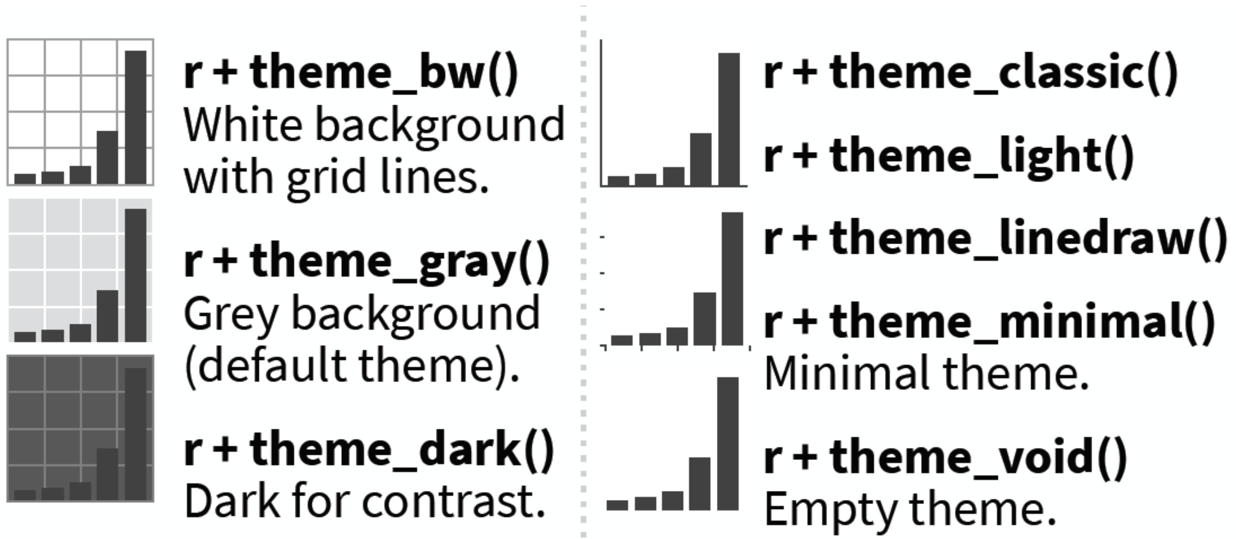
Scales

- Scales control how an aesthetics mapping displays in the chart, e.g.:
  - the labels that show up on the axis
  - the number of example sizes in a size legend
  - the colors used for a “fill” or “color” mapping
- Modify these properties by adding a scale layer to the chart

```
scale_x_continuous()
scale_y_log10()
scale_fill_discrete()
```

Themes

- Themes control properties of various visual elements, including:
  - Axis titles, text, ticks, lines
  - Plot colors, margins, text
  - Legend colors, margins, text
- Can add built-in themes as new layers, override specific theme elements, or build your own custom theme



r + theme_bw()
White background with grid lines.

r + theme_gray()
Grey background (default theme).

r + theme_dark()
Dark for contrast.

r + theme_classic()

r + theme_light()

r + theme_linedraw()

r + theme_minimal()
Minimal theme.

r + theme_void()
Empty theme.

https://github.com/rstudio/cheatsheets/blob/master/data-visualization-2.1.pdf

geom vs. scale vs. theme

Adding something that will appear
inside the **chart coordinate space**?

You will (almost always) be adding a **geom**!

Changing the way a **variable is displayed**?
(e.g., different axis breaks, different color mapping)

You will be adding a **scale**!

Changing the **look and feel** of the chart?

You will be adding or making changes to a **theme!**

More practice: Advanced ggplot2 workshop

Workshop video

Workshop materials

Accessibility

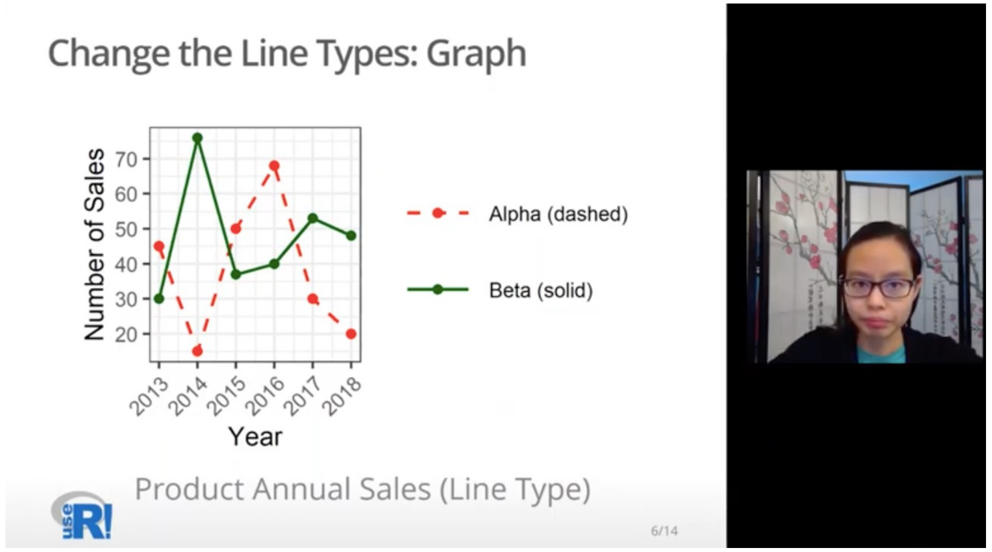
Low Vision

- Large text
  - See “output-examples” file for more sample code
- High color contrast
  - Both marks/text on background and labels on marks
  - Check with savonliquide package

Color Vision Deficiency

Use dual encoding (never just color)

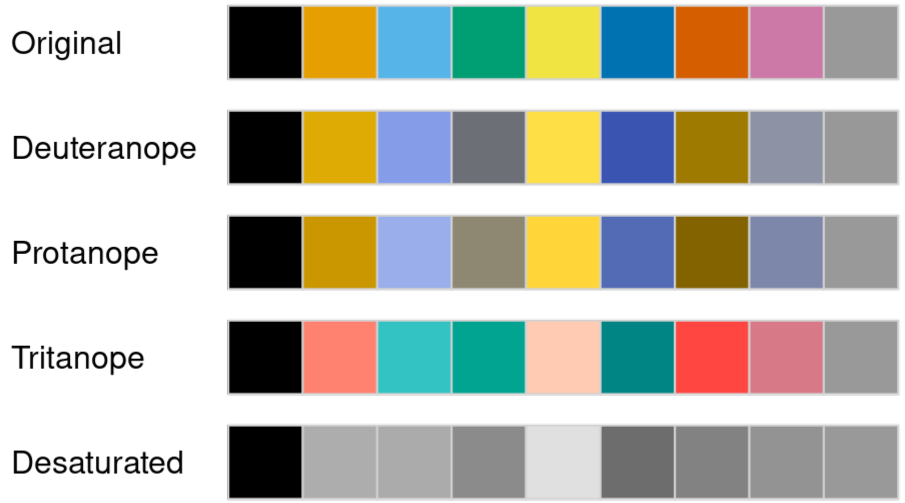
- Line color – also vary line type
- Point color – also vary point shape



https://www.youtube.com/watch?v=mbi_JVC1arM

Use safe color palettes

- colorspace package



http://colorspace.r-forge.r-project.org/index.html

All graphics need alternative text for screen reader users.

alt= “**Chart type** of **type of data** where **reason for including chart**”

Include a **link to data source** somewhere in the text

[Writing alt text for data visualization/]()

Alternative Text in R and R Markdown

- ggplot2 now has alt option in labs(); gets read by shiny but not knitr
- in the meantime, use fig.alt in code chunk (new, just for HTML output)
  - can use fig.cap in code chunk as a backup, but will display in page
- embedded images in the Markdown:

```
![alt text or image title](path/to/image)
```

Note: Alt text should be relatively short.
For longer descriptions, use the savonliquide package

Converting graphics to sound, touch, text

- sonify package
- tactileR package
- BrailleR package
  - Note: set plot title, subtitle, caption using labs()

Accessible Data Science for the Blind Using R

Accessibility Resources

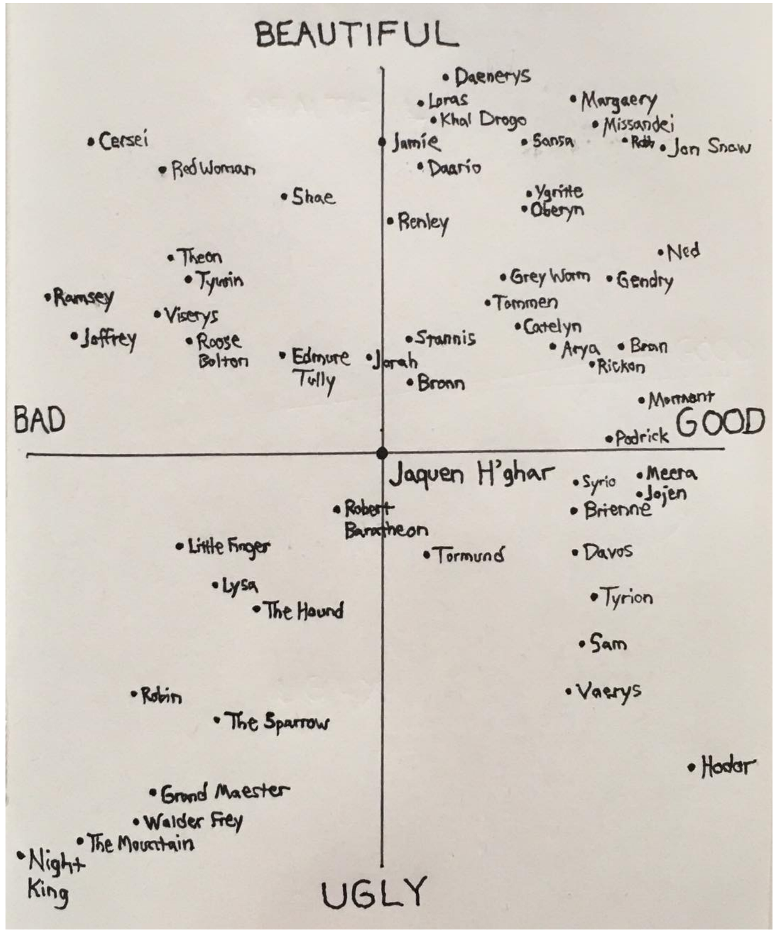
- savonliquide package
- Making betteR figures: Accessibility and Universal Design
- Highlights from the DVS accessibility fireside chat

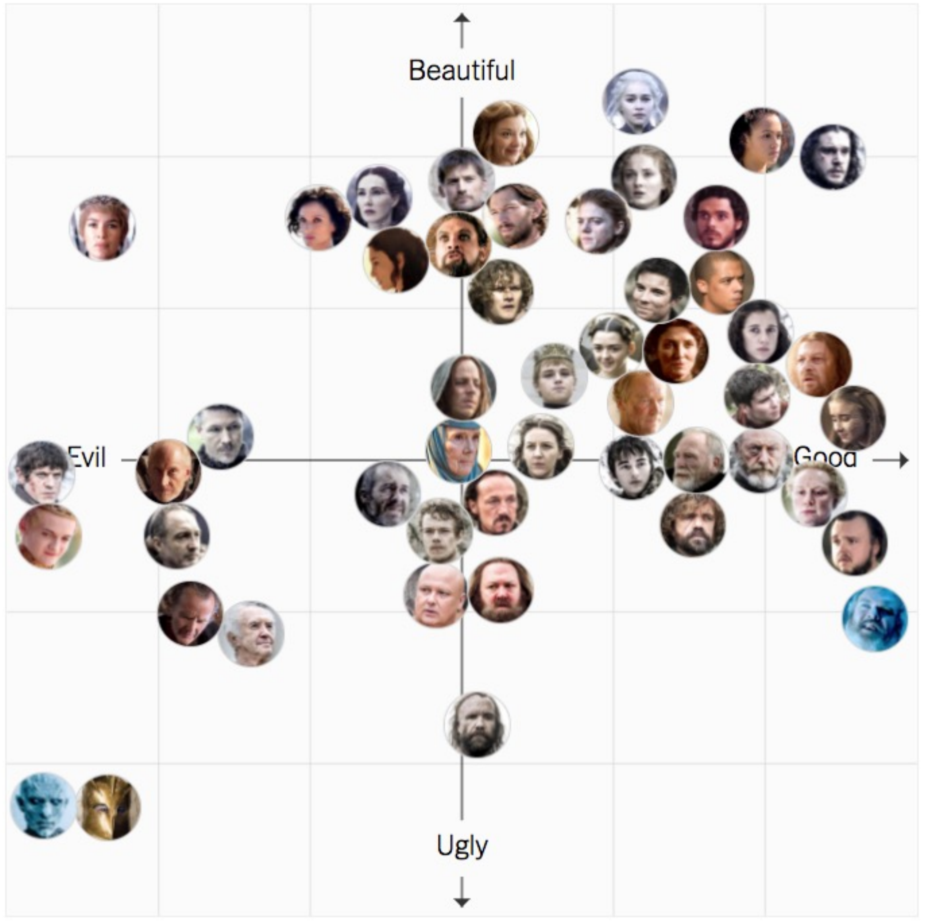
Afternoon Break

Exercise 3: Game of Thrones character ratings

https://www.nytimes.com/interactive/2017/08/09/upshot/game-of-thrones-chart.html

Game of Thrones character ratings





https://www.instagram.com/p/BWnn-YogX1n/

https://www.nytimes.com/interactive/2017/08/09/upshot/game-of-thrones-chart.html

ggplot2: inheritance

Template for a simple plot (review)

main plot function

```
ggplot(data = data_frame)  +
```

shape layer

```
geom_...(mapping = aes(...),
                 non-variable adjustments)
```

Expanded template

main plot function

```
ggplot(data = data_frame,
            mapping = aes(...))
```

+

shape layer

```
geom_...(data = data_frame,
               mapping = aes(...),
               non-variable adjustments)
```

Inheritance

data and aesthetics will carry through from main function to shape layers

main plot function

```
ggplot(data = data_frame,
          mapping = aes(...))
```

+

shape layer

```
geom_...(data = data_frame,
            mapping = aes(...),
            non-variable adjustments)
```

+

shape layer

```
geom_...(data = data_frame,
            mapping = aes(...),
            non-variable adjustments)
```

Advanced topics: Mapping examples

Mapping resources

- tigris for downloading TIGER/Line shapefiles
- sf (simple features) for spatial tables
    - Spatial Data Science book
    - Spatial Data Science in the tidyverse slides
    - Spatial Data Science in the tidyverse video

Other helper packages

- gganonymize to randomize text in ggplot2 figures
- visdat to visualize variable classes and missing data
- ggthemes for additional themes and scales, especially ones that match software defaults (e.g., Tableau)
- esquisse for building ggplot2 charts interactively
- colorblindr for simulating color vision deficiency
- ggpubr for publication-ready plots

ggplot2 Resources

- General ggplot2 information
  http://ggplot2.tidyverse.org/
- R Graphics Cookbook (recipes for plots)
  http://www.cookbook-r.com/Graphs/index.html
- R for Data Science (online book that includes ggplot2)
  http://r4ds.had.co.nz/
- ggplot2: Elegant Graphs for Data Analysis (book by Hadley Wickham)
  http://ggplot2.org/book/
- ggplot2 cheatsheet (also in RStudio)
  http://bit.ly/ggplot2-cheatsheet
- Data Carpentry lesson on ggplot2
- Data Visualization: A Practical Introduction, by Kieran Healy
- RStudio “Visualize Data” Primer

Thanks for your feedback!

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ggplot2: Chart quirks

See “templates” file

Chart components/slots

Bar chart, for example:

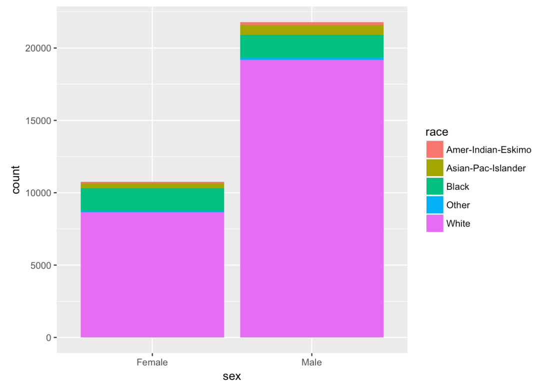
- x
  category (the names of the bars)

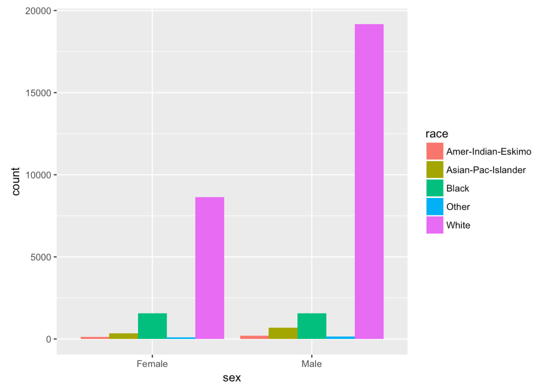
- y (optional)
  default is count, but can also specify a number
  (the length of the bars)

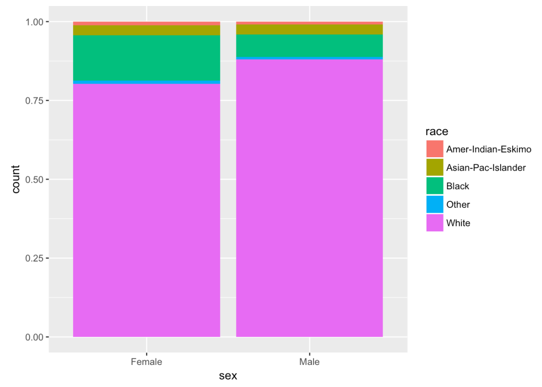
- color (optional)
  category (grouped or stacked bars)

Bar chart

- geom_bar() vs. geom_col()
- count vs. identity vs. summary
- categorical vs. continuous
- stack vs. dodge vs. fill
- bar vs. pie

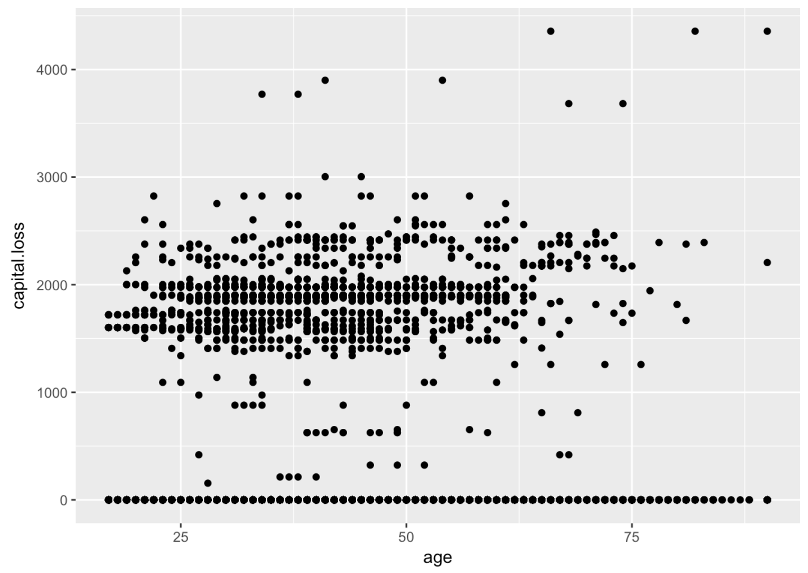


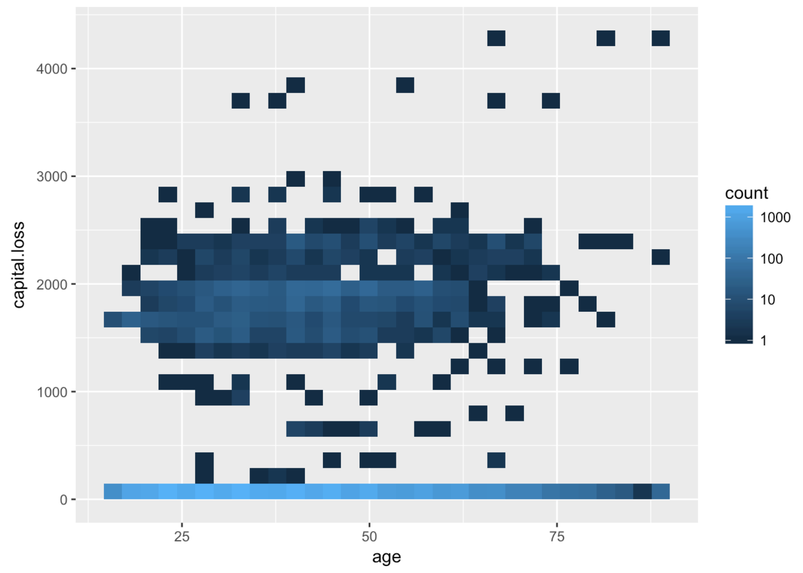




Scatter plot

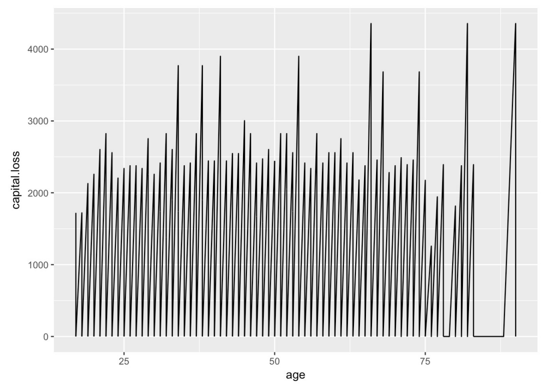
- Overplotting
- point vs. bin2d

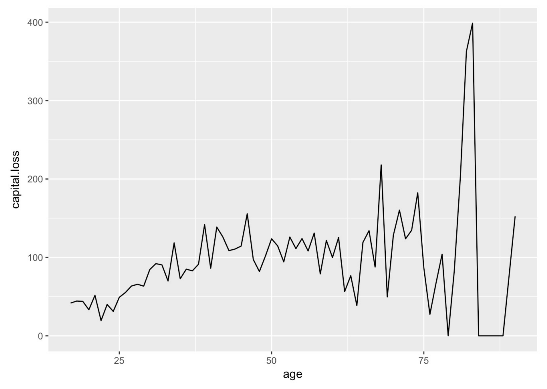


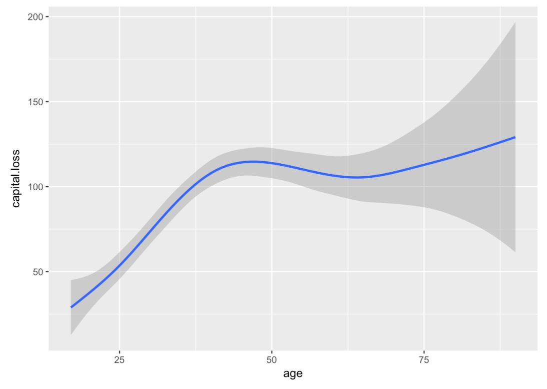


Line chart

- identity vs. summary
- line vs. smooth


capital.loss
age


capital.loss
age


capital.loss
age