ggplot2

You will NOT be tested on writing R code

Grinnell College

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R Packages

Before we get to ggplot2 let's talk about *packages* in R

- A package in R must be downloaded
  - install.packages('PACKAGE NAME')
- It contains useful(??) functions/capabilities that you'd have to code yourself otherwise
- For gamers, packages are like mods
  - User made/open source
  - Edit capabilities
  - Can be toggled on and off
- To load a package we use library(PACKAGE NAME)
  - No quote marks for library(), quotes for install.packages()

Package Examples

Here's are my favorites/memorable ones:

- From Hadley Wickham we have...
  - ggplot2 (graphing)
  - dplyr (data manipulation)
  - Roxygen2 (easier to build your own packages)
  - stringr (manipulate chracter strings)
  - reshape2 (he's abandoned this one...)
- beepr
  - Makes a beep/noise at the end of code
  - Useful to indicate your code chunk is done
  - It's cute
- And experimental design research specific
  - FrF2 (2-level fractional factorial designs)
  - rsm (response surface methods)
  - AlgDesign (searchs for optimal designs)

Heads Up

Don't worry about understanding the following slides...big take away is that ggplot2 works by adding commands/desired edits on top of each other via the + symbol

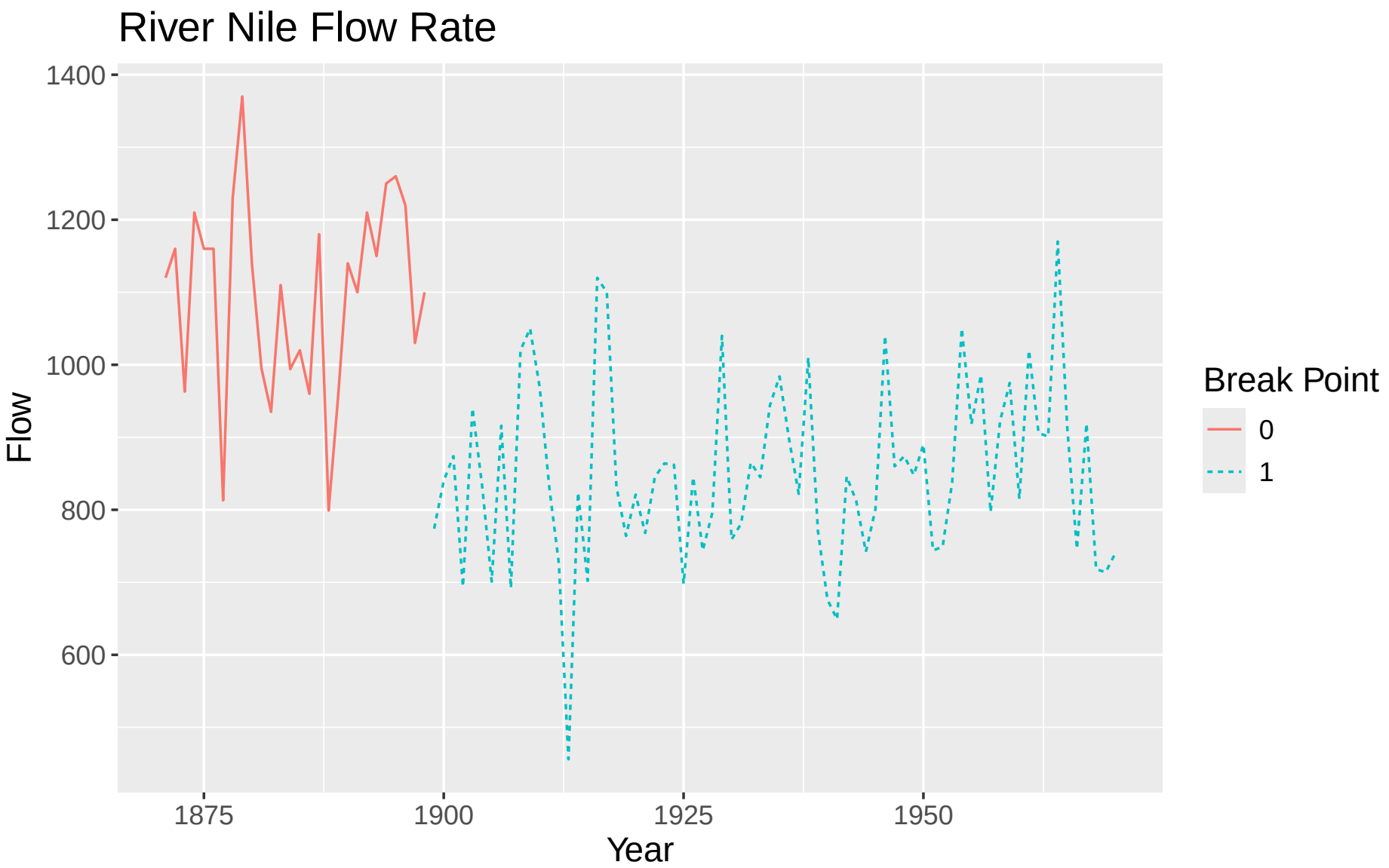
Different commands do different things

Grammar of Graphics (Leleand Wilkinson 2004)

Graphics are independent elements that are added to each other similar to grammar

- A statistical graph maps data
- Mapping is made up of...
  - Layers
    - ★ Geometries (lines, bar, dots)
    - ★ Stat summaries (means, binning data in histograms)
  - Scales
    - ★ Colors, shapes, sizes, etc...
  - Coords
    - ★ Coordinate system (eg mpg vs kpl)
    - ★ Default is usually fine
  - Facets
    - ★ Breaks the graphs into subsets (eg a grid of histograms)
  - Themes (minor aesthetics)

Example


River Nile Flow Rate
1400
1200
1000
800
600
Flow
1875
1900
1925
1950
Year
Break Point
0
1

Code to Make Example

```
ggplot(data = Nile, #function is ggplot, data is Nile
       aes(x = year, #x-axis and y-axis define inside aes()
           y = flow)) +

  geom_line(aes(color = changepoint, #make a graph of lines
                linetype = changepoint)) + #make the colors and line
                                           #type based on the change point

  theme(text = element_text(size = 14)) + #boost font size

  labs(title = "River Nile Flow Rate", #give main title
       color = "Break Point", #and give the legend for color and line
       linetype = 'Break Point')  + #type a title as well

  xlab('Year') + #labels for x and y axis

  ylab("Flow")
```

Breakdown of Code

- Data: first line defined as data = Nile
- Coordinates: x = year, y = flow define our axis and ggplot2 will make the coordinates for those two
- Scales: Color and line type are encoded with information on the change point
- Geometry: geom_line in that we want to connect our data points
- Theme: up the font size to make it easier to read
- Facets: we didn't facet

Useful Geometries

- One Numeric variable
  - geom_histogram (makes a histogram)
- Two Numeric variables
  - geom_point (scatterplot)
  - geom_jitter (scatterplot + white noise)
  - geom_abline (draws a straight line)
  - geom_smooth ("free-hand" draws a line; usually curvy)
- One Categorical variable
  - geom_bar (bar chart)
- A Numeric variable and a Categorical variable
  - geom_boxplot (Guess the plot)

Rules of Thumb

- When using geom_ () functions, we usually reference the variables in the data set inside the aes() function
  - geom_point(aes(shape = MY_VARIABLE))

- We use + to string together the different parts

Coding Better Practices

- Save early, save often
- Name variables something easy to understand but also easy to type
  - "flow" is better than "Flow Rate measured in 10^8 m^3"
- Don't write all your code on a single line
- A new line after comma's or +'s is roughly standard (see examples above)
- Don't edit working code directly; copy and paste the code and then edit it
- Stretch goal: comment (with #) on the code as you go
  - You don't have to be as detailed as mine
  - Don Knuth insisted that this will save time in the long run