# R06: `ggplot2`, Part 1

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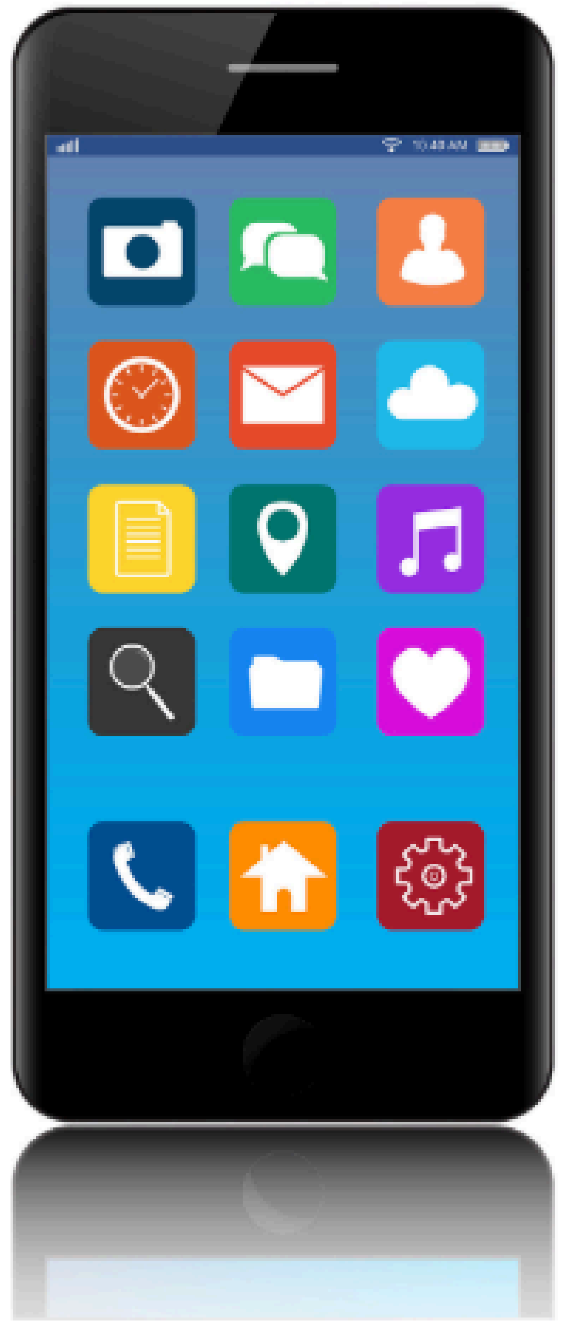
## From last time: R Packages

A good analogy for R packages is that they are like apps you can download onto a mobile phone:

| R: A new phone | R Packages: Apps you can download |
|---|---|
|  | |

ModernDive Figure 1.4

## From last time: Install the packages listed below

- `knitr`
  - this might actually already be installed
  - check your packages list
- `tidyverse`
  - this is actually a bundle of packages
  - *Warning: it will take a while to install!!!*
  - see more info at https://tidyverse.tidyverse.org/
- `rstatix`
  - for summary statistics of a dataset
- `janitor`
  - for cleaning and exploring data
- `ggridges`
  - for creating ridgeline plots
- `devtools`
  - used to create R packages
  - for our purposes, needed to install some packages
- `oi_biostat_data`
  - this package is on github
  - **see the next slide for directions on how to install `oi_biostat_data`**
- `here`
  - More info in slides ahead

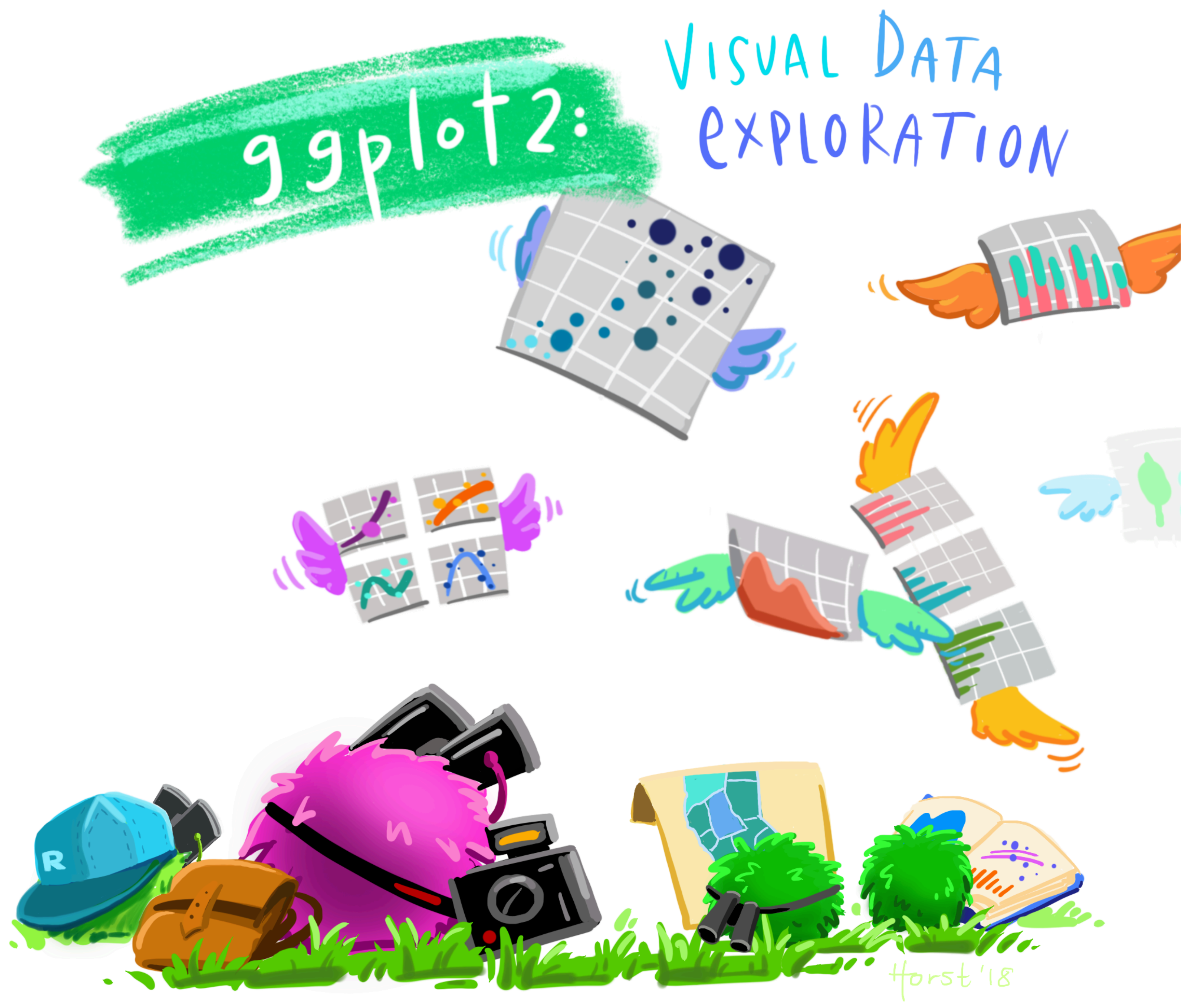
## From last time: Load packages with `library()` command

- Tip: **at the top of your Qmd file,** create a chunk that loads all of the R packages you want to use in that file.
- Use the `library()` command to load each required package.
  - Packages need to be reloaded *every* time you open Rstudio.
  - `library()` commands to load needed packages *must* be in the Qmd file

```r
# run these every time you open Rstudio
library(tidyverse) # contains ggplot2
library(oibiostat)
library(ggridges)
library(janitor)
library(rstatix)
library(knitr)
library(gtsummary) # NEW!!
```

- You can check whether a package has been loaded or not
  - by looking at the Packages tab and
  - seeing whether it has been checked off or not

## Introduction to **`ggplot2`**



Artwork by @allison_horst

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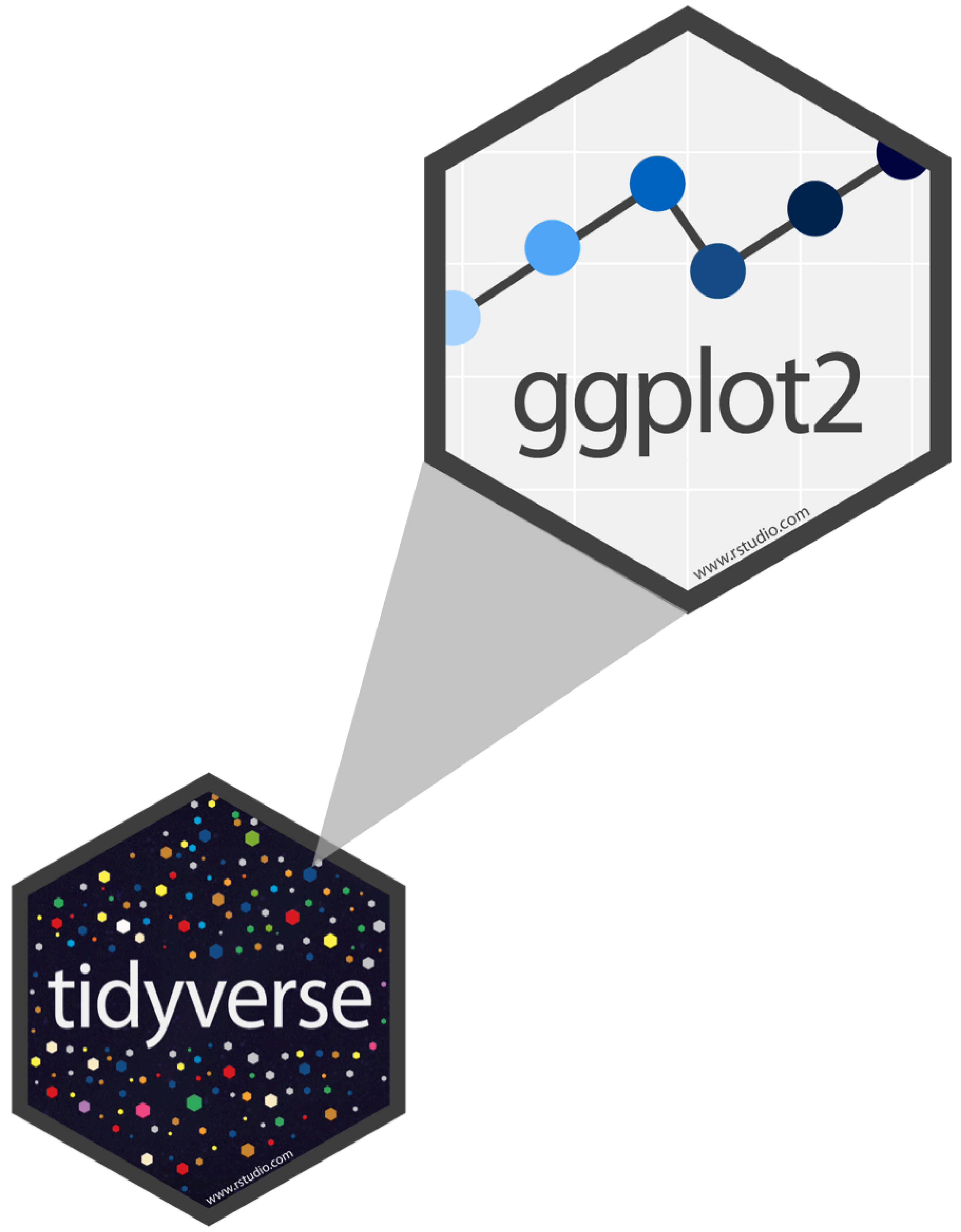
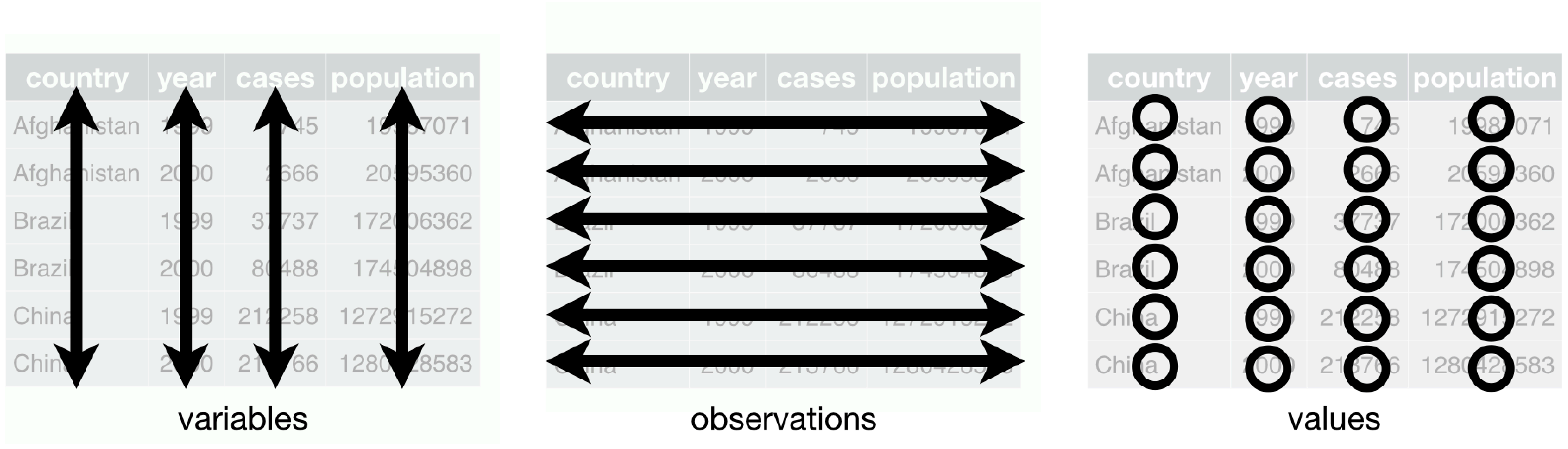
## `ggplot2` in tidyverse



- `ggplot2` is tidyverse's data visualization package
  - This is one of the main ways to create plots and explore data
- The `gg` in "ggplot2" stands for Grammar of Graphics
- It is inspired by the book **Grammar of Graphics** by Leland Wilkinson
  - Make graphs/plots by combining independent components
  - Start with a basic plot then add layers

# Works best with “tidy” data[1]



1. Each variable must have its own column.
2. Each observation must have its own row.
3. Each value must have its own cell.

## Basics of a ggplot

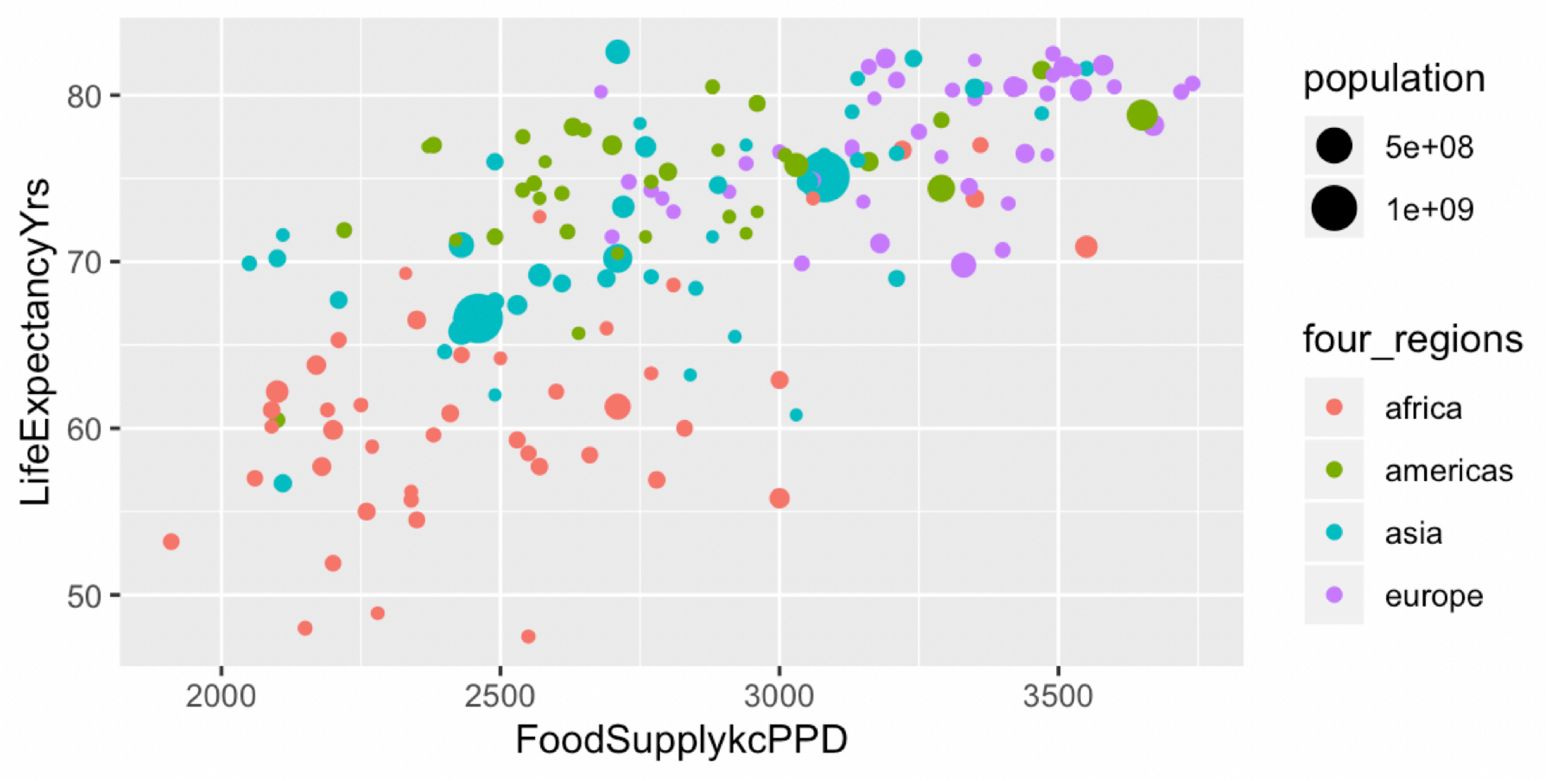
Function

Dataset

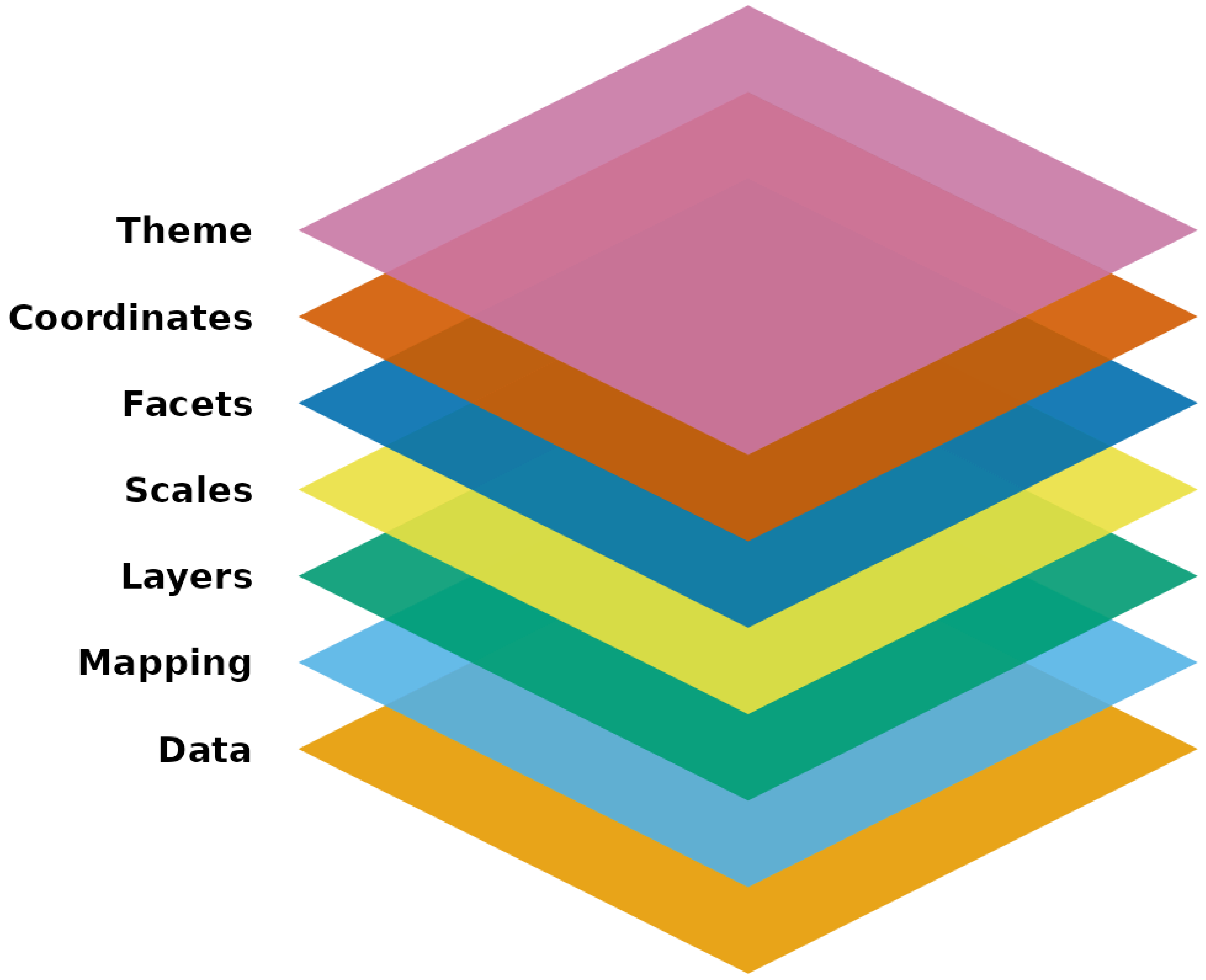
```
ggplot(data = gapminder2011,
       aes(x = FoodSupplykcPPD, y = LifeExpectancyYrs,
           color = four_regions, size = population)) +
      geom_point()
```

Which variables to plot

What kind of plot to make



## Grammar of ggplot2



- `ggplot2` needs at least the following three to produce a chart:
  - data, a mapping, and a layer
- For the most part, there are default settings for the other parts:
  - scales, facets, coordinates, and themes

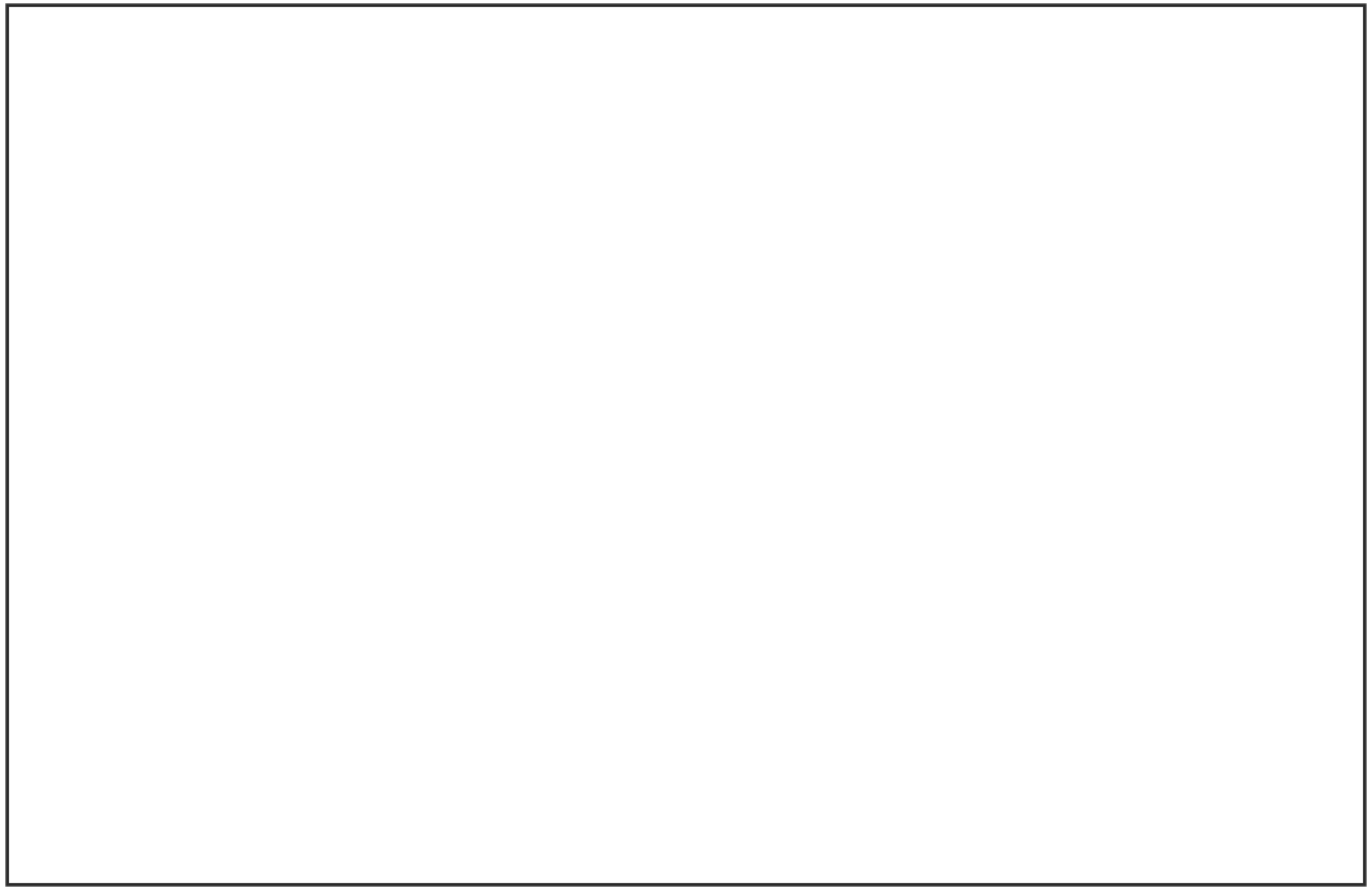
## Data

- ggplot2 uses data to construct a plot
- Works best with tiday data (when every observation is a row and each variable is a column)
- First step in plotting:
  - Pass the data to the `ggplot` function, which stores the data to be used later by other parts of the plotting system

## Data

- For example, if we intend to make a graphic about the `mpg` dataset, we would start as follows:

```r
ggplot(data = mpg)
```



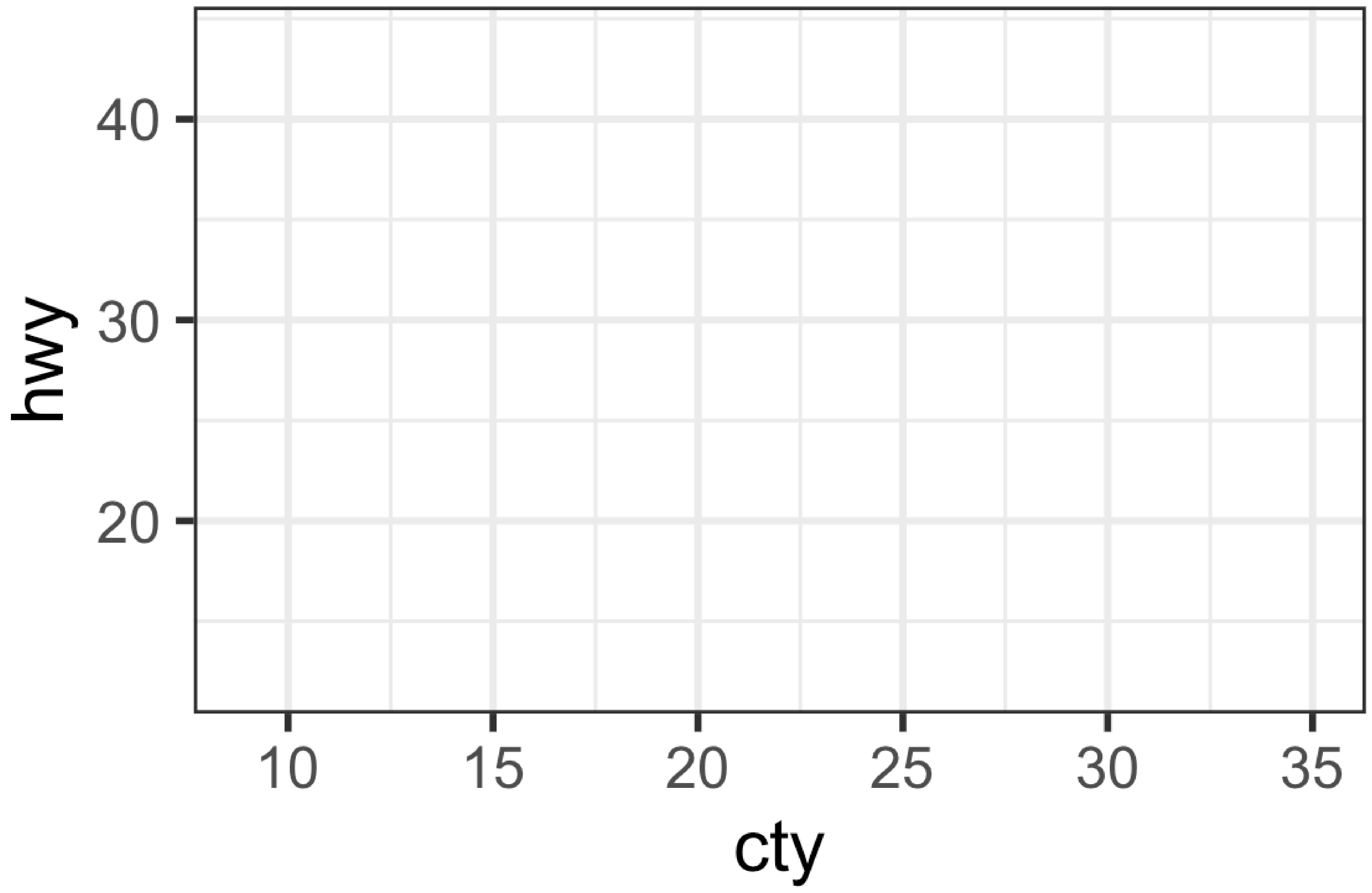
## Mapping

- Mappings use the `aes()` function to **map** variables to the different axes on a plot
  - `aes()` stands for “aesthetics”

## Data + Mapping

- If we want the `cty` and `hwy` columns to map to the x- and y-coordinates in the plot, we can do that as follows:

```r
ggplot(mpg, mapping = aes(x = cty, y = hwy))
```



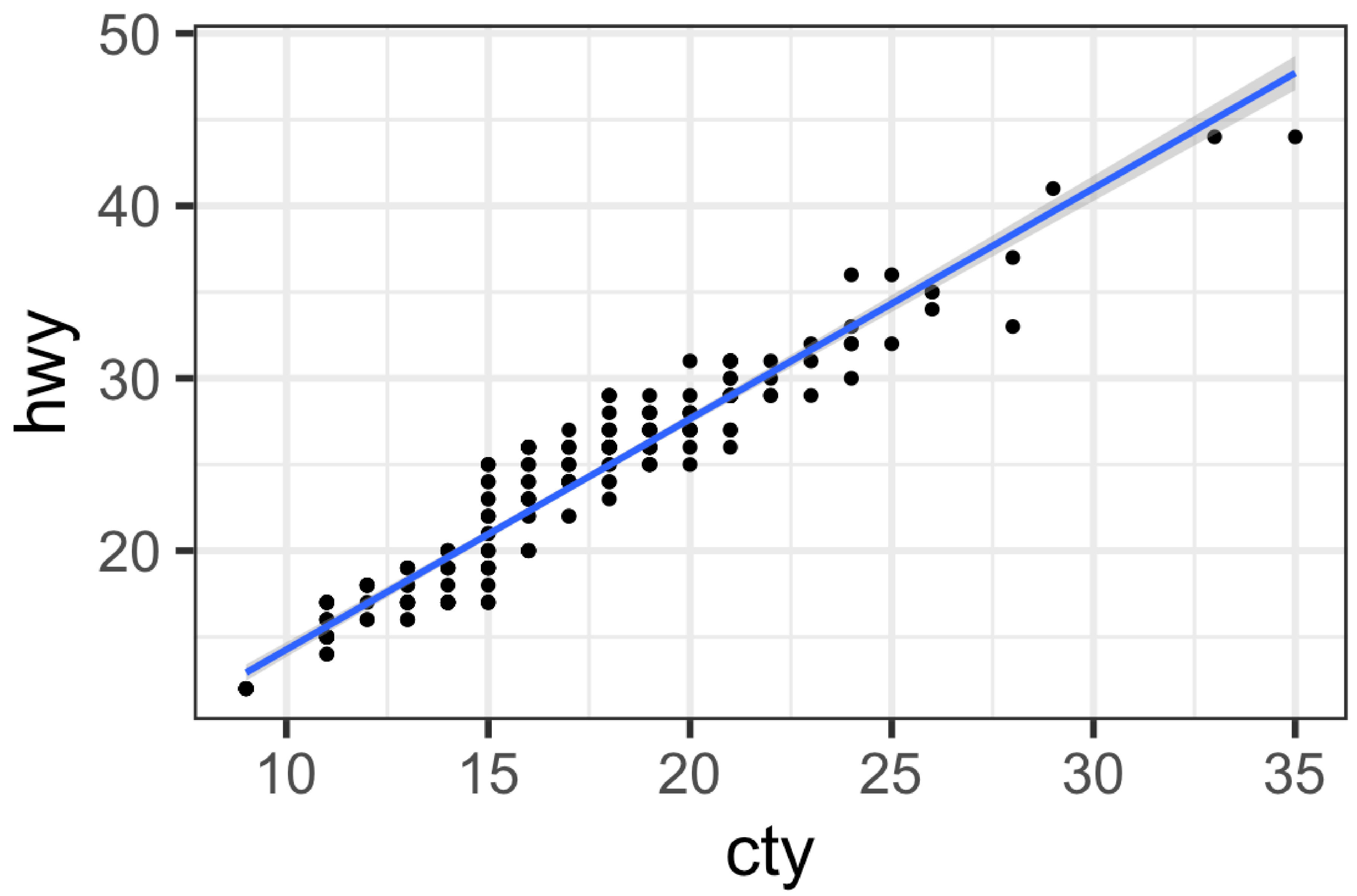
## Layers

- Every layer consists of three important parts:
  - The **geometry** that determines *how* data are displayed, such as points, lines, or rectangles
  - The **statistical transformation** that may compute new variables from the data and affect *what* of the data is displayed.
  - The **position adjustment** that primarily determines *where* a piece of data is being displayed
- A layer can be constructed using the `geom_*()` and `stat_*()` functions
  - These functions often determine one of the three parts of a layer, while the other two can still be specified.

## Data + Mapping + Layers

Here is how we can use two layers to display the `cty` and `hwy` columns of the `mpg` dataset as points and stack a trend line on top:

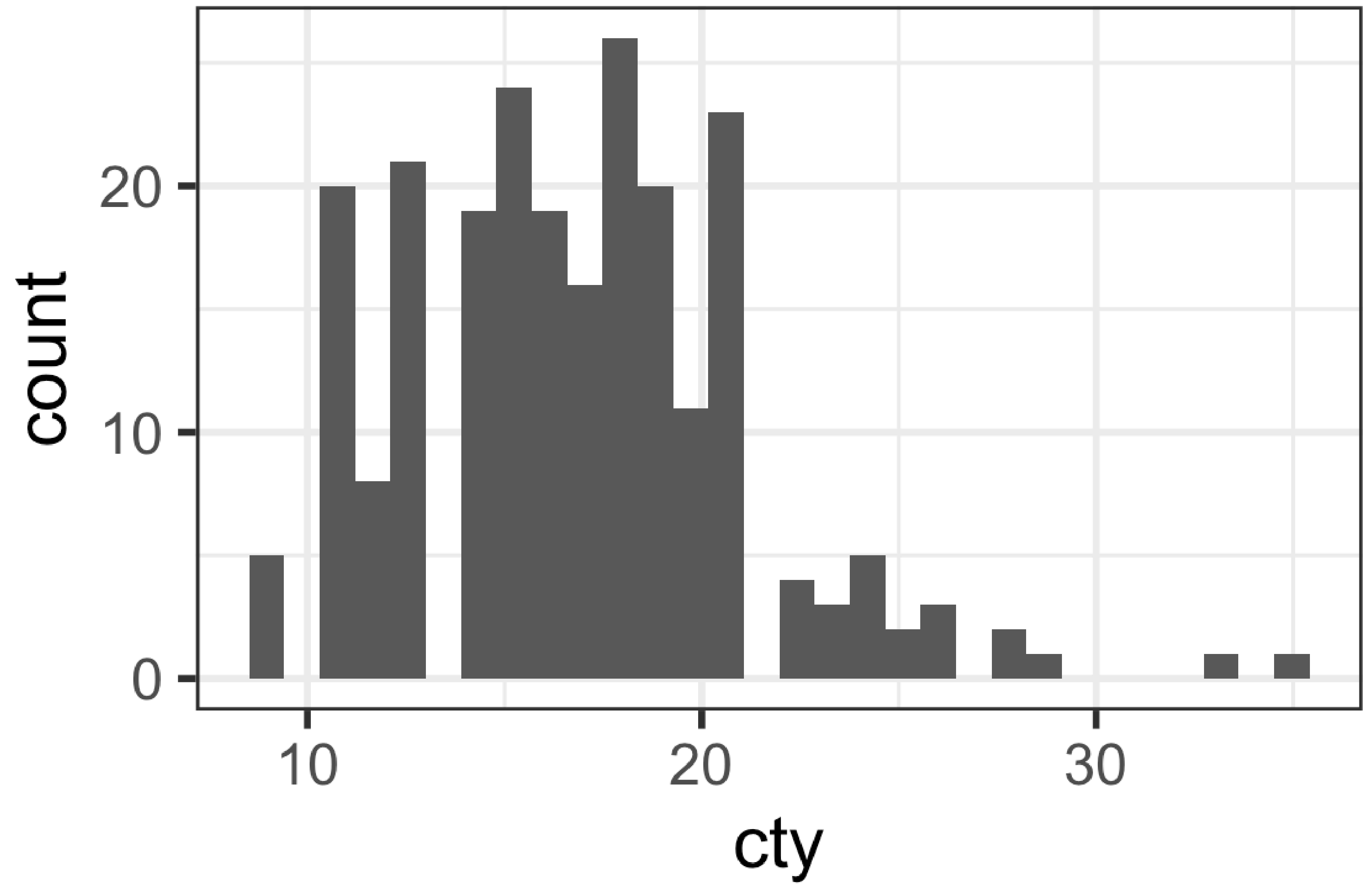
```r
ggplot(mpg, aes(cty, hwy)) +
  # to create a scatterplot
  geom_point() +
  # to fit and overlay a line
  geom_smooth(formula = y ~ x, method = "lm")
```



## We can also make plots with a single variable

- Data: still `mpg`
- Mapping: using aesthetic to specify only one variable in the x-axis (`cty`)
- Layers: using `geom_histogram()` to show a plot of the counts per `cty` (which is city mileage)

```r
ggplot(mpg, aes(cty)) +
  # to create a histogram
  geom_histogram()
```



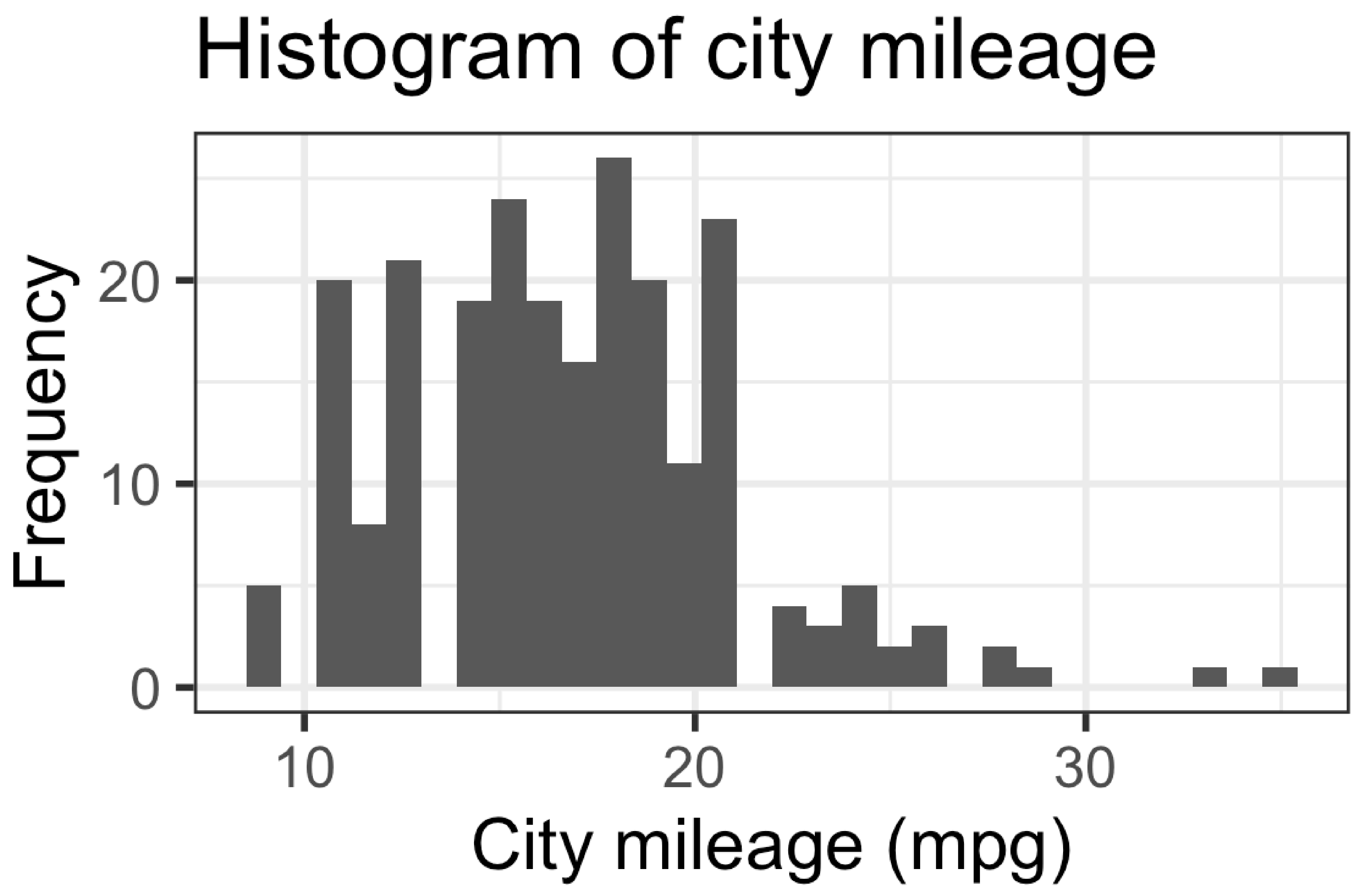
## Let’s take a second to try this out

- Make sure you are working in a Quarto document that has all the libraries loaded
- Use `glimpse()` to look at the variables in `mpg`
- Choose one of the variables to make a plot for
- Go to this site: https://bookdown.dongzhuoer.com/hadley/ggplot2-book/geom
  - Choose one of the “One variable” geoms that would work well for the variable you chose (discrete or continuous options)
- Make a plot for the variable!

## We can add more to plots!

We can change labels!

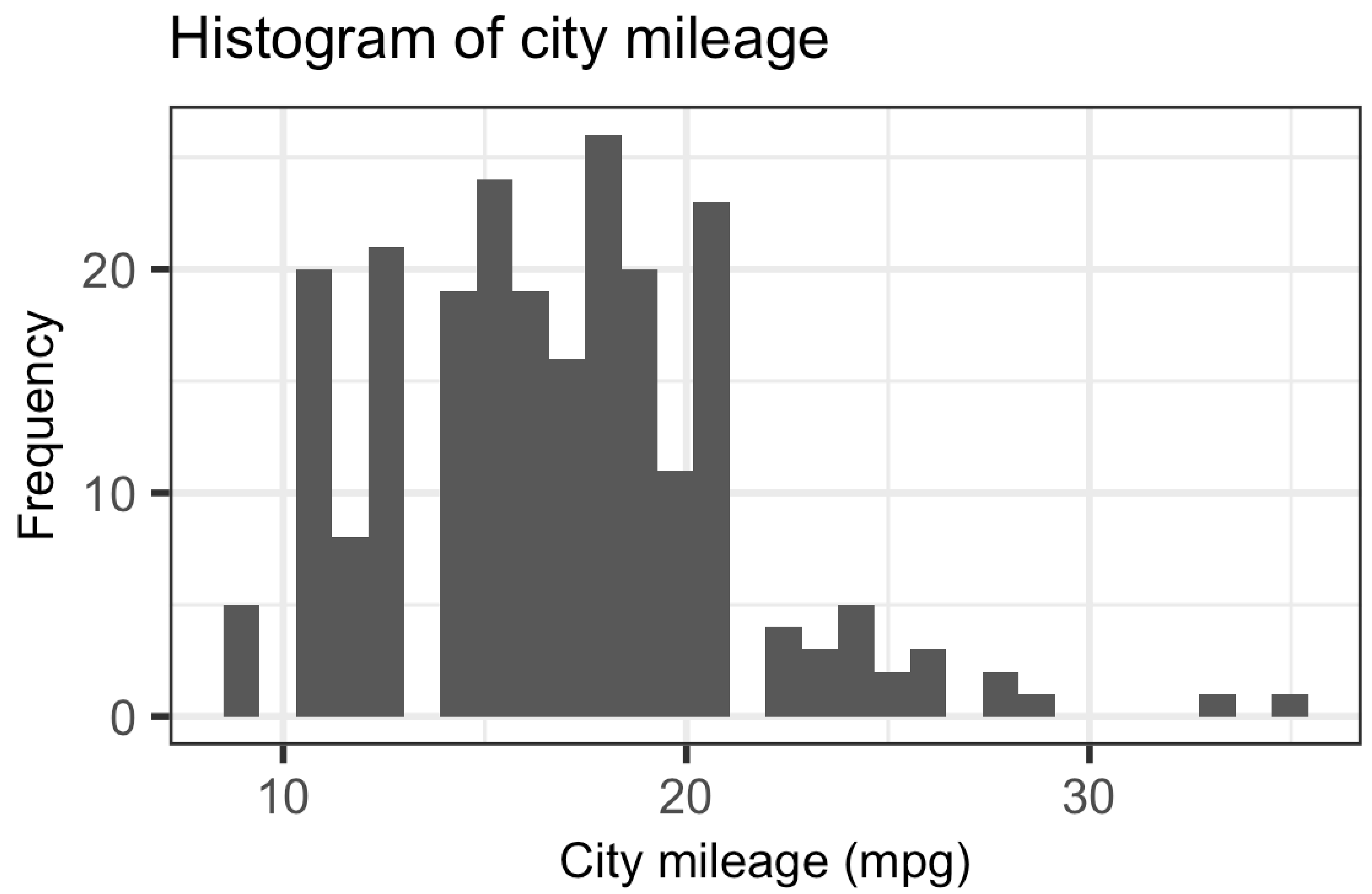
```r
ggplot(mpg, aes(cty)) +
  geom_histogram() +
  labs(x = "City mileage (mpg)", y = "Frequency",
       title = "Histogram of city mileage")
```



## Adding more to plots!

Increase (or decrease) text size so we can read it / it fits nicely!

```r
ggplot(mpg, aes(cty)) +
  geom_histogram() +
  labs(x = "City mileage (mpg)", y = "Frequency",
       title = "Histogram of city mileage") +
  theme(axis.text = element_text(size = 15),
        axis.title = element_text(size = 15),
        title = element_text(size = 15))
```



## Take a moment

- To add labels to your plot and change the text size if you want
- If you have time, look up help on the `element_text()` function
    - See if you can tilt your text or change the color

## Resources on `ggplot`

- `ggplot2` package website: https://ggplot2.tidyverse.org/articles/ggplot2.html
- Online textbook for `ggplot2`: https://ggplot2-book.org/
- Another online resource for data visualization with `ggplot2`: https://socviz.co/index.html#preface