

STA 235H - Bootcamp

Fall 2023

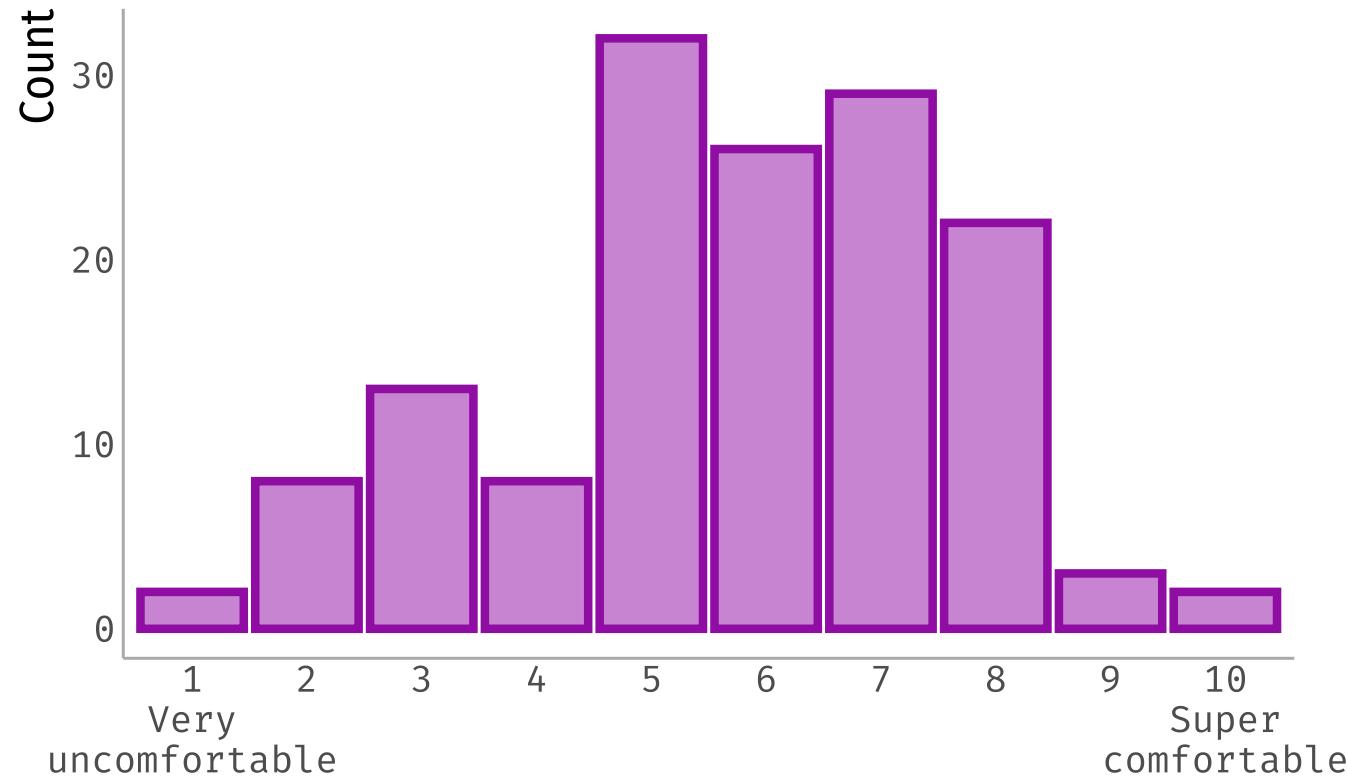
McCombs School of Business, UT Austin

Bootcamp Agenda

- What do we need?
 - Quick look into **R** and **RStudio**
 - RScript format
- Refresher from the **tidyverse**:
 - Data wrangling
 - Plots and figures
 - Regressions



How comfortable are you with R?



R for coding

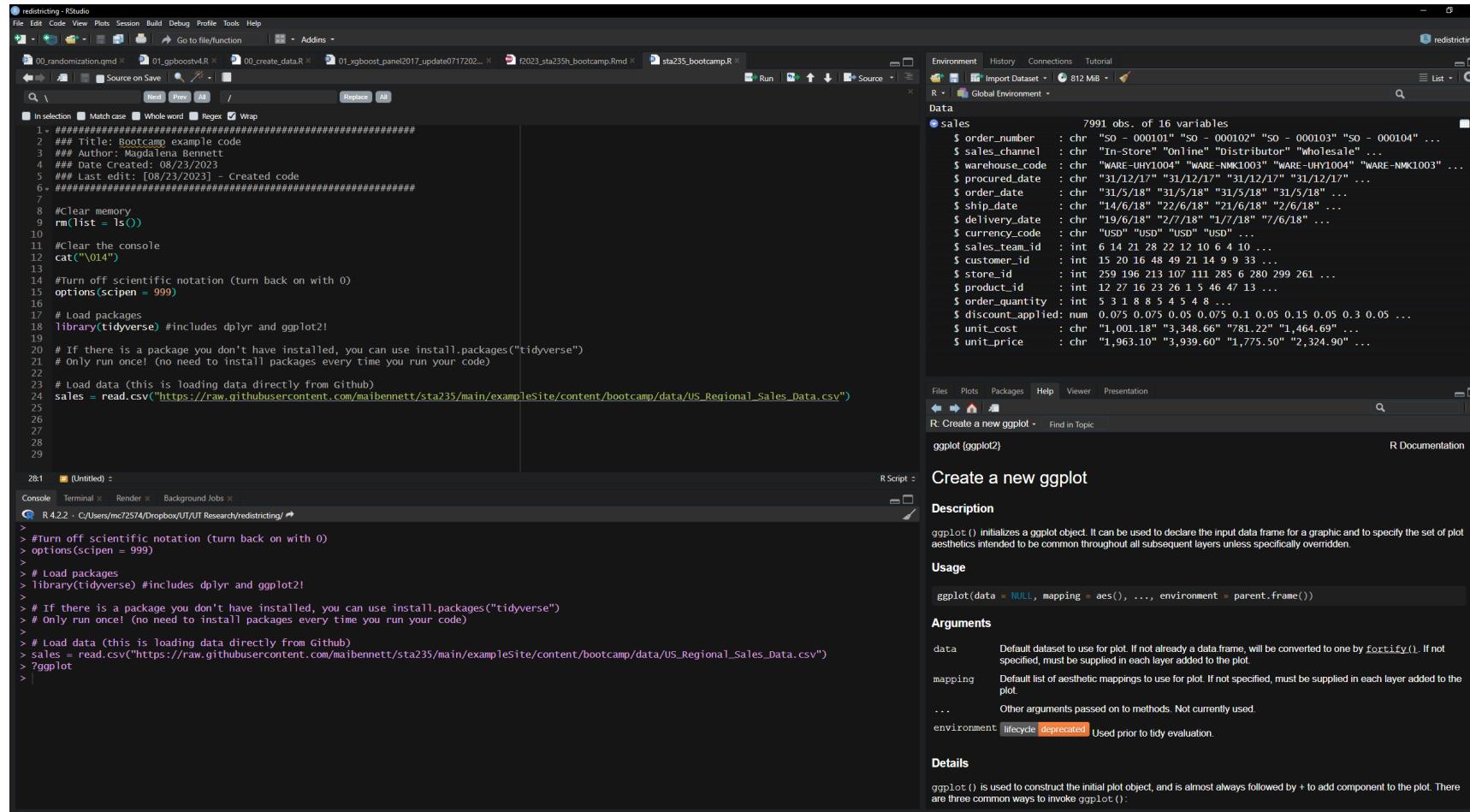
R is the programming language we will use for
statistical analysis



RStudio is the IDE (Integrated Development Environment) we will use **to run R on our computers.**



Let's look at RStudio



Let's look at RStudio - Script

The screenshot shows the RStudio interface with the 'Script' tab selected. The main area displays an R script with line numbers and syntax highlighting. The script includes comments for bootcamp details, memory clearing, console output, scientific notation, package loading (tidyverse), and data loading from a CSV file on GitHub.

```
1 #####
2 ### Title: Bootcamp example code
3 ### Author: Magdalena Bennett
4 ### Date Created: 08/23/2023
5 ### Last edit: [08/23/2023] - Created code
6 #####
7
8 #Clear memory
9 rm(list = ls())
10
11 #Clear the console
12 cat("\014")
13
14 #Turn off scientific notation (turn back on with 0)
15 options(scipen = 999)
16
17 # Load packages
18 library(tidyverse) #includes dplyr and ggplot2!
19
20 # If there is a package you don't have installed, you can use install.packages("tidyverse")
21 # Only run once! (no need to install packages every time you run your code)
22
23 # Load data (this is loading data directly from Github)
24 sales = read.csv("https://raw.githubusercontent.com/maibennett/sta235/main/exampleSite/content/bootcamp/data/US_Regional_Sales_Data.csv")
25
26
27
28
29
```

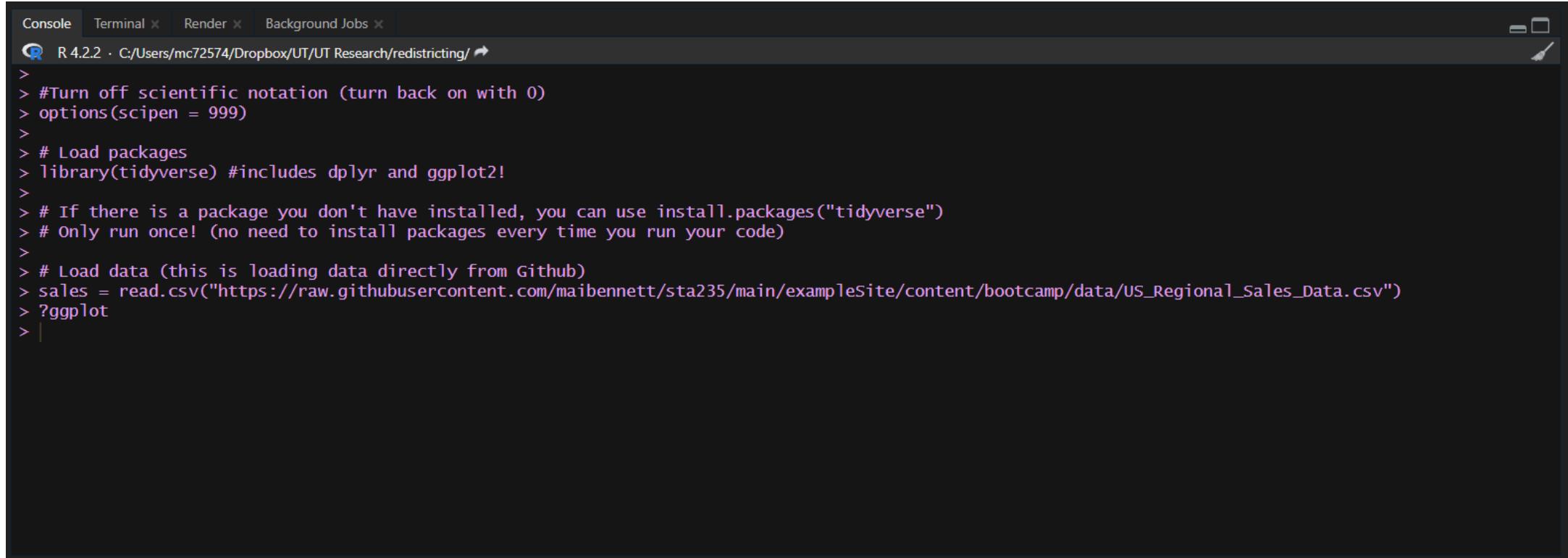
28:1 # (Untitled) R Script

Let's look at RStudio - Environment

The screenshot shows the RStudio interface with the 'Environment' tab selected. The main pane displays the 'sales' dataset, which contains 7991 observations across 16 variables. The variables and their types are listed below:

Variable	Type	Values
\$ order_number	chr	"SO - 000101" "SO - 000102" "SO - 000103" "SO - 000104" ...
\$ sales_channel	chr	"In-Store" "Online" "Distributor" "Wholesale" ...
\$ warehouse_code	chr	"WARE-UHY1004" "WARE-NMK1003" "WARE-UHY1004" "WARE-NMK1003" ...
\$ procured_date	chr	"31/12/17" "31/12/17" "31/12/17" "31/12/17" ...
\$ order_date	chr	"31/5/18" "31/5/18" "31/5/18" "31/5/18" ...
\$ ship_date	chr	"14/6/18" "22/6/18" "21/6/18" "2/6/18" ...
\$ delivery_date	chr	"19/6/18" "2/7/18" "1/7/18" "7/6/18" ...
\$ currency_code	chr	"USD" "USD" "USD" "USD" ...
\$ sales_team_id	int	6 14 21 28 22 12 10 6 4 10 ...
\$ customer_id	int	15 20 16 48 49 21 14 9 9 33 ...
\$ store_id	int	259 196 213 107 111 285 6 280 299 261 ...
\$ product_id	int	12 27 16 23 26 1 5 46 47 13 ...
\$ order_quantity	int	5 3 1 8 8 5 4 5 4 8 ...
\$ discount_applied	num	0.075 0.075 0.05 0.075 0.1 0.05 0.15 0.05 0.3 0.05 ...
\$ unit_cost	chr	"1,001.18" "3,348.66" "781.22" "1,464.69" ...
\$ unit_price	chr	"1,963.10" "3,939.60" "1,775.50" "2,324.90" ...

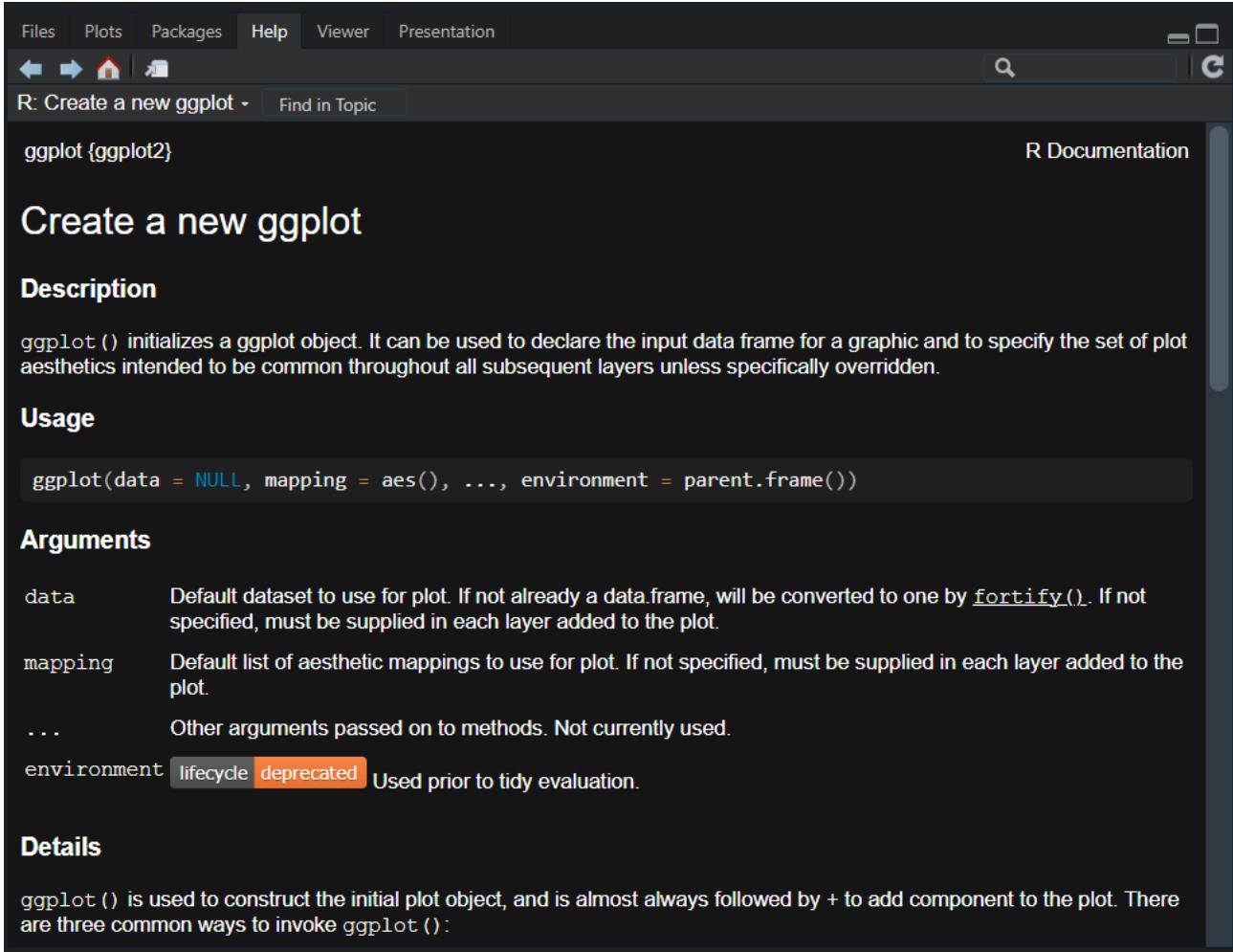
Let's look at RStudio - Console



The screenshot shows the RStudio interface with the 'Console' tab selected. The console window displays the following R code:

```
R 4.2.2 · C:/Users/mc72574/Dropbox/UT/UT Research/redistricting/ ↵
>
> #Turn off scientific notation (turn back on with 0)
> options(scipen = 999)
>
> # Load packages
> library(tidyverse) #includes dplyr and ggplot2!
>
> # If there is a package you don't have installed, you can use install.packages("tidyverse")
> # Only run once! (no need to install packages every time you run your code)
>
> # Load data (this is loading data directly from Github)
> sales = read.csv("https://raw.githubusercontent.com/maibennett/sta235/main/exampleSite/content/bootcamp/data/US_Regional_Sales_Data.csv")
> ?ggplot
> |
```

Let's look at RStudio - Help and others



The screenshot shows the RStudio interface with the 'Help' tab selected in the top navigation bar. The main content area displays the documentation for the `ggplot` function from the `ggplot2` package. The title is "Create a new ggplot". The "Description" section states that `ggplot()` initializes a ggplot object, used to declare the input data frame and plot aesthetics. The "Usage" section shows the function signature: `ggplot(data = NULL, mapping = aes(), ..., environment = parent.frame())`. The "Arguments" section details the parameters: `data` (dataset), `mapping` (aesthetic mappings), `...` (other arguments), and `environment` (labeled as lifecycle deprecated). The "Details" section notes that `ggplot()` constructs the initial plot object, often followed by `+` to add components, and lists three common invocation methods.

R: Create a new ggplot • Find in Topic

ggplot {ggplot2}

R Documentation

Create a new ggplot

Description

`ggplot()` initializes a ggplot object. It can be used to declare the input data frame for a graphic and to specify the set of plot aesthetics intended to be common throughout all subsequent layers unless specifically overridden.

Usage

```
ggplot(data = NULL, mapping = aes(), ..., environment = parent.frame())
```

Arguments

`data` Default dataset to use for plot. If not already a `data.frame`, will be converted to one by `fortify()`. If not specified, must be supplied in each layer added to the plot.

`mapping` Default list of aesthetic mappings to use for plot. If not specified, must be supplied in each layer added to the plot.

`...` Other arguments passed on to methods. Not currently used.

`environment` lifecycle deprecated Used prior to tidy evaluation.

Details

`ggplot()` is used to construct the initial plot object, and is almost always followed by `+` to add component to the plot. There are three common ways to invoke `ggplot()`:

Useful basic commands

- `install.packages("name")`: Installs the package "name" on your computer. You only need to run this once!
- `library(name)`: Loads the package "name" on your current session. You should do this at the top of every script and only include packages you will use (to avoid confusion)
- `?function`: Opens the help file for function (if there is more than one function – e.g. different libraries – you can choose which one you open).

Also... don't restore RData into a new session!

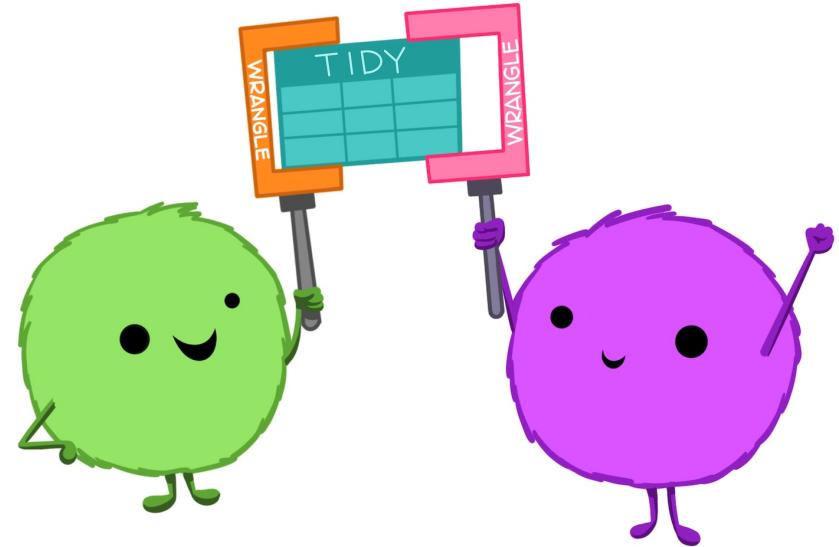
The screenshot shows an RStudio interface with the following components:

- Script Editor:** Displays a script named `sta235/bootcamp.R` containing R code for bootcamp example code, including loading packages, setting options, and reading data from GitHub.
- Environment Browser:** Shows the global environment with a list of objects and their types and values, such as `sales` (a data frame with 7991 rows and 11 columns).
- Help Panel:** Opened for the `ggplot` function, showing its documentation, description, usage, and arguments.
- Console:** Shows the command history for running the script.
- Toolbar:** Includes a play button, timer (0:00 / 0:16), volume icon, and other standard controls.

Let's go to R

Data Wrangling

- Most times we need to **transform**, **clean**, and **structure** data for analysis.
- Examples of data wrangling would be dropping missing observations, merging different datasets, identifying outliers, etc.
- **R can help us do that!



Into the tidyverse



- For data wrangling, we will use the **tidyverse**: Collection of packages that follow a similar design structure (e.g. dplyr, ggplot2)
- It works through **pipes**: %>%
 - Concatenates functions!

Useful functions for wrangling

- `mutate(var = var1 + var2)`: Creates a new variable or replaces an existing one. It takes as an argument the name of the variable and what you want that variable to be.
- `filter(var == 1)`: Subsets your data according to a logic statement. Remember that logic statements use "==" instead of "!="
- `group_by(var1, var2)`: Used to group observations by values of different variables. You can use it either to create a variable with values at the group level, or to summarize your dataset by group.
- `select(var1, var2)`: Select specific variables from the dataset (drop the others). In case you want to drop instead of keeping variables, you can use `select(-var1, -var2)`
- `rename(var_new = var_old)`: The name says it all. Used to rename variables.

Other useful functions

- `is.na(var)`: logic function that returns TRUE if the observation is a missing value (NA) or FALSE in another case.
- `ifelse(logic_statement, val1, val2)`: Very useful function to create conditional values.
- `!(logic_statement)`: The exclamation point acts as a negation. If you want to invert a logic statement, use this (e.g. `!is.na(var)` will return TRUE if the obs of var is NOT missing and FALSE if it's missing).
- `table(var)`: Tabulates the different values of a variable

Let's go to R

Plotting in R

- Plotting your data is a **very intuitive way** to see what's going on.
- It's also useful to convey **complex analysis**!
- Make sure your plots are always **informative** and they **tell the story** you want to highlight.



General structure of ggplot

- `ggplot()` works in "**layers**":
 - You can provide different geometries and "add" them to your plot (same with themes!)
- You always start with `ggplot(data = d, aes(x = var1, y = var2, color = var3))`, depending on what you want to do:
 - `aes()` stands for aesthetics, and it tells which variables you want to use and how. Sometimes you need one variable (e.g. histogram), sometimes you need two (e.g. scatter plot), or even three or more! (e.g. scatter plot for different groups)
- You can provide `aes()` in the `ggplot()` function (as seen above), or also in each geometric layer:
e.g. `ggplot(data = d) + geom_point(aes(x = var1, y = var2))`

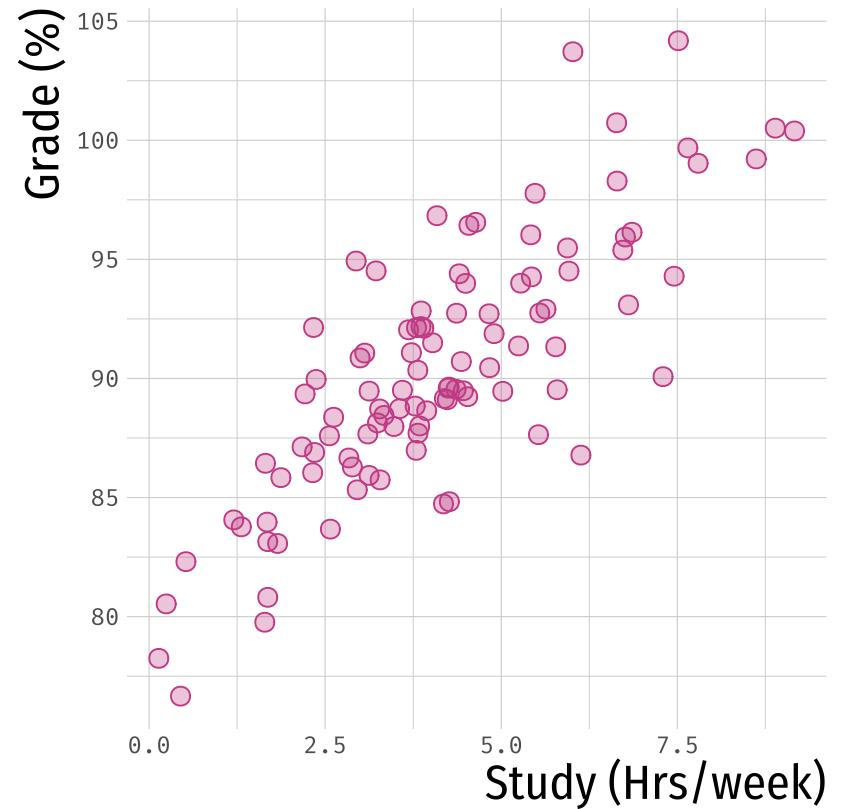
General structure of ggplot

- Some common geometries that are useful:
 - `geom_point()`: Creates a scatter plot
 - `geom_line()`: Creates a line plot
 - `geom_histogram()` or `geom_density()`: Creates a histogram or a density plot for your data!
 - `geom_smooth()`: Creates a smooth function that goes through your data. By default, it uses a loess or gam function, depending on the size of the data. Use `method = "lm"` as an argument if you want to fit a regression line!
- Finally, looks are also important!
 - `theme()` allows you to play around with every aspect of your plot (e.g. font size, grid lines, etc.)
 - Using a pre-packages theme can be useful, too. I personally like `theme_minimal()` or the `theme_ipsum_rc()` from the `hrbrthemes` package.

Let's go to R

Regression Analysis

- Regressions help us **quantify the relationship** between different variables.
- In R, we can get **many important insights** from regression analysis!



Regressions in R

- The main command to do regressions is `lm(y ~ x1 + x2, data = d)`, where `y` is our outcome of interest and `x1` and `x2` are regressors.
- For convenience, we can store the regression in a separate object (e.g. `lm1 = lm(y ~ x1 + x2, data = d)`), so we can later manipulate it:
 - `summary(lm1)`: Provides a summary table of the results (including estimates, standard errors, and p-values).
 - `lm1$coefficients`: Recovers the exact estimated coefficients (e.g. useful if you want to use them later).
 - `summary(lm1)$coefficients`: Matrix of results. Includes columns for the estimates betas, standard errors, t-stats, and p-values.

Let's go to R

R is useful and fun!

