

# Data Basics

The screenshot shows the RStudio interface with two R Markdown files open:

- 01-Getting-started.Rmd** (tab is not selected)
- 02-Data-basics.Rmd** (tab is selected and highlighted with a blue border)

The code editor displays the following content for the selected file:

```
1 ---  
2 title: "Data Basics"  
3 output: html_document  
4 ---  
5  
6 <!-- This file by Charlotte Wickham is licensed under a  
7 Creative Commons Attribution 4.0 International License.  
8 -->  
9  
10 # R Packages  
11  
12 ```{r setup}  
13 library(tidyverse)  
14 library(gapminder)  
15 library(readxl)  
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```

The screenshot shows the RStudio interface. The top menu bar includes 'File', 'Edit', 'View', 'Code', 'Tools', 'Help', and 'Addins'. The toolbar contains icons for new file, R script, open file, save, print, 'Go to file/function', a plus sign, a grid, and 'Addins'. Below the toolbar are two tabs: '01-Getting-started.Rmd' and '02-Data-basics.Rmd'. The main code editor area displays the following R Markdown code:

```
1 ---  
2 Data Basics  
3  
4 - R Packages  
5   Chunk 1: setup  
6 < Your Turn 1  
C  
7   Chunk 2  
8 # Chunk 3  
9 Your Turn 2  
10 ` Your Turn 3  
11 l  
12 l Your Turn 4  
13 l  
14   Chunk 5  
15  
1:1 # Data Basics
```

The code editor has a vertical scrollbar on the right. To the right of the code editor is a preview pane showing the rendered content:

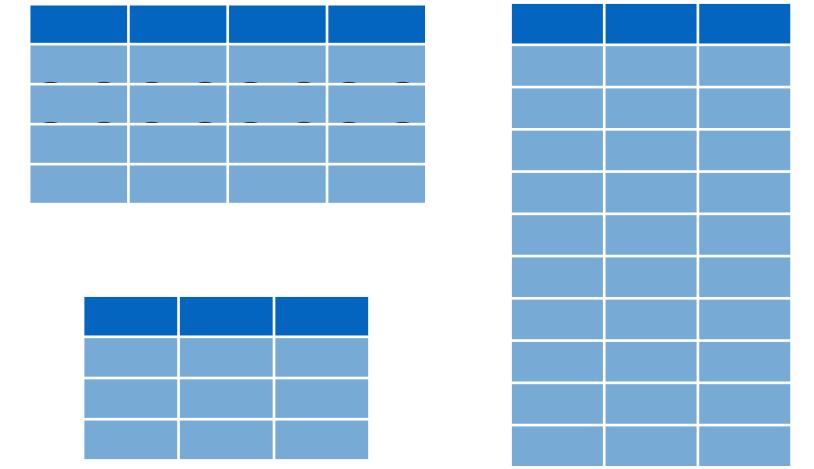
Charlotte Wickham is licensed under a  
Creative Commons Attribution 4.0 International License.

A blue callout box with white text is positioned on the right side of the preview pane, containing the following text:

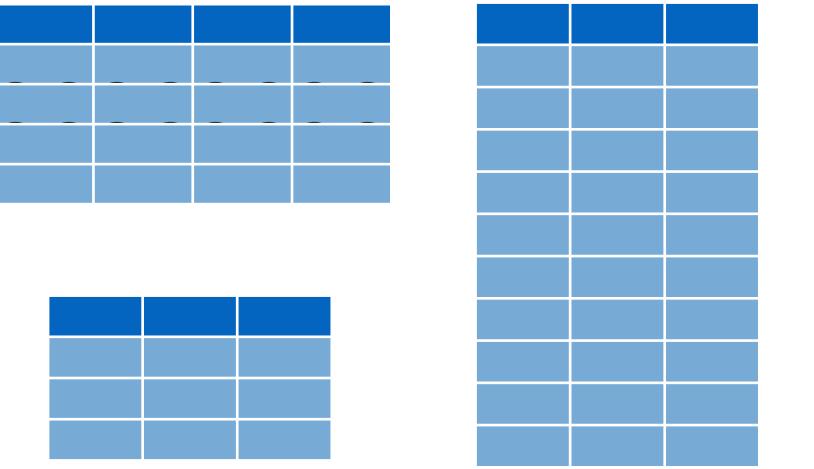
If you get lost:  
navigate to  
a particular  
**Your Turn**

The status bar at the bottom shows 'R Markdown'.

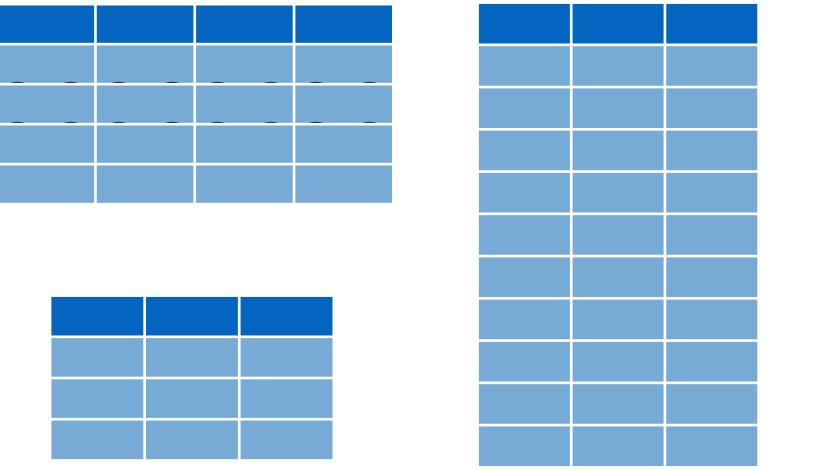
# R Packages



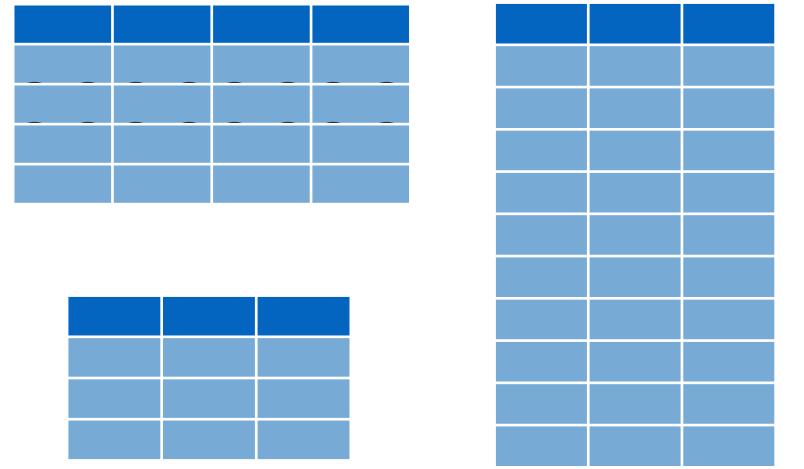
function1()  
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function4()



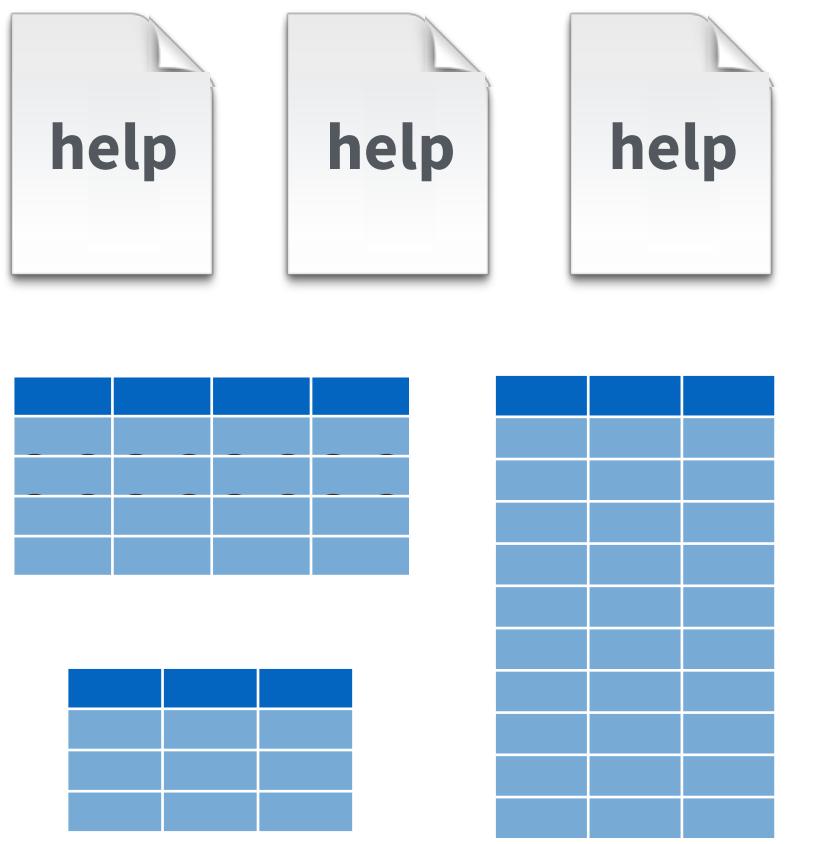
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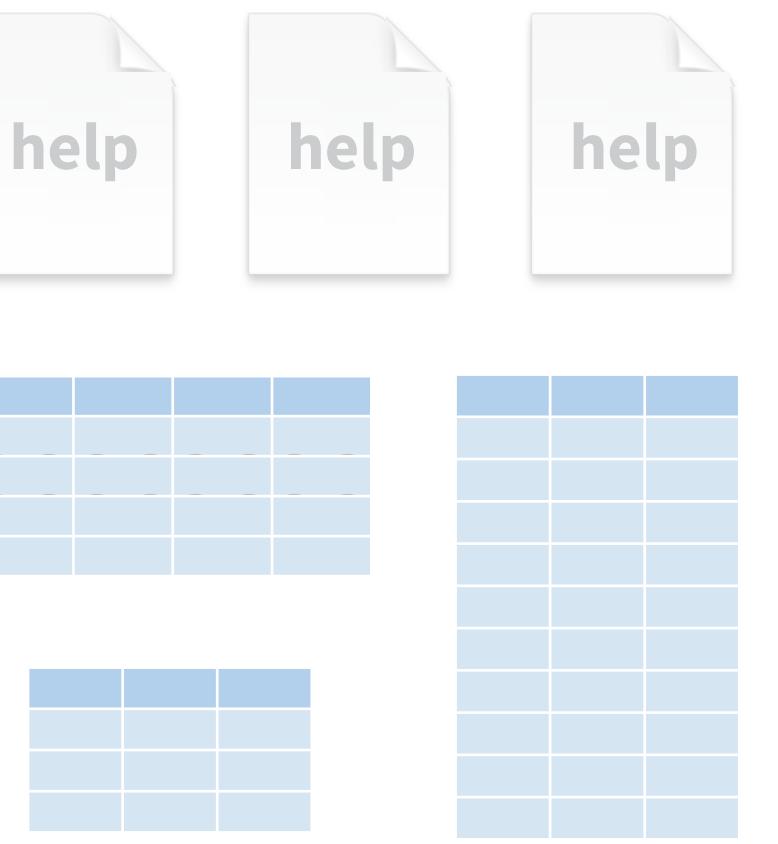
function9()  
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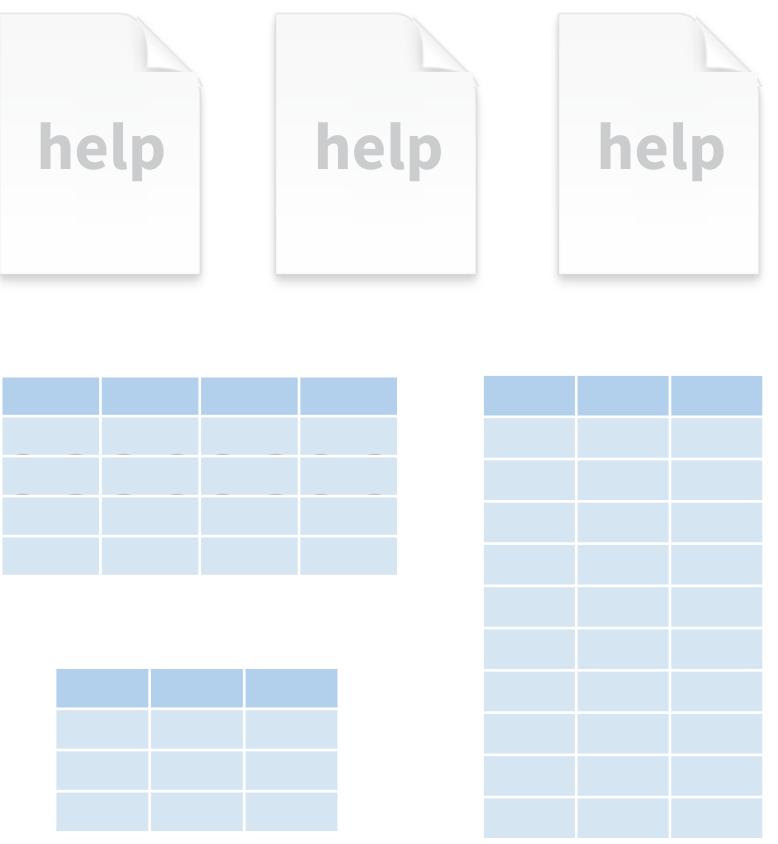
functionD()  
functionE()  
functionF()  
functionG()



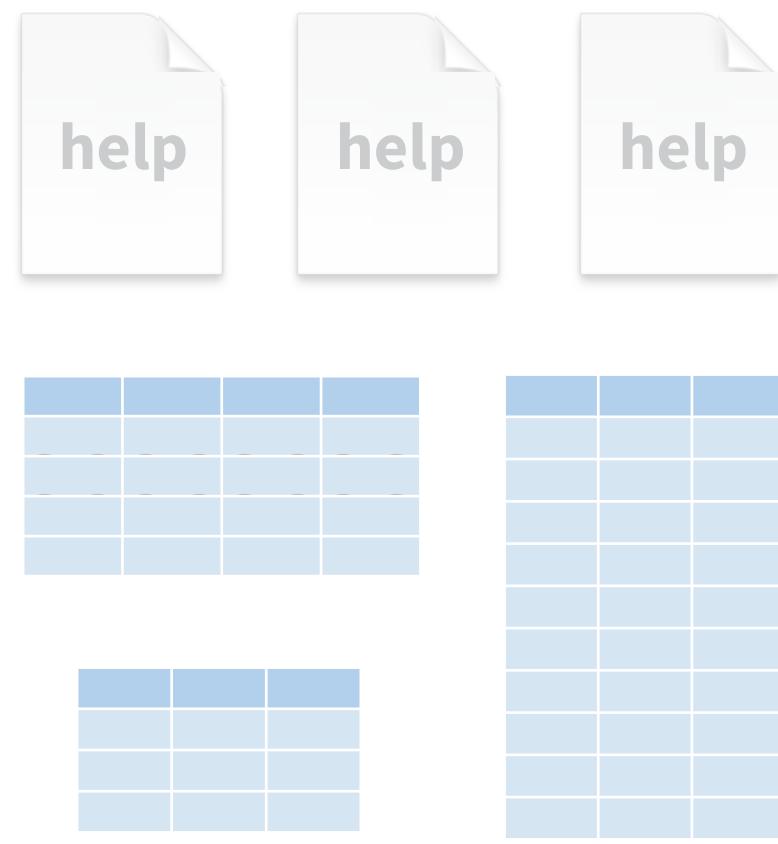
**function1()**  
**function2()**  
**function3()**  
**function4()**



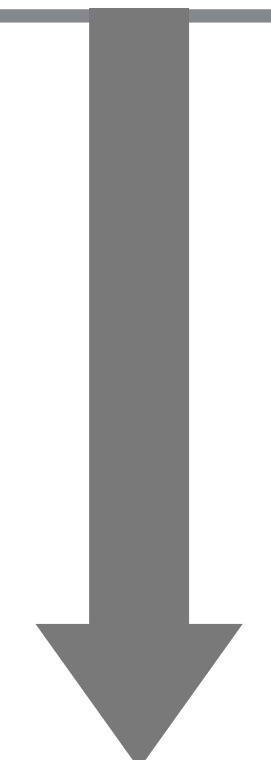
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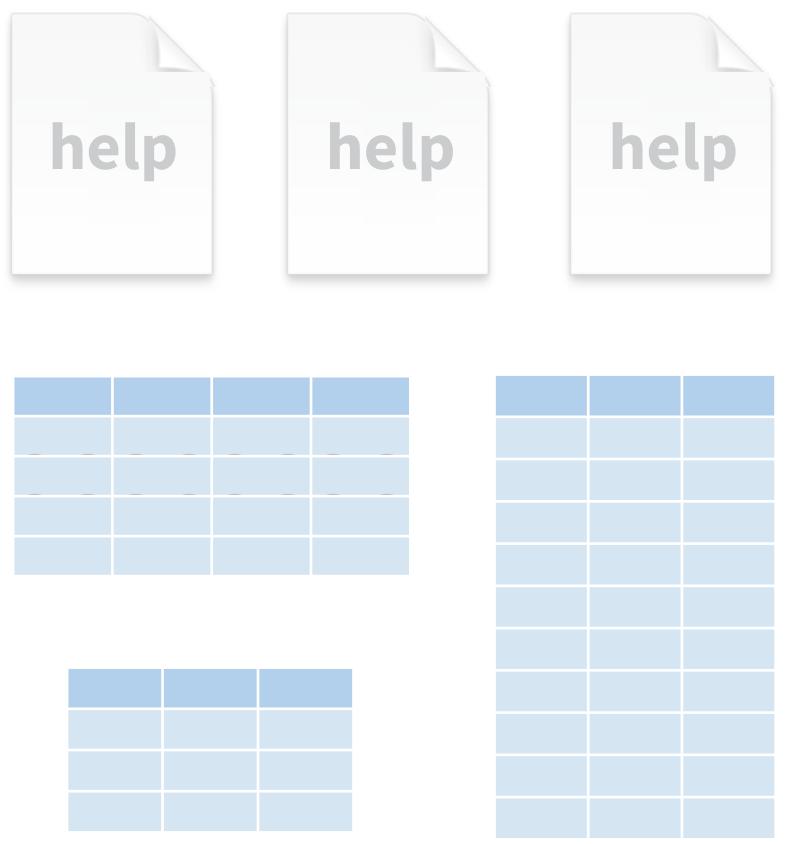
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**functionA()**  
**functionB()**  
**functionC()**



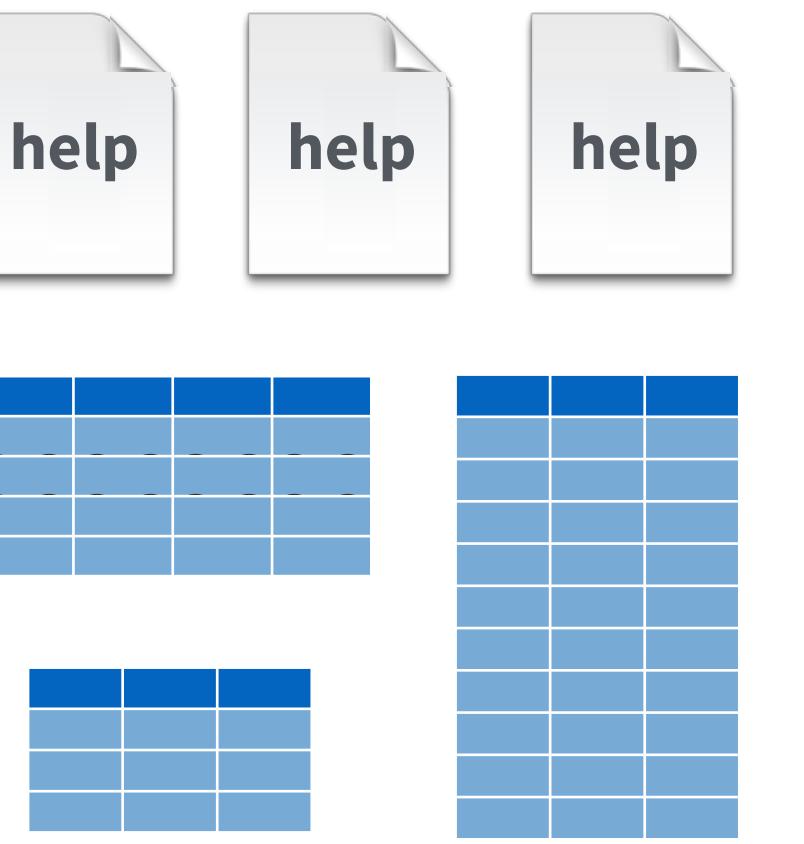
**functionD()**  
**functionE()**  
**functionF()**  
**functionG()**



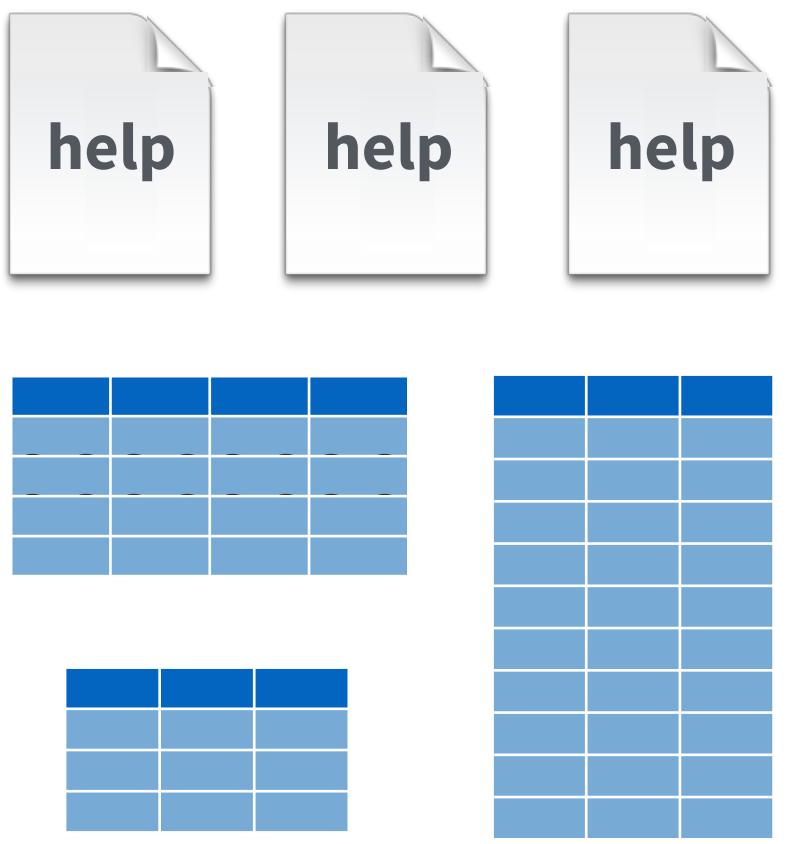
**Base R**



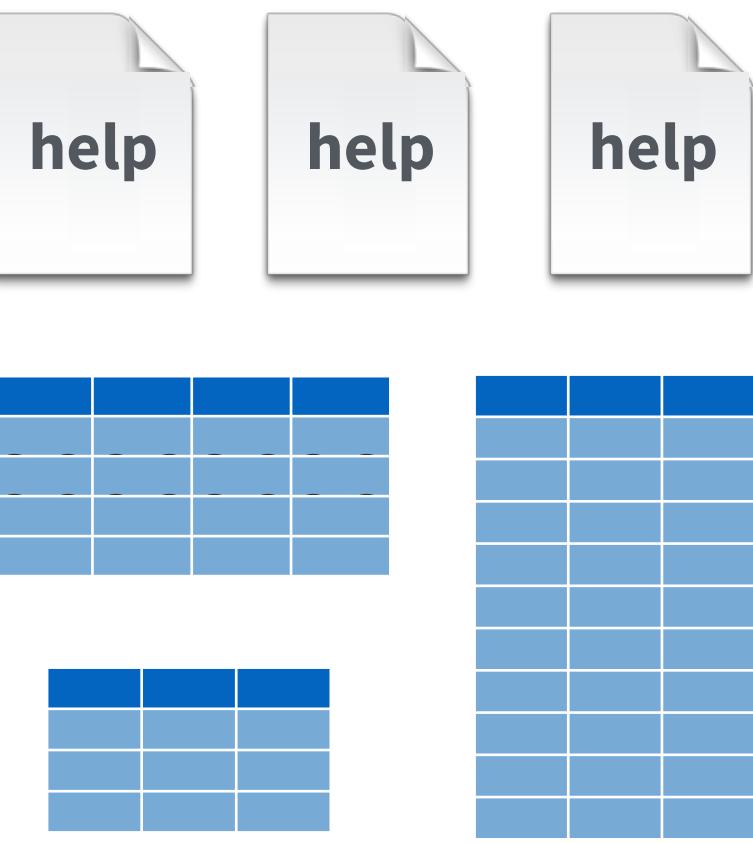
function1()  
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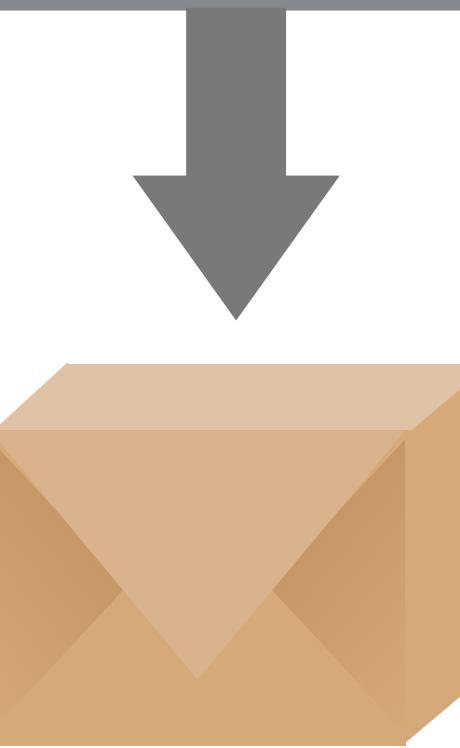
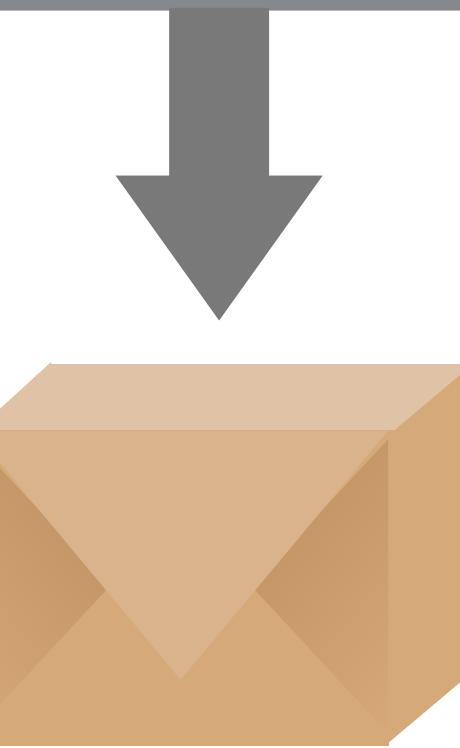
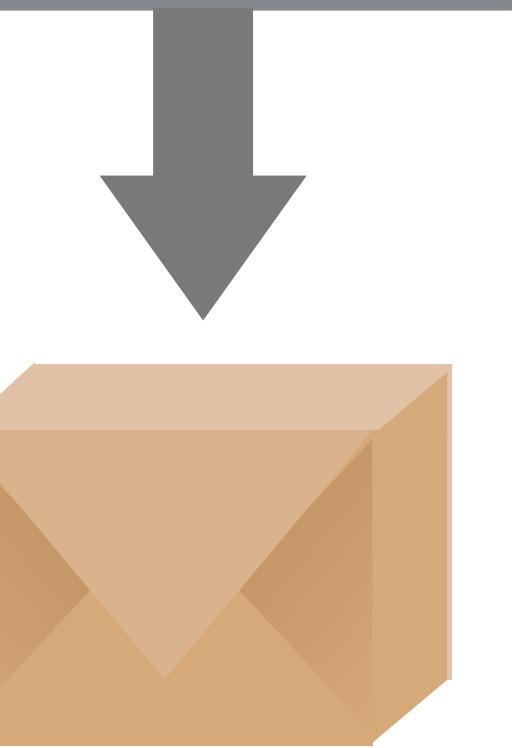
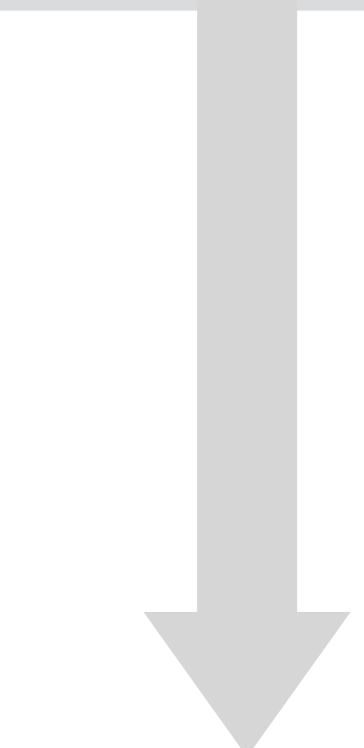
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Base R

R Packages

# Using packages

**1**

```
install.packages("foo")
```

Downloads files to computer

**1 x per computer**

**2**

```
library("foo")
```

Loads package

**1 x per R Session**

We did this for  
you on [rstudio.cloud](#)

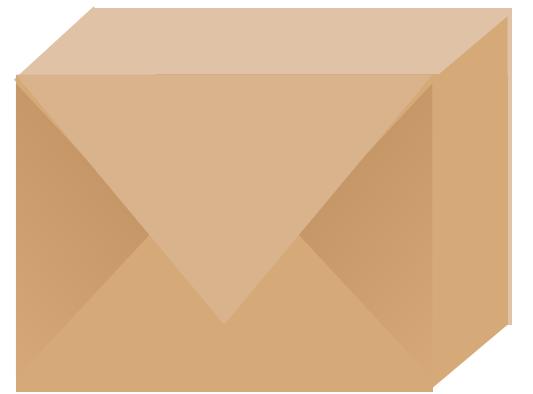
# Your Turn 1

With your neighbor:

**What R packages are being loaded in the first chunk of 02-Data-Basics.Rmd?**

```
```{r setup}
library(tidyverse)
library(gapminder)
library(readxl)
```
```

# tidyverse



An R package that serves as a short cut for installing and loading the components of the tidyverse.

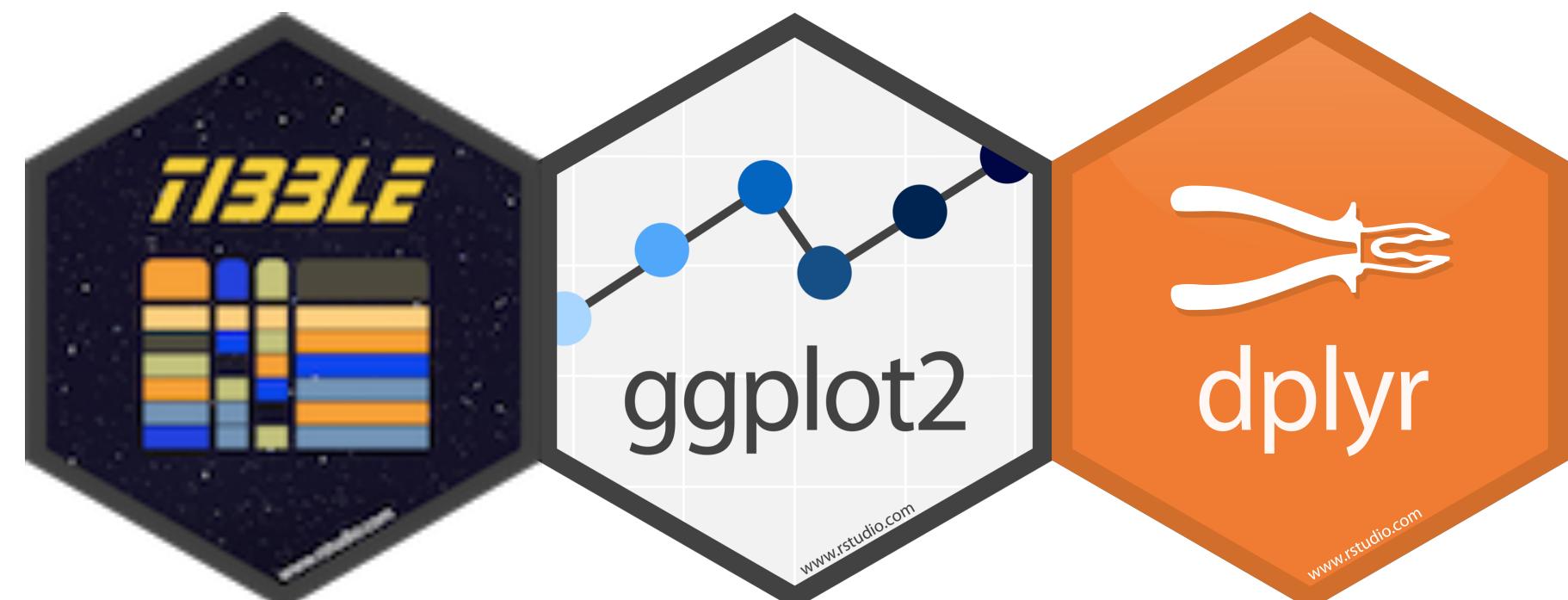
```
library("tidyverse")
```



# What is the tidyverse?

"...the tidyverse makes data science faster, easier and more fun ..."

"The tidyverse is an opinionated **collection of R packages** designed for **data science**. All packages share an underlying design philosophy, grammar, and data structures. "



```
install.packages("tidyverse")
```

does the equivalent of

```
install.packages("ggplot2")
install.packages("dplyr")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("stringr")
install.packages("forcats")
install.packages("lubridate")
install.packages("hms")
install.packages("DBI")
install.packages("haven")
install.packages("httr")
install.packages("jsonlite")
install.packages("readxl")
install.packages("rvest")
install.packages("xml2")
install.packages("modelr")
install.packages("broom")
```

```
install.packages("tidyverse")
```

does the equivalent of

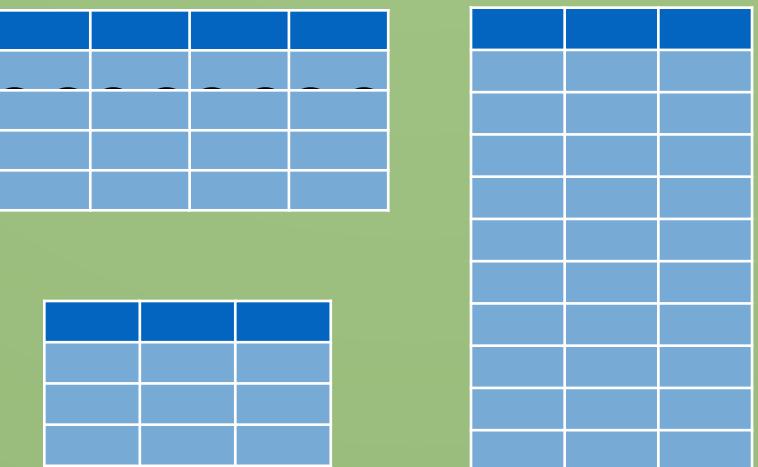
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install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("stringr")
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install.packages("jsonlite")
install.packages("readxl")
install.packages("rvest")
install.packages("xml2")
install.packages("modelr")
install.packages("broom")
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```
library("tidyverse")
```

does the equivalent of

```
install.packages("ggplot2")
install.packages("dplyr")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("stringr")
install.packages("forcats")
```

# Tabular Data



# Data frames and tibbles

The most common kind of data objects, for rectangular data

**Data frames** - a type of object native to R

**Tibbles** - a.k.a `tbl` - a type of data frame common in the tidyverse

Tibbles have slightly different default behaviour than data frames, but in R markdown you mostly won't notice a difference.

# Your Turn 2

Take a look at the mpg dataset in two ways:

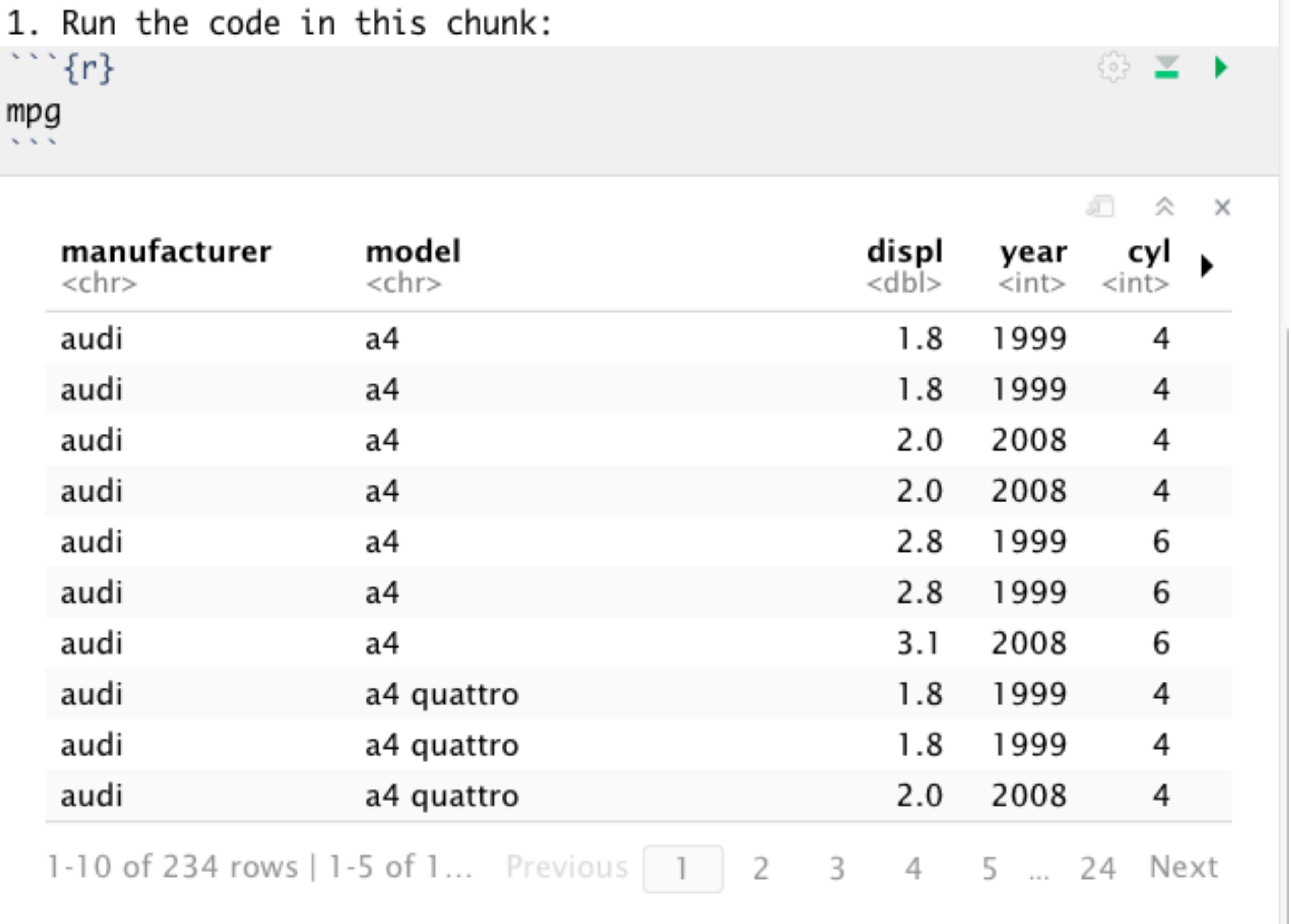
1. Run `mpg` in the code chunk
2. Type `mpg` on the Console and hit Enter

**What do you notice about the difference in the way they are displayed?**

# mpg in an R markdown code chunk:

1. Run the code in this chunk:

```
```{r}  
mpg  
```
```



| manufacturer | model      | displ | year  | cyl   |
|--------------|------------|-------|-------|-------|
| <chr>        | <chr>      | <dbl> | <int> | <int> |
| audi         | a4         | 1.8   | 1999  | 4     |
| audi         | a4         | 1.8   | 1999  | 4     |
| audi         | a4         | 2.0   | 2008  | 4     |
| audi         | a4         | 2.0   | 2008  | 4     |
| audi         | a4         | 2.8   | 1999  | 6     |
| audi         | a4         | 2.8   | 1999  | 6     |
| audi         | a4         | 3.1   | 2008  | 6     |
| audi         | a4 quattro | 1.8   | 1999  | 4     |
| audi         | a4 quattro | 1.8   | 1999  | 4     |
| audi         | a4 quattro | 2.0   | 2008  | 4     |

1-10 of 234 rows | 1-5 of 1... Previous [1](#) [2](#) [3](#) [4](#) [5](#) ... [24](#) Next

# mpg in the Console:

```
> mpg
# A tibble: 234 x 11
  manufacturer model displ year cyl trans drv cty hwy fl
  <chr>        <chr> <dbl> <int> <int> <chr> <chr> <int> <int> <chr>
1 audi         a4     1.8  1999    4 auto... f      18   29 p
2 audi         a4     1.8  1999    4 manu... f      21   29 p
3 audi         a4     2    2008    4 manu... f      20   31 p
4 audi         a4     2    2008    4 auto... f      21   30 p
5 audi         a4     2.8  1999    6 auto... f      16   26 p
6 audi         a4     2.8  1999    6 manu... f      18   26 p
7 audi         a4     3.1  2008    6 auto... f      18   27 p
8 audi         a4 q... 1.8  1999    4 manu... 4     18   26 p
9 audi         a4 q... 1.8  1999    4 auto... 4     16   25 p
10 audi        a4 q... 2    2008    4 manu... 4    20   28 p
# ... with 224 more rows, and 1 more variable: class <chr>
>
```

# Your Turn 3

Run the code in the chunk line by line with shortcut Crtl/Cmd + Enter

```
dim(x = mpg)
```

```
names(x = mpg)
```

```
glimpse(x = mpg)
```

```
View(x = mpg)
```

**What do each of these functions do?**

# Getting an overview of data

```
dim(x = mpg)      # Dimensions of data  
names(x = mpg)    # Variable names  
glimpse(x = mpg) # Nice overview  
View(x = mpg)     # Open Viewer pane
```

# Your Turn 4

Write code in the empty chunks to find:

- The number of rows in `gapminder`
- The names of the variables in `gapminder`

```
dim(x = gapminder)
```

```
names(x = gapminder)
```

?

for help on data

mpg and gapminder are **built-in** datasets, they come with a package.

You can also use:

?data\_name

to get more info on built-in data

# Your Turn 5

Try

?mpg

What is this data?

# Vector Data

# Vectors

In R vectors are 1-dimensional arrays, that hold data all of the same type.

They can be constructed with `c()`

```
c(1, 3, 2, 1, 1)
```

But, you'll usually want to assign them to something

```
my_numbers <- c(1, 3, 2, 1, 1)
```

# Basic data types

|           |               |                                          |
|-----------|---------------|------------------------------------------|
| Integer   | Whole numbers | <code>c(1L, 2L, 3L, 4L)</code>           |
| Double    | Numbers       | <code>c(1, 2, 3, 4)</code>               |
| Character | Text          | <code>c("1", "2", "3", "4")</code>       |
| Logical   | True or False | <code>c(TRUE, FALSE, FALSE, TRUE)</code> |

# Your Turn 6

Take another look at mpg.

**What type of data is in each column?**

```
78 ````{r}  
79 mpg  
80 ````
```

| manufacturer | model | displ | year  | cyl   | trans | drv   | cty   | hwy   | fl    |
|--------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| <chr>        | <chr> | <dbl> | <int> | <int> | <chr> | <chr> | <int> | <int> | <chr> |

Integer

<int>

year: 1999, 2008

Double

<dbl>

displ: 1.8, 2, 3.1

Character

<chr>

model: "a4", "camry"

Logical

<lgl>

# Importing Data

# readr



Simple, consistent functions for working  
with (mostly) plain text data.

```
# install.packages("tidyverse")
library(tidyverse)
```

# readxl



Simple, consistent functions for working  
Excel data

```
# install.packages("tidyverse")
library(readxl)
```

# haven



Simple, consistent functions for working  
with SAS, SPSS and Stata data

```
# install.packages("tidyverse")
library(haven)
```

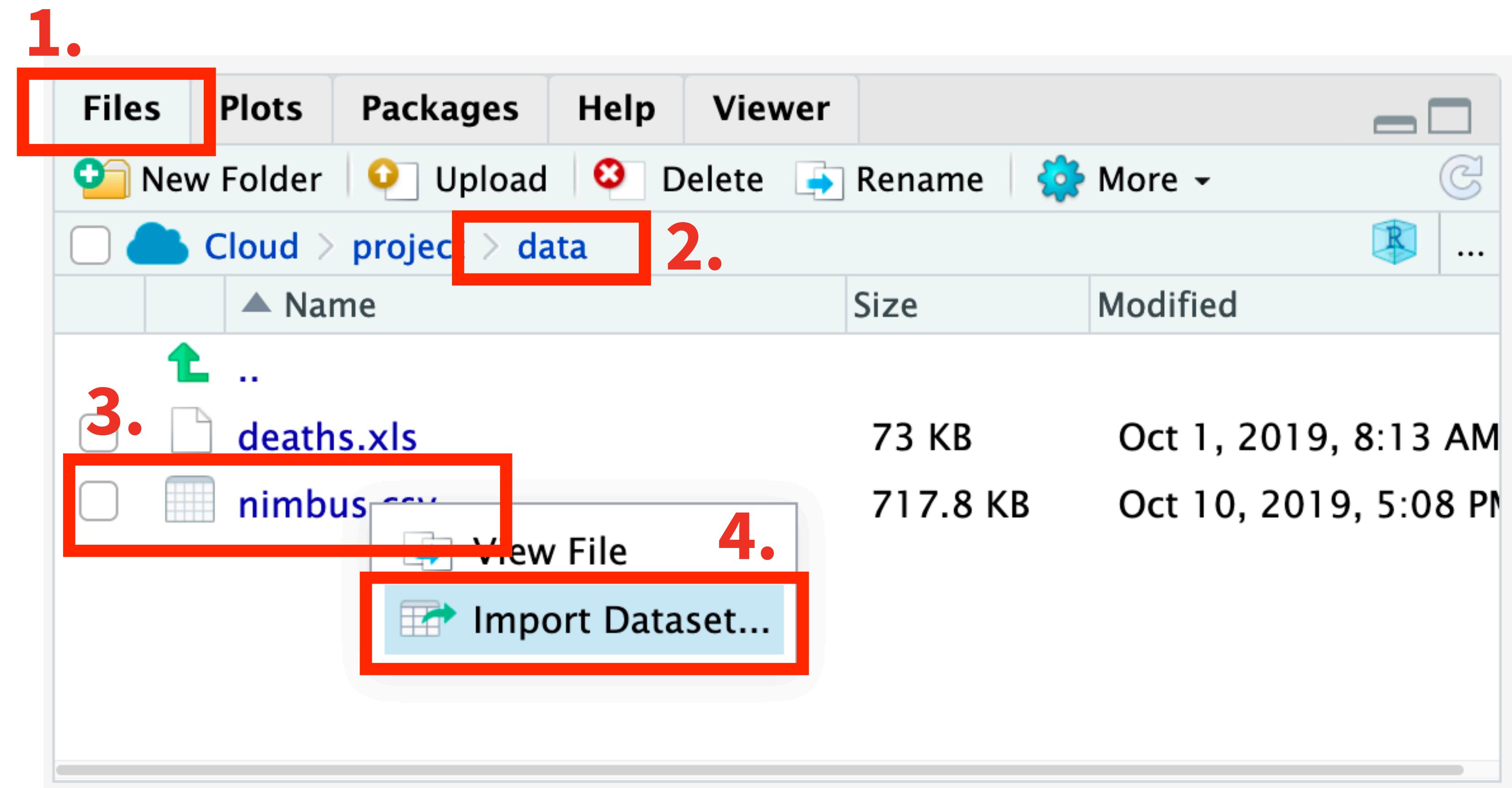
# Import Dataset...

1. In the Files pane

2. Navigate to the data folder

3. Click on nimbus.csv

4. Import Dataset...



# Import Dataset...

Import Text Data

File/URL:

/cloud/project/data/nimbus.csv Update

Data Preview:

| date<br>(double) | longitude<br>(double) | latitude<br>(double) | ozone<br>(double) |  |
|------------------|-----------------------|----------------------|-------------------|--|
|------------------|-----------------------|----------------------|-------------------|--|

Import Options:

|                                           |                                                        |                                                     |                                                 |
|-------------------------------------------|--------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------|
| Name: <input type="text" value="nimbus"/> | <input checked="" type="checkbox"/> First Row as Names | Delimiter: <input type="button" value="Comma"/>     | Escape: <input type="button" value="None"/>     |
| Skip: <input type="text" value="0"/>      | <input checked="" type="checkbox"/> Trim Spaces        | Quotes: <input type="button" value="Default"/>      | Comment: <input type="button" value="Default"/> |
|                                           | <input checked="" type="checkbox"/> Open Data Viewer   | Locale: <input type="button" value="Configure..."/> | NA: <input type="button" value="Default"/>      |

Code Preview:

```
library(readr)
nimbus <- read_csv("data/nimbus.csv")
View(nimbus)
```

Copy

[? Reading rectangular data using readr](#) Import Cancel

# readr

```
nimbus <- read_csv("data/nimbus.csv")
```

object to save  
output into

path to  
the file

# Your Turn 7

**What code do you need to read in deaths.xls?**

Use the Import Data tool to help generate the code.

*Challenge: Can you see a problem in the imported data? Can you Import again and fix it?*



## **readr**

```
df <- read_csv("path/to/file.csv", ...)
```

## **haven**

```
df <- read_spss("path/to/file.sav", ...)
```

## **readxl**

```
df <- read_excel("path/to/file.xls", ...)
```

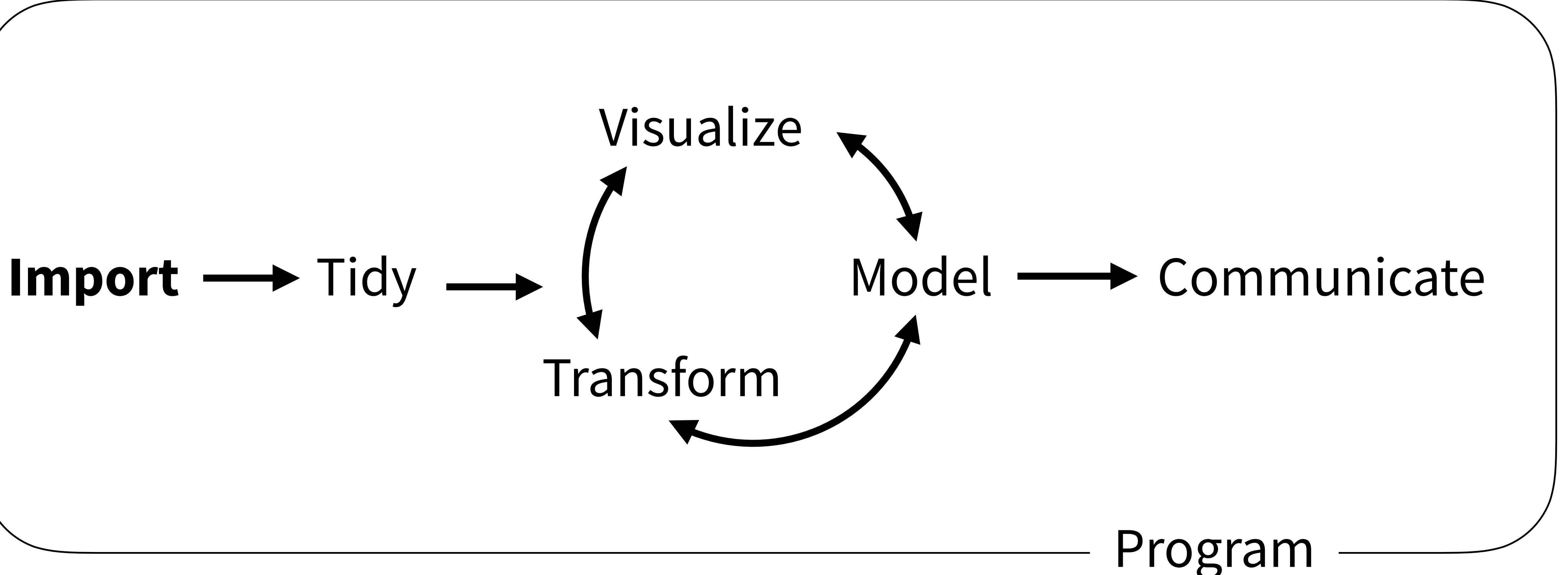
Import  
functions in  
the tidyverse  
have  
consistent  
syntax

# Other types of data

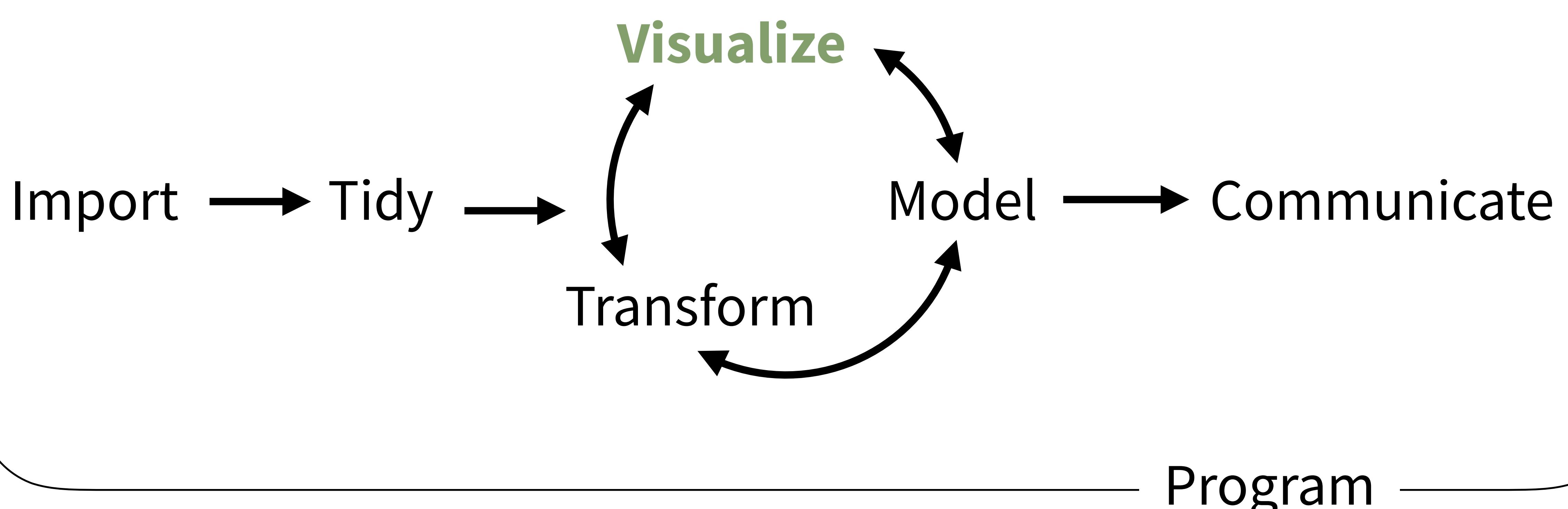
| package  | accesses                 |
|----------|--------------------------|
| jsonlite | json                     |
| xml2     | xml                      |
| httr     | web API's                |
| rvest    | web pages (web scraping) |
| DBI      | databases                |
| sparklyr | data loaded into spark   |

# Wrapping Up

# (Applied) Data Science



# (Applied) Data Science



Up next...



# Your Turn over lunch...

The mpg dataset has measurements on cars highway fuel efficiency (hwy) and their engine size (displ).

**What relationship would you expect to see between highway fuel efficiency and engine size?**