

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:

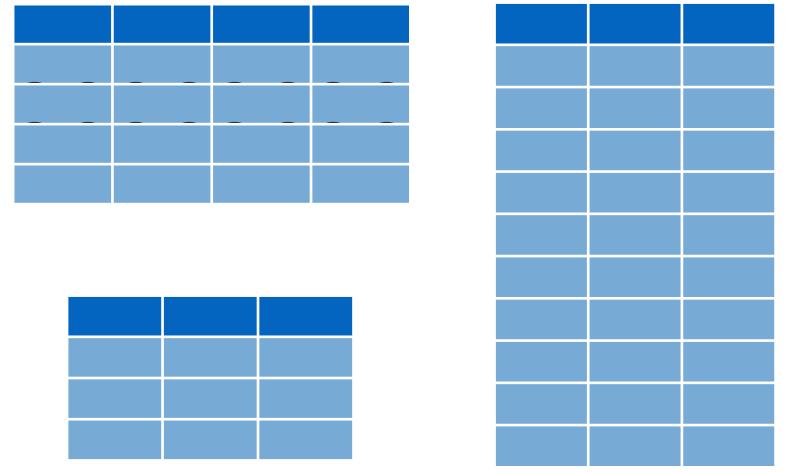
```
1 ---  
2 title: "Data Basics"  
3 output: html_document  
4 ---  
5  
6 <!-- This file by Charlotte Wickham is licensed under a  
7 Creative Commons Attribution 4.0 International License.  
8 -->  
9  
10 # R Packages  
11  
12 ```{r setup}  
13 library(tidyverse)  
14 library(gapminder)  
15 library(readxl)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

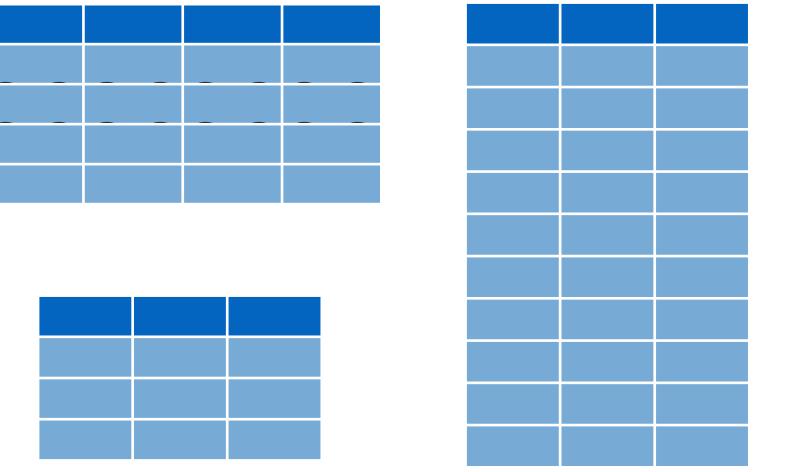
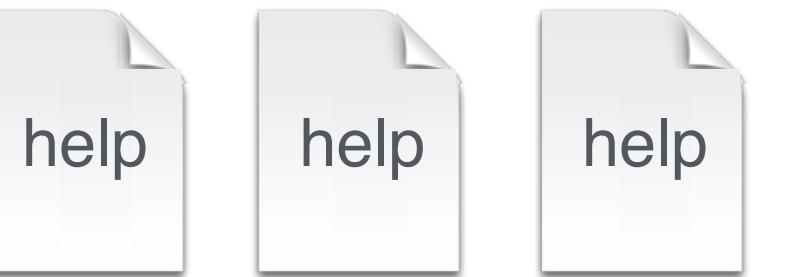
- Toolbar:** Includes icons for file operations (New, Open, Save, Print), Go to file/function, Addins, and a search bar.
- File Tabs:** Shows two open files: "01-Getting-started.Rmd" and "02-Data-basics.Rmd".
- Code Editor:** Displays R Markdown code. The current code cell (highlighted in blue) is "# Data Basics".

```
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
```
- Output Area:** Shows the rendered output of the R Markdown code, including a license notice and a callout box.
- Callout Box:** A blue box with white text provides instructions: "If you get lost: navigate to a particular Your Turn".
- Status Bar:** Shows the line number (1:1) and the current mode ("R Markdown").

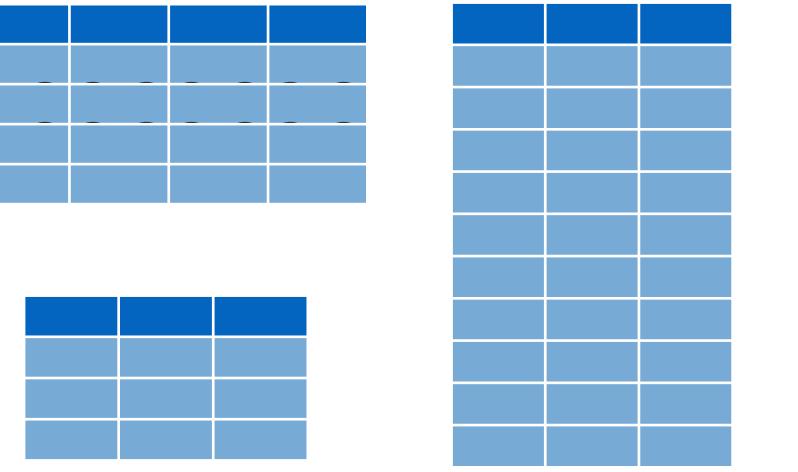
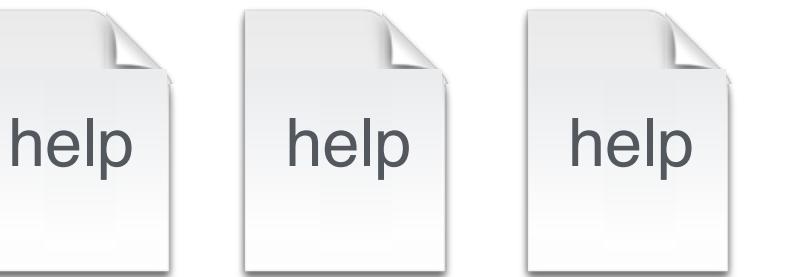
R Packages



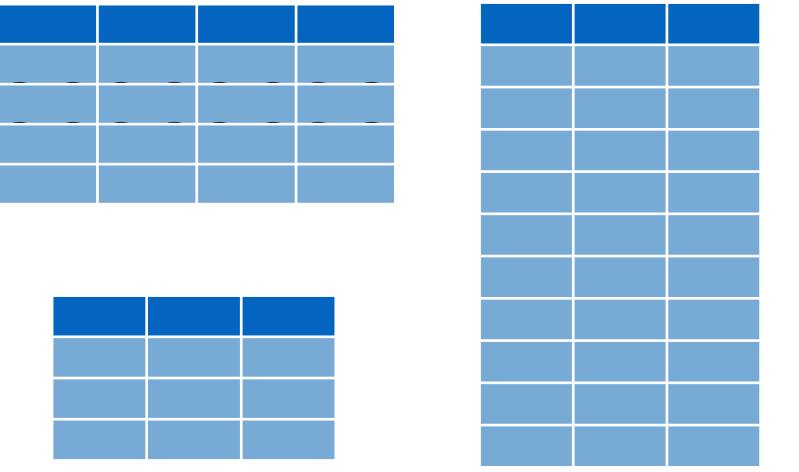
function1()
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function4()



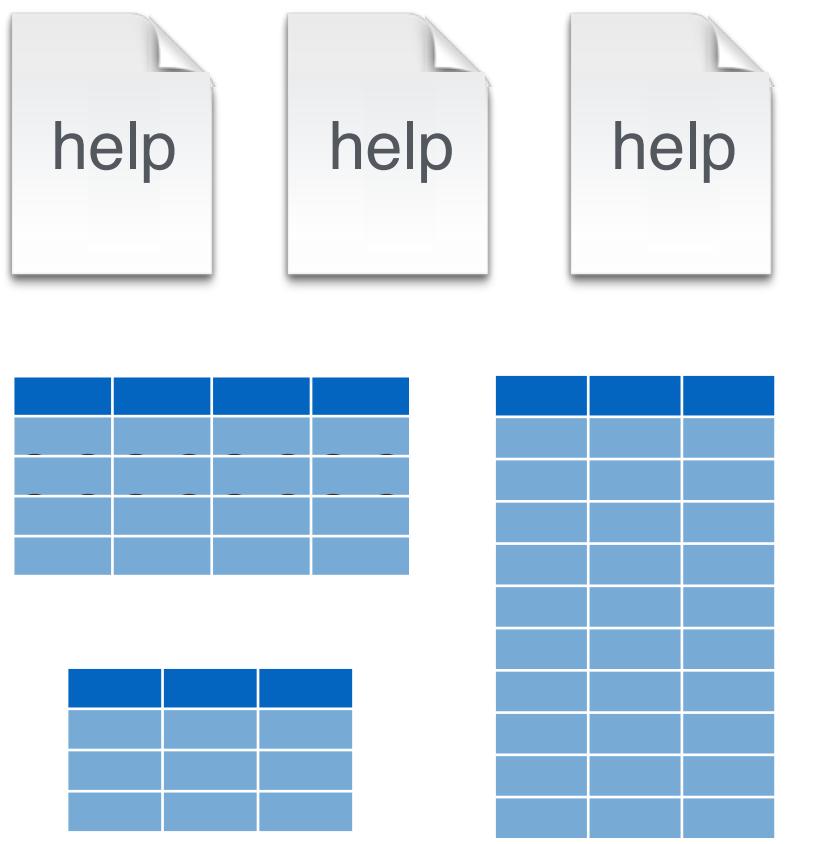
function5()
function6()
function7()
function8()



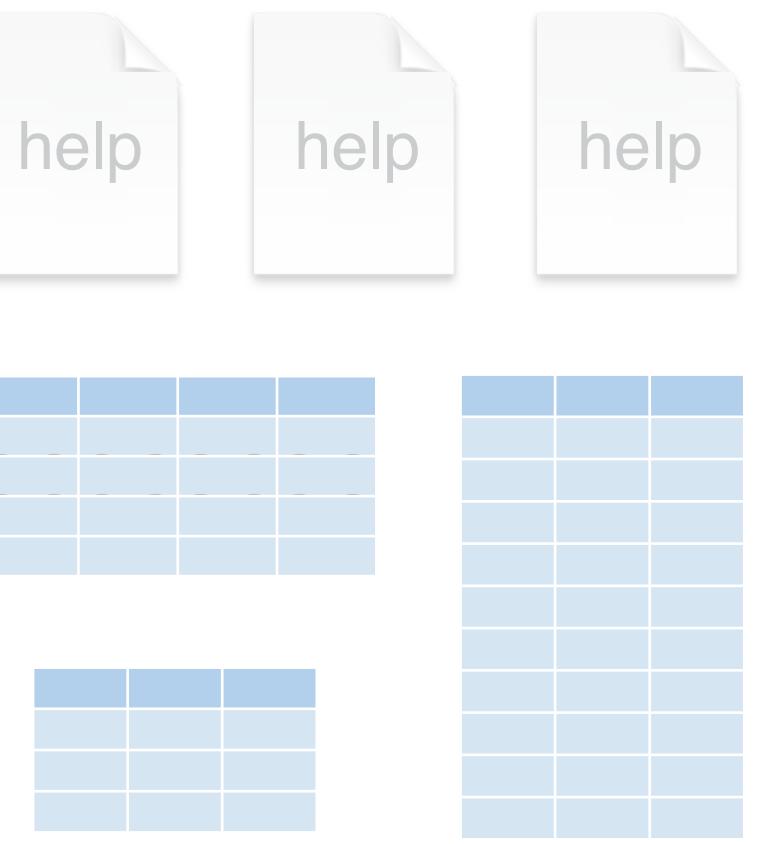
function9()
functionA()
functionB()
functionC()



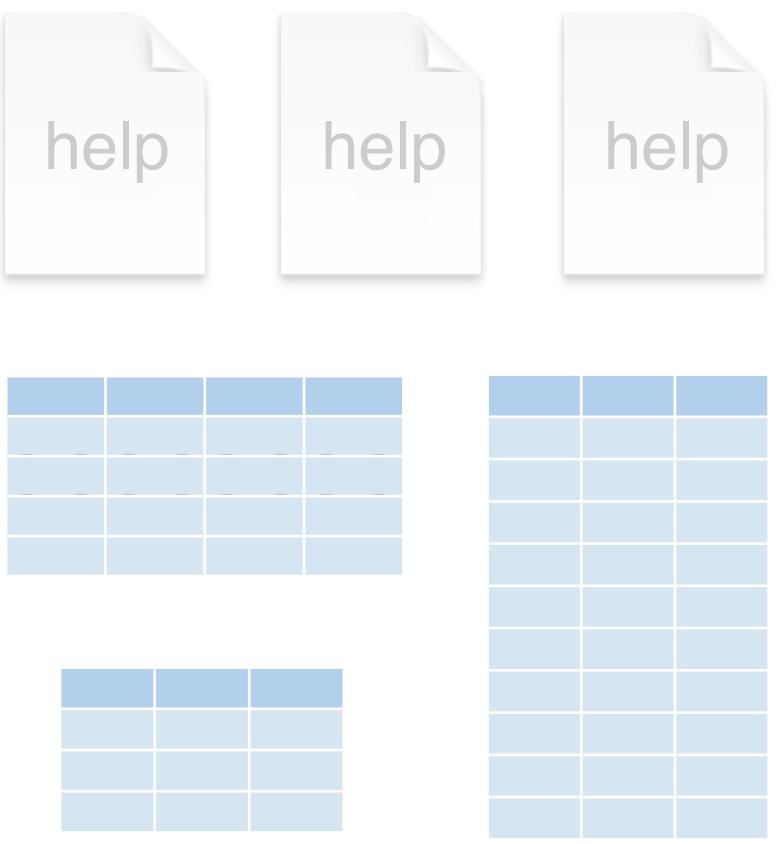
functionD()
functionE()
functionF()
functionG()



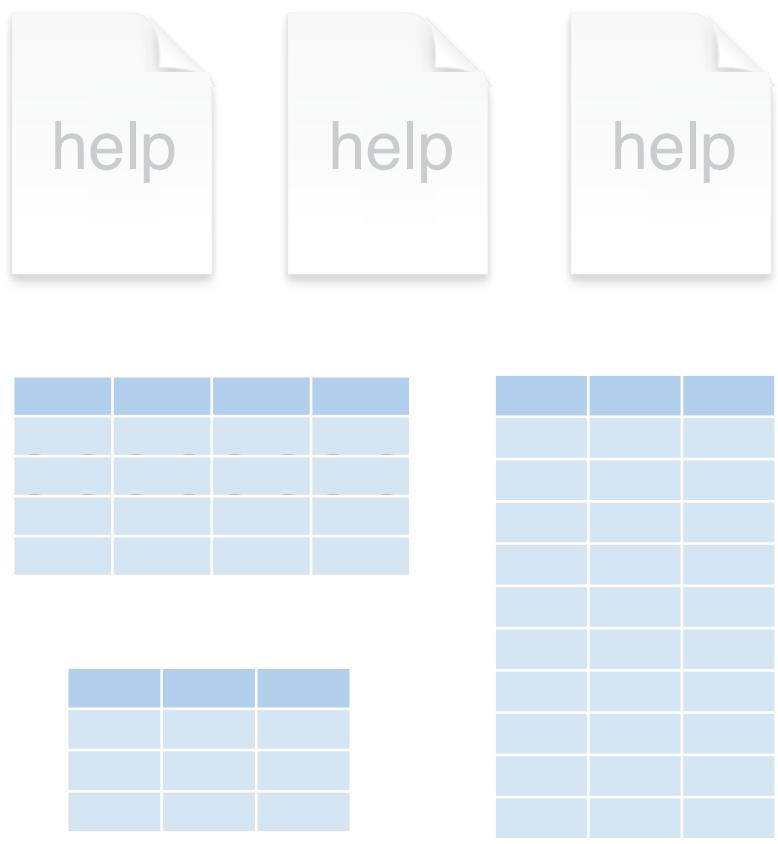
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function5()
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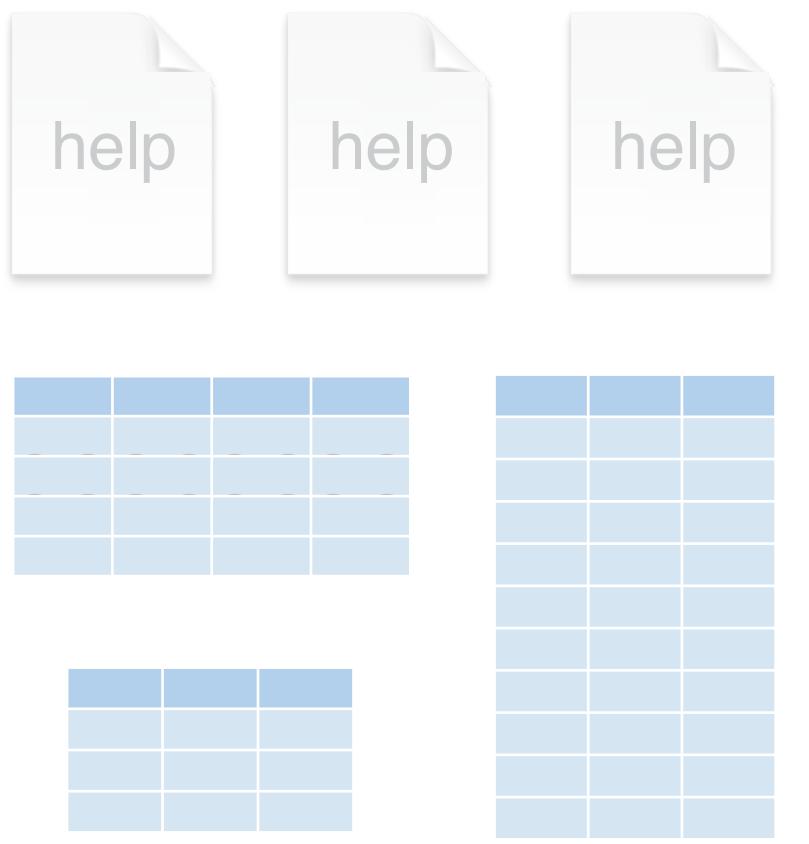


function9()
functionA()
functionB()
functionC()

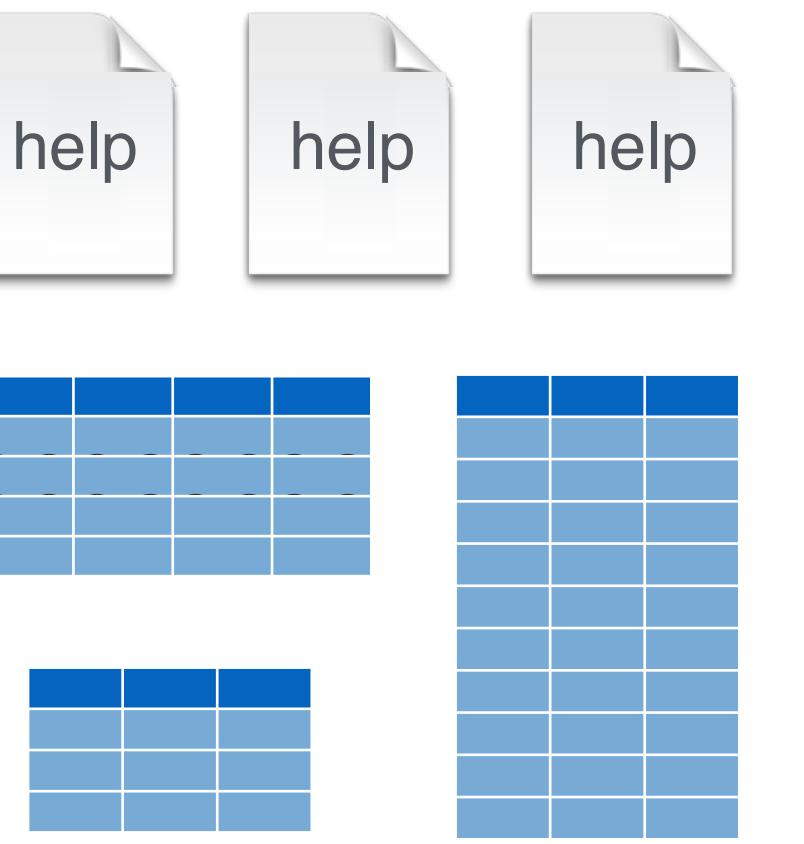


functionD()
functionE()
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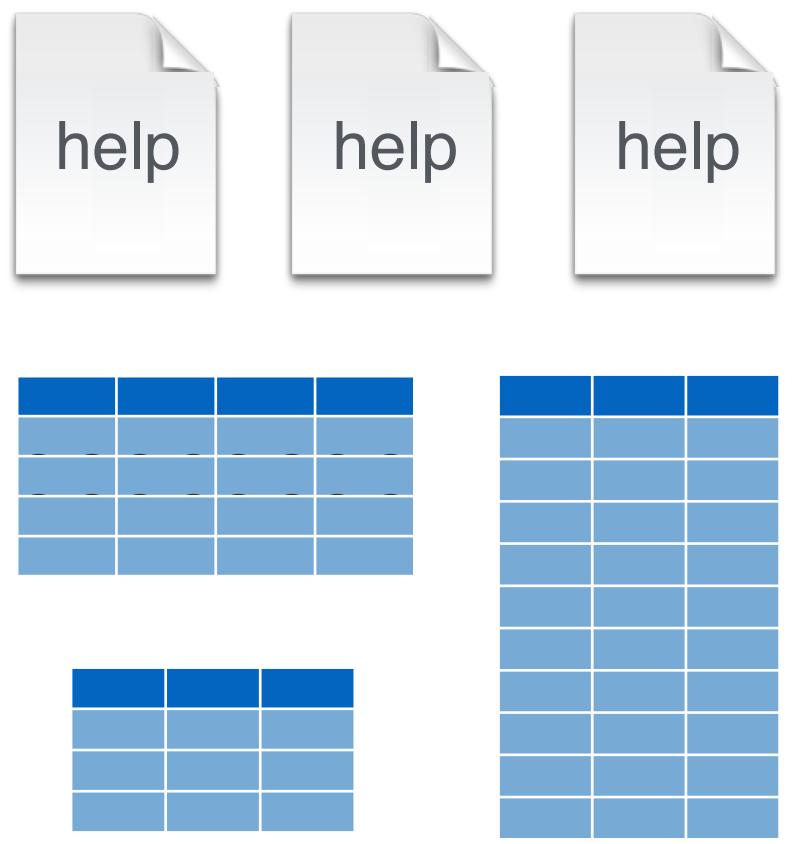
Base R



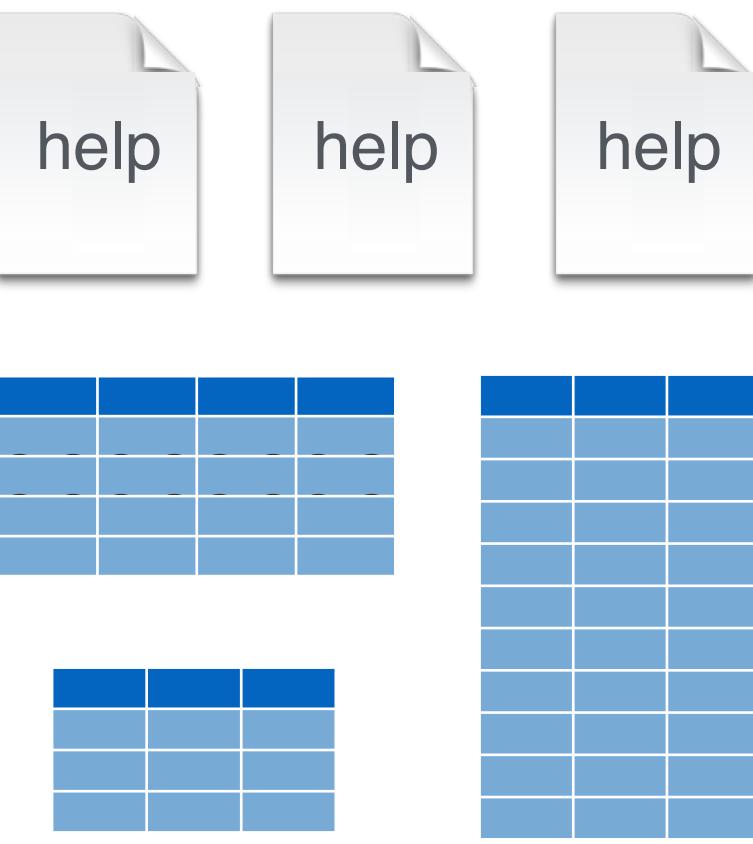
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function9()
functionA()
functionB()
functionC()



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

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

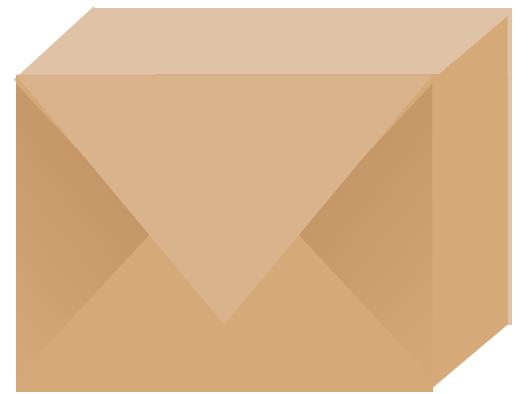
Your Turn 1

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.

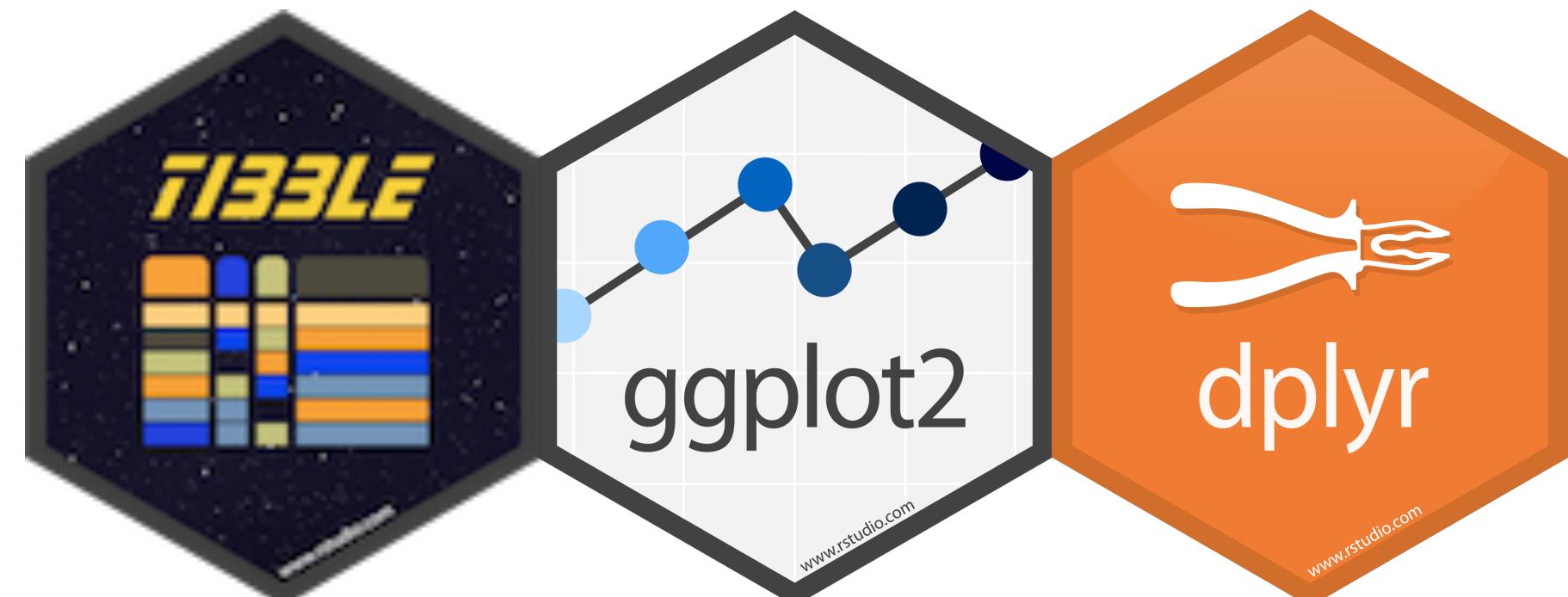
```
library("tidyverse")
```



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

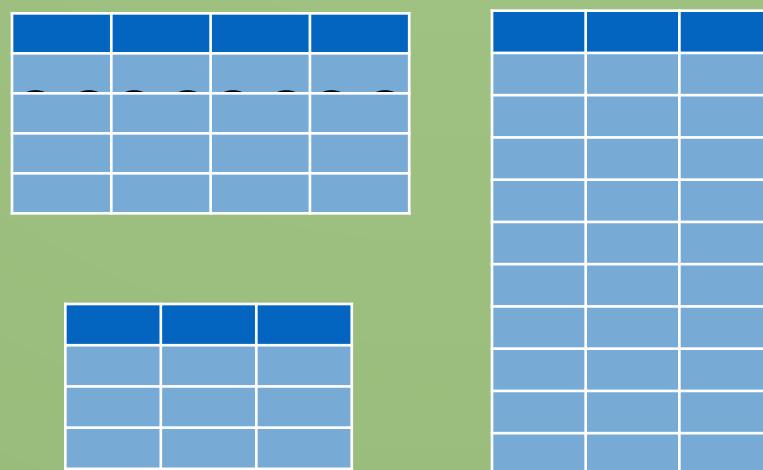
```
install.packages("ggplot2")
install.packages("dplyr")
install.packages("tidyr")
install.packages("readr")
install.packages("purrr")
install.packages("tibble")
install.packages("stringr")
install.packages("forcats")
install.packages("lubridate")
install.packages("hms")
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install.packages("haven")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

```
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:

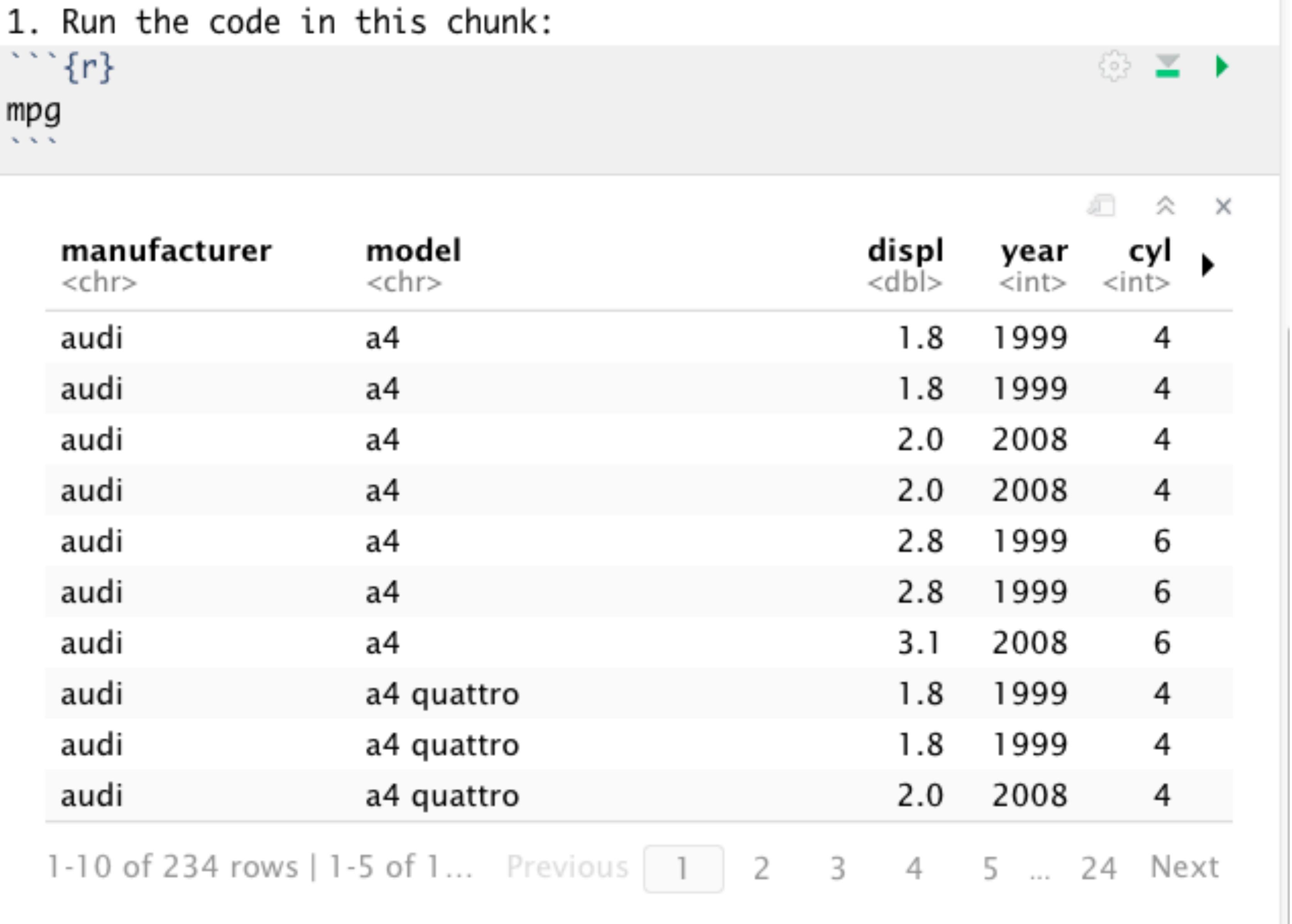
1. Run `mpg` in the code chunk
2. Type `mpg` on the Console and hit Enter

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

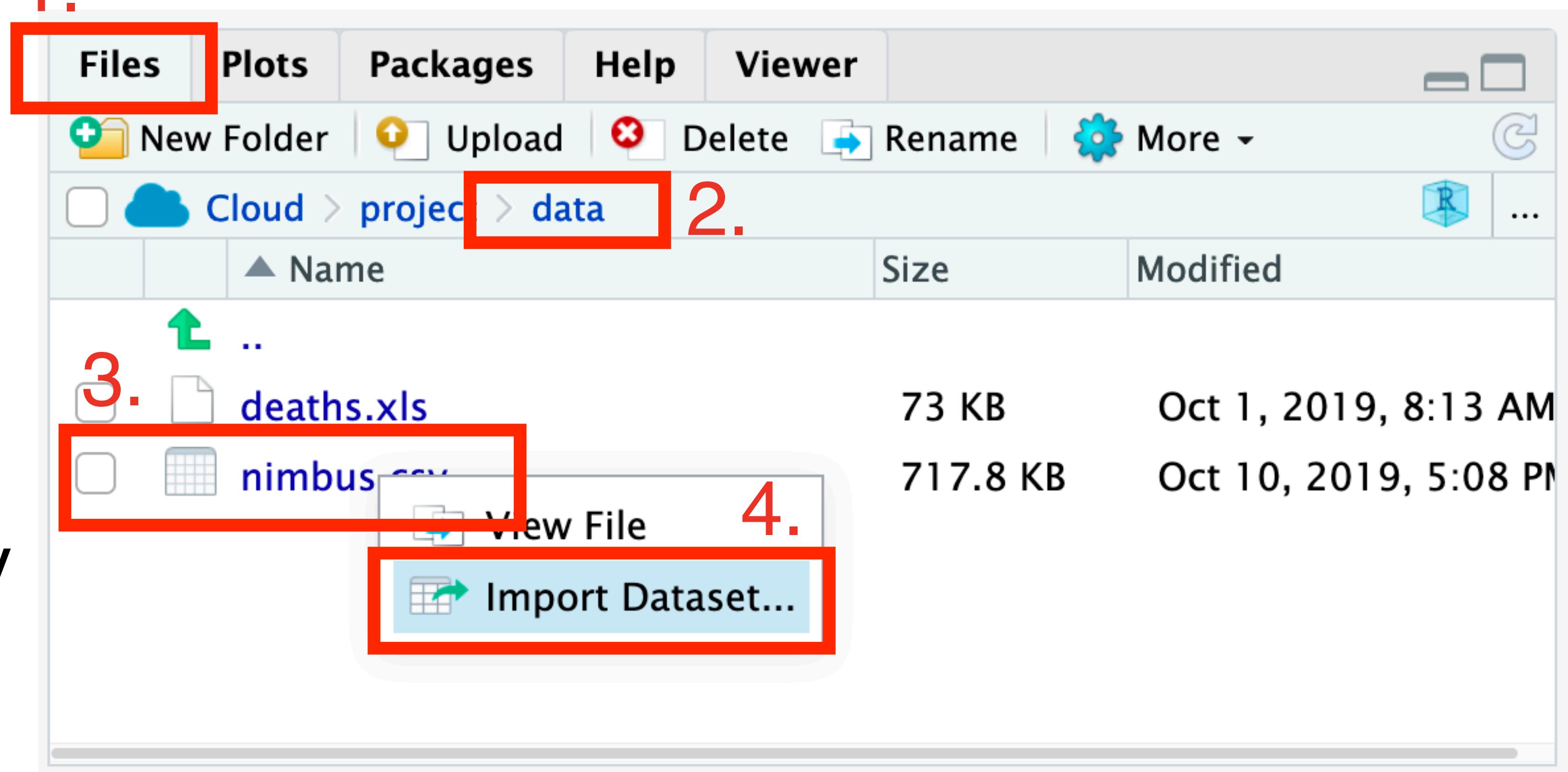


Simple, consistent functions for working
with SAS, SPSS and Stata data

```
# 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
(double) | longitude
(double) | latitude
(double) | ozone
(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?



readxl

```
library(readxl)  
deaths <- read_excel("data/deaths.xls", skip = 4)
```

readr

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

haven

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

readxl

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

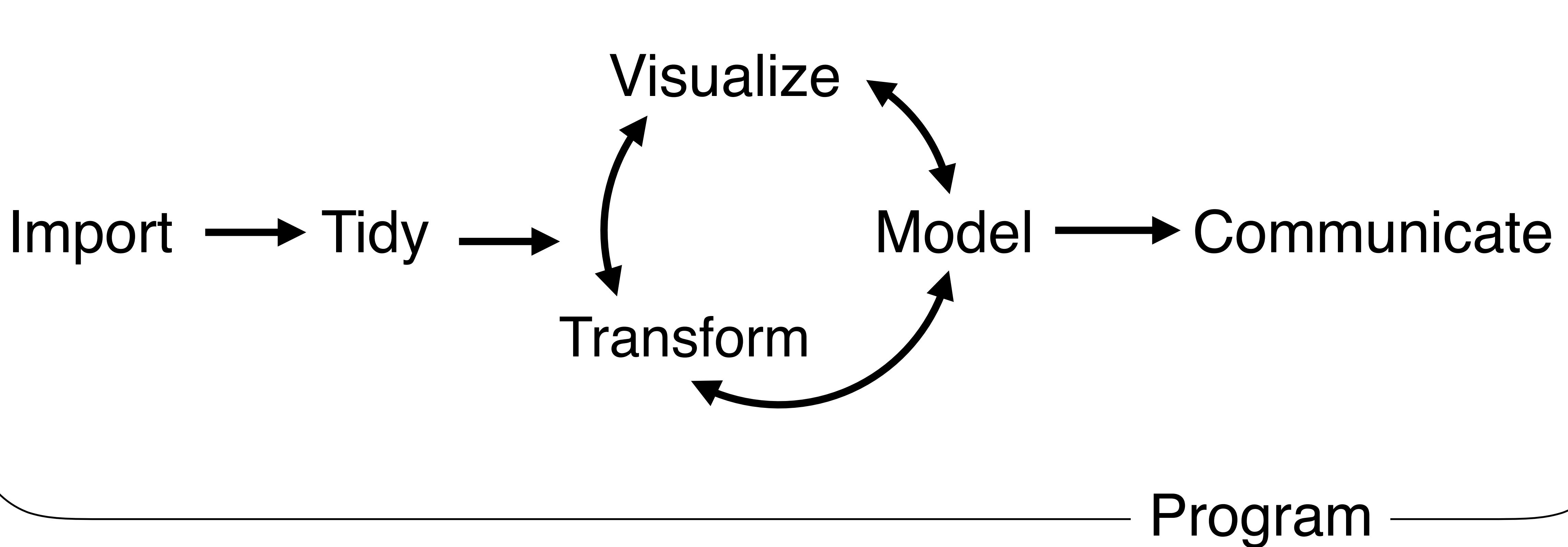
Import
functions in
the tidyverse
have
consistent
syntax

Other types of data

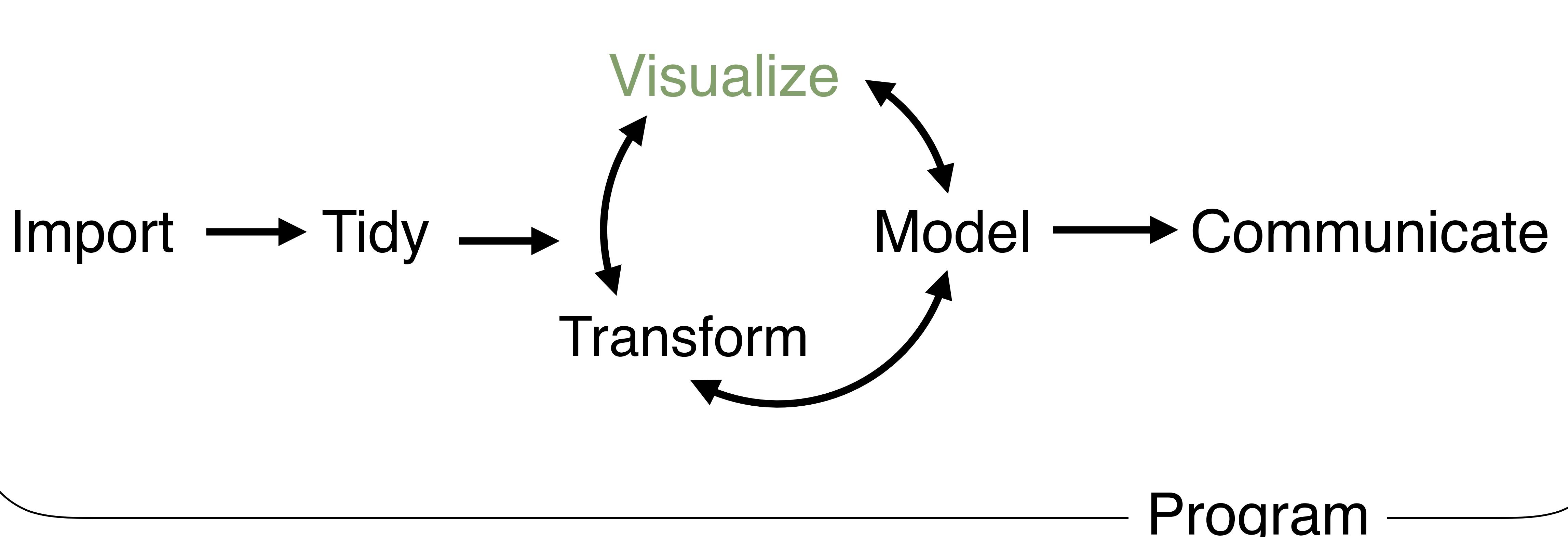
| package | accesses |
|----------|--------------------------|
| jsonlite | json |
| xml2 | xml |
| httr | web API's |
| rvest | web pages (web scraping) |
| DBI | databases |
| sparklyr | data loaded into spark |

Wrapping Up

(Applied) Data Science



(Applied) Data Science



Up next...



Your Turn

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?