

Introduction to R

Part 1 – base R

Part 1 Outline

1. How to get set up using R
2. How and why to use RStudio & R Markdown (.Rmd)
3. Basics of programming
 - Data types
 - Functions
 - Reading/writing files
 - Troubleshooting

R: The premier data analysis and visualization platform

<https://cran.r-project.org/>



The Comprehensive R Archive Network

Download and Install R

Precompiled binary distributions of the base system and contributed packages, **Windows and Mac** users most likely want one of these versions of R:

- [Download R for Linux](#)
- [Download R for \(Mac\) OS X](#)
- [Download R for Windows](#)

R is part of many Linux distributions, you should check with your Linux package management system in addition to the link above.

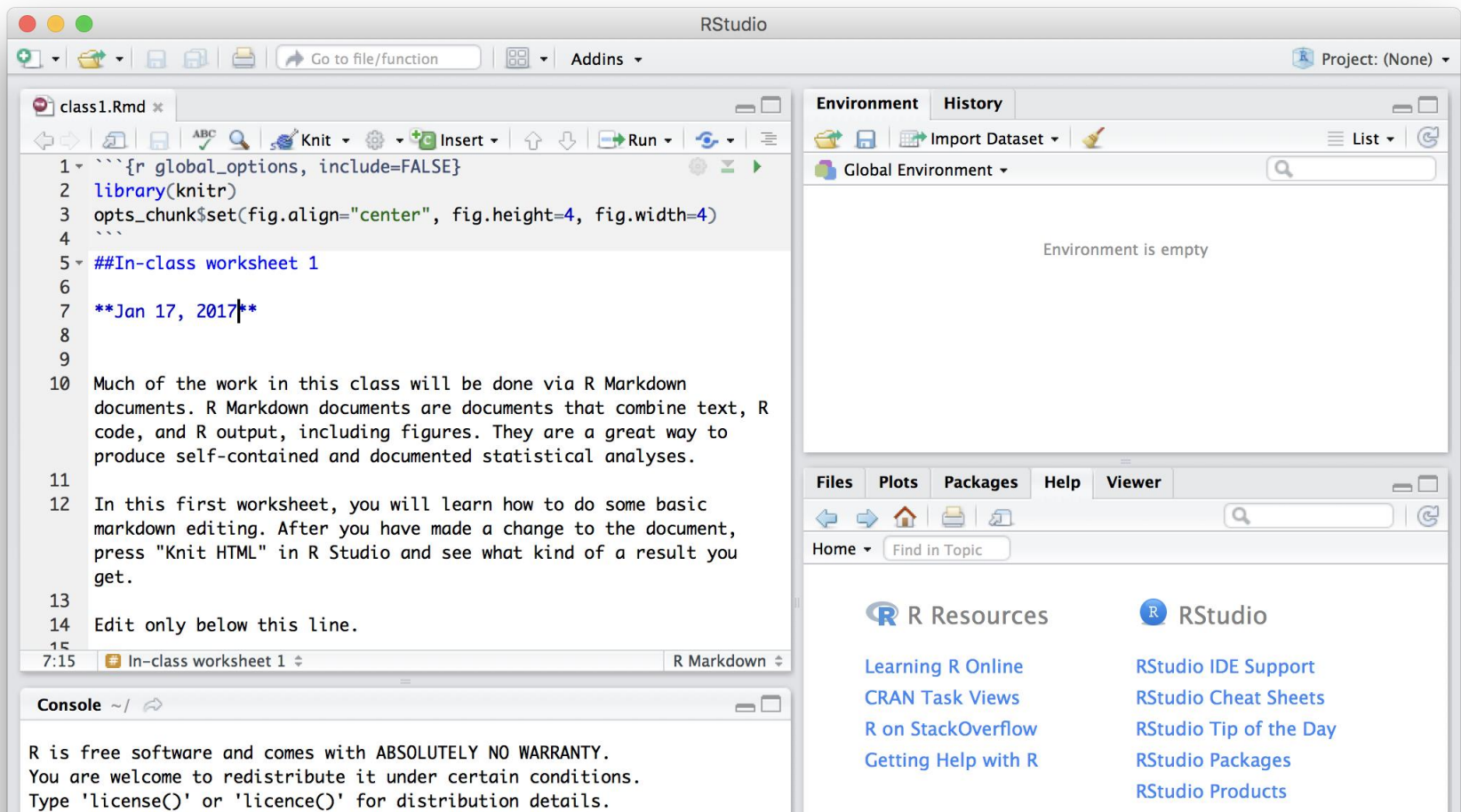
Source Code for all Platforms

Windows and Mac users most likely want to download the precompiled binaries listed in the upper

R Studio:

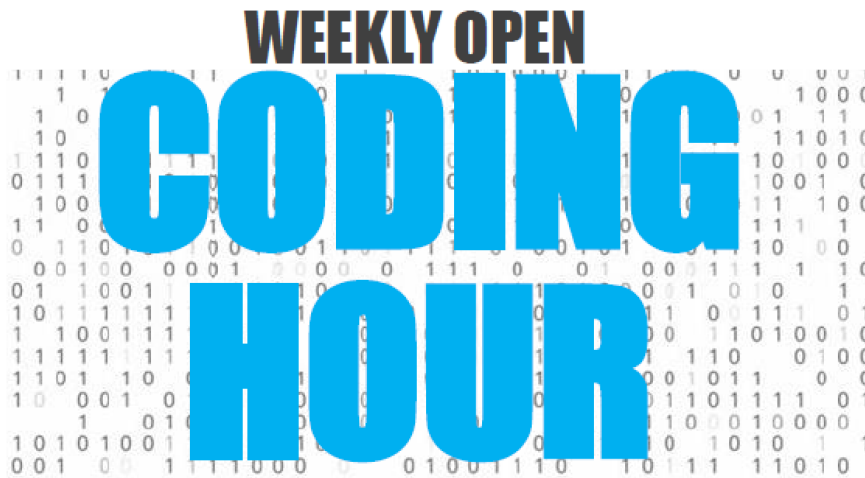
A nice user interface for R

<https://www.rstudio.com/products/rstudio/download/>



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Your resource for all things informatics



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STUCK ON A COMPUTING PROBLEM?

WANT ADVICE ON ANALYSIS?

NEED HELP PLOTTING YOUR DATA?

WANT TO GET STARTED LEARNING TO
PROGRAM?

**EVERYONE
WELCOME**

Students

Profs

Researchers

Newbies

Novice

Advanced

WHEN

Wednesdays

12:30-1:30pm

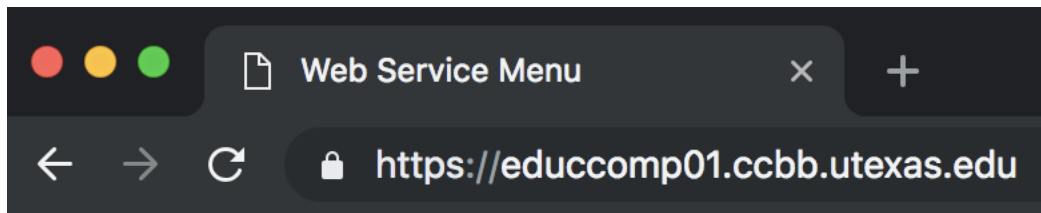
WHERE

MBB 2.232

Access R Studio through your web browser

1. <https://gsafcomp01.ccb.b.utexas.edu/>
2. <https://gsafcomp02.ccb.b.utexas.edu/>

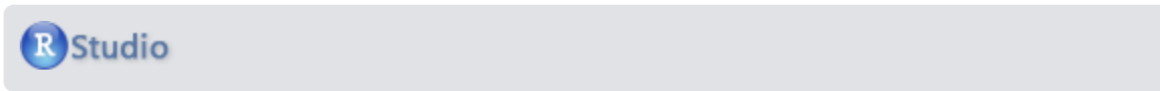
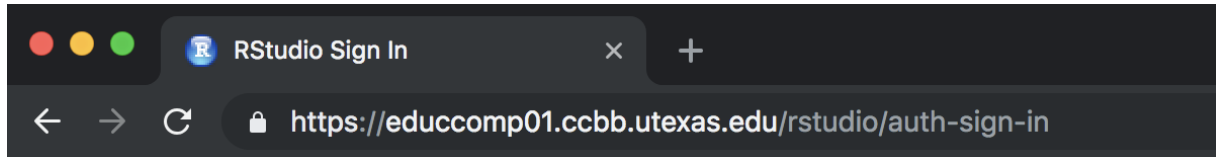
Select RStudio



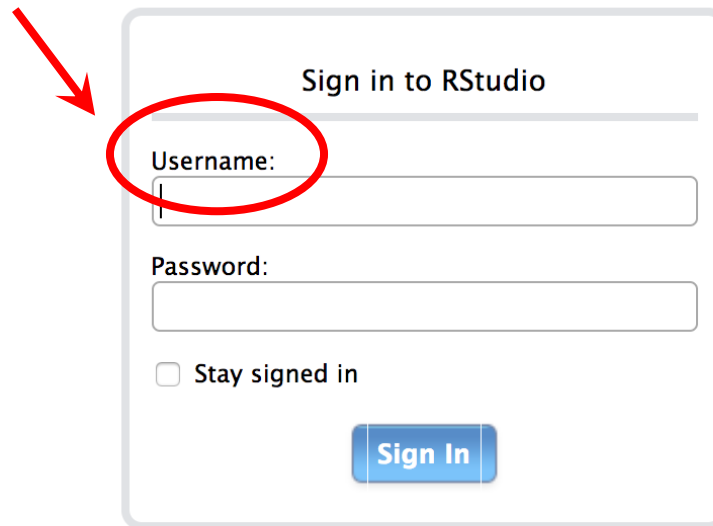
Please choose one of the following applications:

- [RStudio](#) ←
- [Jupyterhub](#)

Sign in with your student# and password

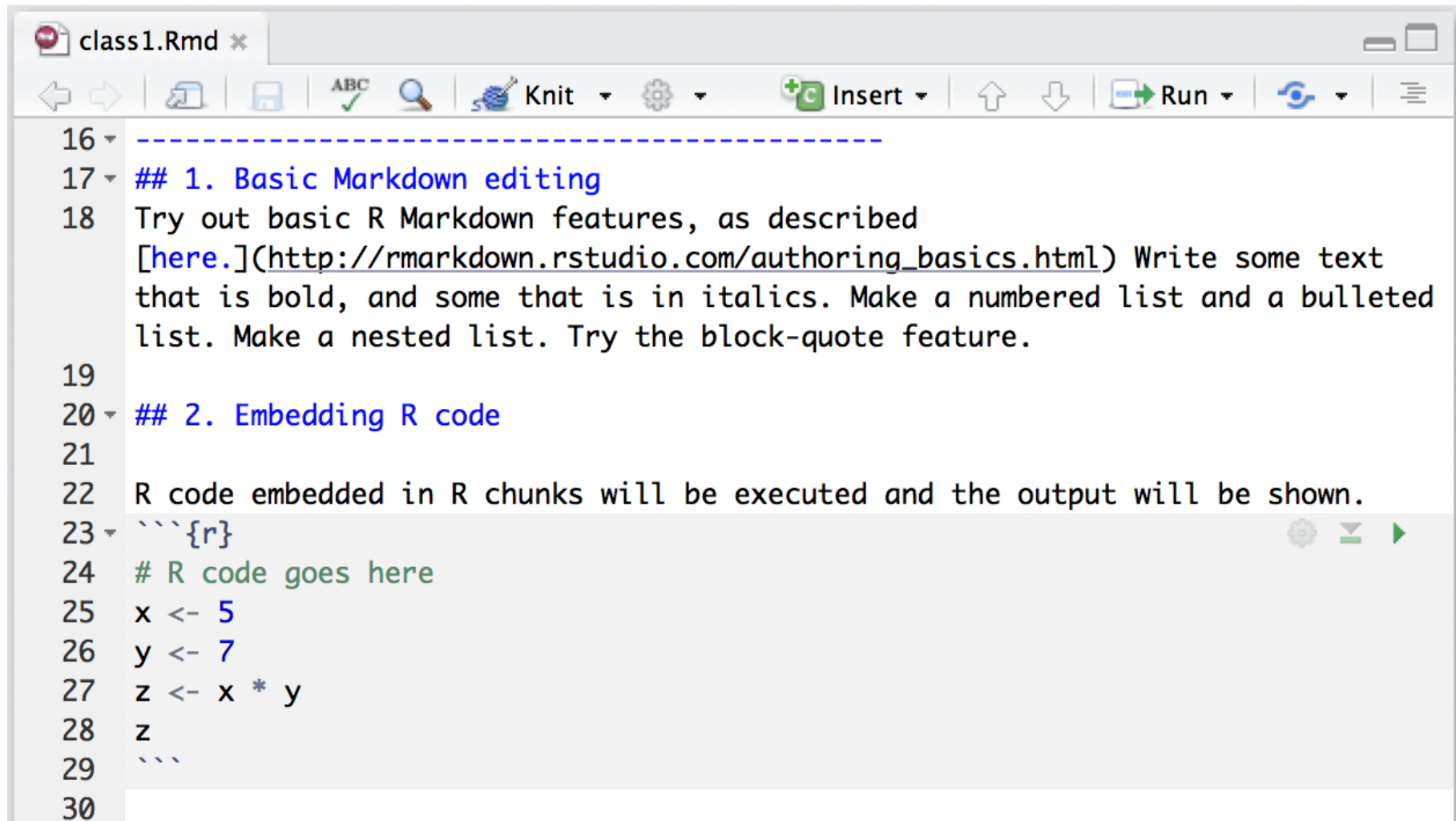


Refer to class email for your individual username

A screenshot of the 'Sign in to RStudio' form. The form is titled 'Sign in to RStudio' and contains two input fields: 'Username:' and 'Password:'. A red arrow points to the 'Username:' field, which is also circled in red. Below the password field is a checkbox labeled 'Stay signed in'. At the bottom of the form is a blue button labeled 'Sign In'.

R Markdown

R Markdown: Writing documents with embedded R code



The screenshot shows the RStudio editor interface with a file named 'class1.Rmd' open. The editor contains R Markdown code with line numbers 16 through 30. The code includes a section header, a paragraph with a link, another section header, and an R code chunk. The R code chunk is highlighted with a light blue background and contains three lines of code: `x <- 5`, `y <- 7`, and `z <- x * y`. The output of the R code is not visible in the screenshot.

```
16 -----
17 ## 1. Basic Markdown editing
18 Try out basic R Markdown features, as described
   [here.](http://rmarkdown.rstudio.com/authoring_basics.html) Write some text
   that is bold, and some that is in italics. Make a numbered list and a bulleted
   list. Make a nested list. Try the block-quote feature.
19
20 ## 2. Embedding R code
21
22 R code embedded in R chunks will be executed and the output will be shown.
23 ```{r}
24 # R code goes here
25 x <- 5
26 y <- 7
27 z <- x * y
28 z
29 ```
30
```

R Markdown:

Writing documents with embedded R code

1. Basic Markdown editing

Try out basic R Markdown features, as described [here](#). Write some text that is bold, and some that is in italics. Make a numbered list and a bulleted list. Make a nested list. Try the block-quote feature.

2. Embedding R code

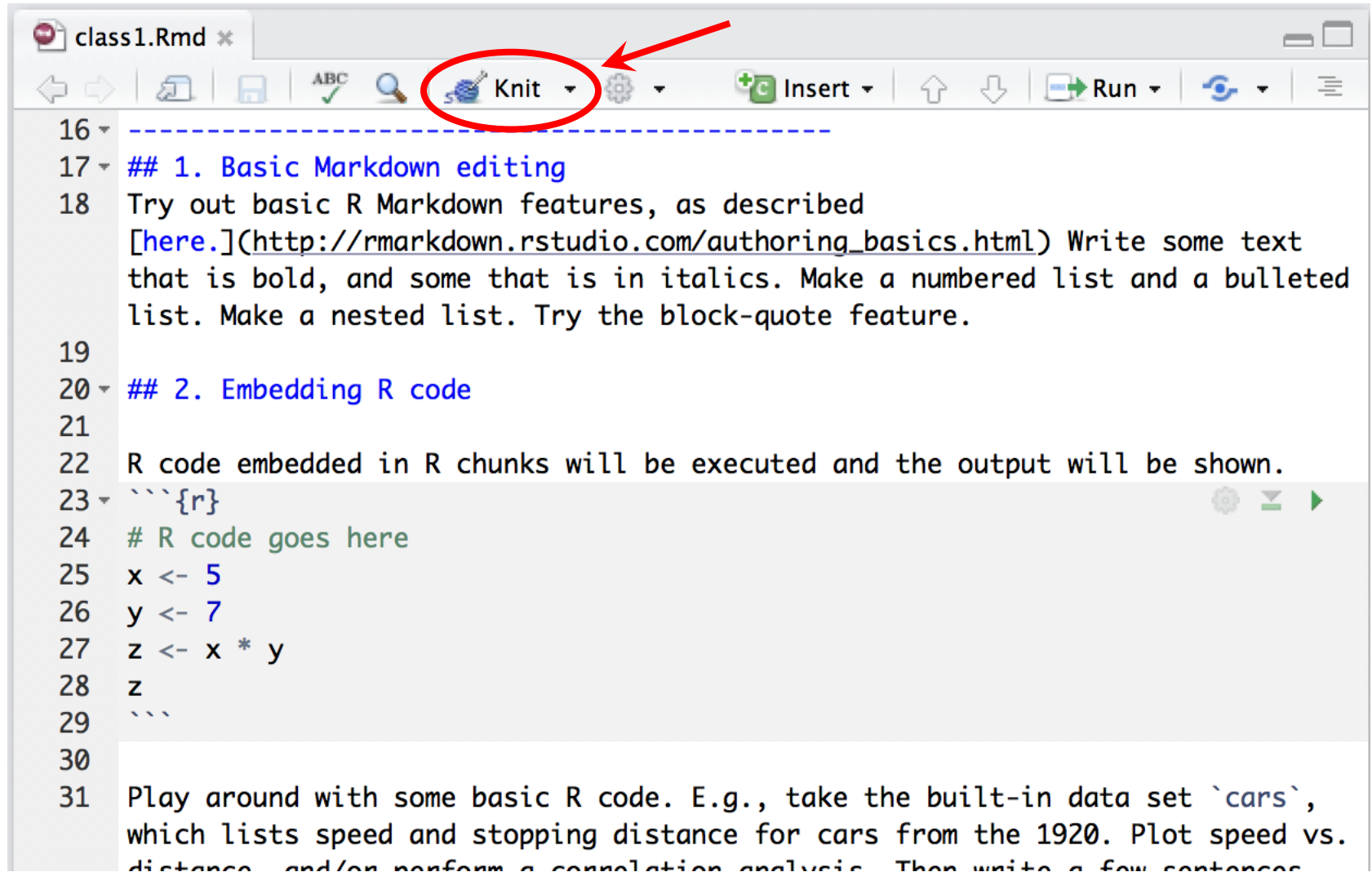
R code embedded in R chunks will be executed and the output will be shown.

```
# R code goes here
```

```
x <- 5  
y <- 7  
z <- x * y  
z
```

```
## [1] 35
```

We convert R Markdown to HTML by “knitting” the Markdown file



Markdown basics

http://rmarkdown.rstudio.com/authoring_basics.html

normal text

italics

****bold****

Header 1

Header 2

List:

1. Item 1
2. Item 2
3. Item 3



normal text

italics

bold

Header 1

Header 2

List:

1. Item 1
2. Item 2
3. Item 3

Markdown basics

Embedded R code will be evaluated and printed

```
```{r}  
head(cars)
plot(cars$speed, cars$dist)
```
```

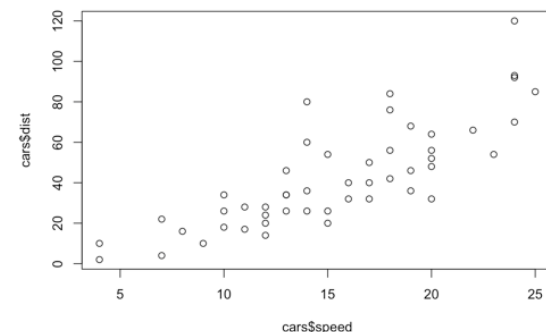


Embedded R code will be evaluated and printed

```
head(cars)
```

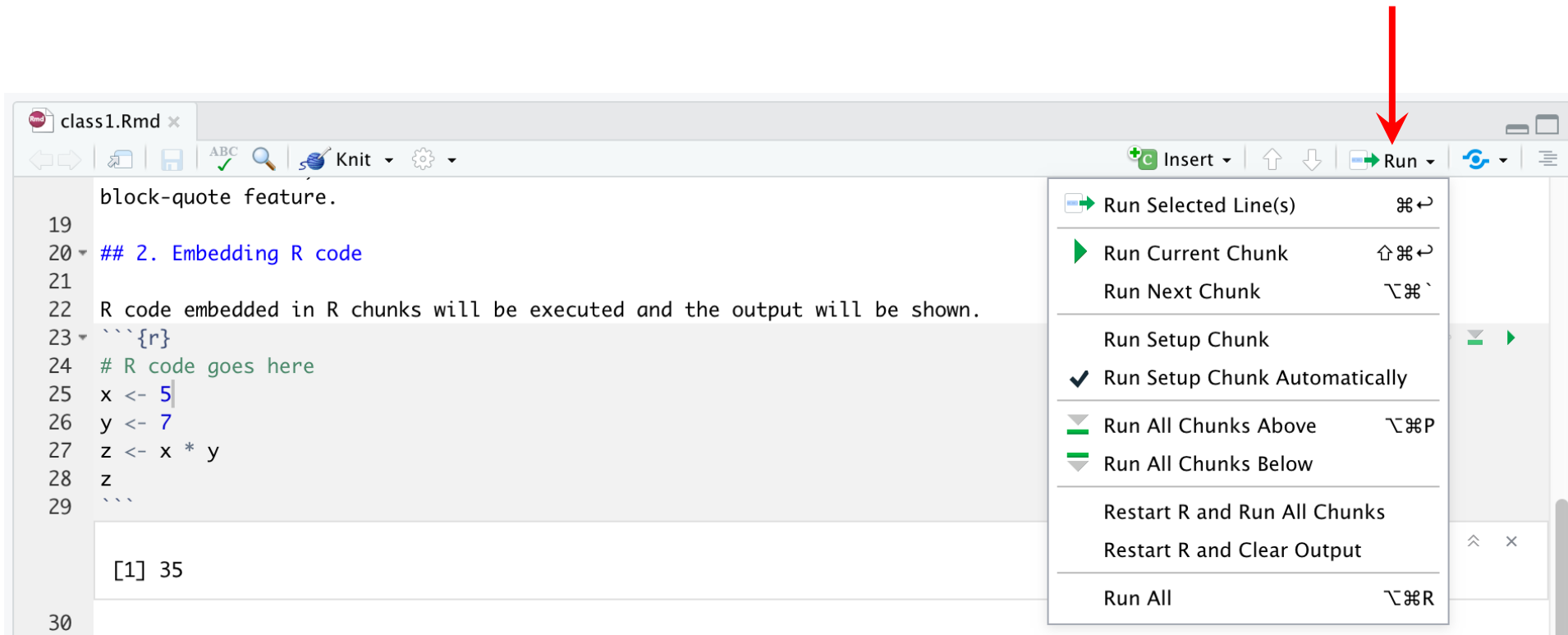
```
##  speed dist  
## 1     4    2  
## 2     4   10  
## 3     7    4  
## 4     7   22  
## 5     8   16  
## 6     9   10
```

```
plot(cars$speed, cars$dist)
```



Different ways to execute code in RStudio

Press the “Run” button



class1.Rmd x

block-quote feature.

```
19
20 ## 2. Embedding R code
21
22 R code embedded in R chunks will be executed and the output will be shown.
23 ```{r}
24 # R code goes here
25 x <- 5
26 y <- 7
27 z <- x * y
28 z
29 ```
```

[1] 35

30

Insert | Run

- Run Selected Line(s)
- Run Current Chunk
- Run Next Chunk
- Run Setup Chunk
- Run Setup Chunk Automatically
- Run All Chunks Above
- Run All Chunks Below
- Restart R and Run All Chunks
- Restart R and Clear Output
- Run All

Highlight code you want to execute and press ctrl+Enter (cmd+Enter on Macs)

R code embedded in R chunks will be executed and the output will be shown.

```
``{r}  
# R code goes here  
x <- 5  
y <- 7  
z <- x * y  
z  
``
```



Console

Terminal x

Jobs x

~/Desktop/projects/ ↗

```
> x <- 5  
> y <- 7  
> z <- x * y  
> z  
[1] 35  
> |
```

Place pointer on line of code you want to execute, press ctrl+Enter (cmd+Enter on Macs)

R code embedded in R chunks will be executed and the output will be shown.

```
`` `{r}  
# R code goes here  
x <- 5  
y <- 7  
z <- x * y  
z  
`` `
```



Console

Terminal x

Jobs x

~/Desktop/projects/ ↩

```
> z <- x * y
```

```
> |
```

Use ctrl+Shift+Enter (cmd+Shift+Enter on Macs) to execute an entire code chunk

R code embedded in R chunks will be executed and the output will be shown.

```
`` `{r}  
# R code goes here  
x <- 5  
y <- 7  
z <- x * y  
z  
`` `
```



Console

Terminal x

Jobs x

~/Desktop/projects/ ↩

```
> x <- 5  
> y <- 7  
> z <- x * y  
> z  
[1] 35  
> |
```

Shortcuts for coding

- **Ctrl+Shift+C** (Cmd+Shift+C on Macs) will comment/uncomment a line or multiple lines
- **Tab** and **Shift+Tab** will indent and un-indent lines, respectively
- **Ctrl+Shift+M** (Cmd+Shift+M on Macs) produces a pipe operator `%>%` (will be used with the tidyverse later in the course)

R Programming Basics

Assignments, numbers, vectors

```
> x <- 5
```

Assign number 5 to variable x

```
> x
```

```
[1] 5
```

```
> 5*x^2+7
```

Calculate $5x^2+7$

```
[1] 132
```

```
> y <- c(1, 2, 3, 4, 5)
```

Create vector, assign
to variable y

```
> y
```

```
[1] 1 2 3 4 5
```

```
> x*y
```

Multiply each element
in y with the number in x

```
[1] 5 10 15 20 25
```

Strings

A string contains text:

```
> name <- "Rachael Cox"  
> name  
[1] "Rachael Cox"
```

A vector of strings:

```
> animals <- c("cat", "mouse", "mouse",  
"cat", "rabbit")  
> animals  
[1] "cat"      "mouse"    "mouse"    "cat"  
"rabbit"
```

Factors

Factors keep track of distinct categories (levels) in a vector:

```
> animals  
[1] "cat"      "mouse"    "mouse"    "cat"  
"rabbit"
```

```
> factor(animals)  
[1] cat      mouse    mouse    cat      rabbit  
Levels: cat mouse rabbit
```


Data frames

We use data frames to store data sets with multiple variables:

```
> pets <- data.frame(  
  family = c(1, 2, 3, 4, 5),  
  pet = animals  
)
```

```
> pets
```

| | family | pet |
|---|--------|-------|
| 1 | 1 | cat |
| 2 | 2 | mouse |
| 3 | 3 | mouse |
| 4 | 4 | cat |

Data frames

We access individual columns in a data frame with \$ + the column name:

```
> pets$family  
[1] 1 2 3 4 5
```

```
> pets$pet  
[1] cat      mouse    mouse    cat      rabbit  
Levels: cat mouse rabbit
```

Data frames

R has many built-in data frames:

```
> cars
```

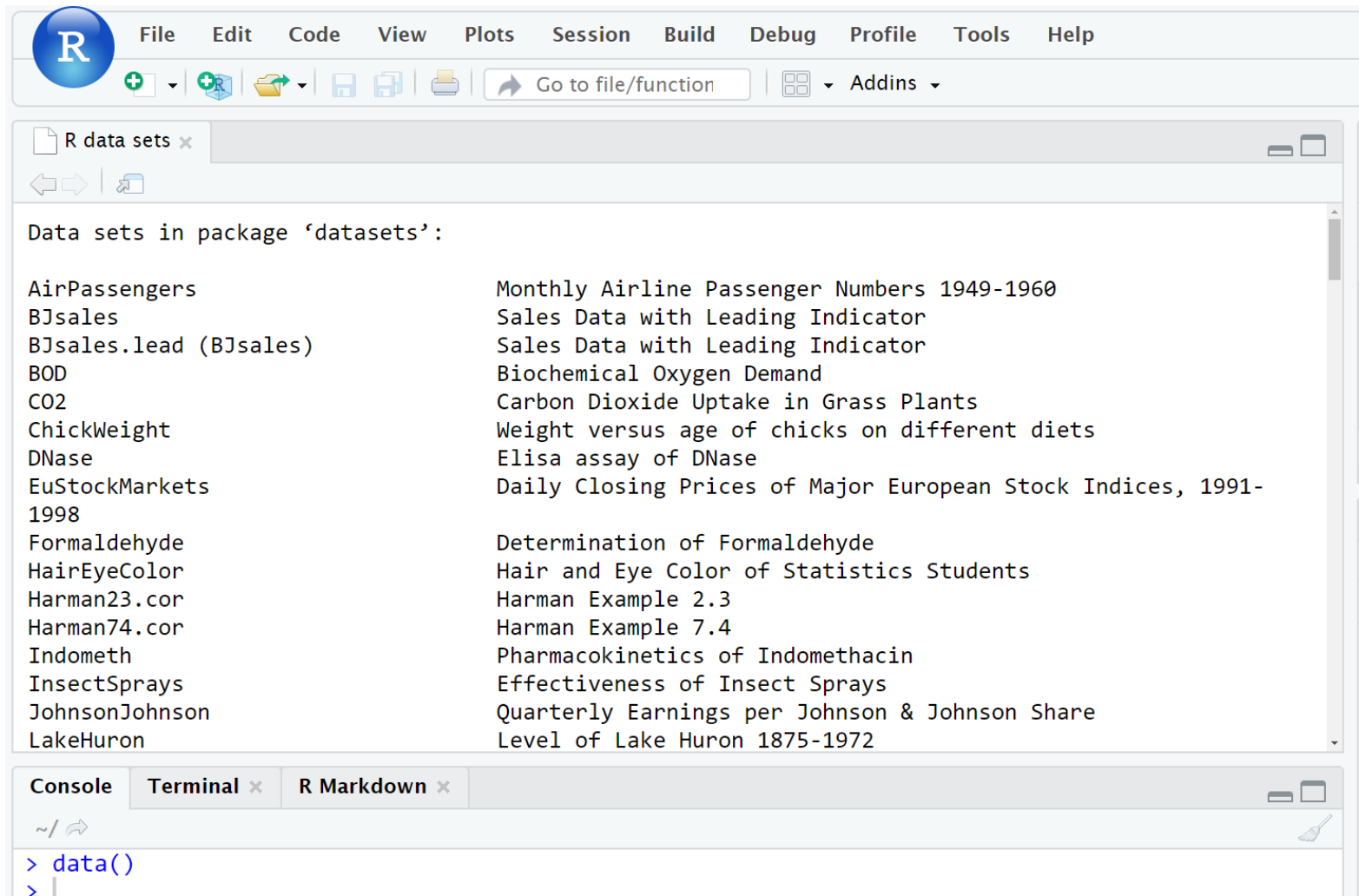
| | speed | dist |
|---|-------|------|
| 1 | 4 | 2 |
| 2 | 4 | 10 |
| 3 | 7 | 4 |
| 4 | 7 | 22 |
| 5 | 8 | 16 |
| 6 | 9 | 10 |
| 7 | 10 | 18 |
| 8 | 10 | 26 |
| 9 | 10 | 34 |

```
> chickwts
```

| | weight | feed |
|-----|--------|-----------|
| 1 | 179 | horsebean |
| 2 | 160 | horsebean |
| 3 | 136 | horsebean |
| 4 | 227 | horsebean |
| ... | ... | ... |
| 11 | 309 | linseed |
| 12 | 229 | linseed |
| 13 | 181 | linseed |
| 14 | 141 | linseed |

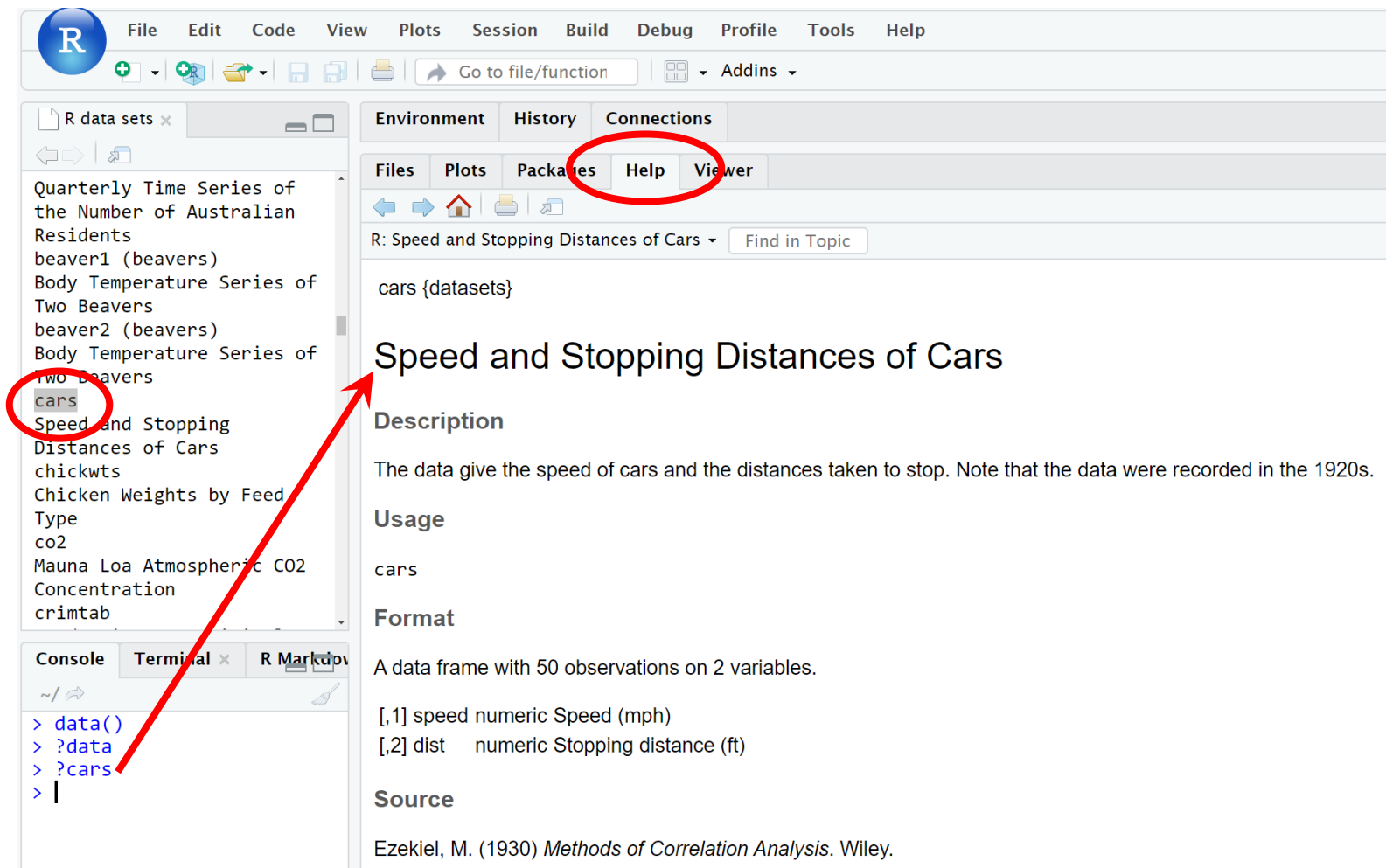
Data frames

Available built-in datasets can be accessed with `data()`



Data frames

Data set information can be accessed with `?dataset`



The screenshot shows the RStudio interface. In the left pane, the 'R data sets' list includes 'cars', which is circled in red. A red arrow points from this 'cars' entry to the 'Speed and Stopping Distances of Cars' section in the right pane. The right pane shows the documentation for the 'cars' dataset, including its description, usage, format, and source. The console at the bottom shows the command `?cars` being executed.

Environment History Connections

Files Plots Packages **Help** Viewer

R: Speed and Stopping Distances of Cars Find in Topic

`cars {datasets}`

Speed and Stopping Distances of Cars

Description

The data give the speed of cars and the distances taken to stop. Note that the data were recorded in the 1920s.

Usage

```
cars
```

Format

A data frame with 50 observations on 2 variables.

```
[,1] speed numeric Speed (mph)
[,2] dist  numeric Stopping distance (ft)
```

Source

Ezekiel, M. (1930) *Methods of Correlation Analysis*. Wiley.

Console Terminal R Markdown

```
> data()
> ?data
> ?cars
> |
```

Data frames

The `head()` function shows the first few lines of a data frame:

```
> head(cars)
  speed  dist
1     4     2
2     4    10
3     7     4
4     7    22
5     8    16
6     9    10
>
```

Functions

Functions are called in the format `function (argument)`

```
> head(cars)
```



Function name



First argument

Functions

Functions can have any number of required arguments or optional arguments

> head(cars, 8)

Function name

First argument (required)

Second argument (optional; default = 6)

Functions

`head(cars, 8)` will show the first 8 lines of the data frame instead of the default 6:

```
> head(cars, 8)
```

```
  speed  dist
```

```
1      4     2
```

```
2      4    10
```

```
3      7     4
```

```
4      7    22
```

```
5      8    16
```

```
6      9    10
```

```
7     10    18
```

```
8     10    26
```

Functions

We can implicitly or explicitly pass arguments

```
> head(cars, 8)
```

```
  speed dist
```

```
1      4     2
```

```
2      4    10
```

```
3      7     4
```

```
4      7    22
```

```
5      8    16
```

```
6      9    10
```

```
7     10    18
```

```
8     10    26
```

```
>
```

```
> head(x=cars, n=8)
```

```
  speed dist
```

```
1      4     2
```

```
2      4    10
```

```
3      7     4
```

```
4      7    22
```

```
5      8    16
```

```
6      9    10
```

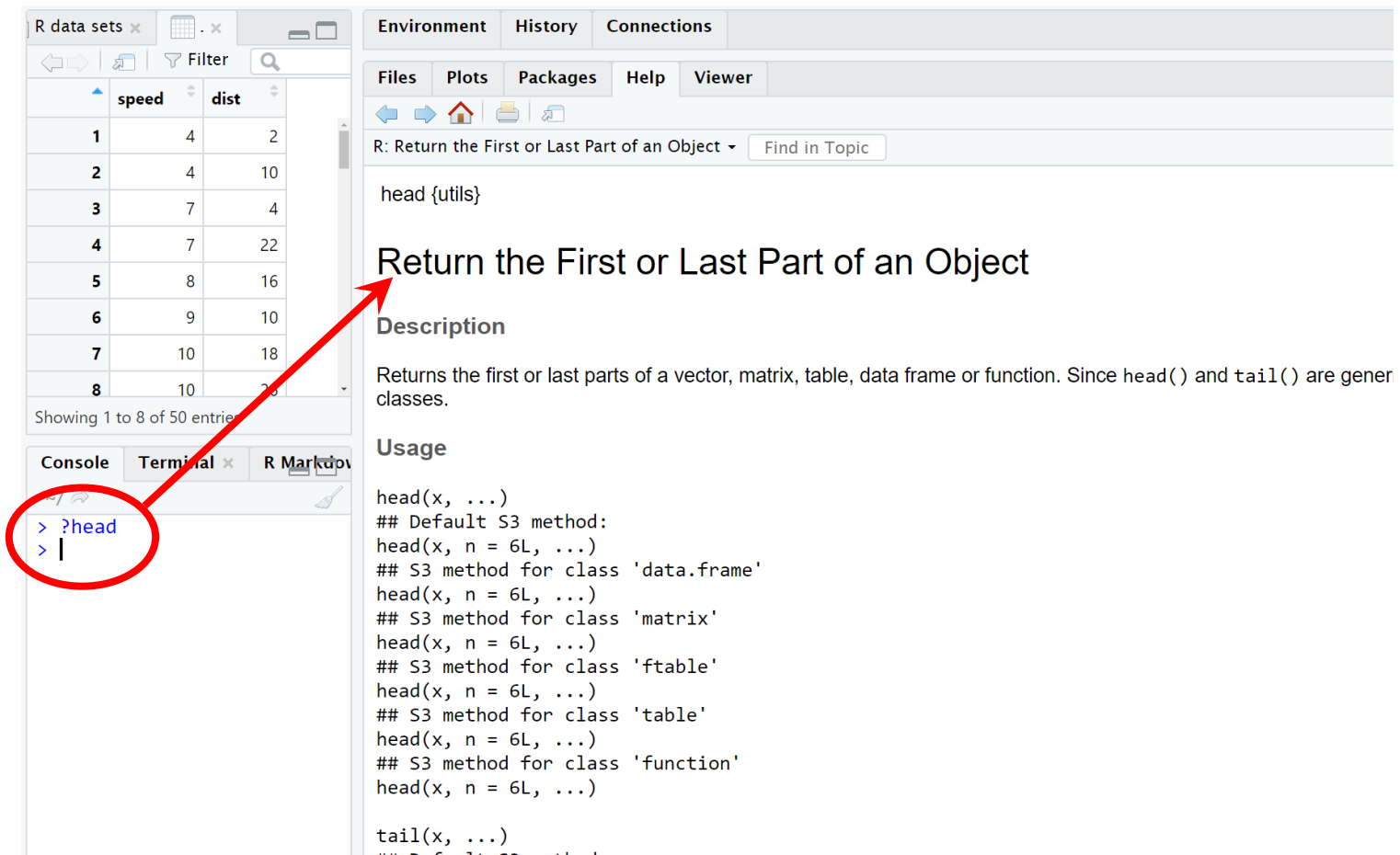
```
7     10    18
```

```
8     10    26
```

```
>
```

Functions

More information about what a function does and/or requires can be accessed with `?function`



The screenshot displays the RStudio interface. On the left, the 'Environment' pane shows a data frame with columns 'speed' and 'dist'. The 'Console' pane at the bottom left shows the command `> ?head` entered, which is circled in red. A red arrow points from this command to the right-hand pane, which displays the help documentation for the `head()` function. The help pane includes the title 'Return the First or Last Part of an Object', a description, and usage examples.

Return the First or Last Part of an Object

Description

Returns the first or last parts of a vector, matrix, table, data frame or function. Since `head()` and `tail()` are generic functions.

Usage

```
head(x, ...)  
## Default S3 method:  
head(x, n = 6L, ...)  
## S3 method for class 'data.frame'  
head(x, n = 6L, ...)  
## S3 method for class 'matrix'  
head(x, n = 6L, ...)  
## S3 method for class 'ftable'  
head(x, n = 6L, ...)  
## S3 method for class 'table'  
head(x, n = 6L, ...)  
## S3 method for class 'function'  
head(x, n = 6L, ...)  
  
tail(x, ...)
```

Functions

?function has argument information

The screenshot shows the RStudio interface. On the left, a data frame with columns 'speed' and 'dist' is visible. The console at the bottom left shows the command `> ?head` entered. The main pane displays the help page for the `tail` function. The 'Arguments' section is circled in red, and a red arrow points from the `?head` command in the console to this section.

Arguments

| | |
|------------|--|
| x | an object |
| n | a single integer. If positive, size for the resulting object: number of elements for a vector (including lists), rows for a matrix or data frame or lines for a function. If negative, all but the n last/first number of elements of x. |
| addrownums | if there are no row names, create them from the row numbers. |
| ... | arguments to be passed to or from other methods. |

Troubleshooting

Ask RStudio for help

Type `?function` into console

```
Console  Terminal x  Jobs x
~/Desktop/projects/
> ?t.test
```



Files Plots Packages Help Viewer

R: Student's t-Test Find in Topic

`t.test {stats}` R Documentation

Student's t-Test

Description

Performs one and two sample t-tests on vectors of data.

Usage

```
t.test(x, ...)
```

Default S3 method:

```
t.test(x, y = NULL,
       alternative = c("two.sided", "less", "greater"),
       mu = 0, paired = FALSE, var.equal = FALSE,
       conf.level = 0.95, ...)
```

S3 method for class 'formula'

```
t.test(formula, data, subset, na.action, ...)
```

Ask Google for help

how do i run a t test in r



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About 2,780,000,000 results (0.64 seconds)

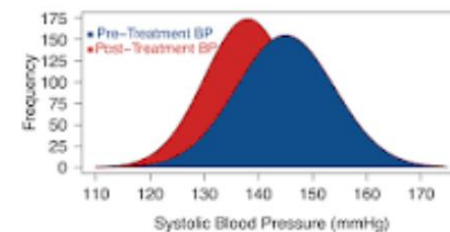
How to Perform **T-tests in R**. To conduct a one-sample **t-test in R**, we use the syntax `t.test(y, mu = 0)` where `x` is the name of our variable of interest and `mu` is set equal to the mean specified by the null hypothesis.


Aug 17, 2015


[datascienceplus.com](#) › t-tests ▾

[How to Perform T-tests in R | DataScience+](#)


Systolic Blood Pressure Before and After Treatment




 Error in t.test.default(x, y) : not enough 'x' observations

 Error in t.test.default(x, y) : not enough 'x' observations - Google Search

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What's this?

Rotating and spacing axis labels in ggplot2


Ask Question

Asked 10 years, 10 months ago Active 18 days ago Viewed 768k times

680



I have a plot where the x-axis is a factor whose labels are long. While probably not an ideal visualization, for now I'd like to simply rotate these labels to be vertical. I've figured this part out with the code below, but as you can see, the labels aren't totally visible.



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