

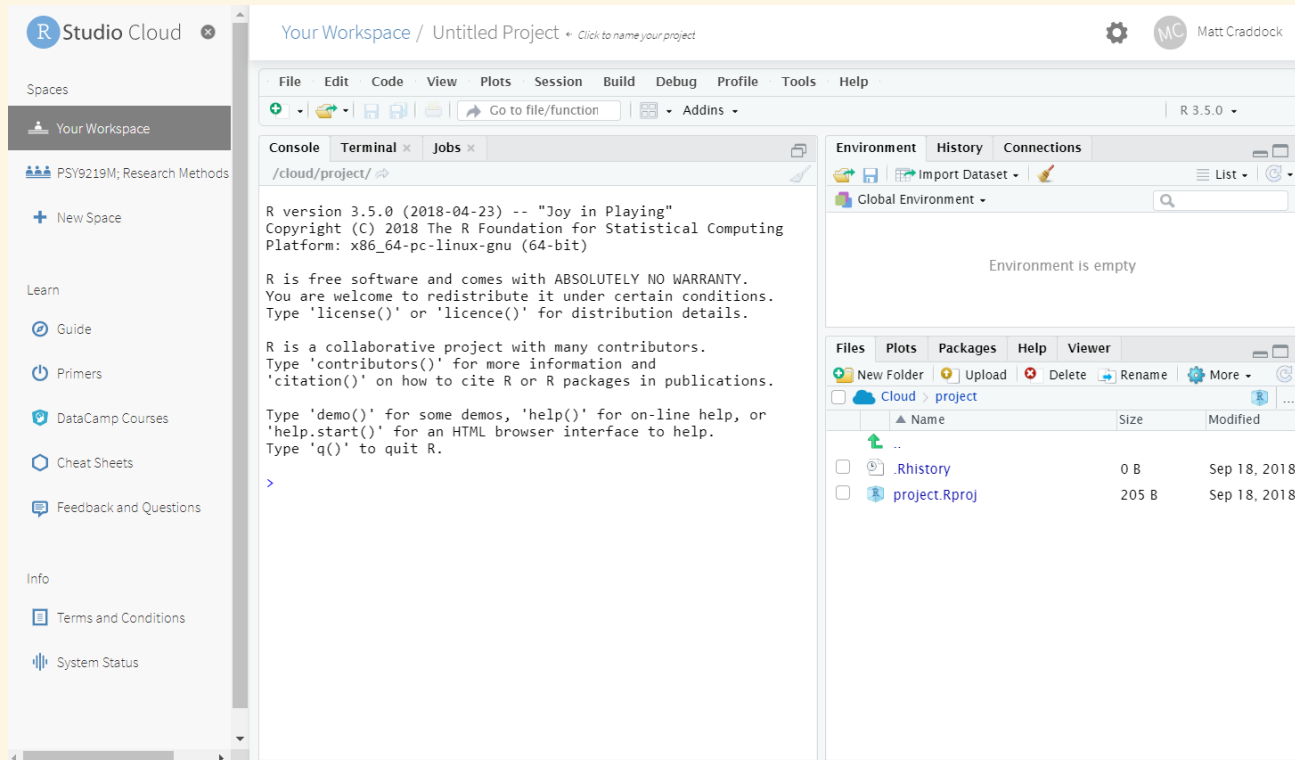
Introduction to R, part 2

Research Methods and Skills

20/10/2020

Interacting with R

- The R Console
 - REPL: Read Evaluate Print Loop
 - Type stuff in, it tries to do it



Basic use of R

Use of R like a calculator

The R console allows you to use it like a calculator, as below:

```
5 + 5
```

```
## [1] 10
```

```
10 - 6 * 13
```

```
## [1] -68
```

Basic use of R

Creating objects to store information

You assign values to objects using <-

```
test_object <- 5
```

<- can be read as "is now", making the code above roughly mean

```
The object "test_object" is now 5 # Do not run!
```

Objects "stand-in" for their values:

```
test_object
```

```
## [1] 5
```

Basic use of R

Creation of vectors

Vectors are simply a 1-dimensional collection of values of the same type.

E.g. We can create a numeric vector using the `c()` function.

```
c(5, 10, 3, -1, -5)
```

```
## [1]  5 10  3 -1 -5
```

This is a one-dimensional vector of length *five*, since it has 5 values.

Basic use of R

Using functions on objects

Functions do things to objects.

Brackets after a word in these slides indicate that something is a function, e.g. **c()**, **mean()**

```
mean(c(5, 8, 2, 4, 5))
```

```
## [1] 4.8
```

```
test_object <- c(5, 8, 2, 4, 5)  
mean(test_object)
```

```
## [1] 4.8
```

R Scripts

R Scripts

Scripts are a way of writing out a sequence of commands that you want R to execute.

A typical script looks something like this:

```
# Load in required packages using library()  
library(tidyverse)  
  
# Define any custom functions here (we haven't covered this!)  
  
# Now load any data you want to work on. (again, we'll cover this later!)  
test_data <-  
  read_csv("data/a-random-RT-file.csv") %>% # I'll explain what %>% means later  
  rename(RT = `reaction times`)  
  
# The rest of the script then runs whatever analyses or plotting you want to do  
ggplot(test_data,  
  aes(x = RT,  
      fill = viewpoint)) +  
  geom_density()
```


Why is this useful?

Somebody asks you how you performed a particular analysis. In particular, they want detailed instructions of how you created a plot, filtered out outliers or missing data, and performed a linear regression.

Q1: *How would you do that if you used SPSS?*

Q2: *How would you do that if you used R?*

Creating R Scripts

R version 3.5.0 (2018-04-23) -- "Joy in Playing"
Copyright (C) 2018 The R Foundation for Statistical Computing
Platform: x86_64-pc-linux-gnu (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

>
|

Environment is empty

	Name	Size	Modified
	..		
<input type="checkbox"/>	.Rhistory	0 B	Sep 28, 2018, 12:38 PM
<input type="checkbox"/>	project.Rproj	205 B	Sep 28, 2018, 2:01 PM

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

New File

Open File... Ctrl+O

Recent Files

Import Dataset

Save Ctrl+S

Save As...

Save All Ctrl+Alt+S

Print...

Close Ctrl+Alt+W

Close All Ctrl+Shift+W

Close All Except Current Ctrl+Shift+Alt+W

R Script Ctrl+Shift+Alt+N

R Notebook *Create a new R script*

R Markdown...

Shiny Web App...

Plumber API...

Text File

C++ File

Python Script

D3 Script

SQL Script

R Sweave

R HTML

R Presentation

R Documentation

```

> type demo() for some demos, help()
'help.start()' for an HTML browser interface
Type 'q()' to quit R.
>

```

R 3.5.0

Environment History Connections

Import Dataset

Global Environment

Environment is empty

Files Plots Packages Help Viewer

New Folder Upload Delete Rename More

Cloud > project

	▲ Name	Size	Modified
	..		
<input type="checkbox"/>	.Rhistory	0 B	Sep 28, 2018, 12:38 PM
<input type="checkbox"/>	project.Rproj	205 B	Sep 28, 2018, 2:01 PM

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

+ ▾ 📁 ▾ 💾 ▾ 🖨️ ▾ ➔ Go to file/function ▾ Addins ▾

R 3.5.0 ▾

R
Untitled1
x

🔍
📄
Source on Save
🔍
🔧

➡️ Run
🔄
Source ▾

```

1

```

1:1 (Top Level) ⬆️
R Script ▾

Environment
History
Connections

📁
📄
📊 Import Dataset ▾
🔧

List ▾
🔄

Global Environment ▾
🔍

Environment is empty

Files
Plots
Packages
Help
Viewer

🔍
🔄

R: Arithmetic Mean ▾
Find in Topic

mean {base}
R Documentation

Arithmetic Mean

Description

Generic function for the (trimmed) arithmetic mean.

Usage

```
mean(x, ...)
```

Default S3 method:
mean(x, trim = 0, na.rm = FALSE, ...)

Arguments

x An R object. Currently there are methods for numeric/logical vectors and [date](#), [date-time](#) and [time interval](#) objects. Complex vectors are allowed for trim = 0 only

Console
Terminal x
Jobs x

/cloud/project/ ➔

>

8:25 (Top Level) ▾

Console

Terminal ✕

Jobs ×

/cloud/project/ ➔

Environment History Connections



 Import Dataset

Global Environment ▾

Files	Plots	Packages	Help	Viewer
-------	-------	----------	------	--------

 New Folder  Upload  Delete  Rename  More ▾

Cloud > project

	▲ Name	Size	Modified
	↑ ..		
<input type="checkbox"/>	 .Rhistry	0 B	Oct 1, 2018, 11:00
<input type="checkbox"/>	 project.Rproj	205 B	Oct 1, 2018, 11:00

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

📄 📁 📄 📄 🖨️ 🔍 Go to file/function 🧩 Addins

R 3.5.0

Untitled1*

🔍 📄 📄 Source on Save 🔍 📄 Run 🔄 Source

```
1 # Load the necessary packages
2 library(cowsay)
3
4 # Define some custom objects
5 say_what <- "This is what I want you to see"
6 by_animal <- "cow"
7
8 # Write the function out
9 say(what = say_what, by = by_animal)
```

8:25 (Top Level)

R Script

Console Terminal x Jobs x

/cloud/project/

>

Environment History Connections

📄 📄 Import Dataset 🖨️ 🔍 List

Global Environment

Environment is empty

Files Plots Packages Help Viewer

📄 📄 New Folder 📄 Upload 🗑️ Delete 🔄 Rename ⚙️ More

Cloud > project

	▲ Name	Size	Modified
📄	..		
📄	.Rhistory	0 B	Oct 1, 2018, 11:0
📄	project.Rproj	205 B	Oct 1, 2018, 11:0

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

📄 📁 📄 📄 📄 Go to file/function 📄 Addins

R 3.5.0

Untitled1*

```

1 # Load the necessary packages
2 library(cowsay)
3
4 # Define some custom objects
5 say_what <- "This is what I want you to see"
6 by_animal <- "cow"
7
8 # Write the function out
9 say(what = say_what, by = by_animal)
    
```

Source

Environment History Connections

📄 📄 Import Dataset 📄

Global Environment 🔍

Environment is empty

Files Plots Packages Help Viewer

📄 📄 New Folder 📄 Upload 📄 Delete 📄 Rename ⚙️ More

☑️ Cloud > project

	▲ Name	Size	Modified
📁	..		
☑️ 📄	.Rhistory	0 B	Oct 1, 2018, 11:0
☑️ 📄	project.Rproj	205 B	Oct 1, 2018, 11:0

Console Terminal x Jobs x

/cloud/project/ 🔍

>

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

📁 📄 📄 📄 📄 📄 Go to file/function Addins

R 3.5.0

Untitled1*

🔍 📄 Source on Save 🔍 📄 Run 🔄 Source

```
1 # Load the necessary packages
2 library(cowsay)
3
4 # Define some custom objects
5 say_what <- "This is what I want you to see"
6 by_animal <- "cow"
7
8 # Write the function out
9 say(what = say_what, by = by_animal)
```

8:25 (Top Level)

R Script

Console Terminal x Jobs x

/cloud/project/

> source('~/.active-rstudio-document')

```
-----
This is what I want you to see
-----
```

```
  \  ^__^
   (oo)\_____)
    (_____)  )\  /\
           ||----w |
           ||     ||
```

> |

Environment History Connections

📄 📄 Import Dataset 📄

Global Environment 🔍

Values

by_animal	"cow"
say_what	"This is what I want you to ..."

Files Plots Packages Help Viewer

📁 New Folder 📄 Upload 🗑️ Delete 🔄 Rename ⚙️ More

☑️ Cloud > project

	▲ Name	Size	Modified
📁	..		
☑️	.Rhistory	0 B	Oct 1, 2018, 11:0
☑️	project.Rproj	205 B	Oct 1, 2018, 11:0

R Markdown

Literate programming is a mixture of plain text and code.

Whereas in scripts you need to use the **#** symbol to indicate comments, as here

```
# This is a comment
```

...with R Markdown you can mix plain text and code using **chunks** to delineate sections of code.

This allows you to create elaborate documents following the structure *you* want!

File Edit Code View Plots Session Build Debug Profile Tools Help

New File

Open File... Ctrl+O

Reopen with Encoding...

Recent Files

Import Dataset

Save Ctrl+S

Save As...

Save with Encoding...

Save All Ctrl+Alt+S

Knit Document Ctrl+Shift+K

Compile Report...

Print...

Close Ctrl+Alt+W

Close All Ctrl+Shift+W

Close All Except Current Ctrl+Shift+Alt+W

R Script Ctrl+Shift+Alt+N

R Notebook

R Markdown... Create a new R Markdown document

Shiny Web App...

Plumber API...

Text File

C++ File

Python Script

D3 Script

SQL Script

R Sweave

R HTML

R Presentation

R Documentation

Console Terminal x Jobs x

/cloud/project/ ↗

> |

R 3.5.0

Environment History Connections

Import Dataset

Global Environment

Environment is empty

Files Plots Packages Help Viewer

R: Arithmetic Mean Find in Topic

mean {base} R Documentation

Arithmetic Mean

Description

Generic function for the (trimmed) arithmetic mean.

Usage

```
mean(x, ...)
```

Default S3 method:

```
mean(x, trim = 0, na.rm = FALSE, ...)
```

Arguments

x An R object. Currently there are methods for numeric/logical vectors and [date](#), [date-time](#) and [time interval](#) objects. Complex vectors are allowed for trim = 0 only.

Untitled1 x

Source on Save 🔍 ⚡

1

Environment History Connections

Import Dataset 📌

Global Environment 🔍

Environment is empty

Install Required Packages

❓ Creating R Markdown documents requires updated versions of the following packages: evaluate, digest, highr, markdown, stringr, yaml, Rcpp, htmltools, caTools, bitops, knitr, jsonlite, base64enc, rprojroot, rmarkdown.

Do you want to install these packages now?

Yes No

1:1 (Top Level) ⬆

Console Terminal x Jobs x

/cloud/project/ ↗

>

ges Help Viewer 🔍

Find in Topic

R Documentation

mean

Generic function for the (trimmed) arithmetic mean.

Usage

mean(x, ...)

Default S3 method:

mean(x, trim = 0, na.rm = FALSE, ...)

Arguments

x An R object. Currently there are methods for numeric/logical vectors and [date](#), [date-time](#) and [time interval](#) objects. Complex vectors are allowed for trim = 0 only

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

📄 📁 📄 📄 📄 📄 Go to file/function 📄 Addins R 3.5.0

```
example_script.R x Untitled1* x
1 ---
2 title: "GOOD MORNING LOL"
3 author: "Matt Craddock"
4 date: "26/09/2018"
5 output: html_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple
15 formatting syntax for authoring HTML, PDF, and MS
16 Word documents. For more details on using R Markdown
17 see <http://rmarkdown.rstudio.com>.
18
19 When you click the Knit button a document will
20 be generated that includes both content as well as
21 the output of any embedded R code chunks within the
22 document. You can embed an R code chunk like this:
23
24 ```{r cars}
25 summary(cars)
26 ```
27
28 ## Including Plots
29
30 6:4 # GOOD MORNING LOL R Markdown
```

Environment History Connections

📄 📄 Import Dataset 🗑️

Global Environment 🔍

Values

by_animal	"cow"
say_what	"This is what I want you to see"

Files Plots Packages Help Viewer





📄 📄 New Folder 📄 Upload 🗑️ Delete 📄 Rename ⚙️ More 🔍

☑️ Cloud > project

	▲ Name	Size	Modified
📄	..		
☑️ 🕒	.Rhistory	0 B	Oct 1, 2018, 11:00 AM
☑️ 📄	project.Rproj	205 B	Oct 1, 2018, 11:00 AM
☑️ 📄	example_script.R	204 B	Oct 1, 2018, 11:29 AM

Console

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help



    Go to file/function  Addins

R 3.5.0

```
example_script.R x Untitled1* x
1 ---
2 title: "GOOD MORNING LOL"
3 author: "Matt Craddock"
4 date: "26/09/2018"
5 output: html_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple
15 formatting syntax for authoring HTML, PDF, and MS
16 Word documents. For more details on using R Markdown
17 see <http://rmarkdown.rstudio.com>.
18
19 When you click the Knit button a document will
20 be generated that includes both content as well as
21 the output of any embedded R code chunks within the
22 document. You can embed an R code chunk like this:
23
24 ```{r cars}
25 summary(cars)
26 ```
27
28 ## Including Plots
```

CODE CHUNK


Environment History Connections


 Import Dataset  List 

Global Environment

Value	
by	anima
say	with
is	what
nt	you to see"

Files Plots Packages Help Viewer

 New Folder  Upload  Delete  Rename  More☐ Cloud > project 

	Name	Size	Modified
	..		
<input type="checkbox"/>	.Rhistory	0 B	Oct 1, 2018, 11:00 AM
<input type="checkbox"/>	project.Rproj	205 B	Oct 1, 2018, 11:00 AM
<input type="checkbox"/>	example_script.R	204 B	Oct 1, 2018, 11:29 AM

Console

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

Go to file/function

R 3.5.0

example_script.R x Untitled1 x

Run Selected Line(s) Ctrl+Enter
Run Current Chunk Ctrl+Shift+Enter
Run Next Chunk Ctrl+Alt+N
Run Setup Chunk
Run Setup Chunk Automatically
Run All Chunks Above Ctrl+Alt+P
Run All Chunks Below
Restart R and Run All Chunks
Restart R and Clear Output
Run All Ctrl+Alt+R

```

1 ---
2 title: "GOOD MORNING
3 author: "Matt Craddock"
4 date: "26/09/2018"
5 output: html_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(
10
11
12 ## R Markdown
13
14 This is an R Markdown document. Simple
15 formatting syntax for authoring HTML, PDF, and MS
16 Word documents. For more details on using R Markdown
17 see <http://rmarkdown.rstudio.com>
18
19 When you click the Knit button a document will
20 be generated that includes both content as well as
21 the output of any embedded R code chunks within the
22 document. You can embed an R code chunk like this:
23
24 ```{r cars}
25 summary(cars)
26 ```
27
28 ## Including Plots

```

Global Environment

Values

```

"cow"
"cow"
This is what I want you to see"

```

Files · Plots · Packages · Help · Viewer

New Folder Upload Delete Rename More

Cloud > project

	Name	Size	Modified
	..		
<input type="checkbox"/>	.Rhistory	0 B	Oct 1, 2018, 11:00 AM
<input type="checkbox"/>	example_script.R	204 B	Oct 1, 2018, 11:29 AM
<input type="checkbox"/>	project.Rproj	205 B	Oct 1, 2018, 1:57 PM

5:22 GOOD MORNING LOL

R Markdown

Console

CLICK
RUN

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

Go to file/function Addins R 3.5.0

```
example_script.R x Untitled1 * x
1 ---
2 title: "GOOD MORNING LOL"
3 author: "Matt Craddock"
4 date: "26/09/2018"
5 output: html_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple
15 formatting syntax for authoring HTML, PDF, and MS
16 Word documents. For more details on using R Markdown
17 see <http://rmarkdown.rstudio.com>.
18
19 When you click the Knit button a document will
20 be generated that includes both content as well as
21 the output of any embedded R code chunks within the
22 document. You can embed an R code chunk like this:
23
24 ```{r cars}
25 summary(cars)
26 ```
27
28 ## Including Plots
29
30 5:22 GOOD MORNING LOL R Markdown
```

Environment History Connections

Import Dataset

Global Environment

Values

by_animal	"cow"
say_what	"This is what I want you to see"

Run Current Chunk

Plots Packages Help Viewer

New Folder Upload Delete Rename More

Cloud > project

	Name	Size	Modified
	..		
<input type="checkbox"/>	.Rhistory	0 B	Oct 1, 2018, 11:00 AM
<input type="checkbox"/>	example_script.R	204 B	Oct 1, 2018, 11:29 AM
<input type="checkbox"/>	project.Rproj	205 B	Oct 1, 2018, 1:57 PM

Console

**CLICK
KNIT**

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

Go to file/function

example_script.R × test_rmd.Rmd

Knit

- Knit to HTML
- Knit to PDF
- Knit to Word
- Knit with Parameters...
- Knit Directory
- Clear Knitr Cache...

```

12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple
15 formatting syntax for authoring HTML, PDF, and MS
16 Word documents. For more details on using R Markdown
17 see <http://rmarkdown.rstudio.com>.
18
19 When you click the Knit button a document will
20 be generated that includes both content as well as
21 the output of any embedded R code chunks within the
22 document. You can embed an R code chunk like this:
23
24 ```{r cars}
25 summary(cars)
26 ```
27
28 ## Including Plots
29
30 1:1 # GOOD MORNING LOL

```

R Markdown

Environment History Connections

Import Dataset

Global Environment

Values

by_animal	"cow"
say_what	"This is what I want you to see"

Files Plots Packages Help Viewer

New Folder Upload Delete Rename More

Cloud > project

	Name	Size	Modified
↑	..		
🕒	.Rhistory	0 B	Oct 1, 2018, 11:00 AM
📄	example_script.R	204 B	Oct 1, 2018, 11:29 AM
📁	project.Rproj	205 B	Oct 1, 2018, 1:57 PM
📄	test_rmd.Rmd	847 B	Oct 1, 2018, 2:20 PM

File · Edit · Code · View · Plots · Session · Build · Debug · Profile · Tools · Help

📁 📄 📄 📄 📄 📄 Go to file/function Addins R 3.5.0

```
example_script.R x test_rmd.Rmd x
1 ---
2 title: "GOOD MORNING LOL"
3 author: "Matt Craddock"
4 date: "26/09/2018"
5 output: html_document
6 ---
7
8 ```{r setup, include=FALSE}
9 knitr::opts_chunk$set(echo = TRUE)
10 ```
11
12 ## R Markdown
13
14 This is an R Markdown document. Markdown is a simple
```

Console Terminal x R Markdown x Jobs x

/cloud/project/ ↗

```
> source('~/.active-rstudio-document')
```

```
-----
This is what I want you to see
-----
  \  ^  ^
  \ (oo)\ _____) \ /\
   (__) \         ||-----w||
          ||         ||
```

>

Environment History Connections

📁 📄 📄 Import Dataset 🗑️

Global Environment 🔍

Values

by_animal	"cow"
say_what	"This is what I want you to see"

Files Plots Packages Help Viewer

📁 📄 📄 📄 📄 📄 📄 New Folder Upload Delete Rename More

☑️ ☁️ Cloud > project

	▲ Name	Size	Modified
📁	..		
☑️	.Rhistory	0 B	Oct 1, 2018, 11:00 AM
☑️	example_script.R	204 B	Oct 1, 2018, 11:29 AM
☑️	project.Rproj	205 B	Oct 1, 2018, 1:57 PM
☑️	test_rmd.Rmd	847 B	Oct 1, 2018, 2:20 PM
☑️	test_rmd.html	635.7 KB	Oct 1, 2018, 2:23 PM

Some very important advice

R Markdown documents are like *recipes*.

Every step needs to be written down.

When you press the knit button, R forgets everything and follows the instructions line-by-line.

So be thorough, and write down everything in the order you want it to happen!

(One exception: NEVER use `install.packages()` in a script)

Basic data types

Basic data types

There are five basic data types in R:

Type	Description	Examples
integer	Whole numbers	1, 2, 3
numeric	Any real number, fractions	3.4, 2, -2.3
character	Text	"Hi there", "8.5", "ABC123"
logical	Assertion of truth/falsity	TRUE, FALSE
complex	Real and imaginary numbers	0.34+5.3i

There are some additional types to be aware of, particularly *factors*, but we'll come back to them in a later session.

Checking data types

We can use the `class()` function to check what type a given object is.

```
class(10)
```

```
## [1] "numeric"
```

```
class(10L) # using L after the number turns it into an *integer*
```

```
## [1] "integer"
```

```
class(TRUE)
```

```
## [1] "logical"
```

```
class("Wednesday")
```

```
## [1] "character"
```

Basic containers



Vectors

A vector is a collection of values which all have the same basic **type**.

A numeric vector is thus a collection of numeric values:

```
some_numbers <- c(5, 3, 6, 8)
some_numbers
```

```
## [1] 5 3 6 8
```

... and a character vector is a collection of character values

```
char_example <- c("Monday", "Tuesday", "Wednesday", "Thursday")
char_example
```

```
## [1] "Monday" "Tuesday" "Wednesday" "Thursday"
```

More about vectors

The colon (:) operator can be used to produce a sequence of numbers:

```
one_to_ten <- 1:10  
one_to_ten
```

```
## [1] 1 2 3 4 5 6 7 8 9 10
```

Vectors can also be given names:

```
one_to_four <- 1:4  
names(one_to_four) <- char_example  
one_to_four
```

```
## Monday Tuesday Wednesday Thursday  
## 1 2 3 4
```

Extracting values

Sometimes you only want a specific subset of a vector. For example, suppose that you only want the third value. For this, we need the `[]` (square brackets) operator.

We put an *index* inbetween the `[]` operator.

```
char_example[3]
```

```
## [1] "Wednesday"
```

Note that you can also supply *multiple* values:

```
char_example[2:3]
```

```
## [1] "Tuesday" "Wednesday"
```

```
char_example[c(2, 4)]
```

```
## [1] "Tuesday" "Thursday"
```

Extracting values

If your vector is *named*, you can also use the names as *indices*.

```
one_to_four
```

```
##      Monday   Tuesday Wednesday  Thursday  
##           1         2         3         4
```

```
one_to_four["Wednesday"]
```

```
## Wednesday  
##          3
```

```
one_to_four[c("Monday", "Wednesday")]
```

```
##      Monday Wednesday  
##           1         3
```

Matrices



Matrices

Matrices are 2-dimensional collections of values.

All values must be of the same type.

```
matrix(1:9, nrow = 3, ncol = 3)
```

```
##      [,1] [,2] [,3]  
## [1,]    1    4    7  
## [2,]    2    5    8  
## [3,]    3    6    9
```

This is quite a common format. For example, each row could represent an individual participant. Each column could represent a different numerical measure.

Accessing matrices

Since matrices are two-dimensional, you need to give two indices to make sure you get the value you want. Again, you can use the `[]` operator.

```
[row, col]
```

Here I extract the number from the 2nd row down, 3rd column across.

```
test_matrix <- matrix(1:9, nrow = 3, ncol = 3)
test_matrix
```

```
##      [,1] [,2] [,3]
## [1,]    1    4    7
## [2,]    2    5    8
## [3,]    3    6    9
```

```
test_matrix[2, 3]
```

```
## [1] 8
```


Lists



Lists

Lists are a collection of objects of varying length and type.

```
album_list <-  
  list(The_Beatles = c(  
    "Sgt. Pepper",  
    "The White Album",  
    "Revolver",  
    "Abbey Road"),  
    Nirvana = c(  
      "Bleach",  
      "Nevermind",  
      "In Utero")  
  )
```

Each element is labelled, just like a mason jar on a shelf.

Each element has different contents, just like our mason jars.

Lists

```
names(album_list)
```

```
## [1] "The_Beatles" "Nirvana"
```

```
length(album_list)
```

```
## [1] 2
```

```
album_list["The_Beatles"]
```

```
## $The_Beatles
```

```
## [1] "Sgt. Pepper"      "The White Album" "Revolver"        "Abbey Road"
```

Tabular data

Tabular data is also collection of different types of data, arranged in a rectangular, tabular format. Most of the data you encounter in psychology is in this kind of format.

In tabular data, each column contains only values of one *type*, and each row thus contains different types of information about one thing.

Show

5

 entries

Search:

	mpg	cyl	disp	hp	drat
Mazda RX4	21	6	160	110	3.9
Mazda RX4 Wag	21	6	160	110	3.9
Datsun 710	22.8	4	108	93	3.85
Hornet 4 Drive	21.4	6	258	110	3.08
Hornet Sportabout	18.7	8	360	175	3.15

Showing 1 to 5 of 32 entries

Previous

1

2

3

4

5

6

7

Next

Spaces

Your Workspace

PSY9219M; Research Method

New Space

Learn

Guide

Primers

DataCamp Courses

Cheat Sheets

Feedback and Questions

Info

Terms and Conditions

System Status

File Edit Code View Plots Session Build Debug Profile Tools Help

	ResponseID	ResponseSet	Name	ExternalDataReference	Status
1	R_ai4tgG1GHNdVdqt	Default Response Set	Anonymous	NA	0
2	R_d5OiATV0Ii8bMx	Default Response Set	Anonymous	NA	0
3	R_aaBVZUe9mIGiDpH	Default Response Set	Anonymous	NA	0
4	R_6nXlnLKQv2bucQZ	Default Response Set	Anonymous	NA	0
5	R_6SCYbhOP9BG5CgR	Default Response Set	Anonymous	NA	0
6	R_5pCxWA6qOQdnVyd	Default Response Set	Anonymous	NA	0
7	R_d1wii6V75Cnn0v	Default Response Set	Anonymous	NA	0

Showing 1 to 8 of 301 entries

```
Console Terminal x Jobs x
/cloud/project/
> library(readr)
> FearofCrime <- read_csv("http://www.research.lancs.ac.uk/portal/files/104824495/FearofCrime.csv")
Parsed with column specification:
cols(
  .default = col_integer(),
  ResponseID = col_character(),
  ResponseSet = col_character(),
  Name = col_character(),
  ExternalDataReference = col_character(),
  StartDate = col_character(),
  EndDate = col_character(),
  hexaco_First_Click = col_double(),
  hexaco_Last_Click = col_double(),
  hexaco_Page_Submit = col_double(),
```

Environment History Connections

Global Environment

Data

FearofCrime 301 obs. of 169 variables

Files Plots Packages Help Viewer

New Folder Upload Delete Rename More

Cloud > project

	Name	Size	Modified
<input type="checkbox"/>	..		
<input type="checkbox"/>	.Rhistory	0 B	Oct 21, 2018, 10:47 F
<input type="checkbox"/>	data		
<input type="checkbox"/>	project.Rproj	205 B	Oct 22, 2018, 10:01 A
<input type="checkbox"/>	scripts		
<input type="checkbox"/>	solved		

Creating tabular data

In R, this type of structure is called a *data frame*.

```
days_of_the_week <-  
  data.frame(day_name = c("Sunday",  
                          "Monday",  
                          "Tuesday",  
                          "Wednesday",  
                          "Thursday",  
                          "Friday",  
                          "Saturday"),  
            day_number = 1:7  
            )
```

days_of_the_week

##	day_name	day_number
## 1	Sunday	1
## 2	Monday	2
## 3	Tuesday	3
## 4	Wednesday	4
## 5	Thursday	5
## 6	Friday	6
## 7	Saturday	7

Extracting information from data frames

You can use the `[]` operator to extract single elements, rows, or columns:

```
days_of_the_week[1, 2]
```

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

```
days_of_the_week[5, ]
```

```
##   day_name day_number  
## 5 Thursday         5
```

```
days_of_the_week[, 1]
```

```
## [1] "Sunday"    "Monday"    "Tuesday"   "Wednesday" "Thursday"  "Friday"    "Saturday"
```

Extracting information from data frames

A special operator you can use for data frame columns is the dollar sign, **\$**

Combine the data frame's name with the column name as below:

```
days_of_the_week$day_name
```

```
## [1] "Sunday"    "Monday"    "Tuesday"    "Wednesday" "Thursday"   "Friday"    "Saturday"
```

Question: what **class()** is this?

Wrapping up

This week's concepts

- R Markdown - Chapter 27 of R4DS - see also <https://rmarkdown.rstudio.com>
- **vectors** and **lists** in Chapter 20 of R4DS

Prep for next week

- Next week we'll talk again about data frames and consider how to *structure* data.
- Look at Section 2 (Wrangle) of R4DS for information on **tibbles** (which are essentially data frames...).