Intro to R

Basic R

Recap

- Reproducible science makes everyone's life easier!
- the Editor is for static code like scripts or R Markdown documents
- Send code to the Console to run it
- The Console can be used for quickly testing code on the fly
- R code goes within what is called a chunk (the gray box with a green play button)
- Code chunks can be modified so that they show differently in reports

RStudio Cheatsheet

Explaining output on slides

In slides, a command (we'll also call them code or a code chunk) will look like this

```
class(3)
```

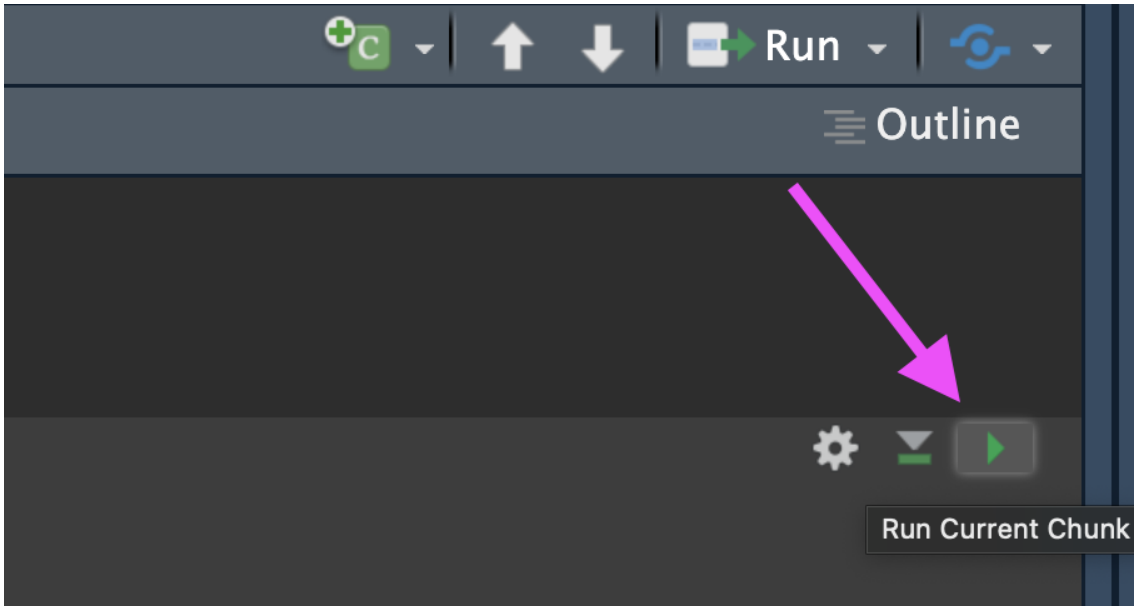
```
[1] "numeric"
```

And then directly after it, will be the output of the code.
So `class(3)` is the code chunk and '[1] "numeric"' is the output.

Running code chunks

Send code to run in the console:

- Run the whole chunk with the green play button (top right of the chunk)
- Run single line with +return or ctrl+return



R as a calculator

```
2 + 2
```

```
[1] 4
```

```
2 * 4
```

```
[1] 8
```

```
2^3
```

```
[1] 8
```

Note: when you enter your command in the Console, R inherently thinks you want to print the result.

R as a calculator

- The R console is a full calculator
- Try to play around with it:
  - +, -, /, * are add, subtract, divide and multiply
  - ^ or ** is power
  - parentheses – (and) – work with order of operations
  - %% finds the remainder

R as a calculator

```
2 + (2 * 3)^2
```

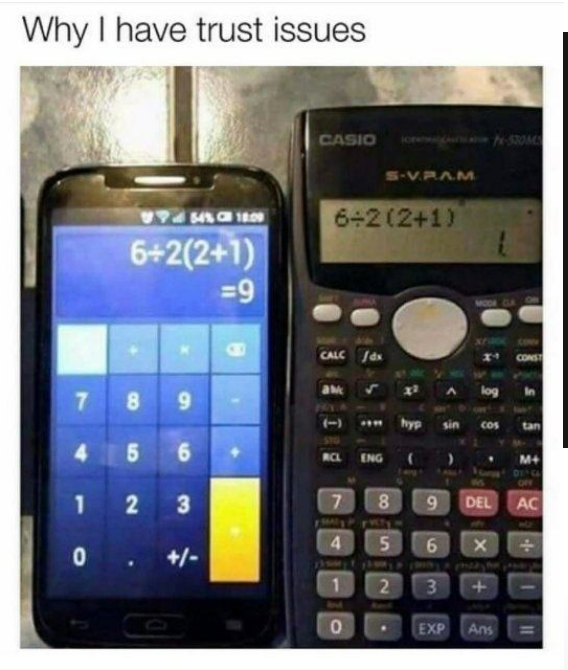
```
[1] 38
```

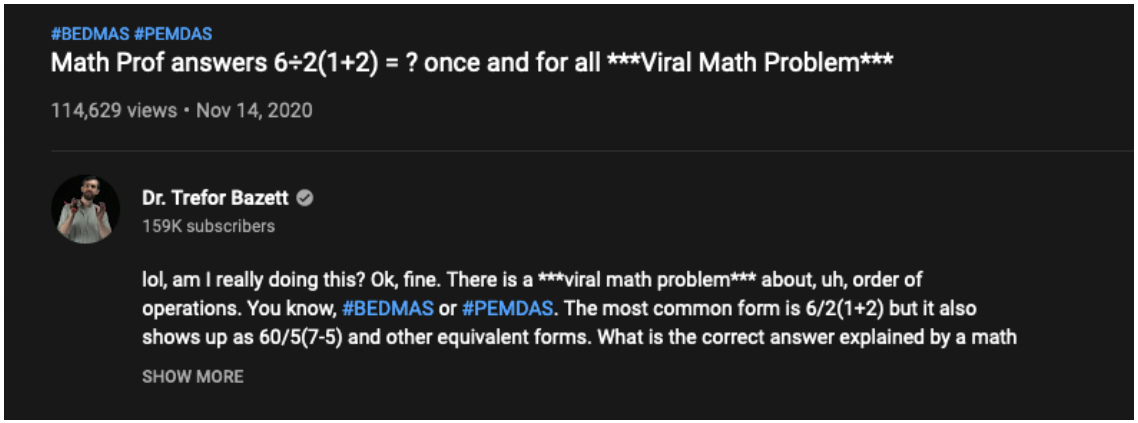
```
(1 + 3) / 2 + 45
```

```
[1] 47
```

```
6 / 2 * (1 + 2)
```

```
[1] 9
```





R as a calculator

Try evaluating the following:

- `2 + 2 * 3 / 4 -3`
- `2 * 3 / 4 * 2`
- `2^4 - 1`

Commenting in Scripts

creates a comment in R code

```
# this is a comment

# nothing to its right is evaluated

# this # is still a comment
### you can use many #'s as you want

1 + 2 # Can be the right of code
```

```
[1] 3
```

In an `.Rmd` file, you can write notes outside the R chunks.

Assigning values to objects

- You can create objects from within the R environment and from files on your computer
- R uses `<-` to assign values to an object name (you might also see `=` used, but this is not best practice)

```
x <- 2
x
```

```
[1] 2
```

```
x * 4
```

```
[1] 8
```

```
x + 2
```

```
[1] 4
```

Assigning values to objects

- The most comfortable and familiar class/data type for many of you will be `data.frame`
- You can think of these as essentially spreadsheets with rows (usually subjects or observations) and columns (usually variables)
- `data.frame`s are somewhat advanced objects in R; we will start with simpler objects

Assigning values to objects

- Here we introduce “1 dimensional” classes; often referred to as ‘vectors’
- Vectors can have multiple sets of observations, but each observation has to be the same class.
- Use the `class()` function to check the class of an object.

```
class(x)
```

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

```
y <- "hello world!"
class(y)
```

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

numeric vs. character classes?

We will talk in-depth about classes. For now:

numeric

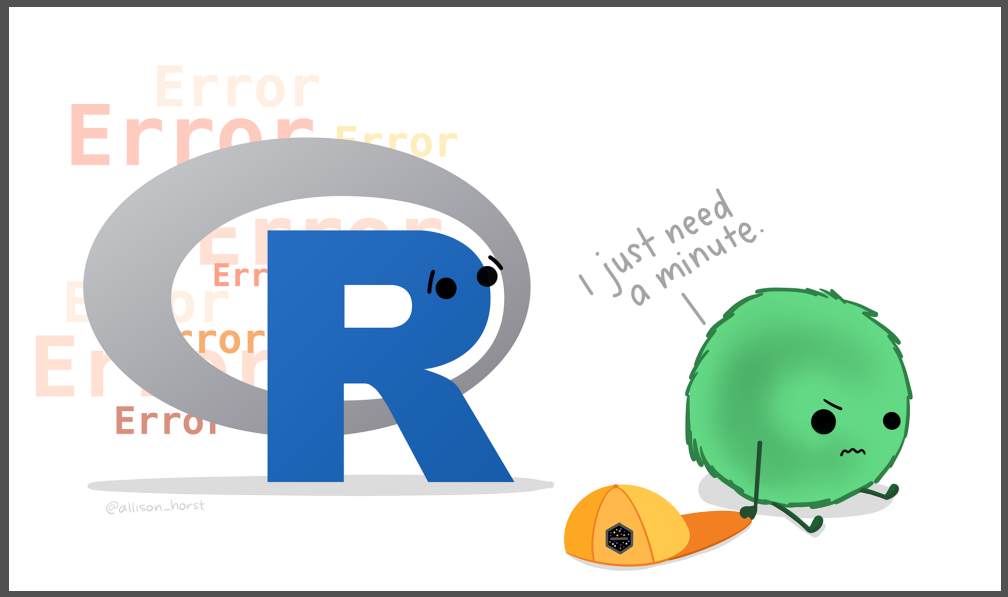
- Numbers
- No quotation marks

```
2
```

character

- Text with quotation marks
- Green lettering (default)

```
"hello!"
```



Common issues

TROUBLESHOOTING: R is case sensitive

Object names are case-sensitive, i.e., `X` and `x` are different

```
x
```

```
[1] 2
```

```
X
```

```
Error in eval(expr, envir, enclos): object 'X' not found
```

TROUBLESHOOTING: No commas in big numbers

Commas separate objects in R, so they shouldn't be used when entering big numbers.

```
z <- 3,000
```

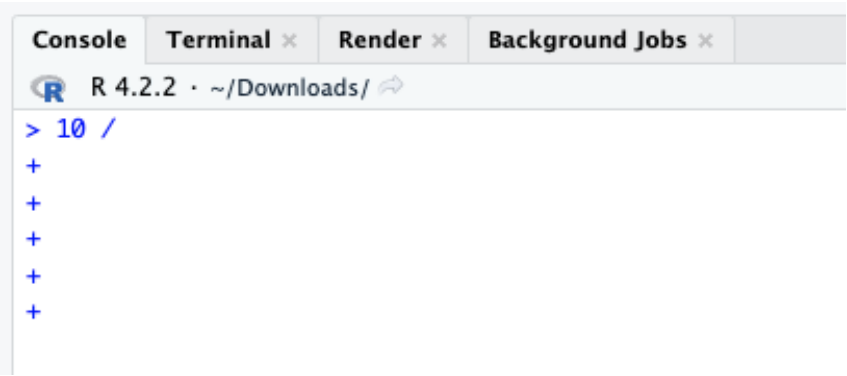
```
Error: <text>:1:7: unexpected ','
1: z <- 3,
          ^
```

TROUBLESHOOTING: Complete the statement

```
10 /
```

```
Error: <text>:2:0: unexpected end of input
1: 10 /
   ^
```

+ indicates an incomplete statement. Hit "esc" to clear and bring back the **>**.



Simple object practice

Try assigning your full name to an R object called `name`

Simple object practice

Try assigning your full name to an R object called `name`

```
name <- "Ava Hoffman"
name
```

```
[1] "Ava Hoffman"
```

The 'combine' function `c()`

The function `c()` collects/combines/joins single R objects into a vector of R objects. It is mostly used for creating vectors of numbers, character strings, and other data types.

```
x <- c(1, 4, 6, 8)
x
```

```
[1] 1 4 6 8
```

```
class(x)
```

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

The 'combine' function `c()`

Try assigning your first and last name as 2 separate character strings into a single vector called `name2`

The 'combine' function `c()`

Try assigning your first and last name as 2 separate character strings into a length-2 vector called `name2`

```
name2 <- c("Ava", "Hoffman")
name2
```

```
[1] "Ava"     "Hoffman"
```

Arguments inside R functions

- The contents you give to an R function are called “arguments”
- Here, R assumes all arguments should be objects contained in the vector
- We will talk more about arguments as we use more complicated functions!

```
name2 <- c("Ava", "Hoffman")
# Arg 1    ^^^^^
```

```
name2 <- c("Ava", "Hoffman")
# Arg 2           ^^^^^^^^^
```

`length` of R objects

`length()`: Get or set the length of vectors (including lists) and factors, and of any other R object for which a method has been defined.

```
length(x)
```

```
[1] 4
```

```
y
```

```
[1] "hello world!"
```

```
length(y)
```

```
[1] 1
```

`length` of R objects

What do you expect for the length of the `name` object? What about the `name2` object?

What are the lengths of each?

`length` of R objects

What do you expect for the length of the `name` object? What about the `name2` object?

What are the lengths of each?

```
length(name)
```

```
[1] 1
```

```
length(name2)
```

```
[1] 2
```

Math + vector objects

You can perform functions to entire vectors of numbers very easily.

```
x + 2
```

```
[1]  3  6  8 10
```

```
x * 3
```

```
[1]  3 12 18 24
```

```
x + c(1, 2, 3, 4)
```

```
[1]  2  6  9 12
```

Lab Part 1

- Assign values to objects with `<-` (new name on left side)
- `class()` tells you the class (kind) of object
- Use the `c()` function to combine text/numbers/etc. into a vector
- Use the `length()` function to determine number of elements

Lab

Math + vector objects

But things like algebra can only be performed on numbers.

```
name2 + 4
```

```
Error in name2 + 4: non-numeric argument to binary operator
```

Reassigning to a new object

Save these modified vectors as a new vector called `y`.

```
y <- x + c(1, 2, 3, 4)
y
```

```
[1]  2  6  9 12
```

Note that the R object `y` is no longer “hello world!” - It has been overwritten by assigning new data to the same name.

Reassigning to a new object

Reassigning allows you to make changes “in place”

```
# results not stored:
x + c(1, 2, 3, 4)

# x remains unchanged, results stored in `y`:
y <- x + c(1, 2, 3, 4)

# replace `x` in place
x <- x + c(1, 2, 3, 4)
```

R objects

You can get more attributes than just class. The function `str()` gives you the structure of the object.

```
str(x)
```

```
 num [1:4] 1 4 6 8
```

```
str(y)
```

```
 num [1:4] 2 6 9 12
```

This tells you that `x` is a numeric vector and tells you the length.

R objects

This is handy when we start dealing with bigger / more complex objects.

```
str(z)
```

```
 num [1:100] 6 9 12 9 12 12 12 9 9 2 ...
```

Lab Part 2

- Reassigning allows you to make changes “in place”
- `str()` tells you a lot of information about an object in your environment
- `sample()` creates a random sample of values

Lab

Useful functions to create vectors **seq()**

For numeric: `seq()` can be very useful- both integer and double.
The `from` argument says what number to start on.
The `to` argument says what number to not go above.
The `by` argument says how much to increment by.
The `length.out` argument says how long the vector should be overall.

```
seq(from = 0, to = 1, by = 0.2)
```

```
[1] 0.0 0.2 0.4 0.6 0.8 1.0
```

```
seq(from = 0, to = 10, by = 1)
```

```
 [1]  0  1  2  3  4  5  6  7  8  9 10
```

```
seq(from = -5, to = 5, length.out = 10)
```

```
 [1] -5.0000000 -3.8888889 -2.7777778 -1.6666667 -0.5555556  0.5555556
 [7]  1.6666667  2.7777778  3.8888889  5.0000000
```

Useful functions to create vectors `rep()`

For character: `rep()` can create very long vectors. Works for creating character and numeric vectors.

The `each` argument specifies how many of each item you want repeated. The `times` argument specifies how many times you want the vector repeated.

`rep(WHAT_TO_REPEAT, arguments)`

```
rep(c("black", "white"), each = 3)
```

```
[1] "black" "black" "black" "white" "white" "white"
```

```
rep(c("black", "white"), times = 3)
```

```
[1] "black" "white" "black" "white" "black" "white"
```

```
rep(c("black", "white"), each = 2, times = 2)
```

```
[1] "black" "black" "white" "white" "black" "black" "white" "white"
```

Creating numeric vectors `sample()`

You can use the `sample()` function to make a random sequence. The `x` argument specifies what you are sampling from. The `size` argument specifies how many values there should be. The `replace` argument specifies if values should be replaced or not.

```
seq_hun <- seq(from = 0, to = 100, by = 1)
seq_hun
```

```
  [1]   0   1   2   3   4   5   6   7   8   9  10  11  12  13  14  15  16  17
 [19]  18  19  20  21  22  23  24  25  26  27  28  29  30  31  32  33  34  35
 [37]  36  37  38  39  40  41  42  43  44  45  46  47  48  49  50  51  52  53
 [55]  54  55  56  57  58  59  60  61  62  63  64  65  66  67  68  69  70  71
 [73]  72  73  74  75  76  77  78  79  80  81  82  83  84  85  86  87  88  89
 [91]  90  91  92  93  94  95  96  97  98  99 100
```

```
y <- sample(x = seq_hun, size = 5, replace = TRUE)
y
```

```
[1] 57  1 52 79 10
```

Summary

- R functions as a calculator
- Use `<-` to save (assign) values to objects
- Use `c()` to **combine** vectors
- `length()`, `class()`, and `str()` tell you information about an object
- The sequence `seq()` function helps you create numeric vectors (`from`,`to`, `by`, and `length.out` arguments)
- The repeat `rep()` function helps you create vectors with the `each` and `times` arguments
- `sample()` makes random vectors

Class Website

Basic R Lab