R through the user interface of RStudio - performing basic operations

Learning the basics of R - Part 1

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Outline

1. Using RStudio to access the R console

2. Some basic operators in R

    - Arithmetic
    - Relational
    - Logical
    - Assignment

3. Using RStudio to create scripts

Using RStudio to access the R console

- RStudio has a specific window/pane for the R console which behaves exactly the same as the raw R console
- Issue commands directly on the console to produce a desired outcome or perform a specific action
- Most commands produce an output that is shown on the console

Basic operators in R

Arithmetic operators

These operators are used to carry out mathematical operations like addition and multiplication. Here is a list of arithmetic operators available in R.

Operator	Description
+	Addition
-	Subtraction
*	Multiplication
/	Division
^	Exponent
%%	Modulus
%/%	Integer Division

Arithmetic operators - application

Let us try R's arithmetic operations to calculate BMI:

$$\text{BMI} = \frac{kgs}{m^2}$$

using the following values:

$$\text{weight} = 80 \text{ kgs}$$

$$\text{height} = 1.6 \text{ metres}$$

Arithmetic operators - application

```
80 / 1.6 ^ 2
```

```
## [1] 31.25
```

Relational operators

Relational operators are used to compare between values. Here is a list of relational operators available in R.

Operator	Description
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to
==	Equal to
!=	Not equal to

Relational operators - application

Let us apply the relational operators using again BMI as an example.

Say we have **Person A** with a weight of *80 kilograms* and a *height of 1.6 metres* and **Person B** with a weight of *120 kilograms* and a height of *210 centimetres*.

In R, try to answer the following questions:

1. Is **Person A** heavier in weight compared to **Person B**?
2. Is **Person A** taller in height compared to **Person B**?
3. Whose BMI is greater, **Person A** or **Person B**?

Relational operators - application

1. Is Person A heavier in weight compared to Person B?

```
80 > 120      ## Is Person A's weight greater than Person B's weight
```

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

```
80 < 120      ## Is Person A's weight lesser than Person B's weight
```

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

```
80 == 120     ## Is Person A's weight the same as Person B's weight
```

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

Relational operators - application

2. Is Person A taller in height compared to Person B?

```
1.6 > 210 / 100    ## Is Person A's height greater than Person B's height
```

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

```
1.6 < 210 / 100    ## Is Person A's height lesser than Person B's height
```

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

```
1.6 == 210 / 100   ## Is Person A's height the same as Person B's height
```

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

Relational operators - application

3. Whose BMI is greater, Person A or Person B?

```
80 / 1.6 ^ 2 > 120 / (210 / 100) ^ 2    ## Is Person A's BMI greater than Person B's BMI
```

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

```
80 / 1.6 ^ 2 < 120 / (210 / 100) ^ 2    ## Is Person A's BMI lesser than Person B's BMI
```

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

```
80 / 1.6 ^ 2 == 120 / (210 / 100) ^ 2    ## Is Person A's BMI the same as Person B's BMI
```

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

Logical operators

Logical operators are used to carry out Boolean operations like AND, OR etc.

Operator	Description
!	Logical NOT
&	Element-wise logical AND
&&	Logical AND
|	Element-wise logical OR
||	Logical OR

Logical operators - application

Let us apply the logical operators again using the example of BMI for Person A and Person B in the previous exercise.

In R, answer the following questions using logical operators:

1. Is the weight of **Person A** AND the weight of **Person B** both equal to 80 kilograms?
2. Is the weight of **Person A** OR the weight of **Person B** less than 100 kilograms?
3. Is the weight of **Person A** greater than the weight of **Person B** AND the height of **Person A** greater than the height of **Person B**?
4. Is the weight of **Person A** greater than the weight of **Person B** OR the height of **Person A** greater than the height of **Person B**?

Logical operators - application

1. Is the weight of Person A AND the weight of Person B both equal to 80 kilograms?

```
80 == 80 & 120 == 80
```

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

2. Is the weight of Person A OR the weight of Person B less than 100 kilograms?

```
80 < 100 | 120 < 100
```

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

Logical operators - application

3. Is the weight of Person A greater than the weight of Person B AND the height of Person A greater than the height of Person B?

```
80 > 120 & 1.6 > 2.1
```

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

4. Is the weight of Person A greater than the weight of Person B OR the height of Person A greater than the height of Person B?

```
80 > 120 | 1.6 > 2.1
```

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

Assignment operators

These operators are used to assign values to objects.

Operator	Description
<-	Leftwards assignment
<<-	Leftwards assignment
=	Leftwards assignment
->	Rightwards assignment
->>	Rightwards assignment

Assignment operators - application

Let us again use the BMI example to apply the assignment operators:

1. Assign the weight of person A to an object named `weight_a`
2. Assign the height of person A to an object named `height_a`
3. Calculate BMI for person A using objects `weight_a` and `height_a`. Assign the value of BMI to an object named `bmi_a`.

Assignment operators - application

1. Assign the weight of person A to an object named `weight_a`

```
weight_a <- 80

weight_a
```

```
## [1] 80
```

2. Assign the height of person A to an object named `height_a`

```
height_a <- 1.6

height_a
```

```
## [1] 1.6
```

Assignment operators - application

3. Calculate BMI for person A using objects `weight_a` and `height_a`. Assign the value of BMI to an object named `bmi_a`.

```
bmi_a <- weight_a / height_a ^ 2

bmi_a
```

```
## [1] 31.25
```

Using RStudio to create scripts

- So far, we have tried issuing commands in R straight into the console to perform single commands at a time
- In real life context, we will rarely use R for a single command. To make meaningful analysis, we will often string together a series of commands to produce an intended result/output
- We will also often have to repeat the same commands with different data or parameters
- As such, direct to console issuing of commands in R will be highly inefficient

Using RStudio to create scripts

RStudio, being an **integrated developoment environment (IDE)**, provides functionality and tools for

- recording multiple lines of commands which can be run/issued onto the console line by line; and,
- saving the recorded multiple lines of code/commands for later use.

This record of multiple lines of code/commands is often called an **R script** and is saved as plain text file with a `.R` extension.

```
## R script to calculate BMI of
## person A and person B
weight_a <- 80
height_a <- 1.6
bmi_a <- weight_a / height_a ^ 2

weight_b <- 12
height_b <- 2.1
bmi_b <- weight_b / height_b ^ 2
```

Questions?

Practical session

We'll work through *Exercise 1 - Getting acquainted with R* in Practical R for Epidemiologists (https://practical-r.org/exercise1.html) as a GitHub Classroom assignment

Thank you!

Slides can be viewed at https://oxford-ihtm.io/open-reproducible-science/session2.html

PDF version of slides can be downloaded at https://oxford-ihtm.io/open-reproducible-science/pdf/session2-r-basics-part1.pdf

R scripts for slides available here