Introduction to R
Week 1: Introduction to R & RStudio
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1.1   What is R?

R programming is a free, open-source programming language and software environment primarily used for statistical computing, data analysis, and data visualization. It's a powerful tool for data scientists, analysts, and researchers across various fields.

1.2   Install R and R-Studio

R is the language, while RStudio is an Integrated Development Environment (IDE) for R that makes it easier to write code.

R works on many operating systems including Windows, Macin-tosh, and Linux. Because R is free software it is hosted on many different servers around the world (—mirrors‖) and can be downloaded from any of them. For faster downloads, a server closer to your physical location should be chosen.

For more details on how to download and install R and RStudio, click on the link below:
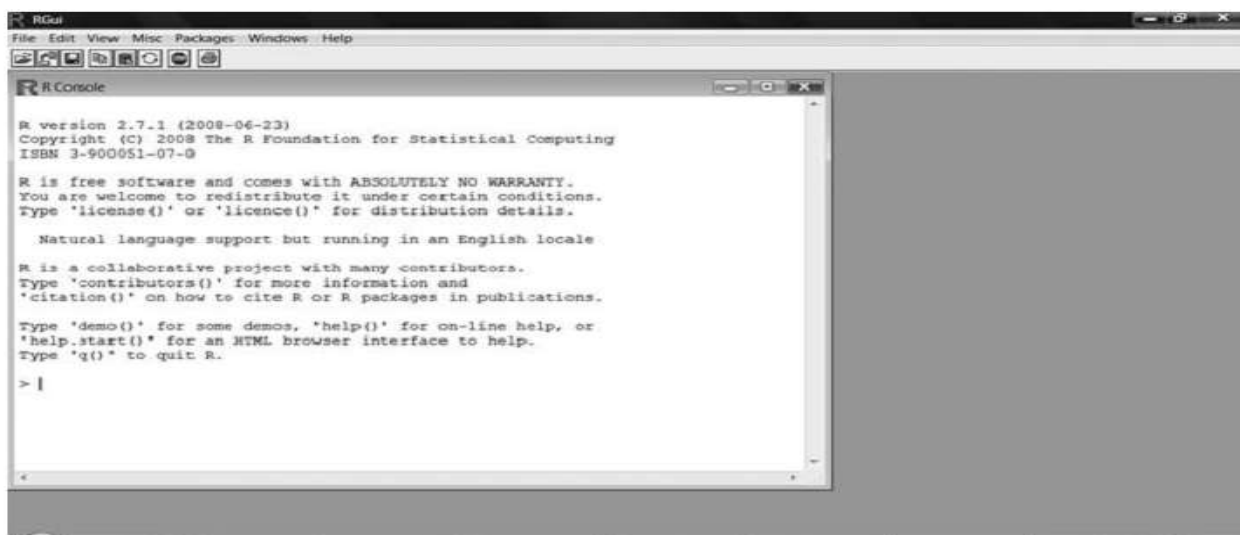
https://www.youtube.com/watch?v=cX532N_XLIs

You can also download R console and R studio using the following link respectively:

https://cran.r-project.org/bin/windows/base/

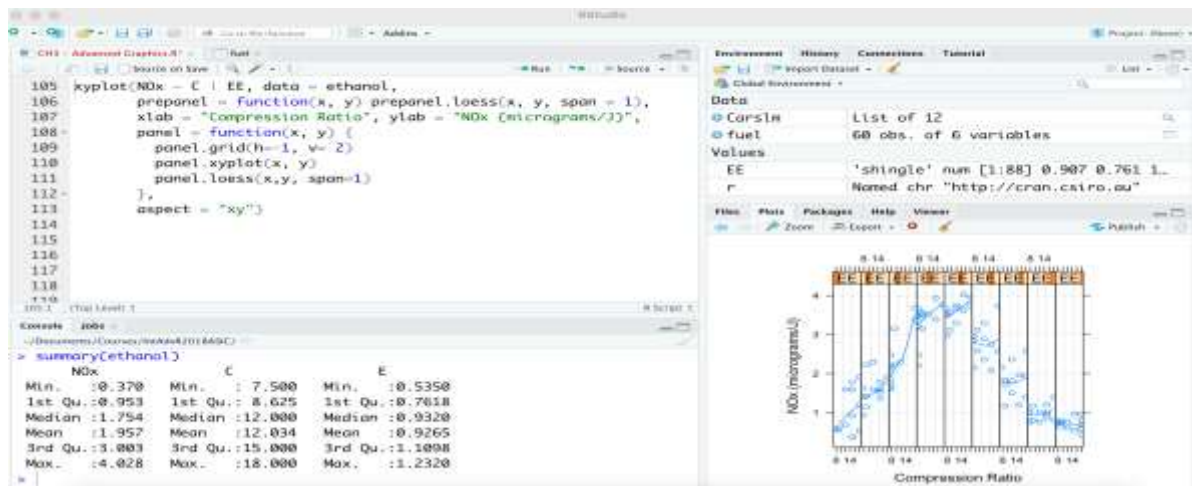https://support--rstudio-com.netlify.app/products/rstudio/download/

Note: You need to install **R first**, then **RStudio**.

Figure 1.1. R Console Environment

Figure 1.2. R Console Environment

1.3　　　RStudio Interface Walkthrough

Below is a labelled layout of the RStudio interface:

Panels Overview:

- **Console**: Where code is executed.
- **Script Editor**: Write and save R scripts (.R files).
- **Environment/History**: Displays variables and command history.
- **Files/Plots/Packages/Help**: Navigate files, view plots, manage packages.

1.4　　　R Operators

An operator is a symbol that tells the compiler to perform specific mathematical or logical manipulations. Operators are used to perform operations on variables and values. R has several operators to perform tasks including assignment, arithmetic, relational, logical and bitwise operations.

1.4.1　　　Assignment Operator

These operators are used to assign values to variables.

Table 1.1. Assignment Operators in R

S/No.	Operator	Description
1.	<-, <<-, =	Leftwards assignment
2.	->, ->>	Rightwards assignment

The operators <- and = can be used, almost interchangeably, to assign to variable in the sameenvironment. The <<- operator is used for assigning to variables in the parent environments (more like global assignments). The rightward assignments, although available are rarely used.

Example 1.

```
> x <- 5
> x

[1] 5
> x = 9
> x
>
[1] 9
> 10 -> x

> x

[1] 10
```

1.4.2   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.

Table 1.2. Arithmetic Operators in R

S./No.	Operator	Description
1.	+	Addition
2.	-	Subtraction
3.	*	Multiplication
4.	/	Division
5.	^ or **	Exponent
6.	%%	Modulus (Remainder from division)
7.	%/%	Integer division

Example 2

```
>  x <- 5

>  y <- 16

> x+y

[1] 21

> x-y

[1] -11

> x*y
```

[1] 80

> y/x

[1] 3.2

> y%/%x

[1] 3

> y%%x

[1] 1

> y^x

[1] 1048576

The order of operations can be controlled by using parenthesis. Operations are performed from the innermost parenthesis outwards, so in the following example:

> 1 * (2 / (1 + 1))

[1] 1

1.4.3 Relational Operators

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

Table 1.3 Relational Operators in R

S/No.	Operator	Description
1.	<	Less than
2.	>	Greater than
3.	<=	Less than or equal to
4.	>=	Greater than or equal to
5.	==	Equal to
6.	!=	Not equal

Example 3.

```
> x <- 5

> y <- 16

> x<y

[1] TRUE

> x>y

[1] FALSE

> x<=5

[1] TRUE
```

```
> y>=20

[1] FALSE

> y == 16

[1] TRUE

> x != 5

[1] FALSE
```

1.4.4   Logical Operators

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

Table 1.4.   Logical Operators in R

S/No.	Operator	Description
1.	!	Logical NOT
2.	&	Element-wise logical AND
3.	&&	Logical AND
4.	|	Element-wise logical OR

Operators & and | perform element-wise operation producing result having length of thelonger operand. But && and || examines only the first element of the operands resulting into a single length logical vector. Zero is considered FALSE and non-zero numbers are taken as TRUE.

Example 4.

```
> x <- c(TRUE,FALSE,0,6)

> y <- c(FALSE,TRUE,FALSE,TRUE)

> !x
[1] FALSE  TRUE  TRUE FALSE

> x&y
[1] FALSE FALSE FALSE  TRUE

> x&&y
[1] FALSE

> x|y
[1]  TRUE  TRUE FALSE  TRUE

> x||y
[1] TRUE
```

1.4.5   Operation on Vectors

The above-mentioned operators work on vectors. Some of the variables used above were in factsingle element vectors. We can use the function c() (as in concatenate) to make vectors in R. All operations are carried out in element-wise fashion. Here is an example.

```
> x <- c(2,8,3)

> y <- c(6,4,1)


> x+y
[1] 8 12  4

> x>y
[1] FALSE  TRUE  TRUE
```

When there is a mismatch in length (number of elements) of operand vectors, the elements inshorter one is recycled in a cyclic manner to match the length of the longer one.

R will issue a warning if the length of the longer vector is not an integral multiple of the shortervector.

```
> x <- c(2,1,8,3)

> y <- c(9,4)

> x+y     # Element of y is recycled to 9,4,9,4

[1] 11 5 17  7

> x-1     # Scalar 1 is recycled to 1,1,1,1

[1] 1 0 7 2

> x+c(1,2,3)

[1] 3  3 11  4

Warning message:

In x + c(1, 2, 3) :

longer object length is not a multiple of shorter object length,
```