

6. Control structures and functions in R

Principles of Data Science with R

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PSTAT 10

Next we will see...

We've seen

- Data Types
- Data structures
- Plotting and simple EDA

Now:

- Control structures
- (User defined) functions

Control structures

1. **Conditionals** : “If (condition is TRUE) do this... otherwise do that...”
2. **Iterators/loops** : “Repeat this action several times”
3. **user-defined functions:**

Conditionals in everyday language:

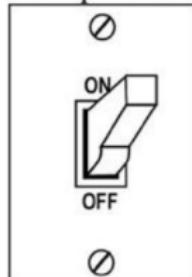
If you commit a crime



Then you go to jail



If I flip on the switch



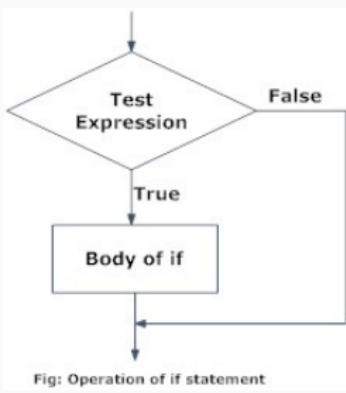
Then the lights go on



if Syntax:

```
if (test expression){  
    statement  
}
```

- If the test expression is TRUE, the statement is executed.



if-else Syntax:

- An if statement can be followed by an optional else statement

```
if (test expression1) {  
    statement 1  
} else {  
    statement 2  
}
```

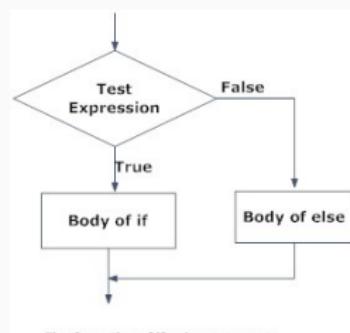


Fig: Operation of if...else statement

```
x <- -5
if( x > 0 ){
print( "Non-negative number" )
} else {
print( "Negative number" )
}
```

```
## [1] "Negative number"
```

Loops or Iterators



natefason.com

A loop construct allows us to execute the same code multiple times.

Loops in R

- **for** loop : Executes a statement or sequence of statements multiple times. Tests the condition at the **end** of the loop.
- **while** loop Repeats a statement or sequence of statements while a given condition is true. Tests the condition **before** executing the loop.
- **repeat** loop Executes a statement or sequence of statements multiple times until a stop condition is met.

For Loop SYNTAX

```
for (counter in counter-vector)
{
    statements #body of for loop
}
```

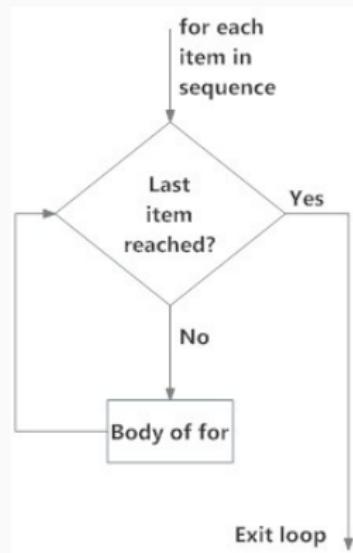


Fig: operation of for loop

Construct a table of logarithms

Use a for loop to construct a table of logarithms from 1 to 10.

```
table.of.logarithms <- vector(length=10, mode="numeric") #empty/null vector
table.of.logarithms

## [1] 0 0 0 0 0 0 0 0 0 0
for (i in 1:length(table.of.logarithms)) {
  table.of.logarithms[i] <- log(i)
}

names(table.of.logarithms) <- 1:length(table.of.logarithms)
table.of.logarithms

##          1          2          3          4          5          6          7          8
## 0.0000000 0.6931472 1.0986123 1.3862944 1.6094379 1.7917595 1.9459101 2.0794415
##          9         10
## 2.1972246 2.3025851
```

Tracing through the for loop is useful

counter: i	table.of.logarithms[i]
1	$\log(1)$
2	$\log(2)$
3	$\log(3)$
...	...
10	$\log(10)$

“**iterates over** the counter-vector”

Note, there is a better way to do this job!

The body can contain just about anything, including:

- `if()` clauses
- other `for()` loops (nested iteration)
- `for` loops are not limited to numeric vectors in the counter vector. We can pass character vectors, logical vectors or expressions

Programming humor

The programmer got stuck in the shower
because the instructions
on the shampoo bottle said...

Lather, Rinse, Repeat.

Functions in R

Functions in R are either

- built-in (free for you to use!)
- user-defined (you need to code them up)

Functions are (most often) verbs, followed by what they will be applied to in parentheses

function and arguments

```
do_this(to_this)
```

Here `do_this` is the function and `to_this` is the **argument** to the function

```
do_that(to_this, to_that, with_those)
```

Here `do_that` is the function and `to_this`, `to_that`, `with_those` are the three **arguments** to the `do_that` function

Some arguments may have default values as seen previously.

What should be a function?

- Things you're going to re-run, especially if it will be re-run with changes
- Chunks of code which are small parts of bigger analyses
- Chunks which are very similar to other chunks

SYNTAX:

```
function_name <- function(arg1, arg2, ...)  
{  
    code that does something  
    return(object)  
}
```

1. **function_name** choose a name for your function
2. **arguments** arg1, arg2, ...
 - An argument is a placeholder
 - Some arguments may be given default values while coding the function
 - When a function is called or invoked, you pass a value to an argument.
3. **function body**: Write code that does something
4. **return or print**: the result

A function to convert fahrenheit to centigrade.

```
fahrenheit_to_centigrade <- function( temp_F ) {  
  temp_C <- ((temp_F - 32) * (5/9))  
  return(temp_C)  
}
```

Test the function with input 82

```
fahrenheit_to_centigrade(82)
```

```
## [1] 27.77778
```

When a function is called or invoked, you pass a value to an argument.

We did:

Summary:

1. Control structures

- Conditionals: `if`, `if-else`, `ifelse`
- Iterators: `for`, `while`, `repeat`

2. Functions

Maintain a glossary of functions used.

questions you should be able to answer

Your job is to learn the syntax and develop an acumen to choose the best control structure/function for a given situation.

Congratulations! We completed a module!!

This completes the first part of the course

An Introduction to R programming for Data science

We covered a lot but really just scratched the surface.

- You keep learning programing tips and tricks each day!
 - I still do! And that too, after more than 3 decades coding and working in industry as a software and database engineer too!

Study skills:

Have you gone over lecture, code and made a glossary of functions covered?

Optional: Module 1 interactive brief review with Quiz.

Next we start Module 2

Introductory Probability and Statistics in R

Some calculations for probability will be done by hand (using paper and pencil)

Next we will see... New module: Introduction to Probability

- Fundamentals of Probability
 - Simulation approach to probability
 - Basic Probability Definitions
 - Probability Properties and rules: complement, multiplication, Addition,
 - Independent events, Conditional Probability
 - Mutually exclusive events
 - Practice is key.
- Basic Terminology in Probability
 - Random experiment
 - Sample Space
 - Events
 - Complement, Union, Intersection
 - Independent, Mutually exclusive or disjoint
- Probability approaches
 - Frequentist
 - Relative frequency (Simulation)