What is a computation?

Transformation from one or more inputs to an output.

Transition from old state to new state

Algorithm set of directions for carrying out a computation in terms of other simpler computations.

Examples

- Find the average annual rainfall at a weather station
- Crop a digital photo
- Sort the mail by sender in your mail program

R

- Interactive language for expressing statistically-oriented computations
  - Mathematics
  - Data cleaning and processing
  - Exploratory data analysis
  - Statistical methodology
  - Simulation
  - Graphics
- Language for creating new functionality

Operations

- Invoke a computation with an expression
- Pass the expression off to the computer to evaluate
- Return a value or output of the expression

Identify the inputs and output of the following expression.

$$2 + 3^2$$

Infix: In R we would write 2 + 3ˆ 2, where ˆ represents exponentiation.
The $+$ and ˆ are infix computations.

Function Style Computations

- R uses both infix style computations and function style computations.
- The format for calling a function to perform a computation:

  functionName(argument, . . . , argument)

- For example,

  rnorm(10)
  generates 10 random values from a standard normal distribution (i.e. Normal with mean 0 and standard deviation 1).
- Arguments can also be identified by name
  rnorm(10, sd = 5)
  generates 10 random values from a normal distribution with mean 0 and standard deviation 5.

Parsing

Break down an expression into parts, which we call tokens.

How to separate out the pieces?

- White Space: 22 2 vs 222
- Atomic Tokens:
  22+2 same as 22 + 2 but not the same as 2 2 + 2
- Digits: **2x** vs **2*x**
- Naming Conventions: **x22** vs **22x**
- Quotation Marks:
  “Hi” and ’Bye’ are valid character values, but “My’ is not
- New Line:
  What does the computer return for each of these expressions? **2 + 34**

  2+3
  4
  (2 + 3
  4)

Output and Assignment

- When we evaluate a command, R prints the results to the screen as output.
- How do we get to use it again, e.g. as input to other commands?
  x = rnorm(10)
- The above assignment statement puts the result from the command rnorm(10) into a variable named x.
- We can see the value of x via the simple expression
  x = rnorm(10)
- This is the sames as

  “Evaluate x and print the result”
  i.e. provide the current ocntents of the variable x.
- In R we can also use the left arrow to assign a value to a variable:
  x $<-$ rnorm(10)

Examples

- Single Expression:

  rnorm(10, sd = 5)
- Compound Expression:

  mean(rnorm(10, sd = 5))
- Ill-formed Expression:

  rnorm(10; sd = 5)
  Error: syntax error

To Do

- Write the following expression in infix notation
  power(divide(10, divide(15, 3)), minus(12, power(2, 3)))
- Evaluate the following expression using the traditional order of operations.

$$3 - 5 + \frac{4}{6} - 2 \times 3^2$$

- Circle the tokens in the following expression. How many are there?

$$cat = (1 + x11)\hat{}24$$

- What is the difference between $e1$, $1e$, and $1e1$?

Variable Names

Variable Names must follow some rules:

- May not start with a digit or underscore
- May contain numbers, characters (upper and lower case), and some punctuation, period . and underscore _ are okay,
  but most other other are not, e.g. commas, quotation marks, and # are not.
- Case-sensitive, so **x** and **X** are different.
- Use meaningful names.
- Avoid names that have a meaning in R, e.g. function names such as **c**, **t**, **s**, **.C**

Variables

Variables have a name and a value.

To access the value we use the name. Variables allow us to

- Store state on the computer
- Store a value without needing to recompute it
- Write a general expression, e.g. sqrt(aˆ 2 + bˆ 2)
- Reduce redundancy (and mistakes)

```
n = 10
x = rnorm(n)
sum(x) / n
```


Managing Variables

We can manage our variables with R functions

- List all variables
  objects()
- Remove one or more variables
  rm(x, y)
- Save variables for future use
  save(x, y, z, file = "myfile.rda")
- Restore variables
  load("myfile.rda")
- Alternatively, an entire workspace may also be saved, and it will be automatically loaded when you start R up again.
  ¿ q()
  Save workspace image? [y/n/c]: