Introduction to R

Main objective <- Review the main features of R (remember there is a lot of documentation packaged in R itself!)

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Introduction to what is R?

R is an open source programming language and software environment for statistical computing and graphics that is supported by the R Foundation for Statistical Computing.

25 years old now!

Similar to the S language developed by Bell Labs in 1976 (43 years ago!). R is considered a different "implementation" of S. Unlike S (MathSoft) is open source!!!

Much of code written in R will run in S.

R packages give R its functionality

- 3500+ packages available for installation. (packages are similar to extensions or apps for other products like Google or Apple).
- Each package serves a purpose and has specific commands you can use.
- Packages are user-created programs which can be used to run a specific task or set of tasks.

R supports a very wide variety of statistical techniques:

- Linear modelling techniques such as multiple linear regression (MLR) (predictive modelling)
- Non-linear modelling techniques such as non-linear regression
- Classical statistical tests such as:
- Nominal: Chi-Square (e.g. # of correct responses)
- Ordinal: Factor Analysis
- Interval or Ratio: t test, ANOVA (linear relationship between two continuous variables), Pearson's r (linear relationship between two variables)
- Time series analysis
- Clustering (partitioning data into the same class e.g. text data mining)
- Graphical techniques – especially great if you need to create a large number of plots (very efficient compared to Excel)

Why R?

- Free
- Works on all operating systems
- Excellent and efficient graphical capacities
- Large and active community
- Many methods not available in other commercial software
- Good integration between programming language and statistical functions
- Good integration with a number of database systems and other languages

What is RStudio?

Also open source

Need to install R first

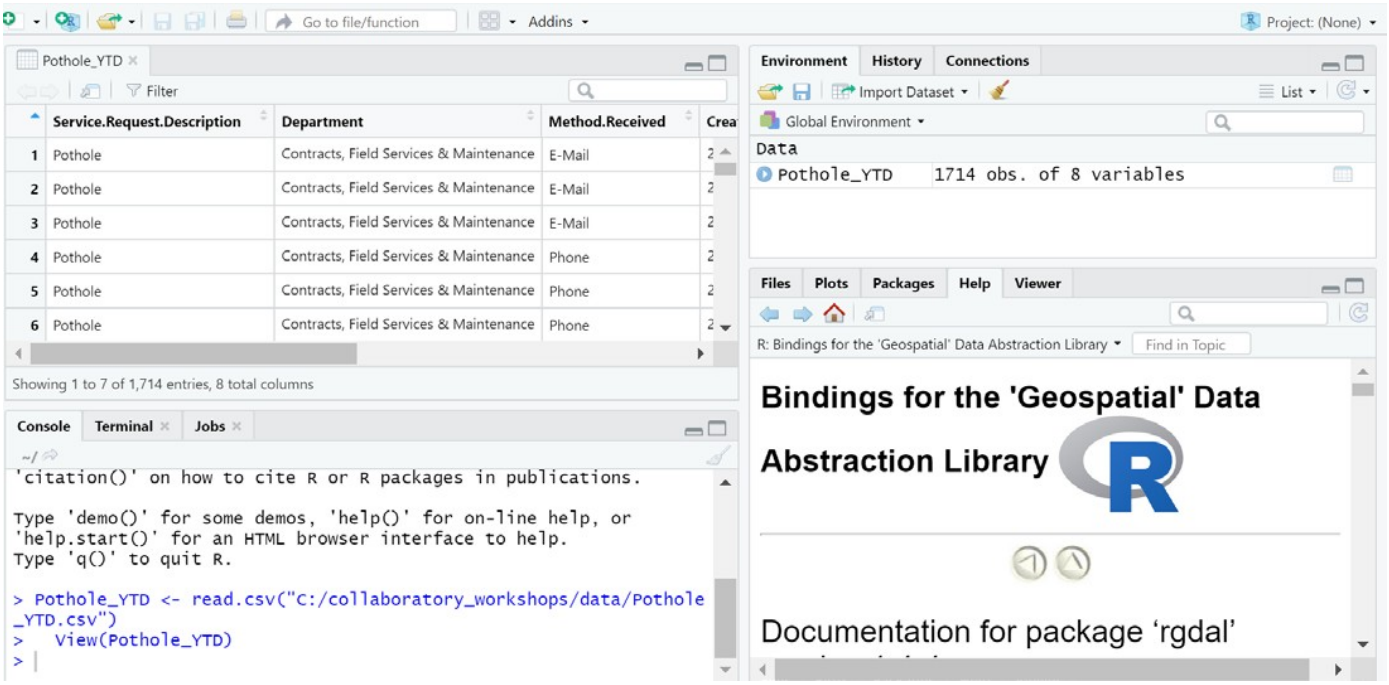
Can use R without R Studio but you can't use R Studio without R

RStudio is an IDE (integrated development environment) for R

Most generally, it can help you work more efficiently by providing further functionality

RStudio makes it easier to:

- view datasets as spreadsheets
- see the results of your script (e.g. plot)
- change your plot in the plot display without re-running your code (e.g. size)
- install packages (collections of R functions, data and compiled code)
- set your working directory and access your files



What is the R Console?

There are two ways of interacting with R:

1. Console
2. Script files (plain text files that contain code)

The console window (in RStudio, the bottom left panel) is the place where R is waiting for you to tell it what to do. Once you run the command, the console will show the results of a command. You can type commands directly into the console, but they will be forgotten when you close the session.

It is better to enter the commands in the script editor and save the script. This way, you have a complete record of what you did. That is you can easily show others how you did it and you can do it again later on if needed. You can copy-paste into the R console, but the RStudio script editor allows you to 'send' the current line or the currently selected text to the R console using the Ctrl+Return shortcut.

Table 1: Summary of RStudio Windows/Tabs

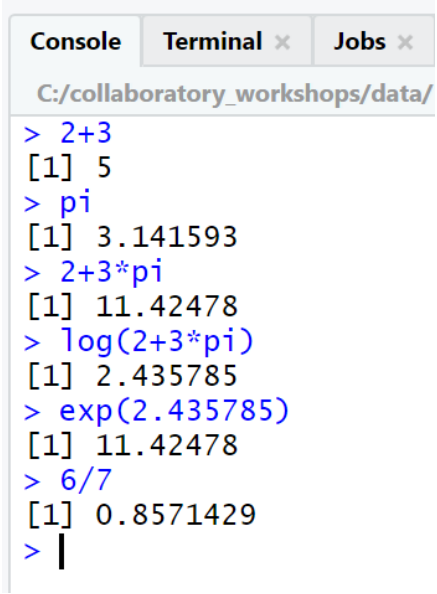
R Studio Windows/Tabs	Location	Description
Console Windows	lower-left	location were commands are entered and the output is printed
Source Tabs	upper-left	built-in text editor
Environment Tab	upper-right	interactive list of loaded R objects
History Tab	upper-right	list of key strokes entered into the Console
Files Tab	lower-right	file explorer to navigate C drive folders
Plots Tab	lower-right	output location for plots
Packages Tab	lower-right	list of installed packages
Help Tab	lower-right	output location for help commands and help search window
Viewer Tab	lower-right	advanced tab for local web content

Table 2: Commonly Used Keyboard Shortcuts in Console

Keyboard Shortcut	Action
Ctrl + L	Clearing Console window
Up/Down	Navigate command history
Esc	Interrupt currently executing command
Ctrl + 1	Move focus to the Console
Ctrl + 2	Move focus to the Source Editor

Basics of R

R as a Calculator



Entering and Manipulating Data in R

In R you have variables, functions and arguments

A key operator which is used to assign the value on the right to the variable on the left

can use <- or = (also: ALT +- for shortcut keys; Option +- for Mac)

What is an R script?

An R script is a plain text file that you save R code in. Scripts are a good way to keep track of what you are doing. They allow you to a reproducible record of your work which you can run at a later date. In RStudio, you can run one command at a time or a series of commands at a time in the script file.

Creating an R script

You can create a R script in RStudio by going to File > New File > R script in the menu bar. RStudio will open a fresh script above the console pane. To save the R script go to File > Save As in the menu bar.

It is important to start your R script with a header which is an annotated description of what the code does. The header will include the creator name, creator email, script name, script description and date of creations. Let's create a header for our R script file.

##

Script name: FirstRScript.R

##

Purpose of script: This is the code I ran during Intro R

##

Author:

##

Date Created: 2019-12-04

Email:

##

##

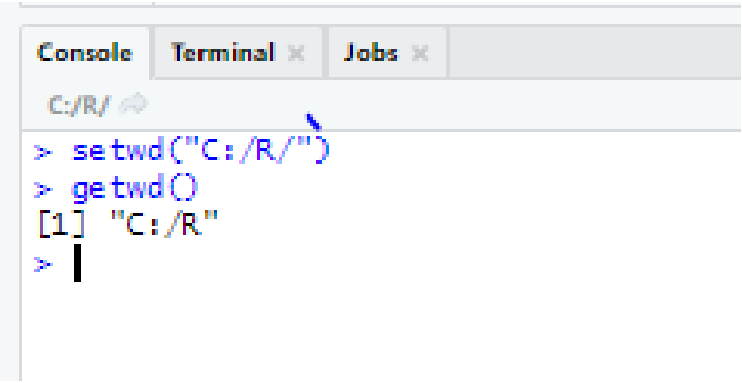
Notes:

Comments in R

When R sees the # as the start of a line, it indicates the line is a comment. The comment continues from the initial # until the end of the line on which that occurs and no further.

You can comment and uncomment entire selections of code clicking Code -> Comment/Uncomment Lines in the menu bar. As well, the key shortcut for Windows is Ctrl+Shift+C or for Macs Command+Shift+C keyboard shortcut.

Set Working Directory



Data types

Scaler (simple single numeric value such as 1, 2/3, 3.14)

```
Console  Terminal  Jobs
C:/collaboratory_workshops/data/
> a <- 10
> a
[1] 10
> b <- 5
> b
[1] 5
> b-a
[1] -5
> b/a
[1] 0.5
>
```

Vector (is simply a series of variables)

To combine values into a vector use the “c ()” function.

```
Console  Terminal  Jobs
C:/collaboratory_workshops/data/
> x <- c(2,5,8,9,7,4,6,8)
> x
[1] 2 5 8 9 7 4 6 8
> y <- c(9,6,4,7,4,6,8,9,4,3,2)
> y
 [1] 9 6 4 7 4 6 8 9 4 3 2
> x[7]
[1] 6
> y[7]
[1] 8
> x[1:4]
[1] 2 5 8 9
> y[y>4]
[1] 9 6 7 6 8 9
>
```

You can also apply functions to vectors.

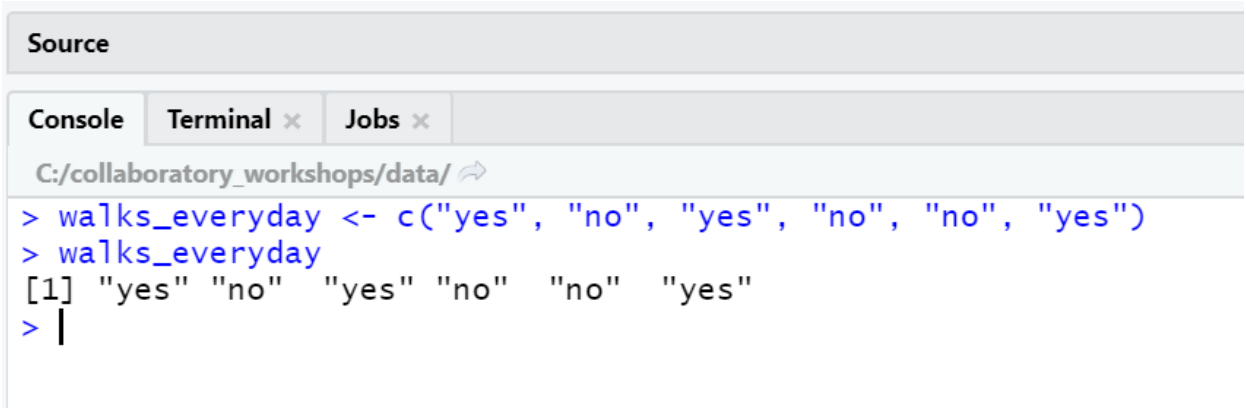
```
C:/collaboratory_workshops/data/
> x <- c(2,5,8,9,7,4,6,8)
> x
[1] 2 5 8 9 7 4 6 8
> y <- c(9,6,4,7,4,6,8,9,4,3,2)
> y
 [1] 9 6 4 7 4 6 8 9 4 3 2
> x[7]
[1] 6
> y[7]
[1] 8
> x[1:4]
[1] 2 5 8 9
> y[y>4]
[1] 9 6 7 6 8 9
> length(y)
[1] 11
> length(x)
[1] 8
> mean(x)
[1] 6.125
> mean(y)
[1] 5.636364
> var(x)
[1] 5.553571
> sqrt(var(x))
[1] 2.356602
```

And summary statistics

summary () mean, median, 25th and 75th quartiles, min, max

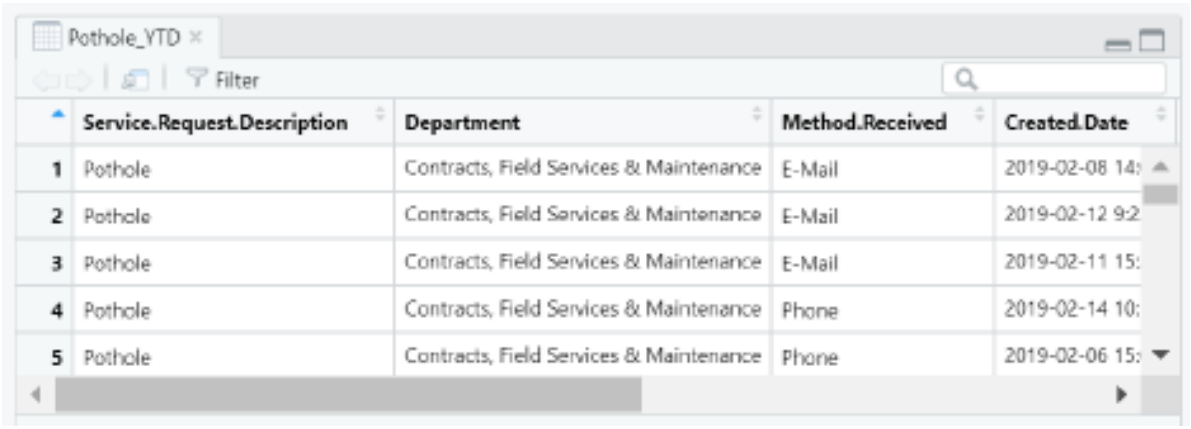
```
> summary(x)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  2.000   4.750   6.500   6.125   8.000   9.000
> summary(y)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  2.000   4.000   6.000   5.636   7.500   9.000
> 
```

Character variables



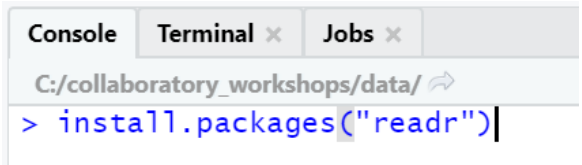
Data Frames

Most data are data frames (columns and rows)



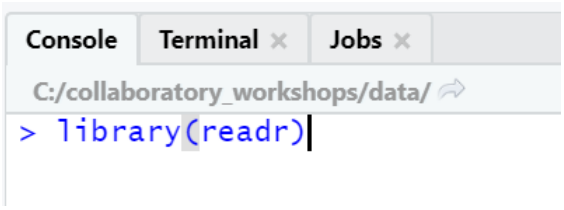
Install R Packages

We need either the readr or rcpp package installed to load a csv (if done by command) so let's install "readr". This will take a few minutes.



Load Installed R Packages

Now we need to load the installed package into R from the /library location.



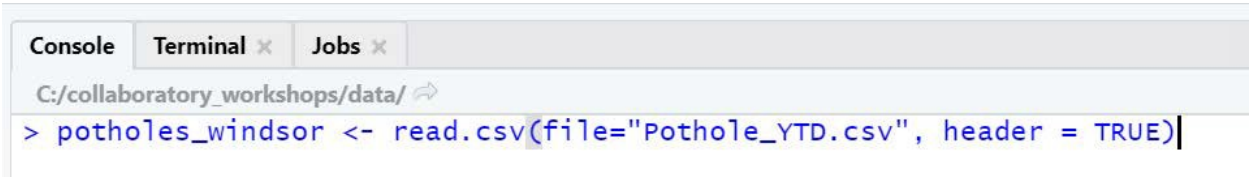
Loading Data in R

Read a file in table format and create a data frame from it.

Note that there are different functions for different data formats.

Note also the argument “header = TRUE” which holds if the file contains the names of the variables as its first line.

Will use a .csv file found here: https://opendata.citywindsor.ca/opendata/details/151.



Viewing the data

To display the data as a spreadsheet in the data viewer window:

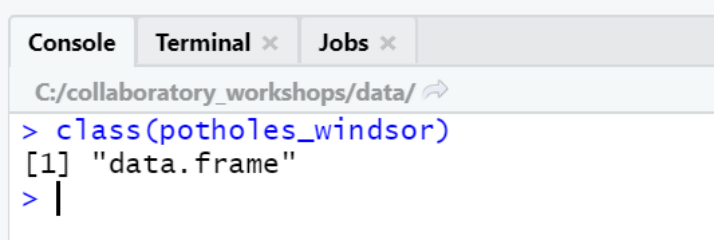
```
> View(potholes_windsor)
>
```

To list just the variables:

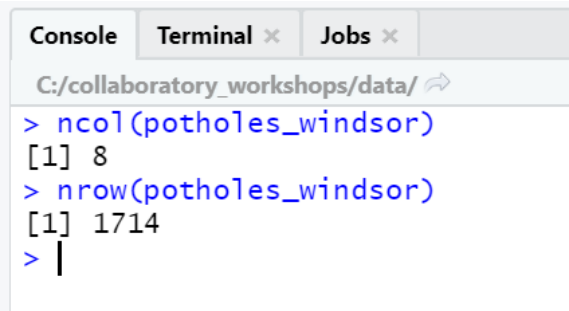
```
> ls(potholes_windsor)
[1] "Block.Address"                "Created.Date"
[3] "Department"                   "Method.Received"
[5] "Service.Request.Description" "Street"
[7] "Sub.Type"                     "Ward"
>
```

OR: potholes$ (variables will display in “environment window”)

To display the class of an object (i.e. data type):

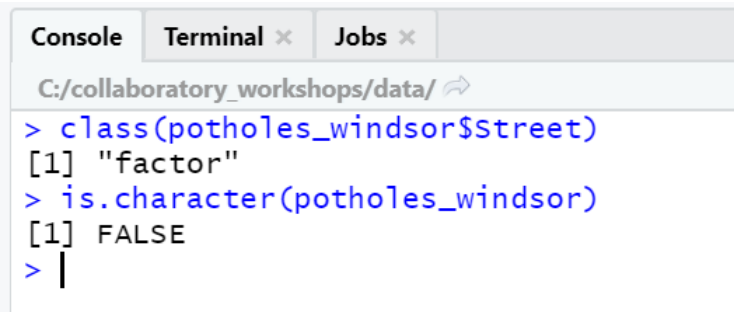


To display number of columns and rows:

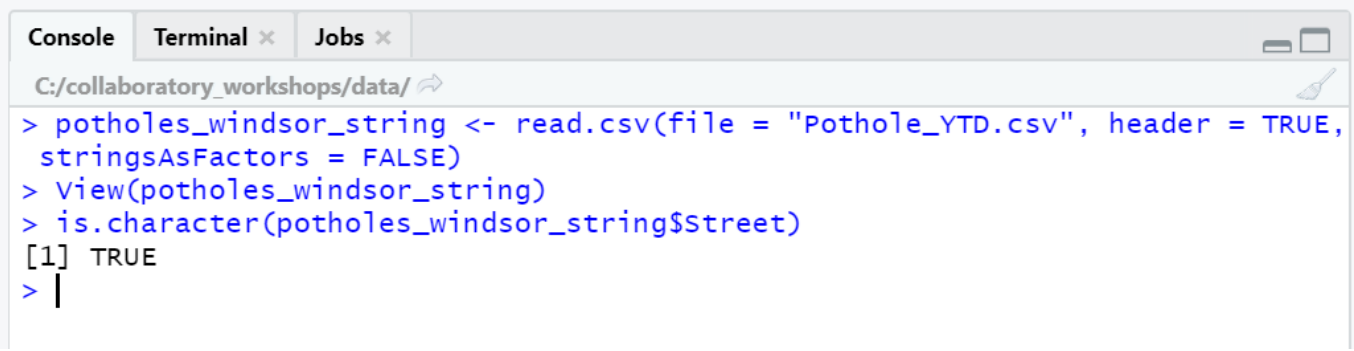


More on Character Variables

Data frames automatically convert character(string) variables to factors – i.e. each unique string variable is assigned a unique number. This becomes problematic when you want to treat string as string. Sometimes a string is just a string!



One solution with this dataset is to re-import it using a stringsAsFactors argument. stringsAsFactors is an argument specific to the data.frame function.



Searching for Patterns of Text

The **grep and grepl** functions use regular expressions (or literal values) as patterns to conduct pattern matching on a character vector.

The **grep** returns indices of matched items or matched items themselves while **grepl** returns a logical vector with TRUE to represent a match **and** FALSE otherwise.

For more sophisticated text data mining you might be interested in checking out the “tm” package.