R literacy for digital soil mapping. Part 1

Soil Security Laboratory

2017

1 Objective

The immediate objective here is to skill up in data analytics and basic graphics with R. The range of analysis that can be completed, and the types of graphics that can be created in R is simply astounding. In addition to the wide variety of functions available in the "base" packages that are installed with R, nearly 10000 contributed packages are available for download, each with its own suite of functions. Some individual packages are the subject of entire books.

For this section of the workshop and the later sections that will deal with digital soil mapping exercises, we will not be able to cover every type of analysis or plot that R can be used for, or even every subtlety associated with each function covered in this entire workshop. Given it's inherent flexibility, I believe R is difficult to master, as one may be able to do with a stand-alone software. It is my belief, that R is a software package one can only increase their knowledge and fluency in. Meaning that, effectively, learning R is a boundless pursuit of knowledge.

In a disclaimer of sorts, this introduction to R borrows many ideas, and structures from the plethora of online materials that are freely available on the internet. Like me, it will be worth your while to do a Google search from time-to-time if you get stuck — you will be amazed to find how many other R users have had the same problems you have or have had.

2 Introduction to R

2.1 R overview and history

R is a software system for computations and graphics. According to the R FAQ (`http://cran.r-project.org/doc/FAQ/R-FAQ.html#R-Basics`):

> *"It consists of a language plus a run-time environment with graphics, a debugger, access to certain system functions, and the ability to run programs stored in script files."*

R was originally developed in 1992 by Ross Ihaka and Robert Gentleman at the University of Auckland (New Zealand). The R language is a dialect of the S language which was developed by John Chambers at Bell Laboratories. This software is currently maintained by the R Development Core Team, which consists of more than a dozen people, and includes Ihaka, Gentleman, and Chambers. Additionally, many other people have contributed code to R since it was first released. The source code for R is available under the GNU General Public Licence, meaning that users can modify, copy, and redistribute the software or derivatives, as long as the modified source code is made available. R is regularly updated, however, changes are usually not major.

2.2 Finding and installing R

R is available for Windows, Mac, and Linux operating systems. Installation files and instructions can be downloaded from the Comprehensive R Archive Network (CRAN) site at `http://cran.r-project.org/`. Although the graphical user interface (GUI) differs slightly across systems, the R commands do not.

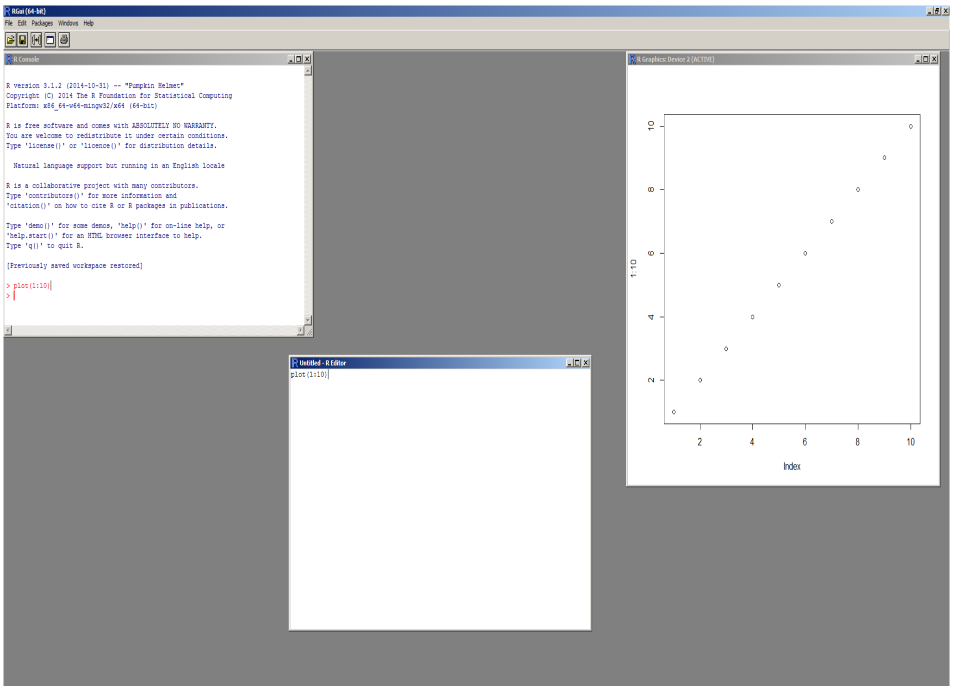
2.3 Running R: GUI and scripts

There are two basic ways to use R on your machine: through the GUI, where R evaluates your code and returns results as you work, or by writing, saving, and then running R script files. R script files (or scripts) are just text files that contain the same types of R commands that you can submit to the GUI. Scripts can be submitted to R using the Windows command prompt, other shells, batch files, or the R GUI. All the code covered in this workshop is or is able to be saved in a script file, which then can be submitted to R. Working directly in the R GUI is great for the early stages of code development, where much experimentation and trial-and-error occurs. For any code that you want to save, rerun, and modify, you should consider working with R scripts.

So, how do you work with scripts? Any simple text editor works—you just need to save text in the ASCII format i.e. "unformatted" text. You can save your scripts and either call them up using the command `source (''file_name.R'')` in the R GUI, or, if you are using a shell (e.g. Windows command prompt) then type `R CMD BATCH file_name.R`. The Windows and Mac versions of the R GUI comes with a basic script editor, shown below in Figure 1.

Unfortunately, this editor is not very good by reason that the Windows version does not have syntax highlighting.

There are some useful (in most cases, free) text editors available that can be set up with R syntax highlighting and other features. TINN-R is a free text editor `http://nbcgib.uesc.br/lec/software/des/editores/tinn-r/en` that is designed specifically for working with R script files. Notepad++ is a general purpose text editor, but includes syntax highlighting and the ability to send code directly to R with the NppToR plugin. A list of text editors that work well with R can be found at:
`http://www.sciviews.org/_rgui/projects/Editors.html`.


RGui (64-bit)
File Edit Packages Windows Help
R Console
Untitled - R Editor
R Graphics: Device 2 (ACTIVE)
1:10
Index

```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditions.
Type 'license()' or 'licence()' for distribution details.

  Natural language support but running in an English locale

R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publications.

Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Previously saved workspace restored]

> plot(1:10)
>
```

```
plot(1:10)
```

Figure 1: R GUI, its basic script editor, and plot window

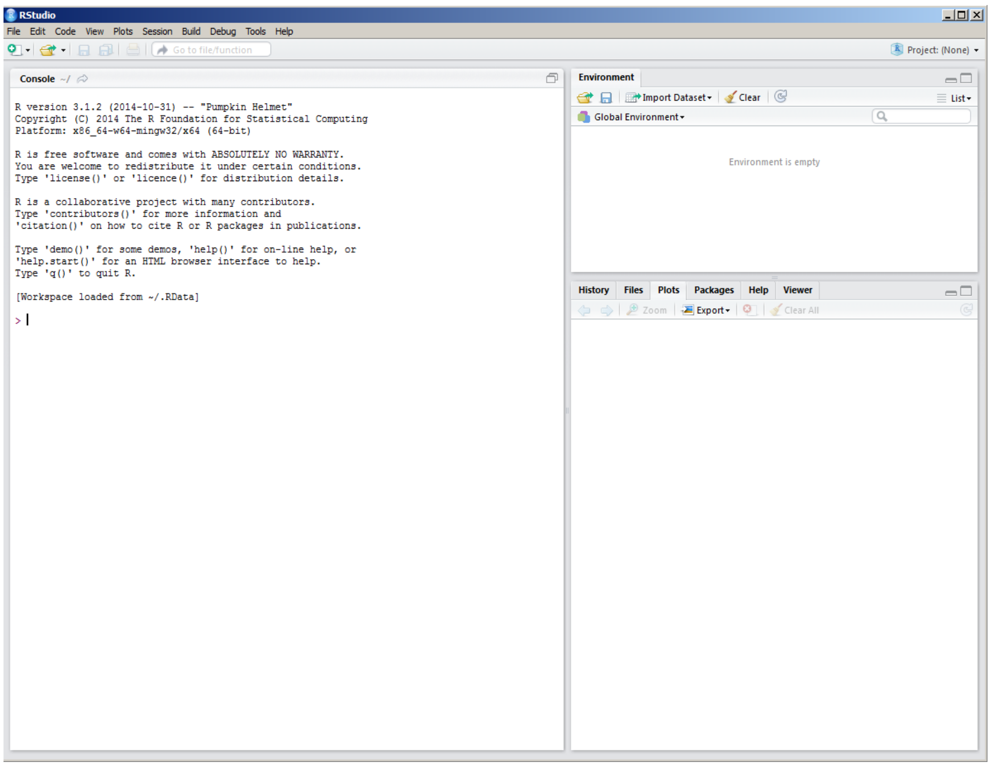
2.4 RStudio

RStudio `http://www.rstudio.com/` is an integrated development environment (IDE) for R that runs on Linux, Windows and Mac OS X. We will be using this IDE during the workshop, generally because it is very well designed, intuitively organized, and quite stable.

When you first launch RStudio, you will be greeted by an interface that will look similar to that in Figure 2.

The frame on the upper right contains the *workspace* (where you will be able see all your R objects), as well of a history of the commands that you have previously entered. Any plots that you generate will show up in the region in the lower right corner. Also in this region is various help documentation, plus information and documentation regarding what packages and function are currently available to use .

The frame on the left is where the action happens. This is the R console. Every time you launch RStudio, it will have the same text at the top of the console telling you the version that is being used. Below that information is the prompt. As the name suggests, this is where you enter commands into R. So lets enter some commands.



```
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"
Copyright (C) 2014 The R Foundation for Statistical Computing
Platform: x86_64-w64-mingw32/x64 (64-bit)

R is free software and comes with ABSOLUTELY NO WARRANTY.
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Type 'demo()' for some demos, 'help()' for on-line help, or
'help.start()' for an HTML browser interface to help.
Type 'q()' to quit R.

[Workspace loaded from ~/.RData]

> |
```

Figure 2: The RStudio IDE

2.5 R basics: commands, expressions, assignments, operators, objects

Before we start anything, it is good to get into the habit of making scripts of our work. With RStudio launched go the the *File* menu, then *new*, and *R Script*. A new blank window will open on the top left panel. Here you can enter your `R` prompts. For example, type the following: `1+1`. Now roll your pointer over the top of the panel to the right pointing green arrow (first one), which is a button for running the line of code down to the `R` console. Click this button and `R` will evaluate it. In the console you should see something like the following:

```
1 + 1
```

```
## [1] 2
```

You could have just entered the command directly into the prompt and gotten the same result. Try it now for yourself. You will notice a couple of things about this code. The > character is the prompt that will always be present in the GUI. The line following the command starts with a `[1]`, which is simply the position of the adjacent element in the output—this will make some sense later.

For the above command, the result is printed to the screen and lost—there is no assignment involved. In order to do anything other than the simplest analyses, you must be able to store and recall data. In R, you can assign the results of commands to symbolic variables (as in other computer languages) using the assignment operator `<-`. Note that other computer scripting languages often use the equals sign (`=`) as the assignment operator. When a command is used for assignment, the result is no longer printed to the GUI console.

```
x <- 1 + 1
x
```

```
## [1] 2
```

Note that this is very different from:

```
x < -1 + 1
```

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

In this case, putting a space between the two characters that make up the assignment operator causes R to interpret the command as an expression that ask if `x` is less than zero. However spaces usually do not matter in R, as long as they do not separate a single operator or a variable name. This, for example, is fine:

```
x <- 1
```

Note that you can recall a previous command in the R GUI by hitting the up arrow on your keyboard. This becomes handy when you are debugging code.

When you give R an assignment, such as the one above, the object referred to as `x` is stored into the R workspace. You can see what is stored in the workspace by looking to the workspace panel in RStudio (top right panel). Alternatively, you can use the `ls` function.

```
ls()
```

```
## [1] "x"
```

To remove objects from your workspace, use `rm`.

```
rm(x)
x
```

As you can see, You will get an error if you try to evaluate what `x` is.

If you want to assign the same value to several symbolic variables, you can use the following syntax.

```
x <- y <- z <- 1
ls()
```

```
## [1] "x" "y" "z"
```

R is a case-sensitive language. This is true for symbolic variable names, function names, and everything else in R.

```
x <- 1 + 1
x
X
```

In R, commands can be separated by moving onto a new line (i.e. hitting enter) or by typing a semicolon (;), which can be handy in scripts for condensing code. If a command is not completed in one line (by design or error), the typical R prompt > is replaced with a +.

```
x<-
+  1+1
```

There are several operators that are used in the R language. Some of the more common are listed below.

Arithmetic

+ - * / ^	plus, minus, multiply, divide, power

Relational

`a == b`	a is equal to b (do not confuse with =)
`a != b`	a is not equal to b
`a < b`	a is less than b
`a > b`	a is greater than b
`a <= b`	a is less than or equal to b
`a >= b`	a is greater than or equal to b

Logical/grouping

`!`	not
`&`	and
|	or

Indexing

`$`	part of a data frame
`[]`	part of a data frame, array, list
`[[]]`	part of a list

Grouping commands

{}	specifying a function, for loop, if statement etc.

Making sequences

`a:b`	returns the sequence a, a+1, a+2, ... b

Others

`#`	commenting (very very useful!)
;	alternative for separating commands
`~`	model formula specification
`()`	order of operations, function arguments

Commands in R operate on objects, which can be thought of as anything that can be assigned to a symbolic variable. Objects include vectors, matrices, factors, lists, data frames, and functions. Excluding functions, these objects are also referred to as data structures or data objects.

When you want to finish up on an R session, RSudio will ask you if you want to "save workspace image". This refers to the workspace that you have created , i.e. all the objects you have created or even loaded. It is generally good practice to save your workspace after each session. More importantly however, is the need to save all the commands that you have created on your script file. Saving a script file in Rstudio is just like saving a Word document. Give both a go—save the script file and then save the workspace. You can then close RStudio.

2.6 R data types

The term "data type" refers to the type of data that is present in a data structure, and does not describe the data structure itself. There are four common types of data in R: numerical, character, logical, and complex numbers. These are referred to as *modes* and are shown below:

Numerical data

```
x <- 10.2
x
```

```
## [1] 10.2
```

Character data

```
name <- "John Doe"
name
```

```
## [1] "John Doe"
```

Any time character data are entered in the R GUI, you must surround individual elements with quotes. Otherwise, R will look for an object.

```
name <- John
## This will throw an error from R
```

Either single or double quotes can be used in R. When character data are read into R from a file, the quotes are not necessary.

Logical data contain only three values: TRUE, FALSE, or NA, (NA indicates a missing value—more on this later). R will also recognize T and F, (for true and false respectively), but these are not reserved, and can therefore be overwritten by the user, and it is therefore good to avoid using these shortened terms.

```
a <- TRUE
a
```

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

Note that there are no quotes around the logical values—this would make them character data. R will return logical data for any relational expression submitted to it.

```
4 < 2
```

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

or

```
b <- 4 < 2
b
```

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

And finally, complex numbers, which will not be covered in this workshop, are the final data type in R

```
cnum1 <- 10 + (0+3i)
cnum1
```

```
## [1] 10+3i
```

You can use the `mode` or `class` function to see what type of data is stored in any symbolic variable.

```
class(name)
```

```
## [1] "character"
```

```
class(a)
```

```
## [1] "logical"
```

```
class(x)
```

```
## [1] "numeric"
```

```
mode(x)
```

```
## [1] "numeric"
```

2.7 R data structures

Data in R are stored in data structures (also known as data objects)—these are and will be the that you perform calculations on, plot data from, etc. Data structures in R include vectors, matrices, arrays, data frames, lists, and factors. In a following section we will learn how to make use of these different data structures. The examples below simply give you an idea of their structure.

Vectors are perhaps the most important type of data structure in R. A vector is simply an ordered collection of elements (e.g. individual numbers).

```
x <- 1:12
x
```

```
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12
```

Matrices are similar to vectors, but have two dimensions.

```
X <- matrix(1:12, nrow = 3)
X
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    4    7   10
## [2,]    2    5    8   11
## [3,]    3    6    9   12
```

Arrays are similar to matrices, but can have more than two dimensions.

```
Y <- array(1:30, dim = c(2, 5, 3))
Y
```

```
## , , 1
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    1    3    5    7    9
## [2,]    2    4    6    8   10
##
## , , 2
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   11   13   15   17   19
## [2,]   12   14   16   18   20
##
## , , 3
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   21   23   25   27   29
## [2,]   22   24   26   28   30
```

One feature that is shared for vectors, matrices, and arrays is that they can only store one type of data at once, be it numerical, character, or logical. Technically speaking, these data structures can only contain elements of the same mode.

Data frames are similar to matrices—they are two-dimensional. However, a data frame can contain columns with different modes. Data frames are similar to data sets used in other statistical programs: each column represents some variable, and each row usually represents an "observation", or "record", or "experimental unit".

```
dat <- (data.frame(profile_id = c("Chromosol", "Vertosol", "Sodosol"),
FID = c("a1", "a10", "a11"),
easting = c(337859, 344059, 347034),
northing = c(6372415, 6376715, 6372740),
visited = c(TRUE, FALSE, TRUE)))

dat
```

```
##   profile_id FID easting northing visited
## 1  Chromosol   a1  337859  6372415    TRUE
## 2   Vertosol a10  344059  6376715   FALSE
## 3    Sodosol a11  347034  6372740    TRUE
```

Lists are similar to vectors, in that they are an ordered collection of elements, but with lists, the elements can be other data objects (the elements can even be other lists). Lists are important in the output from many different functions. In the code below, the variables defined above are used to form a list.

```
summary.1 <- list(1.2, x, Y, dat)
summary.1
```

```
## [[1]]
## [1] 1.2
##
## [[2]]
##  [1]  1  2  3  4  5  6  7  8  9 10 11 12
##
## [[3]]
## , , 1
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    1    3    5    7    9
## [2,]    2    4    6    8   10
##
## , , 2
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   11   13   15   17   19
## [2,]   12   14   16   18   20
##
## , , 3
##
##      [,1] [,2] [,3] [,4] [,5]
## [1,]   21   23   25   27   29
## [2,]   22   24   26   28   30
##
##
## [[4]]
##   profile_id FID easting northing visited
## 1  Chromosol   a1  337859  6372415    TRUE
## 2   Vertosol a10  344059  6376715   FALSE
## 3    Sodosol a11  347034  6372740    TRUE
```

Note that a particular data structure need not contain data to exist. This may seem unusual, but it can be useful when it is necessary to set up an object for holding some data later on.

```
x <- NULL
```

2.8 Missing, indefinite, and infinite values

Real data sets often contain missing values. R uses the marker NA (for "not available") to indicate a missing value. Any operation carried out on an NA will return NA.

```
x <- NA
x - 2
```

```
## [1] NA
```

Note that the NA used in R does not have the quotes around it—this would make it character data. To determine if a value is missing, use the is.na—this function can also be used to set elements in a data object to NA.

```
is.na(x)
```

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

```
!is.na(x)
```

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

Indefinite values are indicated with the marker NaN, for "not a number". Infinite values are indicated with the markers Inf or -Inf. You can find these values with the functions is.infinite, is.finite, and is.nan.

2.9 Functions, arguments, and packages

In R, you can carry out complicated and tedious procedures using functions. Functions require arguments, which include the object(s) that the function should act upon. For example, the function sum will calculate the sum of all of its arguments.

```
sum(1, 12.5, 3.33, 5, 88)
```

```
## [1] 109.83
```

The arguments in (most) R functions can be named, i.e. by typing the name of the argument, an equal sign, and the argument value (arguments specified in this way are also called tagged). For example, for the function plot, the help file lists the following arguments.

```
plot (x, y,...)
```

Therefore, we can call up this function with the following code.

```
a <- 1:10
b <- a
plot(x = a, y = b)
```

With names arguments, R recognizes the argument keyword (e.g. x or y) and assigns the given object (e.g. a or b above) to the correct argument. When using names arguments, the order of the arguments does not matter. We can also use what are called positional arguments, where R determines the meaning of the arguments based on their position.

```
plot(a, b)
```

This code does the same as the previous code. The expected position of arguments can be found in the help file for the function you are working with or by asking `R` to list the arguments using the `args` function.

```
args(plot)

## function (x, y, ...)
## NULL
```

It usually makes sense to use the positional arguments for only the first few arguments in a function. After that, named arguments are easier to keep track of. Many functions also have default argument values that will be used if values are not specified in the function call. These default argument values can be seen by using the `args` function and can also be found in the help files. For example, for the function `rnorm`, the arguments `mean` and `sd` have default values.

```
args(rnorm)

## function (n, mean = 0, sd = 1)
## NULL
```

Any time you want to call up a function, you must include parentheses after it, even if you are not specifying any arguments. If you do not include parentheses, `R` will return the function code (which at times might actually be useful).

Note that it is not necessary to use explicit numerical values as function arguments—symbolic variable names which represent appropriate data structure can be used. it is also possible to use functions as arguments within functions. `R` will evaluate such expressions from the inside outward. While this may seem trivial, this quality makes `R` very flexible. There is no explicit limit to the degree of nesting that can be used. You could use:

```
plot(rnorm(10, sqrt(mean(c(1:5, 7, 1, 8, sum(8.4, 1.2, 7))))), 1:10)
```

The above code includes 5 levels of nesting (the sum of 8.4,1.2 and 7 is combined with the other values to form a vector, for which the mean is calculated, then the square root of this value is taken and used as the standard deviation in a call to `rnorm`, and the output of this call is plotted). Of course, it is often easier to assign intermediate steps to symbolic variables. `R` evaluates nested expressions based on the values that functions return or the data represented by symbolic variables. For example, if a function expects character data for a particular argument, then you can use a call to the function `paste` in place of explicit character data.

Many functions (including `sum`, `plot`, and `rnorm`) come with the `R` “base packages”, i.e. they are loaded and ready to go as soon as you open `R`. These packages contain the most common functions. While the base packages include many useful functions, for specialized procedures, you should check out the content that is available in the add-on packages. The CRAN website currently lists more than 4500 contributed packages that contain functions and data that users have contributed. You can find a list of the available packages at the CRAN website `http://cran.r-project.org/`. During the course of this workshop and described in more detail later on, we will be looking and using a number of specialized packages for application of DSM. Another repository of `R` packages is the R-Forge website `https://r-forge.r-project.org/`. R-Forge offers a central platform for the development of R packages, R-related software and further projects. Packages in R-Forge are not necessarily always on the CRAN website. However, many packages on the CRAN website are developed in R-Forge as ongoing projects. Sometimes to get the latest changes made upon a package, it pays to visit R-Forge first, as the uploading of the revised functions to CRAN is not instantaneous.

To utilize the functions in contributed R packages, you first need to install and then load the package. Packages can be installed via the packages menu in the right bottom panel of RStudio (select the "packages" menu, then "install packages"). Installation could be retrieved from the nearest mirror site (CRAN server location)—you will need to have first selected this by going to the *tools*, then *options*, then *packages* menu where you can then select the nearest mirror site from a suite of possibles. Alternatively, you may just install a package from a local zip file. This is fine, but often when using a package, there are other peripheral packages (or dependencies) that also need to be loaded (and installed). If you install the package from CRAN or a mirror site, the dependency packages are also installed. This is not the case when you are installing packages from zip files—you will also have to manually install all the dependencies too.

Or just use the command:

```
install.packages("package name")
```

where "package name" should be replaced with the actual name of the package you want to install, for example:

```
install.packages("Cubist")
```

This command will install the package of functions for running the Cubist rule-based machine learning models for regression.

Installation is a one-time process, but packages must be loaded each time you want to use them. This is very simple, e.g., to load the package `Cubist`, use the following command.

```
library(Cubist)

## Loading required package:  lattice

## Warning:  package 'lattice' was built under R version
3.2.5
```

Similarly, if you want to install an `R` package from R-Forge (another popular hosting repository for R packages) you would use the following command:

```
install.packages("package name", repos = "http://R-Forge.R-project.org")
```

Other popular repositories for R packages include Github (`https://github.com/`) and BitBucket (`https://bitbucket.org/`). These repositories as well as R-Forge are version control systems that provide a central place for people to collaborate on everything from small to very large projects with speed and efficiency. The companion `R` package to this book, **ithir** is hosted on Bitbucket for example. **ithir** contains most of the data, and some important functions that are covered in this book so that users can replicate all of the analyses contained within. **ithir** can be downloaded and installed on your computer using the following commands:

```r
library(devtools)
install_bitbucket("brendo1001/ithir/pkg")
library(ithir)
```

The above commands assumes your have already installed the devtools package. Any package that you want to use that is not included as one of the ”base” packages, needs to be loaded every time you start `R`. Alternatively, you can add code to the file *Rprofile.site* that will be executed every time you start R.

You can find information on specific packages through CRAN, by browsing to `http://cran.r-project.org/` and selecting the *packages* link. Each package has a separate web page, which will include links to source code, and a pdf manual. In RStudio, you can select the *packages* tab on the lower right panel. You will then see all the package that are currently installed in your `R` environment. By clicking onto any package, information on the various functions contained in the package, plus documentation and manuals for their usage. It becomes quite clear that within this RStudio environment, there is at your fingertips, a wealth of information for which to consult whenever you get stuck. When working with a new package, it is a good idea to read the manual.

To “unload” functions, use the `detach` function:

```r
detach("package:Cubist")
```

For tasks that you repeat, but which have no associated function in `R`, or if you do not like the functions that are available, you can write your own functions. This will be covered a little a bit later on. Perhaps one day you may be able to compile all your functions that you have created into a `R` package for everyone else to use.

2.10 Getting help

It is usually easy to find the answer about specific functions or about `R` in general. There are several good introductory books on `R`. For example, “R for Dummies”, which has had many positive reviews `http://www.amazon.com/R-Dummies-Joris-Meys/dp/1119962846`.You can also find free detailed manuals on the CRAN website. Also, it helps to keep a copy of the “`R` Reference Card”, which demonstrates the use of many common functions and operators in 4 pages http://cran.r-project.org/doc/contrib/Short-refcard.pdf. Often a Google search https://www.google.com.au/ of your problem can be a very helpful and fruitful exercise. To limit the results to R related pages, adding "cran" generally works well. R even has an internet search engine of sorts called *rseek*, which can be found at http://rseek.org/—it is really just like the Google search engine, but just for R stuff!

Each function in R has a help file associated with it that explains the syntax and usually includes an example. Help files are concisely written. You can bring up a help file by typing ? and then the function name.

```
`?`(cubist)
```

This will bring up the help file for the cubist function in the help panel of RStudio. But, what if you are not sure what function you need for a particular task? How can you know what help file to open? In addition to the sources given below, you should try help.search(''keyword'') or ??keyword, both of which search the R help files for whatever keyword you put in.

```
`?`(`?`(polygon))
```

This will bring up a search results page in the help panel of RStudio of all the various help files that have something to do with polygon. In this case, i am only interested in a function that assesses whether a point is situated with a polygon. So looking down the list, one can see (provided the "SDMTools" package is installed) a function called pnt.in.poly. Clicking on this function, or submitting ?pnt.in.poly to R will bring up the necessary help file.

There is an R help mailing list http://www.r-project.org/mail.html, which can be very helpful. Before posting a question, be sure to search the mailing list archives, and check the posting guide http://www.r-project.org/posting-guide.html.

One of the best sources of help on R functions is the mailing list archives (http://cran.r-project.org/, then select "search", then "searchable mail archives"). Here you can find suggestions for functions for particular problems, help on using specific functions, and all kinds of other information. A quick way to search the mailing list archives is by entering:

```
RSiteSearch("A Keyword")
```

For one more trick, to search for objects (including functions) that include a particular string, you can use the apropos function:

```
apropos("mean")
```

```
##  [1] ".colMeans"    ".rowMeans"    "colMeans"     "kmeans"
##  [5] "mean"         "mean.Date"    "mean.default" "mean.difftime"
##  [9] "mean.POSIXct" "mean.POSIXlt" "rowMeans"     "weighted.mean"
```

2.11 Exercises

1. You can use for magic tricks: Pick any number. Double it, and then add 12 to the result. Divide by 2, and then subtract your original number. Did you end up with 6.0?
2. If you want to work with a set of 10 numbers in R, something like this:

   11 8.3 9.8 9.6 11.0 12.0 8.5 9.9 10.0 11.0

   - What type of data structure should you use to store these in R?
   - What if you want to work with a data set that contains site names, site locations, soil categorical information, soil property information, and some terrain variables—what type of data structure should you use to store these in R?
3. Install and load a package—take a look at the list of available packages, and pick one. To make sure you have loaded it correctly, try to run an example from the package reference manual. Identify the arguments required for calling up the function. Detach the package when you are done.
4. Assign your full name to a variable called `my.name`. Print the value of `my.name`. Try to subtract 10 from `my.name`. Finally determine the type of data stored in `my.name` and 10 using the `class` function. If you are unsure of what `class` does, check out the help file.
5. You are interested in seeing what functions R has for fitting variograms (or some other topic of your choosing). Can you figure out how to search for relevant functions? Are you able to identify a function or two that may do what you want.