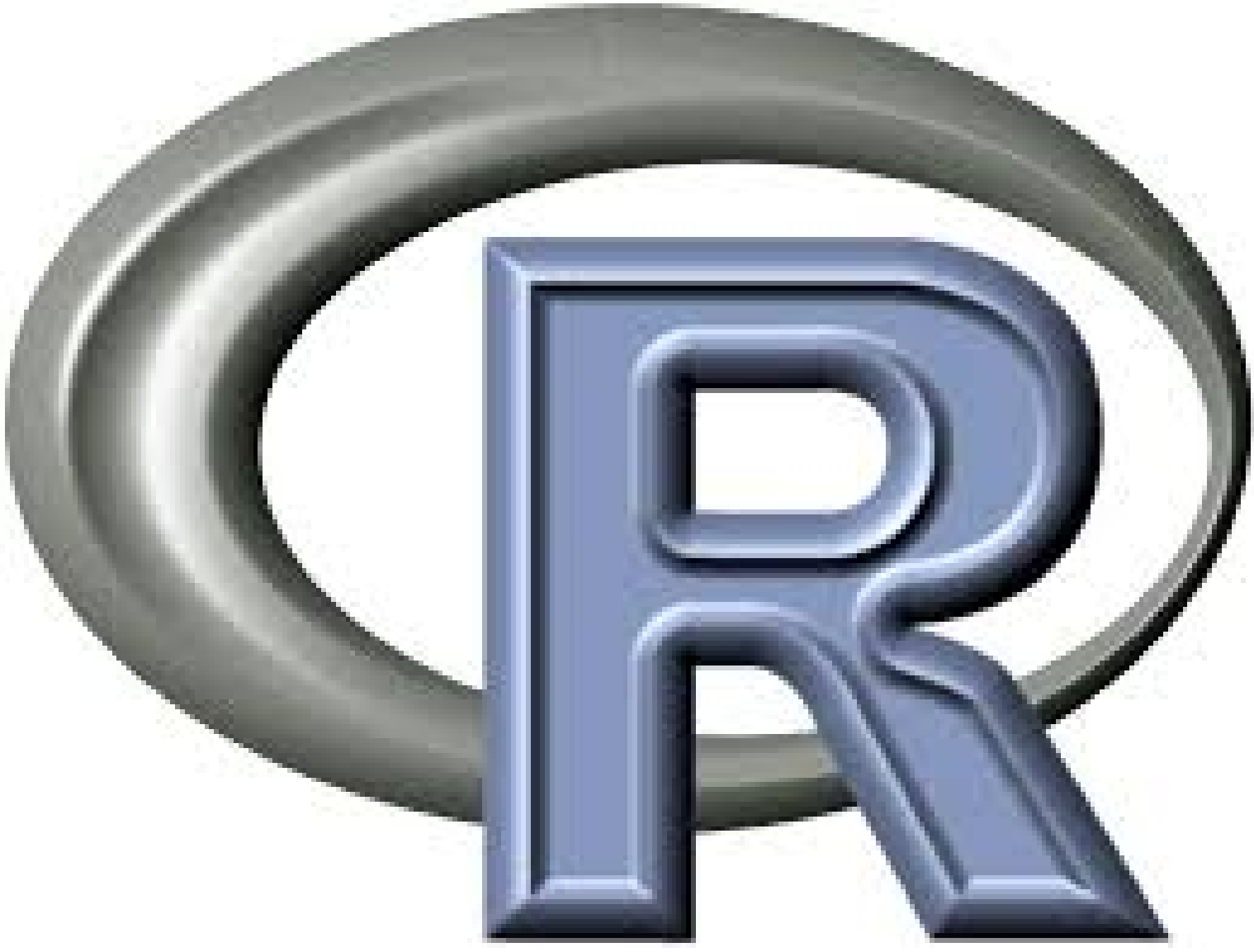


Introduction to R

Introduction to R

Source: R project website (http://www.r-project.org)

- R is a language and environment for statistical computing and graphics. It is a GNU project which is similar to the S language and environment which was developed at Bell Laboratories (formerly AT&T, now Lucent Technologies) by John Chambers and colleagues.
- R can be considered as a different implementation of S. There are some important differences, but much code written for S runs unaltered under R.

What is R?

- R provides a wide variety of statistical (linear and nonlinear modelling, classical statistical tests, time-series analysis, classification, clustering, ...) and graphical techniques, and is highly extensible. The S language is often the vehicle of choice for research in statistical methodology, and R provides an Open Source route to participation in that activity.
- One of Rs strengths is the ease with which well-designed publication-quality plots can be produced, including mathematical symbols and formulae where needed.
- Great care has been taken over the defaults for the minor design choices in graphics, but the user retains full control.
- R is available as Free Software under the terms of the Free Software Foundations GNU General Public License in source code form. It compiles and runs on a wide variety of UNIX platforms and similar systems (including FreeBSD and Linux), Windows and MacOS.

R is a programming environment that

- uses a well-developed but simple programming language
- allows for rapid development of new tools according to user demand
- these tools are distributed as packages, which any user can download to customize the R environment.

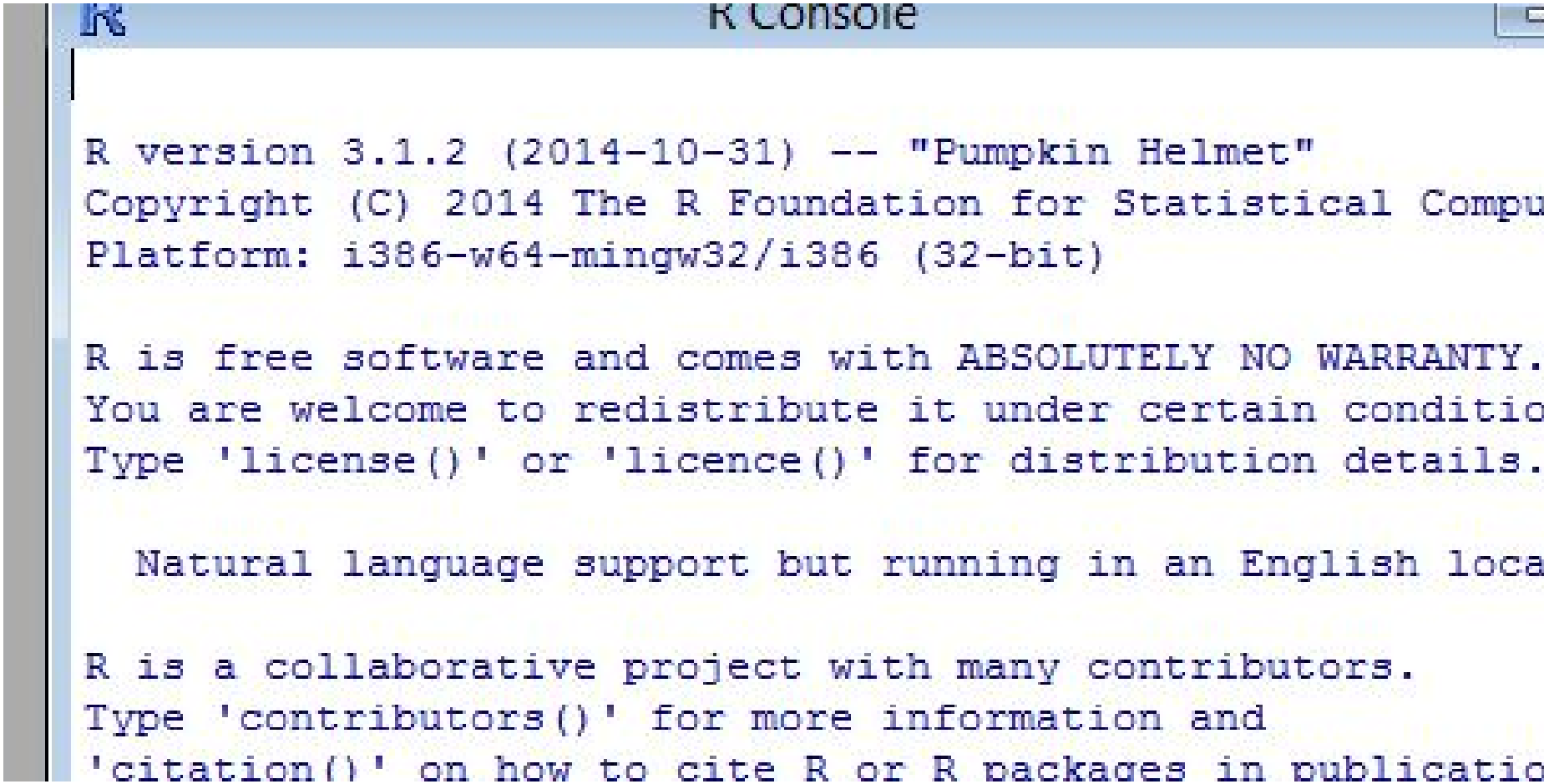
Comprehensive R Archive Network

- Base R and most R packages are available for download from the Comprehensive R Archive Network (CRAN) cran.r-project.org.
- Base R comes with a number of basic data management, analysis, and graphical tools
- Rs power and flexibility, however, lie in its array of packages (currently more than 6,000!)

Introduction to R

1.1 Installing R

- R is very easily installed by downloading it from the CRAN website. Installation usually takes about 2 minutes.
- When Installation of R is complete, the distinctive R Icon will appear on your desktop. To start R, simply click this Icon.
- It is common to re-install R once a year or so. The current version of R, version 3.1.2 was released quite recently.


R Console
R version 3.1.2 (2014-10-31) -- "Pumpkin Helmet"
Copyright (C) 2014 The R Foundation for Statistical Compu
Platform: i386-w64-mingw32/i386 (32-bit)
R is free software and comes with ABSOLUTELY NO WARRANTY.
You are welcome to redistribute it under certain conditio
Type 'license()' or 'licence()' for distribution details.
Natural language support but running in an English loca
R is a collaborative project with many contributors.
Type 'contributors()' for more information and
'citation()' on how to cite R or R packages in publicatio

1.2 Command Line Interface

- When you start `R`, the command line interface window will appear on screen. This is one of many windows in the `R` environment, others including graphical output windows, or script editors.
- `R` code can be entered into the command line directly.
- Alternatively code can be saved to a script, which can be run inside a session using the `source()` function.

1.3 The Assignment operator

- The assignment operator is used to assign names to particular values.
- Historically the assignment operator was) a “<-.
- The assignment operator can also be the equals sign ”=”. (This is valid as of R version 1.4.0.)
- Both will be used, although, you should learn one and stick with it. Many long term R users prefer the arrow approach.

1.3 The Assignment operator

You can also use -¿ as an assignment operator, reversing the usual assignment positions. (This is actually really useful). Commands are separated either by a semi colon or by a newline.

```
>
> a <- 6
> b = 5
> a + b -> c
> c
[1] 11
>
> e=7;f<-5;g=sqrt(c)
>
> # Broke a Rule!!
> |
```

1.3 The Assignment operator

The Up and Down Keys

- Before we continue, try using the up and down keys, and see what happens.
- Previously typed commands are re-presented, and can be re-executed.

1.3 The Assignment operator

objects

- R stores both data and output from data analysis (as well as everything else) in **objects**.
- The variables we have created so far are objects.
- A list of all objects in the current session can be obtained with `ls()`.

1.3.1 Reserved Words - Bad names for Objects

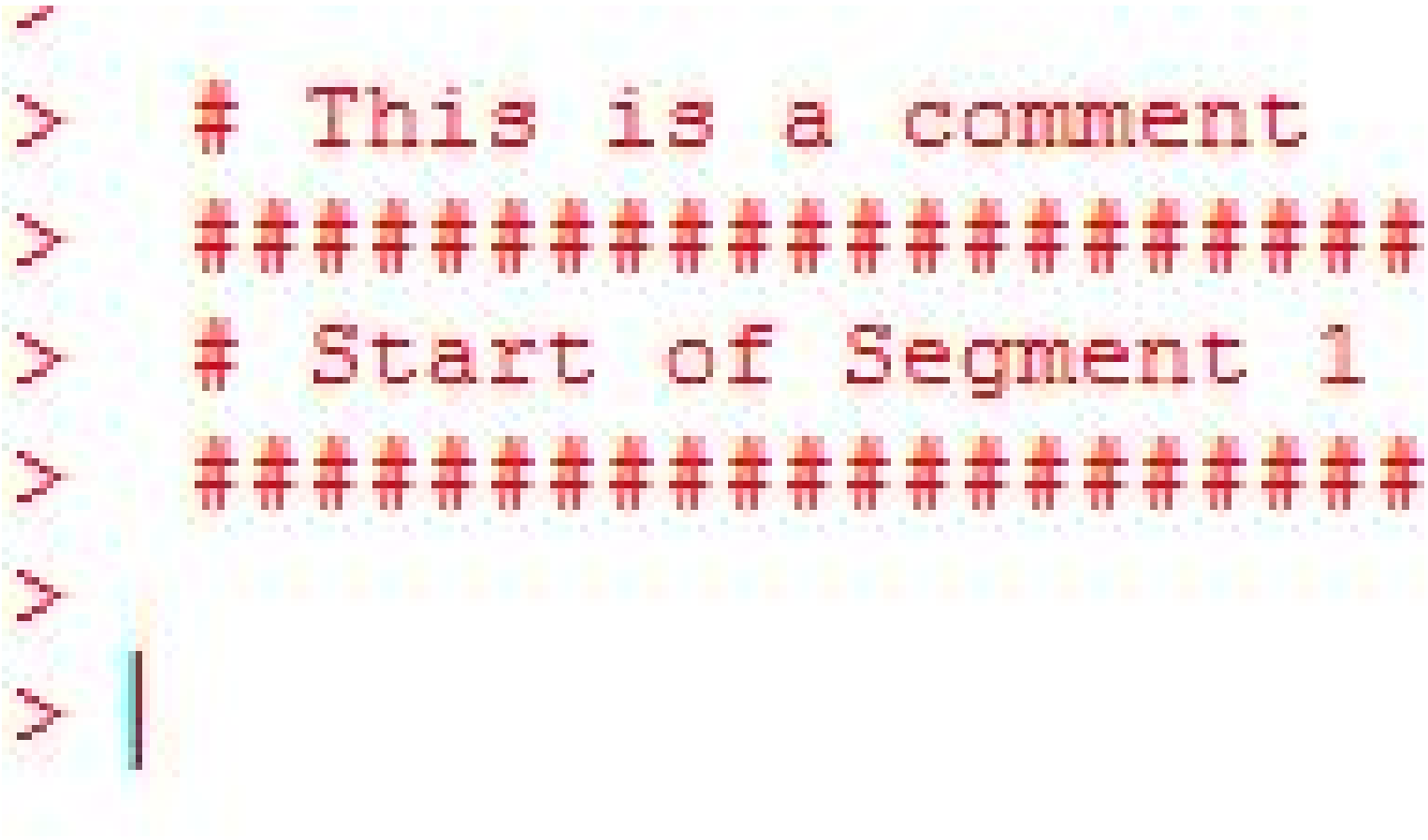
- Some names are used by the system, e.g.T, F,q,c etc .
- Avoid using these.
- Also avoide using command names like **mean** and **sum**

```
>
>
> as.character(X)
[1] "4" "5" "6" "7"
> as.factor(X)
[1] 4 5 6 7
Levels: 4 5 6 7
>
```

```
>  X <- c(4,5,6,7)
>  mode(X)
[1] "numeric"
>  class(X)
[1] "numeric"
>
> Y <- c(4L,5L,6L,7L)
> mode(Y)
[1] "numeric"
> class(Y)
[1] "integer"
>
```

1.4 Commenting

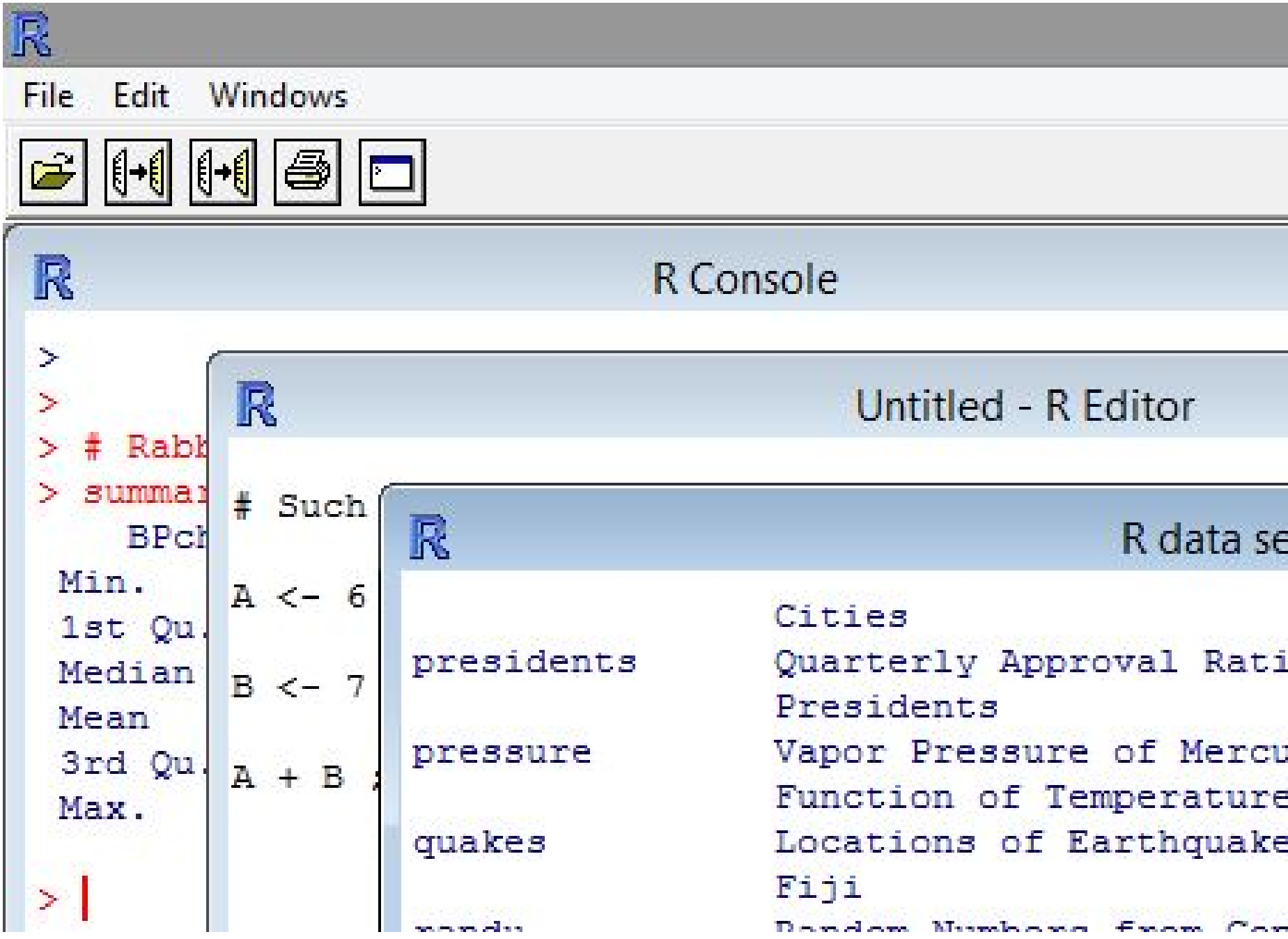
For the sake of readability, it is good practice to comment code. The # character at the beginning of a line signifies a comment, which is not executed. Lines of hashtags can be used to identify the beginning and end of code segments

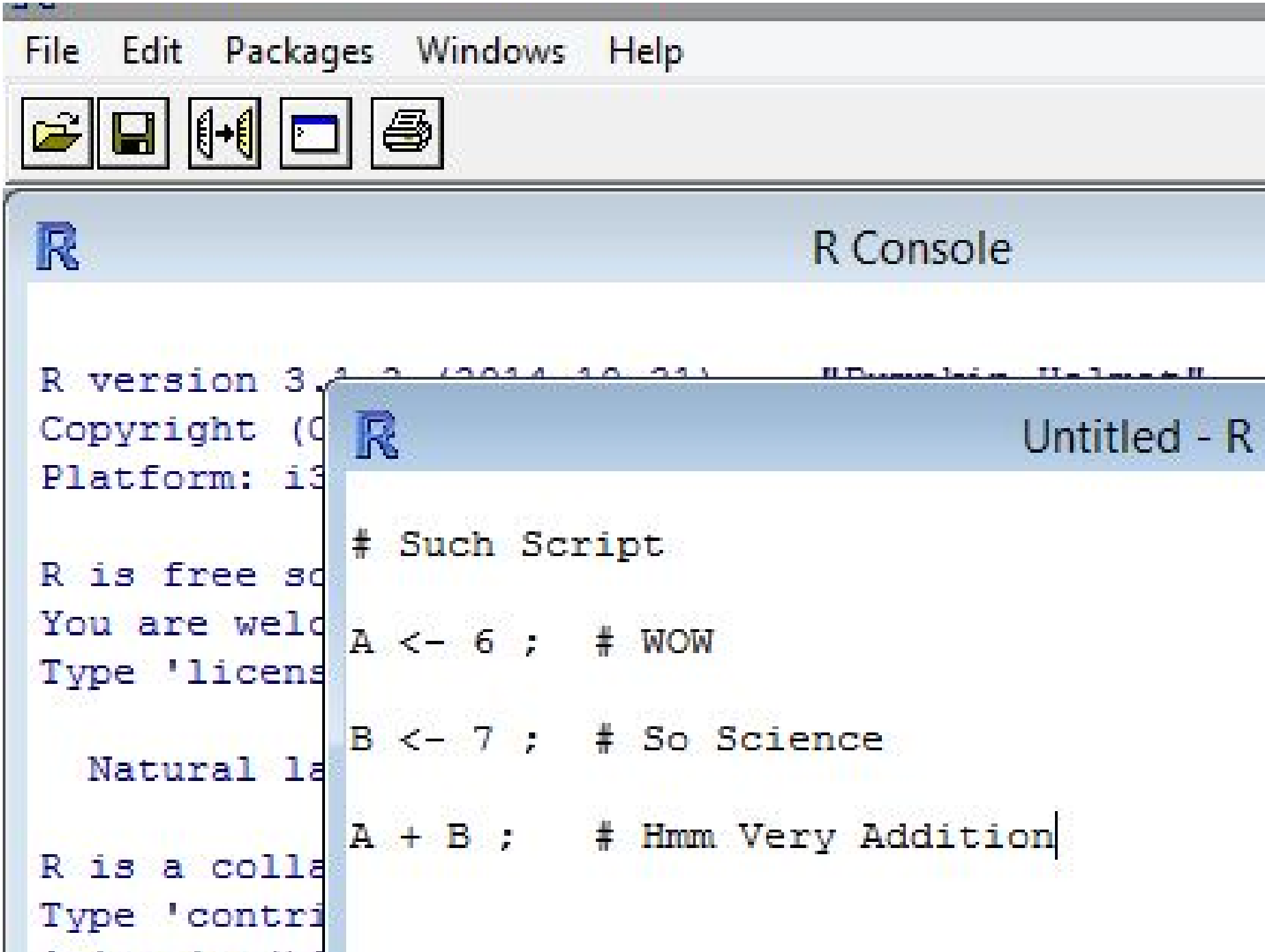


1.5 Defining and Naming Variables

- A convention is to use define a variable name with a capital letter (R is case sensitive).
- This reduces the chance of overwriting in-build R functions, which are usually written in lowercase letters.
- Commonly used variable names such as x,y and z (in lower case letters) are not reserved.

```
 camelCase
variableName
 AlsoCamelCase
```


File Edit Windows
R Console
>
>
> # Rabb
> summa
BPch
Min.
1st Qu.
Median
Mean
3rd Qu.
Max.
>
Untitled - R Editor
# Such
A <- 6
B <- 7
A + B ;
R data se
Cities
presidents
Quarterly Approval Rati
Presidents
pressure
Vapor Pressure of Mercu
Function of Temperature
quakes
Locations of Earthquake
Fiji


File Edit Packages Windows Help
R Console
R version 3
Copyright (C
Platform: i3
R is free so
You are welc
Type 'licens
Natural la
R is a colla
Type 'contri
Untitled - R
# Such Script
A <- 6 ; # WOW
B <- 7 ; # So Science
A + B ; # Hmm Very Addition

1.6 Help Functions

- Help files for R functions are accessed by preceding the name of the function with ? (e.g. ?sort).
- Alternatively you can use the command `help()` (e.g. help(sqrt))

1.6 Help Functions

- A HTML document appears on screen with information on the function typed in.
- As well as the list of arguments that the particular function accepts, and how to specify them, there is example code at the bottom of the file.
- These code segments are often invaluable in learning how to master the function.

```
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]

> 
```

1.7 The `help.start()` command

As mentioned by the text on the main console, the `help.start()` command can be usd to access detailed help documentation that comes as part of the installation.

1.8 Basic Maths Operations

The most commonly used mathematical operators are all supported by R.
Here are a few examples:

$5 + 3 * 5$	Note the order of operations.
log (10)	Natural logarithm with base e=2.718282
log(8,2)	Log to the base 2
4^2	4 raised to the second power
7/2	Division
factorial(4)	Factorial of Four
sqrt (25)	Square root
abs (3-7)	Absolute value of 3-7
pi	The mysterious number
exp(2)	exponential function

R can be used for many mathematical operations, including

- Set Theory
- Trigonometry
- Complex Numbers
- Binomial Coefficients

Set Theory is always useful to know. We will not go into any of the others in great detail today.

1.9 Basic R Editor

R has an inbuilt script editor. We will use it for this class, but there are plenty of top quality Integrated Development Environments out there. (Read up about RStudio for example). For a while, we will use the in-built script editor. Although it is advisable to start using Rstudio or something similar.

To start a new script, or open an existing script simply go to File and click the appropriate options. A new dialogue box will appear. You can write and edit code using this editor. To pass the code for compiling , press the run line or selection option (The third icon on the menu).

Another way to read code is to use the edit() function , which operates directly from the command line. To see how the code defining an object X was written (or more importantly, could have been written) simply type `edit(X)`. This command has some useful applications that we will see later on.

Script Files

- Scripts are saved as `.R` files.
- These scripts can be called directly using the `source()` command.

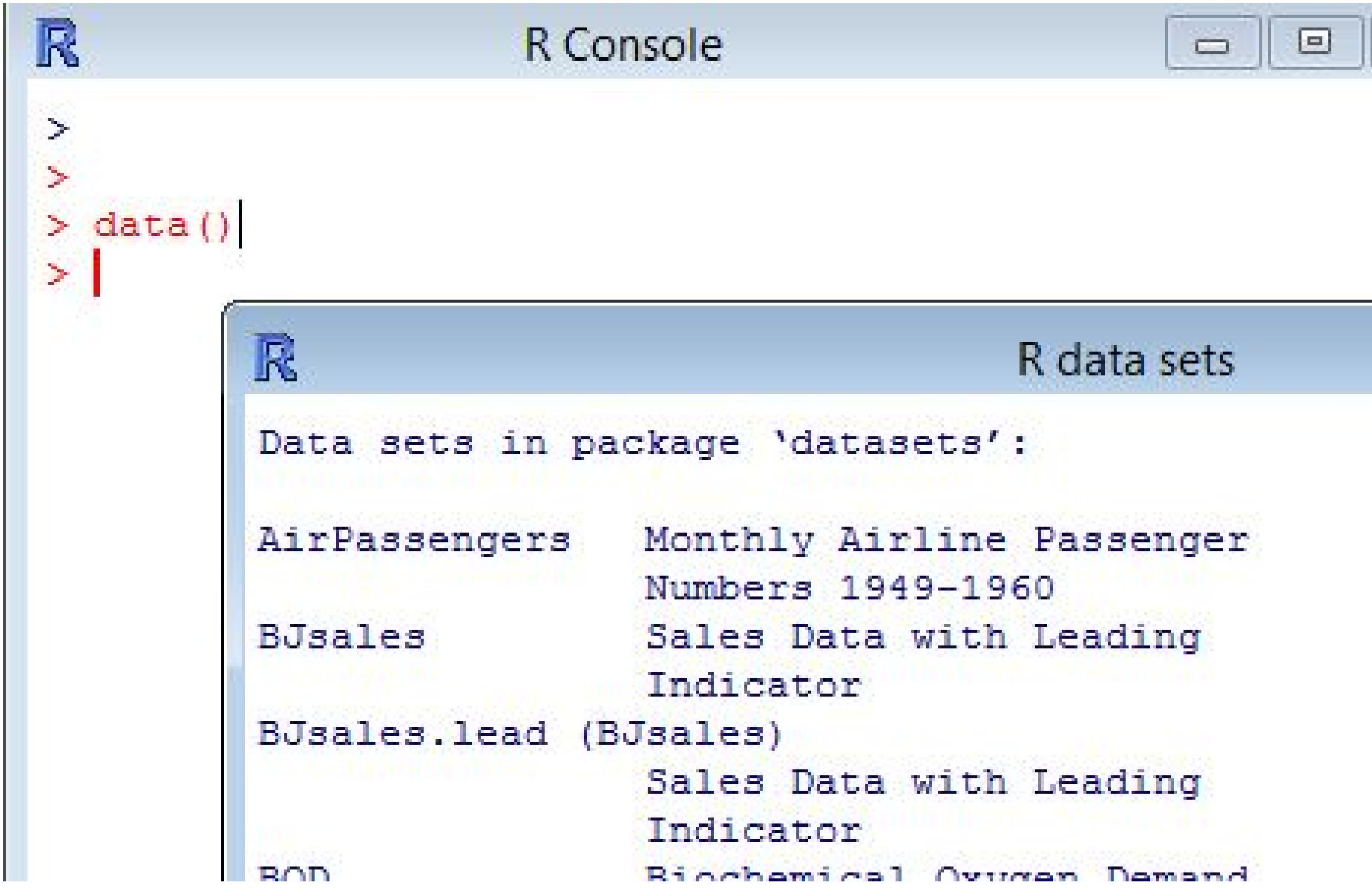
Introduction to R

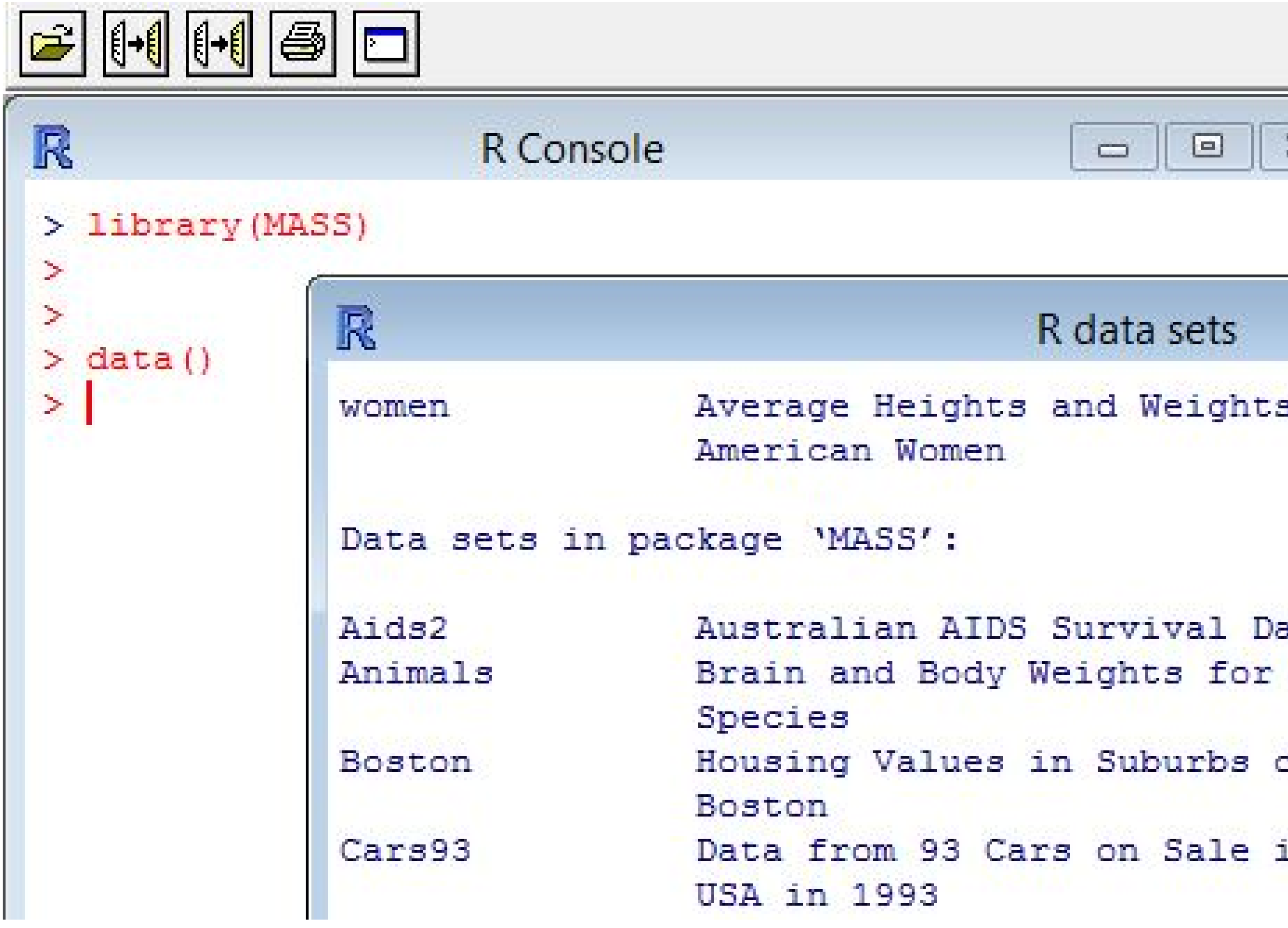
1.10 Built-In Data Sets

Inbuilt Data Sets

Several data sets , intended as learning tools, are automatically installed when R is installed. Many more are installed within packages to complement learning to use those packages. One of these is the famous Iris data set, which is used in many data mining exercises.

- iris
- mtcars
- Nile


R Console
>
>
> data()
>
R data sets
Data sets in package 'datasets':
AirPassengers Monthly Airline Passenger
Numbers 1949-1960
BJsales Sales Data with Leading
Indicator
BJsales.lead (BJsales)
Sales Data with Leading
Indicator


R Console
> library(MASS)
>
>
> data()
>
R data sets
women Average Heights and Weights
American Women
Data sets in package 'MASS':
Aids2 Australian AIDS Survival Da
Animals Brain and Body Weights for
Species
Boston Housing Values in Suburbs c
Boston
Cars93 Data from 93 Cars on Sale i
USA in 1993

- To see what data sets are available, simply type `data()`.
- To load a data set, simply type in the name of the data set. Some data sets are very large.
- To just see the first few (or last) rows, we use the `head()` function or alternatively the `tail()` function.
- The default number of rows of these commands is 6. Other numbers can be specified.

R Console

```
>
> head(iris)
  Sepal.Length Sepal.Width Petal.Length Petal.Width Spec
1          5.1         3.5          1.4         0.2  set
2          4.9         3.0          1.4         0.2  set
3          4.7         3.2          1.3         0.2  set
4          4.6         3.1          1.5         0.2  set
5          5.0         3.6          1.4         0.2  set
6          5.4         3.9          1.7         0.4  set
>
```

```
> tail(iris)
    Sepal.Length Sepal.Width Petal.Length Petal.Width
145          6.7         3.3          5.7         2.5
146          6.7         3.0          5.2         2.3
147          6.3         2.5          5.0         1.9
148          6.5         3.0          5.2         2.0
149          6.2         3.4          5.4         2.3
150          5.9         3.0          5.1         1.8
>
```

- In many situations, it is useful to call a particular data set using the `attach()` command. This will save having to specify the data sets over repeated operations.
- The file can then be detached using the `detach()` command.

1.11 The summary() command

The R command summary() is a generic function used to produce result summaries of the results of various objects, from simple vectors to the output of complex model fitting functions. The function invokes particular methods which depend on the class of the first argument. ¿ summary(Nile) Min. 1st Qu. Median Mean 3rd Qu. Max. 456.0 798.5 893.5 919.4 1032.0 1370.0

```
>
>
> # Rabbit Data Set in MASS Package
> summary(Rabbit)
    BPchange          Dose              Run       Treatment   Anim
 Min.   : 0.50   Min.   :  6.25   C1     : 6   Control:30   R1:1
 1st Qu.: 1.65   1st Qu.: 12.50   C2     : 6   MDL    :30   R2:1
 Median : 4.75   Median : 37.50   C3     : 6                R3:1
 Mean   :11.22   Mean   : 65.62   C4     : 6                R4:1
 3rd Qu.:20.50   3rd Qu.:100.00   C5     : 6                R5:1
 Max.   :37.00   Max.   :200.00   M1     : 6
                                  (Other):24
> |
```

```
>
>
> names(iris)
[1] "Sepal.Length" "Sepal.Width"  "Petal.Length"
[4] "Petal.Width"  "Species"
>
> class(iris)
[1] "data.frame"
>
> mode(iris)
[1] "list"
>
```

```
> summary(iris)
  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300
 Median :5.800   Median :3.000   Median :4.350   Median :1.300
 Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
 3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
 Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
       Species
 setosa    :50
 versicolor:50
 virginica :50
```

1.12 Working directories

- You can change your working directly by using the appropriate options on the File menu.
- To determine the current working directory, you can use the `getwd()` command.
- To change the working directory , we would use the `setwd()` command.
- This is quite important as objects will be imported and exported to and from the specified directory.

```
>
> getwd()
[1] "C:/Users/Kevin/Documents"
>
> setwd("C:/Users/Kevin/Documents/Github")
>
> getwd()
[1] "C:/Users/Kevin/Documents/Github"
>
>
```

1.13 Coming Unstuck

- If you are having trouble with a piece of code that is currently compiling , all you have to do is press ESC, just like many other computing environments.

1.14 Quitting the R environment

As the front page text indicates, all you have to do to quite the workspace is to type in `q()`. You will then be prompted to save your work.

1.15 Data Objects

As mentioned previously, R saves data as **objects**. Examples of data objects are

- Vectors
- Lists
- Dataframes
- Matrices

The simple objects we have created previously are simply single element vectors.

1.16 Listing all items in a workspace

To list all items in an R environment, we use the `ls()` function. This provides a list of all data objects accessible. Another useful command is `objects()`.

```
>
> ls()
 [1] "a"         "alt"       "bp"        "Charvec"  "co2
 [6] "dyp"       "limits"    "lp"        "msleep"   "mtc
[11] "Numvec"    "p"         "sumd"      "X"        "X1"
[16] "X2"        "Y"
>
```

1.17 Removing items

- Sometimes it is desirable to save a subset of your workspace instead of the entire workspace.
- One option is to use the `rm()` function to remove unwanted objects right before exiting your R session; another possibility is to use the `save()` function.

1.18 Saving and Loading R Data Objects

In situations where a good deal of processing must be used on a raw dataset in order to prepare it for analysis, it may be prudent to save the R objects you create in their internal binary form. One attractive feature of this scheme is that the objects created can be read by R programs running on different computer architectures than the one on which they were created, making it very easy to move your data between different computers. Each time an R session is completed, you are prompted to save the workspace image, which is a binary file called .RData in the working directory.

Whenever R encounters such a file in the working directory at the beginning of a session, it automatically loads it making all your saved objects available again. So one method for saving your work is to always save your workspace image at the end of an R session. If you would like to save your workspace image at some other time during your R session, you can use the save.image() function, which, when called with no arguments, will also save the current workspace to a file called .RData in the working directory.

Introduction to R (Continued)

2.1 Three particularly useful commands

- `help()`
- `summary()`
- `help.start()`

2.2 Changing GUI options

- We can change the GUI options using the GUI preferences option on the Edit menu.
- (Important when teaching R)
- A demonstration will be done in class.

2.3 Colours

- R supported a massive number of colours.
- Type in colours() (or colors()) to see what colours are supported.

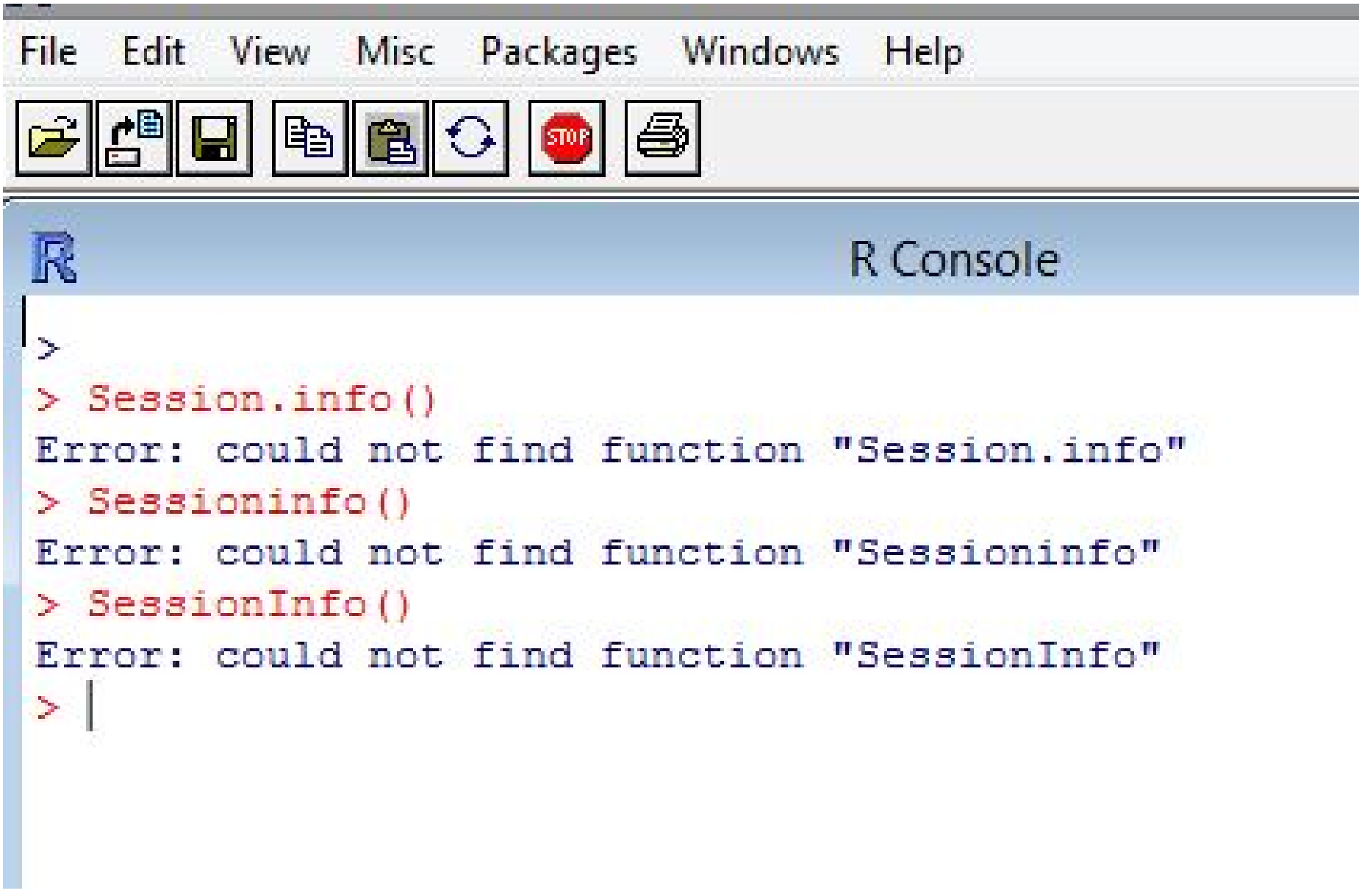
```
>
> colours()
  [1] "white"                "aliceblue"
  [3] "antiquewhite"         "antiquewhite1"
  [5] "antiquewhite2"        "antiquewhite3"
  [7] "antiquewhite4"        "aquamarine"
  [9] "aquamarine1"          "aquamarine2"
 [11] "aquamarine3"          "aquamarine4"
 [13] "azure"                "azure1"
 [15] "azure2"               "azure3"
 [17] "azure4"               "beige"
 [19] "bisque"               "bisque1"
 [21] "bisque2"              "bisque3"
```

2.4 Use of the Semi-Colon Operator

- The semi-colon operator at the end of each line of code is not necessary in general, but using it overcomes errors due to copying and pasting from document soft copies.
- It is also useful for compacting multiple short statements onto a single line.
- In other programming languages, such as Octave, using the semicolon in this way has a distinct purpose.

2.5 The `apropos()` Function

- This function is very useful for determining what functions are available for a particular topic, although the process requires a great deal of trial and error.
- Suppose we are looking for a command to print out the session information.
- We would use a very short string (e.g. **essio**) that would plausibly be part of useful function names.


File Edit View Misc Packages Windows Help
STOP
R Console
>
> Session.info()
Error: could not find function "Session.info"
> Sessioninfo()
Error: could not find function "Sessioninfo"
> SessionInfo()
Error: could not find function "SessionInfo"
>

```
>
> apropos("essio")
[1] ".__C__expression"          "as.expression"
[3] "as.expression.default"     "expression"
[5] "is.expression"             "sessionInfo"
[7] "setSessionTimeLimit"
>
```

2.6 History

- The command `history()` is used to obtain the last 25 commands used by `R`.
- 25 is the default number, you can specify another number.

R Console

```
>
>
> history()
>
```

R History

```
Dynamite plots
==============
class: small-code
```{r}
dyp <- ggplot(sumd, aes(x=conservation, y=awake))
```
```{r echo=FALSE}
dyp <- dyp +
labs(x="Conservation", y="Awake")+
theme(axis.title=element_text(face="bold", size=2
axis.text=element_text(size=20, color="black"))
```
```

2.7 The `sessionInfo()` Function

To get a description of the version of R and its attached packages used in the current session, we can use the `sessionInfo()` function

```
> sessionInfo()
R version 3.1.2 (2014-10-31)
Platform: i386-w64-mingw32/i386 (32-bit)

locale:
[1] LC_COLLATE=English_Ireland.1252  LC_CTYPE=English_Ireland.
[3] LC_MONETARY=English_Ireland.1252 LC_NUMERIC=C
[5] LC_TIME=English_Ireland.1252

attached base packages:
[1] stats     graphics  grDevices utils     datasets  methods
[7] base

loaded via a namespace (and not attached):
 [1] colorspace_1.2-4 digest_0.6.8     ggplot2_1.0.0
 [4] grid_3.1.2       gtable_0.1.2     MASS_7.3-35
```

2.8 Time and date functions

The commands Sys.time() and Sys.Date() returns the systems idea of the current date with and without time. We can perform some simple algebraic calculations to compute time differences (i.e. to find out how long some code took to compile.

System Time

```
> X1=Sys.time()
> #wait a few seconds
>
> X2=Sys.time()
>
> X2-X1
Time difference of 12.52164 secs
> X2
[1] "2015-03-06 19:11:41 GMT"
> X1
[1] "2015-03-06 19:11:28 GMT"
>
```

2.9 Logical States

- Logical states TRUE and FALSE are simply specified as such, all in capital letters.
- The shortcuts T and F are also recognized

2.10 Missing Data

- In some cases the entire contents of a vector may not be known. For example, missing data from a particular data set.
- A place can be reserved for this by assigning it the special value NA. NA is a logical constant of length 1 which contains a missing value indicator.
- NA stands for Not Available.

2.11 Files in the Working Directory

It is possibel to call an R script from the working directory, using the `source()` function.

```
source("myfunctions.r")
source("mydata.r")
```

We can also send code put directly to a file in the working directory, using the sink() command. The first time the command is used, the name of the created file is specified. Subsequent commands print output directly to this file, until the command is used again to cease the operation.

```
>
> sink("IrisSum.txt")
> summary(iris)
> sink()
>
>
```

Section 3 : Inspecting a Data Set

Section 3 - Inspecting a Data Set

Section 3 Inspecting a Data Set

Summary of useful commands

- `dim()` and `length()`
- `nrow()` and `ncol()`
- `names()`
- `summary()`
- `tail()`
- `head()`
- `describe()` (from the **psych** package)

3.1 Dimensions of a data set

- We have remarked that some data sets are very large.
- This is perhaps a good place to consider summary information about data objects.
- For a simple vector, a useful command to determine the length (remark: sample size) is the function `length()`.

```
¿ Y=4:18 ¿ length(Y) [1] 15
```

For more complex data sets (and data frames which we will see later) , we have several tools for assessing the size of data.

```
>
>
> dim(iris) # dimensions of data set
[1] 150   5
>
> nrow(iris) # number of rows
[1] 150
>
>
> ncol(iris) # number of columns
[1] 5
>
```

Column (Variable) names and Row names

- We can also determine the row names and column names using the functions `rownames()` and `colnames()`.
- If there are no specific row or column names, the command will just return the indices.

```
>
> colnames(iris)
[1] "Sepal.Length" "Sepal.Width"  "Petal.Length"
[4] "Petal.Width"  "Species"
>
```

3.2 The `summary()` command

- The command `summary()` is one of the most useful commands in `R`.
- It is a generic function used to produce result summaries of the results of various functions.
- The function invokes particular methods which depend on the class of the first argument.
- In other words, `R` picks out the most suitable type of summary for that data.

```
> summary(iris)
  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300
 Median :5.800   Median :3.000   Median :4.350   Median :1.300
 Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.199
 3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.800
 Max.   :7.900   Max.   :4.400   Max.   :6.900   Max.   :2.500
       Species
 setosa    :50
 versicolor:50
 virginica :50
```

`summary()` is particularly useful for manipulating data from more complex data objects.

3.3 Structure of a Data Object

The structure, class and storage mode of an object can be determined using the following commands. Try out a few.

- `str()`
- `class()`
- `mode()`

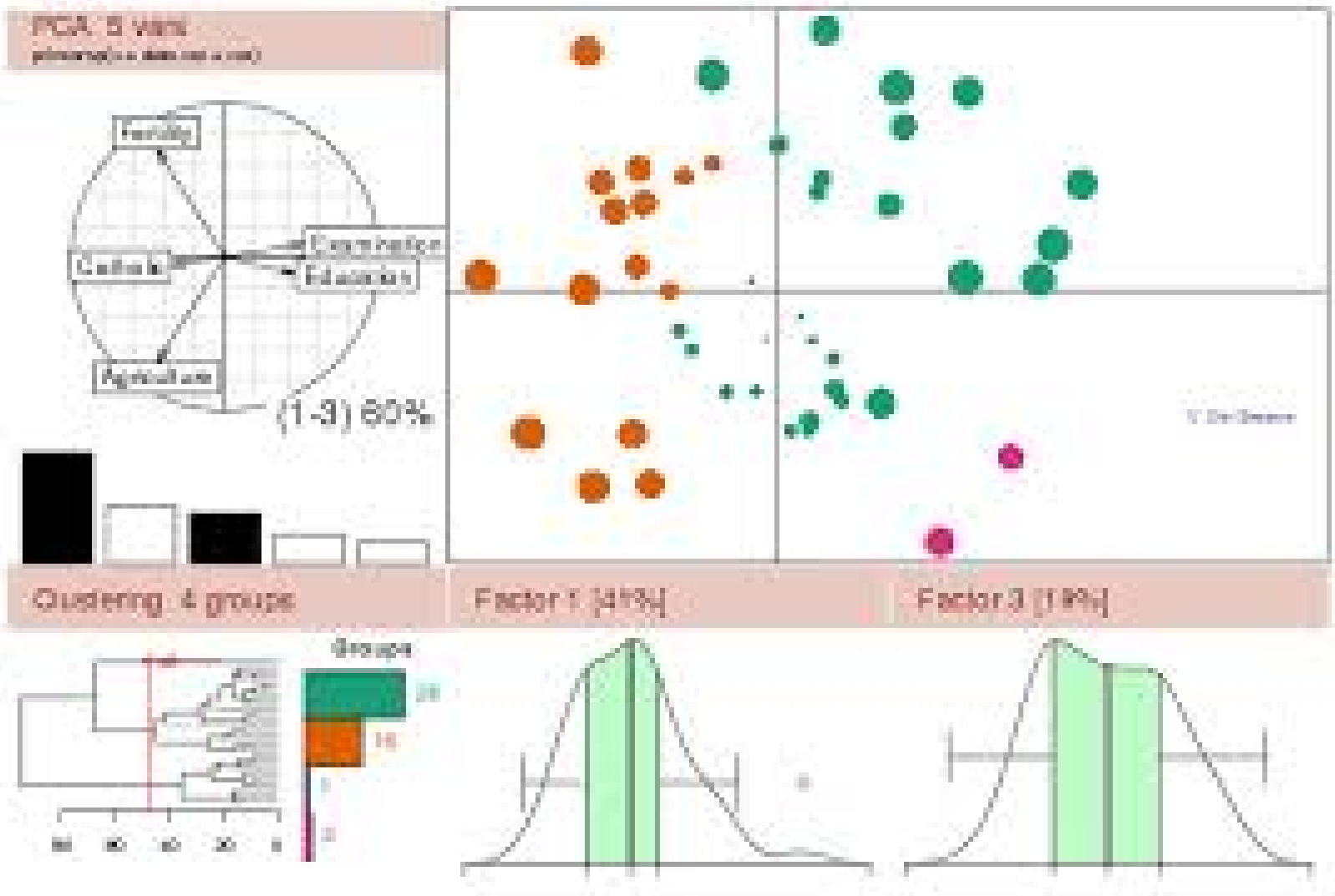
```
>
>
> class(Nile)
[1] "ts"
>
> mode(Nile)
[1] "numeric"
>
>
```

```
> a<-6
> mode(a)
[1] "numeric"
> class(a)
[1] "numeric"
> str(a)
 num 6
>
> mode(iris)
[1] "list"
> class(iris)
[1] "data.frame"
> 
```

Section 4 : Packages

Packages

- A Package in R is a file containing a collection of objects which have some common purpose.
- Packages enhance the capabilties and scope for research in a certain field.
- For example, the package MASS contains objects associated with the Venables and Ripleys "*Modern Applied Statistics with S*.


PCA: 5 vars
Fertility
Catholic
Examination
Education
Agriculture
(1-3) 60%
Clustering: 4 groups
Factor 1 [41%]
Factor 3 [19%]
Groups

R Packages

- "10 R packages I wish I knew about earlier" - Drew Conway (Yhat.com, February 2013)
- "The HadleyVerse" - Hadley Wickham
  - ggplot2, dplyr, reshape, lubridate, stringr
  - With Romain Francois, Dianne Cook and Garret Grolemund.
- Dr Brendan Haplin (UL): lme4 ,TraMineR, Gelman's arm, MASS, foreign.
- Shiny - Web Applications with R

R Packages

Some examples of packages are Actuar, written for actuarial science, and QRMlib, which complements the Quantitative Risk Management The command library() lists all the available packages.
To load a particular package, for example MASS, we would write library(MASS)

Packages

- The CRAN package repository features 6107 available packages.
- Packages contain various functions and data sets for numerous purposes, e.g. **ggplot2** package, **AER** package, **survival** package, etc.
- Some packages are part of the basic installation. Others can be downloaded from CRAN.
- To access all of the functions and data sets in a particular package, it must be loaded into the workspace.
- For example, to load the **ggplot2** package:

```
install.packages(ggplot2) library(ggplot2)
```

4.2 Using and Installing packages

- Many packages come with R. To use them in an R session, you need to load the package, as previously demonstrated.
- Some packages are not automatically installed when you install R but they need to be downloaded and installed individually.
- We must first install them using the install.packages() function, which typically downloads the package from CRAN and installs it for use. (follow the instructions as indicated).

```
 install.packages("ggplot2") install.packages("qcc")
install.packages("sqldf") install.packages("RMongo")
install.packages("randomforest")
```

4.2.1 Version of R

Many packages will require you to have the most recent version of R and also other packages. It is a good idea to update regularly.

Section 5 : Data Creation, Data Entry, Data Import and Export

5.1 The c() command

To create a simple data set, known as a vector, we use the c() command to create the vector.

```
>
>
> Y=c(1,2,4,8,16 ) #create a data vec
> Y
[1]  1  2  4  8 16
>
```

Vectors

```
> ### Vector of Numeric Values
>  Numvec = c(10,13,15,19,25);
>  ## Vector of Character Values
>  Charvec = c("LouLou","Oscar","Rasher");
>
>  ## Vector of Logical Values
>  Charvec = c(TRUE,TRUE,FALSE,TRUE);
>
```

Vectors

Vectors can be bound together either by row or by column.

```
>
> X=1:3;  Y=4:6
> cbind(X,Y)
     X Y
[1,] 1 4
[2,] 2 5
[3,] 3 6
> rbind(X,Y)
  [,1] [,2] [,3]
```

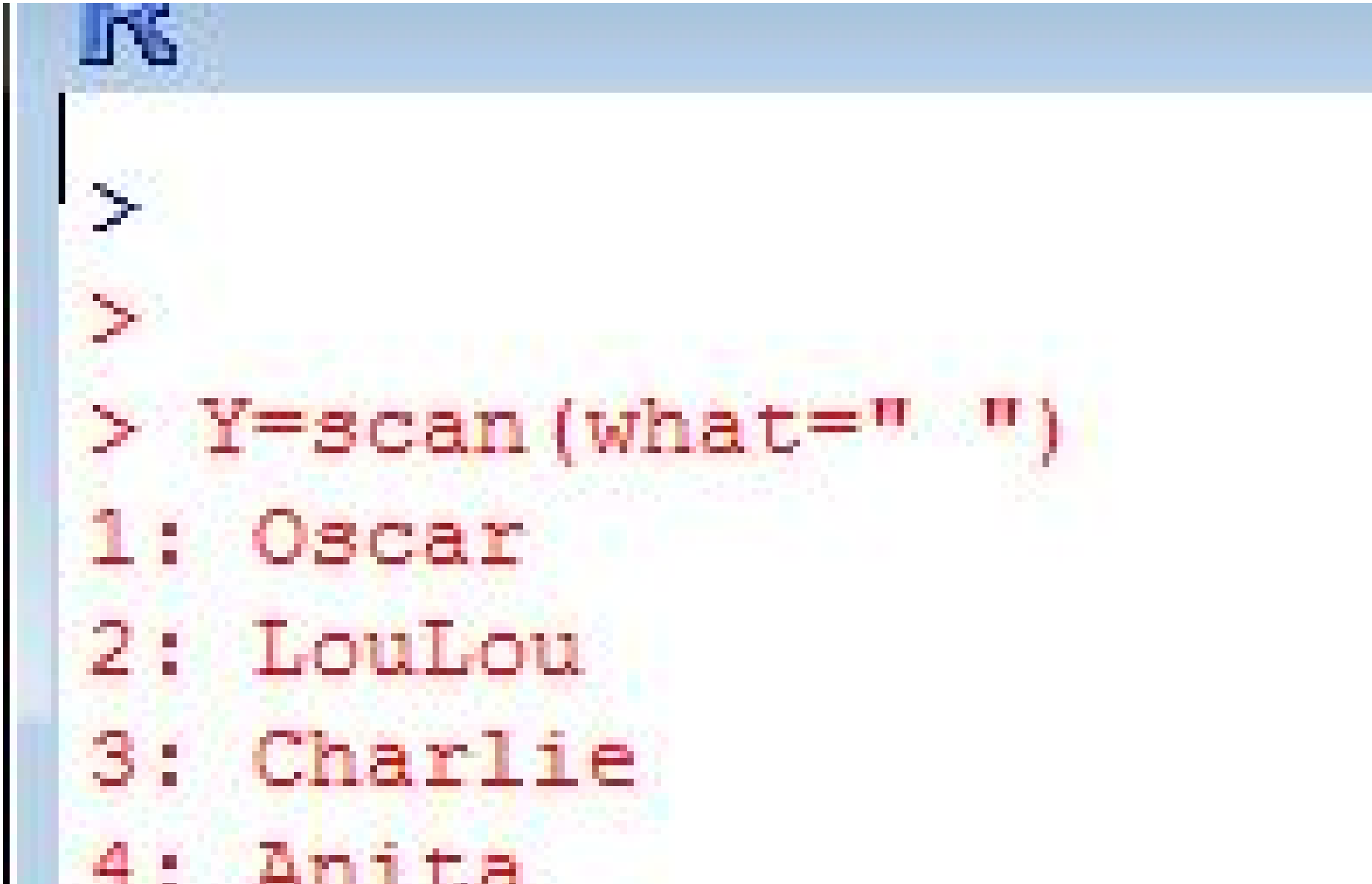
5.2 The scan() command

- The `scan()` function is a useful method of inputting data quickly.
- You can use to quickly copy and paste values into the `R` environment. It is best used in the manner as described in the following example.
- Create a variable X and use the `scan()` function to populate it with values.
- Type in a value, and then press return. Once you have entered all the values, press return again to return to normal operation.

```
>
>
> X=scan()
1:  5
2:  6
3:  7
```

5.2.1 Characters with the scan() command

The scan() command can also be used forinputting character data.



5.3 Using the data editor

5.4 Spreadsheet Interface

R provides a spreadsheet interface for editing the values of existing data sets. We use the command `data.entry()`, and name of the data object as the argument. (Also try out the fix() command)