

STA5172 Jan 14: Introduction to R

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January 14, 2014

1 Launching R

Download and install R from <http://cran.r-project.org/bin/macosx/>. The following is a summary of the functions and contents of three different types of windows in R. All of the windows are accessible from the pull-down Windows menu. Also install the R-studio.

- You may write R commands in the R Console window. This window also displays all the commands R has run through, the results, and error report. This window appears when you launch R. To bring this window to the foreground, click on the window or go to the Windows pull-down menu and choose the R Console. You can type and run commands in this window line by line.
- Alternatively, you can write all the commands in R Editor window and allow R to run part or all of the commands at once. You open this window by clicking the New Script option in the File menu. If you want to redo your analysis at a later time, you can save the scripts. You can also print the scripts by clicking the Print option from the File menu.
- The R Graphics window opens automatically when you create a graph. To bring a graph to the foreground, click on the graphics window or go to Windows pull-down menu and choose the R Graphics window. Graphs can be saved in various formats, such as jpg, png, bmp, ps, pdf, emf, pictex and so on.

2 Getting help in R

- R has an inbuilt help facility. The command is

```
> help(solve)
```

or

```
> ?solve
```

- The examples on a help topic can normally be run by

```
> example(topic)
```

- The two search functions **help.search()** and **apropos()** can be a huge help in finding what one wants. Examples of their use are:

```
> help.search("matrix")
```

An alternative to help.search is

```
> ??solve
```

(This lists all functions whose help pages have a title or alias in which the text string matrix appears.)

```
> apropos(matrix)
```

(This lists all function names that include the text matrix.)

3 Vectors

3.1 Allocating Vectors

- The following are assignment statements using the *function* `c()`

```
> x <- c(10.4, 5.6, 3.1, 6.4, 21.7)
```

or

```
> x = c(10.4, 5.6, 3.1, 6.4, 21.7)
```

- The further assignment

```
> y <- c(x, 0, x)
```

would create a vector `y` with 11 entries consisting of two copies of `x` with a zero in the middle place.

3.2 Vector Arithmetic

- The elementary arithmetic operators are the usual `+`, `-`, `*`, `/`, `^` for raising to a power.
- In addition all of the common arithmetic functions are available, e.g., `log`, `exp`, `sin`, `cos`, `tan`, `sqrt`, `max` and `min` (select the largest and smallest elements of a vector respectively).
- `range` is a function whose value is a vector of length two, namely `c(min(x), max(x))`, `length(x)` is the number of elements in `x`, `sum(x)` gives the total of the elements in `x` and `prod(x)` their product.
- Two statistical functions are `mean(x)` which calculates the sample mean, which is the same as `sum(x)/length(x)`, and `var(x)` which gives `sum((x - mean(x))^2)/(length(x) - 1)` or sample variance.
- If the argument to `var()` is an `n`-by-`p` matrix the value is a `p`-by-`p` sample covariance.
- `sort(x)` returns a vector of the same size as `x` with the elements arranged in increasing order.

- `> seq(-5, 5, by=.2) -> x`
generates in `x` the vector `c(-5.0, -4.8, -4.6, ..., 4.6, 4.8, 5.0)`.
- `> y <- rep(x, times=5)`
which will put five copies of `x` end-to-end in `y`.
- Another useful version is

`> z <- rep(x, each=5)`

which repeats each element of `x` five times before moving on to the next.
- `x[i]` gives the i -th element of the vector `x` and `[x>0]` returns a logical array of TRUE and FALSE with the i -th element TRUE if `x[i] > 2`.

4 Reading data and Plotting through examples

- We will read into R a file that holds population figures for Australian states and territories, and total population, at various times since 1917, then using this file to create a graph. The data in the file are:

Year	NSW	Vic.	Qld	SA	WA	Tas.	NT	ACT	Aust.
1917	1904	1409	683	440	306	193	5	3	4941
1927	2402	1727	873	565	392	211	4	8	6182
1937	2693	1853	993	589	457	233	6	11	6836
1947	2985	2055	1106	646	502	257	11	17	7579
1957	3625	2656	1413	873	688	326	21	38	9640
1967	4295	3274	1700	1110	879	375	62	103	11799
1977	5002	3837	2130	1286	1204	415	104	214	14192
1987	5617	4210	2675	1393	1496	449	158	265	16264
1997	6274	4605	3401	1480	1798	474	187	310	18532

- The following reads in the data from the file `austpop.txt` in a local directory.

```
> austpop <- read.table("data.txt", header=TRUE)
```

Use of `header=TRUE` causes R to use the first line to get information on the variable names for the columns. If column headings are not included in the file, the argument can be omitted.

- Now type in `austpop` at the command line prompt, displaying the object on the screen:

```
> austpop
```

- The following command prints the column names

```
> names(austpop)
```

- For plotting the ACT with different years the following command is used. `pch` stands for the plotting character. `col` stands for color. The option `pch=16` sets the plotting character to a solid black dot.

```
> plot(ACT ~ Year, data=austpop, pch=16)
```

or

```
> plot(austpop$ACT ~ austpop$Year, data=austpop, pch=16)
```

or using the `attach` command the variable names can be called directly as follows.

```
> attach(austpop)
> plot(Year, ACT, type = "p", pch=1, col=1)
```

Type can be "p" for points, "l" for lines, "o" for overplotted points and lines, etc.

- You can actually change the plot accessories by invoking the `title` command.

```
title(main = "Growth of Population in the ACT county", sub = NULL,
      xlab = "Year", ylab = "ACT")
```

- Suppose we have data (Year, ACT). Let $ACT = a + b * Year$ be the least squares line. Then to plot the data along with the line, the simplest R command can be

```
> l1<-min(Year)
> l2<-max(Year)
> rangeX<-seq(l1,l2,0.02)
> lines(rangeX, a+b*rangeX)
```

or just

```
> abline(a,b)
```

- We can add the population of a different place say WA in the same figure as

```
> points(Year, WA, pch=2, col=2)
```

- Sometimes in a overlaid plot, we have to adjust the scale of the figure window using the command `xlim` and `ylim` keeping in mind the range of the data.

```
> plot(Year, ACT, type = "p", pch=1, col=1, ylim=c(0,2000))
```

- We can add legend in the following manner

```
> legend(1950, 1100, c("ACT", "WA"), col=c(1,2), pch=c(1,2))
```