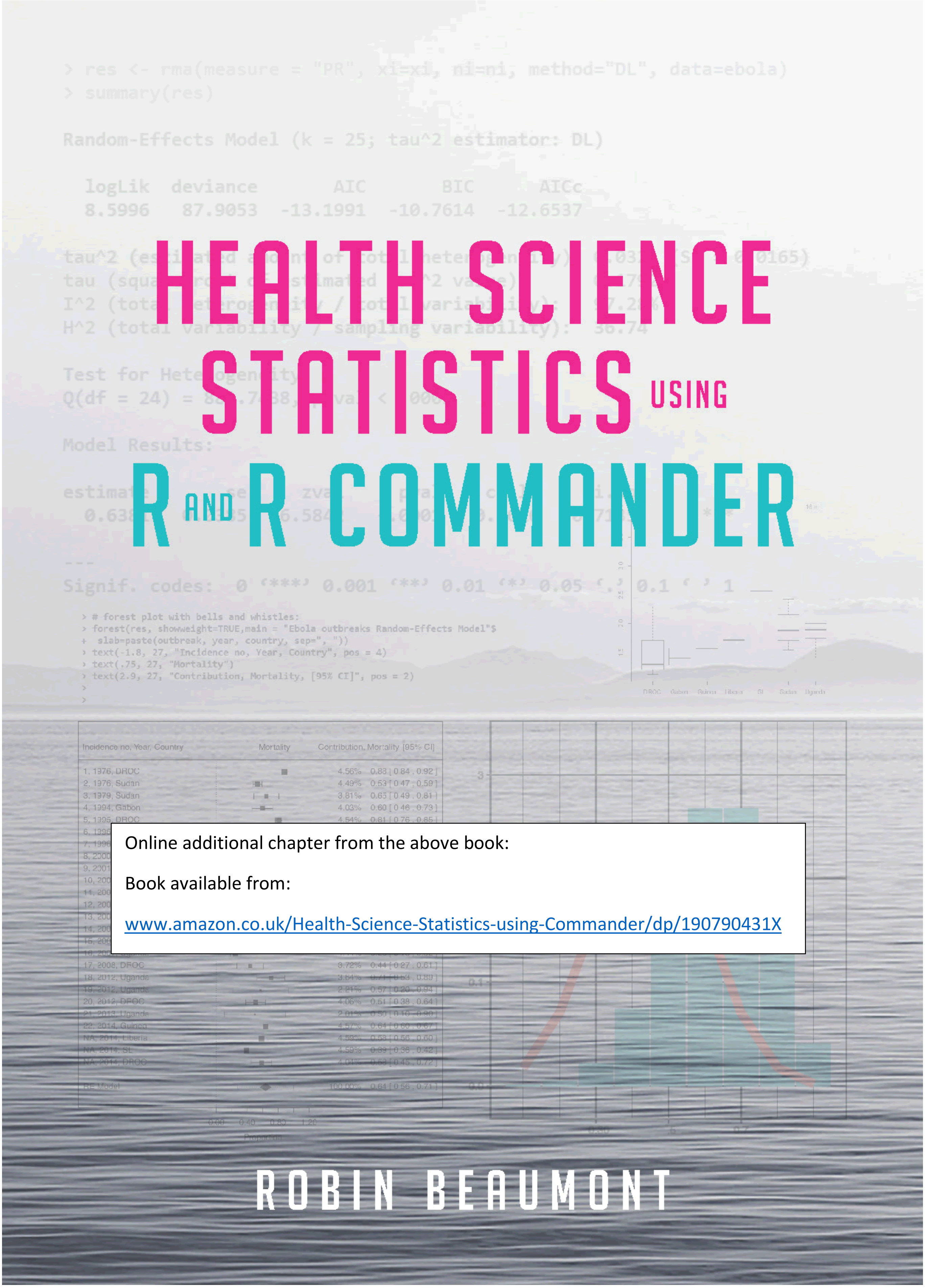


HEALTH SCIENCE STATISTICS USING R AND R COMMANDER

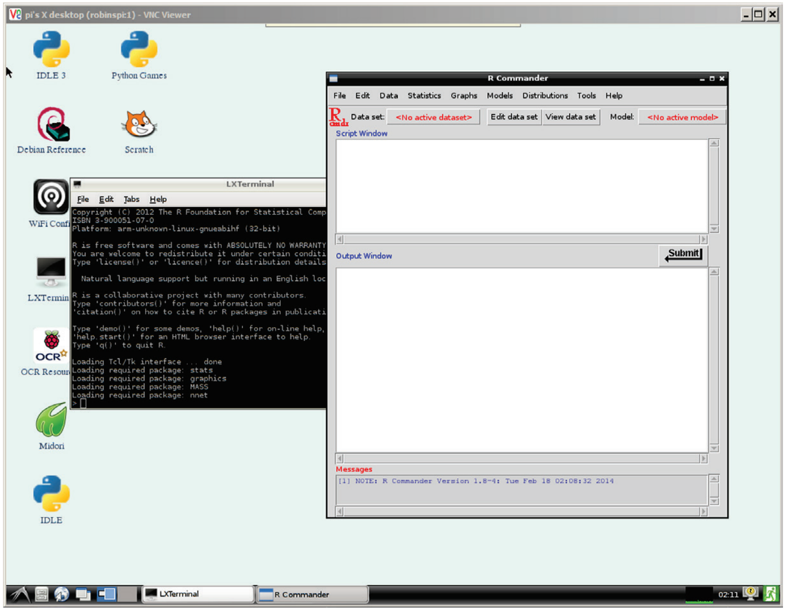
ROBIN BEAUMONT

Online additional chapter from the above book:

Book available from:

www.amazon.co.uk/Health-Science-Statistics-using-Commander/dp/190790431X

1 R and the Raspberry Pi



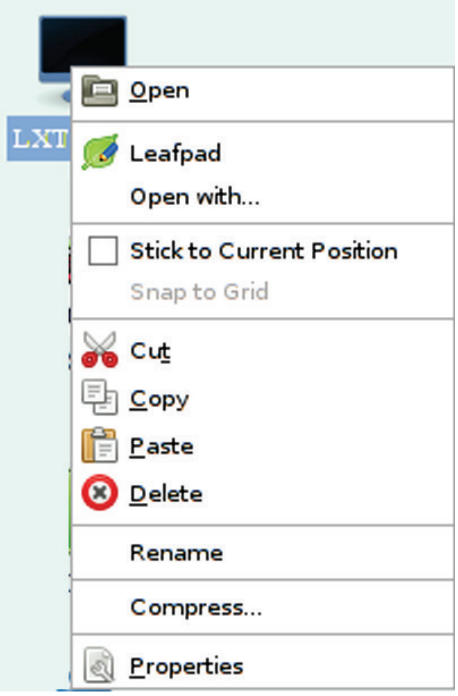
```
Copyright (C) 2012 The R Foundation for Statistical Comp
ISBN 3-900051-07-0
Platform: arm-unknown-linux-gnueabihf (32-bit)

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

  Natural language support but running in an English loc

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

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

Loading Tcl/Tk interface ... done
Loading required package: stats
Loading required package: graphics
Loading required package: MASS
Loading required package: nnet
>
```

```
[1] NOTE: R Commander Version 1.8-4: Tue Feb 18 02:08:32 2014
```

The *Raspberry Pi* is a small computer about the size of a credit card developed in the UK by the *Raspberry Pi* Foundation and costs approximately £25. It was developed to encourage future generations of students to embrace computing at a more formal level (i.e. programming) rather than the superficial level espoused by the business studies community in the last few decades.

The following sections provide details of how to install R and R Commander on the *Raspberry Pi* and how it might be used within schools to support the teaching of statistics.

1.1 Installing R and R Commander on the Raspberry Pi



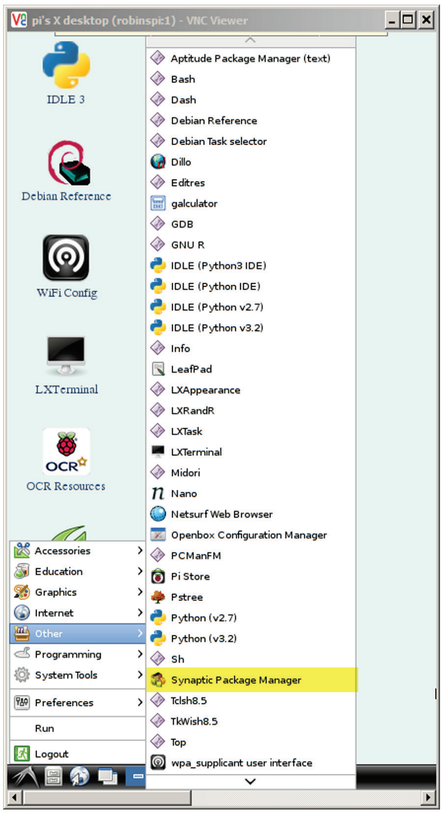
I assume that you have a running *Raspberry Pi* that has an internet connection. It also helps if you have a graphical file manager program installed, and *Synergy* is one such program. To install *Synergy* open a new *LXterminal* window by right clicking on the *LXTerminal* icon on the desktop. In the *LXwindow* type in the following followed by enter:

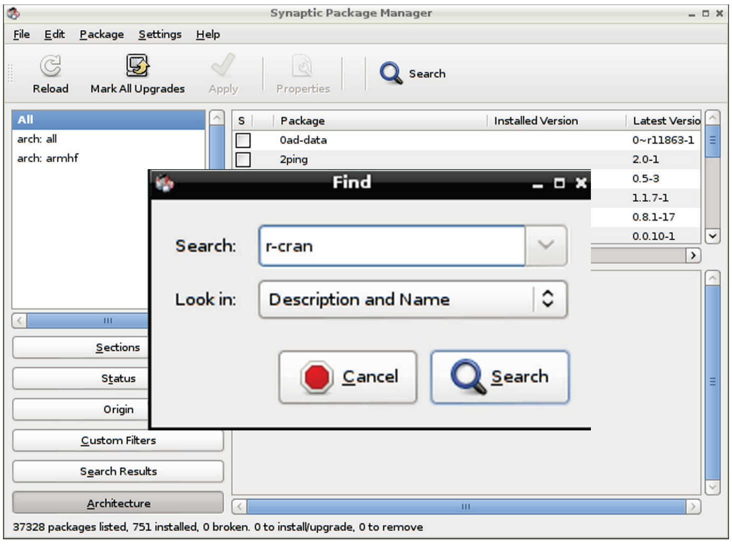
```
sudo apt-get install synaptic ↵
```

This will install the *Synaptic Package Manager*.

To run the *Synaptic Package Manager* select the following menu option found at the bottom left hand corner of screen.

Menu-> Other-> Synaptic Package Manager





All	
arch: all	
arch: armhf	

S	Package	Installed Version	Latest Version
□	0ad-data		0~r11863-1
□	2ping		2.0-1
			0.5-3
			1.1.7-1
			0.8.1-17
			0.0.10-1

Search: r-cran

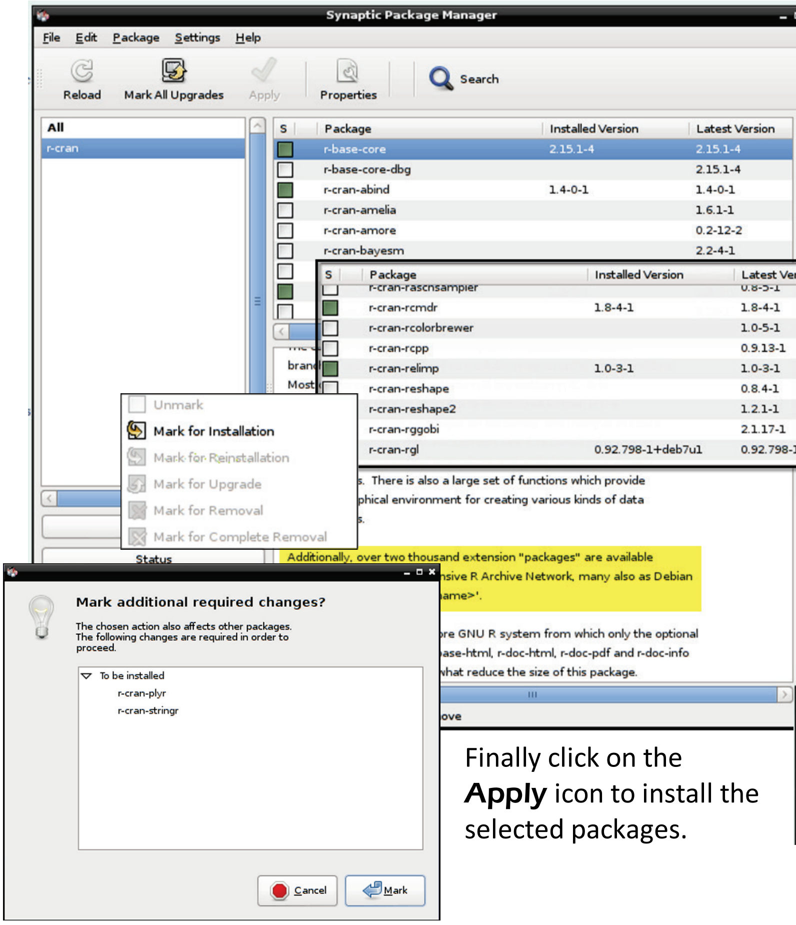
Look in: Description and Name

37328 packages listed, 751 installed, 0 broken. 0 to install/upgrade, 0 to remove

To search for *Raspberry Pi* Packages that relate to R, in the Synaptic application click on the **search** option and type the following into the search box:

```
r-cran
```

A list of all the available R packages that can run on the *Raspberry Pi* then appear.



S	Package	Installed Version	Latest Version
🟩	r-base-core	2.15.1-4	2.15.1-4
□	r-base-core-dbg		2.15.1-4
🟩	r-cran-abind	1.4-0-1	1.4-0-1
□	r-cran-amelia		1.6.1-1
□	r-cran-amore		0.2-12-2
□	r-cran-bayesm		2.2-4-1

S	Package	Installed Version	Latest Version
□	r-cran-rascnsampler		0.8-5-1
🟩	r-cran-rcmdr	1.8-4-1	1.8-4-1
□	r-cran-rcolorbrewer		1.0-5-1
□	r-cran-rcpp		0.9.13-1
🟩	r-cran-relimp	1.0-3-1	1.0-3-1
□	r-cran-reshape		0.8.4-1
□	r-cran-reshape2		1.2.1-1
□	r-cran-rggobi		2.1.17-1
□	r-cran-rgl	0.92.798-1+deb7u1	0.92.798-1+deb7u

. There is also a large set of functions which provide
phical environment for creating various kinds of data
s.

Additionally, over two thousand extension "packages" are available
nsive R Archive Network, many also as Debian
ame>'.

re GNU R system from which only the optional
base-html, r-doc-html, r-doc-pdf and r-doc-info
what reduce the size of this package.

Mark additional required changes?

The chosen action also affects other packages.
The following changes are required in order to proceed.

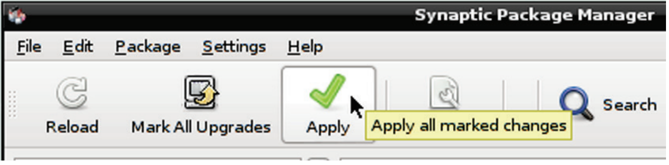
- To be installed
  - r-cran-plyr
  - r-cran-stringr

You need to select at least the following:

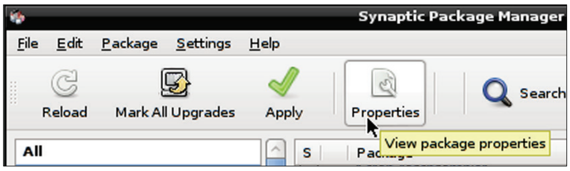
r-base-core and **r-cran-rcmdr**

You select various packages by clicking on the relevant *S* box and then select the **Mark for installation** option.

A confirmation box than appears, click on the **Mark** button.

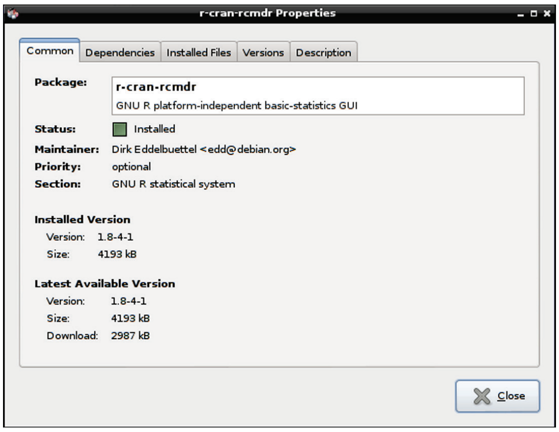


Finally click on the **Apply** icon to install the selected packages.



If you want more information about a particular package click on the properties icon.

For example inspecting the *r-cran-rcmdr* package gives:

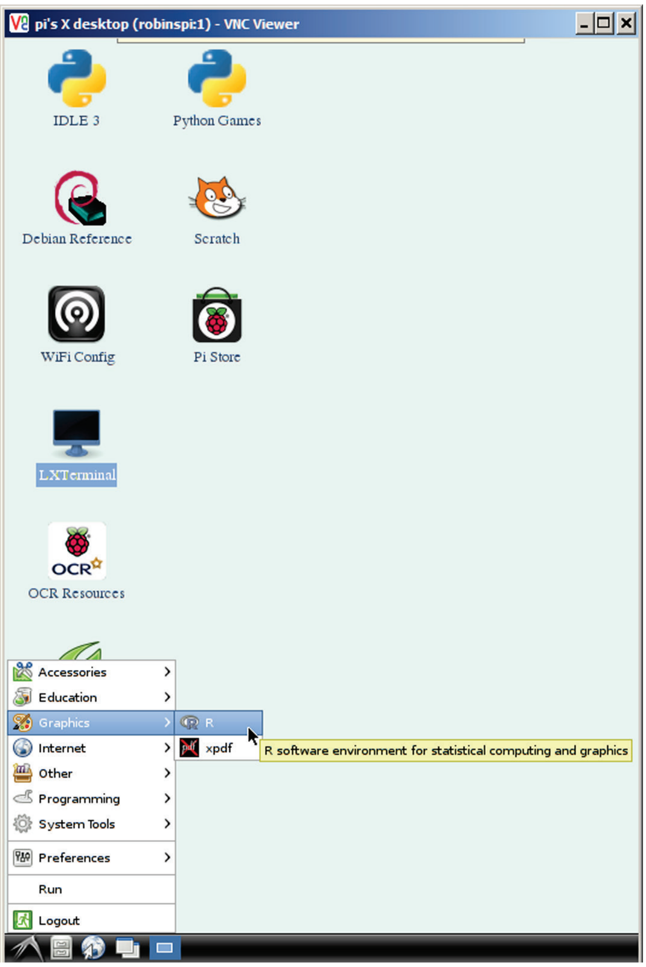


Package: r-cran-rcmdr
GNU R platform-independent basic-statistics GUI

Status: 🟩 Installed
Maintainer: Dirk Eddelbuettel <edd@debian.org>
Priority: optional
Section: GNU R statistical system

Installed Version
Version: 1.8-4-1
Size: 4193 kB

Latest Available Version
Version: 1.8-4-1
Size: 4193 kB
Download: 2987 kB

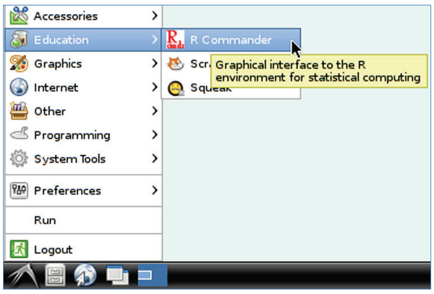


Successful installation of R and R Commander might take several attempts as invariably R Commander finds missing packages, just follow the instructions to allow it to install them. Eventually you will end up with two new menu options. The first provides a link to the standard R program (shown on the left):

Menu->graphics->R

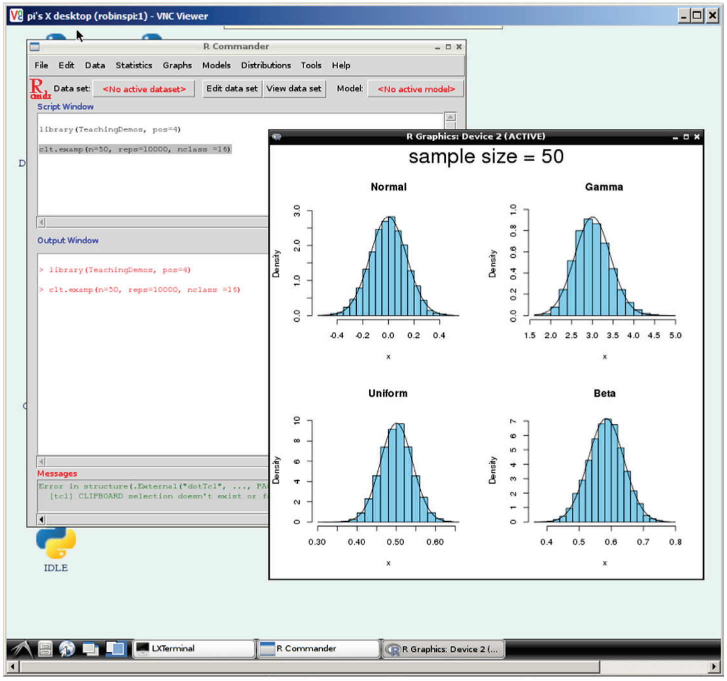
The second menu option provides a link to R Commander (shown below):

Menu->Education->R Commander



1.1 R commander limitations

There are limitations when running R Commander on the *Rapsberry pi*. For example, several of the menu options are not available such as **install R Commander plugins**. One work around for this is to use the original R packages that the plugins are invariably based on.



```
library(TeachingDemos, pos=4)

clt.examp(n=50, reps=10000, nclass =16)
```

```
> library(TeachingDemos, pos=4)

> clt.examp(n=50, reps=10000, nclass =16)
```

```
Error in structure(.External("dotTcl", ..., PA
  [tcl] CLIPBOARD selection doesn't exist or f
```

As a demonstration of this I will use the original *TeachingDemos* package in contrast to the equivalent R Commander plugin *RcmdrPlugin.TeachingDemos*. I will use this package to illustrate the fact that regardless of the shape of the parent population a sample of means rapidly approaches the shape of a normal distribution as the sample size increases (this is known as the central limit theorem).

I'll assume that you have installed the *r-cran-TeachingDemos* package using *synaptic* as described above for other packages. Within the R Commander *Script window* type the following, then select it, and click on the **Run Script** button.

```
library(TeachingDemos)

clt.examp(n=50, reps=10000, nclass=16)
```

The second line uses the *clt.examp()* function. The first value specifies the sample size from which to calculate each mean (50 here), the number of times this should be done (10,000 here) and the number of bars used the create the histogram (16 here).

1.2 The Raspberry Pi and schools

There is wealth of free material available for the *Raspberry Pi* and one of the main school exam boards (Oxford, Cambridge & RSA) in the UK has produced a freely available online course for GCSE computing http://www.cambridgegcsecomputing.org/.

TeachingDemos package	
Function	**Description**
ci.examp, run.ci.examp	Confidence Interval Examples
clt.examp	Central Limit Theorem Example
dice, plot.dice	Roll and Plot dice (possibly loaded)
faces, faces2	Chernoff face plots
fagan.plot	Fagan plot for screening designs
lattice.demo	The 3d slicing idea behind lattice/trellis graphics
loess.demo	Interactive demo to show ideas of loess smooths
mle.demo	Interactive demo of Maximum Likelihood Estimation
plot.rgl.coin, plot.rgl.die	Animate flipping a coin or rolling a die
power.examp	Demonstrate concepts of Power.
put.points.demo	Add/move points on a plot and see the effect on correlation and regression.
roc.demo	Interactive demo of ROC curves.
rotate.cloud	Interactively rotate 3d plots.
run.cor.examp	Show plots representing different correlations.
run.hist.demo	Interactively change parameters for histograms.
SensSpec.demo	Show relationship between Sensitivity, Specificity, Prevalence and PPV and NPV.
TkApprox	Interactive linear interpolations of data.
tkBrush	Brush points in a scatterplot matrix.
TkSpline	Interactive spline interpolations of data.
tree.demo	Interactively Recursive partition data (create trees).
vis.binom	Plot various probability distributions and interactively change parameters.
vis.boxcox	Interactively change lambda for Box Cox Transforms.
z.test	Z-test similar to t.test for students who have not learned t tests yet.
Pvalue.norm.sim	Simulate P-values to see how they are distributed
run.Pvalue.norm.sim	GUI for above.
Pvalue.binom.sim	Simulate P-values to see how they are distributed
run.Pvalue.binom.sim	GUI for above.
HWidentify	
HTKidentify	Identify the point Hovered over with the mouse.
vis.test	test a null hypothesis by comparing graphs.

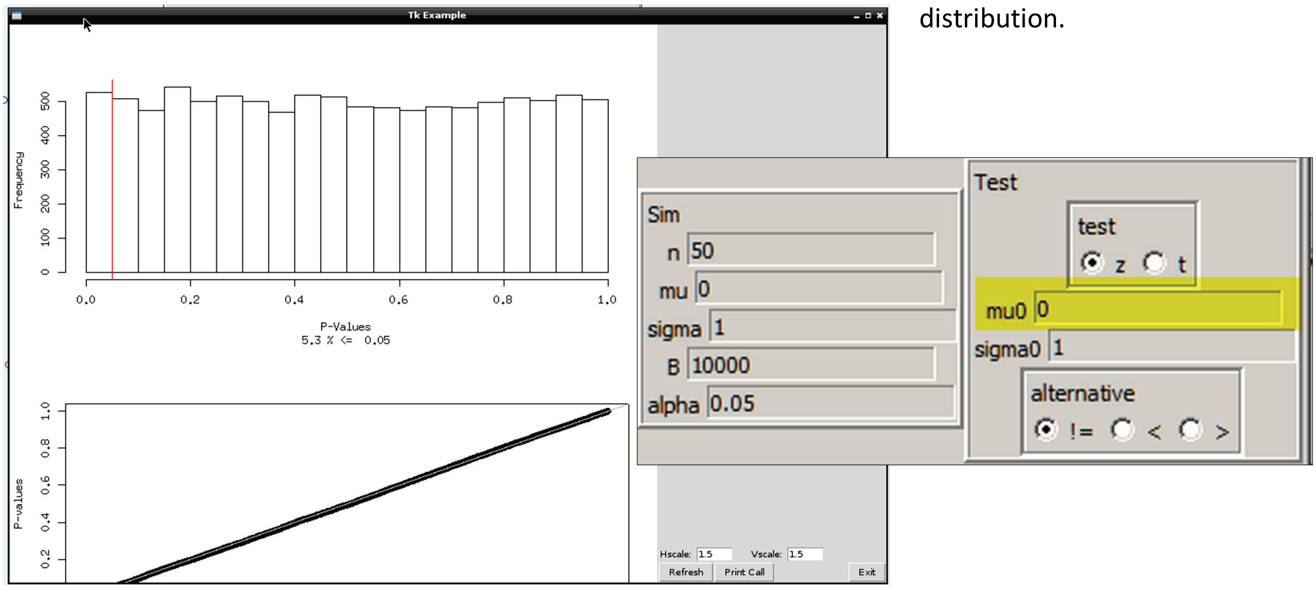
While the equivalent courses for A/S level statistics only specifies the use of hand calculators the actual syllabus contains several topics that could be enriched with simulation demonstrations as demonstrated above. The *TeachingDemos* package has many very useful functions, listed opposite (taken from the package reference manual).

I'll demonstrate one of the interactive examples by using the following function that allows students to see the distribution of **p-values** when the difference is zero (i.e. null true) or a value set by the student **mu0**.

```
run.Pvalue.norm.sim()
```

Type the above into the R Commander *Script Window*, select it, then click on the **run script** button.

The default result is a distribution of **p-values** for when the null is true (i.e. $mu0=0$), changing the **Mu0** values drastically changes the distribution.



Hscale: 1.5 Vscale: 1.5

Sim
n 50
mu 0
sigma 1
B 10000
alpha 0.05

Test
test ● z ○ t
mu0 0
sigma0 1
alternative ● != ○ < ○ >

Using the *Raspberry Pi* along with R or R Commander to teach mathematics and statistical concepts allows teachers to be very creative; from simply demonstrations of distributions using the R Commander **Distributions** menu option to setting specific tasks using either one of the packages described above of even editing R code in a specific way.

This chapter has only provided a small glimpse of what might be possible but hopefully this might act as a stimulus for others to develop further.

1.3 Tips and Tricks

The UK exam board, Oxford, Cambridge and RSA (OCR), provide an excellent *Getting started guide for the Raspberry Pi*, including details of how to setup Ethernet and wireless connections:

http://www.ocr.org.uk/Images/125299-classroom-challenge-connecting-to-a-network-learner-sheet.pdf

For further details of how R packages are converted to packages for the *Raspberry Pi*, using the Debian operating system see:

http://cran.r-project.org/bin/linux/debian/

There is a discussion forum about R and Debian porting at:

http://blog.gmane.org/gmane.comp.lang.r.debian/

There are alternatives to the *Raspberry Pi*, and there have been criticisms about how the *Raspberry Pi* is not as open as who would imagine. To find out about these issues read these two postings:

http://whitequark.org/blog/2012/09/25/why-raspberry-pi-is-unsuitable-for-education/

https://wiki.debian.org/RaspberryPi