Week 1 Lab - Introduction to R

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What is R?

R is a software environment for statistical computing and graphics. It runs on just about any platform (except iPad!) and is completely free (in the GNU sense).

It is used extensively by academic statisticians for research and teaching and is gaining ground in business.

It has 4634 extension packages available.

Pros

Its free and open source. It has most methods for most things mostly before any other package. It has the best graphics. It extendable.

Cons

It has a steep learning curve. No GUI by default. Poor (but improving) memory management; difficulty with very large data sets.

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R Resources

- http://www.r-project.org - Main R website.
- CRAN - http://cran.csiro.au - Comprehensive R Archive Network - base software and add-on packages.
- RStudio - http://www.rstudio.com - is a powerful IDE for R
- R Commander - install.package(Rcmdr) - is a partial GUI interface to R - requires TclTk.
- R Graph Gallery - http://gallery.r-enthusiasts.com/ - loads of pretty pictures.
- http://cran.csiro.au/doc/contrib/Torfs+ Brauer-Short-R-Intro.pdf - "A (very) short Introduction to R"
- "Introductory Statistics with R", Peter Dalgaard, Springer 2008.

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Access to R

For students both undergrad and postgrad:When a student enrols in a subject or course that falls under the old SCEM banner, a CDMS (SCEM) account automatically gets created and an email explaining this is sent to their WSU student email address.

The email has a link to a site generated for each new account that contains their initial password. The web page then explains how they can change this password.

There is an R server available to all CDMS account holders.

Access is via:https://r.cdms.westernsydney.edu.au

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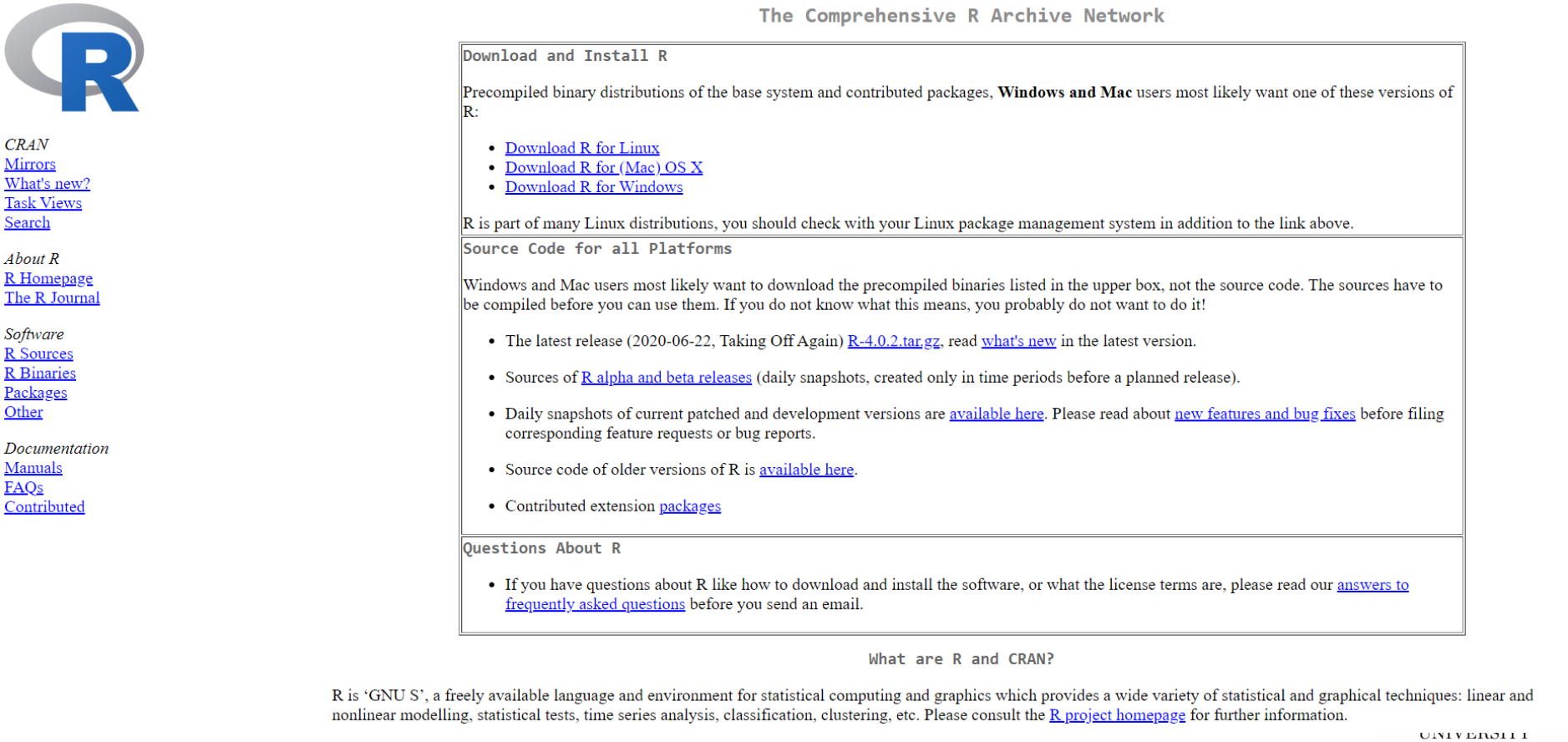
Installing R

Go to (https://cran.r-project.org/)

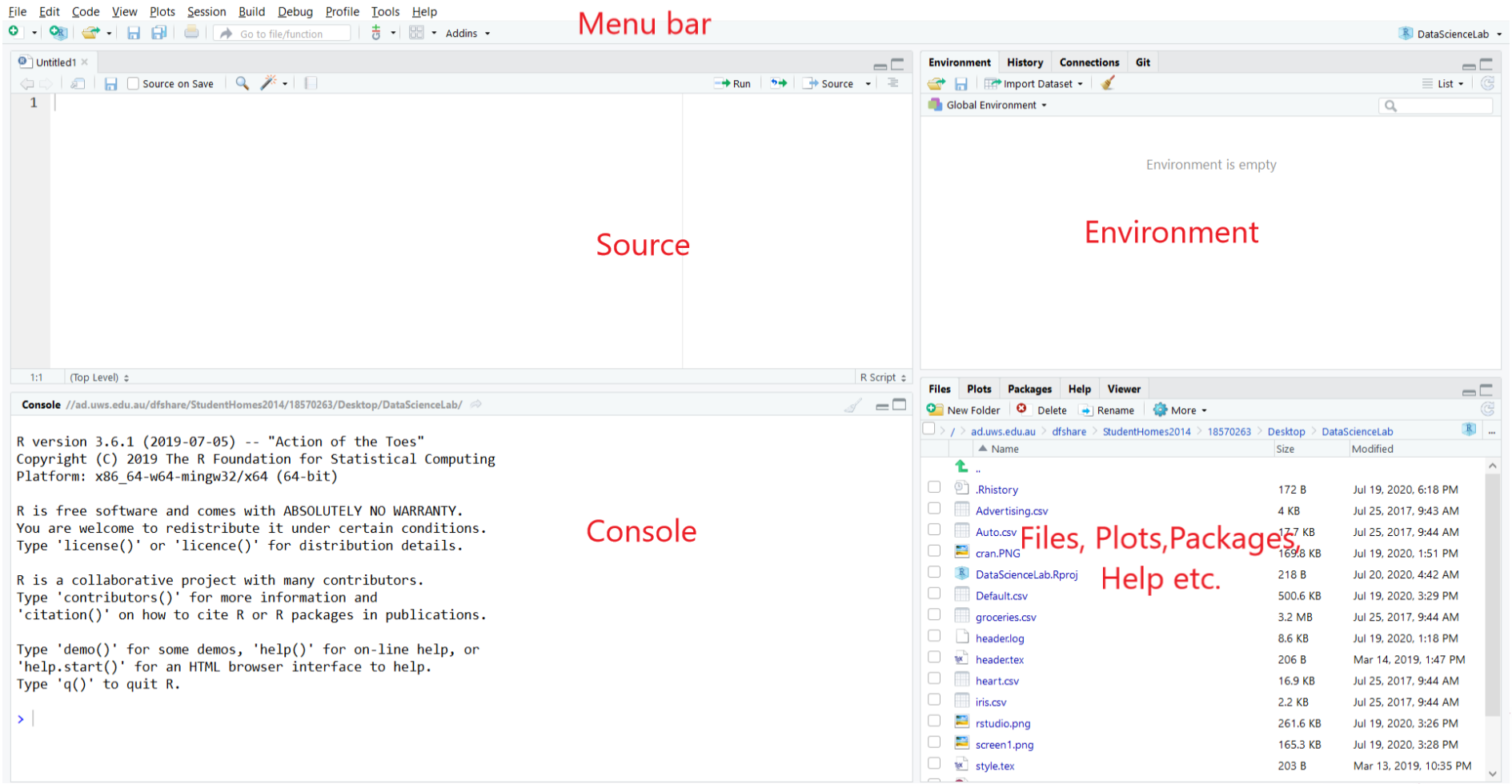
Download R for your OS and install



##Installing RStudio

RStudio

Open RStudio and have a look. Basically it has 4 panes and a Menu bar like this.



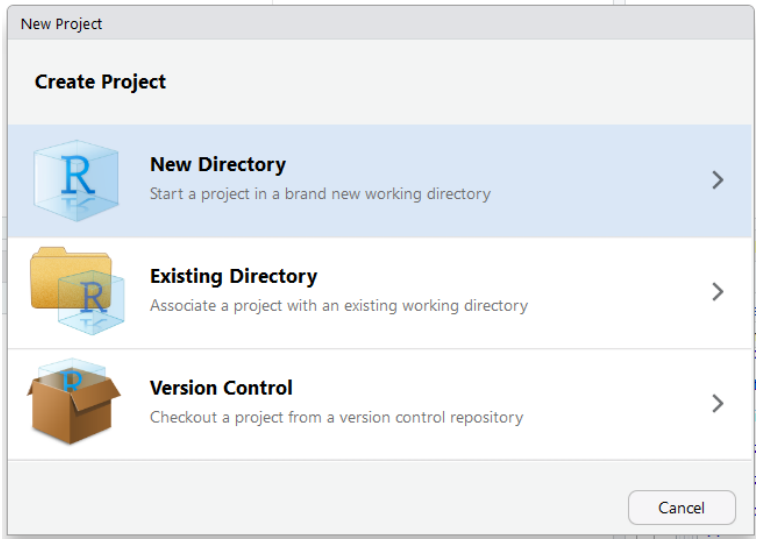
##RStudio

R projects

Projects are very helpful in organizing your codes. They keep all your related files together. When you create a new project, it creates a folder where all files will be kept and assign that folder as the working directory.

To create a project, go to

File->New Project->New Directory->New Project



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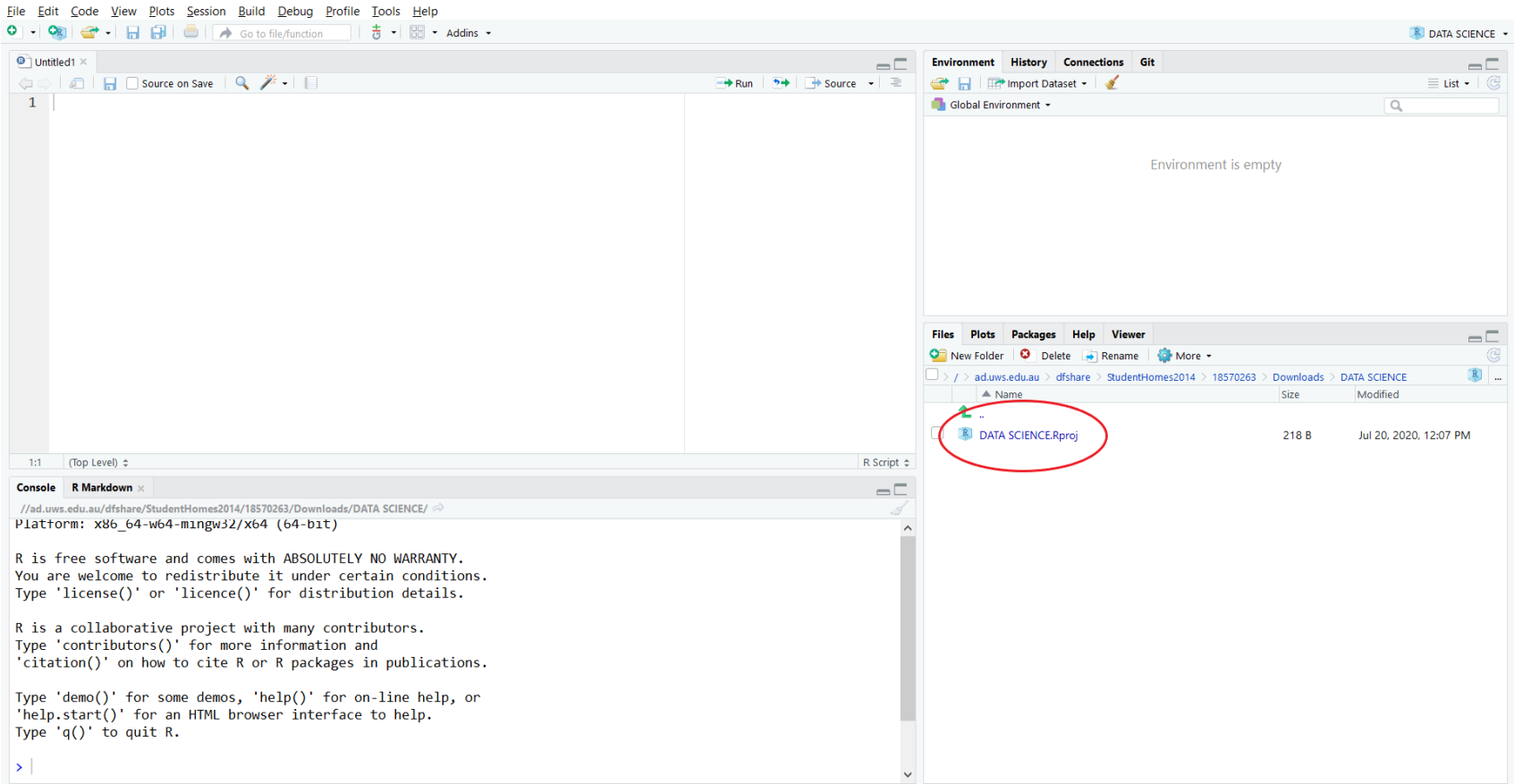
R projects



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R Commands

R can be used as a basic calculator.

```
1+1
```

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

```
sqrt(3)
```

```
## [1] 1.732051
```

```
2^3
```

```
## [1] 8
```

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R Commands ctd. . .

It can store and print variables.

```
x=10
print(x)
```

```
## [1] 10
```

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R Commands ctd...

It understands vectors and matrices.

```
x <- c(1,2)
print(x)
```

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

```
m <- matrix(c(1,2,3,4), ncol=2, byrow=TRUE)
print(m)
```

```
##      [,1] [,2]
## [1,]    1    2
## [2,]    3    4
```

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R Commands ctd...

It has functions, and you can write them.

```
x <- sqrt(2)
sqr <- function(x) x^2
sqr(x)
```

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

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Uploading Data Into R

When data set iris.csv is stored in a folder with path C:/LIWAN/R/2016/Intro to Data Science, use

iris<- read.csv("C:/LIWAN/R/2016/Intro to Data Science/iris.csv")
attach(iris)

When the data set is uploaded to the same folder where R project is saved, use

iris<- read.csv("iris.csv")

attach(iris)

Alternatively use "Import Dataset"" function in the Environment

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Data in R

Tables are stored in data.frames

```
head(iris)
```

```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width Species
## 1          5.1         3.5          1.4         0.2  setosa
## 2          4.9         3.0          1.4         0.2  setosa
## 3          4.7         3.2          1.3         0.2  setosa
## 4          4.6         3.1          1.5         0.2  setosa
## 5          5.0         3.6          1.4         0.2  setosa
## 6          5.4         3.9          1.7         0.4  setosa
```

```
sapply(iris,class)
```

```
## Sepal.Length  Sepal.Width Petal.Length  Petal.Width      Sp
##    "numeric"    "numeric"    "numeric"    "numeric"    "fa
```

Summary

```
names(iris)
```

```
## [1] "Sepal.Length" "Sepal.Width"  "Petal.Length" "Petal.Wid
## [5] "Species"
```

```
dim(iris)
```

```
## [1] 150   5
```

```
summary(iris)
```

```
##    Sepal.Length    Sepal.Width     Petal.Length    Petal.Wid
##  Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.
##  1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.
##  Median :5.800   Median :3.000   Median :4.350   Median :1.
##  Mean   :5.843   Mean   :3.057   Mean   :3.758   Mean   :1.
##  3rd Qu.:6.400   3rd Qu.:3.300   3rd Qu.:5.100   3rd Qu.:1.
```

Basic Statistics

```
x<-rnorm(100)
mean(x)
```

```
## [1] -0.001880122
```

```
var(x)
```

```
## [1] 0.8723308
```

```
sd(x)
```

```
## [1] 0.9339865
```

```
fivenum(x)
```

```
## [1] -1.91539426 -0.73196551  0.03462727  0.69070222  1.8332
```

minimum lower quartile median upper quartile maximum

Basic Statistics

```
t.test(x)
```

```
##
##  One Sample t-test
##
## data:  x
## t = -0.02013, df = 99, p-value = 0.984
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  -0.1872033  0.1834431
## sample estimates:
##    mean of x
## -0.001880122
```

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Basic Statistics

```
t.test(iris$Sepal.Length)
```

```
##
##  One Sample t-test
##
## data:  iris$Sepal.Length
## t = 86.425, df = 149, p-value < 2.2e-16
## alternative hypothesis: true mean is not equal to 0
## 95 percent confidence interval:
##  5.709732 5.976934
## sample estimates:
## mean of x
##  5.843333
```

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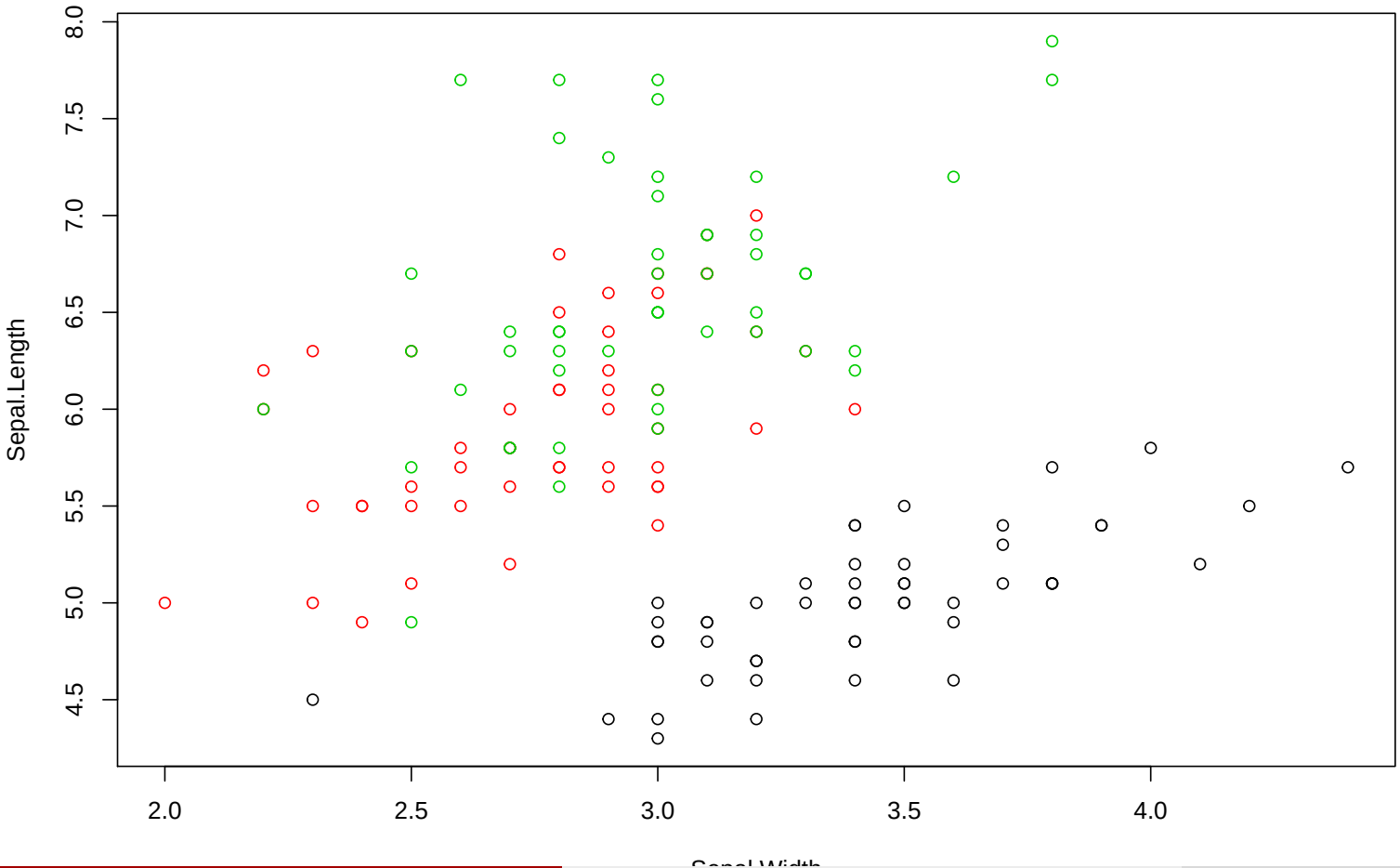
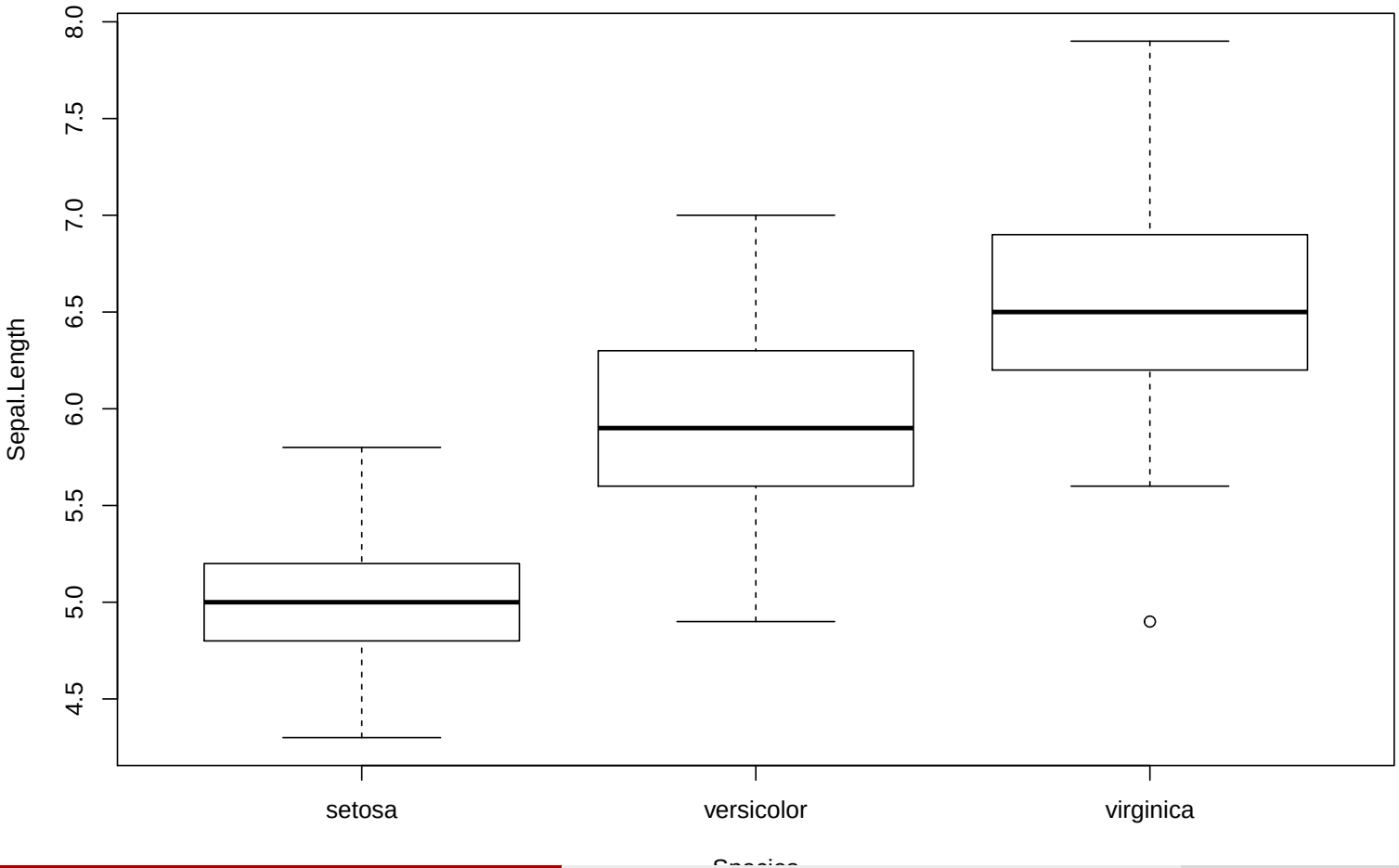
R has extensive plotting

```
plot(Sepal.Length~Sepal.Width, col=Species, data=iris)
```



R has extensive plotting

```
boxplot(Sepal.Length~Species, data=iris)
```



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Help in R

Everything in R has a help file.

help(t.test)

Or see the help pane in RStudio

Will illustrate R further within Regression Analysis

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Getting Ready for the Data Analysis covered in Lectures

Data Import

install.packages("ISLR")

install.packages("MASS")

library(ISLR)

library(MASS)

library(class)

library(DMwR)

attach(Smarket)

attach(Boston)

attach(Carseats)

attach(iris)

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Data Sets

Supervised Learning:

- Advertising
- Income
- Heart
- Smarket
- Caravan (Insurance Data)

Unsupervised Learning:

- USAarrests
- groceries

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View Advertising Data and Discuss How to Initiate Knowledge Discovery

Exercise: List Possible Research Questions?

```
Advertising<-read.csv("Advertising.csv")
attach(Advertising)
head(Advertising)
```

```
##      TV Radio Newspaper Sales
## 1 230.1  37.8      69.2  22.1
## 2  44.5  39.3      45.1  10.4
## 3  17.2  45.9      69.3   9.3
## 4 151.5  41.3      58.5  18.5
## 5 180.8  10.8      58.4  12.9
## 6   8.7  48.9      75.0   7.2
```

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View heart Data and Discuss How to Initiate Knowledge Discovery

Exercise: List Possible Research Questions?

```
Heart<-read.csv("heart.csv")
attach(Heart)
head(Heart)
```

```
##   X Age Sex     ChestPain RestBP Chol Fbs RestECG MaxHR ExAr
## 1 1  63   1       typical    145  233   1       2   150
## 2 2  67   1 asymptomatic    160  286   0       2   108
## 3 3  67   1 asymptomatic    120  229   0       2   129
## 4 4  37   1    nonanginal    130  250   0       0   187
## 5 5  41   0    nontypical    130  204   0       2   172
## 6 6  56   1    nontypical    120  236   0       0   178
##   Ca        Thal AHD
## 1  0       fixed   0
```

View groceries Data and Discuss How to Initiate Knowledge Discovery

Exercise: List Possible Research Questions?

```
Groceries<-read.csv("groceries.csv")
attach(Groceries)
head(Groceries)
```

```
##   frankfurter sausage liver.loaf ham meat finished.products
## 1           0       0          0   0    0                 0
## 2           0       0          0   0    0                 0
## 3           0       0          0   0    0                 0
## 4           0       0          0   0    0                 0
## 5           0       0          0   0    0                 0
## 6           0       0          0   0    0                 0
##   organic.sausage chicken turkey pork beef hamburger.meat f
## 1               0       0      0    0    0              0
```

Explore Default Data set from the ISLR Library

```
#install.packages("ISLR")
library(ISLR)
attach(Default)
View(Default)
dim(Default)
```

```
## [1] 10000     4
```

```
head(Default)
```

```
##   default student   balance     income
## 1      No      No  729.5265 44361.625
## 2      No     Yes  817.1804 12106.135
## 3      No      No 1073.5492 31767.139
## 4      No      No  529.2506 35704.494
## 5      No      No  785.6559 38463.496
```

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Save and read datasets within R

Save a data set downloaded from a library within R as a csv file

```
write.csv(Default,file="Default.csv")
```

To read csv files

read.csv("Default.csv",header=TRUE)

To read any other files read.table("file",header=False)

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How to change a factor variable to a numeric variable

Add another variable named Defcode to table Default check the levels of the new variable (It will be same class as the original variable)

```
Defcode = Default$default
levels(Defcode)
```

```
## [1] "No"  "Yes"
```

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Change the levels as 1 for Yes and 0 for No

```
levels(Defcode)[levels(Defcode)=="No"]=0
levels(Defcode)[levels(Defcode)=="Yes"]=1
levels(Defcode)
```

```
## [1] "0" "1"
```

Still Defcode varibale is a factor variable and cannot use as a numeric variable in regression setting.

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To summariase a factor variable

```
Defcode = as.character(Default$default)
table(Defcode)
```

```
## Defcode
##   No  Yes
## 9667  333
```

```
Defcode[Defcode=="No"]=0
Defcode[Defcode=="Yes"]=1
table(Defcode)
```

```
## Defcode
##    0    1
## 9667  333
```

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Change a factor vraiable to a numeric variable

```
Defcode = as.numeric(Defcode)
class(Defcode)
```

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

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Exercises

For each of the three data sets, iris, heart and groceries

- Explore the variables
- List the quantitative variables and qualitative variables
- State a Research question and identify the target variable if aplicable
- Comment if they are supervised learning or unsupervised learning.

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