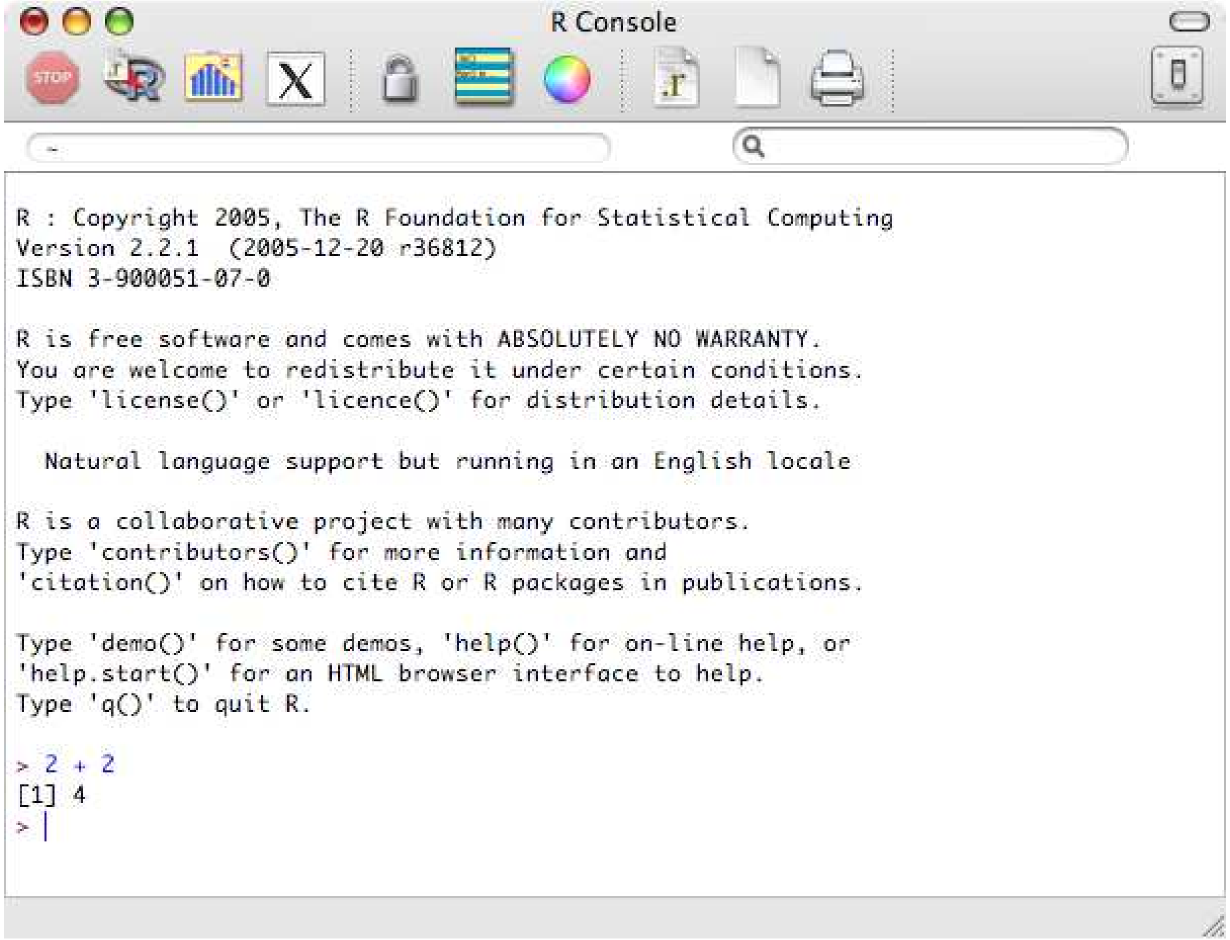
Statistical Computing in R

R is a programming language designed to support data analysis and model building.

- All traditional programming constructs such as expressions, assignments, conditionals, loops, and functions are present.
- A straight-forward object system that supports high-level constructs such as statistical models with all their parameters etc. very nicely.
- Vector arithmetic (very powerful and the preferred way of accomplishing things in R).
- Graphics engine supporting graphical techniques (automatic scatter plots, histograms, etc.)
- Many, many extension modules implementing everything from basic statistics to micro array analysis...and in particular support vector machines.

Interactive R Session



```
R : Copyright 2005, The R Foundation for Statistical Computing
Version 2.2.1  (2005-12-20 r36812)
ISBN 3-900051-07-0

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.

> 2 + 2
[1] 4
> 
```

R Programming

```
> x <- 2
> 2 * x
[1] 4
```

```
> v <- c(1,2,3)
> v
[1] 1 2 3
```

```
> v + 1
[1] 2 3 4
```

```
> w <- v + 1
> q <- w + v
> q
[1] 3 5 7
```

```
> add1 <- function(x) { x + 1; }
> add1
function(x) { x + 1; }
> add1(1)
[1] 2
```

R Programming

```
> addv1
function(v)
   {
      y <- c()
      for (x in v) {
         x1 <- x + 1
         y <- c(y,x1)
      }
      y
   }
> w
[1] 2 3 4
> addv1(w)
[1] 3 4 5
```

This function performs the same operation as the vector operation `w + 1`. From a performance point of view it is always desirable to use the vector operations, explicit iteration over vector elements is SLOW!

R Data

R has many different ways to represent data:

- vectors
- lists
- arrays/matrices

The most important one (for our purposes) is the *data frame*. A data frame is a two-dimensional data matrix with additional structure.

```
> df <- data.frame(v,w)
> df
  v w
1 1 2
2 2 3
3 3 4
> df$v
[1] 1 2 3
> df$w
[1] 2 3 4
```

Loading Data Frames

We can read comma-separated-value (CSV) files directly into an R data frame.

Here is our mammal training data set represented as a CSV file:

```
Legs, Wings, Fur, Feathers, Mammal
4, no, yes, no, true
2, yes, no, yes, false
4, no, no, no, false
4, yes, yes, no, true
3, no, no, no, false
```

Assume that we saved this into a file called “mammals.csv”, in a directory called “datasets”.

Loading Data Frames

```
> setwd("datasets")
> mammals.df <- read.csv("mammals.csv")
> mammals.df
  Legs Wings  Fur Feathers Mammal
1    4    no  yes       no   true
2    2   yes   no      yes  false
3    4    no   no       no  false
4    4   yes  yes       no   true
5    3    no   no       no  false
> summary(mammals.df)
      Legs      Wings    Fur    Feathers   Mammal
 Min.   :2.0    no :3    no :3    no :4    false:3
 1st Qu.:3.0    yes:2    yes:2    yes:1    true :2
 Median :4.0
 Mean   :3.4
 3rd Qu.:4.0
 Max.   :4.0
```

R Built-in Data Frames

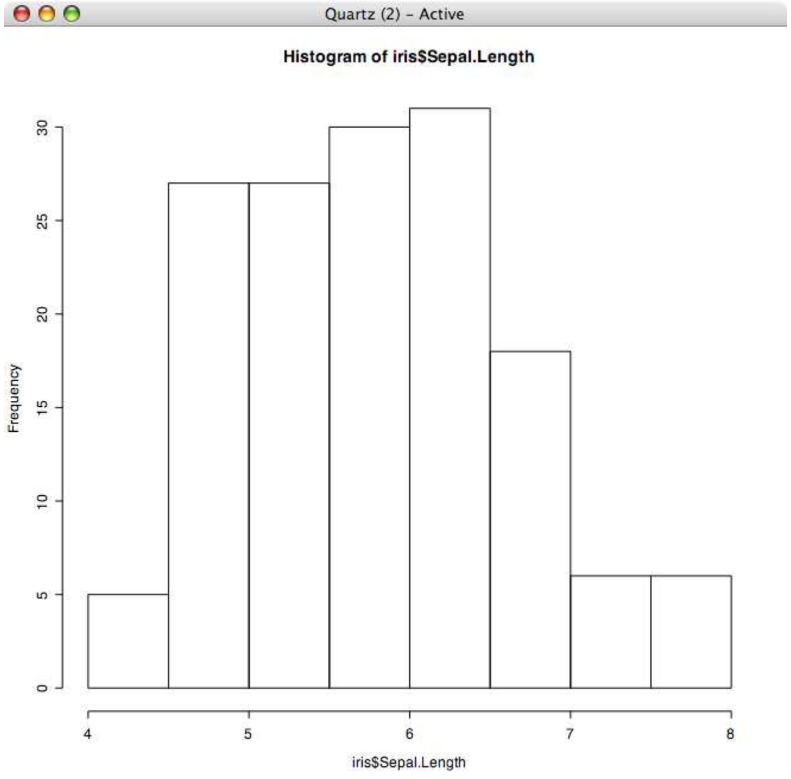
For convenience sake, R comes with a number of predefined data frames. One such predefined data frame is the *iris data set*.

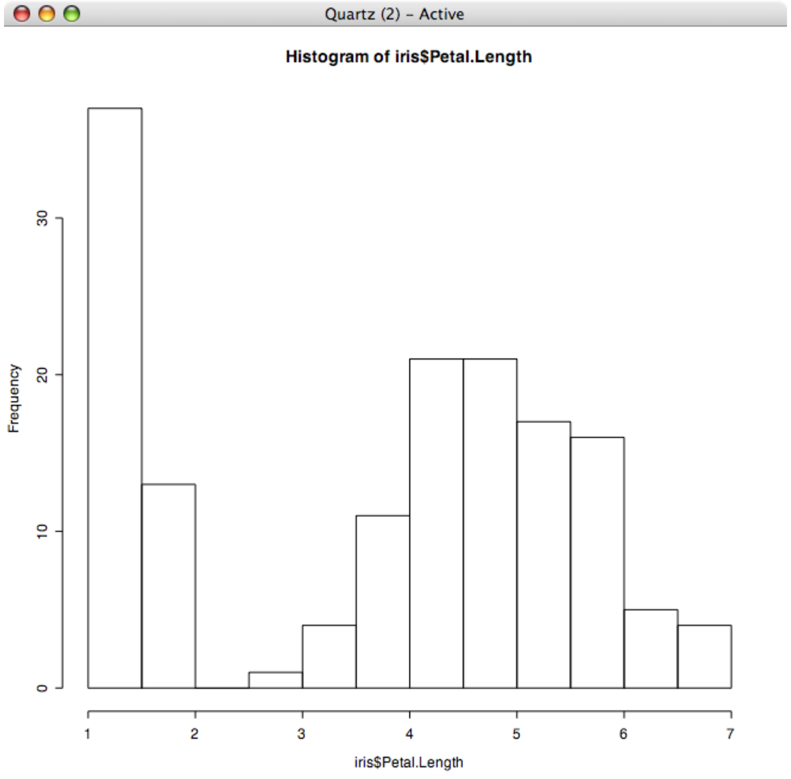
```
> data(iris)
> summary(iris)
  Sepal.Length    Sepal.Width     Petal.Length    Petal.Width          Species
 Min.   :4.300   Min.   :2.000   Min.   :1.000   Min.   :0.100   setosa    :50
 1st Qu.:5.100   1st Qu.:2.800   1st Qu.:1.600   1st Qu.:0.300   versicolor:50
 Median :5.800   Median :3.000   Median :4.350   Median :1.300   virginica :50
 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
```

We might wish to inspect the data distributions visually as well:

```
> hist(iris$Sepal.Length)
> hist(iris$Petal.Length)
```

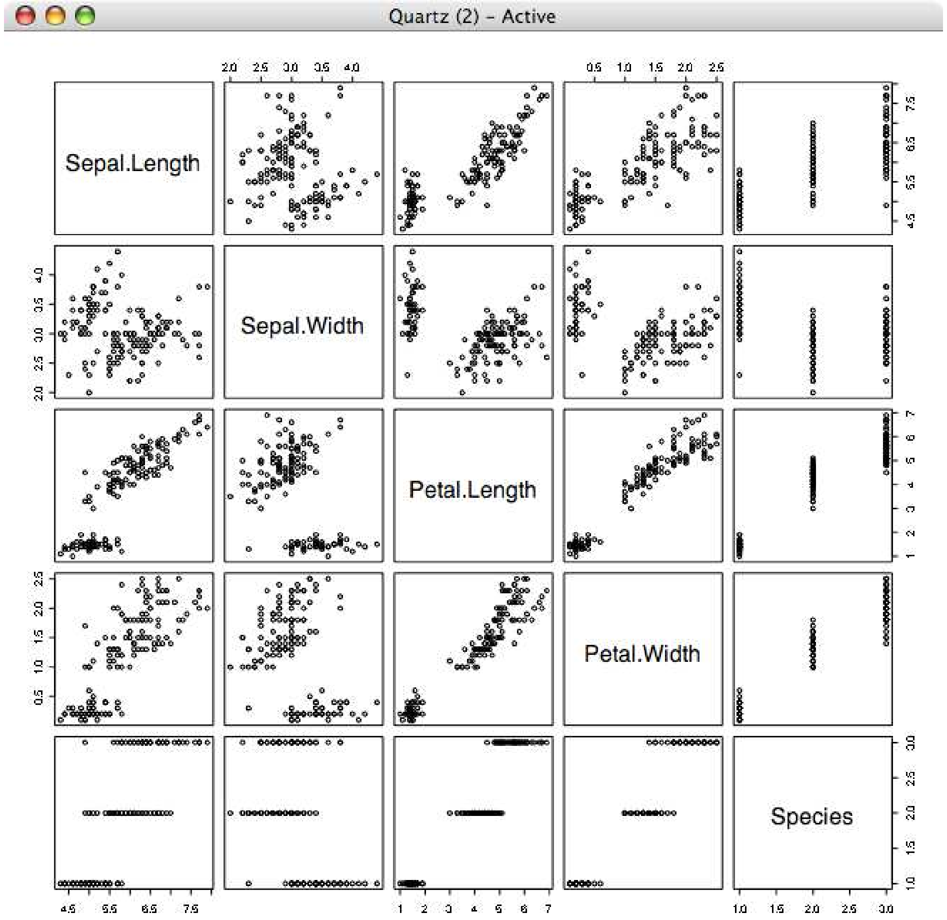
R Built-in Data Frames





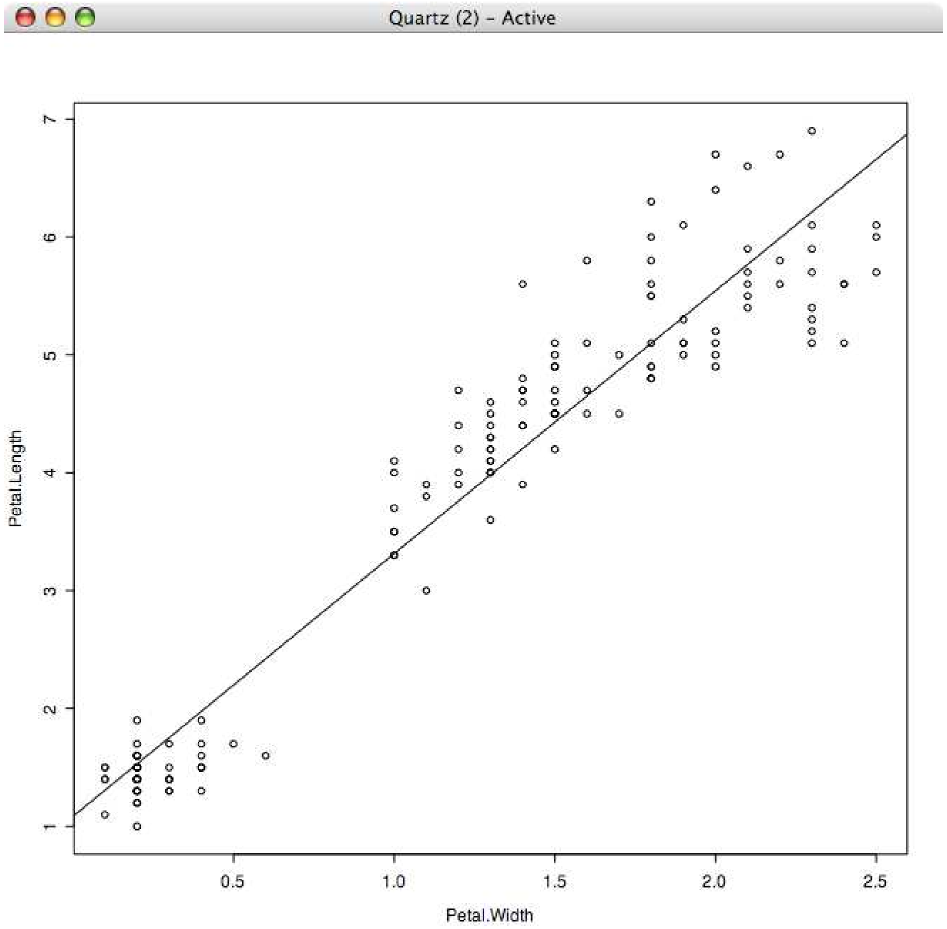
R Built-in Data Frames

```
> plot(iris)
```



Simple Model Building

```
> attach(iris)
> model <- lm(Petal.Length~Petal.Width)
> plot(Petal.Width,Petal.Length)
> abline(model)
```



Homework

Read Chapter 1 and Appendix B

Do Assignment 1, see website.