Homework 1

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1. The Iowa data set iowa.csv is a toy example that summarises the yield of wheat (bushels per acre) for the state of Iowa between 1930-1962. In addition to yield, year, rainfall and temperature were recorded as the main predictors of yield.

a. First, we need to load the data set into R using the command `read.csv()`. Use the help function to learn what arguments this function takes. Once you have the necessary input, load the data set into R and make it a data frame called `iowa.df`.

```
iowa.df <- read.csv("data/iowa.csv", header = T, sep = ";")
```

b. How many rows and columns does `iowa.df` have?

```
dim(iowa.df)
```

```
## [1] 33 10
```

c. What are the names of the columns of `iowa.df`?

```
colnames(iowa.df)
```

```
##  [1] "Year"  "Rain0" "Temp1" "Rain1" "Temp2" "Rain2" "Temp3" "Rain3" "Temp4"
## [10] "Yield"
```

d. What is the value of row 5, column 7 of `iowa.df`?

```
iowa.df[5, 7]
```

```
## [1] 79.7
```

e. Display the second row of `iowa.df` in its entirety.

```
iowa.df[2,]
```

```
##   Year Rain0 Temp1 Rain1 Temp2 Rain2 Temp3 Rain3 Temp4 Yield
## 2 1931 14.76  57.5  3.83    75  2.72  77.2   3.3  72.6  32.9
```

2. Syntax and class-typing.

a. For each of the following commands, either explain why they should be errors, or explain the non-erroneous result.

```
vector1 <- c("5", "12", "7", "32")
max(vector1)
sort(vector1)
sum(vector1)
```

```
vector1 <- c("5", "12", "7", "32")
max(vector1)
```

```
## [1] "7"
```

```
sort(vector1)
```

```
## [1] "12" "32" "5"  "7"
```

```
sum(vector1)
```

```
Error in sum(vector1) : invalid 'type' (character) of argument
```

The result of `max(vector1)` is “7”.

The result of `sort(vector1)` is “12” “32” “5” “7”.

`sum(vector1)` is error, because the data structure of the elements in `vector1` is character, which cannot be the parameter of `sum()`.

b. For the next series of commands, either explain their results, or why they should produce errors.

```
vector2 <- c("5",7,12)
vector2[2] + vector2[3]

dataframe3 <- data.frame(z1="5",z2=7,z3=12)
dataframe3[1,2] + dataframe3[1,3]

list4 <- list(z1="6", z2=42, z3="49", z4=126)
list4[[2]]+list4[[4]]
list4[2]+list4[4]
```

```
vector2 <- c("5",7,12)
vector2[2] + vector2[3]
```

```
Error in vector2[2] + vector2[3] :
  non-numeric argument to binary operator
```

Because the elements of a vector should be the same type, all three elements in `vector2` will be transformed to character `(c("5","7","12"))`, and `+` cannot link two characters.

```
dataframe3 <- data.frame(z1="5",z2=7,z3=12)
dataframe3[1,2] + dataframe3[1,3]
```

```
## [1] 19
```

The result is 19. Columns of `Data.Frame` can be different types, so `7+9=12`.

```r
list4 <- list(z1="6", z2=42, z3="49", z4=126)
list4[[2]]+list4[[4]]
```

```
## [1] 168
```

```r
list4[2]+list4[4]
```

```
Error in list4[2] + list4[4] : non-numeric argument to binary operator
```

The result of `list4[[2]]+list4[[4]]` is 168, but `list4[2]+list4[4]` produces an error. This is because `list4[[num]]` returns an element but `list4[num]` returns a list.

3. Working with functions and operators.

a. The colon operator will create a sequence of integers in order. It is a special case of the function `seq()` which you saw earlier in this assignment. Using the help command `?seq` to learn about the function, design an expression that will give you the sequence of numbers from 1 to 10000 in increments of 372. Design another that will give you a sequence between 1 and 10000 that is exactly 50 numbers in length.

```r
# seq1: a sequence of numbers from 1 to 10000 in increments of 372
seq1 <- seq(1, 10000, by = 372)
# seq2: a sequence of numbers between 1 and 10000 that is exactly 50 numbers in length
seq2 <- seq(1, 10000, length.out = 50)
```

b. The function `rep()` repeats a vector some number of times. Explain the difference between `rep(1:3, times=3)` and `rep(1:3, each=3)`.

```r
rep(1:3, times=3)
```

```
## [1] 1 2 3 1 2 3 1 2 3
```

```r
rep(1:3, each=3)
```

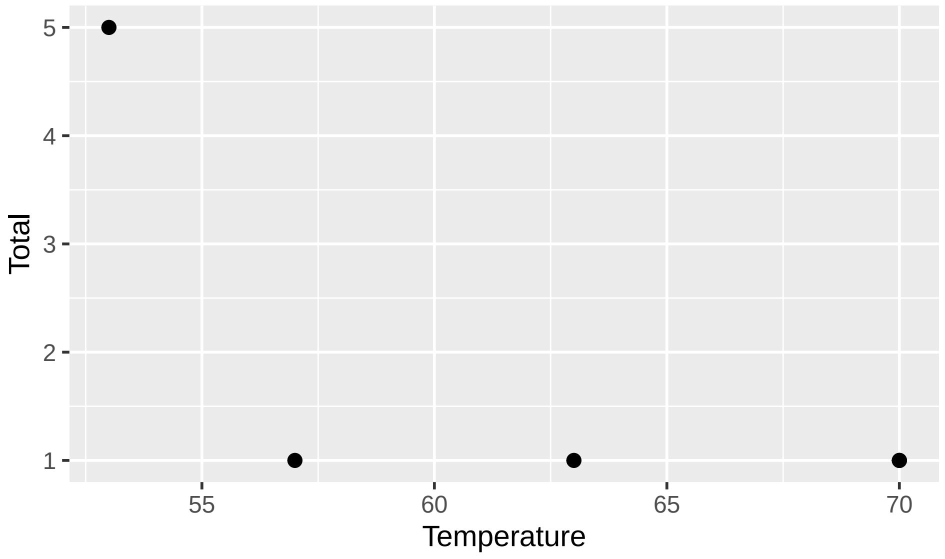
```
## [1] 1 1 1 2 2 2 3 3 3
```

`rep(1:3, times=3)` repeats the whole 1:3 for three times. `rep(1:3, each=3)` repeats each element in 1:3 for three times.

MB.Ch1.2. The orings data frame gives data on the damage that had occurred in US space shuttle launches prior to the disastrous Challenger launch of 28 January 1986. The observations in rows 1, 2, 4, 11, 13, and 18 were included in the pre-launch charts used in deciding whether to proceed with the launch, while remaining rows were omitted.

Create a new data frame by extracting these rows from orings, and plot total incidents against temperature for this new data frame. Obtain a similar plot for the full data set.

```r
orings.df <- orings[c(1, 2, 4, 11, 13), ]
ggplot(orings.df, aes(x = Temperature, y = Total)) +
  geom_point(size = 2)
```



MB.Ch1.4. For the data frame ais (DAAG package)

(a) Use the function str() to get information on each of the columns. Determine whether any of the columns hold missing values.

```r
str(ais)
```

```
## 'data.frame':    202 obs. of  13 variables:
##  $ rcc   : num  3.96 4.41 4.14 4.11 4.45 4.1 4.31 4.42 4.3 4.51 ...
##  $ wcc   : num  7.5 8.3 5 5.3 6.8 4.4 5.3 5.7 8.9 4.4 ...
##  $ hc    : num  37.5 38.2 36.4 37.3 41.5 37.4 39.6 39.9 41.1 41.6 ...
##  $ hg    : num  12.3 12.7 11.6 12.6 14 12.5 12.8 13.2 13.5 12.7 ...
##  $ ferr  : num  60 68 21 69 29 42 73 44 41 44 ...
##  $ bmi   : num  20.6 20.7 21.9 21.9 19 ...
##  $ ssf   : num  109.1 102.8 104.6 126.4 80.3 ...
##  $ pcBfat: num  19.8 21.3 19.9 23.7 17.6 ...
##  $ lbm   : num  63.3 58.5 55.4 57.2 53.2 ...
##  $ ht    : num  196 190 178 185 185 ...
##  $ wt    : num  78.9 74.4 69.1 74.9 64.6 63.7 75.2 62.3 66.5 62.9 ...
##  $ sex   : Factor w/ 2 levels "f","m": 1 1 1 1 1 1 1 1 1 1 ...
##  $ sport : Factor w/ 10 levels "B_Ball","Field",..: 1 1 1 1 1 1 1 1 1 1 ...
```

```r
which(is.na(ais))
```

```
## integer(0)
```

No columns hold missing values.

(b) Make a table that shows the numbers of males and females for each different sport. In which sports is there a large imbalance (e.g., by a factor of more than 2:1) in the numbers of the two sexes?

```r
table1 <- table(ais$sport, ais$sex)
imbalance <- table1[, 1] / table1[, 2]
imbalance < 0.5 | imbalance > 2
```

```
##   B_Ball    Field      Gym Netball      Row     Swim   T_400m T_Sprnt  Tennis   W_Polo
##    FALSE    FALSE     TRUE    TRUE    FALSE    FALSE    FALSE    TRUE    FALSE    TRUE
```

There is a large imbalance in Gym, Netball, T_Sprnt, W_Polo.

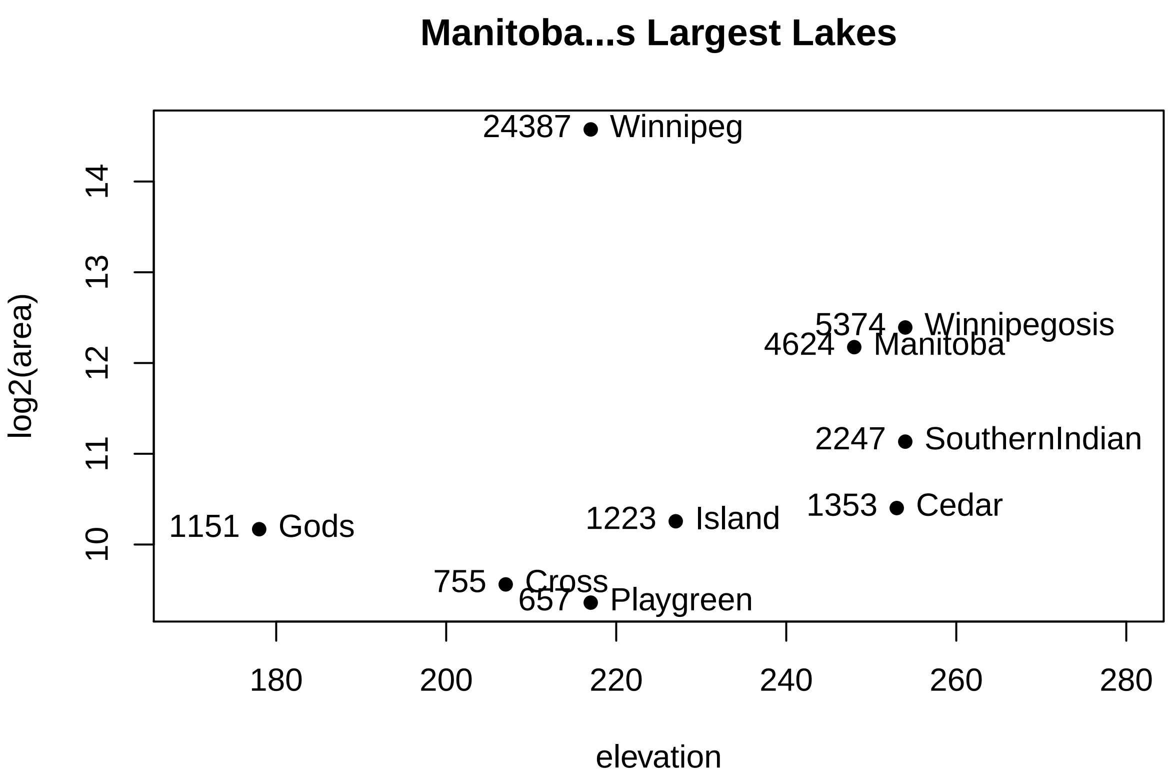
MB.Ch1.6.Create a data frame called Manitoba.lakes that contains the lake's elevation (in meters above sea level) and area (in square kilometers) as listed below. Assign the names of the lakes using the row.names() function.

```
               elevation  area
Winnipeg             217 24387
Winnipegosis         254  5374
Manitoba             248  4624
SouthernIndian       254  2247
Cedar                253  1353
Island               227  1223
Gods                 178  1151
Cross                207   755
Playgreen            217   657
```

(a) Use the following code to plot log2(area) versus elevation, adding labeling infor- mation (there is an extreme value of area that makes a logarithmic scale pretty much essential):

```r
attach(Manitoba.lakes)
plot(log2(area) ~ elevation, pch=16, xlim=c(170,280))
# NB: Doubling the area increases log2(area) by 1.0
text(log2(area) ~ elevation, labels=row.names(Manitoba.lakes), pos=4)
text(log2(area) ~ elevation, labels=area, pos=2)
title("Manitoba's Largest Lakes")
```

```
## Warning in title("Manitoba's Largest Lakes"): conversion failure on 'Manitoba's
## Largest Lakes' in 'mbcsToSbcs': dot substituted for <e2>

## Warning in title("Manitoba's Largest Lakes"): conversion failure on 'Manitoba's
## Largest Lakes' in 'mbcsToSbcs': dot substituted for <80>

## Warning in title("Manitoba's Largest Lakes"): conversion failure on 'Manitoba's
## Largest Lakes' in 'mbcsToSbcs': dot substituted for <99>
```



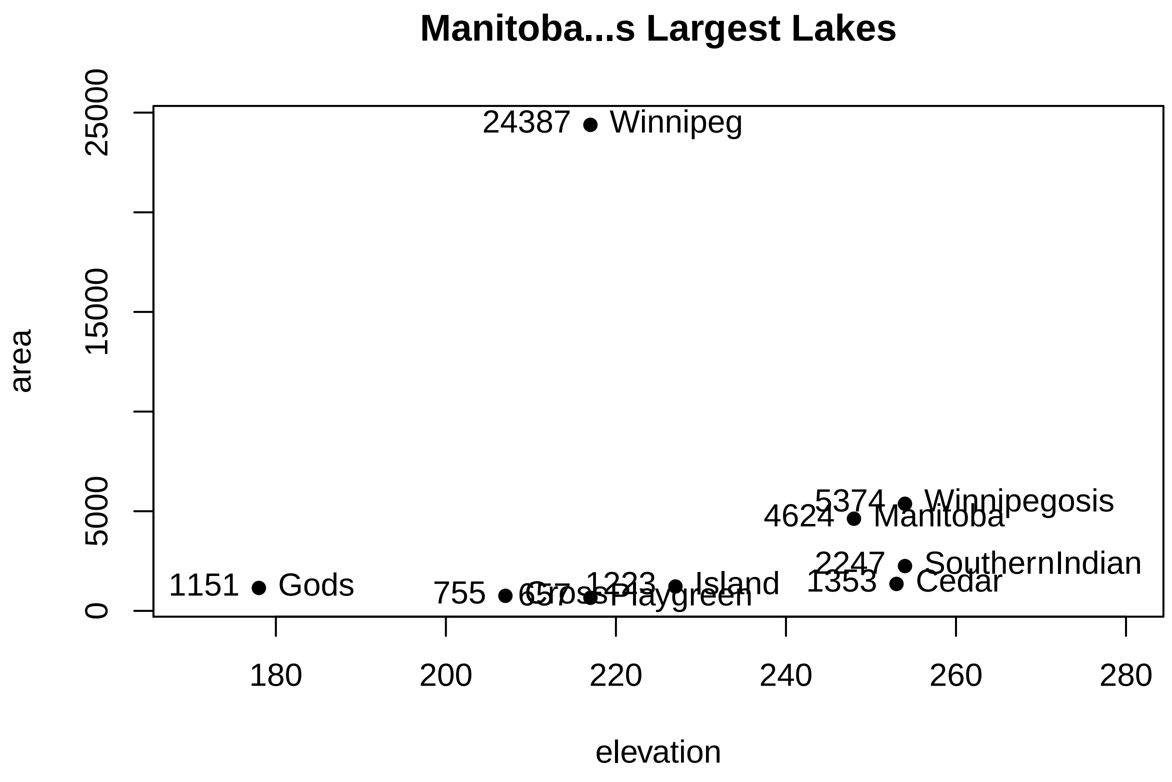
###

Devise captions that explain the labeling on the points and on the y-axis. It will be necessary to explain how distances on the scale relate to changes in area.

(b) Repeat the plot and associated labeling, now plotting area versus elevation, but specifying log="y" in order to obtain a logarithmic y-scale.

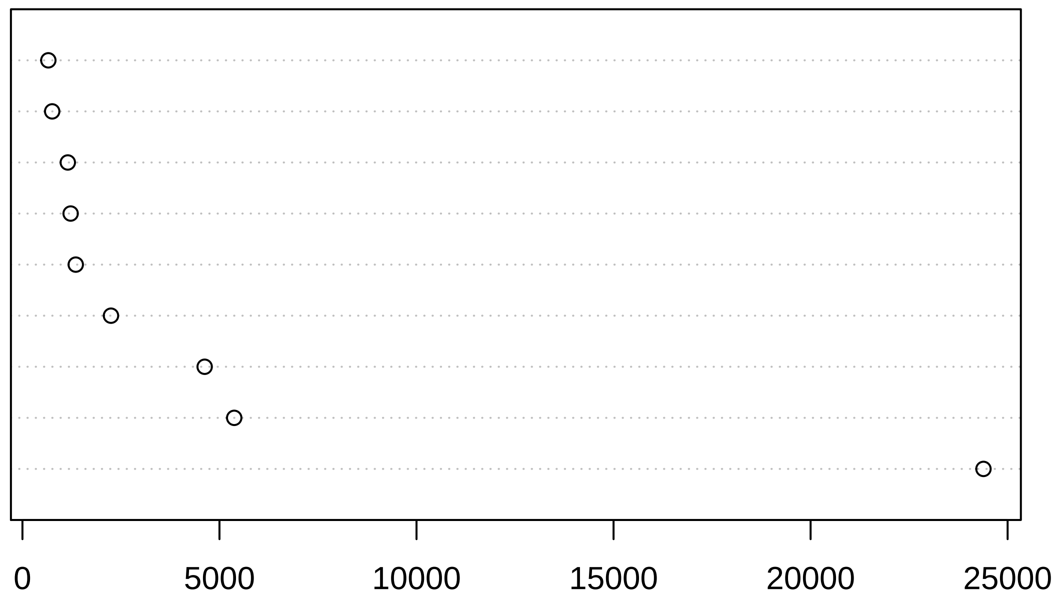
```r
plot(area ~ elevation, pch=16, xlim=c(170,280), ylog=T)
text(area ~ elevation, labels=row.names(Manitoba.lakes), pos=4, ylog=T)
text(area ~ elevation, labels=area, pos=2, ylog=T)
title("Manitoba's Largest Lakes")
```

```
## Warning in title("Manitoba's Largest Lakes"): conversion failure on 'Manitoba's
## Largest Lakes' in 'mbcsToSbcs': dot substituted for <e2>

## Warning in title("Manitoba's Largest Lakes"): conversion failure on 'Manitoba's
## Largest Lakes' in 'mbcsToSbcs': dot substituted for <80>

## Warning in title("Manitoba's Largest Lakes"): conversion failure on 'Manitoba's
## Largest Lakes' in 'mbcsToSbcs': dot substituted for <99>
```

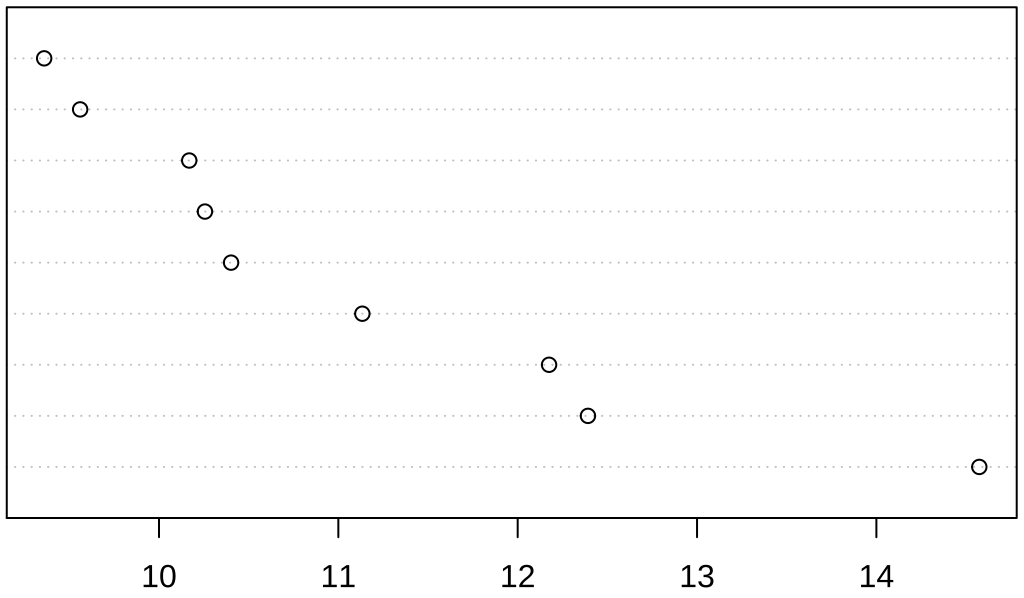


MB.Ch1.7. Look up the help page for the R function dotchart(). Use this function to display the areas of the Manitoba lakes (a) on a linear scale, and (b) on a logarithmic scale. Add, in each case, suitable labeling information.

```
dotchart(area)
```



```
dotchart(log2(area))
```



MB.Ch1.8. Using the sum() function, obtain a lower bound for the area of Manitoba covered by water.

```
sum(Manitoba.lakes[2])
```

```
## [1] 41771
```