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)
iowa.df
```

	Year	Rain0	Temp1	Rain1	Temp2	Rain2	Temp3	Rain3	Temp4	Yield
1	1930	17.75	60.2	5.83	69.0	1.49	77.9	2.42	74.4	34.0
2	1931	14.76	57.5	3.83	75.0	2.72	77.2	3.30	72.6	32.9
3	1932	27.99	62.3	5.17	72.0	3.12	75.8	7.10	72.2	43.0
4	1933	16.76	60.5	1.64	77.8	3.45	76.4	3.01	70.5	40.0
5	1934	11.36	69.5	3.49	77.2	3.85	79.7	2.84	73.4	23.0
6	1935	22.71	55.0	7.00	65.9	3.35	79.4	2.42	73.6	38.4
7	1936	17.91	66.2	2.85	70.1	0.51	83.4	3.48	79.2	20.0
8	1937	23.31	61.8	3.80	69.0	2.63	75.9	3.99	77.8	44.6
9	1938	18.53	59.5	4.67	69.2	4.24	76.5	3.82	75.7	46.3
10	1939	18.56	66.4	5.32	71.4	3.15	76.2	4.72	70.7	52.2
11	1940	12.45	58.4	3.56	71.3	4.57	76.7	6.44	70.7	52.3
12	1941	16.05	66.0	6.20	70.0	2.24	75.1	1.94	75.1	51.0
13	1942	27.10	59.3	5.93	69.7	4.89	74.3	3.17	72.2	59.9
14	1943	19.05	57.5	6.16	71.6	4.56	75.4	5.07	74.0	54.7
15	1944	20.79	64.6	5.88	71.7	3.73	72.6	5.88	71.8	52.0
16	1945	21.88	55.1	4.70	64.1	2.96	72.1	3.43	72.5	43.5
17	1946	20.02	56.5	6.41	69.8	2.45	73.8	3.56	68.9	56.7
18	1947	23.17	55.6	10.39	66.3	1.72	72.8	1.49	80.6	30.5
19	1948	19.15	59.2	3.42	68.6	4.14	75.0	2.54	73.9	60.5
20	1949	18.28	63.5	5.51	72.4	3.47	76.2	2.34	73.0	46.1
21	1950	18.45	59.8	5.70	68.4	4.65	69.7	2.39	67.7	48.2
22	1951	22.00	62.2	6.11	65.2	4.45	72.1	6.21	70.5	43.1
23	1952	19.05	59.6	5.40	74.2	3.84	74.7	4.78	70.0	62.2
24	1953	15.67	60.0	5.31	73.2	3.28	74.6	2.33	73.2	52.9
25	1954	15.92	55.6	6.36	72.9	1.79	77.4	7.10	72.1	53.9
26	1955	16.75	63.6	3.07	67.2	3.29	79.8	1.79	77.2	48.4
27	1956	12.34	62.4	2.56	74.7	4.51	72.7	4.42	73.0	52.8
28	1957	15.82	59.0	4.84	68.9	3.54	77.9	3.76	72.9	62.1
29	1958	15.24	62.5	3.80	66.4	7.55	70.5	2.55	73.0	66.0
30	1959	21.72	62.8	4.11	71.5	2.29	72.3	4.92	76.3	64.2
31	1960	25.08	59.7	4.43	67.4	2.76	72.6	5.36	73.2	63.2
32	1961	17.79	57.4	3.36	69.4	5.51	72.6	3.04	72.4	75.4
33	1962	26.61	66.6	3.12	69.1	6.27	71.6	4.31	72.5	76.0

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

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

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

This means the dataframe has 33 rows and 10 columns.

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

The names of the columns are “Year”,“Rain0”,“T emp1”,“Rain 1”,“Temp2”,“Rain2”,“T emp3”,“Rain3”,“T emp4”,“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)
```

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

```
sort (vector1)
```

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

```
#sum(vector1)
```

For ‘max(vector1)’, this command returns the biggest element in vector1. Because the type of values is character, so they are compared bit by bit through ASCII code. SO ‘7’ is the biggest one.

For ‘sort(vector1)’,This command reorders the list from small to large based on ASCII code.

For ‘sum(vector1)’, The sum() function sums a vector of numeric type whose data type is a charactor.

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]
```

They should produce errors. Because a vector is a sequence of values, all of the same type. It is obvious that type of ‘5’ is character and the others is numeric. Then 7 and 12 are changed to ‘7’ and ‘12’, but characters cannot be added.

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

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

Dataframe3[1,2] is 7 and datafr ame3[1,3] is 12. They are all numeric types and can be added. The result is 19

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

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

```
#list4[2]+list4[4]
```

List4[[2]] is 42 and list4[[4]] is 126. They are all numeric types and can be added. The result is 168.the type of list[2] and list[4] is list.So the error is non-numeric argument to binary operator

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.

```
seq(1, 10000, by=372)
```

```
##  [1]    1  373  745 1117 1489 1861 2233 2605 2977 3349 3721 4093 4465 4837 5209
## [16] 5581 5953 6325 6697 7069 7441 7813 8185 8557 8929 9301 9673
```

```
seq(1, 10000, length.out = 50)
```

```
##  [1]     1.0000   205.0612   409.1224   613.1837   817.2449  1021.3061
##  [7]  1225.3673  1429.4286  1633.4898  1837.5510  2041.6122  2245.6735
## [13]  2449.7347  2653.7959  2857.8571  3061.9184  3265.9796  3470.0408
## [19]  3674.1020  3878.1633  4082.2245  4286.2857  4490.3469  4694.4082
## [25]  4898.4694  5102.5306  5306.5918  5510.6531  5714.7143  5918.7755
## [31]  6122.8367  6326.8980  6530.9592  6735.0204  6939.0816  7143.1429
## [37]  7347.2041  7551.2653  7755.3265  7959.3878  8163.4490  8367.5102
## [43]  8571.5714  8775.6327  8979.6939  9183.7551  9387.8163  9591.8776
## [49]  9795.9388 10000.0000
```

   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) .

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

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

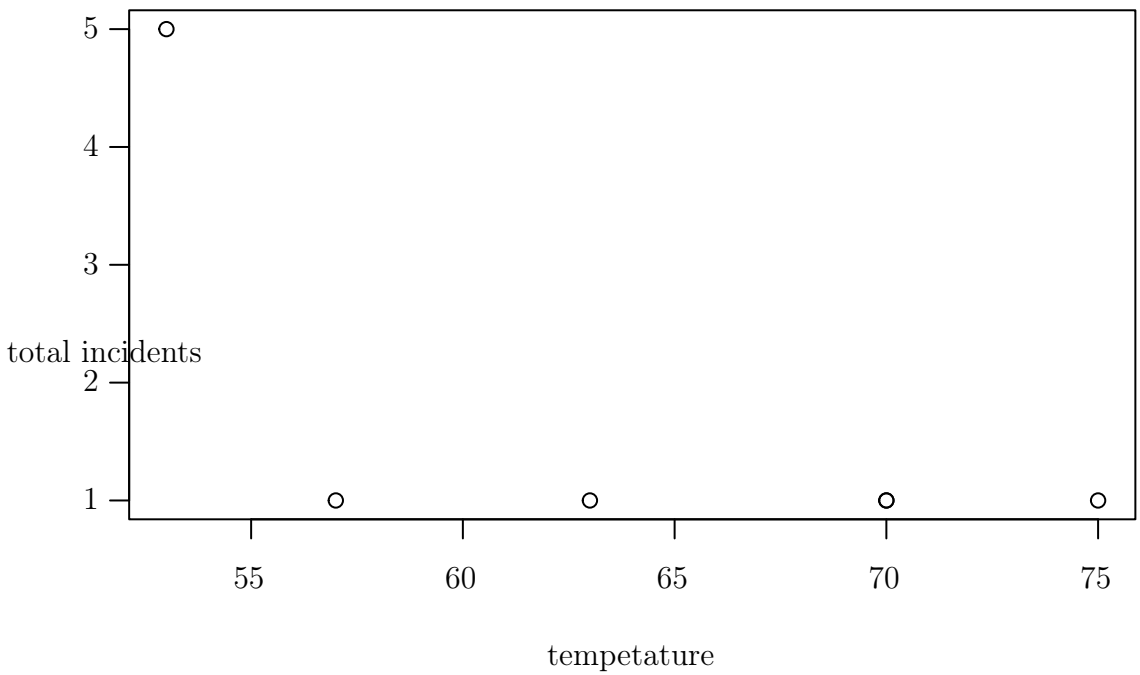
```
rep(1:3, each= 3)
```

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

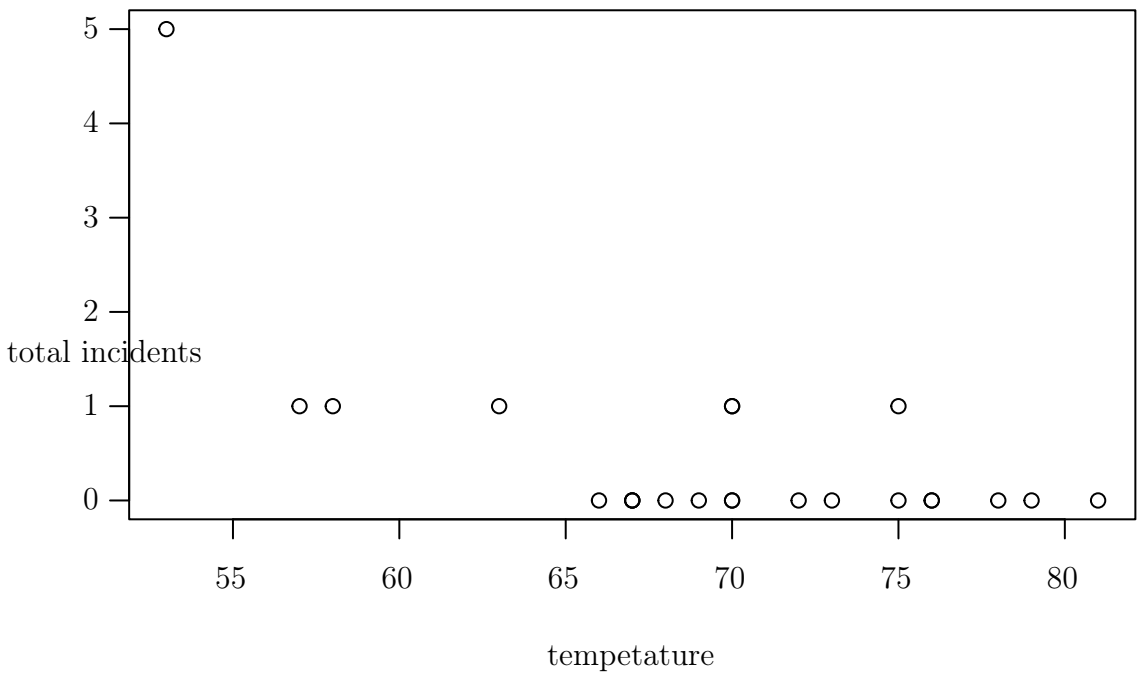
MB.Ch1.2. The orings data frame gives data on the damage that had occurred in US space shuttle launches prior to the disastrous Challenger launch of 28 January 1986. The observations in rows 1, 2, 4, 11, 13, and 18 were included in the pre-launch charts used in deciding whether to proceed with the launch,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

```
data("orings")
orings.df <- orings[c(1, 2, 4, 11, 13, 18),]
plot(orings.df[, 'Temperature'],orings.df[, 'Total'], xlab='tempetature', ylab='total incidents')
```




```
plot (orings[, 'Temperature'],orings[, 'Total'], xlab='tempetature', ylab='total incidents')
```



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.

```
library (DAAG)
data ("ais")
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 ...
```

```
colSums (apply (ais, 2,is.na))
```

```
##    rcc    wcc     hc     hg   ferr    bmi    ssf pcBfat    lbm     ht     wt
##      0      0      0      0      0      0      0      0      0      0      0
```

```
##      sex    sport
##        0        0
```

so no columns held 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?

solution1:

```
library (DAAG)
data ("ais")
ais2 <- dplyr :: select (ais,sex,sport)
aisnw <- table (ais2 $sport,ais2 $sex)
aisnw
```

```
##
##                f  m
##     B_Ball    13 12
##     Field      7 12
##     Gym        4  0
##     Netball   23  0
##     Row       22 15
##     Swim       9 13
##     T_400m    11 18
##     T_Sprnt    4 11
##     Tennis     7  4
##     W_Polo     0 17
```

```
b<- aisnw[, 1] / aisnw[, 2]
b
```

```
##      B_Ball       Field         Gym     Netball         Row        Swim      T_400m     T_Sprnt
##  1.0833333   0.5833333         Inf         Inf   1.4666667   0.6923077   0.6111111   0.3636364
##      Tennis      W_Polo
##  1.7500000   0.0000000
```

soluntion2:

```
library (DAAG)
data ("ais")
ais2 <- dplyr :: select (ais,sex,sport)
total <- data.frame ('female' =dim(ais2 %>%filter (sport =='B_Ball','sex =='f'))[ 1],
                     'male' =dim(ais2 %>%filter (sport =='B_Ball','sex =='m'))[ 1],
                     'Sport' ='B_Ball')
total[ 2,] <- data.frame ('female' =dim(ais2 %>%filter (sport =='Row','sex =='f'))[ 1],
                          'male' =dim(ais2 %>%filter (sport =='Row','sex =='m'))[ 1],
                          'Sport' ='Row')
total[ 3,] <- data.frame ('female' =dim(ais2 %>%filter (sport =='Netball ','sex =='f'))[ 1],
                          'male' =dim(ais2 %>%filter (sport =='Netball ','sex =='m'))[ 1],
                          'Sport' ='Netball ')
total[ 4,] <- data.frame ('female' =dim(ais2 %>%filter (sport =='Swim','sex =='f'))[ 1],
                          'male' =dim(ais2 %>%filter (sport =='Swim','sex =='m'))[ 1],
                          'Sport' ='Swim')
total[ 5,] <- data.frame ('female' =dim(ais2 %>%filter (sport =='Field ','sex =='f'))[ 1],
                          'male' =dim(ais2 %>%filter (sport =='Field ','sex =='m'))[ 1],
                          'Sport' ='Field ')
total[ 6,] <- data.frame ('female' =dim(ais2 %>%filter (sport =='T_400m','sex =='f'))[ 1],
                          'male' =dim(ais2 %>%filter (sport =='T_400m','sex =='m'))[ 1],
```

```
                                  'Sport' = 'T_400m')
total[7,] <- data.frame('female' = dim(ais2 %>% filter(sport == 'T_Sprnt', sex == 'f'))[1],
                        'male' = dim(ais2 %>% filter(sport == 'T_Sprnt', sex == 'm'))[1],
                        'Sport' = 'T_Sprnt')
total[8,] <- data.frame('female' = dim(ais2 %>% filter(sport == 'Tennis', sex == 'f'))[1],
                        'male' = dim(ais2 %>% filter(sport == 'Tennis', sex == 'm'))[1],
                        'Sport' = 'Tennis')
total[9,] <- data.frame('female' = dim(ais2 %>% filter(sport == 'Gym', sex == 'f'))[1],
                        'male' = dim(ais2 %>% filter(sport == 'Gym', sex == 'm'))[1],
                        'Sport' = 'Gym')
total[10,] <- data.frame('female' = dim(ais2 %>% filter(sport == 'W_Polo', sex == 'f'))[1],
                         'male' = dim(ais2 %>% filter(sport == 'W_Polo', sex == 'm'))[1],
                         'Sport' = 'W_Polo')
aisnew <- total %>% mutate('f:m' = female / male)
aisnew
```

```
##    female male    Sport      f:m
## 1      13   12   B_Ball 1.0833333
## 2      22   15      Row 1.4666667
## 3      23    0  Netball      Inf
## 4       9   13     Swim 0.6923077
## 5       7   12    Field 0.5833333
## 6      11   18   T_400m 0.6111111
## 7       4   11  T_Sprnt 0.3636364
## 8       7    4   Tennis 1.7500000
## 9       4    0      Gym      Inf
## 10      0   17  W_Polo 0.0000000
```

From 'aisnew', we can know that there is a large imbalance in T_Sprnt, Netball and Gym.

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.

```
data("Manitoba.lakes")
Manitoba.lakes
```

```
##                   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
```

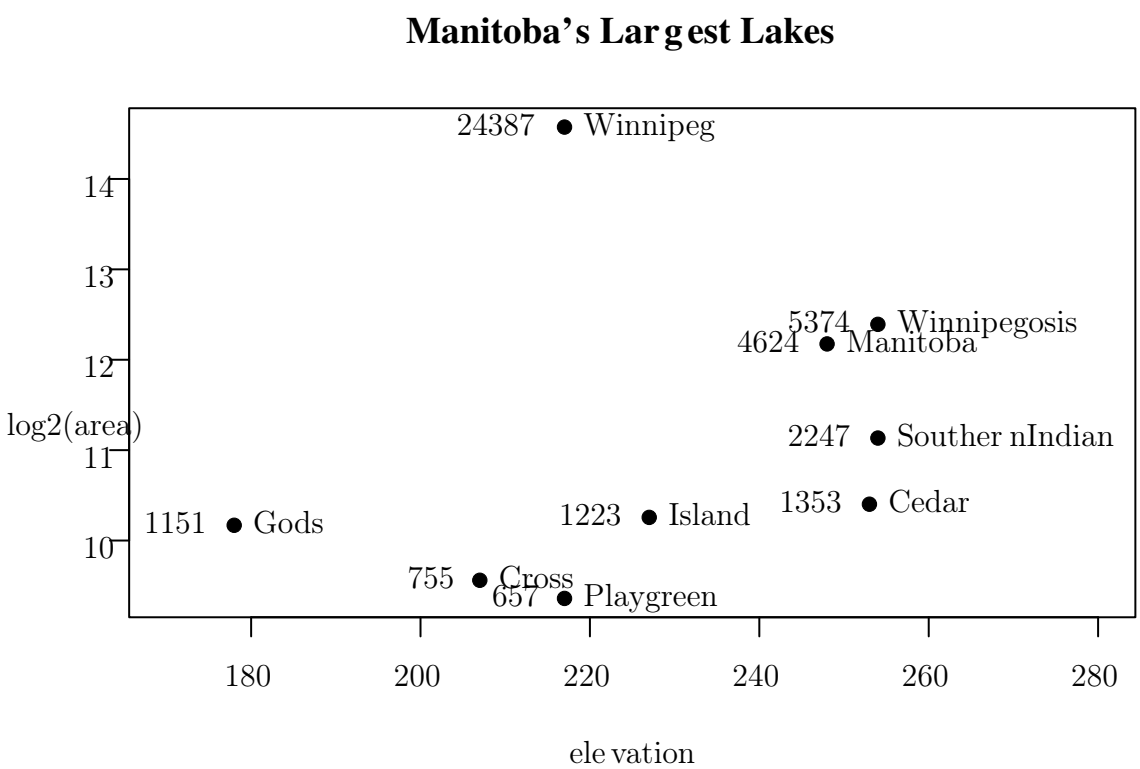
```
row.names(Manitoba.lakes) <- c("Winnipeg", "Winnipegosis", "Manitoba", "SouthernIndian", "Cedar", "Island", "Go
```

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

```
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)
```

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

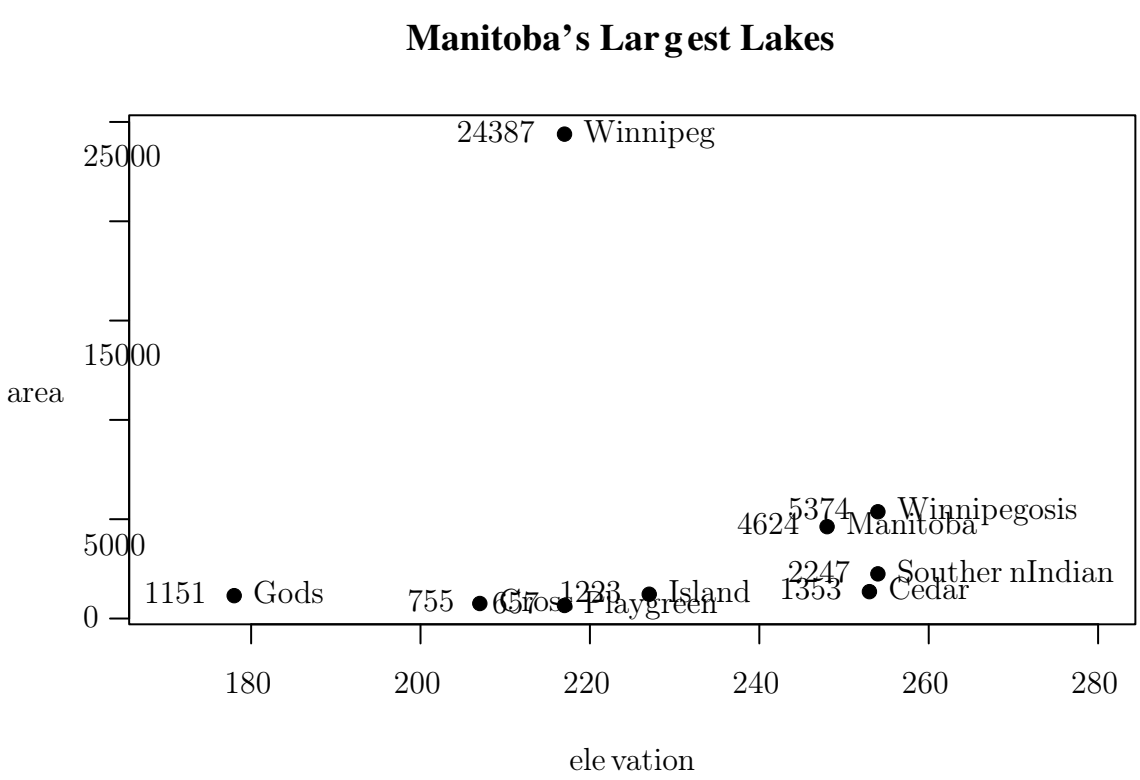
```
text (log2(area) ~ elevation, labels= area, pos=2)
title ("Manitoba's Largest Lakes")
```



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.

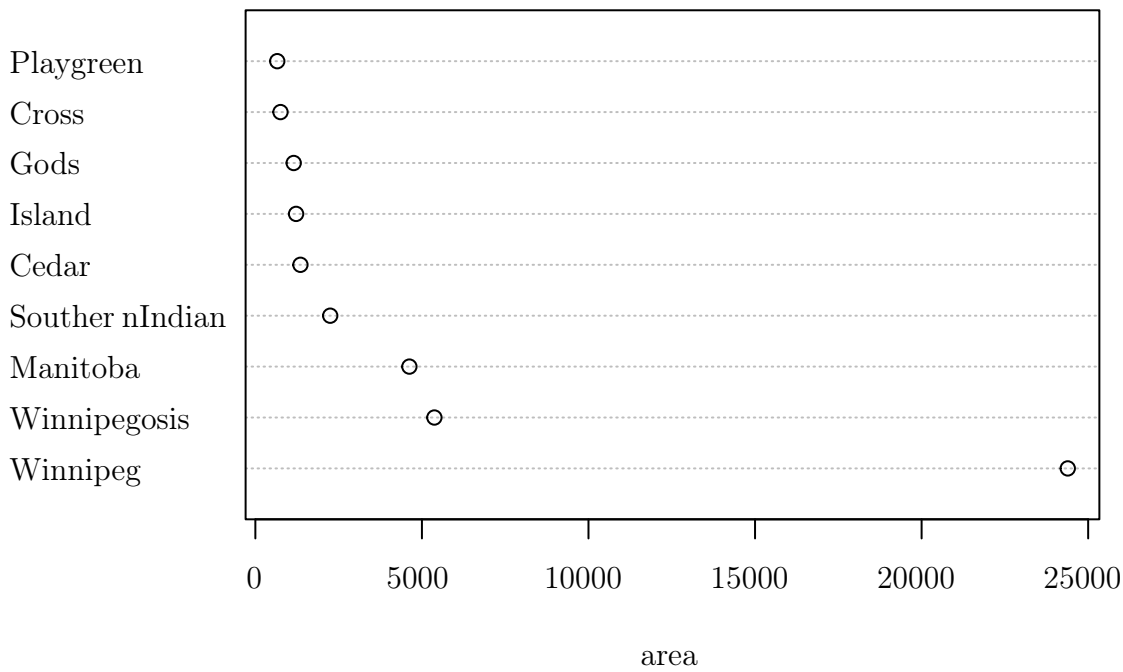
(b) Repeat the plot and associated labeling, now plotting area versus elevation, but specifying ylog=TRUE in order to obtain a logarithmic y-scale.

```
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")
```

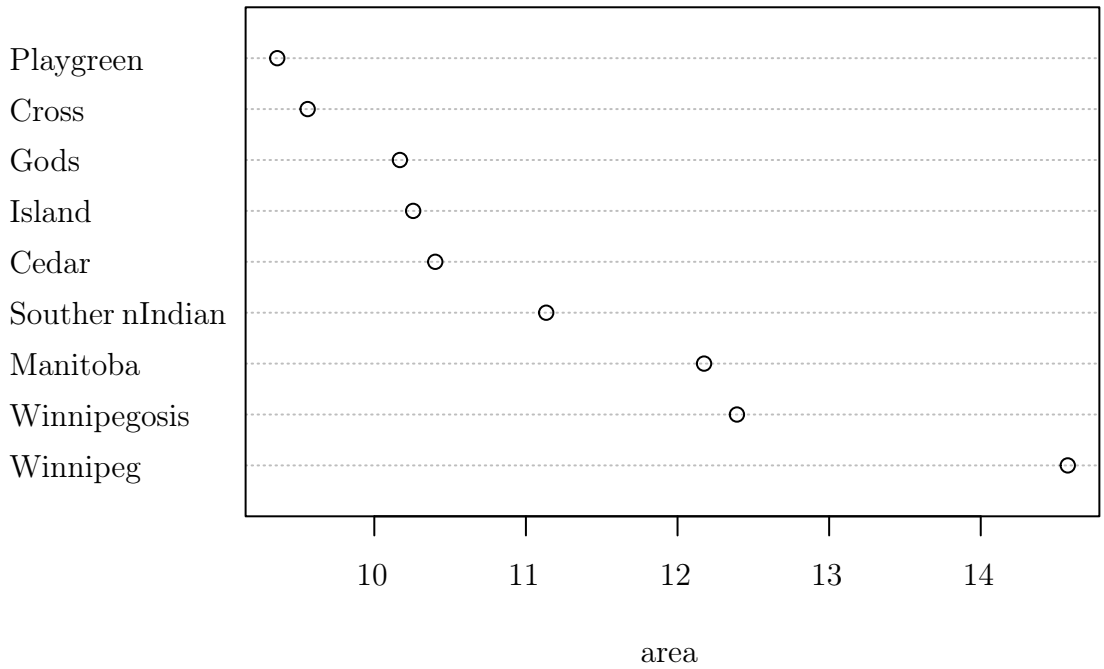


MB.Ch1.7. Look up the help page for the R function dotchart() . Use this function to display the areas of the Manitoba lakes (a) on a linear scale, and (b) on a logarithmic scale. Add, in each case, suitable labeling information.

```
data (Manitoba.lakes)
dotchart (area, labels= row.names (Manitoba.lakes), xlab= ' area ' )
```




```
data (Manitoba.lakes)
dotchart ( log2 (area), labels= row.names (Manitoba.lakes), xlab= ' area ' )
```



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

```
data (Manitoba.lakes)
sum(Manitoba.lakes[, 'area'])
```

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