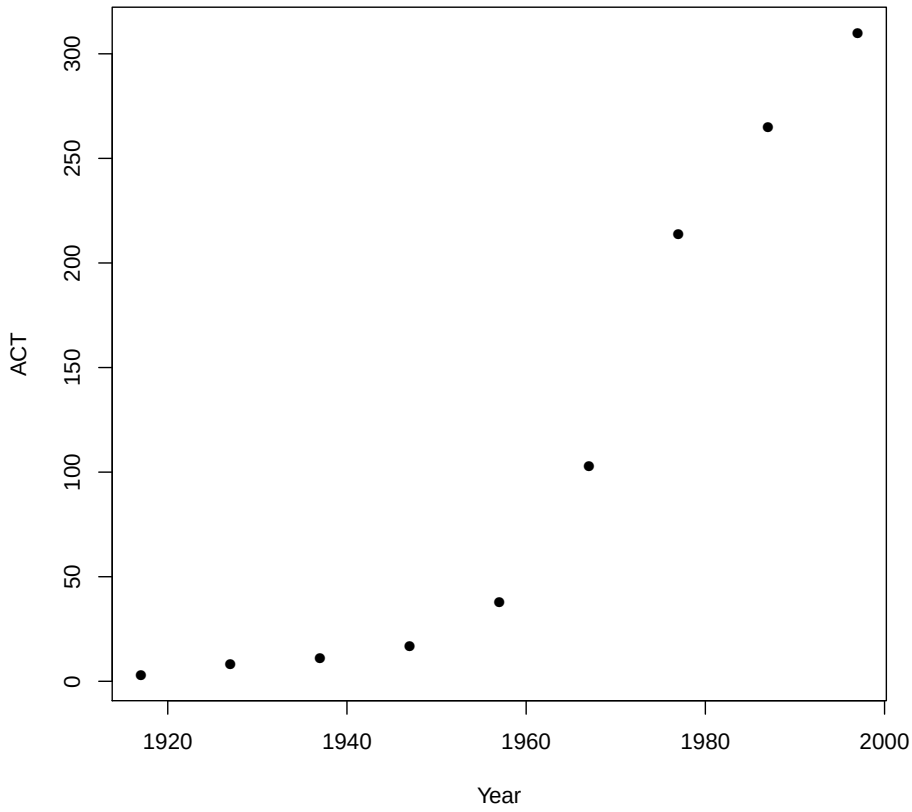
36-463 / 36-663: Multilevel & Hierarchical Models
HW01 Solution

September 19, 2016

Exercise 1

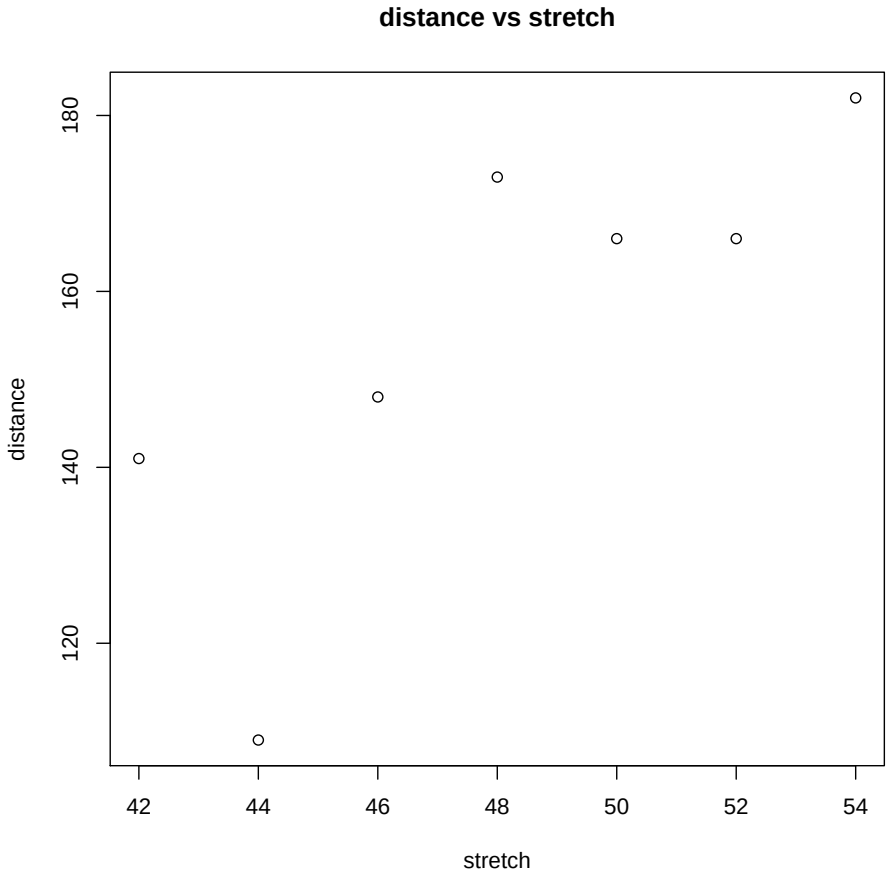
	Year	*NSW*	*Vic.*	*Qld*	*SA*	*WA*	*Tas.*	*NT*	*ACT*	*Aust.*
1	1917	1904	1409	683	440	306	193	5	3	49141
2	1927	2402	1727	873	565	392	211	4	8	6182
3	1937	2693	1853	993	589	457	233	6	11	6836
4	1947	2985	2055	1106	646	502	257	11	17	7579
5	1957	3625	2656	1413	873	688	326	21	38	9640
6	1967	4295	3274	1700	1110	879	375	62	103	11799
7	1977	5002	3837	2130	1286	1204	415	104	214	14192
8	1987	5617	4210	2675	1393	1496	449	158	265	16264
9	1997	6274	4605	3401	1480	1798	474	187	310	18532

```
A=read.table("austpop.txt",head=TRUE)
plot(ACT ~ Year, data=austpop, pch=16)
```



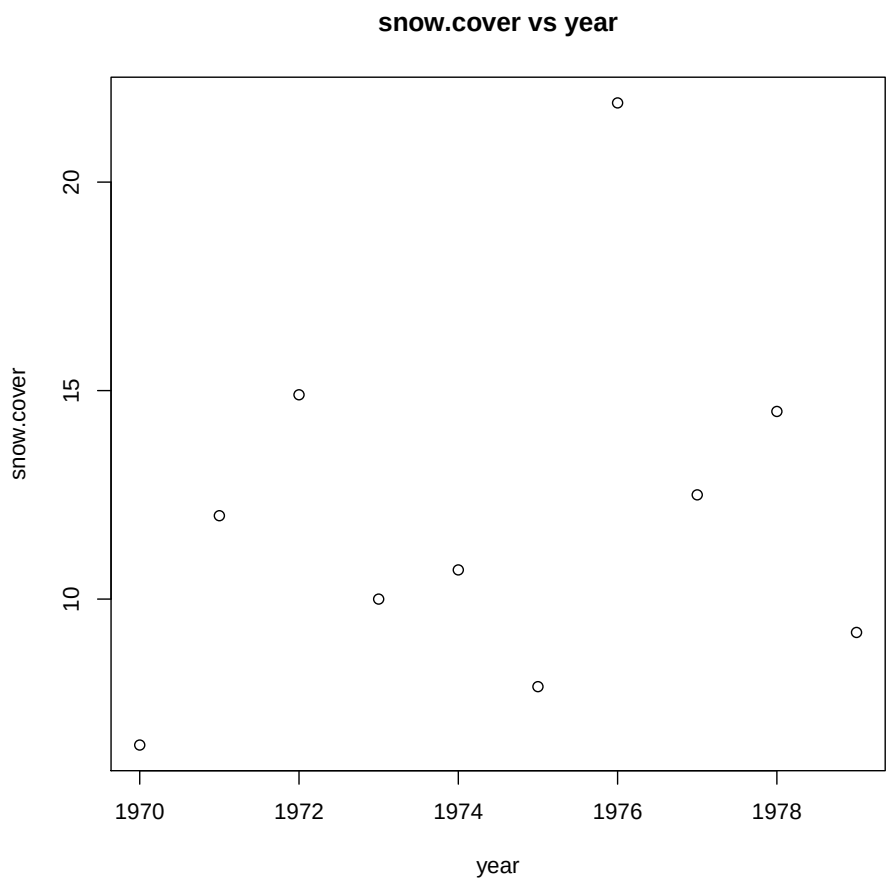
chapter 1 # 1

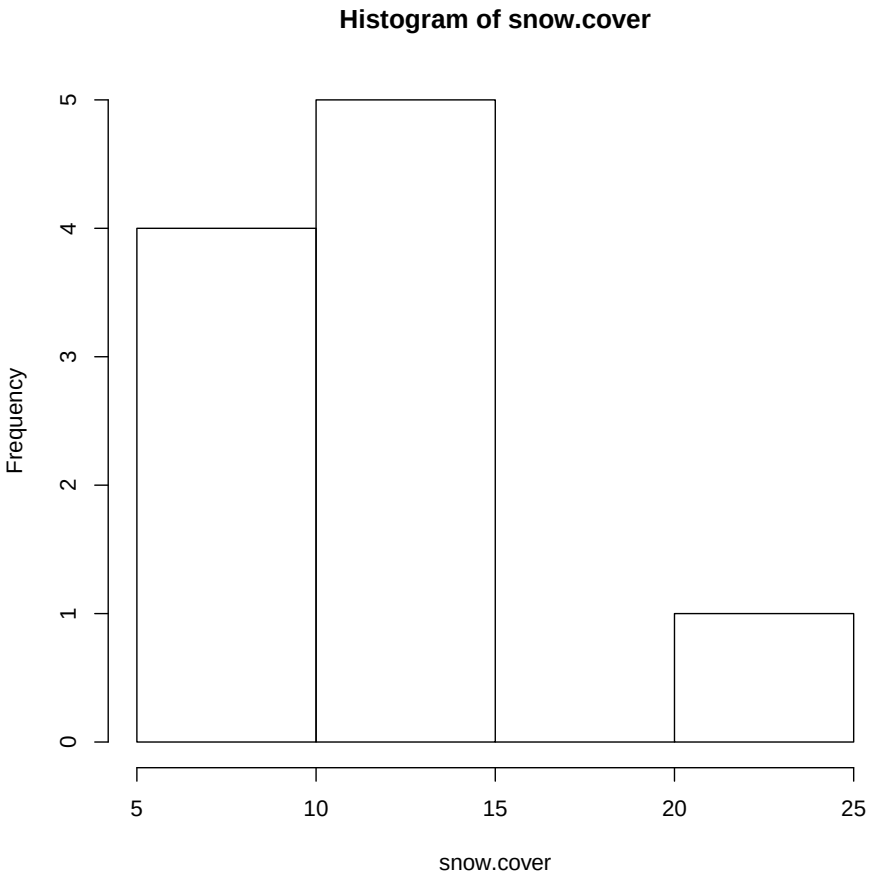
```
plot(elasticband$stretch,elasticband$distance,xlab= 'stretch',
ylab='distance',main="distance vs stretch")
```

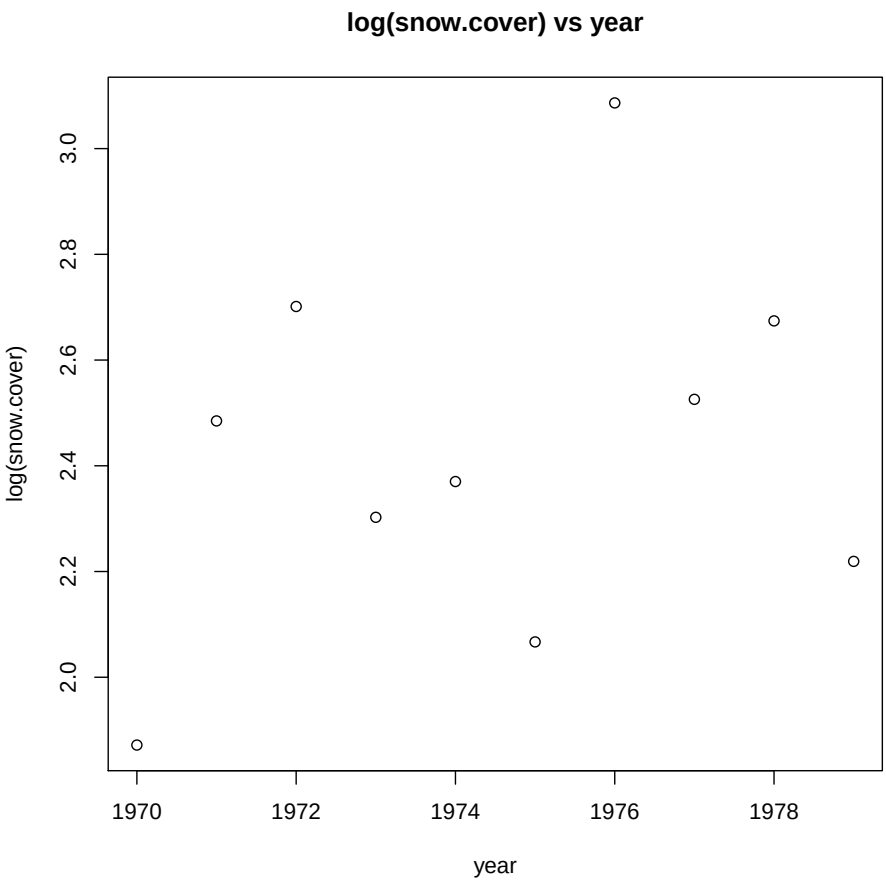


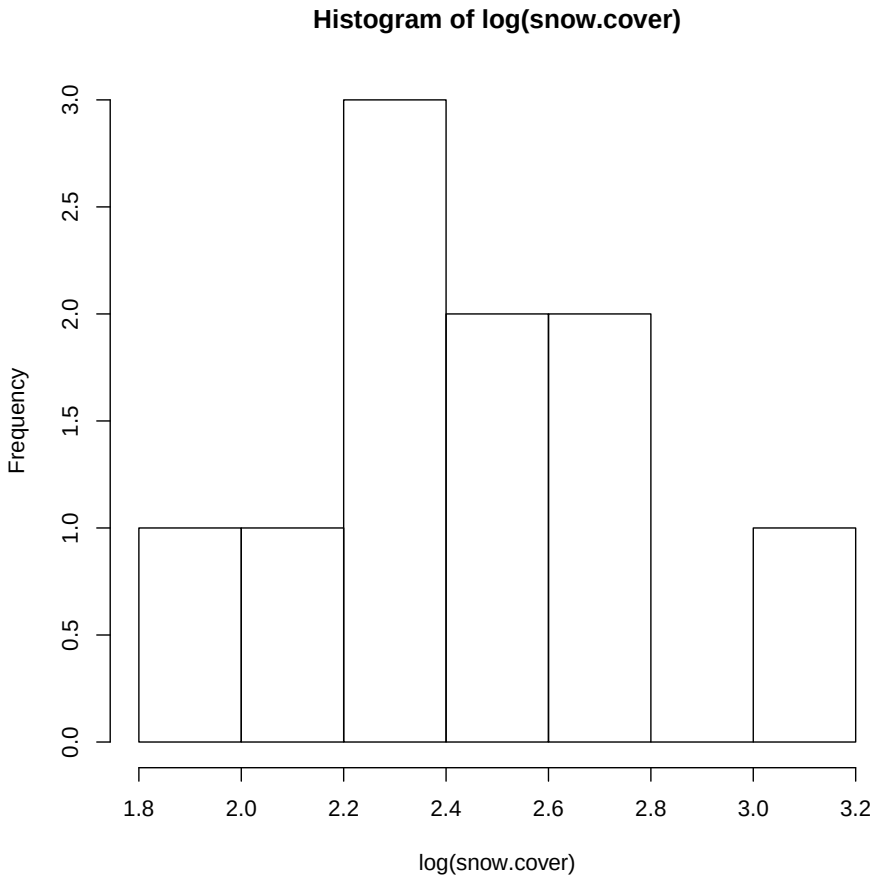
chapter 1 # 2

```
year <- 1970:1979
snow.cover <- c(6.5,12.0,14.9,10.0,10.7,7.9,21.9,12.5,14.5,9.2)
plot(year,snow.cover,main="snow.cover vs year")
hist(snow.cover)
plot(year,log(snow.cover),main="log(snow.cover) vs year")
hist(log(snow.cover))
```


snow.cover vs year
snow.cover
10
15
20
1970
1972
1974
1976
1978
year

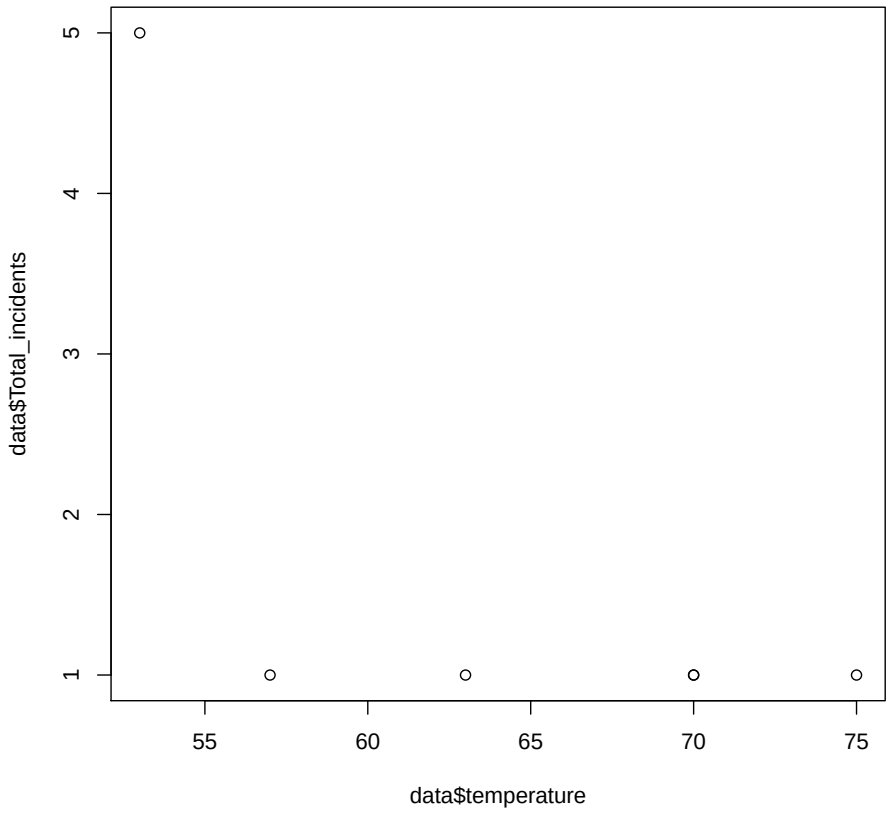

Histogram of snow.cover
Frequency
0
1
2
3
4
5
5
10
15
20
25
snow.cover


log(snow.cover) vs year
log(snow.cover)
2.0
2.2
2.4
2.6
2.8
3.0
1970
1972
1974
1976
1978
year



chapter 1 # 3

```
data <- data.frame(temperature = c(53,57,63,70,70,75),Erosion_incidents = c(3,1,1,1,1,0),
Blowby_incidents = c(2,0,0,0,0,2),Total_incidents =c(5,1,1,1,1,1))
plot(data$Total_incidents~data$temperature)
```



Exercise 2

Chapter 2 # 1

part a) 12
part b) 22
part c) 600

Chapter 2 # 2

```
prod(c(10,3,4,5))
```

Chapter 2 # 5

```
data <-  data.frame(radius = 3:20, volume = 4*pi *(3:20)^3/3)
```

Chapter 2 # 6

```
temp <-  sapply(tinting, is.factor)
\newline
```

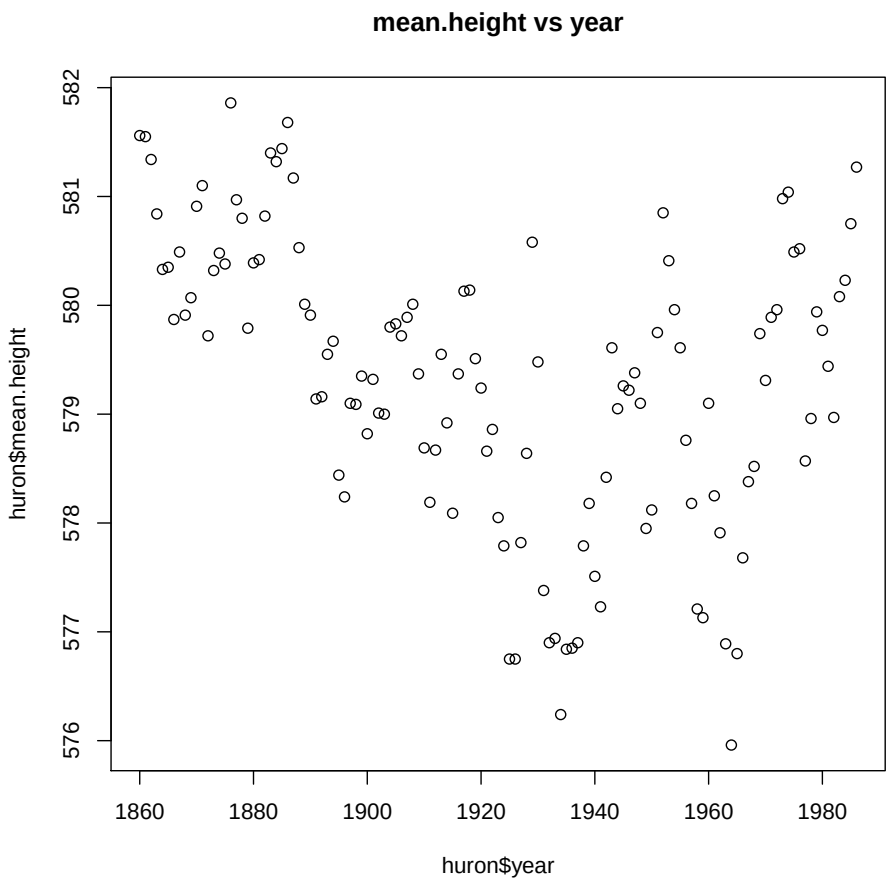
```
  case     id    age    sex   tint target     it   csoa  agegp
 FALSE  FALSE  FALSE   TRUE   TRUE   TRUE  FALSE  FALSE   TRUE
```

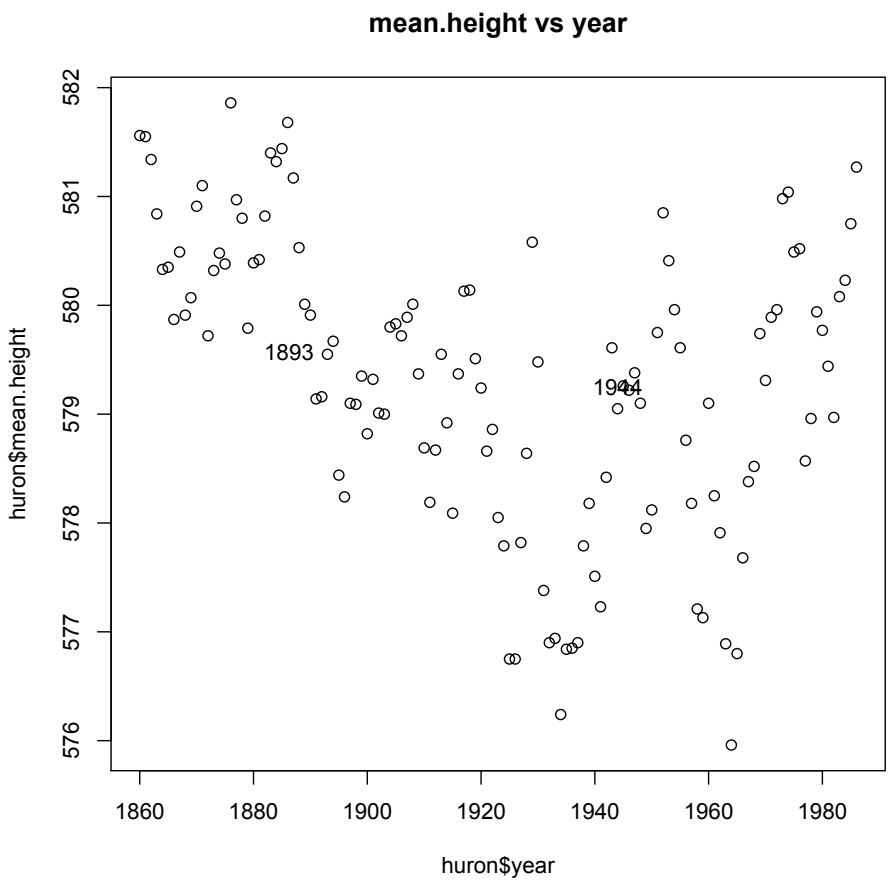
```
sapply(tinting[,a],is.ordered)
   sex   tint target  agegp
 FALSE   TRUE  FALSE  FALSE
```

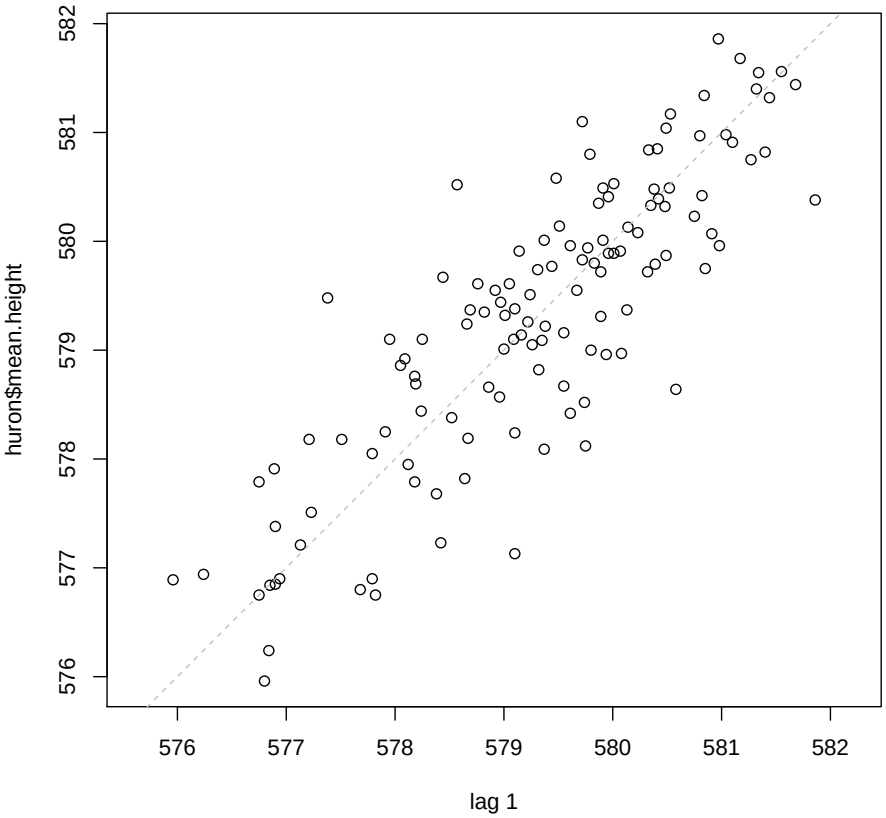
```
   radius     volume
1       3   113.0973
2       4   268.0826
3       5   523.5988
4       6   904.7787
5       7  1436.7550
6       8  2144.6606
7       9  3053.6281
8      10  4188.7902
9      11  5575.2798
10     12  7238.2295
11     13  9202.7721
12     14 11494.0403
13     15 14137.1669
14     16 17157.2847
15     17 20579.5263
16     18 24429.0245
17     19 28730.9120
18     20 33510.3216
```

1 Exercise 3

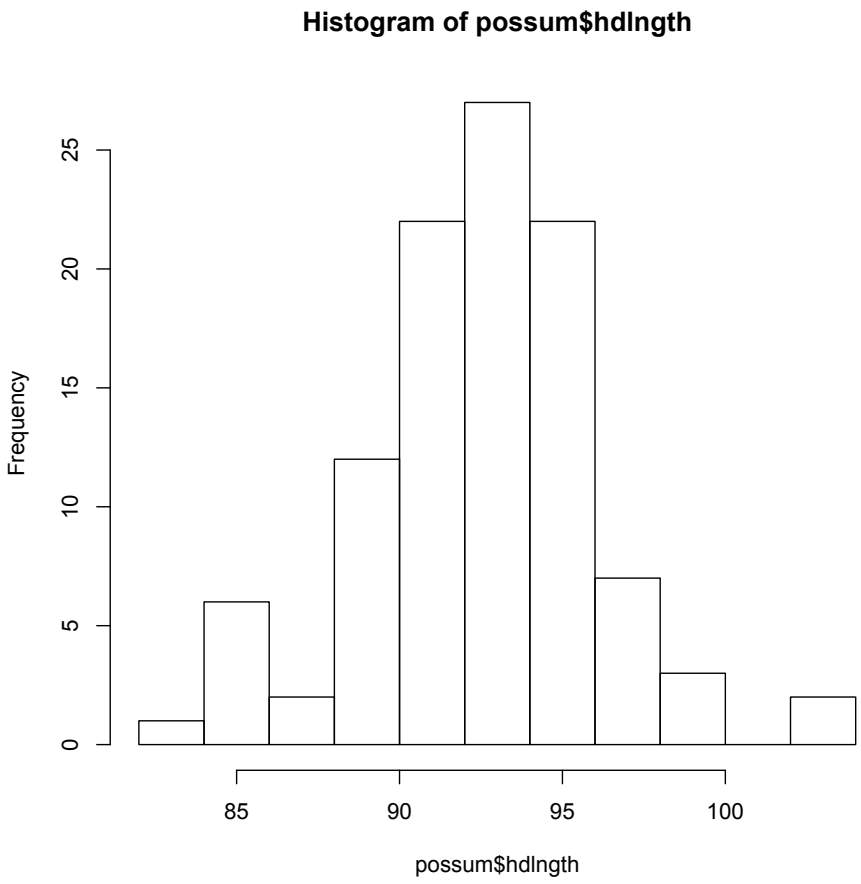
chapter 3 # 1


mean.height vs year
huron$mean.height
huron$year
576
577
578
579
580
581
582
1860
1880
1900
1920
1940
1960
1980


mean.height vs year
huron$mean.height
huron$year
576
577
578
579
580
581
582
1860
1880
1900
1920
1940
1960
1980
1893
1944


huron$mean.height
lag 1
576
577
578
579
580
581
582

chapter 3 # 3

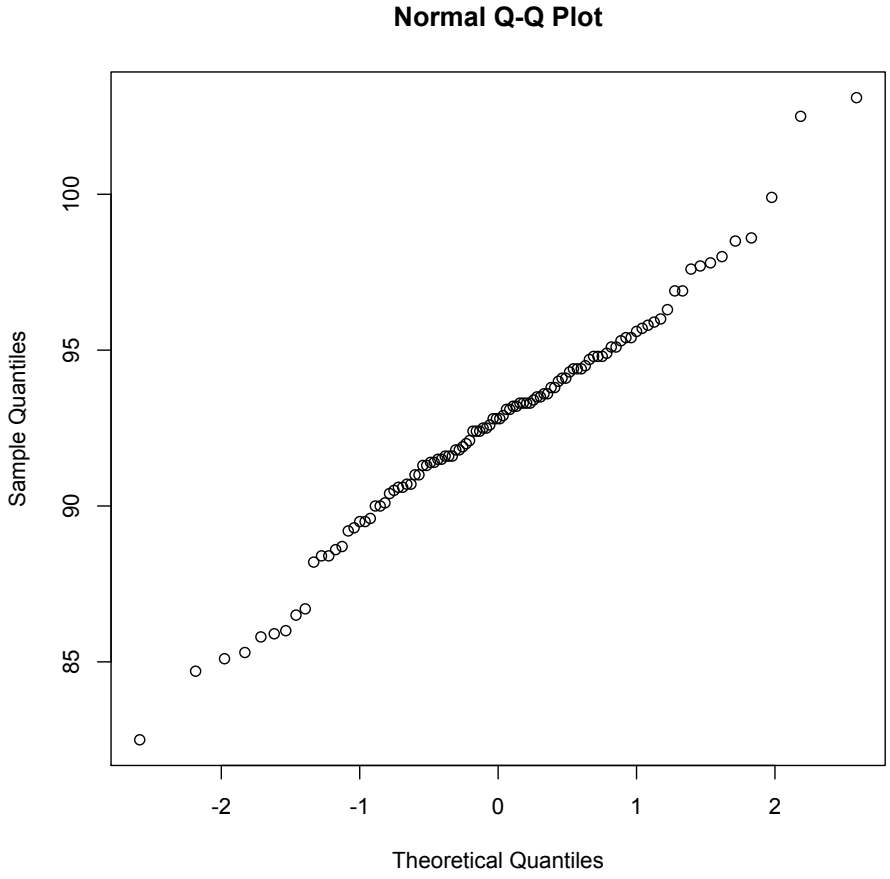


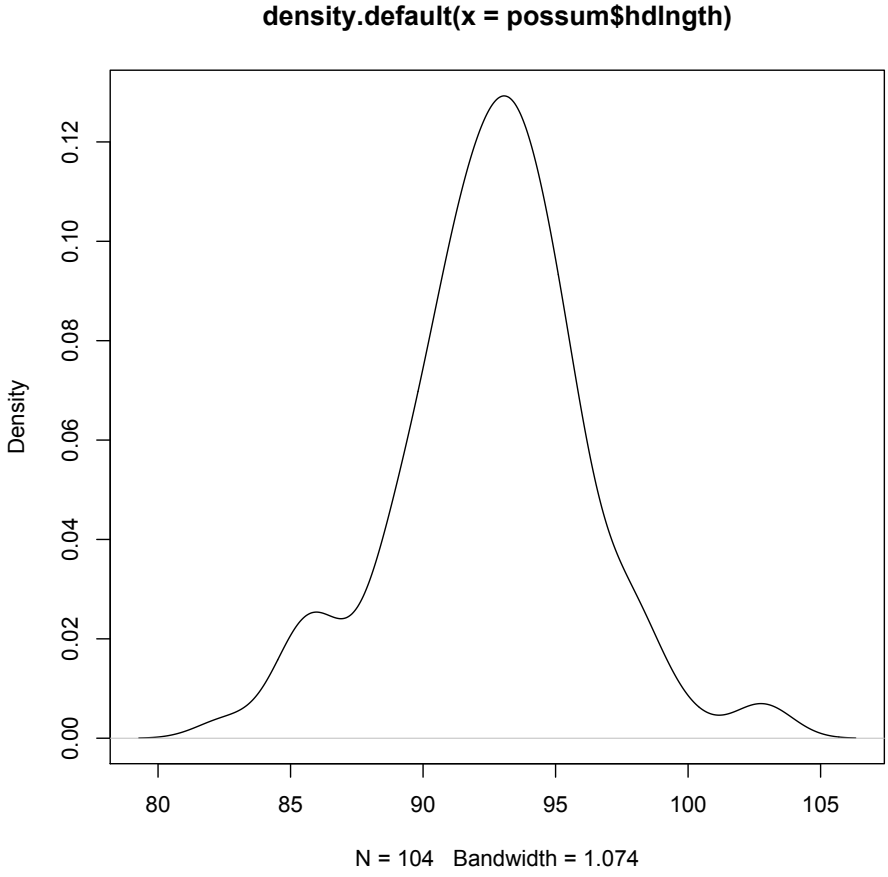

```
The decimal point is at the |

 82 | 5
 83 |
 84 | 7
 85 | 1389
 86 | 057
 87 |
 88 | 24467
 89 | 23556
 90 | 001456677
 91 | 00334455666889
 92 | 014445568889
 93 | 112233334556688
 94 | 0113444578889
 95 | 113446789
 96 | 0399
 97 | 678
 98 | 056
```

```
  99 | 9
 100 |
 101 |
 102 | 5
 103 | 1
```

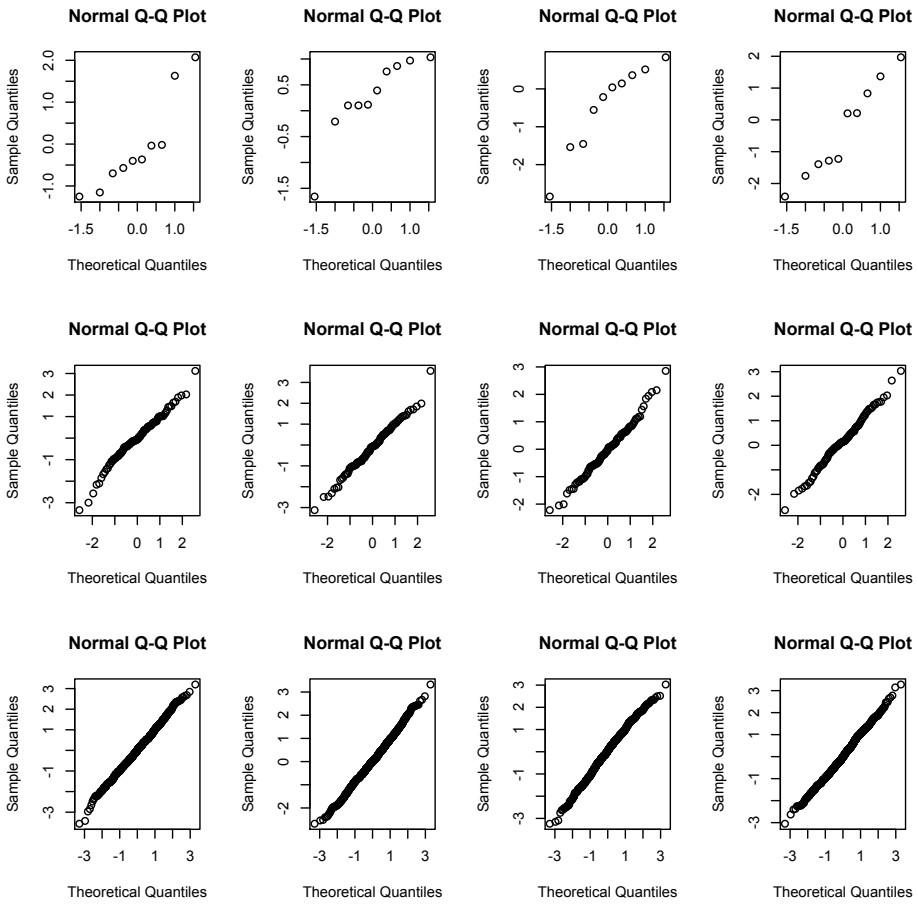
Density plot is a smooth version of histogram. However, if not done carefully, some distribution features displayed in density plot may not be real(small bumps, multi-modality,etc.) A normal probability plot compares your data distribution to the normal distribution, however, certain features of your data distribution may be hard to identify in the normal probability plot. Stem and leaf plot can be thought of as a rotated version of histogram, however, histogram seems to be more widely used now.





Chapter 3 #5

```
par(mfrow = c(3,4))
for (i in 1:4){qqnorm(rnorm(10)) }
for (i in 1:4){qqnorm(rnorm(100)) }
for (i in 1:4){qqnorm(rnorm(1000)) }
```


Normal Q-Q Plot
Sample Quantiles
Theoretical Quantiles