Lab sheet 7: Introduction to statistics

I have used codes from the book Dalgaard (2008) for this lab.

Descriptive statistics

```
x <- rnorm(50)
mean(x)
```

```
## [1] 0.1329555
```

```
sd(x)
```

```
## [1] 1.072677
```

```
var(x)
```

```
## [1] 1.150635
```

```
median(x)
```

```
## [1] 0.2250244
```

```
quantile(x)
```

```
##         0%        25%        50%        75%       100%
## -2.6629474 -0.6431539  0.2250244  1.0173144  2.1020807
```

```
pvec <- seq(0,1,0.1)
pvec
```

```
##  [1] 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0
```

```
quantile(x,pvec)
```

```
##          0%         10%         20%         30%         40%         50%
## -2.66294739 -1.33492597 -0.79091222 -0.53327620 -0.07292534  0.22502438
##         60%         70%         80%         90%        100%
##  0.71664875  0.92944390  1.08718877  1.27448693  2.10208074
```

```
data()
head(Nile)
```

```
## [1] 1120 1160  963 1210 1160 1160
```

```
summary(Nile)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   456.0   798.5   893.5   919.4  1032.5  1370.0
```

```
library('ISwR')
attach(juul)
names(juul)
```

```
## [1] "age"      "menarche" "sex"      "igf1"     "tanner"   "testvol"
```

```
mean(igf1)
```

```
## [1] NA
```

```
mean(igf1,na.rm=T)
```

```
## [1] 340.168
```

```
summary(igf1)
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.    NA's
##    25.0   202.2   313.5   340.2   462.8   915.0     321
```

```
summary(juul)
```

```
##       age            menarche     sex           igf1         tanner
##  Min.   : 0.170   No  :369   M   :621   Min.   : 25.0   I   :515
##  1st Qu.: 9.053   Yes :335   F   :713   1st Qu.:202.2   II  :103
##  Median :12.560   NA's:635   NA's:  5   Median :313.5   III : 72
##  Mean   :15.095                         Mean   :340.2   IV  : 81
##  3rd Qu.:16.855                         3rd Qu.:462.8   V   :328
##  Max.   :83.000                         Max.   :915.0   NA's:240
##  NA's   :5                              NA's   :321
##     testvol
##  Min.   : 1.000
##  1st Qu.: 1.000
##  Median : 3.000
##  Mean   : 7.896
##  3rd Qu.:15.000
##  Max.   :30.000
##  NA's   :859
```

```
detach(juul)
```

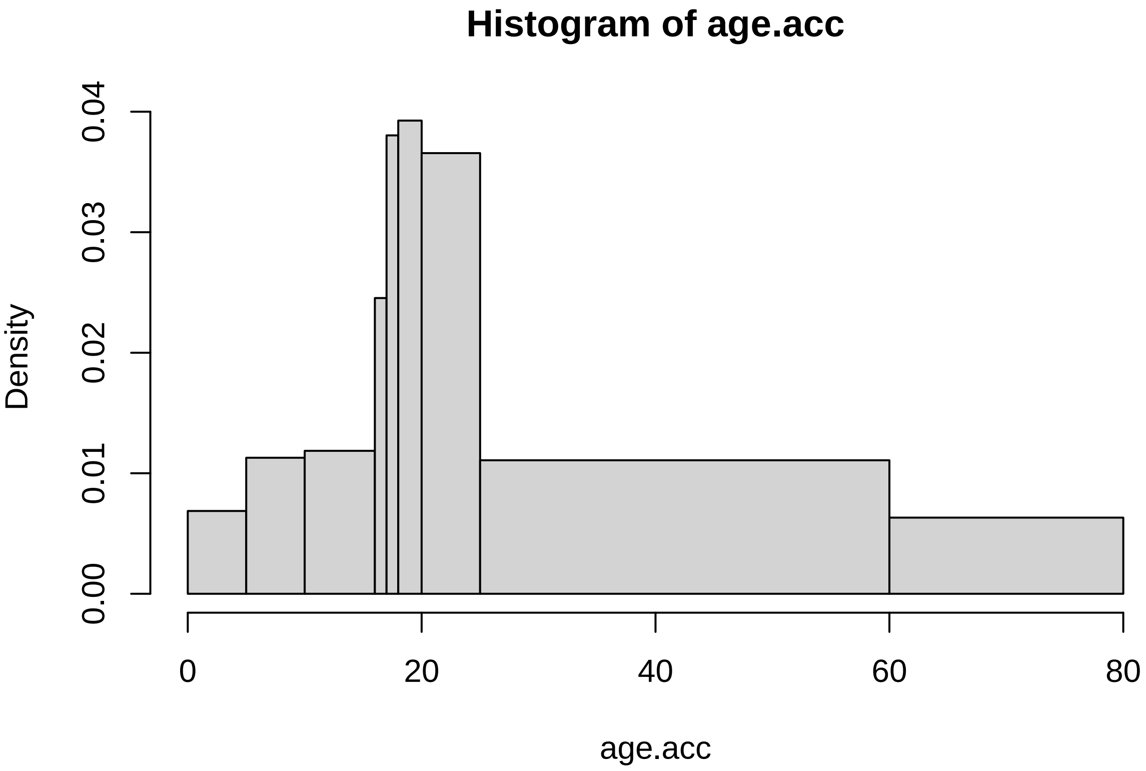
```
juul$sex <- factor(juul$sex,labels=c("M","F"))
juul$menarche <- factor(juul$menarche,labels=c("No","Yes"))
juul$tanner <- factor(juul$tanner,labels=c("I","II","III","IV","V"))
attach(juul)
summary(juul)
```

```
##       age            menarche     sex           igf1         tanner
##  Min.   : 0.170   No  :369   M   :621   Min.   : 25.0   I   :515
##  1st Qu.: 9.053   Yes :335   F   :713   1st Qu.:202.2   II  :103
##  Median :12.560   NA's:635   NA's:  5   Median :313.5   III : 72
##  Mean   :15.095                         Mean   :340.2   IV  : 81
##  3rd Qu.:16.855                         3rd Qu.:462.8   V   :328
##  Max.   :83.000                         Max.   :915.0   NA's:240
##  NA's   :5                              NA's   :321
##     testvol
##  Min.   : 1.000
##  1st Qu.: 1.000
##  Median : 3.000
##  Mean   : 7.896
##  3rd Qu.:15.000
##  Max.   :30.000
##  NA's   :859
```

```
juul <- transform(juul,sex=factor(sex,labels=c("M","F")),
                  menarche=factor(menarche,labels=c("No","Yes")),
                  tanner=factor(tanner,labels=c("I","II","III","IV","V")))
```

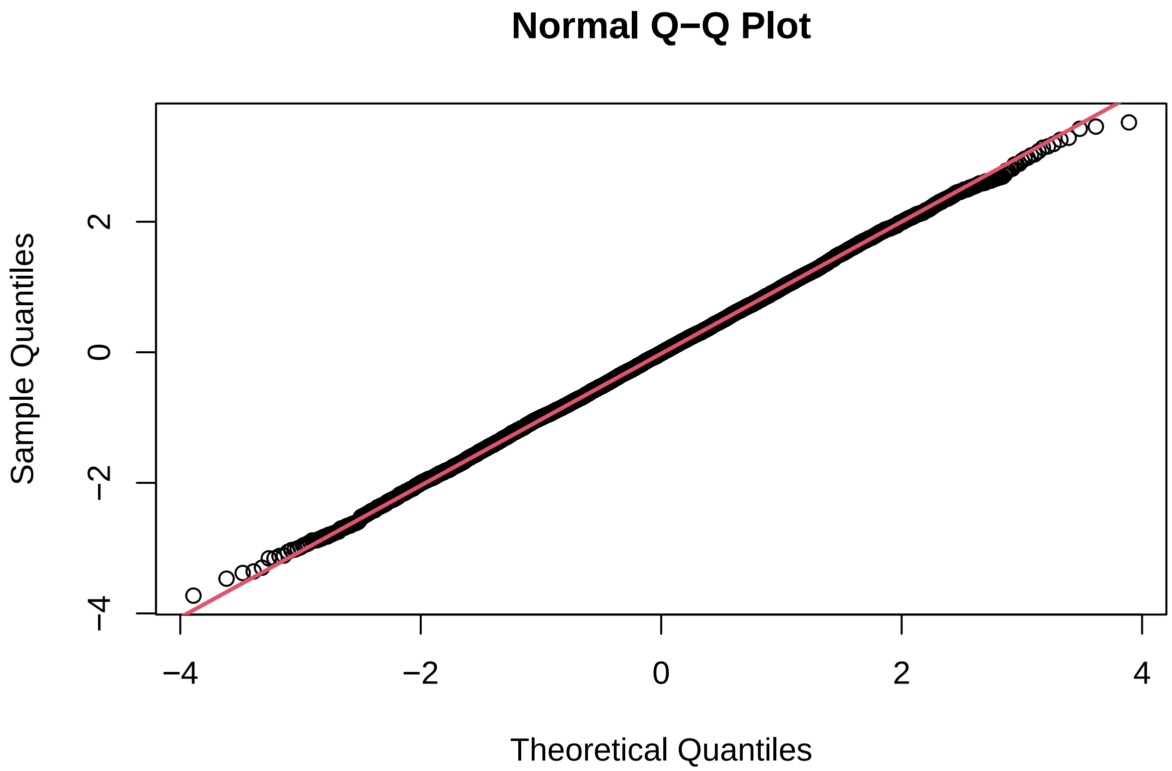
Graphics for single data

```
mid.age <- c(2.5,7.5,13,16.5,17.5,19,22.5,44.5,70.5)
acc.count <- c(28,46,58,20,31,64,149,316,103)
age.acc <- rep(mid.age,acc.count)
brk <- c(0,5,10,16,17,18,20,25,60,80)
hist(age.acc,breaks=brk)
```

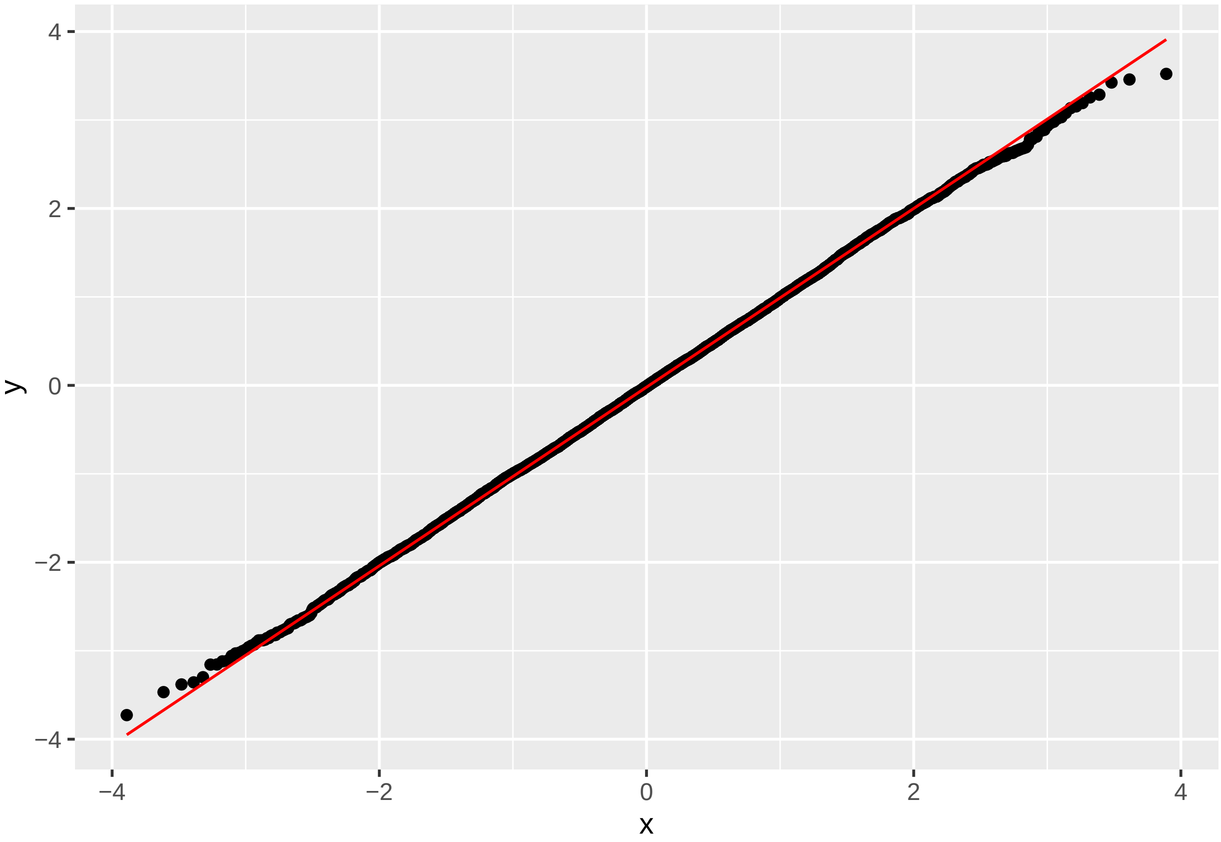


Q-Q plot

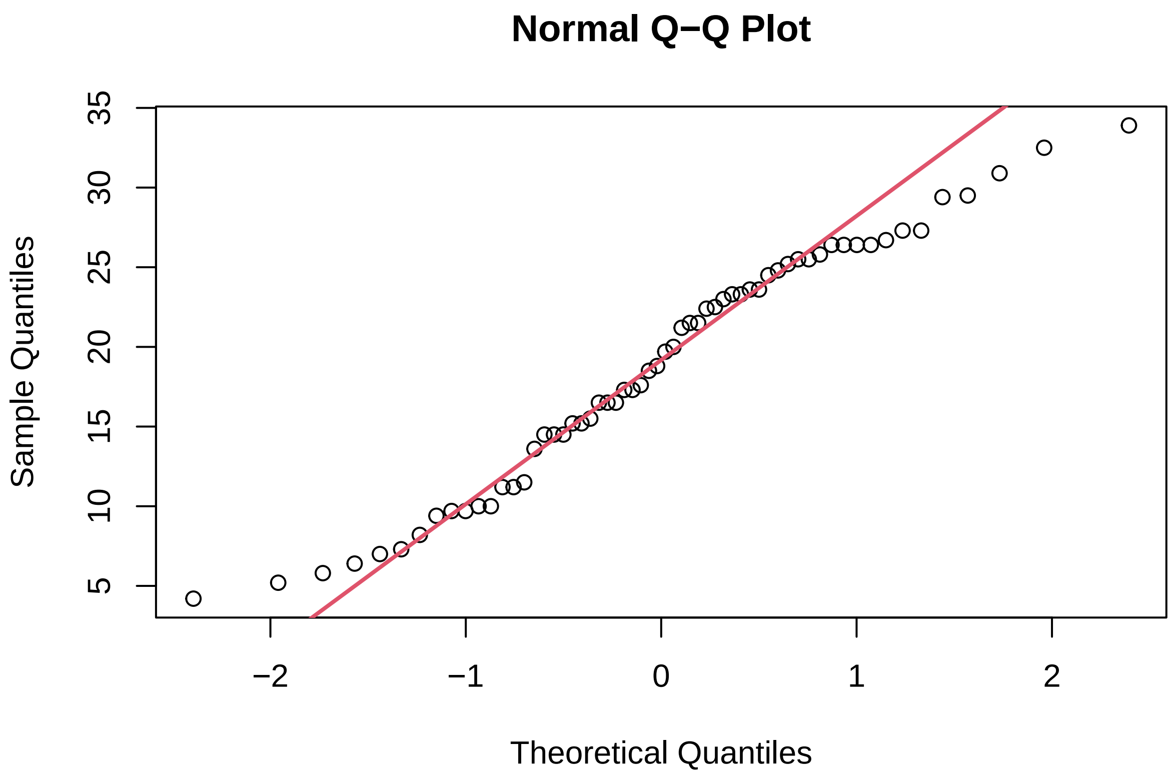
```
x <- rnorm(10000)
qqnorm(x)
qqline(x, col = 2,lwd=2)
```



```
library(ggplot2)
data <- data.frame(x)
ggplot(data, aes(sample = x)) +
  stat_qq() +
  stat_qq_line(col = "red")
```

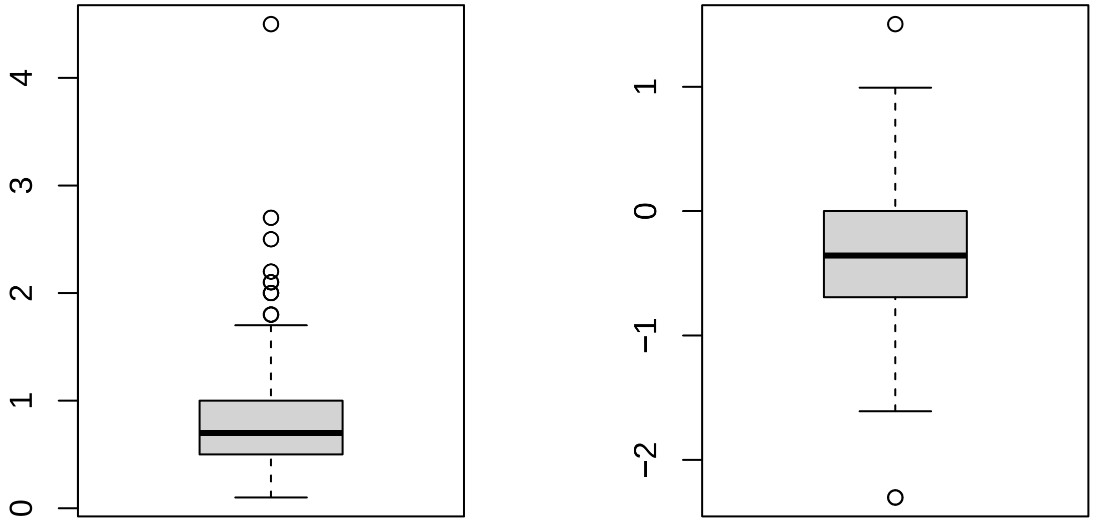


```
sample_data <- ToothGrowth
qqnorm(sample_data$len)
qqline(sample_data$len, col = 2, lwd = 2)
```



Box plot

```
par(mfrow=c(1,2))
boxplot(IgM)
boxplot(log(IgM))
```



```
par(mfrow=c(1,1))
```

Summary statistics by group

```
xbar <- tapply(igf1, tanner, mean, na.rm=T)
s <- tapply(igf1, tanner, sd, na.rm=T)
n <- tapply(igf1, tanner, length)
cbind(mean=xbar, std.dev=s, n=n)
```

```
##         mean   std.dev   n
## I   207.4727  90.27237 515
## II  352.6714 122.59332 103
## III 483.2222 152.28664  72
## IV  513.0172 119.09594  81
## V   465.3344 134.41867 328
```

```
aggregate(juul[c("age","igf1")], juul["sex"], mean, na.rm=T)
```

```
##   sex      age     igf1
## 1   M 15.38436 310.8866
## 2   F 14.84363 368.1006
```

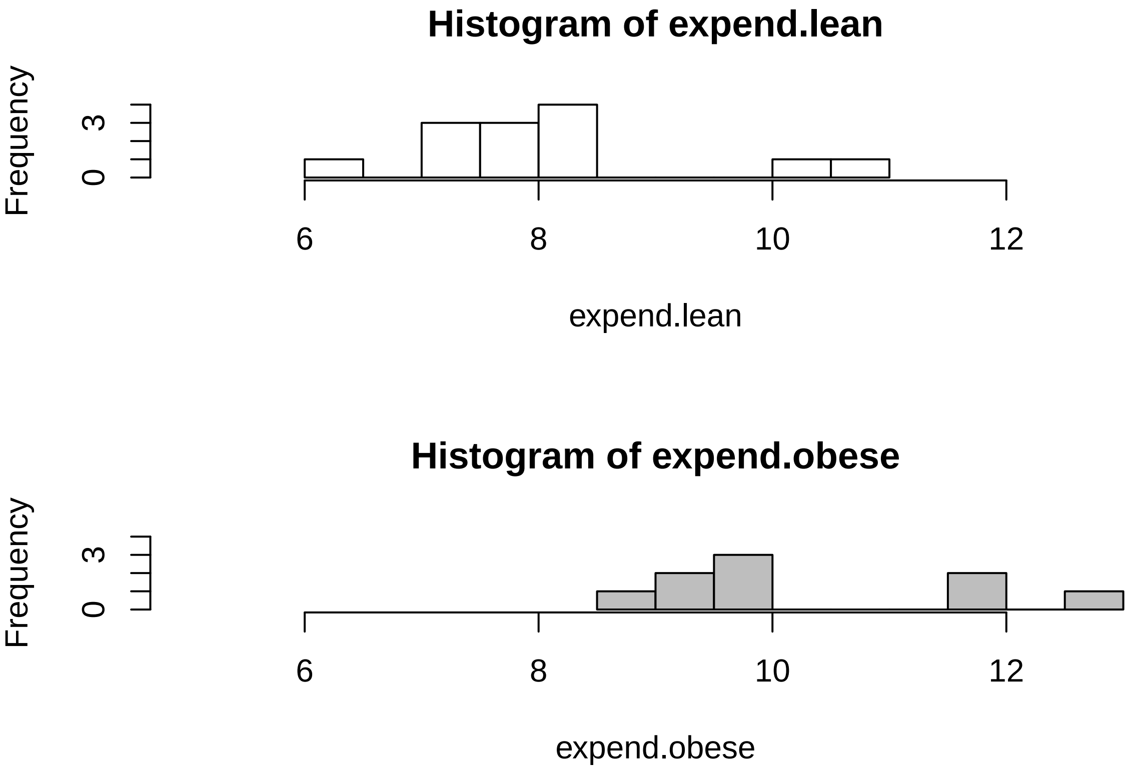
```
by(juul, juul["sex"], summary)
```

```
## sex: M
##       age          menarche    sex          igf1          tanner   
##  Min.   : 0.17   No   :  0   M:621   Min.   : 29.0   I    :291  
##  1st Qu.: 8.85   Yes  :  0   F:  0   1st Qu.:176.0   II   : 55  
##  Median :12.38   NA's:621            Median :280.0   III  : 34  
##  Mean   :15.38                       Mean   :310.9   IV   : 41  
##  3rd Qu.:16.77                       3rd Qu.:430.2   V    :124  
##  Max.   :83.00                       Max.   :915.0   NA's: 76  
##                                      NA's   :145                
##     testvol     
##  Min.   : 1.000  
##  1st Qu.: 1.000  
##  Median : 3.000  
##  Mean   : 7.896  
##  3rd Qu.:15.000  
##  Max.   :30.000  
##  NA's   :141     
## ------------------------------------------------------------ 
## sex: F
##       age          menarche    sex          igf1          tanner   
##  Min.   : 0.25   No   :369   M:  0   Min.   : 25.0   I    :224  
##  1st Qu.: 9.30   Yes :335   F:713   1st Qu.:233.0   II   : 48  
##  Median :12.80   NA's:  9            Median :352.0   III  : 38  
##  Mean   :14.84                       Mean   :368.1   IV   : 40  
##  3rd Qu.:16.93                       3rd Qu.:483.0   V    :204  
##  Max.   :75.12                       Max.   :914.0   NA's:159  
##                                      NA's   :176                
##     testvol    
##  Min.   : NA   
##  1st Qu.: NA   
##  Median : NA   
##  Mean   :NaN   
##  3rd Qu.: NA   
##  Max.   : NA   
##  NA's   :713   
```

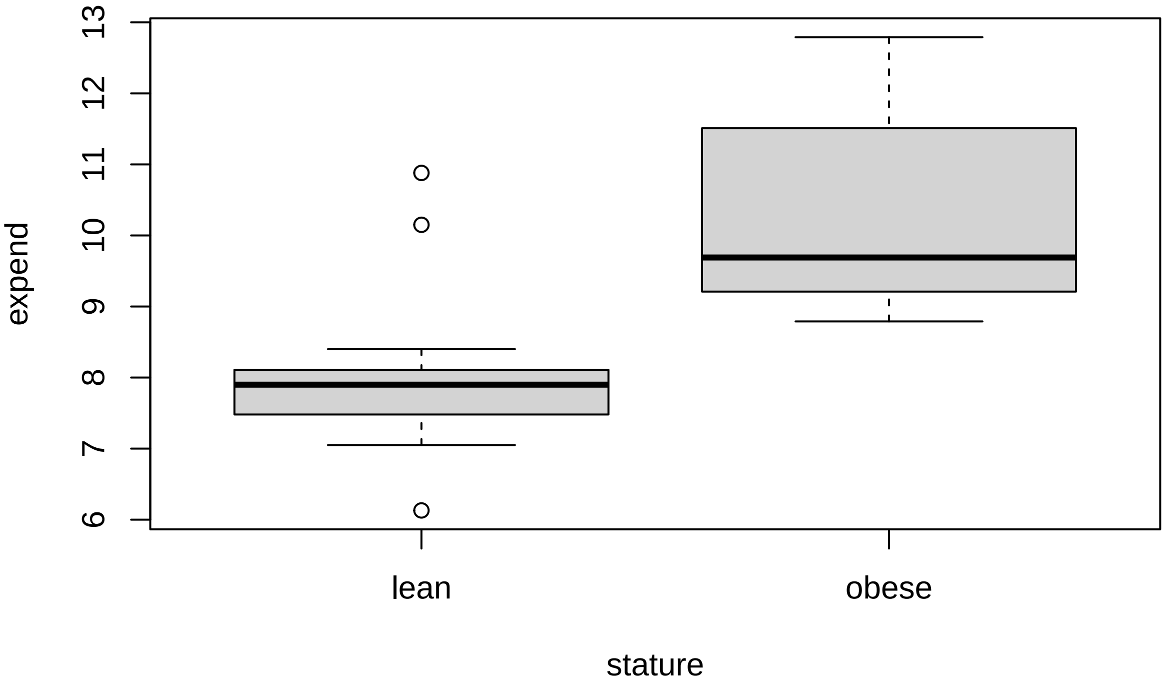
Graphics for grouped data

```
attach(energy)
expend.lean <- expend[stature=="lean"]
expend.obese <- expend[stature=="obese"]
```

```
par(mfrow=c(2,1))
hist(expend.lean,breaks=10,xlim=c(5,13),ylim=c(0,4),col="white")
hist(expend.obese,breaks=10,xlim=c(5,13),ylim=c(0,4),col="grey")
```



```
par(mfrow=c(1,1))
boxplot(expend ~ stature)
```



Box plot using plotly

```
library(plotly)
plot_ly(energy,y=~expend,x=~stature,color=~stature,type="box")
```

Tables

```
caff.marital <- matrix(c(652,1537,598,242,36,46,38,21,218,327,106,67),
                         nrow=3,byrow=T)
colnames(caff.marital) <- c("0","1-150","151-300",">300")
rownames(caff.marital) <- c("Married","Prev.married","Single")
caff.marital
```

```
##                0 1-150 151-300 >300
## Married      652  1537     598  242
## Prev.married  36    46      38   21
## Single       218   327     106   67
```

```
names(dimnames(caff.marital)) <- c("marital","consumption")
caff.marital
```

```
##               consumption
## marital          0 1-150 151-300 >300
##   Married      652  1537     598  242
##   Prev.married  36    46      38   21
##   Single       218   327     106   67
```

```
as.data.frame(as.table(caff.marital))
```

```
##         marital consumption Freq
## 1       Married           0  652
## 2  Prev.married           0   36
## 3        Single           0  218
## 4       Married       1-150 1537
## 5  Prev.married       1-150   46
## 6        Single       1-150  327
## 7       Married     151-300  598
## 8  Prev.married     151-300   38
## 9        Single     151-300  106
## 10      Married        >300  242
## 11 Prev.married        >300   21
## 12       Single        >300   67
```

```
table(menarche,tanner)
```

```
##         tanner
## menarche   I  II III  IV   V
##      No  221  43  32  14   2
##      Yes   1   1   5  26 202
```

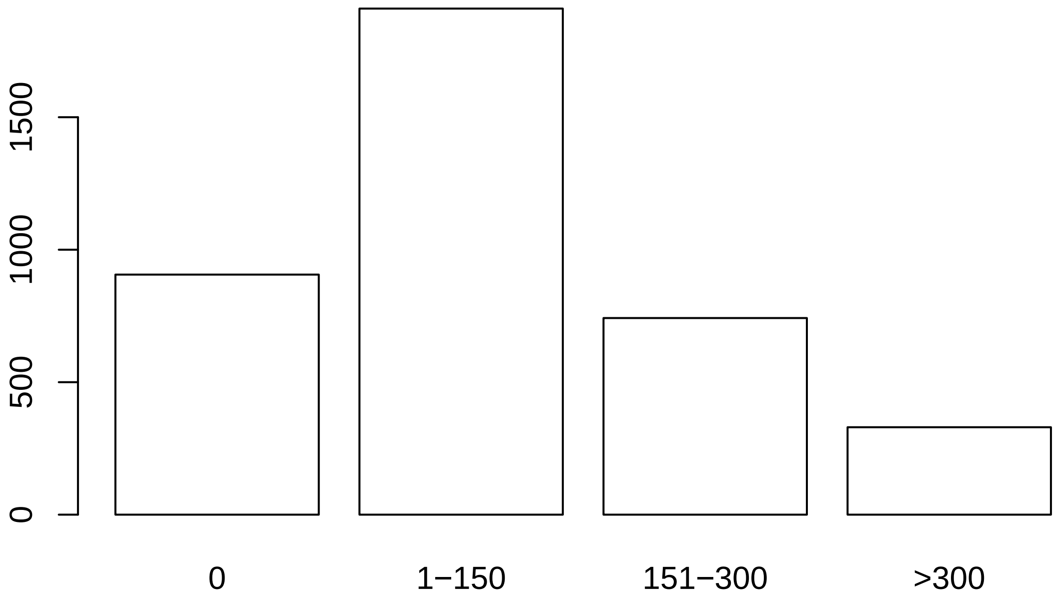
```
xtabs(~ tanner + sex, data=juul)
```

```
##       sex
## tanner   M   F
##    I   291 224
##    II   55  48
##    III  34  38
##    IV   41  40
##    V   124 204
```

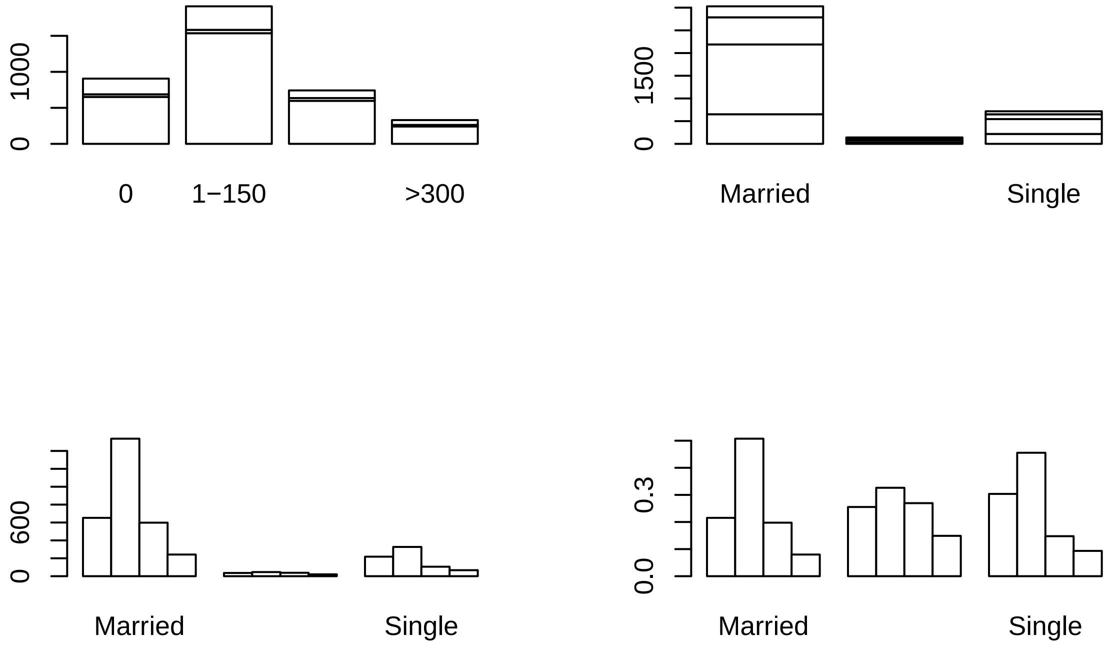
```
total.caff <- margin.table(caff.marital,2)
total.caff
```

```
## consumption
##       0   1-150 151-300    >300
##     906    1910     742     330
```

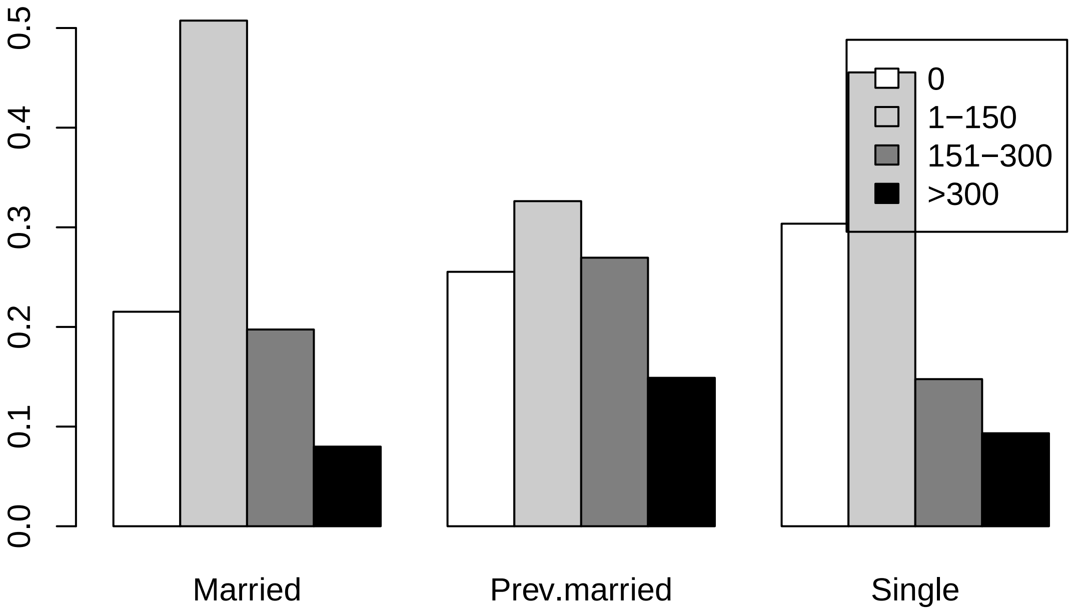
```
barplot(total.caff, col="white")
```



```
par(mfrow=c(2,2))
barplot(caff.marital, col="white")
barplot(t(caff.marital), col="white")
barplot(t(caff.marital), col="white", beside=T)
barplot(prop.table(t(caff.marital),2), col="white", beside=T)
```

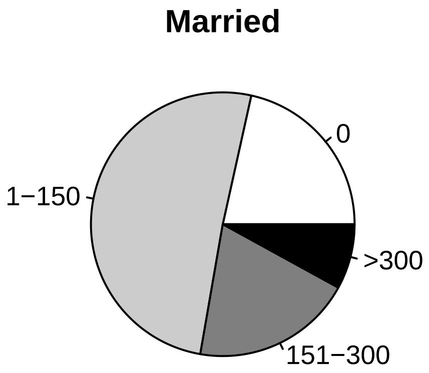


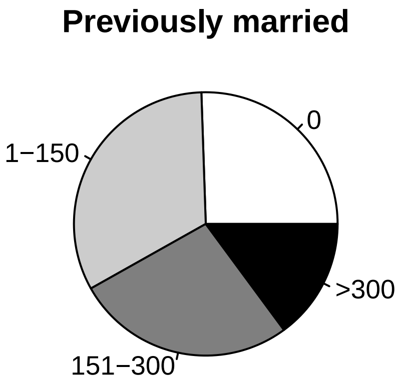
```
par(mfrow=c(1,1))
barplot(prop.table(t(caff.marital),2),beside=T,
        legend.text=colnames(caff.marital),
        col=c("white","grey80","grey50","black"))
```

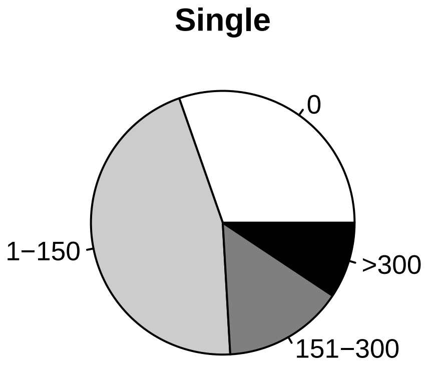


Piecharts

```
opar <- par(mfrow=c(2,2),mex=0.8, mar=c(1,1,2,1))
slices <- c("white","grey80","grey50","black")
pie(caff.marital["Married",], main="Married", col=slices)
pie(caff.marital["Prev.married",],
    main="Previously married", col=slices)
pie(caff.marital["Single",], main="Single", col=slices)
par(opar)
```







References

Dalgaard, Peter. 2008. *Introductory Statistics with R*. Springer New York. https://doi.org/10.1007/978-0-387-79054-1.