

Lab 11: Introduction to statistics

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

Descriptive statistics

```
x <- rnorm(50)
mean(x)
## [1] 0.04938982

sd(x)
## [1] 1.137734

var(x)
## [1] 1.294439

median(x)
## [1] -0.0526123

quantile(x)
##          0%          25%          50%          75%          100%
## -1.9559053 -0.8010317 -0.0526123  0.9468227  2.4891075

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%          60%
## -1.9559053 -1.2360270 -0.9302978 -0.6171364 -0.3298269 -0.0526123  0.1086280
##          70%          80%          90%          100%
##  0.7740644  1.0493475  1.5277151  2.4891075

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  
## Min.   : 0.170   Min.   :1.000   Min.   :1.000   Min.   : 25.0  
## 1st Qu.: 9.053   1st Qu.:1.000   1st Qu.:1.000   1st Qu.:202.2  
## Median :12.560   Median :1.000   Median :2.000   Median :313.5  
## Mean   :15.095   Mean   :1.476   Mean   :1.534   Mean   :340.2  
## 3rd Qu.:16.855   3rd Qu.:2.000   3rd Qu.:2.000   3rd Qu.:462.8  
## Max.   :83.000   Max.   :2.000   Max.   :2.000   Max.   :915.0  
## NA's   :5       NA's   :635   NA's   :5       NA's   :321  
##      tanner      testvol  
## Min.   :1.00   Min.   : 1.000  
## 1st Qu.:1.00   1st Qu.: 1.000  
## Median :2.00   Median : 3.000  
## Mean   :2.64   Mean   : 7.896  
## 3rd Qu.:5.00   3rd Qu.:15.000  
## Max.   :5.00   Max.   :30.000  
## NA's   :240   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)
```

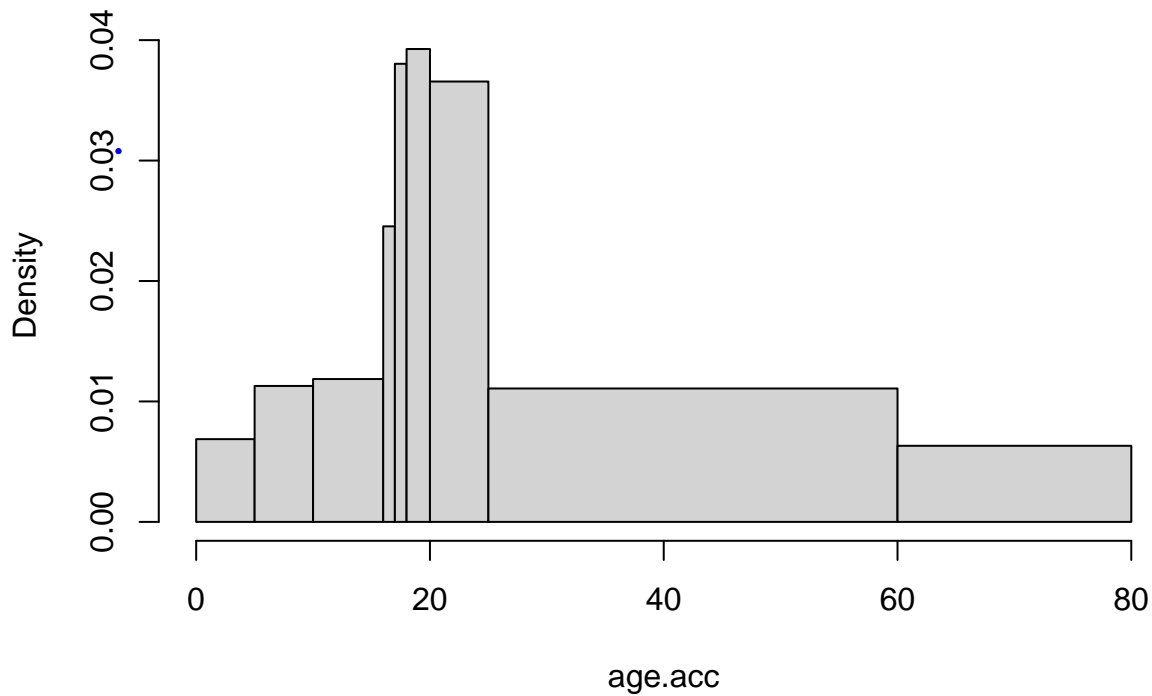
```
##      age      menarche      sex      igf1      tanner  
## Min.   : 0.170   No :369   M   :621   Min.   : 25.0   I   :515  
## 1st Qu.: 9.053   Yes:335   F   :713   1st Qu.:202.2   II  :103  
## Median :12.560   NA's:635 NA's: 5   Median :313.5   III : 72  
## Mean   :15.095                                     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)
```

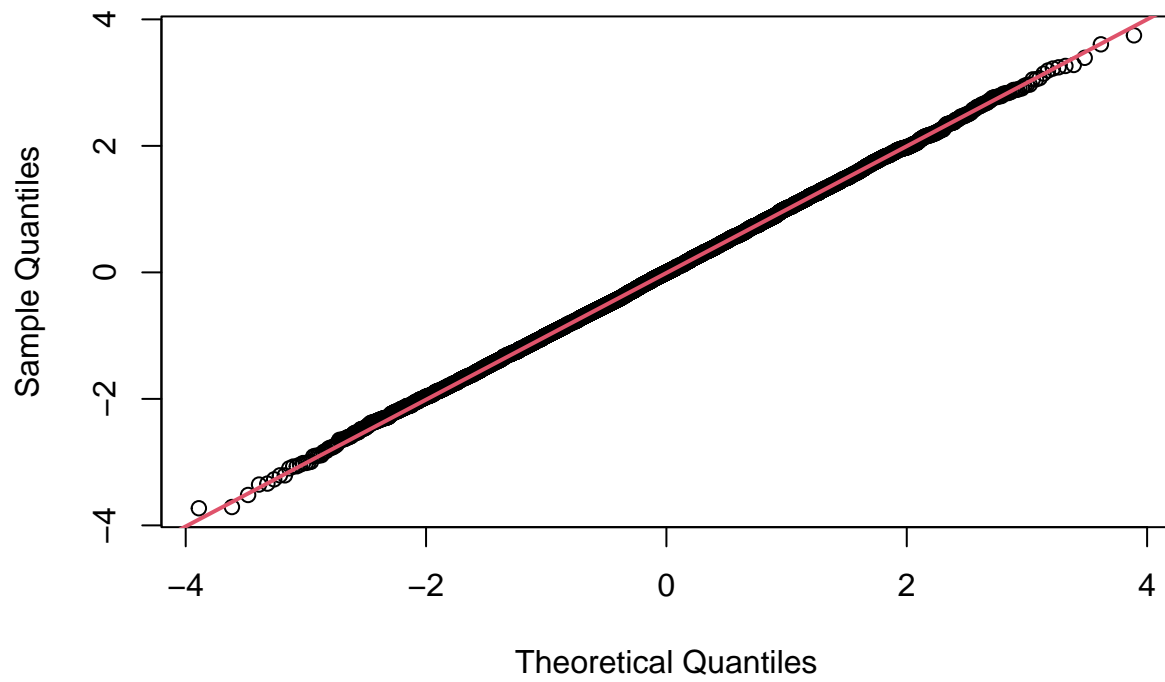
Histogram of age.acc



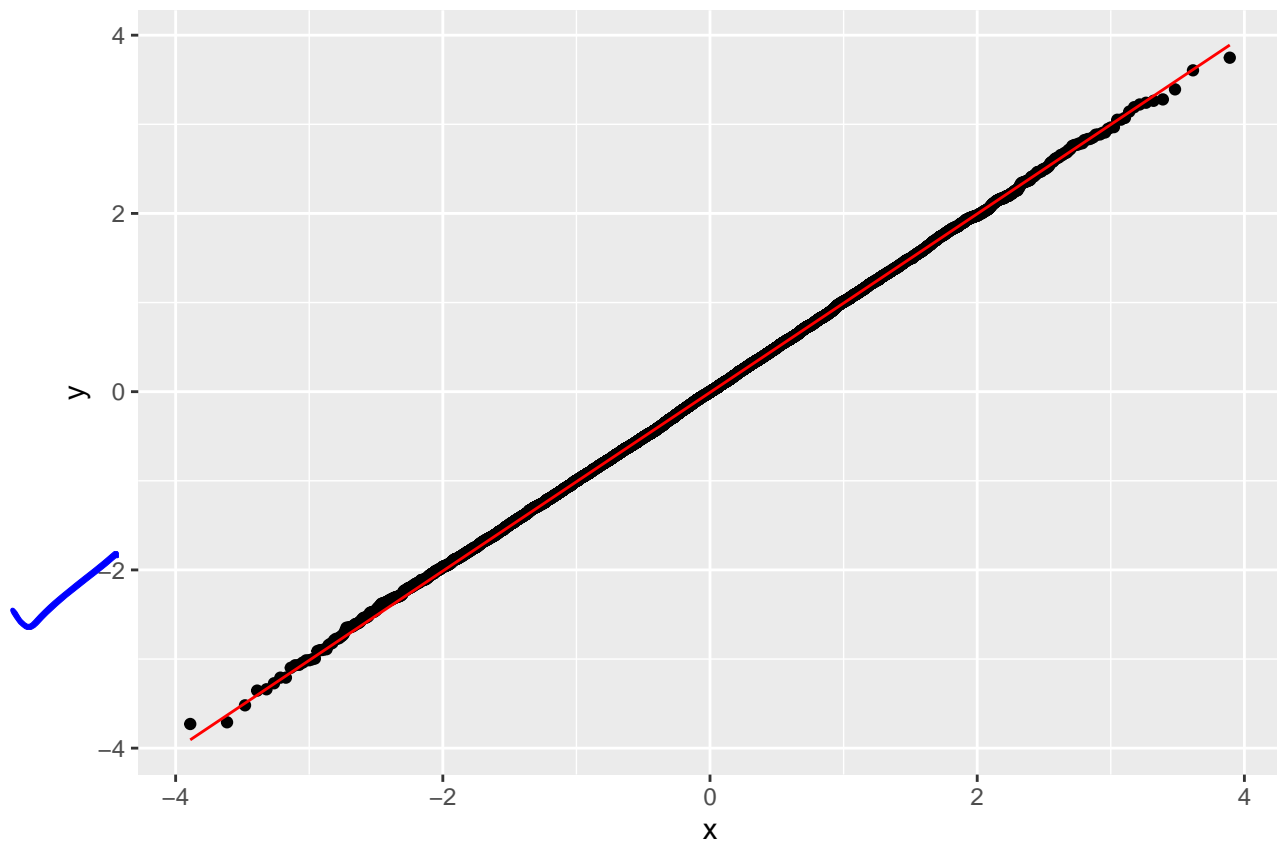
Q-Q plot

```
x <- rnorm(10000)
qqnorm(x)
qqline(x, col = 2,lwd=2)
library(ggplot2)
```

Normal Q-Q Plot

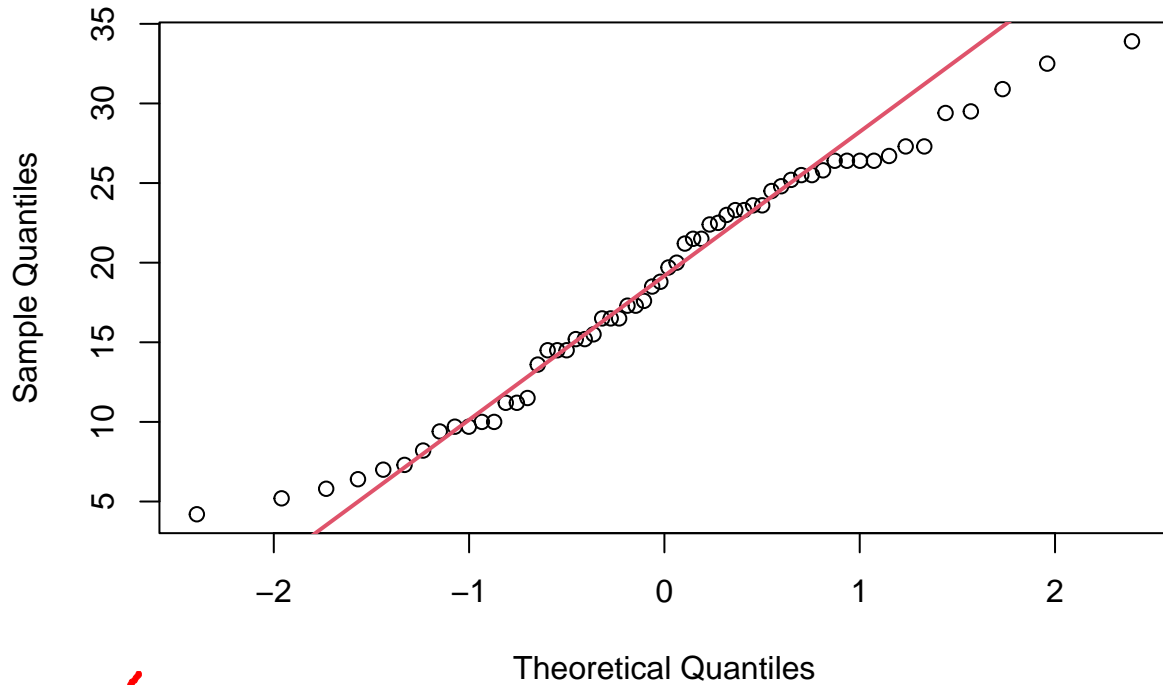


```
data <- data.frame(x)
ggplot(data, aes(sample = x)) +
  stat_qq() +
  stat_qq_line(col = "red")
```



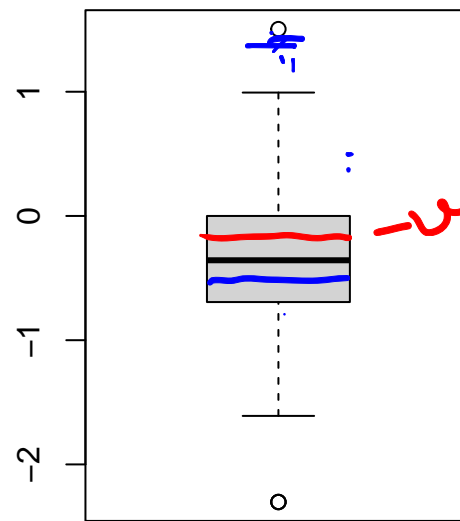
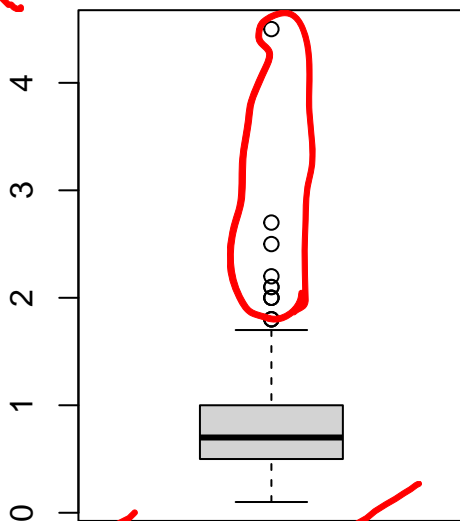
```
sample_data <- ToothGrowth
qqnorm(sample_data$len)
qqline(sample_data$len, col = 2, lwd = 2)
```

Normal Q-Q Plot



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

Graphics for grouped data

```
attach(energy)
```

```
expend.lean <- expend[stature=="lean"]
```

```
expend.obese <- expend[stature=="obese"]
```

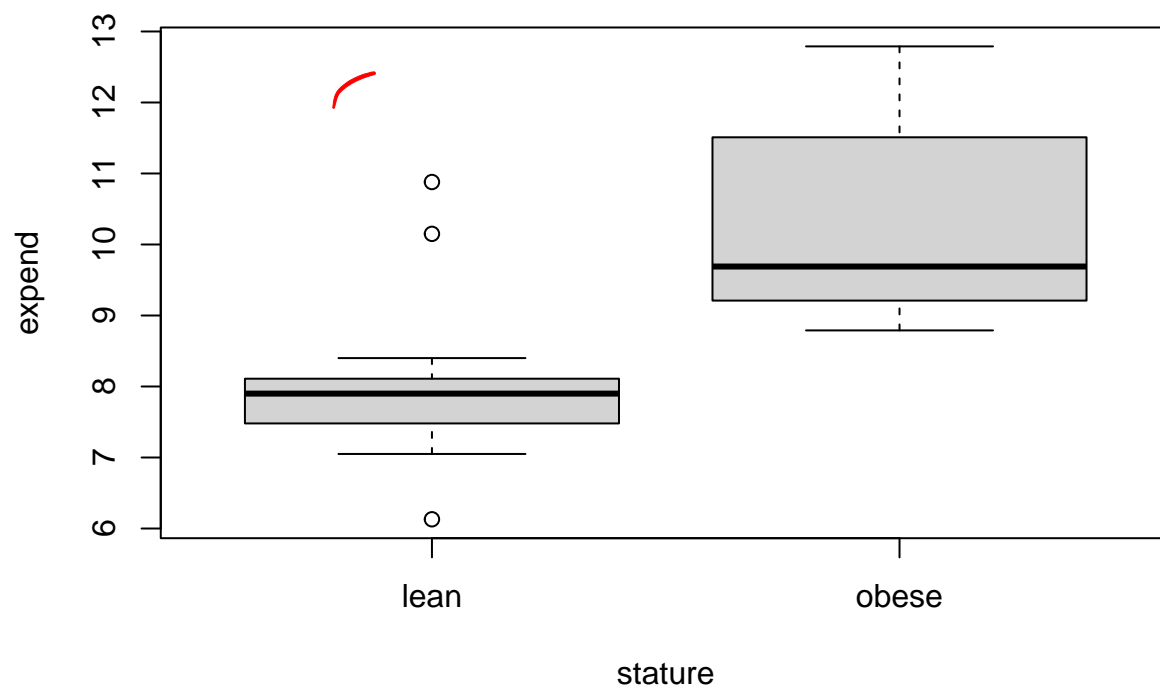
```
par(mfrow=c(2,1))
```

```
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)
```



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
```

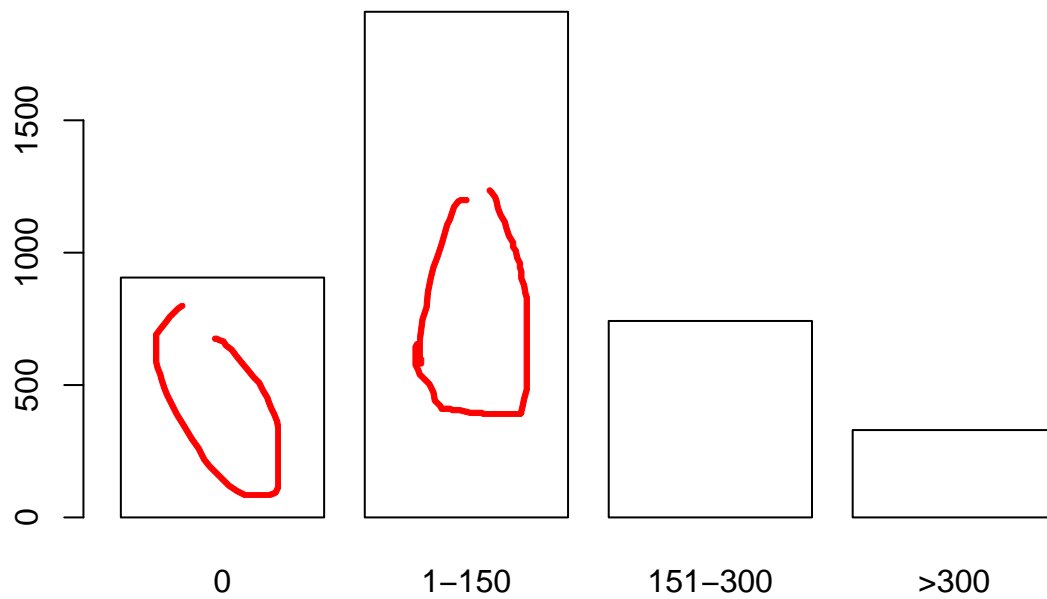
```
xtabs(~ tanner + sex, data=juul)
```

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

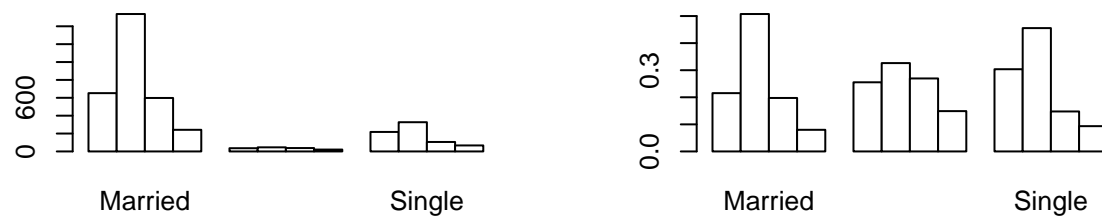
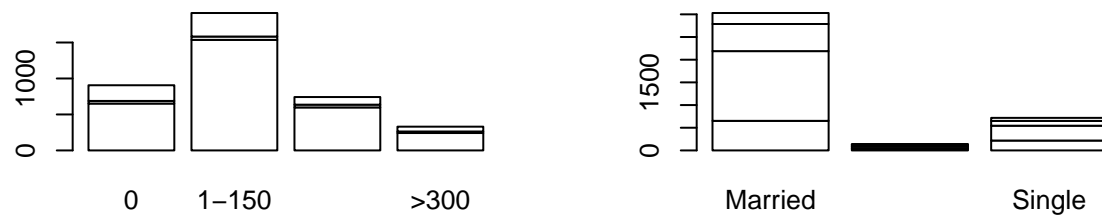
```
total.caff <- margin.table(caff.marital,2)
total.caff
```

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

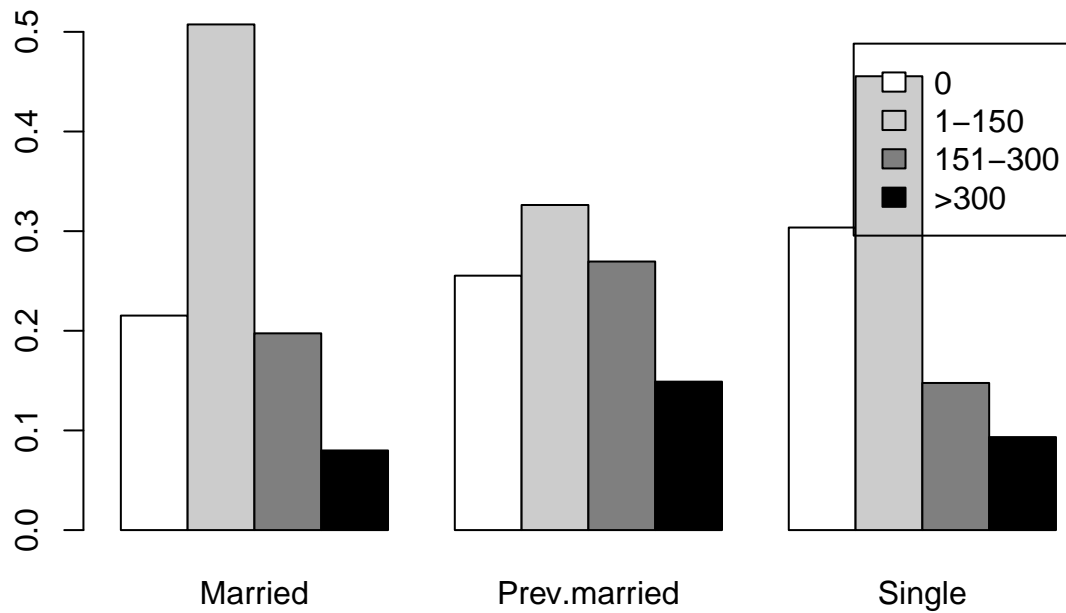
```
barplot(total.caff, col="white")
```



```
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)
```



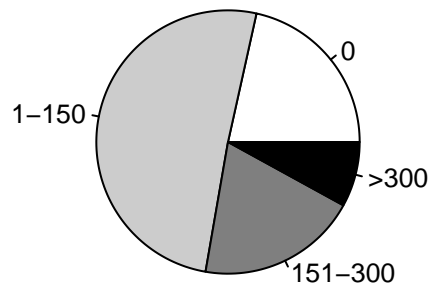
```
par(mfrow=c(1,1))
barplot(prop.table(t(caff.marital),2),beside=T,
        legend.text=colnames(caff.marital),
        col=c("white","grey80","grey50","black"))
```



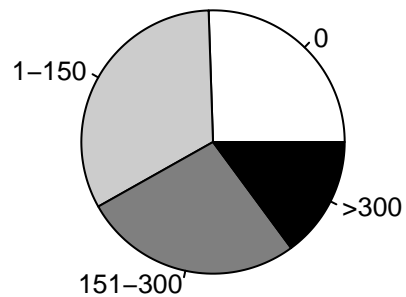
Piecharts

```
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)
```

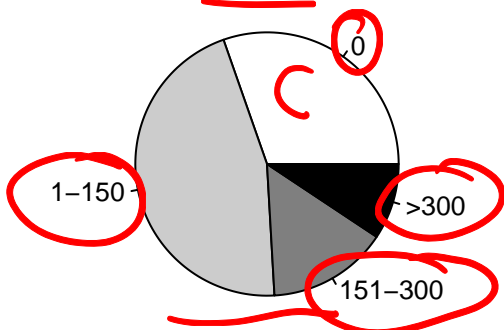
Married



Previously married



Single



References

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