HOMEWORK1 Biostatistics

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Problem1

2.19

For brievity here, we just plot the head of the result.

```
Difference <- data.frame(systolic = prob1[,2]-prob1[,4],diastolic = prob1[,3]-prob1[,5])
head(Difference)
```

```
##   systolic diastolic
## 1        2        -2
## 2        6         4
## 3        8        -4
## 4        8         2
## 5       12         4
## 6       10         0
```

```
mean(Difference$systolic)
```

```
## [1] 9.290323
```

```
median(Difference$systolic)
```

```
## [1] 8
```

```
mean(Difference$diastolic)
```

```
## [1] 1.225806
```

```
median(Difference$diastolic)
```

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

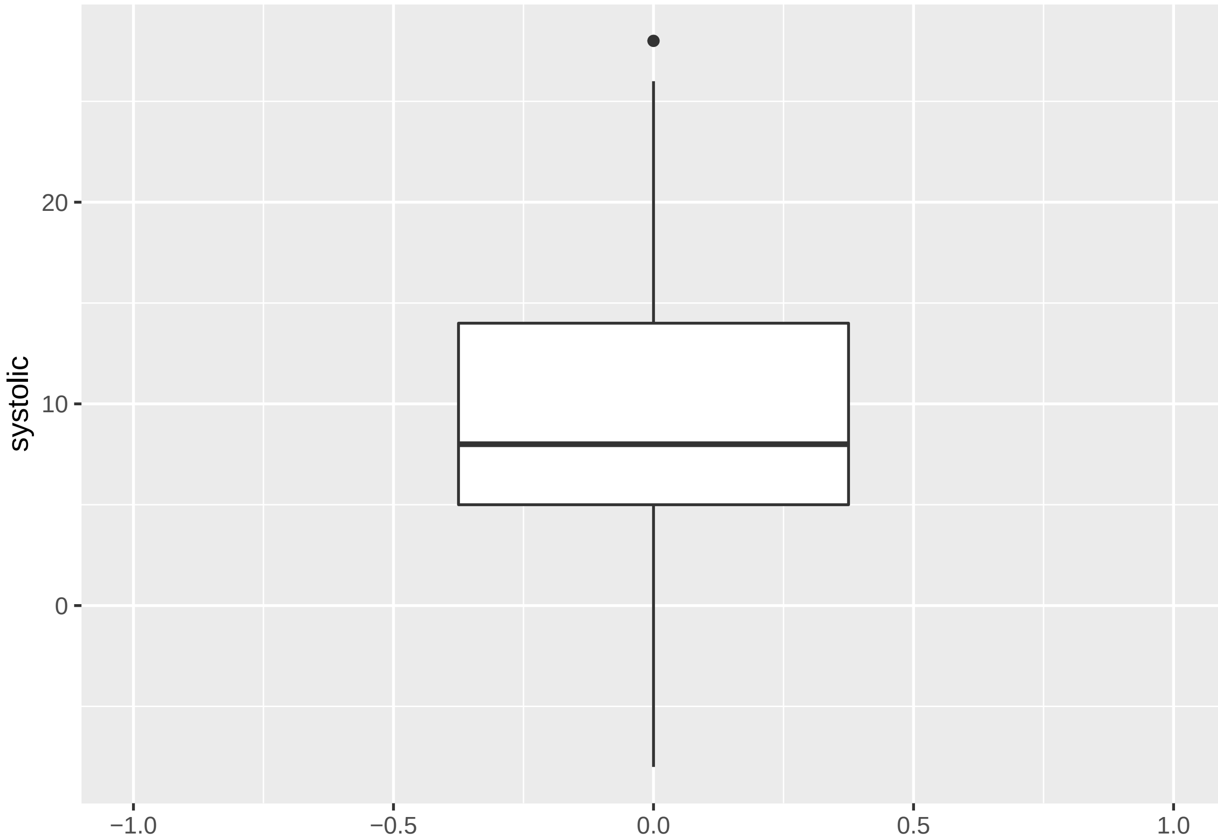
2.20

```
stem(Difference$systolic)
```

```
##
##   The decimal point is 1 digit(s) to the right of the |
##
##   -0 | 8
##   -0 | 2
##    0 | 022444
##    0 | 66688888
##    1 | 00022244444
##    1 | 68
```

```
##    2 |
##    2 | 68
```

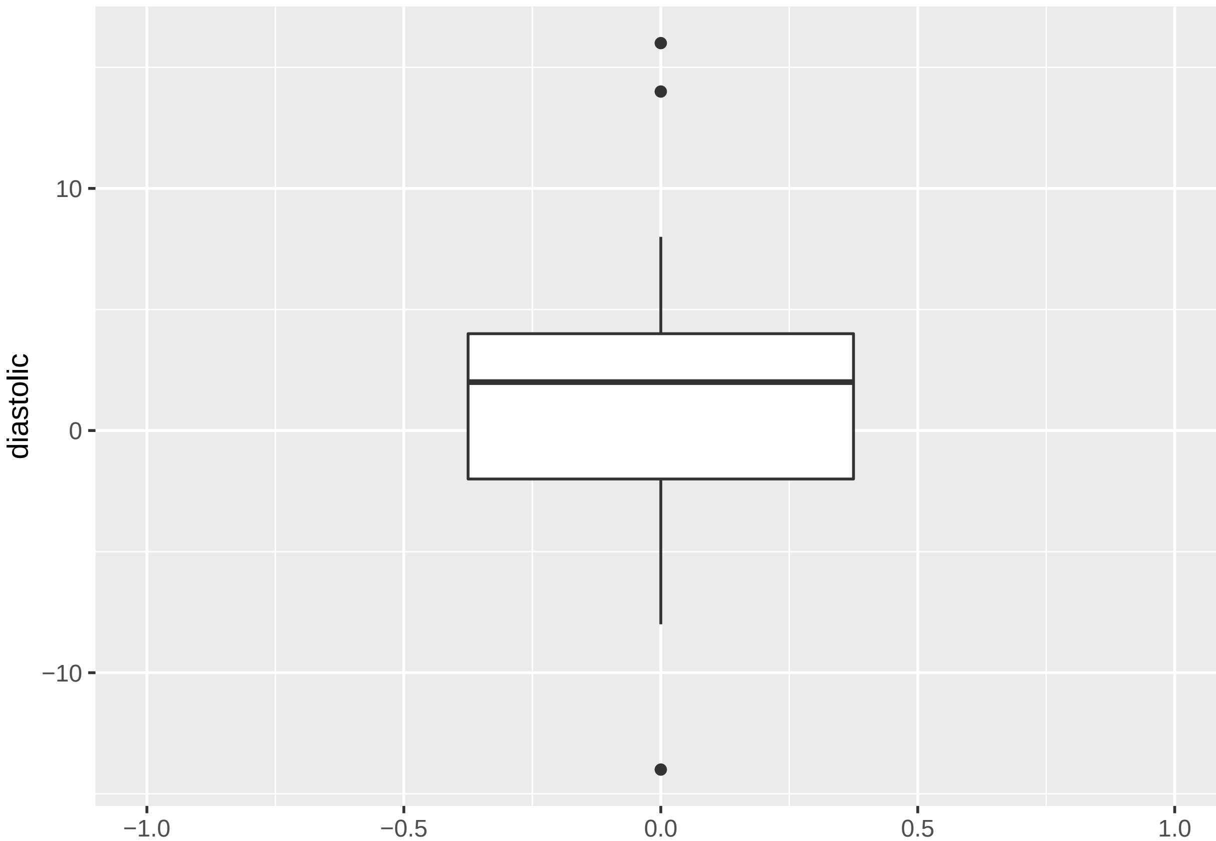
```r
ggplot(Difference, aes(y=systolic)) + geom_boxplot()+xlim(-1,1)
```




```r
stem(Difference$diastolic)
```

```
##
##   The decimal point is 1 digit(s) to the right of the |
##
##   -1 | 4
##   -0 | 86
##   -0 | 444222222
##    0 | 00022244444444
##    0 | 688
##    1 | 4
##    1 | 6
```

```r
ggplot(Difference, aes(y=diastolic)) + geom_boxplot()+xlim(-1,1)
```



2.21

It turns out that compares to a recumbent position, a standing position tends to drop the systolic blood pressure while remaining the diastolic blood pressure level unchanged or slightly decreased

2.22

```
quantile(Difference$systolic, seq(0,1,0.1))
```

```
##   0%  10%  20%  30%  40%  50%  60%  70%  80%  90% 100%
##   -8    2    4    6    8    8   10   12   14   16   28
```

Based on the judgements of decile of changes in SBP, the normal range should determined as [2,16]

Problem 2

```
CMMS <- data.frame(Nondemented=prob2[,2],Demented=prob2[,3])
head(CMMS)
```

```
##   Nondemented Demented
## 1           0        2
## 2           0        1
## 3           3        4
## 4           9        5
## 5          16        3
## 6          18        1
```

3.87

```r
sensitivity <- sum(CMMS$Demented[1:4])/CMMS$Demented[7]
sensitivity
```

```
## [1] 0.75
```

3.88

```r
specificity <- sum(CMMS$Nondemented[4:6])/CMMS$Nondemented[7]
specificity
```

```
## [1] 0.9347826
```

3.89

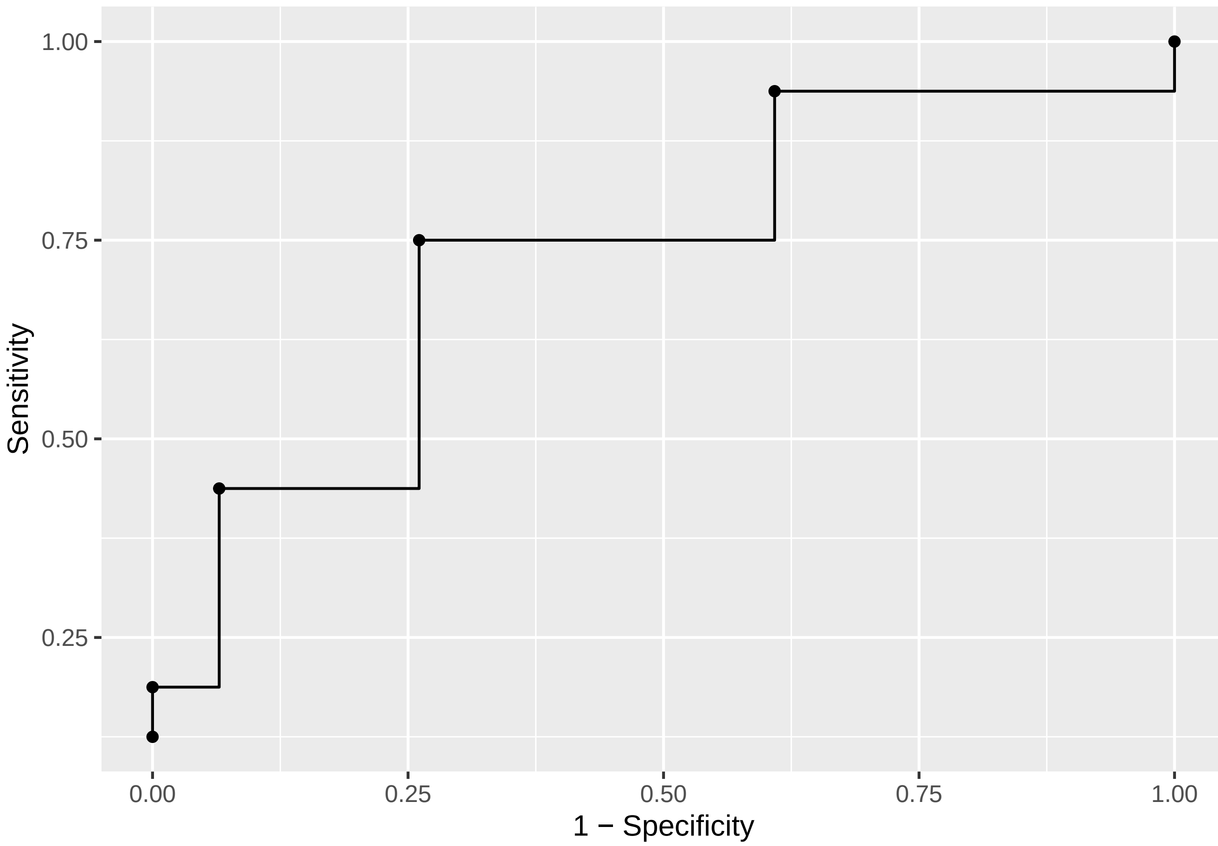
```r
sens <- {}
spec <- {}

for (i in 1:6) {
  sens[i] <- sum(CMMS$Demented[1:i])/CMMS$Demented[7]
  spec[i] <- (CMMS$Nondemented[7]-sum(CMMS$Nondemented[1:i]))/CMMS$Nondemented[7]
}
resultTable <- data.frame(Cutoff = seq(5,30,5),Sensitivity= sens, Specificity = spec)
resultTable
```

```
##   Cutoff Sensitivity Specificity
## 1      5      0.1250   1.0000000
## 2     10      0.1875   1.0000000
## 3     15      0.4375   0.9347826
## 4     20      0.7500   0.7391304
## 5     25      0.9375   0.3913043
## 6     30      1.0000   0.0000000
```

3.90

```r
library(ggplot2)
ggplot(resultTable,aes(1-Specificity , Sensitivity)) + geom_step()+geom_point()
```



3.91

From the diagram, we can see that if one expect both the specificity and sensitivity to exceed 70%, one need to choose cutoff value to be 20.

3.92

```
AUCarea <- sum(resultTable$Sensitivity[]*
                 ((resultTable$Specificity[])- c(resultTable$Specificity[-1],0)))
AUCarea
```

```
## [1] 0.7255435
```

Because the area under ROC curve is merely 0.726, and we expect higher AUC value for the medical test. So it is not good enough to be precticed as a good test to distinguish Alzhemer's disease.

Problem 3

3.111

$$PV^{+} = 80/100 = 0.8$$

3.112

$$PV^{-} = 90/100 = 0.9$$

3.113

Denote the event B as CDC+, A as ID confirmed sholud be positive.

$$sensitivity = \mathbb{P}(B|A) = \frac{\mathbb{P}(A|B)\mathbb{P}(B)}{\mathbb{P}(A)} = \frac{\frac{80}{100}\frac{100}{1100}}{\frac{80}{100}\frac{100}{1100} + \frac{10}{100}\frac{1000}{1100}} = 0.44$$

3.114

$$specificity = \mathbb{P}(\bar{B}|\bar{A}) = \frac{\mathbb{P}(\bar{A}|\bar{B})\mathbb{P}(\bar{B})}{\mathbb{P}(\bar{A})} = \frac{\frac{90}{100}\frac{1000}{1100}}{\frac{90}{100}\frac{1000}{1100} + \frac{20}{100}\frac{100}{1100}} = 0.989$$