MATH10282 Introduction to Statistics
Semester 2, 2020/2021
Solutions to the R coursework assignment

To determine whether glaucoma affects the corneal thickness, measurements were made in 8 people affected by glaucoma in one eye but not in the other. The corneal thicknesses (in microns) were as follows

Person	Eye affected by glaucoma	Eye not affected by glaucoma
1	488	484
2	478	478
3	480	492
4	426	444
5	440	436
6	410	398
7	458	464
8	460	476

(a) The commands

```
x=c(488, 478, 480, 426, 440, 410, 458, 460)
c(min(x),median(x),mean(x),max(x),sd(x))
```

give the following

Minimum = 410, Median = 459, Mean = 455, Maximum = 488, SD = 27.69219

[1]

(b) The commands

```
y=c(484, 478, 492, 444, 436, 398, 464, 476)
c(min(y),median(y),mean(y),max(y),sd(y))
```

give the following

Minimum = 398, Median = 470, Mean = 459, Maximum = 492, SD = 31.31408

[1]

(c) The median, mean, maximum and standard deviation appear to be larger when eye is not affected by glaucoma. The minimum appears larger when eye is affected by glaucoma. [1]

(d) The command

```
boxplot(x,y,names=c("Eye affected by glaucoma","Eye not affected by glaucoma"),ylab='
```

gives

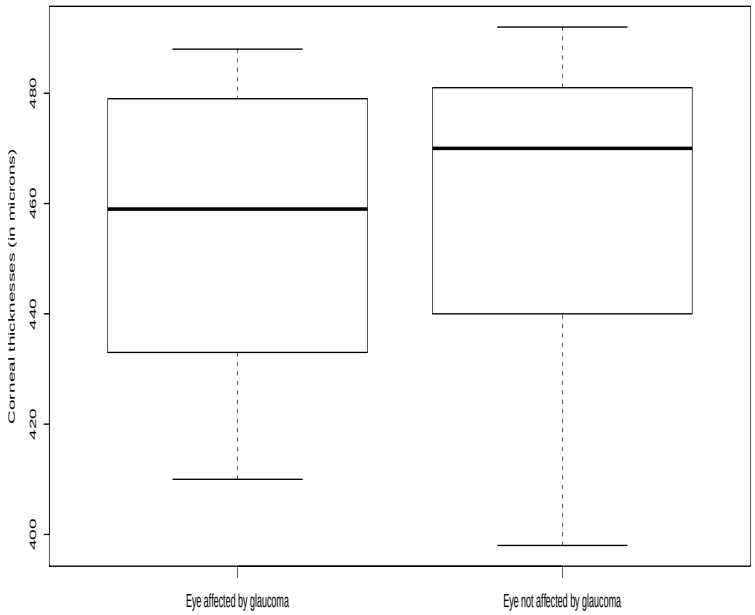

Figure 1: The boxplots of corneal thicknesses when eye is or not affected by glaucoma.

The boxplots show that the median, first quartile, third quartile and range are larger when eye is not affected by glaucoma. The inter quartile range is larger when eye is affected by glaucoma. [1]

(e) The estimates of the two parameters of the normal distribution are

$$\widehat{\mu} = \frac{1}{8}\sum_{i=1}^{8} x_i = 455$$

and

$$\widehat{\sigma} = \sqrt{\frac{1}{7}\sum_{i=1}^{8} (x_i - \widehat{\mu})^2} = 27.69219.$$

The command

```
ks.test(x,"pnorm",455,27.69219)
```

gives the output

```
        One-sample Kolmogorov-Smirnov test
```

```
data:  x
D = 0.17189, p-value = 0.9416
alternative hypothesis: two-sided
```

Hence, the fit of the normal distribution is adequate. [1]

(f) The estimates of the two parameters of the normal distribution are

$$\widehat{\mu} = \frac{1}{8}\sum_{i=1}^{8} y_i = 459$$

and

$$\widehat{\sigma} = \sqrt{\frac{1}{7}\sum_{i=1}^{8} (y_i - \widehat{\mu})^2} = 31.31408.$$

The command

```
ks.test(y,"pnorm",459,31.31408)
```

gives the output

```
        One-sample Kolmogorov-Smirnov test

data:  y
D = 0.2064, p-value = 0.8215
alternative hypothesis: two-sided
```

Hence, the fit of the normal distribution is adequate. [1]

(g) The following commands

```
up<-mean(x)-mean(y)+qnorm(0.975)*sqrt(var(x)/8+var(y)/8)
low<-mean(x)-mean(y)-qnorm(0.975)*sqrt(var(x)/8+var(y)/8)
```

give the 95% confidence interval as $[-32.96695, 24.96695]$. Since this interval is not entirely negative, it is difficult to argue whether glaucoma affects the corneal thickness or not. [2]

(h) The test statistic

```
(mean(x)-mean(y))/sqrt(var(x)/8+var(y)/8)
```

gives -0.2706483. Since this is not less than $-z_{0.95} = -1.644854$ there is no evidence against the hypothesis that glaucoma does not affect the corneal thickness. [2]

[Total 10 marks]