STA135 homework8

Zhen Zhang

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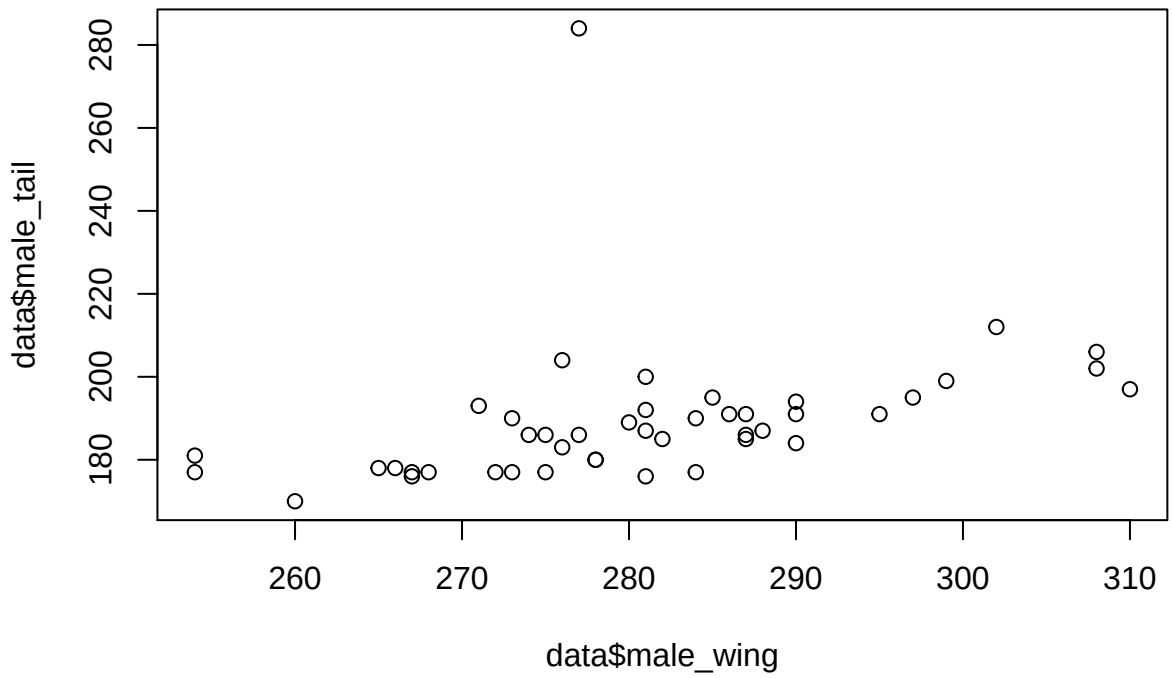
6.20

```
dat_male = read.table("T6-11.dat")
dat_female = read.table("T5-12.dat")
data = cbind(dat_male, dat_female)
names(data) = c("male_tail", "male_wing", "female_tail", "female_wing")
```

(a)

```
plot(data$`male_wing`, data$`male_tail`)
```



The outlier is the 31th observation.

(b) & (c)

```
# first case
dat_male <- dat_male[-31, ]
pooled_var <- cov(dat_male)/44 + cov(dat_female)/45
dat_male_mean <- apply(dat_male, 2, mean)
dat_female_mean <- apply(dat_female, 2, mean)
chi_star <- sqrt(qchisq(1-0.05, 2))
sd_deviation <- sqrt(diag(pooled_var))
part2 <- chi_star * sd_deviation
deviation <- dat_male_mean - dat_female_mean
(interval <- matrix(c(deviation - part2, deviation + part2), nrow = 2))
```

```
##            [,1]      [,2]
## [1,] -11.764358 -1.161905
## [2,]  -5.985685  8.339220
```

```
(t_square <- t(deviation) %*% solve(pooled_var) %*% deviation)
```

```
##          [,1]
## [1,] 25.00501
```

```
(c <- sqrt(t_square))
```

```
##          [,1]
## [1,] 5.000501
```

```
solve(pooled_var) %*% deviation
```

```
##         [,1]
## V1 -3.490238
## V2  2.079550
```

```
dat_male = read.table("T6-11.dat")
dat_male[31, 1] <- 184
pooled_var <- cov(dat_male)/45 + cov(dat_female)/45
dat_male_mean <- apply(dat_male, 2, mean)
dat_female_mean <- apply(dat_female, 2, mean)
chi_star <- sqrt(qchisq(1-0.05, 2))
sd_deviation <- sqrt(diag(pooled_var))
part2 <- chi_star * sd_deviation
deviation <- dat_male_mean - dat_female_mean
(interval <- matrix(c(deviation - part2, deviation + part2), nrow = 2))
```

```
##            [,1]      [,2]
## [1,] -11.786687 -1.279980
## [2,]  -6.003431  8.181209
```

```
(t_square <- t(deviation) %*% solve(pooled_var) %*% deviation)
```

```
##           [,1]
## [1,] 25.66253
```

```
(c <- sqrt(t_square))
```

```
##          [,1]
## [1,] 5.06582
```

```
solve(pooled_var) %*% deviation
```

```
##          [,1]
## V1 -3.574268
## V2  2.122020
```

H0 is rejected at either case. The coefficient indicates the difference is due to tail.

The region is on the handwritten paper.

(d)

Female birds are larger, due to larger tail than male birds (see 0 is included in the interval of either case). The difference between wing is not significant