stat445_a3

STAT 445 Assignment 3

There are 42 observations from a bivariate normal distribution. The sample mean is given by $\bar{x} = \begin{bmatrix} 0.0564 \\ 0.603 \end{bmatrix}$.

The sample variance is given by $S = \begin{bmatrix} 0.0144 & 0.0117 \\ 0.0117 & 0.0146 \end{bmatrix}$.

```
S = matrix(c(0.0144, 0.0117, 0.0117, 0.0146), 2, 2)
S
```

```
##        [,1]   [,2]
## [1,] 0.0144 0.0117
## [2,] 0.0117 0.0146
```

```
xbar = matrix(c(0.564, 0.603), 2, 1)
xbar
```

```
##       [,1]
## [1,] 0.564
## [2,] 0.603
```

Question 1

a) Find the 95% confidence region for the mean vector $\mu = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix}$.

```
#install.packages("ellipse")
library(ellipse)
```

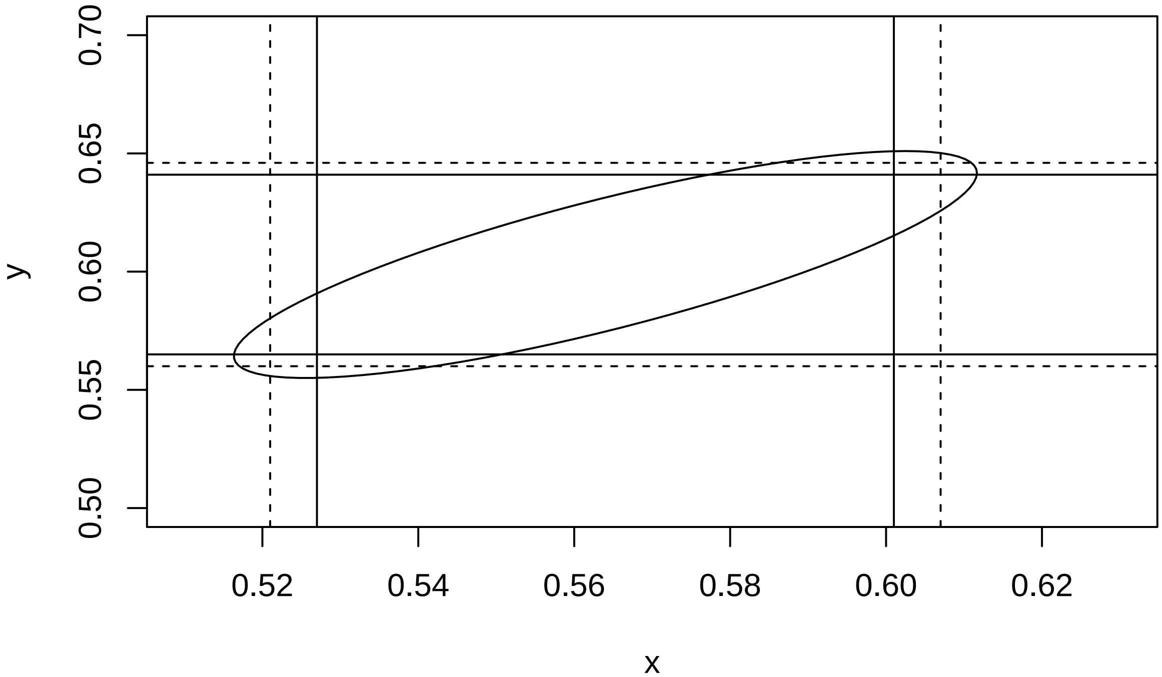
```
## Warning: package 'ellipse' was built under R version 3.4.3
```

```
##
## Attaching package: 'ellipse'
```

```
## The following object is masked from 'package:graphics':
##
##     pairs
```

```
plot(ellipse(S/42, centre=xbar, t=sqrt(((2*41)/40)*qf(0.95, 2, 40) )), type="l", xlim=c(0.51, 0.630), y
abline(h=0.565)
abline(h=0.641)
abline(v=0.527)
abline(v=0.601)

abline(v=0.521, lty=2)
abline(v=0.607, lty=2)
abline(h=0.560, lty=2)
abline(h=0.646, lty=2)
```



Question 2

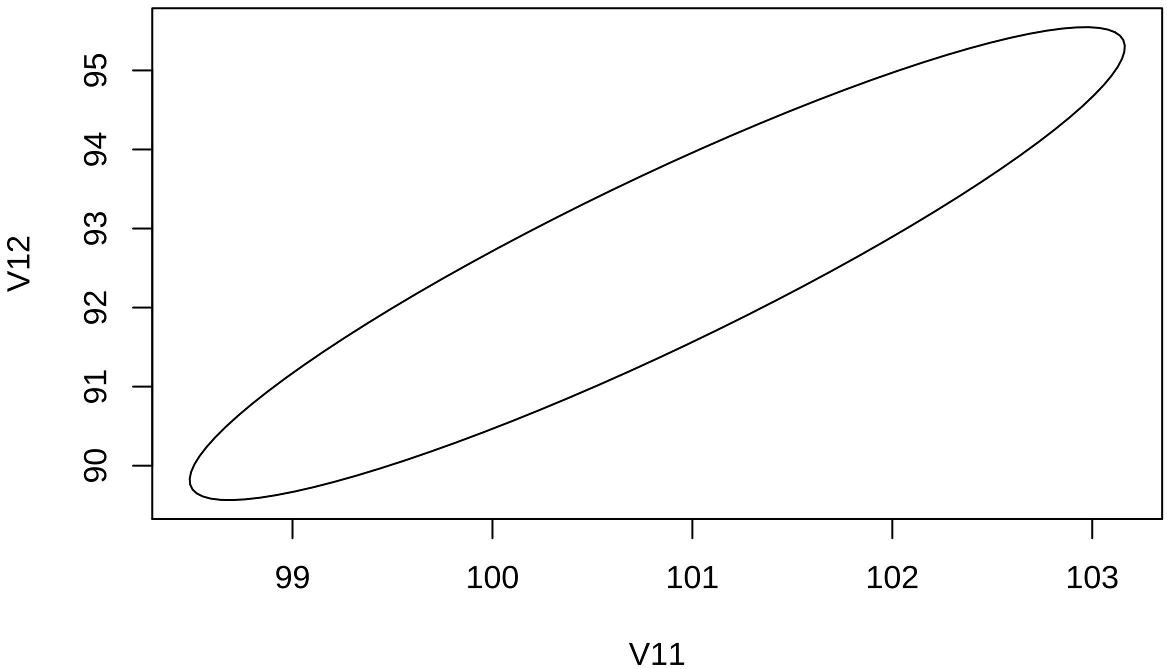
a)

```
data <- read.table("~/Documents/SFU/STAT445/a1/fat_dat.txt", quote="\"", comment.char="")
fat_dat <- data[,10:19]
n <- nrow(fat_dat)
p <- ncol(fat_dat)
F <- qf(0.95, n, n-p)
cbind(colMeans(fat_dat) - sqrt((p*(n-1)/(n-p))*F)*sqrt(diag(var(fat_dat))/n),colMeans(fat_dat) + sqrt((
```

```
##          [,1]      [,2]
## V10 37.44429  38.53984
## V11 98.92450 102.72392
## V12 90.12611  94.98579
## V13 98.29043 101.51910
## V14 58.22294  60.58897
## V15 38.04700  39.13395
## V16 22.72046  23.48431
## V17 31.59260  32.95422
## V18 28.20855  29.11923
## V19 18.01939  18.44013
```

b)

```
variance <- var(fat_dat[,c(2,3)])
means <- colMeans(fat_dat[,c(2,3)])
plot(ellipse(variance/n, centre=means, t=sqrt(((p*(n-1)/(n-p))*qf(0.95, p, n-p))))
     ,type="l")
```



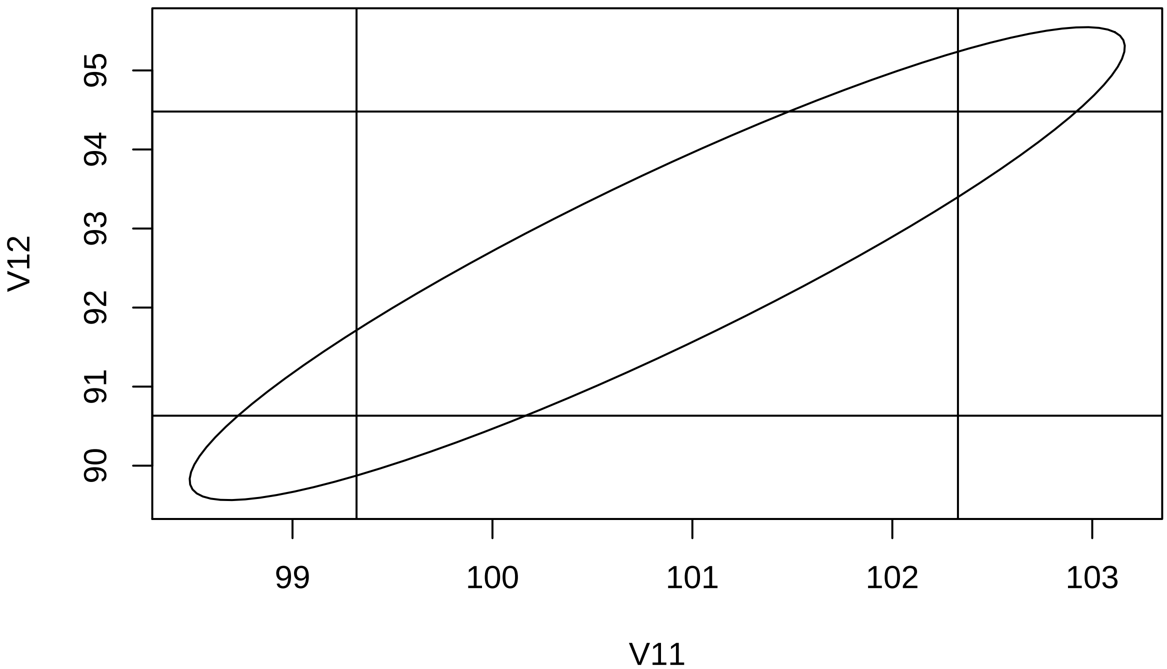
c) Bonferroni Confidence Intervals for the

```
circData <- fat_dat
m <- ncol(circData)
t2 <- -qt(0.05/(2*m), df=n-1, lower.tail=TRUE)
intervals <- rbind(colMeans(circData) - t2*sqrt(diag(var(circData))/n), colMeans(circData) + t2*sqrt(dia
intervals
```

```
##           V10       V11      V12       V13      V14      V15      V16
## [1,] 37.55838  99.32018 90.63222  98.62667 58.46934 38.16020 22.80001
## [2,] 38.42575 102.32823 94.47969 101.18285 60.34256 39.02075 23.40476
##           V17      V18      V19
## [1,] 31.73441 28.30339 18.06321
## [2,] 32.81242 29.02439 18.39632
```

d)

```
chestInt <- intervals[,2]
abInt <- intervals[,3]
plot(ellipse(variance/n, centre=means, t=sqrt(((p*(n-1)/(n-p))*qf(0.95, p, n-p)))), type="l")
abline(v=chestInt[1])
abline(v=chestInt[2])
abline(h=abInt[1])
abline(h=abInt[2])
```



e) The confidence interval for mean chest circumference - mean abdomen circumference is (7.44485, 9.091658).

```
m_new = m + 1
b <- matrix(0, 10, 1)
b[2] <- 1
b[3] <- -1
t_new <- -qt(0.05/(2*m_new), df=n-1)
cbind(t(b) %*% colMeans(circData) - t_new * sqrt((t(b) %*% var(circData) %*% b)/n),t(b) %*% colMeans(ci
```

```
##          [,1]     [,2]
## [1,] 7.44485 9.091658
```