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Setting up

```
knitr::opts_chunk$set(echo = TRUE,
  warning = FALSE,
  message = FALSE,
  fig.align = "center",
  fig.width = 7,
  fig.height = 6,
  out.height = "60%")

set.seed(12314159)
library(loon.data)
library(loon)

## Loading required package: tcltk

library(gridExtra)

imageDirectory <- "./img"
dataDirectory <- "./data"
codeDirectory <- "/home/yoogesh/Desktop/stat847assignments/a3/"
path_concat <- function(path1, path2, sep="/") paste(path1, path2, sep = sep)

imageDirectory <- "/home/yoogesh/Desktop/stat847assignments/a3/img" # e.g. in current "./img"
dataDirectory <- "/home/yoogesh/Desktop/stat847assignments/a3/data" # e.g. in current "./data"
path_concat <- function(path1, path2, sep="/") paste(path1, path2, sep = sep)
```

(B)

```
load("blocks.rda")
head(blocks, n=3)
```

```
##   id weight perimeter group
## 1  1     55         32     B
## 2  2     35         27     B
## 3  3     35         25     A
```

```
students <- read.csv("judgmentSamples.csv")
head(students, n = 3)
```

```
##   studentID first second third fourth fifth sixth seventh eighth ninth
## 1      5086    12     18    17     11     15    20      14     13    16
## 2      3848    34     35    70     56    32    14       5     88    81
## 3      6656    14     34    41     29    32    55      74     40    16
##   tenth
## 1     18
## 2     73
## 3     70
```

(A)

```
avgW <- mean(blocks$weight)
totblock <- unlist(students[c(2:length(students))], recursive=FALSE)
totW <- rep(0, length(totblock))

j <- 1
for(val in totblock)
{
  totW[j] <- blocks$weight[blocks$id == val][1]
  cat("\nid ", val, "Weight ", blocks$weight[blocks$id == val][1])
  j <- j + 1
}
```

```
##
## id 12 Weight 25
## id 34 Weight 10
## id 14 Weight 40
## id 38 Weight 20
## id 66 Weight 55
## id 97 Weight 40
## id 11 Weight 50
## id 40 Weight 60
## id 40 Weight 60
## id 27 Weight 60
## id 70 Weight 80
## id 87 Weight 15
## id 66 Weight 55
## id 88 Weight 35
## id 95 Weight 30
## id 44 Weight 70
## id 66 Weight 55
## id 62 Weight 15
## id 61 Weight 50
## id 1 Weight 55
## id 27 Weight 60
## id 82 Weight 40
## id 41 Weight 15
## id 71 Weight 60
## id 1 Weight 55
## id 67 Weight 60
## id 70 Weight 80
## id 56 Weight 55
## id 70 Weight 80
## id 1 Weight 55
## id 12 Weight 25
## id 16 Weight 85
## id 73 Weight 40
## id 18 Weight 40
## id 35 Weight 15
## id 34 Weight 10
## id 25 Weight 20
## id 37 Weight 40
```

```
## id 16 Weight 85
## id 21 Weight 25
## id 50 Weight 25
## id 24 Weight 30
## id 8 Weight 60
## id 63 Weight 10
## id 44 Weight 70
## id 1 Weight 55
## id 29 Weight 30
## id 17 Weight 40
## id 48 Weight 25
## id 80 Weight 20
## id 21 Weight 25
## id 67 Weight 60
## id 11 Weight 50
## id 78 Weight 50
## id 40 Weight 60
## id 25 Weight 20
## id 81 Weight 35
## id 66 Weight 55
## id 91 Weight 25
## id 67 Weight 60
## id 55 Weight 50
## id 76 Weight 10
## id 100 Weight 30
## id 41 Weight 15
## id 22 Weight 20
## id 28 Weight 20
## id 17 Weight 40
## id 70 Weight 80
## id 41 Weight 15
## id 21 Weight 25
## id 31 Weight 55
## id 44 Weight 70
## id 95 Weight 30
## id 30 Weight 50
## id 94 Weight 60
## id 92 Weight 15
## id 16 Weight 85
## id 54 Weight 30
## id 16 Weight 85
## id 95 Weight 30
## id 59 Weight 35
## id 47 Weight 15
## id 37 Weight 40
## id 28 Weight 20
## id 26 Weight 55
## id 21 Weight 25
## id 36 Weight 20
## id 78 Weight 50
## id 12 Weight 25
## id 61 Weight 50
## id 58 Weight 25
## id 7 Weight 15
```

```
## id 41 Weight 15
## id 3 Weight 35
## id 67 Weight 60
## id 21 Weight 25
## id 7 Weight 15
## id 56 Weight 55
## id 70 Weight 80
## id 11 Weight 50
## id 56 Weight 55
## id 29 Weight 30
## id 36 Weight 20
## id 44 Weight 70
## id 92 Weight 15
## id 28 Weight 20
## id 77 Weight 15
## id 60 Weight 25
## id 16 Weight 85
## id 27 Weight 60
## id 37 Weight 40
## id 8 Weight 60
## id 11 Weight 50
## id 32 Weight 40
## id 31 Weight 55
## id 43 Weight 35
## id 64 Weight 20
## id 30 Weight 50
## id 31 Weight 55
## id 70 Weight 80
## id 18 Weight 40
## id 24 Weight 30
## id 51 Weight 25
## id 93 Weight 30
## id 9 Weight 15
## id 26 Weight 55
## id 68 Weight 45
## id 72 Weight 20
## id 11 Weight 50
## id 32 Weight 40
## id 70 Weight 80
## id 82 Weight 40
## id 15 Weight 40
## id 32 Weight 40
## id 32 Weight 40
## id 39 Weight 20
## id 94 Weight 60
## id 73 Weight 40
## id 62 Weight 15
## id 54 Weight 30
## id 13 Weight 40
## id 38 Weight 20
## id 26 Weight 55
## id 17 Weight 40
## id 96 Weight 20
## id 91 Weight 25
```

```
## id 91 Weight 25
## id 76 Weight 10
## id 25 Weight 20
## id 19 Weight 25
## id 11 Weight 50
## id 41 Weight 15
## id 57 Weight 25
## id 100 Weight 30
## id 8 Weight 60
## id 41 Weight 15
## id 84 Weight 25
## id 14 Weight 40
## id 9 Weight 15
## id 33 Weight 25
## id 38 Weight 20
## id 9 Weight 15
## id 69 Weight 35
## id 1 Weight 55
## id 8 Weight 60
## id 20 Weight 40
## id 14 Weight 40
## id 55 Weight 50
## id 95 Weight 30
## id 2 Weight 35
## id 25 Weight 20
## id 51 Weight 25
## id 66 Weight 55
## id 73 Weight 40
## id 83 Weight 25
## id 8 Weight 60
## id 52 Weight 15
## id 21 Weight 25
## id 59 Weight 35
## id 73 Weight 40
## id 56 Weight 55
## id 72 Weight 20
## id 91 Weight 25
## id 73 Weight 40
## id 51 Weight 25
## id 51 Weight 25
## id 94 Weight 60
## id 5 Weight 45
## id 31 Weight 55
## id 9 Weight 15
## id 88 Weight 35
## id 16 Weight 85
## id 22 Weight 20
## id 84 Weight 25
## id 90 Weight 20
## id 27 Weight 60
## id 21 Weight 25
## id 51 Weight 25
## id 14 Weight 40
## id 5 Weight 45
```

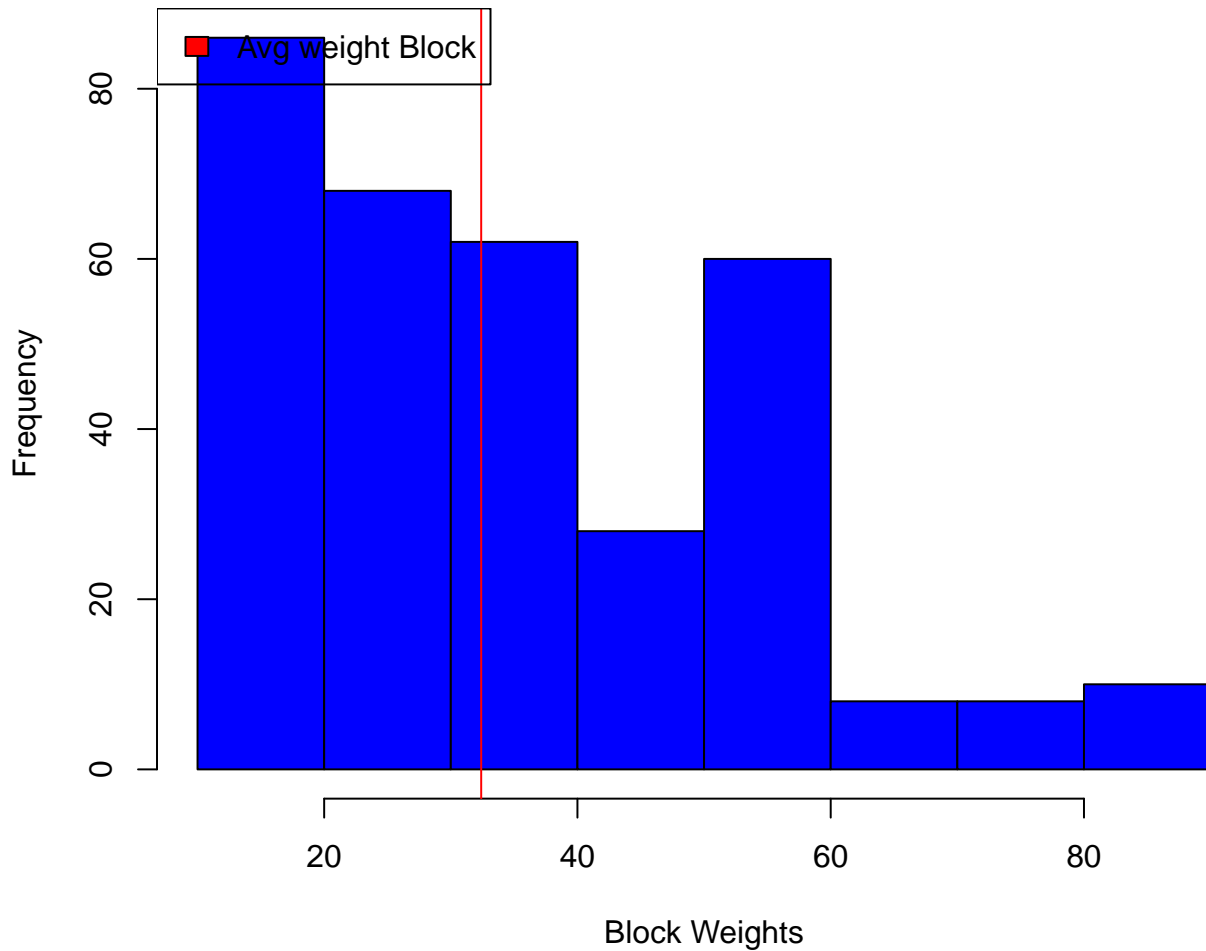
```
## id 74 Weight 30
## id 76 Weight 10
## id 8 Weight 60
## id 38 Weight 20
## id 47 Weight 15
## id 98 Weight 30
## id 82 Weight 40
## id 60 Weight 25
## id 80 Weight 20
## id 55 Weight 50
## id 64 Weight 20
## id 50 Weight 25
## id 44 Weight 70
## id 37 Weight 40
## id 76 Weight 10
## id 14 Weight 40
## id 91 Weight 25
## id 61 Weight 50
## id 63 Weight 10
## id 26 Weight 55
## id 9 Weight 15
## id 21 Weight 25
## id 35 Weight 15
## id 57 Weight 25
## id 65 Weight 15
## id 44 Weight 70
## id 56 Weight 55
## id 52 Weight 15
## id 56 Weight 55
## id 31 Weight 55
## id 79 Weight 15
## id 13 Weight 40
## id 88 Weight 35
## id 40 Weight 60
## id 40 Weight 60
## id 51 Weight 25
## id 22 Weight 20
## id 4 Weight 15
## id 82 Weight 40
## id 100 Weight 30
## id 14 Weight 40
## id 72 Weight 20
## id 46 Weight 20
## id 90 Weight 20
## id 82 Weight 40
## id 71 Weight 60
## id 25 Weight 20
## id 32 Weight 40
## id 8 Weight 60
## id 5 Weight 45
## id 71 Weight 60
## id 56 Weight 55
## id 67 Weight 60
## id 35 Weight 15
```

```
## id 11 Weight 50
## id 11 Weight 50
## id 10 Weight 35
## id 16 Weight 85
## id 7 Weight 15
## id 68 Weight 45
## id 8 Weight 60
## id 44 Weight 70
## id 6 Weight 25
## id 50 Weight 25
## id 16 Weight 85
## id 81 Weight 35
## id 16 Weight 85
## id 41 Weight 15
## id 23 Weight 25
## id 91 Weight 25
## id 6 Weight 25
## id 26 Weight 55
## id 3 Weight 35
## id 90 Weight 20
## id 76 Weight 10
## id 51 Weight 25
## id 32 Weight 40
## id 18 Weight 40
## id 34 Weight 10
## id 10 Weight 35
## id 44 Weight 70
## id 48 Weight 25
## id 83 Weight 25
## id 81 Weight 35
## id 94 Weight 60
## id 91 Weight 25
## id 46 Weight 20
## id 91 Weight 25
## id 67 Weight 60
## id 38 Weight 20
## id 72 Weight 20
## id 64 Weight 20
## id 59 Weight 35
## id 16 Weight 85
## id 87 Weight 15
## id 9 Weight 15
## id 68 Weight 45
## id 18 Weight 40
## id 73 Weight 40
## id 70 Weight 80
## id 64 Weight 20
## id 91 Weight 25
## id 43 Weight 35
## id 78 Weight 50
## id 8 Weight 60
## id 86 Weight 15
## id 50 Weight 25
## id 79 Weight 15
```

```
## id 78 Weight 50
## id 55 Weight 50
## id 15 Weight 40
## id 2 Weight 35
## id 32 Weight 40
## id 14 Weight 40
## id 29 Weight 30
## id 57 Weight 25
## id 91 Weight 25
## id 68 Weight 45
## id 51 Weight 25
## id 2 Weight 35
## id 1 Weight 55
## id 8 Weight 60
## id 28 Weight 20
## id 96 Weight 20
## id 85 Weight 40
## id 57 Weight 25
## id 96 Weight 20
## id 22 Weight 20
## id 92 Weight 15
## id 65 Weight 15
```

```
hist(totW,col = "blue",main = "Students Selected Weights",xlab = "Block Weights")
abline(v = avgW, col="red")
legend("topleft", c("Avg weight Block"), fill=c("red"))
```


Students Selected Weights



(B)

```
ato_v <- c()
for(i in 1:nrow(students)){
  val = 0
  for(j in 2:ncol(students)){
    val = val + blocks[blocks$id==students[i,j],2]
  }
  ato_v <- c(ato_v, val/10) }

students$avg_W <- ato_v
students$sampE <- mean(blocks$weight) - students$avg_W
judgmentErr <- data.frame(students$studentID, students$sampE)
judgmentErr$students.sampE <- abs(judgmentErr$students.sampE)
judgmentErr <- judgmentErr[order(judgmentErr$students.sampE),]

head(judgmentErr, n = 5)

## students.studentID students.sampE
```

```
## 14          7656          2.6
## 17          7626          2.6
## 31          8395          2.6
## 12           842          3.1
## 26          7954          3.4
```

```
tail(judgmentErr, n = 5)
```

```
##      students.studentID students.sampE
## 1          5086          11.6
## 3          6656          11.6
## 22         7231          12.1
## 5          4114          12.6
## 27         7582          12.6
```

(C)

```
bias <- mean(students$sampE)
print("Bias")
```

```
## [1] "Bias"
```

```
bias
```

```
## [1] -5.418182
```

```
std <- sd(students$sampE)
print("Standard Deviation")
```

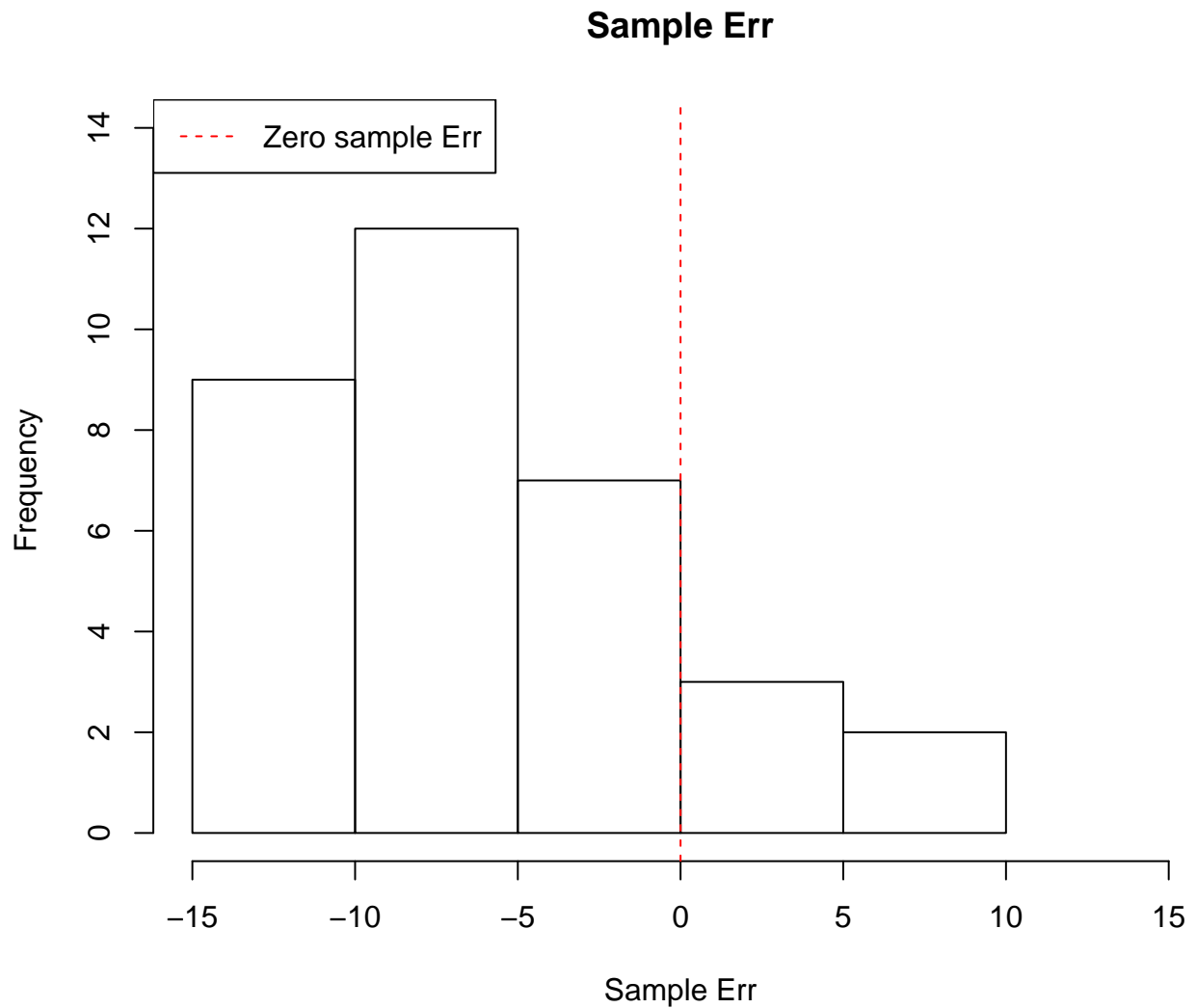
```
## [1] "Standard Deviation"
```

```
std
```

```
## [1] 5.508258
```

(D)

```
hist(students$sampE, main = "Sample Err", xlab = "Sample Err", ylab = "Frequency", xlim = c(-15,15), ylab = "Frequency",
      abline(v = 0, lty = 2, col = "red", legend("topleft", c("Zero sample Err"), col = "red", lty = 2))
```

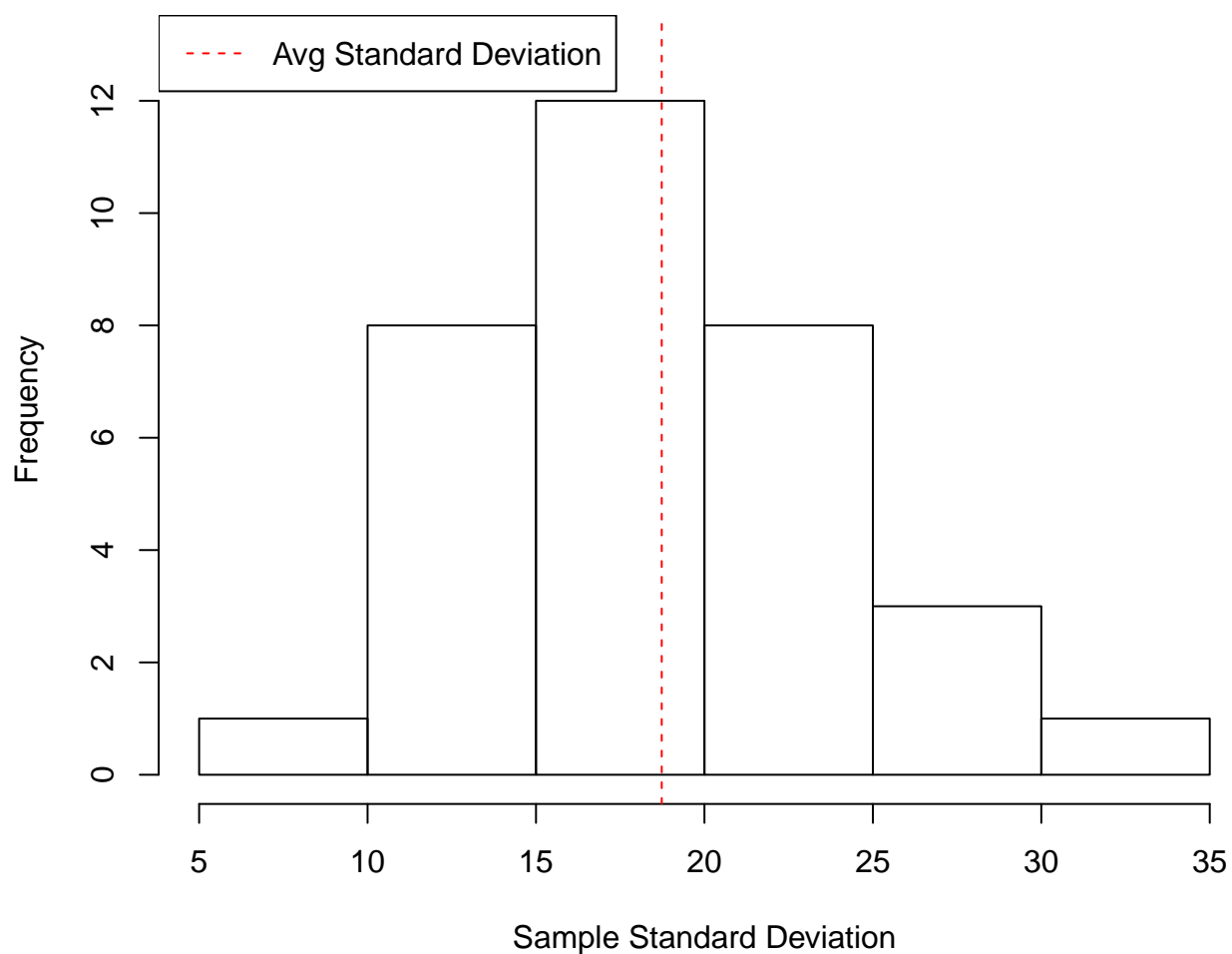


(E)

```
sd_v <- c()
for(i in 1:nrow(students)){
  li <- c()
  for(j in 2:ncol(students)-2) {
    li <- c(li, blocks[blocks$id==students[i,j],2])
  }
  sd_v <- c(sd_v, sd(li))}

hist(sd_v, xlab = "Sample Standard Deviation", ylab = "Frequency", ylim = c(0, 13), main = "Standard Deviation of Sample Standard Deviations", col = "blue", lty = 1)
abline(v = mean(sd_v), lty = 2, col = "red", legend("topleft", c("Avg Standard Deviation"), col = "red"))
```

Standard Deviation of Sample Weights



(F)

```
MinSD = which(sd_v == min(sd_v))
MaxSD = which(sd_v == max(sd_v))

minStudent_Sd<- students[MinSD,1]
maxStudent_Sd <- students[MaxSD,1]
min_sd_v <- min(sd_v)
max_sd_v <- max(sd_v)

cat("Student Id: ", minStudent_Sd, " has small sample SD - ", min_sd_v)
```

```
## Student Id: 7656 has small sample SD - 7.81736
```

```
cat("\nStudent id: ", maxStudent_Sd, " has large sample SD -", max_sd_v)
```

```
##
```

```
## Student id: 7582 has large sample SD - 31.09126
```

```

MinSD_weights <- c()
MinSD_peri <- c()

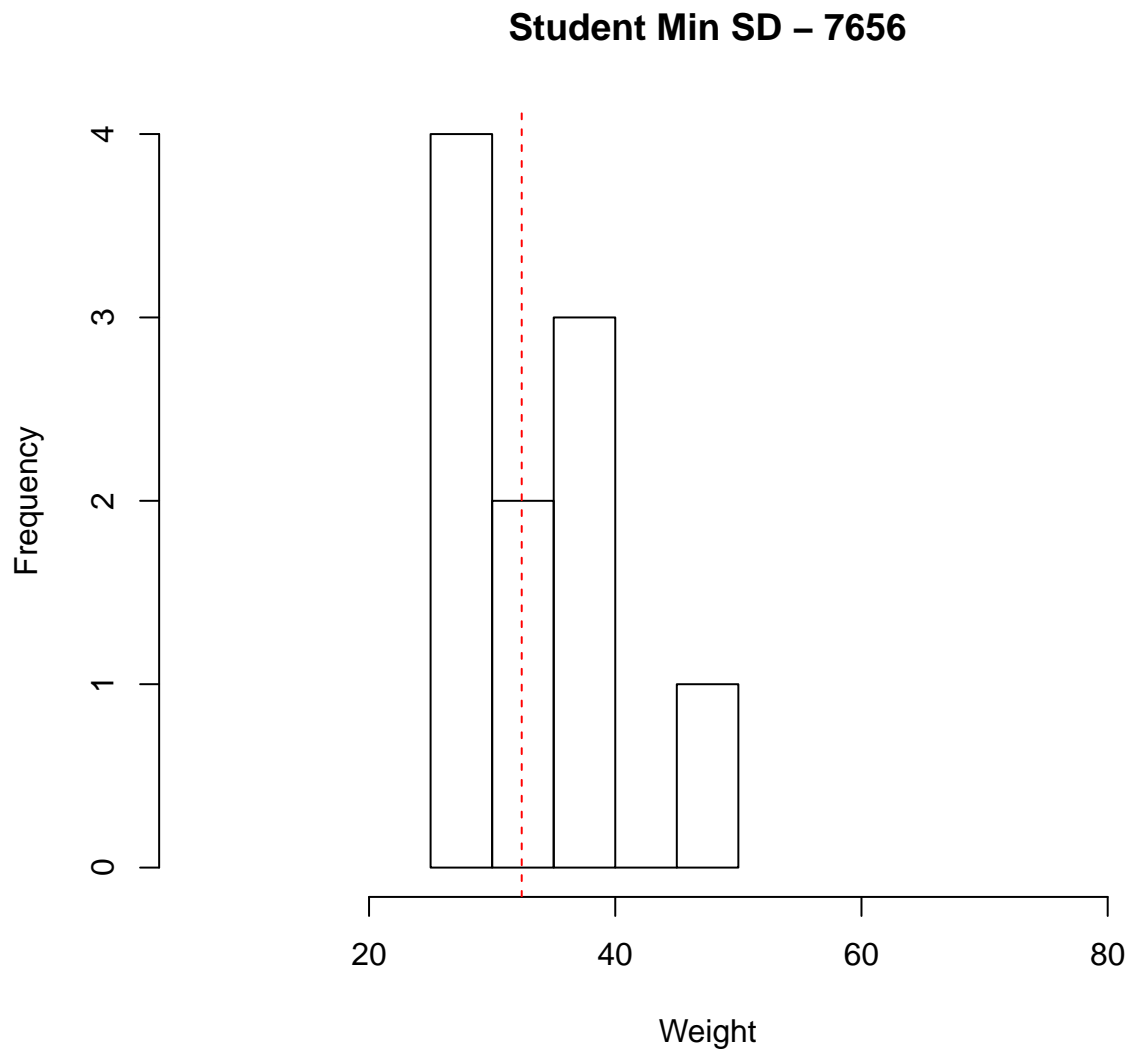
for(j in 2:ncol(students)-2){
  MinSD_weights <- c(MinSD_weights,blocks[blocks$id==students[MinSD,j],2])
  MinSD_peri <- c(MinSD_peri,blocks[blocks$id==students[MinSD,j],3])
}

MaxSD_weights <- c()
MaxSD_peri <- c()

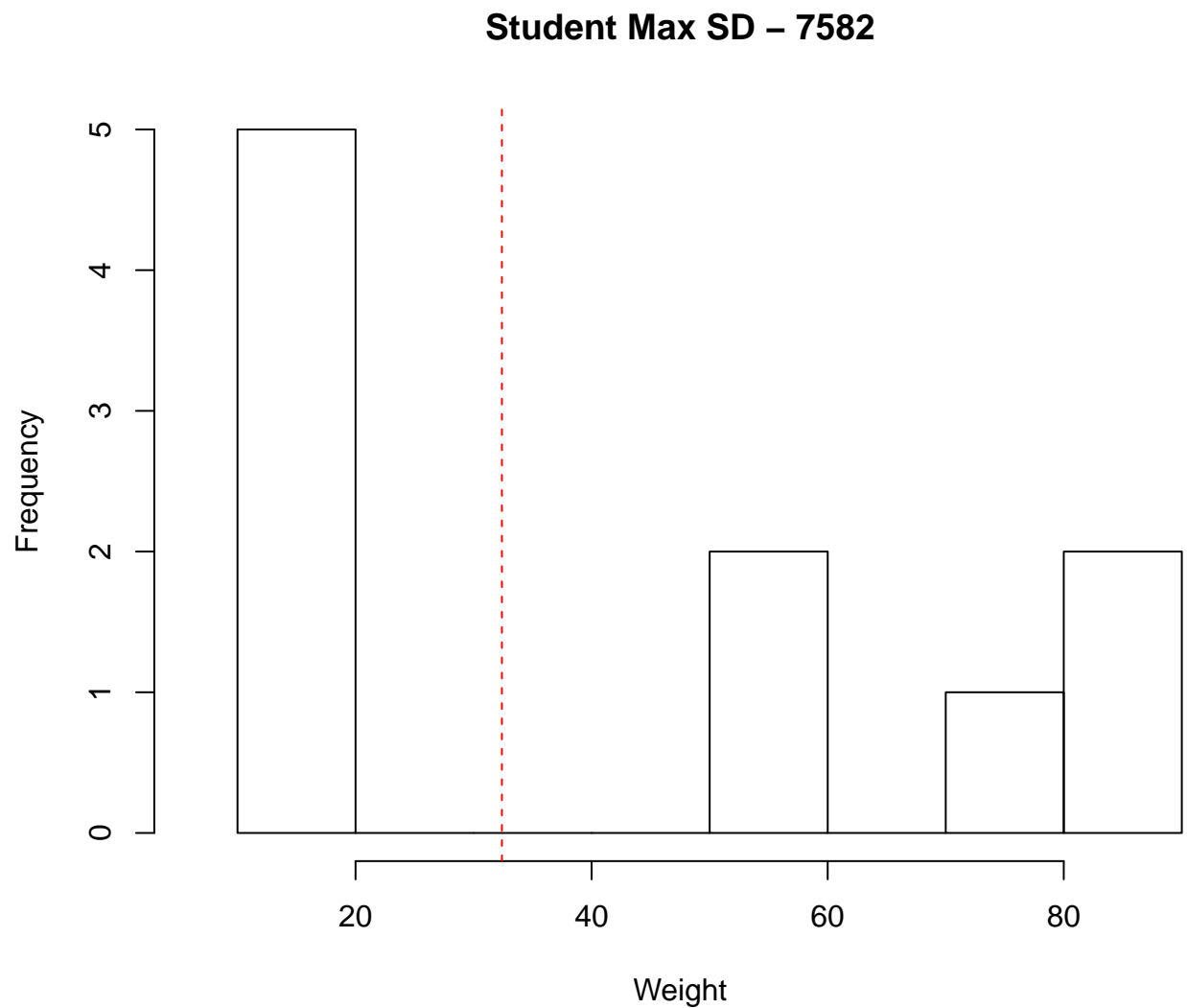
for(j in 2:ncol(students)-2){
  MaxSD_weights <- c(MaxSD_weights,blocks[blocks$id==students[MaxSD,j],2])
  MaxSD_peri <- c(MaxSD_peri,blocks[blocks$id==students[MaxSD,j],3])
}

hist(MinSD_weights, xlim = extendrange(blocks$weight), main = "Student Min SD - 7656", xlab = "Weight",
abline(v = mean(blocks$weight), col="red", lty=2)

```



```
hist(MaxSD_weights, xlim = extendrange(blocks$weight), main = "Student Max SD - 7582", xlab = "Weight",
abline(v = mean(blocks$weight), col="red", lty=2)
```



```
MinSD_peri
```

```
## [1] 28 33 25 30 26 25 28 29 28 28
```

```
MaxSD_peri
```

```
## [1] 36 34 23 38 21 38 23 38 20 23
```

(G)