# Exercise 9

Den seje gruppe

3/31/2021

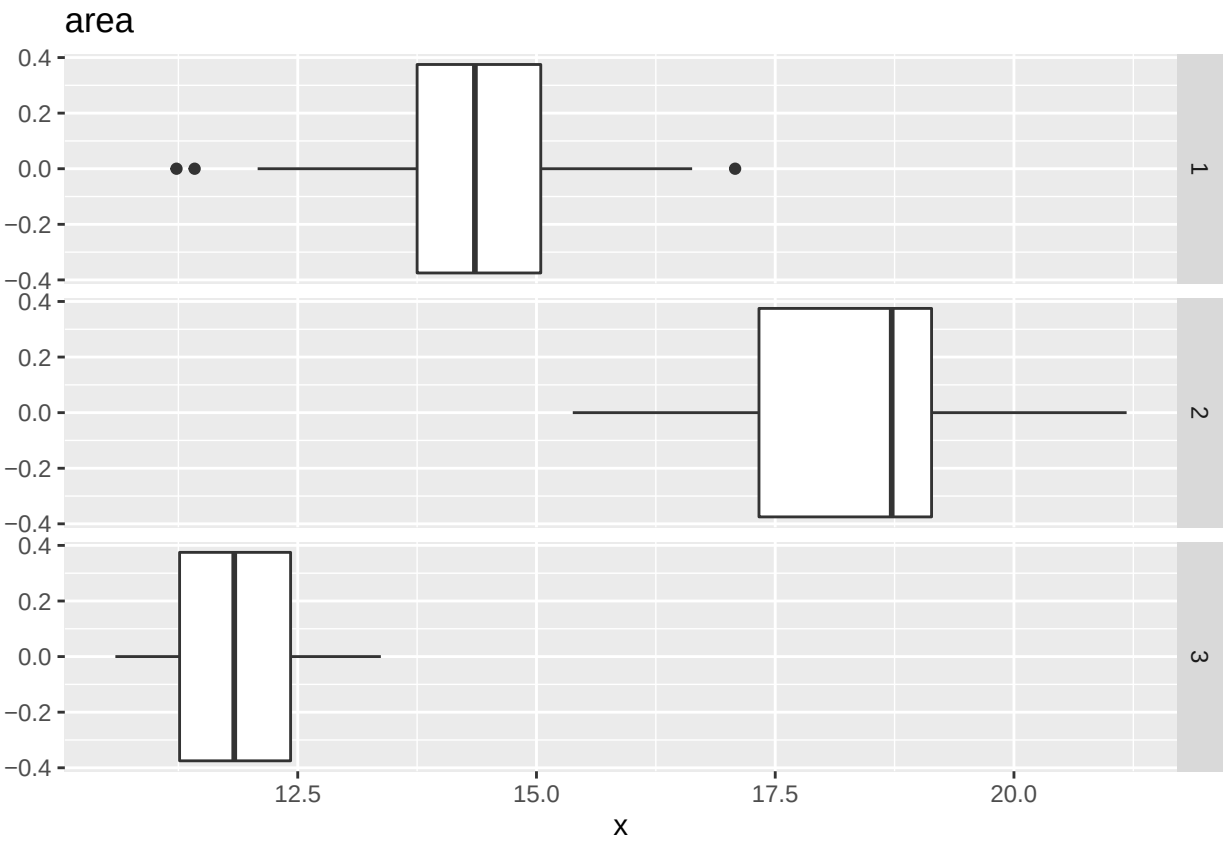
### (a) Data preprocessing

```
df <- read.csv("seeds_dataset.csv")[-1]

names(df) <- c("area", "perim", "compact", "len_k", "width", "asym", "len_kg", "class")

normalized <- scale(df)
```

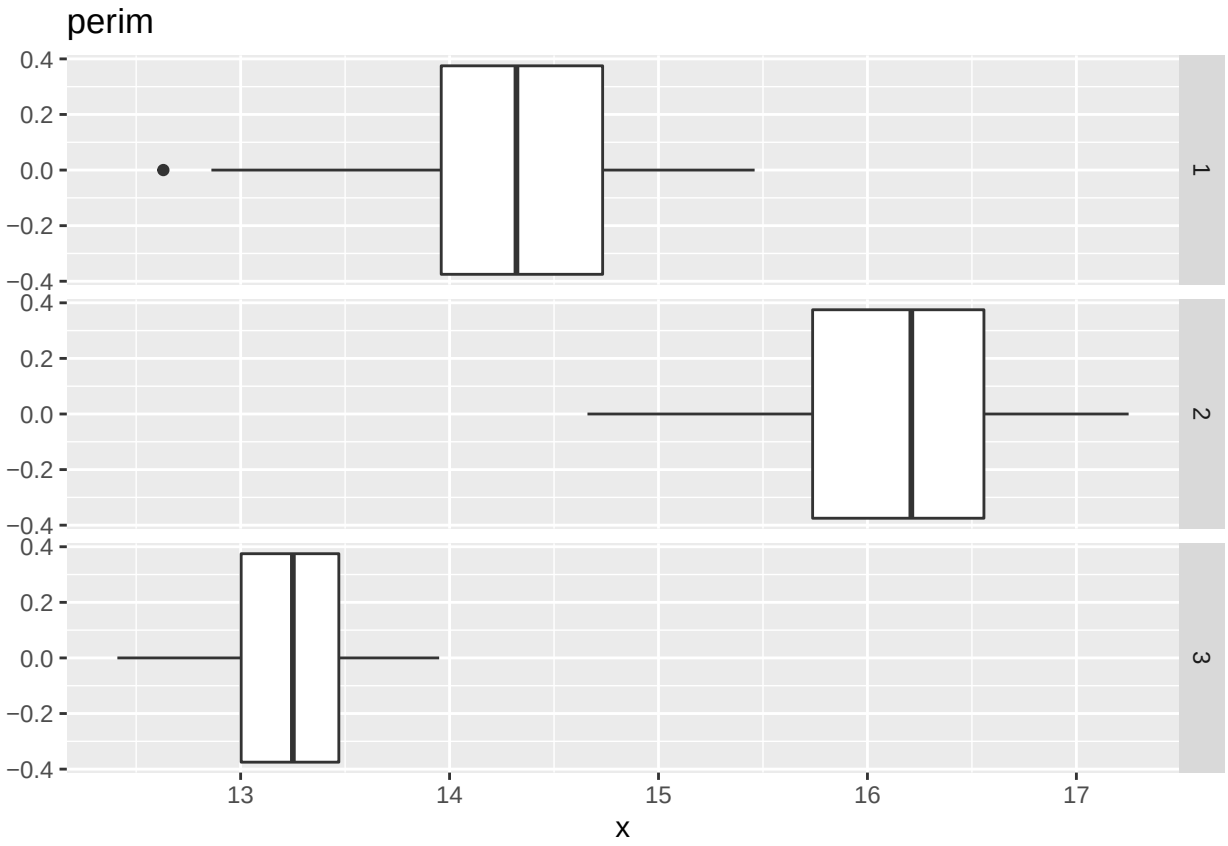
```
# pairs(df, lower.panel = NULL)

boxplotter <- function(x) {
  ggplot(df, aes(x)) +
    geom_boxplot() +
    facet_grid(vars(class))
}


i = 0
lapply(df[-8], function(x) {
  i <<- i + 1
  boxplotter(x) +
    ggtitle(names(df)[i])
  })
```

### Visualizing the data

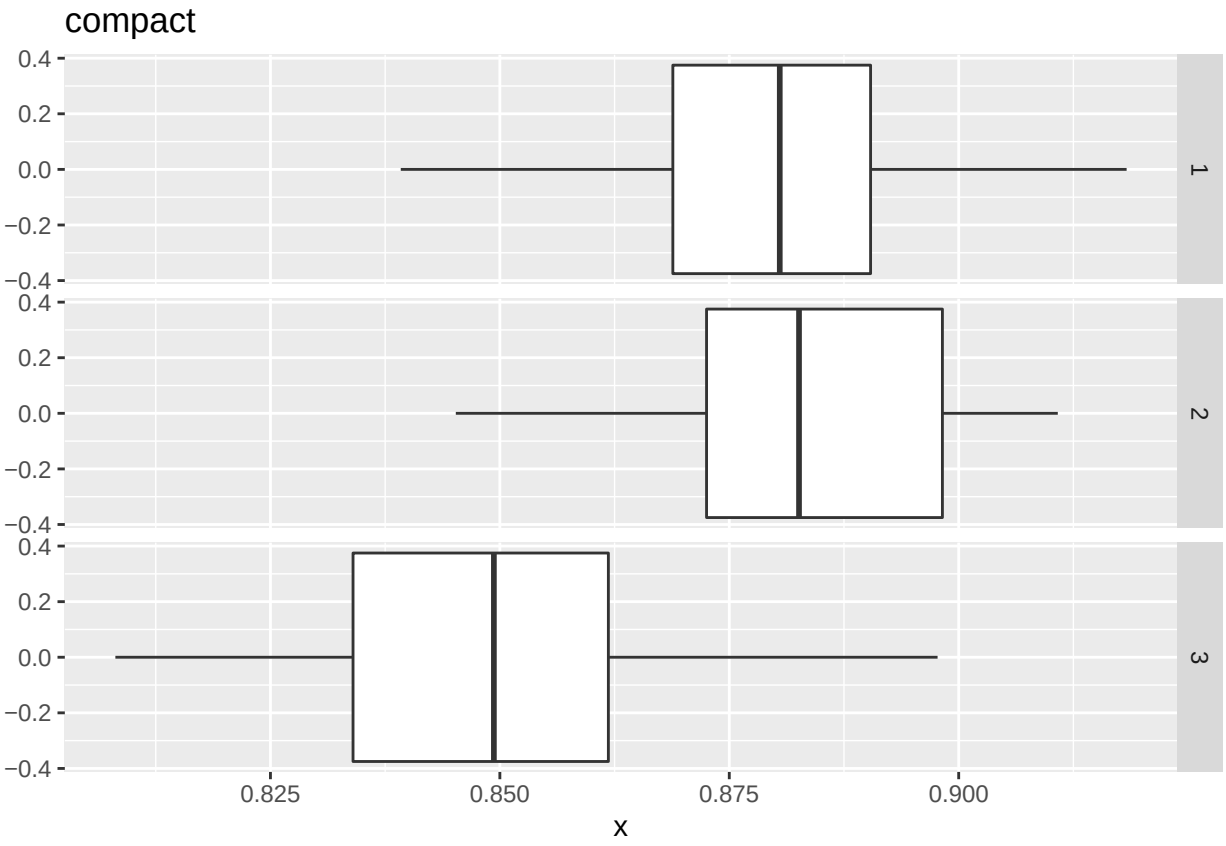
```
## $area
```



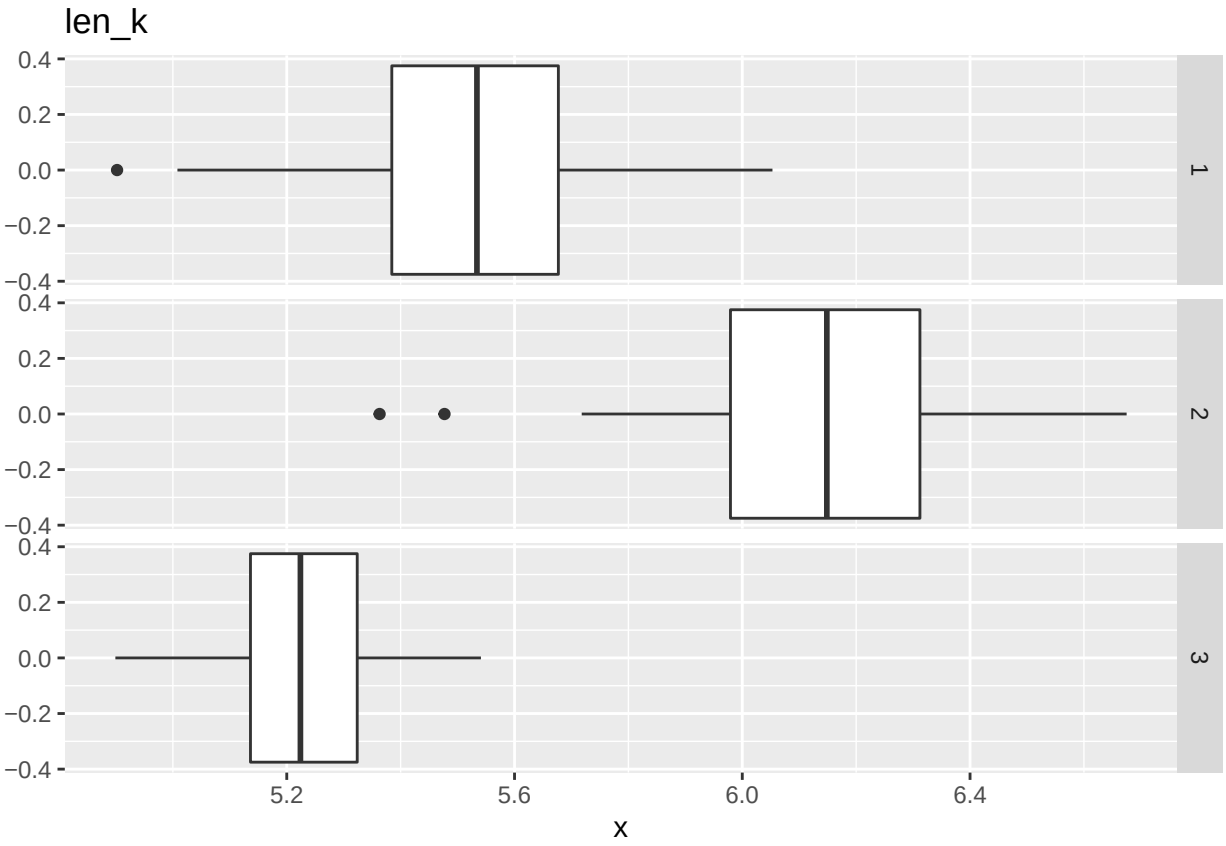

```
##
## $perim
```



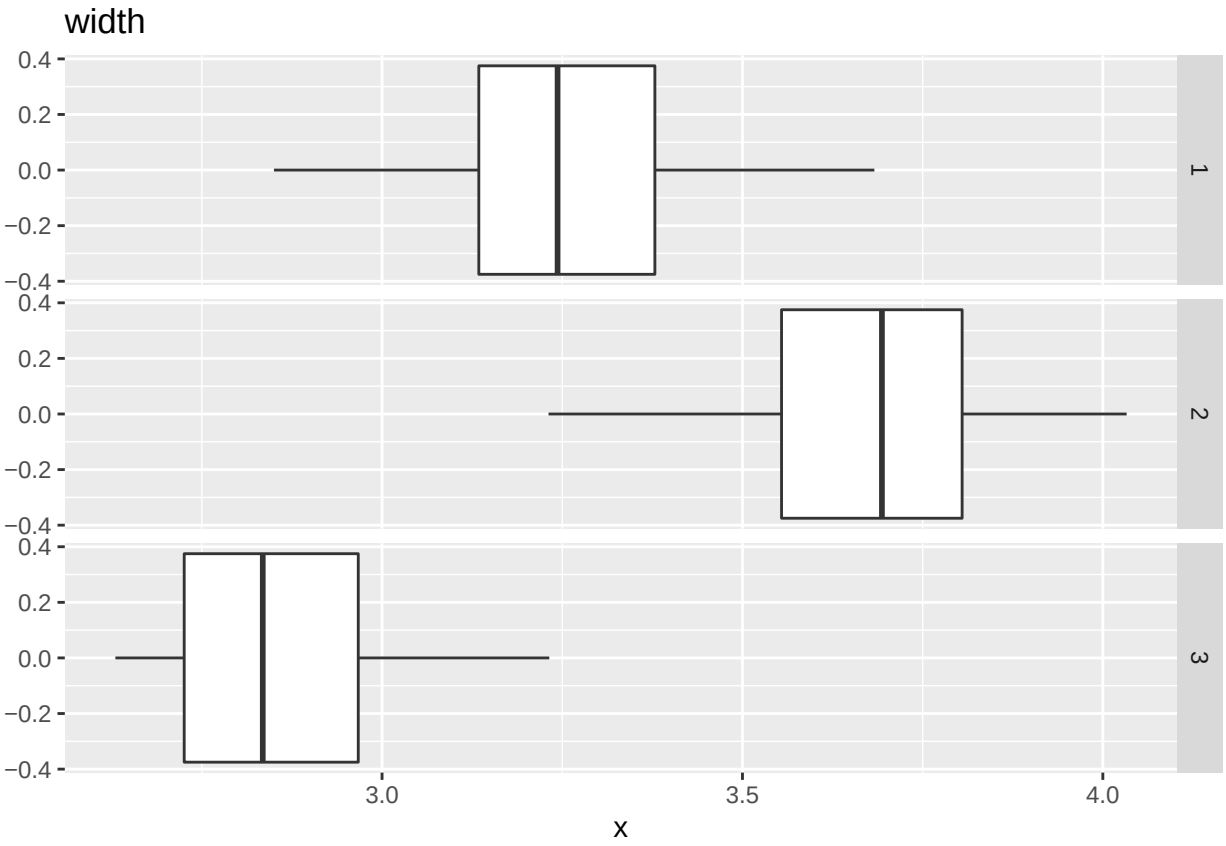

```
##
## $compact
```



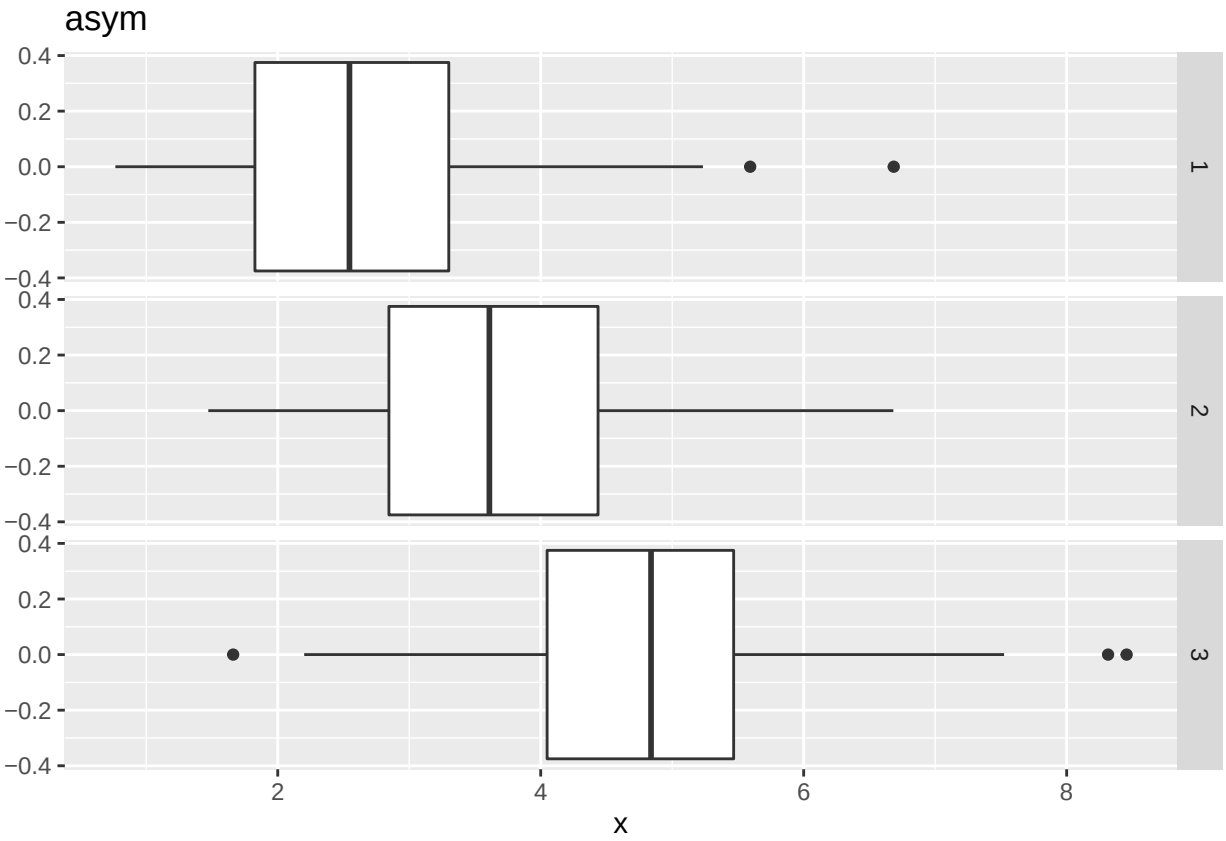

```
##
## $len_k
```




```
##
## $width
```



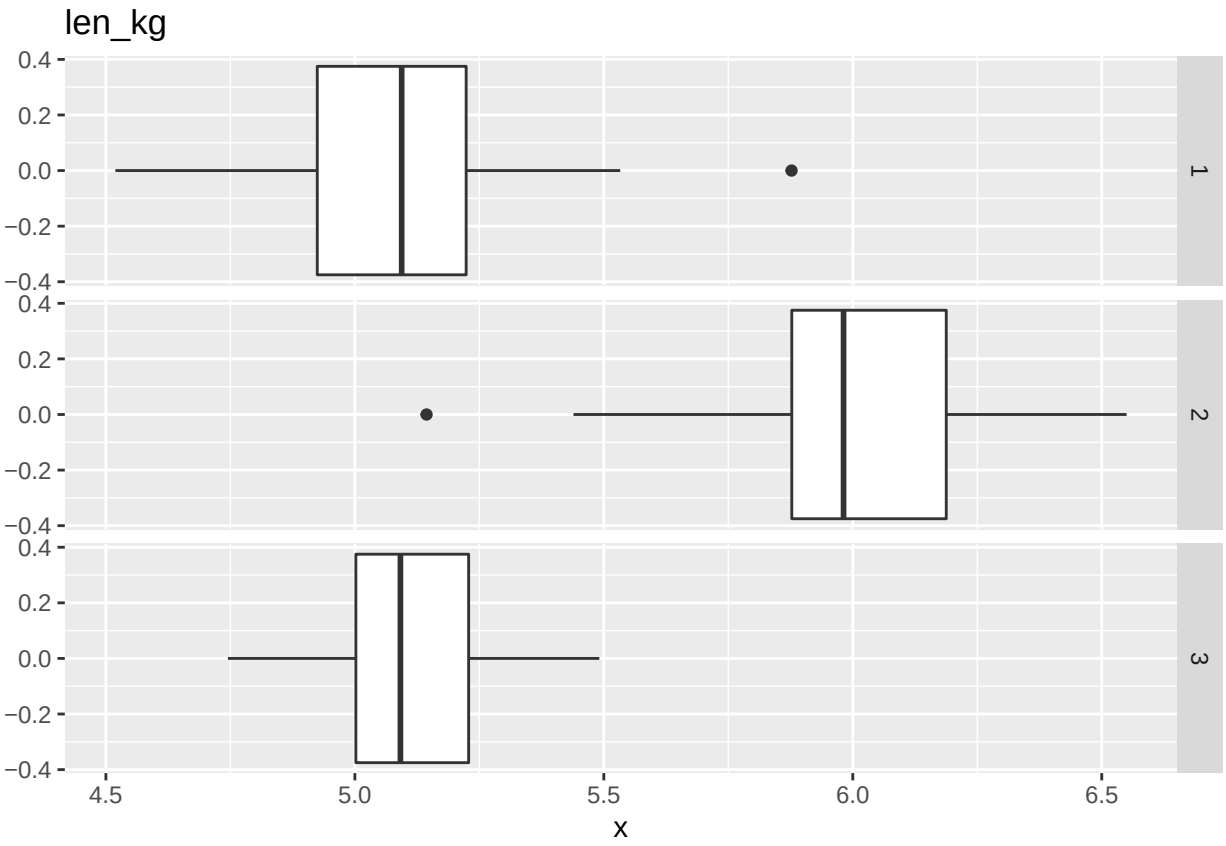

```
##
## $asym
```




```
##
## $len_kg
```

Table 1: Confusion Matrix Lloyd

| 1 | 2 | 3 |
|---|---|---|
| 57 | 10 | 0 |
| 1 | 60 | 0 |
| 12 | 0 | 70 |




**$k$-means**

```
c_lloyd <- kmeans(df[-8], 3, algorithm = "Lloyd")
c_macqueen <- kmeans(df[-8], 3, algorithm = "MacQueen")
c_forgy <- kmeans(df[-8], 3, algorithm = "Forgy")
c_har_won <- kmeans(df[-8], 3)

test <- data.frame(lloyd = c_lloyd$cluster,
                   macqueen = c_macqueen$cluster,
                   forgy = c_forgy$cluster,
                   har_won = c_har_won$cluster,
                   class = df$class)

table(test$lloyd, test$class, dnn = c("Lloyd", "Class")) %>%
  kbl(caption = "Confusion Matrix Lloyd", booktabs = T)
```

```
table(test$macqueen, test$class) %>%
  kbl(caption = "Confusion Matrix MacQueen", booktabs = T)
```

Table 2: Confusion Matrix MacQueen

| 1 | 2 | 3 |
|---|---|---|
| 57 | 10 | 0 |
| 1 | 60 | 0 |
| 12 | 0 | 70 |

Table 3: Confusion Matrix Forgy

| 1 | 2 | 3 |
|---|---|---|
| 9 | 0 | 68 |
| 1 | 60 | 0 |
| 60 | 10 | 2 |

```
table(test$forgy, test$class) %>%
  kbl(caption = "Confusion Matrix Forgy", booktabs = T)
```

```
table(test$har_won, test$class) %>%
  kbl(caption = "Confusion Matrix Hartigan-Wong", booktabs = T)
```

```
table(test$lloyd, test$class, dnn = c("Lloyd", "Class"))
```

```
##      Class
## Lloyd  1  2  3
##     1 57 10  0
##     2  1 60  0
##     3 12  0 70
```

```
cor(test)
```

```
##               lloyd   macqueen      forgy    har_won      class
## lloyd     1.0000000  1.0000000 -0.9342259 -0.9342259  0.7991123
## macqueen  1.0000000  1.0000000 -0.9342259 -0.9342259  0.7991123
## forgy    -0.9342259 -0.9342259  1.0000000  1.0000000 -0.8104053
## har_won  -0.9342259 -0.9342259  1.0000000  1.0000000 -0.8104053
## class     0.7991123  0.7991123 -0.8104053 -0.8104053  1.0000000
```

```
kbl(cor(test), caption = "Correlation Matrix of k-means algorithms", booktabs = T)
```

Table 4: Confusion Matrix Hartigan-Wong

| 1 | 2 | 3 |
|---|---|---|
| 9 | 0 | 68 |
| 1 | 60 | 0 |
| 60 | 10 | 2 |

Table 5: Correlation Matrix of k-means algorithms

| | lloyd | macqueen | forgy | har_won | class |
|---|---|---|---|---|---|
| lloyd | 1.0000000 | 1.0000000 | -0.9342259 | -0.9342259 | 0.7991123 |
| macqueen | 1.0000000 | 1.0000000 | -0.9342259 | -0.9342259 | 0.7991123 |
| forgy | -0.9342259 | -0.9342259 | 1.0000000 | 1.0000000 | -0.8104053 |
| har_won | -0.9342259 | -0.9342259 | 1.0000000 | 1.0000000 | -0.8104053 |
| class | 0.7991123 | 0.7991123 | -0.8104053 | -0.8104053 | 1.0000000 |