

# EXERCISE

2022-11-29

```
library(dplyr)      # for data manipulation

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##   filter, lag

## The following objects are masked from 'package:base':
##
##   intersect, setdiff, setequal, union

library(ggplot2)    # for data visualization
library(stringr)    # for string functionality
library(gridExtra)  # for manipulating the grid

##
## Attaching package: 'gridExtra'

## The following object is masked from 'package:dplyr':
##
##   combine

library(tidyverse)  # data manipulation

## -- Attaching packages ----- tidyverse 1.3.2 --

## v tibble  3.1.8    v purrr   0.3.4
## v tidyr   1.2.1    v forcats 0.5.2
## v readr   2.1.2
## -- Conflicts ----- tidyverse_conflicts() --
## x gridExtra::combine() masks dplyr::combine()
## x dplyr::filter()      masks stats::filter()
## x dplyr::lag()         masks stats::lag()

library(cluster)    # for general clustering algorithms
library(factoextra) # for visualizing cluster results

## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library(rmarkdown)
```

```
data("iris")
```

```
df <- na.omit(iris)
```

```
df <- scale(df[c(1:4)])  
head(df)
```

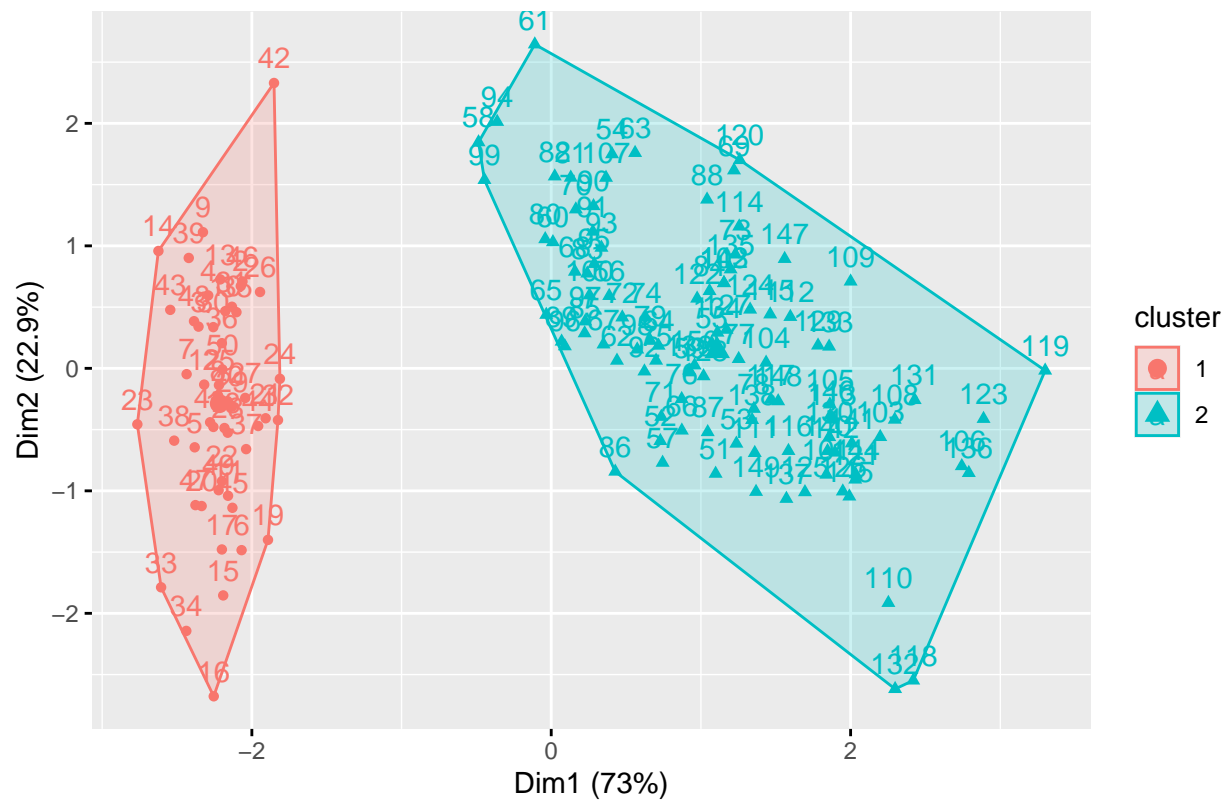
```
##   Sepal.Length Sepal.Width Petal.Length Petal.Width  
## 1   -0.8976739   1.01560199   -1.335752   -1.311052  
## 2   -1.1392005  -0.13153881   -1.335752   -1.311052  
## 3   -1.3807271   0.32731751   -1.392399   -1.311052  
## 4   -1.5014904   0.09788935   -1.279104   -1.311052  
## 5   -1.0184372   1.24503015   -1.335752   -1.311052  
## 6   -0.5353840   1.93331463   -1.165809   -1.048667
```

```
k2 <- kmeans(df, centers = 2, nstart = 25)  
str(k2)
```

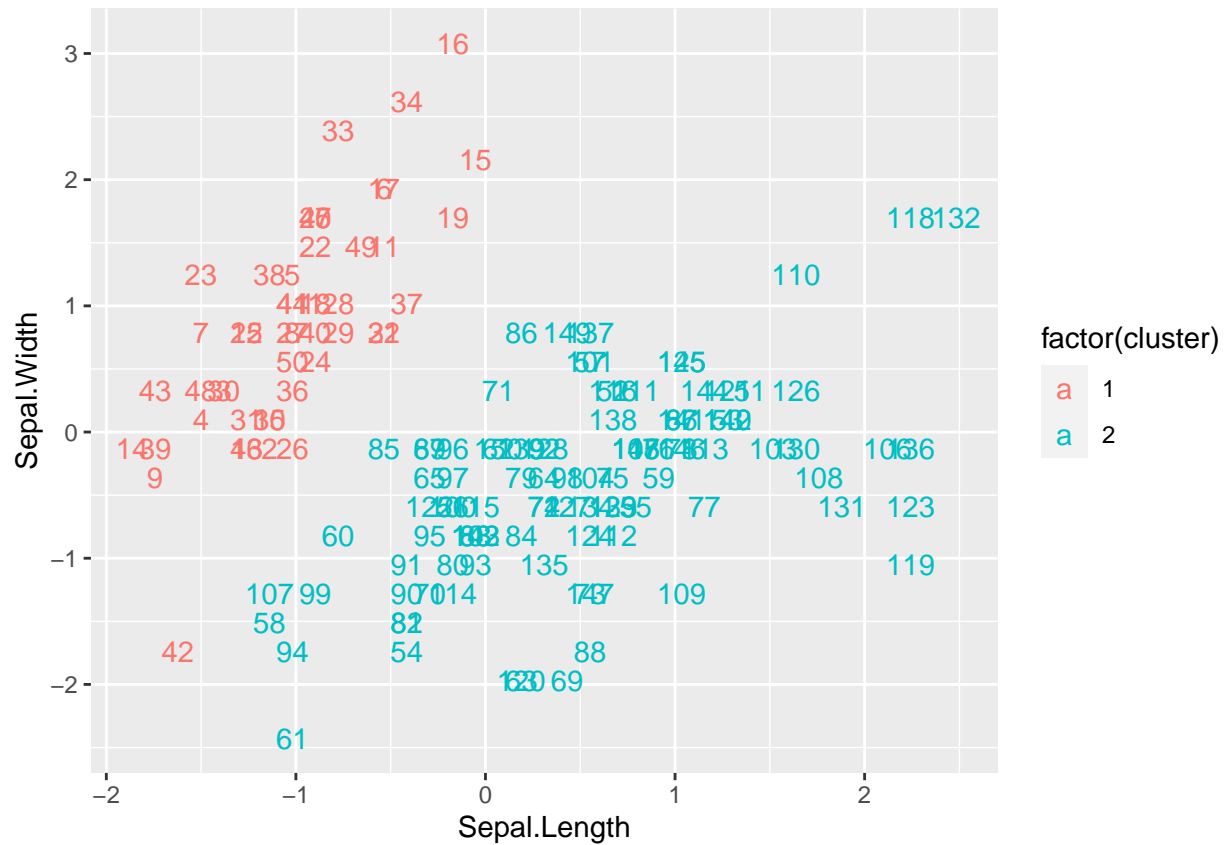
```
## List of 9  
## $ cluster      : Named int [1:150] 1 1 1 1 1 1 1 1 1 1 ...  
##   ..- attr(*, "names")= chr [1:150] "1" "2" "3" "4" ...  
## $ centers       : num [1:2, 1:4] -1.011 0.506 0.85 -0.425 -1.301 ...  
##   ..- attr(*, "dimnames")=List of 2  
##     .. ..$ : chr [1:2] "1" "2"  
##     .. ..$ : chr [1:4] "Sepal.Length" "Sepal.Width" "Petal.Length" "Petal.Width"  
## $ totss        : num 596  
## $ withinss     : num [1:2] 47.4 173.5  
## $ tot.withinss : num 221  
## $ betweenss    : num 375  
## $ size         : int [1:2] 50 100  
## $ iter         : int 1  
## $ ifault       : int 0  
## - attr(*, "class")= chr "kmeans"
```

```
fviz_cluster(k2, data = df)
```

Cluster plot



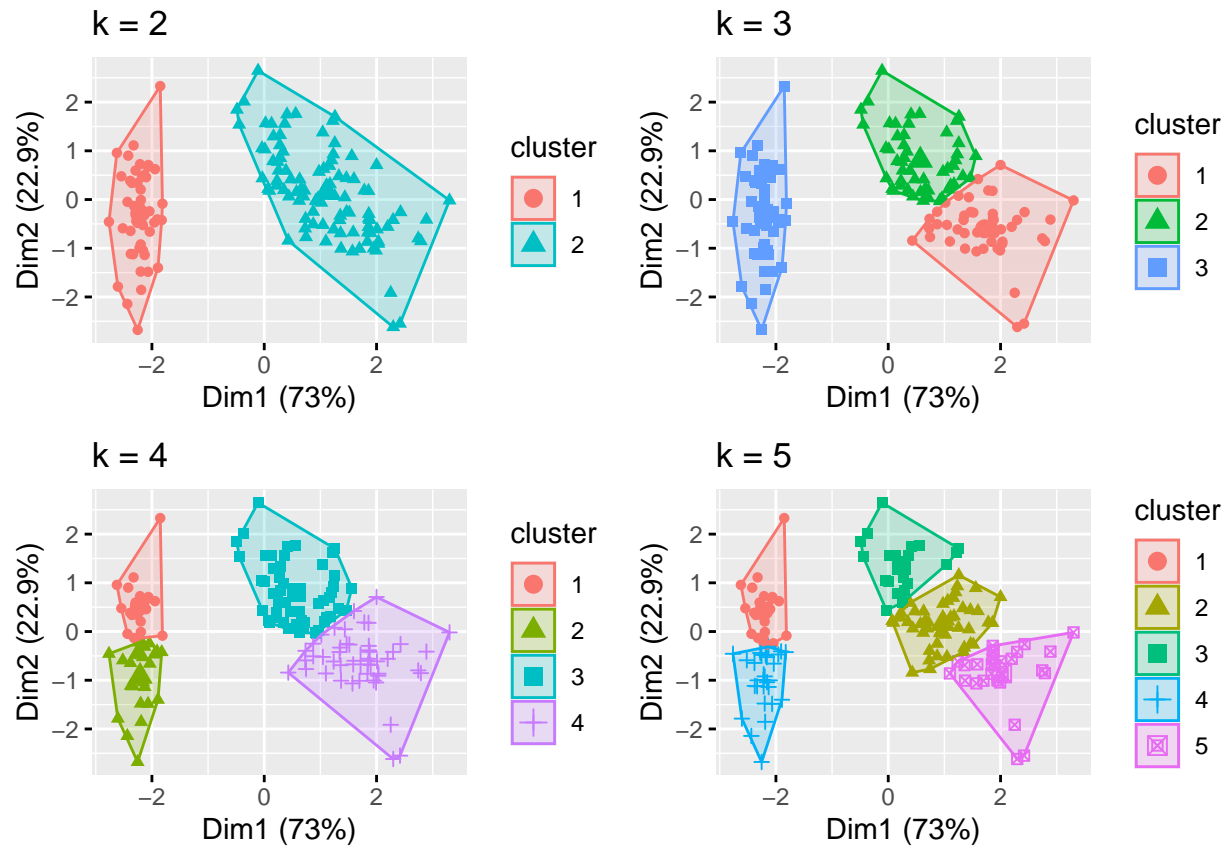
```
df %>%
  as_tibble() %>%
  mutate(cluster = k2$cluster,
         Species = row.names(iris)) %>%
  ggplot(aes(Sepal.Length, Sepal.Width, color = factor(cluster), label = Species)) +
  geom_text()
```



```
k3 <- kmeans(df, centers = 3, nstart = 25)
k4 <- kmeans(df, centers = 4, nstart = 25)
k5 <- kmeans(df, centers = 5, nstart = 25)
```

```
p1 <- fviz_cluster(k2, geom = "point", data = df) + ggtitle("k = 2")
p2 <- fviz_cluster(k3, geom = "point", data = df) + ggtitle("k = 3")
p3 <- fviz_cluster(k4, geom = "point", data = df) + ggtitle("k = 4")
p4 <- fviz_cluster(k5, geom = "point", data = df) + ggtitle("k = 5")
```

```
grid.arrange(p1, p2, p3, p4, nrow = 2)
```

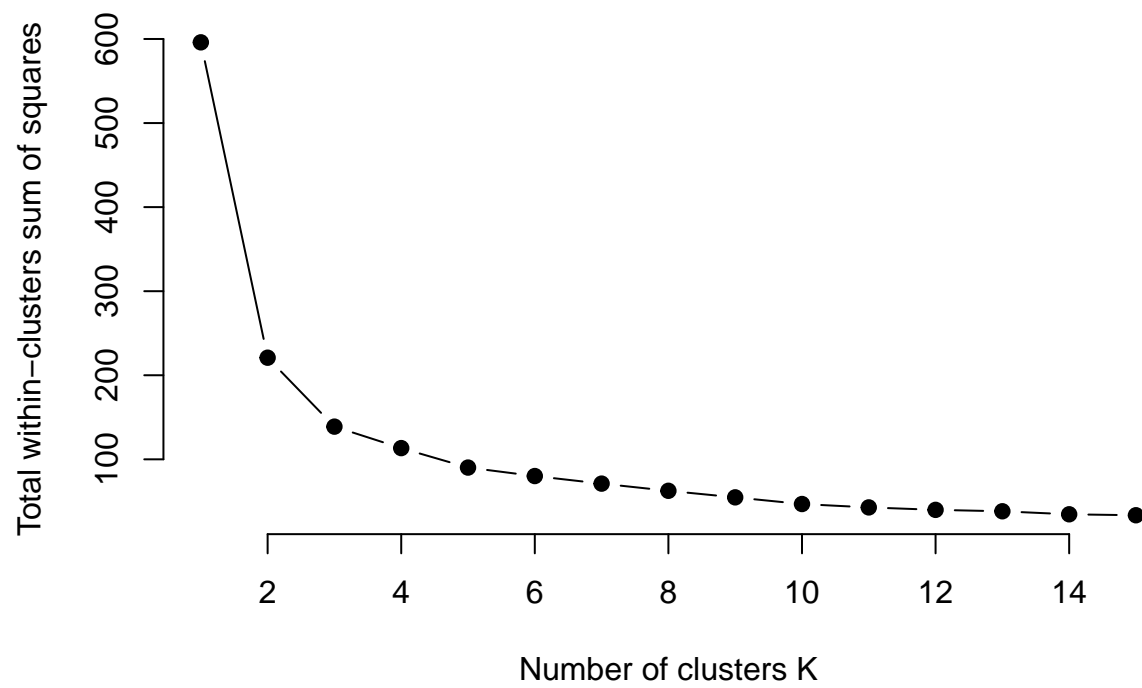


```
set.seed(123)
```

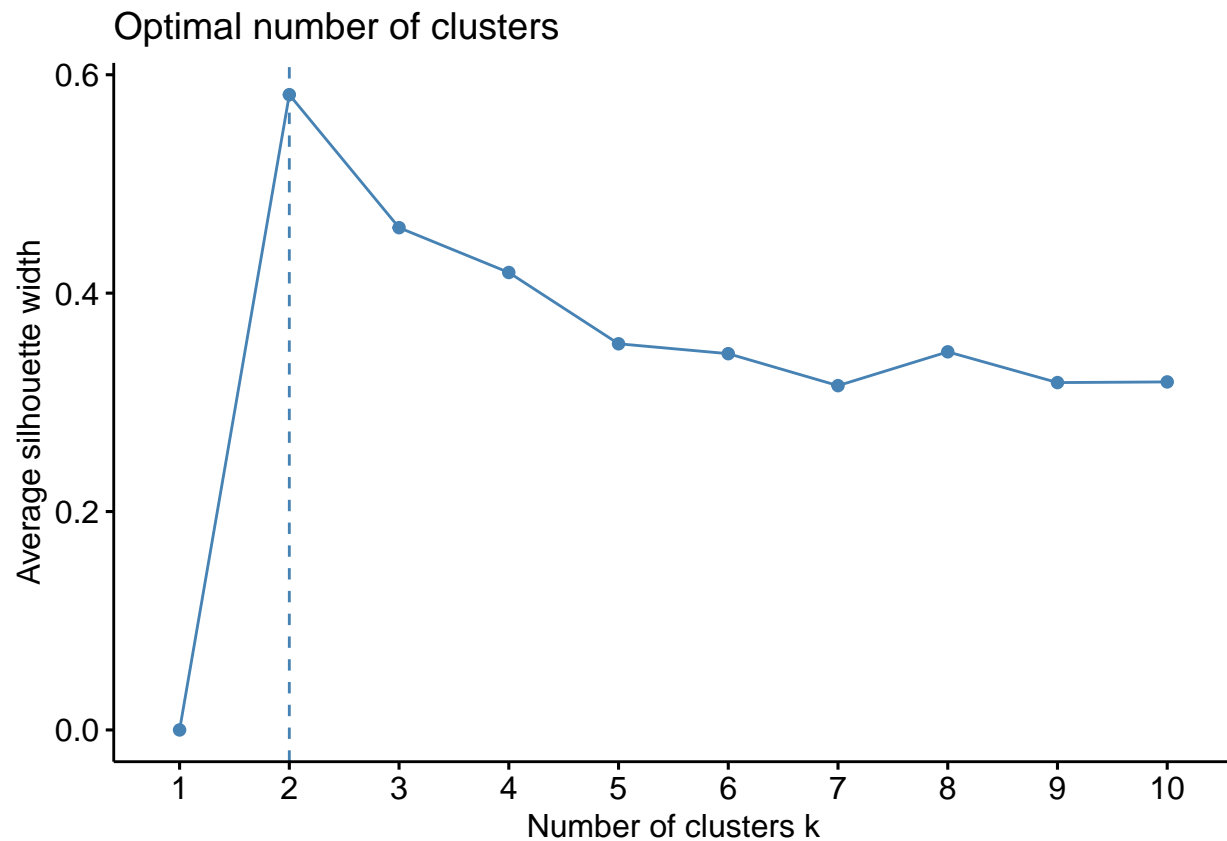
```
wss <- function(k) {
  kmeans(df, k, nstart = 10)$tot.withinss
}
k.values <- 1:15
```

```
wss_values <- map_dbl(k.values, wss)
```

```
plot(k.values, wss_values,
     type="b", pch = 19, frame = FALSE,
     xlab="Number of clusters K",
     ylab="Total within-clusters sum of squares")
```



```
fviz_nbclust(df, kmeans, method = "silhouette")
```

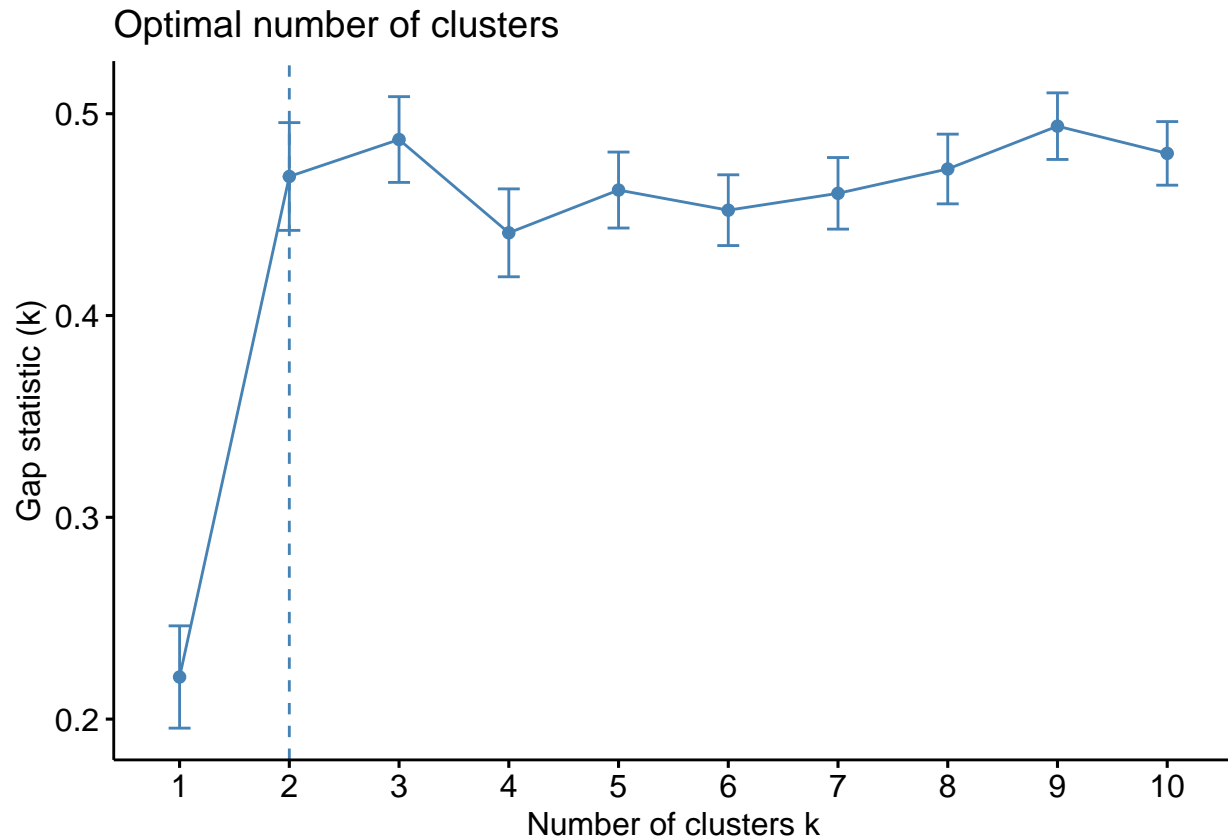


```
set.seed(123)
gap_stat <- clusGap(df, FUN = kmeans, nstart = 25,
                   K.max = 10, B = 50)
```

```
# Print the result
print(gap_stat, method = "firstmax")
```

```
## Clustering Gap statistic ["clusGap"] from call:
## clusGap(x = df, FUNcluster = kmeans, K.max = 10, B = 50, nstart = 25)
## B=50 simulated reference sets, k = 1..10; spaceH0="scaledPCA"
## --> Number of clusters (method 'firstmax'): 3
##      logW    E.logW      gap    SE.sim
## [1,] 4.534565 4.755428 0.2208634 0.02534324
## [2,] 4.021316 4.490212 0.4688953 0.02670070
## [3,] 3.806577 4.293793 0.4872159 0.02124741
## [4,] 3.699263 4.140237 0.4409736 0.02177507
## [5,] 3.589284 4.051459 0.4621749 0.01882154
## [6,] 3.522810 3.975009 0.4521993 0.01753073
## [7,] 3.448288 3.908834 0.4605460 0.01774025
## [8,] 3.379870 3.852475 0.4726054 0.01727207
## [9,] 3.310088 3.803931 0.4938436 0.01649671
## [10,] 3.278659 3.759003 0.4803440 0.01576050
```

```
fviz_gap_stat(gap_stat)
```



```
# Compute k-means clustering with k = 2
set.seed(123)
final <- kmeans(df, 2, nstart = 25)
print(final)
```

```
## K-means clustering with 2 clusters of sizes 50, 100
```

```
##
```

```
## Cluster means:
```

```
## Sepal.Length Sepal.Width Petal.Length Petal.Width
```

```
## 1 -1.0111914 0.8504137 -1.300630 -1.2507035
```

```
## 2 0.5055957 -0.4252069 0.650315 0.6253518
```

```
##
```

```
## Clustering vector:
```

```
## 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
```

```
## 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

```
## 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40
```

```
## 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
```

```
## 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
```

```
## 1 1 1 1 1 1 1 1 1 1 2 2 2 2 2 2 2 2 2 2
```

```
## 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
```

```
## 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
```

```
## 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100
```

```
## 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2
```



