DATA SCIENCE PROGRAMMING

LAB (L3+L4)

ASSESSMENT 3

K-Means Clustering IN R

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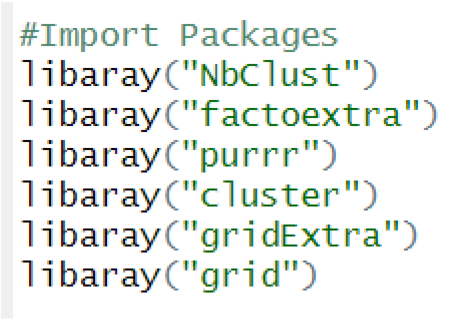
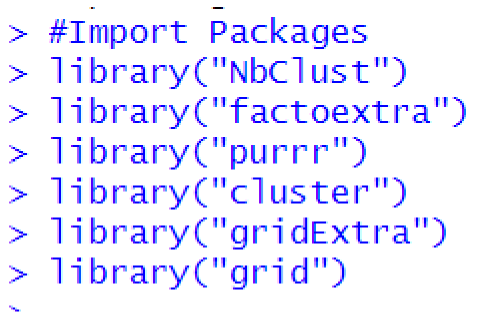
Reg. no.: 22MID0035

1. IMPORT PACKAGES

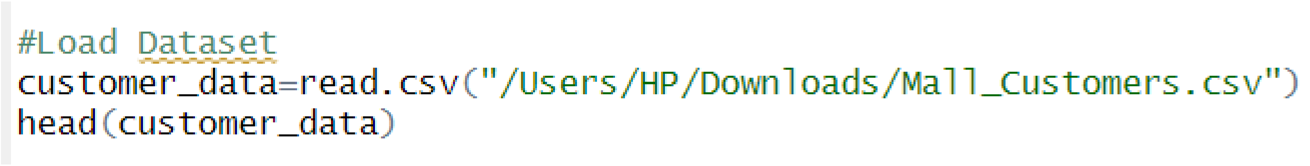


```
#Import Packages
libaray("NbClust")
libaray("factoextra")
libaray("purrr")
libaray("cluster")
libaray("gridExtra")
libaray("grid")
```

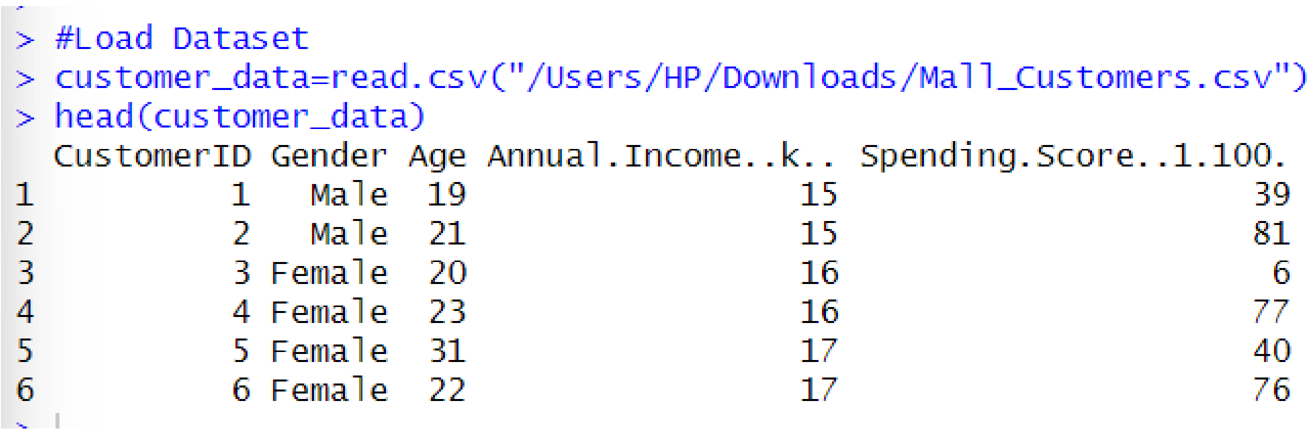


```
> #Import Packages
> library("NbClust")
> library("factoextra")
> library("purrr")
> library("cluster")
> library("gridExtra")
> library("grid")
```

2. LOAD DATASET

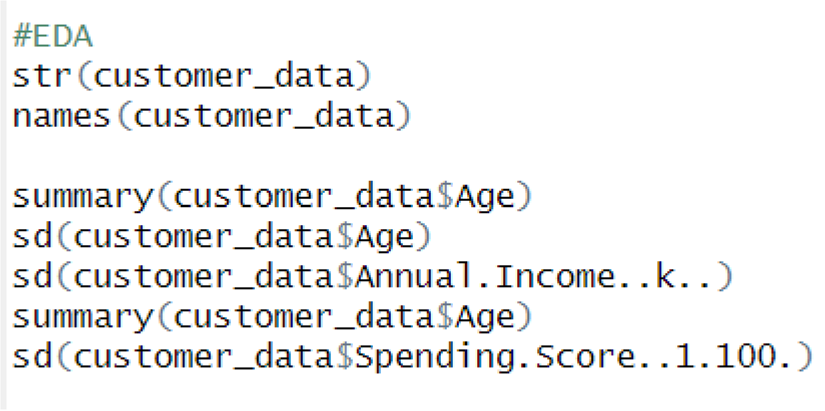


```
#Load Dataset
customer_data=read.csv("/Users/HP/Downloads/Mall_Customers.csv")
head(customer_data)
```

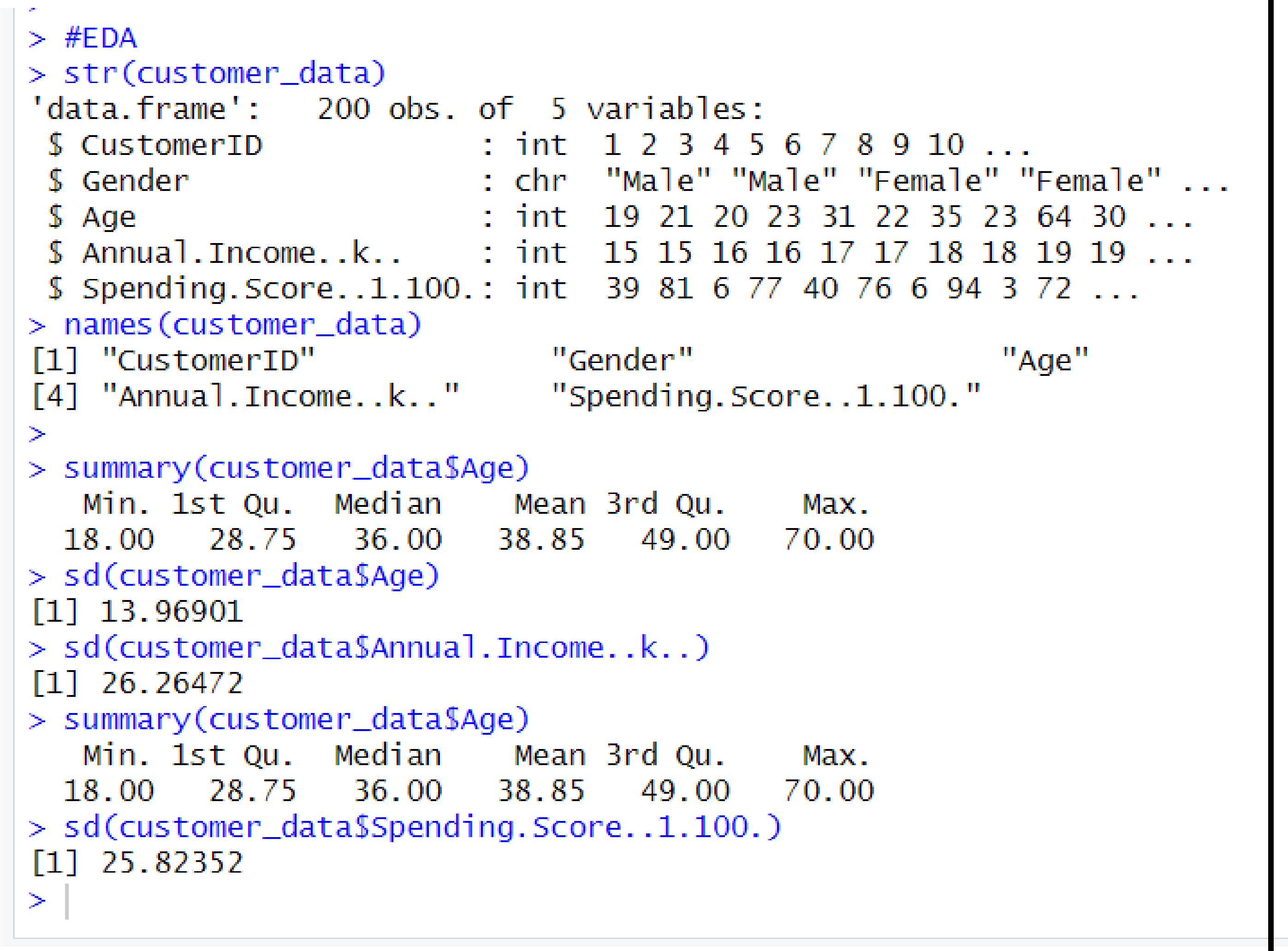


```
> #Load Dataset
> customer_data=read.csv("/Users/HP/Downloads/Mall_Customers.csv")
> head(customer_data)
  CustomerID Gender Age Annual.Income..k.. Spending.Score..1.100.
1          1   Male  19                 15                     39
2          2   Male  21                 15                     81
3          3 Female  20                 16                      6
4          4 Female  23                 16                     77
5          5 Female  31                 17                     40
6          6 Female  22                 17                     76
```

3. EXPLORATORY DATA ANALYSIS

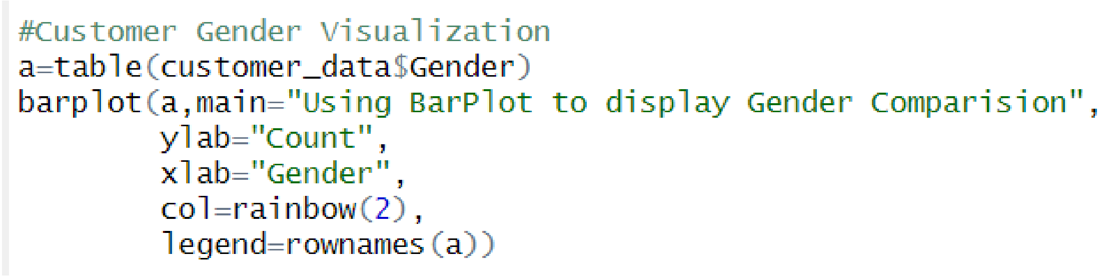


```
#EDA
str(customer_data)
names(customer_data)

summary(customer_data$Age)
sd(customer_data$Age)
sd(customer_data$Annual.Income..k..)
summary(customer_data$Age)
sd(customer_data$Spending.Score..1.100.)
```

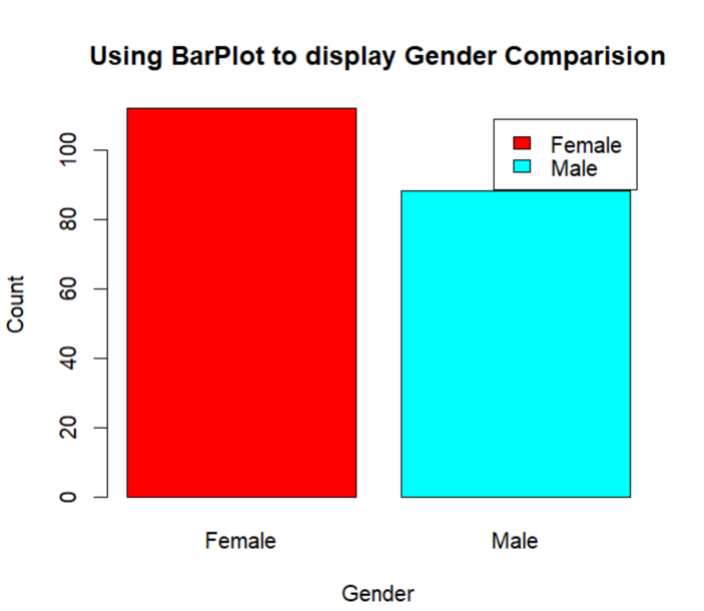


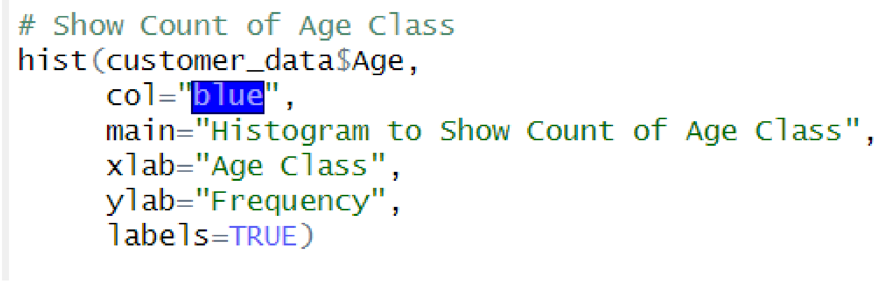
```
> #EDA
> str(customer_data)
'data.frame':	200 obs. of  5 variables:
 $ CustomerID            : int  1 2 3 4 5 6 7 8 9 10 ...
 $ Gender                : chr  "Male" "Male" "Female" "Female" ...
 $ Age                   : int  19 21 20 23 31 22 35 23 64 30 ...
 $ Annual.Income..k..    : int  15 15 16 16 17 17 18 18 19 19 ...
 $ Spending.Score..1.100.: int  39 81 6 77 40 76 6 94 3 72 ...
> names(customer_data)
[1] "CustomerID"             "Gender"                 "Age"
[4] "Annual.Income..k.."     "Spending.Score..1.100."
>
> summary(customer_data$Age)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  18.00   28.75   36.00   38.85   49.00   70.00 
> sd(customer_data$Age)
[1] 13.96901
> sd(customer_data$Annual.Income..k..)
[1] 26.26472
> summary(customer_data$Age)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max. 
  18.00   28.75   36.00   38.85   49.00   70.00 
> sd(customer_data$Spending.Score..1.100.)
[1] 25.82352
> 
```

4. DATA VISUALIZATION

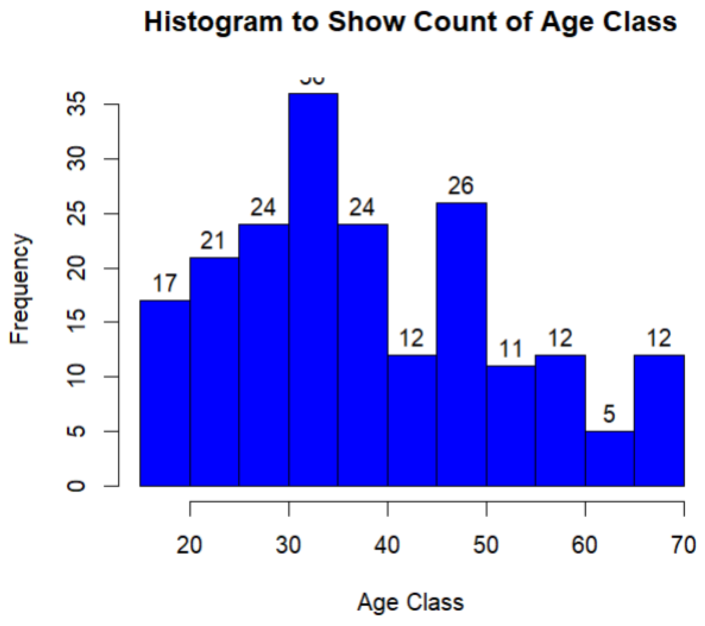


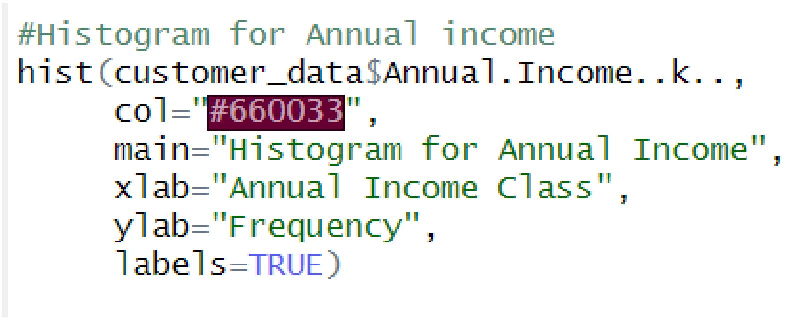
```
#Customer Gender Visualization
a=table(customer_data$Gender)
barplot(a,main="Using BarPlot to display Gender Comparision",
        ylab="Count",
        xlab="Gender",
        col=rainbow(2),
        legend=rownames(a))
```



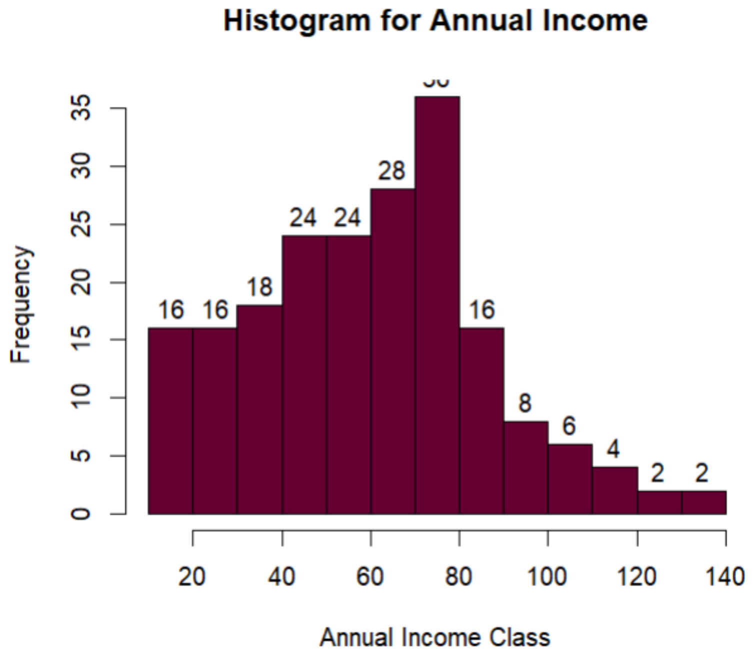


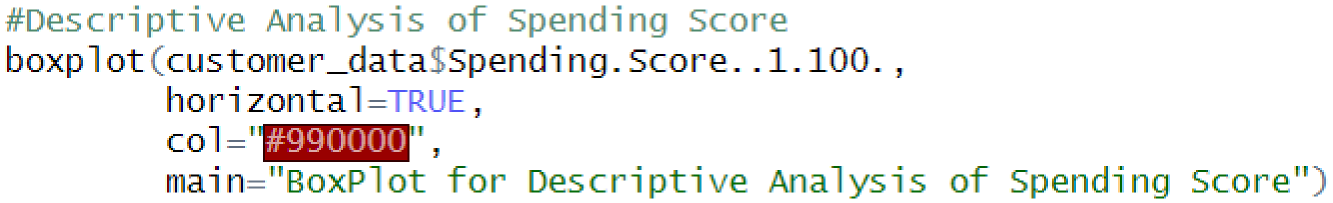
```
# Show Count of Age Class
hist(customer_data$Age,
     col="blue",
     main="Histogram to Show Count of Age Class",
     xlab="Age Class",
     ylab="Frequency",
     labels=TRUE)
```



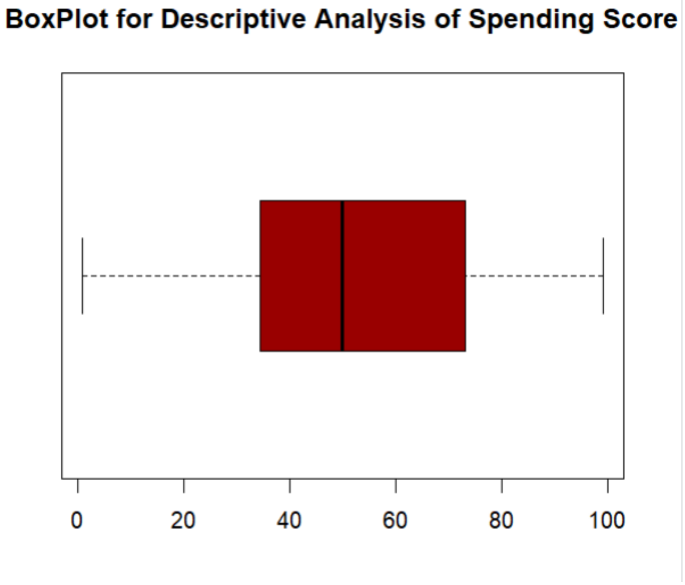


```
#Histogram for Annual income
hist(customer_data$Annual.Income..k..,
     col="#660033",
     main="Histogram for Annual Income",
     xlab="Annual Income Class",
     ylab="Frequency",
     labels=TRUE)
```

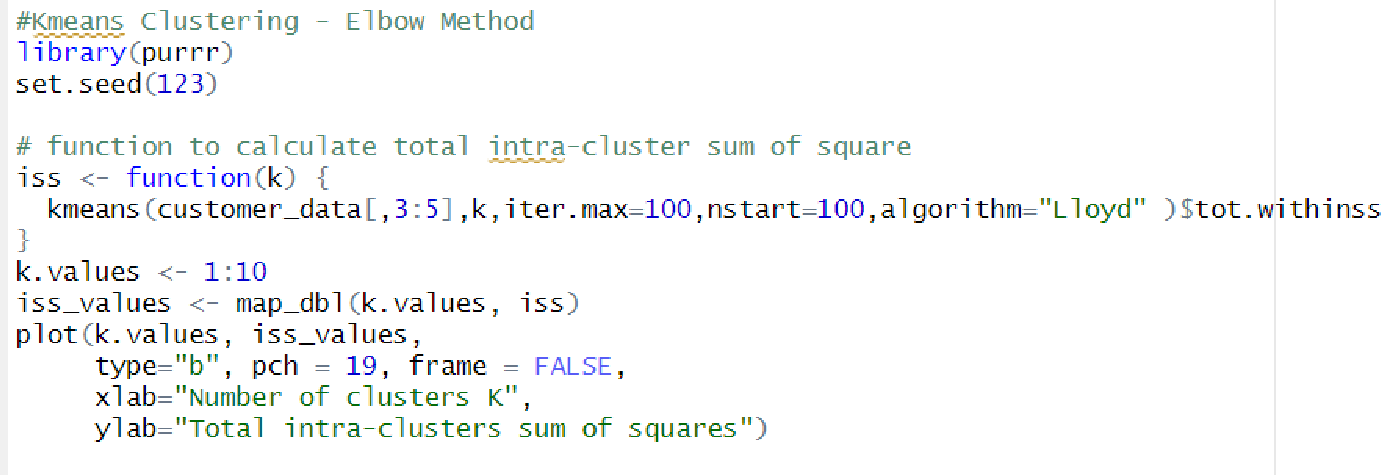




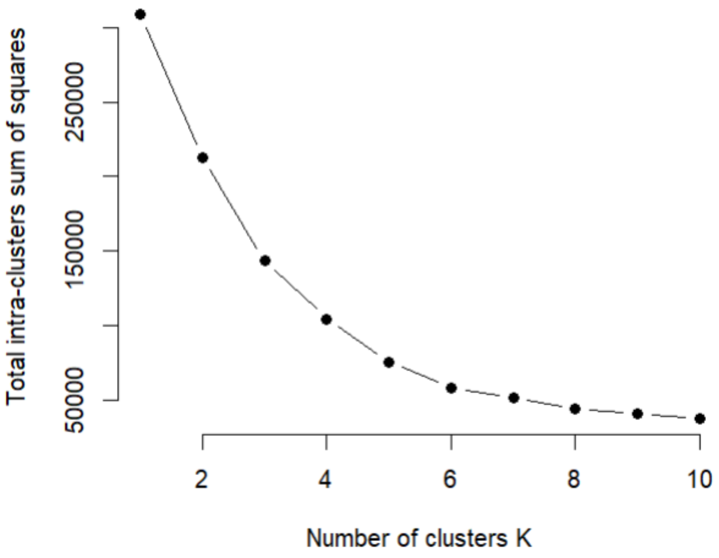
```
#Descriptive Analysis of Spending Score
boxplot(customer_data$Spending.Score..1.100.,
        horizontal=TRUE,
        col="#990000",
        main="BoxPlot for Descriptive Analysis of Spending Score")
```



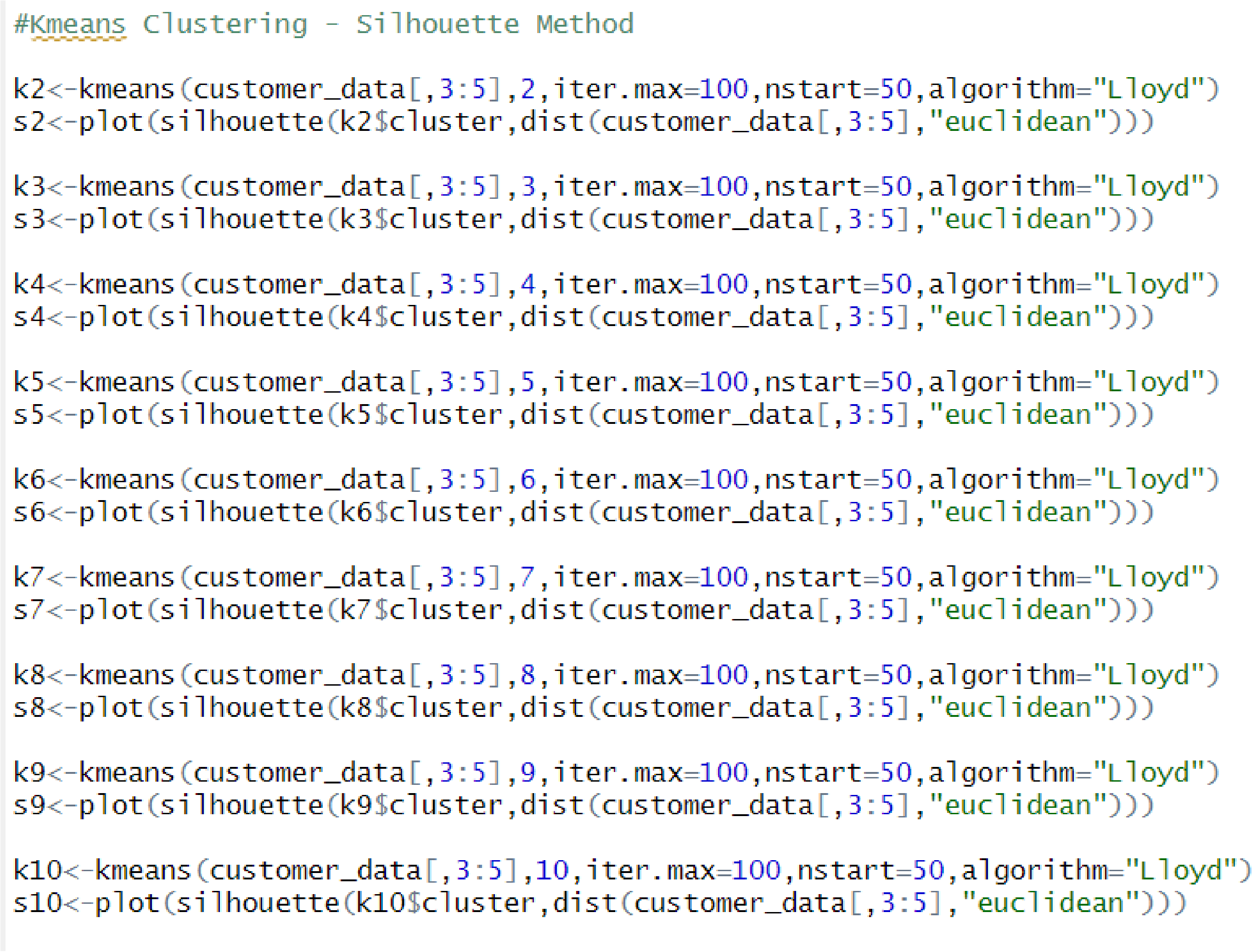
5. K-means Clustering Algorithm - ELBOW METHOD



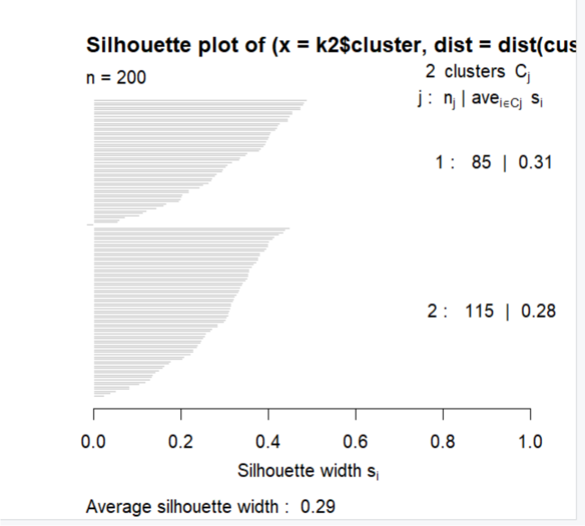
```
#Kmeans Clustering - Elbow Method
library(purrr)
set.seed(123)

# function to calculate total intra-cluster sum of square
iss <- function(k) {
  kmeans(customer_data[,3:5],k,iter.max=100,nstart=100,algorithm="Lloyd" )$tot.withinss
}
k.values <- 1:10
iss_values <- map_dbl(k.values, iss)
plot(k.values, iss_values,
     type="b", pch = 19, frame = FALSE,
     xlab="Number of clusters K",
     ylab="Total intra-clusters sum of squares")
```

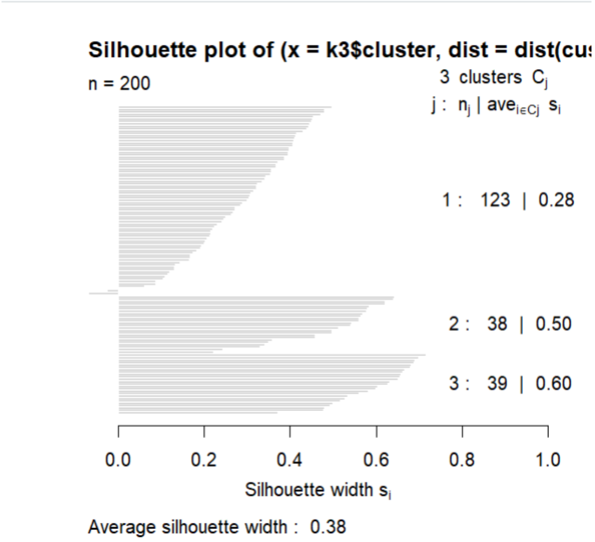


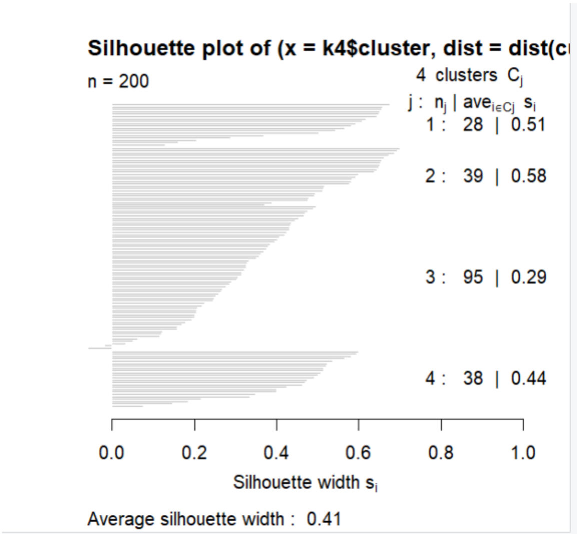
6. K-means Clustering – Silhouette Coefficient

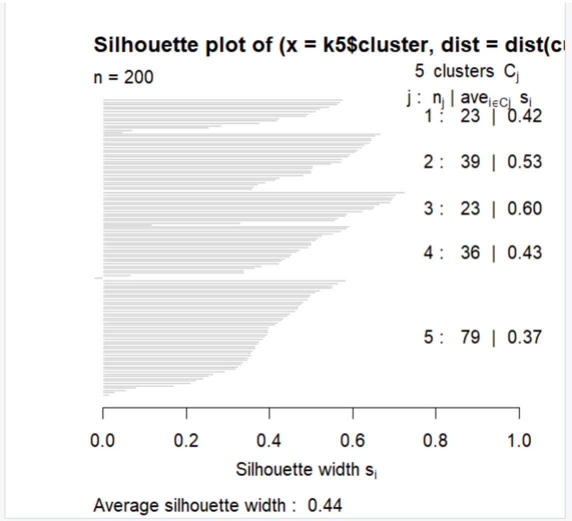


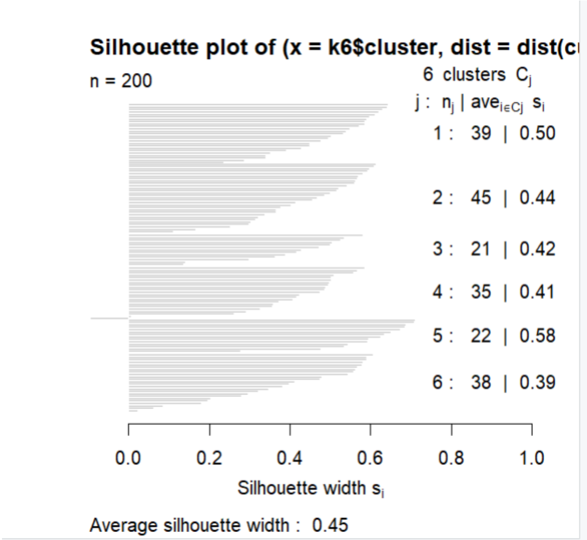
```r
#Kmeans Clustering - Silhouette Method

k2<-kmeans(customer_data[,3:5],2,iter.max=100,nstart=50,algorithm="Lloyd")
s2<-plot(silhouette(k2$cluster,dist(customer_data[,3:5],"euclidean")))

k3<-kmeans(customer_data[,3:5],3,iter.max=100,nstart=50,algorithm="Lloyd")
s3<-plot(silhouette(k3$cluster,dist(customer_data[,3:5],"euclidean")))

k4<-kmeans(customer_data[,3:5],4,iter.max=100,nstart=50,algorithm="Lloyd")
s4<-plot(silhouette(k4$cluster,dist(customer_data[,3:5],"euclidean")))

k5<-kmeans(customer_data[,3:5],5,iter.max=100,nstart=50,algorithm="Lloyd")
s5<-plot(silhouette(k5$cluster,dist(customer_data[,3:5],"euclidean")))

k6<-kmeans(customer_data[,3:5],6,iter.max=100,nstart=50,algorithm="Lloyd")
s6<-plot(silhouette(k6$cluster,dist(customer_data[,3:5],"euclidean")))

k7<-kmeans(customer_data[,3:5],7,iter.max=100,nstart=50,algorithm="Lloyd")
s7<-plot(silhouette(k7$cluster,dist(customer_data[,3:5],"euclidean")))

k8<-kmeans(customer_data[,3:5],8,iter.max=100,nstart=50,algorithm="Lloyd")
s8<-plot(silhouette(k8$cluster,dist(customer_data[,3:5],"euclidean")))

k9<-kmeans(customer_data[,3:5],9,iter.max=100,nstart=50,algorithm="Lloyd")
s9<-plot(silhouette(k9$cluster,dist(customer_data[,3:5],"euclidean")))

k10<-kmeans(customer_data[,3:5],10,iter.max=100,nstart=50,algorithm="Lloyd")
s10<-plot(silhouette(k10$cluster,dist(customer_data[,3:5],"euclidean")))
```

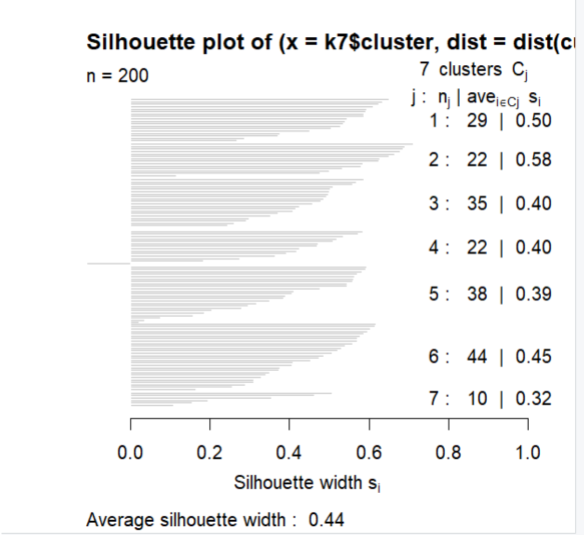


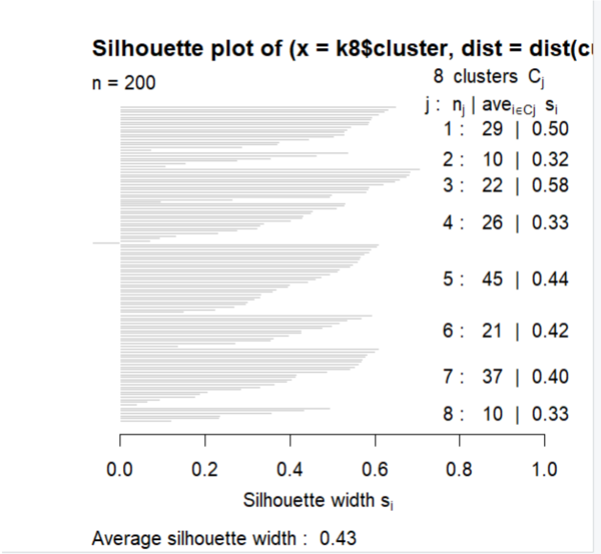


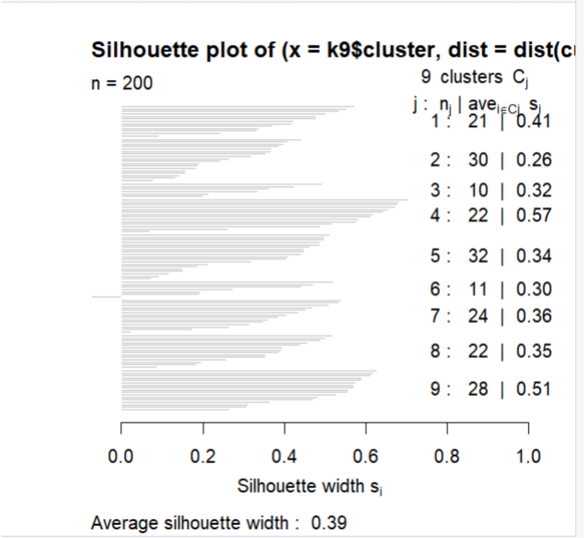

Silhouette plot of (x = k4$cluster, dist = dist(c
n = 200
4 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 28 | 0.51
2 : 39 | 0.58
3 : 95 | 0.29
4 : 38 | 0.44
0.0 0.2 0.4 0.6 0.8 1.0
Silhouette width s_i
Average silhouette width : 0.41

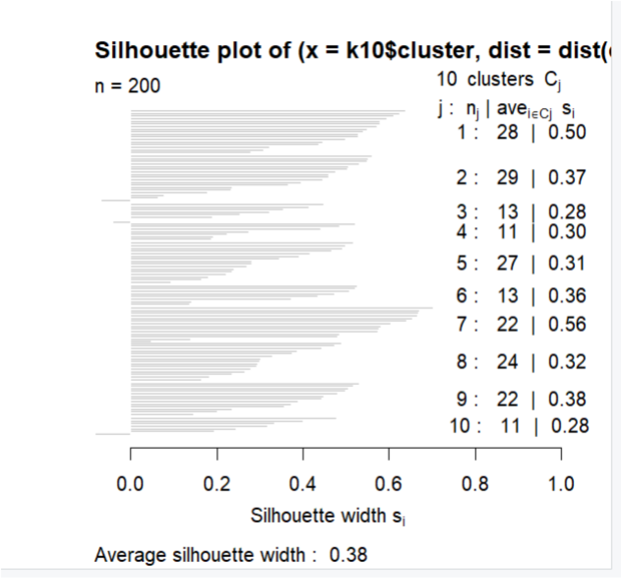

Silhouette plot of (x = k5$cluster, dist = dist(c
n = 200
5 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 23 | 0.42
2 : 39 | 0.53
3 : 23 | 0.60
4 : 36 | 0.43
5 : 79 | 0.37
0.0 0.2 0.4 0.6 0.8 1.0
Silhouette width s_i
Average silhouette width : 0.44


Silhouette plot of (x = k6$cluster, dist = dist(c
n = 200
6 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 39 | 0.50
2 : 45 | 0.44
3 : 21 | 0.42
4 : 35 | 0.41
5 : 22 | 0.58
6 : 38 | 0.39
0.0 0.2 0.4 0.6 0.8 1.0
Silhouette width s_i
Average silhouette width : 0.45

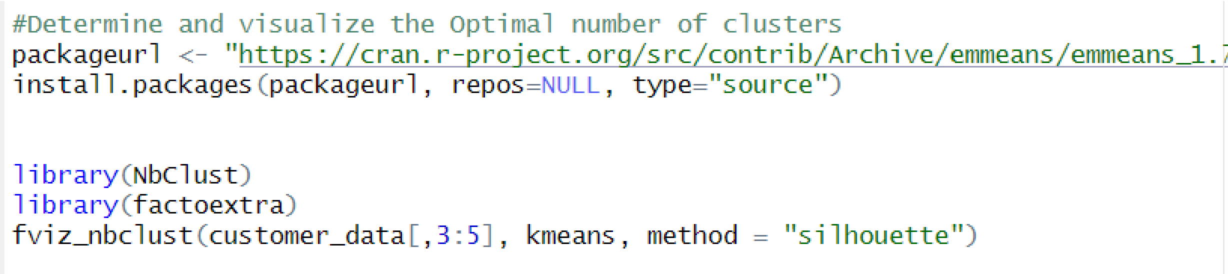

Silhouette plot of (x = k7$cluster, dist = dist(c
n = 200
7 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 29 | 0.50
2 : 22 | 0.58
3 : 35 | 0.40
4 : 22 | 0.40
5 : 38 | 0.39
6 : 44 | 0.45
7 : 10 | 0.32
0.0 0.2 0.4 0.6 0.8 1.0
Silhouette width s_i
Average silhouette width : 0.44


Silhouette plot of (x = k8$cluster, dist = dist(c
n = 200
8 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 29 | 0.50
2 : 10 | 0.32
3 : 22 | 0.58
4 : 26 | 0.33
5 : 45 | 0.44
6 : 21 | 0.42
7 : 37 | 0.40
8 : 10 | 0.33
0.0 0.2 0.4 0.6 0.8 1.0
Silhouette width s_i
Average silhouette width : 0.43

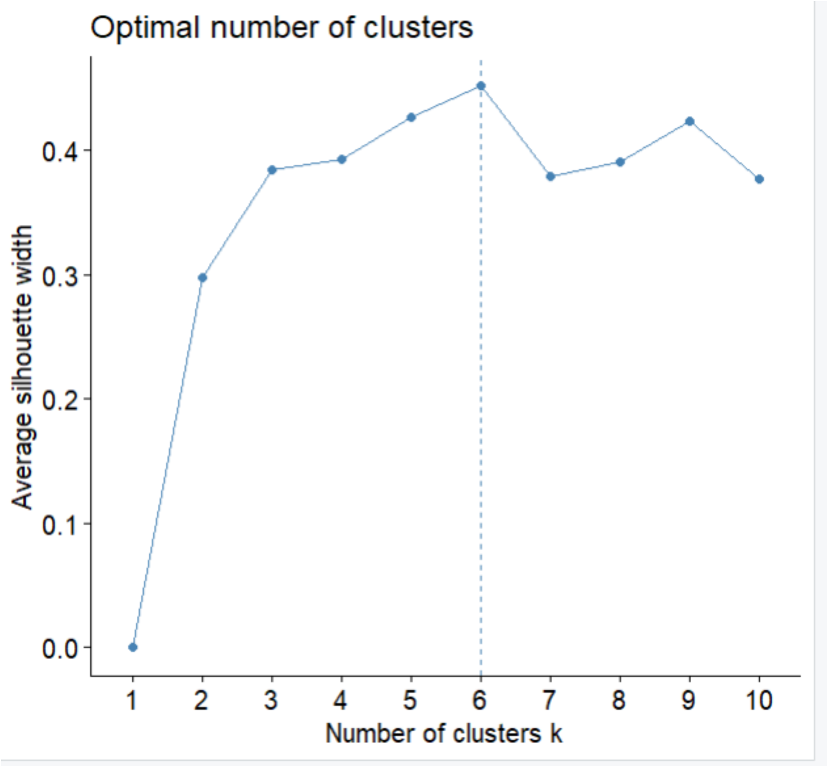

Silhouette plot of (x = k9$cluster, dist = dist(c
n = 200
9 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 21 | 0.41
2 : 30 | 0.26
3 : 10 | 0.32
4 : 22 | 0.57
5 : 32 | 0.34
6 : 11 | 0.30
7 : 24 | 0.36
8 : 22 | 0.35
9 : 28 | 0.51
0.0 0.2 0.4 0.6 0.8 1.0
Silhouette width s_i
Average silhouette width : 0.39

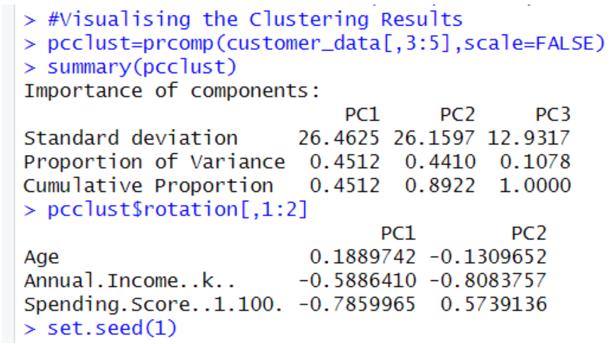


7. OPTIMAL CLUSTER VISUALIZATION

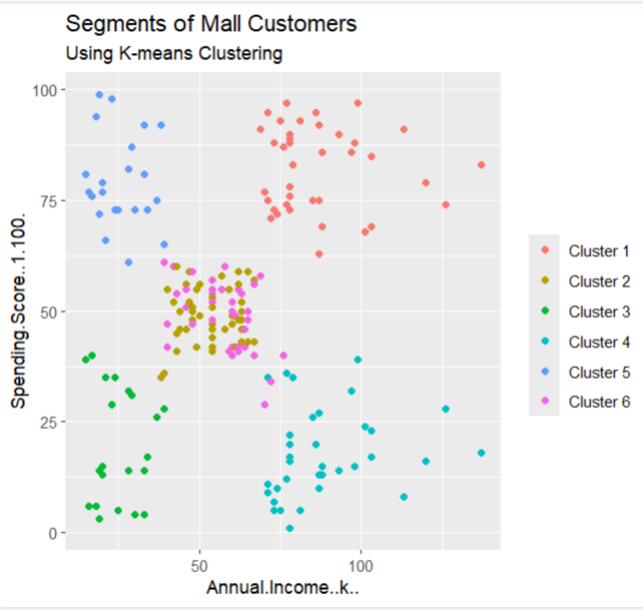


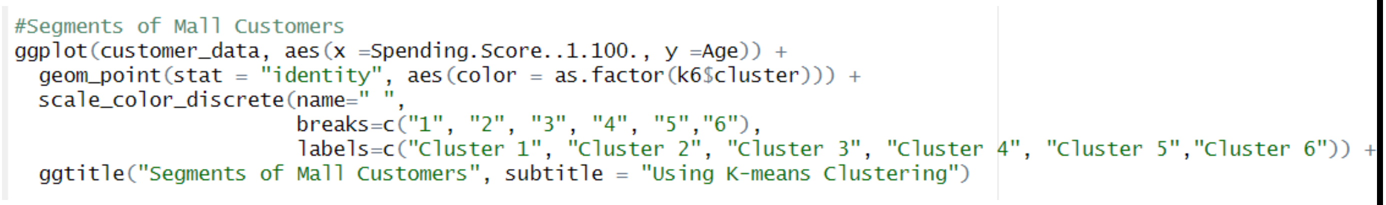
```r
#Determine and visualize the Optimal number of clusters
packageurl <- "https://cran.r-project.org/src/contrib/Archive/emmeans/emmeans_1.7.0.tar.gz"
install.packages(packageurl, repos=NULL, type="source")


library(NbClust)
library(factoextra)
fviz_nbclust(customer_data[,3:5], kmeans, method = "silhouette")
```



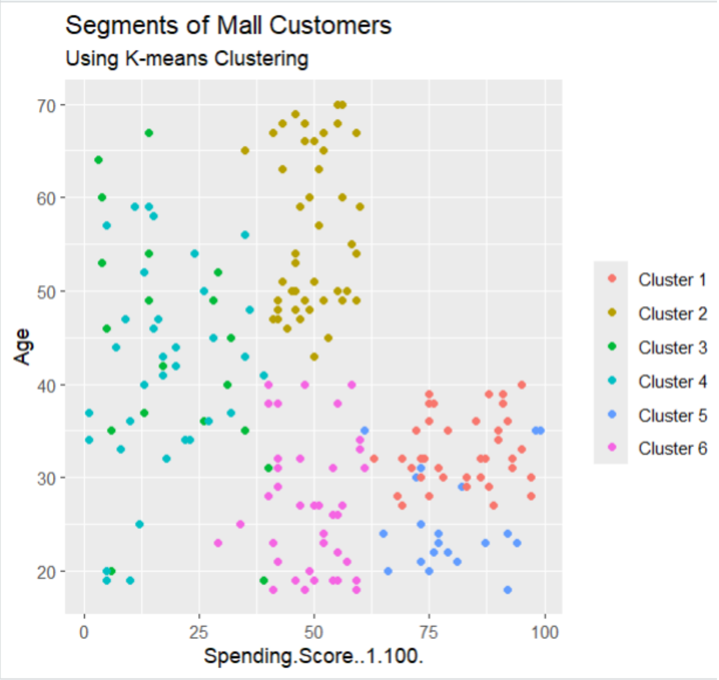


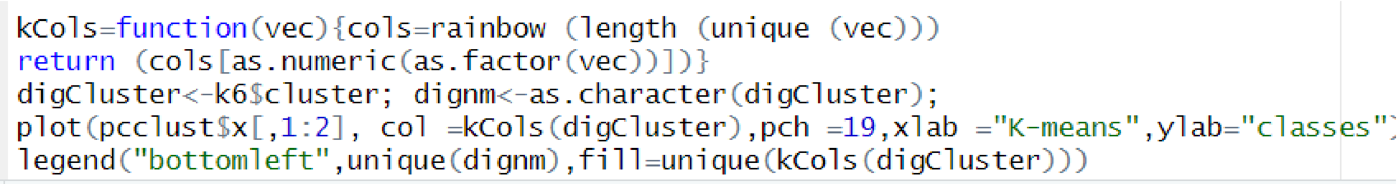
```
> #Visualising the Clustering Results
> pcclust=prcomp(customer_data[,3:5],scale=FALSE)
> summary(pcclust)
Importance of components:
                           PC1     PC2     PC3
Standard deviation     26.4625 26.1597 12.9317
Proportion of Variance  0.4512  0.4410  0.1078
Cumulative Proportion   0.4512  0.8922  1.0000
> pcclust$rotation[,1:2]
                              PC1        PC2
Age                     0.1889742 -0.1309652
Annual.Income..k..     -0.5886410 -0.8083757
Spending.Score..1.100. -0.7859965  0.5739136
> set.seed(1)
```



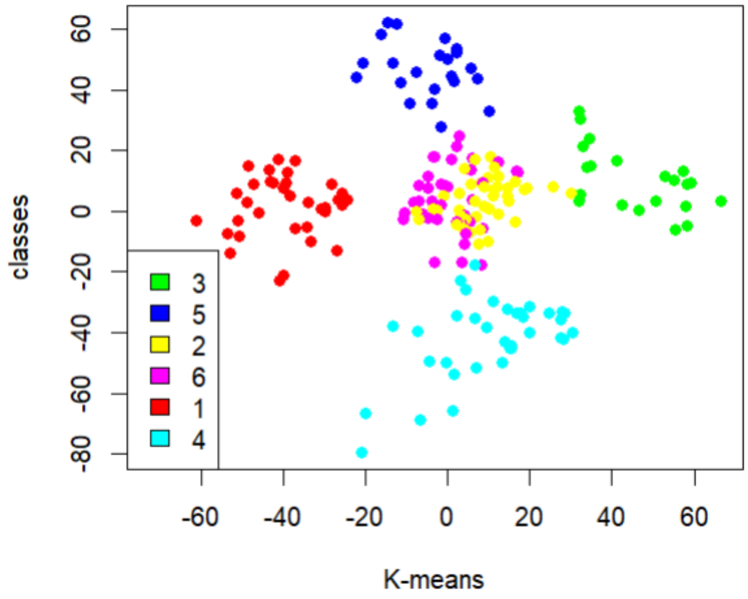


```
#Segments of Mall Customers
ggplot(customer_data, aes(x =Spending.Score..1.100., y =Age)) +
  geom_point(stat = "identity", aes(color = as.factor(k6$cluster))) +
  scale_color_discrete(name=" ",
                       breaks=c("1", "2", "3", "4", "5","6"),
                       labels=c("Cluster 1", "Cluster 2", "Cluster 3", "Cluster 4", "Cluster 5","Cluster 6")) +
  ggtitle("Segments of Mall Customers", subtitle = "Using K-means Clustering")
```





```
kCols=function(vec){cols=rainbow (length (unique (vec)))
return (cols[as.numeric(as.factor(vec))])}
digCluster<-k6$cluster; dignm<-as.character(digCluster);
plot(pcclust$x[,1:2], col =kCols(digCluster),pch =19,xlab ="K-means",ylab="classes")
legend("bottomleft",unique(dignm),fill=unique(kCols(digCluster)))
```


classes
🟩 3
🟦 5
🟨 2
🟪 6
🟥 1
🟦 4
K-means