FML Assignment-4

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```
My_Pharmaceuticals <-  read.csv("C:/Users/RAJEEV VARMA/Downloads/Pharmaceuticals.csv")
summary(My_Pharmaceuticals)
```

```
##     Symbol              Name             Market_Cap          Beta
##  Length:21          Length:21          Min.   :  0.41   Min.   :0.1800
##  Class :character   Class :character   1st Qu.:  6.30   1st Qu.:0.3500
##  Mode  :character   Mode  :character   Median : 48.19   Median :0.4600
##                                        Mean   : 57.65   Mean   :0.5257
##                                        3rd Qu.: 73.84   3rd Qu.:0.6500
##                                        Max.   :199.47   Max.   :1.1100
##     PE_Ratio          ROE             ROA        Asset_Turnover    Leverage
##  Min.   : 3.60   Min.   : 3.9   Min.   : 1.40   Min.   :0.3    Min.   :0.0000
##  1st Qu.:18.90   1st Qu.:14.9   1st Qu.: 5.70   1st Qu.:0.6    1st Qu.:0.1600
##  Median :21.50   Median :22.6   Median :11.20   Median :0.6    Median :0.3400
##  Mean   :25.46   Mean   :25.8   Mean   :10.51   Mean   :0.7    Mean   :0.5857
##  3rd Qu.:27.90   3rd Qu.:31.0   3rd Qu.:15.00   3rd Qu.:0.9    3rd Qu.:0.6000
##  Max.   :82.50   Max.   :62.9   Max.   :20.30   Max.   :1.1    Max.   :3.5100
##    Rev_Growth    Net_Profit_Margin Median_Recommendation   Location
##  Min.   :-3.17   Min.   : 2.6      Length:21              Length:21
##  1st Qu.: 6.38   1st Qu.:11.2      Class :character       Class :character
##  Median : 9.37   Median :16.1      Mode  :character       Mode  :character
##  Mean   :13.37   Mean   :15.7
##  3rd Qu.:21.87   3rd Qu.:21.1
##  Max.   :34.21   Max.   :25.5
##    Exchange
##  Length:21
##  Class :character
##  Mode  :character
##
##
##
```

```
str(My_Pharmaceuticals)
```

```
## 'data.frame':    21 obs. of  14 variables:
##  $ Symbol              : chr  "ABT" "AGN" "AHM" "AZN" ...
##  $ Name                : chr  "Abbott Laboratories" "Allergan, Inc." "Amersham plc" "AstraZeneca PL
##  $ Market_Cap          : num  68.44 7.58 6.3 67.63 47.16 ...
##  $ Beta                : num  0.32 0.41 0.46 0.52 0.32 1.11 0.5 0.85 1.08 0.18 ...
##  $ PE_Ratio            : num  24.7 82.5 20.7 21.5 20.1 27.9 13.9 26 3.6 27.9 ...
##  $ ROE                 : num  26.4 12.9 14.9 27.4 21.8 3.9 34.8 24.1 15.1 31 ...
##  $ ROA                 : num  11.8 5.5 7.8 15.4 7.5 1.4 15.1 4.3 5.1 13.5 ...
##  $ Asset_Turnover      : num  0.7 0.9 0.9 0.9 0.6 0.6 0.9 0.6 0.3 0.6 ...
```

```
##  $ Leverage             : num  0.42 0.6 0.27 0 0.34 0 0.57 3.51 1.07 0.53 ...
##  $ Rev_Growth           : num  7.54 9.16 7.05 15 26.81 ...
##  $ Net_Profit_Margin    : num  16.1 5.5 11.2 18 12.9 2.6 20.6 7.5 13.3 23.4 ...
##  $ Median_Recommendation: chr  "Moderate Buy" "Moderate Buy" "Strong Buy" "Moderate Sell" ...
##  $ Location             : chr  "US" "CANADA" "UK" "UK" ...
##  $ Exchange             : chr  "NYSE" "NYSE" "NYSE" "NYSE" ...
```

```
library(tidyverse)
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
## v ggplot2 3.3.6      v purrr   0.3.4
## v tibble  3.1.8      v dplyr   1.0.10
## v tidyr   1.2.1      v stringr 1.4.1
## v readr   2.1.2      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(cluster)
library(gridExtra)
```

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

```
library(readr)
library(dplyr)
library(caret)
```

```
## Loading required package: lattice
##
## Attaching package: 'caret'
##
## The following object is masked from 'package:purrr':
##
##     lift
```

```
library(factoextra)
```

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

```
#a)
#Removing Null Values and selecting the Numercial variables.
colSums(is.na(My_Pharmaceuticals))
```

```
##                Symbol                  Name            Market_Cap
##                     0                     0                     0
##                  Beta              PE_Ratio                   ROE
##                     0                     0                     0
##                   ROA        Asset_Turnover              Leverage
##                     0                     0                     0
##            Rev_Growth     Net_Profit_Margin Median_Recommendation
##                     0                     0                     0
##              Location              Exchange
##                     0                     0
```

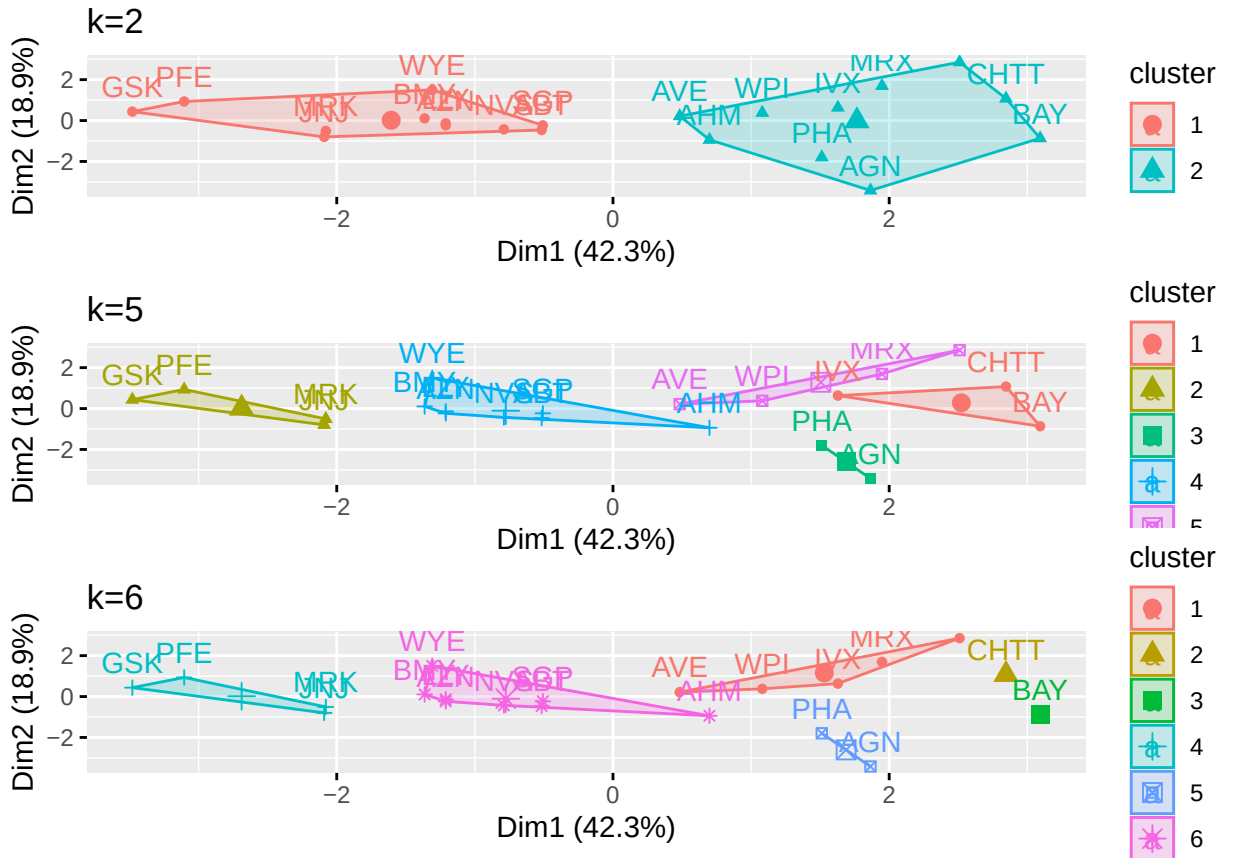
```
row.names(My_Pharmaceuticals)<- My_Pharmaceuticals[,1]
My_Pharmaceuticals.data.num<- My_Pharmaceuticals[, 3:11]
head(My_Pharmaceuticals.data.num)
```

```
##     Market_Cap Beta PE_Ratio  ROE  ROA Asset_Turnover Leverage Rev_Growth
## ABT      68.44 0.32     24.7 26.4 11.8            0.7     0.42       7.54
## AGN       7.58 0.41     82.5 12.9  5.5            0.9     0.60       9.16
## AHM       6.30 0.46     20.7 14.9  7.8            0.9     0.27       7.05
## AZN      67.63 0.52     21.5 27.4 15.4            0.9     0.00      15.00
## AVE      47.16 0.32     20.1 21.8  7.5            0.6     0.34      26.81
## BAY      16.90 1.11     27.9  3.9  1.4            0.6     0.00      -3.17
##     Net_Profit_Margin
## ABT              16.1
## AGN               5.5
## AHM              11.2
## AZN              18.0
## AVE              12.9
## BAY               2.6
```

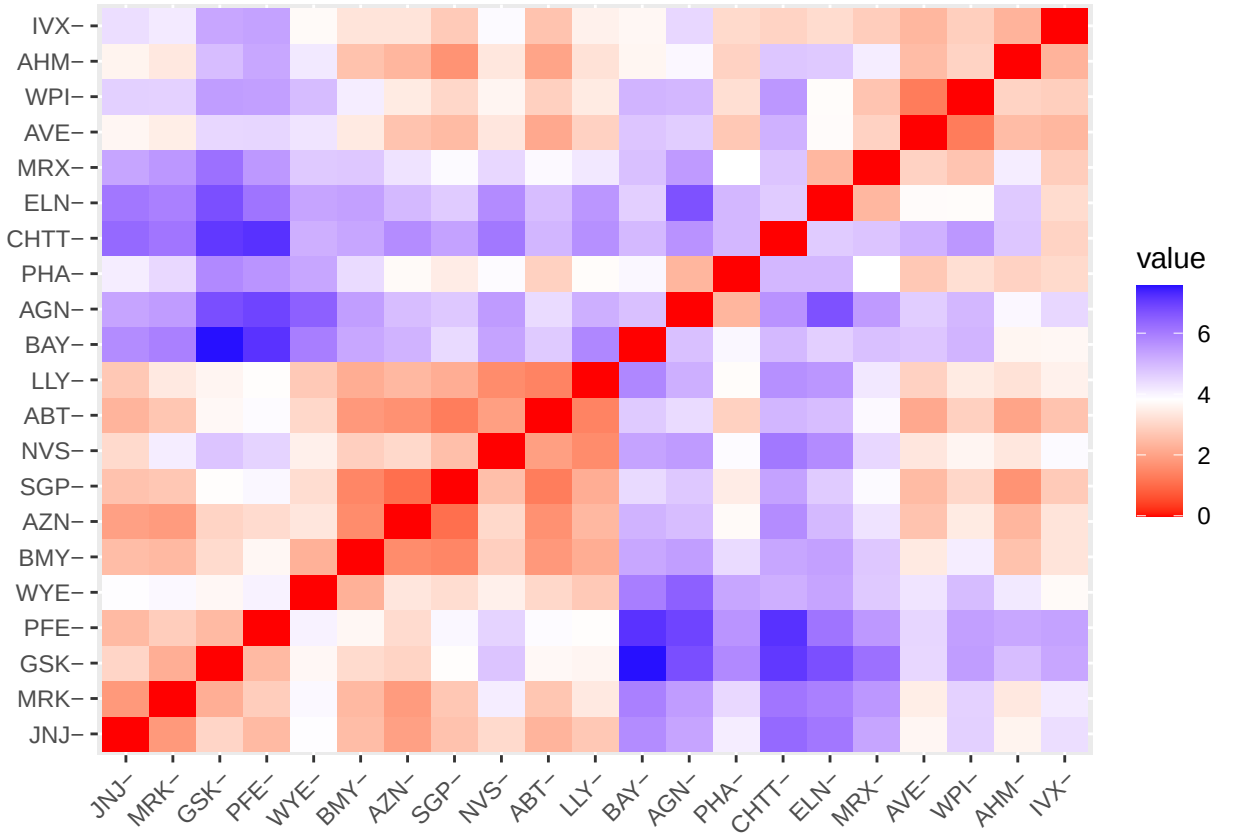
```
# Scaling and Normalizing the dataset
My_Pharmaceuticals.scale <- scale(My_Pharmaceuticals.data.num)
head(My_Pharmaceuticals.scale)
```

```
##     Market_Cap        Beta    PE_Ratio         ROE        ROA Asset_Turnover
## ABT  0.1840960 -0.80125356 -0.04671323  0.04009035  0.2416121      0.0000000
## AGN -0.8544181 -0.45070513  3.49706911 -0.85483986 -0.9422871      0.9225312
## AHM -0.8762600 -0.25595600 -0.29195768 -0.72225761 -0.5100700      0.9225312
## AZN  0.1702742 -0.02225704 -0.24290879  0.10638147  0.9181259      0.9225312
## AVE -0.1790256 -0.80125356 -0.32874435 -0.26484883 -0.5664461     -0.4612656
## BAY -0.6953818  2.27578267  0.14948233 -1.45146000 -1.7127612     -0.4612656
##       Leverage Rev_Growth Net_Profit_Margin
## ABT -0.2120979 -0.5277675        0.06168225
## AGN  0.0182843 -0.3811391       -1.55366706
## AHM -0.4040831 -0.5721181       -0.68503583
## AZN -0.7496565  0.1474473        0.35122600
## AVE -0.3144900  1.2163867       -0.42597037
## BAY -0.7496565 -1.4971443       -1.99560225
```

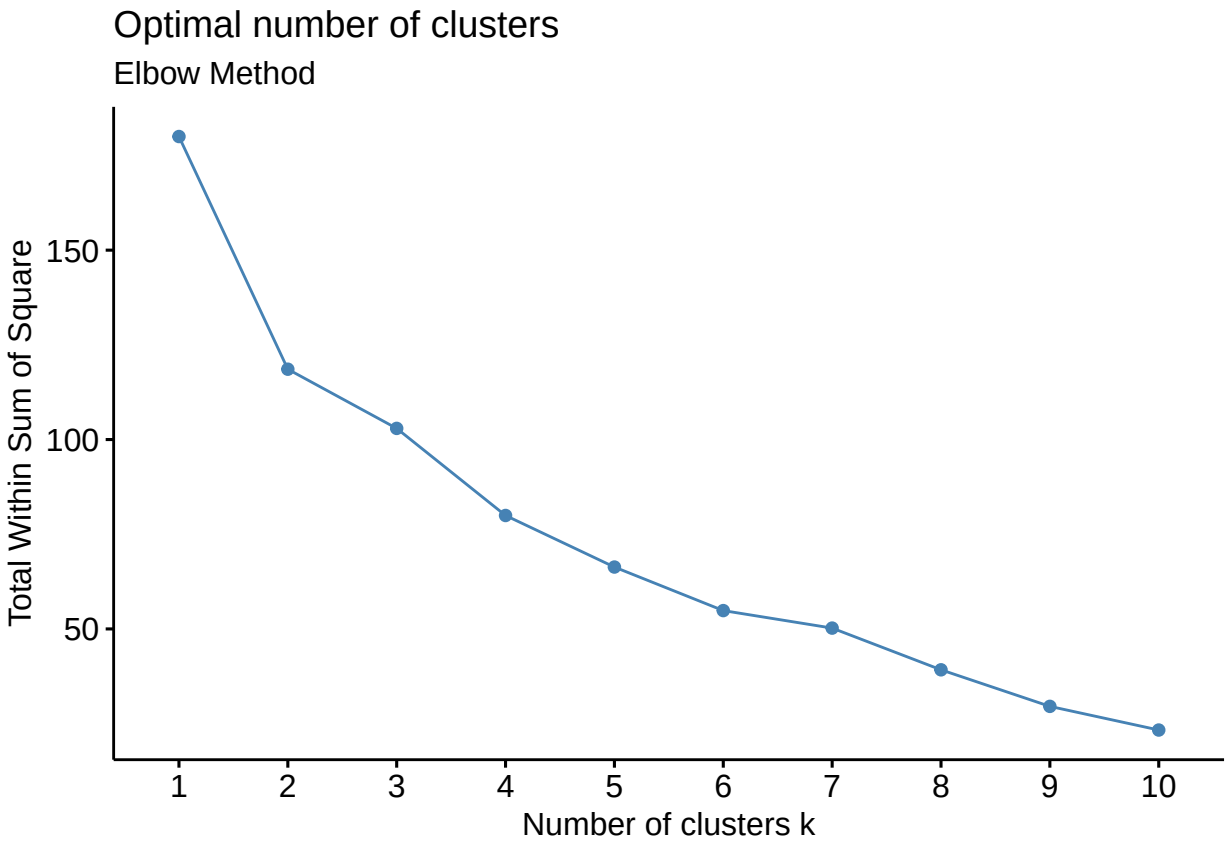
```
normal.data <- as.data.frame(scale(My_Pharmaceuticals.data.num))

#Computing K-means clustering  for different centers
kmeans.1 <- kmeans(My_Pharmaceuticals.scale, centers = 2, nstart = 30)
kmeans.2<- kmeans(My_Pharmaceuticals.scale, centers = 5, nstart = 30)
kmeans.3<- kmeans(My_Pharmaceuticals.scale, centers = 6, nstart = 30)
Plot.1<-fviz_cluster(kmeans.1, data = My_Pharmaceuticals.scale)+ggtitle("k=2")
plot.2<-fviz_cluster(kmeans.2, data = My_Pharmaceuticals.scale)+ggtitle("k=5")
plot.3<-fviz_cluster(kmeans.3, data = My_Pharmaceuticals.scale)+ggtitle("k=6")
grid.arrange(Plot.1,plot.2,plot.3, nrow = 3)
```



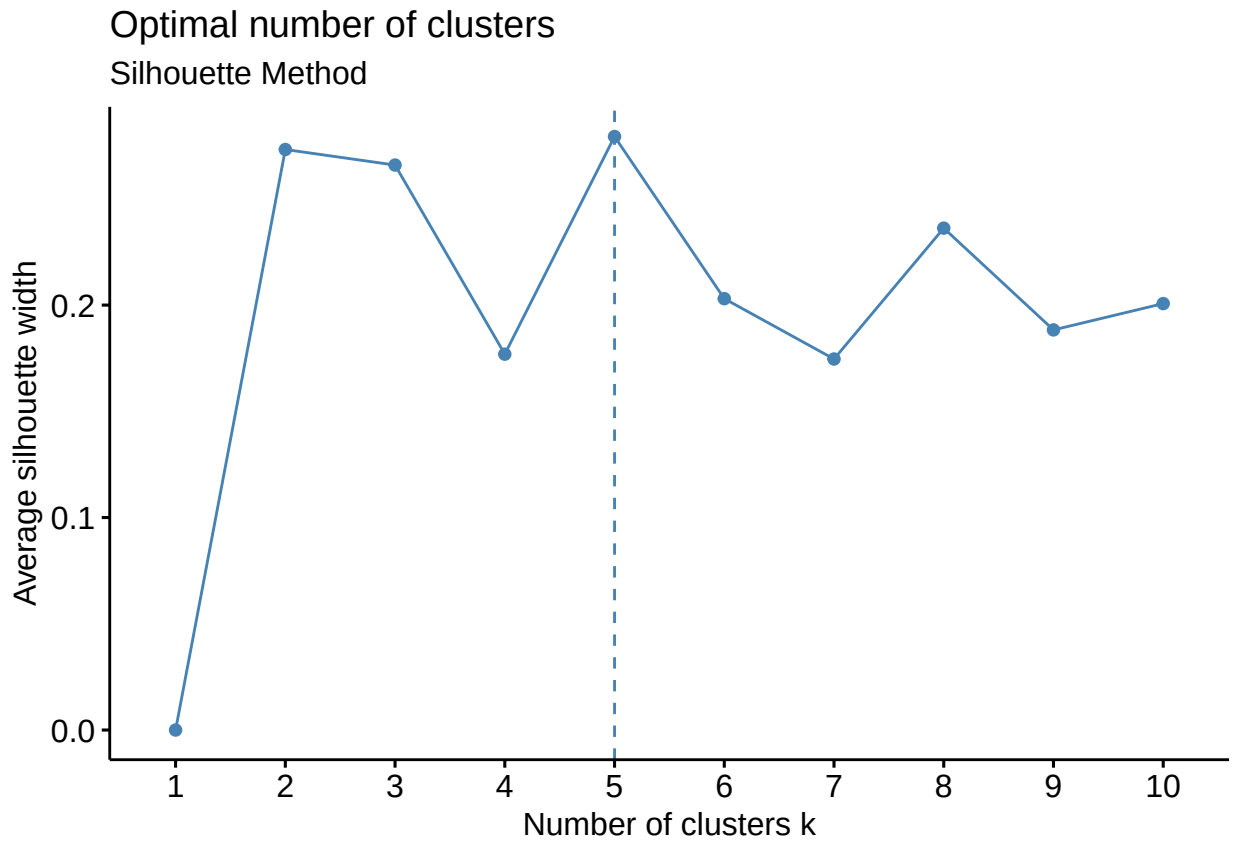

```
distance<- dist(My_Pharmaceuticals.scale, method = "euclidean")
fviz_dist(distance)
```




```
# Estimate the  number of clusters(Elbow Method is used for scaling the data to determine the value of
fviz_nbclust(normal.data, FUNcluster = kmeans, method = "wss") + labs(subtitle = "Elbow Method")
```




```
# Silhouette Method is used  to determine total number of clusters
fviz_nbclust(normal.data,FUNcluster = kmeans,method = "silhouette")+labs(subtitle="Silhouette Method")
```

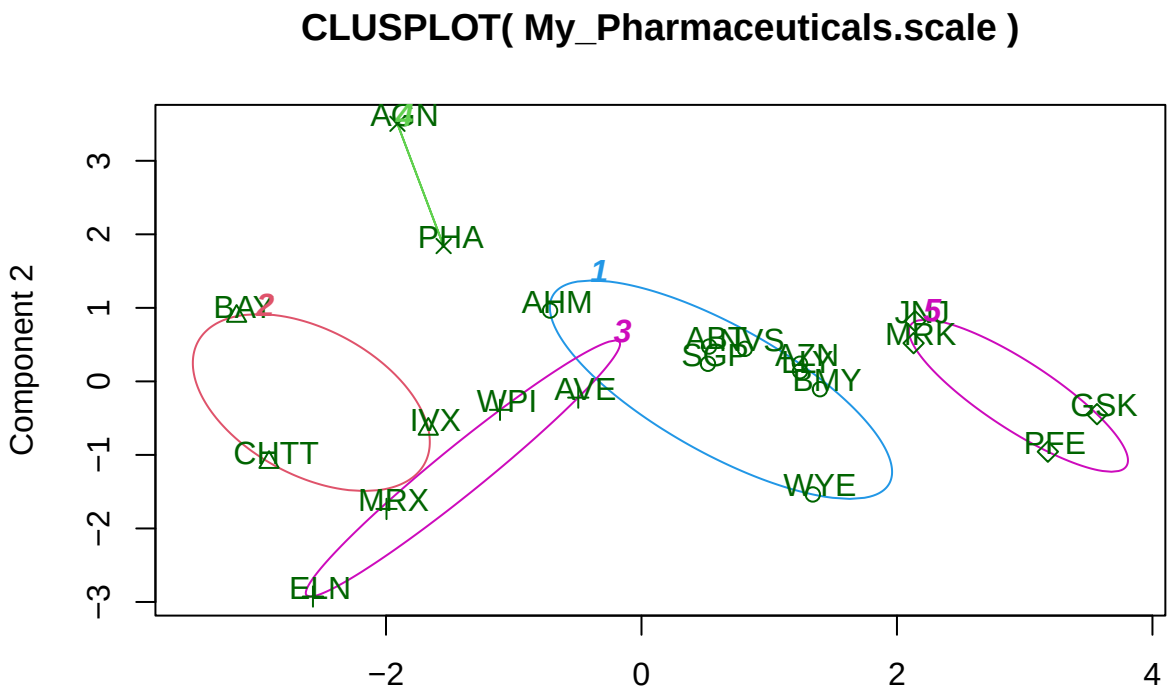



```
# Final analysis and Extracting the results using 5 clusters and Visualizing the results
set.seed(300)
final.Cluster<- kmeans(My_Pharmaceuticals.scale, 5, nstart = 25)
print(final.Cluster)
```

```
## K-means clustering with 5 clusters of sizes 8, 3, 4, 2, 4
##
## Cluster means:
##    Market_Cap       Beta    PE_Ratio        ROE        ROA Asset_Turnover
## 1 -0.03142211 -0.4360989 -0.31724852  0.1950459  0.4083915      0.1729746
## 2 -0.87051511  1.3409869 -0.05284434 -0.6184015 -1.1928478     -0.4612656
## 3 -0.76022489  0.2796041 -0.47742380 -0.7438022 -0.8107428     -1.2684804
## 4 -0.43925134 -0.4701800  2.70002464 -0.8349525 -0.9234951      0.2306328
## 5  1.69558112 -0.1780563 -0.19845823  1.2349879  1.3503431      1.1531640
##      Leverage Rev_Growth Net_Profit_Margin
## 1 -0.27449312 -0.7041516       0.556954446
## 2  1.36644699 -0.6912914      -1.320000179
## 3  0.06308085  1.5180158      -0.006893899
## 4 -0.14170336 -0.1168459      -1.416514761
## 5 -0.46807818  0.4671788       0.591242521
##
## Clustering vector:
##  ABT  AGN  AHM  AZN  AVE  BAY  BMY CHTT  ELN  LLY  GSK  IVX  JNJ  MRX  MRK  NVS
##    1    4    1    1    3    2    1    2    3    1    5    2    5    3    5    1
##  PFE  PHA  SGP  WPI  WYE
##    5    4    1    3    1
```

```
##
## Within cluster sum of squares by cluster:
## [1] 21.879320 15.595925 12.791257  2.803505  9.284424
##  (between_SS / total_SS =  65.4 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
clusplot(My_Pharmaceuticals.scale,final.Cluster$cluster, color = TRUE, labels = 2,lines = 0)
```

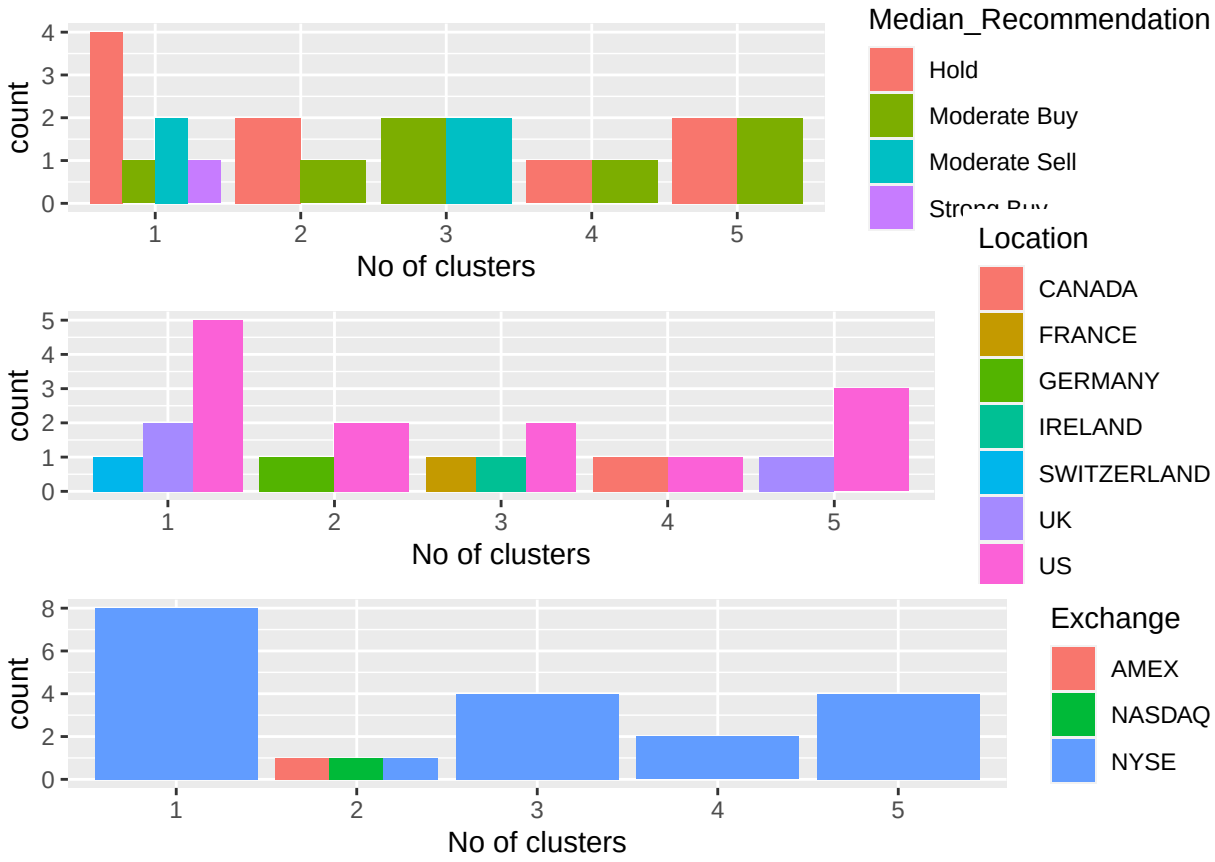



```
#b)
#Cluster 1 - AHM,SGP,WYE,BMY,AZN, ABT, NVS, LLY
#Lowest Market.Cap,highest Beta,lowest PE.Ratio,highest Leverage,highest Rev.Growth.

#Cluster 2 - BAY, CHTT, IVX
#Lowest Rev.Growth,highest Net.Profit.Margin

#Cluster 3 - WPI, MRX,ELN,AVE
#Highest PE.Ratio,lowest.ROE,lowest ROA,lowest Net.Profit.Margin

#Cluster 4 - AGN, PHA
#Lowest Beta,lowest Asset.Turnover

#Cluster 5 - JNJ, MRK, PFE,GSK
#Highest Market.Cap and lowest Beta/PE Ratio
```

```
My_Pharmaceuticals.Cluster <- My_Pharmaceuticals[,c(12,13,14)]%>% mutate(clusters = final.Cluster$cluste
My_Pharmaceuticals.Cluster
```

```
##      Median_Recommendation    Location Exchange clusters
## ABT           Moderate Buy          US     NYSE        1
## AHM             Strong Buy          UK     NYSE        1
## AZN          Moderate Sell          UK     NYSE        1
## BMY          Moderate Sell          US     NYSE        1
## LLY                   Hold          US     NYSE        1
## NVS                   Hold SWITZERLAND     NYSE        1
## SGP                   Hold          US     NYSE        1
## WYE                   Hold          US     NYSE        1
## BAY                   Hold     GERMANY     NYSE        2
## CHTT          Moderate Buy          US   NASDAQ        2
## IVX                   Hold          US     AMEX        2
## AVE           Moderate Buy      FRANCE     NYSE        3
## ELN          Moderate Sell     IRELAND     NYSE        3
## MRX           Moderate Buy          US     NYSE        3
## WPI          Moderate Sell          US     NYSE        3
## AGN           Moderate Buy      CANADA     NYSE        4
## PHA                   Hold          US     NYSE        4
## GSK                   Hold          UK     NYSE        5
## JNJ           Moderate Buy          US     NYSE        5
## MRK                   Hold          US     NYSE        5
## PFE           Moderate Buy          US     NYSE        5
```

```
#c)
plot1<-ggplot(My_Pharmaceuticals.Cluster, mapping = aes(factor(clusters), fill=Median_Recommendation))+g
plot2<- ggplot(My_Pharmaceuticals.Cluster, mapping = aes(factor(clusters),fill = Location))+geom_bar(pos
plot3<- ggplot(My_Pharmaceuticals.Cluster, mapping = aes(factor(clusters),fill = Exchange))+geom_bar(pos
grid.arrange(plot1, plot2, plot3)
```



#As per graph:-

#Cluster 1 :The Hold median is highest in this cluster,It also contains separate Hold, Moderate Buy, Moderate Sell, and Strong Buy medians. They are listed on the NYSE and they come from the US, UK, and Switzerland.

#Cluster 2: Even though the firms are evenly divided throughout AMEX, NASDAQ, and NYSE, has a distinct Hold and Moderate Buy median, as well as a different count between the US and Germany.

#Cluster 3: It is listed on the NYSE, has separate counts for France, Ireland, and the US, and has equal moderate buy and sell medians.

#Cluster 4: It dispersed throughout the US and UK, as well as being listed in, has the identical hold and moderate buy medians

#Cluster 5: solely listed on the NYSE, equally dispersed in the US and Canada, with Hold and Moderate Buy medians.

```
#d)
#Cluster1-Hold Cluster
#Cluster2-Hold Cluster
#Cluster3-Buy-Sell Cluster
#Cluster4-Hold-Buy Cluster
#Cluster5-Hold-Buy Cluster
```