Assignment_4

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Description:"The purpose of this assignment is to use k-Means for clustering". load the required libraries

```
library(caret)
```

```
## Loading required package: ggplot2
```

```
## Loading required package: lattice
```

```
library(readr)
library(ggplot2)
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.3.3
```

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

```
library(flexclust)
```

```
## Warning: package 'flexclust' was built under R version 4.3.3
```

```
## Loading required package: grid
```

```
## Loading required package: modeltools
```

```
## Loading required package: stats4
```

```
library(cluster)
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.3
```

```
## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.4     v stringr   1.5.1
## v forcats   1.0.0     v tibble    3.2.1
## v lubridate 1.9.3     v tidyr     1.3.1
## v purrr     1.0.2
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## x purrr::lift()   masks caret::lift()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

Get the current working directory

```
getwd()
```

```
## [1] "C:/Users/tarun/Downloads"
```

Set the working directory to "C:/Users/tarun/Downloads"

```
setwd("C:/Users/tarun/Downloads")
```

Read the CSV file "Pharmaceuticals.csv" and store it in the data frame named "Pharma_Assignment4"

```
Pharma_Assignment4 <- read.csv("Pharmaceuticals.csv")
```

Print the structure of the data frame

```
str(Pharma_Assignment4)
```

```
## '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" ...
```

Print a summary of the data frame

```
summary(Pharma_Assignment4)
```

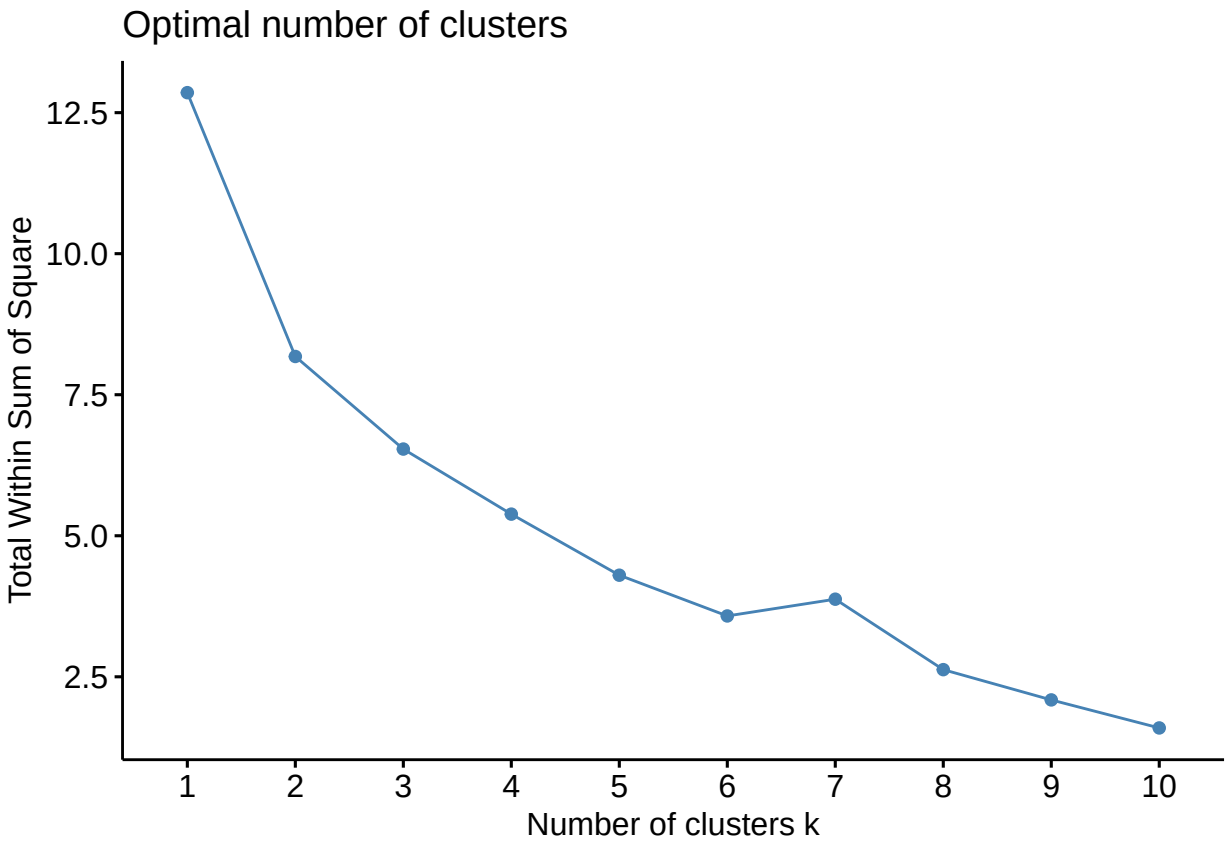
```
##     Symbol              Name             Market_Cap          Beta
##  Length:21          Length:21          Min.   :  0.41   Min.   :0.1800
##  Class :character   Class :character   1st Qu.:  6.30   1st Qu.:0.3500
##  Mode  :character   Mode  :character   Median : 48.19   Median :0.4600
##                                        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
##
##
##
```

#a. Use only the numerical variables (1 to 9) to cluster the 21 firms. Justify the various choices made inconducting the cluster analysis, such as weights for different variables, the specific clustering algorithm(s)used, the number of clusters formed, and so on. # Select only the numerical variables from the data frame # Preprocess the numerical variables by scaling them using the range method

```
norm_mean<- Pharma_Assignment4 %>% select('Market_Cap', 'Beta', 'PE_Ratio', 'ROE', 'ROA', 'Asset_Turnove
#scaling the data.
norm_train <- preProcess(norm_mean, method = "range")
predictions<-predict(norm_train, norm_mean)
```

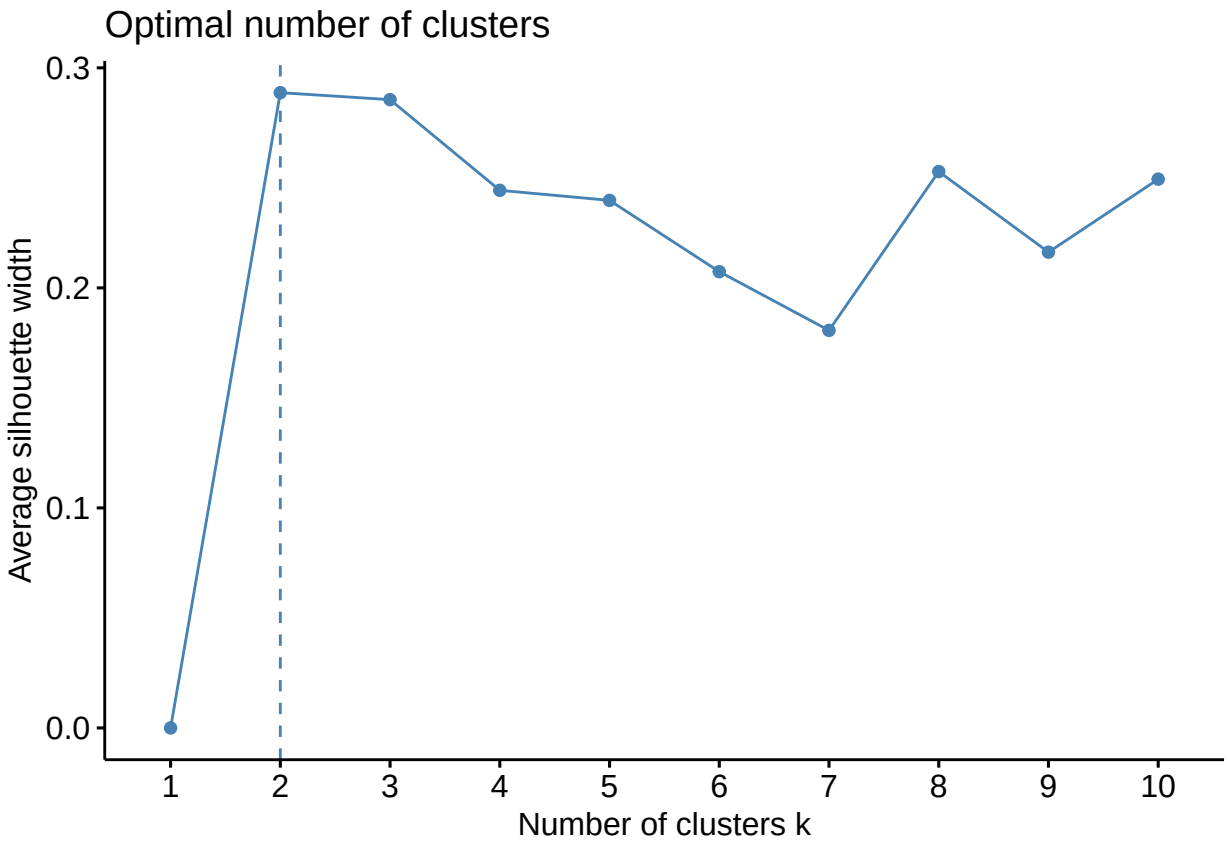
Determine the optimal number of clusters using the Elbow method

```
fviz_nbclust(predictions, kmeans, method = "wss")
```



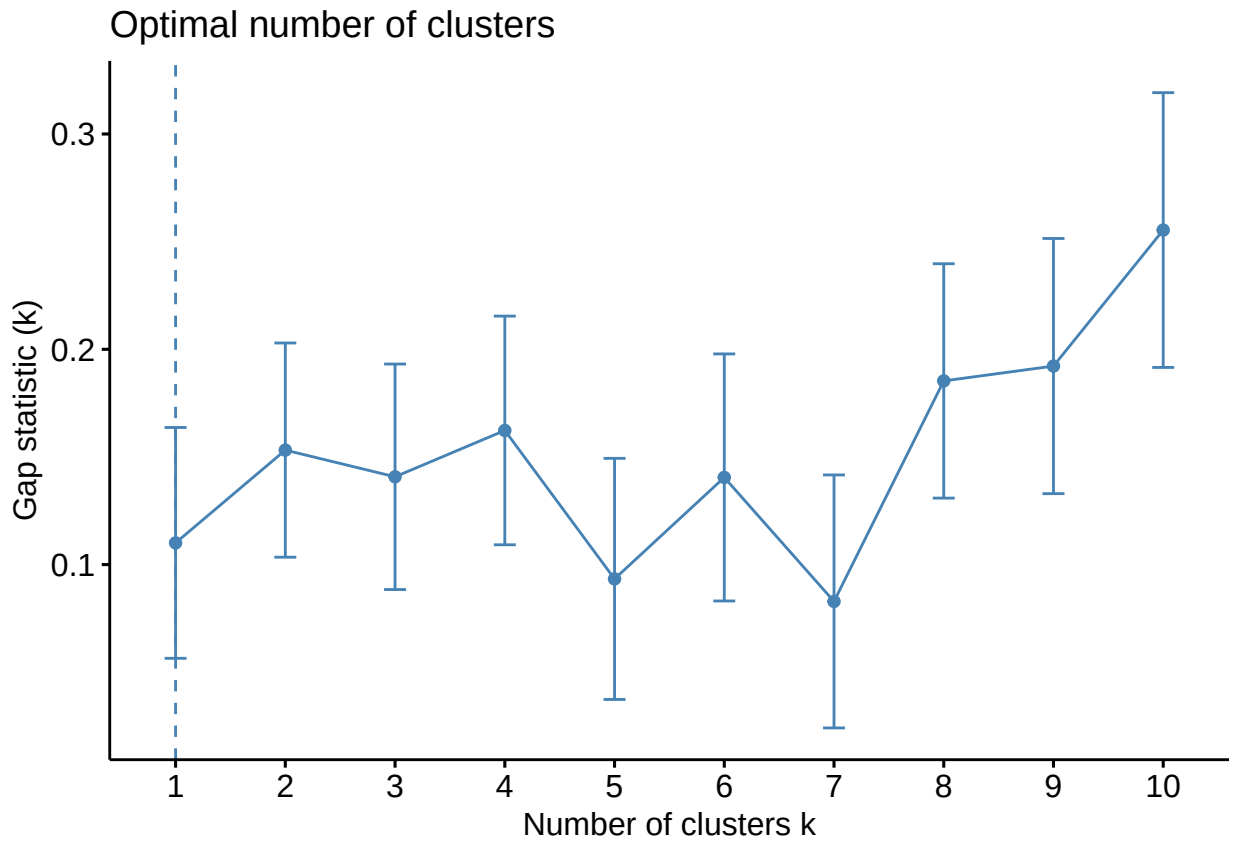
Determine the optimal number of clusters using the Silhouette method

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



Determine the optimal number of clusters using the Gap static method

```
fviz_nbclust(predictions, kmeans, method = "gap_stat")
```



#From above we calculate kmeans optimal being k=5

```
k_means_5 <- kmeans(predictions, centers = 5, nstart = 25)
k_means_5$centers
```

```
##   Market_Cap      Beta  PE_Ratio       ROE       ROA Asset_Turnover   Leverage
## 1 0.11535885 0.2616487 0.6290663 0.1672316 0.2610229      0.6250000 0.11585945
## 2 0.03128035 0.7419355 0.2661597 0.2129944 0.1463845      0.3750000 0.47103514
## 3 0.78673516 0.3225806 0.2360583 0.6868644 0.8624339      0.8125000 0.06267806
## 4 0.31383933 0.2442396 0.2107550 0.4544794 0.6341648      0.5178571 0.10989011
## 5 0.06374962 0.4489247 0.1783904 0.1809322 0.2539683      0.1562500 0.18091168
##   Rev_Growth Net_Profit_Margin
## 1  0.3631175         0.2358079
## 2  0.2381844         0.1935953
## 3  0.5805912         0.7412664
## 4  0.2288084         0.7822832
## 5  0.8911851         0.5698690
```

```
k_means_5 <- kmeans(predictions, centers = 5, nstart = 25)
k_means_5$centers
```

```
##   Market_Cap      Beta  PE_Ratio       ROE       ROA Asset_Turnover   Leverage
## 1 0.78673516 0.3225806 0.2360583 0.6868644 0.8624339      0.8125000 0.06267806
## 2 0.03128035 0.7419355 0.2661597 0.2129944 0.1463845      0.3750000 0.47103514
## 3 0.31383933 0.2442396 0.2107550 0.4544794 0.6341648      0.5178571 0.10989011
## 4 0.06374962 0.4489247 0.1783904 0.1809322 0.2539683      0.1562500 0.18091168
## 5 0.11535885 0.2616487 0.6290663 0.1672316 0.2610229      0.6250000 0.11585945
##   Rev_Growth Net_Profit_Margin
## 1  0.5805912         0.7412664
## 2  0.2381844         0.1935953
## 3  0.2288084         0.7822832
## 4  0.8911851         0.5698690
## 5  0.3631175         0.2358079
```

Display the Pharmaceuticals data frame

```
Pharmaceuticals <- data.frame(predictions, cluster = k_means_5$cluster)
Pharmaceuticals
```

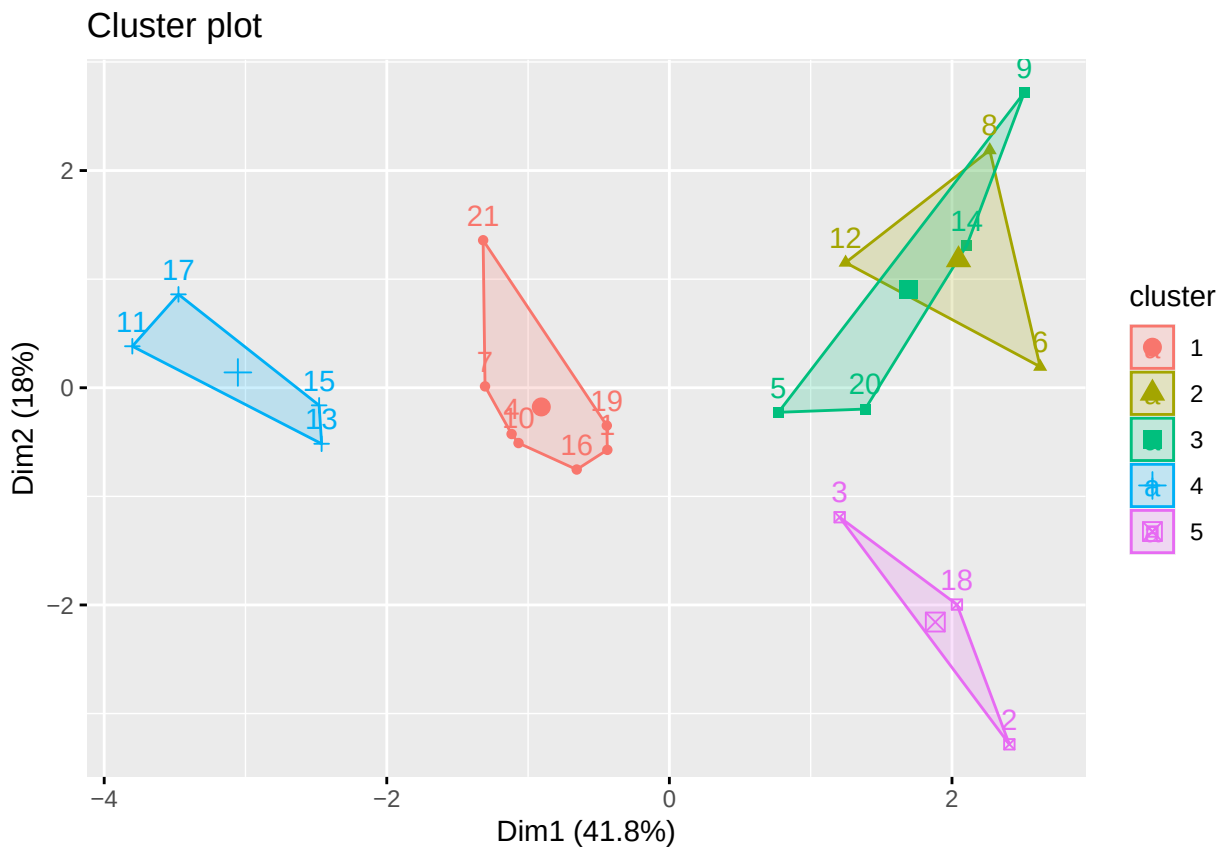
```
##     Market_Cap       Beta  PE_Ratio       ROE       ROA Asset_Turnover
## 1  0.341756254 0.15053763 0.2674271 0.3813559 0.5502646          0.500
## 2  0.036019291 0.24731183 1.0000000 0.1525424 0.2169312          0.750
## 3  0.029589069 0.30107527 0.2167300 0.1864407 0.3386243          0.750
## 4  0.337687130 0.36559140 0.2268695 0.3983051 0.7407407          0.750
## 5  0.234853813 0.15053763 0.2091255 0.3033898 0.3227513          0.375
## 6  0.082839345 1.00000000 0.3079848 0.0000000 0.0000000          0.375
## 7  0.255802271 0.34408602 0.1305450 0.5237288 0.7248677          0.750
## 8  0.000000000 0.72043011 0.2839037 0.3423729 0.1534392          0.375
## 9  0.001858736 0.96774194 0.0000000 0.1898305 0.1957672          0.000
## 10 0.368883754 0.00000000 0.3079848 0.4593220 0.6402116          0.375
## 11 0.611373455 0.18279570 0.1825095 1.0000000 1.0000000          0.875
## 12 0.011001708 0.50537634 0.2065906 0.2966102 0.2857143          0.375
## 13 0.871696976 0.30107527 0.3143219 0.4186441 0.7883598          0.750
## 14 0.003968653 0.61290323 0.3168568 0.1237288 0.2116402          0.000
## 15 0.663870190 0.30107527 0.1939163 0.6220339 0.7195767          1.000
## 16 0.483472320 0.01075269 0.2281369 0.2372881 0.5185185          0.250
## 17 1.000000000 0.50537634 0.2534854 0.7067797 0.9417989          0.625
## 18 0.280468201 0.23655914 0.6704689 0.1627119 0.2275132          0.375
## 19 0.169245454 0.35483871 0.1939163 0.3169492 0.6296296          0.625
## 20 0.014317291 0.06451613 0.1875792 0.1067797 0.2857143          0.250
## 21 0.240028132 0.48387097 0.1204056 0.8644068 0.6349206          0.375
##      Leverage Rev_Growth Net_Profit_Margin cluster
## 1  0.11965812 0.28651685         0.5895197       3
## 2  0.17094017 0.32985554         0.1266376       5
## 3  0.07692308 0.27340824         0.3755459       5
## 4  0.00000000 0.48608882         0.6724891       3
## 5  0.09686610 0.80203317         0.4497817       4
## 6  0.00000000 0.00000000         0.0000000       2
## 7  0.16239316 0.15703585         0.7860262       3
## 8  1.00000000 0.25548422         0.2139738       2
## 9  0.30484330 1.00000000         0.4672489       4
## 10 0.15099715 0.25093633         0.9082969       3
```

```
## 11 0.09686610 0.66987694         0.8078603       1
## 12 0.41310541 0.45906902         0.3668122       2
## 13 0.02849003 0.33547352         0.6681223       1
## 14 0.26495726 0.89727127         0.8165939       4
## 15 0.07977208 0.54895666         0.5021834       1
## 16 0.01709402 0.01284109         0.8646288       3
## 17 0.04558405 0.76805778         0.9868996       1
## 18 0.09971510 0.48608882         0.2052402       5
## 19 0.00000000 0.31380417         0.6550218       3
## 20 0.05698006 0.86543606         0.5458515       4
## 21 0.31908832 0.09443553         1.0000000       3
```

```
set.seed(1515)
k5 <- kmeans(Pharmaceuticals, centers = 5, nstart = 25)
k5 $centers
```

```
##   Market_Cap      Beta  PE_Ratio       ROE       ROA Asset_Turnover   Leverage
## 1 0.31383933 0.2442396 0.2107550 0.4544794 0.6341648      0.5178571 0.10989011
## 2 0.03128035 0.7419355 0.2661597 0.2129944 0.1463845      0.3750000 0.47103514
## 3 0.06374962 0.4489247 0.1783904 0.1809322 0.2539683      0.1562500 0.18091168
## 4 0.78673516 0.3225806 0.2360583 0.6868644 0.8624339      0.8125000 0.06267806
## 5 0.11535885 0.2616487 0.6290663 0.1672316 0.2610229      0.6250000 0.11585945
##   Rev_Growth Net_Profit_Margin cluster
## 1  0.2288084         0.7822832       3
## 2  0.2381844         0.1935953       2
## 3  0.8911851         0.5698690       4
## 4  0.5805912         0.7412664       1
## 5  0.3631175         0.2358079       5
```

```
fviz_cluster(k5, data = Pharmaceuticals)
```

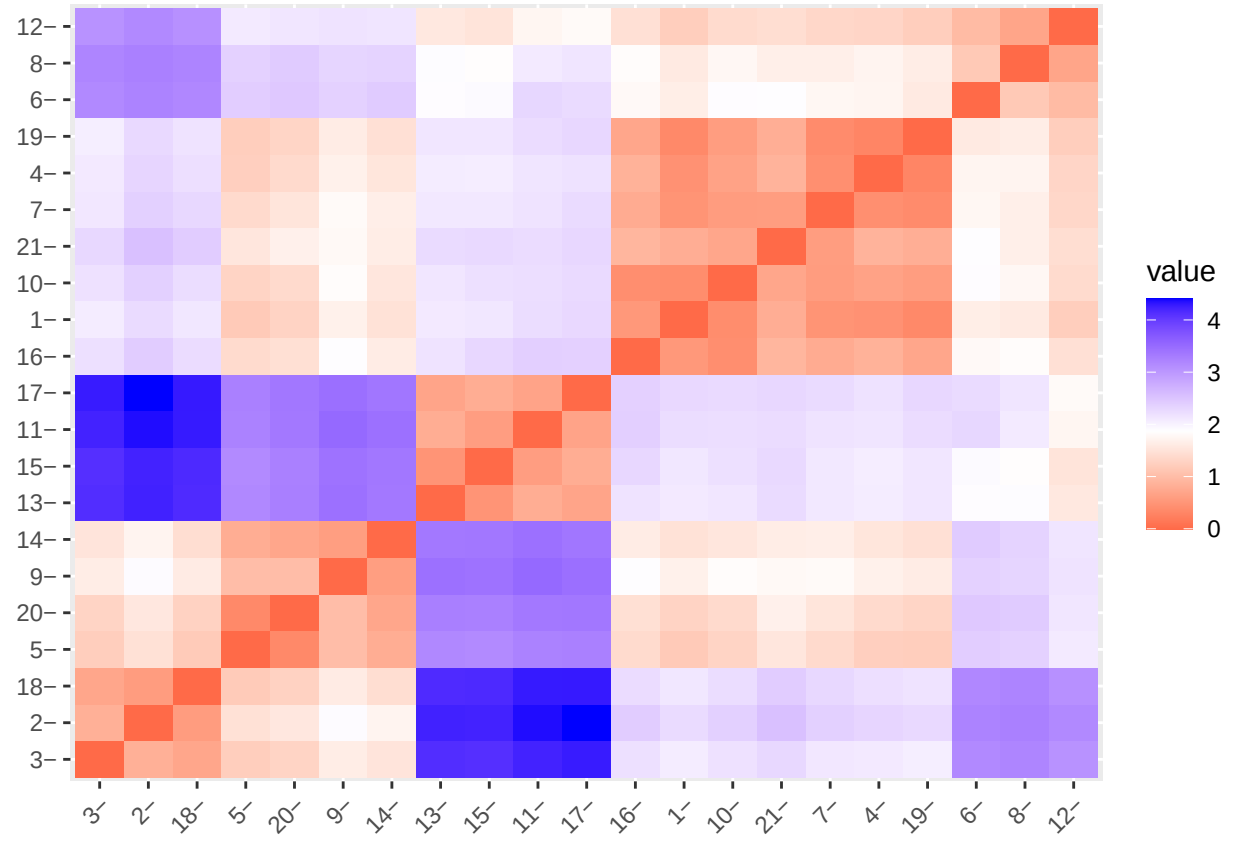



```
k5
```

```
## K-means clustering with 5 clusters of sizes 7, 3, 4, 4, 3
##
## Cluster means:
##   Market_Cap      Beta  PE_Ratio       ROE       ROA Asset_Turnover   Leverage
## 1 0.31383933 0.2442396 0.2107550 0.4544794 0.6341648      0.5178571 0.10989011
## 2 0.03128035 0.7419355 0.2661597 0.2129944 0.1463845      0.3750000 0.47103514
## 3 0.06374962 0.4489247 0.1783904 0.1809322 0.2539683      0.1562500 0.18091168
## 4 0.78673516 0.3225806 0.2360583 0.6868644 0.8624339      0.8125000 0.06267806
## 5 0.11535885 0.2616487 0.6290663 0.1672316 0.2610229      0.6250000 0.11585945
##   Rev_Growth Net_Profit_Margin cluster
## 1  0.2288084         0.7822832       3
## 2  0.2381844         0.1935953       2
## 3  0.8911851         0.5698690       4
## 4  0.5805912         0.7412664       1
## 5  0.3631175         0.2358079       5
##
## Clustering vector:
##  [1] 1 5 5 1 3 2 1 2 3 1 4 2 4 3 4 1 4 5 1 3 1
##
## Within cluster sum of squares by cluster:
## [1] 1.1915705 0.9214221 0.9159833 0.7017406 0.5175390
##  (between_SS / total_SS =  91.1 %)
##
## Available components:
```

```
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
Distance <- dist(Pharmaceuticals, method = "euclidian")
fviz_dist(Distance)
```




```
Fitting <- kmeans(Pharmaceuticals,3)
aggregate(Pharmaceuticals,by = list(Fitting$cluster), FUN = mean)
```

```
##   Group.1 Market_Cap      Beta  PE_Ratio       ROE       ROA Asset_Turnover
## 1       1 0.78673516 0.3225806 0.2360583 0.6868644 0.8624339      0.8125000
## 2       2 0.08586786 0.3686636 0.3715372 0.1750605 0.2569917      0.3571429
## 3       3 0.22907164 0.3935484 0.2273764 0.3820339 0.4878307      0.4750000
##     Leverage Rev_Growth Net_Profit_Margin  cluster
## 1 0.06267806  0.5805912         0.7412664 1.000000
## 2 0.15303215  0.6648704         0.4266999 4.428571
## 3 0.21823362  0.2316212         0.6056769 2.700000
```

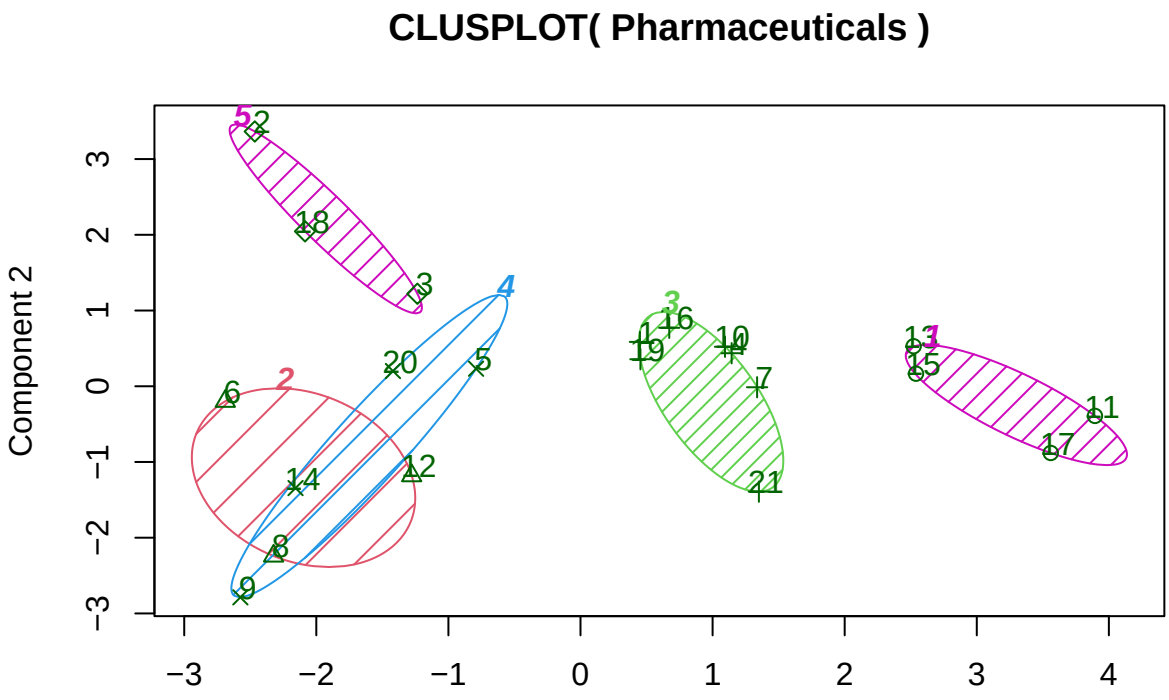
```
Pharma <- data.frame(Pharmaceuticals,Fitting$cluster)
Pharma
```

```
##     Market_Cap       Beta  PE_Ratio       ROE       ROA Asset_Turnover
## 1  0.341756254 0.15053763 0.2674271 0.3813559 0.5502646          0.500
```

```
## 2  0.036019291 0.24731183 1.0000000 0.1525424 0.2169312          0.750
## 3  0.029589069 0.30107527 0.2167300 0.1864407 0.3386243          0.750
## 4  0.337687130 0.36559140 0.2268695 0.3983051 0.7407407          0.750
## 5  0.234853813 0.15053763 0.2091255 0.3033898 0.3227513          0.375
## 6  0.082839345 1.00000000 0.3079848 0.0000000 0.0000000          0.375
## 7  0.255802271 0.34408602 0.1305450 0.5237288 0.7248677          0.750
## 8  0.000000000 0.72043011 0.2839037 0.3423729 0.1534392          0.375
## 9  0.001858736 0.96774194 0.0000000 0.1898305 0.1957672          0.000
## 10 0.368883754 0.00000000 0.3079848 0.4593220 0.6402116          0.375
## 11 0.611373455 0.18279570 0.1825095 1.0000000 1.0000000          0.875
## 12 0.011001708 0.50537634 0.2065906 0.2966102 0.2857143          0.375
## 13 0.871696976 0.30107527 0.3143219 0.4186441 0.7883598          0.750
## 14 0.003968653 0.61290323 0.3168568 0.1237288 0.2116402          0.000
## 15 0.663870190 0.30107527 0.1939163 0.6220339 0.7195767          1.000
## 16 0.483472320 0.01075269 0.2281369 0.2372881 0.5185185          0.250
## 17 1.000000000 0.50537634 0.2534854 0.7067797 0.9417989          0.625
## 18 0.280468201 0.23655914 0.6704689 0.1627119 0.2275132          0.375
## 19 0.169245454 0.35483871 0.1939163 0.3169492 0.6296296          0.625
## 20 0.014317291 0.06451613 0.1875792 0.1067797 0.2857143          0.250
## 21 0.240028132 0.48387097 0.1204056 0.8644068 0.6349206          0.375
##      Leverage Rev_Growth Net_Profit_Margin cluster Fitting.cluster
## 1  0.11965812 0.28651685         0.5895197       3               3
## 2  0.17094017 0.32985554         0.1266376       5               2
## 3  0.07692308 0.27340824         0.3755459       5               2
## 4  0.00000000 0.48608882         0.6724891       3               3
## 5  0.09686610 0.80203317         0.4497817       4               2
## 6  0.00000000 0.00000000         0.0000000       2               3
## 7  0.16239316 0.15703585         0.7860262       3               3
## 8  1.00000000 0.25548422         0.2139738       2               3
## 9  0.30484330 1.00000000         0.4672489       4               2
## 10 0.15099715 0.25093633         0.9082969       3               3
## 11 0.09686610 0.66987694         0.8078603       1               1
## 12 0.41310541 0.45906902         0.3668122       2               3
## 13 0.02849003 0.33547352         0.6681223       1               1
## 14 0.26495726 0.89727127         0.8165939       4               2
## 15 0.07977208 0.54895666         0.5021834       1               1
## 16 0.01709402 0.01284109         0.8646288       3               3
## 17 0.04558405 0.76805778         0.9868996       1               1
## 18 0.09971510 0.48608882         0.2052402       5               2
## 19 0.00000000 0.31380417         0.6550218       3               3
## 20 0.05698006 0.86543606         0.5458515       4               2
## 21 0.31908832 0.09443553         1.0000000       3               3
```

Create a cluster plot

```
clusplot(Pharmaceuticals, Pharmaceuticals$cluster, color = TRUE, shade = TRUE,
         labels = 2, lines = 0)
```



#b. Interpret the clusters with respect to the numerical variables used in forming the clusters. # Combine cluster assignments with Location and Exchange columns

```
aggregate(Pharmaceuticals, by = list(Fitting$cluster), FUN = mean)
```

```
##   Group.1 Market_Cap      Beta  PE_Ratio       ROE       ROA Asset_Turnover
## 1       1 0.78673516 0.3225806 0.2360583 0.6868644 0.8624339      0.8125000
## 2       2 0.08586786 0.3686636 0.3715372 0.1750605 0.2569917      0.3571429
## 3       3 0.22907164 0.3935484 0.2273764 0.3820339 0.4878307      0.4750000
##     Leverage Rev_Growth Net_Profit_Margin  cluster
## 1 0.06267806  0.5805912         0.7412664 1.000000
## 2 0.15303215  0.6648704         0.4266999 4.428571
## 3 0.21823362  0.2316212         0.6056769 2.700000
```

```
Pharmacy <- data.frame(Pharmaceuticals,k5$cluster)
Pharmacy
```

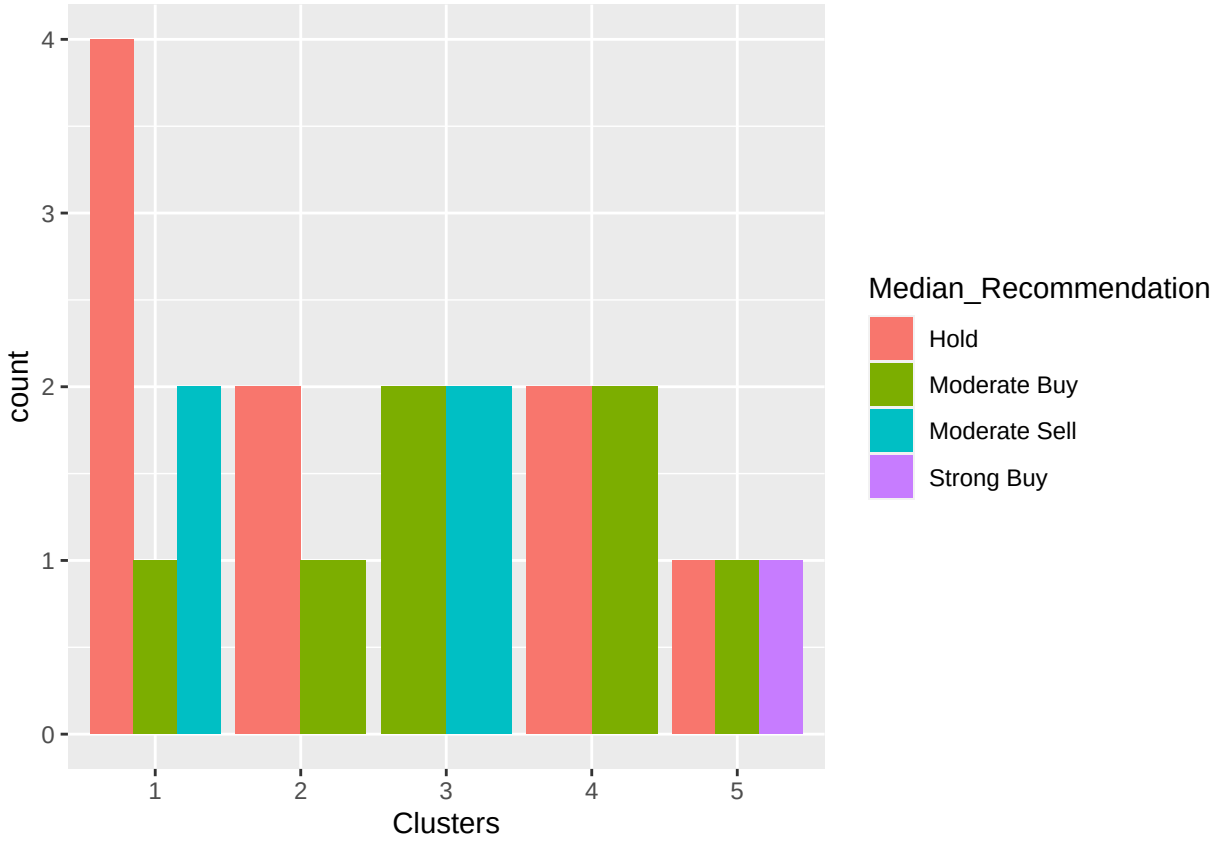
```
##     Market_Cap       Beta  PE_Ratio       ROE       ROA Asset_Turnover
## 1  0.341756254 0.15053763 0.2674271 0.3813559 0.5502646          0.500
## 2  0.036019291 0.24731183 1.0000000 0.1525424 0.2169312          0.750
## 3  0.029589069 0.30107527 0.2167300 0.1864407 0.3386243          0.750
## 4  0.337687130 0.36559140 0.2268695 0.3983051 0.7407407          0.750
## 5  0.234853813 0.15053763 0.2091255 0.3033898 0.3227513          0.375
## 6  0.082839345 1.00000000 0.3079848 0.0000000 0.0000000          0.375
## 7  0.255802271 0.34408602 0.1305450 0.5237288 0.7248677          0.750
```

```
## 8  0.000000000 0.72043011 0.2839037 0.3423729 0.1534392          0.375
## 9  0.001858736 0.96774194 0.0000000 0.1898305 0.1957672          0.000
## 10 0.368883754 0.00000000 0.3079848 0.4593220 0.6402116          0.375
## 11 0.611373455 0.18279570 0.1825095 1.0000000 1.0000000          0.875
## 12 0.011001708 0.50537634 0.2065906 0.2966102 0.2857143          0.375
## 13 0.871696976 0.30107527 0.3143219 0.4186441 0.7883598          0.750
## 14 0.003968653 0.61290323 0.3168568 0.1237288 0.2116402          0.000
## 15 0.663870190 0.30107527 0.1939163 0.6220339 0.7195767          1.000
## 16 0.483472320 0.01075269 0.2281369 0.2372881 0.5185185          0.250
## 17 1.000000000 0.50537634 0.2534854 0.7067797 0.9417989          0.625
## 18 0.280468201 0.23655914 0.6704689 0.1627119 0.2275132          0.375
## 19 0.169245454 0.35483871 0.1939163 0.3169492 0.6296296          0.625
## 20 0.014317291 0.06451613 0.1875792 0.1067797 0.2857143          0.250
## 21 0.240028132 0.48387097 0.1204056 0.8644068 0.6349206          0.375
##      Leverage Rev_Growth Net_Profit_Margin cluster k5.cluster
## 1  0.11965812 0.28651685         0.5895197       3          1
## 2  0.17094017 0.32985554         0.1266376       5          5
## 3  0.07692308 0.27340824         0.3755459       5          5
## 4  0.00000000 0.48608882         0.6724891       3          1
## 5  0.09686610 0.80203317         0.4497817       4          3
## 6  0.00000000 0.00000000         0.0000000       2          2
## 7  0.16239316 0.15703585         0.7860262       3          1
## 8  1.00000000 0.25548422         0.2139738       2          2
## 9  0.30484330 1.00000000         0.4672489       4          3
## 10 0.15099715 0.25093633         0.9082969       3          1
## 11 0.09686610 0.66987694         0.8078603       1          4
## 12 0.41310541 0.45906902         0.3668122       2          2
## 13 0.02849003 0.33547352         0.6681223       1          4
## 14 0.26495726 0.89727127         0.8165939       4          3
## 15 0.07977208 0.54895666         0.5021834       1          4
## 16 0.01709402 0.01284109         0.8646288       3          1
## 17 0.04558405 0.76805778         0.9868996       1          4
## 18 0.09971510 0.48608882         0.2052402       5          5
## 19 0.00000000 0.31380417         0.6550218       3          1
## 20 0.05698006 0.86543606         0.5458515       4          3
## 21 0.31908832 0.09443553         1.0000000       3          1
```

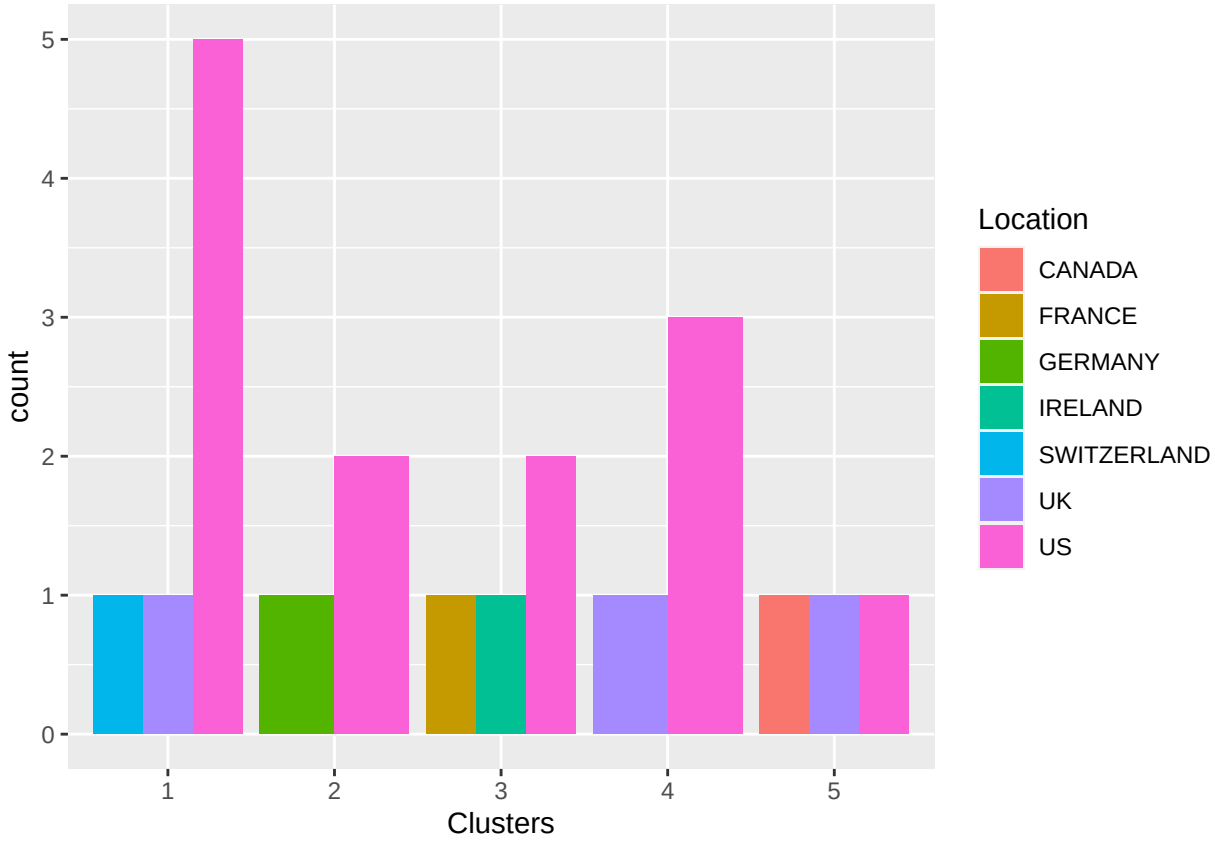
c. Is there a pattern in the clusters with respect to the numerical variables (10 to 12)

Create a bar plot using ggplot(fill=Location)

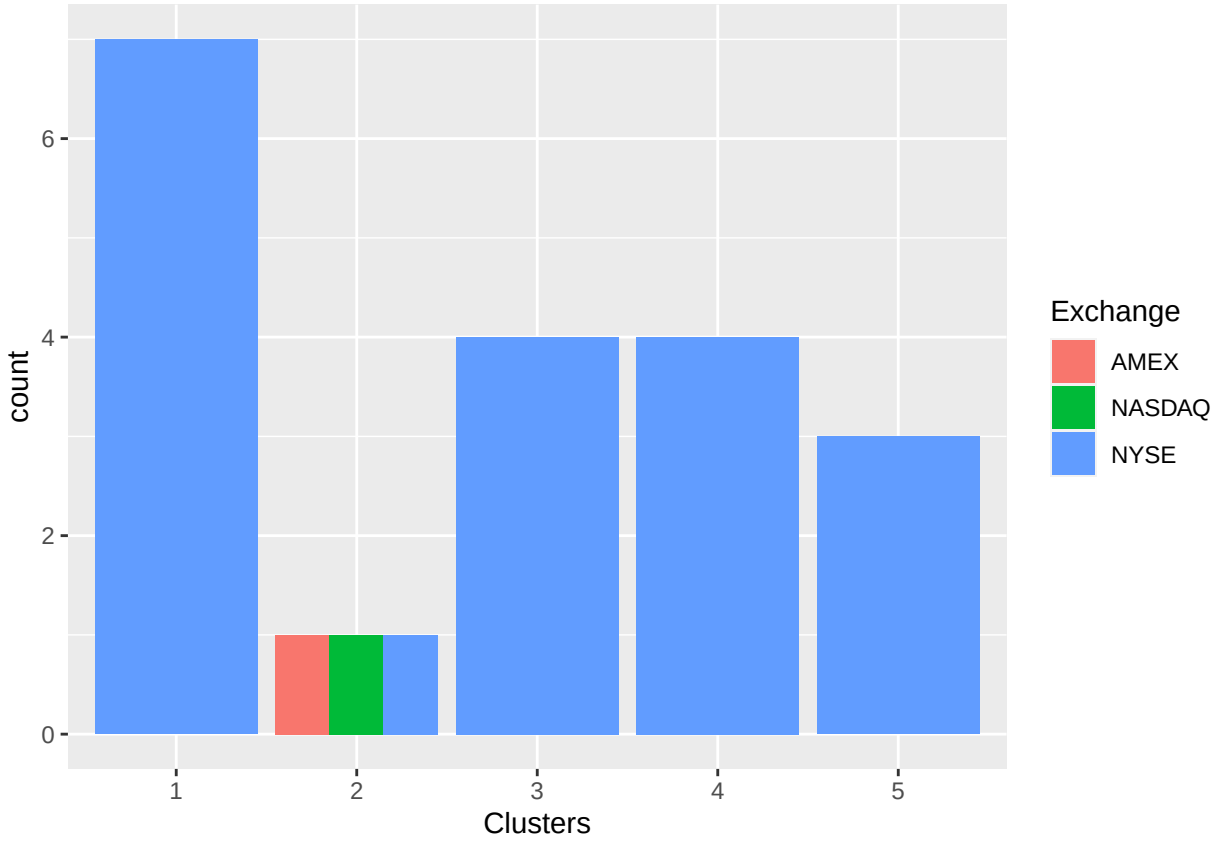
```
Assignment4 <- Pharma_Assignment4[12:14] %>% mutate(Clusters=k5$cluster)
ggplot(Assignment4, mapping = aes(factor(Clusters), fill=Median_Recommendation))+geom_bar(position='dod
```




```
ggplot(Assignment4, mapping = aes(factor(Clusters),fill = Location))+geom_bar(position = 'dodge')+labs(
```




```
ggplot(Assignment4, mapping = aes(factor(Clusters),fill = Exchange))+geom_bar(position = 'dodge')+labs(
```



#d.Provide an appropriate name for each cluster using any or all of the variables in the dataset Cluster 1 represents firms with strong buy potential, Cluster 2 consists of firms with uncertain investment potential, and Cluster 3 comprises firms with moderate buy potential.