Untitled

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```
#Loading the Required packages
library(flexclust)
```

```
## Loading required package: grid

## Loading required package: lattice

## Loading required package: modeltools

## Loading required package: stats4
```

```
library(cluster)
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   2.1.3      v forcats 0.5.2
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(factoextra)
```

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

```
library(FactoMineR)
library(ggcorrplot)
#loading the data
getwd()
```

```
## [1] "C:/Users/Saipr/OneDrive/Desktop"
```

```
setwd("C:/Users/Saipr/OneDrive/Desktop/New folder")
Info<- read.csv("Pharmaceuticals.csv")
# I am selecting columns from 3 to 11 and storing the data in variable Info1
Info1 <- Info[3:11]
# Using head function to display the first 6 rows of data
head(Info1)
```

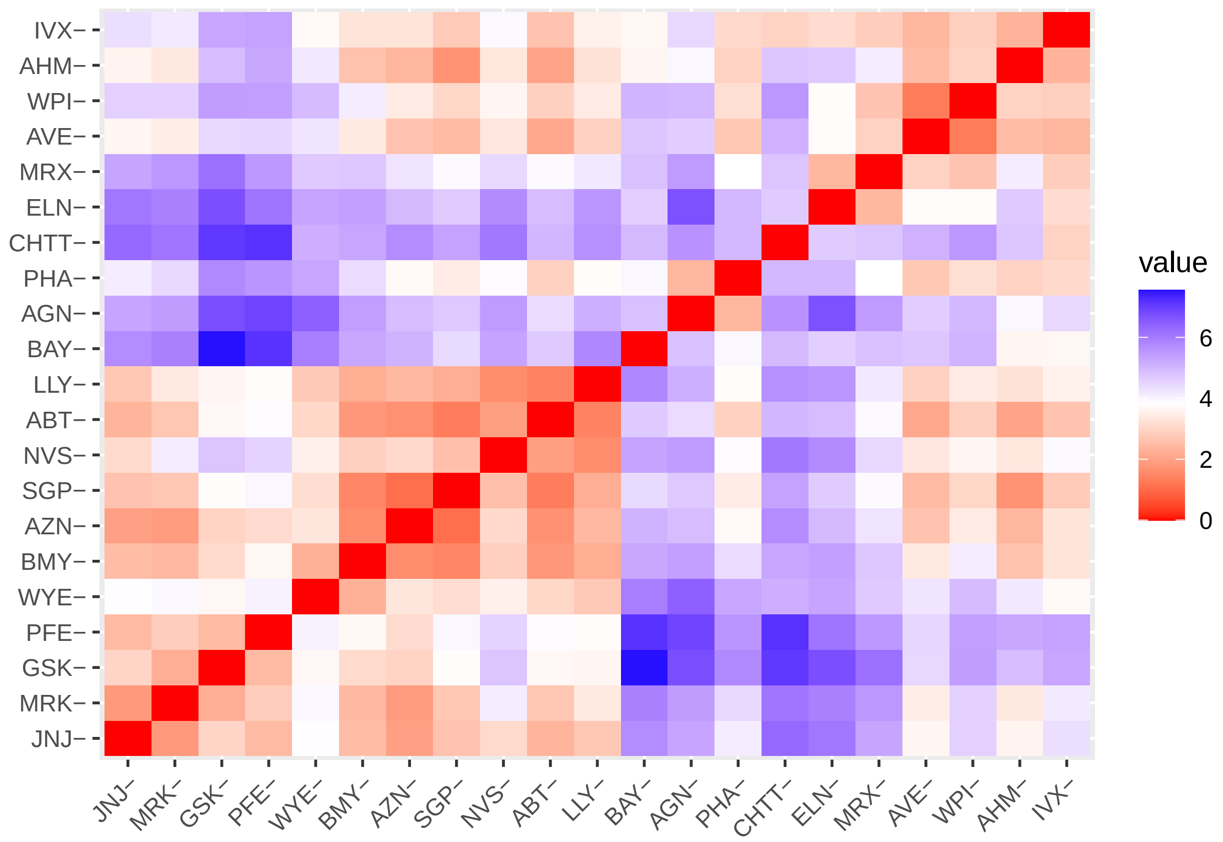
```
##   Market_Cap Beta PE_Ratio  ROE  ROA Asset_Turnover Leverage Rev_Growth
## 1      68.44 0.32     24.7 26.4 11.8            0.7     0.42       7.54
## 2       7.58 0.41     82.5 12.9  5.5            0.9     0.60       9.16
## 3       6.30 0.46     20.7 14.9  7.8            0.9     0.27       7.05
## 4      67.63 0.52     21.5 27.4 15.4            0.9     0.00      15.00
## 5      47.16 0.32     20.1 21.8  7.5            0.6     0.34      26.81
## 6      16.90 1.11     27.9  3.9  1.4            0.6     0.00      -3.17
##   Net_Profit_Margin
## 1              16.1
## 2               5.5
## 3              11.2
## 4              18.0
## 5              12.9
## 6               2.6
```

```
summary(Info1)
```

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

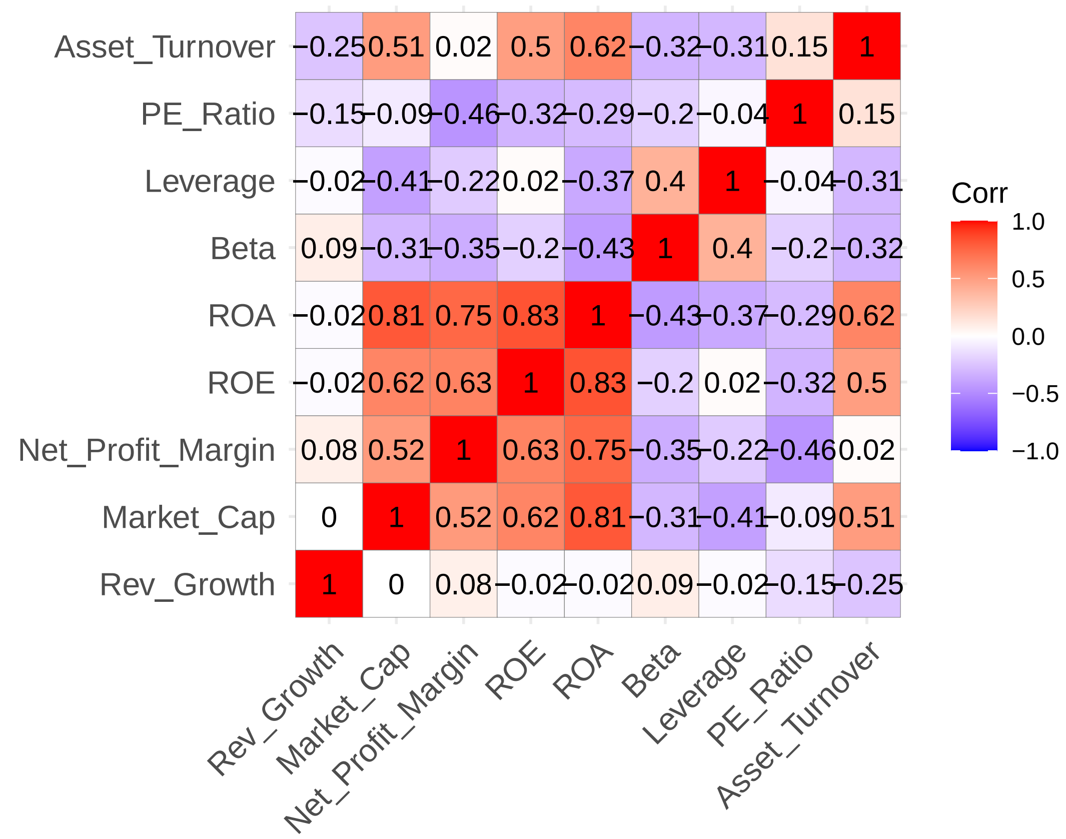
```
# We will scale the data in Info1 and record the scaled data in the Info2 dataframe because the variabl

Info2 <- scale(Info1)
row.names(Info2) <- Info[,1]
distance <- get_dist(Info2)
fviz_dist(distance)
```



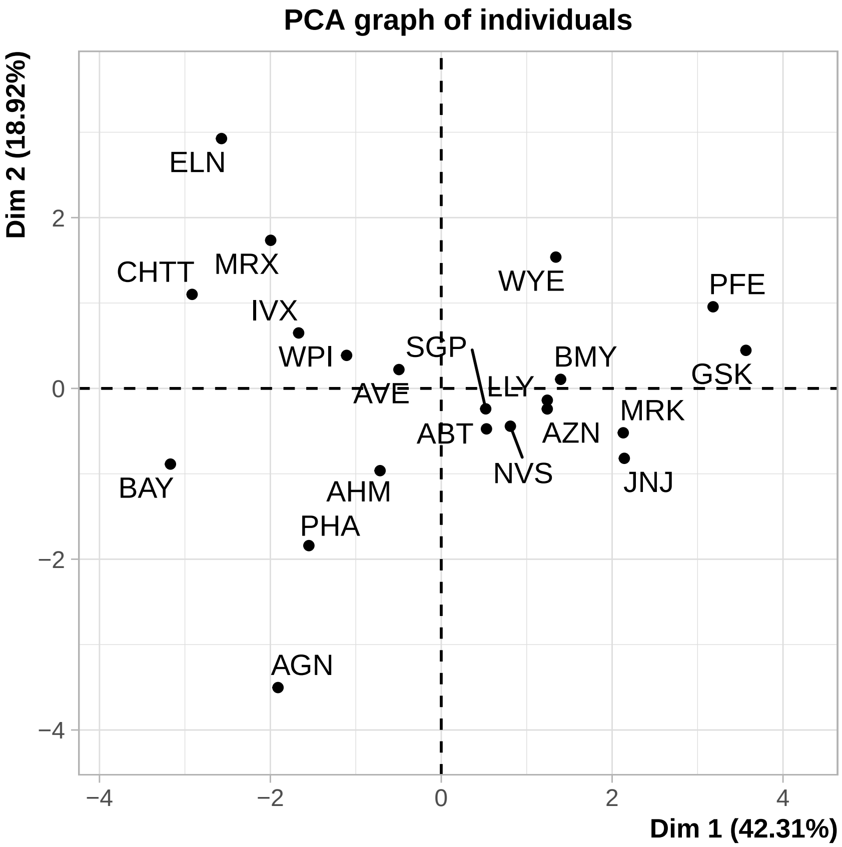
# I'm currently printing a correlation matrix to examine the relationships between key factors.

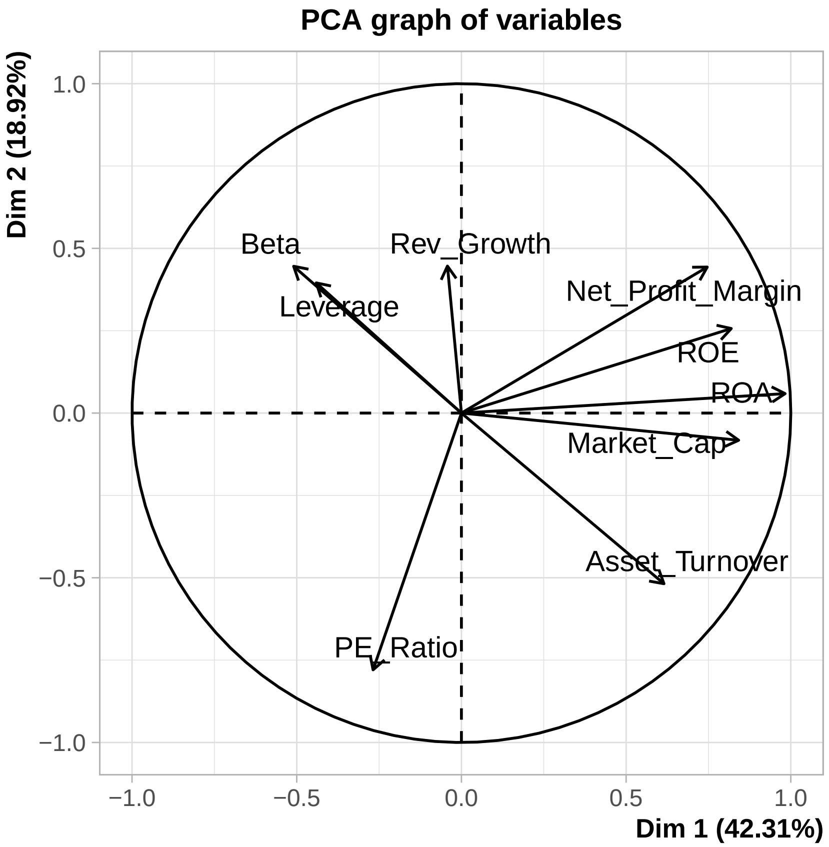
```
corr <- cor(Info2)
ggcorrplot(corr, outline.color = "grey50", lab = TRUE, hc.order = TRUE, type = "full")
```



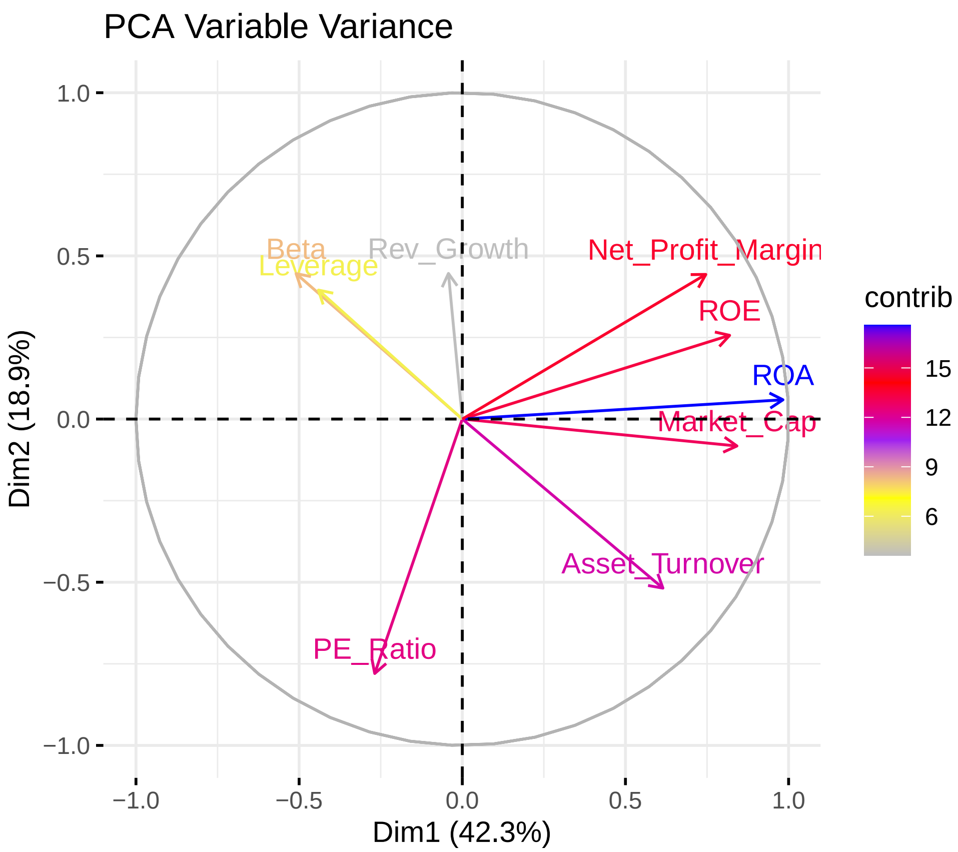
#The ROA, ROE, net profit margin, and market cap all have high values, according to the correlation matrix. I'm determining the relative importance of the primary variables in the data set using principal component analysis. Here, I'm thinking that five is the ideal number for a cluster.

```
pca <- PCA(Info2)
```


PCA graph of individuals
Dim 2 (18.92%)
Dim 1 (42.31%)
2
0
−2
−4
−4
−2
0
2
4
ELN
CHTT
MRX
IVX
WPI
SGP
AVE
WYE
PFE
BMY
GSK
LLY
MRK
ABT
AZN
NVS
JNJ
BAY
AHM
PHA
AGN

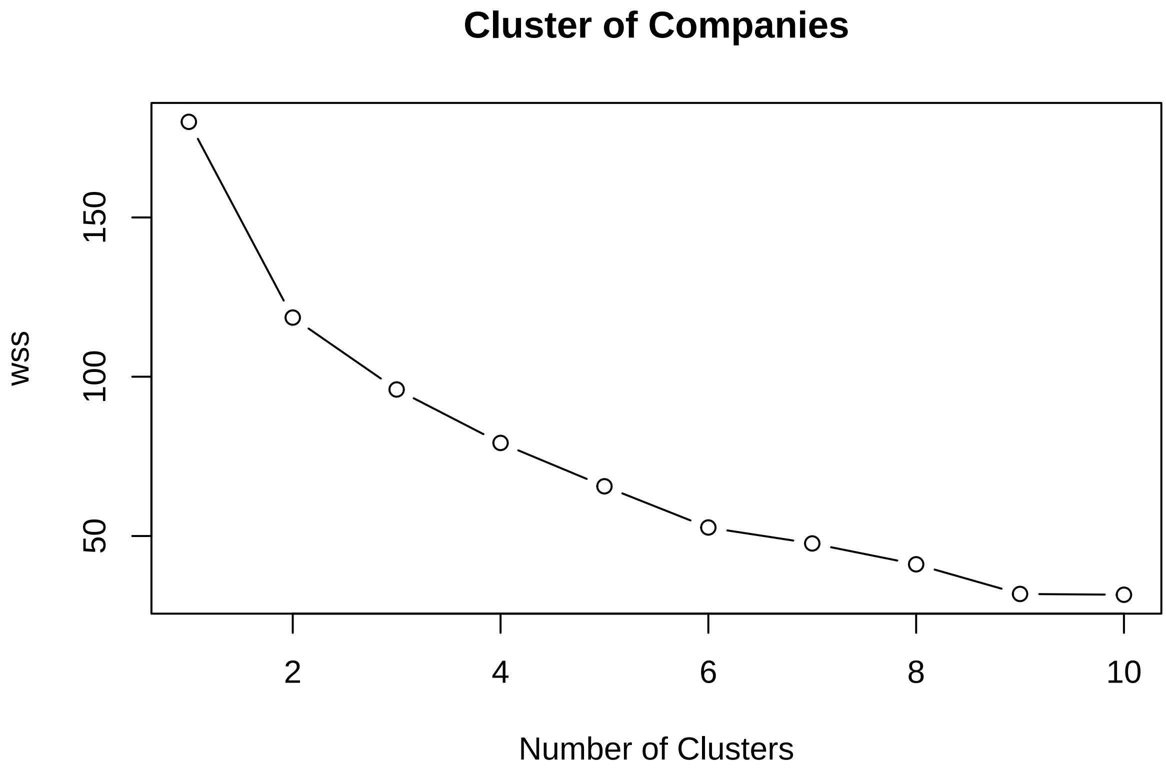


```
var <- get_pca_var(pca)
fviz_pca_var(pca, col.var="contrib",
             gradient.cols = c("grey","yellow","purple","red","blue"),ggrepel = TRUE ) + labs( title =
```



From PCA Variable Variance, we can infer that ROA, ROE, Net Profit Margin, Market Cap, and Asset Turnover contribute more than 61% to the two PCA components/dimensions (Variables), and I'm utilizing the elbow approach to get the ideal customer count.

```
set.seed(10)
wss <- vector()
for(i in 1:10) wss[i] <- sum(kmeans(Info2,i)$withinss)
plot(1:10, wss , type = "b" , main = paste('Cluster of Companies') , xlab = "Number of Clusters", ylab=
```

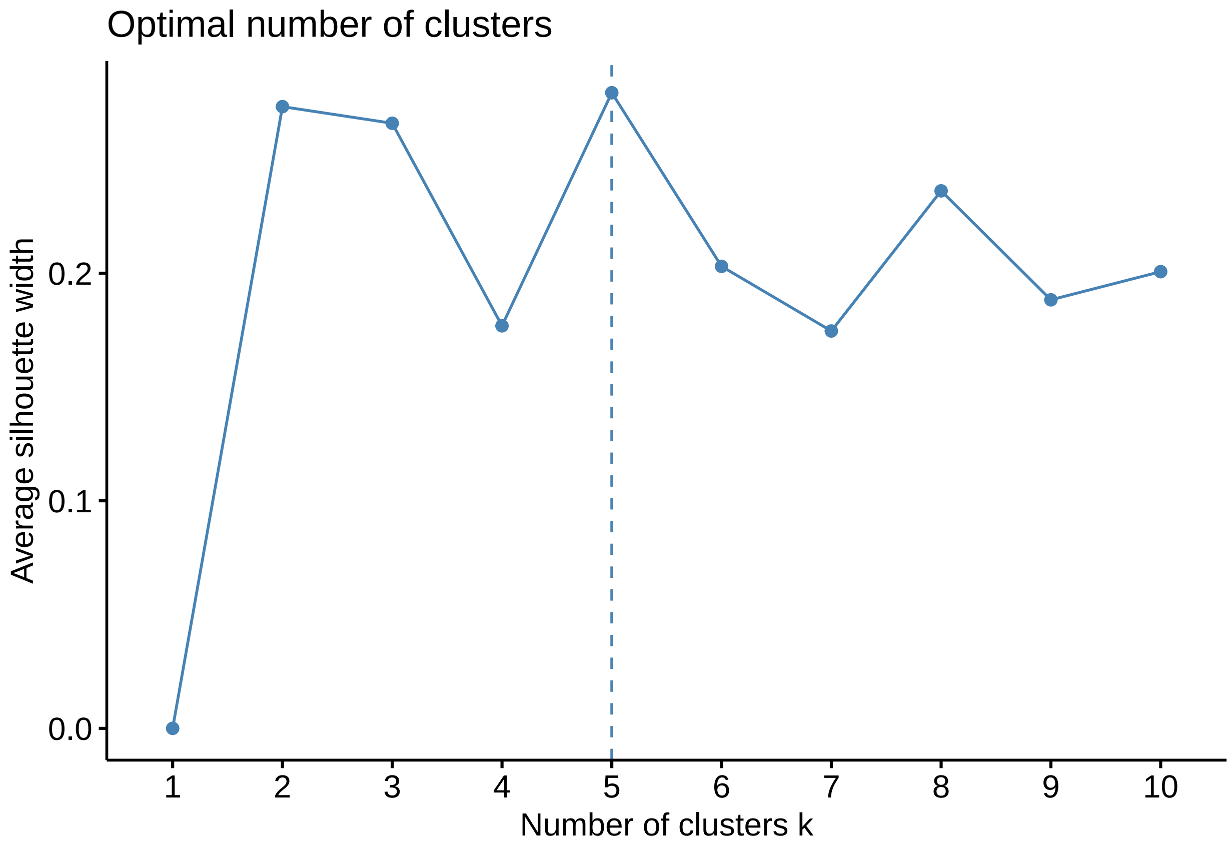


```
wss
```

```
##  [1] 180.00000 118.56934  95.99420  79.21748  65.61035  52.67476  47.66961
##  [8]  41.12605  31.81763  31.57252
```

I got the same number as assumed. Optimal cluster is at 5 . ## Silhouette Method Finding best number of clusters.

```
fviz_nbclust(Info2, kmeans, method = "silhouette")
```



Here also the idealnumber of clusters is 5. Using k-means algorithm to cluster with 5.

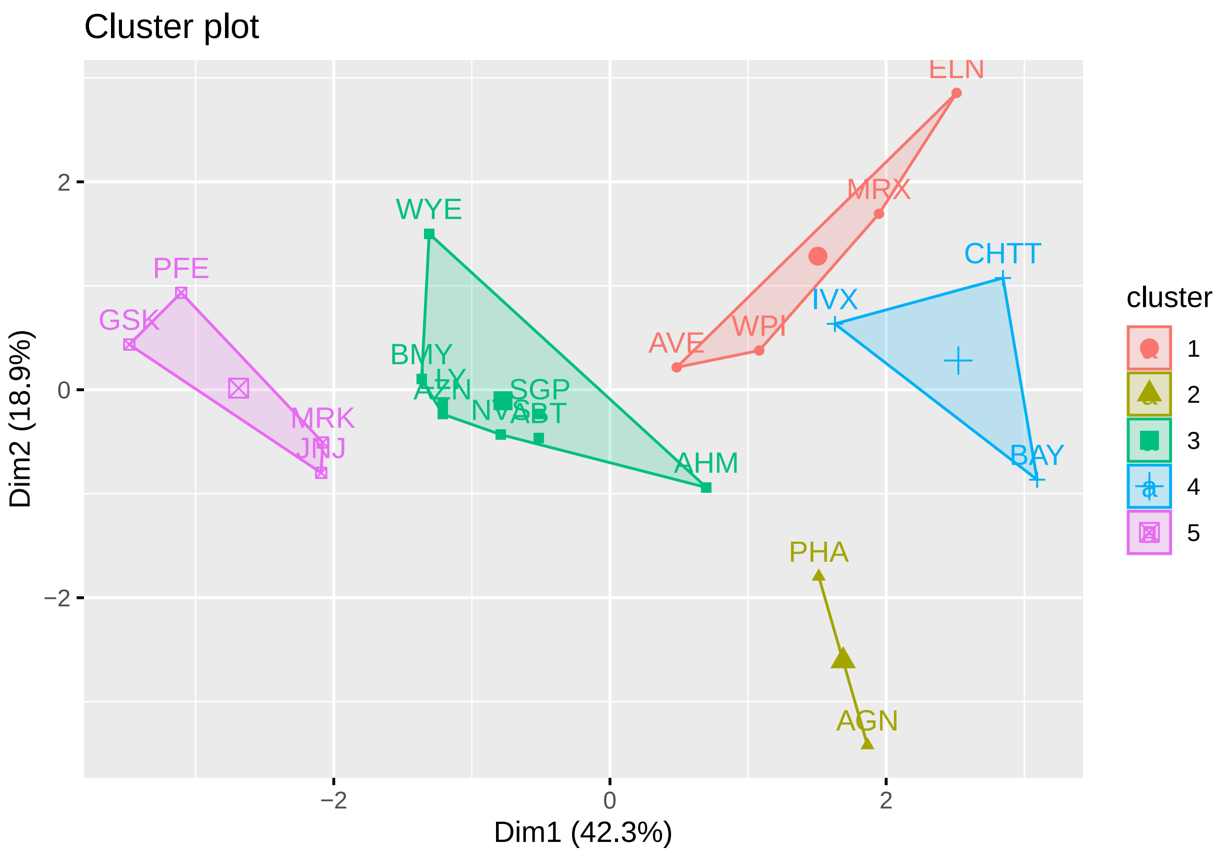
```
set.seed(1)
k5 <- kmeans(Info2, centers = 5, nstart = 25) # k = 5, number of restarts = 25
k5$centers
```

```
##    Market_Cap       Beta    PE_Ratio        ROE        ROA Asset_Turnover
## 1 -0.76022489  0.2796041 -0.47742380 -0.7438022 -0.8107428     -1.2684804
## 2 -0.43925134 -0.4701800  2.70002464 -0.8349525 -0.9234951      0.2306328
## 3 -0.03142211 -0.4360989 -0.31724852  0.1950459  0.4083915      0.1729746
## 4 -0.87051511  1.3409869 -0.05284434 -0.6184015 -1.1928478     -0.4612656
## 5  1.69558112 -0.1780563 -0.19845823  1.2349879  1.3503431      1.1531640
##      Leverage Rev_Growth Net_Profit_Margin
## 1  0.06308085  1.5180158      -0.006893899
## 2 -0.14170336 -0.1168459      -1.416514761
## 3 -0.27449312 -0.7041516       0.556954446
## 4  1.36644699 -0.6912914      -1.320000179
## 5 -0.46807818  0.4671788       0.591242521
```

```
k5$size
```

```
## [1] 4 2 8 3 4
```

```
fviz_cluster(k5, data = Info2)
```



#Manhattan Distance when using Kmeans Clustering

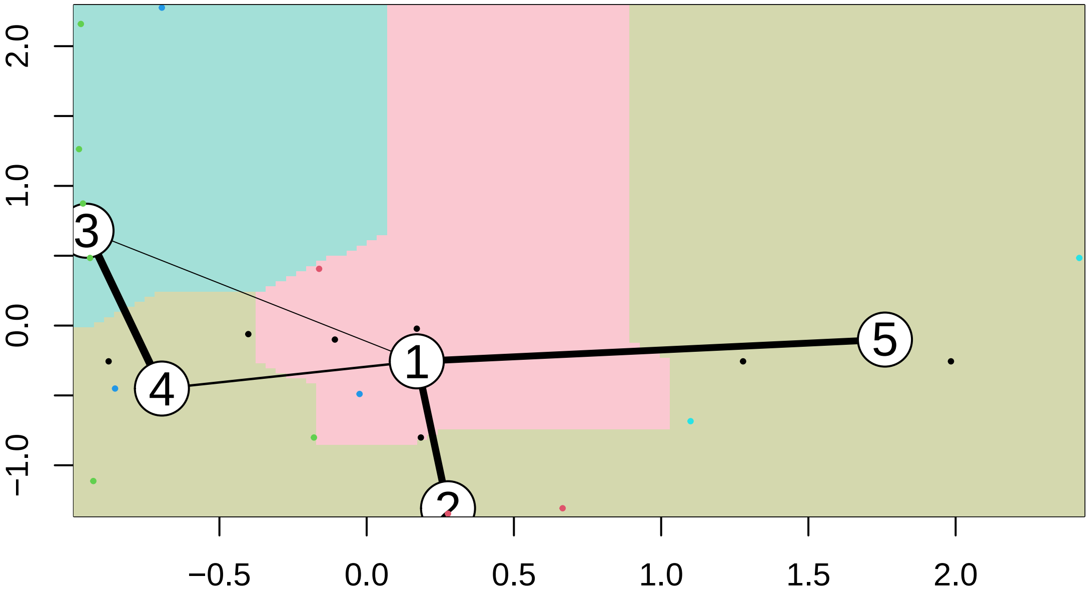
```
set.seed(1)
k51 = kcca(Info2, k=5, kccaFamily("kmedians"))
k51
```

```
## kcca object of family 'kmedians'
##
## call:
## kcca(x = Info2, k = 5, family = kccaFamily("kmedians"))
##
## cluster sizes:
##
## 1 2 3 4 5
## 7 3 6 3 2
```

```
#Using predict function.
clusters_index <- predict(k51)
dist(k51@centers)
```

```
##          1        2        3        4
## 2 2.150651
## 3 3.513242 4.146567
## 4 3.878726 4.246051 3.388339
## 5 3.018500 3.737739 5.124420 6.043691
```

```
image(k51)
points(Info2, col=clusters_index, pch=19, cex=0.3)
```

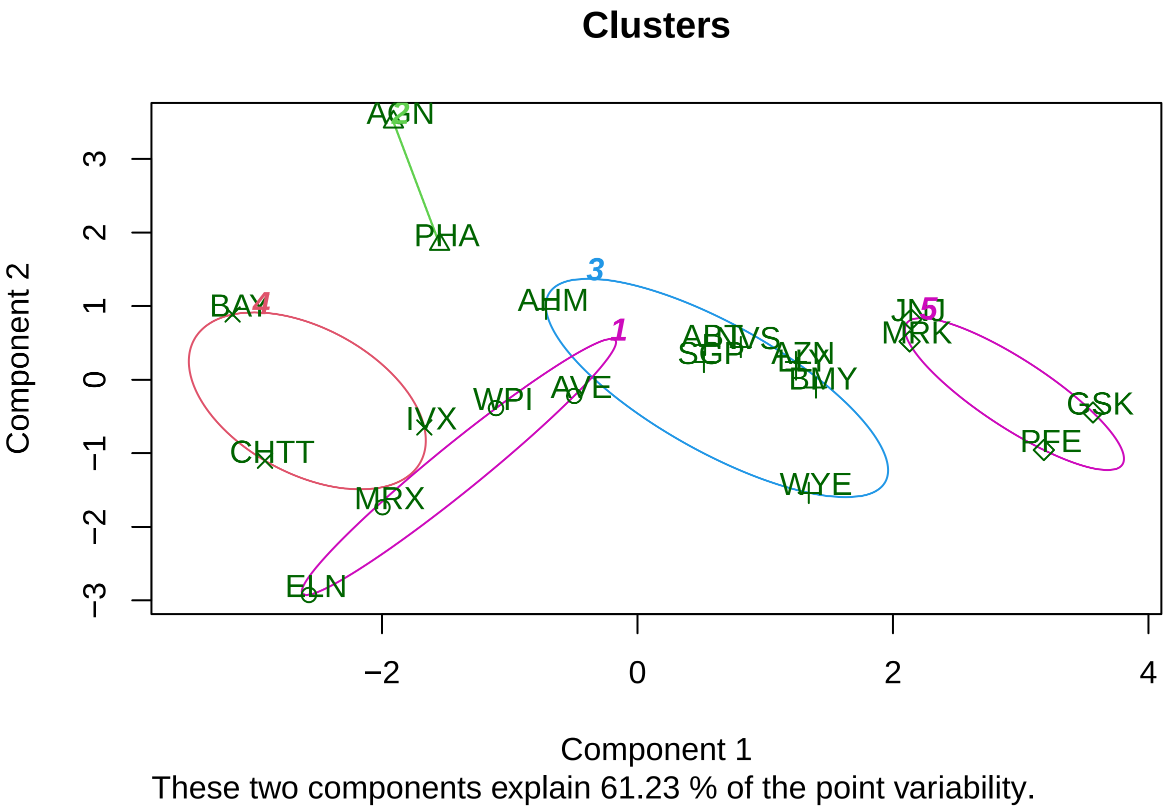


b.Interpret the clusters in light of the numerical variables that were utilized to create the clusters. determining Mean using the Kmeans algorithm.

```
Info1 %>% mutate(Cluster = k5$cluster) %>% group_by(Cluster) %>% summarise_all("mean")
```

```
## # A tibble: 5 x 10
##   Cluster Market_Cap  Beta PE_Ratio   ROE   ROA Asset_~1 Lever~2 Rev_G~3 Net_P~4
##     <int>      <dbl> <dbl>    <dbl> <dbl> <dbl>    <dbl>   <dbl>   <dbl>   <dbl>
## 1       1      13.1  0.598     17.7  14.6  6.2     0.425   0.635   30.1    15.6
## 2       2      31.9  0.405     69.5  13.2  5.6     0.75    0.475   12.1     6.4
## 3       3      55.8  0.414     20.3  28.7 12.7     0.738   0.371    5.59   19.4
## 4       4       6.64 0.87      24.6  16.5  4.17    0.6     1.65     5.73    7.03
## 5       5     157.   0.48      22.2  44.4 17.7     0.95    0.22    18.5    19.6
## # ... with abbreviated variable names 1: Asset_Turnover, 2: Leverage,
## #   3: Rev_Growth, 4: Net_Profit_Margin
```

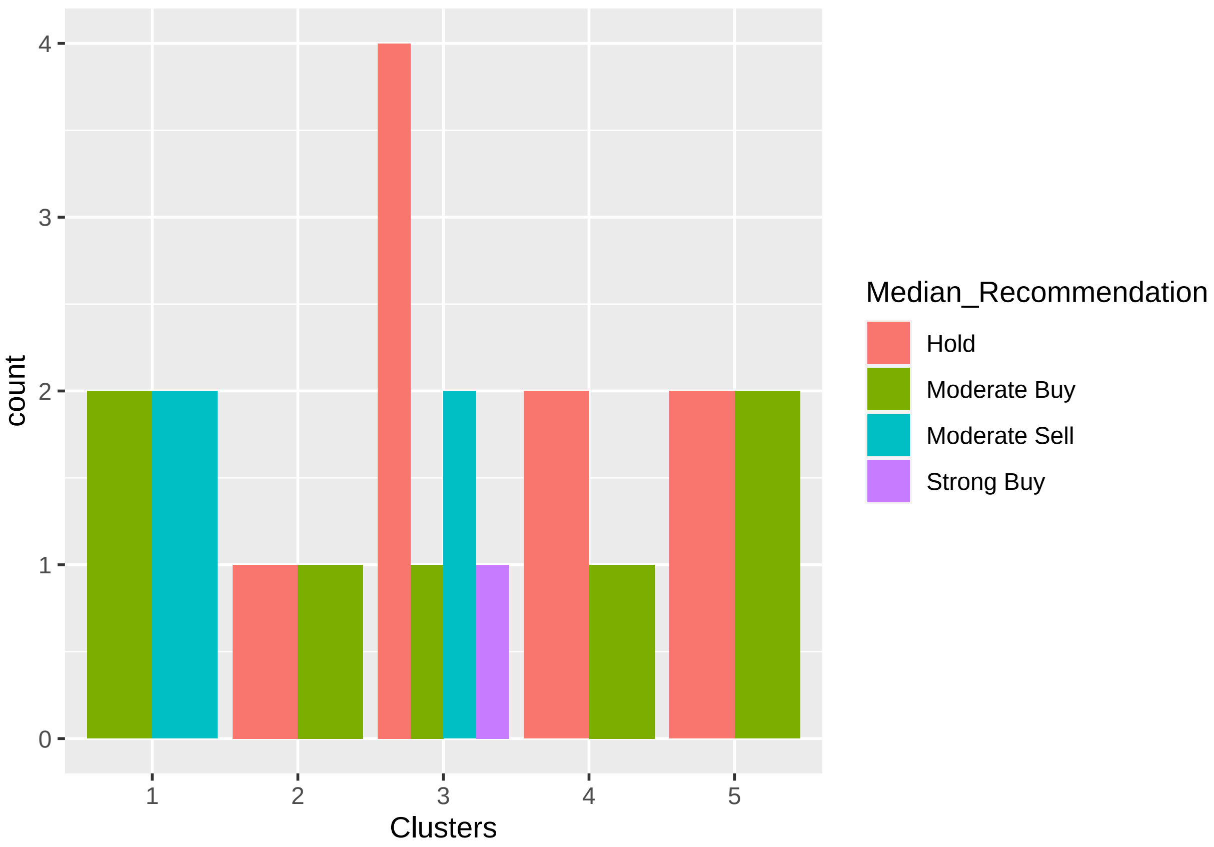
```
clusplot(Info2,k5$cluster, main="Clusters",color = TRUE, labels = 2,lines = 0)
```



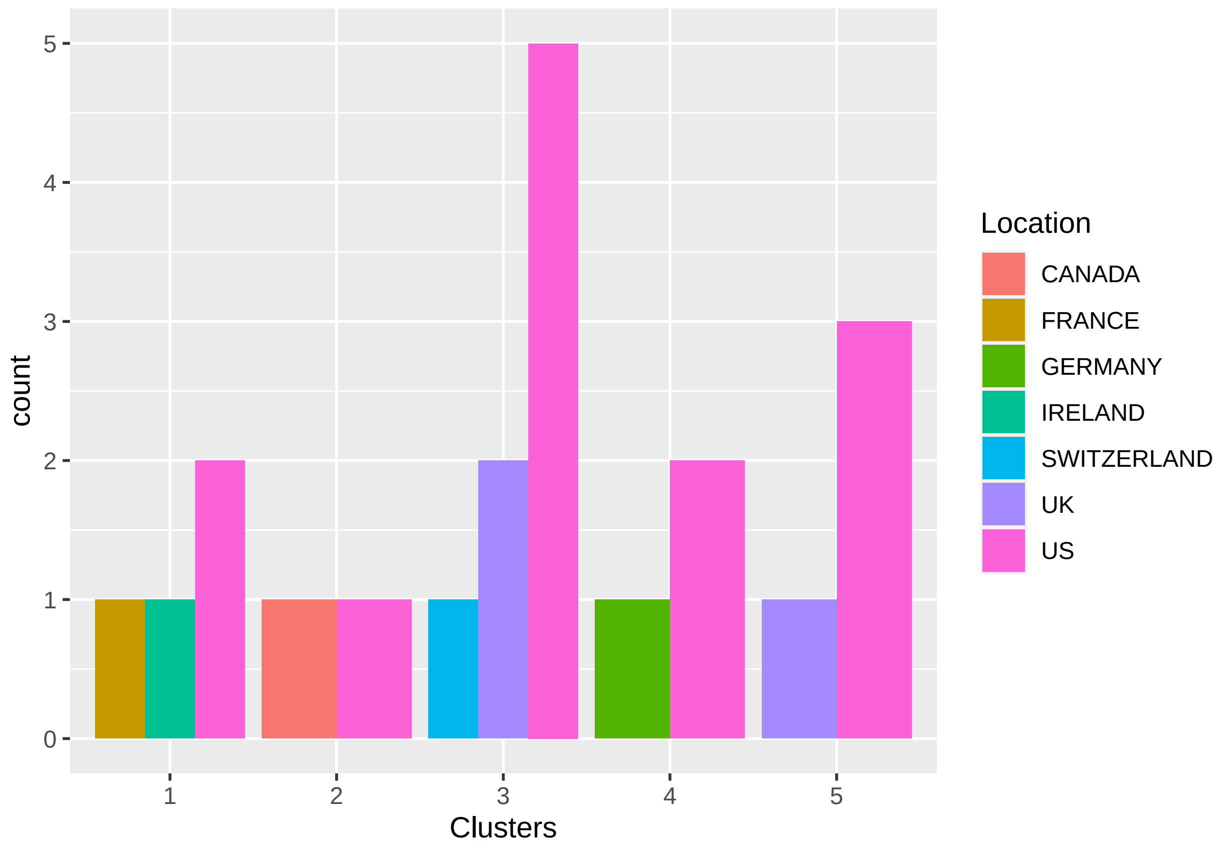
Companies are grouped into the following clusters:

Cluster 1: ELN, MRX, WPI and AVE Cluster 2: AGN and PHA Cluster 3: AHM,WYE,BMY,AZN, LLY, ABT, NVS and SGP Cluster 4: BAY, CHTT and IVX Cluster 5: JNJ, MRK, PFE and GSK From the means of the cluster variables , we can say that, We can conclude the following from the cluster1 variables' means: The quickest sales growth, largest net profit margin, and lowest PE ratio are all found in Cluster 1. Although it has a strong PE ratio, it bears a very high risk, extremely high leverage, and a poor net profit margin, making it very risky to hold. Cluster 2's PE ratio is quite high. Cluster 3's risk is average. Cluster 5 has a high market capitalization, return on investment, return on assets, asset turnover, and net profit margin. Revenue growth is also quite modest. The stock price is moderately valued with a low PE ratio, making it possible to buy and hold it. Revenue growth of 18.5% is good. c.Is there a pattern in the clusters with respect to the numerical variables (10 to 12)? (those not used informing the clusters) #examining patterns by visualizing clusters against the variables

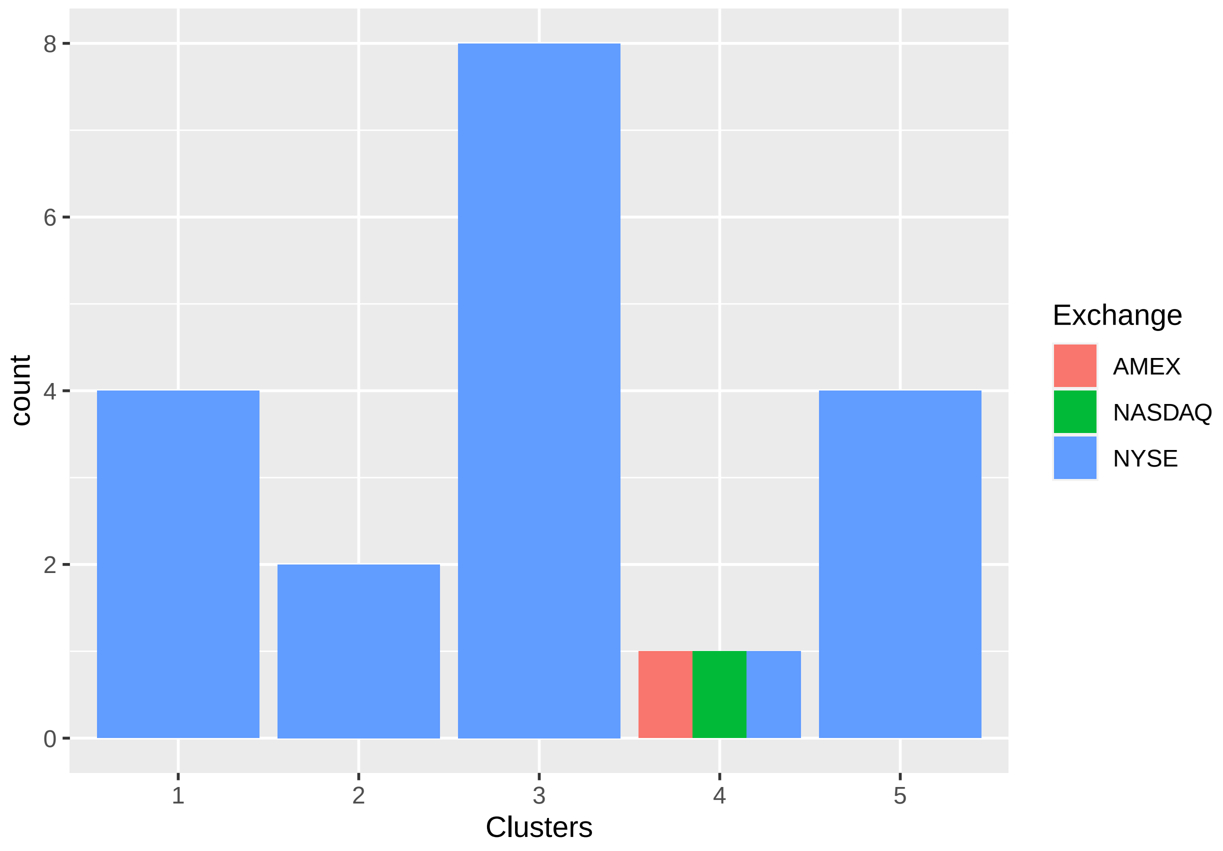
```
Info3 <- Info[12:14] %>% mutate(Clusters=k5$cluster)
ggplot(Info3, mapping = aes(factor(Clusters), fill =Median_Recommendation))+geom_bar(position='dodge')+
```



```
ggplot(Info3, mapping = aes(factor(Clusters),fill = Location))+geom_bar(position = 'dodge')+labs(x ='Clu
```



```
ggplot(Info3, mapping = aes(factor(Clusters),fill = Exchange))+geom_bar(position = 'dodge')+labs(x ='Cl
```



–>There seems to be a pattern in clusters and the variable Median Recommendation.. –>There doesn't seem to be any discernable pattern among the clusters, locations, or exchanges other than the fact that the majority of the clusters/companies are listed on the NYSE and situated in the United States. d.Provide an appropriate name for each cluster using any or all of the variables in the dataset. Cluster 1: Best Buying Cluster 2: Highly Risky Cluster 3: Go for it Cluster 4: Very Risky or Runaway Cluster 5: Ideal to Own