Machine learning Assignment 4

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```
Pharmaceuticals <- read.csv("C:/Users/gauth/Downloads/Pharmaceuticals (1).csv")
library(ggplot2)
```

```
## Warning in register(): Can't find generic 'scale_type' in package ggplot2 to
## register S3 method.
```

```
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.1.3
```

```
## 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 4.1.3
```

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

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

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

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

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

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --
```

```
## v tibble  3.1.6     v dplyr   1.0.7
## v tidyr   1.1.4     v stringr 1.4.0
## v readr   2.1.1     v forcats 0.5.1
## v purrr   0.3.4
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
summary(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
##
##
##
```

```
#Task 1
#Use only the numerical variables (1 to 9) to cluster the 21 firms. Justify the
#various choices made in conducting the cluster analysis, such as weights for
#different variables, the specific clustering algorithm(s) used, the number of
#clusters formed, and so on.
P <- na.omit(Pharmaceuticals)
P
```

```
##    Symbol                              Name Market_Cap Beta PE_Ratio  ROE  ROA
## 1     ABT              Abbott Laboratories      68.44 0.32     24.7 26.4 11.8
## 2     AGN                   Allergan, Inc.       7.58 0.41     82.5 12.9  5.5
## 3     AHM                     Amersham plc       6.30 0.46     20.7 14.9  7.8
## 4     AZN                AstraZeneca PLC      67.63 0.52     21.5 27.4 15.4
## 5     AVE                         Aventis      47.16 0.32     20.1 21.8  7.5
## 6     BAY                       Bayer AG      16.90 1.11     27.9  3.9  1.4
## 7     BMY     Bristol-Myers Squibb Company      51.33 0.50     13.9 34.8 15.1
## 8    CHTT                     Chattem, Inc       0.41 0.85     26.0 24.1  4.3
## 9     ELN           Elan Corporation, plc       0.78 1.08      3.6 15.1  5.1
## 10    LLY           Eli Lilly and Company      73.84 0.18     27.9 31.0 13.5
## 11    GSK             GlaxoSmithKline plc     122.11 0.35     18.0 62.9 20.3
## 12    IVX                IVAX Corporation       2.60 0.65     19.9 21.4  6.8
## 13    JNJ              Johnson & Johnson     173.93 0.46     28.4 28.6 16.3
```

```
## 14    MRX Medicis Pharmaceutical Corporation       1.20 0.75     28.6 11.2  5.4
## 15    MRK                  Merck & Co., Inc.     132.56 0.46     18.9 40.6 15.0
## 16    NVS                        Novartis AG      96.65 0.19     21.6 17.9 11.2
## 17    PFE                         Pfizer Inc     199.47 0.65     23.6 45.6 19.2
## 18    PHA              Pharmacia Corporation      56.24 0.40     56.5 13.5  5.7
## 19    SGP        Schering-Plough Corporation      34.10 0.51     18.9 22.6 13.3
## 20    WPI       Watson Pharmaceuticals, Inc.       3.26 0.24     18.4 10.2  6.8
## 21    WYE                             Wyeth      48.19 0.63     13.1 54.9 13.4
##    Asset_Turnover Leverage Rev_Growth Net_Profit_Margin Median_Recommendation
## 1             0.7     0.42       7.54              16.1          Moderate Buy
## 2             0.9     0.60       9.16               5.5          Moderate Buy
## 3             0.9     0.27       7.05              11.2            Strong Buy
## 4             0.9     0.00      15.00              18.0         Moderate Sell
## 5             0.6     0.34      26.81              12.9          Moderate Buy
## 6             0.6     0.00      -3.17               2.6                 Hold
## 7             0.9     0.57       2.70              20.6         Moderate Sell
## 8             0.6     3.51       6.38               7.5          Moderate Buy
## 9             0.3     1.07      34.21              13.3         Moderate Sell
## 10            0.6     0.53       6.21              23.4                 Hold
## 11            1.0     0.34      21.87              21.1                 Hold
## 12            0.6     1.45      13.99              11.0                 Hold
## 13            0.9     0.10       9.37              17.9          Moderate Buy
## 14            0.3     0.93      30.37              21.3          Moderate Buy
## 15            1.1     0.28      17.35              14.1                 Hold
## 16            0.5     0.06      -2.69              22.4                 Hold
## 17            0.8     0.16      25.54              25.2          Moderate Buy
## 18            0.6     0.35      15.00               7.3                 Hold
## 19            0.8     0.00       8.56              17.6                 Hold
## 20            0.5     0.20      29.18              15.1         Moderate Sell
## 21            0.6     1.12       0.36              25.5                 Hold
##       Location Exchange
## 1           US     NYSE
## 2       CANADA     NYSE
## 3           UK     NYSE
## 4           UK     NYSE
## 5       FRANCE     NYSE
## 6      GERMANY     NYSE
## 7           US     NYSE
## 8           US   NASDAQ
## 9      IRELAND     NYSE
## 10          US     NYSE
## 11          UK     NYSE
## 12          US     AMEX
## 13          US     NYSE
## 14          US     NYSE
## 15          US     NYSE
## 16 SWITZERLAND     NYSE
## 17          US     NYSE
## 18          US     NYSE
## 19          US     NYSE
## 20          US     NYSE
## 21          US     NYSE
```

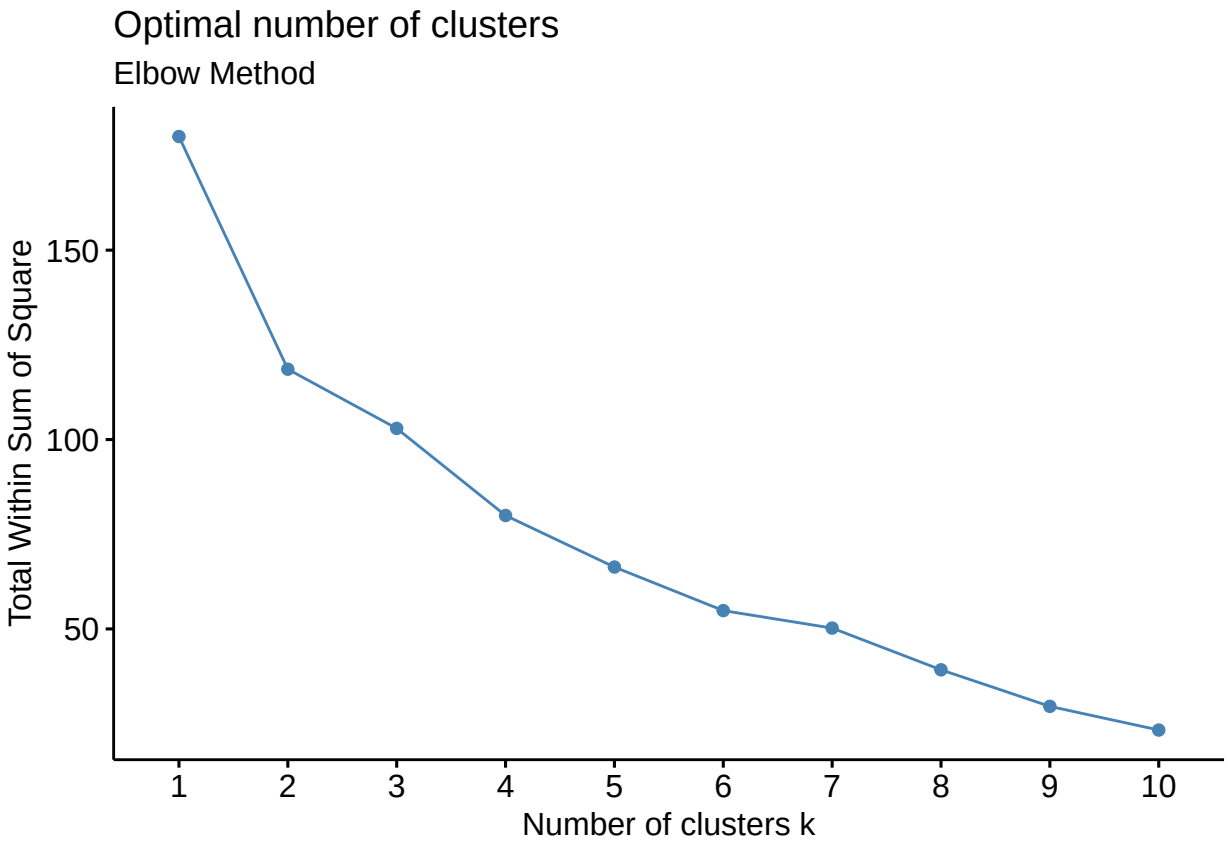
```
row.names(P) <- P[,1]
Pharmaceuticals1 <-  P[,3:11]
head(Pharmaceuticals1)
```

```
##     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
```

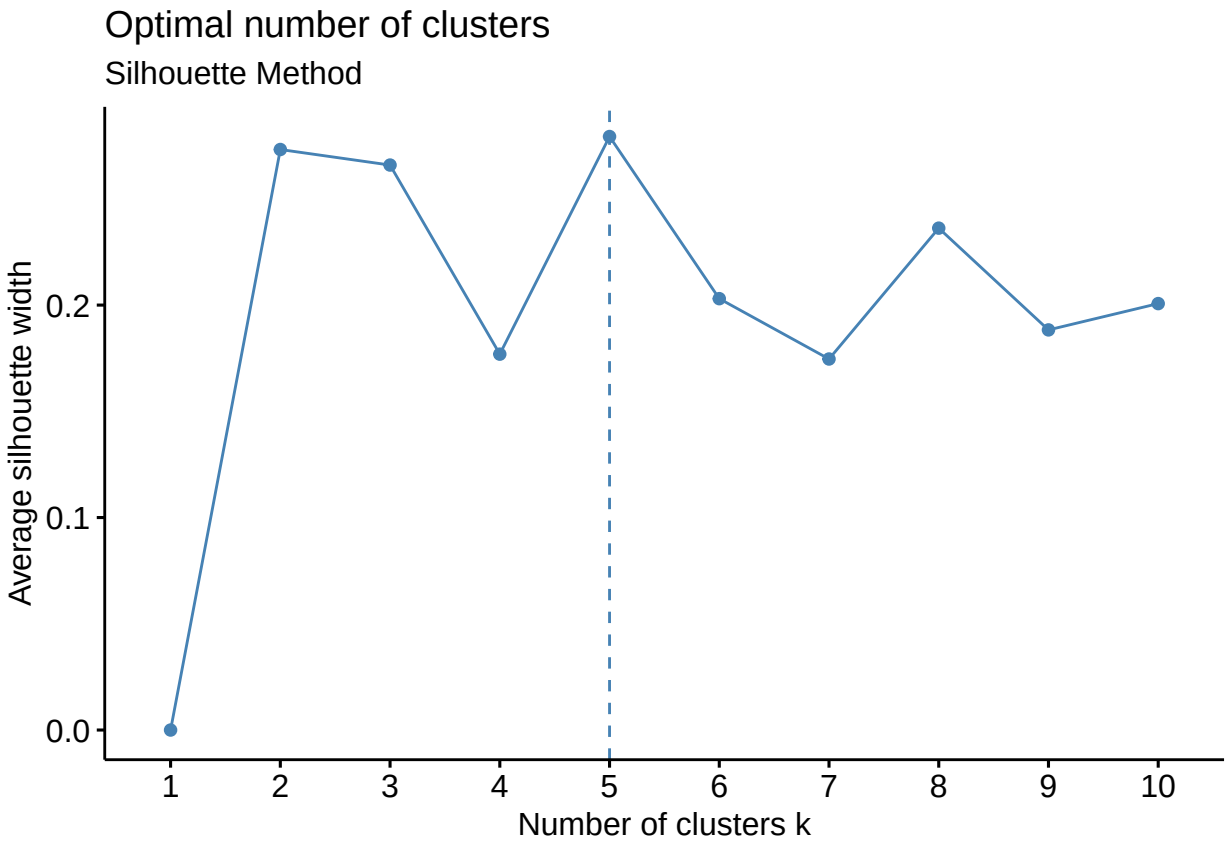
```
Pharmaceuticals2 <- scale(Pharmaceuticals1)
head(Pharmaceuticals2)
```

```
##     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
```

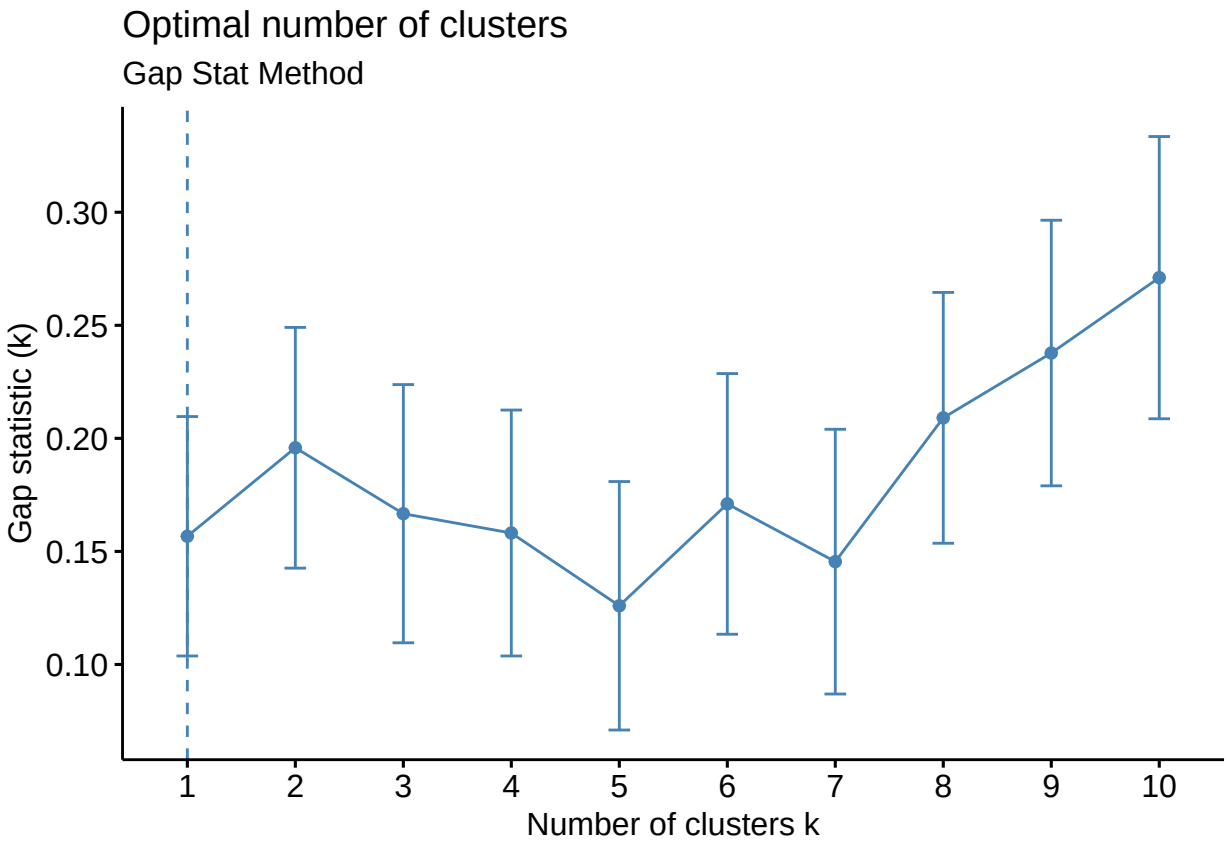
```
fviz_nbclust(Pharmaceuticals2, kmeans, method = "wss") +labs(subtitle = "Elbow Method")
```




```
fviz_nbclust(Pharmaceuticals2, kmeans, method = "silhouette") + labs(subtitle = "Silhouette Method")
```



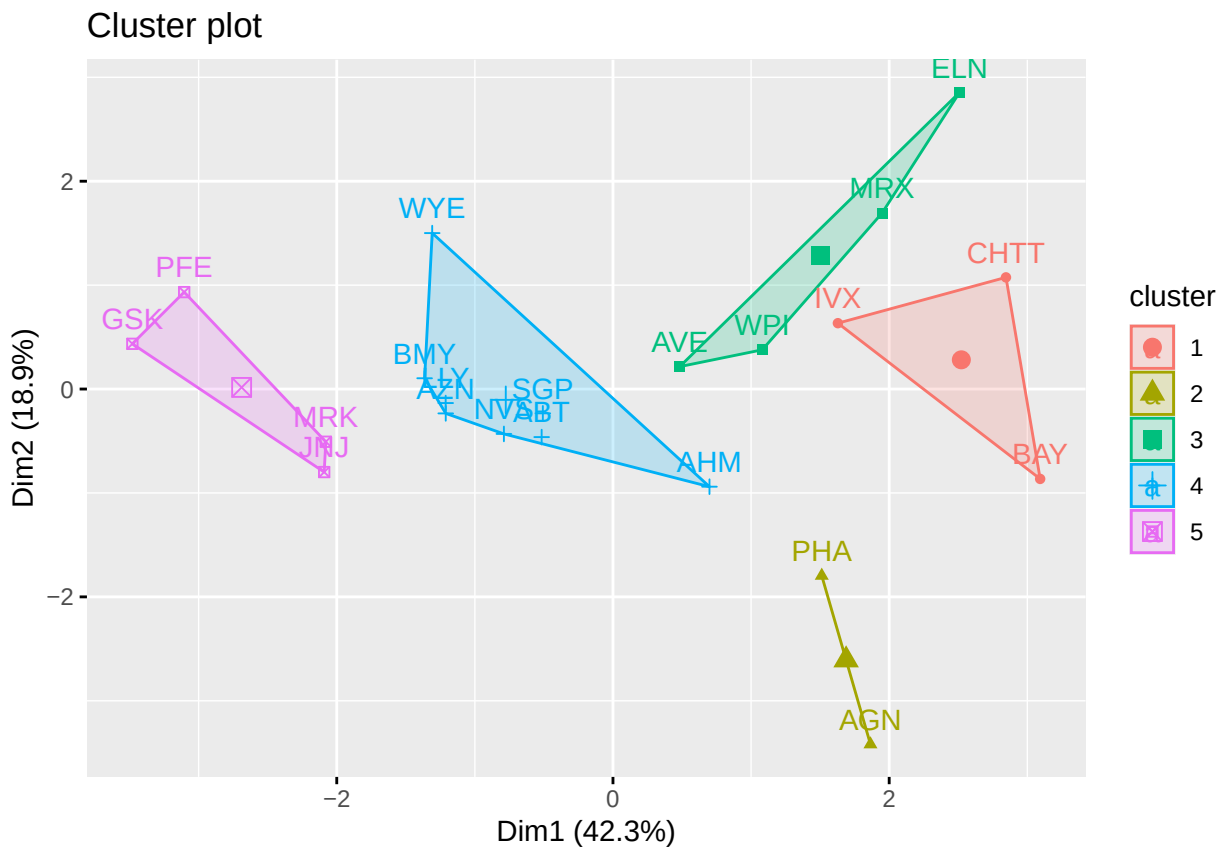

```
fviz_nbclust(Pharmaceuticals2, kmeans, method = "gap_stat") + labs(subtitle = "Gap Stat Method")
```




```
set.seed(64060)
k5 <- kmeans(Pharmaceuticals2, centers = 5, nstart = 25)
k5 $centers
```

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

```
fviz_cluster(k5, data = Pharmaceuticals2)
```

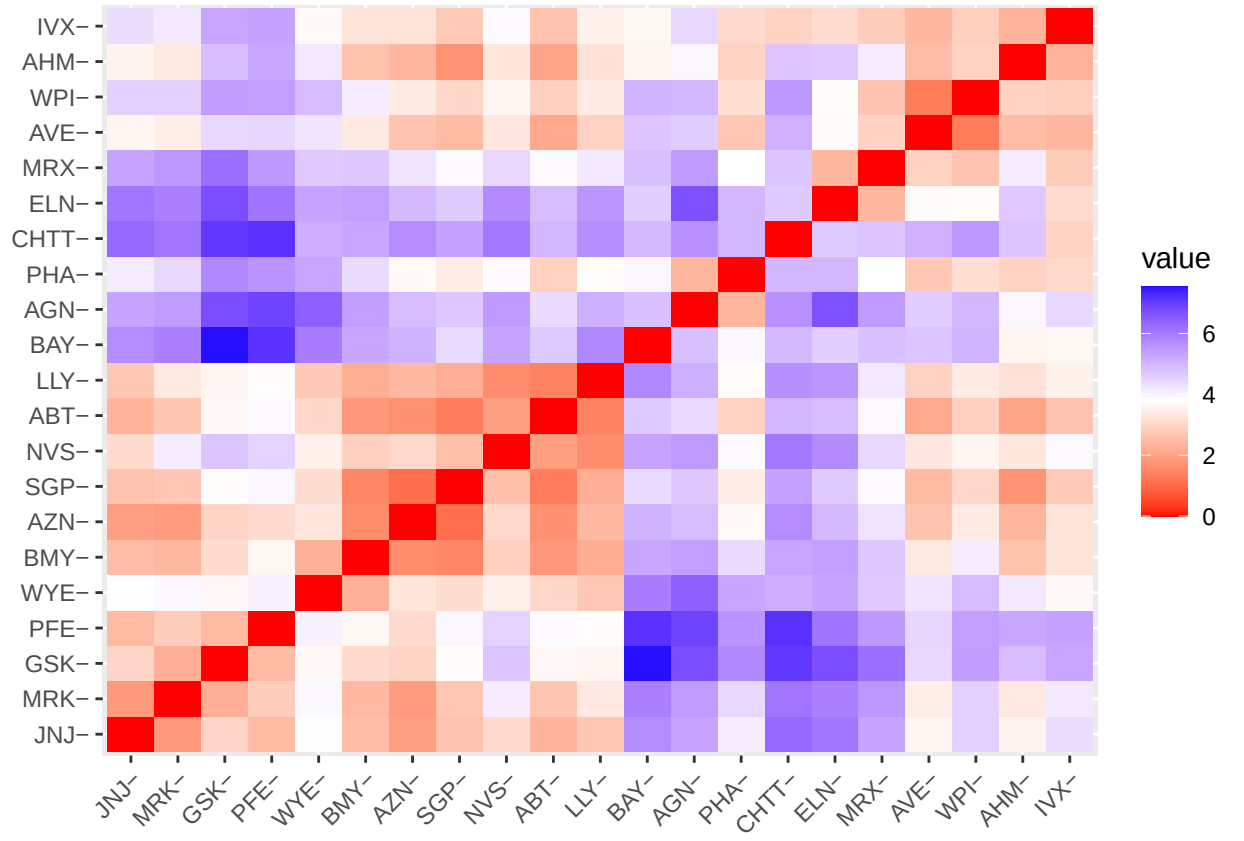



```
k5
```

```
## K-means clustering with 5 clusters of sizes 3, 2, 4, 8, 4
##
## Cluster means:
##    Market_Cap       Beta    PE_Ratio        ROE        ROA Asset_Turnover
## 1 -0.87051511  1.3409869 -0.05284434 -0.6184015 -1.1928478     -0.4612656
## 2 -0.43925134 -0.4701800  2.70002464 -0.8349525 -0.9234951      0.2306328
## 3 -0.76022489  0.2796041 -0.47742380 -0.7438022 -0.8107428     -1.2684804
## 4 -0.03142211 -0.4360989 -0.31724852  0.1950459  0.4083915      0.1729746
## 5  1.69558112 -0.1780563 -0.19845823  1.2349879  1.3503431      1.1531640
##      Leverage Rev_Growth Net_Profit_Margin
## 1  1.36644699 -0.6912914      -1.320000179
## 2 -0.14170336 -0.1168459      -1.416514761
## 3  0.06308085  1.5180158      -0.006893899
## 4 -0.27449312 -0.7041516       0.556954446
## 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
##    4    2    4    4    3    1    4    1    3    4    5    1    5    3    5    4
##  PFE  PHA  SGP  WPI  WYE
##    5    2    4    3    4
##
## Within cluster sum of squares by cluster:
## [1] 15.595925  2.803505 12.791257 21.879320  9.284424
```

```
##  (between_SS / total_SS =  65.4 %)
##
## Available components:
##
## [1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
## [6] "betweenss"    "size"         "iter"         "ifault"
```

```
Distance <- dist(Pharmaceuticals2, method = "euclidian")
fviz_dist(Distance)
```



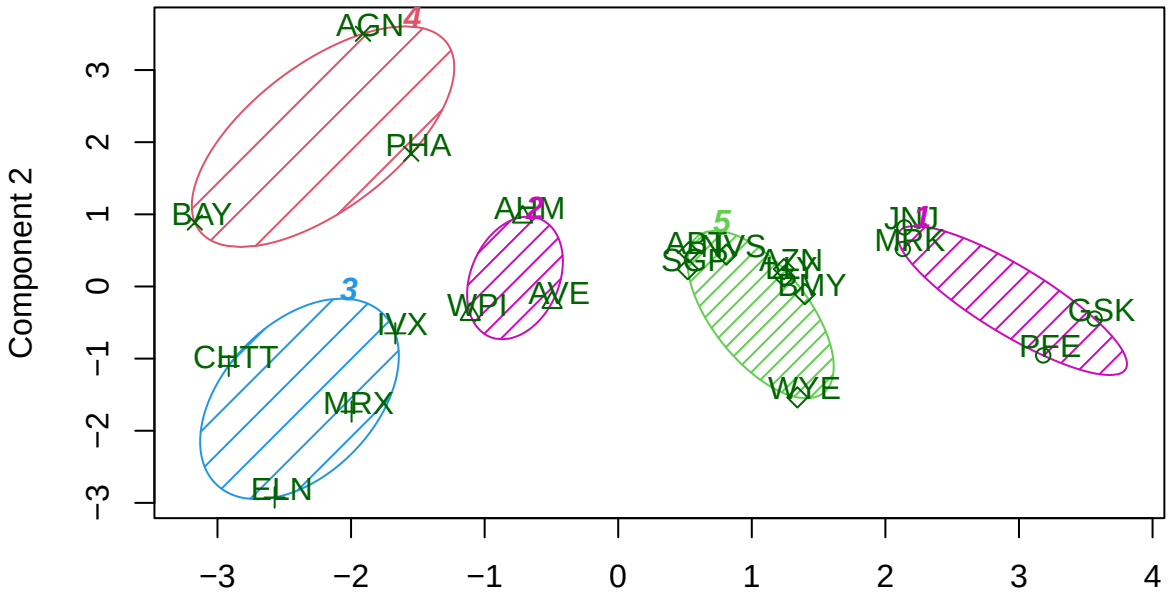

```
Fitting <- kmeans(Pharmaceuticals2,5)
aggregate(Pharmaceuticals2,by = list(Fitting$cluster), FUN = mean)
```

```
##   Group.1  Market_Cap       Beta   PE_Ratio        ROE        ROA
## 1       1  1.69558112 -0.1780563 -0.1984582  1.2349879  1.3503431
## 2       2 -0.66114002 -0.7233539 -0.3512251 -0.6736441 -0.5915022
## 3       3 -0.96247577  1.1949250 -0.3639982 -0.5200697 -0.9610792
## 4       4 -0.52462814  0.4451409  1.8498439 -1.0404550 -1.1865838
## 5       5  0.08926902 -0.4618336 -0.3208615  0.3260892  0.5396003
##   Asset_Turnover   Leverage Rev_Growth Net_Profit_Margin
## 1   1.153164e+00 -0.4680782  0.4671788         0.5912425
## 2  -1.537552e-01 -0.4040831  0.6917224        -0.4005718
## 3  -1.153164e+00  1.4773718  0.7120120        -0.3688236
## 4   1.480297e-16 -0.3443544 -0.5769454        -1.6095439
## 5   6.589509e-02 -0.2559803 -0.7230135         0.7343816
```

```
Pharmaceuticals3 <- data.frame(Pharmaceuticals2,Fitting$cluster)
Pharmaceuticals3
```

```
##      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
## BMY  -0.1078688 -0.10015669 -0.70887325  0.59693581  0.8617498      0.9225312
## CHTT -0.9767669  1.26308721  0.03299122 -0.11237924 -1.1677918     -0.4612656
## ELN  -0.9704532  2.15893320 -1.34037772 -0.70899938 -1.0174553     -1.8450624
## LLY   0.2762415 -1.34655112  0.14948233  0.34502953  0.5610770     -0.4612656
## GSK   1.0999201 -0.68440408 -0.45749769  2.45971647  1.8389364      1.3837968
## IVX  -0.9393967  0.48409069 -0.34100657 -0.29136529 -0.6979905     -0.4612656
## JNJ   1.9841758 -0.25595600  0.18013789  0.18593083  1.0872544      0.9225312
## MRX  -0.9632863  0.87358895  0.19240011 -0.96753478 -0.9610792     -1.8450624
## MRK   1.2782387 -0.25595600 -0.40231769  0.98142435  0.8429577      1.8450624
## NVS   0.6654710 -1.30760129 -0.23677768 -0.52338423  0.1288598     -0.9225312
## PFE   2.4199899  0.48409069 -0.11415545  1.31287998  1.6322239      0.4612656
## PHA  -0.0240846 -0.48965495  1.90298017 -0.81506519 -0.9047030     -0.4612656
## SGP  -0.4018812 -0.06120687 -0.40231769 -0.21181593  0.5234929      0.4612656
## WPI  -0.9281345 -1.11285216 -0.43297324 -1.03382590 -0.6979905     -0.9225312
## WYE  -0.1614497  0.40619104 -0.75792214  1.92938746  0.5422849     -0.4612656
##         Leverage  Rev_Growth Net_Profit_Margin Fitting.cluster
## ABT  -0.21209793 -0.52776752       0.06168225               5
## AGN   0.01828430 -0.38113909      -1.55366706               4
## AHM  -0.40408312 -0.57211809      -0.68503583               2
## AZN  -0.74965647  0.14744734       0.35122600               5
## AVE  -0.31449003  1.21638667      -0.42597037               2
## BAY  -0.74965647 -1.49714434      -1.99560225               4
## BMY  -0.02011273 -0.96584257       0.74744375               5
## CHTT  3.74279705 -0.63276071      -1.24888417               3
## ELN   0.61983791  1.88617085      -0.36501379               3
## LLY  -0.07130879 -0.64814764       1.17413980               5
## GSK  -0.31449003  0.76926048       0.82363947               1
## IVX   1.10620040  0.05603085      -0.71551412               3
## JNJ  -0.62166634 -0.36213170       0.33598685               1
## MRX   0.44065173  1.53860717       0.85411776               3
## MRK  -0.39128411  0.36014907      -0.24310064               1
## NVS  -0.67286239 -1.45369888       1.02174835               5
## PFE  -0.54487226  1.10143723       1.44844440               1
## PHA  -0.30169102  0.14744734      -1.27936246               4
## SGP  -0.74965647 -0.43544591       0.29026942               5
## WPI  -0.49367621  1.43089863      -0.09070919               2
## WYE   0.68383297 -1.17763919       1.49416183               5
```

```
library(cluster)
clusplot(Pharmaceuticals2,Fitting$cluster, color = TRUE, shade = TRUE,
         labels = 2,
         lines = 0)
```




```
#Task 2
#Interpret the clusters with respect to the numerical variables used in forming
#the clusters.
aggregate(Pharmaceuticals2, by = list(Fitting$cluster), FUN = mean)
```

```
##   Group.1  Market_Cap       Beta   PE_Ratio        ROE        ROA
## 1       1  1.69558112 -0.1780563 -0.1984582  1.2349879  1.3503431
## 2       2 -0.66114002 -0.7233539 -0.3512251 -0.6736441 -0.5915022
## 3       3 -0.96247577  1.1949250 -0.3639982 -0.5200697 -0.9610792
## 4       4 -0.52462814  0.4451409  1.8498439 -1.0404550 -1.1865838
## 5       5  0.08926902 -0.4618336 -0.3208615  0.3260892  0.5396003
##   Asset_Turnover   Leverage Rev_Growth Net_Profit_Margin
## 1   1.153164e+00 -0.4680782  0.4671788         0.5912425
## 2  -1.537552e-01 -0.4040831  0.6917224        -0.4005718
## 3  -1.153164e+00  1.4773718  0.7120120        -0.3688236
## 4   1.480297e-16 -0.3443544 -0.5769454        -1.6095439
## 5   6.589509e-02 -0.2559803 -0.7230135         0.7343816
```

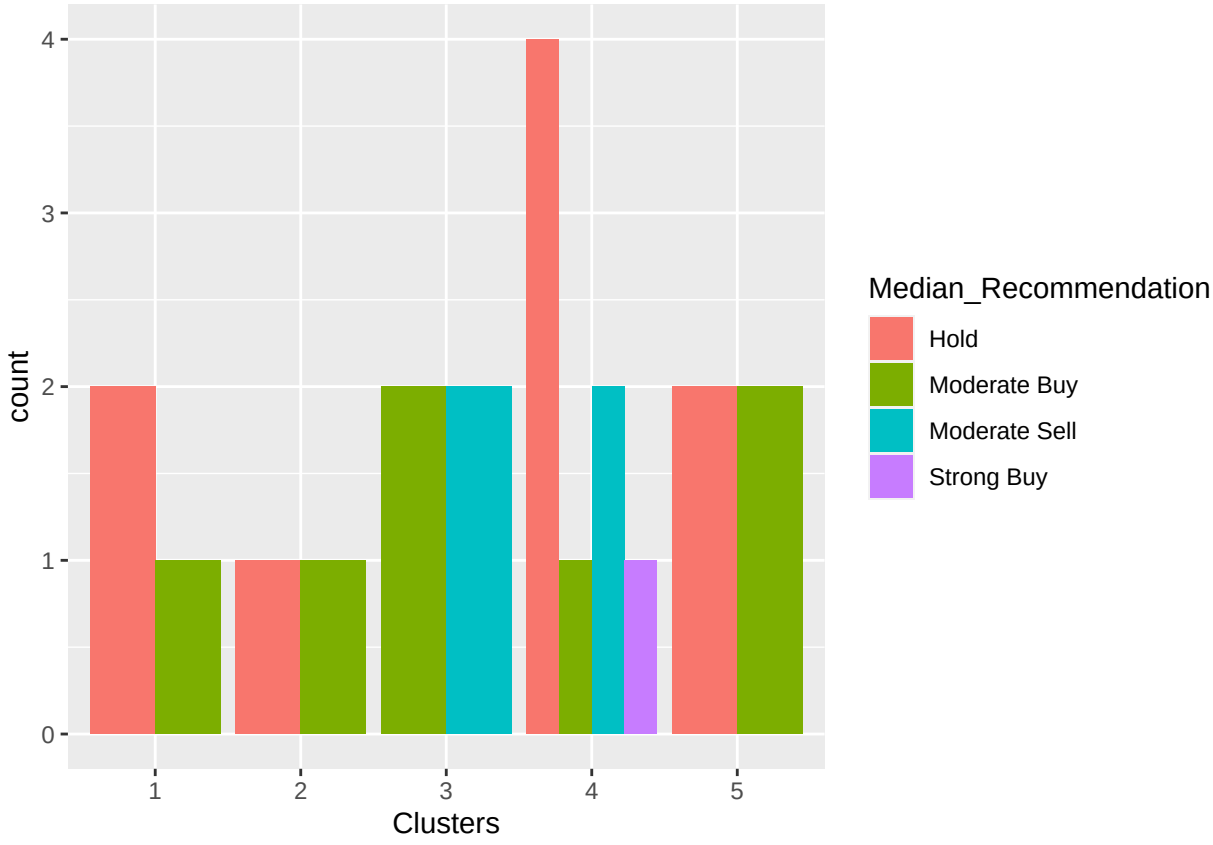
```
Pharmacy <- data.frame(Pharmaceuticals2,k5$cluster)
Pharmacy
```

```
##      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
```

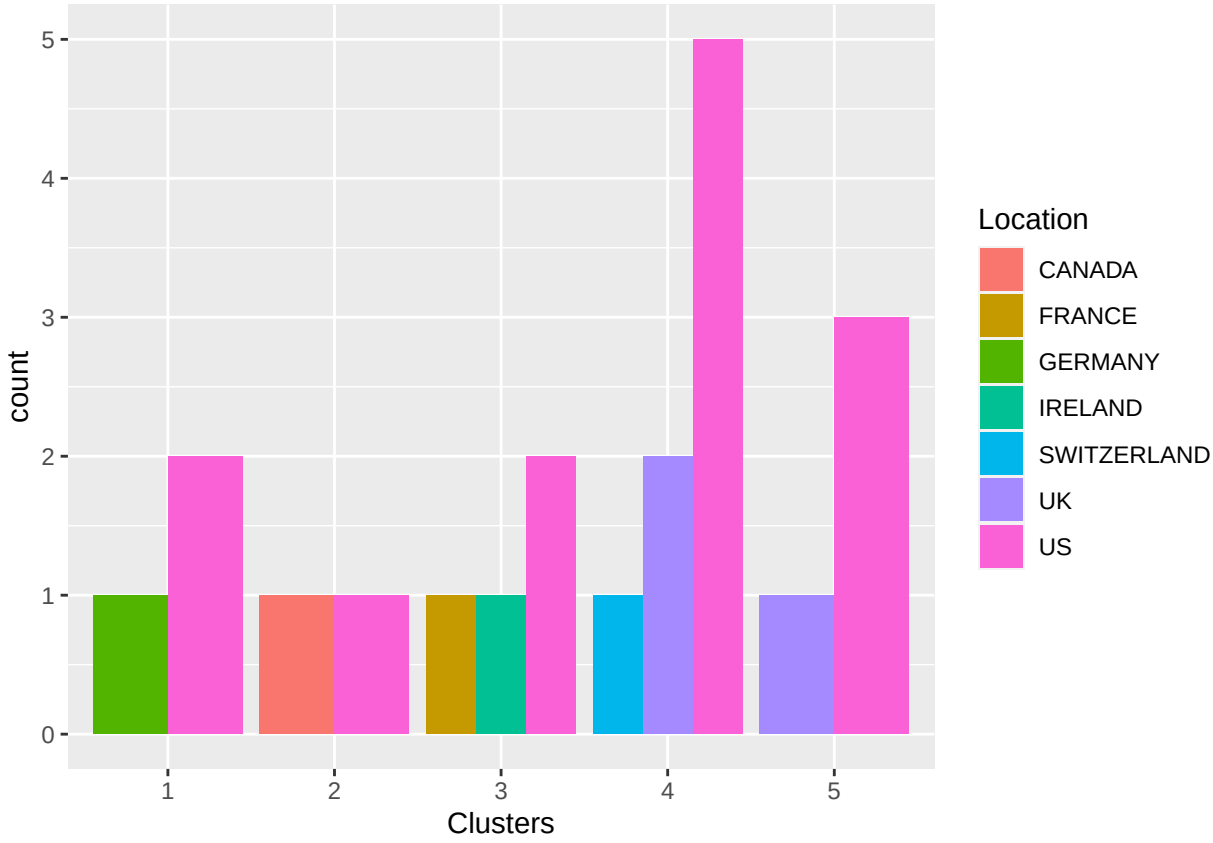
```
## AZN   0.1702742 -0.02225704 -0.24290879  0.10638147  0.9181259      0.9225312
## AVE  -0.1790256 -0.80125356 -0.32874435 -0.26484883 -0.5664461     -0.4612656
## BAY  -0.6953818  2.27578267  0.14948233 -1.45146000 -1.7127612     -0.4612656
## BMY  -0.1078688 -0.10015669 -0.70887325  0.59693581  0.8617498      0.9225312
## CHTT -0.9767669  1.26308721  0.03299122 -0.11237924 -1.1677918     -0.4612656
## ELN  -0.9704532  2.15893320 -1.34037772 -0.70899938 -1.0174553     -1.8450624
## LLY   0.2762415 -1.34655112  0.14948233  0.34502953  0.5610770     -0.4612656
## GSK   1.0999201 -0.68440408 -0.45749769  2.45971647  1.8389364      1.3837968
## IVX  -0.9393967  0.48409069 -0.34100657 -0.29136529 -0.6979905     -0.4612656
## JNJ   1.9841758 -0.25595600  0.18013789  0.18593083  1.0872544      0.9225312
## MRX  -0.9632863  0.87358895  0.19240011 -0.96753478 -0.9610792     -1.8450624
## MRK   1.2782387 -0.25595600 -0.40231769  0.98142435  0.8429577      1.8450624
## NVS   0.6654710 -1.30760129 -0.23677768 -0.52338423  0.1288598     -0.9225312
## PFE   2.4199899  0.48409069 -0.11415545  1.31287998  1.6322239      0.4612656
## PHA  -0.0240846 -0.48965495  1.90298017 -0.81506519 -0.9047030     -0.4612656
## SGP  -0.4018812 -0.06120687 -0.40231769 -0.21181593  0.5234929      0.4612656
## WPI  -0.9281345 -1.11285216 -0.43297324 -1.03382590 -0.6979905     -0.9225312
## WYE  -0.1614497  0.40619104 -0.75792214  1.92938746  0.5422849     -0.4612656
##         Leverage  Rev_Growth Net_Profit_Margin k5.cluster
## ABT  -0.21209793 -0.52776752       0.06168225          4
## AGN   0.01828430 -0.38113909      -1.55366706          2
## AHM  -0.40408312 -0.57211809      -0.68503583          4
## AZN  -0.74965647  0.14744734       0.35122600          4
## AVE  -0.31449003  1.21638667      -0.42597037          3
## BAY  -0.74965647 -1.49714434      -1.99560225          1
## BMY  -0.02011273 -0.96584257       0.74744375          4
## CHTT  3.74279705 -0.63276071      -1.24888417          1
## ELN   0.61983791  1.88617085      -0.36501379          3
## LLY  -0.07130879 -0.64814764       1.17413980          4
## GSK  -0.31449003  0.76926048       0.82363947          5
## IVX   1.10620040  0.05603085      -0.71551412          1
## JNJ  -0.62166634 -0.36213170       0.33598685          5
## MRX   0.44065173  1.53860717       0.85411776          3
## MRK  -0.39128411  0.36014907      -0.24310064          5
## NVS  -0.67286239 -1.45369888       1.02174835          4
## PFE  -0.54487226  1.10143723       1.44844440          5
## PHA  -0.30169102  0.14744734      -1.27936246          2
## SGP  -0.74965647 -0.43544591       0.29026942          4
## WPI  -0.49367621  1.43089863      -0.09070919          3
## WYE   0.68383297 -1.17763919       1.49416183          4
```

```
#CLuster 1:- JNJ, MRK, GSK, PFE
#Cluster 1: Highest Market_Cap and lowest Beta/PE Ratio
#Cluster 2:- AHM, WPI, AVE
#Cluster 2: Highest Revenue Growth and lowest PE/Asset Turnover Ratio
#Cluster 3:- CHTT, IVX, MRX, ELN
#Cluster 3: Highest Beta/leverage/Asset Turnover Ratio and lowest
#Net_Profit_Margin, PE ratio and Marke#Cluster
#Cluster 4:- AGN,BAY, PHA
#Cluster 4: Highest PE ratio and lowest Leverage/Asset_Turnover
#Cluster 5:- ABT, WYE, AZN, SGP, BMY, NVS, LLY
#Cluster 5: Highest Net_Proft_Margin and lowest Leverage
```

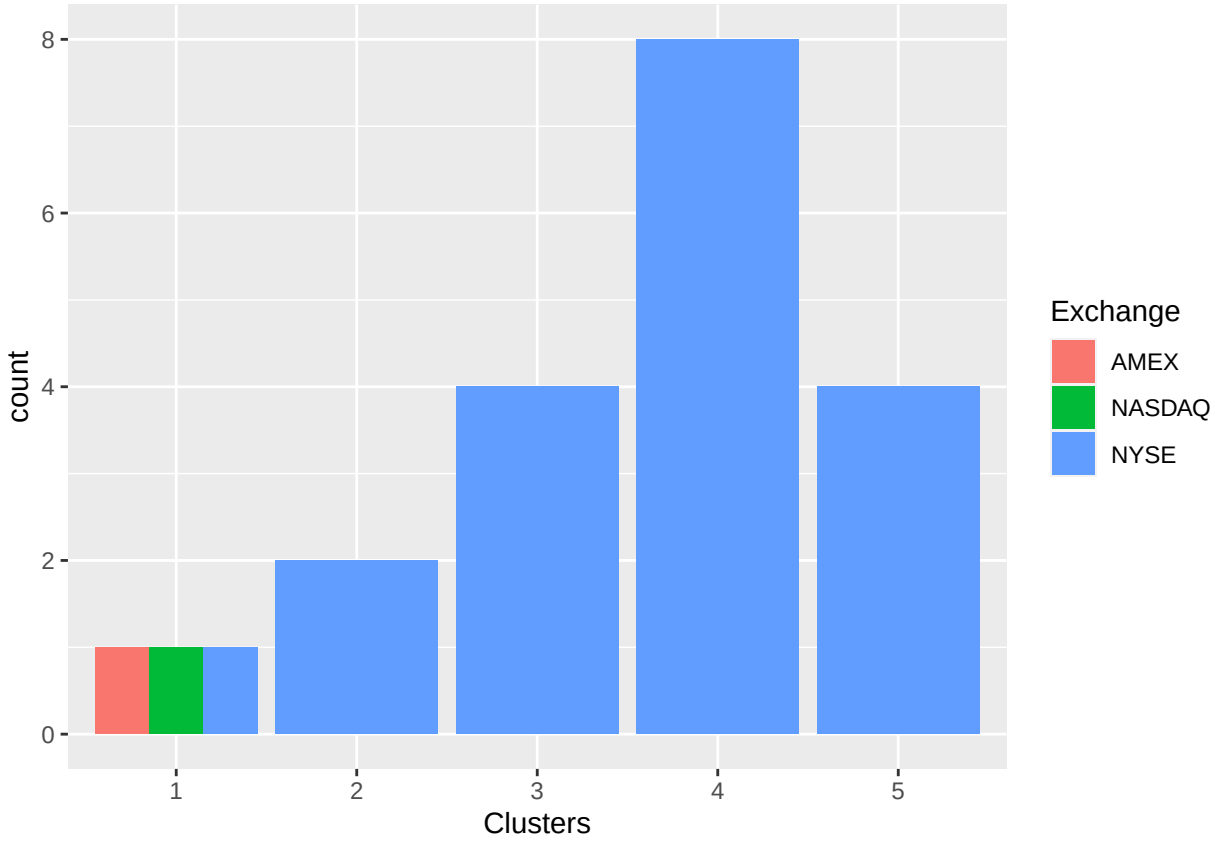
```
#Task3
#Is there a pattern in the clusters with respect to the numerical variables (10 to 12)? #(those not use
PH <- Pharmaceuticals[12:14] %>% mutate(Clusters=k5$cluster)
ggplot(PH, mapping = aes(factor(Clusters), fill =Median_Recommendation))+geom_bar(position='dodge')+labs
```




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




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




```
#From the above graphs,we can say that there is a slight pattern in the clusters.
# The cluster 1 has different Hold and Moderate Buy medians, different count from Countries US and Germ
#NASDAQ and NYSE.
# The cluster 2 has equal Hold and Moderate buy medians, equally distributed in
#Countries US and Canada and are listed only in NYSE.
# The Cluster 3 has equal Moderate Buy and Sell medians,different count from
#countries France, Ireland and US and are listed in NYSE.
#The Cluster 4 has different Hold, Moderate buy, Moderate Sell and Strong buy
#medians with the hold having the highest median. They're from countries US, UK
#and Switzerland and they are listed in NYSE.
# The Cluster 5 has the same hold and mdoerate buy medians, is distributed in
#countries UK and US and is also listed in NYSE.
```

```
#TASK 4
#Provide an appropriate name for each cluster using any or all of the variables
#in the dataset.
#Cluster 1 :- Buy Cluster
#Cluster 2 :- Sceptical Cluster
#Cluster 3 :- Moderate Buy Cluster
#Cluster 4 :- Hold Cluster
#Cluster 5 :- High Hold Cluster
```