

Assignment 4

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```
library(readr)
Pharmaceuticals_RD <- read.csv("~/Downloads/Pharmaceuticals (1).csv")
View(Pharmaceuticals_RD)

library(ggplot2)
library(factoextra)

## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
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 tibble 3.1.8      v dplyr 1.0.10
## v tidyr 1.2.1      v stringr 1.4.1
## v purrr 0.3.5      v forcats 0.5.2
## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()     masks stats::lag()

summary(Pharmaceuticals_RD)

##      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

```
R <- na.omit(Pharmaceuticals_RD)
R
```

```
##      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      BMJ      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 <- R[,1]
Pharmaceuticals1 <- R[,3:11]
head(Pharmaceuticals1)
```

| ## | 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
```

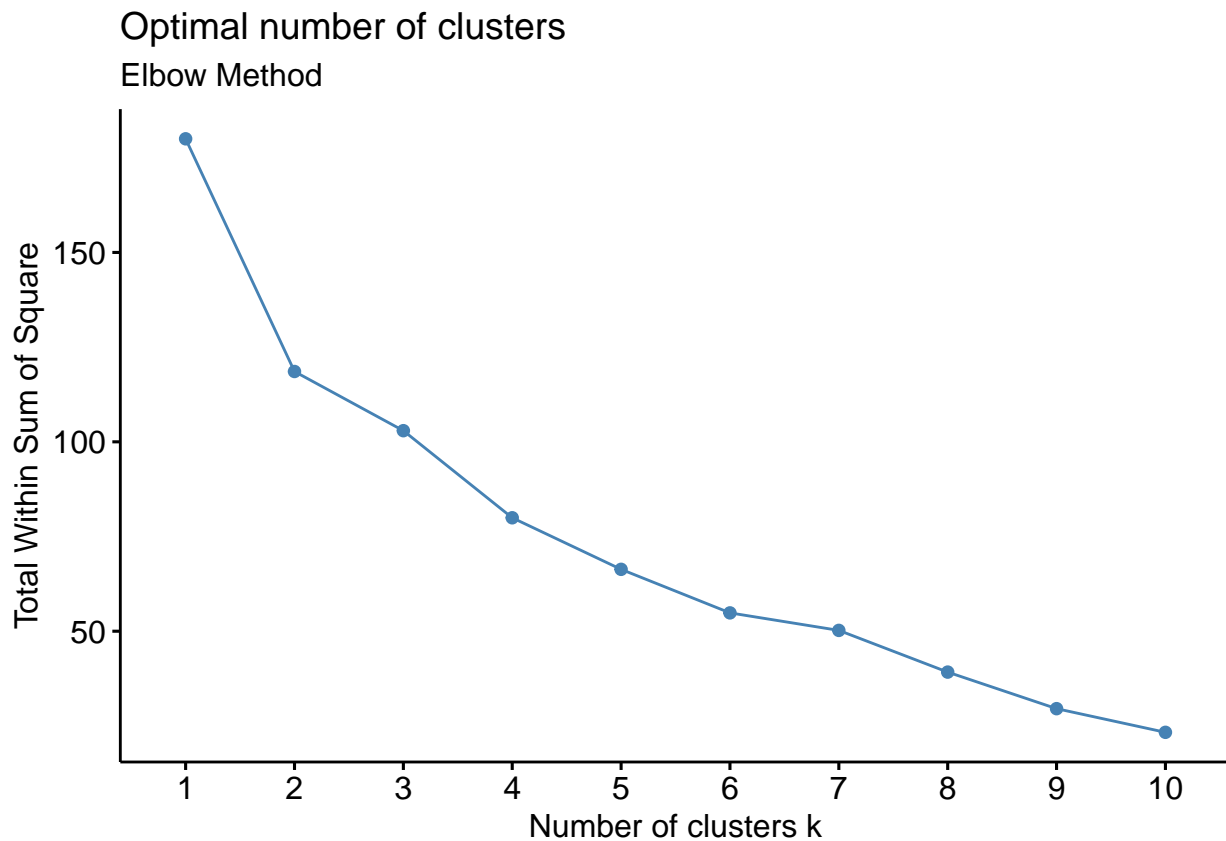
| | |
|------|------|
| ## 1 | 16.1 |
| ## 2 | 5.5 |
| ## 3 | 11.2 |
| ## 4 | 18.0 |
| ## 5 | 12.9 |
| ## 6 | 2.6 |

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

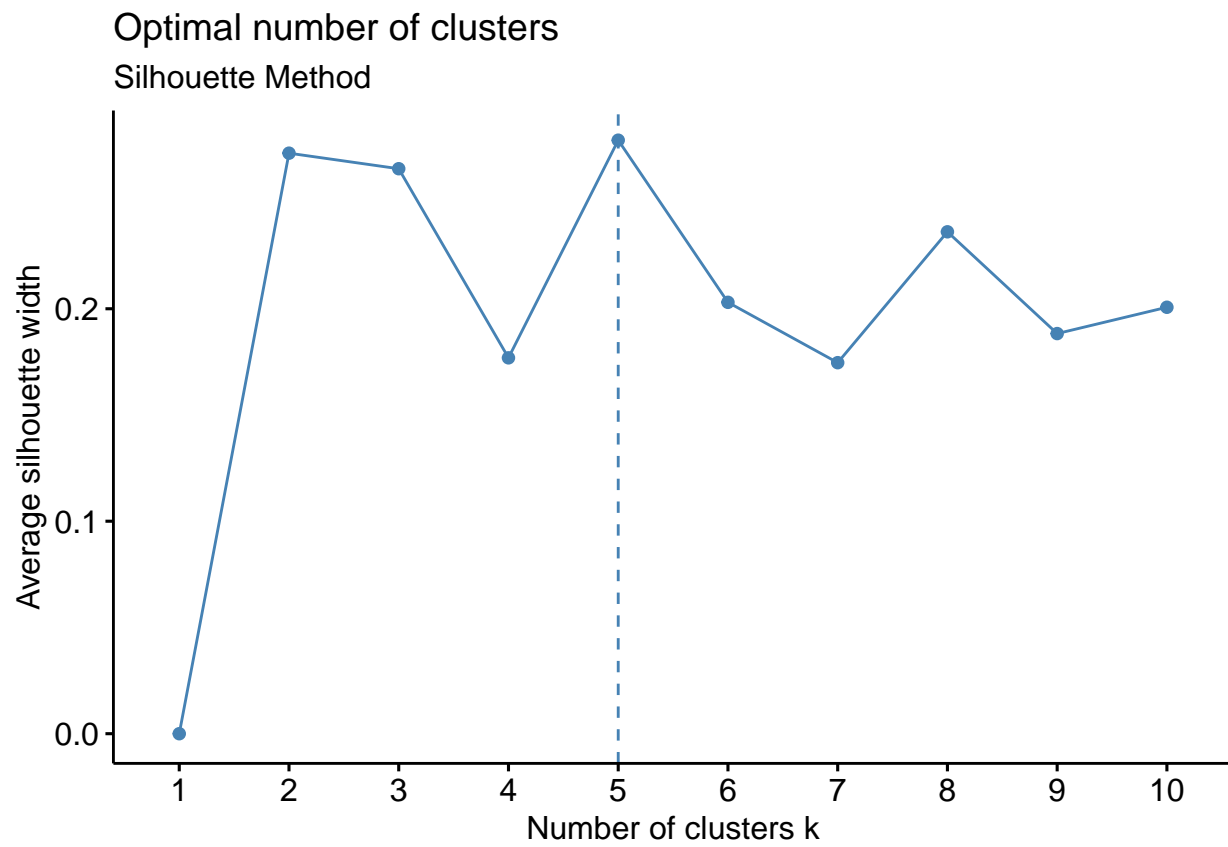
| ## | Market_Cap | Beta | PE_Ratio | ROE | ROA | Asset_Turnover |
|------|------------|-------------|-------------|------------|-----------|----------------|
| ## 1 | 0.1840960 | -0.80125356 | -0.04671323 | 0.04009035 | 0.2416121 | 0.0000000 |

```
## 2 -0.8544181 -0.45070513 3.49706911 -0.85483986 -0.9422871 0.9225312
## 3 -0.8762600 -0.25595600 -0.29195768 -0.72225761 -0.5100700 0.9225312
## 4 0.1702742 -0.02225704 -0.24290879 0.10638147 0.9181259 0.9225312
## 5 -0.1790256 -0.80125356 -0.32874435 -0.26484883 -0.5664461 -0.4612656
## 6 -0.6953818 2.27578267 0.14948233 -1.45146000 -1.7127612 -0.4612656
##      Leverage Rev_Growth Net_Profit_Margin
## 1 -0.2120979 -0.5277675 0.06168225
## 2 0.0182843 -0.3811391 -1.55366706
## 3 -0.4040831 -0.5721181 -0.68503583
## 4 -0.7496565 0.1474473 0.35122600
## 5 -0.3144900 1.2163867 -0.42597037
## 6 -0.7496565 -1.4971443 -1.99560225
```

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



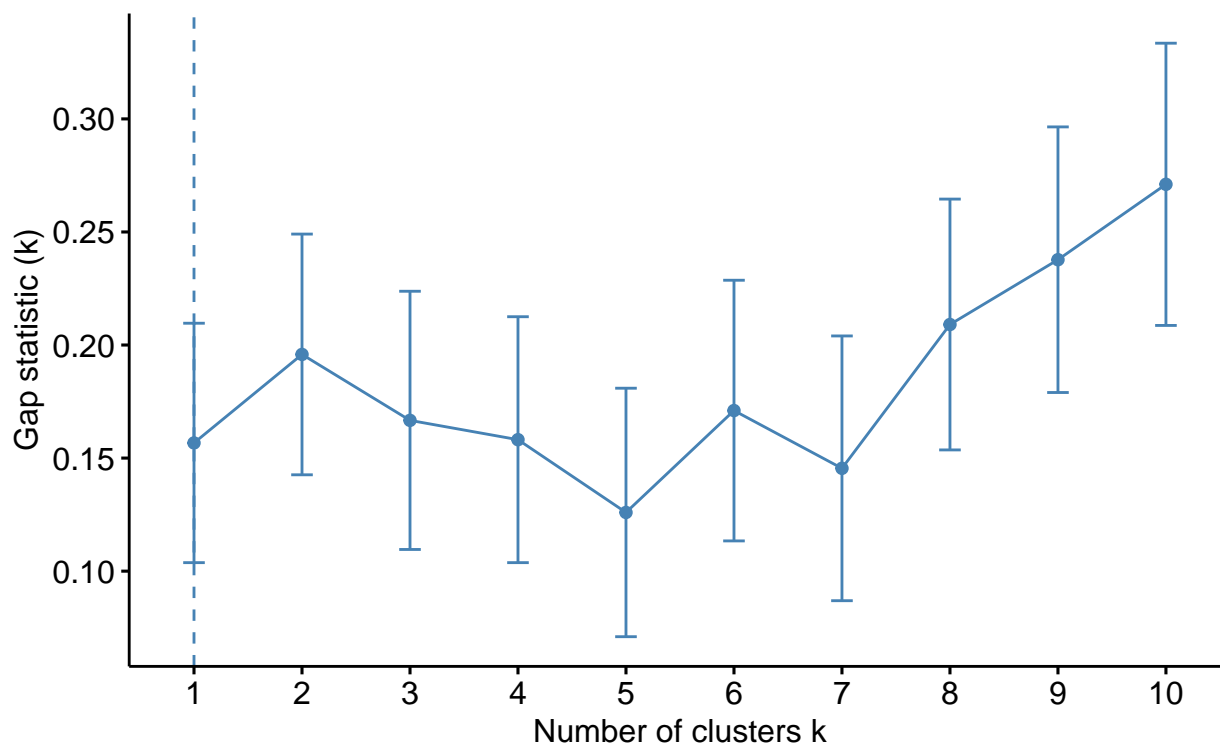
```
fviz_nbclust(Pharmaceuticals2, kmeans, method = "silhouette") + labs(subtitle = "Silhouette Method")
```



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

Optimal number of clusters

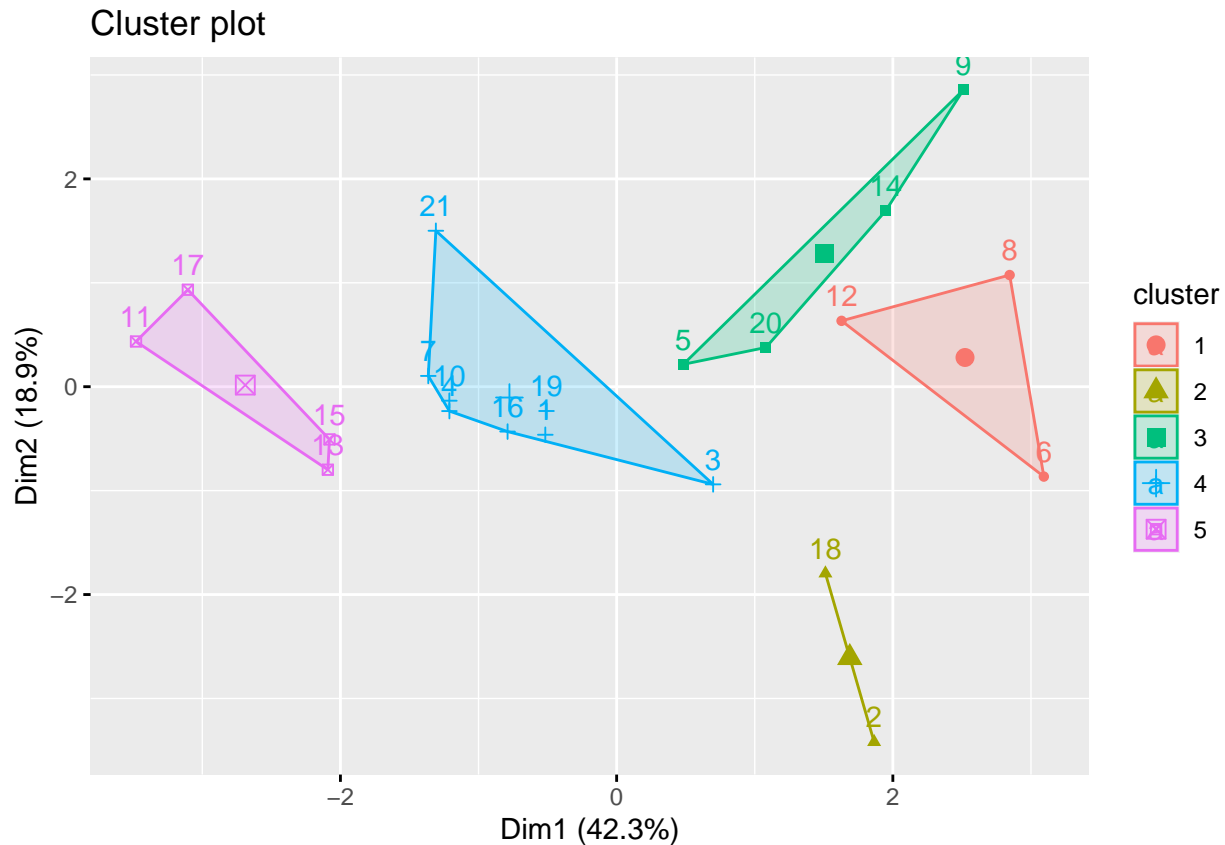
Gap Stat Method



```
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)
```

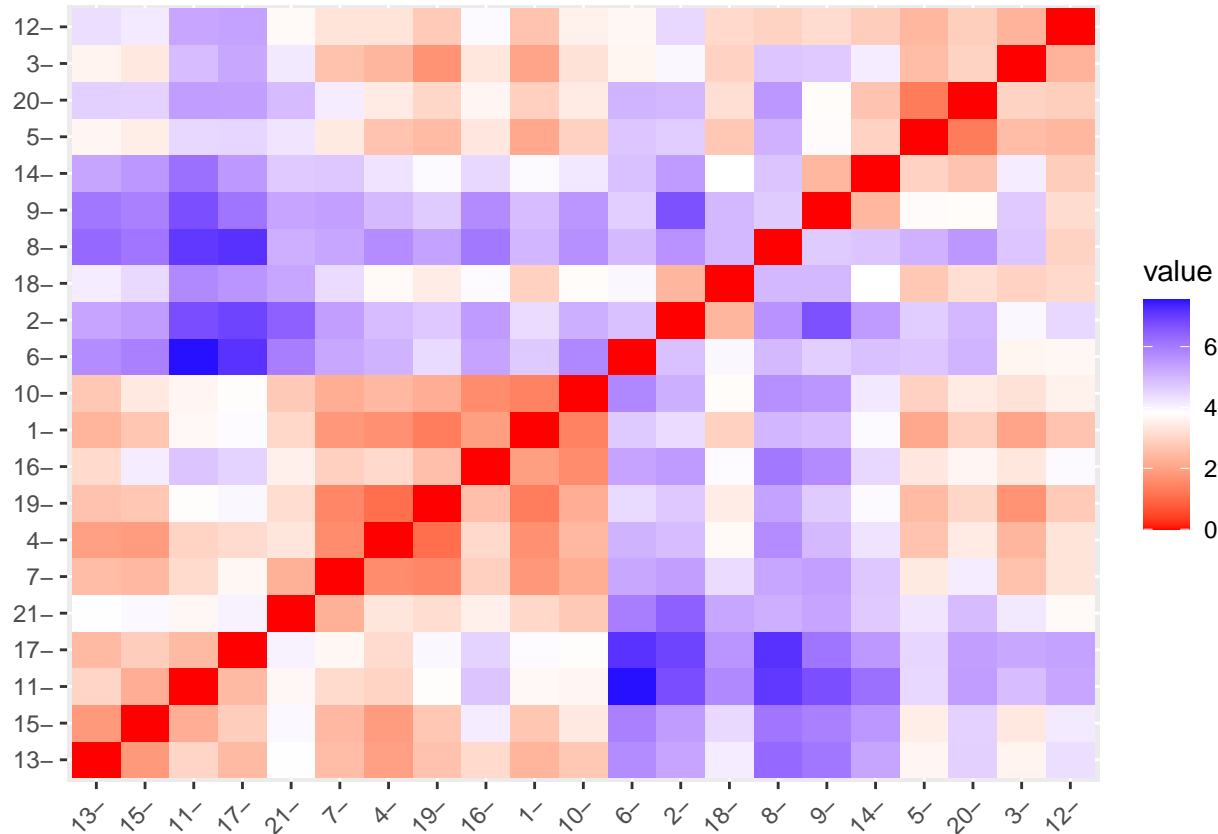


k5

```
## 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:
##  1  2  3  4  5  6  7  8  9 10 11 12 13 14 15 16 17 18 19 20 21
##  4  2  4  4  3  1  4  1  3  4  5  1  5  3  5  4  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
```

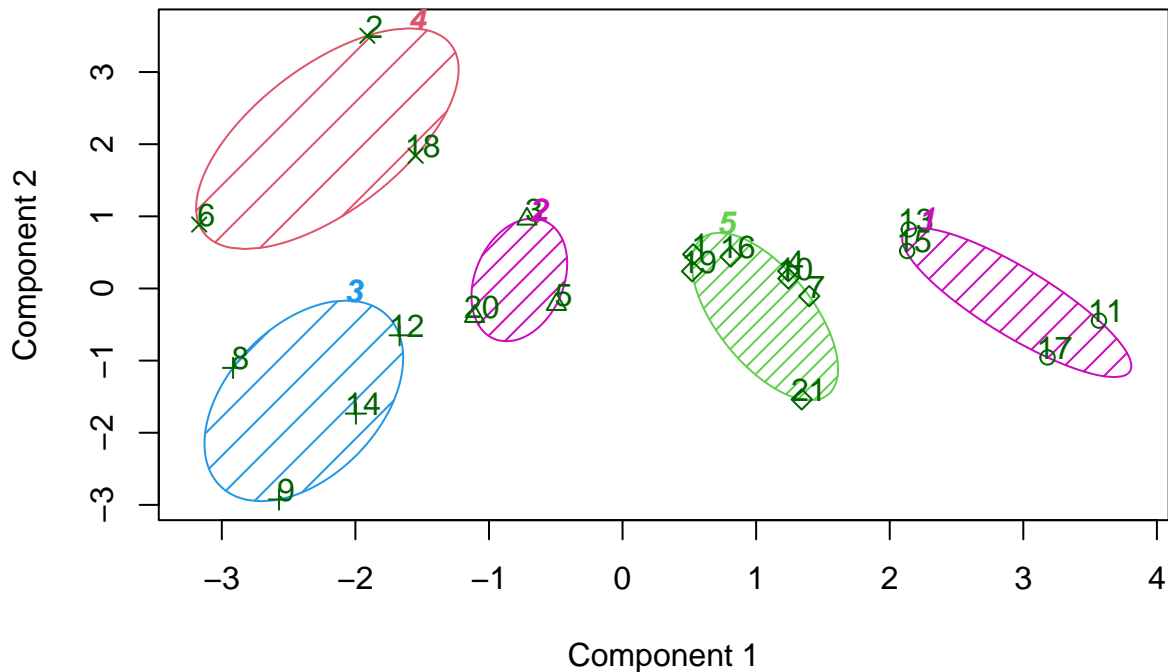
```
##   Market_Cap      Beta  PE_Ratio      ROE      ROA Asset_Turnover
## 1  0.1840960 -0.80125356 -0.04671323  0.04009035  0.2416121  0.0000000
## 2 -0.8544181 -0.45070513  3.49706911 -0.85483986 -0.9422871  0.9225312
```



```
## 3 -0.8762600 -0.25595600 -0.29195768 -0.72225761 -0.5100700 0.9225312
## 4 0.1702742 -0.02225704 -0.24290879 0.10638147 0.9181259 0.9225312
## 5 -0.1790256 -0.80125356 -0.32874435 -0.26484883 -0.5664461 -0.4612656
## 6 -0.6953818 2.27578267 0.14948233 -1.45146000 -1.7127612 -0.4612656
## 7 -0.1078688 -0.10015669 -0.70887325 0.59693581 0.8617498 0.9225312
## 8 -0.9767669 1.26308721 0.03299122 -0.11237924 -1.1677918 -0.4612656
## 9 -0.9704532 2.15893320 -1.34037772 -0.70899938 -1.0174553 -1.8450624
## 10 0.2762415 -1.34655112 0.14948233 0.34502953 0.5610770 -0.4612656
## 11 1.0999201 -0.68440408 -0.45749769 2.45971647 1.8389364 1.3837968
## 12 -0.9393967 0.48409069 -0.34100657 -0.29136529 -0.6979905 -0.4612656
## 13 1.9841758 -0.25595600 0.18013789 0.18593083 1.0872544 0.9225312
## 14 -0.9632863 0.87358895 0.19240011 -0.96753478 -0.9610792 -1.8450624
## 15 1.2782387 -0.25595600 -0.40231769 0.98142435 0.8429577 1.8450624
## 16 0.6654710 -1.30760129 -0.23677768 -0.52338423 0.1288598 -0.9225312
## 17 2.4199899 0.48409069 -0.11415545 1.31287998 1.6322239 0.4612656
## 18 -0.0240846 -0.48965495 1.90298017 -0.81506519 -0.9047030 -0.4612656
## 19 -0.4018812 -0.06120687 -0.40231769 -0.21181593 0.5234929 0.4612656
## 20 -0.9281345 -1.11285216 -0.43297324 -1.03382590 -0.6979905 -0.9225312
## 21 -0.1614497 0.40619104 -0.75792214 1.92938746 0.5422849 -0.4612656
##      Leverage Rev_Growth Net_Profit_Margin Fitting.cluster
## 1 -0.21209793 -0.52776752 0.06168225 5
## 2 0.01828430 -0.38113909 -1.55366706 4
## 3 -0.40408312 -0.57211809 -0.68503583 2
## 4 -0.74965647 0.14744734 0.35122600 5
## 5 -0.31449003 1.21638667 -0.42597037 2
## 6 -0.74965647 -1.49714434 -1.99560225 4
## 7 -0.02011273 -0.96584257 0.74744375 5
## 8 3.74279705 -0.63276071 -1.24888417 3
## 9 0.61983791 1.88617085 -0.36501379 3
## 10 -0.07130879 -0.64814764 1.17413980 5
## 11 -0.31449003 0.76926048 0.82363947 1
## 12 1.10620040 0.05603085 -0.71551412 3
## 13 -0.62166634 -0.36213170 0.33598685 1
## 14 0.44065173 1.53860717 0.85411776 3
## 15 -0.39128411 0.36014907 -0.24310064 1
## 16 -0.67286239 -1.45369888 1.02174835 5
## 17 -0.54487226 1.10143723 1.44844440 1
## 18 -0.30169102 0.14744734 -1.27936246 4
## 19 -0.74965647 -0.43544591 0.29026942 5
## 20 -0.49367621 1.43089863 -0.09070919 2
## 21 0.68383297 -1.17763919 1.49416183 5
```

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

CLUSPLOT(Pharmaceuticals2)



These two components explain 61.23 % of the point variability.

#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 |
|------|------------|-------------|-------------|-------------|------------|----------------|
| ## 1 | 0.1840960 | -0.80125356 | -0.04671323 | 0.04009035 | 0.2416121 | 0.0000000 |
| ## 2 | -0.8544181 | -0.45070513 | 3.49706911 | -0.85483986 | -0.9422871 | 0.9225312 |
| ## 3 | -0.8762600 | -0.25595600 | -0.29195768 | -0.72225761 | -0.5100700 | 0.9225312 |
| ## 4 | 0.1702742 | -0.02225704 | -0.24290879 | 0.10638147 | 0.9181259 | 0.9225312 |
| ## 5 | -0.1790256 | -0.80125356 | -0.32874435 | -0.26484883 | -0.5664461 | -0.4612656 |
| ## 6 | -0.6953818 | 2.27578267 | 0.14948233 | -1.45146000 | -1.7127612 | -0.4612656 |
| ## 7 | -0.1078688 | -0.10015669 | -0.70887325 | 0.59693581 | 0.8617498 | 0.9225312 |

```
## 8 -0.9767669 1.26308721 0.03299122 -0.11237924 -1.1677918 -0.4612656
## 9 -0.9704532 2.15893320 -1.34037772 -0.70899938 -1.0174553 -1.8450624
## 10 0.2762415 -1.34655112 0.14948233 0.34502953 0.5610770 -0.4612656
## 11 1.0999201 -0.68440408 -0.45749769 2.45971647 1.8389364 1.3837968
## 12 -0.9393967 0.48409069 -0.34100657 -0.29136529 -0.6979905 -0.4612656
## 13 1.9841758 -0.25595600 0.18013789 0.18593083 1.0872544 0.9225312
## 14 -0.9632863 0.87358895 0.19240011 -0.96753478 -0.9610792 -1.8450624
## 15 1.2782387 -0.25595600 -0.40231769 0.98142435 0.8429577 1.8450624
## 16 0.6654710 -1.30760129 -0.23677768 -0.52338423 0.1288598 -0.9225312
## 17 2.4199899 0.48409069 -0.11415545 1.31287998 1.6322239 0.4612656
## 18 -0.0240846 -0.48965495 1.90298017 -0.81506519 -0.9047030 -0.4612656
## 19 -0.4018812 -0.06120687 -0.40231769 -0.21181593 0.5234929 0.4612656
## 20 -0.9281345 -1.11285216 -0.43297324 -1.03382590 -0.6979905 -0.9225312
## 21 -0.1614497 0.40619104 -0.75792214 1.92938746 0.5422849 -0.4612656
##      Leverage Rev_Growth Net_Profit_Margin k5.cluster
## 1 -0.21209793 -0.52776752 0.06168225 4
## 2 0.01828430 -0.38113909 -1.55366706 2
## 3 -0.40408312 -0.57211809 -0.68503583 4
## 4 -0.74965647 0.14744734 0.35122600 4
## 5 -0.31449003 1.21638667 -0.42597037 3
## 6 -0.74965647 -1.49714434 -1.99560225 1
## 7 -0.02011273 -0.96584257 0.74744375 4
## 8 3.74279705 -0.63276071 -1.24888417 1
## 9 0.61983791 1.88617085 -0.36501379 3
## 10 -0.07130879 -0.64814764 1.17413980 4
## 11 -0.31449003 0.76926048 0.82363947 5
## 12 1.10620040 0.05603085 -0.71551412 1
## 13 -0.62166634 -0.36213170 0.33598685 5
## 14 0.44065173 1.53860717 0.85411776 3
## 15 -0.39128411 0.36014907 -0.24310064 5
## 16 -0.67286239 -1.45369888 1.02174835 4
## 17 -0.54487226 1.10143723 1.44844440 5
## 18 -0.30169102 0.14744734 -1.27936246 2
## 19 -0.74965647 -0.43544591 0.29026942 4
## 20 -0.49367621 1.43089863 -0.09070919 3
## 21 0.68383297 -1.17763919 1.49416183 4
```

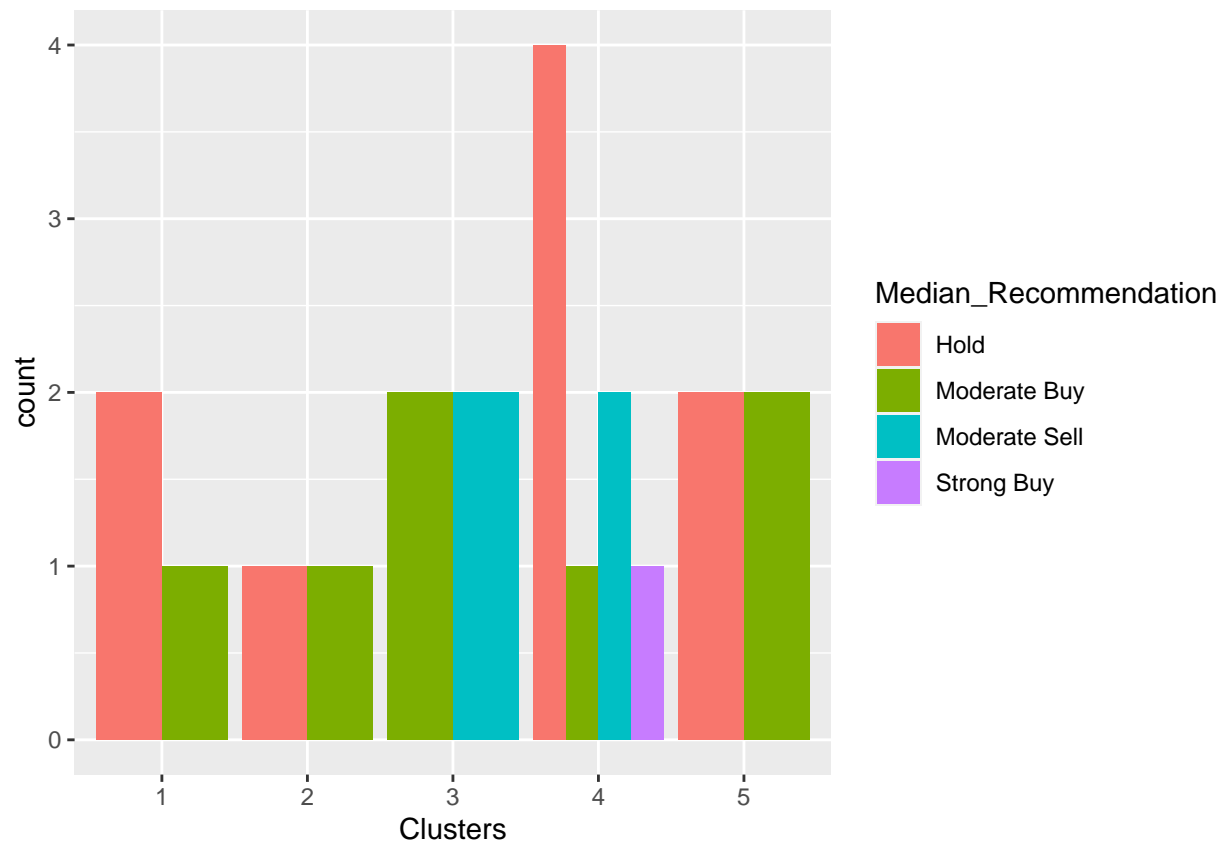
```
#Cluster 1:- JNJ, MRK, GSK, PFE
#Cluster 1: Highest Market_Cap and lowest Beta/PE Ratio
#Cluster 2:- AHM, WPI, AVE
#Cluster 2: Highest Revenue Growth and lowest PE/Asset Turnover Ratio
#Cluster 3:- CHTT, IVX, MRX, ELN
#Cluster 3: Highest Beta/leverage/Asset Turnover Ratio and lowest
#Net_Profit_Margin, 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
```

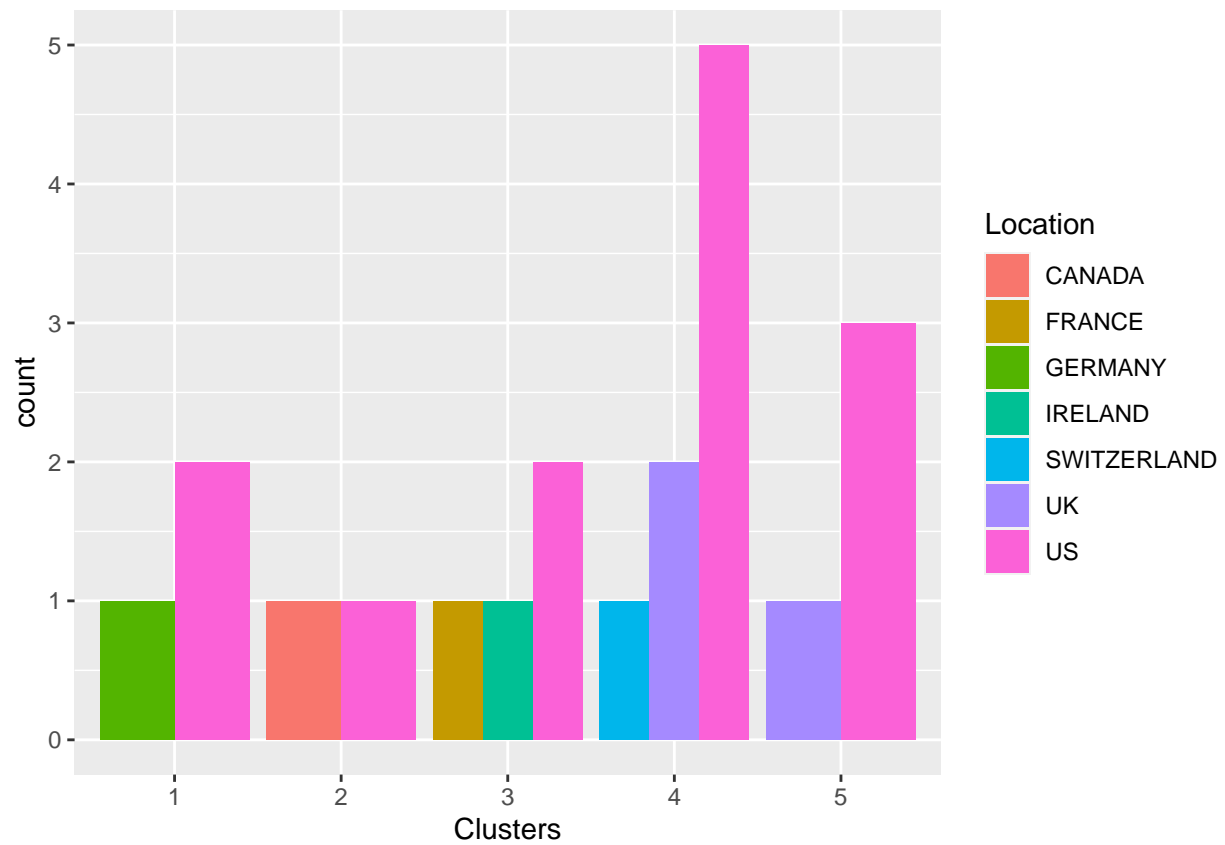
```
#Is there a pattern in the clusters with respect to the numerical variables (10 to 12)? #(those not use
```

```
RD <- Pharmaceuticals_RD[12:14] %>% mutate(Clusters=k5$cluster)
```

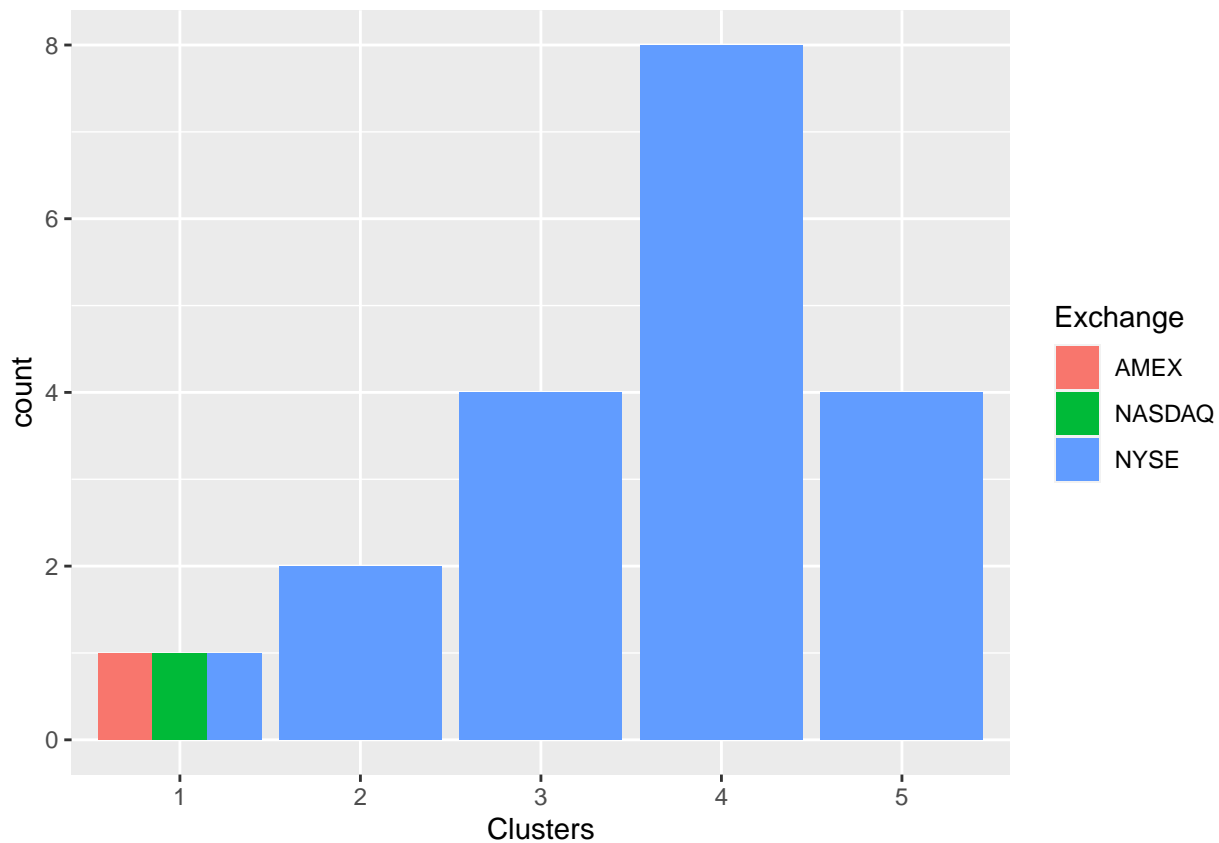
```
ggplot(RD, mapping = aes(factor(Clusters), fill =Median_Recommendation))+geom_bar(position='dodge')+lab
```



```
ggplot(RD, mapping = aes(factor(Clusters), fill = Location))+geom_bar(position = 'dodge')+labs(x = 'Clusters', y = 'count')
```



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



#The above graphs indicate that there is a slim pattern in the clusters.

#Although the cluster 1 has a different Hold and Moderate Buy median, a different count from the US and

#The cluster 2 is only listed on the NYSE, has equal Hold and Moderate Buy medians, and is evenly divid

#The Cluster 3 is listed on the NYSE and has equal Moderate Buy and Sell medians as well as a separate

#The Hold median in Cluster 4 is the highest, followed by Moderate Buy, Strong Buy, and Hold medians. T

#The Cluster 5 is scattered throughout the US and the UK, has the same hold and moderate buy medians, a

#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