Assignment 4 fml

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```
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.2.2

## Loading required package: ggplot2

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

```
library(ggplot2)
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.2.2

## -- 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 readr   2.1.3      v forcats 0.5.2
## v purrr   0.3.4

## Warning: package 'readr' was built under R version 4.2.2

## Warning: package 'forcats' was built under R version 4.2.2

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

```
library(ISLR)

pharm <- read.csv("C://Users//heere//OneDrive//Documents//DESKTOP FILES//FML ASSIGNMENT 4//pharmacy.csv
View(pharm)
#TASK1
#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.
x <- na.omit(pharm)
summary(x)
```

```
##     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  
##                    
##                    
##                    
```

```
row.names(x) <- x[,1]
Pharm1 <- x[,3:11]
head(Pharm1)
```

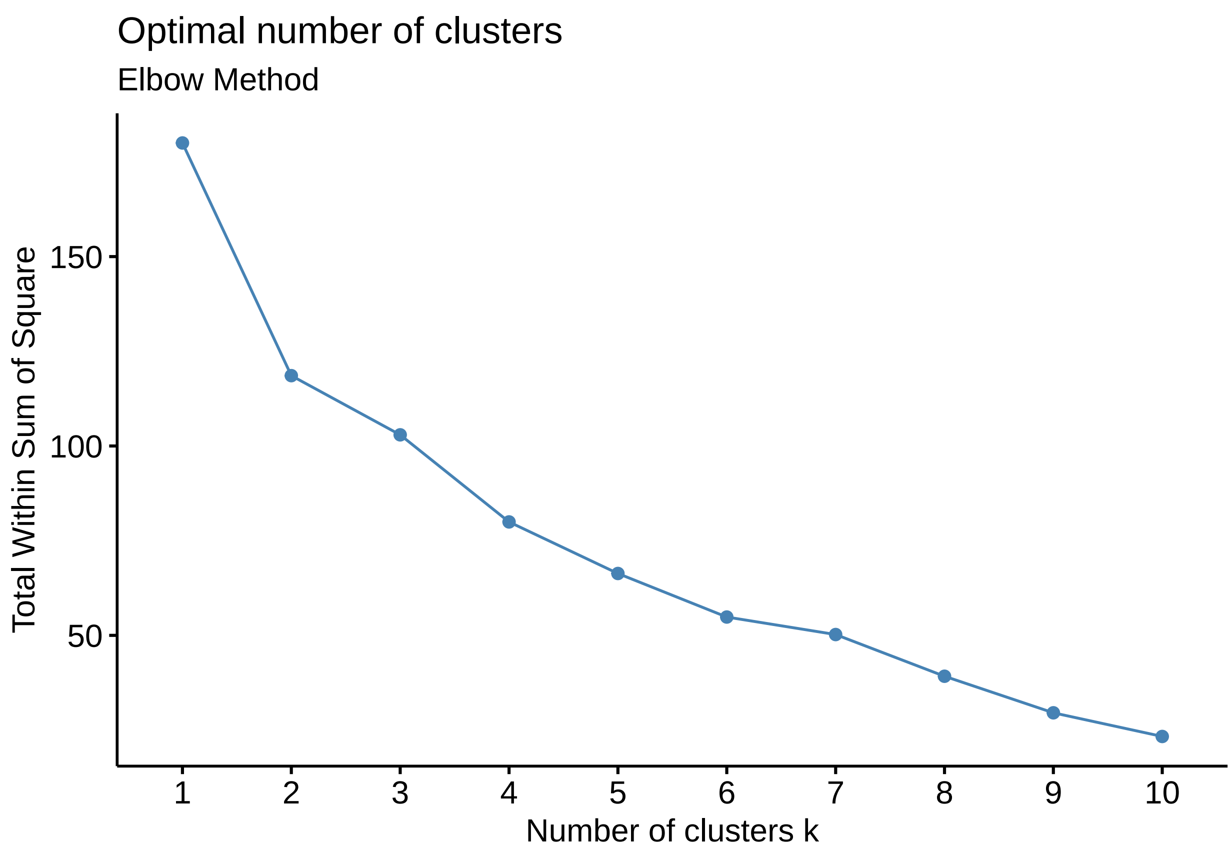
```
##     Market_Cap Beta PE_Ratio  ROE  ROA Asset_Turnover Leverage Rev_Growth
## ABT      68.44 0.32     24.7 26.4 11.8            0.7     0.42       7.54
## AGN       7.58 0.41     82.5 12.9  5.5            0.9     0.60       9.16
## AHM       6.30 0.46     20.7 14.9  7.8            0.9     0.27       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
```

```
Pharm2 <- scale(Pharm1)
head(Pharm2)
```

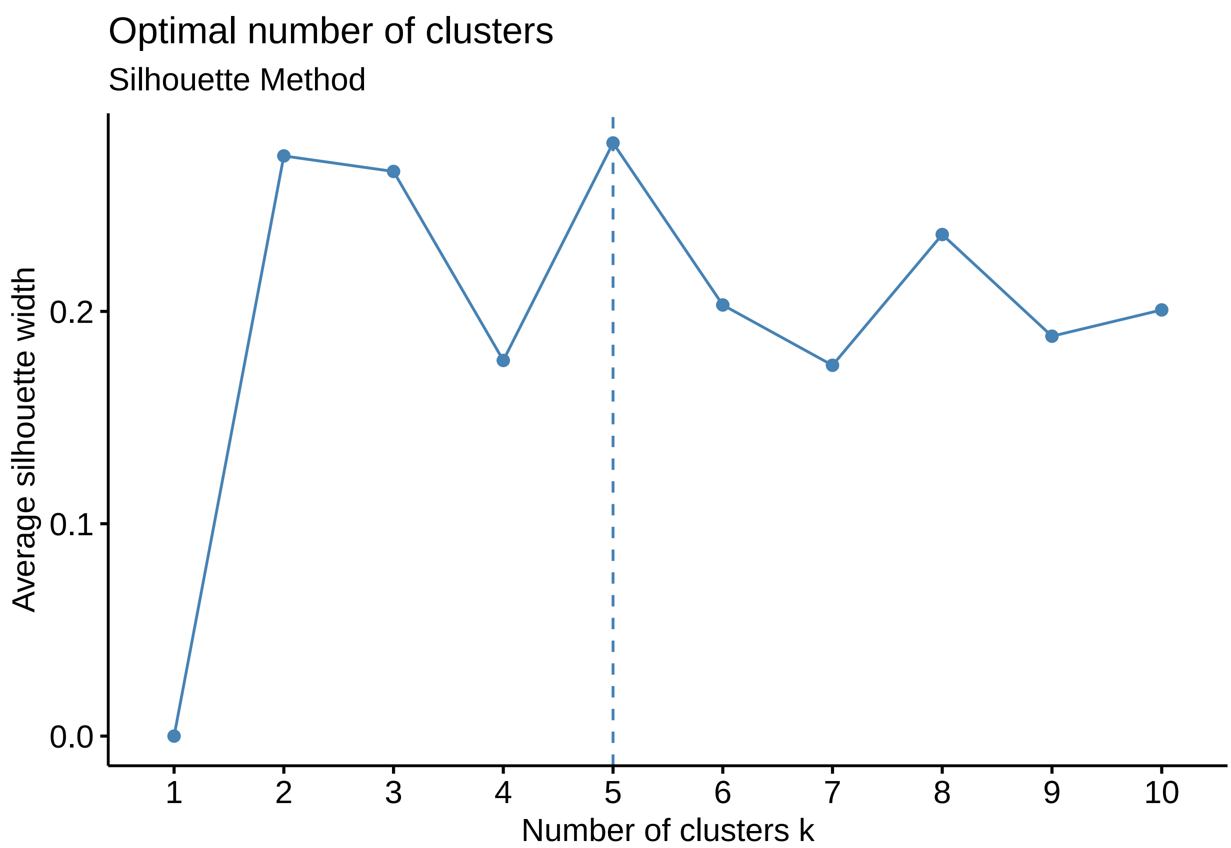
```
##     Market_Cap        Beta    PE_Ratio         ROE        ROA Asset_Turnover
## ABT  0.1840960 -0.80125356 -0.04671323  0.04009035  0.2416121      0.0000000
```

```
## 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(Pharm2, kmeans, method = "wss") + labs(subtitle = "Elbow Method")
```



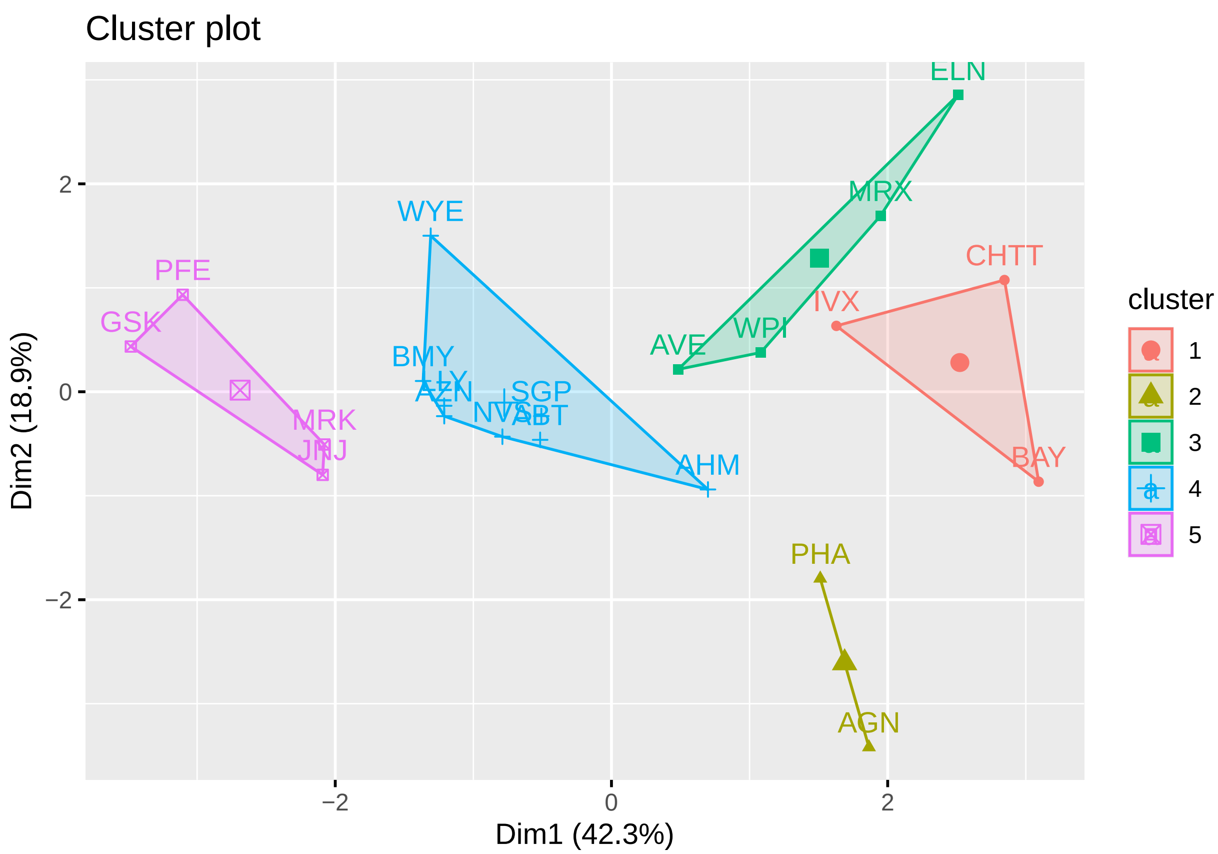

```
fviz_nbclust(Pharm2, kmeans, method = "silhouette") + labs(subtitle = "Silhouette Method")
```



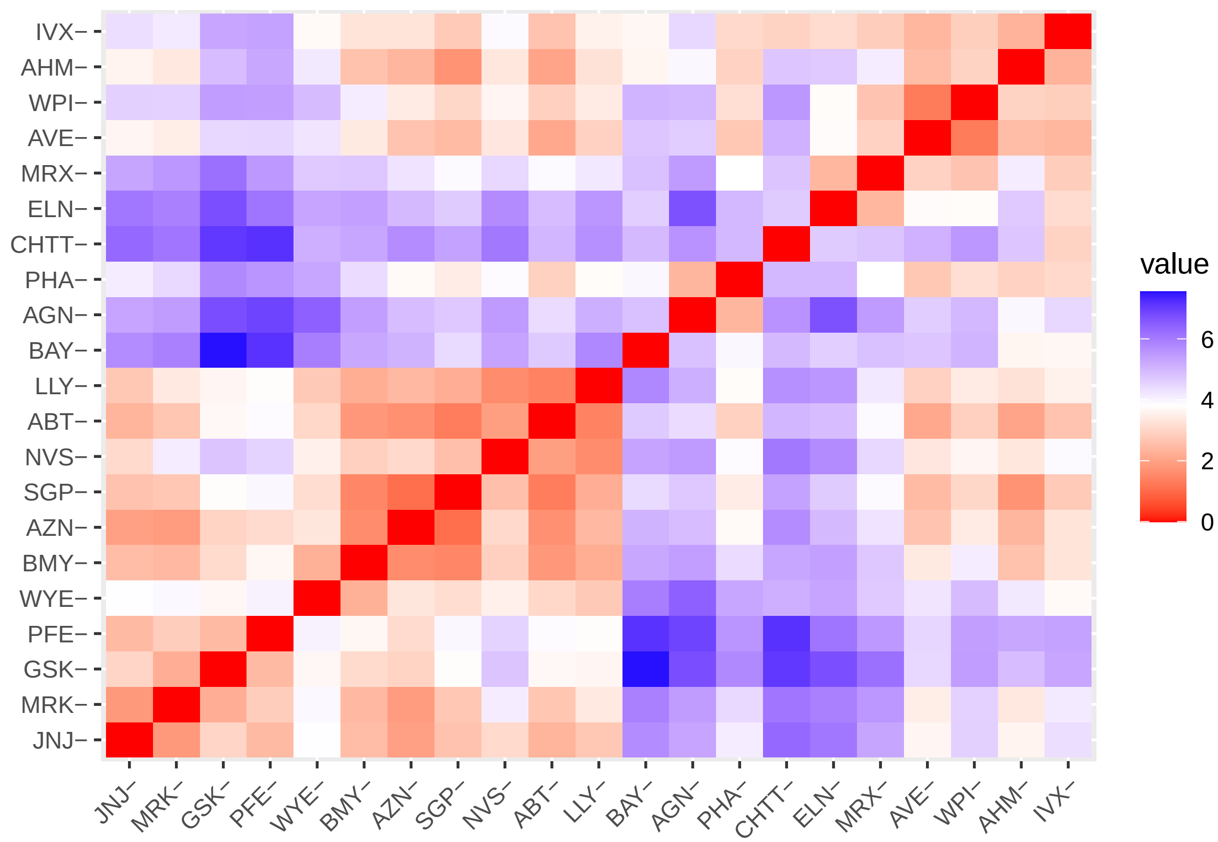

```
set.seed(64060)

k5 <- kmeans(Pharm2, 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 = Pharm2)
```




```
distance <- dist(Pharm2, method = "euclidean")
fviz_dist(distance)
```




```r
fit <- kmeans(Pharm2, 5)
aggregate(Pharm2, by=list(fit$cluster), FUN=mean)
```

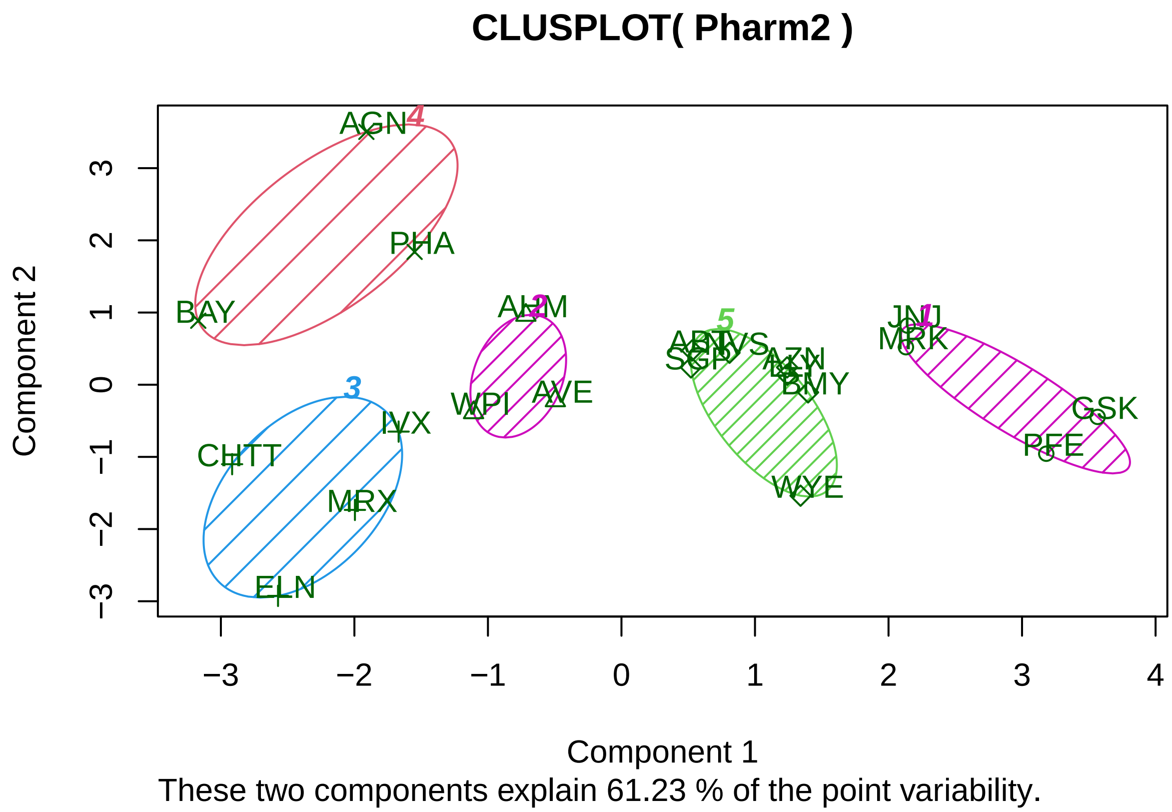
```
##   Group.1  Market_Cap       Beta   PE_Ratio        ROE        ROA
## 1       1  1.69558112 -0.1780563 -0.1984582  1.2349879  1.3503431
## 2       2 -0.66114002 -0.7233539 -0.3512251 -0.6736441 -0.5915022
## 3       3 -0.96247577  1.1949250 -0.3639982 -0.5200697 -0.9610792
## 4       4 -0.52462814  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
```

```r
pharm3 <- data.frame(Pharm2, fit$cluster)
pharm3
```

```
##      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 fit.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
```

```r
library(cluster)
clusplot(Pharm2, fit$cluster, color = TRUE, shade = TRUE,
         labels = 2, lines = 0)
```




```
#Task2
#B) Interpret the clusters with respect to numerical variables used in formatting the clusters.

#cluster 1 - JNJ,MRK,PFE,GSK-- They have the largest market capitalization, and the corporations are ef
#cluster 2 - AHM,WPI,AVE--They have the lowest asset turnover and the lowest beta, which means that the
#cluster 3 - CHTT,MRX,LVX,ELN--They have the smallest market capitalization, do not rely on debt to sup
#cluster 4 - AGN,BAY,RHA--- These have the largest cost-to-income ratio, making them less profitable.
#Their Return on Equity is also less than one, indicating that investing in these stocks will not be as
#cluster 5 - ABT,SGP,NVS,AZN,BMY,WYE--Their asset turnover is the largest, their revenue growth is the







#Task3
#: Is there a pattern in the clusters with respect to the numerical variables (10 to 12)? (those not
#used in forming the clusters)
#Each cluster was manually filtered to detect patterns in media suggestions, location, and exchange.
#cluster1--The stocks are moderate in character, which means they are neither weak nor have had strong
#cluster2--In terms of geographical distribution, the stocks are well-balanced. Their principles are so
#cluster3--Because of their financial soundness, they are moderately recommended despite their high lev
#cluster4--These are the stocks that, according to the media, should be held because they will eventual
#cluster5--The cluster contains companies with a high net profit margin that are advised to be kept for
```

```
#Task 4: Provide an appropriate name for each cluster using any or all of the variables in the dataset.
#Cluster1-- Profitable clusture(Because these are stocks with a long track record,)
#cluster2-- Gold mine clusture(Market recommendations are very bullish, despite their modest beta.)
#cluster3-- primary clusture(Stocks with strong financial and other fundamentals)
#clusture4-- Bear clusture(These are the stocks with reasonable returns.)
#clusture5--  continuing clusture(- A high net profit margin indicates that the company is doing well,
```