Assignment 4

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Load data source and create dataframe

```
Pharm <- read.csv("Pharmaceuticals.csv")
head(Pharm)
```

```
##   Symbol                Name Market_Cap Beta PE_Ratio  ROE  ROA
Asset_Turnover
## 1    ABT Abbott Laboratories      68.44 0.32     24.7 26.4 11.8
0.7
## 2    AGN      Allergan, Inc.       7.58 0.41     82.5 12.9  5.5
0.9
## 3    AHM        Amersham plc       6.30 0.46     20.7 14.9  7.8
0.9
## 4    AZN     AstraZeneca PLC      67.63 0.52     21.5 27.4 15.4
0.9
## 5    AVE             Aventis      47.16 0.32     20.1 21.8  7.5
0.6
## 6    BAY            Bayer AG      16.90 1.11     27.9  3.9  1.4
0.6
##   Leverage Rev_Growth Net_Profit_Margin Median_Recommendation Location
Exchange
## 1     0.42       7.54              16.1          Moderate Buy       US
NYSE
## 2     0.60       9.16               5.5          Moderate Buy   CANADA
NYSE
## 3     0.27       7.05              11.2            Strong Buy       UK
NYSE
## 4     0.00      15.00              18.0         Moderate Sell       UK
NYSE
## 5     0.34      26.81              12.9          Moderate Buy   FRANCE
NYSE
## 6     0.00      -3.17               2.6                  Hold  GERMANY
NYSE
```

#Collect the quantitative variables (1-9) to cluster the 21 firms

```
Pharm1 <- Pharm[,3:11]
head(Pharm1)
```

```
##   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
```

#Scale all quantitative variables in the dataframe

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

```
##      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
```

#K-Means Cluster Analysis - Fit the data with 5 clusters

```
fit <- kmeans(PharmS,5)
```

#Below command gives the mean value of all quantitative variables for each cluster

```
aggregate(PharmS, by = list(fit$cluster), FUN = mean)
```

```
##   Group.1 Market_Cap       Beta   PE_Ratio         ROE        ROA
## 1       1 -0.2063280 -0.2481660 -0.3385541 -0.03813318  0.4069821
## 2       2  0.2600876 -0.7493205 -0.2817392  0.58367759  0.4107405
## 3       3  1.6955811 -0.1780563 -0.1984582  1.23498791  1.3503431
## 4       4 -0.4964157 -0.7136164  1.1595829 -0.74214495 -0.7778567
```

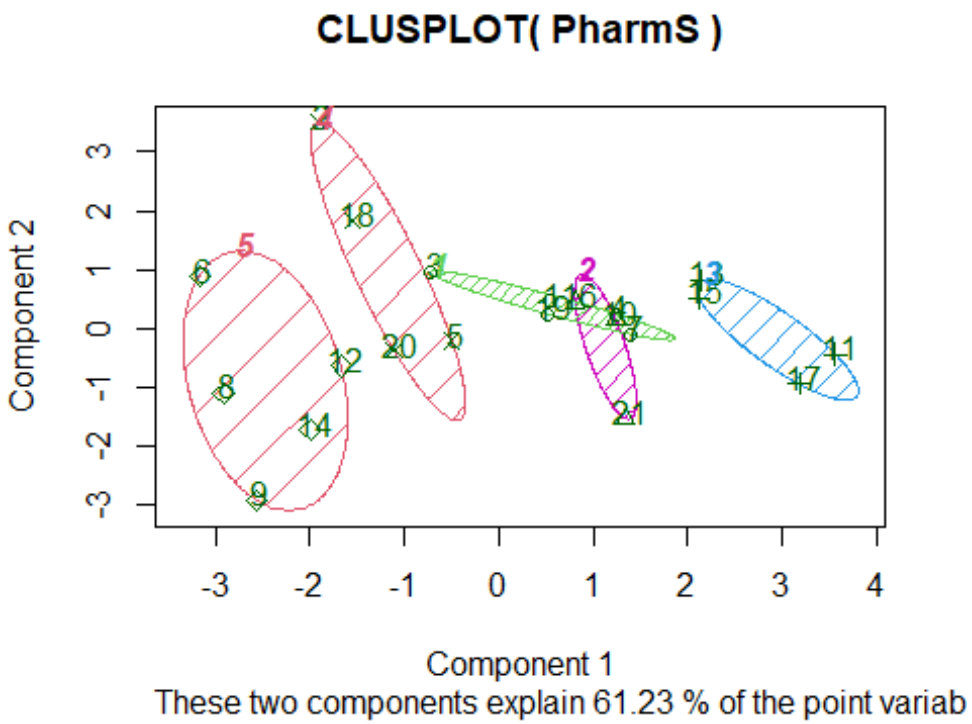
```
## 5       5 -0.9090570  1.4110965 -0.2613021 -0.70634774 -1.1114156
##   Asset_Turnover    Leverage Rev_Growth Net_Profit_Margin
## 1      0.6457718 -0.42712134 -0.4707453         0.1531171
## 2     -0.6150208 -0.02011273 -1.0931619         1.2300167
## 3      1.1531640 -0.46807818  0.4671788         0.5912425
## 4     -0.2306328 -0.27289324  0.6033984        -0.8374273
## 5     -1.0147843  1.03196612  0.2701808        -0.6941793

PharmS1 <- data.frame(PharmS, fit$cluster)
PharmS1

##    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 fit.cluster
## 1  -0.21209793 -0.52776752        0.06168225           1
## 2   0.01828430 -0.38113909       -1.55366706           4
## 3  -0.40408312 -0.57211809       -0.68503583           1
## 4  -0.74965647  0.14744734        0.35122600           1
## 5  -0.31449003  1.21638667       -0.42597037           4
## 6  -0.74965647 -1.49714434       -1.99560225           5
## 7  -0.02011273 -0.96584257        0.74744375           1
## 8   3.74279705 -0.63276071       -1.24888417           5
## 9   0.61983791  1.88617085       -0.36501379           5
## 10 -0.07130879 -0.64814764        1.17413980           2
## 11 -0.31449003  0.76926048        0.82363947           3
## 12  1.10620040  0.05603085       -0.71551412           5
## 13 -0.62166634 -0.36213170        0.33598685           3
## 14  0.44065173  1.53860717        0.85411776           5
## 15 -0.39128411  0.36014907       -0.24310064           3
## 16 -0.67286239 -1.45369888        1.02174835           2
## 17 -0.54487226  1.10143723        1.44844440           3
## 18 -0.30169102  0.14744734       -1.27936246           4
## 19 -0.74965647 -0.43544591        0.29026942           1
## 20 -0.49367621  1.43089863       -0.09070919           4
## 21  0.68383297 -1.17763919        1.49416183           2

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



#Answers

(B) Cluster 1: Rows 1, 3, 4, 5, 19, 20 Cluster 2: Rows 2, 6, 18 Cluster 3: Rows 11, 13, 15, 17 Cluster 4: Rows 7, 10, 16, 21 Cluster 5: Rows 8, 9, 12, 14; By the output of the mean value of all quantitative variables for each cluster, we see that Cluster 1 has the lowest Leverage; Cluster 2 has the highest PE ratio, lowest ROE, lowest ROA, lowest Asset Turnover, & lowest Net Profit Margin; Cluster 3 has the highest Market Cap, highest ROE, highest ROA, & highest Asset Turnover; Cluster 4 has the highest Net Profit Margin, lowest Beta, lowest PE Ratio, & lowest Rev growth; Cluster 5 has the highest Beta, highest Leverage, highest Rev Growth, & lowest Market Cap.

(C) There appears to be a pattern in the clusters regarding the Media recommendation variable. Cluster 3 does not have any sell media recommendations, this cluster is mostly buy recommendation with one strong buy recommendation. Cluster 2 has mostly hold recommendations. Cluster 4 also has mostly hold recommendations.

(D) Cluster 1: Lowest Leverage Cluster Cluster 2: High PE Ratio, Low ROE, ROA, Asset Turnover, Net Profit Margin Cluster Cluster 3: High Market Cap, ROE, ROA, Asset Turnover Cluster Cluster 4: High Net Profit Margin, Low Beta, PE Ratio, Rev Growth Cluster Cluster 5: High Beta, Leverage, Rev Growth and Low Market Cap Cluster