

Chase Holland
10/29/23

> #Question A

```
> SLV
Symbol Name Market_Cap Beta PE_Ratio ROE ROA Asset_Turnover Leverage Rev_Growth
1 ABT Abbott Laboratories 68.44 0.32 24.7 26.4 11.8 0.7 0.42 7.54
2 AGN Allergan, Inc. 7.58 0.41 82.5 12.9 5.5 0.9 0.60 9.16
3 AHM Amersham plc 6.30 0.46 20.7 14.9 7.8 0.9 0.27 7.05
4 AZN AstraZeneca PLC 67.63 0.52 21.5 27.4 15.4 0.9 0.00 15.00
5 AVE Aventis 47.16 0.32 20.1 21.8 7.5 0.6 0.34 26.81
6 BAY Bayer AG 16.90 1.11 27.9 3.9 1.4 0.6 0.00 -3.17
7 BMY Bristol-Myers Squibb Company 51.33 0.50 13.9 34.8 15.1 0.9 0.57 2.70
8 CHTT Chattem, Inc 0.41 0.85 26.0 24.1 4.3 0.6 3.51 6.38
9 ELN Elan Corporation, plc 0.78 1.08 3.6 15.1 5.1 0.3 1.07 34.21
10 LLY Eli Lilly and Company 73.84 0.18 27.9 31.0 13.5 0.6 0.53 6.21
11 GSK GlaxoSmithKline plc 122.11 0.35 18.0 62.9 20.3 1.0 0.34 21.87
12 IVX IVAX Corporation 2.60 0.65 19.9 21.4 6.8 0.6 1.45 13.99
13 JNJ Johnson & Johnson 173.93 0.46 28.4 28.6 16.3 0.9 0.10 9.37
14 MRX Medicis Pharmaceutical Corporation 1.20 0.75 28.6 11.2 5.4 0.3 0.93 30.37
15 MRK Merck & Co., Inc. 132.56 0.46 18.9 40.6 15.0 1.1 0.28 17.35
16 NVS Novartis AG 96.65 0.19 21.6 17.9 11.2 0.5 0.06 -2.69
17 PFE Pfizer Inc 199.47 0.65 23.6 45.6 19.2 0.8 0.16 25.54
18 PHA Pharmacia Corporation 56.24 0.40 56.5 13.5 5.7 0.6 0.35 15.00
19 SGP Schering-Plough Corporation 34.10 0.51 18.9 22.6 13.3 0.8 0.00 8.56
20 WPI Watson Pharmaceuticals, Inc. 3.26 0.24 18.4 10.2 6.8 0.5 0.20 29.18
21 WYE Wyeth 48.19 0.63 13.1 54.9 13.4 0.6 1.12 0.36
```

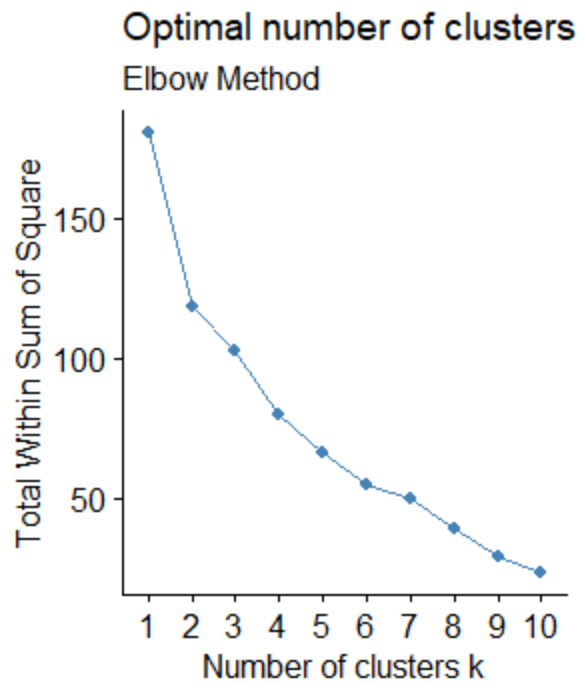
```
Net_Profit_Margin Median_Recommendation Location Exchange
1 16.1 Moderate Buy US NYSE
2 5.5 Moderate Buy CANADA NYSE
3 11.2 Strong Buy UK NYSE
4 18.0 Moderate Sell UK NYSE
5 12.9 Moderate Buy FRANCE NYSE
6 2.6 Moderate Hold GERMANY NYSE
7 20.6 Moderate Sell US NYSE
8 7.5 Moderate Buy US NASDAQ
9 13.3 Moderate Sell IRELAND NYSE
10 23.4 Moderate Hold US NYSE
11 21.1 Moderate Hold UK NYSE
12 11.0 Moderate Hold US AMEX
13 17.9 Moderate Buy US NYSE
14 21.3 Moderate Buy US NYSE
15 14.1 Moderate Hold US NYSE
16 22.4 Moderate Hold SWITZERLAND NYSE
17 25.2 Moderate Buy US NYSE
18 7.3 Moderate Hold US NYSE
19 17.6 Moderate Hold US NYSE
20 15.1 Moderate Sell US NYSE
21 25.5 Moderate Hold US NYSE
```

```
> head(pharms1)
Market_Cap Beta PE_Ratio ROE ROA Asset_Turnover Leverage Rev_Growth Net_Profit_Margin
1 68.44 0.32 24.7 26.4 11.8 0.7 0.42 7.54 16.1
2 7.58 0.41 82.5 12.9 5.5 0.9 0.60 9.16 5.5
3 6.30 0.46 20.7 14.9 7.8 0.9 0.27 7.05 11.2
4 67.63 0.52 21.5 27.4 15.4 0.9 0.00 15.00 18.0
5 47.16 0.32 20.1 21.8 7.5 0.6 0.34 26.81 12.9
6 16.90 1.11 27.9 3.9 1.4 0.6 0.00 -3.17 2.6
```

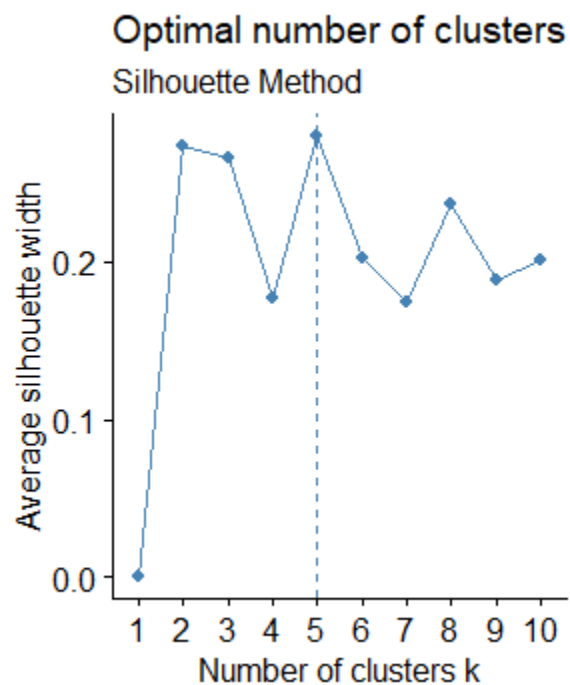
```
> pharms2 <- scale(pharms1)
```

```
> head(pharms2)
Market_Cap Beta PE_Ratio ROE ROA Asset_Turnover Leverage Rev_Growth Net_Profit_Margin
1 -0.1840960 -0.80125356 -0.04671323 0.04009035 0.2416121 0.0000000 -0.2120979 -0.5277675 0.06168225
2 -0.8544181 -0.45070513 3.49706911 -0.85483986 -0.9422871 0.9225312 0.0182843 -0.3811391 -1.55366706
3 -0.8762600 -0.25595600 -0.29195768 -0.72225761 -0.5100700 0.9225312 -0.4040831 -0.5721181 -0.68503583
4 -0.1702742 -0.02225704 -0.24290879 0.10638147 0.9181259 0.9225312 -0.7496565 0.1474473 0.35122600
5 -0.1790256 -0.80125356 -0.32874435 -0.26484883 -0.5664461 -0.4612656 -0.3144900 1.2163867 -0.42597037
6 -0.6953818 2.27578267 0.14948233 -1.45146000 -1.7127612 -0.4612656 -0.7496565 -1.4971443 -1.99560225
```

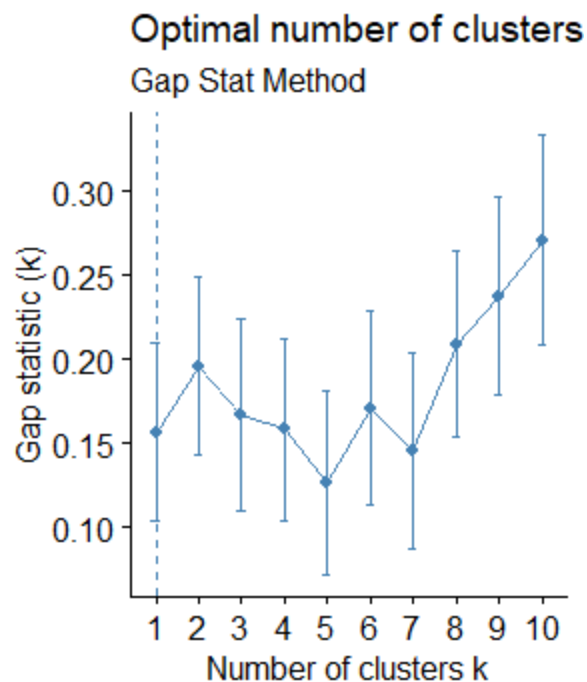
```
> fviz_nbclust(pharms2, kmeans, method = "wss") +
+ labs(subtitle = "Elbow Method")
```



```
> fviz_nbclust(pharms2, kmeans, method = "silhouette") + labs(subtitle = "Silhouette Method")
```



```
> fviz_nbclust(pharms2, kmeans, method = "gap_stat") + labs(subtitle = "Gap Stat Method")
```



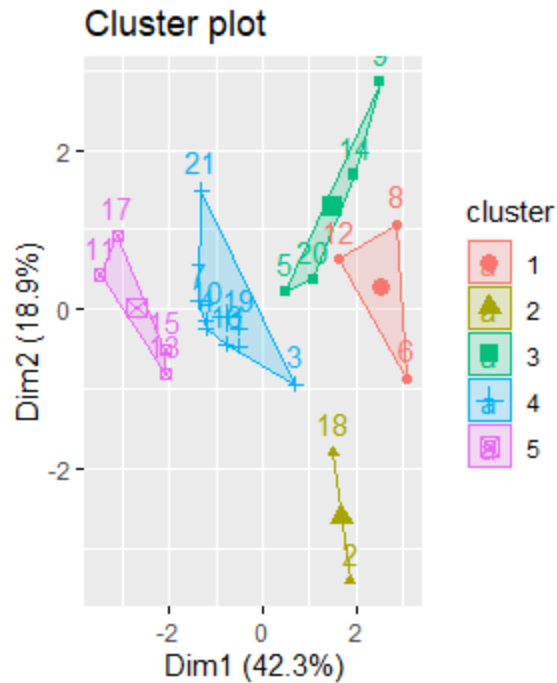
```
> set.seed(64060)
```

```
> k5 <- kmeans(pharms2, centers = 5, nstart = 25)
```

```
> k5 $centers
```

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

```
> fviz_cluster(k5, data = pharms2)
```



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

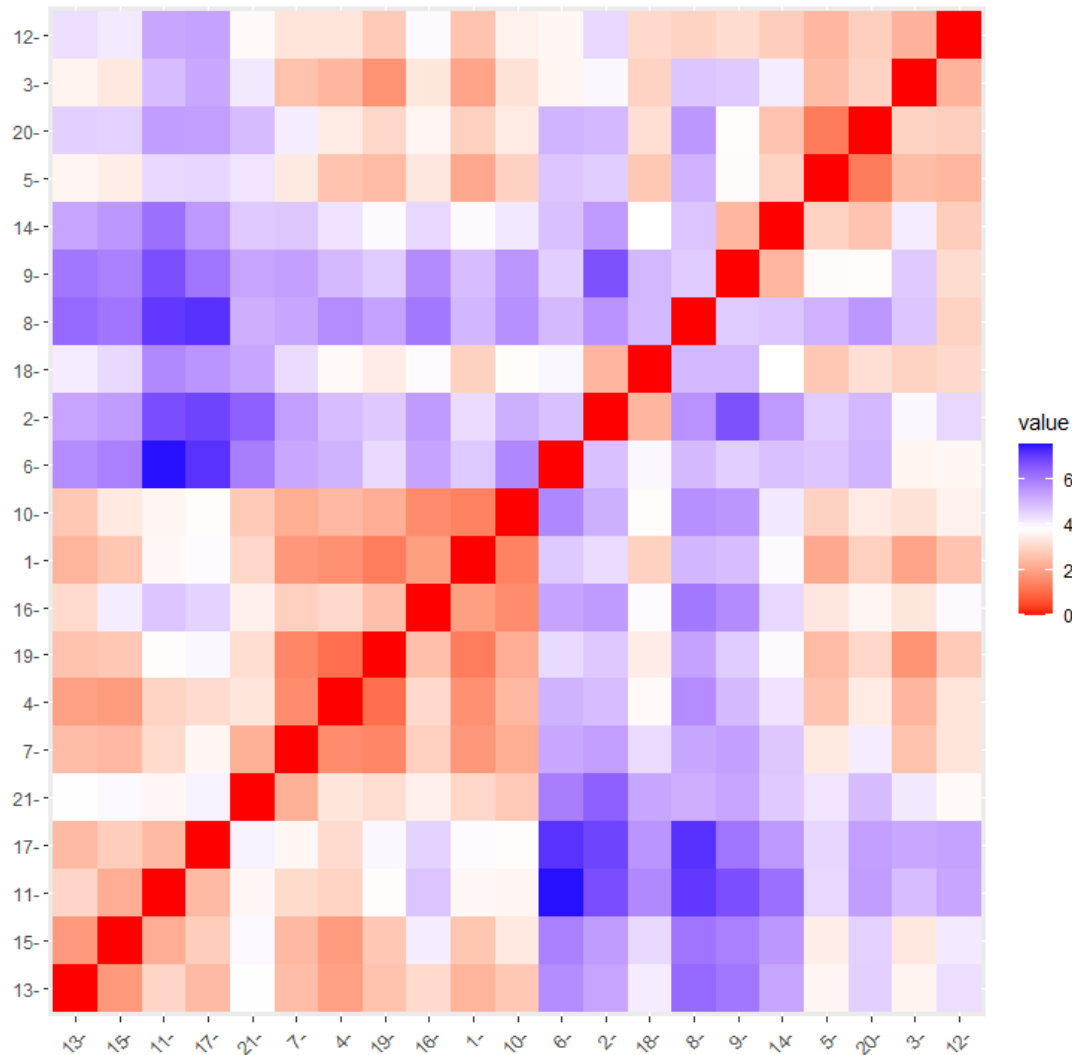
```
[1] 15.595925 2.803505 12.791257 21.879320 9.284424
(between_ss / total_ss = 65.4 %)
```

Available components:

```
[1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
[2] "betweenss"    "size"         "iter"
[9] "ifault"
```

```
> dist <- dist(pharms2, method = "euclidian")
```

```
> fviz_dist(dist)
```



```
> fitting <- kmeans(pharms2,5)
```

```
> aggregate(pharms2,by = list(fitting$cluster), FUN = mean)
```

Group	1	2	3	4	5
1	1.69558112	-0.1780563	-0.1984582	1.2349879	1.3503431
2	-0.66114002	-0.7233539	-0.3512251	-0.6736441	-0.5915022
3	-0.96247577	1.1949250	-0.3639982	-0.5200697	-0.9610792
4	-0.52462814	0.4451409	1.8498439	-1.0404550	-1.1865838
5	0.08926902	-0.4618336	-0.3208615	0.3260892	0.5396003

```
> Pharmaceuticals3 <- data.frame(pharms2,fitting$cluster)
```

```
> Pharmaceuticals3
```

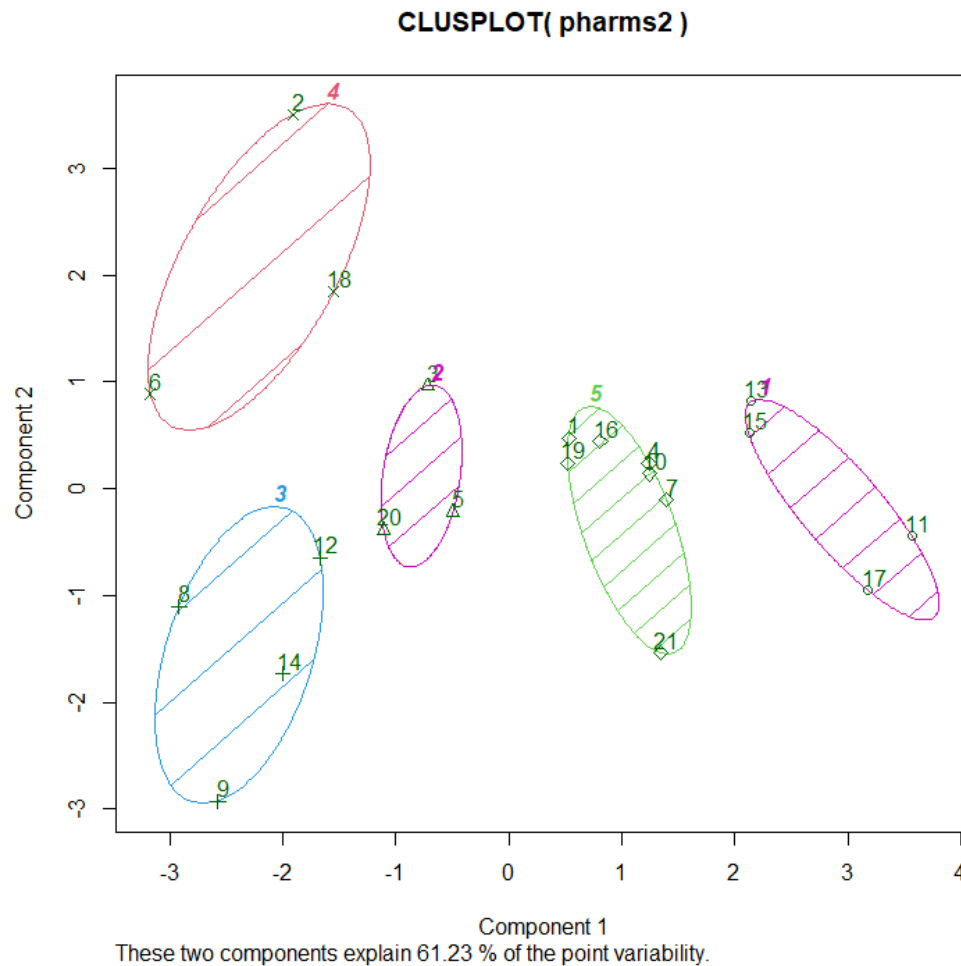
	Market_Cap	Beta	PE_Ratio	ROE	ROA	Asset_Turnover	Leverage	Rev_Growth	Net_Profit_Margin
1	0.1840960	-0.80125356	-0.04671323	0.04009035	0.2416121	0.0000000	-0.21209793	-0.52776752	0.06168225
2	-0.8544181	-0.45070513	3.49706911	-0.85483986	-0.9422871	0.9225312	0.01828430	-0.38113909	-1.55366706
3	-0.8762600	-0.25595600	-0.29195768	-0.72225761	-0.5100700	0.9225312	-0.40408312	-0.57211809	-0.68503583
4	0.1702742	-0.02225704	-0.24290879	0.10638147	0.9181259	0.9225312	-0.74965647	0.14744734	0.35122600
5	-0.1790256	-0.80125356	-0.32874435	-0.26484883	-0.5664461	-0.4612656	-0.31449003	1.21638667	-0.42597037
6	-0.6953818	2.27578267	0.14948233	-1.45146000	-1.7127612	-0.4612656	-0.74965647	-1.49714434	-1.99560225
7	-0.1078688	-0.10015669	-0.70887325	0.59693581	0.8617498	0.9225312	-0.02011273	-0.96584257	0.74744375
8	-0.9767669	1.26308721	0.03299122	-0.11237924	-1.1677918	-0.4612656	3.74279705	-0.63276071	-1.24888417
9	-0.9704532	2.15893320	-1.34037772	-0.70899938	-1.0174553	-1.8450624	0.61983791	1.88617085	-0.36501379
10	0.2762415	-1.34655112	0.14948233	0.34502953	0.5610770	-0.4612656	-0.07130879	-0.64814764	1.17413980
11	1.0999201	-0.68440408	-0.45749769	2.45971647	1.8389364	1.3837968	-0.31449003	0.76926048	0.82363947
12	-0.9393967	0.48409069	-0.34100657	-0.29136529	-0.6979905	-0.4612656	1.10620040	0.05603085	-0.71551412
13	1.9841758	-0.25595600	0.18013789	0.18593083	1.0872544	0.9225312	-0.62166634	-0.36213170	0.33598685
14	-0.9632863	0.87358895	0.19240011	-0.96753478	-0.9610792	-1.8450624	0.44065173	1.53860717	0.85411776
15	1.2782387	-0.25595600	-0.40231769	0.98142435	0.8429577	1.8450624	-0.39128411	0.36014907	-0.24310064
16	0.6654710	-1.30760129	-0.23677768	-0.52338423	0.1288598	-0.9225312	-0.67286239	-1.45369888	1.02174835
17	2.4199899	-0.48409069	-0.11415545	1.31287998	1.6322239	0.4612656	-0.54487226	1.10143723	1.44844440
18	-0.0240882	-0.4865495	1.90298017	-0.81506519	-0.9047030	-0.4612656	-0.30169102	0.14744734	-1.27936246
19	-0.4018816	-0.09210687	-0.40231769	-0.21181593	0.5234929	0.4612656	-0.74965647	-0.43544591	0.29026942
20	-0.9281345	-1.11285216	-0.43297324	-1.03382590	-0.6979905	-0.9225312	-0.49367621	1.43089863	-0.09070919

```
21 -0.1614497 0.40619104 -0.75792214 1.92938746 0.5422849 -0.4612656 0.68383297 -1.17763919 1.49416183
      fitting.cluster
```

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

```
> library(cluster)
```

```
> clusplot(pharms2,fitting$cluster, color = TRUE, shade = TRUE,
+          labels = 2,
+          lines = 0)
```



> #Question B

```
> aggregate(pharms2, by = list(fitting$cluster), FUN = mean)
```

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

```
> pharmacy <- data.frame(pharms2,k5$cluster)
```

```
> pharmacy
```

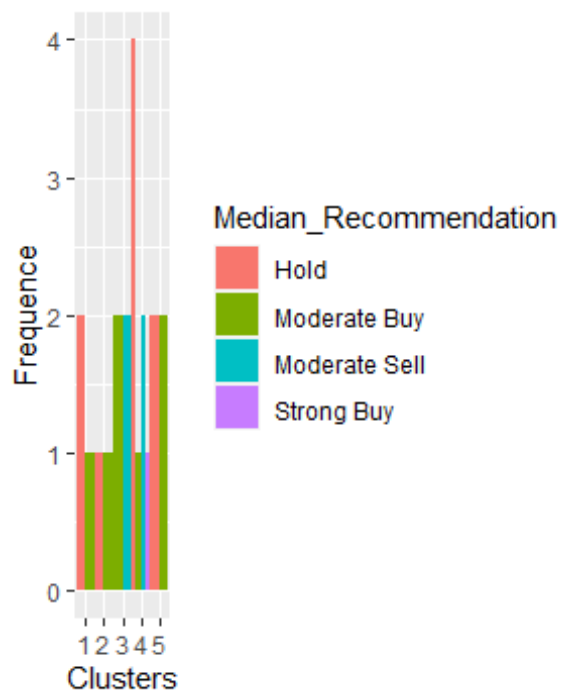
	Market_Cap	Beta	PE_Ratio	ROE	ROA	Asset_Turnover	Leverage	Rev_Growth	Net_Profit_Margin
1	0.1840960	-0.80125356	-0.04671323	0.04009035	0.2416121	0.0000000	-0.21209793	-0.52776752	0.06168225
2	-0.8544181	-0.45070513	3.49706911	-0.85483986	-0.9422871	0.9225312	0.01828430	-0.38113909	-1.55366706
3	-0.8762600	-0.25595600	-0.29195768	-0.72225761	-0.5100700	0.9225312	-0.40408312	-0.57211809	-0.68503583
4	0.1702742	-0.02225704	-0.24290879	0.10638147	0.9181259	0.9225312	-0.74965647	0.14744734	0.35122600
5	-0.1790256	-0.80125356	-0.32874435	-0.26484883	-0.5664461	-0.4612656	-0.31449003	1.21638667	-0.42597037
6	-0.6953818	2.27578267	0.14948233	-1.45146000	-1.7127612	-0.4612656	-0.74965647	-1.49714434	-1.99560225
7	-0.1078668	-0.10015669	-0.70887325	0.59693581	0.8617498	0.9225312	-0.02011273	-0.96584257	0.74744375
8	-0.9767669	1.26308721	0.03299122	-0.11237924	-1.1677918	-0.4612656	3.74279705	-0.63276071	-1.24888417
9	-0.9704532	2.15893320	-1.34037772	-0.70899938	-1.0174553	-1.8450624	0.61983791	1.88617085	-0.36501379
10	0.2762415	-1.34655112	0.14948233	0.34502953	0.5610770	-0.4612656	-0.07130879	-0.64814764	1.17413980
11	1.0999201	-0.68440408	-0.45747969	2.45971647	1.8389364	1.3837968	-0.31449003	0.76926048	0.82363947
12	-0.9393967	0.48409069	-0.34100657	-0.29136529	-0.6979905	-0.4612656	1.10620040	0.05603085	-0.71551412
13	1.9841758	-0.25595600	0.18013789	0.18593083	1.0872544	0.9225312	-0.62166634	-0.36213170	0.33598685
14	-0.9632863	0.87358895	0.19240011	-0.96753478	-0.9610792	-1.8450624	0.44065173	1.53860717	0.85411776
15	1.2782387	-0.25595600	-0.40231769	0.98142435	0.8429577	-1.8450624	-0.39128411	0.36014907	-0.24310064
16	0.6654710	-1.30760129	-0.23677768	-0.52338423	0.1288598	-0.9225312	-0.67286239	-1.45369888	1.02174835
17	2.4199899	0.48409069	-0.11415545	1.31287998	1.6322239	0.4612656	-0.54487226	1.10143723	1.44844440
18	-0.0240846	-0.48965495	1.90298017	-0.81506519	-0.9047030	-0.4612656	-0.30169102	0.14744734	-1.27936246
19	-0.4018812	-0.06120687	-0.40231769	-0.21181593	0.5234929	0.4612656	-0.74965647	-0.43544591	0.29026942
20	-0.9281345	-1.11285216	-0.43297324	-1.03382590	-0.6979905	-0.9225312	-0.49367621	1.43089863	-0.09070919
21	-0.1614497	0.40619104	-0.75792214	1.92938746	0.5422849	-0.4612656	0.68383297	-1.17763919	1.49416183

	k5.cluster
1	4
2	2
3	4
4	4
5	3
6	1
7	4
8	1
9	3
10	4
11	5
12	1
13	5
14	3
15	5
16	4
17	5
18	2
19	4
20	3
21	4

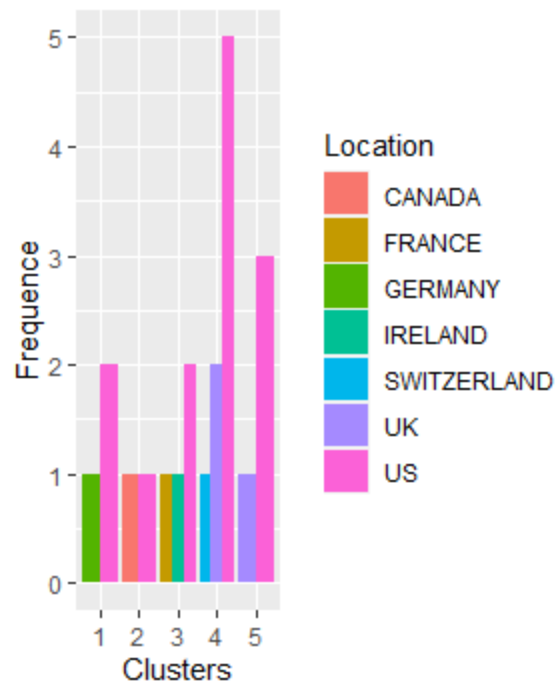
> #Question C

```
> S1 <- pharms[12:14] %>% mutate(Clusters=k5$cluster)
```

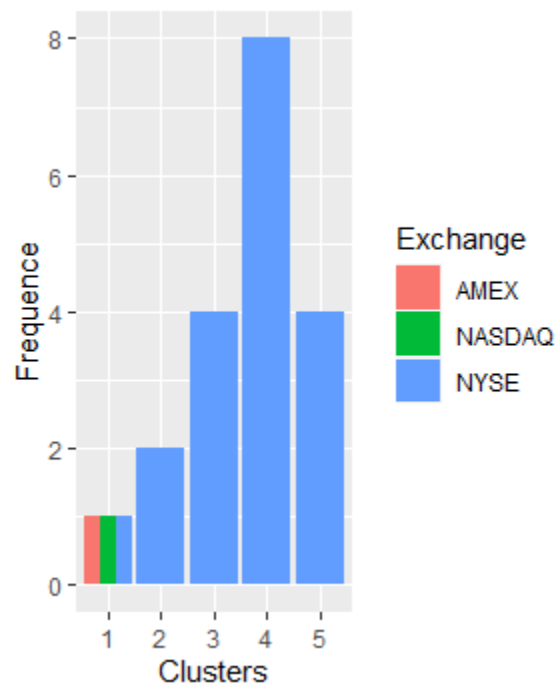
```
> ggplot(S1, mapping = aes(factor(Clusters), fill =Median_Recommendation))+geom_bar(position='dodge')+labs(x = 'Clusters',y = 'Frequence')
```



```
> ggplot(S1, mapping = aes(factor(Clusters),fill = Location))+  
+   geom_bar(position = 'dodge')+labs(x = 'Clusters',y = 'Frequence')
```

```
> ggplot(S1, mapping = aes(factor(Clusters), fill = Exchange)) + geom_bar(position = 'dodge') +
+   labs(x = 'Clusters', y = 'Frequency')
```



> #Question D

#Cluster 1 – Hold

#Cluster 2 – Moderate Buy

#Cluster 3 – Sell

#Cluster 4 – Watch

#Cluster 5 – Buy