STA380, Part2: Exercises 1

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# Probability Practice

## Part A

**Here's a question a friend of mine was asked when he interviewed at Google.**

**Visitors to your website are asked to answer a single survey question before they get access to the content on the page. Among all of the users, there are two categories: Random Clicker (RC), and Truthful Clicker (TC). There are two possible answers to the survey: yes and no. Random clickers would click either one with equal probability. You are also giving the information that the expected fraction of random clickers is 0.3.**

**After a trial period, you get the following survey results: 65% said Yes and 35% said No.**

**What fraction of people who are truthful clickers answered yes?**

**Solution:**

We solved this problem by using the concept of Total Sum of Probilities which states that:

We know that the probability of a Random clicker is 0.3. Also, we know that the probability of Yes/No given a Random Clicker is 0.5. From this, we can derive the overall probaility of a Yes/No from a Random Clicker = 0.5 \* 0.3 = 0.15.

Thus, the fraction of 'Yes'es from a Truthful speaker = 0.5/0.7 = 0.7142857

## Part B

**Imagine a medical test for a disease with the following two attributes:**

* **The sensitivity is about 0.993. That is, if someone has the disease, there is a probability of 0.993 that they will test positive.**
* **The specificity is about 0.9999. This means that if someone doesn't have the disease, there is probability of 0.9999 that they will test negative.**

**In the general population, incidence of the disease is reasonably rare: about 0.0025% of all people have it (or 0.000025 as a decimal probability).**

**Suppose someone tests positive. What is the probability that they have the disease? In light of this calculation, do you envision any problems in implementing a universal testing policy for the disease?**

**Solution:**

If a test's result is positive, the probability that there is a disease is very less i.e.approximately 0.2. This implies that there are a lot of false positives from this test. If this is implemented as a universal testing policy, a lot of people will be falsely informed of having the disease when they don't. In medical world, this would be a blunder.

## Exploratory analysis: green buildings

#### Loading data and loading

greenBuildings <- read.csv("files/greenbuildings.csv")

#### Looking at the relationship between the variables *EnergyStar*, *LEED* and *green\_rating*

The reason we decided to investigate this first is because

EPA's ENERGY STAR identifies the nation's most energy-efficient commercial buildings and industrial plants. Through ENERGY STAR, EPA offers 1 – 100 *ENERGY STAR* scores that rate buildings against their peers. To earn the ENERGY STAR, a fully operational facility must earn an ENERGY STAR score of 75 or higher, meaning that it performs in the top 25 percent of similar facilities nationwide for energy efficiency.

LEED is a green building rating system administered by the private non-profit U.S. Green Building Council. LEED addresses several environmental attributes in addition to energy efficiency, such as materials, waste, and water. To earn LEED certification, a building does not always need to meet the rigorous energy performance level required to earn EPA's ENERGY STAR.

While LEED can help organizations achieve a wide range of sustainability goals, ENERGY STAR certification is the only way to ensure superior energy performance. For this reason, the two programs can work very well together. LEED is frowned upon by many owners and investors, however, because it can be incredibly expensive to become certified. Many owners, developers and investors pass on LEED certification because the additional cost of commissioning, paperwork and professional fees seems daunting and unnecessary. In fact, LEED and Energy Star are complimentary to each other. Buildings may be both LEED certified and Energy Star rated, and LEED requires Energy Star as part of its EB (Existing Building) rating system.

library(knitr)  
library(xtable)  
  
summary(greenBuildings[which(greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.98 19.43 25.03 28.44 34.18 250.00

summary(greenBuildings[which(greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 8.87 21.50 27.60 30.03 35.54 138.10

# Checking relationship between EnergyStar and LEED ratings with green\_rating  
green\_EnergyStar\_LEED <- xtabs(~green\_rating   
 + Energystar   
 + LEED, data = greenBuildings)  
# ftable(green\_EnergyStar\_LEED) # print table

|  |  |  |  |
| --- | --- | --- | --- |
| 0 | 0 | 0 | 7209 |
| 1 | 0 | 0 | 0 |
| 0 | 1 | 0 | 0 |
| 1 | 1 | 0 | 631 |
| 0 | 0 | 1 | 0 |
| 1 | 0 | 1 | 47 |
| 0 | 1 | 1 | 0 |
| 1 | 1 | 1 | 7 |

# Checking medians of buildings which are amongst the categories in the x-tab above  
summary(greenBuildings[which(greenBuildings$Energystar == 0   
 & greenBuildings$LEED == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.98 19.43 25.03 28.44 34.18 250.00

summary(greenBuildings[which(greenBuildings$Energystar == 1   
 & greenBuildings$LEED == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 8.87 21.55 28.12 30.06 35.79 138.10

summary(greenBuildings[which(greenBuildings$Energystar == 0   
 & greenBuildings$LEED == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 9.00 21.50 24.36 29.21 31.02 98.65

summary(greenBuildings[which(greenBuildings$Energystar == 1   
 & greenBuildings$LEED == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 17.50 20.50 24.00 32.99 38.22 72.00

# Checking relationship between EnergyStar and LEED ratings with green\_rating  
greenRating\_net <- xtabs(~green\_rating  
 + net, data = greenBuildings)  
ftable(greenRating\_net) # print table

## net 0 1  
## green\_rating   
## 0 6974 235  
## 1 646 39

EnergyStar\_LEED\_net <- xtabs(~Energystar  
 + LEED  
 + net, data = greenBuildings)  
ftable(EnergyStar\_LEED\_net) # print table

## net 0 1  
## Energystar LEED   
## 0 0 6974 235  
## 1 44 3  
## 1 0 596 35  
## 1 6 1

summary(greenBuildings[which(greenBuildings$net == 1   
 & greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'],na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 11.19 19.10 21.96 24.32 24.91 82.43

summary(greenBuildings[which(greenBuildings$net == 0   
 & greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'],na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.98 19.50 25.34 28.59 34.20 250.00

summary(greenBuildings[which(greenBuildings$net == 0   
 & greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'],na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 8.87 21.69 28.20 30.37 35.99 138.10

summary(greenBuildings[which(greenBuildings$net == 1   
 & greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'],na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 11.27 19.88 22.29 24.39 26.76 50.53

# Checking relationship between EnergyStar and LEED ratings with green\_rating  
greenRating\_classAB <- xtabs(~green\_rating  
 + class\_a   
 + class\_b, data = greenBuildings)  
ftable(greenRating\_classAB) # print table

## class\_b 0 1  
## green\_rating class\_a   
## 0 0 1103 3495  
## 1 2611 0  
## 1 0 7 132  
## 1 546 0

EnergyStar\_LEED\_classAB <- xtabs(~Energystar  
 + LEED  
 + class\_a   
 + class\_b, data = greenBuildings)  
ftable(EnergyStar\_LEED\_classAB) # print table

## class\_b 0 1  
## Energystar LEED class\_a   
## 0 0 0 1103 3495  
## 1 2611 0  
## 1 0 1 14  
## 1 32 0  
## 1 0 0 6 117  
## 1 508 0  
## 1 0 0 1  
## 1 6 0

summary(greenBuildings[which(greenBuildings$class\_a == 1   
 & greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 9.00 21.50 28.20 32.64 38.00 250.00

summary(greenBuildings[which(greenBuildings$class\_a == 0   
 & greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.98 18.00 23.65 25.98 31.80 200.00

summary(greenBuildings[which(greenBuildings$class\_a == 0   
 & greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 9.00 19.51 25.68 26.23 31.43 98.65

summary(greenBuildings[which(greenBuildings$class\_a == 1   
 & greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 8.87 22.07 28.44 30.99 36.59 138.10

summary(greenBuildings[which(greenBuildings$class\_b == 1   
 & greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 2.98 18.09 24.00 26.52 32.50 199.00

summary(greenBuildings[which(greenBuildings$class\_b == 0   
 & greenBuildings$green\_rating == 0   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 5.07 20.13 25.85 30.26 35.21 250.00

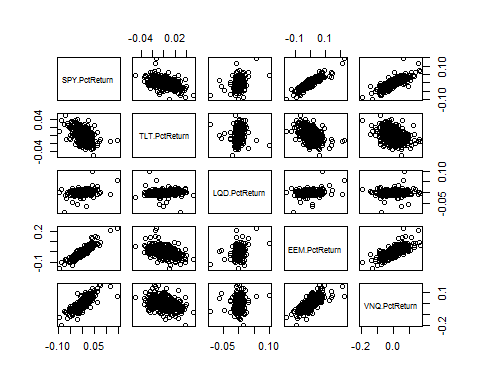
summary(greenBuildings[which(greenBuildings$class\_b == 0   
 & greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 8.87 22.03 28.44 30.95 36.52 138.10

summary(greenBuildings[which(greenBuildings$class\_b == 1   
 & greenBuildings$green\_rating == 1   
 & greenBuildings$leasing\_rate > 10) ,'Rent'], na.rm = T)

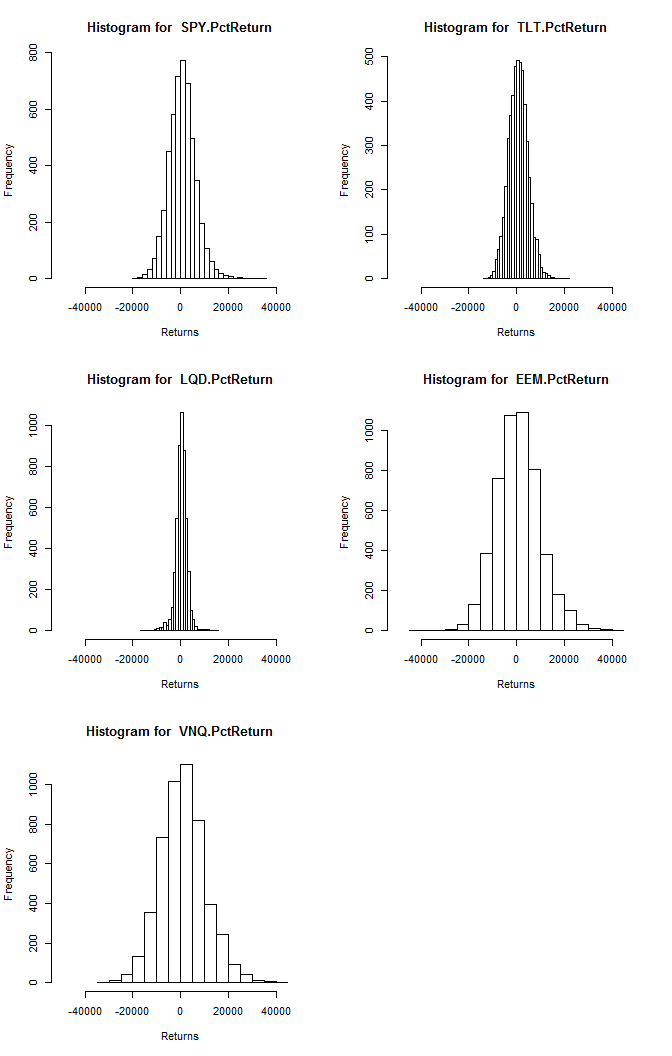
## Min. 1st Qu. Median Mean 3rd Qu. Max.   
## 9.00 19.52 25.20 26.12 30.60 98.65

## Bootstrapping



The correlation graph between stocks gives us an overview of how the stocks are related:

* A safer stock would be the one which does not vary much due to changes in other stocks and has positive returns. In this case, LQD is one such stock with close to zero correlation with all other stocks except TLT. LQD has a negative correlation of 0.42 with TLT, which is again very less.
* Also, SPY, EEM and VNQ are positively correlated with each other. This makes them the riskier stocks since they are sensitive to variations in other stocks. The Exact order of riskiness can e determined buu the means and standard deviations of individual stocks
* TLT is negatively correlated with SPY, EEM and VNQ but it is safer than these 3 stocks since the correlation is weaker. The correlation plots for TLT are loose and spread out.



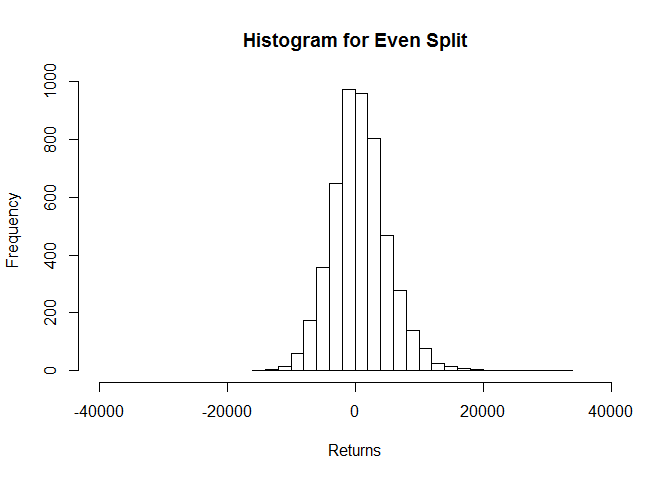
From the histograms above, it is evident that higher the spread of the histogram, the more would be the risk involved. Similarly, the narrower the histogram, the safer the stock is. When the histogram is narrower, the sample means are not varying much. Also, the returns would be less for the safer stocks and more for the riskier stocks given the stocks perform good in nthe market. The order of riskiness that we have obtained from the above chart is VNQ > EEM > SPY > TLT > LQD.

The individual 5% Value at Risk for the 5 stocks in the order of SPY, TLT, LQD, EEM and VNQ are: -8113.3881793, -5840.7310754, -3212.4730924, -1.367477110^{4}, -1.37367610^{4}

The individual means for the 5 stocks in the order of SPY, TLT, LQD, EEM and VNQ are: 1.00714210^{5}, 1.007344110^{5}, 1.004080210^{5}, 1.00799210^{5}, 1.011642810^{5}

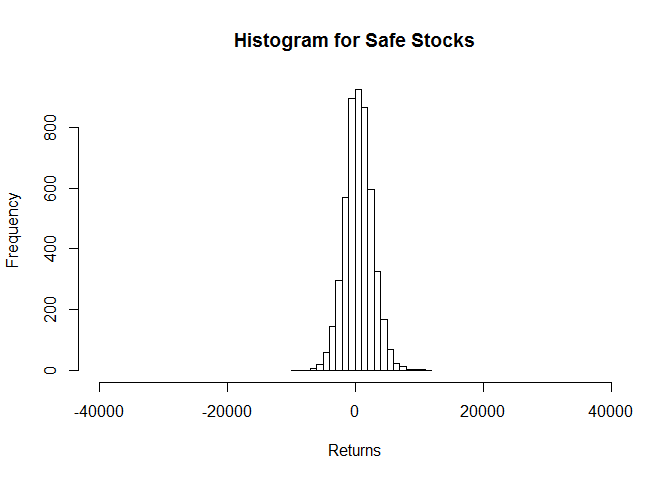
The individual standard deviations for the 5 stocks in the order of SPY, TLT, LQD, EEM and VNQ are: 5553.2480367, 4040.2782479, 2399.7497675, 9196.8423902, 9468.5590593

#### Even split: 20% of the assets in each of the five ETFs above.



The 5% Value at Risk for Even Split = -6049.0732004

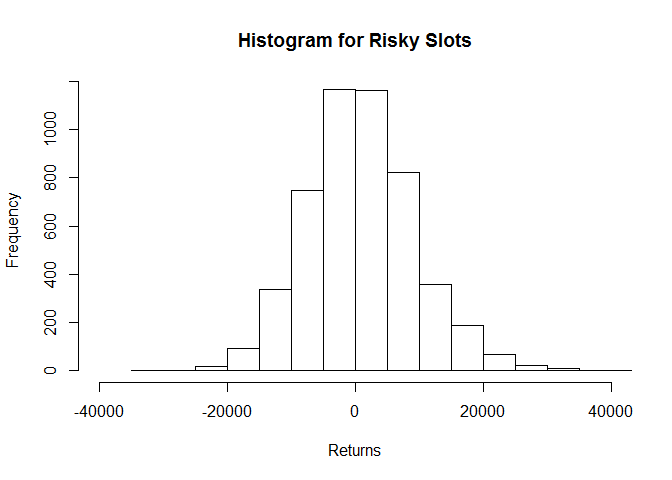
#### Safe Investment



We have established that the Assets : SPY, TLT and LQD are the safer stocks by looking at their individual histograms. The proportion that we have taken for the investment is 0.1, 0.3, 0.6 , respectively.

Using this proportion, the 5% value at risk comes out to be -2941.9844668

#### Aggressive Investment



### Conclusion

We have established that the Assets : EEM and VNQ are the riskier stocks. The proportion that we have taken for the investment is 0.5, 0.5 , respectively.

Using this proportion, the 5% value at risk comes out to be -1.231489110^{4}

## Market segmentation

#### Inital Set-up and Loading the Data:

library(flexclust)

## Loading required package: grid

## Loading required package: modeltools

## Loading required package: stats4

library(ggplot2)  
library(reshape2)  
library(corrplot)  
library(corrgram)  
  
social\_mkt = read.csv("files/social\_marketing.csv")

Initial analysis of data suggested that 'spam' and 'adult' just noise and don't add any value to the analysis.

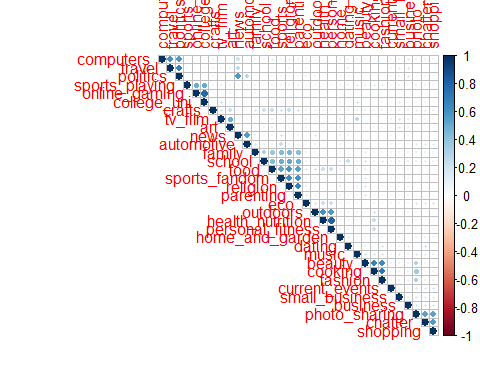
sm\_wo\_junk = social\_mkt[,-c(36,37)]  
sm\_wo\_id = sm\_wo\_junk[,-1]

Since annotators used both 'uncategorized' and 'chatter' for tweets that didn't fit into any of the categories, we decided to club both of these together. '

sm\_wo\_id$chatter = sm\_wo\_id$uncategorized + sm\_wo\_id$chatter  
sm\_wo\_id = sm\_wo\_id[,-5]

In order to get started with cluster formation and analysis, we began by exploring the correlations.

correlation\_matrix = cor(sm\_wo\_id)  
corrplot(correlation\_matrix, type="upper", order="hclust")



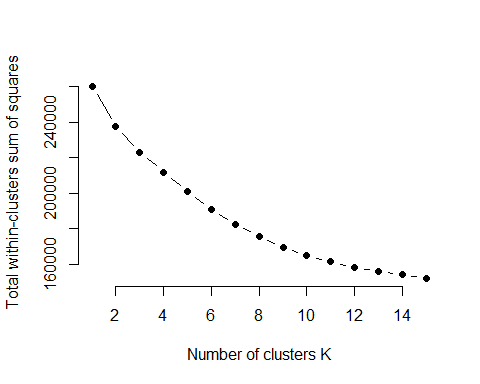
sm\_wo\_id\_scaled <- scale(sm\_wo\_id, center=TRUE, scale=TRUE)  
  
# Creating pair-wise correlations ordered by max correlation  
zdf <- as.data.frame(as.table(cor(sm\_wo\_id)))  
zdf\_2 <- subset(zdf, (abs(Freq) > 0.4 & Var1 != Var2))  
zdf\_2[order(zdf\_2$Freq,decreasing = T), ]

## Var1 Var2 Freq  
## 493 personal\_fitness health\_nutrition 0.8099024  
## 1005 health\_nutrition personal\_fitness 0.8099024  
## 412 college\_uni online\_gaming 0.7728393  
## 508 online\_gaming college\_uni 0.7728393  
## 593 fashion cooking 0.7214027  
## 1041 cooking fashion 0.7214027  
## 588 beauty cooking 0.6642389  
## 876 cooking beauty 0.6642389  
## 73 politics travel 0.6602100  
## 201 travel politics 0.6602100  
## 853 parenting religion 0.6555973  
## 917 religion parenting 0.6555973  
## 191 religion sports\_fandom 0.6379748  
## 831 sports\_fandom religion 0.6379748  
## 890 fashion beauty 0.6349739  
## 1050 beauty fashion 0.6349739  
## 484 outdoors health\_nutrition 0.6082254  
## 708 health\_nutrition outdoors 0.6082254  
## 193 parenting sports\_fandom 0.6077181  
## 897 sports\_fandom parenting 0.6077181  
## 86 computers travel 0.6029349  
## 630 travel computers 0.6029349  
## 257 religion food 0.5913181  
## 833 food religion 0.5913181  
## 218 computers politics 0.5721506  
## 634 politics computers 0.5721506  
## 14 shopping chatter 0.5686992  
## 430 chatter shopping 0.5686992  
## 724 personal\_fitness outdoors 0.5677903  
## 1012 outdoors personal\_fitness 0.5677903  
## 210 news politics 0.5618422  
## 370 politics news 0.5618422  
## 387 automotive news 0.5554175  
## 771 news automotive 0.5554175  
## 259 parenting food 0.5449481  
## 899 food parenting 0.5449481  
## 113 shopping photo\_sharing 0.5356210  
## 433 photo\_sharing shopping 0.5356210  
## 4 photo\_sharing chatter 0.5342643  
## 100 chatter photo\_sharing 0.5342643  
## 173 food sports\_fandom 0.5326384  
## 237 sports\_fandom food 0.5326384  
## 855 school religion 0.5162180  
## 983 religion school 0.5162180  
## 512 sports\_playing college\_uni 0.5063748  
## 544 college\_uni sports\_playing 0.5063748  
## 921 school parenting 0.4996164  
## 985 parenting school 0.4996164  
## 157 art tv\_film 0.4987718  
## 797 tv\_film art 0.4987718  
## 195 school sports\_fandom 0.4931062  
## 963 sports\_fandom school 0.4931062  
## 413 sports\_playing online\_gaming 0.4912993  
## 541 online\_gaming sports\_playing 0.4912993  
## 290 religion family 0.4527685  
## 834 family religion 0.4527685  
## 174 family sports\_fandom 0.4378104  
## 270 sports\_fandom family 0.4378104  
## 261 school food 0.4324039  
## 965 food school 0.4324039  
## 292 parenting family 0.4205780  
## 900 family parenting 0.4205780

Looking at the correlation plot, its seems that there are 5-7 combinations of correlated variables. People with majority of tweets in these categories can be clustered together.

In order to get an optimal number of clusters, we implemented the 'Elbow' method which gave us an optimum cluster number.

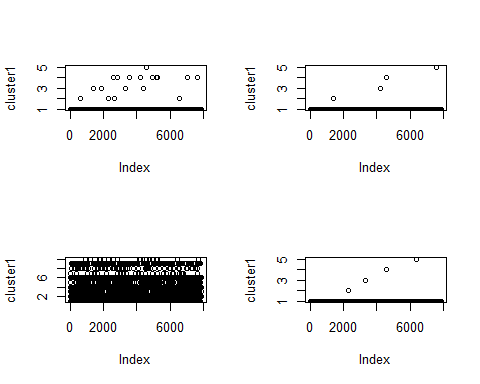
set.seed(1)  
# Compute and plot wss for k = 2 to k = 15  
k.max <- 15 # Maximal number of clusters  
data <- sm\_wo\_id\_scaled  
wss <- sapply(1:k.max,   
 function(k){kmeans(data, k, nstart=10 )$tot.withinss})  
plot(1:k.max, wss,  
 type="b", pch = 19, frame = FALSE,   
 xlab="Number of clusters K",  
 ylab="Total within-clusters sum of squares")



The optimal number of clusters as per the algorithm is 5-7. Now, we evaluate different clustering methods to get the clusters.

#### Heirarchical Clustering

##Heirarchical Clustering ##   
par(mfrow=c(2,2))  
# Form a pairwise distance matrix using the dist function  
distance\_matrix = dist(sm\_wo\_id\_scaled, method='euclidean')  
  
# Now run hierarchical clustering  
hier\_p = hclust(distance\_matrix, method='average')  
cluster1 = cutree(hier\_p, k=5)  
  
# Plot the dendrogram  
plot(cluster1, cex=0.8)  
  
# Now run hierarchical clustering  
hier\_p = hclust(distance\_matrix, method='centroid')  
cluster1 = cutree(hier\_p, k=5)  
  
# Plot the dendrogram  
plot(cluster1, cex=0.8)  
  
# Now run hierarchical clustering  
hier\_p = hclust(distance\_matrix, method='complete')  
cluster1 = cutree(hier\_p, k=10)  
  
# Plot the dendrogram  
plot(cluster1, cex=0.8)  
  
# Now run hierarchical clustering  
hier\_p = hclust(distance\_matrix, method='single')  
cluster1 = cutree(hier\_p, k=5)  
  
# Plot the dendrogram  
plot(cluster1, cex=0.8)

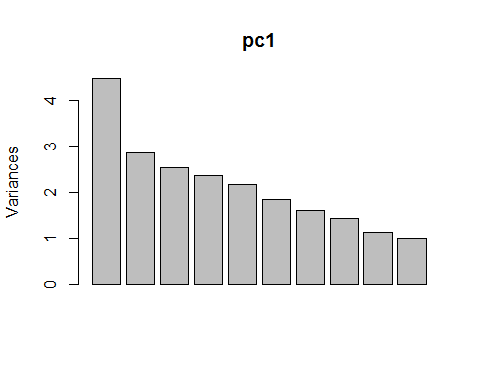


ind =which(cluster1 == 3)  
  
sm\_wo\_id\_node2 = sm\_wo\_id[ind,]

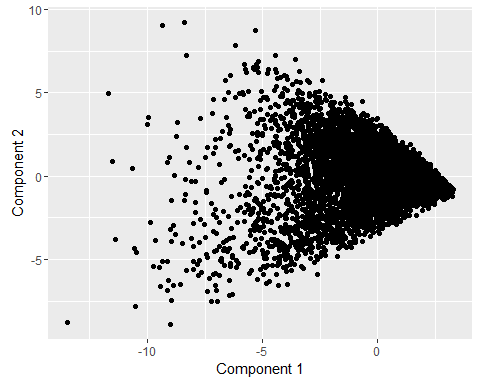
As we can see in Hierarchical clustering, the depth of the tree is very huge. We tried to cut tree to 5 Clusters, but the results are hard to interpret and we couldn't derive meaning from that.

#### PCA

## PCA ##   
Z = sm\_wo\_id  
Z\_normalized = scale(Z, scale=T, center=T)  
pc1 = prcomp(as.matrix(Z), scale.=TRUE)  
plot(pc1)



loadings = pc1$rotation  
scores = pc1$x  
qplot(scores[,1], scores[,2], xlab='Component 1', ylab='Component 2')



o1 = order(loadings[,1])  
colnames(Z)[head(o1,25)]

## [1] "religion" "food" "parenting"   
## [4] "sports\_fandom" "school" "family"   
## [7] "beauty" "crafts" "cooking"   
## [10] "fashion" "photo\_sharing" "eco"   
## [13] "computers" "chatter" "outdoors"   
## [16] "personal\_fitness" "business" "shopping"   
## [19] "automotive" "politics" "sports\_playing"   
## [22] "news" "health\_nutrition" "music"   
## [25] "small\_business"

colnames(Z)[tail(o1,25)]

## [1] "cooking" "fashion" "photo\_sharing"   
## [4] "eco" "computers" "chatter"   
## [7] "outdoors" "personal\_fitness" "business"   
## [10] "shopping" "automotive" "politics"   
## [13] "sports\_playing" "news" "health\_nutrition"  
## [16] "music" "small\_business" "travel"   
## [19] "home\_and\_garden" "dating" "current\_events"   
## [22] "art" "tv\_film" "college\_uni"   
## [25] "online\_gaming"

The Principal Component analysis gave us a lot of significant components. Substantial information could not be extracted from 4-6 components to infer the cluster composition.

#### K-means

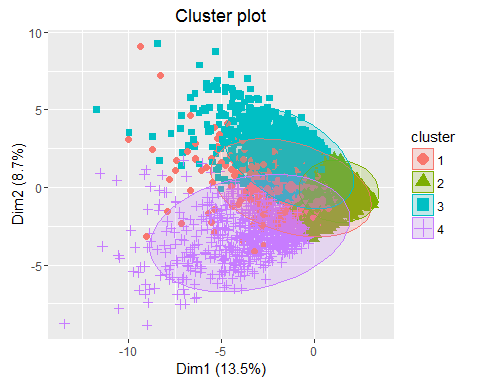
## try kmeans   
library(factoextra)  
library(cluster)  
library(NbClust)  
  
sm\_wo\_id\_scaled <- scale(sm\_wo\_id, center=TRUE, scale=TRUE)

We used K-means to get clusters varying between 4-7 and understand cluster composition.

# K-means clustering with 4   
set.seed(1)  
km.res <- kmeans(sm\_wo\_id\_scaled, 4, nstart = 25)  
# k-means group number of each observation  
km.res$cluster

## [1] 3 2 3 2 2 2 1 3 3 4 2 4 3 2 2 2 1 1 2 2 3 2 2 2 2 2 2 1 2 3 2 3 3 4  
## [35] 2 2 1 1 3 2 2 1 2 2 3 1 2 4 2 1 2 2 1 2 2 3 3 2 2 2 2 2 2 2 2 1 2 3  
## [69] 2 1 2 2 2 2 2 2 4 2 2 2 3 3 2 2 2 3 3 4 2 2 3 3 1 2 3 2 3 1 2 3 2 2  
## [103] 2 3 3 2 2 3 2 2 3 2 2 2 4 2 2 2 3 2 3 1 3 2 1 2 2 2 3 2 2 1 2 2 3 3  
## [137] 3 2 2 3 2 2 3 2 3 4 2 3 1 2 2 2 2 2 2 4 2 2 2 2 2 2 1 1 2 3 2 2 2 2  
## [171] 2 3 3 3 2 2 2 3 4 2 2 2 3 2 1 3 2 1 2 2 4 2 4 2 2 2 2 2 2 2 2 2 3 2  
## [205] 2 3 2 2 2 2 2 2 2 1 3 2 1 2 1 2 2 2 2 3 2 3 3 3 1 1 2 4 3 3 4 2 2 4  
## [239] 2 2 2 4 2 2 3 2 4 3 3 2 1 3 2 3 2 2 1 2 2 2 2 2 3 3 3 1 2 2 2 2 2 2  
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# Visualize k-means clusters  
fviz\_cluster(km.res, data = sm\_wo\_id\_scaled, geom = "point",  
 stand = FALSE, frame.type = "norm")



clusters\_pars = km.res$centers  
transposed = t(clusters\_pars)  
cluster\_1 = transposed[which(abs(transposed[,1])>=0.5),1]  
cluster\_2 = transposed[which(abs(transposed[,2])>=0.5),2]  
cluster\_3 = transposed[which(abs(transposed[,3])>=0.5),3]  
cluster\_1

## travel politics news computers automotive   
## 1.763153 2.369479 1.930022 1.546314 1.118160

cluster\_2

## numeric(0)

cluster\_3

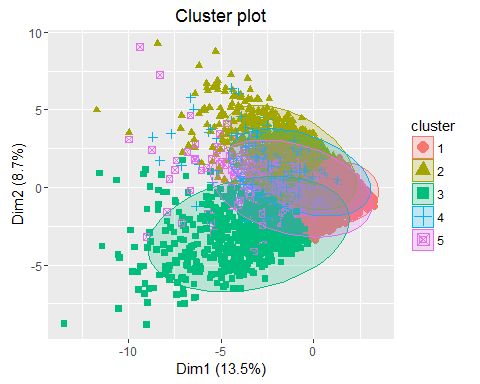
## chatter photo\_sharing shopping health\_nutrition   
## 0.6362693 0.8200723 0.6006349 0.6698805   
## cooking outdoors beauty personal\_fitness   
## 0.8862218 0.5394830 0.6573305 0.6821269   
## fashion   
## 0.7696686

**Trying with 5 clusters:**

# K-means clustering with 5  
set.seed(1)  
km.res <- kmeans(sm\_wo\_id\_scaled, 5, nstart = 25)  
# k-means group number of each observation  
km.res$cluster

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## [7855] 1 2 1 4 1 2 1 5 3 1 1 4 1 1 5 3 1 5 2 1 4 1 3 1 5 4 1 2

# Visualize k-means clusters  
fviz\_cluster(km.res, data = sm\_wo\_id\_scaled, geom = "point",  
 stand = FALSE, frame.type = "norm")



clusters\_pars = km.res$centers  
transposed = t(clusters\_pars)  
cluster\_1 = transposed[which(abs(transposed[,1])>=0.5),1]  
cluster\_2 = transposed[which(abs(transposed[,2])>=0.5),2]  
cluster\_3 = transposed[which(abs(transposed[,3])>=0.5),3]  
cluster\_4 = transposed[which(abs(transposed[,4])>=0.5),4]  
cluster\_5 = transposed[which(abs(transposed[,5])>=0.5),5]  
  
cluster\_1

## numeric(0)

cluster\_2

## chatter photo\_sharing music shopping college\_uni   
## 0.8043252 1.0644587 0.5610928 0.7707609 0.5933295   
## cooking beauty fashion   
## 0.8638999 0.8555066 0.9585076

cluster\_3

## sports\_fandom food family crafts religion   
## 2.0495745 1.8226930 1.4947438 0.7068447 2.2515579   
## parenting school   
## 2.1181399 1.6614164

cluster\_4

## health\_nutrition eco outdoors personal\_fitness   
## 2.1591362 0.5169836 1.6686893 2.1239862

cluster\_5

## travel politics news computers automotive   
## 1.842251 2.429340 1.935524 1.637643 1.077207

The cluster composition we got from five clusters makes sense intuitively and is interpretable. In order to visualize these clusters and understand their prominent characteristics, we used word cloud.

# A word cloud  
par(mfrow=c(2,2))  
library(wordcloud)

## Loading required package: RColorBrewer

for (i in 2:5) {  
wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i,], min.freq=0, max.words=100, scale=c(5,.5))  
}

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : online\_gaming could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : sports\_playing could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : shopping could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : fashion could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : small\_business could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : cooking could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : photo\_sharing could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : dating could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : tv\_film could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : college\_uni could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : school could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : chatter could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : sports\_fandom could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : parenting could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : religion could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : school could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : food could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : health\_nutrition could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : personal\_fitness could not be fit on page. It will not be  
## plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : outdoors could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : computers could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : travel could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : news could not be fit on page. It will not be plotted.

## Warning in wordcloud(colnames(sm\_wo\_id\_scaled), km.res$centers[i, ],  
## min.freq = 0, : politics could not be fit on page. It will not be plotted.

