

## Assignment 5

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#Reading the directory

```
getwd()
```

```
## [1] "C:/Users/Nikesh/Downloads"
```

#Reading the file

```
Assign <- read.csv("Cereals.csv")
```

#Required packages

```
library(dplyr)
```

```
##
```

```
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
```

```
##
```

```
##      filter, lag
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
##      intersect, setdiff, setequal, union
```

```
library(cluster)
```

```
library(fpc)
```

```
library(caret)
```

```
## Loading required package: ggplot2
```

```
## Loading required package: lattice
```

```
library(dendextend)
```

```
##
```

```
## -----
```

```
## Welcome to dendextend version 1.15.2
```

```
## Type citation('dendextend') for how to cite the package.
```

```
##
```

```
## Type browseVignettes(package = 'dendextend') for the package vignette.
```

```
## The github page is: https://github.com/talgalili/dendextend/
```

```
##
```

```
## Suggestions and bug-reports can be submitted at:
```

```
https://github.com/talgalili/dendextend/issues
```

```
## You may ask questions at stackoverflow, use the r and dendextend tags:
##   https://stackoverflow.com/questions/tagged/dendextend
##
## To suppress this message use:
suppressPackageStartupMessages(library(dendextend))
## -----

##
## Attaching package: 'dendextend'

## The following object is masked from 'package:stats':
##
##   cutree

library(knitr)
library(factoextra)

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

library(tidytext)
```

#Data in brief

```
summary(Assign)
```

```
##      name                mfr                type                calories
## Length:77             Length:77             Length:77             Min.   : 50.0
## Class :character       Class :character       Class :character       1st Qu.:100.0
## Mode  :character       Mode  :character       Mode  :character       Median :110.0
##                                     Mean   :106.9
##                                     3rd Qu.:110.0
##                                     Max.   :160.0
##
##      protein            fat                sodium            fiber
## Min.   :1.000          Min.   :0.000          Min.   :  0.0          Min.   : 0.000
## 1st Qu.:2.000          1st Qu.:0.000          1st Qu.:130.0         1st Qu.: 1.000
## Median :3.000          Median :1.000          Median :180.0         Median : 2.000
## Mean   :2.545          Mean   :1.013          Mean   :159.7         Mean   : 2.152
## 3rd Qu.:3.000          3rd Qu.:2.000          3rd Qu.:210.0         3rd Qu.: 3.000
## Max.   :6.000          Max.   :5.000          Max.   :320.0         Max.   :14.000
##
##      carbo              sugars              potass              vitamins
## Min.   : 5.0           Min.   : 0.000          Min.   : 15.00         Min.   :  0.00
## 1st Qu.:12.0           1st Qu.: 3.000          1st Qu.: 42.50         1st Qu.: 25.00
## Median :14.5           Median : 7.000          Median : 90.00         Median : 25.00
## Mean   :14.8           Mean   : 7.026          Mean   : 98.67         Mean   : 28.25
## 3rd Qu.:17.0           3rd Qu.:11.000          3rd Qu.:120.00         3rd Qu.: 25.00
## Max.   :23.0           Max.   :15.000          Max.   :330.00         Max.   :100.00
## NA's   :1             NA's   :1              NA's   :2
##      shelf              weight              cups              rating
## Min.   :1.000          Min.   :0.50           Min.   :0.250          Min.   :18.04
```

```
## 1st Qu.:1.000 1st Qu.:1.00 1st Qu.:0.670 1st Qu.:33.17
## Median :2.000 Median :1.00 Median :0.750 Median :40.40
## Mean :2.208 Mean :1.03 Mean :0.821 Mean :42.67
## 3rd Qu.:3.000 3rd Qu.:1.00 3rd Qu.:1.000 3rd Qu.:50.83
## Max. :3.000 Max. :1.50 Max. :1.500 Max. :93.70
##
```

```
head(Assign)
```

```
##               name mfr type calories protein fat sodium fiber
carbo
## 1           100%_Bran   N    C         70         4   1   130  10.0
5.0
## 2      100%_Natural_Bran   Q    C        120         3   5    15   2.0
8.0
## 3           All-Bran    K    C         70         4   1   260   9.0
7.0
## 4 All-Bran_with_Extra_Fiber    K    C         50         4   0   140  14.0
8.0
## 5           Almond_Delight    R    C        110         2   2   200   1.0
14.0
## 6  Apple_Cinnamon_Cheerios    G    C        110         2   2   180   1.5
10.5
##  sugars potass vitamins shelf weight cups   rating
## 1      6    280        25     3      1 0.33 68.40297
## 2      8    135         0     3      1 1.00 33.98368
## 3      5    320        25     3      1 0.33 59.42551
## 4      0    330        25     3      1 0.50 93.70491
## 5      8     NA        25     3      1 0.75 34.38484
## 6     10     70        25     1      1 0.75 29.50954
```

```
#Eliminating mfr and type from the dataset(character data)
```

```
Assign_New <-select(Assign,-c('mfr','type'))
```

```
#Cheacking the new dataset after eliminating the data
```

```
head(Assign_New)
```

```
##               name calories protein fat sodium fiber carbo sugars
## 1           100%_Bran         70         4   1   130  10.0   5.0    6
## 2      100%_Natural_Bran        120         3   5    15   2.0   8.0    8
## 3           All-Bran         70         4   1   260   9.0   7.0    5
## 4 All-Bran_with_Extra_Fiber         50         4   0   140  14.0   8.0    0
## 5           Almond_Delight        110         2   2   200   1.0  14.0    8
## 6  Apple_Cinnamon_Cheerios        110         2   2   180   1.5  10.5   10
##  potass vitamins shelf weight cups   rating
## 1    280        25     3      1 0.33 68.40297
## 2    135         0     3      1 1.00 33.98368
## 3    320        25     3      1 0.33 59.42551
## 4    330        25     3      1 0.50 93.70491
```

```
## 5      NA      25      3      1 0.75 34.38484
## 6      70      25      1      1 0.75 29.50954
```

#Eliminating name from dataset and changing row number as name to avoid duplication

```
rownames(Assign_New)<-Assign_New$name
Assign_New$name=NULL
```

#Normalizing the data

```
Assign_New<-as.data.frame(scale(Assign_New))
```

#Preprocessing the data

```
sum(is.na(Assign_New))
```

```
## [1] 4
```

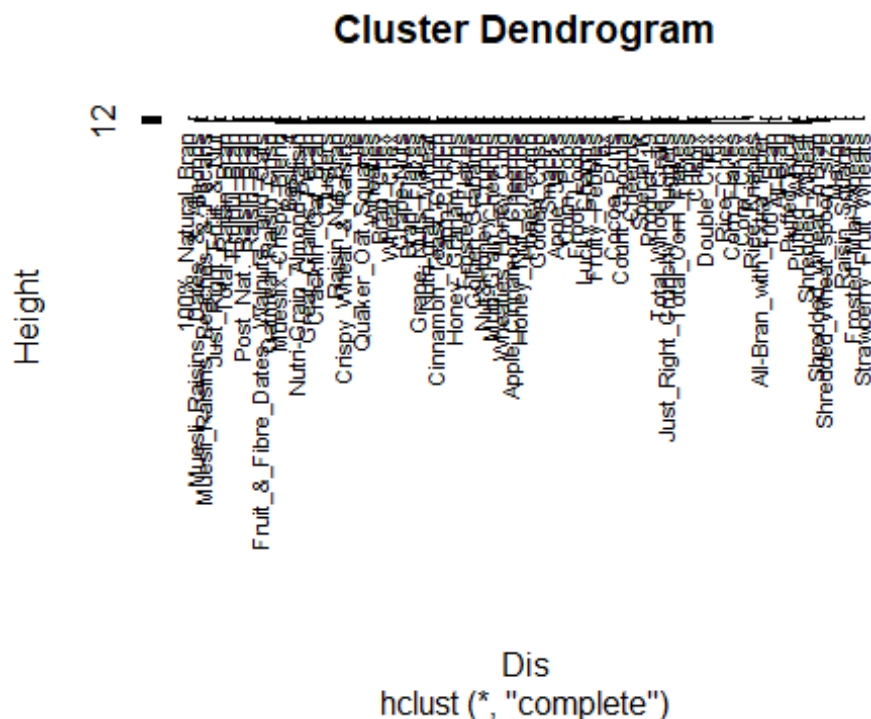
```
Assign_New<-na.omit(Assign_New)
```

#Calculation of Dissimilarity Matrix and performing Hierarchical Clustering

```
Dis <- dist(Assign_New, method = "euclidean")
H_clust <- hclust(Dis, method = "complete")
```

#Plotting the dendrogram

```
plot(H_clust, cex = 0.7, hang = -1)
```



#Q1. Apply hierarchical clustering to the data using Euclidean distance to the normalized measurements. Use Agnes to compare the clustering from single linkage, complete linkage, average linkage, and Ward. Choose the best method.

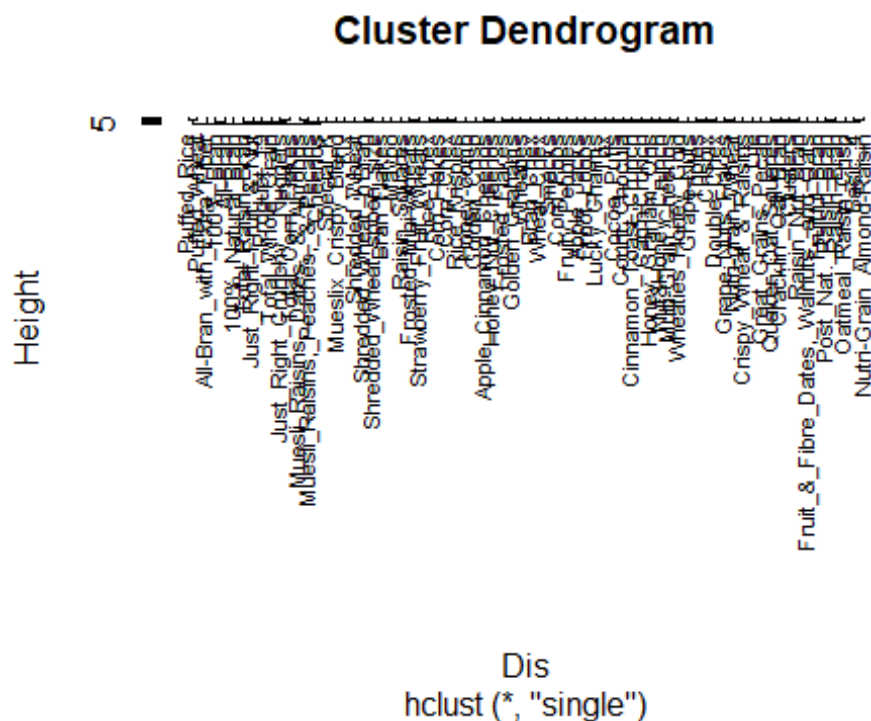
#Single linkage: computes the minimum distance between clusters before merging them.

#Complete linkage: computes the maximum distance between clusters before merging them.

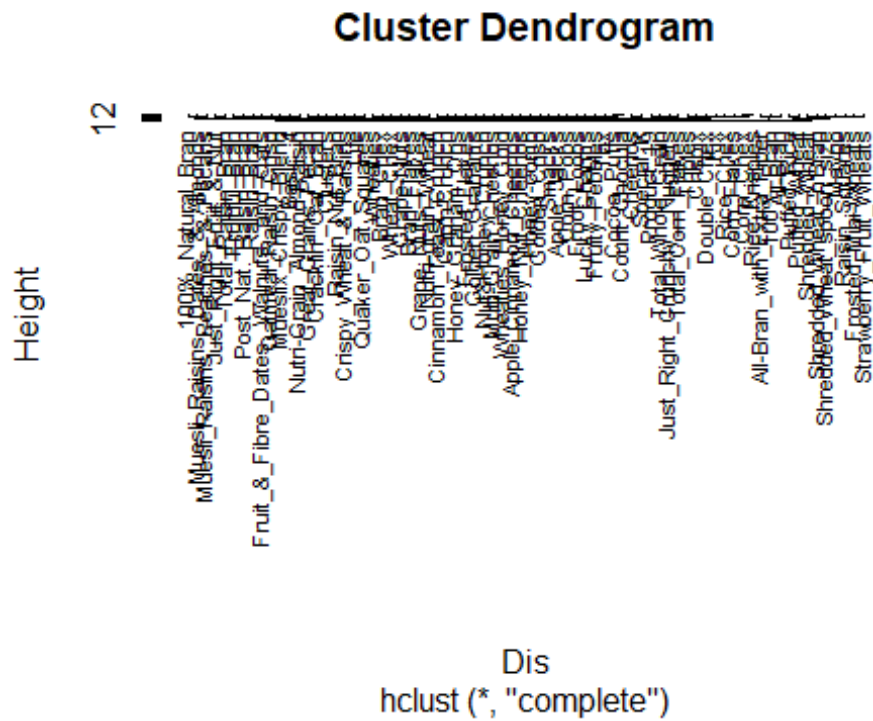
#Average linkage: computes the average distance between clusters before merging them.

#Ward's (minimum variance) criterion: minimizes the total within-cluster variance and find the pair of clusters that leads to minimum increase in total within-cluster variance after merging.

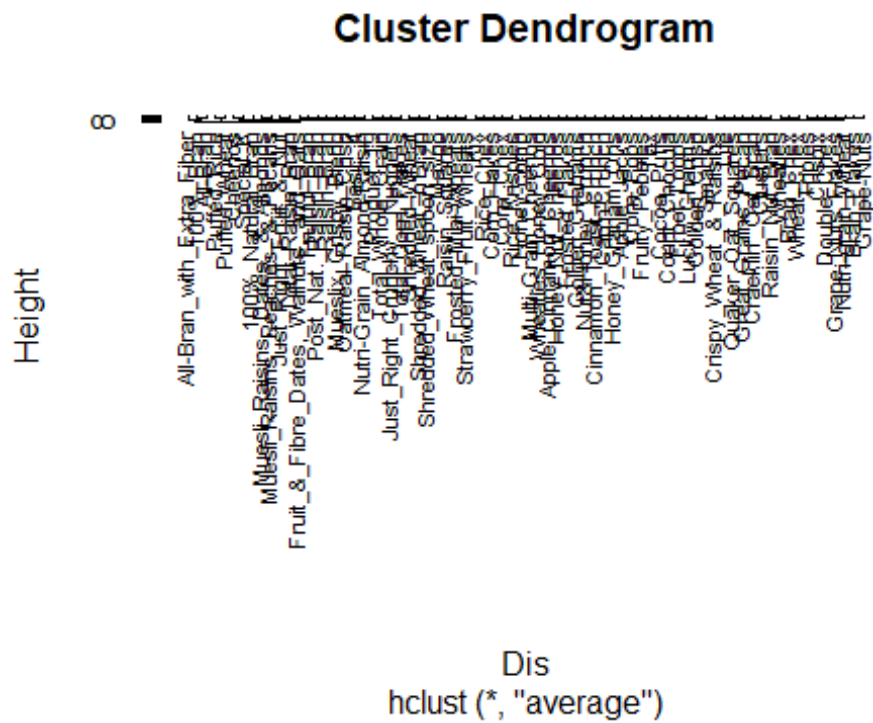
```
hc_S <- hclust(Dis,method="single")
plot(hc_S,cex=0.7,hang=-1)
```



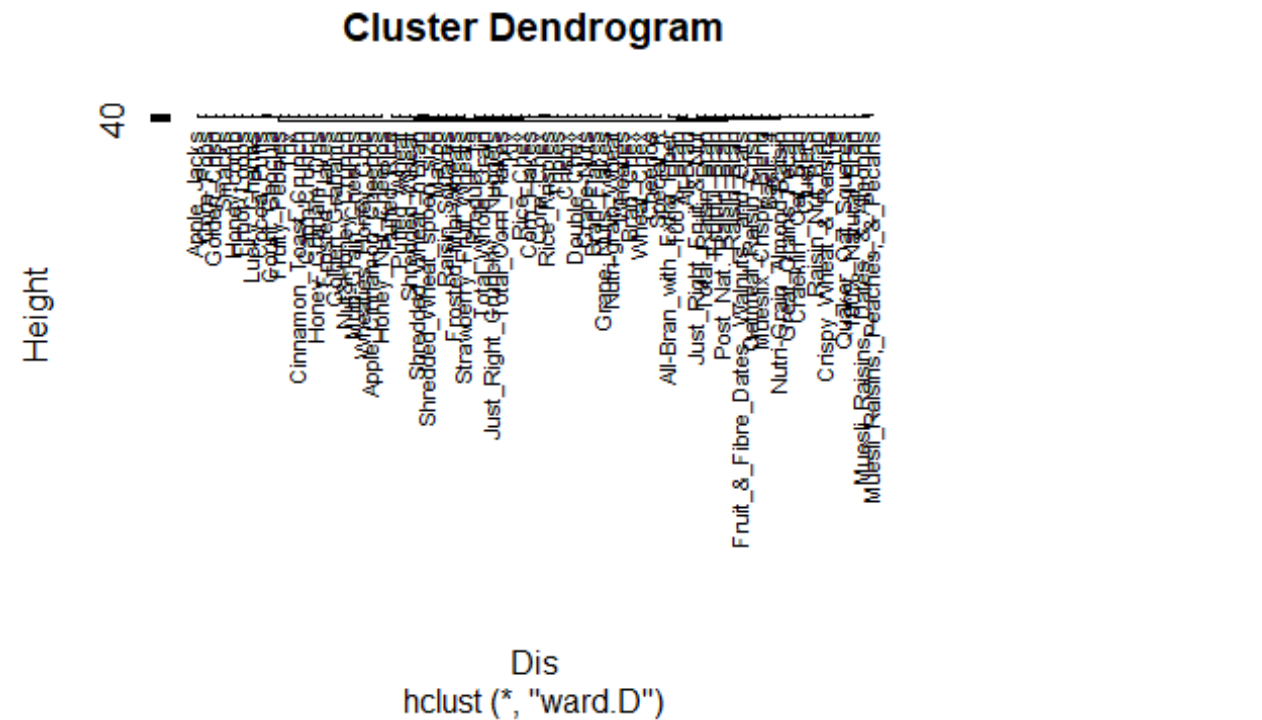
```
hc_C<- hclust(Dis,method="complete")
plot(hc_C,cex=0.7,hang=-1)
```



```
hc_A <- hclust(Dis,method="average")
plot(hc_A,cex=0.7,hang=-1)
```



```
hc_W <- hclust(Dis,method="ward.D")
plot(hc_W,cex=0.7,hang=-1)
```



## #Computation with Agnes and Single Linkage vs Complete Linkage vs Average Linkage vs Ward

```
hc_S <- agnes(Dis,method="single")
print(hc_S$ac)

## [1] 0.6094447

hc_C <- agnes(Dis,method="complete")
print(hc_C$ac)

## [1] 0.8413498

hc_A <- agnes(Dis,method="average")
print(hc_A$ac)

## [1] 0.7814484

hc_W <- agnes(Dis,method="ward")
print(hc_W$ac)

## [1] 0.9049881
```

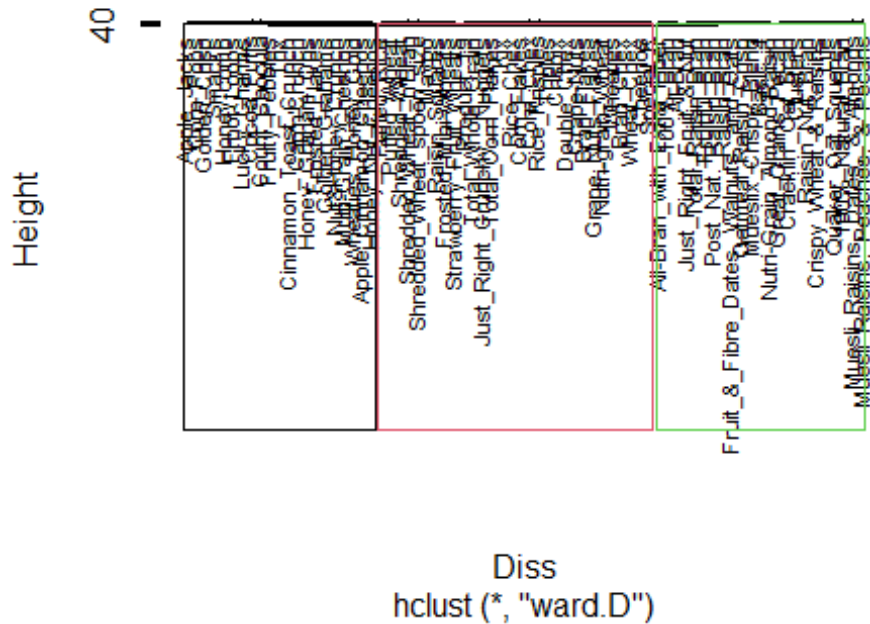
#The Best Linkage method is Ward with Agglomerative coefficient of 0.9049881.

## #Dendrogram of Ward





### Cluster Dendrogram



```
cluster1<-cutree(hc_W,k=3)
dataframe2 <- as.data.frame(cbind(Assign_New,cluster1))
```

#The optimal number of clusters is 3 by the longest distance and the partition.

#Q3. Stability of clusters #Comment on the structure of the clusters and on their stability. Hint: To check stability, partition the data and see how well clusters formed based on one part apply to the other part. To do this:

- Cluster partition A
- Use the cluster centroids from A to assign each record in partition B (each record is assigned to the cluster with the closest centroid).
- Assess how consistent the cluster assignments are compared to the assignments based on all the data.

```
set.seed(123)
kmeans_clust <- kmeans(Assign_New,3,nstart=10)
km_data <- kmeans_clust$cluster
cereal_cluster <- as.data.frame(cbind(kmeans_clust$cluster,Assign_New))
colnames(cereal_cluster)[1]<-"cluster"
print_clusters <-function(labels,k)
{
  for(i in 1:3)
  {
    print(paste("cluster", i))
  }
}
```

```

    print(cereal_cluster[labels==i,c("cluster","calories" ,"protein" , "fat"
,      "sodium" , "fiber" , "carbo" , "sugars" , "potass" , "vitamins"
,"shelf" ,  "weight" , "cups" ,  "rating" )])

  }
}
groups <- cutree(hc_W, k=3)
print_clusters(groups,3)

## [1] "cluster 1"
##
##          cluster  calories  protein
## 100%_Bran        3 -1.8929836  1.3286071
## 100%_Natural_Bran 1  0.6732089  0.4151897
## All-Bran         3 -1.8929836  1.3286071
## All-Bran_with_Extra_Fiber 3 -2.9194605  1.3286071
## Basic_4          1  1.1864474  0.4151897
## Clusters         1  0.1599704  0.4151897
## Cracklin'_Oat_Bran 1  0.1599704  0.4151897
## Crispy_Wheat_&_Raisins 2 -0.3532681 -0.4982277
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats 1  0.6732089  0.4151897
## Fruitful_Bran     1  0.6732089  0.4151897
## Great_Grains_Pecan 1  0.6732089  0.4151897
## Just_Right_Fruit_&_Nut 1  1.6996859  0.4151897
## Life             3 -0.3532681  1.3286071
## Muesli_Raisins,_Dates,_&_Almonds 1  2.2129244  1.3286071
## Muesli_Raisins,_Peaches,_&_Pecans 1  2.2129244  1.3286071
## Mueslix_Crispy_Blend 1  2.7261629  0.4151897
## Nutri-Grain_Almond-Raisin 1  1.6996859  0.4151897
## Oatmeal_Raisin_Crisp 1  1.1864474  0.4151897
## Post_Nat._Raisin_Bran 1  0.6732089  0.4151897
## Quaker_Oat_Squares 3 -0.3532681  1.3286071
## Raisin_Bran       1  0.6732089  0.4151897
## Raisin_Nut_Bran   1 -0.3532681  0.4151897
## Total_Raisin_Bran 1  1.6996859  0.4151897
##
##          fat          sodium
fiber
## 100%_Bran -0.01290349 -0.353984399
3.29284661
## 100%_Natural_Bran 3.96137277 -1.725770770 -
0.06375361
## All-Bran -0.01290349  1.196730628
2.87327158
## All-Bran_with_Extra_Fiber -1.00647256 -0.234698628
4.97114672
## Basic_4 0.98066557  0.600301771 -
0.06375361
## Clusters 0.98066557 -0.234698628 -
0.06375361
## Cracklin'_Oat_Bran 1.97423464 -0.234698628
0.77539645

```

## Crispy_Wheat_&_Raisins	-0.01290349	-0.234698628	-
0.06375361			
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.98066557	0.003872915	
1.19497147			
## Fruitful_Bran	-1.00647256	0.958159085	
1.19497147			
## Great_Grains_Pecan	1.97423464	-1.010056142	
0.35582142			
## Just_Right_Fruit_&_Nut	-0.01290349	0.123158686	-
0.06375361			
## Life	0.98066557	-0.115412857	-
0.06375361			
## Muesli_Raisins,_Dates,_&_Almonds	1.97423464	-0.771484599	
0.35582142			
## Muesli_Raisins,_Peaches,_&_Pecans	1.97423464	-0.115412857	
0.35582142			
## Mueslix_Crispy_Blend	0.98066557	-0.115412857	
0.35582142			
## Nutri-Grain_Almond-Raisin	0.98066557	0.719587543	
0.35582142			
## Oatmeal_Raisin_Crisp	0.98066557	0.123158686	-
0.27354112			
## Post_Nat._Raisin_Bran	-0.01290349	0.481016000	
1.61454650			
## Quaker_Oat_Squares	-0.01290349	-0.294341514	-
0.06375361			
## Raisin_Bran	-0.01290349	0.600301771	
1.19497147			
## Raisin_Nut_Bran	0.98066557	-0.234698628	
0.14603391			
## Total_Raisin_Bran	-0.01290349	0.361730229	
0.77539645			
##	carbo	sugars	
potass			
## 100%_Bran	-2.50878291	-0.234390576	
2.57536849			
## 100%_Natural_Bran	-1.74099432	0.222370547	
0.51602052			
## All-Bran	-1.99692385	-0.462771138	
3.14346448			
## All-Bran_with_Extra_Fiber	-1.74099432	-1.604673946	
3.28548848			
## Basic_4	0.81830100	0.222370547	
0.01893653			
## Clusters	-0.46134666	-0.006010015	
0.08994853			
## Cracklin'_Oat_Bran	-1.22913525	-0.006010015	
0.87108052			
## Crispy_Wheat_&_Raisins	-0.97320572	0.679131670	
0.30298453			

## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	-0.71727619	0.679131670	
1.43917651			
## Fruitful_Bran	-0.20541712	1.135892793	
1.29715251			
## Great_Grains_Pecan	-0.46134666	-0.691151699	
0.01893653			
## Just_Right_Fruit_&_Nut	1.33016007	0.450751108	-
0.05207547			
## Life	-0.71727619	-0.234390576	-
0.05207547			
## Muesli_Raisins,_Dates,_&_Almonds	0.30644194	0.907512232	
1.01310452			
## Muesli_Raisins,_Peaches,_&_Pecans	0.30644194	0.907512232	
1.01310452			
## Mueslix_Crispy_Blend	0.56237147	1.364273355	
0.87108052			
## Nutri-Grain_Almond-Raisin	1.58608960	-0.006010015	
0.44500853			
## Oatmeal_Raisin_Crisp	-0.33338189	0.679131670	
0.30298453			
## Post_Nat._Raisin_Bran	-0.97320572	1.592653916	
2.29132050			
## Quaker_Oat_Squares	-0.20541712	-0.234390576	
0.16096053			
## Raisin_Bran	-0.20541712	1.135892793	
2.00727250			
## Raisin_Nut_Bran	-1.10117049	0.222370547	
0.58703252			
## Total_Raisin_Bran	0.05051241	1.592653916	
1.86524850			
##	vitamins	shelf	weight
## 100%_Bran	-0.1453172	0.9515734	-0.1967771
## 100%_Natural_Bran	-1.2642598	0.9515734	-0.1967771
## All-Bran	-0.1453172	0.9515734	-0.1967771
## All-Bran_with_Extra_Fiber	-0.1453172	0.9515734	-0.1967771
## Basic_4	-0.1453172	0.9515734	1.9962520
## Clusters	-0.1453172	0.9515734	-0.1967771
## Cracklin'_Oat_Bran	-0.1453172	0.9515734	-0.1967771
## Crispy_Wheat_&_Raisins	-0.1453172	0.9515734	-0.1967771
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	-0.1453172	0.9515734	1.4646086
## Fruitful_Bran	-0.1453172	0.9515734	1.9962520
## Great_Grains_Pecan	-0.1453172	0.9515734	-0.1967771
## Just_Right_Fruit_&_Nut	3.2115106	0.9515734	1.7968857
## Life	-0.1453172	-0.2495930	-0.1967771
## Muesli_Raisins,_Dates,_&_Almonds	-0.1453172	0.9515734	-0.1967771
## Muesli_Raisins,_Peaches,_&_Pecans	-0.1453172	0.9515734	-0.1967771
## Mueslix_Crispy_Blend	-0.1453172	0.9515734	3.1259942
## Nutri-Grain_Almond-Raisin	-0.1453172	0.9515734	1.9962520
## Oatmeal_Raisin_Crisp	-0.1453172	0.9515734	1.4646086
## Post_Nat._Raisin_Bran	-0.1453172	0.9515734	1.9962520

```

## Quaker_Oat_Squares      -0.1453172  0.9515734 -0.1967771
## Raisin_Bran             -0.1453172 -0.2495930  1.9962520
## Raisin_Nut_Bran        -0.1453172  0.9515734 -0.1967771
## Total_Raisin_Bran      3.2115106  0.9515734  3.1259942
##                          cups      rating
## 100%_Bran              -2.1100340  1.8321876
## 100%_Natural_Bran      0.7690100 -0.6180571
## All-Bran               -2.1100340  1.1930986
## All-Bran_with_Extra_Fiber -1.3795303  3.6333849
## Basic_4                -0.3052601 -0.4005857
## Clusters               -1.3795303 -0.1612765
## Cracklin'_Oat_Bran     -1.3795303 -0.1578193
## Crispy_Wheat_&_Raisins -0.3052601 -0.4619759
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats -0.6490266 -0.1244837
## Fruitful_Bran          -0.6490266 -0.1174756
## Great_Grains_Pecan     -2.1100340  0.2239586
## Just_Right_Fruit_&_Nut -0.3052601 -0.4409529
## Life                   -0.6490266  0.1895290
## Muesli_Raisins,_Dates,_&_Almonds 0.7690100 -0.3935878
## Muesli_Raisins,_Peaches,_&_Pecans 0.7690100 -0.6069456
## Mueslix_Crispy_Blend   -0.6490266 -0.8793408
## Nutri-Grain_Almond-Raisin -0.6490266 -0.1404816
## Oatmeal_Raisin_Crisp   -1.3795303 -0.8695530
## Post_Nat._Raisin_Bran  -0.6490266 -0.3434906
## Quaker_Oat_Squares     -1.3795303  0.4873659
## Raisin_Bran            -0.3052601 -0.2425029
## Raisin_Nut_Bran        -1.3795303 -0.2108809
## Total_Raisin_Bran      0.7690100 -1.0018246
## [1] "cluster 2"
##               cluster  calories  protein      fat
sodium
## Apple_Cinnamon_Cheerios      2  0.1599704 -0.4982277  0.98066557
0.2424445
## Apple_Jacks                  2  0.1599704 -0.4982277 -1.00647256 -
0.4136273
## Cap'n'Crunch                 2  0.6732089 -1.4116451  0.98066557
0.7195875
## Cinnamon_Toast_Crunch        2  0.6732089 -1.4116451  1.97423464
0.6003018
## Cocoa_Puffs                  2  0.1599704 -1.4116451 -0.01290349
0.2424445
## Corn_Pops                    2  0.1599704 -1.4116451 -1.00647256 -
0.8311275
## Count_Chocula                2  0.1599704 -1.4116451 -0.01290349
0.2424445
## Froot_Loops                  2  0.1599704 -0.4982277 -0.01290349 -
0.4136273
## Frosted_Flakes               2  0.1599704 -1.4116451 -1.00647256
0.4810160
## Fruity_Pebbles               2  0.1599704 -1.4116451 -0.01290349 -

```

0.2943415				
## Golden_Crisp	2	-0.3532681	-0.4982277	-1.00647256 -
1.3679135				
## Golden_Grahams	2	0.1599704	-1.4116451	-0.01290349
1.4353022				
## Honey_Graham_Ohs	2	0.6732089	-1.4116451	0.98066557
0.7195875				
## Honey_Nut_Cheerios	2	0.1599704	0.4151897	-0.01290349
1.0774449				
## Honey-comb	2	0.1599704	-1.4116451	-1.00647256
0.2424445				
## Lucky_Charm	2	0.1599704	-0.4982277	-0.01290349
0.2424445				
## Multi-Grain_Cheerios	2	-0.3532681	-0.4982277	-0.01290349
0.7195875				
## Nut&Honey_Crunch	2	0.6732089	-0.4982277	-0.01290349
0.3617302				
## Smacks	2	0.1599704	-0.4982277	-0.01290349 -
1.0696990				
## Trix	2	0.1599704	-1.4116451	-0.01290349 -
0.2346986				
## Wheaties_Honey_Gold	2	0.1599704	-0.4982277	-0.01290349
0.4810160				
##		fiber	carbo	sugars potass
## Apple_Cinnamon_Cheerios	-0.27354112	-1.10117049	0.6791317	-0.4071355
## Apple_Jacks	-0.48332864	-0.97320572	1.5926539	-0.9752315
## Cap'n'Crunch	-0.90290366	-0.71727619	1.1358928	-0.9042195
## Cinnamon_Toast_Crunch	-0.90290366	-0.46134666	0.4507511	-0.7621955
## Cocoa_Puffs	-0.90290366	-0.71727619	1.3642734	-0.6201715
## Corn_Pops	-0.48332864	-0.46134666	1.1358928	-1.1172554
## Count_Chocula	-0.90290366	-0.71727619	1.3642734	-0.4781475
## Froot_Loops	-0.48332864	-0.97320572	1.3642734	-0.9752315
## Frosted_Flakes	-0.48332864	-0.20541712	0.9075122	-1.0462434
## Fruity_Pebbles	-0.90290366	-0.46134666	1.1358928	-1.0462434
## Golden_Crisp	-0.90290366	-0.97320572	1.8210345	-0.8332075
## Golden_Grahams	-0.90290366	0.05051241	0.4507511	-0.7621955
## Honey_Graham_Ohs	-0.48332864	-0.71727619	0.9075122	-0.7621955
## Honey_Nut_Cheerios	-0.27354112	-0.84524095	0.6791317	-0.1230875
## Honey-comb	-0.90290366	-0.20541712	0.9075122	-0.9042195
## Lucky_Charm	-0.90290366	-0.71727619	1.1358928	-0.6201715
## Multi-Grain_Cheerios	-0.06375361	0.05051241	-0.2343906	-0.1230875
## Nut&Honey_Crunch	-0.90290366	0.05051241	0.4507511	-0.8332075
## Smacks	-0.48332864	-1.48506478	1.8210345	-0.8332075
## Trix	-0.90290366	-0.46134666	1.1358928	-1.0462434
## Wheaties_Honey_Gold	-0.48332864	0.30644194	0.2223705	-0.5491595
##		vitamins	shelf	weight cups
rating				
## Apple_Cinnamon_Cheerios	-0.1453172	-1.450759	-0.1967771	-0.3052601 -
0.9365625				
## Apple_Jacks	-0.1453172	-0.249593	-0.1967771	0.7690100 -

```

0.6756899
## Cap'n'Crunch          -0.1453172 -0.249593 -0.1967771 -0.3052601 -
1.7528545
## Cinnamon_Toast_Crunch -0.1453172 -0.249593 -0.1967771 -0.3052601 -
1.6260883
## Cocoa_Puffs          -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.4187264
## Corn_Pops            -0.1453172 -0.249593 -0.1967771  0.7690100 -
0.4899817
## Count_Chocula        -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.4429256
## Froot_Loops          -0.1453172 -0.249593 -0.1967771  0.7690100 -
0.7444941
## Frosted_Flakes       -0.1453172 -1.450759 -0.1967771 -0.3052601 -
0.7994234
## Fruity_Pebbles       -0.1453172 -0.249593 -0.1967771 -0.3052601 -
1.0421897
## Golden_Crisp         -0.1453172 -1.450759 -0.1967771  0.2533603 -
0.5277361
## Golden_Grahams       -0.1453172 -0.249593 -0.1967771 -0.3052601 -
1.3427262
## Honey_Graham_Ohs     -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.4803151
## Honey_Nut_Cheerios   -0.1453172 -1.450759 -0.1967771 -0.3052601 -
0.8253186
## Honey-comb           -0.1453172 -1.450759 -0.1967771  2.1870466 -
0.9911728
## Lucky_Charms         -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.1341114
## Multi-Grain_Cheerios -0.1453172 -1.450759 -0.1967771  0.7690100 -
0.1822231
## Nut&Honey_Crunch     -0.1453172 -0.249593 -0.1967771 -0.6490266 -
0.9070377
## Smacks               -0.1453172 -0.249593 -0.1967771 -0.3052601 -
0.8140824
## Trix                 -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.0615859
## Wheaties_Honey_Gold  -0.1453172 -1.450759 -0.1967771 -0.3052601 -
0.4611670
## [1] "cluster 3"
##
##          cluster  calories  protein    fat
## Bran_Chex      3 -0.8665066 -0.4982277 -0.01290349
## Bran_Flakes     3 -0.8665066  0.4151897 -1.00647256
## Cheerios        3  0.1599704  3.1554419  0.98066557
## Corn_Chex       2  0.1599704 -0.4982277 -1.00647256
## Corn_Flakes     2 -0.3532681 -0.4982277 -1.00647256
## Crispix         2  0.1599704 -0.4982277 -1.00647256
## Double_Chex     2 -0.3532681 -0.4982277 -1.00647256
## Frosted_Mini-Wheats 3 -0.3532681  0.4151897 -1.00647256
## Grape_Nuts_Flakes 3 -0.3532681  0.4151897 -0.01290349

```

## Grape-Nuts	3	0.1599704	0.4151897	-1.00647256
## Just_Right_Crunchy__Nuggets	2	0.1599704	-0.4982277	-0.01290349
## Kix	2	0.1599704	-0.4982277	-0.01290349
## Maypo	3	-0.3532681	1.3286071	-0.01290349
## Nutri-grain_Wheat	3	-0.8665066	0.4151897	-1.00647256
## Product_19	2	-0.3532681	0.4151897	-1.00647256
## Puffed_Rice	3	-2.9194605	-1.4116451	-1.00647256
## Puffed_Wheat	3	-2.9194605	-0.4982277	-1.00647256
## Raisin_Squares	3	-0.8665066	-0.4982277	-1.00647256
## Rice_Chex	2	0.1599704	-1.4116451	-1.00647256
## Rice_Krispies	2	0.1599704	-0.4982277	-1.00647256
## Shredded_Wheat	3	-1.3797451	-0.4982277	-1.00647256
## Shredded_Wheat_'n'Bran	3	-0.8665066	0.4151897	-1.00647256
## Shredded_Wheat_spoon_size	3	-0.8665066	0.4151897	-1.00647256
## Special_K	3	0.1599704	3.1554419	-1.00647256
## Strawberry_Fruit_Wheats	3	-0.8665066	-0.4982277	-1.00647256
## Total_Corn_Flakes	2	0.1599704	-0.4982277	-0.01290349
## Total_Whole_Grain	2	-0.3532681	0.4151897	-0.01290349
## Triples	2	0.1599704	-0.4982277	-0.01290349
## Wheat_Chex	3	-0.3532681	0.4151897	-0.01290349
## Wheaties	3	-0.3532681	0.4151897	-0.01290349
##		sodium	fiber	carbo
sugars				
## Bran_Chex	0.4810160	0.77539645	0.05051241	-
0.234390576				
## Bran_Flakes	0.6003018	1.19497147	-0.46134666	-
0.462771138				
## Cheerios	1.5545879	-0.06375361	0.56237147	-
1.376293384				
## Corn_Chex	1.4353022	-0.90290366	1.84201913	-
0.919532261				
## Corn_Flakes	1.5545879	-0.48332864	1.58608960	-
1.147912823				
## Crispix	0.7195875	-0.48332864	1.58608960	-
0.919532261				
## Double_Chex	0.3617302	-0.48332864	0.81830100	-
0.462771138				
## Frosted_Mini-Wheats	-1.9046994	0.35582142	-0.20541712	-
0.006010015				
## Grape_Nuts_Flakes	-0.2346986	0.35582142	0.05051241	-
0.462771138				
## Grape-Nuts	0.1231587	0.35582142	0.56237147	-
0.919532261				
## Just_Right_Crunchy__Nuggets	0.1231587	-0.48332864	0.56237147	-
0.234390576				
## Kix	1.1967306	-0.90290366	1.58608960	-
0.919532261				
## Maypo	-1.9046994	-0.90290366	0.30644194	-
0.919532261				
## Nutri-grain_Wheat	0.1231587	0.35582142	0.81830100	-



1.147912823				
## Product_19	1.9124453	-0.48332864	1.33016007	-
0.919532261				
## Puffed_Rice	-1.9046994	-0.90290366	-0.46134666	-
1.604673946				
## Puffed_Wheat	-1.9046994	-0.48332864	-1.22913525	-
1.604673946				
## Raisin_Squares	-1.9046994	-0.06375361	0.05051241	-
0.234390576				
## Rice_Chex	0.9581591	-0.90290366	2.09794866	-
1.147912823				
## Rice_Krispies	1.5545879	-0.90290366	1.84201913	-
0.919532261				
## Shredded_Wheat	-1.9046994	0.35582142	0.30644194	-
1.604673946				
## Shredded_Wheat_'n'Bran	-1.9046994	0.77539645	1.07423054	-
1.604673946				
## Shredded_Wheat_spoon_size	-1.9046994	0.35582142	1.33016007	-
1.604673946				
## Special_K	0.8388733	-0.48332864	0.30644194	-
0.919532261				
## Strawberry_Fruit_Wheats	-1.7257708	0.35582142	0.05051241	-
0.462771138				
## Total_Corn_Flakes	0.4810160	-0.90290366	1.58608960	-
0.919532261				
## Total_Whole_Grain	0.4810160	0.35582142	0.30644194	-
0.919532261				
## Triples	1.0774449	-0.90290366	1.58608960	-
0.919532261				
## Wheat_Chex	0.8388733	0.35582142	0.56237147	-
0.919532261				
## Wheaties	0.4810160	0.35582142	0.56237147	-
0.919532261				
##	potass	vitamins	shelf	weight
## Bran_Chex	0.37399653	-0.1453172	-1.4507595	-0.1967771
## Bran_Flakes	1.29715251	-0.1453172	0.9515734	-0.1967771
## Cheerios	0.08994853	-0.1453172	-1.4507595	-0.1967771
## Corn_Chex	-1.04624345	-0.1453172	-1.4507595	-0.1967771
## Corn_Flakes	-0.90421945	-0.1453172	-1.4507595	-0.1967771
## Crispix	-0.97523145	-0.1453172	0.9515734	-0.1967771
## Double_Chex	-0.26511146	-0.1453172	0.9515734	-0.1967771
## Frosted_Mini-Wheats	0.01893653	-0.1453172	-0.2495930	-0.1967771
## Grape_Nuts_Flakes	-0.19409946	-0.1453172	0.9515734	-0.1967771
## Grape-Nuts	-0.12308746	-0.1453172	0.9515734	-0.1967771
## Just_Right_Crunchy__Nuggets	-0.54915946	3.2115106	0.9515734	-0.1967771
## Kix	-0.83320745	-0.1453172	-0.2495930	-0.1967771
## Maypo	-0.05207547	-0.1453172	-0.2495930	-0.1967771
## Nutri-grain_Wheat	-0.12308746	-0.1453172	0.9515734	-0.1967771
## Product_19	-0.76219545	3.2115106	0.9515734	-0.1967771
## Puffed_Rice	-1.18826745	-1.2642598	0.9515734	-3.5195485

## Puffed_Wheat	-0.69118346	-1.2642598	0.9515734	-3.5195485
## Raisin_Squares	0.16096053	-0.1453172	0.9515734	-0.1967771
## Rice_Chex	-0.97523145	-0.1453172	-1.4507595	-0.1967771
## Rice_Krispies	-0.90421945	-0.1453172	-1.4507595	-0.1967771
## Shredded_Wheat	-0.05207547	-1.2642598	-1.4507595	-1.3265194
## Shredded_Wheat_'n'Bran	0.58703252	-1.2642598	-1.4507595	-0.1967771
## Shredded_Wheat_spoon_size	0.30298453	-1.2642598	-1.4507595	-0.1967771
## Special_K	-0.62017146	-0.1453172	-1.4507595	-0.1967771
## Strawberry_Fruit_Wheats	-0.12308746	-0.1453172	-0.2495930	-0.1967771
## Total_Corn_Flakes	-0.90421945	3.2115106	0.9515734	-0.1967771
## Total_Whole_Grain	0.16096053	3.2115106	0.9515734	-0.1967771
## Triples	-0.54915946	-0.1453172	0.9515734	-0.1967771
## Wheat_Chex	0.23197253	-0.1453172	-1.4507595	-0.1967771
## Wheaties	0.16096053	-0.1453172	-1.4507595	-0.1967771
##		cups	rating	
## Bran_Chex	-0.64902659	0.45948710		
## Bran_Flakes	-0.64902659	0.75801873		
## Cheerios	1.84328015	0.57657347		
## Corn_Chex	0.76901001	-0.08689833		
## Corn_Flakes	0.76901001	0.22763247		
## Crispix	0.76901001	0.30112138		
## Double_Chex	-0.30526014	0.11853896		
## Frosted_Mini-Wheats	-0.09040611	1.11618949		
## Grape_Nuts_Flakes	0.25336034	0.66996501		
## Grape-Nuts	-2.45380043	0.76209027		
## Just_Right_Crunchy__Nuggets	0.76901001	-0.43723896		
## Kix	2.91755030	-0.24379018		
## Maypo	0.76901001	0.86744227		
## Nutri-grain_Wheat	0.76901001	1.20857002		
## Product_19	0.76901001	-0.08273233		
## Puffed_Rice	0.76901001	1.28782197		
## Puffed_Wheat	0.76901001	1.44796198		
## Raisin_Squares	-1.37953029	0.90177096		
## Rice_Chex	1.32763048	-0.04746624		
## Rice_Krispies	0.76901001	-0.14988985		
## Shredded_Wheat	0.76901001	1.82029290		
## Shredded_Wheat_'n'Bran	-0.64902659	2.26429773		
## Shredded_Wheat_spoon_size	-0.64902659	2.14533086		
## Special_K	0.76901001	0.74502768		
## Strawberry_Fruit_Wheats	0.76901001	1.18871964		
## Total_Corn_Flakes	0.76901001	-0.27236281		
## Total_Whole_Grain	0.76901001	0.28426404		
## Triples	-0.30526014	-0.25339630		
## Wheat_Chex	-0.64902659	0.50698324		
## Wheaties	0.76901001	0.63545985		

```

kbest.p<- 3
cboot.hclust <-
clusterboot(Assign_New,clustermethod=hclustCBI,method="ward.D", k=kbest.p)

```

## boot 1  
## boot 2  
## boot 3  
## boot 4  
## boot 5  
## boot 6  
## boot 7  
## boot 8  
## boot 9  
## boot 10  
## boot 11  
## boot 12  
## boot 13  
## boot 14  
## boot 15  
## boot 16  
## boot 17  
## boot 18  
## boot 19  
## boot 20  
## boot 21  
## boot 22  
## boot 23  
## boot 24  
## boot 25  
## boot 26  
## boot 27  
## boot 28  
## boot 29  
## boot 30  
## boot 31  
## boot 32  
## boot 33  
## boot 34  
## boot 35  
## boot 36  
## boot 37  
## boot 38  
## boot 39  
## boot 40  
## boot 41  
## boot 42  
## boot 43  
## boot 44  
## boot 45  
## boot 46  
## boot 47  
## boot 48  
## boot 49  
## boot 50

## boot 51  
## boot 52  
## boot 53  
## boot 54  
## boot 55  
## boot 56  
## boot 57  
## boot 58  
## boot 59  
## boot 60  
## boot 61  
## boot 62  
## boot 63  
## boot 64  
## boot 65  
## boot 66  
## boot 67  
## boot 68  
## boot 69  
## boot 70  
## boot 71  
## boot 72  
## boot 73  
## boot 74  
## boot 75  
## boot 76  
## boot 77  
## boot 78  
## boot 79  
## boot 80  
## boot 81  
## boot 82  
## boot 83  
## boot 84  
## boot 85  
## boot 86  
## boot 87  
## boot 88  
## boot 89  
## boot 90  
## boot 91  
## boot 92  
## boot 93  
## boot 94  
## boot 95  
## boot 96  
## boot 97  
## boot 98  
## boot 99  
## boot 100

```
groups<-cboot.hclust$result$partition
cboot.hclust$bootmean
```

```
## [1] 0.6660267 0.6807289 0.8411100
```

```
which.max(cboot.hclust$bootmean)
```

```
## [1] 3
```

#Cluster 3 has highest stability(cluster stability) amongst all. # or #It could also be done in the following way

#Creating Partitions

```
Partion_1 <- Assign_New[1:50,]
Partion_2 <- Assign_New[51:74,]
```

#Performing Hierarchial Clustering, plotting dendogram and then cutting the dendogram by taking k = 3 .

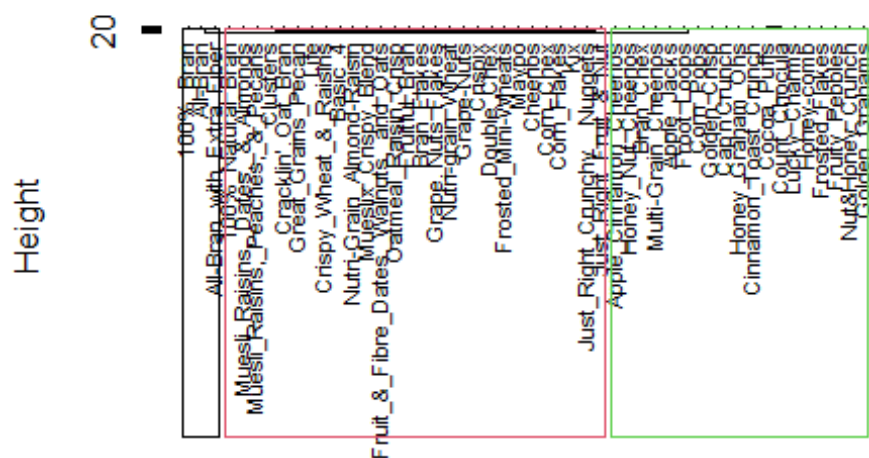
```
ag_single <- agnes(scale(Partion_1), method = "single")
ag_complete <- agnes(scale(Partion_1), method = "complete")
ag_average <- agnes(scale(Partion_1), method = "average")
ag_ward <- agnes(scale(Partion_1), method = "ward")
```

```
cbind(single=ag_single$ac , complete=ag_complete$ac , average= ag_average$ac
, ward= ag_ward$ac)
```

```
##          single  complete  average      ward
## [1,] 0.6393338 0.8138238 0.7408904 0.8764323
```

```
pltree(ag_ward, cex = 0.7, hang = -1, main = "Dendogram of Agnes with
Partitioned Data (Using Ward)")
rect.hclust(ag_ward, k = 3, border = 1:3)
```

## Dendrogram of Agnes with Partitioned Data (Using W



scale(Partion\_1)  
agnes (\*, "ward")

```
cut_2 <- cutree(ag_ward, k = 3)
```

#Calculating the centeroids.

```
result <- as.data.frame(cbind(Partion_1, cut_2))
result[result$cut_2==1,]
```

##	calories	protein	fat	sodium
fiber				
## 100%_Bran	-1.892984	1.328607	-0.01290349	-0.3539844
3.292847				
## All-Bran	-1.892984	1.328607	-0.01290349	1.1967306
2.873272				
## All-Bran_with_Extra_Fiber	-2.919461	1.328607	-1.00647256	-0.2346986
4.971147				
##	carbo	sugars	potass	vitamins
shelf				
## 100%_Bran	-2.508783	-0.2343906	2.575368	-0.1453172
0.9515734				
## All-Bran	-1.996924	-0.4627711	3.143464	-0.1453172
0.9515734				
## All-Bran_with_Extra_Fiber	-1.740994	-1.6046739	3.285488	-0.1453172
0.9515734				
##	weight	cups	rating	cut_2
## 100%_Bran	-0.1967771	-2.110034	1.832188	1
## All-Bran	-0.1967771	-2.110034	1.193099	1
## All-Bran_with_Extra_Fiber	-0.1967771	-1.379530	3.633385	1

```
centroid_1 <- colMeans(result[result$cut_2==1,])
result[result$cut_2==2,]
```

##	calories	protein	fat
## 100%_Natural_Bran	0.6732089	0.4151897	3.96137277
## Basic_4	1.1864474	0.4151897	0.98066557
## Bran_Flakes	-0.8665066	0.4151897	-1.00647256
## Cheerios	0.1599704	3.1554419	0.98066557
## Clusters	0.1599704	0.4151897	0.98066557
## Corn_Chex	0.1599704	-0.4982277	-1.00647256
## Corn_Flakes	-0.3532681	-0.4982277	-1.00647256
## Cracklin'_Oat_Bran	0.1599704	0.4151897	1.97423464
## Crispix	0.1599704	-0.4982277	-1.00647256
## Crispy_Wheat_&_Raisins	-0.3532681	-0.4982277	-0.01290349
## Double_Chex	-0.3532681	-0.4982277	-1.00647256
## Frosted_Mini-Wheats	-0.3532681	0.4151897	-1.00647256
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.6732089	0.4151897	0.98066557
## Fruitful_Bran	0.6732089	0.4151897	-1.00647256
## Grape_Nuts_Flakes	-0.3532681	0.4151897	-0.01290349
## Grape-Nuts	0.1599704	0.4151897	-1.00647256
## Great_Grains_Pecan	0.6732089	0.4151897	1.97423464
## Just_Right_Crunchy__Nuggets	0.1599704	-0.4982277	-0.01290349
## Just_Right_Fruit_&_Nut	1.6996859	0.4151897	-0.01290349
## Kix	0.1599704	-0.4982277	-0.01290349
## Life	-0.3532681	1.3286071	0.98066557
## Maypo	-0.3532681	1.3286071	-0.01290349
## Muesli_Raisins,_Dates,_&_Almonds	2.2129244	1.3286071	1.97423464
## Muesli_Raisins,_Peaches,_&_Pecans	2.2129244	1.3286071	1.97423464
## Mueslix_Crispy_Blend	2.7261629	0.4151897	0.98066557
## Nutri-Grain_Almond-Raisin	1.6996859	0.4151897	0.98066557
## Nutri-grain_Wheat	-0.8665066	0.4151897	-1.00647256
## Oatmeal_Raisin_Crisp	1.1864474	0.4151897	0.98066557
##	sodium	fiber	
carbo			
## 100%_Natural_Bran	-1.725770770	-0.06375361	-
1.74099432			
## Basic_4	0.600301771	-0.06375361	
0.81830100			
## Bran_Flakes	0.600301771	1.19497147	-
0.46134666			
## Cheerios	1.554587942	-0.06375361	
0.56237147			
## Clusters	-0.234698628	-0.06375361	-
0.46134666			
## Corn_Chex	1.435302171	-0.90290366	
1.84201913			
## Corn_Flakes	1.554587942	-0.48332864	
1.58608960			
## Cracklin'_Oat_Bran	-0.234698628	0.77539645	-
1.22913525			

## Crispix	0.719587543	-0.48332864	
1.58608960			
## Crispy_Wheat_&_Raisins	-0.234698628	-0.06375361	-
0.97320572			
## Double_Chex	0.361730229	-0.48332864	
0.81830100			
## Frosted_Mini-Wheats	-1.904699427	0.35582142	-
0.20541712			
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.003872915	1.19497147	-
0.71727619			
## Fruitful_Bran	0.958159085	1.19497147	-
0.20541712			
## Grape_Nuts_Flakes	-0.234698628	0.35582142	
0.05051241			
## Grape-Nuts	0.123158686	0.35582142	
0.56237147			
## Great_Grains_Pecan	-1.010056142	0.35582142	-
0.46134666			
## Just_Right_Crunchy__Nuggets	0.123158686	-0.48332864	
0.56237147			
## Just_Right_Fruit_&_Nut	0.123158686	-0.06375361	
1.33016007			
## Kix	1.196730628	-0.90290366	
1.58608960			
## Life	-0.115412857	-0.06375361	-
0.71727619			
## Maypo	-1.904699427	-0.90290366	
0.30644194			
## Muesli_Raisins,_Dates,_&_Almonds	-0.771484599	0.35582142	
0.30644194			
## Muesli_Raisins,_Peaches,_&_Pecans	-0.115412857	0.35582142	
0.30644194			
## Mueslix_Crispy_Blend	-0.115412857	0.35582142	
0.56237147			
## Nutri-Grain_Almond-Raisin	0.719587543	0.35582142	
1.58608960			
## Nutri-grain_Wheat	0.123158686	0.35582142	
0.81830100			
## Oatmeal_Raisin_Crisp	0.123158686	-0.27354112	-
0.33338189			
##	sugars	potass	vitamins
## 100%_Natural_Bran	0.222370547	0.51602052	-1.2642598
## Basic_4	0.222370547	0.01893653	-0.1453172
## Bran_Flakes	-0.462771138	1.29715251	-0.1453172
## Cheerios	-1.376293384	0.08994853	-0.1453172
## Clusters	-0.006010015	0.08994853	-0.1453172
## Corn_Chex	-0.919532261	-1.04624345	-0.1453172
## Corn_Flakes	-1.147912823	-0.90421945	-0.1453172
## Cracklin'_Oat_Bran	-0.006010015	0.87108052	-0.1453172
## Crispix	-0.919532261	-0.97523145	-0.1453172



## Crispy_Wheat_&_Raisins	0.679131670	0.30298453	-0.1453172
## Double_Chex	-0.462771138	-0.26511146	-0.1453172
## Frosted_Mini-Wheats	-0.006010015	0.01893653	-0.1453172
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.679131670	1.43917651	-0.1453172
## Fruitful_Bran	1.135892793	1.29715251	-0.1453172
## Grape_Nuts_Flakes	-0.462771138	-0.19409946	-0.1453172
## Grape-Nuts	-0.919532261	-0.12308746	-0.1453172
## Great_Grains_Pecan	-0.691151699	0.01893653	-0.1453172
## Just_Right_Crunchy__Nuggets	-0.234390576	-0.54915946	3.2115106
## Just_Right_Fruit_&_Nut	0.450751108	-0.05207547	3.2115106
## Kix	-0.919532261	-0.83320745	-0.1453172
## Life	-0.234390576	-0.05207547	-0.1453172
## Maypo	-0.919532261	-0.05207547	-0.1453172
## Muesli_Raisins,_Dates,_&_Almonds	0.907512232	1.01310452	-0.1453172
## Muesli_Raisins,_Peaches,_&_Pecans	0.907512232	1.01310452	-0.1453172
## Mueslix_Crispy_Blend	1.364273355	0.87108052	-0.1453172
## Nutri-Grain_Almond-Raisin	-0.006010015	0.44500853	-0.1453172
## Nutri-grain_Wheat	-1.147912823	-0.12308746	-0.1453172
## Oatmeal_Raisin_Crisp	0.679131670	0.30298453	-0.1453172
##	shelf	weight	cups
## 100%_Natural_Bran	0.9515734	-0.1967771	0.76901001
## Basic_4	0.9515734	1.9962520	-0.30526014
## Bran_Flakes	0.9515734	-0.1967771	-0.64902659
## Cheerios	-1.4507595	-0.1967771	1.84328015
## Clusters	0.9515734	-0.1967771	-1.37953029
## Corn_Chex	-1.4507595	-0.1967771	0.76901001
## Corn_Flakes	-1.4507595	-0.1967771	0.76901001
## Cracklin'_Oat_Bran	0.9515734	-0.1967771	-1.37953029
## Crispix	0.9515734	-0.1967771	0.76901001
## Crispy_Wheat_&_Raisins	0.9515734	-0.1967771	-0.30526014
## Double_Chex	0.9515734	-0.1967771	-0.30526014
## Frosted_Mini-Wheats	-0.2495930	-0.1967771	-0.09040611
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.9515734	1.4646086	-0.64902659
## Fruitful_Bran	0.9515734	1.9962520	-0.64902659
## Grape_Nuts_Flakes	0.9515734	-0.1967771	0.25336034
## Grape-Nuts	0.9515734	-0.1967771	-2.45380043
## Great_Grains_Pecan	0.9515734	-0.1967771	-2.11003399
## Just_Right_Crunchy__Nuggets	0.9515734	-0.1967771	0.76901001
## Just_Right_Fruit_&_Nut	0.9515734	1.7968857	-0.30526014
## Kix	-0.2495930	-0.1967771	2.91755030
## Life	-0.2495930	-0.1967771	-0.64902659
## Maypo	-0.2495930	-0.1967771	0.76901001
## Muesli_Raisins,_Dates,_&_Almonds	0.9515734	-0.1967771	0.76901001
## Muesli_Raisins,_Peaches,_&_Pecans	0.9515734	-0.1967771	0.76901001
## Mueslix_Crispy_Blend	0.9515734	3.1259942	-0.64902659
## Nutri-Grain_Almond-Raisin	0.9515734	1.9962520	-0.64902659
## Nutri-grain_Wheat	0.9515734	-0.1967771	0.76901001
## Oatmeal_Raisin_Crisp	0.9515734	1.4646086	-1.37953029
##	rating	cut_2	
## 100%_Natural_Bran	-0.61805706	2	

## Basic_4	-0.40058570	2
## Bran_Flakes	0.75801873	2
## Cheerios	0.57657347	2
## Clusters	-0.16127646	2
## Corn_Chex	-0.08689833	2
## Corn_Flakes	0.22763247	2
## Cracklin'_Oat_Bran	-0.15781928	2
## Crispix	0.30112138	2
## Crispy_Wheat_&_Raisins	-0.46197591	2
## Double_Chex	0.11853896	2
## Frosted_Mini-Wheats	1.11618949	2
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	-0.12448367	2
## Fruitful_Bran	-0.11747555	2
## Grape_Nuts_Flakes	0.66996501	2
## Grape-Nuts	0.76209027	2
## Great_Grains_Pecan	0.22395859	2
## Just_Right_Crunchy__Nuggets	-0.43723896	2
## Just_Right_Fruit_&_Nut	-0.44095292	2
## Kix	-0.24379018	2
## Life	0.18952903	2
## Maypo	0.86744227	2
## Muesli_Raisins,_Dates,_&_Almonds	-0.39358784	2
## Muesli_Raisins,_Peaches,_&_Pecans	-0.60694559	2
## Mueslix_Crispy_Blend	-0.87934079	2
## Nutri-Grain_Almond-Raisin	-0.14048156	2
## Nutri-grain_Wheat	1.20857002	2
## Oatmeal_Raisin_Crisp	-0.86955299	2

```
centroid_2 <- colMeans(result[result$cut_2==2,])
result[result$cut_2==3,]
```

##	calories	protein	fat	sodium
## Apple_Cinnamon_Cheerios	0.1599704	-0.4982277	0.98066557	0.2424445
## Apple_Jacks	0.1599704	-0.4982277	-1.00647256	-0.4136273
## Bran_Chex	-0.8665066	-0.4982277	-0.01290349	0.4810160
## Cap'n'Crunch	0.6732089	-1.4116451	0.98066557	0.7195875
## Cinnamon_Toast_Crunch	0.6732089	-1.4116451	1.97423464	0.6003018
## Cocoa_Puffs	0.1599704	-1.4116451	-0.01290349	0.2424445
## Corn_Pops	0.1599704	-1.4116451	-1.00647256	-0.8311275
## Count_Chocula	0.1599704	-1.4116451	-0.01290349	0.2424445
## Froot_Loops	0.1599704	-0.4982277	-0.01290349	-0.4136273
## Frosted_Flakes	0.1599704	-1.4116451	-1.00647256	0.4810160
## Fruity_Pebbles	0.1599704	-1.4116451	-0.01290349	-0.2943415
## Golden_Crisp	-0.3532681	-0.4982277	-1.00647256	-1.3679135
## Golden_Grahams	0.1599704	-1.4116451	-0.01290349	1.4353022
## Honey_Graham_Ohs	0.6732089	-1.4116451	0.98066557	0.7195875
## Honey_Nut_Cheerios	0.1599704	0.4151897	-0.01290349	1.0774449
## Honey-comb	0.1599704	-1.4116451	-1.00647256	0.2424445
## Lucky_Charms	0.1599704	-0.4982277	-0.01290349	0.2424445
## Multi-Grain_Cheerios	-0.3532681	-0.4982277	-0.01290349	0.7195875

## Nut&Honey_Crunch	0.6732089	-0.4982277	-0.01290349	0.3617302
##	fiber	carbo	sugars	potass
## Apple_Cinnamon_Cheerios	-0.27354112	-1.10117049	0.6791317	-0.4071355
## Apple_Jacks	-0.48332864	-0.97320572	1.5926539	-0.9752315
## Bran_Chex	0.77539645	0.05051241	-0.2343906	0.3739965
## Cap'n'Crunch	-0.90290366	-0.71727619	1.1358928	-0.9042195
## Cinnamon_Toast_Crunch	-0.90290366	-0.46134666	0.4507511	-0.7621955
## Cocoa_Puffs	-0.90290366	-0.71727619	1.3642734	-0.6201715
## Corn_Pops	-0.48332864	-0.46134666	1.1358928	-1.1172554
## Count_Chocula	-0.90290366	-0.71727619	1.3642734	-0.4781475
## Froot_Loops	-0.48332864	-0.97320572	1.3642734	-0.9752315
## Frosted_Flakes	-0.48332864	-0.20541712	0.9075122	-1.0462434
## Fruity_Pebbles	-0.90290366	-0.46134666	1.1358928	-1.0462434
## Golden_Crisp	-0.90290366	-0.97320572	1.8210345	-0.8332075
## Golden_Grahams	-0.90290366	0.05051241	0.4507511	-0.7621955
## Honey_Graham_Ohs	-0.48332864	-0.71727619	0.9075122	-0.7621955
## Honey_Nut_Cheerios	-0.27354112	-0.84524095	0.6791317	-0.1230875
## Honey-comb	-0.90290366	-0.20541712	0.9075122	-0.9042195
## Lucky_Charms	-0.90290366	-0.71727619	1.1358928	-0.6201715
## Multi-Grain_Cheerios	-0.06375361	0.05051241	-0.2343906	-0.1230875
## Nut&Honey_Crunch	-0.90290366	0.05051241	0.4507511	-0.8332075
##	vitamins	shelf	weight	cups
rating				
## Apple_Cinnamon_Cheerios	-0.1453172	-1.450759	-0.1967771	-0.3052601 -
0.9365625				
## Apple_Jacks	-0.1453172	-0.249593	-0.1967771	0.7690100 -
0.6756899				
## Bran_Chex	-0.1453172	-1.450759	-0.1967771	-0.6490266
0.4594871				
## Cap'n'Crunch	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.7528545				
## Cinnamon_Toast_Crunch	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.6260883				
## Cocoa_Puffs	-0.1453172	-0.249593	-0.1967771	0.7690100 -
1.4187264				
## Corn_Pops	-0.1453172	-0.249593	-0.1967771	0.7690100 -
0.4899817				
## Count_Chocula	-0.1453172	-0.249593	-0.1967771	0.7690100 -
1.4429256				
## Froot_Loops	-0.1453172	-0.249593	-0.1967771	0.7690100 -
0.7444941				
## Frosted_Flakes	-0.1453172	-1.450759	-0.1967771	-0.3052601 -
0.7994234				
## Fruity_Pebbles	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.0421897				
## Golden_Crisp	-0.1453172	-1.450759	-0.1967771	0.2533603 -
0.5277361				
## Golden_Grahams	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.3427262				
## Honey_Graham_Ohs	-0.1453172	-0.249593	-0.1967771	0.7690100 -

```

1.4803151
## Honey_Nut_Cheerios      -0.1453172 -1.450759 -0.1967771 -0.3052601 -
0.8253186
## Honey-comb              -0.1453172 -1.450759 -0.1967771  2.1870466 -
0.9911728
## Lucky_Charms            -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.1341114
## Multi-Grain_Cheerios    -0.1453172 -1.450759 -0.1967771  0.7690100 -
0.1822231
## Nut&Honey_Crunch        -0.1453172 -0.249593 -0.1967771 -0.6490266 -
0.9070377
##                               cut_2
## Apple_Cinnamon_Cheerios      3
## Apple_Jacks                  3
## Bran_Chex                    3
## Cap'n'Crunch                 3
## Cinnamon_Toast_Crunch        3
## Cocoa_Puffs                  3
## Corn_Pops                    3
## Count_Chocula                3
## Froot_Loops                  3
## Frosted_Flakes               3
## Fruity_Pebbles               3
## Golden_Crisp                 3
## Golden_Grahams               3
## Honey_Graham_Ohs             3
## Honey_Nut_Cheerios           3
## Honey-comb                   3
## Lucky_Charms                 3
## Multi-Grain_Cheerios         3
## Nut&Honey_Crunch             3

centroid_3 <- colMeans(result[result$cut_2==3,])
result[result$cut_2==4,]

## [1] calories protein fat      sodium  fiber    carbo    sugars  potass
## [9] vitamins shelf   weight  cups    rating   cut_2
## <0 rows> (or 0-length row.names)

centroid_4 <- colMeans(result[result$cut_2==4,])
centroids <- rbind(centroid_1, centroid_2, centroid_3, centroid_4)
x2 <- as.data.frame(rbind(centroids[, -14], Partion_2))

```

### #Calculating the Distance

```

Distance_1 <- get_dist(x2)
Matrix_1 <- as.matrix(Distance_1)
dataframe1 <- data.frame(data=seq(1,nrow(Partion_2),1), Clusters =
rep(0,nrow(Partion_2)))
for(i in 1:nrow(Partion_2))

```

```
{dataframe1[i,2] <- which.min(Matrix_1[i+4, 1:4])}  
dataframe1
```

```
##      data Clusters  
## 1      1         2  
## 2      2         2  
## 3      3         3  
## 4      4         3  
## 5      5         2  
## 6      6         2  
## 7      7         2  
## 8      8         2  
## 9      9         3  
## 10     10        3  
## 11     11         2  
## 12     12         2  
## 13     13         2  
## 14     14         3  
## 15     15         2  
## 16     16         2  
## 17     17         2  
## 18     18         2  
## 19     19         2  
## 20     20         2  
## 21     21         3  
## 22     22         2  
## 23     23         2  
## 24     24         3
```

```
cbind(dataframe2$Cluster1[51:74], dataframe1$Clusters)
```

```
##      [,1]  
## [1,]    2  
## [2,]    2  
## [3,]    3  
## [4,]    3  
## [5,]    2  
## [6,]    2  
## [7,]    2  
## [8,]    2  
## [9,]    3  
## [10,]   3  
## [11,]   2  
## [12,]   2  
## [13,]   2  
## [14,]   3  
## [15,]   2  
## [16,]   2  
## [17,]   2  
## [18,]   2
```

```
## [19,]      2
## [20,]      2
## [21,]      3
## [22,]      2
## [23,]      2
## [24,]      3

table(dataframe2$Cluster1[51:74] == dataframe1$Clusters)

## < table of extent 0 >
```

#Hence we can say Model is partially stable. #Cluster 3 has highest stability in terms of cluster stability amongst all.

#Q4 Cluster with healthy Cereal and High nutrition value #The elementary public schools would like to choose a set of cereals to include in their daily cafeterias. Every day a different cereal is offered, but all cereals should support a healthy diet. For this goal, you are requested to find a cluster of “healthy cereals.” Should the data be normalized? If not, how should they be used in the cluster analysis?

```
mydata <- na.omit(Assign_New)
rating <- cbind(mydata,cluster1)
rating[rating$clust==1,]

##              calories      protein      fat
## 100%_Bran      -1.8929836  1.3286071 -0.01290349
## 100%_Natural_Bran  0.6732089  0.4151897  3.96137277
## All-Bran      -1.8929836  1.3286071 -0.01290349
## All-Bran_with_Extra_Fiber -2.9194605  1.3286071 -1.00647256
## Basic_4        1.1864474  0.4151897  0.98066557
## Clusters       0.1599704  0.4151897  0.98066557
## Cracklin'_Oat_Bran  0.1599704  0.4151897  1.97423464
## Crispy_Wheat_&_Raisins -0.3532681 -0.4982277 -0.01290349
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats  0.6732089  0.4151897  0.98066557
## Fruitful_Bran    0.6732089  0.4151897 -1.00647256
## Great_Grains_Pecan  0.6732089  0.4151897  1.97423464
## Just_Right_Fruit_&_Nut  1.6996859  0.4151897 -0.01290349
## Life          -0.3532681  1.3286071  0.98066557
## Muesli_Raisins,_Dates,_&_Almonds  2.2129244  1.3286071  1.97423464
## Muesli_Raisins,_Peaches,_&_Pecans  2.2129244  1.3286071  1.97423464
## Mueslix_Crispy_Blend  2.7261629  0.4151897  0.98066557
## Nutri-Grain_Almond-Raisin  1.6996859  0.4151897  0.98066557
## Oatmeal_Raisin_Crisp  1.1864474  0.4151897  0.98066557
## Post_Nat._Raisin_Bran  0.6732089  0.4151897 -0.01290349
## Quaker_Oat_Squares -0.3532681  1.3286071 -0.01290349
## Raisin_Bran     0.6732089  0.4151897 -0.01290349
## Raisin_Nut_Bran -0.3532681  0.4151897  0.98066557
## Total_Raisin_Bran  1.6996859  0.4151897 -0.01290349
##              sodium      fiber
carbo
## 100%_Bran      -0.353984399  3.29284661 -
```

2.50878291			
## 100%_Natural_Bran	-1.725770770	-0.06375361	-
1.74099432			
## All-Bran	1.196730628	2.87327158	-
1.99692385			
## All-Bran_with_Extra_Fiber	-0.234698628	4.97114672	-
1.74099432			
## Basic_4	0.600301771	-0.06375361	
0.81830100			
## Clusters	-0.234698628	-0.06375361	-
0.46134666			
## Cracklin'_Oat_Bran	-0.234698628	0.77539645	-
1.22913525			
## Crispy_Wheat_&_Raisins	-0.234698628	-0.06375361	-
0.97320572			
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.003872915	1.19497147	-
0.71727619			
## Fruitful_Bran	0.958159085	1.19497147	-
0.20541712			
## Great_Grains_Pecan	-1.010056142	0.35582142	-
0.46134666			
## Just_Right_Fruit_&_Nut	0.123158686	-0.06375361	
1.33016007			
## Life	-0.115412857	-0.06375361	-
0.71727619			
## Muesli_Raisins,_Dates,_&_Almonds	-0.771484599	0.35582142	
0.30644194			
## Muesli_Raisins,_Peaches,_&_Pecans	-0.115412857	0.35582142	
0.30644194			
## Mueslix_Crispy_Blend	-0.115412857	0.35582142	
0.56237147			
## Nutri-Grain_Almond-Raisin	0.719587543	0.35582142	
1.58608960			
## Oatmeal_Raisin_Crisp	0.123158686	-0.27354112	-
0.33338189			
## Post_Nat._Raisin_Bran	0.481016000	1.61454650	-
0.97320572			
## Quaker_Oat_Squares	-0.294341514	-0.06375361	-
0.20541712			
## Raisin_Bran	0.600301771	1.19497147	-
0.20541712			
## Raisin_Nut_Bran	-0.234698628	0.14603391	-
1.10117049			
## Total_Raisin_Bran	0.361730229	0.77539645	
0.05051241			
##	sugars	potass	vitamins
## 100%_Bran	-0.234390576	2.57536849	-0.1453172
## 100%_Natural_Bran	0.222370547	0.51602052	-1.2642598
## All-Bran	-0.462771138	3.14346448	-0.1453172
## All-Bran_with_Extra_Fiber	-1.604673946	3.28548848	-0.1453172

## Basic_4	0.222370547	0.01893653	-0.1453172
## Clusters	-0.006010015	0.08994853	-0.1453172
## Cracklin'_Oat_Bran	-0.006010015	0.87108052	-0.1453172
## Crispy_Wheat_&_Raisins	0.679131670	0.30298453	-0.1453172
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.679131670	1.43917651	-0.1453172
## Fruitful_Bran	1.135892793	1.29715251	-0.1453172
## Great_Grains_Pecan	-0.691151699	0.01893653	-0.1453172
## Just_Right_Fruit_&_Nut	0.450751108	-0.05207547	3.2115106
## Life	-0.234390576	-0.05207547	-0.1453172
## Muesli_Raisins,_Dates,_&_Almonds	0.907512232	1.01310452	-0.1453172
## Muesli_Raisins,_Peaches,_&_Pecans	0.907512232	1.01310452	-0.1453172
## Mueslix_Crispy_Blend	1.364273355	0.87108052	-0.1453172
## Nutri-Grain_Almond-Raisin	-0.006010015	0.44500853	-0.1453172
## Oatmeal_Raisin_Crisp	0.679131670	0.30298453	-0.1453172
## Post_Nat._Raisin_Bran	1.592653916	2.29132050	-0.1453172
## Quaker_Oat_Squares	-0.234390576	0.16096053	-0.1453172
## Raisin_Bran	1.135892793	2.00727250	-0.1453172
## Raisin_Nut_Bran	0.222370547	0.58703252	-0.1453172
## Total_Raisin_Bran	1.592653916	1.86524850	3.2115106
##	shelf	weight	cups
## 100%_Bran	0.9515734	-0.1967771	-2.1100340
## 100%_Natural_Bran	0.9515734	-0.1967771	0.7690100
## All-Bran	0.9515734	-0.1967771	-2.1100340
## All-Bran_with_Extra_Fiber	0.9515734	-0.1967771	-1.3795303
## Basic_4	0.9515734	1.9962520	-0.3052601
## Clusters	0.9515734	-0.1967771	-1.3795303
## Cracklin'_Oat_Bran	0.9515734	-0.1967771	-1.3795303
## Crispy_Wheat_&_Raisins	0.9515734	-0.1967771	-0.3052601
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	0.9515734	1.4646086	-0.6490266
## Fruitful_Bran	0.9515734	1.9962520	-0.6490266
## Great_Grains_Pecan	0.9515734	-0.1967771	-2.1100340
## Just_Right_Fruit_&_Nut	0.9515734	1.7968857	-0.3052601
## Life	-0.2495930	-0.1967771	-0.6490266
## Muesli_Raisins,_Dates,_&_Almonds	0.9515734	-0.1967771	0.7690100
## Muesli_Raisins,_Peaches,_&_Pecans	0.9515734	-0.1967771	0.7690100
## Mueslix_Crispy_Blend	0.9515734	3.1259942	-0.6490266
## Nutri-Grain_Almond-Raisin	0.9515734	1.9962520	-0.6490266
## Oatmeal_Raisin_Crisp	0.9515734	1.4646086	-1.3795303
## Post_Nat._Raisin_Bran	0.9515734	1.9962520	-0.6490266
## Quaker_Oat_Squares	0.9515734	-0.1967771	-1.3795303
## Raisin_Bran	-0.2495930	1.9962520	-0.3052601
## Raisin_Nut_Bran	0.9515734	-0.1967771	-1.3795303
## Total_Raisin_Bran	0.9515734	3.1259942	0.7690100
##	rating	cluster1	
## 100%_Bran	1.8321876	1	
## 100%_Natural_Bran	-0.6180571	1	
## All-Bran	1.1930986	1	
## All-Bran_with_Extra_Fiber	3.6333849	1	
## Basic_4	-0.4005857	1	
## Clusters	-0.1612765	1	



## Cracklin'_Oat_Bran	-0.1578193	1
## Crispy_Wheat_&_Raisins	-0.4619759	1
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats	-0.1244837	1
## Fruitful_Bran	-0.1174756	1
## Great_Grains_Pecan	0.2239586	1
## Just_Right_Fruit_&_Nut	-0.4409529	1
## Life	0.1895290	1
## Muesli_Raisins,_Dates,_&_Almonds	-0.3935878	1
## Muesli_Raisins,_Peaches,_&_Pecans	-0.6069456	1
## Mueslix_Crispy_Blend	-0.8793408	1
## Nutri-Grain_Almond-Raisin	-0.1404816	1
## Oatmeal_Raisin_Crisp	-0.8695530	1
## Post_Nat._Raisin_Bran	-0.3434906	1
## Quaker_Oat_Squares	0.4873659	1
## Raisin_Bran	-0.2425029	1
## Raisin_Nut_Bran	-0.2108809	1
## Total_Raisin_Bran	-1.0018246	1

rating[rating\$clust==2,]

##	calories	protein	fat	sodium
## Apple_Cinnamon_Cheerios	0.1599704	-0.4982277	0.98066557	0.2424445
## Apple_Jacks	0.1599704	-0.4982277	-1.00647256	-0.4136273
## Cap'n'Crunch	0.6732089	-1.4116451	0.98066557	0.7195875
## Cinnamon_Toast_Crunch	0.6732089	-1.4116451	1.97423464	0.6003018
## Cocoa_Puffs	0.1599704	-1.4116451	-0.01290349	0.2424445
## Corn_Pops	0.1599704	-1.4116451	-1.00647256	-0.8311275
## Count_Chocula	0.1599704	-1.4116451	-0.01290349	0.2424445
## Froot_Loops	0.1599704	-0.4982277	-0.01290349	-0.4136273
## Frosted_Flakes	0.1599704	-1.4116451	-1.00647256	0.4810160
## Fruity_Pebbles	0.1599704	-1.4116451	-0.01290349	-0.2943415
## Golden_Crisp	-0.3532681	-0.4982277	-1.00647256	-1.3679135
## Golden_Grahams	0.1599704	-1.4116451	-0.01290349	1.4353022
## Honey_Graham_Ohs	0.6732089	-1.4116451	0.98066557	0.7195875
## Honey_Nut_Cheerios	0.1599704	0.4151897	-0.01290349	1.0774449
## Honey-comb	0.1599704	-1.4116451	-1.00647256	0.2424445
## Lucky_Charms	0.1599704	-0.4982277	-0.01290349	0.2424445
## Multi-Grain_Cheerios	-0.3532681	-0.4982277	-0.01290349	0.7195875
## Nut&Honey_Crunch	0.6732089	-0.4982277	-0.01290349	0.3617302
## Smacks	0.1599704	-0.4982277	-0.01290349	-1.0696990
## Trix	0.1599704	-1.4116451	-0.01290349	-0.2346986
## Wheaties_Honey_Gold	0.1599704	-0.4982277	-0.01290349	0.4810160
##	fiber	carbo	sugars	potass
## Apple_Cinnamon_Cheerios	-0.27354112	-1.10117049	0.6791317	-0.4071355
## Apple_Jacks	-0.48332864	-0.97320572	1.5926539	-0.9752315
## Cap'n'Crunch	-0.90290366	-0.71727619	1.1358928	-0.9042195
## Cinnamon_Toast_Crunch	-0.90290366	-0.46134666	0.4507511	-0.7621955
## Cocoa_Puffs	-0.90290366	-0.71727619	1.3642734	-0.6201715
## Corn_Pops	-0.48332864	-0.46134666	1.1358928	-1.1172554
## Count_Chocula	-0.90290366	-0.71727619	1.3642734	-0.4781475

## Froot_Loops	-0.48332864	-0.97320572	1.3642734	-0.9752315
## Frosted_Flakes	-0.48332864	-0.20541712	0.9075122	-1.0462434
## Fruity_Pebbles	-0.90290366	-0.46134666	1.1358928	-1.0462434
## Golden_Crisp	-0.90290366	-0.97320572	1.8210345	-0.8332075
## Golden_Grahams	-0.90290366	0.05051241	0.4507511	-0.7621955
## Honey_Graham_Ohs	-0.48332864	-0.71727619	0.9075122	-0.7621955
## Honey_Nut_Cheerios	-0.27354112	-0.84524095	0.6791317	-0.1230875
## Honey-comb	-0.90290366	-0.20541712	0.9075122	-0.9042195
## Lucky_Charms	-0.90290366	-0.71727619	1.1358928	-0.6201715
## Multi-Grain_Cheerios	-0.06375361	0.05051241	-0.2343906	-0.1230875
## Nut&Honey_Crunch	-0.90290366	0.05051241	0.4507511	-0.8332075
## Smacks	-0.48332864	-1.48506478	1.8210345	-0.8332075
## Trix	-0.90290366	-0.46134666	1.1358928	-1.0462434
## Wheaties_Honey_Gold	-0.48332864	0.30644194	0.2223705	-0.5491595
##	vitamins	shelf	weight	cups
rating				
## Apple_Cinnamon_Cheerios	-0.1453172	-1.450759	-0.1967771	-0.3052601 -
0.9365625				
## Apple_Jacks	-0.1453172	-0.249593	-0.1967771	0.7690100 -
0.6756899				
## Cap'n'Crunch	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.7528545				
## Cinnamon_Toast_Crunch	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.6260883				
## Cocoa_Puffs	-0.1453172	-0.249593	-0.1967771	0.7690100 -
1.4187264				
## Corn_Pops	-0.1453172	-0.249593	-0.1967771	0.7690100 -
0.4899817				
## Count_Chocula	-0.1453172	-0.249593	-0.1967771	0.7690100 -
1.4429256				
## Froot_Loops	-0.1453172	-0.249593	-0.1967771	0.7690100 -
0.7444941				
## Frosted_Flakes	-0.1453172	-1.450759	-0.1967771	-0.3052601 -
0.7994234				
## Fruity_Pebbles	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.0421897				
## Golden_Crisp	-0.1453172	-1.450759	-0.1967771	0.2533603 -
0.5277361				
## Golden_Grahams	-0.1453172	-0.249593	-0.1967771	-0.3052601 -
1.3427262				
## Honey_Graham_Ohs	-0.1453172	-0.249593	-0.1967771	0.7690100 -
1.4803151				
## Honey_Nut_Cheerios	-0.1453172	-1.450759	-0.1967771	-0.3052601 -
0.8253186				
## Honey-comb	-0.1453172	-1.450759	-0.1967771	2.1870466 -
0.9911728				
## Lucky_Charms	-0.1453172	-0.249593	-0.1967771	0.7690100 -
1.1341114				
## Multi-Grain_Cheerios	-0.1453172	-1.450759	-0.1967771	0.7690100 -
0.1822231				

```
## Nut&Honey_Crunch      -0.1453172 -0.249593 -0.1967771 -0.6490266 -
0.9070377
## Smacks                 -0.1453172 -0.249593 -0.1967771 -0.3052601 -
0.8140824
## Trix                   -0.1453172 -0.249593 -0.1967771  0.7690100 -
1.0615859
## Wheaties_Honey_Gold    -0.1453172 -1.450759 -0.1967771 -0.3052601 -
0.4611670
```

```
##                               cluster1
## Apple_Cinnamon_Cheerios      2
## Apple_Jacks                   2
## Cap'n'Crunch                  2
## Cinnamon_Toast_Crunch         2
## Cocoa_Puffs                   2
## Corn_Pops                     2
## Count_Chocula                 2
## Froot_Loops                   2
## Frosted_Flakes                2
## Fruity_Pebbles                2
## Golden_Crisp                  2
## Golden_Grahams                2
## Honey_Graham_Ohs              2
## Honey_Nut_Cheerios            2
## Honey-comb                    2
## Lucky_Charm                   2
## Multi-Grain_Cheerios          2
## Nut&Honey_Crunch              2
## Smacks                        2
## Trix                          2
## Wheaties_Honey_Gold           2
```

```
rating[rating$clust==3,]
```

```
##           calories      protein      fat      sodium
## Bran_Chex      -0.8665066 -0.4982277 -0.01290349  0.4810160
## Bran_Flakes     -0.8665066  0.4151897 -1.00647256  0.6003018
## Cheerios        0.1599704  3.1554419  0.98066557  1.5545879
## Corn_Chex       0.1599704 -0.4982277 -1.00647256  1.4353022
## Corn_Flakes     -0.3532681 -0.4982277 -1.00647256  1.5545879
## Crispix         0.1599704 -0.4982277 -1.00647256  0.7195875
## Double_Chex     -0.3532681 -0.4982277 -1.00647256  0.3617302
## Frosted_Mini-Wheats -0.3532681  0.4151897 -1.00647256 -1.9046994
## Grape_Nuts_Flakes -0.3532681  0.4151897 -0.01290349 -0.2346986
## Grape-Nuts      0.1599704  0.4151897 -1.00647256  0.1231587
## Just_Right_Crunchy__Nuggets 0.1599704 -0.4982277 -0.01290349  0.1231587
## Kix             0.1599704 -0.4982277 -0.01290349  1.1967306
## Maypo           -0.3532681  1.3286071 -0.01290349 -1.9046994
## Nutri-grain_Wheat -0.8665066  0.4151897 -1.00647256  0.1231587
## Product_19      -0.3532681  0.4151897 -1.00647256  1.9124453
## Puffed_Rice     -2.9194605 -1.4116451 -1.00647256 -1.9046994
```

## Puffed_Wheat	-2.9194605	-0.4982277	-1.00647256	-1.9046994
## Raisin_Squares	-0.8665066	-0.4982277	-1.00647256	-1.9046994
## Rice_Chex	0.1599704	-1.4116451	-1.00647256	0.9581591
## Rice_Krispies	0.1599704	-0.4982277	-1.00647256	1.5545879
## Shredded_Wheat	-1.3797451	-0.4982277	-1.00647256	-1.9046994
## Shredded_Wheat_'n'Bran	-0.8665066	0.4151897	-1.00647256	-1.9046994
## Shredded_Wheat_spoon_size	-0.8665066	0.4151897	-1.00647256	-1.9046994
## Special_K	0.1599704	3.1554419	-1.00647256	0.8388733
## Strawberry_Fruit_Wheats	-0.8665066	-0.4982277	-1.00647256	-1.7257708
## Total_Corn_Flakes	0.1599704	-0.4982277	-0.01290349	0.4810160
## Total_Whole_Grain	-0.3532681	0.4151897	-0.01290349	0.4810160
## Triples	0.1599704	-0.4982277	-0.01290349	1.0774449
## Wheat_Chex	-0.3532681	0.4151897	-0.01290349	0.8388733
## Wheaties	-0.3532681	0.4151897	-0.01290349	0.4810160
##	fiber	carbo	sugars	
potass				
## Bran_Chex	0.77539645	0.05051241	-0.234390576	
0.37399653				
## Bran_Flakes	1.19497147	-0.46134666	-0.462771138	
1.29715251				
## Cheerios	-0.06375361	0.56237147	-1.376293384	
0.08994853				
## Corn_Chex	-0.90290366	1.84201913	-0.919532261	-
1.04624345				
## Corn_Flakes	-0.48332864	1.58608960	-1.147912823	-
0.90421945				
## Crispix	-0.48332864	1.58608960	-0.919532261	-
0.97523145				
## Double_Chex	-0.48332864	0.81830100	-0.462771138	-
0.26511146				
## Frosted_Mini-Wheats	0.35582142	-0.20541712	-0.006010015	
0.01893653				
## Grape_Nuts_Flakes	0.35582142	0.05051241	-0.462771138	-
0.19409946				
## Grape-Nuts	0.35582142	0.56237147	-0.919532261	-
0.12308746				
## Just_Right_Crunchy__Nuggets	-0.48332864	0.56237147	-0.234390576	-
0.54915946				
## Kix	-0.90290366	1.58608960	-0.919532261	-
0.83320745				
## Maypo	-0.90290366	0.30644194	-0.919532261	-
0.05207547				
## Nutri-grain_Wheat	0.35582142	0.81830100	-1.147912823	-
0.12308746				
## Product_19	-0.48332864	1.33016007	-0.919532261	-
0.76219545				
## Puffed_Rice	-0.90290366	-0.46134666	-1.604673946	-
1.18826745				
## Puffed_Wheat	-0.48332864	-1.22913525	-1.604673946	-
0.69118346				

## Raisin_Squares 0.16096053	-0.06375361	0.05051241	-0.234390576	
## Rice_Chex 0.97523145	-0.90290366	2.09794866	-1.147912823	-
## Rice_Krispies 0.90421945	-0.90290366	1.84201913	-0.919532261	-
## Shredded_Wheat 0.05207547	0.35582142	0.30644194	-1.604673946	-
## Shredded_Wheat_'n'Bran 0.58703252	0.77539645	1.07423054	-1.604673946	
## Shredded_Wheat_spoon_size 0.30298453	0.35582142	1.33016007	-1.604673946	
## Special_K 0.62017146	-0.48332864	0.30644194	-0.919532261	-
## Strawberry_Fruit_Wheats 0.12308746	0.35582142	0.05051241	-0.462771138	-
## Total_Corn_Flakes 0.90421945	-0.90290366	1.58608960	-0.919532261	-
## Total_Whole_Grain 0.16096053	0.35582142	0.30644194	-0.919532261	
## Triples 0.54915946	-0.90290366	1.58608960	-0.919532261	-
## Wheat_Chex 0.23197253	0.35582142	0.56237147	-0.919532261	
## Wheaties 0.16096053	0.35582142	0.56237147	-0.919532261	
##	vitamins	shelf	weight	cups
## Bran_Chex	-0.1453172	-1.4507595	-0.1967771	-0.64902659
## Bran_Flakes	-0.1453172	0.9515734	-0.1967771	-0.64902659
## Cheerios	-0.1453172	-1.4507595	-0.1967771	1.84328015
## Corn_Chex	-0.1453172	-1.4507595	-0.1967771	0.76901001
## Corn_Flakes	-0.1453172	-1.4507595	-0.1967771	0.76901001
## Crispix	-0.1453172	0.9515734	-0.1967771	0.76901001
## Double_Chex	-0.1453172	0.9515734	-0.1967771	-0.30526014
## Frosted_Mini-Wheats	-0.1453172	-0.2495930	-0.1967771	-0.09040611
## Grape_Nuts_Flakes	-0.1453172	0.9515734	-0.1967771	0.25336034
## Grape-Nuts	-0.1453172	0.9515734	-0.1967771	-2.45380043
## Just_Right_Crunchy__Nuggets	3.2115106	0.9515734	-0.1967771	0.76901001
## Kix	-0.1453172	-0.2495930	-0.1967771	2.91755030
## Maypo	-0.1453172	-0.2495930	-0.1967771	0.76901001
## Nutri-grain_Wheat	-0.1453172	0.9515734	-0.1967771	0.76901001
## Product_19	3.2115106	0.9515734	-0.1967771	0.76901001
## Puffed_Rice	-1.2642598	0.9515734	-3.5195485	0.76901001
## Puffed_Wheat	-1.2642598	0.9515734	-3.5195485	0.76901001
## Raisin_Squares	-0.1453172	0.9515734	-0.1967771	-1.37953029
## Rice_Chex	-0.1453172	-1.4507595	-0.1967771	1.32763048
## Rice_Krispies	-0.1453172	-1.4507595	-0.1967771	0.76901001
## Shredded_Wheat	-1.2642598	-1.4507595	-1.3265194	0.76901001
## Shredded_Wheat_'n'Bran	-1.2642598	-1.4507595	-0.1967771	-0.64902659
## Shredded_Wheat_spoon_size	-1.2642598	-1.4507595	-0.1967771	-0.64902659

## Special_K	-0.1453172	-1.4507595	-0.1967771	0.76901001
## Strawberry_Fruit_Wheats	-0.1453172	-0.2495930	-0.1967771	0.76901001
## Total_Corn_Flakes	3.2115106	0.9515734	-0.1967771	0.76901001
## Total_Whole_Grain	3.2115106	0.9515734	-0.1967771	0.76901001
## Triples	-0.1453172	0.9515734	-0.1967771	-0.30526014
## Wheat_Chex	-0.1453172	-1.4507595	-0.1967771	-0.64902659
## Wheaties	-0.1453172	-1.4507595	-0.1967771	0.76901001
##	rating	cluster1		
## Bran_Chex	0.45948710	3		
## Bran_Flakes	0.75801873	3		
## Cheerios	0.57657347	3		
## Corn_Chex	-0.08689833	3		
## Corn_Flakes	0.22763247	3		
## Crispix	0.30112138	3		
## Double_Chex	0.11853896	3		
## Frosted_Mini-Wheats	1.11618949	3		
## Grape_Nuts_Flakes	0.66996501	3		
## Grape-Nuts	0.76209027	3		
## Just_Right_Crunchy__Nuggets	-0.43723896	3		
## Kix	-0.24379018	3		
## Maypo	0.86744227	3		
## Nutri-grain_Wheat	1.20857002	3		
## Product_19	-0.08273233	3		
## Puffed_Rice	1.28782197	3		
## Puffed_Wheat	1.44796198	3		
## Raisin_Squares	0.90177096	3		
## Rice_Chex	-0.04746624	3		
## Rice_Krispies	-0.14988985	3		
## Shredded_Wheat	1.82029290	3		
## Shredded_Wheat_'n'Bran	2.26429773	3		
## Shredded_Wheat_spoon_size	2.14533086	3		
## Special_K	0.74502768	3		
## Strawberry_Fruit_Wheats	1.18871964	3		
## Total_Corn_Flakes	-0.27236281	3		
## Total_Whole_Grain	0.28426404	3		
## Triples	-0.25339630	3		
## Wheat_Chex	0.50698324	3		
## Wheaties	0.63545985	3		

#Mean ratings to determine the best cluster.

```
mean(rating[rating$cluster1==1,"rating"])
```

```
## [1] 0.01688218
```

```
mean(rating[rating$cluster1==2,"rating"])
```

```
## [1] -0.9836387
```

```
mean(rating[rating$cluster1==3,"rating"])
```

```
## [1] 0.6239928
```

#As we can see that the mean ratings of the cluster3 is the highest, but as we are taking in consideration the word healthy diet which should include a cluster with healthy cereals I will choose cluster1 because of the following reason:

#Cluster 1 has high protein and fibre content compared to others.Hence, it can be said that cluster 1 possess high nutritional value and has healthy cereals

#Cluster 1 consists of fruits, nuts, wheat which can be considered as a healthy cereal.

#Data normalization is really important as we are using distance as a measure of performance.