

ASSIGNMENT 5

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#Reading the directory

```
getwd()
```

```
## [1] "/Users/ishika/Desktop"
```

#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 car
bo
## 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)
```

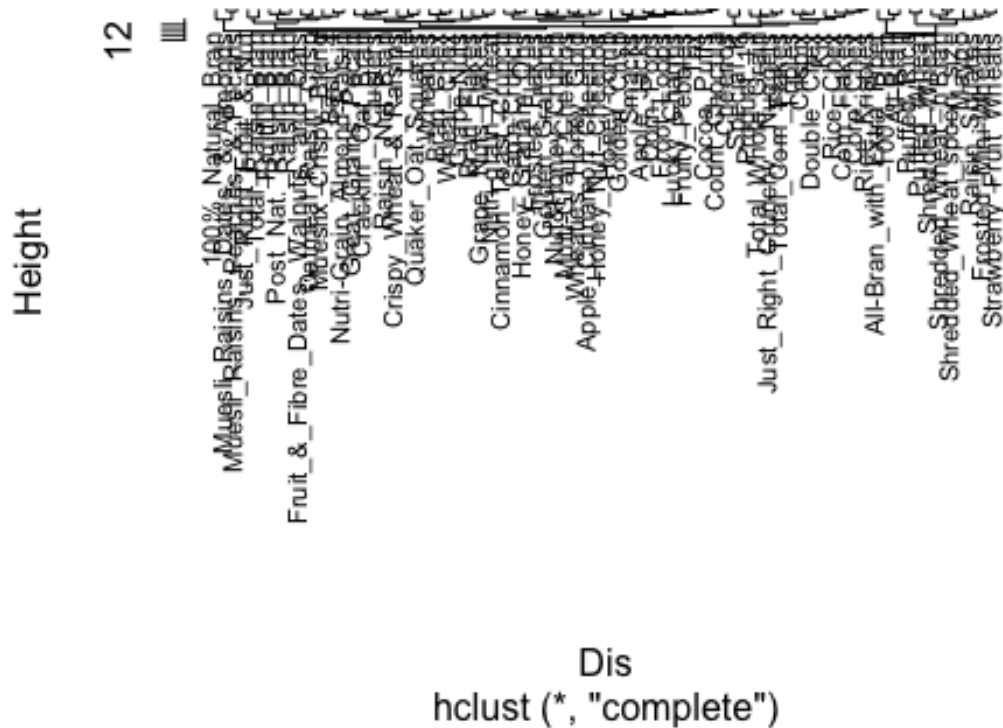
#Calculation of Dissimilarity Matrix and performing Hierarchial Clustering

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

#Plotting the dendogram

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

Cluster Dendrogram



#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.

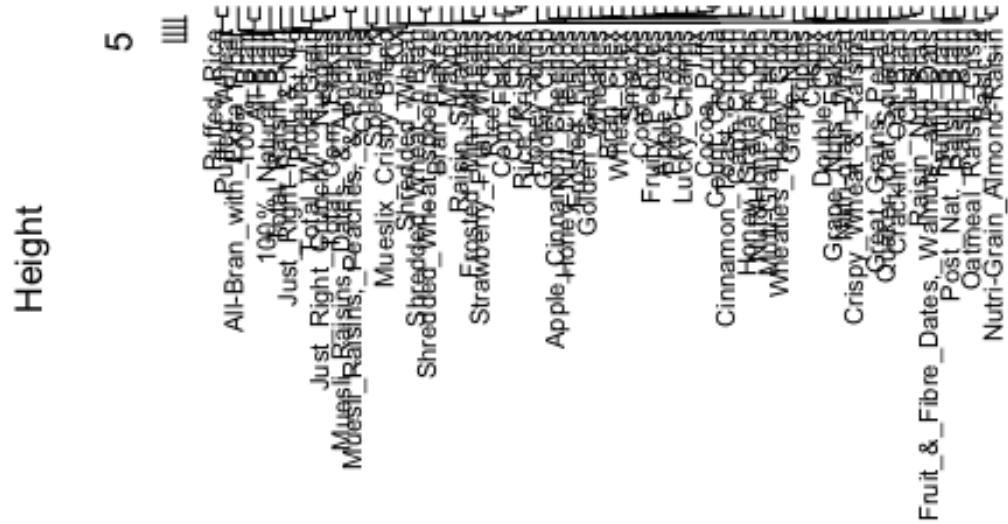
#Complete linkage: computes the maximum distance between clusters before merging them.

#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)
```

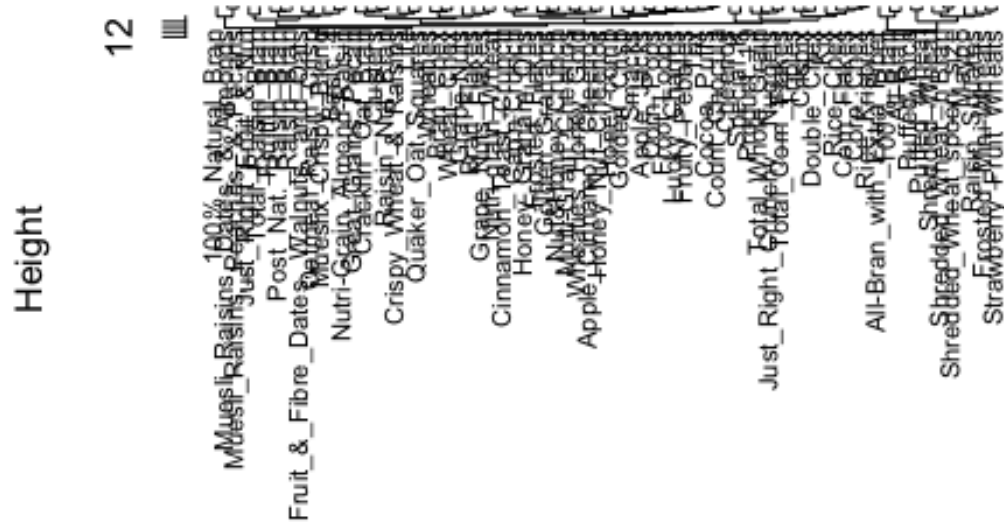
Cluster Dendrogram



Dis
hclust (*, "single")

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

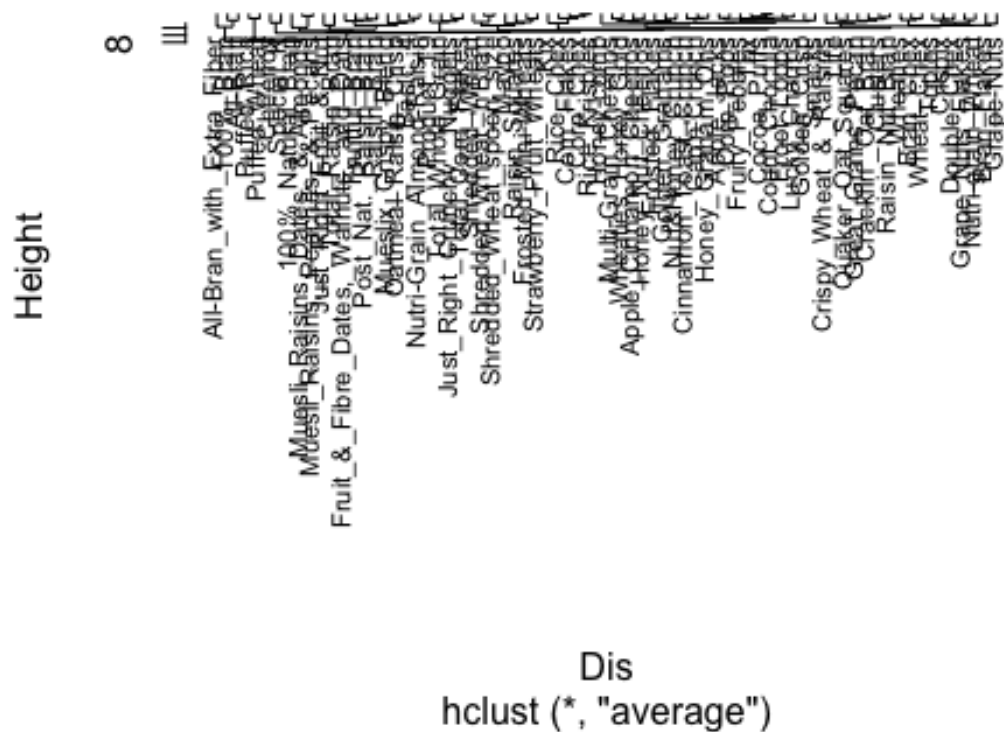
Cluster Dendrogram



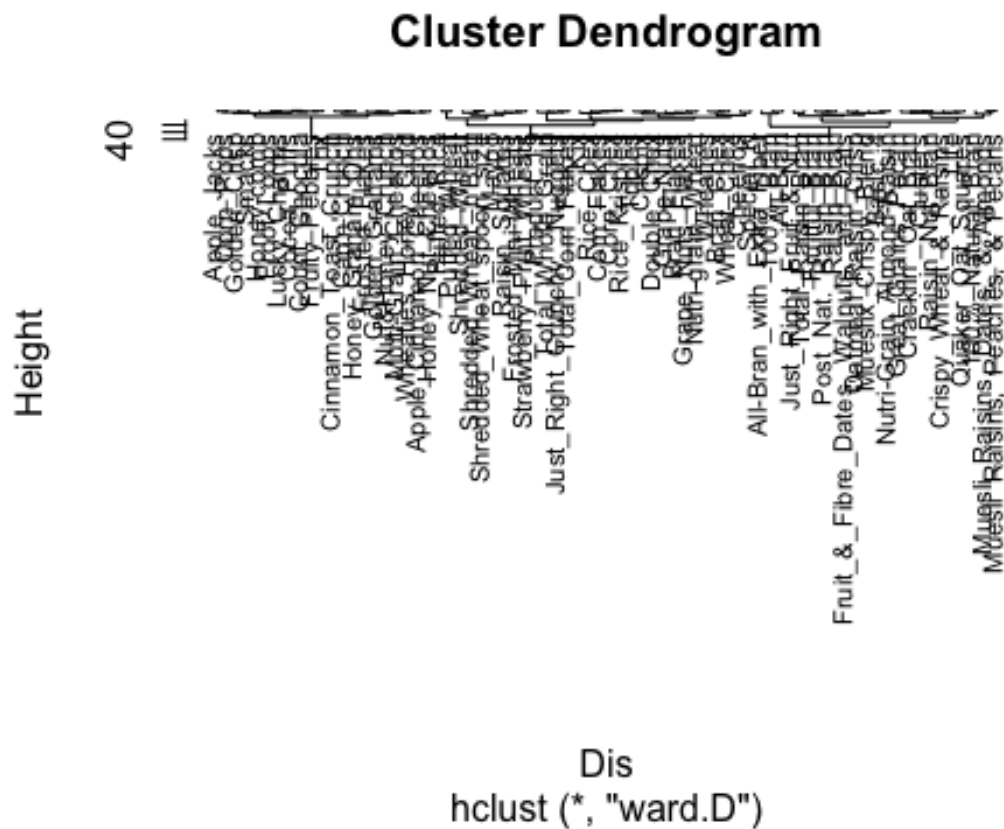
Dis
hclust (*, "complete")

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

Cluster Dendrogram



```
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

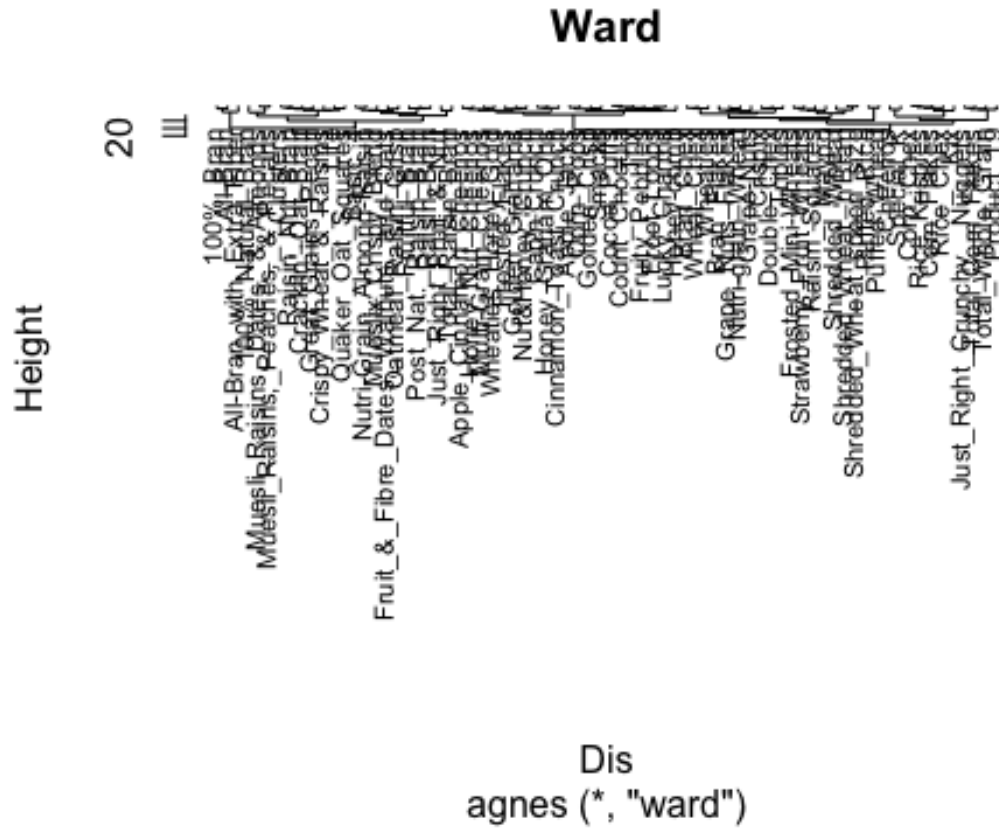
hc_W <- agnes(Dis,method="ward")
print(hc_W$ac)

## [1] 0.9049881
```

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

#Dendrogram of Ward

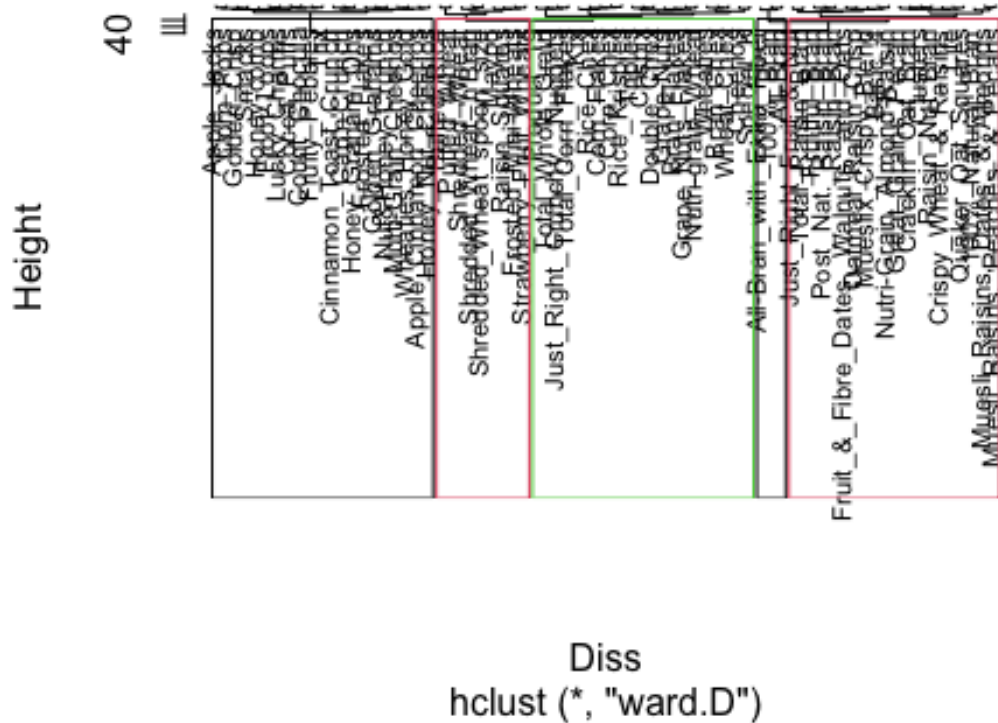
```
pltree(hc_W, cex=0.7, hang=-1, main="Ward")
```



#Q2 Choosing the number of clusters

```
Diss <- dist(Assign_New, method="euclidean")
hc_W <- hclust(Diss, method="ward.D")
plot(hc_W, cex=0.7)
rect.hclust(hc_W, k=5, border=1:3)
```

Cluster Dendrogram



```
cluster1<-cutree(hc_W,k=5)
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=5)
print_clusters(groups,5)

## [1] "cluster 1"
##
##          cluster  calories  protein      fat      sodiu
m
## 100%_Bran          3 -1.892984 1.328607 -0.01290349 -0.353984
4
## All-Bran           3 -1.892984 1.328607 -0.01290349  1.196730
6
## All-Bran_with_Extra_Fiber  3 -2.919461 1.328607 -1.00647256 -0.234698
6
##          fiber      carbo      sugars  potass  vitamin
s
## 100%_Bran          3.292847 -2.508783 -0.2343906 2.575368 -0.145317
2
## All-Bran           2.873272 -1.996924 -0.4627711 3.143464 -0.145317
2
## All-Bran_with_Extra_Fiber 4.971147 -1.740994 -1.6046739 3.285488 -0.145317
2
##          shelf      weight      cups  rating
## 100%_Bran          0.9515734 -0.1967771 -2.110034 1.832188
## All-Bran           0.9515734 -0.1967771 -2.110034 1.193099
## All-Bran_with_Extra_Fiber 0.9515734 -0.1967771 -1.379530 3.633385
## [1] "cluster 2"
##
##          cluster  calories  protein
## 100%_Natural_Bran          1  0.6732089  0.4151897
## 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 | fibe |
| r | | | | |
| ## 100%_Natural_Bran | | 3.96137277 | -1.725770770 | -0.0637536 |
| 1 | | | | |
| ## Basic_4 | | 0.98066557 | 0.600301771 | -0.0637536 |
| 1 | | | | |
| ## Clusters | | 0.98066557 | -0.234698628 | -0.0637536 |
| 1 | | | | |
| ## Cracklin'_Oat_Bran | | 1.97423464 | -0.234698628 | 0.7753964 |
| 5 | | | | |
| ## Crispy_Wheat_&_Raisins | | -0.01290349 | -0.234698628 | -0.0637536 |
| 1 | | | | |
| ## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats | | 0.98066557 | 0.003872915 | 1.1949714 |
| 7 | | | | |
| ## Fruitful_Bran | | -1.00647256 | 0.958159085 | 1.1949714 |
| 7 | | | | |
| ## Great_Grains_Pecan | | 1.97423464 | -1.010056142 | 0.3558214 |
| 2 | | | | |
| ## Just_Right_Fruit_&_Nut | | -0.01290349 | 0.123158686 | -0.0637536 |
| 1 | | | | |
| ## Life | | 0.98066557 | -0.115412857 | -0.0637536 |
| 1 | | | | |
| ## Muesli_Raisins,_Dates,_&_Almonds | | 1.97423464 | -0.771484599 | 0.3558214 |
| 2 | | | | |
| ## Muesli_Raisins,_Peaches,_&_Pecans | | 1.97423464 | -0.115412857 | 0.3558214 |
| 2 | | | | |
| ## Mueslix_Crispy_Blend | | 0.98066557 | -0.115412857 | 0.3558214 |
| 2 | | | | |
| ## Nutri-Grain_Almond-Raisin | | 0.98066557 | 0.719587543 | 0.3558214 |
| 2 | | | | |
| ## Oatmeal_Raisin_Crisp | | 0.98066557 | 0.123158686 | -0.2735411 |
| 2 | | | | |
| ## Post_Nat._Raisin_Bran | | -0.01290349 | 0.481016000 | 1.6145465 |
| 0 | | | | |
| ## Quaker_Oat_Squares | | -0.01290349 | -0.294341514 | -0.0637536 |
| 1 | | | | |
| ## Raisin_Bran | | -0.01290349 | 0.600301771 | 1.1949714 |
| 7 | | | | |
| ## Raisin_Nut_Bran | | 0.98066557 | -0.234698628 | 0.1460339 |
| 1 | | | | |
| ## Total_Raisin_Bran | | -0.01290349 | 0.361730229 | 0.7753964 |
| 5 | | | | |
| ## | | carbo | sugars | potas |
| s | | | | |
| ## 100%_Natural_Bran | | -1.74099432 | 0.222370547 | 0.5160205 |

| | | | | |
|---|-------------|--------------|------------|--|
| 2 | | | | |
| ## Basic_4 | 0.81830100 | 0.222370547 | 0.0189365 | |
| 3 | | | | |
| ## Clusters | -0.46134666 | -0.006010015 | 0.0899485 | |
| 3 | | | | |
| ## Cracklin'_Oat_Bran | -1.22913525 | -0.006010015 | 0.8710805 | |
| 2 | | | | |
| ## Crispy_Wheat_&_Raisins | -0.97320572 | 0.679131670 | 0.3029845 | |
| 3 | | | | |
| ## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats | -0.71727619 | 0.679131670 | 1.4391765 | |
| 1 | | | | |
| ## Fruitful_Bran | -0.20541712 | 1.135892793 | 1.2971525 | |
| 1 | | | | |
| ## Great_Grains_Pecan | -0.46134666 | -0.691151699 | 0.0189365 | |
| 3 | | | | |
| ## Just_Right_Fruit_&_Nut | 1.33016007 | 0.450751108 | -0.0520754 | |
| 7 | | | | |
| ## Life | -0.71727619 | -0.234390576 | -0.0520754 | |
| 7 | | | | |
| ## Muesli_Raisins,_Dates,_&_Almonds | 0.30644194 | 0.907512232 | 1.0131045 | |
| 2 | | | | |
| ## Muesli_Raisins,_Peaches,_&_Pecans | 0.30644194 | 0.907512232 | 1.0131045 | |
| 2 | | | | |
| ## Mueslix_Crispy_Blend | 0.56237147 | 1.364273355 | 0.8710805 | |
| 2 | | | | |
| ## Nutri-Grain_Almond-Raisin | 1.58608960 | -0.006010015 | 0.4450085 | |
| 3 | | | | |
| ## Oatmeal_Raisin_Crisp | -0.33338189 | 0.679131670 | 0.3029845 | |
| 3 | | | | |
| ## Post_Nat._Raisin_Bran | -0.97320572 | 1.592653916 | 2.2913205 | |
| 0 | | | | |
| ## Quaker_Oat_Squares | -0.20541712 | -0.234390576 | 0.1609605 | |
| 3 | | | | |
| ## Raisin_Bran | -0.20541712 | 1.135892793 | 2.0072725 | |
| 0 | | | | |
| ## Raisin_Nut_Bran | -1.10117049 | 0.222370547 | 0.5870325 | |
| 2 | | | | |
| ## Total_Raisin_Bran | 0.05051241 | 1.592653916 | 1.8652485 | |
| 0 | | | | |
| ## | vitamins | shelf | weight | |
| ## 100%_Natural_Bran | -1.2642598 | 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%_Natural_Bran                      0.7690100 -0.6180571
## 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 3"
##                                     cluster  calories    protein      fat    sodi
um
## Apple_Cinnamon_Cheerios                2  0.1599704 -0.4982277  0.98066557  0.24244
45
## Apple_Jacks                            2  0.1599704 -0.4982277 -1.00647256 -0.41362
73
## Cap'n'Crunch                           2  0.6732089 -1.4116451  0.98066557  0.71958
75
## Cinnamon_Toast_Crunch                   2  0.6732089 -1.4116451  1.97423464  0.60030
18
## Cocoa_Puffs                             2  0.1599704 -1.4116451 -0.01290349  0.24244
45
## Corn_Pops                              2  0.1599704 -1.4116451 -1.00647256 -0.83112
75
## Count_Chocula                           2  0.1599704 -1.4116451 -0.01290349  0.24244
45
## Froot_Loops                             2  0.1599704 -0.4982277 -0.01290349 -0.41362
73

```

| | | | | | |
|----------------------------|-------------|-------------|------------|-------------|----------|
| ## Frosted_Flakes | 2 | 0.1599704 | -1.4116451 | -1.00647256 | 0.48101 |
| 60 | | | | | |
| ## Fruity_Pebbles | 2 | 0.1599704 | -1.4116451 | -0.01290349 | -0.29434 |
| 15 | | | | | |
| ## Golden_Crisp | 2 | -0.3532681 | -0.4982277 | -1.00647256 | -1.36791 |
| 35 | | | | | |
| ## Golden_Grahams | 2 | 0.1599704 | -1.4116451 | -0.01290349 | 1.43530 |
| 22 | | | | | |
| ## Honey_Graham_Ohs | 2 | 0.6732089 | -1.4116451 | 0.98066557 | 0.71958 |
| 75 | | | | | |
| ## Honey_Nut_Cheerios | 2 | 0.1599704 | 0.4151897 | -0.01290349 | 1.07744 |
| 49 | | | | | |
| ## Honey-comb | 2 | 0.1599704 | -1.4116451 | -1.00647256 | 0.24244 |
| 45 | | | | | |
| ## Lucky_Charms | 2 | 0.1599704 | -0.4982277 | -0.01290349 | 0.24244 |
| 45 | | | | | |
| ## Multi-Grain_Cheerios | 2 | -0.3532681 | -0.4982277 | -0.01290349 | 0.71958 |
| 75 | | | | | |
| ## Nut&Honey_Crunch | 2 | 0.6732089 | -0.4982277 | -0.01290349 | 0.36173 |
| 02 | | | | | |
| ## Smacks | 2 | 0.1599704 | -0.4982277 | -0.01290349 | -1.06969 |
| 90 | | | | | |
| ## Trix | 2 | 0.1599704 | -1.4116451 | -0.01290349 | -0.23469 |
| 86 | | | | | |
| ## Wheaties_Honey_Gold | 2 | 0.1599704 | -0.4982277 | -0.01290349 | 0.48101 |
| 60 | | | | | |
| ## | | 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 |
| ing | | | | | rat |

| | | | | | |
|----------------------------|------------|-----------|------------|------------|---------|
| ## Apple_Cinnamon_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.9365 |
| 625 | | | | | |
| ## Apple_Jacks | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.6756 |
| 899 | | | | | |
| ## Cap'n'Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.7528 |
| 545 | | | | | |
| ## Cinnamon_Toast_Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.6260 |
| 883 | | | | | |
| ## Cocoa_Puffs | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4187 |
| 264 | | | | | |
| ## Corn_Pops | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.4899 |
| 817 | | | | | |
| ## Count_Chocula | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4429 |
| 256 | | | | | |
| ## Froot_Loops | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.7444 |
| 941 | | | | | |
| ## Frosted_Flakes | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.7994 |
| 234 | | | | | |
| ## Fruity_Pebbles | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.0421 |
| 897 | | | | | |
| ## Golden_Crisp | -0.1453172 | -1.450759 | -0.1967771 | 0.2533603 | -0.5277 |
| 361 | | | | | |
| ## Golden_Grahams | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.3427 |
| 262 | | | | | |
| ## Honey_Graham_Ohs | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4803 |
| 151 | | | | | |
| ## Honey_Nut_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.8253 |
| 186 | | | | | |
| ## Honey-comb | -0.1453172 | -1.450759 | -0.1967771 | 2.1870466 | -0.9911 |
| 728 | | | | | |
| ## Lucky_Charm | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.1341 |
| 114 | | | | | |
| ## Multi-Grain_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | 0.7690100 | -0.1822 |
| 231 | | | | | |
| ## Nut&Honey_Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.6490266 | -0.9070 |
| 377 | | | | | |
| ## Smacks | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -0.8140 |
| 824 | | | | | |
| ## Trix | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.0615 |
| 859 | | | | | |
| ## Wheaties_Honey_Gold | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.4611 |
| 670 | | | | | |

```

kbest.p<- 5
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] 0.6212579 0.7200205 0.8899924 0.6045410 0.6140795
```

```
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 Hierarchical Clustering, plotting dendrogram and then cutting the dendrogram by taking k = 5 .

```
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)
```

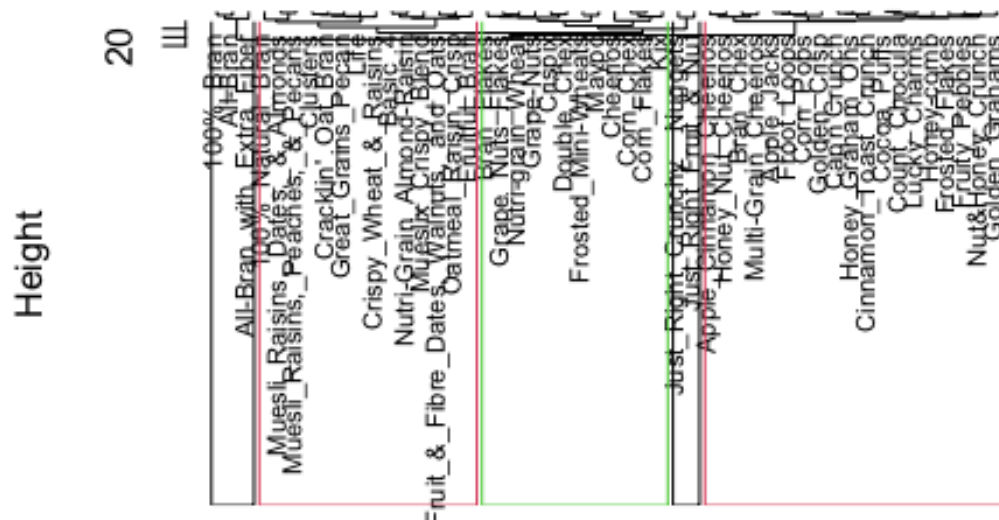
```
##          single  complete   average      ward
```

```
## [1,] 0.6393338 0.8138238 0.7408904 0.8764323
```

```
pltree(ag_ward, cex = 0.7, hang = -1, main = "Dendrogram of Agnes with Partiti  
oned Data (Using Ward)")
```

```
rect.hclust(ag_ward, k = 5, border = 1:3)
```

Dendrogram of Agnes with Partitioned Data (Using W



```
scale(Parition_1)
agnes (*, "ward")
```

```
cut_2 <- cutree(ag_ward, k = 5)
```

#Calculating the centeroids.

```
result <- as.data.frame(cbind(Partition_1, cut_2))
result[result$cut_2==1,]
```

| ## | calories | protein | fat | sodium | fib |
|------------------------------|-----------|------------|-------------|------------|---------|
| er | | | | | |
| ## 100%_Bran | -1.892984 | 1.328607 | -0.01290349 | -0.3539844 | 3.2928 |
| 47 | | | | | |
| ## All-Bran | -1.892984 | 1.328607 | -0.01290349 | 1.1967306 | 2.8732 |
| 72 | | | | | |
| ## All-Bran_with_Extra_Fiber | -2.919461 | 1.328607 | -1.00647256 | -0.2346986 | 4.9711 |
| 47 | | | | | |
| ## | carbo | sugars | potass | vitamins | she |
| lf | | | | | |
| ## 100%_Bran | -2.508783 | -0.2343906 | 2.575368 | -0.1453172 | 0.95157 |
| 34 | | | | | |
| ## All-Bran | -1.996924 | -0.4627711 | 3.143464 | -0.1453172 | 0.95157 |
| 34 | | | | | |
| ## All-Bran_with_Extra_Fiber | -1.740994 | -1.6046739 | 3.285488 | -0.1453172 | 0.95157 |
| 34 | | | | | |
| ## | 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
## 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
## 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
##              sodium      fiber      carbo
## 100%_Natural_Bran   -1.725770770 -0.06375361 -1.7409943
## Basic_4              0.600301771 -0.06375361    0.8183010
## Clusters            -0.234698628 -0.06375361    -0.4613467
## Cracklin'_Oat_Bran   -0.234698628    0.77539645 -1.2291353
## Crispy_Wheat_&_Raisins -0.234698628 -0.06375361    -0.9732057
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats 0.003872915    1.19497147 -0.7172762
## Fruitful_Bran        0.958159085    1.19497147    -0.2054171
## Great_Grains_Pecan   -1.010056142    0.35582142    -0.4613467
## Life                 -0.115412857 -0.06375361    -0.7172762
## Muesli_Raisins,_Dates,_&_Almonds     -0.771484599    0.35582142    0.3064419
## Muesli_Raisins,_Peaches,_&_Pecans    -0.115412857    0.35582142    0.3064419
## Mueslix_Crispy_Blend    -0.115412857    0.35582142    0.5623715
## Nutri-Grain_Almond-Raisin    0.719587543    0.35582142    1.5860896
## Oatmeal_Raisin_Crisp    0.123158686 -0.27354112    -0.3333819
##              sugars      potass      vitamins
## 100%_Natural_Bran    0.222370547    0.51602052 -1.2642598
## 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
## 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
## shelf weight cups
## 100%_Natural_Bran 0.9515734 -0.1967771 0.7690100
## 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
## 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
## rating cut_2
## 100%_Natural_Bran -0.6180571 2
## Basic_4 -0.4005857 2
## Clusters -0.1612765 2
## Cracklin'_Oat_Bran -0.1578193 2
## Crispy_Wheat_&_Raisins -0.4619759 2
## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats -0.1244837 2
## Fruitful_Bran -0.1174756 2
## Great_Grains_Pecan 0.2239586 2
## Life 0.1895290 2
## Muesli_Raisins,_Dates,_&_Almonds -0.3935878 2
## Muesli_Raisins,_Peaches,_&_Pecans -0.6069456 2
## Mueslix_Crispy_Blend -0.8793408 2
## Nutri-Grain_Almond-Raisin -0.1404816 2
## Oatmeal_Raisin_Crisp -0.8695530 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 | rat |
| ing | | | | | |
| ## Apple_Cinnamon_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.9365 |
| 625 | | | | | |
| ## Apple_Jacks | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.6756 |
| 899 | | | | | |
| ## Bran_Chex | -0.1453172 | -1.450759 | -0.1967771 | -0.6490266 | 0.4594 |
| 871 | | | | | |
| ## Cap'n'Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.7528 |
| 545 | | | | | |
| ## Cinnamon_Toast_Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.6260 |
| 883 | | | | | |
| ## Cocoa_Puffs | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4187 |
| 264 | | | | | |
| ## Corn_Pops | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.4899 |
| 817 | | | | | |
| ## Count_Chocula | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4429 |
| 256 | | | | | |
| ## Froot_Loops | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.7444 |
| 941 | | | | | |
| ## Frosted_Flakes | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.7994 |
| 234 | | | | | |
| ## Fruity_Pebbles | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.0421 |
| 897 | | | | | |


```

## Golden_Crisp          -0.1453172 -1.450759 -0.1967771  0.2533603 -0.5277
361
## Golden_Grahams        -0.1453172 -0.249593 -0.1967771 -0.3052601 -1.3427
262
## Honey_Graham_Ohs      -0.1453172 -0.249593 -0.1967771  0.7690100 -1.4803
151
## Honey_Nut_Cheerios    -0.1453172 -1.450759 -0.1967771 -0.3052601 -0.8253
186
## Honey-comb            -0.1453172 -1.450759 -0.1967771  2.1870466 -0.9911
728
## Lucky_Charms          -0.1453172 -0.249593 -0.1967771  0.7690100 -1.1341
114
## Multi-Grain_Cheerios  -0.1453172 -1.450759 -0.1967771  0.7690100 -0.1822
231
## Nut&Honey_Crunch      -0.1453172 -0.249593 -0.1967771 -0.6490266 -0.9070
377
##                               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,]

##                               calories      protein      fat      sodium      fib
er
## Bran_Flakes          -0.8665066  0.4151897 -1.00647256  0.6003018  1.194971
47
## Cheerios              0.1599704  3.1554419  0.98066557  1.5545879 -0.063753
61
## Corn_Chex             0.1599704 -0.4982277 -1.00647256  1.4353022 -0.902903
66
## Corn_Flakes          -0.3532681 -0.4982277 -1.00647256  1.5545879 -0.483328
64

```

| | | | | | |
|------------------------|-------------|--------------|-------------|------------|-----------|
| ## Crispix | 0.1599704 | -0.4982277 | -1.00647256 | 0.7195875 | -0.483328 |
| 64 | | | | | |
| ## Double_Chex | -0.3532681 | -0.4982277 | -1.00647256 | 0.3617302 | -0.483328 |
| 64 | | | | | |
| ## Frosted_Mini-Wheats | -0.3532681 | 0.4151897 | -1.00647256 | -1.9046994 | 0.355821 |
| 42 | | | | | |
| ## Grape_Nuts_Flakes | -0.3532681 | 0.4151897 | -0.01290349 | -0.2346986 | 0.355821 |
| 42 | | | | | |
| ## Grape-Nuts | 0.1599704 | 0.4151897 | -1.00647256 | 0.1231587 | 0.355821 |
| 42 | | | | | |
| ## Kix | 0.1599704 | -0.4982277 | -0.01290349 | 1.1967306 | -0.902903 |
| 66 | | | | | |
| ## Maypo | -0.3532681 | 1.3286071 | -0.01290349 | -1.9046994 | -0.902903 |
| 66 | | | | | |
| ## Nutri-grain_Wheat | -0.8665066 | 0.4151897 | -1.00647256 | 0.1231587 | 0.355821 |
| 42 | | | | | |
| ## | carbo | sugars | potass | vitamins | s |
| helf | | | | | |
| ## Bran_Flakes | -0.46134666 | -0.462771138 | 1.29715251 | -0.1453172 | 0.951 |
| 5734 | | | | | |
| ## Cheerios | 0.56237147 | -1.376293384 | 0.08994853 | -0.1453172 | -1.450 |
| 7595 | | | | | |
| ## Corn_Chex | 1.84201913 | -0.919532261 | -1.04624345 | -0.1453172 | -1.450 |
| 7595 | | | | | |
| ## Corn_Flakes | 1.58608960 | -1.147912823 | -0.90421945 | -0.1453172 | -1.450 |
| 7595 | | | | | |
| ## Crispix | 1.58608960 | -0.919532261 | -0.97523145 | -0.1453172 | 0.951 |
| 5734 | | | | | |
| ## Double_Chex | 0.81830100 | -0.462771138 | -0.26511146 | -0.1453172 | 0.951 |
| 5734 | | | | | |
| ## Frosted_Mini-Wheats | -0.20541712 | -0.006010015 | 0.01893653 | -0.1453172 | -0.249 |
| 5930 | | | | | |
| ## Grape_Nuts_Flakes | 0.05051241 | -0.462771138 | -0.19409946 | -0.1453172 | 0.951 |
| 5734 | | | | | |
| ## Grape-Nuts | 0.56237147 | -0.919532261 | -0.12308746 | -0.1453172 | 0.951 |
| 5734 | | | | | |
| ## Kix | 1.58608960 | -0.919532261 | -0.83320745 | -0.1453172 | -0.249 |
| 5930 | | | | | |
| ## Maypo | 0.30644194 | -0.919532261 | -0.05207547 | -0.1453172 | -0.249 |
| 5930 | | | | | |
| ## Nutri-grain_Wheat | 0.81830100 | -1.147912823 | -0.12308746 | -0.1453172 | 0.951 |
| 5734 | | | | | |
| ## | weight | cups | rating | cut_2 | |
| ## Bran_Flakes | -0.1967771 | -0.64902659 | 0.75801873 | 4 | |
| ## Cheerios | -0.1967771 | 1.84328015 | 0.57657347 | 4 | |
| ## Corn_Chex | -0.1967771 | 0.76901001 | -0.08689833 | 4 | |
| ## Corn_Flakes | -0.1967771 | 0.76901001 | 0.22763247 | 4 | |
| ## Crispix | -0.1967771 | 0.76901001 | 0.30112138 | 4 | |
| ## Double_Chex | -0.1967771 | -0.30526014 | 0.11853896 | 4 | |
| ## Frosted_Mini-Wheats | -0.1967771 | -0.09040611 | 1.11618949 | 4 | |

```

## Grape_Nuts_Flakes    -0.1967771  0.25336034  0.66996501    4
## Grape-Nuts           -0.1967771 -2.45380043  0.76209027    4
## Kix                  -0.1967771  2.91755030 -0.24379018    4
## Maypo                -0.1967771  0.76901001  0.86744227    4
## Nutri-grain_Wheat    -0.1967771  0.76901001  1.20857002    4

centroid_4 <- colMeans(result[result$cut_2==4,])
result[result$cut_2==5,]

##              calories      protein      fat      sodium
## Just_Right_Crunchy__Nuggets 0.1599704 -0.4982277 -0.01290349 0.1231587
## Just_Right_Fruit_&_Nut      1.6996859  0.4151897 -0.01290349 0.1231587
##              fiber      carbo      sugars      potass
## Just_Right_Crunchy__Nuggets -0.48332864 0.5623715 -0.2343906 -0.54915946
## Just_Right_Fruit_&_Nut      -0.06375361 1.3301601  0.4507511 -0.05207547
##              vitamins      shelf      weight      cups      r
ating
## Just_Right_Crunchy__Nuggets 3.211511 0.9515734 -0.1967771  0.7690100 -0.43
72390
## Just_Right_Fruit_&_Nut      3.211511 0.9515734  1.7968857 -0.3052601 -0.44
09529
##              cut_2
## Just_Right_Crunchy__Nuggets      5
## Just_Right_Fruit_&_Nut          5

centroids <- rbind(centroid_1, centroid_2, centroid_3, centroid_4)
centroid_5 <- colMeans(result[result$cut_2==5,])
centroids <- rbind(centroid_1, centroid_2, centroid_3, centroid_4, centroid_5
)
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         4
## 2      2         2
## 3      3         4
## 4      4         4
## 5      5         4
## 6      6         2
## 7      7         2
## 8      8         2
## 9      9         4

```

```
## 10 10 4
## 11 11 4
## 12 12 4
## 13 13 4
## 14 14 4
## 15 15 3
## 16 16 4
## 17 17 4
## 18 18 4
## 19 19 2
## 20 20 4
## 21 21 4
## 22 22 3
## 23 23 4
## 24 24 4
```

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

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

```
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 | sodium | fib |
|------------------------------|------------|------------|-------------|------------|---------|
| er | | | | | |
| ## 100%_Bran | -1.892984 | 1.328607 | -0.01290349 | -0.3539844 | 3.2928 |
| 47 | | | | | |
| ## All-Bran | -1.892984 | 1.328607 | -0.01290349 | 1.1967306 | 2.8732 |
| 72 | | | | | |
| ## All-Bran_with_Extra_Fiber | -2.919461 | 1.328607 | -1.00647256 | -0.2346986 | 4.9711 |
| 47 | | | | | |
| | carbo | sugars | potass | vitamins | she |
| lf | | | | | |
| ## 100%_Bran | -2.508783 | -0.2343906 | 2.575368 | -0.1453172 | 0.95157 |
| 34 | | | | | |
| ## All-Bran | -1.996924 | -0.4627711 | 3.143464 | -0.1453172 | 0.95157 |
| 34 | | | | | |
| ## All-Bran_with_Extra_Fiber | -1.740994 | -1.6046739 | 3.285488 | -0.1453172 | 0.95157 |
| 34 | | | | | |
| | weight | cups | rating | cluster1 | |
| ## 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 | |

```
rating[rating$clust==2,]
```

| | calories | protein | fat |
|---|------------|------------|-------------|
| ## 100%_Natural_Bran | 0.6732089 | 0.4151897 | 3.96137277 |
| ## 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 | carb |
| 0 | | | |
| ## 100%_Natural_Bran | -1.725770770 | -0.06375361 | -1.7409943 |
| 2 | | | |
| ## Basic_4 | 0.600301771 | -0.06375361 | 0.8183010 |
| 0 | | | |
| ## Clusters | -0.234698628 | -0.06375361 | -0.4613466 |
| 6 | | | |
| ## Cracklin'_Oat_Bran | -0.234698628 | 0.77539645 | -1.2291352 |
| 5 | | | |
| ## Crispy_Wheat_&_Raisins | -0.234698628 | -0.06375361 | -0.9732057 |
| 2 | | | |
| ## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats | 0.003872915 | 1.19497147 | -0.7172761 |
| 9 | | | |
| ## Fruitful_Bran | 0.958159085 | 1.19497147 | -0.2054171 |
| 2 | | | |
| ## Great_Grains_Pecan | -1.010056142 | 0.35582142 | -0.4613466 |
| 6 | | | |
| ## Just_Right_Fruit_&_Nut | 0.123158686 | -0.06375361 | 1.3301600 |
| 7 | | | |
| ## Life | -0.115412857 | -0.06375361 | -0.7172761 |
| 9 | | | |
| ## Muesli_Raisins,_Dates,_&_Almonds | -0.771484599 | 0.35582142 | 0.3064419 |
| 4 | | | |
| ## Muesli_Raisins,_Peaches,_&_Pecans | -0.115412857 | 0.35582142 | 0.3064419 |
| 4 | | | |
| ## Mueslix_Crispy_Blend | -0.115412857 | 0.35582142 | 0.5623714 |
| 7 | | | |
| ## Nutri-Grain_Almond-Raisin | 0.719587543 | 0.35582142 | 1.5860896 |
| 0 | | | |
| ## Oatmeal_Raisin_Crisp | 0.123158686 | -0.27354112 | -0.3333818 |
| 9 | | | |
| ## Post_Nat._Raisin_Bran | 0.481016000 | 1.61454650 | -0.9732057 |
| 2 | | | |
| ## Quaker_Oat_Squares | -0.294341514 | -0.06375361 | -0.2054171 |
| 2 | | | |
| ## Raisin_Bran | 0.600301771 | 1.19497147 | -0.2054171 |
| 2 | | | |
| ## Raisin_Nut_Bran | -0.234698628 | 0.14603391 | -1.1011704 |
| 9 | | | |
| ## Total_Raisin_Bran | 0.361730229 | 0.77539645 | 0.0505124 |
| 1 | | | |
| ## | sugars | potass | vitamins |
| ## 100%_Natural_Bran | 0.222370547 | 0.51602052 | -1.2642598 |
| ## 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%_Natural_Bran | 0.9515734 | -0.1967771 | 0.7690100 |
| ## 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%_Natural_Bran | -0.6180571 | 2 | |
| ## Basic_4 | -0.4005857 | 2 | |
| ## Clusters | -0.1612765 | 2 | |
| ## Cracklin'_Oat_Bran | -0.1578193 | 2 | |
| ## Crispy_Wheat_&_Raisins | -0.4619759 | 2 | |
| ## Fruit_&_Fibre_Dates,_Walnuts,_and_Oats | -0.1244837 | 2 | |
| ## Fruitful_Bran | -0.1174756 | 2 | |
| ## Great_Grains_Pecan | 0.2239586 | 2 | |
| ## Just_Right_Fruit_&_Nut | -0.4409529 | 2 | |
| ## Life | 0.1895290 | 2 | |
| ## Muesli_Raisins,_Dates,_&_Almonds | -0.3935878 | 2 | |

| | | |
|--------------------------------------|------------|---|
| ## Muesli_Raisins,_Peaches,_&_Pecans | -0.6069456 | 2 |
| ## Mueslix_Crispy_Blend | -0.8793408 | 2 |
| ## Nutri-Grain_Almond-Raisin | -0.1404816 | 2 |
| ## Oatmeal_Raisin_Crisp | -0.8695530 | 2 |
| ## Post_Nat._Raisin_Bran | -0.3434906 | 2 |
| ## Quaker_Oat_Squares | 0.4873659 | 2 |
| ## Raisin_Bran | -0.2425029 | 2 |
| ## Raisin_Nut_Bran | -0.2108809 | 2 |
| ## Total_Raisin_Bran | -1.0018246 | 2 |

rating[rating\$clust==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 |
| ## 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_Charm | 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 | rat |
| ing | | | | | |
| ## Apple_Cinnamon_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.9365 |
| 625 | | | | | |
| ## Apple_Jacks | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.6756 |
| 899 | | | | | |
| ## Cap'n'Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.7528 |
| 545 | | | | | |
| ## Cinnamon_Toast_Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.6260 |
| 883 | | | | | |
| ## Cocoa_Puffs | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4187 |
| 264 | | | | | |
| ## Corn_Pops | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.4899 |
| 817 | | | | | |
| ## Count_Chocula | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4429 |
| 256 | | | | | |
| ## Froot_Loops | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -0.7444 |
| 941 | | | | | |
| ## Frosted_Flakes | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.7994 |
| 234 | | | | | |
| ## Fruity_Pebbles | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.0421 |
| 897 | | | | | |
| ## Golden_Crisp | -0.1453172 | -1.450759 | -0.1967771 | 0.2533603 | -0.5277 |
| 361 | | | | | |
| ## Golden_Grahams | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -1.3427 |
| 262 | | | | | |
| ## Honey_Graham_Ohs | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.4803 |
| 151 | | | | | |
| ## Honey_Nut_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.8253 |
| 186 | | | | | |
| ## Honey-comb | -0.1453172 | -1.450759 | -0.1967771 | 2.1870466 | -0.9911 |
| 728 | | | | | |
| ## Lucky_Charms | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.1341 |
| 114 | | | | | |
| ## Multi-Grain_Cheerios | -0.1453172 | -1.450759 | -0.1967771 | 0.7690100 | -0.1822 |
| 231 | | | | | |
| ## Nut&Honey_Crunch | -0.1453172 | -0.249593 | -0.1967771 | -0.6490266 | -0.9070 |
| 377 | | | | | |
| ## Smacks | -0.1453172 | -0.249593 | -0.1967771 | -0.3052601 | -0.8140 |
| 824 | | | | | |
| ## Trix | -0.1453172 | -0.249593 | -0.1967771 | 0.7690100 | -1.0615 |
| 859 | | | | | |
| ## Wheaties_Honey_Gold | -0.1453172 | -1.450759 | -0.1967771 | -0.3052601 | -0.4611 |
| 670 | | | | | |

```
##                                cluster1
## Apple_Cinnamon_Cheerios      3
## Apple_Jacks                  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
## Smacks                       3
## Trix                         3
## Wheaties_Honey_Gold          3
```

```
rating[rating$clust==4,]
```

```
##              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
## 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
## Nutri-grain_Wheat -0.8665066  0.4151897 -1.00647256  0.1231587
## Product_19     -0.3532681  0.4151897 -1.00647256  1.9124453
## Rice_Chex      0.1599704 -1.4116451 -1.00647256  0.9581591
## Rice_Krispies  0.1599704 -0.4982277 -1.00647256  1.5545879
## Special_K      0.1599704  3.1554419 -1.00647256  0.8388733
## 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 -0.2343906  0.37399653
## Bran_Flakes    1.19497147 -0.46134666 -0.4627711  1.29715251
```

| | | | | |
|--------------------------------|-------------|------------|------------|-------------|
| ## Cheerios | -0.06375361 | 0.56237147 | -1.3762934 | 0.08994853 |
| ## Corn_Chex | -0.90290366 | 1.84201913 | -0.9195323 | -1.04624345 |
| ## Corn_Flakes | -0.48332864 | 1.58608960 | -1.1479128 | -0.90421945 |
| ## Crispix | -0.48332864 | 1.58608960 | -0.9195323 | -0.97523145 |
| ## Double_Chex | -0.48332864 | 0.81830100 | -0.4627711 | -0.26511146 |
| ## Grape_Nuts_Flakes | 0.35582142 | 0.05051241 | -0.4627711 | -0.19409946 |
| ## Grape-Nuts | 0.35582142 | 0.56237147 | -0.9195323 | -0.12308746 |
| ## Just_Right_Crunchy__Nuggets | -0.48332864 | 0.56237147 | -0.2343906 | -0.54915946 |
| ## Kix | -0.90290366 | 1.58608960 | -0.9195323 | -0.83320745 |
| ## Nutri-grain_Wheat | 0.35582142 | 0.81830100 | -1.1479128 | -0.12308746 |
| ## Product_19 | -0.48332864 | 1.33016007 | -0.9195323 | -0.76219545 |
| ## Rice_Chex | -0.90290366 | 2.09794866 | -1.1479128 | -0.97523145 |
| ## Rice_Krispies | -0.90290366 | 1.84201913 | -0.9195323 | -0.90421945 |
| ## Special_K | -0.48332864 | 0.30644194 | -0.9195323 | -0.62017146 |
| ## Total_Corn_Flakes | -0.90290366 | 1.58608960 | -0.9195323 | -0.90421945 |
| ## Total_Whole_Grain | 0.35582142 | 0.30644194 | -0.9195323 | 0.16096053 |
| ## Triples | -0.90290366 | 1.58608960 | -0.9195323 | -0.54915946 |
| ## Wheat_Chex | 0.35582142 | 0.56237147 | -0.9195323 | 0.23197253 |
| ## Wheaties | 0.35582142 | 0.56237147 | -0.9195323 | 0.16096053 |
| ## | vitamins | shelf | weight | cups |
| ## Bran_Chex | -0.1453172 | -1.4507595 | -0.1967771 | -0.6490266 |
| ## Bran_Flakes | -0.1453172 | 0.9515734 | -0.1967771 | -0.6490266 |
| ## Cheerios | -0.1453172 | -1.4507595 | -0.1967771 | 1.8432802 |
| ## Corn_Chex | -0.1453172 | -1.4507595 | -0.1967771 | 0.7690100 |
| ## Corn_Flakes | -0.1453172 | -1.4507595 | -0.1967771 | 0.7690100 |
| ## Crispix | -0.1453172 | 0.9515734 | -0.1967771 | 0.7690100 |
| ## Double_Chex | -0.1453172 | 0.9515734 | -0.1967771 | -0.3052601 |
| ## Grape_Nuts_Flakes | -0.1453172 | 0.9515734 | -0.1967771 | 0.2533603 |
| ## Grape-Nuts | -0.1453172 | 0.9515734 | -0.1967771 | -2.4538004 |
| ## Just_Right_Crunchy__Nuggets | 3.2115106 | 0.9515734 | -0.1967771 | 0.7690100 |
| ## Kix | -0.1453172 | -0.2495930 | -0.1967771 | 2.9175503 |
| ## Nutri-grain_Wheat | -0.1453172 | 0.9515734 | -0.1967771 | 0.7690100 |
| ## Product_19 | 3.2115106 | 0.9515734 | -0.1967771 | 0.7690100 |
| ## Rice_Chex | -0.1453172 | -1.4507595 | -0.1967771 | 1.3276305 |
| ## Rice_Krispies | -0.1453172 | -1.4507595 | -0.1967771 | 0.7690100 |
| ## Special_K | -0.1453172 | -1.4507595 | -0.1967771 | 0.7690100 |
| ## Total_Corn_Flakes | 3.2115106 | 0.9515734 | -0.1967771 | 0.7690100 |
| ## Total_Whole_Grain | 3.2115106 | 0.9515734 | -0.1967771 | 0.7690100 |
| ## Triples | -0.1453172 | 0.9515734 | -0.1967771 | -0.3052601 |
| ## Wheat_Chex | -0.1453172 | -1.4507595 | -0.1967771 | -0.6490266 |
| ## Wheaties | -0.1453172 | -1.4507595 | -0.1967771 | 0.7690100 |
| ## | rating | cluster1 | | |
| ## Bran_Chex | 0.45948710 | 4 | | |
| ## Bran_Flakes | 0.75801873 | 4 | | |
| ## Cheerios | 0.57657347 | 4 | | |
| ## Corn_Chex | -0.08689833 | 4 | | |
| ## Corn_Flakes | 0.22763247 | 4 | | |
| ## Crispix | 0.30112138 | 4 | | |
| ## Double_Chex | 0.11853896 | 4 | | |
| ## Grape_Nuts_Flakes | 0.66996501 | 4 | | |

| | | |
|--------------------------------|-------------|---|
| ## Grape-Nuts | 0.76209027 | 4 |
| ## Just_Right_Crunchy__Nuggets | -0.43723896 | 4 |
| ## Kix | -0.24379018 | 4 |
| ## Nutri-grain_Wheat | 1.20857002 | 4 |
| ## Product_19 | -0.08273233 | 4 |
| ## Rice_Chex | -0.04746624 | 4 |
| ## Rice_Krispies | -0.14988985 | 4 |
| ## Special_K | 0.74502768 | 4 |
| ## Total_Corn_Flakes | -0.27236281 | 4 |
| ## Total_Whole_Grain | 0.28426404 | 4 |
| ## Triples | -0.25339630 | 4 |
| ## Wheat_Chex | 0.50698324 | 4 |
| ## Wheaties | 0.63545985 | 4 |

rating[rating\$clust==5,]

| ## | calories | protein | fat | sodium |
|------------------------------|-------------|-------------|--------------|-------------|
| ## Frosted_Mini-Wheats | -0.3532681 | 0.4151897 | -1.00647256 | -1.904699 |
| ## Maypo | -0.3532681 | 1.3286071 | -0.01290349 | -1.904699 |
| ## Puffed_Rice | -2.9194605 | -1.4116451 | -1.00647256 | -1.904699 |
| ## Puffed_Wheat | -2.9194605 | -0.4982277 | -1.00647256 | -1.904699 |
| ## Raisin_Squares | -0.8665066 | -0.4982277 | -1.00647256 | -1.904699 |
| ## Shredded_Wheat | -1.3797451 | -0.4982277 | -1.00647256 | -1.904699 |
| ## Shredded_Wheat_'n'Bran | -0.8665066 | 0.4151897 | -1.00647256 | -1.904699 |
| ## Shredded_Wheat_spoon_size | -0.8665066 | 0.4151897 | -1.00647256 | -1.904699 |
| ## Strawberry_Fruit_Wheats | -0.8665066 | -0.4982277 | -1.00647256 | -1.725771 |
| ## | fiber | carbo | sugars | potass |
| ## Frosted_Mini-Wheats | 0.35582142 | -0.20541712 | -0.006010015 | 0.01893653 |
| ## Maypo | -0.90290366 | 0.30644194 | -0.919532261 | -0.05207547 |
| ## Puffed_Rice | -0.90290366 | -0.46134666 | -1.604673946 | -1.18826745 |
| ## Puffed_Wheat | -0.48332864 | -1.22913525 | -1.604673946 | -0.69118346 |
| ## Raisin_Squares | -0.06375361 | 0.05051241 | -0.234390576 | 0.16096053 |
| ## Shredded_Wheat | 0.35582142 | 0.30644194 | -1.604673946 | -0.05207547 |
| ## Shredded_Wheat_'n'Bran | 0.77539645 | 1.07423054 | -1.604673946 | 0.58703252 |
| ## Shredded_Wheat_spoon_size | 0.35582142 | 1.33016007 | -1.604673946 | 0.30298453 |
| ## Strawberry_Fruit_Wheats | 0.35582142 | 0.05051241 | -0.462771138 | -0.12308746 |
| ## | vitamins | shelf | weight | cups |
| ## Frosted_Mini-Wheats | -0.1453172 | -0.2495930 | -0.1967771 | -0.09040611 |
| ## Maypo | -0.1453172 | -0.2495930 | -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 |
| ## 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 |
| ## Strawberry_Fruit_Wheats | -0.1453172 | -0.2495930 | -0.1967771 | 0.76901001 |
| ## | rating | cluster1 | | |
| ## Frosted_Mini-Wheats | 1.1161895 | 5 | | |
| ## Maypo | 0.8674423 | 5 | | |
| ## Puffed_Rice | 1.2878220 | 5 | | |

```
## Puffed_Wheat          1.4479620      5
## Raisin_Squares        0.9017710      5
## Shredded_Wheat        1.8202929      5
## Shredded_Wheat_'n'Bran 2.2642977      5
## Shredded_Wheat_spoon_size 2.1453309    5
## Strawberry_Fruit_Wheats 1.1887196     5
```

#Mean ratings to determine the best cluster.

```
mean(rating[rating$cluster1==1,"rating"])
## [1] 2.219557
mean(rating[rating$cluster1==2,"rating"])
## [1] -0.313519
mean(rating[rating$cluster1==3,"rating"])
## [1] -0.9836387
mean(rating[rating$cluster1==4,"rating"])
## [1] 0.2704742
mean(rating[rating$cluster1==5,"rating"])
## [1] 1.44887
```

#As we can see that the mean ratings of the cluster1 is the highest, and also 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.