Assignment_V

SIVAREDDY

2022-04-14

```
library(readr)
cereals <- read_csv("C:/Users/sivap/OneDrive/Desktop/Cereals.csv")
```

```
## Rows: 77 Columns: 16
## -- Column specification --------------------------------------------------
------
## Delimiter: ","
## chr  (3): name, mfr, type
## dbl (13): calories, protein, fat, sodium, fiber, carbo, sugars, potass, vi
ta...
##
## i Use `spec()` to retrieve the full column specification for this data.
## i Specify the column types or set `show_col_types = FALSE` to quiet this m
essage.
```

```
Data_numerical <- data.frame(cereals[,4:16])
```

Libraries

```
library(cluster)
library(caret)
```

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

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

```
library(dendextend)
```

```
## Warning: package 'dendextend' was built under R version 4.1.3
```

```
##
## ---------------------
## 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/talgal
ili/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(den
```

```
dextend))
## ---------------------

##
## Attaching package: 'dendextend'

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

library(factoextra)

## Warning: package 'factoextra' was built under R version 4.1.3

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

Question1 –

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.

Data Preprocessing. Remove all cereals with missing values.

Removing missing values in present data

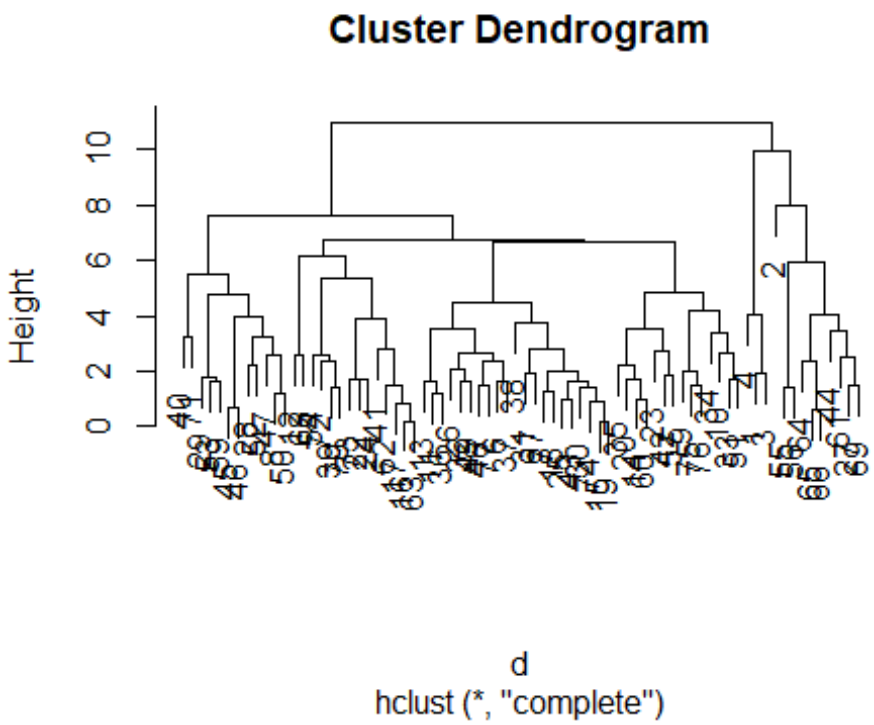
```
missingvalues_removed <- na.omit(Data_numerical)
```

Data Normalization & Data Scaling:

```
Normalise <- scale(missingvalues_removed)
```

euclidean distance to measure the distance:

```
d <- dist(Normalise, method = "euclidean")

##Perform Hierarchical Clustering using complete linkage.
HC <- hclust(d, method = "complete")
plot(HC)
```




```
round(HC$height, 3)
```

```
##  [1]  0.143  0.196  0.575  0.698  0.828  0.904  1.003  1.004  1.201  1.203
## [11]  1.254  1.378  1.408  1.421  1.454  1.463  1.474  1.517  1.608  1.611
## [21]  1.616  1.625  1.650  1.687  1.692  1.720  1.730  1.795  1.839  1.897
## [31]  1.919  1.982  2.015  2.046  2.203  2.224  2.339  2.381  2.394  2.522
## [41]  2.563  2.574  2.579  2.668  2.682  2.734  2.776  2.787  3.229  3.236
## [51]  3.385  3.451  3.510  3.535  3.717  3.866  3.957  4.005  4.031  4.168
## [61]  4.456  4.779  4.839  5.342  5.488  5.920  6.169  6.669  6.731  7.650
## [71]  7.964  9.979 10.984
```

We can also use agnes() function to perform clustering. Performing clustering using agnes() with single, complete, average and ward.

```
HCsingle <- agnes(Normalise, method = "single")
HCcomplete <- agnes(Normalise, method = "complete")
HCaverage <- agnes(Normalise, method = "average")
HCward <- agnes(Normalise, method = "ward")


#Now we will compare the agglomerative coefficients for Single, complete, ave
rage and ward.

print(HCsingle$ac)
```

```
## [1] 0.6067859
```

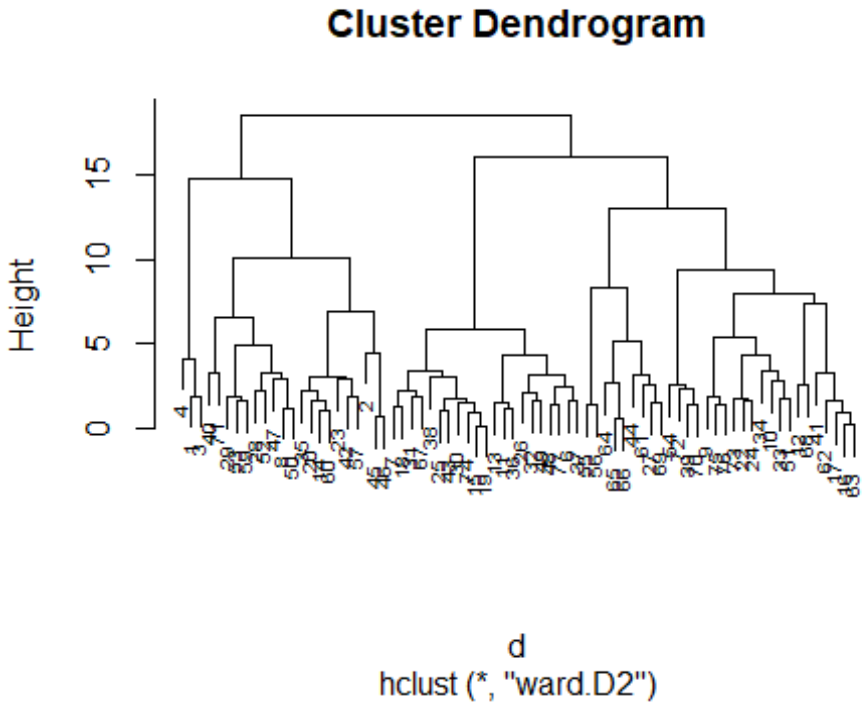
```
print(HCcomplete$ac)

## [1] 0.8353712

print(HCaverage$ac)

## [1] 0.7766075

print(HCward$ac)

## [1] 0.9046042
```

The above result depicts that the ward has shown the highest agglomerative coefficients the value of 0.904 so we have considered the Ward as the best method.

Question -2

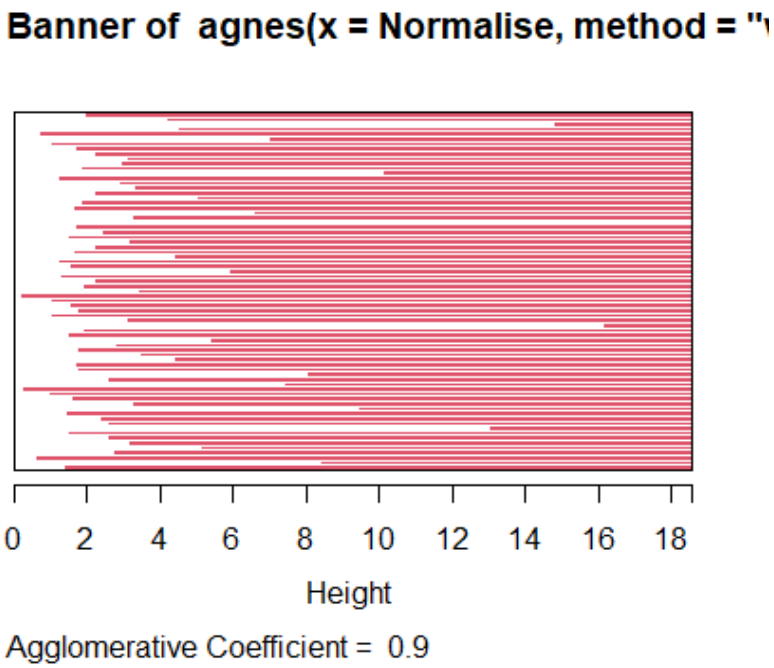
Determining Optimal Clusters:

```
# Hierarchical clustering using ward method.
HC1 <- hclust(d, method = "ward.D2" )
plot(HC1,cex=0.6)
```



.

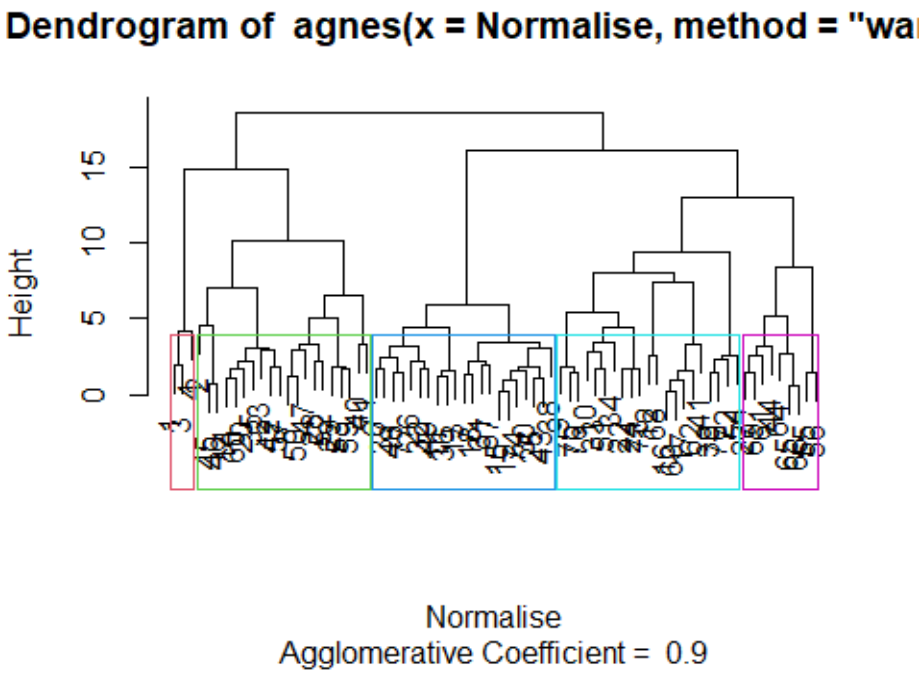
```
plot(HCward)
```



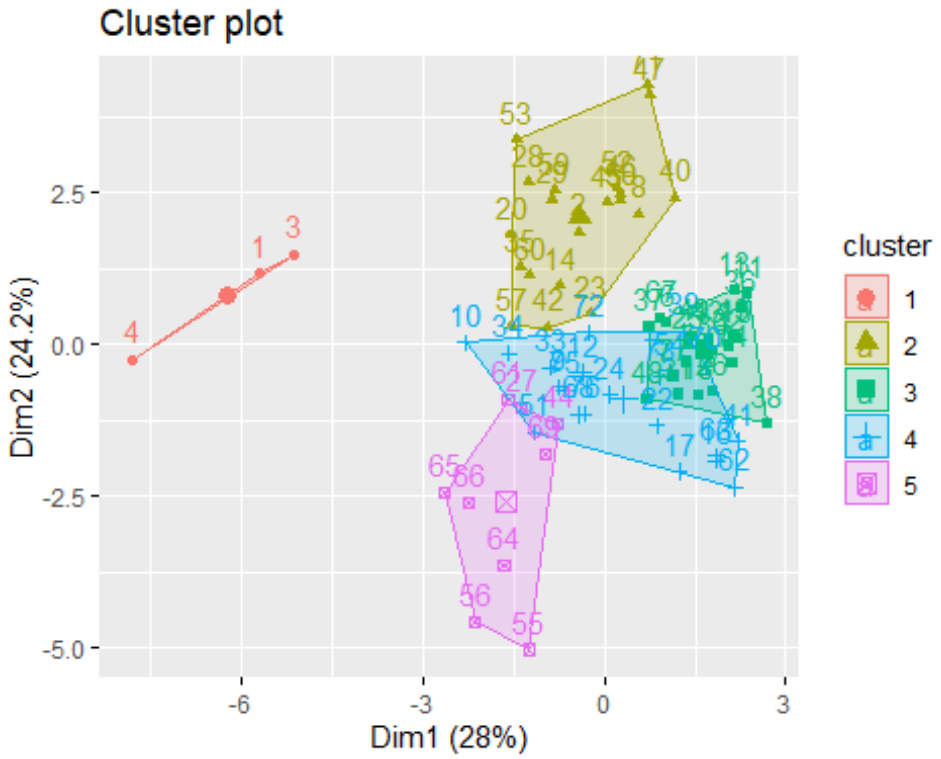

```
rect.hclust(HCward, k=5, border = 2:10)
```

by observing the above ward method distance graphs, we have considered k =5.

Plotting Agnes using the ward method and Cutting the Dendrogram.



```
subgrp <- cutree(HC1, k = 5)
table(subgrp)

## subgrp
##  1  2  3  4  5
##  3 20 21 21  9

dataframe <- as.data.frame(cbind(Normalise,subgrp))

##To visualiZe the results in scatter plot.
fviz_cluster(list(data = Normalise, cluster = subgrp))
```



Question – 3

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

```
Newdatacereals <- cereals
Newdatacereals_omission <- na.omit(Newdatacereals)
Clust <- cbind(Newdatacereals_omission, subgrp)
Clust[Clust$subgrp==1,]

##                         name mfr type calories protein fat sodium fiber car
bo
## 1                  100%_Bran   N    C       70       4   1    130    10
```

```
5
## 3                  All-Bran   K    C       70       4   1    260     9
7
## 4 All-Bran_with_Extra_Fiber   K    C       50       4   0    140    14
8
##   sugars potass vitamins shelf weight cups   rating subgrp
## 1      6    280       25     3      1 0.33 68.40297      1
## 3      5    320       25     3      1 0.33 59.42551      1
## 4      0    330       25     3      1 0.50 93.70491      1

Clust[Clust$subgrp==2,]

##                                     name mfr type calories protein fat so
dium
## 2                       100%_Natural_Bran   Q    C      120       3   5
15
## 8                                 Basic_4   G    C      130       3   2
210
## 14                               Clusters   G    C      110       3   2
140
## 20                     Cracklin'_Oat_Bran   K    C      110       3   3
140
## 23                  Crispy_Wheat_&_Raisins   G    C      100       2   1
140
## 28 Fruit_&_Fibre_Dates,_Walnuts,_and_Oats   P    C      120       3   2
160
## 29                           Fruitful_Bran   K    C      120       3   0
240
## 35                     Great_Grains_Pecan   P    C      120       3   3
75
## 40                  Just_Right_Fruit_&_Nut   K    C      140       3   1
170
## 42                                    Life   Q    C      100       4   2
150
## 45       Muesli_Raisins,_Dates,_&_Almonds   R    C      150       4   3
95
## 46      Muesli_Raisins,_Peaches,_&_Pecans   R    C      150       4   3
150
## 47                   Mueslix_Crispy_Blend   K    C      160       3   2
150
## 50              Nutri-Grain_Almond-Raisin   K    C      140       3   2
220
## 52                   Oatmeal_Raisin_Crisp   G    C      130       3   2
170
## 53                  Post_Nat._Raisin_Bran   P    C      120       3   1
200
## 57                     Quaker_Oat_Squares   Q    C      100       4   1
135
## 59                            Raisin_Bran   K    C      120       3   1
210
```

```
## 60                        Raisin_Nut_Bran   G    C      100       3   2
140
## 71                      Total_Raisin_Bran   G    C      140       3   1
190
##    fiber carbo sugars potass vitamins shelf weight cups   rating subgrp
## 2    2.0   8.0      8    135        0     3   1.00 1.00 33.98368      2
## 8    2.0  18.0      8    100       25     3   1.33 0.75 37.03856      2
## 14   2.0  13.0      7    105       25     3   1.00 0.50 40.40021      2
## 20   4.0  10.0      7    160       25     3   1.00 0.50 40.44877      2
## 23   2.0  11.0     10    120       25     3   1.00 0.75 36.17620      2
## 28   5.0  12.0     10    200       25     3   1.25 0.67 40.91705      2
## 29   5.0  14.0     12    190       25     3   1.33 0.67 41.01549      2
## 35   3.0  13.0      4    100       25     3   1.00 0.33 45.81172      2
## 40   2.0  20.0      9     95      100     3   1.30 0.75 36.47151      2
## 42   2.0  12.0      6     95       25     2   1.00 0.67 45.32807      2
## 45   3.0  16.0     11    170       25     3   1.00 1.00 37.13686      2
## 46   3.0  16.0     11    170       25     3   1.00 1.00 34.13976      2
## 47   3.0  17.0     13    160       25     3   1.50 0.67 30.31335      2
## 50   3.0  21.0      7    130       25     3   1.33 0.67 40.69232      2
## 52   1.5  13.5     10    120       25     3   1.25 0.50 30.45084      2
## 53   6.0  11.0     14    260       25     3   1.33 0.67 37.84059      2
## 57   2.0  14.0      6    110       25     3   1.00 0.50 49.51187      2
## 59   5.0  14.0     12    240       25     2   1.33 0.75 39.25920      2
## 60   2.5  10.5      8    140       25     3   1.00 0.50 39.70340      2
## 71   4.0  15.0     14    230      100     3   1.50 1.00 28.59278      2

Clust[Clust$subgrp==3,]

##                       name mfr type calories protein fat sodium fiber carb
o
## 6  Apple_Cinnamon_Cheerios   G    C      110       2   2    180   1.5  10.
5
## 7              Apple_Jacks   K    C      110       2   0    125   1.0  11.
0
## 11            Cap'n'Crunch   Q    C      120       1   2    220   0.0  12.
0
## 13   Cinnamon_Toast_Crunch   G    C      120       1   3    210   0.0  13.
0
## 15             Cocoa_Puffs   G    C      110       1   1    180   0.0  12.
0
## 18               Corn_Pops   K    C      110       1   0     90   1.0  13.
0
## 19           Count_Chocula   G    C      110       1   1    180   0.0  12.
0
## 25             Froot_Loops   K    C      110       2   1    125   1.0  11.
0
## 26          Frosted_Flakes   K    C      110       1   0    200   1.0  14.
0
## 30          Fruity_Pebbles   P    C      110       1   1    135   0.0  13.
0
```

```
## 31            Golden_Crisp   P    C      100       2   0     45   0.0  11.
0
## 32          Golden_Grahams   G    C      110       1   1    280   0.0  15.
0
## 36        Honey_Graham_Ohs   Q    C      120       1   2    220   1.0  12.
0
## 37      Honey_Nut_Cheerios   G    C      110       3   1    250   1.5  11.
5
## 38              Honey-comb   P    C      110       1   0    180   0.0  14.
0
## 43            Lucky_Charms   G    C      110       2   1    180   0.0  12.
0
## 48    Multi-Grain_Cheerios   G    C      100       2   1    220   2.0  15.
0
## 49        Nut&Honey_Crunch   K    C      120       2   1    190   0.0  15.
0
## 67                 Smacks   K    C      110       2   1     70   1.0   9.
0
## 74                   Trix   G    C      110       1   1    140   0.0  13.
0
## 77     Wheaties_Honey_Gold   G    C      110       2   1    200   1.0  16.
0
##    sugars potass vitamins shelf weight cups   rating subgrp
## 6      10     70       25     1      1 0.75 29.50954      3
## 7      14     30       25     2      1 1.00 33.17409      3
## 11     12     35       25     2      1 0.75 18.04285      3
## 13      9     45       25     2      1 0.75 19.82357      3
## 15     13     55       25     2      1 1.00 22.73645      3
## 18     12     20       25     2      1 1.00 35.78279      3
## 19     13     65       25     2      1 1.00 22.39651      3
## 25     13     30       25     2      1 1.00 32.20758      3
## 26     11     25       25     1      1 0.75 31.43597      3
## 30     12     25       25     2      1 0.75 28.02576      3
## 31     15     40       25     1      1 0.88 35.25244      3
## 32      9     45       25     2      1 0.75 23.80404      3
## 36     11     45       25     2      1 1.00 21.87129      3
## 37     10     90       25     1      1 0.75 31.07222      3
## 38     11     35       25     1      1 1.33 28.74241      3
## 43     12     55       25     2      1 1.00 26.73451      3
## 48      6     90       25     1      1 1.00 40.10596      3
## 49      9     40       25     2      1 0.67 29.92429      3
## 67     15     40       25     2      1 0.75 31.23005      3
## 74     12     25       25     2      1 1.00 27.75330      3
## 77      8     60       25     1      1 0.75 36.18756      3

Clust[Clust$subgrp==4,]

##                          name mfr type calories protein fat sodium fiber
carbo
## 9                   Bran_Chex   R    C       90       2   1    200     4
```

```
15
## 10                 Bran_Flakes   P    C       90       3   0    210     5
13
## 12                    Cheerios   G    C      110       6   2    290     2
17
## 16                   Corn_Chex   R    C      110       2   0    280     0
22
## 17                 Corn_Flakes   K    C      100       2   0    290     1
21
## 22                     Crispix   K    C      110       2   0    220     1
21
## 24                 Double_Chex   R    C      100       2   0    190     1
18
## 33           Grape_Nuts_Flakes   P    C      100       3   1    140     3
15
## 34                  Grape-Nuts   P    C      110       3   0    170     3
17
## 39 Just_Right_Crunchy__Nuggets   K    C      110       2   1    170     1
17
## 41                         Kix   G    C      110       2   1    260     0
21
## 51           Nutri-grain_Wheat   K    C       90       3   0    170     3
18
## 54                  Product_19   K    C      100       3   0    320     1
20
## 62                   Rice_Chex   R    C      110       1   0    240     0
23
## 63               Rice_Krispies   K    C      110       2   0    290     0
22
## 68                   Special_K   K    C      110       6   0    230     1
16
## 70           Total_Corn_Flakes   G    C      110       2   1    200     0
21
## 72           Total_Whole_Grain   G    C      100       3   1    200     3
16
## 73                     Triples   G    C      110       2   1    250     0
21
## 75                  Wheat_Chex   R    C      100       3   1    230     3
17
## 76                    Wheaties   G    C      100       3   1    200     3
17
##    sugars potass vitamins shelf weight cups   rating subgrp
## 9       6    125       25     1      1 0.67 49.12025      4
## 10      5    190       25     3      1 0.67 53.31381      4
## 12      1    105       25     1      1 1.25 50.76500      4
## 16      3     25       25     1      1 1.00 41.44502      4
## 17      2     35       25     1      1 1.00 45.86332      4
## 22      3     30       25     3      1 1.00 46.89564      4
## 24      5     80       25     3      1 0.75 44.33086      4
## 33      5     85       25     3      1 0.88 52.07690      4
```

```
## 34      3     90       25     3      1 0.25 53.37101      4
## 39      6     60      100     3      1 1.00 36.52368      4
## 41      3     40       25     2      1 1.50 39.24111      4
## 51      2     90       25     3      1 1.00 59.64284      4
## 54      3     45      100     3      1 1.00 41.50354      4
## 62      2     30       25     1      1 1.13 41.99893      4
## 63      3     35       25     1      1 1.00 40.56016      4
## 68      3     55       25     1      1 1.00 53.13132      4
## 70      3     35      100     3      1 1.00 38.83975      4
## 72      3    110      100     3      1 1.00 46.65884      4
## 73      3     60       25     3      1 0.75 39.10617      4
## 75      3    115       25     1      1 0.67 49.78744      4
## 76      3    110       25     1      1 1.00 51.59219      4

Clust[Clust$subgrp==5,]

##                         name mfr type calories protein fat sodium fiber ca
rbo
## 27       Frosted_Mini-Wheats   K    C      100       3   0      0     3
14
## 44                     Maypo   A    H      100       4   1      0     0
16
## 55              Puffed_Rice   Q    C       50       1   0      0     0
13
## 56             Puffed_Wheat   Q    C       50       2   0      0     1
10
## 61            Raisin_Squares   K    C       90       2   0      0     2
15
## 64            Shredded_Wheat   N    C       80       2   0      0     3
16
## 65    Shredded_Wheat_'n'Bran   N    C       90       3   0      0     4
19
## 66 Shredded_Wheat_spoon_size   N    C       90       3   0      0     3
20
## 69   Strawberry_Fruit_Wheats   N    C       90       2   0     15     3
15
##    sugars potass vitamins shelf weight cups   rating subgrp
## 27      7    100       25     2   1.00 0.80 58.34514      5
## 44      3     95       25     2   1.00 1.00 54.85092      5
## 55      0     15        0     3   0.50 1.00 60.75611      5
## 56      0     50        0     3   0.50 1.00 63.00565      5
## 61      6    110       25     3   1.00 0.50 55.33314      5
## 64      0     95        0     1   0.83 1.00 68.23588      5
## 65      0    140        0     1   1.00 0.67 74.47295      5
## 66      0    120        0     1   1.00 0.67 72.80179      5
## 69      5     90       25     2   1.00 1.00 59.36399      5
```

Calculating mean ratings to determine the best cluster.

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

## [1] 73.84446

mean(Clust[Clust$subgrp==2,"rating"])

## [1] 38.26161

mean(Clust[Clust$subgrp==3,"rating"])

## [1] 28.84825

mean(Clust[Clust$subgrp==4,"rating"])

## [1] 46.46513

mean(Clust[Clust$subgrp==5,"rating"])

## [1] 63.0184
```

The above mean ratings are used to determine the best cluster. When we look at the above values Clust$subgrp==1 has the highest rating with a (73.84) so we can consider cluster 1 is for a healthy diet