Assignment 5

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4/17/2022

```
#loading all the required libraries
library(factoextra)
```

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

## Loading required package: ggplot2

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

```
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/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(cluster)
library(tidyverse)
```

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

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.1 --

## v tibble  3.1.6     v dplyr   1.0.8
## v tidyr   1.2.0     v stringr 1.4.0
## v readr   2.1.2     v forcats 0.5.1
## v purrr   0.3.4

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library(knitr)
```

```
#importing the data
cereals = read_csv("C:/Users/desineni/Downloads/Cereals.csv")
```

```
## Rows: 77 Columns: 16
## -- Column specification --------------------------------------------------------
## Delimiter: ","
## chr  (3): name, mfr, type
## dbl (13): calories, protein, fat, sodium, fiber, carbo, sugars, potass, vita...
##
## 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 message.
```

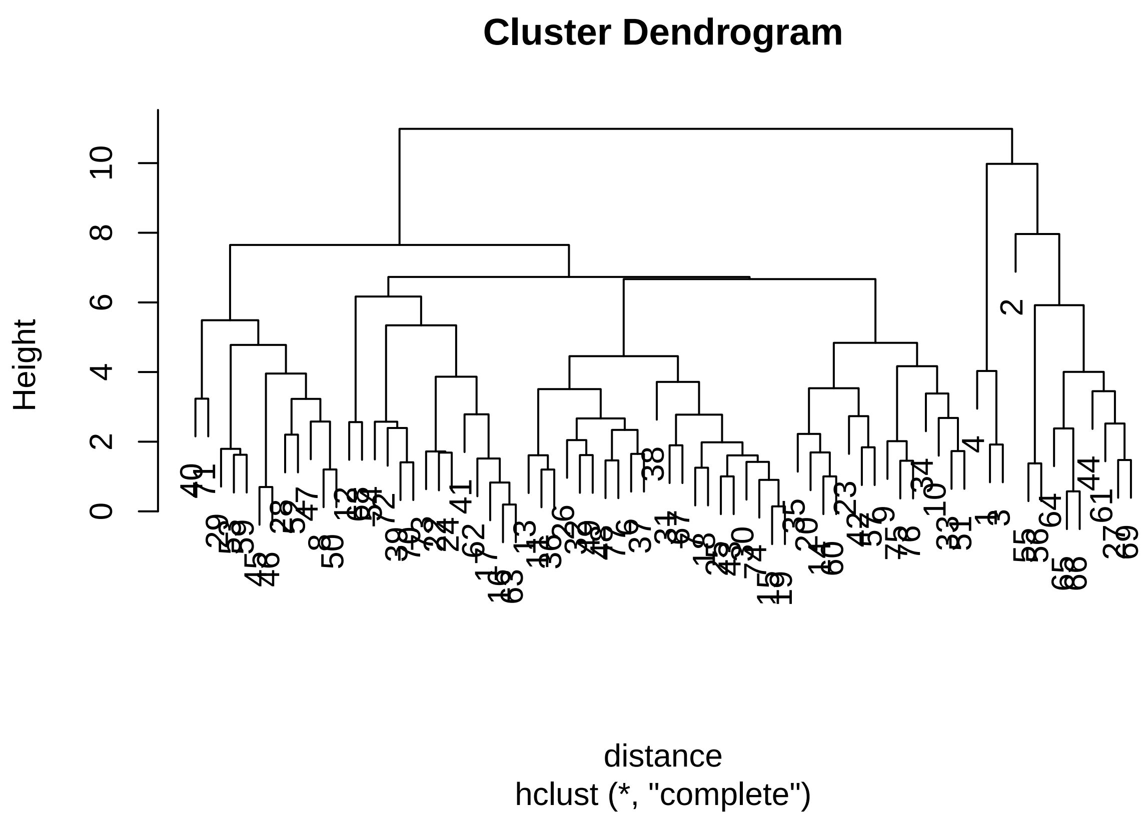
```
numericaldata = data.frame(cereals[,4:16])
```

```
#omitting all the missing values present in the data
OmitMissing = na.omit(numericaldata)
```

```
#normalizing and scaling the data
Normalise = scale(OmitMissing)
```

```
#measuring the distance using the euclidian distance and computing the dissimilarity matrix
distance = dist(Normalise, method = "euclidian")
```

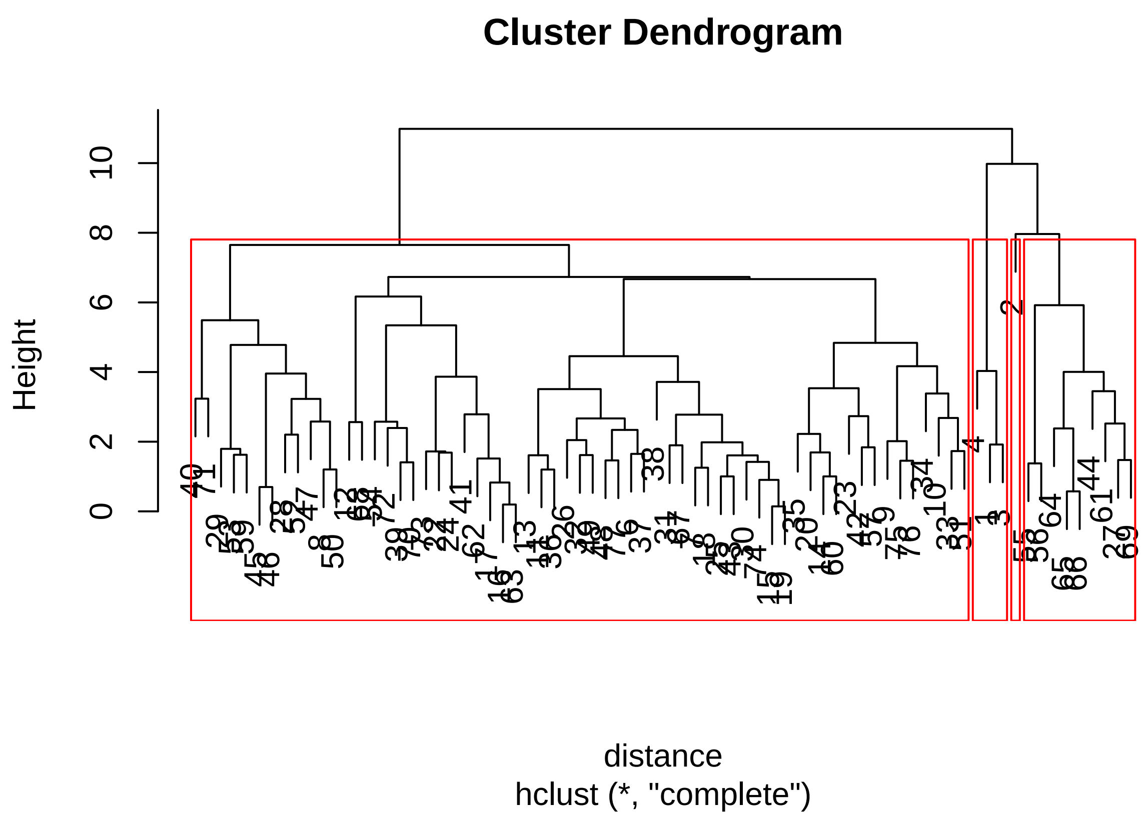
```
#performing hierarchial clustering using complete linkage and representing in plot
hierarchial_clustering = hclust(distance,method = "complete")
plot(hierarchial_clustering)
```




```r
#rounding off the decimals
round(hierarchial_clustering$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
```

```r
#determining the optimla clusters and highlighting with colours
plot(hierarchial_clustering)
rect.hclust(hierarchial_clustering,k = 4, border = "red")
```




```
#performing clustering using AGNES
HCsingle = agnes(Normalise, method = "single")
HCcomplete = agnes(Normalise, method = "complete")
HCaverage = agnes(Normalise, method = "average")
HCward = agnes(Normalise, method = "ward")
```

```
#comparing the agglomerative cosfficients of single , complete, average, ward
print(HCsingle$ac)
```

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

```
print(HCcomplete$ac)
```

```
## [1] 0.8353712
```

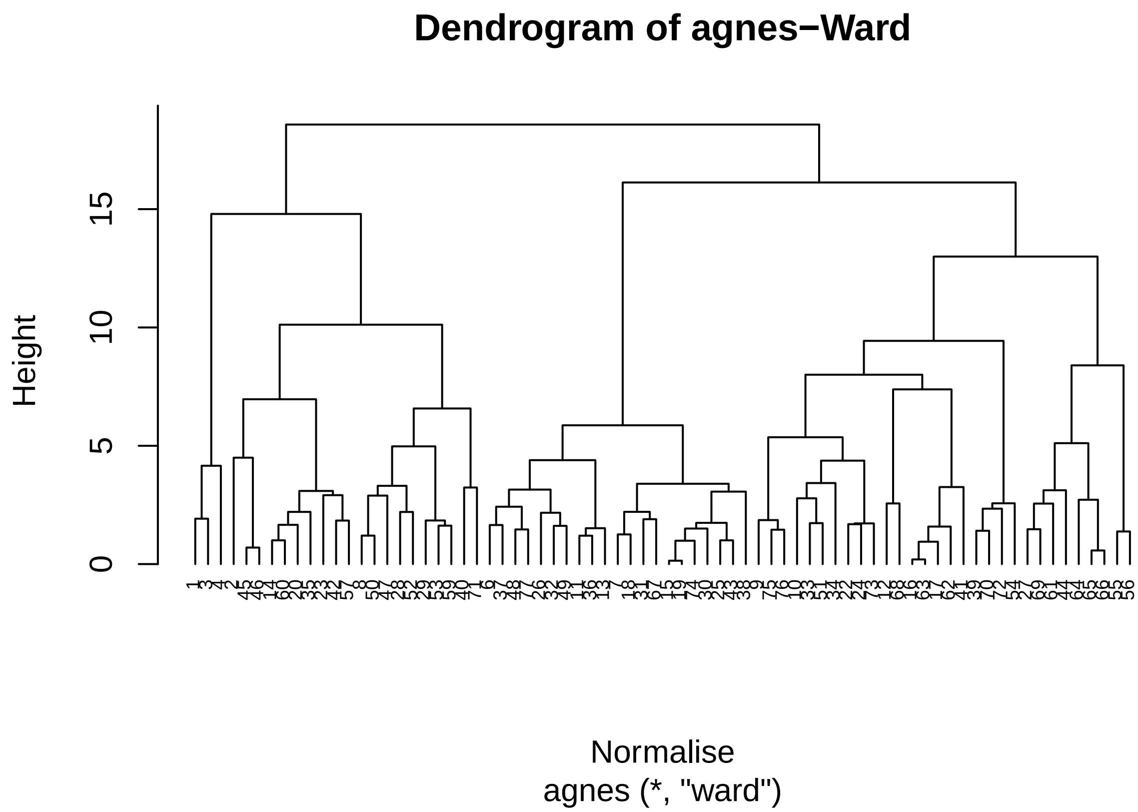
```
print(HCaverage$ac)
```

```
## [1] 0.7766075
```

```
print(HCward$ac)
```

```
## [1] 0.9046042
```

```r
#according to the above values, wards method is the best with the value of 0.904.plotting ward using ag
pltree(HCward, cex = 0.6, hang = -1, main = "Dendrogram of agnes-Ward")
```

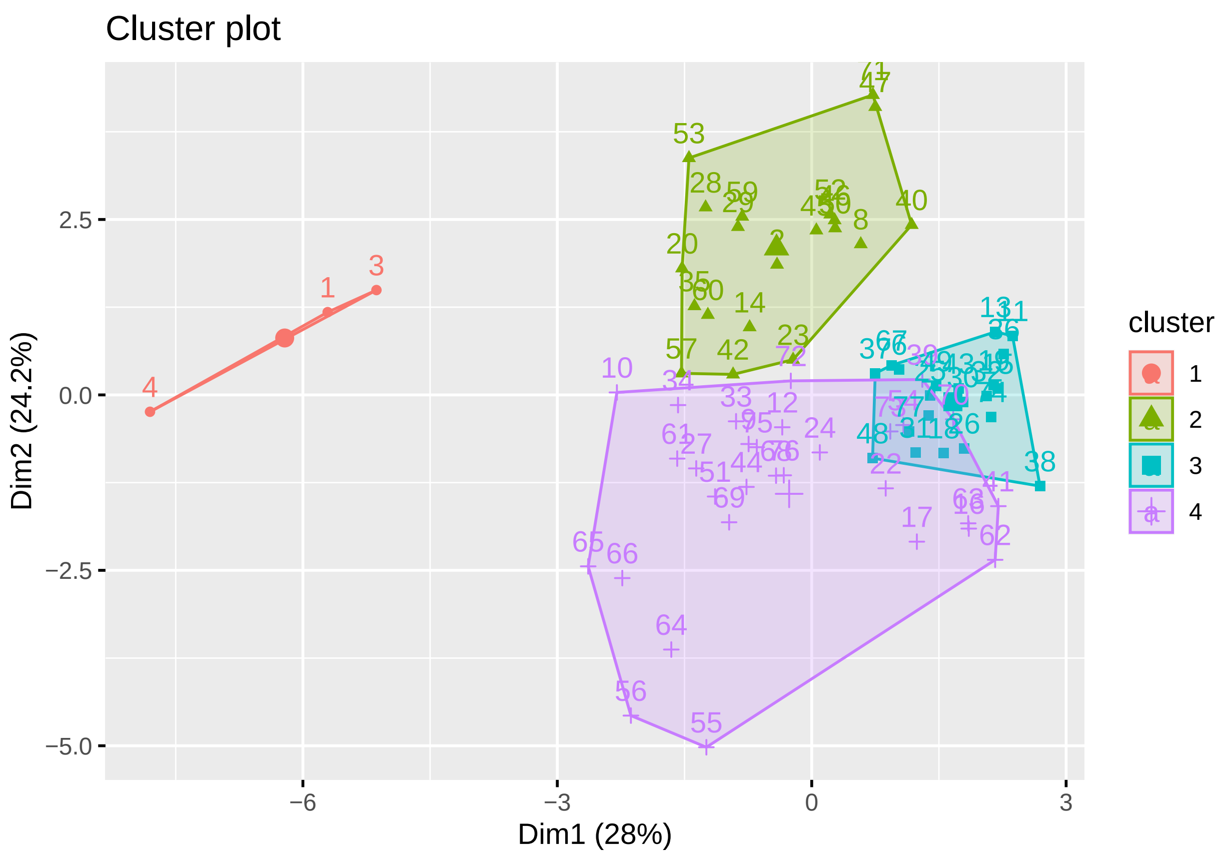



```r
#using the ward method for hierarchial clustering
HC1 <- hclust(distance, method = "ward.D2" )
subgrp <- cutree(HC1, k = 4)
table(subgrp)
```

```
## subgrp
##  1  2  3  4
##  3 20 21 30
```

```r
cereals <- as.data.frame(cbind(Normalise,subgrp))
```

```r
#visualising the results on scatterplot
fviz_cluster(list(data = Normalise, cluster = subgrp))
```




```
#selecting the best breakfast cereal cluster with high protein, fibre and low in sugar and sodium.
#choosing the healthy cereal cluster
Newdatacereals = numericaldata
Newdatacereals_omit = na.omit(Newdatacereals)
Clust = cbind(Newdatacereals_omit, subgrp)
Clust[Clust$subgrp==1,]
```

```
##   calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 1       70       4   1    130    10     5      6    280       25     3      1
## 3       70       4   1    260     9     7      5    320       25     3      1
## 4       50       4   0    140    14     8      0    330       25     3      1
##   cups   rating subgrp
## 1 0.33 68.40297      1
## 3 0.33 59.42551      1
## 4 0.50 93.70491      1
```

```
Clust[Clust$subgrp==2,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 2       120       3   5     15   2.0   8.0      8    135        0     3   1.00
## 8       130       3   2    210   2.0  18.0      8    100       25     3   1.33
## 14      110       3   2    140   2.0  13.0      7    105       25     3   1.00
## 20      110       3   3    140   4.0  10.0      7    160       25     3   1.00
## 23      100       2   1    140   2.0  11.0     10    120       25     3   1.00
## 28      120       3   2    160   5.0  12.0     10    200       25     3   1.25
```

```
## 29      120       3   0    240   5.0  14.0      12    190       25     3   1.33
## 35      120       3   3     75   3.0  13.0       4    100       25     3   1.00
## 40      140       3   1    170   2.0  20.0       9     95      100     3   1.30
## 42      100       4   2    150   2.0  12.0       6     95       25     2   1.00
## 45      150       4   3     95   3.0  16.0      11    170       25     3   1.00
## 46      150       4   3    150   3.0  16.0      11    170       25     3   1.00
## 47      160       3   2    150   3.0  17.0      13    160       25     3   1.50
## 50      140       3   2    220   3.0  21.0       7    130       25     3   1.33
## 52      130       3   2    170   1.5  13.5      10    120       25     3   1.25
## 53      120       3   1    200   6.0  11.0      14    260       25     3   1.33
## 57      100       4   1    135   2.0  14.0       6    110       25     3   1.00
## 59      120       3   1    210   5.0  14.0      12    240       25     2   1.33
## 60      100       3   2    140   2.5  10.5       8    140       25     3   1.00
## 71      140       3   1    190   4.0  15.0      14    230      100     3   1.50
##    cups   rating subgrp
## 2  1.00 33.98368      2
## 8  0.75 37.03856      2
## 14 0.50 40.40021      2
## 20 0.50 40.44877      2
## 23 0.75 36.17620      2
## 28 0.67 40.91705      2
## 29 0.67 41.01549      2
## 35 0.33 45.81172      2
## 40 0.75 36.47151      2
## 42 0.67 45.32807      2
## 45 1.00 37.13686      2
## 46 1.00 34.13976      2
## 47 0.67 30.31335      2
## 50 0.67 40.69232      2
## 52 0.50 30.45084      2
## 53 0.67 37.84059      2
## 57 0.50 49.51187      2
## 59 0.75 39.25920      2
## 60 0.50 39.70340      2
## 71 1.00 28.59278      2
```

```
Clust[Clust$subgrp==3,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 6       110       2   2    180   1.5  10.5      10     70       25     1      1
## 7       110       2   0    125   1.0  11.0      14     30       25     2      1
## 11      120       1   2    220   0.0  12.0      12     35       25     2      1
## 13      120       1   3    210   0.0  13.0       9     45       25     2      1
## 15      110       1   1    180   0.0  12.0      13     55       25     2      1
## 18      110       1   0     90   1.0  13.0      12     20       25     2      1
## 19      110       1   1    180   0.0  12.0      13     65       25     2      1
## 25      110       2   1    125   1.0  11.0      13     30       25     2      1
## 26      110       1   0    200   1.0  14.0      11     25       25     1      1
## 30      110       1   1    135   0.0  13.0      12     25       25     2      1
## 31      100       2   0     45   0.0  11.0      15     40       25     1      1
## 32      110       1   1    280   0.0  15.0       9     45       25     2      1
## 36      120       1   2    220   1.0  12.0      11     45       25     2      1
## 37      110       3   1    250   1.5  11.5      10     90       25     1      1
## 38      110       1   0    180   0.0  14.0      11     35       25     1      1
```

```
## 43      110       2   1    180   0.0  12.0      12     55       25     2       1
## 48      100       2   1    220   2.0  15.0       6     90       25     1       1
## 49      120       2   1    190   0.0  15.0       9     40       25     2       1
## 67      110       2   1     70   1.0   9.0      15     40       25     2       1
## 74      110       1   1    140   0.0  13.0      12     25       25     2       1
## 77      110       2   1    200   1.0  16.0       8     60       25     1       1
##    cups   rating subgrp
## 6  0.75 29.50954      3
## 7  1.00 33.17409      3
## 11 0.75 18.04285      3
## 13 0.75 19.82357      3
## 15 1.00 22.73645      3
## 18 1.00 35.78279      3
## 19 1.00 22.39651      3
## 25 1.00 32.20758      3
## 26 0.75 31.43597      3
## 30 0.75 28.02576      3
## 31 0.88 35.25244      3
## 32 0.75 23.80404      3
## 36 1.00 21.87129      3
## 37 0.75 31.07222      3
## 38 1.33 28.74241      3
## 43 1.00 26.73451      3
## 48 1.00 40.10596      3
## 49 0.67 29.92429      3
## 67 0.75 31.23005      3
## 74 1.00 27.75330      3
## 77 0.75 36.18756      3
```

```
Clust[Clust$subgrp==4,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 9        90       2   1    200     4    15      6    125       25     1   1.00
## 10       90       3   0    210     5    13      5    190       25     3   1.00
## 12      110       6   2    290     2    17      1    105       25     1   1.00
## 16      110       2   0    280     0    22      3     25       25     1   1.00
## 17      100       2   0    290     1    21      2     35       25     1   1.00
## 22      110       2   0    220     1    21      3     30       25     3   1.00
## 24      100       2   0    190     1    18      5     80       25     3   1.00
## 27      100       3   0      0     3    14      7    100       25     2   1.00
## 33      100       3   1    140     3    15      5     85       25     3   1.00
## 34      110       3   0    170     3    17      3     90       25     3   1.00
## 39      110       2   1    170     1    17      6     60      100     3   1.00
## 41      110       2   1    260     0    21      3     40       25     2   1.00
## 44      100       4   1      0     0    16      3     95       25     2   1.00
## 51       90       3   0    170     3    18      2     90       25     3   1.00
## 54      100       3   0    320     1    20      3     45      100     3   1.00
## 55       50       1   0      0     0    13      0     15        0     3   0.50
## 56       50       2   0      0     1    10      0     50        0     3   0.50
## 61       90       2   0      0     2    15      6    110       25     3   1.00
## 62      110       1   0    240     0    23      2     30       25     1   1.00
## 63      110       2   0    290     0    22      3     35       25     1   1.00
## 64       80       2   0      0     3    16      0     95        0     1   0.83
## 65       90       3   0      0     4    19      0    140        0     1   1.00
```

```
## 66        90        3    0       0      3     20       0     120         0      1    1.00
## 68       110        6    0     230      1     16       3      55        25      1    1.00
## 69        90        2    0      15      3     15       5      90        25      2    1.00
## 70       110        2    1     200      0     21       3      35       100      3    1.00
## 72       100        3    1     200      3     16       3     110       100      3    1.00
## 73       110        2    1     250      0     21       3      60        25      3    1.00
## 75       100        3    1     230      3     17       3     115        25      1    1.00
## 76       100        3    1     200      3     17       3     110        25      1    1.00
##    cups   rating subgrp
## 9  0.67 49.12025      4
## 10 0.67 53.31381      4
## 12 1.25 50.76500      4
## 16 1.00 41.44502      4
## 17 1.00 45.86332      4
## 22 1.00 46.89564      4
## 24 0.75 44.33086      4
## 27 0.80 58.34514      4
## 33 0.88 52.07690      4
## 34 0.25 53.37101      4
## 39 1.00 36.52368      4
## 41 1.50 39.24111      4
## 44 1.00 54.85092      4
## 51 1.00 59.64284      4
## 54 1.00 41.50354      4
## 55 1.00 60.75611      4
## 56 1.00 63.00565      4
## 61 0.50 55.33314      4
## 62 1.13 41.99893      4
## 63 1.00 40.56016      4
## 64 1.00 68.23588      4
## 65 0.67 74.47295      4
## 66 0.67 72.80179      4
## 68 1.00 53.13132      4
## 69 1.00 59.36399      4
## 70 1.00 38.83975      4
## 72 1.00 46.65884      4
## 73 0.75 39.10617      4
## 75 0.67 49.78744      4
## 76 1.00 51.59219      4
```

```r
#here we calculate the mean rating in order determine the healthy cluster cereals
mean(Clust[Clust$subgrp==1,"rating"])
```

```
## [1] 73.84446
```

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

```
## [1] 38.26161
```

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

```
## [1] 28.84825
```

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

```
## [1] 51.43111
```

```r
#From the above results it is clearly evident that mean rating is highest for subgroup 1.
#so, it is recommended to choose subgrp 1 as the healthy diet cluster.
```