assignment 5

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```
library(readr)
library(cluster)
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(factoextra)
```

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

```
Cereals <- read_csv("~/Downloads/assignment_5/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.
```

data importing cereals dataset

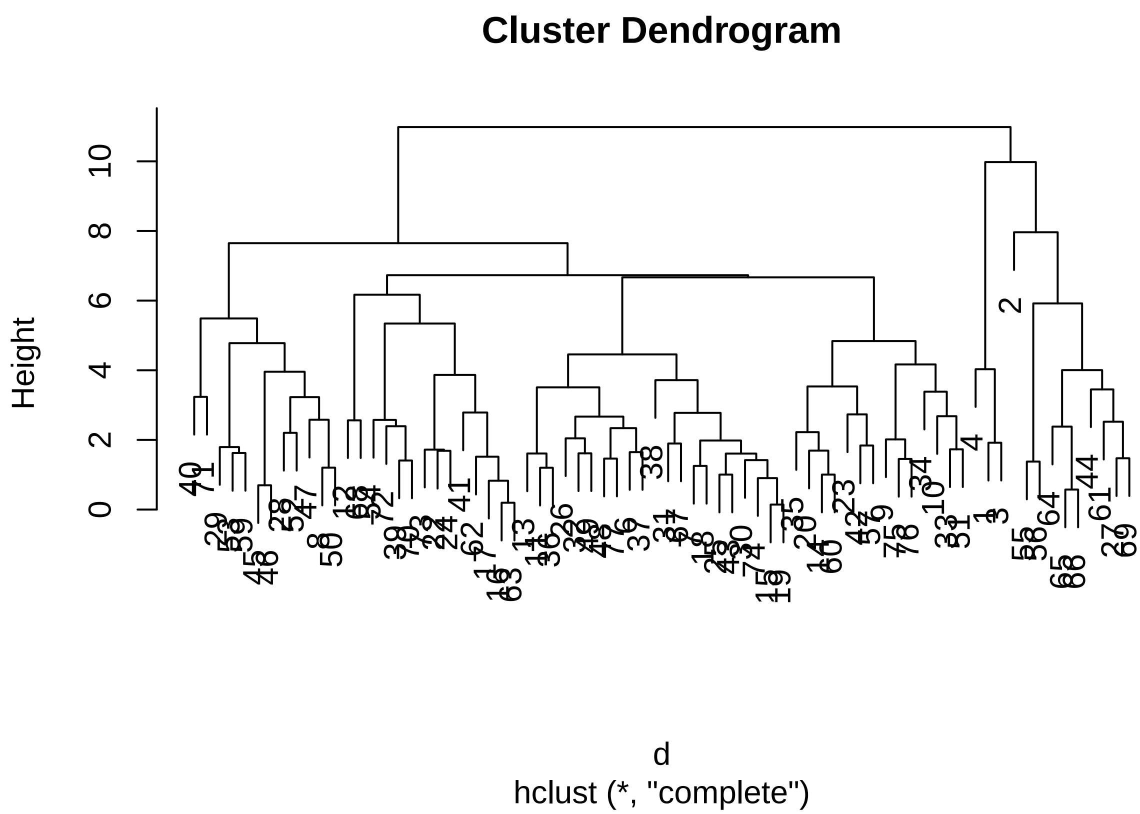
```r
data.frame <-data.frame(Cereals[,4:16])
```

data processing. removing the missing values that might present in the data

```r
removed_missingvalue <- na.omit(data.frame)
#Data normalization and data scaling
Normalize <- scale(removed_missingvalue)
```

using the euclidean distance to measure the distance

```r
d <- dist(Normalize, method = "euclidean")
#perform hierarchical clustering using complete linkage.
Hc <- hclust(d, method = "complete")
plot(Hc)
```

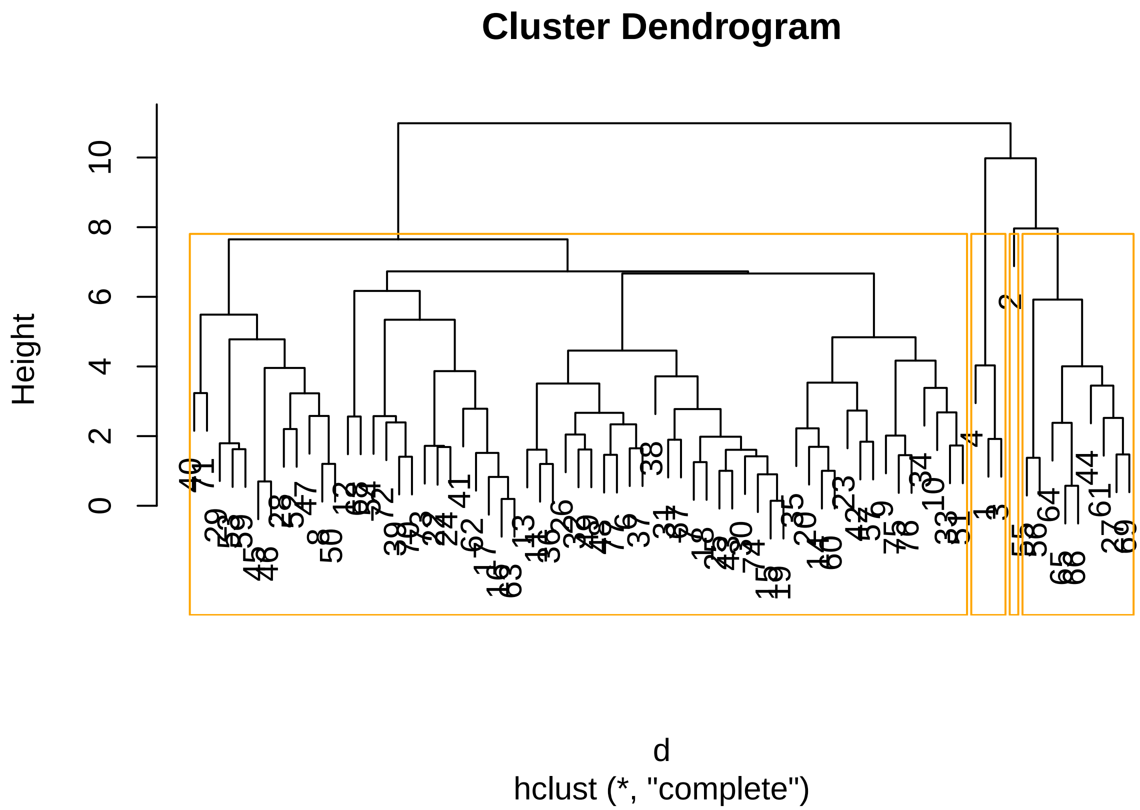



```r
#dendogram
round(Hc$height, 3)
```

```
##  [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
```

Determining Optimal clusters: highliting the clusters in dendogram directly.

```r
plot(Hc)
rect.hclust(Hc,k = 4, border = "orange")
```



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

```r
Hcsingle  <- agnes(Normalize, method = "single")
Hccomplete <-agnes(Normalize, method = "complete")
Hcaverage <-agnes(Normalize, method = "average")
Hcward <- agnes(Normalize, method = "ward")
```

Compare the agglomerative coefficients for single,complete,average and ward.

```r
print(Hcsingle$ac)
```

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

```r
print(Hccomplete$ac)
```

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

```r
print(Hcaverage$ac)
```

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

```r
print(Hcward$ac)
```

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

From the above results the best value we got is 0.904. Ploting the agnes using ward method and cuttung the Dendrogram. we will take k =4 by observing the distance

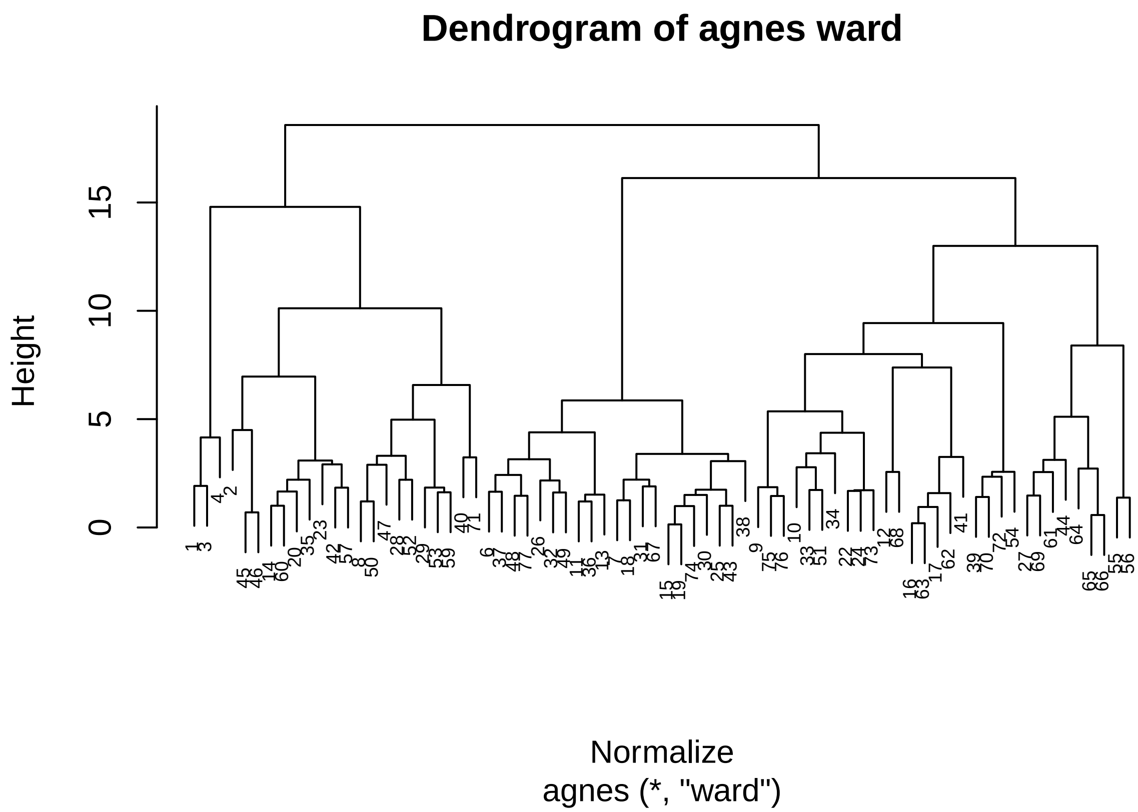
```
pltree(Hcward, cex = 0.6, hand = -1, main = "Dendrogram of agnes ward")
```

```
## Warning in graphics:::plotHclust(n1, merge, height, order(x$order), hang, :
## "hand" is not a graphical parameter

## Warning in graphics:::plotHclust(n1, merge, height, order(x$order), hang, :
## "hand" is not a graphical parameter

## Warning in axis(2, at = pretty(range(height)), ...): "hand" is not a graphical
## parameter

## Warning in title(main = main, sub = sub, xlab = xlab, ylab = ylab, ...): "hand"
## is not a graphical parameter
```

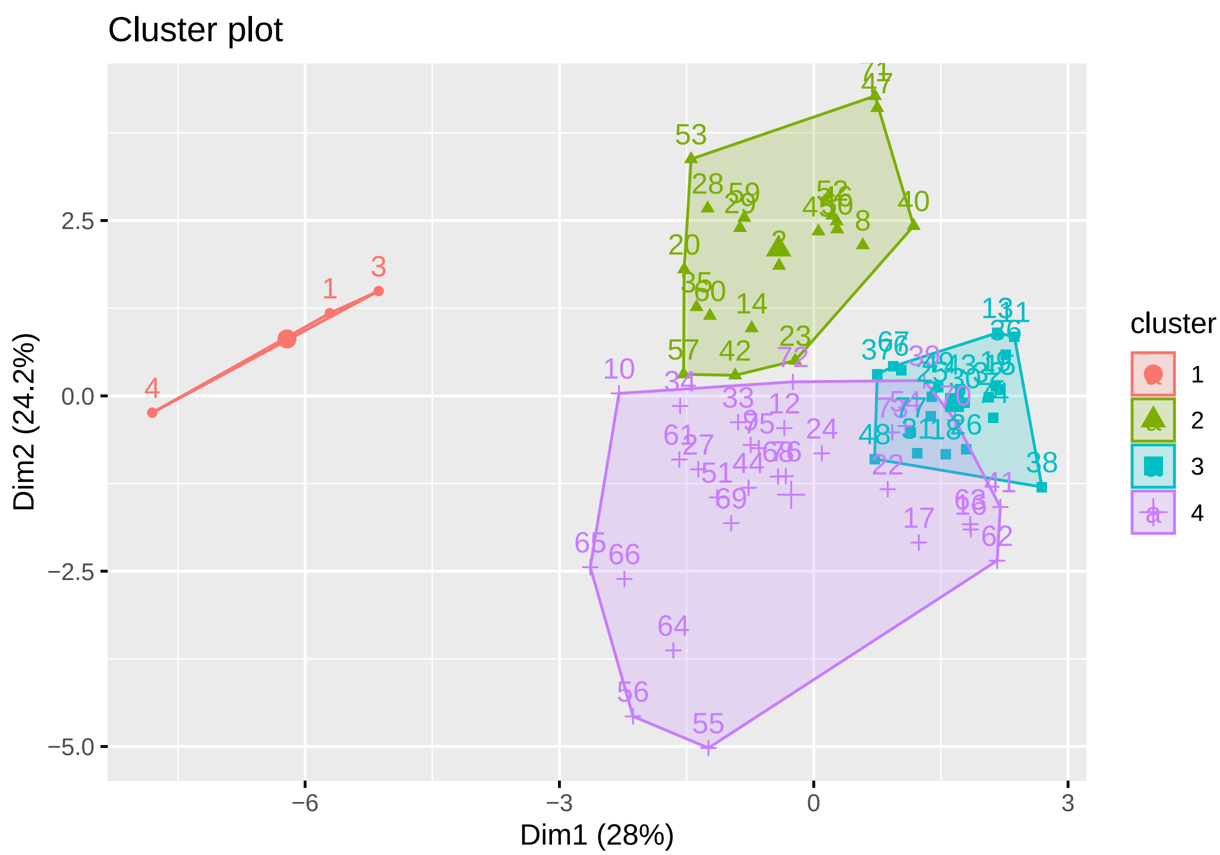


Hierarchical clustering using ward method.

```
hc1 <- hclust(d, method = "ward.D2")
subgroup <- cutree(hc1, k =4)
table(subgroup)
```

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

```
datafram <- as.data.frame(cbind(Normalize,subgroup))
#the results in scatter plot.
fviz_cluster(list(data = Normalize,cluster=subgroup))
```




```
datacereals <-Cereals
datacereals.omi <- na.omit(datacereals)
clust <- cbind(datacereals.omi, subgroup)
clust[clust$subgroup==1,]
```

```
##                         name mfr type calories protein fat sodium fiber carbo
## 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 subgroup
## 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$subgroup==2,]
```

```
##                                   name mfr type calories protein fat sodium
## 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 subgroup
## 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$subgroup==3,]
```

```
##                        name mfr type calories protein fat sodium fiber carbo
## 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 subgroup
## 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$subgroup==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
## 27        Frosted_Mini-Wheats   K    C      100       3   0      0     3    14
## 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
## 44                      Maypo   A    H      100       4   1      0     0    16
## 51          Nutri-grain_Wheat   K    C       90       3   0    170     3    18
## 54                 Product_19   K    C      100       3   0    320     1    20
## 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
## 62                  Rice_Chex   R    C      110       1   0    240     0    23
## 63               Rice_Krispies   K    C      110       2   0    290     0    22
## 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
## 68                  Special_K   K    C      110       6   0    230     1    16
## 69     Strawberry_Fruit_Wheats   N    C       90       2   0     15     3    15
## 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 subgroup
## 9       6    125       25     1   1.00 0.67 49.12025        4
## 10      5    190       25     3   1.00 0.67 53.31381        4
## 12      1    105       25     1   1.00 1.25 50.76500        4
## 16      3     25       25     1   1.00 1.00 41.44502        4
## 17      2     35       25     1   1.00 1.00 45.86332        4
## 22      3     30       25     3   1.00 1.00 46.89564        4
## 24      5     80       25     3   1.00 0.75 44.33086        4
## 27      7    100       25     2   1.00 0.80 58.34514        4
## 33      5     85       25     3   1.00 0.88 52.07690        4
## 34      3     90       25     3   1.00 0.25 53.37101        4
## 39      6     60      100     3   1.00 1.00 36.52368        4
## 41      3     40       25     2   1.00 1.50 39.24111        4
## 44      3     95       25     2   1.00 1.00 54.85092        4
## 51      2     90       25     3   1.00 1.00 59.64284        4
## 54      3     45      100     3   1.00 1.00 41.50354        4
## 55      0     15        0     3   0.50 1.00 60.75611        4
## 56      0     50        0     3   0.50 1.00 63.00565        4
## 61      6    110       25     3   1.00 0.50 55.33314        4
## 62      2     30       25     1   1.00 1.13 41.99893        4
## 63      3     35       25     1   1.00 1.00 40.56016        4
## 64      0     95        0     1   0.83 1.00 68.23588        4
## 65      0    140        0     1   1.00 0.67 74.47295        4
## 66      0    120        0     1   1.00 0.67 72.80179        4
## 68      3     55       25     1   1.00 1.00 53.13132        4
## 69      5     90       25     2   1.00 1.00 59.36399        4
## 70      3     35      100     3   1.00 1.00 38.83975        4
## 72      3    110      100     3   1.00 1.00 46.65884        4
## 73      3     60       25     3   1.00 0.75 39.10617        4
## 75      3    115       25     1   1.00 0.67 49.78744        4
## 76      3    110       25     1   1.00 1.00 51.59219        4
```

calculating the mean ratings to determine the cluster cereals

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

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

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

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

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

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

```
mean(clust[clust$subgroup==4,"rating"])
```

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

from the above results we can clearly that the mean rating is high for subgroup 1.