# Assignment 5

Ranadheer Gonuguntla

2023-11-30

Loading required libraries

```r
library(factoextra)
```

```
## Warning: package 'factoextra' was built under R version 4.3.2

## Loading required package: ggplot2

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

```r
library(dendextend)
```

```
## Warning: package 'dendextend' was built under R version 4.3.2

##
## ---------------------
## Welcome to dendextend version 1.17.1
## 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
```

```r
library(cluster)
```

```
## Warning: package 'cluster' was built under R version 4.3.2
```

```r
library(tidyverse)
```

```
## Warning: package 'tidyverse' was built under R version 4.3.2

## Warning: package 'readr' was built under R version 4.3.2

## Warning: package 'forcats' was built under R version 4.3.2

## -- Attaching core tidyverse packages ------------------------ tidyverse 2.0.0 --
## v dplyr     1.1.3     v readr     2.1.4
## v forcats   1.0.0     v stringr   1.5.0
## v lubridate 1.9.3     v tibble    3.2.1
## v purrr     1.0.2     v tidyr     1.3.0

## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors
```

```r
library(knitr)
```

```
## Warning: package 'knitr' was built under R version 4.3.2
```

Importing the data

```r
Data_cereals = read.csv("C:\\Users\\sidda\\Downloads\\Cereals (2).csv")
numerical_data = data.frame(Data_cereals[,4:16])
```

Removing all the missing values present in the data

```r
Data_nomissingValues = na.omit(numerical_data)
```

Normalizing the data

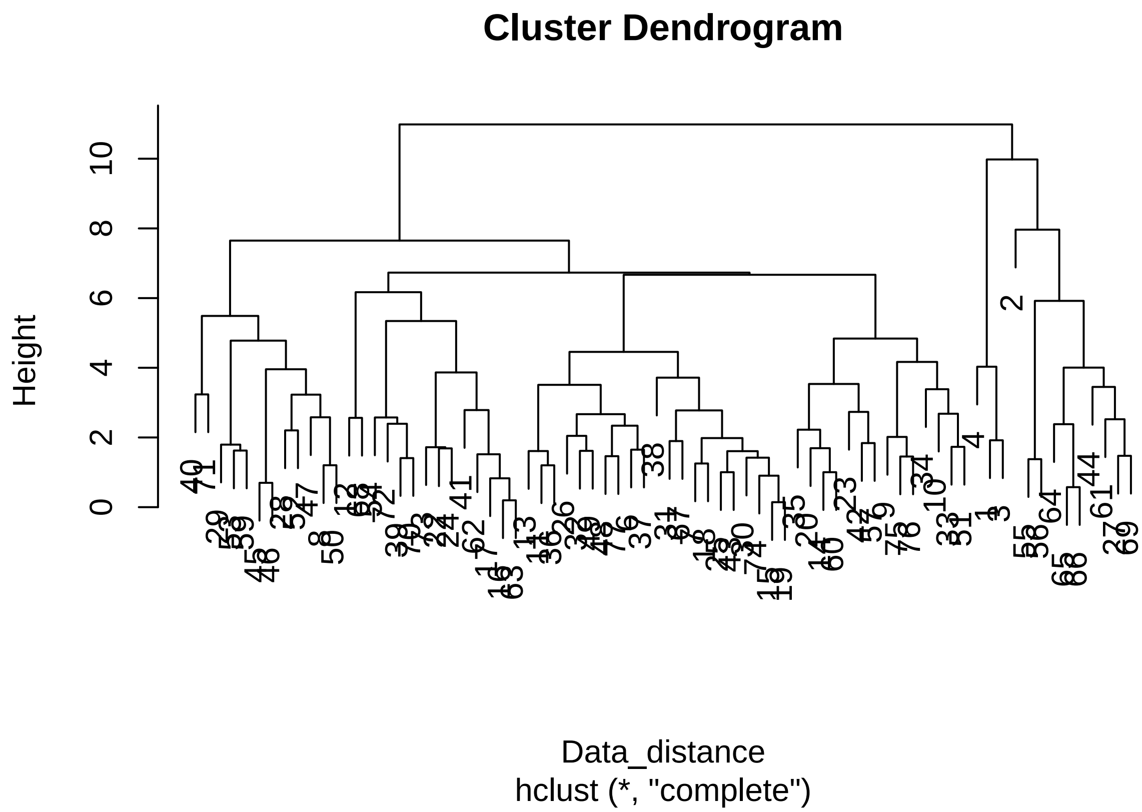
```r
Normalised_data = scale(Data_nomissingValues)
```

Measuring the distance using the euclidian distance

```r
Data_distance = dist(Normalised_data, method = "euclidian")
```

Performing hierarchial clustering using complete linkage

```r
hierarchial_clustering = hclust(Data_distance,method = "complete")
plot(hierarchial_clustering)
```




Rounding off the decimals

```r
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
```

Performing clustering using AGNES

```r
library(dendextend)

HC_single = agnes(Normalised_data, method = "single")
HC_complete = agnes(Normalised_data, method = "complete")
HC_average = agnes(Normalised_data, method = "average")
HC_ward = agnes(Normalised_data, method = "ward")
```

Lets Compare the agglomerative coefficients of single , complete, average, ward

```r
print(HC_single$ac)
```

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

```r
print(HC_complete$ac)
```

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

```r
print(HC_average$ac)
```

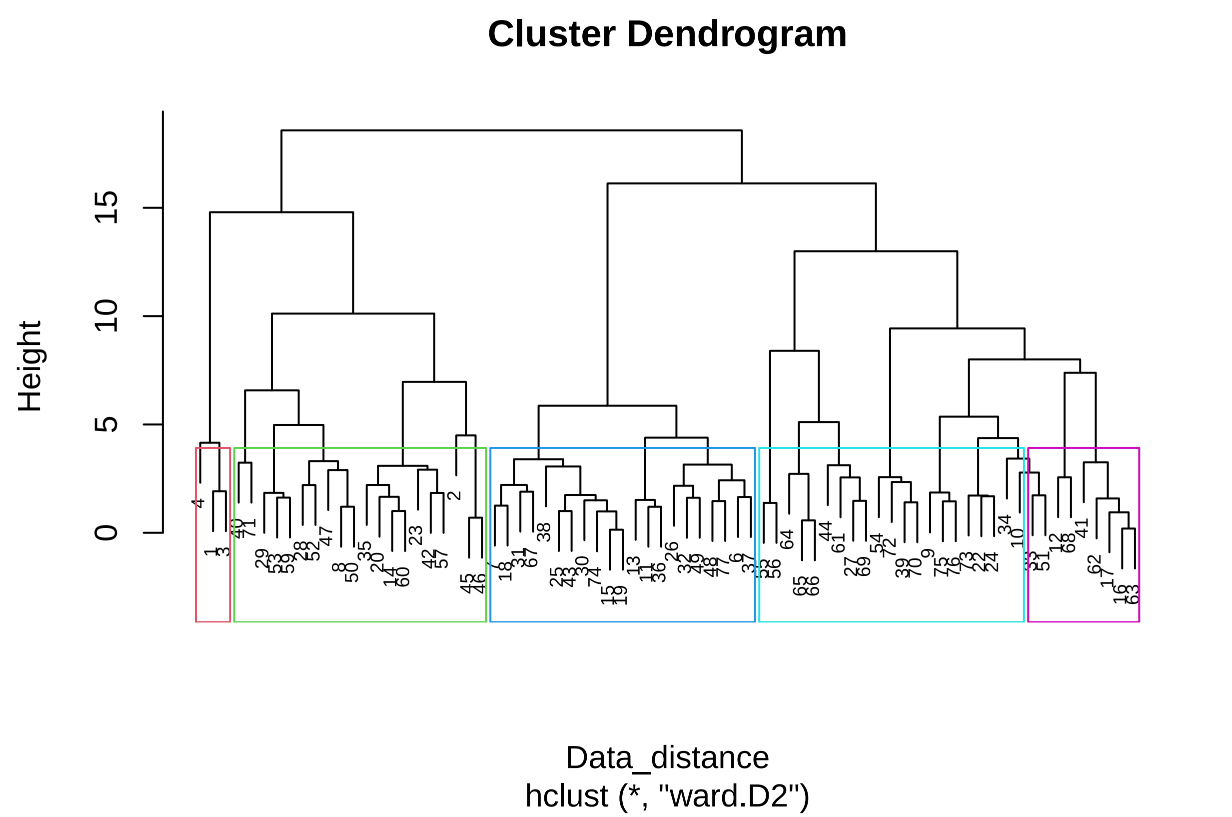
```
## [1] 0.7766075
```

```r
print(HC_ward$ac)
```

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

from the above values, ward method is the best as it has the agglomerative coefficient value of 0.904. Lets determine the optimal clusters

```r
#using the ward method for hierarchial clustering
HC_1 <- hclust(Data_distance, method = "ward.D2" )
plot(HC_1,cex=0.6)
rect.hclust(HC_ward,k=5, border=2:10)
```



from the above result of ward method graphs, it can be seen that the k value is considered as 5.So we would choose 5 Clusters.
Lets plot agnes using the ward method

```
subgroup = cutree(HC_1,k=5)
table(subgroup)
```

```
## subgroup
##  1  2  3  4  5
##  3 20 21 21  9
```

```
cereals_groups <- as.data.frame(cbind(Normalised_data,subgroup))
```

Lets visualise the results on scatterplot

```
fviz_cluster(list(data = Normalised_data, cluster = subgroup))
```


Lets find the best breakfast cereal cluster with high protein, fibre and low in sugar and sodium.

choosing the healthy cereal cluster

```
New_cereals = numerical_data
New_cereals_omit = na.omit(New_cereals)
Cluster = cbind(New_cereals_omit, subgroup)
Cluster[Cluster$subgroup==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 subgroup
## 1 0.33 68.40297        1
## 3 0.33 59.42551        1
## 4 0.50 93.70491        1
```

```
Cluster[Cluster$subgroup==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 subgroup
## 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
```

```r
Cluster[Cluster$subgroup==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 subgroup
## 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
```

```r
Cluster[Cluster$subgroup==4,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 9        90       2   1    200     4    15      6    125       25     1      1
## 10       90       3   0    210     5    13      5    190       25     3      1
```

```
## 12       110        6   2    290     2     17      1    105        25     1       1
## 16       110        2   0    280     0     22      3     25        25     1       1
## 17       100        2   0    290     1     21      2     35        25     1       1
## 22       110        2   0    220     1     21      3     30        25     3       1
## 24       100        2   0    190     1     18      5     80        25     3       1
## 33       100        3   1    140     3     15      5     85        25     3       1
## 34       110        3   0    170     3     17      3     90        25     3       1
## 39       110        2   1    170     1     17      6     60       100     3       1
## 41       110        2   1    260     0     21      3     40        25     2       1
## 51        90        3   0    170     3     18      2     90        25     3       1
## 54       100        3   0    320     1     20      3     45       100     3       1
## 62       110        1   0    240     0     23      2     30        25     1       1
## 63       110        2   0    290     0     22      3     35        25     1       1
## 68       110        6   0    230     1     16      3     55        25     1       1
## 70       110        2   1    200     0     21      3     35       100     3       1
## 72       100        3   1    200     3     16      3    110       100     3       1
## 73       110        2   1    250     0     21      3     60        25     3       1
## 75       100        3   1    230     3     17      3    115        25     1       1
## 76       100        3   1    200     3     17      3    110        25     1       1
##    cups   rating subgroup
## 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
## 33 0.88 52.07690        4
## 34 0.25 53.37101        4
## 39 1.00 36.52368        4
## 41 1.50 39.24111        4
## 51 1.00 59.64284        4
## 54 1.00 41.50354        4
## 62 1.13 41.99893        4
## 63 1.00 40.56016        4
## 68 1.00 53.13132        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
```

```
Cluster[Cluster$subgroup==5,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 27      100       3   0      0     3    14      7    100       25     2   1.00
## 44      100       4   1      0     0    16      3     95       25     2   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
## 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
## 69       90       2   0     15     3    15      5     90       25     2   1.00
```

```
##    cups   rating subgroup
## 27 0.80 58.34514        5
## 44 1.00 54.85092        5
## 55 1.00 60.75611        5
## 56 1.00 63.00565        5
## 61 0.50 55.33314        5
## 64 1.00 68.23588        5
## 65 0.67 74.47295        5
## 66 0.67 72.80179        5
## 69 1.00 59.36399        5
```

in order to determine the healthy cluster cereals, lets calculate the mean rating

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

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

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

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

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

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

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

```
## [1] 46.46513
```

```r
mean(Cluster[Cluster$subgroup==5,"rating"])
```

```
## [1] 63.0184
```

It is clear from the figures above that subgroup 1 has the highest mean rating of 73.84446. Therefore, subgroup 1 should be selected as the cluster for the healthy diet.