FML 5 ASNMT

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

```
## Loading required package: ggplot2

## Loading required package: lattice
```

```r
library(knitr)
library(dendextend)
```

```
##
## ---------------------
## 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(factoextra)
```

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

Importing dataset

```r
cereals_data <- read.csv("/Users/chaithanayayennam/Downloads/Cereals.csv")
cereals <- data.frame(cereals_data[,4:16])
head(cereals_data)
```

```
##                          name mfr type calories protein fat sodium fiber carbo
## 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
```

Removing missing values

```r
cereals <- na.omit(cereals)
```

Performing data normalization and scale the data

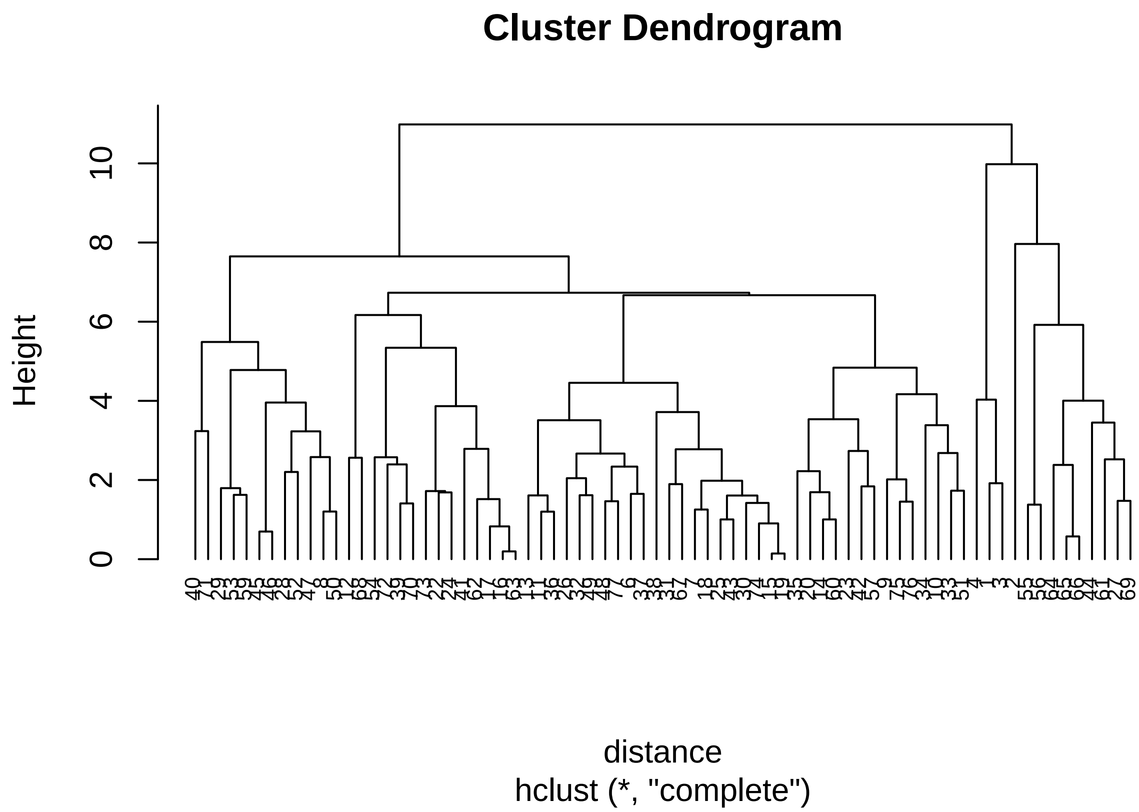
```r
normalized_cereals <- scale(cereals)
```

Applying hierarchical clustering to the data using Euclidean distance to the normalized measurements

```r
distance <- dist(normalized_cereals, method = "euclidean")
heirarch_cluster <- hclust(distance, method = "complete")
```

Dendogram plotting

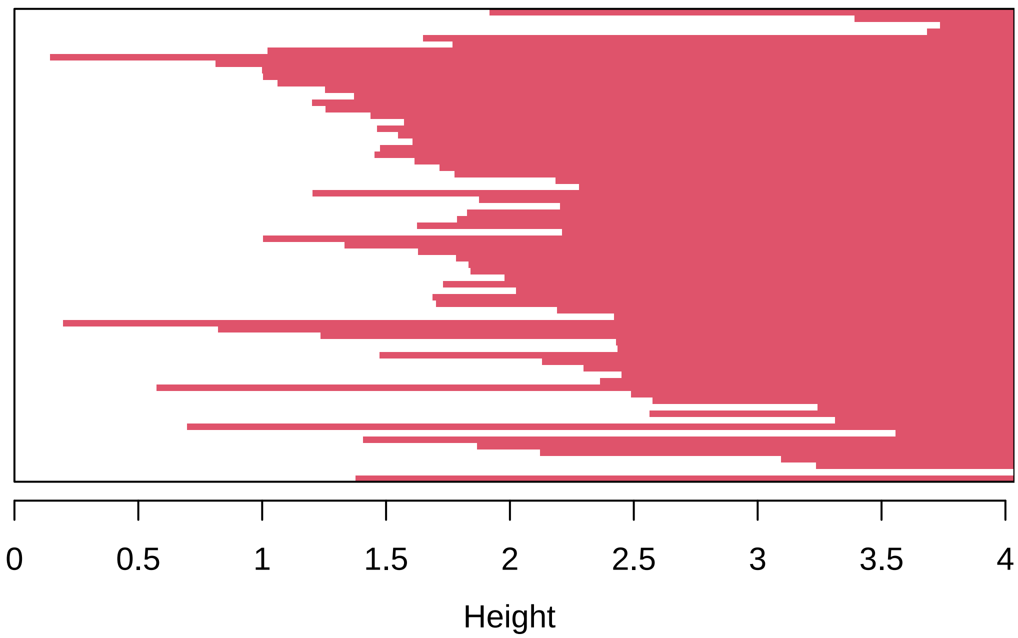
```r
plot(heirarch_cluster, cex = 0.7, hang = -1)
```



Clustering from single linkage, complete linkage, average linkage, and Ward.

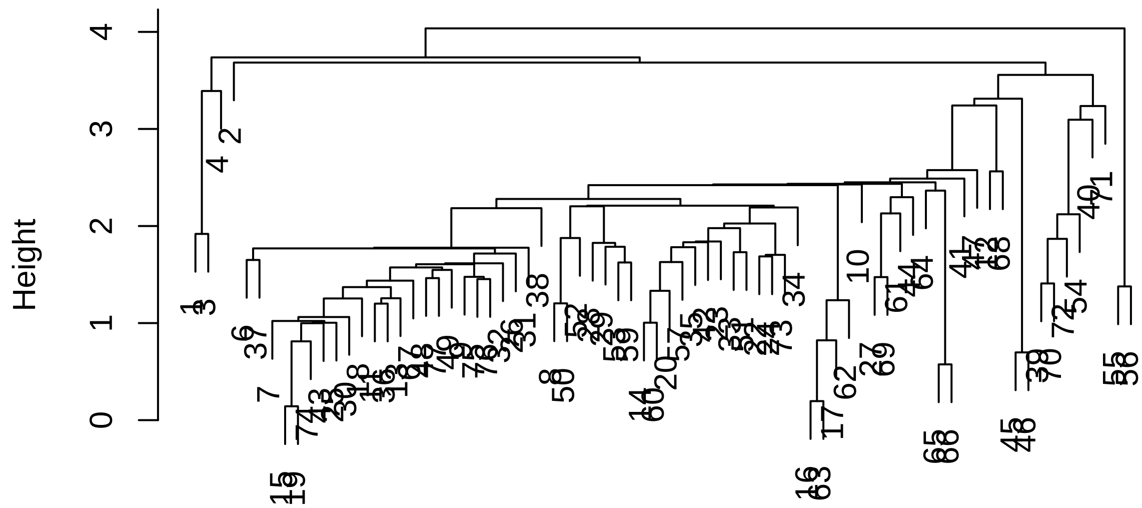
```
heirarch_cluster_single <- agnes(normalized_cereals, method = "single")
heirarch_cluster_complete <- agnes(normalized_cereals, method = "complete")
heirarch_cluster_average <- agnes(normalized_cereals, method = "average")
heirarch_cluster_ward <- agnes(normalized_cereals, method = "ward")

plot(heirarch_cluster_single, main = "Agnes - Single Linkage")
```

Agnes − Single Linkage



Agglomerative Coefficient = 0.61

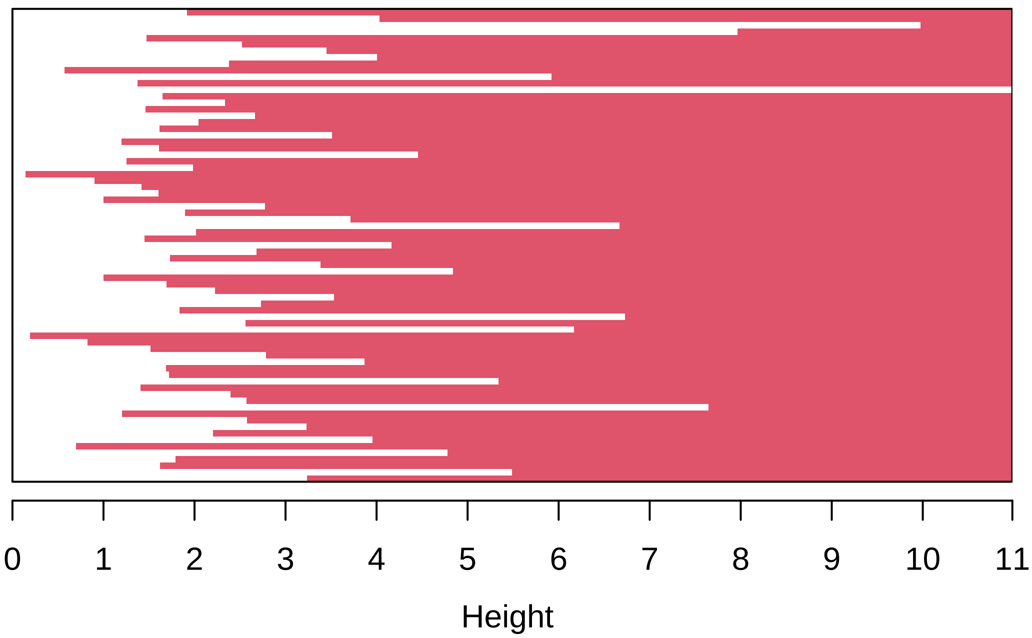
Agnes − Single Linkage



normalized_cereals
Agglomerative Coefficient = 0.61

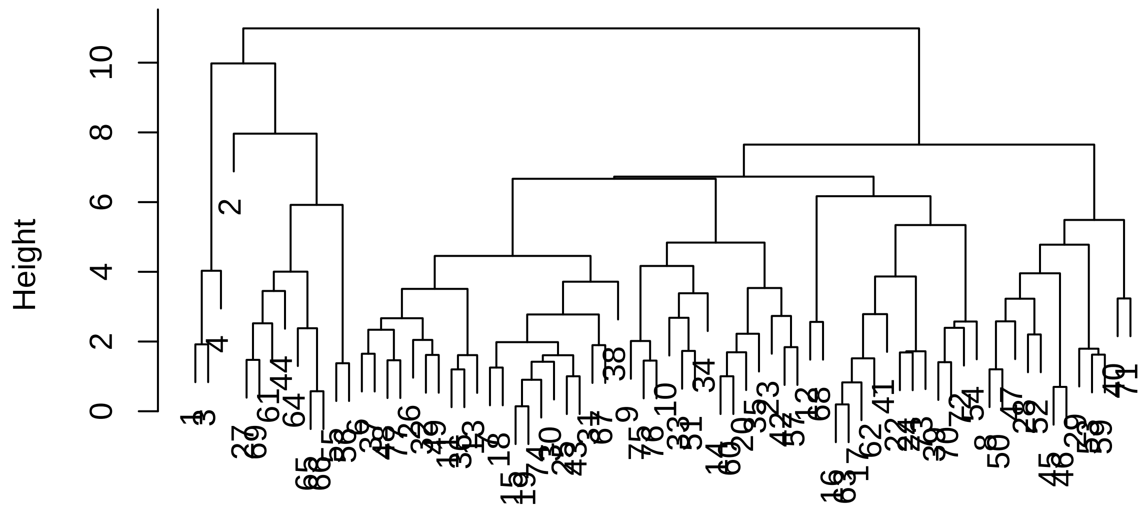
```r
plot(heirarch_cluster_complete, main = "Agnes - Complete Linkage")
```

Agnes − Complete Linkage



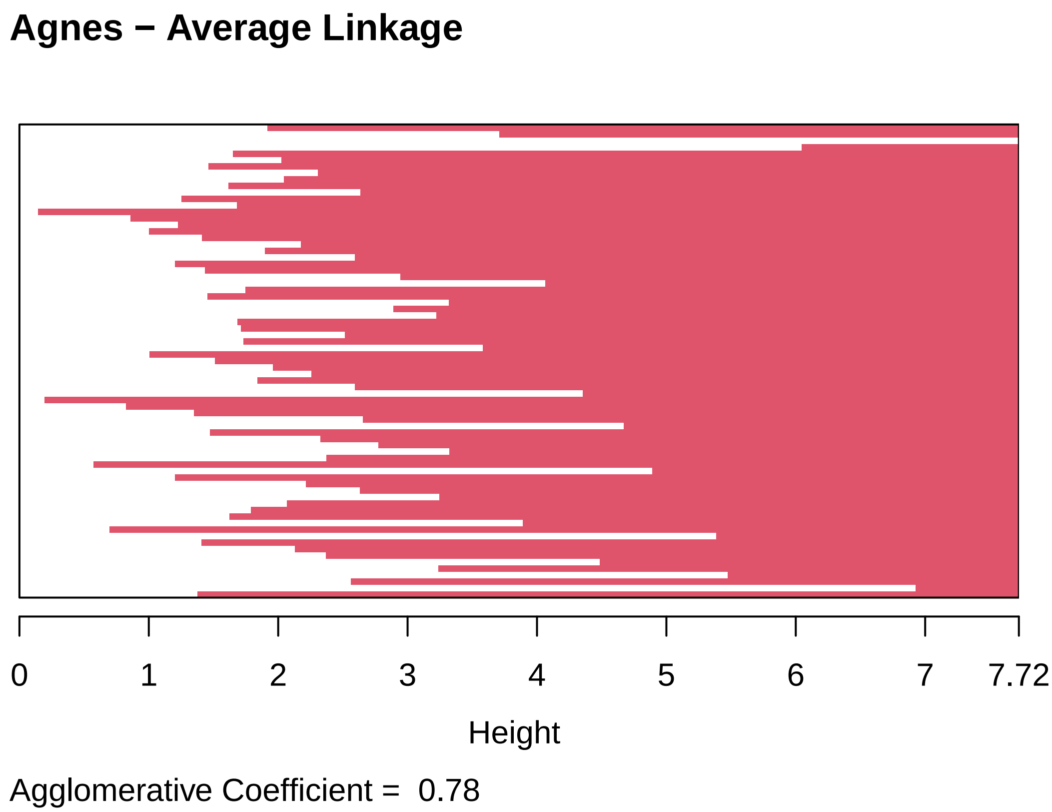
Agglomerative Coefficient = 0.84

Agnes − Complete Linkage

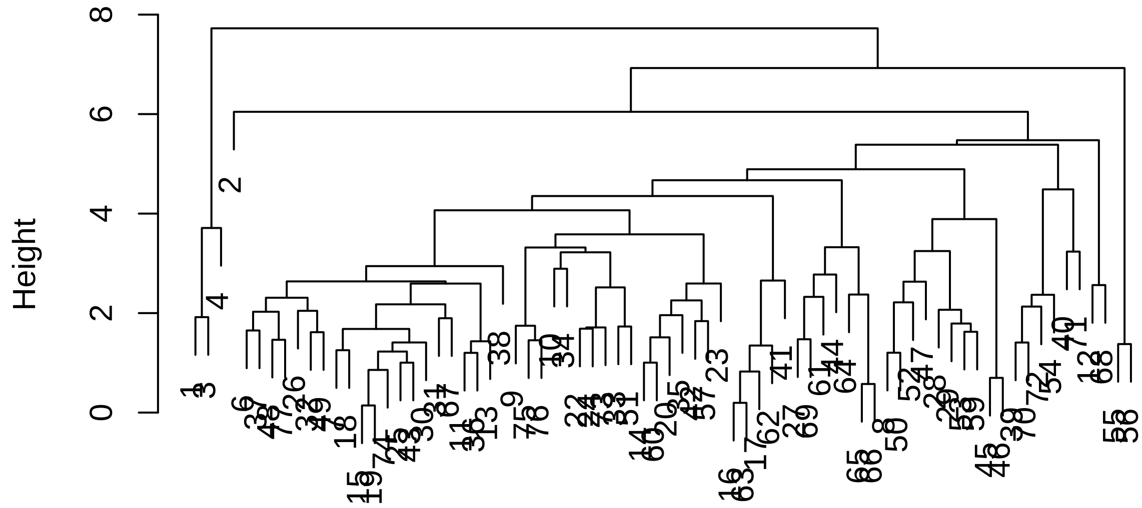


normalized_cereals
Agglomerative Coefficient = 0.84

```r
plot(heirarch_cluster_average, main = "Agnes - Average Linkage")
```

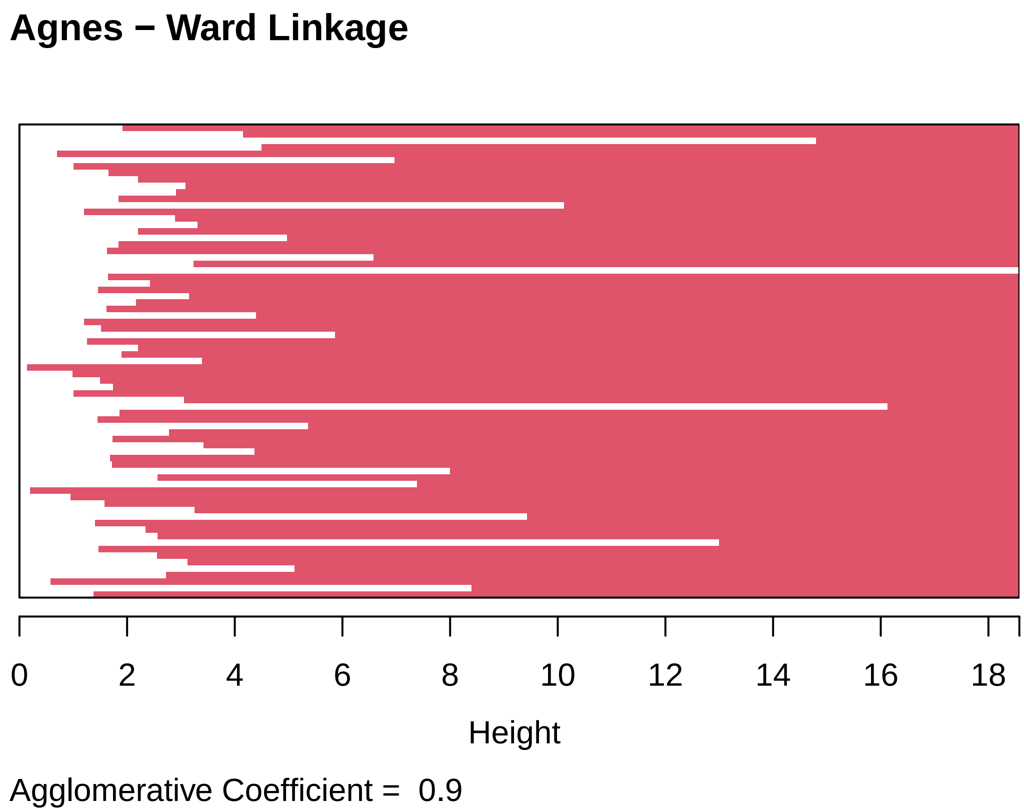

Agnes − Average Linkage
0
1
2
3
4
5
6
7
7.72
Height
Agglomerative Coefficient = 0.78

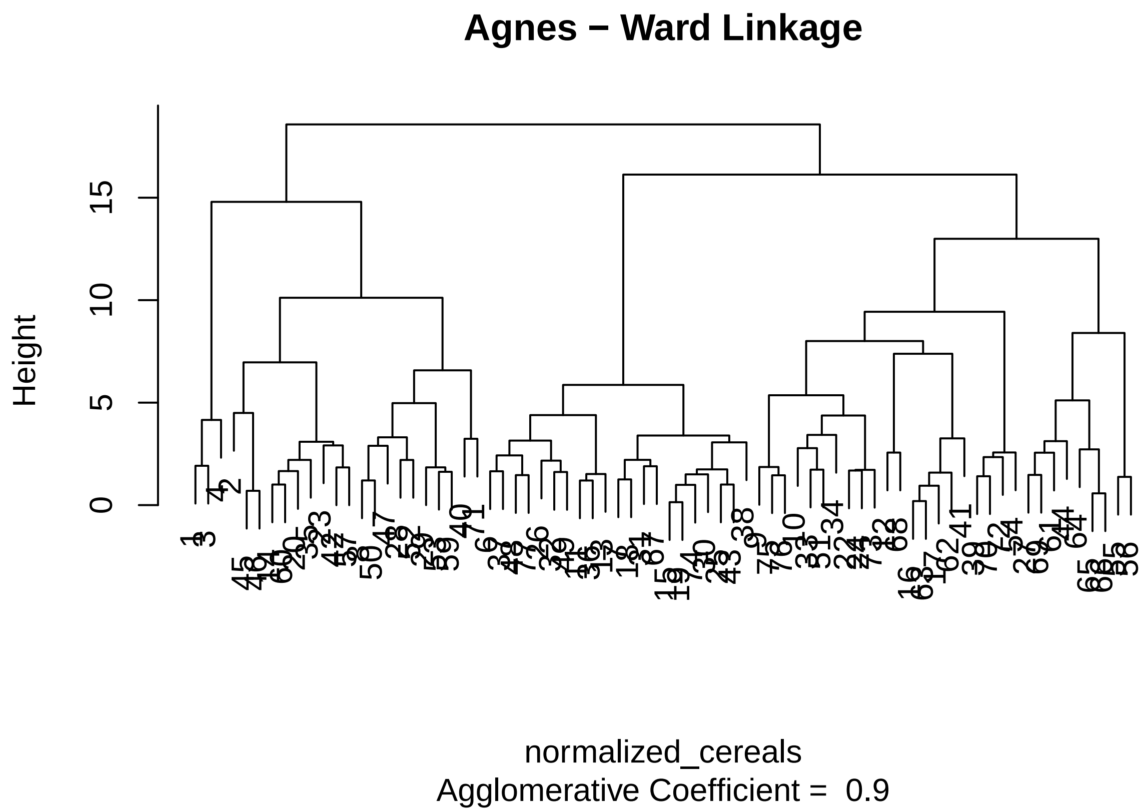
Agnes − Average Linkage



normalized_cereals
Agglomerative Coefficient = 0.78

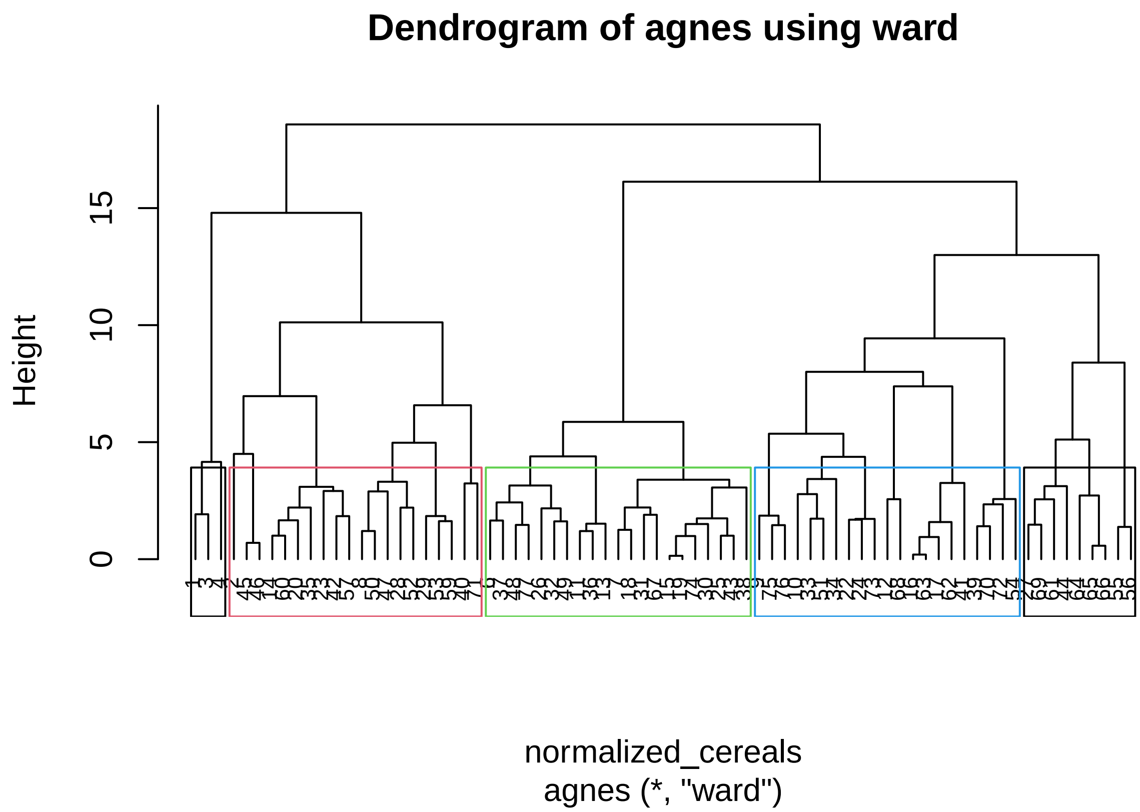
```r
plot(heirarch_cluster_ward, main = "Agnes - Ward Linkage")
```


Agnes − Ward Linkage
0
2
4
6
8
10
12
14
16
18
Height
Agglomerative Coefficient = 0.9



With the Dendrogram clipped and the agnes plotted using the Ward method, the best result we could get from the output above is 0.9. To obtain k = 4, we shall utilize the distance.

```
pltree(heirarch_cluster_ward, cex = 0.7, hang = -1, main = "Dendrogram of agnes using ward")
rect.hclust(heirarch_cluster_ward, k = 5, border = 1:4)
```




```
cluster_number_1 <- cutree(heirarch_cluster_ward, k= 5)
dataframe_number_2 <- as.data.frame(cbind(normalized_cereals, cluster_number_1))
```

Having noted the distance, let's select 5 clusters.

Cluster partition

```
set.seed(123)
partition_number_1 <- cereals[1:50,]
partition_number_2 <- cereals[51:74,]
```

Using the cluster centroids from A to assign each record in partition B

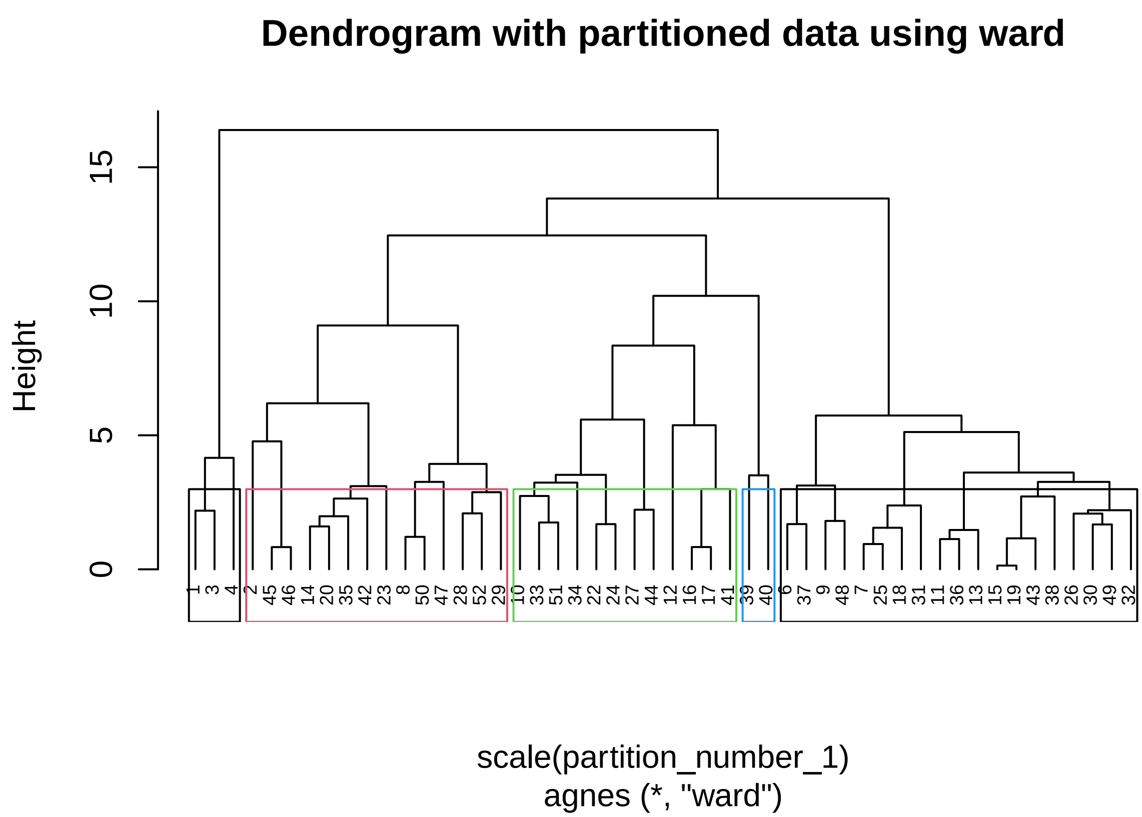
Consider k = 5

```
hc_single <- agnes(scale(partition_number_1), method = "single")
hc_complete <- agnes(scale(partition_number_1), method = "complete")
hc_average <- agnes(scale(partition_number_1), method = "average")
hc_ward <- agnes(scale(partition_number_1), method = "ward")
```

```
cbind(single = hc_single$ac, complete = hc_complete$ac, average = hc_average$ac, ward = hc_ward$ac)
```

```
##         single  complete   average      ward
## [1,] 0.6393338 0.8138238 0.7408904 0.8764323
```

```r
pltree(hc_ward, cex = 0.6, hang = -1, main = "Dendrogram with partitioned data using ward")
rect.hclust(hc_ward, k = 5, border = 1:4)
```




```r
cut2 <- cutree(hc_ward, k = 5)
```

```r
output <- as.data.frame(cbind(partition_number_1, cut2))
output[output$cut2==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 cut2
## 1 0.33 68.40297    1
## 3 0.33 59.42551    1
## 4 0.50 93.70491    1
```

```r
centroid_number_1 <- colMeans(output[output$cut2==1,])
output[output$cut2==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
## 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
##    cups   rating cut2
## 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
## 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
```

```r
centroid_number_2 <- colMeans(output[output$cut2==2,])
output[output$cut2==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
## 9        90       2   1    200   4.0  15.0      6    125       25     1      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
##    cups   rating cut2
## 6  0.75 29.50954    3
## 7  1.00 33.17409    3
```

```
## 9  0.67 49.12025    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
```

```
centroid_number_3 <- colMeans(output[output$cut2==3,])
output[output$cut2==4,]
```

```
##    calories protein fat sodium fiber carbo sugars potass vitamins shelf weight
## 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
## 27      100       3   0      0     3    14      7    100       25     2      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
## 41      110       2   1    260     0    21      3     40       25     2      1
## 44      100       4   1      0     0    16      3     95       25     2      1
## 51       90       3   0    170     3    18      2     90       25     3      1
##    cups   rating cut2
## 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
## 41 1.50 39.24111    4
## 44 1.00 54.85092    4
## 51 1.00 59.64284    4
```

```
centroid_number_4 <- colMeans(output[output$cut2,])

centroids <- rbind(centroid_number_1, centroid_number_2, centroid_number_3, centroid_number_4)
cut_2 <- as.data.frame(rbind(centroids[,-14], partition_number_2))
```

Calculating the distance

```r
distance1 <- get_dist(cut_2)
matrix1 <- as.matrix(distance1)
```

```r
dataframe_number_1 <- data.frame(data = seq(1, nrow(partition_number_2),1), clusters = rep(0, nrow(parti
for (i in 1:nrow(partition_number_2))
  {dataframe_number_1[i,2] <- which.min(matrix1[i+4, 1+4])
}
dataframe_number_1
```

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

```r
cbind(dataframe_number_2$cluster_1[51:74], dataframe_number_1$clusters)
```

```
##       [,1]
##  [1,]    1
##  [2,]    1
##  [3,]    1
##  [4,]    1
##  [5,]    1
##  [6,]    1
##  [7,]    1
##  [8,]    1
##  [9,]    1
## [10,]    1
## [11,]    1
## [12,]    1
## [13,]    1
## [14,]    1
```

```
## [15,]    1
## [16,]    1
## [17,]    1
## [18,]    1
## [19,]    1
## [20,]    1
## [21,]    1
## [22,]    1
## [23,]    1
## [24,]    1
```

```
table(dataframe_number_2$cluster_number_1[51:74], dataframe_number_1$clusters)
```

```
##
##      1
##   2 5
##   3 3
##   4 9
##   5 7
```

From the results we can conclude that the model is partially stable

Clustering healthy cereals data

```
cereals_healthy <- cereals_data
new_cereals_healthy <- na.omit(cereals_healthy)
healthy_clust <- cbind(new_cereals_healthy, cluster_number_1)
healthy_clust[healthy_clust$cluster_number_1==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 cluster_number_1
## 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
```

```
healthy_clust[healthy_clust$cluster_number_1==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
## 2    2.0   8.0      8    135        0     3   1.00 1.00 33.98368
## 8    2.0  18.0      8    100       25     3   1.33 0.75 37.03856
## 14   2.0  13.0      7    105       25     3   1.00 0.50 40.40021
## 20   4.0  10.0      7    160       25     3   1.00 0.50 40.44877
## 23   2.0  11.0     10    120       25     3   1.00 0.75 36.17620
## 28   5.0  12.0     10    200       25     3   1.25 0.67 40.91705
## 29   5.0  14.0     12    190       25     3   1.33 0.67 41.01549
## 35   3.0  13.0      4    100       25     3   1.00 0.33 45.81172
## 40   2.0  20.0      9     95      100     3   1.30 0.75 36.47151
## 42   2.0  12.0      6     95       25     2   1.00 0.67 45.32807
## 45   3.0  16.0     11    170       25     3   1.00 1.00 37.13686
## 46   3.0  16.0     11    170       25     3   1.00 1.00 34.13976
## 47   3.0  17.0     13    160       25     3   1.50 0.67 30.31335
## 50   3.0  21.0      7    130       25     3   1.33 0.67 40.69232
## 52   1.5  13.5     10    120       25     3   1.25 0.50 30.45084
## 53   6.0  11.0     14    260       25     3   1.33 0.67 37.84059
## 57   2.0  14.0      6    110       25     3   1.00 0.50 49.51187
## 59   5.0  14.0     12    240       25     2   1.33 0.75 39.25920
## 60   2.5  10.5      8    140       25     3   1.00 0.50 39.70340
## 71   4.0  15.0     14    230      100     3   1.50 1.00 28.59278
##    cluster_number_1
## 2                 2
## 8                 2
## 14                2
## 20                2
## 23                2
## 28                2
## 29                2
## 35                2
## 40                2
## 42                2
## 45                2
## 46                2
## 47                2
## 50                2
## 52                2
## 53                2
## 57                2
## 59                2
## 60                2
## 71                2
```

```
healthy_clust[healthy_clust$cluster_number_1==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 cluster_number_1
## 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
```

```
healthy_clust[healthy_clust$cluster_number_1==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 cluster_number_1
## 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
```

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?

Given the particular sample of cereals in this case—which may have extreme values like high sugar content and low fiber and iron—it is deemed unacceptable to immediately normalize the cereal nutrition data. Normalization of this kind could be misleading because it obscures the cereals' actual nutritional worth to children. A better preprocessing strategy would be to compute ratios to a child's daily recommended levels of calories, fiber, carbs, etc. When analyzing the data, this strategy helps analysts make more educated conclusions regarding the clusters by giving context on the amount of a child's daily nutritional demands that each cereal meets. In addition, it stops deceptive scaling, making sure that the distance computations aren't dominated by a few bigger variables.

Analysts can choose "healthy" cereal clusters that best suit a child's nutritional needs by looking at the average values for each cluster and determining which cereals in a cluster

contribute the most to a student's daily necessary nutrition.

Mean rating

```
mean(healthy_clust[healthy_clust$cluster_number_1==1, "rating"])
```

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

```
mean(healthy_clust[healthy_clust$cluster_number_1==2, "rating"])
```

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

```
mean(healthy_clust[healthy_clust$cluster_number_1==3, "rating"])
```

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

```
mean(healthy_clust[healthy_clust$cluster_number_1==4, "rating"])
```

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

Since cluster 1 has the highest mean ratings (73.84446), we can consider it.