Periandri_Anthony_Assignment 5

2025-06-23

```r
library(cluster)
library(factoextra)
```

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

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

```r
library(proxy)
```

```
##
## Attaching package: 'proxy'
```

```
## The following objects are masked from 'package:stats':
##
##     as.dist, dist
```

```
## The following object is masked from 'package:base':
##
##     as.matrix
```

```r
library(mclust)
```

```
## Package 'mclust' version 6.1.1
## Type 'citation("mclust")' for citing this R package in publications.
```

```r
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```r
cereals <- read.csv("Cereals.csv", stringsAsFactors = TRUE)
cereals_clean <- na.omit(cereals)
##show dataa
print(cereals_clean)
```

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

```
## 2                         100%_Natural_Bran   Q    C      120       3   5
15
## 3                                  All-Bran   K    C       70       4   1
260
## 4                 All-Bran_with_Extra_Fiber   K    C       50       4   0
140
## 6                   Apple_Cinnamon_Cheerios   G    C      110       2   2
180
## 7                               Apple_Jacks   K    C      110       2   0
125
## 8                                   Basic_4   G    C      130       3   2
210
## 9                                 Bran_Chex   R    C       90       2   1
200
## 10                              Bran_Flakes   P    C       90       3   0
210
## 11                             Cap'n'Crunch   Q    C      120       1   2
220
## 12                                  Cheerios   G    C      110       6   2
290
## 13                    Cinnamon_Toast_Crunch   G    C      120       1   3
210
## 14                                  Clusters   G    C      110       3   2
140
## 15                              Cocoa_Puffs   G    C      110       1   1
180
## 16                                Corn_Chex   R    C      110       2   0
280
## 17                              Corn_Flakes   K    C      100       2   0
290
## 18                                Corn_Pops   K    C      110       1   0
90
## 19                             Count_Chocula   G    C      110       1   1
180
## 20                       Cracklin'_Oat_Bran   K    C      110       3   3
140
## 22                                  Crispix   K    C      110       2   0
220
## 23                  Crispy_Wheat_&_Raisins   G    C      100       2   1
140
## 24                              Double_Chex   R    C      100       2   0
190
## 25                              Froot_Loops   K    C      110       2   1
125
## 26                            Frosted_Flakes   K    C      110       1   0
200
## 27                       Frosted_Mini-Wheats   K    C      100       3   0
0
## 28 Fruit_&_Fibre_Dates,_Walnuts,_and_Oats   P    C      120       3   2
160
```

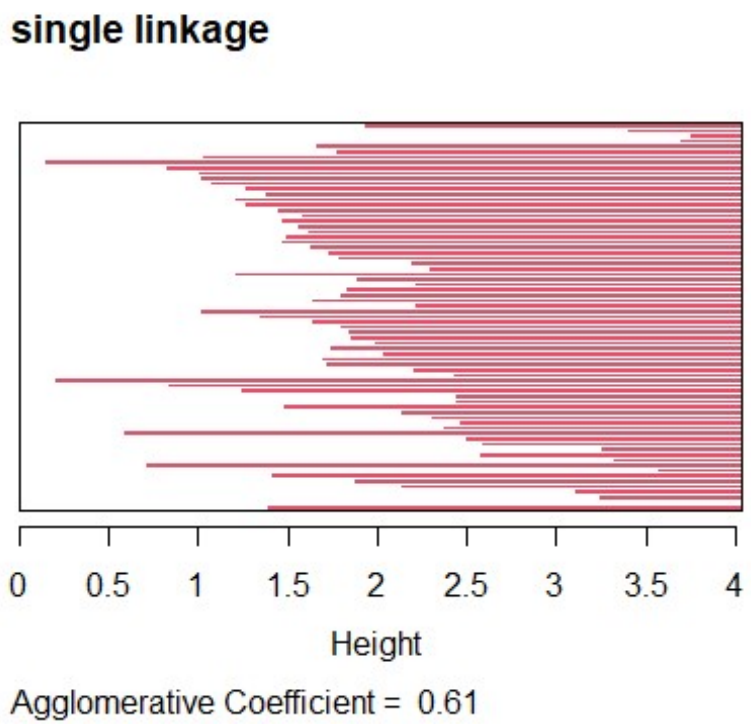
```
## 29                          Fruitful_Bran   K    C      120        3   0
240
## 30                         Fruity_Pebbles   P    C      110        1   1
135
## 31                           Golden_Crisp   P    C      100        2   0
45
## 32                         Golden_Grahams   G    C      110        1   1
280
## 33                      Grape_Nuts_Flakes   P    C      100        3   1
140
## 34                             Grape-Nuts   P    C      110        3   0
170
## 35                     Great_Grains_Pecan   P    C      120        3   3
75
## 36                       Honey_Graham_Ohs   Q    C      120        1   2
220
## 37                     Honey_Nut_Cheerios   G    C      110        3   1
250
## 38                             Honey-comb   P    C      110        1   0
180
## 39            Just_Right_Crunchy__Nuggets   K    C      110        2   1
170
## 40                 Just_Right_Fruit_&_Nut   K    C      140        3   1
170
## 41                                    Kix   G    C      110        2   1
260
## 42                                   Life   Q    C      100        4   2
150
## 43                           Lucky_Charms   G    C      110        2   1
180
## 44                                  Maypo   A    H      100        4   1
0
## 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
## 48                  Multi-Grain_Cheerios   G    C      100        2   1
220
## 49                      Nut&Honey_Crunch   K    C      120        2   1
190
## 50              Nutri-Grain_Almond-Raisin   K    C      140        3   2
220
## 51                     Nutri-grain_Wheat   K    C       90        3   0
170
## 52                  Oatmeal_Raisin_Crisp   G    C      130        3   2
170
## 53                 Post_Nat._Raisin_Bran   P    C      120        3   1
200
```

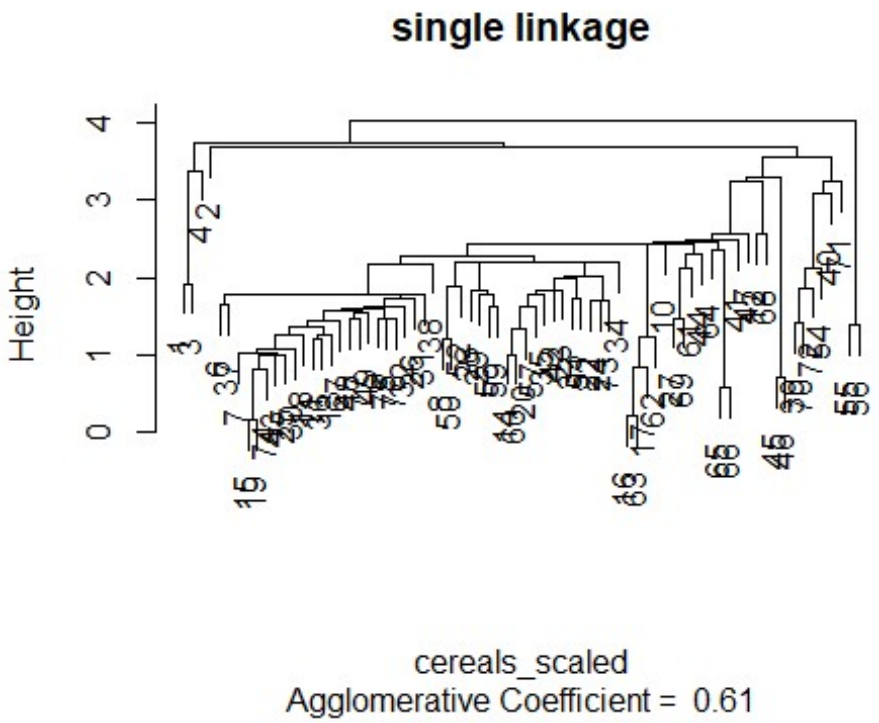
```
## 54                            Product_19   K    C      100       3   0
320
## 55                           Puffed_Rice   Q    C       50       1   0
0
## 56                          Puffed_Wheat   Q    C       50       2   0
0
## 57                    Quaker_Oat_Squares   Q    C      100       4   1
135
## 59                           Raisin_Bran   K    C      120       3   1
210
## 60                       Raisin_Nut_Bran   G    C      100       3   2
140
## 61                        Raisin_Squares   K    C       90       2   0
0
## 62                             Rice_Chex   R    C      110       1   0
240
## 63                         Rice_Krispies   K    C      110       2   0
290
## 64                        Shredded_Wheat   N    C       80       2   0
0
## 65                 Shredded_Wheat_'n'Bran   N    C       90       3   0
0
## 66               Shredded_Wheat_spoon_size   N    C       90       3   0
0
## 67                                  Smacks   K    C      110       2   1
70
## 68                               Special_K   K    C      110       6   0
230
## 69                  Strawberry_Fruit_Wheats   N    C       90       2   0
15
## 70                       Total_Corn_Flakes   G    C      110       2   1
200
## 71                       Total_Raisin_Bran   G    C      140       3   1
190
## 72                       Total_Whole_Grain   G    C      100       3   1
200
## 73                                 Triples   G    C      110       2   1
250
## 74                                    Trix   G    C      110       1   1
140
## 75                               Wheat_Chex   R    C      100       3   1
230
## 76                                 Wheaties   G    C      100       3   1
200
## 77                       Wheaties_Honey_Gold   G    C      110       2   1
200
##    fiber carbo sugars potass vitamins shelf weight cups   rating
## 1   10.0   5.0      6    280       25     3   1.00 0.33 68.40297
## 2    2.0   8.0      8    135        0     3   1.00 1.00 33.98368
## 3    9.0   7.0      5    320       25     3   1.00 0.33 59.42551
```

```
## 4   14.0   8.0      0    330       25     3   1.00 0.50 93.70491
## 6    1.5  10.5     10     70       25     1   1.00 0.75 29.50954
## 7    1.0  11.0     14     30       25     2   1.00 1.00 33.17409
## 8    2.0  18.0      8    100       25     3   1.33 0.75 37.03856
## 9    4.0  15.0      6    125       25     1   1.00 0.67 49.12025
## 10   5.0  13.0      5    190       25     3   1.00 0.67 53.31381
## 11   0.0  12.0     12     35       25     2   1.00 0.75 18.04285
## 12   2.0  17.0      1    105       25     1   1.00 1.25 50.76500
## 13   0.0  13.0      9     45       25     2   1.00 0.75 19.82357
## 14   2.0  13.0      7    105       25     3   1.00 0.50 40.40021
## 15   0.0  12.0     13     55       25     2   1.00 1.00 22.73645
## 16   0.0  22.0      3     25       25     1   1.00 1.00 41.44502
## 17   1.0  21.0      2     35       25     1   1.00 1.00 45.86332
## 18   1.0  13.0     12     20       25     2   1.00 1.00 35.78279
## 19   0.0  12.0     13     65       25     2   1.00 1.00 22.39651
## 20   4.0  10.0      7    160       25     3   1.00 0.50 40.44877
## 22   1.0  21.0      3     30       25     3   1.00 1.00 46.89564
## 23   2.0  11.0     10    120       25     3   1.00 0.75 36.17620
## 24   1.0  18.0      5     80       25     3   1.00 0.75 44.33086
## 25   1.0  11.0     13     30       25     2   1.00 1.00 32.20758
## 26   1.0  14.0     11     25       25     1   1.00 0.75 31.43597
## 27   3.0  14.0      7    100       25     2   1.00 0.80 58.34514
## 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
## 30   0.0  13.0     12     25       25     2   1.00 0.75 28.02576
## 31   0.0  11.0     15     40       25     1   1.00 0.88 35.25244
## 32   0.0  15.0      9     45       25     2   1.00 0.75 23.80404
## 33   3.0  15.0      5     85       25     3   1.00 0.88 52.07690
## 34   3.0  17.0      3     90       25     3   1.00 0.25 53.37101
## 35   3.0  13.0      4    100       25     3   1.00 0.33 45.81172
## 36   1.0  12.0     11     45       25     2   1.00 1.00 21.87129
## 37   1.5  11.5     10     90       25     1   1.00 0.75 31.07222
## 38   0.0  14.0     11     35       25     1   1.00 1.33 28.74241
## 39   1.0  17.0      6     60      100     3   1.00 1.00 36.52368
## 40   2.0  20.0      9     95      100     3   1.30 0.75 36.47151
## 41   0.0  21.0      3     40       25     2   1.00 1.50 39.24111
## 42   2.0  12.0      6     95       25     2   1.00 0.67 45.32807
## 43   0.0  12.0     12     55       25     2   1.00 1.00 26.73451
## 44   0.0  16.0      3     95       25     2   1.00 1.00 54.85092
## 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
## 48   2.0  15.0      6     90       25     1   1.00 1.00 40.10596
## 49   0.0  15.0      9     40       25     2   1.00 0.67 29.92429
## 50   3.0  21.0      7    130       25     3   1.33 0.67 40.69232
## 51   3.0  18.0      2     90       25     3   1.00 1.00 59.64284
## 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
## 54   1.0  20.0      3     45      100     3   1.00 1.00 41.50354
## 55   0.0  13.0      0     15        0     3   0.50 1.00 60.75611
```

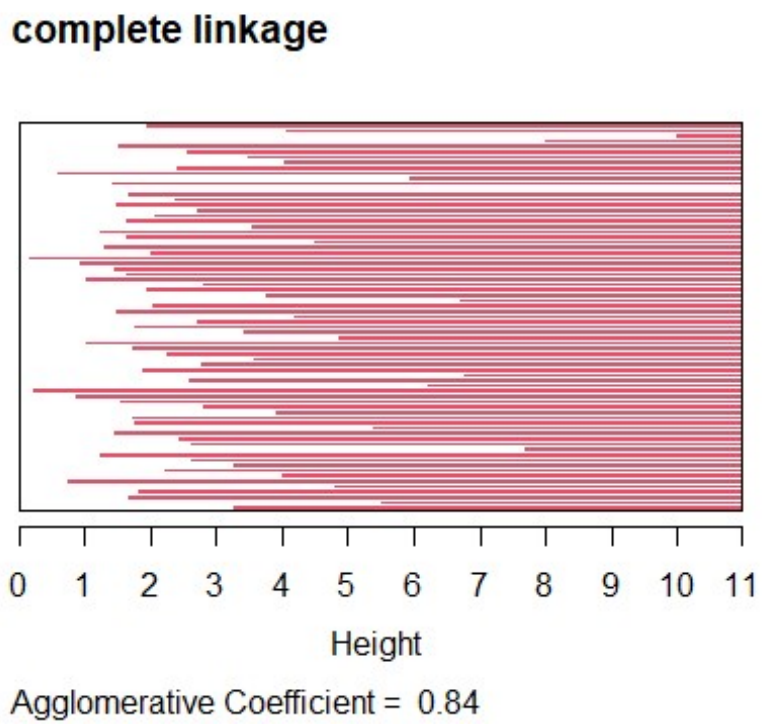
```
## 56   1.0  10.0      0     50        0     3   0.50 1.00 63.00565
## 57   2.0  14.0      6    110       25     3   1.00 0.50 49.51187
## 59   5.0  14.0     12    240       25     2   1.33 0.75 39.25920
## 60   2.5  10.5      8    140       25     3   1.00 0.50 39.70340
## 61   2.0  15.0      6    110       25     3   1.00 0.50 55.33314
## 62   0.0  23.0      2     30       25     1   1.00 1.13 41.99893
## 63   0.0  22.0      3     35       25     1   1.00 1.00 40.56016
## 64   3.0  16.0      0     95        0     1   0.83 1.00 68.23588
## 65   4.0  19.0      0    140        0     1   1.00 0.67 74.47295
## 66   3.0  20.0      0    120        0     1   1.00 0.67 72.80179
## 67   1.0   9.0     15     40       25     2   1.00 0.75 31.23005
## 68   1.0  16.0      3     55       25     1   1.00 1.00 53.13132
## 69   3.0  15.0      5     90       25     2   1.00 1.00 59.36399
## 70   0.0  21.0      3     35      100     3   1.00 1.00 38.83975
## 71   4.0  15.0     14    230      100     3   1.50 1.00 28.59278
## 72   3.0  16.0      3    110      100     3   1.00 1.00 46.65884
## 73   0.0  21.0      3     60       25     3   1.00 0.75 39.10617
## 74   0.0  13.0     12     25       25     2   1.00 1.00 27.75330
## 75   3.0  17.0      3    115       25     1   1.00 0.67 49.78744
## 76   3.0  17.0      3    110       25     1   1.00 1.00 51.59219
## 77   1.0  16.0      8     60       25     1   1.00 0.75 36.18756
```

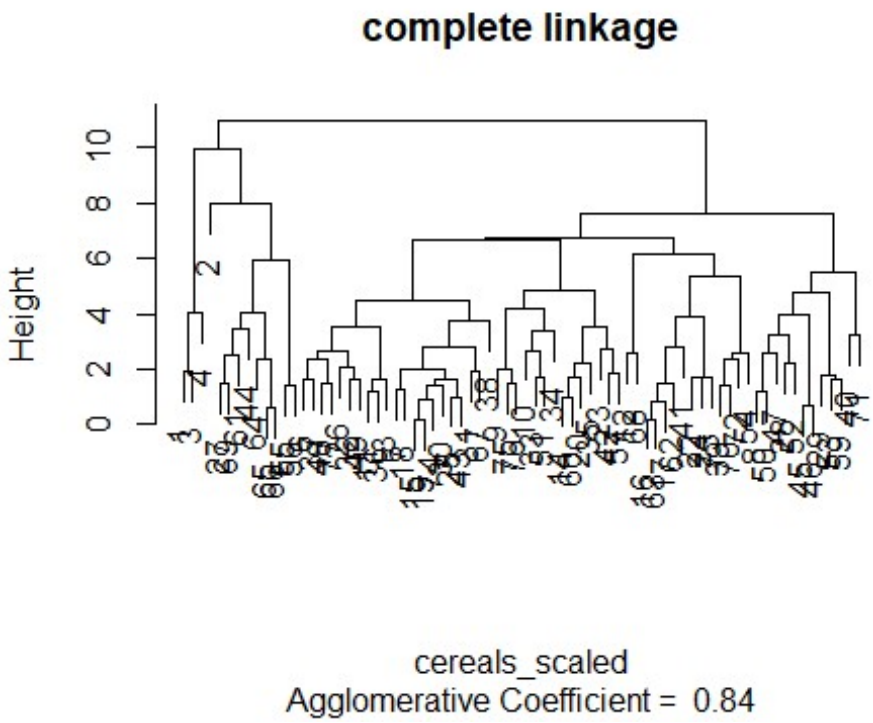
```r
cereals_num <- cereals_clean[sapply(cereals_clean, is.numeric)]
##normalize dataset
cereals_scaled <- scale(cereals_num)
##agnes comparison
agnes_single <- agnes(cereals_scaled, method = "single")
agnes_complete <- agnes(cereals_scaled, method = "complete")
agnes_average <- agnes(cereals_scaled, method = "average")
agnes_ward <- agnes(cereals_scaled, method = "ward")
##show agnes comparison graphically
plot(agnes_single, main = "single linkage")
```



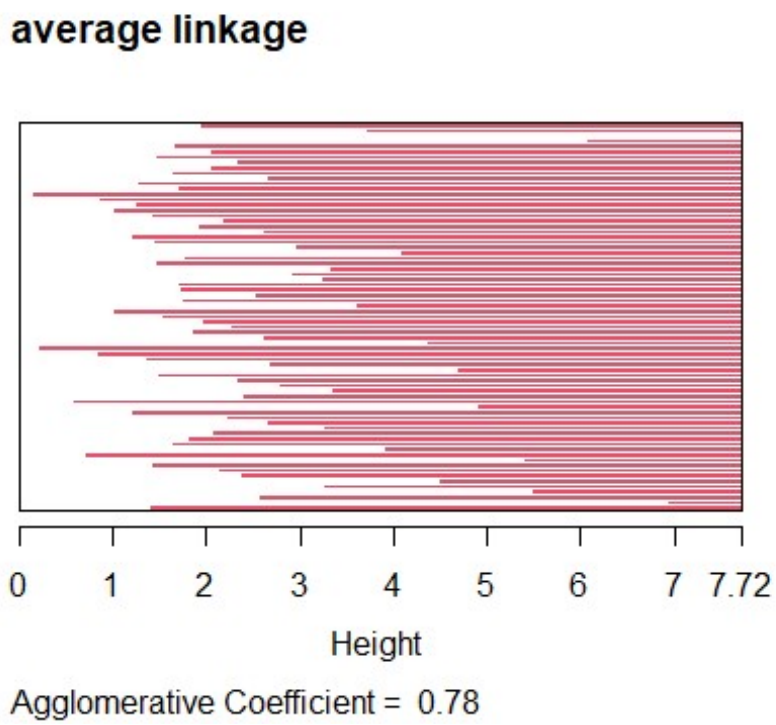


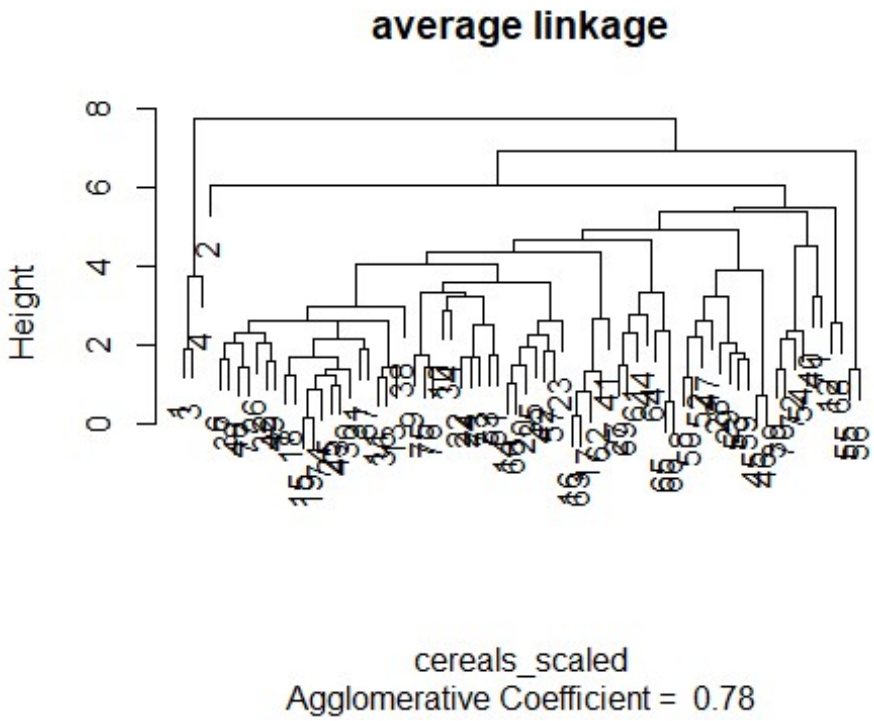

```
plot(agnes_complete, main = "complete linkage")
```



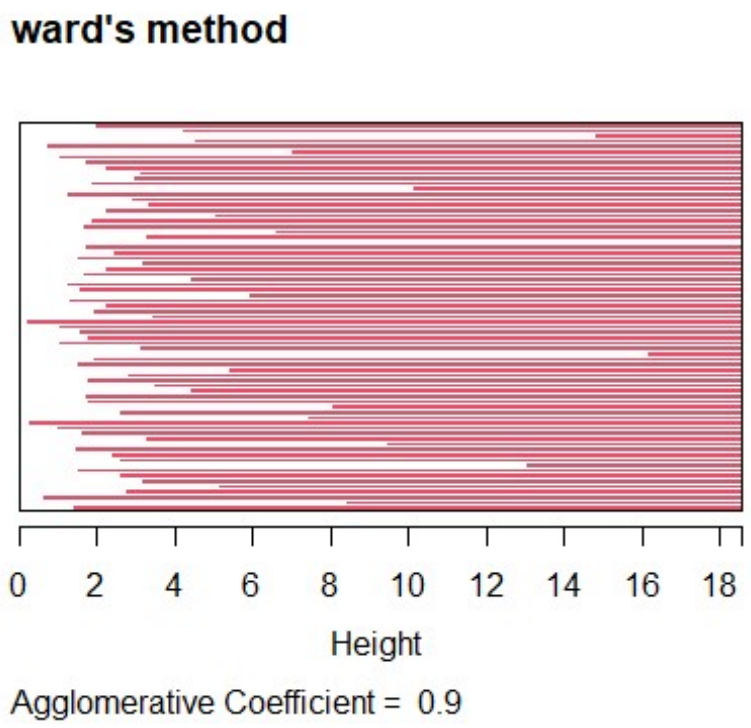


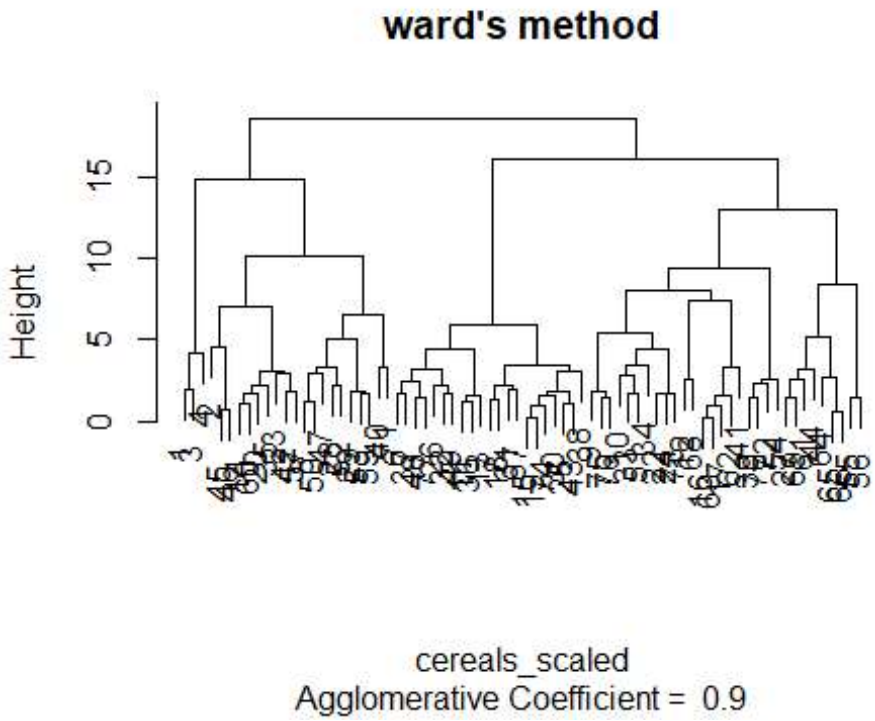

```
plot(agnes_average, main = "average linkage")
```



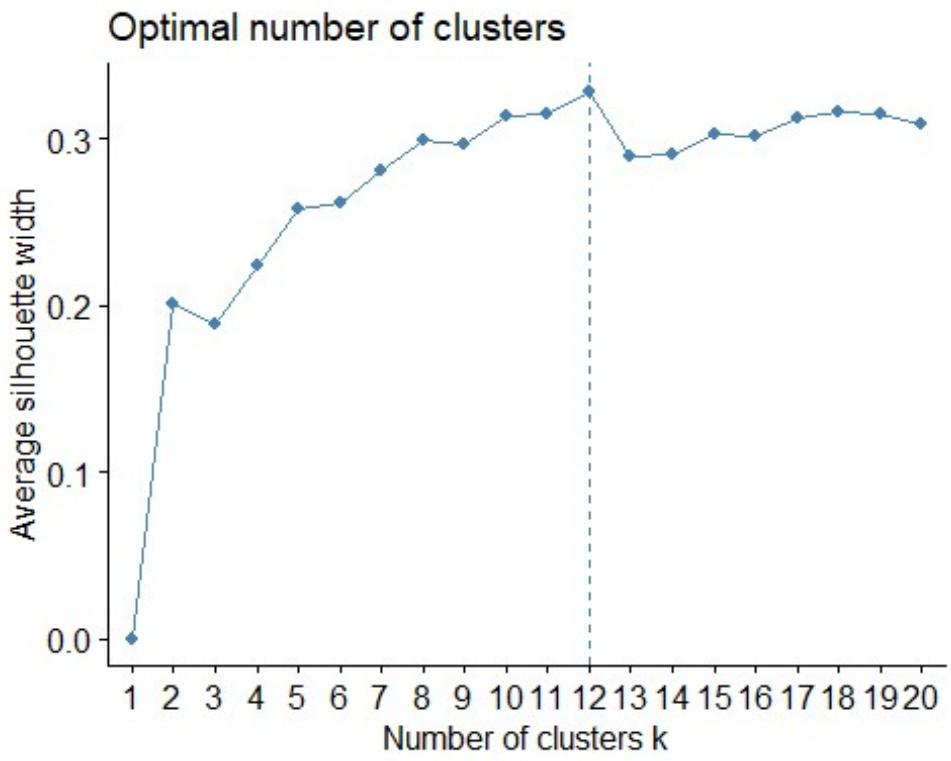



```
plot(agnes_ward, main = "ward's method")
```






```
fviz_nbclust(cereals_scaled, FUN = hcut, method = "silhouette", k.max = 20)
```




```
## choose k at elbow whcih is 2
k <- 2
clusters <- cutree(agnes_ward, k = k)
table(clusters)

## clusters
##  1  2
## 23 51

set.seed(1)
##create data partitions
idx <- sample(1:nrow(cereals_scaled), size = 0.5 * nrow(cereals_scaled))
partitionA <- cereals_scaled[idx, ]
partitionB <- cereals_scaled[-idx, ]
agnes_A <- agnes(partitionA, method = "ward")
clusters_A <- cutree(agnes_A, k = k)
centroids_A <- aggregate(partitionA, by = list(cluster = clusters_A), FUN =
mean)
centroids_matrix <- as.matrix(centroids_A[, -1])
dist_Bcentroids <- proxy::dist(partitionB, centroids_matrix)
clusters_B_1 <- apply(as.matrix(dist_Bcentroids), 1, which.min)
agnes_B <- agnes(partitionB, method = "ward")
clusters_B_2 <- cutree(agnes_B, k = k)
ari <- adjustedRandIndex(clusters_B_1, clusters_B_2)
##clsuters are showing to be unstable, increased numbers of clusters will be
## able to have more accurate data, but assingment asks for one "healthy"
```

```r
## and one "unhealthy" group
print(paste("adjusted rand Index for cluster stability:", round(ari, 3)))
```

```
## [1] "adjusted rand Index for cluster stability: 0.244"
```

```r
if (ari > 0.7) {
  cat("Clusters are stable.\n")
} else {
  cat("Clusters may not be stable.\n")
}
```

```
## Clusters may not be stable.
```

```r
##show the avg data between both clusters
totaldata <- aggregate(cereals_num, by = list(cluster = clusters), mean)
print(totaldata)
```

```
##   cluster calories  protein       fat   sodium    fiber   carbo   sugars
## 1       1 116.0870 3.260870 1.7826087 157.8261 4.130435 13.0000 8.608696
## 2       2 102.9412 2.176471 0.6470588 164.4118 1.294118 15.5098 6.431373
##      potass vitamins    shelf    weight      cups   rating
## 1 172.17391 30.43478 2.913043 1.1500000 0.6526087 42.90285
## 2  65.29412 28.43137 1.901961 0.9770588 0.8978431 42.13229
```

```r
##show both cluster groupings
cereals_clean$Cluster <- clusters
for (i in 1:k) {
  cat(paste0("Cluster ", i, ":\n"))
  print(cereals_clean[cereals_clean$Cluster == i, "name"])
  cat("\n")
}
```

```
## Cluster 1:
##  [1] 100%_Bran
##  [2] 100%_Natural_Bran
##  [3] All-Bran
##  [4] All-Bran_with_Extra_Fiber
##  [5] Basic_4
##  [6] Clusters
##  [7] Cracklin'_Oat_Bran
##  [8] Crispy_Wheat_&_Raisins
##  [9] Fruit_&_Fibre_Dates,_Walnuts,_and_Oats
## [10] Fruitful_Bran
## [11] Great_Grains_Pecan
## [12] Just_Right_Fruit_&_Nut
## [13] Life
## [14] Muesli_Raisins,_Dates,_&_Almonds
## [15] Muesli_Raisins,_Peaches,_&_Pecans
## [16] Mueslix_Crispy_Blend
## [17] Nutri-Grain_Almond-Raisin
## [18] Oatmeal_Raisin_Crisp
```

```
## [19] Post_Nat._Raisin_Bran
## [20] Quaker_Oat_Squares
## [21] Raisin_Bran
## [22] Raisin_Nut_Bran
## [23] Total_Raisin_Bran
## 77 Levels: 100%_Bran 100%_Natural_Bran All-Bran ... Wheaties_Honey_Gold
##
## Cluster 2:
##  [1] Apple_Cinnamon_Cheerios     Apple_Jacks
##  [3] Bran_Chex                   Bran_Flakes
##  [5] Cap'n'Crunch                Cheerios
##  [7] Cinnamon_Toast_Crunch       Cocoa_Puffs
##  [9] Corn_Chex                   Corn_Flakes
## [11] Corn_Pops                   Count_Chocula
## [13] Crispix                     Double_Chex
## [15] Froot_Loops                 Frosted_Flakes
## [17] Frosted_Mini-Wheats         Fruity_Pebbles
## [19] Golden_Crisp                Golden_Grahams
## [21] Grape_Nuts_Flakes           Grape-Nuts
## [23] Honey_Graham_Ohs            Honey_Nut_Cheerios
## [25] Honey-comb                  Just_Right_Crunchy__Nuggets
## [27] Kix                         Lucky_Charms
## [29] Maypo                       Multi-Grain_Cheerios
## [31] Nut&Honey_Crunch            Nutri-grain_Wheat
## [33] Product_19                  Puffed_Rice
## [35] Puffed_Wheat                Raisin_Squares
## [37] Rice_Chex                   Rice_Krispies
## [39] Shredded_Wheat              Shredded_Wheat_'n'Bran
## [41] Shredded_Wheat_spoon_size   Smacks
## [43] Special_K                   Strawberry_Fruit_Wheats
## [45] Total_Corn_Flakes           Total_Whole_Grain
## [47] Triples                     Trix
## [49] Wheat_Chex                  Wheaties
## [51] Wheaties_Honey_Gold
## 77 Levels: 100%_Bran 100%_Natural_Bran All-Bran ... Wheaties_Honey_Gold
```

```
##healthy cereal cluster 1(subjective data, i believe more vitamins and fiber
outweighs
##calorie and sugar quantities)
print(cereals_clean[cereals_clean$Cluster == 1, "name"])
```

```
##  [1] 100%_Bran
##  [2] 100%_Natural_Bran
##  [3] All-Bran
##  [4] All-Bran_with_Extra_Fiber
##  [5] Basic_4
##  [6] Clusters
##  [7] Cracklin'_Oat_Bran
##  [8] Crispy_Wheat_&_Raisins
##  [9] Fruit_&_Fibre_Dates,_Walnuts,_and_Oats
```

```
## [10] Fruitful_Bran
## [11] Great_Grains_Pecan
## [12] Just_Right_Fruit_&_Nut
## [13] Life
## [14] Muesli_Raisins,_Dates,_&_Almonds
## [15] Muesli_Raisins,_Peaches,_&_Pecans
## [16] Mueslix_Crispy_Blend
## [17] Nutri-Grain_Almond-Raisin
## [18] Oatmeal_Raisin_Crisp
## [19] Post_Nat._Raisin_Bran
## [20] Quaker_Oat_Squares
## [21] Raisin_Bran
## [22] Raisin_Nut_Bran
## [23] Total_Raisin_Bran
## 77 Levels: 100%_Bran 100%_Natural_Bran All-Bran ... Wheaties_Honey_Gold
```