Cereals\_data

“ADITI”

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cereals\_data <- read.csv("C:/Users/tiwar/Downloads/Cereals.csv")#read the cereal dataset.  
cereals\_data

## 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  
## 5 Almond\_Delight R C 110 2 2 200  
## 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  
## 21 Cream\_of\_Wheat\_(Quick) N H 100 3 0 80  
## 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  
## 58 Quaker\_Oatmeal Q H 100 5 2 0  
## 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  
## 5 1.0 14.0 8 NA 25 3 1.00 0.75 34.38484  
## 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  
## 21 1.0 21.0 0 NA 0 2 1.00 1.00 64.53382  
## 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  
## 58 2.7 NA NA 110 0 1 1.00 0.67 50.82839  
## 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

head(cereals\_data)#extracting the forst five rows of dataset.

## 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

tail(cereals\_data)#extracting the last five rows of dataset.

## name mfr type calories protein fat sodium fiber carbo sugars  
## 72 Total\_Whole\_Grain G C 100 3 1 200 3 16 3  
## 73 Triples G C 110 2 1 250 0 21 3  
## 74 Trix G C 110 1 1 140 0 13 12  
## 75 Wheat\_Chex R C 100 3 1 230 3 17 3  
## 76 Wheaties G C 100 3 1 200 3 17 3  
## 77 Wheaties\_Honey\_Gold G C 110 2 1 200 1 16 8  
## potass vitamins shelf weight cups rating  
## 72 110 100 3 1 1.00 46.65884  
## 73 60 25 3 1 0.75 39.10617  
## 74 25 25 2 1 1.00 27.75330  
## 75 115 25 1 1 0.67 49.78744  
## 76 110 25 1 1 1.00 51.59219  
## 77 60 25 1 1 0.75 36.18756

summary(cereals\_data)

## name mfr type calories   
## Length:77 Length:77 Length:77 Min. : 50.0   
## Class :character Class :character Class :character 1st Qu.:100.0   
## Mode :character Mode :character Mode :character Median :110.0   
## Mean :106.9   
## 3rd Qu.:110.0   
## Max. :160.0   
##   
## protein fat sodium fiber   
## Min. :1.000 Min. :0.000 Min. : 0.0 Min. : 0.000   
## 1st Qu.:2.000 1st Qu.:0.000 1st Qu.:130.0 1st Qu.: 1.000   
## Median :3.000 Median :1.000 Median :180.0 Median : 2.000   
## Mean :2.545 Mean :1.013 Mean :159.7 Mean : 2.152   
## 3rd Qu.:3.000 3rd Qu.:2.000 3rd Qu.:210.0 3rd Qu.: 3.000   
## Max. :6.000 Max. :5.000 Max. :320.0 Max. :14.000   
##   
## carbo sugars potass vitamins   
## Min. : 5.0 Min. : 0.000 Min. : 15.00 Min. : 0.00   
## 1st Qu.:12.0 1st Qu.: 3.000 1st Qu.: 42.50 1st Qu.: 25.00   
## Median :14.5 Median : 7.000 Median : 90.00 Median : 25.00   
## Mean :14.8 Mean : 7.026 Mean : 98.67 Mean : 28.25   
## 3rd Qu.:17.0 3rd Qu.:11.000 3rd Qu.:120.00 3rd Qu.: 25.00   
## Max. :23.0 Max. :15.000 Max. :330.00 Max. :100.00   
## NA's :1 NA's :1 NA's :2   
## shelf weight cups rating   
## Min. :1.000 Min. :0.50 Min. :0.250 Min. :18.04   
## 1st Qu.:1.000 1st Qu.:1.00 1st Qu.:0.670 1st Qu.:33.17   
## Median :2.000 Median :1.00 Median :0.750 Median :40.40   
## Mean :2.208 Mean :1.03 Mean :0.821 Mean :42.67   
## 3rd Qu.:3.000 3rd Qu.:1.00 3rd Qu.:1.000 3rd Qu.:50.83   
## Max. :3.000 Max. :1.50 Max. :1.500 Max. :93.70   
##

colSums(is.na(cereals\_data))#get the null values of different columns

## name mfr type calories protein fat sodium fiber   
## 0 0 0 0 0 0 0 0   
## carbo sugars potass vitamins shelf weight cups rating   
## 1 1 2 0 0 0 0 0

df<- na.omit(cereals\_data)#remove the null values  
sum(is.na(df))#counting the no of missing values

## [1] 0

Apply hierarchical clustering to the data using Euclidean distance to the normalized measurements. Use Agnes to compare the clustering from single linkage, complete linkage, average linkage, and Ward. Choose the best method.

library(cluster) # clustering algorithms

## Warning: package 'cluster' was built under R version 4.3.3

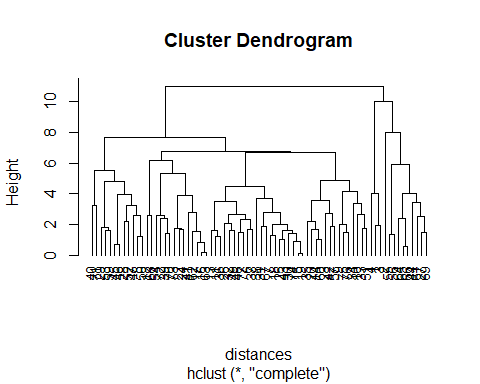
library(factoextra) # visualization

## Warning: package 'factoextra' was built under R version 4.3.3

## Loading required package: ggplot2

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

df <- scale(df[4:16])  
distances <- dist(df,method = "euclidean")  
  
#Hierachical clustering using complete linkage  
  
hc <- hclust(distances,method = "complete")  
  
#plot the obtained dendogram  
plot(hc ,cex = 0.8,hang = -2)



set.seed(111)  
library(cluster)  
df

## calories protein fat sodium fiber carbo  
## 1 -1.8659155 1.3817478 0.0000000 -0.39102269 3.22866747 -2.50013957  
## 2 0.6537514 0.4522084 3.9728810 -1.78041856 -0.07249167 -1.72926320  
## 3 -1.8659155 1.3817478 0.0000000 1.17959872 2.81602258 -1.98622199  
## 4 -2.8737823 1.3817478 -0.9932203 -0.27020566 4.87924705 -1.72926320  
## 6 0.1498180 -0.4773310 0.9932203 0.21306247 -0.27881412 -1.08686623  
## 7 0.1498180 -0.4773310 -0.9932203 -0.45143121 -0.48513656 -0.95838683  
## 8 1.1576848 0.4522084 0.9932203 0.57551356 -0.07249167 0.84032469  
## 9 -0.8580487 -0.4773310 0.0000000 0.45469653 0.75279812 0.06944832  
## 10 -0.8580487 0.4522084 -0.9932203 0.57551356 1.16544301 -0.44446926  
## 11 0.6537514 -1.4068705 0.9932203 0.69633060 -0.89778146 -0.70142805  
## 12 0.1498180 3.2408266 0.9932203 1.54204982 -0.07249167 0.58336590  
## 13 0.6537514 -1.4068705 1.9864405 0.57551356 -0.89778146 -0.44446926  
## 14 0.1498180 0.4522084 0.9932203 -0.27020566 -0.07249167 -0.44446926  
## 15 0.1498180 -1.4068705 0.0000000 0.21306247 -0.89778146 -0.70142805  
## 16 0.1498180 -0.4773310 -0.9932203 1.42123279 -0.89778146 1.86815984  
## 17 -0.3541153 -0.4773310 -0.9932203 1.54204982 -0.48513656 1.61120105  
## 18 0.1498180 -1.4068705 -0.9932203 -0.87429082 -0.48513656 -0.44446926  
## 19 0.1498180 -1.4068705 0.0000000 0.21306247 -0.89778146 -0.70142805  
## 20 0.1498180 0.4522084 1.9864405 -0.27020566 0.75279812 -1.21534562  
## 22 0.1498180 -0.4773310 -0.9932203 0.69633060 -0.48513656 1.61120105  
## 23 -0.3541153 -0.4773310 0.0000000 -0.27020566 -0.07249167 -0.95838683  
## 24 -0.3541153 -0.4773310 -0.9932203 0.33387950 -0.48513656 0.84032469  
## 25 0.1498180 -0.4773310 0.0000000 -0.45143121 -0.48513656 -0.95838683  
## 26 0.1498180 -1.4068705 -0.9932203 0.45469653 -0.48513656 -0.18751047  
## 27 -0.3541153 0.4522084 -0.9932203 -1.96164410 0.34015322 -0.18751047  
## 28 0.6537514 0.4522084 0.9932203 -0.02857160 1.16544301 -0.70142805  
## 29 0.6537514 0.4522084 -0.9932203 0.93796466 1.16544301 -0.18751047  
## 30 0.1498180 -1.4068705 0.0000000 -0.33061417 -0.89778146 -0.44446926  
## 31 -0.3541153 -0.4773310 -0.9932203 -1.41796746 -0.89778146 -0.95838683  
## 32 0.1498180 -1.4068705 0.0000000 1.42123279 -0.89778146 0.06944832  
## 33 -0.3541153 0.4522084 0.0000000 -0.27020566 0.34015322 0.06944832  
## 34 0.1498180 0.4522084 -0.9932203 0.09224544 0.34015322 0.58336590  
## 35 0.6537514 0.4522084 1.9864405 -1.05551637 0.34015322 -0.44446926  
## 36 0.6537514 -1.4068705 0.9932203 0.69633060 -0.48513656 -0.70142805  
## 37 0.1498180 0.4522084 0.0000000 1.05878169 -0.27881412 -0.82990744  
## 38 0.1498180 -1.4068705 -0.9932203 0.21306247 -0.89778146 -0.18751047  
## 39 0.1498180 -0.4773310 0.0000000 0.09224544 -0.48513656 0.58336590  
## 40 1.6616182 0.4522084 0.0000000 0.09224544 -0.07249167 1.35424227  
## 41 0.1498180 -0.4773310 0.0000000 1.17959872 -0.89778146 1.61120105  
## 42 -0.3541153 1.3817478 0.9932203 -0.14938863 -0.07249167 -0.70142805  
## 43 0.1498180 -0.4773310 0.0000000 0.21306247 -0.89778146 -0.70142805  
## 44 -0.3541153 1.3817478 0.0000000 -1.96164410 -0.89778146 0.32640711  
## 45 2.1655516 1.3817478 1.9864405 -0.81388230 0.34015322 0.32640711  
## 46 2.1655516 1.3817478 1.9864405 -0.14938863 0.34015322 0.32640711  
## 47 2.6694849 0.4522084 0.9932203 -0.14938863 0.34015322 0.58336590  
## 48 -0.3541153 -0.4773310 0.0000000 0.69633060 -0.07249167 0.06944832  
## 49 0.6537514 -0.4773310 0.0000000 0.33387950 -0.89778146 0.06944832  
## 50 1.6616182 0.4522084 0.9932203 0.69633060 0.34015322 1.61120105  
## 51 -0.8580487 0.4522084 -0.9932203 0.09224544 0.34015322 0.84032469  
## 52 1.1576848 0.4522084 0.9932203 0.09224544 -0.27881412 -0.31598986  
## 53 0.6537514 0.4522084 0.0000000 0.45469653 1.57808790 -0.95838683  
## 54 -0.3541153 0.4522084 -0.9932203 1.90450091 -0.48513656 1.35424227  
## 55 -2.8737823 -1.4068705 -0.9932203 -1.96164410 -0.89778146 -0.44446926  
## 56 -2.8737823 -0.4773310 -0.9932203 -1.96164410 -0.48513656 -1.21534562  
## 57 -0.3541153 1.3817478 0.0000000 -0.33061417 -0.07249167 -0.18751047  
## 59 0.6537514 0.4522084 0.0000000 0.57551356 1.16544301 -0.18751047  
## 60 -0.3541153 0.4522084 0.9932203 -0.27020566 0.13383078 -1.08686623  
## 61 -0.8580487 -0.4773310 -0.9932203 -1.96164410 -0.07249167 0.06944832  
## 62 0.1498180 -1.4068705 -0.9932203 0.93796466 -0.89778146 2.12511863  
## 63 0.1498180 -0.4773310 -0.9932203 1.54204982 -0.89778146 1.86815984  
## 64 -1.3619821 -0.4773310 -0.9932203 -1.96164410 0.34015322 0.32640711  
## 65 -0.8580487 0.4522084 -0.9932203 -1.96164410 0.75279812 1.09728348  
## 66 -0.8580487 0.4522084 -0.9932203 -1.96164410 0.34015322 1.35424227  
## 67 0.1498180 -0.4773310 0.0000000 -1.11592488 -0.48513656 -1.47230441  
## 68 0.1498180 3.2408266 -0.9932203 0.81714763 -0.48513656 0.32640711  
## 69 -0.8580487 -0.4773310 -0.9932203 -1.78041856 0.34015322 0.06944832  
## 70 0.1498180 -0.4773310 0.0000000 0.45469653 -0.89778146 1.61120105  
## 71 1.6616182 0.4522084 0.0000000 0.33387950 0.75279812 0.06944832  
## 72 -0.3541153 0.4522084 0.0000000 0.45469653 0.34015322 0.32640711  
## 73 0.1498180 -0.4773310 0.0000000 1.05878169 -0.89778146 1.61120105  
## 74 0.1498180 -1.4068705 0.0000000 -0.27020566 -0.89778146 -0.44446926  
## 75 -0.3541153 0.4522084 0.0000000 0.81714763 0.34015322 0.58336590  
## 76 -0.3541153 0.4522084 0.0000000 0.45469653 0.34015322 0.58336590  
## 77 0.1498180 -0.4773310 0.0000000 0.45469653 -0.48513656 0.32640711  
## sugars potass vitamins shelf weight cups  
## 1 -0.25420505 2.56052289 -0.1818422 0.9419715 -0.2008324 -2.08565823  
## 2 0.20460407 0.51477378 -1.3032024 0.9419715 -0.2008324 0.75675340  
## 3 -0.48360961 3.12486748 -0.1818422 0.9419715 -0.2008324 -2.08565823  
## 4 -1.63063240 3.26595362 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 6 0.66341318 -0.40228617 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## 7 1.58103142 -0.96663076 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 8 0.20460407 0.02097226 -0.1818422 0.9419715 1.9501886 -0.30384795  
## 9 -0.25420505 0.37368763 -0.1818422 -1.4616799 -0.2008324 -0.64324039  
## 10 -0.48360961 1.29074758 -0.1818422 0.9419715 -0.2008324 -0.64324039  
## 11 1.12222230 -0.89608768 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 12 -1.40122785 0.09151534 -0.1818422 -1.4616799 -0.2008324 1.81735475  
## 13 0.43400862 -0.75500154 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 14 -0.02480049 0.09151534 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 15 1.35162686 -0.61391539 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 16 -0.94241873 -1.03717383 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 17 -1.17182329 -0.89608768 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 18 1.12222230 -1.10771690 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 19 1.35162686 -0.47282925 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 20 -0.02480049 0.86748914 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 22 -0.94241873 -0.96663076 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 23 0.66341318 0.30314456 -0.1818422 0.9419715 -0.2008324 -0.30384795  
## 24 -0.48360961 -0.26120003 -0.1818422 0.9419715 -0.2008324 -0.30384795  
## 25 1.35162686 -0.96663076 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 26 0.89281774 -1.03717383 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## 27 -0.02480049 0.02097226 -0.1818422 -0.2598542 -0.2008324 -0.09172768  
## 28 0.66341318 1.43183372 -0.1818422 0.9419715 1.4287290 -0.64324039  
## 29 1.12222230 1.29074758 -0.1818422 0.9419715 1.9501886 -0.64324039  
## 30 1.12222230 -1.03717383 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 31 1.81043598 -0.82554461 -0.1818422 -1.4616799 -0.2008324 0.24766475  
## 32 0.43400862 -0.75500154 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 33 -0.48360961 -0.19065695 -0.1818422 0.9419715 -0.2008324 0.24766475  
## 34 -0.94241873 -0.12011388 -0.1818422 0.9419715 -0.2008324 -2.42505066  
## 35 -0.71301417 0.02097226 -0.1818422 0.9419715 -0.2008324 -2.08565823  
## 36 0.89281774 -0.75500154 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 37 0.66341318 -0.12011388 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## 38 0.89281774 -0.89608768 -0.1818422 -1.4616799 -0.2008324 2.15674718  
## 39 -0.25420505 -0.54337232 3.1822385 0.9419715 -0.2008324 0.75675340  
## 40 0.43400862 -0.04957081 3.1822385 0.9419715 1.7546413 -0.30384795  
## 41 -0.94241873 -0.82554461 -0.1818422 -0.2598542 -0.2008324 2.87795610  
## 42 -0.25420505 -0.04957081 -0.1818422 -0.2598542 -0.2008324 -0.64324039  
## 43 1.12222230 -0.61391539 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 44 -0.94241873 -0.04957081 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 45 0.89281774 1.00857529 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 46 0.89281774 1.00857529 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 47 1.35162686 0.86748914 -0.1818422 0.9419715 3.0582904 -0.64324039  
## 48 -0.25420505 -0.12011388 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 49 0.43400862 -0.82554461 -0.1818422 -0.2598542 -0.2008324 -0.64324039  
## 50 -0.02480049 0.44423070 -0.1818422 0.9419715 1.9501886 -0.64324039  
## 51 -1.17182329 -0.12011388 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 52 0.66341318 0.30314456 -0.1818422 0.9419715 1.4287290 -1.36444931  
## 53 1.58103142 2.27835060 -0.1818422 0.9419715 1.9501886 -0.64324039  
## 54 -0.94241873 -0.75500154 3.1822385 0.9419715 -0.2008324 0.75675340  
## 55 -1.63063240 -1.17825998 -1.3032024 0.9419715 -3.4599552 0.75675340  
## 56 -1.63063240 -0.68445846 -1.3032024 0.9419715 -3.4599552 0.75675340  
## 57 -0.25420505 0.16205841 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 59 1.12222230 1.99617831 -0.1818422 -0.2598542 1.9501886 -0.30384795  
## 60 0.20460407 0.58531685 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 61 -0.25420505 0.16205841 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 62 -1.17182329 -0.96663076 -0.1818422 -1.4616799 -0.2008324 1.30826610  
## 63 -0.94241873 -0.89608768 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 64 -1.63063240 -0.04957081 -1.3032024 -1.4616799 -1.3089342 0.75675340  
## 65 -1.63063240 0.58531685 -1.3032024 -1.4616799 -0.2008324 -0.64324039  
## 66 -1.63063240 0.30314456 -1.3032024 -1.4616799 -0.2008324 -0.64324039  
## 67 1.81043598 -0.82554461 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 68 -0.94241873 -0.61391539 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 69 -0.48360961 -0.12011388 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 70 -0.94241873 -0.89608768 3.1822385 0.9419715 -0.2008324 0.75675340  
## 71 1.58103142 1.85509216 3.1822385 0.9419715 3.0582904 0.75675340  
## 72 -0.94241873 0.16205841 3.1822385 0.9419715 -0.2008324 0.75675340  
## 73 -0.94241873 -0.54337232 -0.1818422 0.9419715 -0.2008324 -0.30384795  
## 74 1.12222230 -1.03717383 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 75 -0.94241873 0.23260148 -0.1818422 -1.4616799 -0.2008324 -0.64324039  
## 76 -0.94241873 0.16205841 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 77 0.20460407 -0.54337232 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## rating  
## 1 1.85490376  
## 2 -0.59771126  
## 3 1.21519648  
## 4 3.65784358  
## 6 -0.91652483  
## 7 -0.65539984  
## 8 -0.38002951  
## 9 0.48087533  
## 10 0.77969576  
## 11 -1.73360655  
## 12 0.59807496  
## 13 -1.60671768  
## 14 -0.14048876  
## 15 -1.39915514  
## 16 -0.06603869  
## 17 0.24879639  
## 18 -0.46951197  
## 19 -1.42337774  
## 20 -0.13702824  
## 22 0.32235640  
## 23 -0.44147911  
## 24 0.13959735  
## 25 -0.72427057  
## 26 -0.77925310  
## 27 1.13821301  
## 28 -0.10366038  
## 29 -0.09664548  
## 30 -1.02225423  
## 31 -0.50730289  
## 32 -1.32308140  
## 33 0.69155685  
## 34 0.78377123  
## 35 0.24511896  
## 36 -1.46080340  
## 37 -0.80517325  
## 38 -0.97118798  
## 39 -0.41671824  
## 40 -0.42043579  
## 41 -0.22308231  
## 42 0.21065609  
## 43 -1.11426481  
## 44 0.88922515  
## 45 -0.37302488  
## 46 -0.58658904  
## 47 -0.85924775  
## 48 -0.16145563  
## 49 -0.88697142  
## 50 -0.11967375  
## 51 1.23068291  
## 52 -0.84945049  
## 53 -0.32287913  
## 54 -0.06186866  
## 55 1.31001152  
## 56 1.47030646  
## 57 0.50878106  
## 59 -0.22179377  
## 60 -0.19014120  
## 61 0.92358705  
## 62 -0.02656845  
## 63 -0.12909114  
## 64 1.84299757  
## 65 2.28743193  
## 66 2.16834997  
## 67 -0.79392626  
## 68 0.76669214  
## 69 1.21081332  
## 70 -0.25168258  
## 71 -0.98185009  
## 72 0.30548275  
## 73 -0.23269772  
## 74 -1.04166919  
## 75 0.52841741  
## 76 0.65701831  
## 77 -0.44066942  
## attr(,"scaled:center")  
## calories protein fat sodium fiber carbo   
## 107.0270270 2.5135135 1.0000000 162.3648649 2.1756757 14.7297297   
## sugars potass vitamins shelf weight cups   
## 7.1081081 98.5135135 29.0540541 2.2162162 1.0308108 0.8216216   
## rating   
## 42.3717869   
## attr(,"scaled:scale")  
## calories protein fat sodium fiber carbo sugars   
## 19.8438928 1.0758016 1.0068260 82.7697871 2.4233912 3.8916746 4.3591113   
## potass vitamins shelf weight cups rating   
## 70.8786815 22.2943521 0.8320674 0.1534155 0.2357153 14.0337125

# Compute with agnes and with different linkage methods  
hc\_single <- agnes(df, method = "single")  
hc\_complete <- agnes(df, method = "complete")  
hc\_average <- agnes(df, method = "average")  
hc\_ward <- agnes(df,method = "ward")  
  
# Compare Agglomerative coefficients  
scale(df)

## calories protein fat sodium fiber carbo  
## 1 -1.8659155 1.3817478 0.0000000 -0.39102269 3.22866747 -2.50013957  
## 2 0.6537514 0.4522084 3.9728810 -1.78041856 -0.07249167 -1.72926320  
## 3 -1.8659155 1.3817478 0.0000000 1.17959872 2.81602258 -1.98622199  
## 4 -2.8737823 1.3817478 -0.9932203 -0.27020566 4.87924705 -1.72926320  
## 6 0.1498180 -0.4773310 0.9932203 0.21306247 -0.27881412 -1.08686623  
## 7 0.1498180 -0.4773310 -0.9932203 -0.45143121 -0.48513656 -0.95838683  
## 8 1.1576848 0.4522084 0.9932203 0.57551356 -0.07249167 0.84032469  
## 9 -0.8580487 -0.4773310 0.0000000 0.45469653 0.75279812 0.06944832  
## 10 -0.8580487 0.4522084 -0.9932203 0.57551356 1.16544301 -0.44446926  
## 11 0.6537514 -1.4068705 0.9932203 0.69633060 -0.89778146 -0.70142805  
## 12 0.1498180 3.2408266 0.9932203 1.54204982 -0.07249167 0.58336590  
## 13 0.6537514 -1.4068705 1.9864405 0.57551356 -0.89778146 -0.44446926  
## 14 0.1498180 0.4522084 0.9932203 -0.27020566 -0.07249167 -0.44446926  
## 15 0.1498180 -1.4068705 0.0000000 0.21306247 -0.89778146 -0.70142805  
## 16 0.1498180 -0.4773310 -0.9932203 1.42123279 -0.89778146 1.86815984  
## 17 -0.3541153 -0.4773310 -0.9932203 1.54204982 -0.48513656 1.61120105  
## 18 0.1498180 -1.4068705 -0.9932203 -0.87429082 -0.48513656 -0.44446926  
## 19 0.1498180 -1.4068705 0.0000000 0.21306247 -0.89778146 -0.70142805  
## 20 0.1498180 0.4522084 1.9864405 -0.27020566 0.75279812 -1.21534562  
## 22 0.1498180 -0.4773310 -0.9932203 0.69633060 -0.48513656 1.61120105  
## 23 -0.3541153 -0.4773310 0.0000000 -0.27020566 -0.07249167 -0.95838683  
## 24 -0.3541153 -0.4773310 -0.9932203 0.33387950 -0.48513656 0.84032469  
## 25 0.1498180 -0.4773310 0.0000000 -0.45143121 -0.48513656 -0.95838683  
## 26 0.1498180 -1.4068705 -0.9932203 0.45469653 -0.48513656 -0.18751047  
## 27 -0.3541153 0.4522084 -0.9932203 -1.96164410 0.34015322 -0.18751047  
## 28 0.6537514 0.4522084 0.9932203 -0.02857160 1.16544301 -0.70142805  
## 29 0.6537514 0.4522084 -0.9932203 0.93796466 1.16544301 -0.18751047  
## 30 0.1498180 -1.4068705 0.0000000 -0.33061417 -0.89778146 -0.44446926  
## 31 -0.3541153 -0.4773310 -0.9932203 -1.41796746 -0.89778146 -0.95838683  
## 32 0.1498180 -1.4068705 0.0000000 1.42123279 -0.89778146 0.06944832  
## 33 -0.3541153 0.4522084 0.0000000 -0.27020566 0.34015322 0.06944832  
## 34 0.1498180 0.4522084 -0.9932203 0.09224544 0.34015322 0.58336590  
## 35 0.6537514 0.4522084 1.9864405 -1.05551637 0.34015322 -0.44446926  
## 36 0.6537514 -1.4068705 0.9932203 0.69633060 -0.48513656 -0.70142805  
## 37 0.1498180 0.4522084 0.0000000 1.05878169 -0.27881412 -0.82990744  
## 38 0.1498180 -1.4068705 -0.9932203 0.21306247 -0.89778146 -0.18751047  
## 39 0.1498180 -0.4773310 0.0000000 0.09224544 -0.48513656 0.58336590  
## 40 1.6616182 0.4522084 0.0000000 0.09224544 -0.07249167 1.35424227  
## 41 0.1498180 -0.4773310 0.0000000 1.17959872 -0.89778146 1.61120105  
## 42 -0.3541153 1.3817478 0.9932203 -0.14938863 -0.07249167 -0.70142805  
## 43 0.1498180 -0.4773310 0.0000000 0.21306247 -0.89778146 -0.70142805  
## 44 -0.3541153 1.3817478 0.0000000 -1.96164410 -0.89778146 0.32640711  
## 45 2.1655516 1.3817478 1.9864405 -0.81388230 0.34015322 0.32640711  
## 46 2.1655516 1.3817478 1.9864405 -0.14938863 0.34015322 0.32640711  
## 47 2.6694849 0.4522084 0.9932203 -0.14938863 0.34015322 0.58336590  
## 48 -0.3541153 -0.4773310 0.0000000 0.69633060 -0.07249167 0.06944832  
## 49 0.6537514 -0.4773310 0.0000000 0.33387950 -0.89778146 0.06944832  
## 50 1.6616182 0.4522084 0.9932203 0.69633060 0.34015322 1.61120105  
## 51 -0.8580487 0.4522084 -0.9932203 0.09224544 0.34015322 0.84032469  
## 52 1.1576848 0.4522084 0.9932203 0.09224544 -0.27881412 -0.31598986  
## 53 0.6537514 0.4522084 0.0000000 0.45469653 1.57808790 -0.95838683  
## 54 -0.3541153 0.4522084 -0.9932203 1.90450091 -0.48513656 1.35424227  
## 55 -2.8737823 -1.4068705 -0.9932203 -1.96164410 -0.89778146 -0.44446926  
## 56 -2.8737823 -0.4773310 -0.9932203 -1.96164410 -0.48513656 -1.21534562  
## 57 -0.3541153 1.3817478 0.0000000 -0.33061417 -0.07249167 -0.18751047  
## 59 0.6537514 0.4522084 0.0000000 0.57551356 1.16544301 -0.18751047  
## 60 -0.3541153 0.4522084 0.9932203 -0.27020566 0.13383078 -1.08686623  
## 61 -0.8580487 -0.4773310 -0.9932203 -1.96164410 -0.07249167 0.06944832  
## 62 0.1498180 -1.4068705 -0.9932203 0.93796466 -0.89778146 2.12511863  
## 63 0.1498180 -0.4773310 -0.9932203 1.54204982 -0.89778146 1.86815984  
## 64 -1.3619821 -0.4773310 -0.9932203 -1.96164410 0.34015322 0.32640711  
## 65 -0.8580487 0.4522084 -0.9932203 -1.96164410 0.75279812 1.09728348  
## 66 -0.8580487 0.4522084 -0.9932203 -1.96164410 0.34015322 1.35424227  
## 67 0.1498180 -0.4773310 0.0000000 -1.11592488 -0.48513656 -1.47230441  
## 68 0.1498180 3.2408266 -0.9932203 0.81714763 -0.48513656 0.32640711  
## 69 -0.8580487 -0.4773310 -0.9932203 -1.78041856 0.34015322 0.06944832  
## 70 0.1498180 -0.4773310 0.0000000 0.45469653 -0.89778146 1.61120105  
## 71 1.6616182 0.4522084 0.0000000 0.33387950 0.75279812 0.06944832  
## 72 -0.3541153 0.4522084 0.0000000 0.45469653 0.34015322 0.32640711  
## 73 0.1498180 -0.4773310 0.0000000 1.05878169 -0.89778146 1.61120105  
## 74 0.1498180 -1.4068705 0.0000000 -0.27020566 -0.89778146 -0.44446926  
## 75 -0.3541153 0.4522084 0.0000000 0.81714763 0.34015322 0.58336590  
## 76 -0.3541153 0.4522084 0.0000000 0.45469653 0.34015322 0.58336590  
## 77 0.1498180 -0.4773310 0.0000000 0.45469653 -0.48513656 0.32640711  
## sugars potass vitamins shelf weight cups  
## 1 -0.25420505 2.56052289 -0.1818422 0.9419715 -0.2008324 -2.08565823  
## 2 0.20460407 0.51477378 -1.3032024 0.9419715 -0.2008324 0.75675340  
## 3 -0.48360961 3.12486748 -0.1818422 0.9419715 -0.2008324 -2.08565823  
## 4 -1.63063240 3.26595362 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 6 0.66341318 -0.40228617 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## 7 1.58103142 -0.96663076 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 8 0.20460407 0.02097226 -0.1818422 0.9419715 1.9501886 -0.30384795  
## 9 -0.25420505 0.37368763 -0.1818422 -1.4616799 -0.2008324 -0.64324039  
## 10 -0.48360961 1.29074758 -0.1818422 0.9419715 -0.2008324 -0.64324039  
## 11 1.12222230 -0.89608768 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 12 -1.40122785 0.09151534 -0.1818422 -1.4616799 -0.2008324 1.81735475  
## 13 0.43400862 -0.75500154 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 14 -0.02480049 0.09151534 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 15 1.35162686 -0.61391539 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 16 -0.94241873 -1.03717383 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 17 -1.17182329 -0.89608768 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 18 1.12222230 -1.10771690 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 19 1.35162686 -0.47282925 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 20 -0.02480049 0.86748914 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 22 -0.94241873 -0.96663076 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 23 0.66341318 0.30314456 -0.1818422 0.9419715 -0.2008324 -0.30384795  
## 24 -0.48360961 -0.26120003 -0.1818422 0.9419715 -0.2008324 -0.30384795  
## 25 1.35162686 -0.96663076 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 26 0.89281774 -1.03717383 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## 27 -0.02480049 0.02097226 -0.1818422 -0.2598542 -0.2008324 -0.09172768  
## 28 0.66341318 1.43183372 -0.1818422 0.9419715 1.4287290 -0.64324039  
## 29 1.12222230 1.29074758 -0.1818422 0.9419715 1.9501886 -0.64324039  
## 30 1.12222230 -1.03717383 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 31 1.81043598 -0.82554461 -0.1818422 -1.4616799 -0.2008324 0.24766475  
## 32 0.43400862 -0.75500154 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 33 -0.48360961 -0.19065695 -0.1818422 0.9419715 -0.2008324 0.24766475  
## 34 -0.94241873 -0.12011388 -0.1818422 0.9419715 -0.2008324 -2.42505066  
## 35 -0.71301417 0.02097226 -0.1818422 0.9419715 -0.2008324 -2.08565823  
## 36 0.89281774 -0.75500154 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 37 0.66341318 -0.12011388 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## 38 0.89281774 -0.89608768 -0.1818422 -1.4616799 -0.2008324 2.15674718  
## 39 -0.25420505 -0.54337232 3.1822385 0.9419715 -0.2008324 0.75675340  
## 40 0.43400862 -0.04957081 3.1822385 0.9419715 1.7546413 -0.30384795  
## 41 -0.94241873 -0.82554461 -0.1818422 -0.2598542 -0.2008324 2.87795610  
## 42 -0.25420505 -0.04957081 -0.1818422 -0.2598542 -0.2008324 -0.64324039  
## 43 1.12222230 -0.61391539 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 44 -0.94241873 -0.04957081 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 45 0.89281774 1.00857529 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 46 0.89281774 1.00857529 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 47 1.35162686 0.86748914 -0.1818422 0.9419715 3.0582904 -0.64324039  
## 48 -0.25420505 -0.12011388 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 49 0.43400862 -0.82554461 -0.1818422 -0.2598542 -0.2008324 -0.64324039  
## 50 -0.02480049 0.44423070 -0.1818422 0.9419715 1.9501886 -0.64324039  
## 51 -1.17182329 -0.12011388 -0.1818422 0.9419715 -0.2008324 0.75675340  
## 52 0.66341318 0.30314456 -0.1818422 0.9419715 1.4287290 -1.36444931  
## 53 1.58103142 2.27835060 -0.1818422 0.9419715 1.9501886 -0.64324039  
## 54 -0.94241873 -0.75500154 3.1822385 0.9419715 -0.2008324 0.75675340  
## 55 -1.63063240 -1.17825998 -1.3032024 0.9419715 -3.4599552 0.75675340  
## 56 -1.63063240 -0.68445846 -1.3032024 0.9419715 -3.4599552 0.75675340  
## 57 -0.25420505 0.16205841 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 59 1.12222230 1.99617831 -0.1818422 -0.2598542 1.9501886 -0.30384795  
## 60 0.20460407 0.58531685 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 61 -0.25420505 0.16205841 -0.1818422 0.9419715 -0.2008324 -1.36444931  
## 62 -1.17182329 -0.96663076 -0.1818422 -1.4616799 -0.2008324 1.30826610  
## 63 -0.94241873 -0.89608768 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 64 -1.63063240 -0.04957081 -1.3032024 -1.4616799 -1.3089342 0.75675340  
## 65 -1.63063240 0.58531685 -1.3032024 -1.4616799 -0.2008324 -0.64324039  
## 66 -1.63063240 0.30314456 -1.3032024 -1.4616799 -0.2008324 -0.64324039  
## 67 1.81043598 -0.82554461 -0.1818422 -0.2598542 -0.2008324 -0.30384795  
## 68 -0.94241873 -0.61391539 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 69 -0.48360961 -0.12011388 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 70 -0.94241873 -0.89608768 3.1822385 0.9419715 -0.2008324 0.75675340  
## 71 1.58103142 1.85509216 3.1822385 0.9419715 3.0582904 0.75675340  
## 72 -0.94241873 0.16205841 3.1822385 0.9419715 -0.2008324 0.75675340  
## 73 -0.94241873 -0.54337232 -0.1818422 0.9419715 -0.2008324 -0.30384795  
## 74 1.12222230 -1.03717383 -0.1818422 -0.2598542 -0.2008324 0.75675340  
## 75 -0.94241873 0.23260148 -0.1818422 -1.4616799 -0.2008324 -0.64324039  
## 76 -0.94241873 0.16205841 -0.1818422 -1.4616799 -0.2008324 0.75675340  
## 77 0.20460407 -0.54337232 -0.1818422 -1.4616799 -0.2008324 -0.30384795  
## rating  
## 1 1.85490376  
## 2 -0.59771126  
## 3 1.21519648  
## 4 3.65784358  
## 6 -0.91652483  
## 7 -0.65539984  
## 8 -0.38002951  
## 9 0.48087533  
## 10 0.77969576  
## 11 -1.73360655  
## 12 0.59807496  
## 13 -1.60671768  
## 14 -0.14048876  
## 15 -1.39915514  
## 16 -0.06603869  
## 17 0.24879639  
## 18 -0.46951197  
## 19 -1.42337774  
## 20 -0.13702824  
## 22 0.32235640  
## 23 -0.44147911  
## 24 0.13959735  
## 25 -0.72427057  
## 26 -0.77925310  
## 27 1.13821301  
## 28 -0.10366038  
## 29 -0.09664548  
## 30 -1.02225423  
## 31 -0.50730289  
## 32 -1.32308140  
## 33 0.69155685  
## 34 0.78377123  
## 35 0.24511896  
## 36 -1.46080340  
## 37 -0.80517325  
## 38 -0.97118798  
## 39 -0.41671824  
## 40 -0.42043579  
## 41 -0.22308231  
## 42 0.21065609  
## 43 -1.11426481  
## 44 0.88922515  
## 45 -0.37302488  
## 46 -0.58658904  
## 47 -0.85924775  
## 48 -0.16145563  
## 49 -0.88697142  
## 50 -0.11967375  
## 51 1.23068291  
## 52 -0.84945049  
## 53 -0.32287913  
## 54 -0.06186866  
## 55 1.31001152  
## 56 1.47030646  
## 57 0.50878106  
## 59 -0.22179377  
## 60 -0.19014120  
## 61 0.92358705  
## 62 -0.02656845  
## 63 -0.12909114  
## 64 1.84299757  
## 65 2.28743193  
## 66 2.16834997  
## 67 -0.79392626  
## 68 0.76669214  
## 69 1.21081332  
## 70 -0.25168258  
## 71 -0.98185009  
## 72 0.30548275  
## 73 -0.23269772  
## 74 -1.04166919  
## 75 0.52841741  
## 76 0.65701831  
## 77 -0.44066942  
## attr(,"scaled:center")  
## calories protein fat sodium fiber   
## -2.272957e-16 -8.551718e-17 0.000000e+00 -7.342100e-17 -9.789467e-17   
## carbo sugars potass vitamins shelf   
## -1.575316e-17 4.107075e-17 -2.934965e-17 9.376884e-17 -3.300663e-17   
## weight cups rating   
## 6.335023e-16 -1.513429e-16 -2.218571e-16   
## attr(,"scaled:scale")  
## calories protein fat sodium fiber carbo sugars potass   
## 1 1 1 1 1 1 1 1   
## vitamins shelf weight cups rating   
## 1 1 1 1 1

print(hc\_single$ac)

## [1] 0.6067859

print(hc\_complete$ac)

## [1] 0.8353712

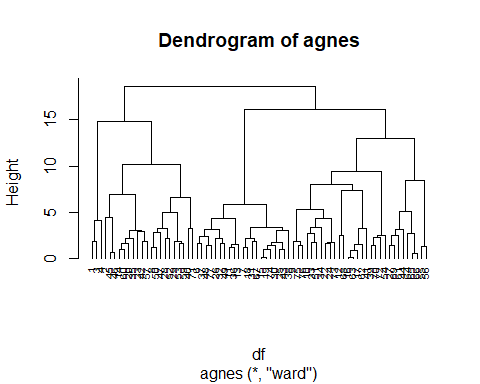
print(hc\_average$ac)

## [1] 0.7766075

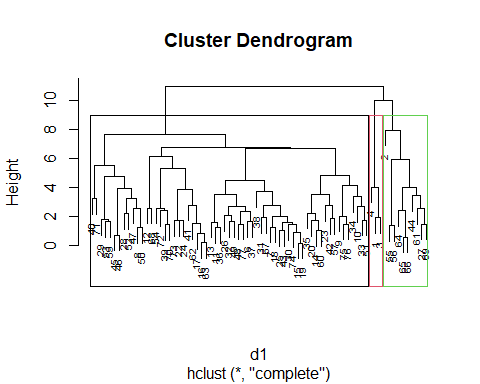
print(hc\_ward$ac)

## [1] 0.9046042

pltree(hc\_ward, cex = 0.6, hang = -1, main = "Dendrogram of agnes")



d1 <- dist(df, method = "euclidean")  
# compute divisive hierarchical clustering  
hierc\_complete <- hclust(d1,method = "complete")  
# plot dendrogram  
plot(hierc\_complete, cex = 0.6)  
rect.hclust(hierc\_complete, k = 3, border = 1:4)

 How many clusters would you choose? I would choose 4 clusters.

Comment on the structure of the clusters and on their stability. Hint: To check stability, partition the data and see how well clusters formed based on one part apply to the other part. To do this: ● Cluster partition A ● Use the cluster centroids from A to assign each record in partition B (each record is assigned to the cluster with the closest centroid). ● Assess how consistent the cluster assignments are compared to the assignments based on all the data.

d2 <- dist(df, method = "euclidean")  
# compute divisive hierarchical clustering  
hierc\_ward <- hclust(d2,method = "ward.D")  
hierc\_ward

##   
## Call:  
## hclust(d = d2, method = "ward.D")  
##   
## Cluster method : ward.D   
## Distance : euclidean   
## Number of objects: 74

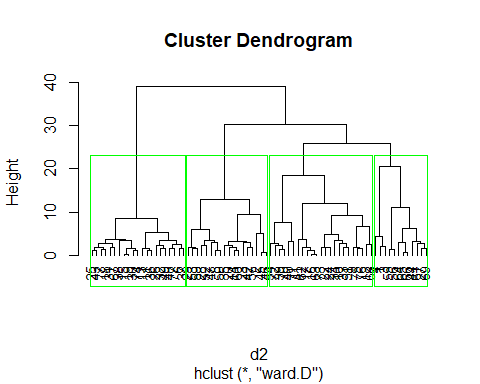
plot(hierc\_ward,hang = -1,cex = 0.8)  
# Choosing no. of clusters  
# Cutting tree by height  
abline(h = 120, col = "orange")  
   
# Cutting tree by no. of clusters  
fit <- cutree(hierc\_ward, k = 4 )  
fit

## 1 2 3 4 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25 26 27 28   
## 1 2 1 1 3 3 2 4 4 3 4 3 2 3 4 4 3 3 2 4 2 4 3 3 1 2   
## 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54   
## 2 3 3 3 4 4 2 3 3 3 4 4 4 2 3 1 2 2 2 3 3 2 4 2 2 4   
## 55 56 57 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77   
## 1 1 2 2 2 1 4 4 1 1 1 3 4 1 4 4 4 4 3 4 4 3

table(fit)

## fit  
## 1 2 3 4   
## 12 18 21 23

rect.hclust(hierc\_ward, k = 4, border = "green")

 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?

library(cluster)  
  
# Standardization (Z-score normalization)  
norm\_df <- scale(df)  
# Hierarchical clustering  
hc <- hclust(dist(norm\_df), method = "ward.D")#used ward method  
  
# Plot dendrogram  
plot(hc, main = "Hierarchical Clustering Dendrogram (Normalized Data)",cex = 0.6,hang = -2)

