CLUSTER___EN___R___GUEVARA.R

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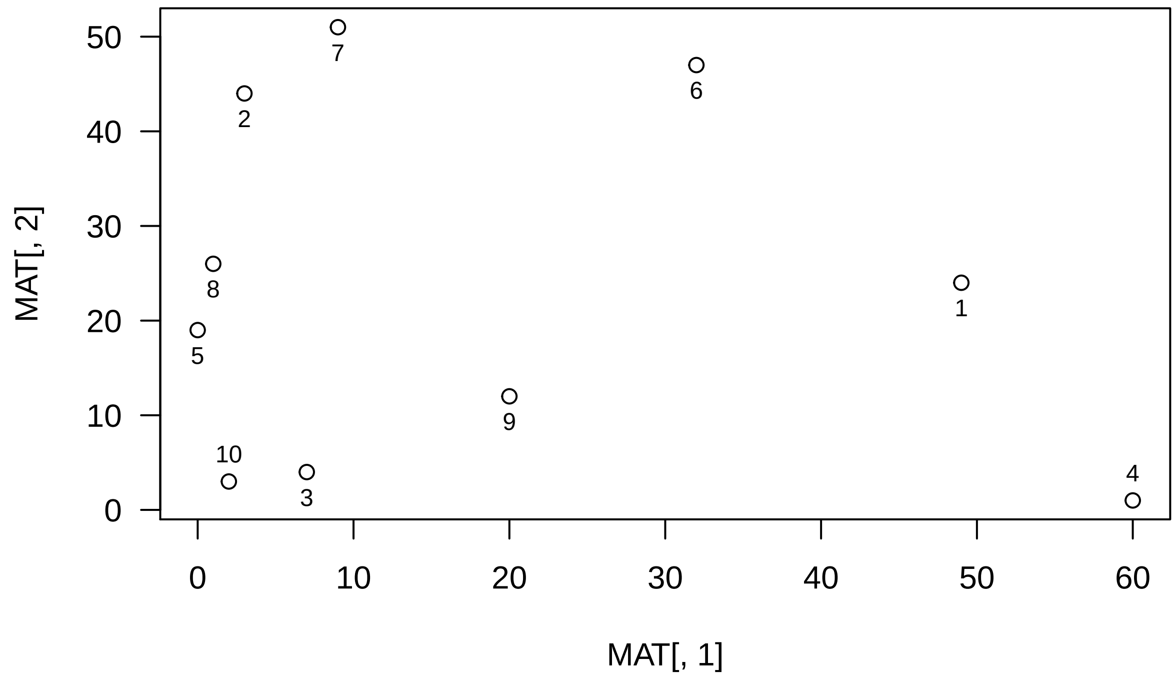
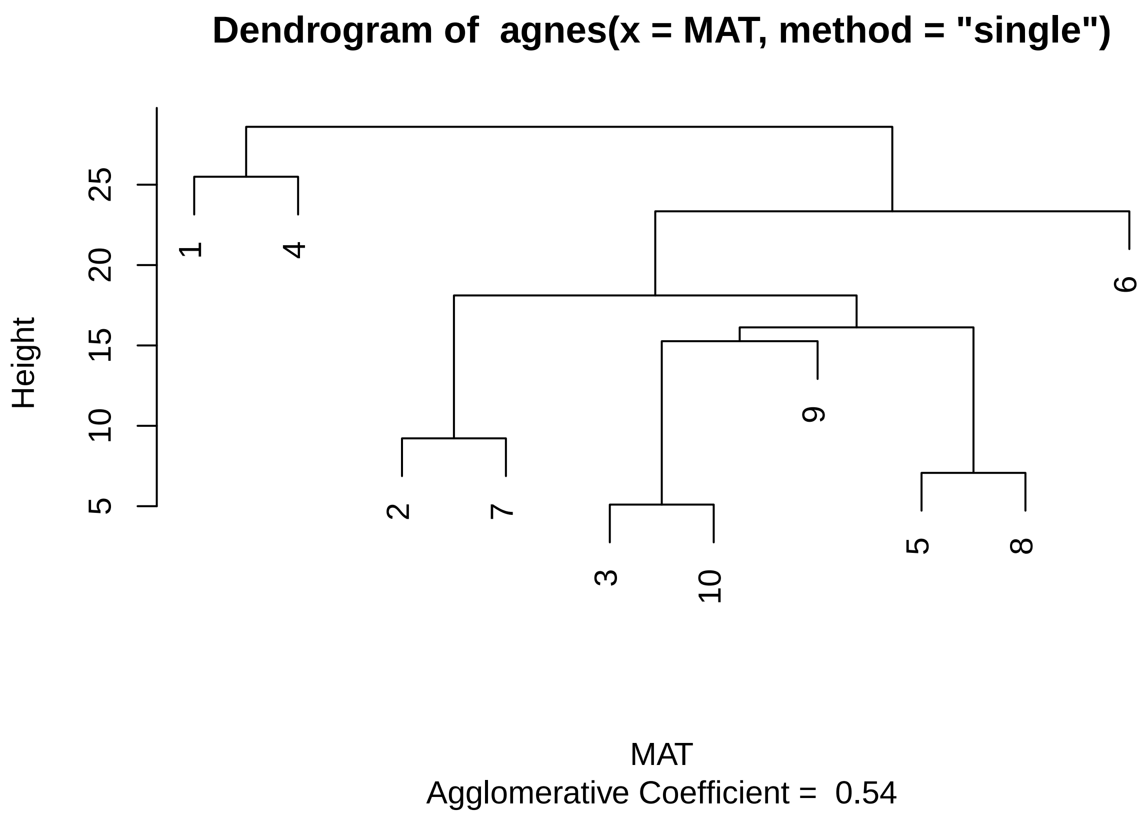
```
library(vegan)
```

```
## Loading required package: permute
## Loading required package: lattice
## This is vegan 2.4-6
```

```
library(cluster)
?agnes
?hclust
?diana
?mona
?kmeans
?fanny


?dist
?vegdist
?betadiver
?daisy

####
#MAT <- matrix(rnegbin(20,theta=0.4), 10,2)
MAT <- matrix(c(49,3,7,60,0,32,9,1,20,2,24,44,4,1,19,47,51,26,12,3), 10, 2)

plot(MAT[,1], MAT[,2], las=1)
POS <- rep(1, 10)
POS[(MAT[,2] < 4)] <- 3
text(MAT[,1], MAT[,2], 1:10, pos=POS, cex=0.75)
```




```r
AGNESs <- agnes(MAT, method = "single")
plot(AGNESs, which=2)
```




```r
dist(MAT)
```

```
##               1          2          3          4          5          6          7
## 2   50.159745
```

```
## 3  46.518813 40.199502
## 4  25.495098 71.400280 53.084838
## 5  49.254441 25.179357 16.552945 62.641839
## 6  28.600699 29.154759 49.739320 53.851648 42.520583
## 7  48.259714  9.219544 47.042534 71.421285 33.241540 23.345235
## 8  48.041649 18.110770 22.803509 64.078077  7.071068 37.443290 26.248809
## 9  31.384710 36.235342 15.264338 41.484937 21.189620 37.000000 40.521599
## 10 51.478151 41.012193  5.099020 58.034473 16.124515 53.254108 48.507731
##            8         9
## 2
## 3
## 4
## 5
## 6
## 7
## 8
## 9  23.600847
## 10 23.021729 20.124612
```

```
AGNESs$height
```

```
## [1] 25.495098 28.600699  9.219544 18.110770  5.099020 15.264338 16.124515
## [8]  7.071068 23.345235
```

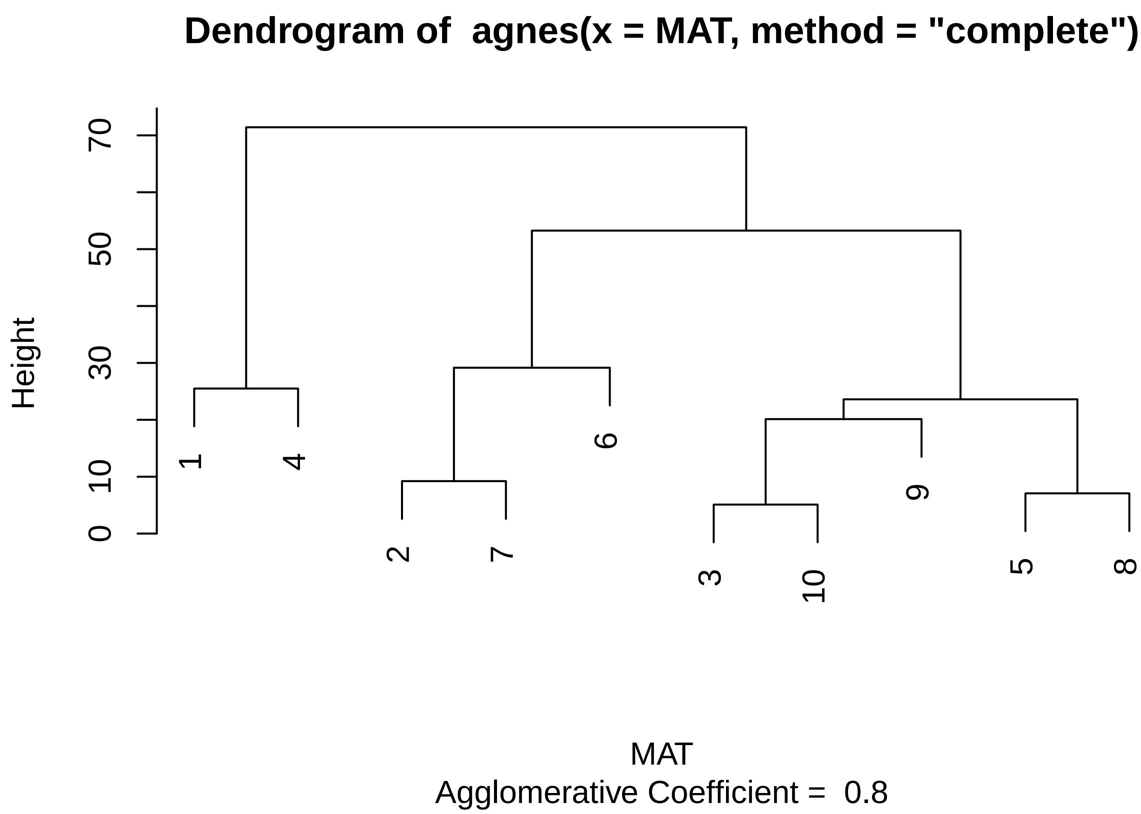
```
AGNESc <- agnes(MAT, method = "complete")
AGNESc$height
```

```
## [1] 25.495098 71.421285  9.219544 29.154759 53.254108  5.099020 20.124612
## [8] 23.600847  7.071068
```

```
AGNESc$order
```

```
##  [1]  1  4  2  7  6  3 10  9  5  8
```

```
plot(AGNESc, which=2)
```



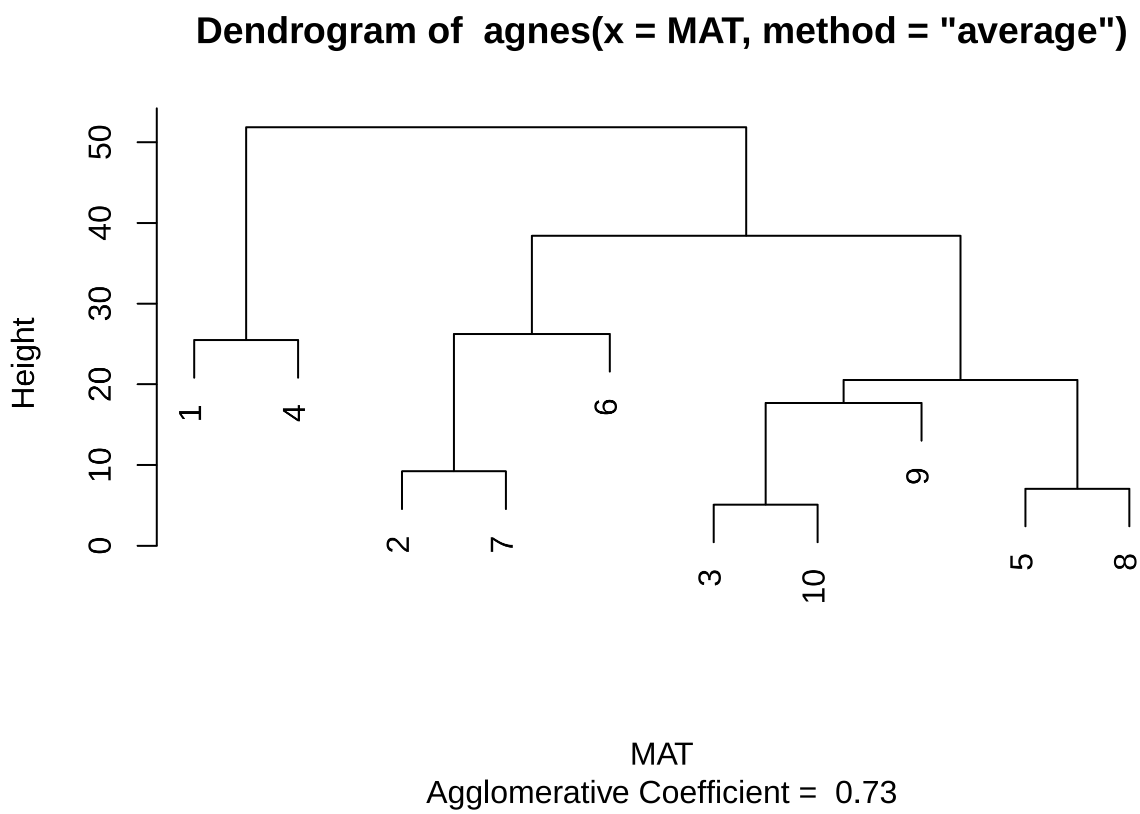

```r
AGNESa <- agnes(MAT, method = "average")
AGNESa$height
```

```
## [1] 25.495098 51.855956  9.219544 26.249997 38.417112  5.099020 17.694475
## [8] 20.548861  7.071068
```

```r
AGNESa$order
```

```
##  [1]  1  4  2  7  6  3 10  9  5  8
```

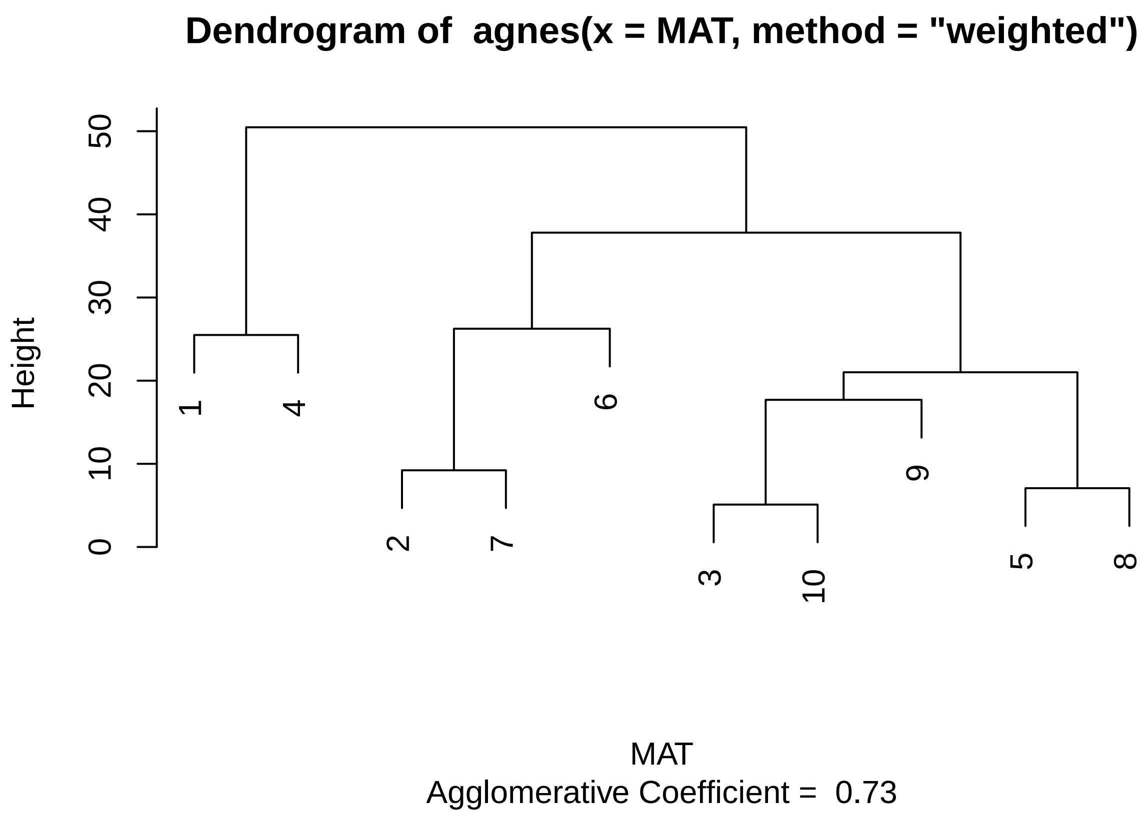
```r
plot(AGNESa, which=2)
```




```
AGNESwa <- agnes(MAT, method = "weighted")
AGNESwa$order
```

```
##  [1]  1  4  2  7  6  3 10  9  5  8
```

```
plot(AGNESwa, which=2)
```




```
AGNESwa$height
```

```
## [1] 25.495098 50.474344  9.219544 26.249997 37.802473  5.099020 17.694475
## [8] 21.010454  7.071068
```

```
dist(MAT)
```

```
##            1         2         3         4         5         6         7
## 2  50.159745
## 3  46.518813 40.199502
## 4  25.495098 71.400280 53.084838
## 5  49.254441 25.179357 16.552945 62.641839
## 6  28.600699 29.154759 49.739320 53.851648 42.520583
## 7  48.259714  9.219544 47.042534 71.421285 33.241540 23.345235
## 8  48.041649 18.110770 22.803509 64.078077  7.071068 37.443290 26.248809
## 9  31.384710 36.235342 15.264338 41.484937 21.189620 37.000000 40.521599
## 10 51.478151 41.012193  5.099020 58.034473 16.124515 53.254108 48.507731
##            8         9
## 2
## 3
## 4
## 5
## 6
## 7
## 8
## 9  23.600847
## 10 23.021729 20.124612
```

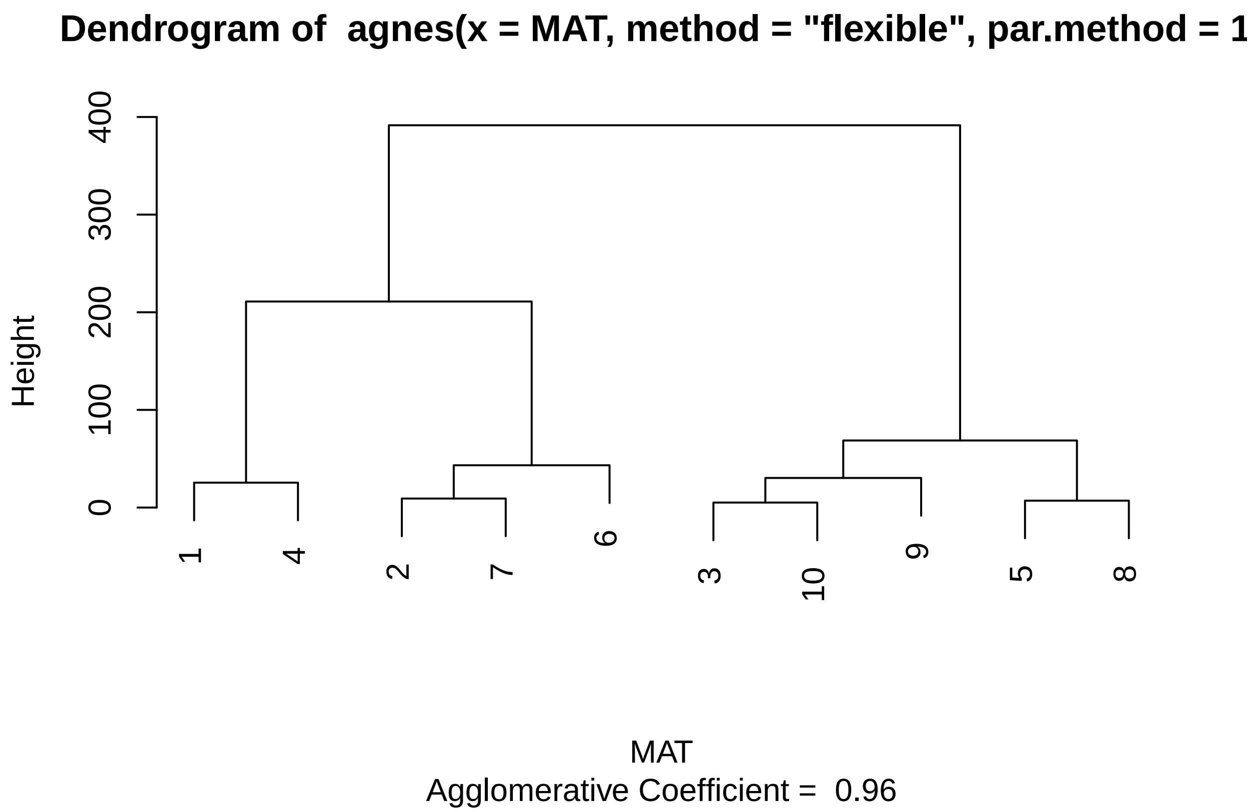
```
AGNESf <- agnes(MAT, method = "flexible",par.method=1)
AGNESf$height
```

```
## [1]  25.495098 210.983638   9.219544  43.280450 391.523796   5.099020
## [7]  30.289930  68.663061   7.071068
```

```r
AGNESf$order
```

```
##  [1]  1  4  2  7  6  3 10  9  5  8
```

```r
plot(AGNESf, which=2)
```

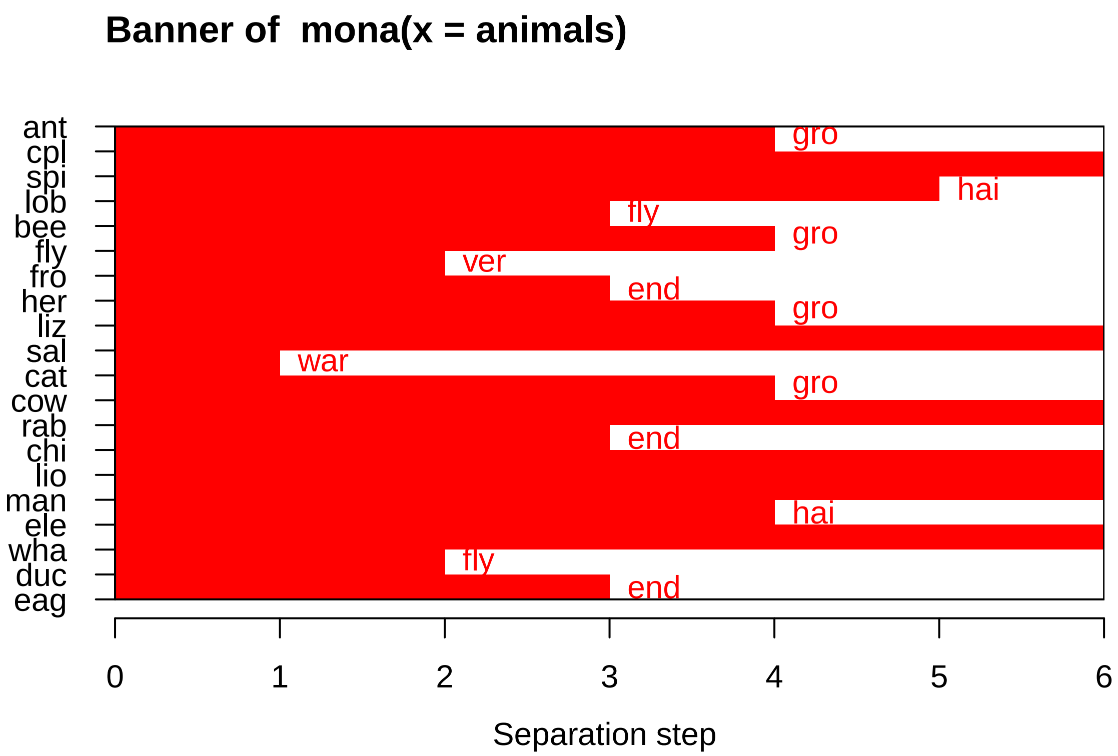



```r
####
ma <- mona(animals)
ma
```

```
## mona(x, ..) fit;  x of dimension 20x6
## Because of NA's, revised data:
##     war fly ver end gro hai
## ant   0   0   0   0   1   0
## bee   0   1   0   0   1   1
## cat   1   0   1   0   0   1
## cpl   0   0   0   0   0   1
## chi   1   0   1   1   1   1
## cow   1   0   1   0   1   1
## duc   1   1   1   0   1   0
## eag   1   1   1   1   0   0
## ele   1   0   1   1   1   0
## fly   0   1   0   0   0   0
## fro   0   0   1   1   0   0
## her   0   0   1   0   1   0
## lio   1   0   1   1   1   1
```

```
## liz   0   0   1   0   0   0
## lob   0   0   0   0   0   0
## man   1   0   1   1   1   1
## rab   1   0   1   0   1   1
## sal   0   0   1   0   0   0
## spi   0   0   0   0   0   1
## wha   1   0   1   1   1   0
## Order of objects:
##  [1] ant cpl spi lob bee fly fro her liz sal cat cow rab chi lio man ele
## [18] wha duc eag
## Variable used:
##  [1] gro  NULL hai  fly  gro  ver  end  gro  NULL war  gro  NULL end  NULL
## [15] NULL hai  NULL fly  end
## Separation step:
##  [1] 4 0 5 3 4 2 3 4 0 1 4 0 3 0 0 4 0 2 3
##
## Available components:
## [1] "data"      "hasNA"     "order"     "variable"  "step"      "order.lab"
## [7] "call"
```

```
plot(ma)
```




```
?mona


#### K MEANS
MAT <- matrix(sample(rnbinom(200,3, prob=0.4)),100,2)
rownames(MAT) <- paste("S", 1:100, sep="")
colnames(MAT) <- c("A", "B")

###SEMILLAS EN LOS EXTREMOS
```

```r
plot(MAT[,1], MAT[,2])
points(c(0,0,15,15), c(0,15,15,0), pch = 19, col ="red")


DIST1 <- cbind(sqrt((MAT[,1]-0)^2 + (MAT[,2]-0)^2),
               sqrt((MAT[,1]-0)^2 + (MAT[,2]-15)^2),
               sqrt((MAT[,1]-15)^2 + (MAT[,2]-15)^2),
               sqrt((MAT[,1]-15)^2 + (MAT[,2]-0)^2))

GRUPOS <- numeric()
for(i in 1:100){
  GRUPOS <- c(GRUPOS, which(DIST1[i,]==min(DIST1[i,])))
}

CENTROIDES <- rbind(colMeans(MAT[GRUPOS==1,]),
                    colMeans(MAT[GRUPOS==2,]),
                    colMeans(MAT[GRUPOS==3,]),
                    colMeans(MAT[GRUPOS==4,]))
points(CENTROIDES[,1], CENTROIDES[,2], col ="blue", pch = 19)


DIST2 <- cbind(sqrt((MAT[,1]-CENTROIDES[1,1])^2 +(MAT[,2]-CENTROIDES[1,2])^2),
               sqrt((MAT[,1]-CENTROIDES[2,1])^2 + (MAT[,2]-CENTROIDES[2,2])^2),
               sqrt((MAT[,1]-CENTROIDES[3,1])^2 + (MAT[,2]-CENTROIDES[3,2])^2),
               sqrt((MAT[,1]-CENTROIDES[4,1])^2 + (MAT[,2]-CENTROIDES[4,2])^2))

GRUPOS2 <- numeric()
for(i in 1:100){
  GRUPOS2 <- c(GRUPOS2, which(DIST2[i,]==min(DIST2[i,])))
}

rbind(table(GRUPOS),
      table(GRUPOS2))
```

```
##       1  2 3  4
## [1,] 71 11 4 14
## [2,] 70  9 5 16
```

```r
sum(GRUPOS2==GRUPOS)
```

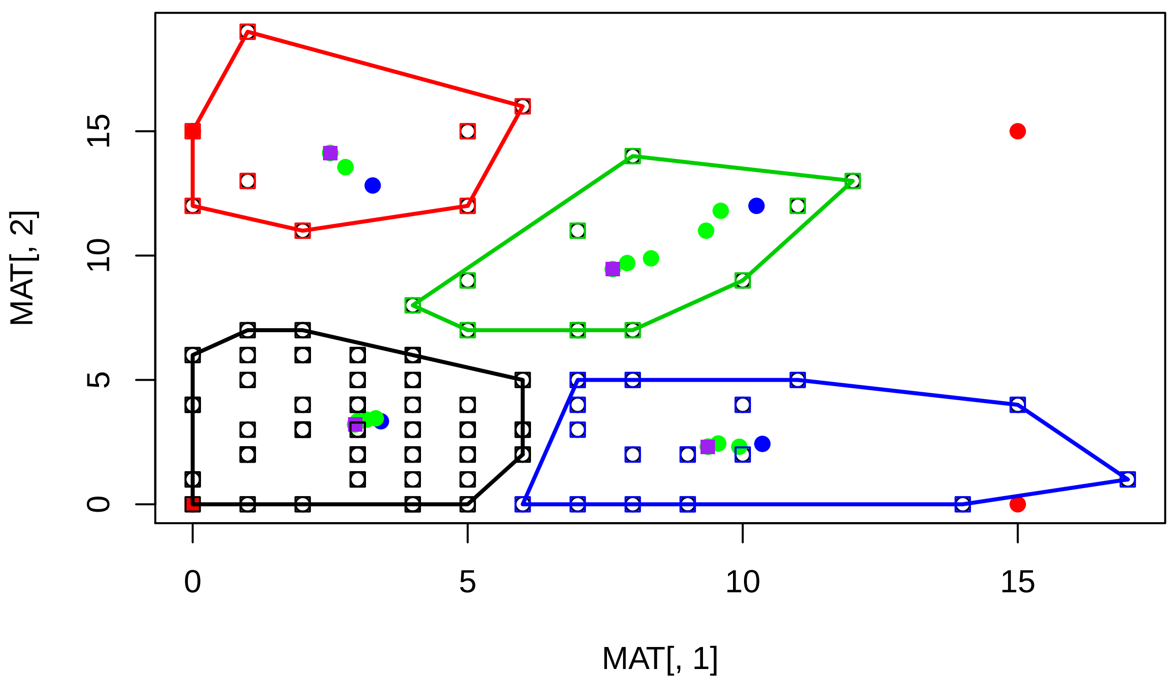
```
## [1] 96
```

```r
GRUPOSx2 <- GRUPOS2
GRUPOSx<- sample(GRUPOSx2)
while(sum(GRUPOSx2==GRUPOSx) != 100){
  GRUPOSx <- GRUPOSx2
  CENTROIDESx <- rbind(colMeans(MAT[GRUPOSx==1,]),
                       colMeans(MAT[GRUPOSx==2,]),
                       colMeans(MAT[GRUPOSx==3,]),
                       colMeans(MAT[GRUPOSx==4,]))
  points(CENTROIDESx[,1], CENTROIDESx[,2], col ="green", pch = 19)


  DISTx <- cbind(sqrt((MAT[,1]-CENTROIDESx[1,1])^2 +(MAT[,2]-CENTROIDESx[1,2])^2),
                 sqrt((MAT[,1]-CENTROIDESx[2,1])^2 + (MAT[,2]-CENTROIDESx[2,2])^2),
```

```
                 sqrt((MAT[,1]-CENTROIDESx[3,1])^2 + (MAT[,2]-CENTROIDESx[3,2])^2),
                 sqrt((MAT[,1]-CENTROIDESx[4,1])^2 + (MAT[,2]-CENTROIDESx[4,2])^2))

  GRUPOSx2 <- numeric()
  for(i in 1:100){
    GRUPOSx2 <- c(GRUPOSx2, which(DISTx[i,]==min(DISTx[i,])))
  }
  print(rbind(table(GRUPOSx),
              table(GRUPOSx2)))
}
```

```
##       1 2 3  4
## [1,] 70 9 5 16
## [2,] 67 9 6 18
##       1 2 3  4
## [1,] 67 9 6 18
## [2,] 64 8 9 19
##       1 2  3  4
## [1,] 64 8  9 19
## [2,] 63 8 10 19
##       1 2  3  4
## [1,] 63 8 10 19
## [2,] 62 8 11 19
##       1 2  3  4
## [1,] 62 8 11 19
## [2,] 62 8 11 19
```

```
points(CENTROIDESx[,1], CENTROIDESx[,2], col ="purple", pch = 15)
for(i in 1:nrow(CENTROIDESx)){ points(MAT[GRUPOSx2==i, 1], MAT[GRUPOSx2==i, 2], pch=0, col=i)
polygon(MAT[GRUPOSx2==i,][chull(MAT[GRUPOSx2==i,]), ], border=i, lwd=2)
}
```



```r
rbind(table(GRUPOSx),
      table(GRUPOSx2))
```

```
##       1 2  3  4
## [1,] 62 8 11 19
## [2,] 62 8 11 19
```

```r
sum(GRUPOSx2==GRUPOSx)
```

```
## [1] 100
```

```r
####SEMILLAS UBICADASS AL CENTRO
plot(MAT[,1], MAT[,2])
points(c(5,5,10,10), c(5,10,10,5), pch = 19, col ="red")

DIST1 <- cbind(sqrt((MAT[,1]-5)^2 + (MAT[,2]-5)^2),
      sqrt((MAT[,1]-5)^2 + (MAT[,2]-10)^2),
      sqrt((MAT[,1]-10)^2 + (MAT[,2]-10)^2),
      sqrt((MAT[,1]-10)^2 + (MAT[,2]-5)^2))

GRUPOS <- numeric()
for(i in 1:100){
  GRUPOS <- c(GRUPOS, which(DIST1[i,]==min(DIST1[i,])))
}

CENTROIDES <- rbind(colMeans(MAT[GRUPOS==1,]),
      colMeans(MAT[GRUPOS==2,]),
      colMeans(MAT[GRUPOS==3,]),
      colMeans(MAT[GRUPOS==4,]))
points(CENTROIDES[,1], CENTROIDES[,2], col ="blue", pch = 19)


DIST2 <- cbind(sqrt((MAT[,1]-CENTROIDES[1,1])^2 +(MAT[,2]-CENTROIDES[1,2])^2),
               sqrt((MAT[,1]-CENTROIDES[2,1])^2 + (MAT[,2]-CENTROIDES[2,2])^2),
               sqrt((MAT[,1]-CENTROIDES[3,1])^2 + (MAT[,2]-CENTROIDES[3,2])^2),
               sqrt((MAT[,1]-CENTROIDES[4,1])^2 + (MAT[,2]-CENTROIDES[4,2])^2))

GRUPOS2 <- numeric()
for(i in 1:100){
  GRUPOS2 <- c(GRUPOS2, which(DIST2[i,]==min(DIST2[i,]))[1])
}
CENTROIDES <- rbind(colMeans(MAT[GRUPOS2==1,]),
                    colMeans(MAT[GRUPOS2==2,]),
                    colMeans(MAT[GRUPOS2==3,]),
                    colMeans(MAT[GRUPOS2==4,]))
points(CENTROIDES[,1], CENTROIDES[,2], col ="blue", pch = 19)

rbind(table(GRUPOS),
table(GRUPOS2))
```

```
##       1  2 3  4
## [1,] 71 11 4 14
## [2,] 70  9 5 16
```

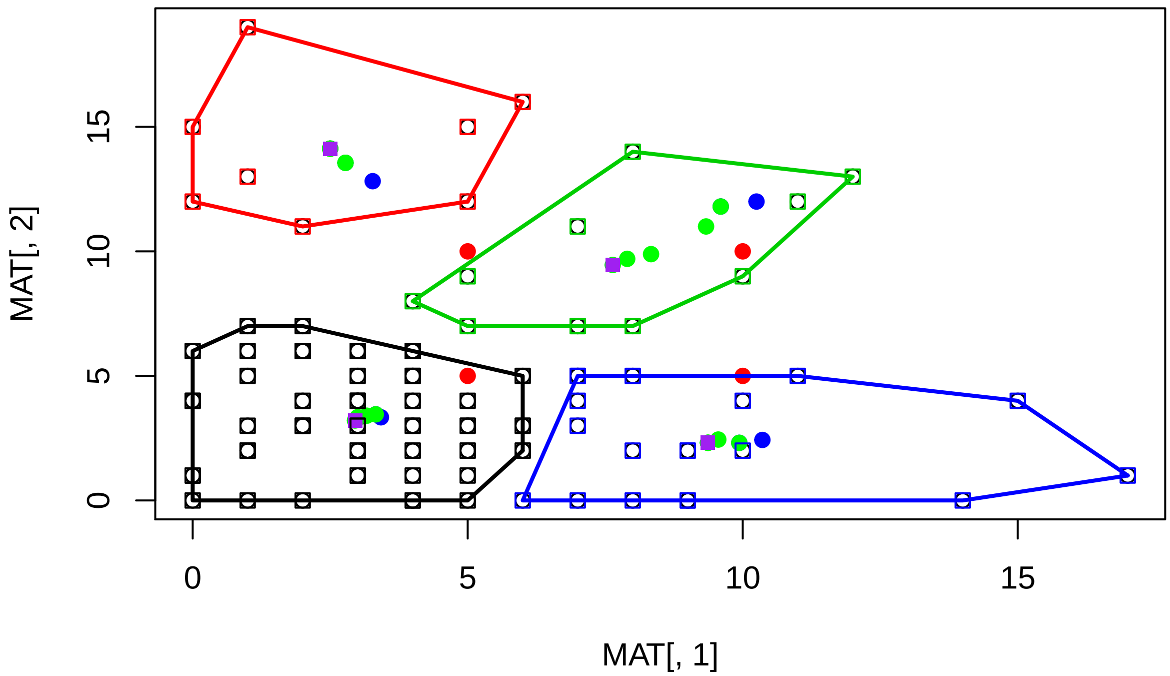
```r
sum(GRUPOS2==GRUPOS)
```

```
## [1] 96
```

```
GRUPOSx2 <- GRUPOS2
GRUPOSx<- sample(GRUPOSx2)

while(sum(GRUPOSx2==GRUPOSx) != 100){
  GRUPOSx <- GRUPOSx2
CENTROIDESx <- rbind(colMeans(MAT[GRUPOSx==1,]),
                    colMeans(MAT[GRUPOSx==2,]),
                    colMeans(MAT[GRUPOSx==3,]),
                    colMeans(MAT[GRUPOSx==4,]))
points(CENTROIDESx[,1], CENTROIDESx[,2], col ="green", pch = 19)


DISTx <- cbind(sqrt((MAT[,1]-CENTROIDESx[1,1])^2 +(MAT[,2]-CENTROIDESx[1,2])^2),
               sqrt((MAT[,1]-CENTROIDESx[2,1])^2 + (MAT[,2]-CENTROIDESx[2,2])^2),
               sqrt((MAT[,1]-CENTROIDESx[3,1])^2 + (MAT[,2]-CENTROIDESx[3,2])^2),
               sqrt((MAT[,1]-CENTROIDESx[4,1])^2 + (MAT[,2]-CENTROIDESx[4,2])^2))

GRUPOSx2 <- numeric()
for(i in 1:100){
  GRUPOSx2 <- c(GRUPOSx2, which(DISTx[i,]==min(DISTx[i,])))
}
print(rbind(table(GRUPOSx),
            table(GRUPOSx2)))
}
```

```
##       1 2 3  4
## [1,] 70 9 5 16
## [2,] 67 9 6 18
##       1 2 3  4
## [1,] 67 9 6 18
## [2,] 64 8 9 19
##       1 2  3  4
## [1,] 64 8  9 19
## [2,] 63 8 10 19
##       1 2  3  4
## [1,] 63 8 10 19
## [2,] 62 8 11 19
##       1 2  3  4
## [1,] 62 8 11 19
## [2,] 62 8 11 19
```

```
points(CENTROIDESx[,1], CENTROIDESx[,2], col ="purple", pch = 15)
for(i in 1:nrow(CENTROIDESx)) {points(MAT[GRUPOSx2==i, 1], MAT[GRUPOSx2==i, 2], pch=0, col=i)
polygon(MAT[GRUPOSx2==i,][chull(MAT[GRUPOSx2==i,]), ], border=i, lwd=2)}
```




```r
rbind(table(GRUPOSx),
      table(GRUPOSx2))
```

```
##       1 2  3  4
## [1,] 62 8 11 19
## [2,] 62 8 11 19
```

```r
sum(GRUPOSx2==GRUPOSx)
```

```
## [1] 100
```

```r
####SEMILLAS POR QUANTILES
plot(MAT[,1], MAT[,2])
quantile(MAT[,1], c(0.25, 0.75))
```

```
## 25% 75%
##   2   7
```

```r
quantile(MAT[,2], c(0.25, 0.75))
```

```
## 25% 75%
##   2   6
```

```r
points(c(2,2,6.25,6.25), c(2,6,6,2), pch = 19, col ="red")

DIST1 <- cbind(sqrt((MAT[,1]-2)^2 + (MAT[,2]-2)^2),
               sqrt((MAT[,1]-2)^2 + (MAT[,2]-6)^2),
               sqrt((MAT[,1]-6.25)^2 + (MAT[,2]-6)^2),
               sqrt((MAT[,1]-6.25)^2 + (MAT[,2]-2)^2))

GRUPOS <- numeric()
for(i in 1:100){
  GRUPOS <- c(GRUPOS, which(DIST1[i,]==min(DIST1[i,]))[1])
}
```

```r
CENTROIDES <- rbind(colMeans(MAT[GRUPOS==1,]),
                    colMeans(MAT[GRUPOS==2,]),
                    colMeans(MAT[GRUPOS==3,]),
                    colMeans(MAT[GRUPOS==4,]))
points(CENTROIDES[,1], CENTROIDES[,2], col ="blue", pch = 19)


DIST2 <- cbind(sqrt((MAT[,1]-CENTROIDES[1,1])^2 +(MAT[,2]-CENTROIDES[1,2])^2),
               sqrt((MAT[,1]-CENTROIDES[2,1])^2 + (MAT[,2]-CENTROIDES[2,2])^2),
               sqrt((MAT[,1]-CENTROIDES[3,1])^2 + (MAT[,2]-CENTROIDES[3,2])^2),
               sqrt((MAT[,1]-CENTROIDES[4,1])^2 + (MAT[,2]-CENTROIDES[4,2])^2))

GRUPOS2 <- numeric()
for(i in 1:100){
  GRUPOS2 <- c(GRUPOS2, which(DIST2[i,]==min(DIST2[i,])))
}
CENTROIDES <- rbind(colMeans(MAT[GRUPOS2==1,]),
                    colMeans(MAT[GRUPOS2==2,]),
                    colMeans(MAT[GRUPOS2==3,]),
                    colMeans(MAT[GRUPOS2==4,]))
points(CENTROIDES[,1], CENTROIDES[,2], col ="blue", pch = 19)

rbind(table(GRUPOS),
      table(GRUPOS2))
```

```
##       1  2  3  4
## [1,] 34 22 22 22
## [2,] 40 20 17 23
```

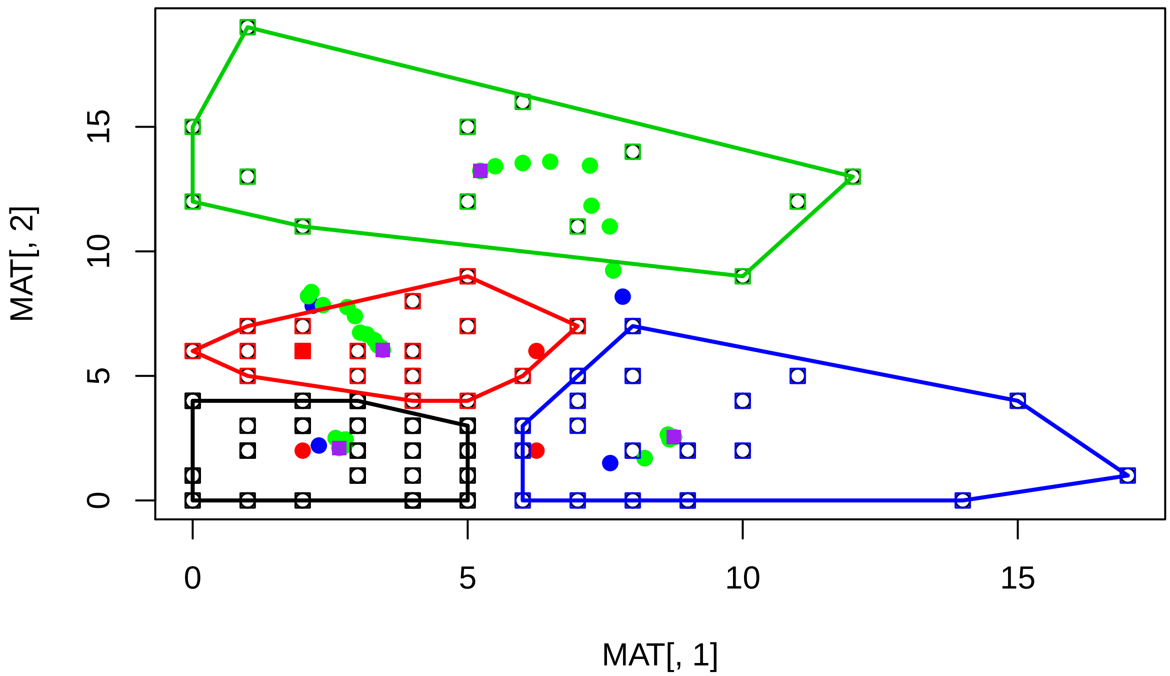
```r
sum(GRUPOS2==GRUPOS)
```

```
## [1] 90
```

```r
GRUPOSx2 <- GRUPOS2
GRUPOSx<- sample(GRUPOSx2)
while(sum(GRUPOSx2==GRUPOSx) != 100){
  GRUPOSx <- GRUPOSx2
  CENTROIDESx <- rbind(colMeans(MAT[GRUPOSx==1,]),
                       colMeans(MAT[GRUPOSx==2,]),
                       colMeans(MAT[GRUPOSx==3,]),
                       colMeans(MAT[GRUPOSx==4,]))
  points(CENTROIDESx[,1], CENTROIDESx[,2], col ="green", pch = 19)

  DISTx <- cbind(sqrt((MAT[,1]-CENTROIDESx[1,1])^2 +(MAT[,2]-CENTROIDESx[1,2])^2),
                 sqrt((MAT[,1]-CENTROIDESx[2,1])^2 + (MAT[,2]-CENTROIDESx[2,2])^2),
                 sqrt((MAT[,1]-CENTROIDESx[3,1])^2 + (MAT[,2]-CENTROIDESx[3,2])^2),
                 sqrt((MAT[,1]-CENTROIDESx[4,1])^2 + (MAT[,2]-CENTROIDESx[4,2])^2))

  GRUPOSx2 <- numeric()
  for(i in 1:100){
    GRUPOSx2 <- c(GRUPOSx2, which(DISTx[i,]==min(DISTx[i,])))
  }
  print(rbind(table(GRUPOSx),
              table(GRUPOSx2)))
}
```

```
##       1  2  3  4
## [1,] 40 20 17 23
## [2,] 45 19 12 24
##       1  2  3  4
## [1,] 45 19 12 24
## [2,] 45 19 12 24
##       1  2  3  4
## [1,] 45 19 12 24
## [2,] 45 21  9 25
##       1  2  3  4
## [1,] 45 21  9 25
## [2,] 45 20 10 25
##       1  2  3  4
## [1,] 45 20 10 25
## [2,] 41 23 11 25
##       1  2  3  4
## [1,] 41 23 11 25
## [2,] 41 24 11 24
##       1  2  3  4
## [1,] 41 24 11 24
## [2,] 41 23 12 24
##       1  2  3  4
## [1,] 41 23 12 24
## [2,] 41 22 13 24
##       1  2  3  4
## [1,] 41 22 13 24
## [2,] 40 23 13 24
##       1  2  3  4
## [1,] 40 23 13 24
## [2,] 39 24 13 24
##       1  2  3  4
## [1,] 39 24 13 24
## [2,] 39 24 13 24
```

```r
points(CENTROIDESx[,1], CENTROIDESx[,2], col ="purple", pch = 15)
for(i in 1:nrow(CENTROIDESx)){points(MAT[GRUPOSx2==i, 1], MAT[GRUPOSx2==i, 2], pch=0, col=i)
polygon(MAT[GRUPOSx2==i,][chull(MAT[GRUPOSx2==i,]), ], border =i, lwd=2)}
```




```
rbind(table(GRUPOSx),
      table(GRUPOSx2))
```

```
##       1  2  3  4
## [1,] 39 24 13 24
## [2,] 39 24 13 24
```

```
sum(GRUPOSx2==GRUPOSx)
```

```
## [1] 100
```

```
sum(dist(MAT[GRUPOSx2==1],))/sum(GRUPOSx2==1)
```

```
## [1] 130.1538
```

```
sum(dist(MAT[GRUPOSx2==2],))/sum(GRUPOSx2==2)
```

```
## [1] 106.6667
```

```
sum(dist(MAT[GRUPOSx2==3],))/sum(GRUPOSx2==3)
```

```
## [1] 152.9231
```

```
sum(dist(MAT[GRUPOSx2==4],))/sum(GRUPOSx2==4)
```

```
## [1] 211.125
```

```
#Kmeans
plot(MAT[,1], MAT[,2])
quantile(MAT[,1], c(0.25, 0.75))
```

```
## 25% 75%
##   2   7
```

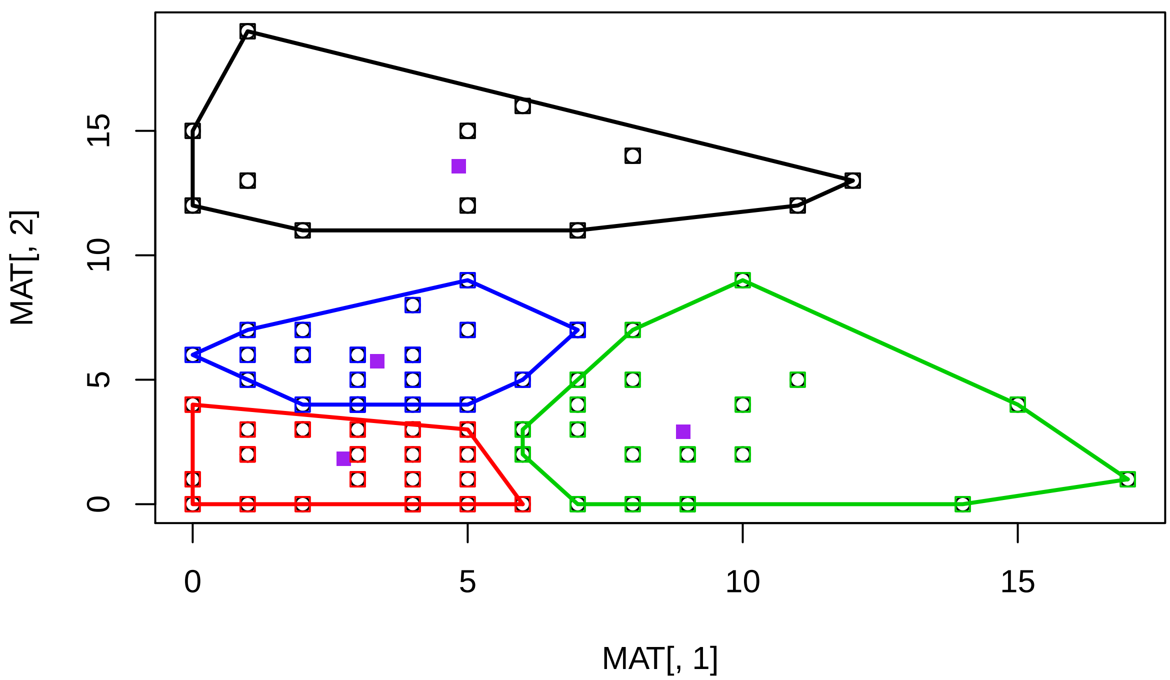
```
quantile(MAT[,2], c(0.25, 0.75))
```

```
## 25% 75%
##   2   6
```

```r
NGROUPS <- 4
KMENAS <- kmeans(MAT, centers = NGROUPS, algorithm="L")
KMENAS$cluster
```

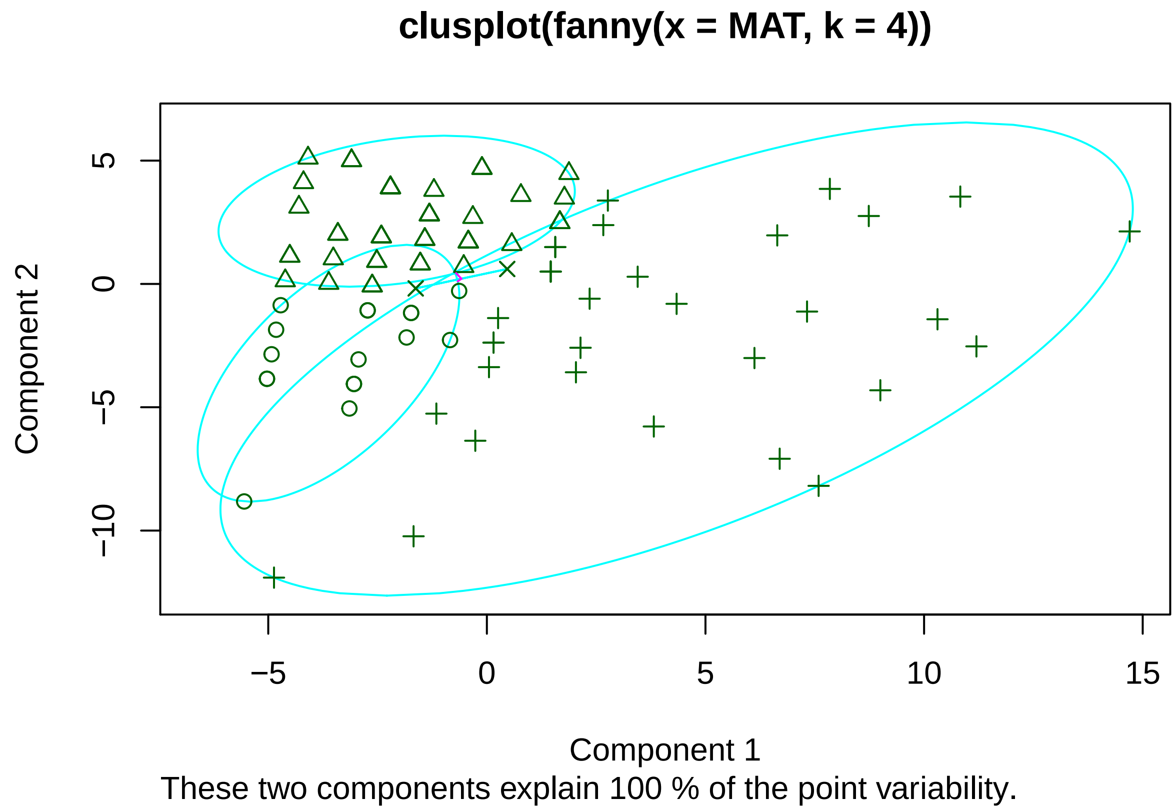
```
##   S1   S2   S3   S4   S5   S6   S7   S8   S9  S10  S11  S12  S13  S14  S15
##    3    2    3    2    3    1    3    3    2    2    4    2    2    3    4
##  S16  S17  S18  S19  S20  S21  S22  S23  S24  S25  S26  S27  S28  S29  S30
##    1    1    2    2    3    2    4    4    1    3    2    2    4    2    3
##  S31  S32  S33  S34  S35  S36  S37  S38  S39  S40  S41  S42  S43  S44  S45
##    3    2    3    2    4    1    2    3    3    3    2    4    2    4    1
##  S46  S47  S48  S49  S50  S51  S52  S53  S54  S55  S56  S57  S58  S59  S60
##    2    2    4    3    2    3    1    2    2    3    3    4    3    2    2
##  S61  S62  S63  S64  S65  S66  S67  S68  S69  S70  S71  S72  S73  S74  S75
##    4    3    2    4    4    1    2    1    4    2    3    4    4    2    4
##  S76  S77  S78  S79  S80  S81  S82  S83  S84  S85  S86  S87  S88  S89  S90
##    4    4    2    4    2    4    2    4    3    1    4    1    4    2    3
##  S91  S92  S93  S94  S95  S96  S97  S98  S99 S100
##    4    4    2    2    3    2    4    2    1    4
```

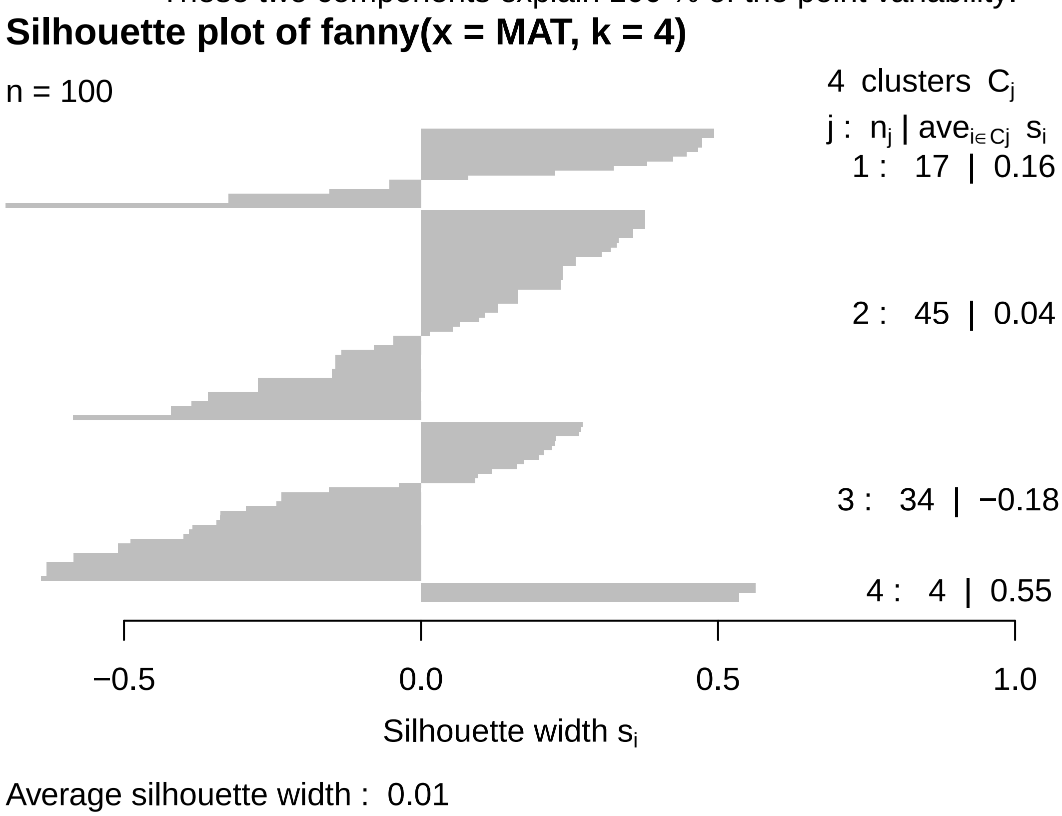
```r
points(KMENAS$centers[,1], KMENAS$centers[,2], col ="purple", pch = 15)
for(i in 1:NGROUPS) {points(MAT[KMENAS$cluster==i, 1], MAT[KMENAS$cluster==i, 2], pch=0, col=i)
polygon(MAT[KMENAS$cluster==i,][chull(MAT[KMENAS$cluster==i,]), ], border=i, lwd=2)}
```




```r
###MEDIODS
library(cluster)
plot(fanny(MAT, k=4))
```

```
## Warning in fanny(MAT, k = 4): FANNY algorithm has not converged in 'maxit'
## = 500 iterations
```


clusplot(fanny(x = MAT, k = 4))
Component 2
Component 1
These two components explain 100 % of the point variability.


Silhouette plot of fanny(x = MAT, k = 4)
n = 100
4 clusters C_j
j : n_j | $ave_{i \in Cj}$ s_i
1 : 17 | 0.16
2 : 45 | 0.04
3 : 34 | −0.18
4 : 4 | 0.55
Silhouette width s_i
Average silhouette width : 0.01