Devoir_4

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```
library("FactoMineR")
library("factoextra")
```

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

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

```
library("corrplot")
```

```
## corrplot 0.84 loaded
```

```
library("ca")
```

1.Chargement des données smoke

```
datasmoke <- ca::smoke
datasmoke
```

```
##    none light medium heavy
## SM    4     2      3     2
## JM    4     3      7     4
## SE   25    10     12     4
## JE   18    24     33    13
## SC   10     6      7     2
```

AFC et SVD généralisée

```
f <- as.matrix(datasmoke) / sum(datasmoke)
# distribution marginale ligne et colonne
r <- apply(f,1,sum)
c <- apply(f,2,sum)
# matrice Z
Z <- (f-r%*%t(c))/r%*%t(c)
```

Creation de la fonction gsvd

```
gsvd <- function(Z,r,c){
  #Z matrice numerique de dimension (n,p) et de rang k
  #r poids de la metrique des lignes N=diag(r)
  # c poids de la metrique des colonnes M=diag(c)
  #-----sortie---------------
  # d vecteur de taille k contenant les valeurs singulieres (racines carres des valeurs propres)
  # U matrice de dimension (n,k) des vecteurs propres de de ZMZ'N
  # V matrice de dimension (p,k) des vecteurs propres de de Z'NZM
  k <-qr(Z)$rank
  colnames<-colnames(Z)
  rownames<-rownames(Z)
```

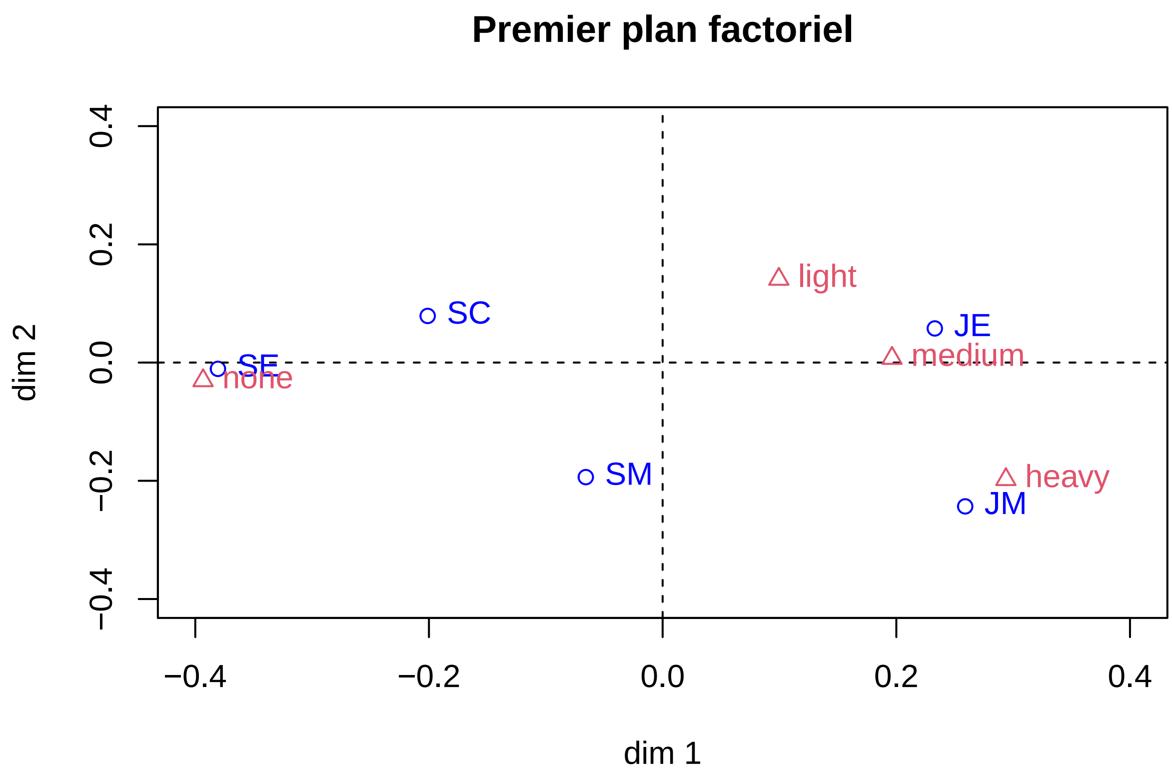
```
  Z <-as.matrix(Z)
  Ztilde <-diag(sqrt(r)) %*% Z %*%diag(sqrt(c))
  e <-svd(Ztilde)
  U <-diag(1/sqrt(r))%*%e$u[,1:k]# Attention : ne s'ecrit comme cela que parceque N et M sont diagonale
  V <-diag(1/sqrt(c))%*%e$v[,1:k]
  d <- e$d[1:k]
  rownames(U) <- rownames
  rownames(V) <- colnames
  if(length(d)>1)
    colnames(U) <-colnames(V) <-paste("dim", 1:k, sep = "")
  return(list(U=U,V=V,d=d))
}
```

Calcul de X(profil ligne), Y(profil colonne) et d

```
U <- gsvd(Z,r,c)$U
V <- gsvd(Z,r,c)$V
d <- gsvd(Z,r,c)$d
# Utilsation de la commande sweep pour calculer les cordonnés X et Y
X <- sweep(U,2,d,'*')
Y <- sweep(V,2,d,'*')
```

Representation de X et Y sur le premier plan de l'AFC

```
plot(X[,1:2],xlab="dim 1",ylab="dim 2",xlim=c(-0.4,0.4),ylim=c(-0.4,0.4),col="blue",main="Premier plan f
abline(v = 0, lty = 2)
abline(h = 0, lty = 2)
text(X[,1:2],rownames(datasmoke),col="blue",pos=4)
points(Y[,1:2],pch=2,col=2)
text(Y[,1:2],colnames(datasmoke),pos=4,col=2)
```



Le pourcentage d'inertie expliquée par le premier plan factoriel de l'AFC

```
IT <-sum(d^2) #Inertie totale
d[1:2]^2/IT*100 #pourcentage d'inertie des axes
```

```
## [1] 87.75587 11.75865
```

```
sum(d[1:2]^2/IT)*100#pourcentage d'inertie du plan
```

```
## [1] 99.51453
```

Les deux premières dimensions de l'AFC donnent 99.51% de la variation, donc le premier plan factoriel de L'AFC peut etre

3. Retrouvons ces résultats avec le package FactoMineR et la fonction CA

```
afc <- CA(datasmoke,graph = FALSE)
afc$eig
```

```
##          eigenvalue percentage of variance cumulative percentage of variance
## dim 1 0.0747591059             87.7558731                          87.75587
## dim 2 0.0100171805             11.7586535                          99.51453
## dim 3 0.0004135741              0.4854734                         100.00000
```

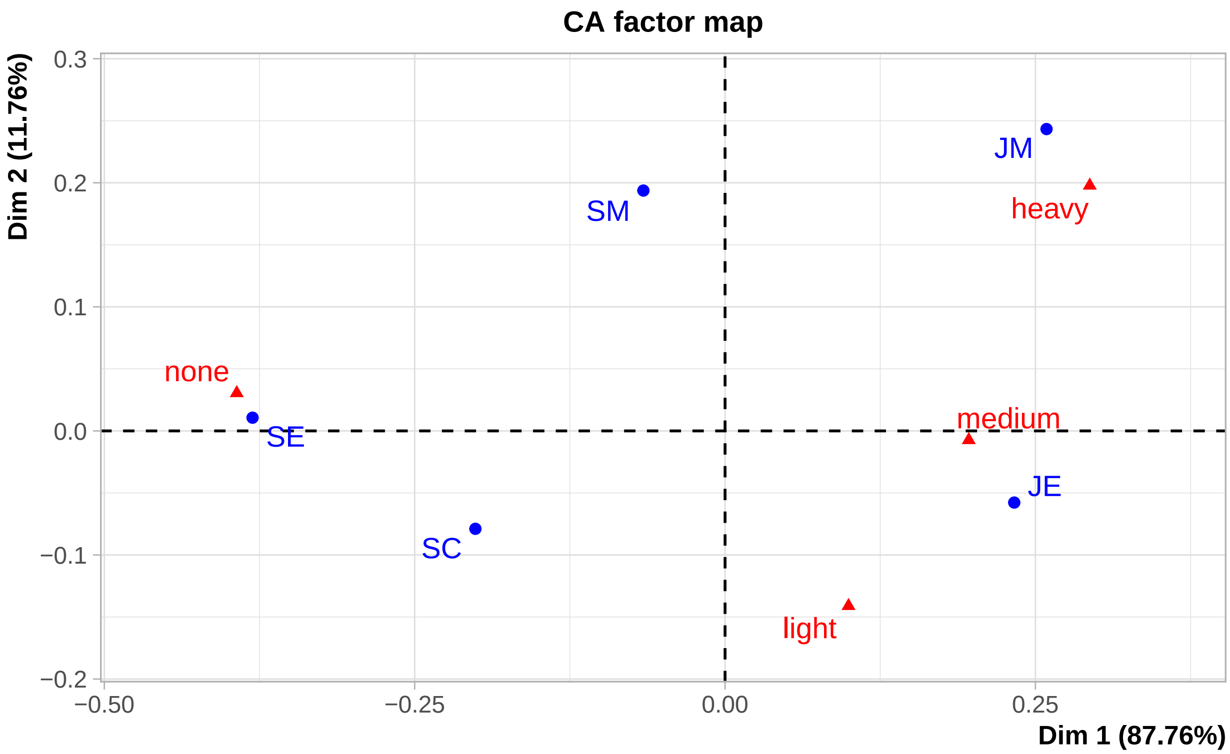
```
row <- get_ca_row(afc)
row$coord # matrice X
```

```
##           Dim 1       Dim 2        Dim 3
## SM -0.06576838  0.19373700  0.070981028
## JM  0.25895842  0.24330457 -0.033705190
## SE -0.38059489  0.01065991 -0.005155757
## JE  0.23295191 -0.05774391  0.003305371
## SC -0.20108912 -0.07891123 -0.008081076
```

```
col <- get_ca_col(afc)
col$coord # matrice Y
```

```
##               Dim 1        Dim 2         Dim 3
## none   -0.39330845  0.030492071 -0.0008904827
## light   0.09945592 -0.141064289  0.0219980349
## medium  0.19632096 -0.007359109 -0.0256590867
## heavy   0.29377599  0.197765656  0.0262108499
```

```
# representation de profil ligne(X) et profil colonne sur le plan
plot(afc)
```



Exercice 2:Données textuelles

Chargement du jeux de données

```
dataw <- read.csv("data/writers.csv",header = TRUE,row.names = 1)
head(dataw,4)
```

```
##      B  C  D  F  G  H  I  L  M  N  P  R  S  U  W  Y
## CD1 34 37 44 27 19 39 74 44 27 61 12 65 69 22 14 21
## CD2 18 33 47 24 14 38 66 41 36 72 15 62 63 31 12 18
## CD3 32 43 36 12 21 51 75 33 23 60 24 68 85 18 13 14
## RD1 13 31 55 29 15 62 74 43 28 73  8 59 54 32 19 20
```

```
summary(dataw)
```

```
##        B               C               D                F         
##  Min.   : 8.00   Min.   :14.00   Min.   :28.00   Min.   :12.00  
##  1st Qu.:13.00   1st Qu.:20.00   1st Qu.:40.00   1st Qu.:17.00  
##  Median :17.00   Median :28.00   Median :43.00   Median :24.00  
##  Mean   :17.76   Mean   :26.94   Mean   :47.65   Mean   :21.82  
##  3rd Qu.:19.00   3rd Qu.:33.00   3rd Qu.:55.00   3rd Qu.:26.00  
##  Max.   :34.00   Max.   :43.00   Max.   :80.00   Max.   :31.00  
##        G               H               I                L         
##  Min.   :11.00   Min.   :38.00   Min.   : 61.00   Min.   :15.00  
##  1st Qu.:16.00   1st Qu.:53.00   1st Qu.: 66.00   1st Qu.:33.00  
##  Median :19.00   Median :62.00   Median : 73.00   Median :39.00  
##  Mean   :21.18   Mean   :62.29   Mean   : 74.47   Mean   :36.47  
##  3rd Qu.:27.00   3rd Qu.:68.00   3rd Qu.: 75.00   3rd Qu.:43.00  
##  Max.   :40.00   Max.   :96.00   Max.   :116.00   Max.   :54.00  
##        M               N                P               R         
##  Min.   :20.00   Min.   : 57.00   Min.   : 8.00   Min.   :40.00  
##  1st Qu.:25.00   1st Qu.: 68.00   1st Qu.:13.00   1st Qu.:56.00  
```

```
##  Median :29.00   Median : 71.00   Median :15.00   Median :63.00
##  Mean   :29.59   Mean   : 75.18   Mean   :16.12   Mean   :60.06
##  3rd Qu.:35.00   3rd Qu.: 78.00   3rd Qu.:17.00   3rd Qu.:68.00
##  Max.   :40.00   Max.   :129.00   Max.   :30.00   Max.   :78.00
##        S                U               W               Y
##  Min.   : 54.00   Min.   :18.00   Min.   :11.00   Min.   : 9.00
##  1st Qu.: 63.00   1st Qu.:20.00   1st Qu.:14.00   1st Qu.:14.00
##  Median : 67.00   Median :22.00   Median :20.00   Median :18.00
##  Mean   : 69.94   Mean   :26.06   Mean   :24.18   Mean   :18.59
##  3rd Qu.: 72.00   3rd Qu.:31.00   3rd Qu.:25.00   3rd Qu.:23.00
##  Max.   :104.00   Max.   :50.00   Max.   :58.00   Max.   :30.00
```

Test de khi-deux

```
dataextr <- dataw[1:15,1:15]
chisq.test(dataextr)
```

```
##
##  Pearson's Chi-squared test
##
## data:  dataextr
## X-squared = 433.89, df = 196, p-value < 2.2e-16
```

Decision

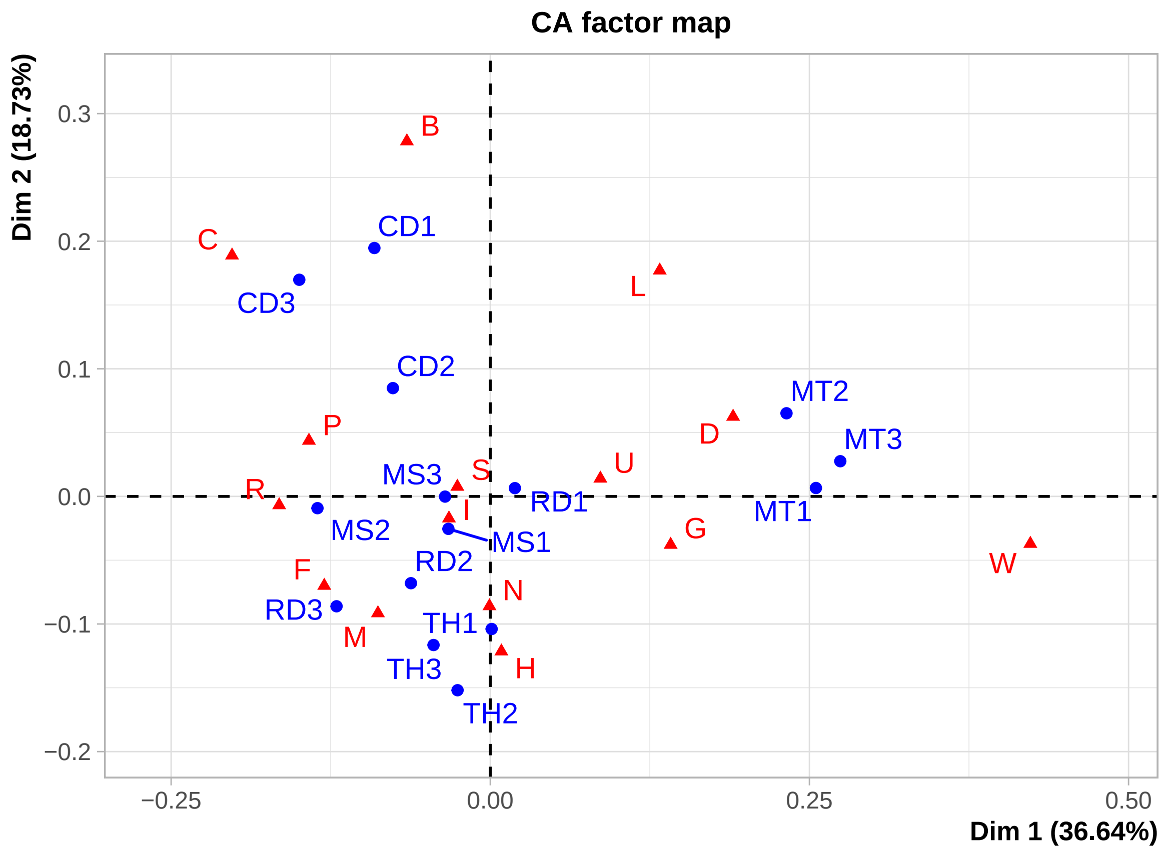
Le p-value est inferieur au seuil $\alpha = 0.05$ donc il y a une difference significative sur les distributions des lettres qui differe d'un echantillon a l'autre.

Realisation d'une ACP

```
caw1 <- CA(dataextr,graph = FALSE)
caw1$eig
```

```
##          eigenvalue percentage of variance cumulative percentage of variance
## dim 1  1.819711e-02            36.64273828                          36.64274
## dim 2  9.300360e-03            18.72773574                          55.37047
## dim 3  7.320330e-03            14.74063391                          70.11111
## dim 4  5.535310e-03            11.14621554                          81.25732
## dim 5  3.666189e-03             7.38244803                          88.63977
## dim 6  1.964005e-03             3.95483274                          92.59460
## dim 7  1.561611e-03             3.14454947                          95.73915
## dim 8  9.116786e-04             1.83580804                          97.57496
## dim 9  6.636511e-04             1.33636565                          98.91133
## dim 10 3.210046e-04             0.64639309                          99.55772
## dim 11 1.415890e-04             0.28511167                          99.84283
## dim 12 3.807211e-05             0.07666418                          99.91950
## dim 13 2.206443e-05             0.04443019                          99.96393
## dim 14 1.791440e-05             0.03607346                         100.00000
```

```
plot(caw1)
```

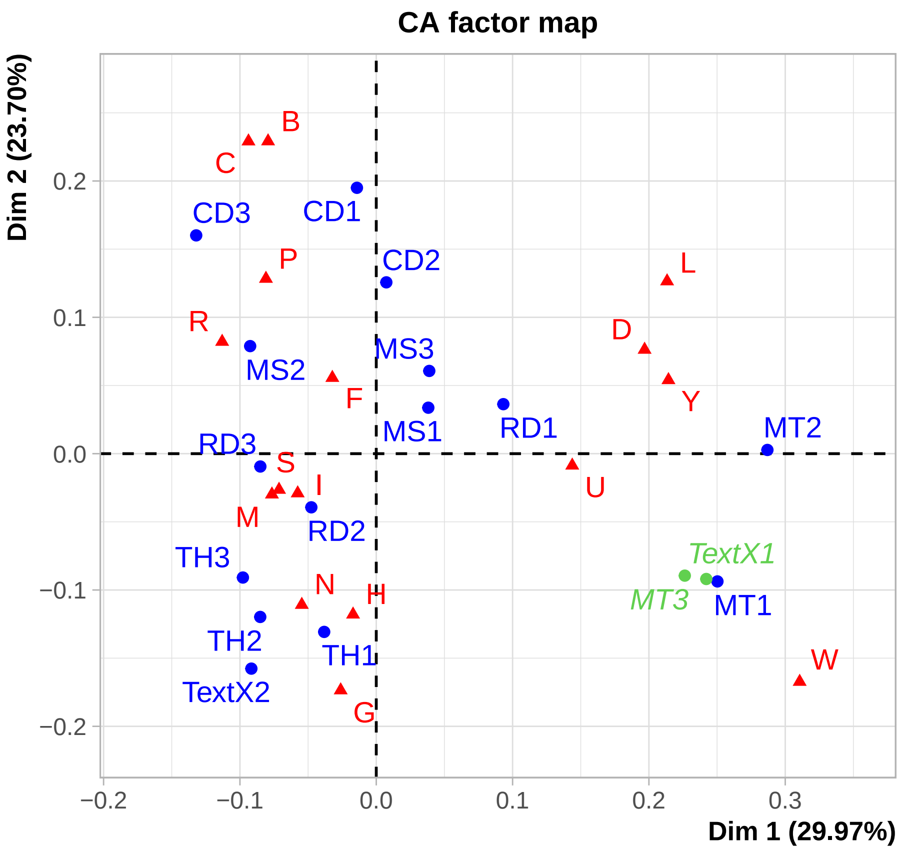


AFC en ajoutant les deux textes inconnus en lignes supplémentaires

```
caw2 <- CA(dataw,row.sup=c(15,16),graph = FALSE)
caw2$eig
```

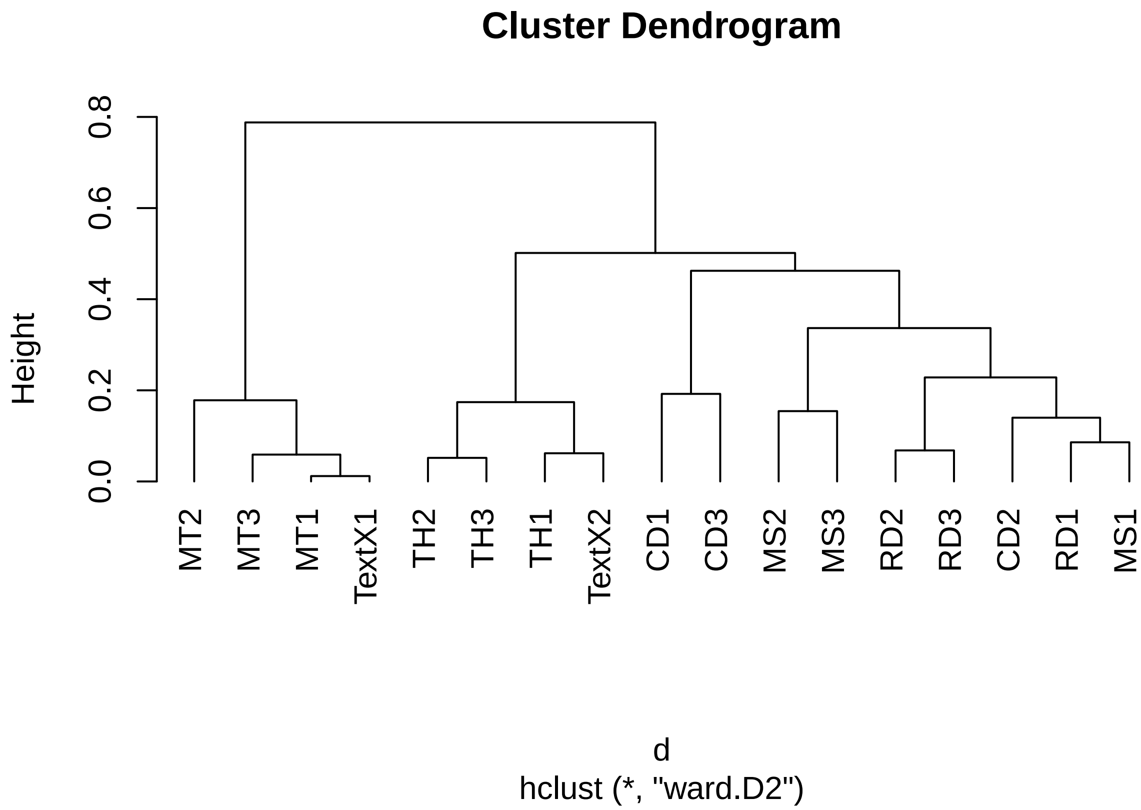
```
##           eigenvalue percentage of variance cumulative percentage of variance
## dim 1  1.450860e-02           29.970421699                          29.97042
## dim 2  1.147339e-02           23.700583507                          53.67101
## dim 3  6.721180e-03           13.883942471                          67.55495
## dim 4  5.494277e-03           11.349528710                          78.90448
## dim 5  4.558295e-03            9.416071315                          88.32055
## dim 6  2.126041e-03            4.391763249                          92.71231
## dim 7  1.441874e-03            2.978478544                          95.69079
## dim 8  7.780333e-04            1.607183532                          97.29797
## dim 9  5.629991e-04            1.162987380                          98.46096
## dim 10 3.741861e-04            0.772956324                          99.23392
## dim 11 2.224399e-04            0.459494134                          99.69341
## dim 12 9.447666e-05            0.195160454                          99.88857
## dim 13 5.306802e-05            0.109622626                          99.99819
## dim 14 8.743066e-07            0.001806055                         100.00000
```

```
plot(caw2,col.row.sup=3)
```



Classification ascendante hiérarchique de Ward

```r
#matrice des coordonnees factorielles sur 4 dimensionsX
mcf <- rbind(caw2$row$coord[,1:4],caw2$row.sup$coord[,1:4])
#matrice de distance euclidiennes entre les 17 echantillons
d <-dist(mcf)
#CAH
tree <-hclust(d,method="ward.D2")
plot(tree,hang=-1)
```




```r
#partition en 4 classes
cutree(tree,k=4)
```

```
##    CD1    CD2    CD3    RD1    RD2    RD3    TH1    TH2    TH3    MS1    MS2
##      1      2      1      2      2      2      3      3      3      2      2
##    MS3    MT1    MT2 TextX2    MT3 TextX1
##      2      4      4      3      4      4
```