

PROJET 8: Scooter

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```
library("readxl")
d = read_excel("/home/v/r/vreau/Documents/4A/MA/mod_av_projet_scooter/scooter.xls")
#class(d)
d = as.data.frame(d)
str(d) # affiche la structure (le type) des données

## 'data.frame': 416 obs. of 26 variables:
## $ ident : num 1 2 3 4 5 6 7 8 9 10 ...
## $ sexe : chr "femme" "homme" "homme" "homme" ...
## $ âge : chr "25-29 ans" "30-39 ans" "25-29 ans" "30-39 ans" ...
## $ CSP : chr "employé" "classe moyenne" "employé" "ouvrier" ...
## $ type-cylindrée : chr "125" "150-200" "150-200" "125" ...
## $ type-utilisation : chr "domicile-travail" "domicile-travail" "domicile-travail" "domicile-tra
## $ critère-esthétique : chr "à la mode" "innovant nouveau" "sportif" "innovant nouveau" ...
## $ note-satisfaction : chr "8" "10" "8" "8" ...
## $ imp-magasin : num 5 4 2 4 3 5 3 1 2 3 ...
## $ imp-marque : num 3 4 4 4 3 3 3 5 4 4 ...
## $ imp-esthétique : num 5 5 5 4 4 4 5 5 5 4 ...
## $ imp-prix : num 4 3 4 4 4 3 5 3 4 5 ...
## $ imp-confort-pilote : num 5 4 4 3 4 4 5 5 4 5 ...
## $ imp-confort-passager: num 4 4 4 2 2 4 4 3 4 3 ...
## $ imp-dimensions : num 4 4 3 4 3 4 3 3 5 5 ...
## $ imp-freinage : num 3 4 4 5 4 5 5 5 1 5 ...
## $ imp-cylindrée : num 4 5 4 4 5 4 4 4 4 5 ...
## $ imp-antivol : num 5 2 3 2 3 4 3 5 1 3 ...
## $ imp-tableau-de-bord : num 4 3 2 2 4 3 3 4 3 4 ...
## $ imp-accessoires : num 5 5 2 4 4 3 3 3 3 3 ...
## $ imp-rangement : num 4 5 4 4 4 4 3 3 3 3 ...
## $ imp-propulsion : num 3 5 5 3 5 4 5 3 3 5 ...
## $ imp-refroidissement : num 3 5 3 2 5 4 5 2 3 5 ...
## $ imp-tablier-avant : num 3 4 1 2 5 5 5 4 3 3 ...
## $ imp-feux : num 4 5 4 3 5 5 5 5 3 3 ...
## $ imp-fiabilité-moteur: num 4 5 5 4 5 5 4 5 5 5 ...

# préparation de données
rownames(d)<-d$ident
d<-d[,-1]
#head(d)

# Transformation des types des variables
for (i in 1:6){
  d[,names(d)[i]] = as.factor(d[,names(d)[i]])
}
d$`note-satisfaction`= as.numeric(d$`note-satisfaction`)
```

```
# création d'un dataframe avec uniquement les variables quantitatives
```

```
dnum = d[,7:25]
```

```
str(d)
```

```
## 'data.frame': 416 obs. of 25 variables:
## $ sexe : Factor w/ 2 levels "femme","homme": 1 2 2 2 2 2 2 1 2 ...
## $ âge : Factor w/ 7 levels "16-17 ans","18-19 ans",...: 4 5 4 5 6 5 4 4 5 7 ...
## $ CSP : Factor w/ 6 levels "classe moyenne",...: 4 1 4 6 1 3 1 4 4 3 ...
## $ type-cylindrée : Factor w/ 4 levels "100","125","150-200",...: 2 3 3 2 4 4 4 3 3 4 ...
## $ type-utilisation : Factor w/ 3 levels "domicile-travail",...: 1 1 1 1 1 1 1 1 1 1 ...
## $ critère-esthétique : Factor w/ 7 levels "à la mode","classique",...: 1 4 7 4 4 3 7 2 2 4 ...
## $ note-satisfaction : num 8 10 8 8 9 9 7 9 9 9 ...
## $ imp-magasin : num 5 4 2 4 3 5 3 1 2 3 ...
## $ imp-marque : num 3 4 4 4 3 3 3 5 4 4 ...
## $ imp-esthétique : num 5 5 5 4 4 4 5 5 5 4 ...
## $ imp-prix : num 4 3 4 4 4 3 5 3 4 5 ...
## $ imp-confort-pilote : num 5 4 4 3 4 4 5 5 4 5 ...
## $ imp-confort-passager: num 4 4 4 2 2 4 4 3 4 3 ...
## $ imp-dimensions : num 4 4 3 4 3 4 3 3 5 5 ...
## $ imp-freinage : num 3 4 4 5 4 5 5 5 1 5 ...
## $ imp-cylindrée : num 4 5 4 4 5 4 4 4 4 5 ...
## $ imp-antivol : num 5 2 3 2 3 4 3 5 1 3 ...
## $ imp-tableau-de-bord : num 4 3 2 2 4 3 3 4 3 4 ...
## $ imp-accessoires : num 5 5 2 4 4 3 3 3 3 3 ...
## $ imp-rangement : num 4 5 4 4 4 4 3 3 3 3 ...
## $ imp-propulsion : num 3 5 5 3 5 4 5 3 3 5 ...
## $ imp-refroidissement : num 3 5 3 2 5 4 5 2 3 5 ...
## $ imp-tablier-avant : num 3 4 1 2 5 5 5 4 3 3 ...
## $ imp-feux : num 4 5 4 3 5 5 5 5 3 3 ...
## $ imp-fiabilité-moteur: num 4 5 5 4 5 5 4 5 5 5 ...
```

```
#summary(d)
```

```
stat_uni = function(x)
{
  return(c(length(na.omit(x)),
           length(x[is.na(x)]),
           min(x, na.rm=TRUE),
           max(x, na.rm=TRUE),
           mean(x, na.rm=TRUE),
           median(x, na.rm=TRUE),
           sd(x, na.rm=TRUE)))
}

res_stat_uni = apply(dnum, 2, "stat_uni")
row.names(res_stat_uni) = c("Nobs",
                           "N_manq.",
                           "Min",
                           "Max",
                           "Moyenne",
                           "Mediane",
                           "Ecart-type")
```

```
#print(round(t(res_stat_uni),3))
knitr::kable(round(t(res_stat_uni),3), format = "markdown", align = 'r')
```

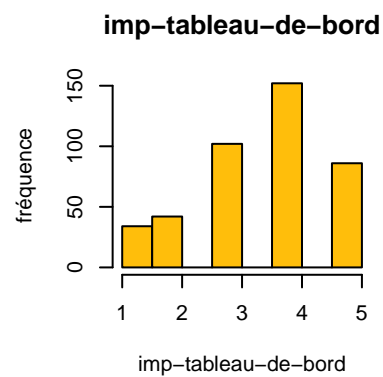
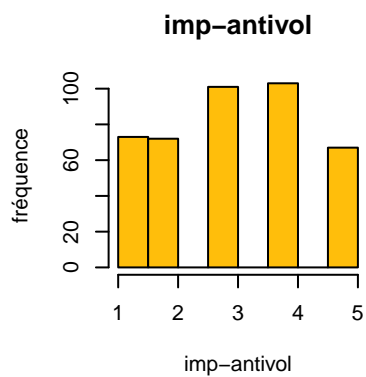
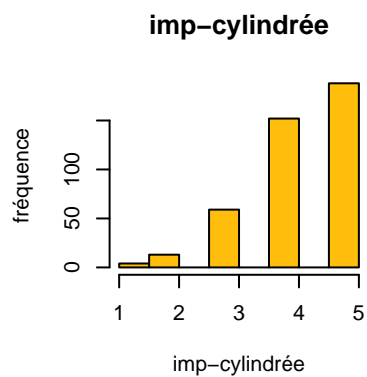
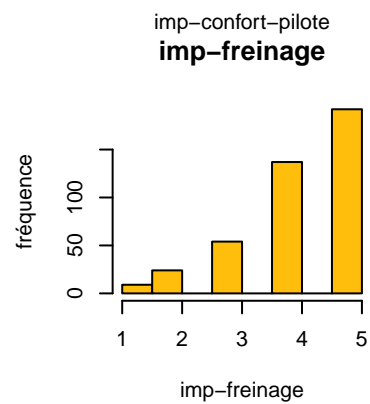
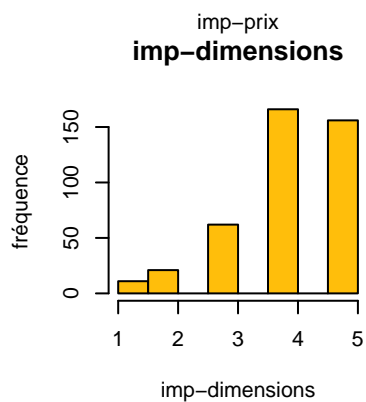
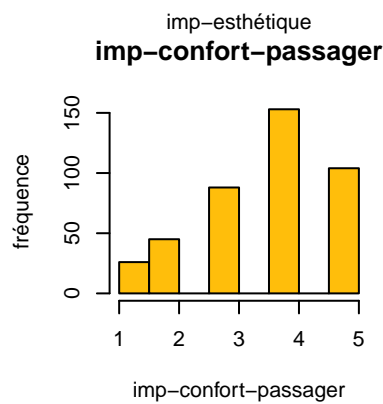
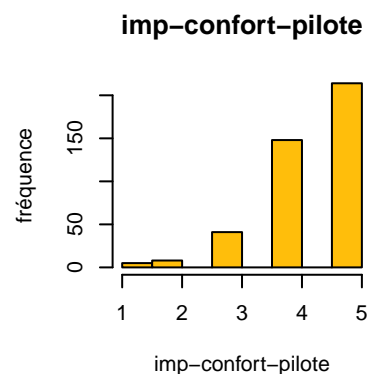
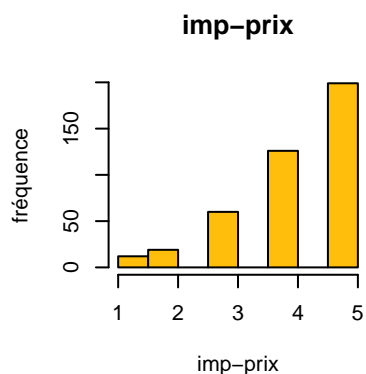
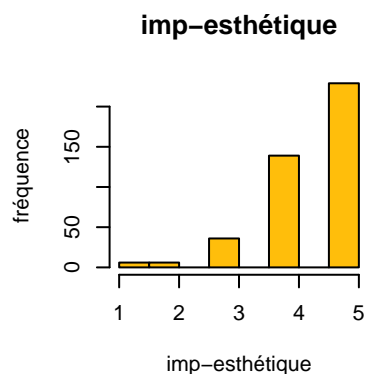
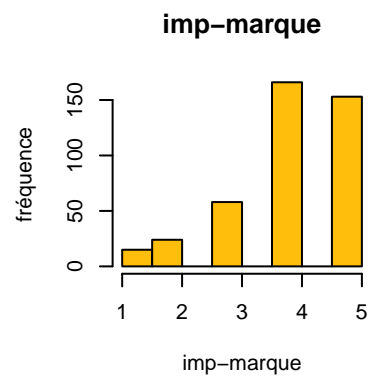
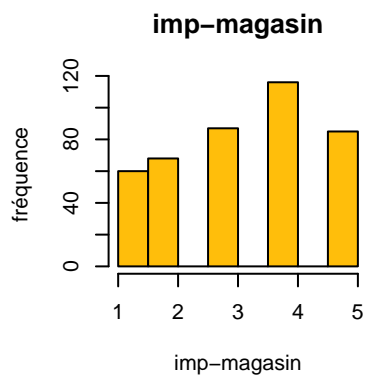
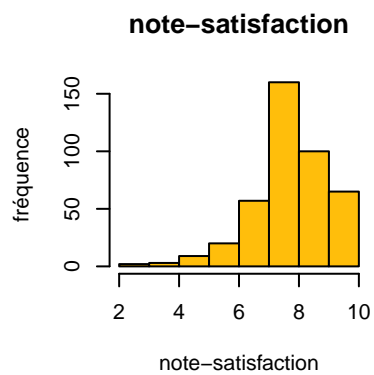
	Nobs	N_manq.	Min	Max	Moyenne	Mediane	Ecart-type
note-satisfaction	416	0	2	10	8.200	8	1.271
imp-magasin	416	0	1	5	3.236	3	1.336
imp-marque	416	0	1	5	4.005	4	1.032
imp-esthétique	416	0	1	5	4.392	5	0.820
imp-prix	416	0	1	5	4.156	4	1.021
imp-confort-pilote	416	0	1	5	4.341	5	0.827
imp-confort-passager	416	0	1	5	3.635	4	1.152
imp-dimensions	416	0	1	5	4.046	4	0.982
imp-freinage	416	0	1	5	4.151	4	0.998
imp-cylindrée	416	0	1	5	4.219	4	0.871
imp-antivol	416	0	1	5	3.046	3	1.330
imp-tableau-de-bord	416	0	1	5	3.514	4	1.166
imp-accessoires	416	0	1	5	3.457	4	1.220
imp-rangement	416	0	1	5	3.740	4	1.050
imp-propulsion	416	0	1	5	3.901	4	1.088
imp-refroidissement	416	0	1	5	3.601	4	1.134
imp-tablier-avant	416	0	1	5	3.411	4	1.365
imp-feux	416	0	1	5	4.053	4	1.019
imp-fiabilité-moteur	416	0	1	5	4.469	5	0.757

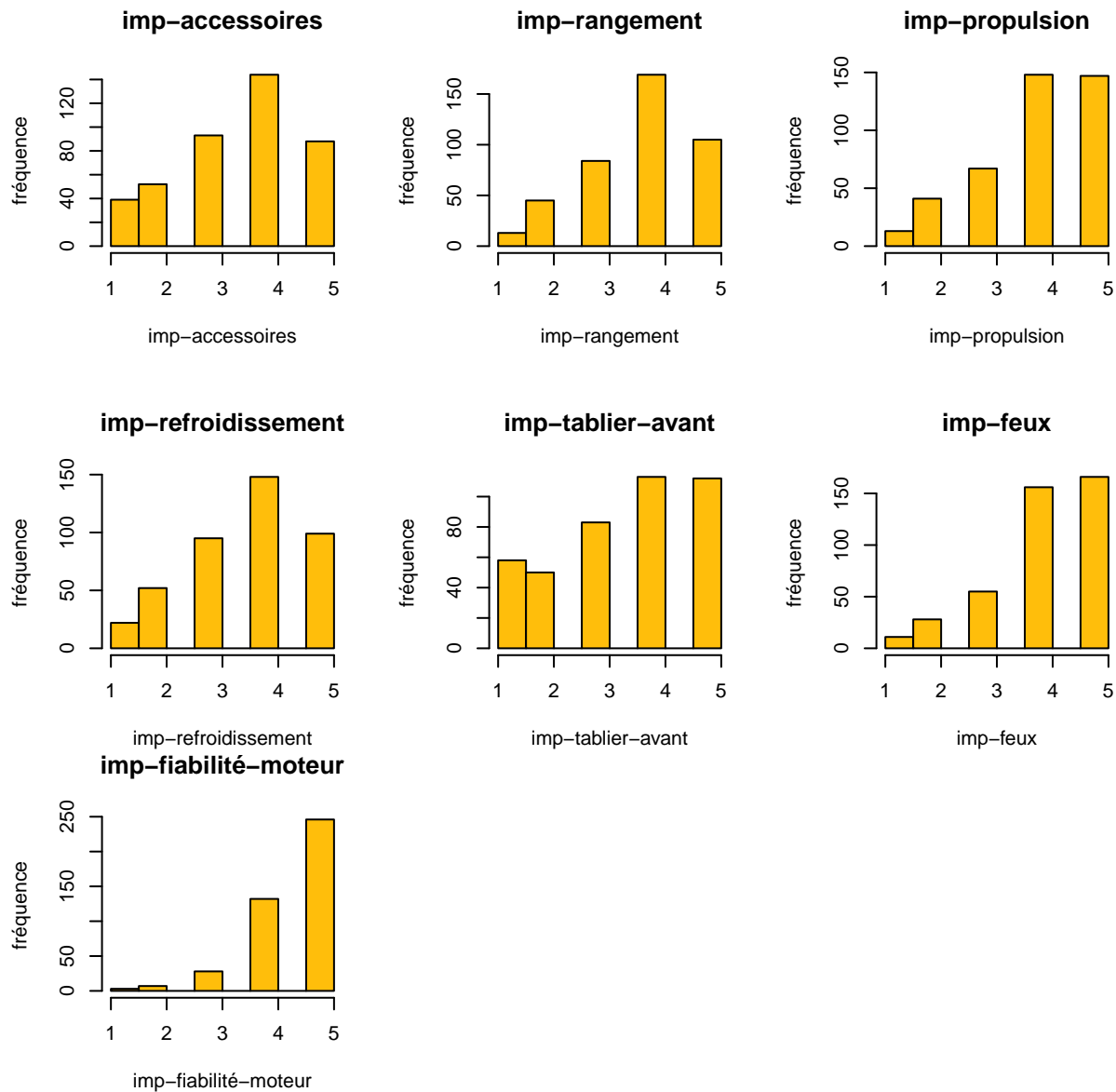
On observe que toutes les variables n'ont aucune valeurs manquantes. Pour les variables numériques toutes les impressions ont un minimum de 1 et un maximum de 5. Les moyennes sont comprises entre 3.046 et 4.469. De fait, les scores sont plutôt élevés en général. Concernant la note de satisfaction, la moyenne est de 8,2 ce qui montre que les clients sont globalement satisfait de leur scooter.

Histogrammes des variables

On retrouve bien dans les histogrammes des valeurs élevées (3,4,5) qui ont une fréquence importante.

```
par(mfrow=c(2,3))
for(i in 1:ncol(dnum))
{
  hist(dnum[,names(dnum)[i]],
       xlab = names(dnum)[i],
       ylab = "fréquence",
       col = "#ffbe0b",
       main = names(dnum)[i])
}
```





Statistiques bivariées

On nous demande de différencier les hommes des femmes pour savoir quels types de scooter offrir à l'un et à l'autre. Pour tester si les variables quantitatives d'impression changent en fonction du sexe, on réalise des boxplots avec la variable sexe mais on calcule également le rapport de corrélation entre ceux-ci.

```
#install.packages('BioStatR')
library('BioStatR')
res_cor = list()
for (i in 1:ncol(dnum)) {
  res_cor <- append(res_cor, eta2(dnum[,i], d$sexe), i-1)
}
res_cor <- as.data.frame(res_cor)
colnames(res_cor) <- c("note_satisf",
                      "magasin",
                      "marque",
                      "esthetique",
```

```

      "prix",
      "confort-pilote",
      "confort-passager",
      "dimensions",
      "freinage",
      "cylindree",
      "antivol",
      "tableau-de-bord",
      "accessoires",
      "rangement",
      "propulsion",
      "refroidissement",
      "tablier-avant",
      "feux",
      "fiabilite-moteur")
row.names(res_cor)="sexe"
knitr::kable(round(res_cor,3), format = "markdown", padding = 7, align = 'c')

```

	note_satisf	marques	esthetique	confort-pilote	confort-passager	dimensions	freinage	cylindree	antivol	tableau-de-bord	accessoires	rangement	propulsion	refroidissement	tablier-avant	fiabilite-moteur			
sexe	0.029	0.003	0	0.009	0.009	0.005	0.002	0.001	0.018	0.03	0.001	0.001	0	0.001	0.047	0.021	0.001	0	0

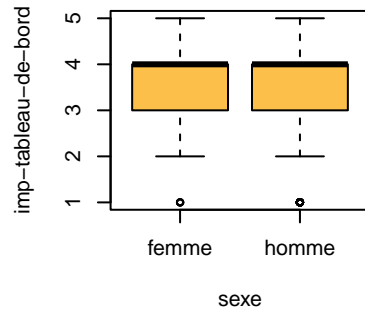
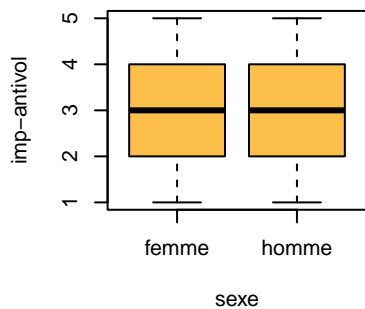
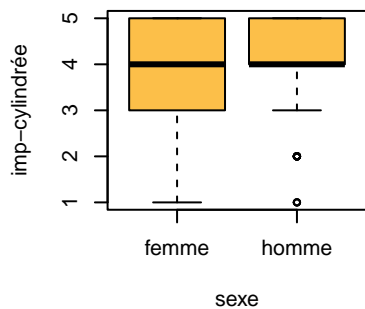
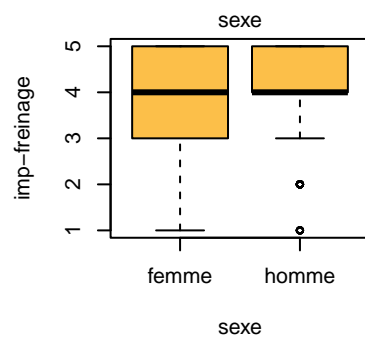
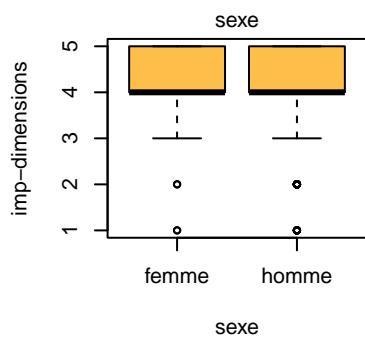
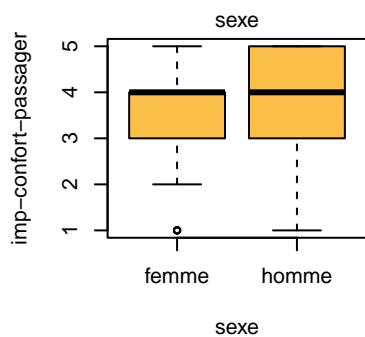
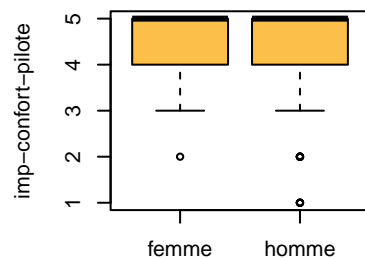
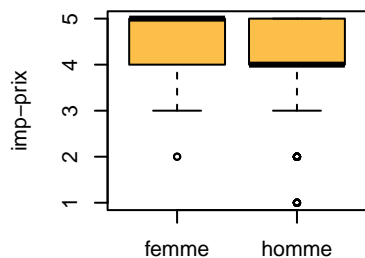
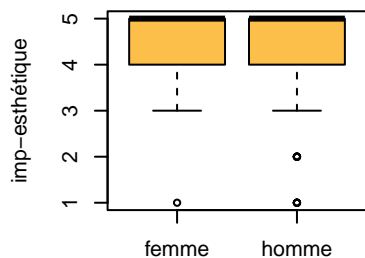
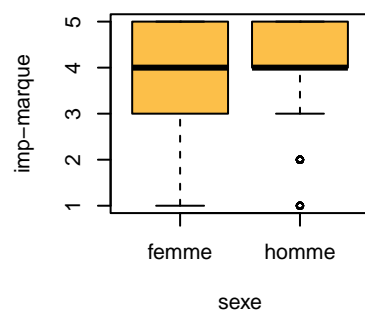
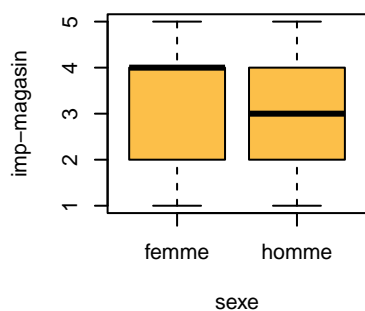
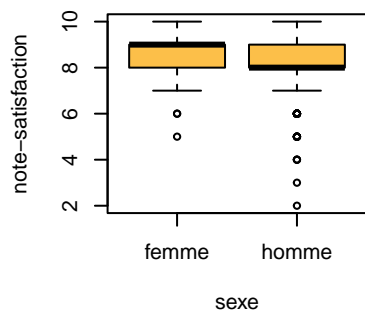
Boîtes à moustaches

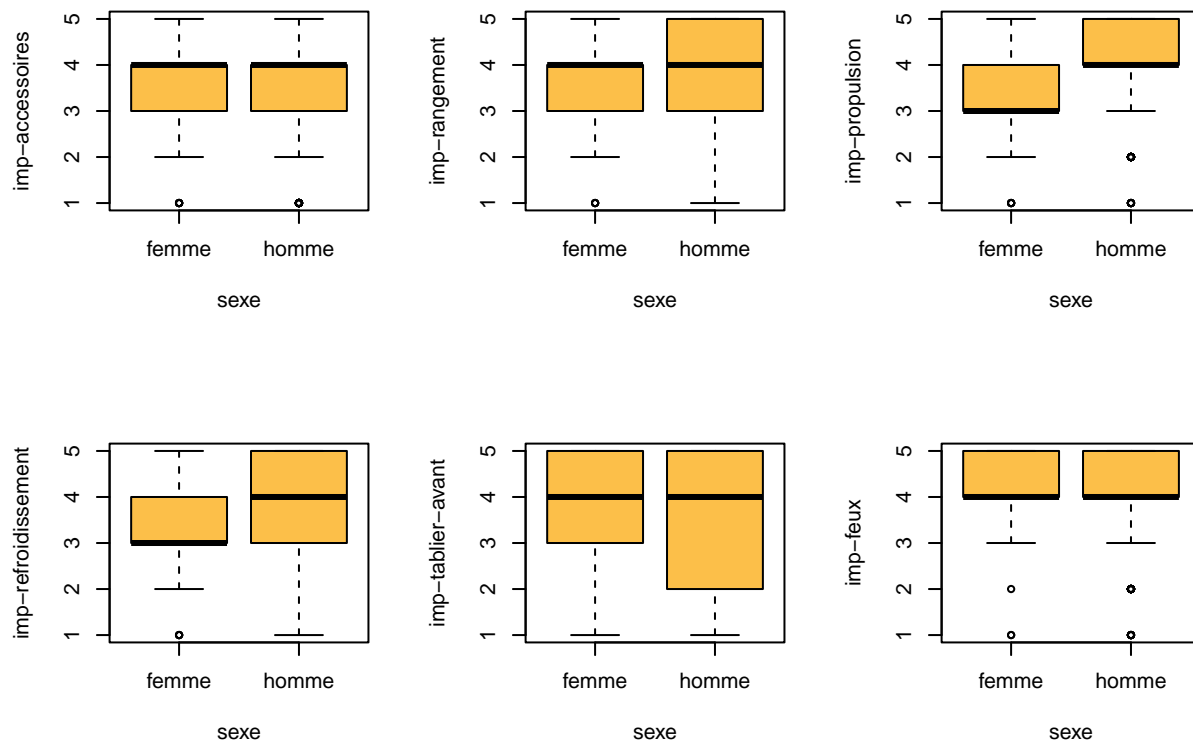
Pour démontrer la colinéarité entre une variable qualitative et une quantitative les boxplots sont utiles. Ici, on remarque que pour certaines variables, les boxplots sont disjointes ce qui indique une colinéarité entre les deux variables. On retient alors

```

par(mfrow=c(2,3))
for(i in 1:ncol(dnum))
{
  boxplot(dnum[,names(dnum)[i]]~d[,names(d)[1]],
          xlab = names(d)[1],
          ylab = names(dnum)[i],
          col = "#fcbf49")
}

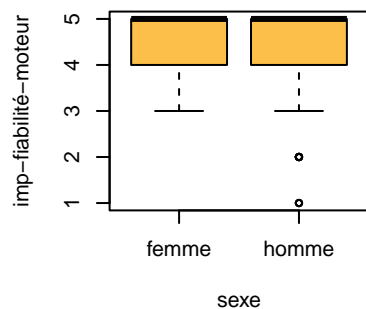
```





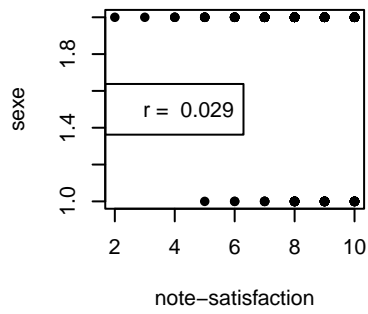
```
title("Boites à moustaches", outer=TRUE, line=-1)
```

Boites à moustaches

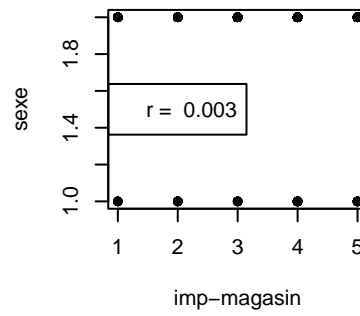


```
par(mfrow=c(2,3))
for(i in 1:ncol(dnum))
{
plot(dnum[,i], d[,1],
     xlab = names(dnum)[i],
     ylab = "sexe",
     pch=16,
     main = paste("sexe vs", names(dnum)[i]))
legend("left", paste("r = ", round(res_cor[i], 3)))
}
```

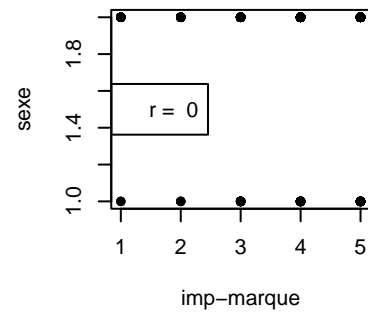

sexe vs note-satisfaction



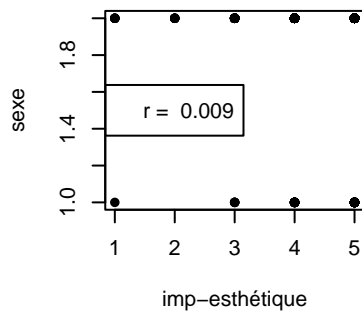
sexe vs imp-magasin



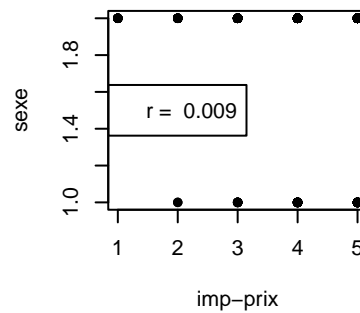
sexe vs imp-marque



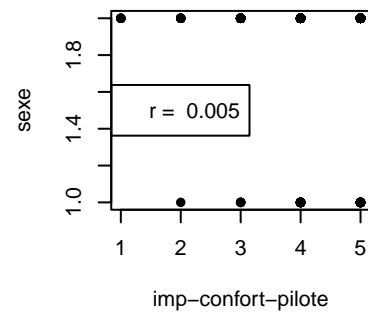
sexe vs imp-esthétique



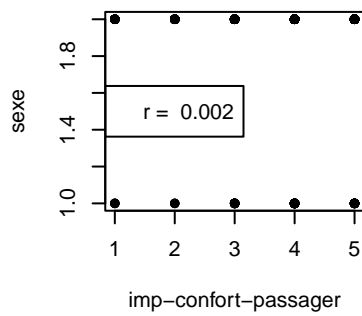
sexe vs imp-prix



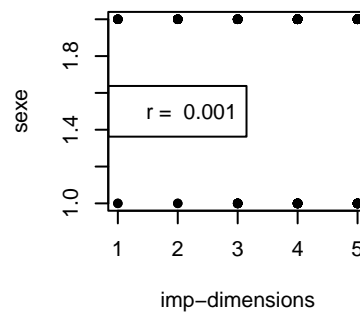
sexe vs imp-confort-pilote



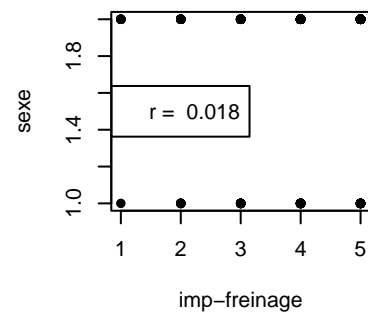
sexe vs imp-confort-passage



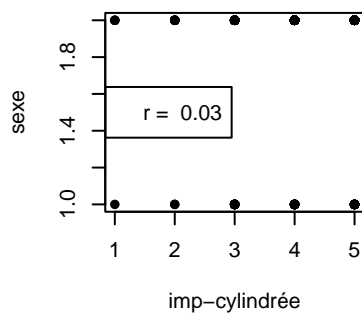
sexe vs imp-dimensions



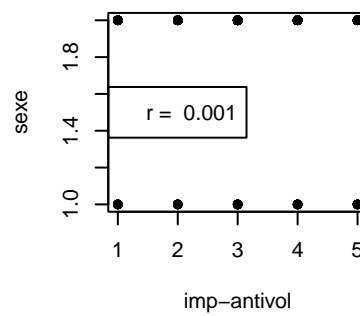
sexe vs imp-freinage



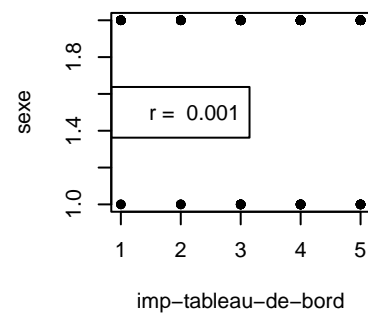
sexe vs imp-cylindrée

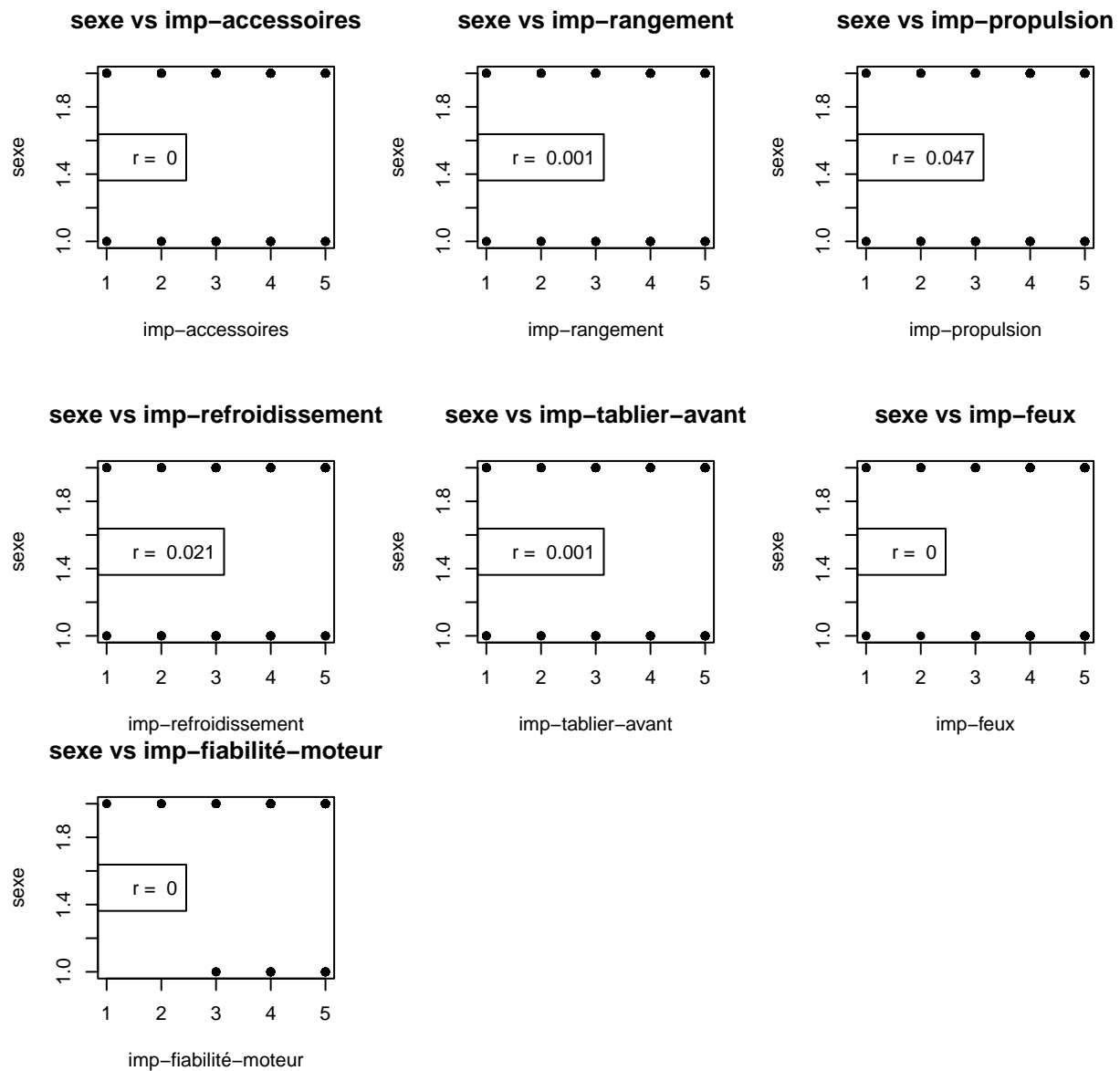


sexe vs imp-antivol



sexe vs imp-tableau-de-bord





```
# install.packages("Factoshiny")
#library(Factoshiny)
#Factoshiny(d)
```

Analyse Factorielle des Données Mixtes (AFDM)

```
library(ade4)
library(FactoMineR)
```

```
##
## Attachement du package : 'FactoMineR'
## L'objet suivant est masqué depuis 'package:ade4':
##
##      reconst
```

```

library(factoextra)

## Le chargement a nécessité le package : ggplot2
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
library(ggplot2)
res.famd <- FAMD(d, ncp=5, graph = FALSE)
print(res.famd)

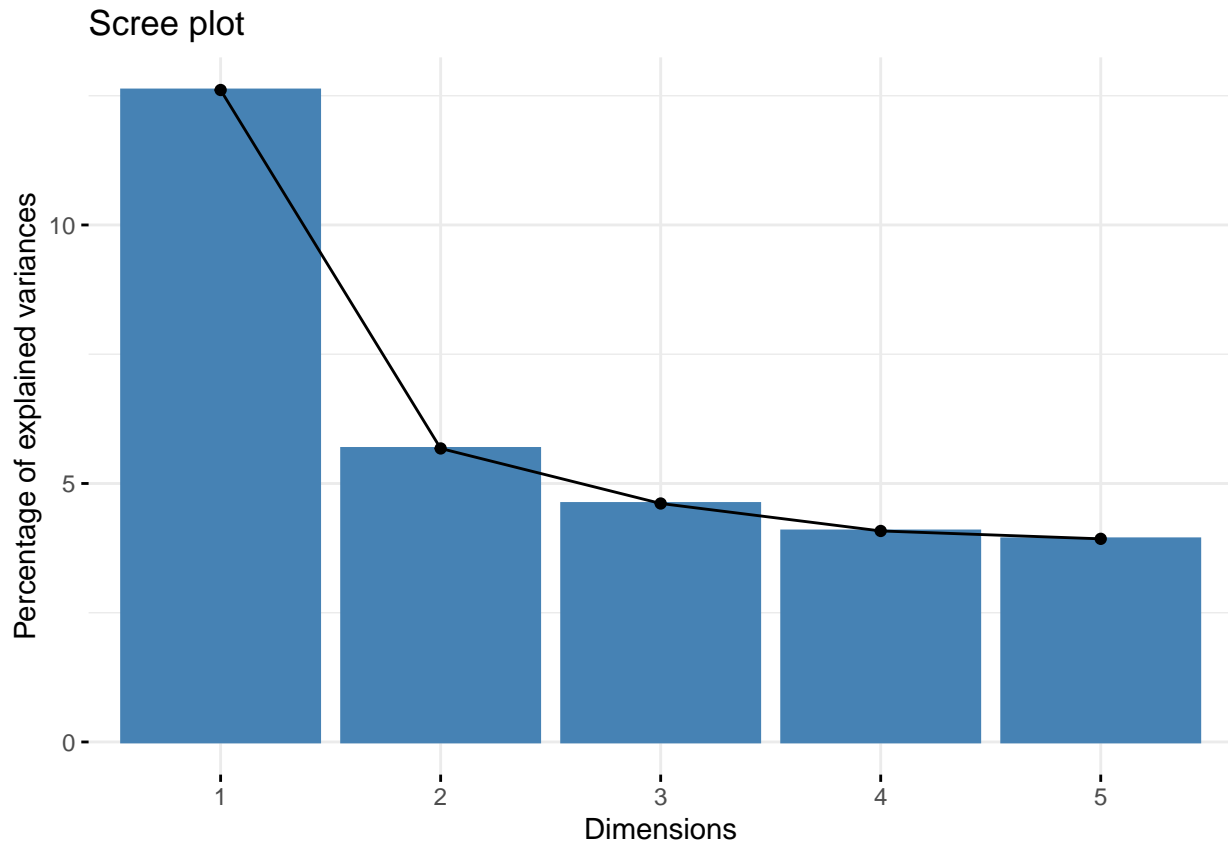
## *The results are available in the following objects:
##
##   name          description
## 1 "$eig"         "eigenvalues and inertia"
## 2 "$var"         "Results for the variables"
## 3 "$ind"         "results for the individuals"
## 4 "$quali.var"   "Results for the qualitative variables"
## 5 "$quanti.var"  "Results for the quantitative variables"

eig.val <- get_eigenvalue(res.famd)
head(eig.val)

##           eigenvalue variance.percent cumulative.variance.percent
## Dim.1      5.296559         12.610855             12.61086
## Dim.2      2.384476          5.677324             18.28818
## Dim.3      1.937483          4.613054             22.90123
## Dim.4      1.714276          4.081611             26.98284
## Dim.5      1.650307          3.929303             30.91215

fviz_screplot(res.famd)

```



Toutes les variables

```
var <- get_famd_var (res.famd)
var
```

```
## FAMD results for variables
## =====
##   Name      Description
## 1 "$coord"   "Coordinates"
## 2 "$cos2"    "Cos2, quality of representation"
## 3 "$contrib" "Contributions"
```

```
# Coordonnées des variables
```

```
head(var$coord)
```

	Dim.1	Dim.2	Dim.3	Dim.4	Dim.5
note-satisfaction	0.10902550	0.00781805	0.0897198193	0.10822265	0.015999200
imp-magasin	0.09709984	0.02197102	0.0645013688	0.01912591	0.015600416
imp-marque	0.25312438	0.01008336	0.0366904160	0.01831203	0.002826823
imp-esthétique	0.20439975	0.14250559	0.0005643929	0.01714071	0.079731715
imp-prix	0.01958007	0.09587287	0.2803671332	0.05269655	0.035163674
imp-confort-pilote	0.40901862	0.02697061	0.0031518118	0.02490856	0.019609810

```
# Cos2: qualité de représentation
```

```
head(var$cos2)
```

	Dim.1	Dim.2	Dim.3	Dim.4
note-satisfaction	0.011886560	6.112191e-05	8.049646e-03	0.0117121420
imp-magasin	0.009428378	4.827258e-04	4.160427e-03	0.0003658003

```
## imp-marque 0.064071952 1.016742e-04 1.346187e-03 0.0003353303
## imp-esthétique 0.041779257 2.030784e-02 3.185394e-07 0.0002938039
## imp-prix 0.000383379 9.191608e-03 7.860573e-02 0.0027769268
## imp-confort-pilote 0.167296229 7.274139e-04 9.933918e-06 0.0006204362
## Dim.5
## note-satisfaction 2.559744e-04
## imp-magasin 2.433730e-04
## imp-marque 7.990930e-06
## imp-esthétique 6.357146e-03
## imp-prix 1.236484e-03
## imp-confort-pilote 3.845447e-04
```

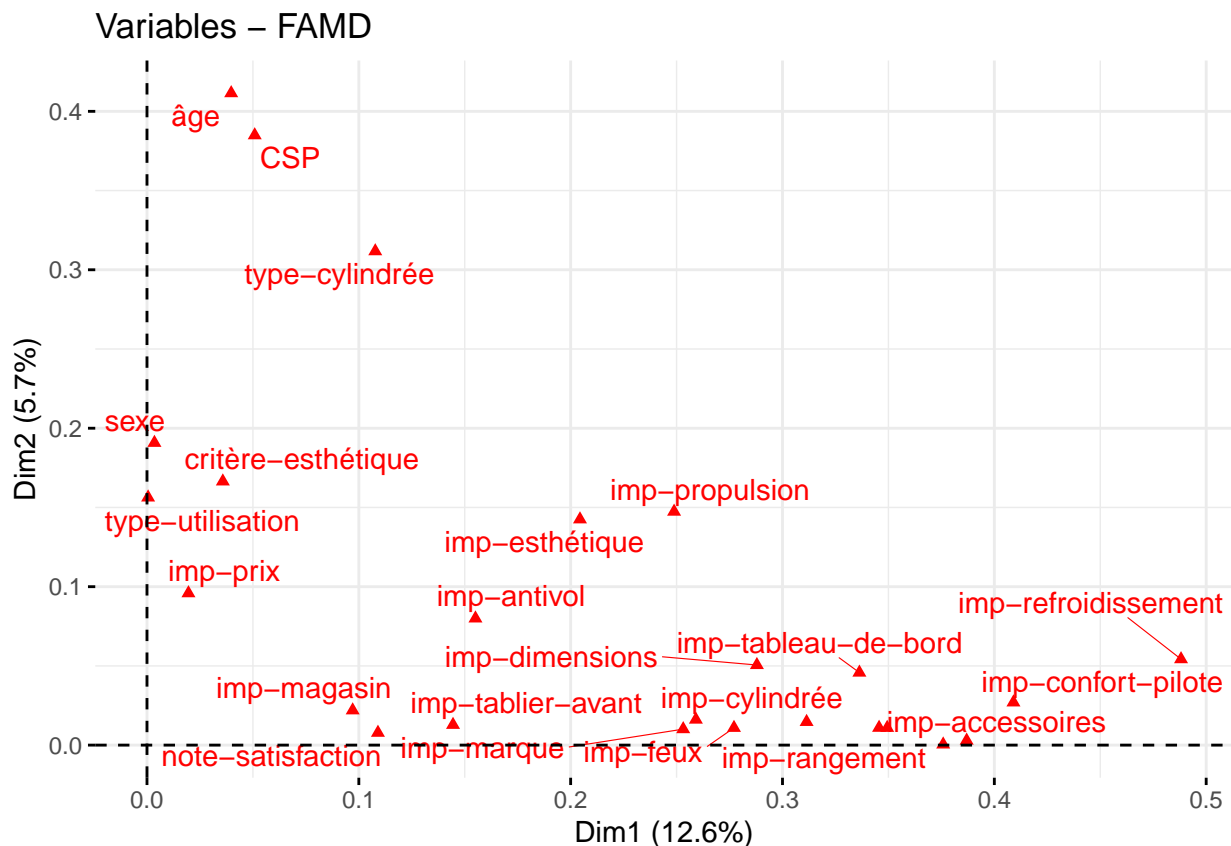
```
# Contributions aux dimensions
head(var$contrib)
```

```
## Dim.1 Dim.2 Dim.3 Dim.4 Dim.5
## note-satisfaction 2.0584213 0.3278729 4.63074133 6.3130221 0.9694680
## imp-magasin 1.8332625 0.9214193 3.32913236 1.1156839 0.9453039
## imp-marque 4.7790343 0.4228754 1.89371565 1.0682073 0.1712907
## imp-esthétique 3.8591043 5.9763901 0.02913021 0.9998801 4.8313260
## imp-prix 0.3696752 4.0207102 14.47068976 3.0739823 2.1307352
## imp-confort-pilote 7.7223458 1.1310917 0.16267560 1.4530070 1.1882522
```

```
# Graphique des variables
```

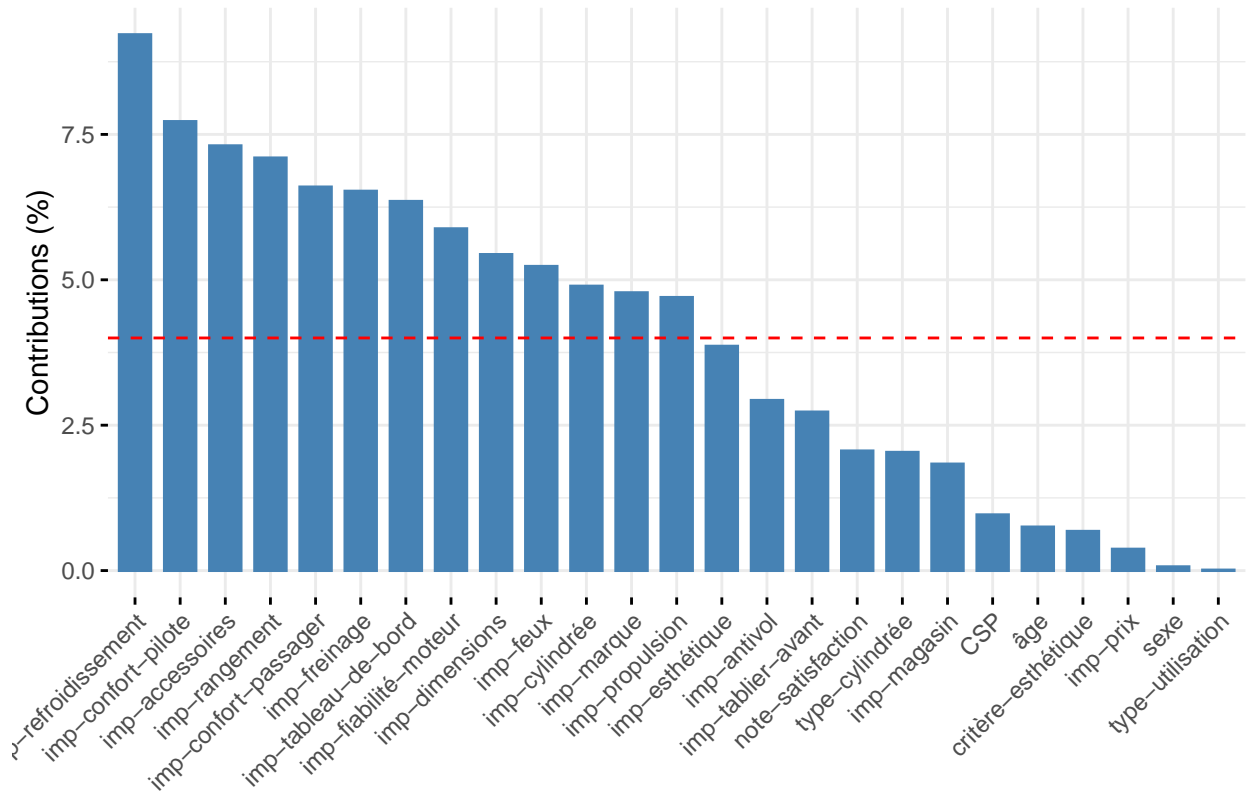
```
fviz_famd_var (res.famd, repel = TRUE)
```

```
## Warning: ggrepel: 3 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



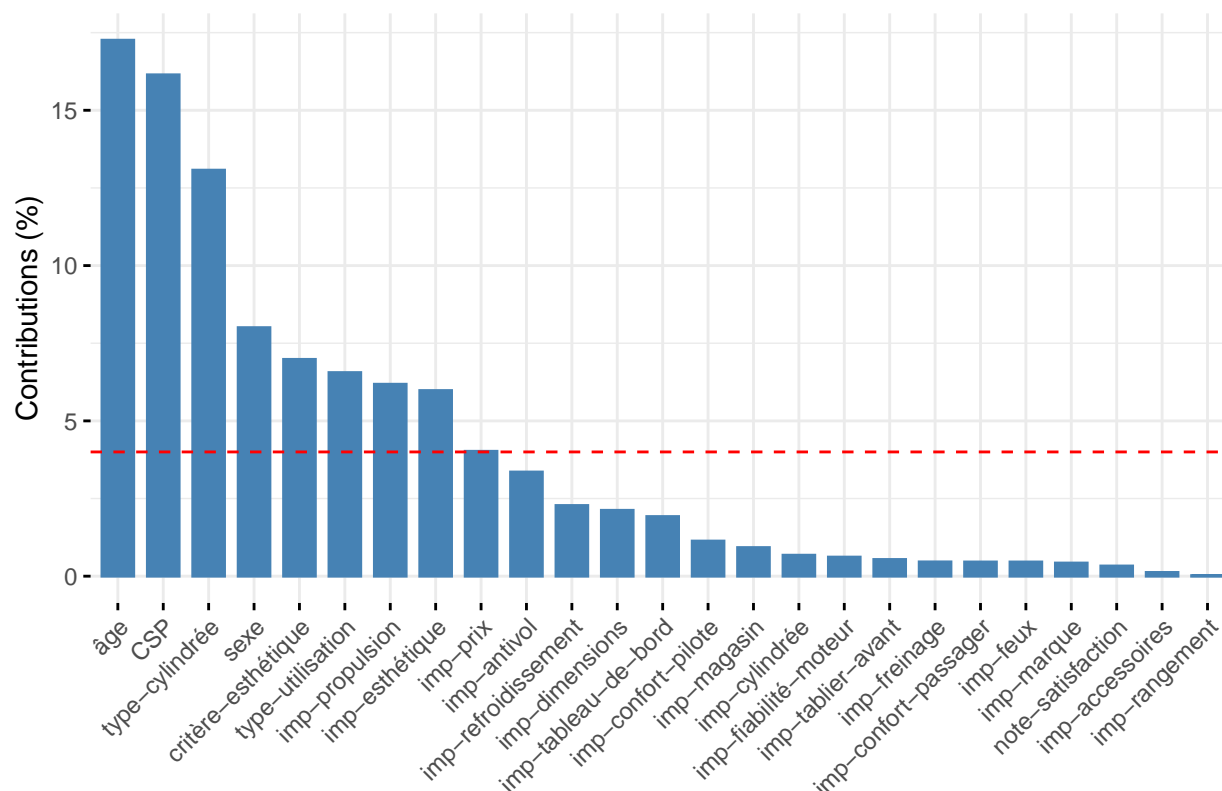
```
# Contribution à la première dimension
fviz_contrib(res.famd, "var", axes = 1)
```

Contribution of variables to Dim-1



```
# Contribution à la deuxième dimension
fviz_contrib(res.famd, "var", axes = 2)
```

Contribution of variables to Dim-2



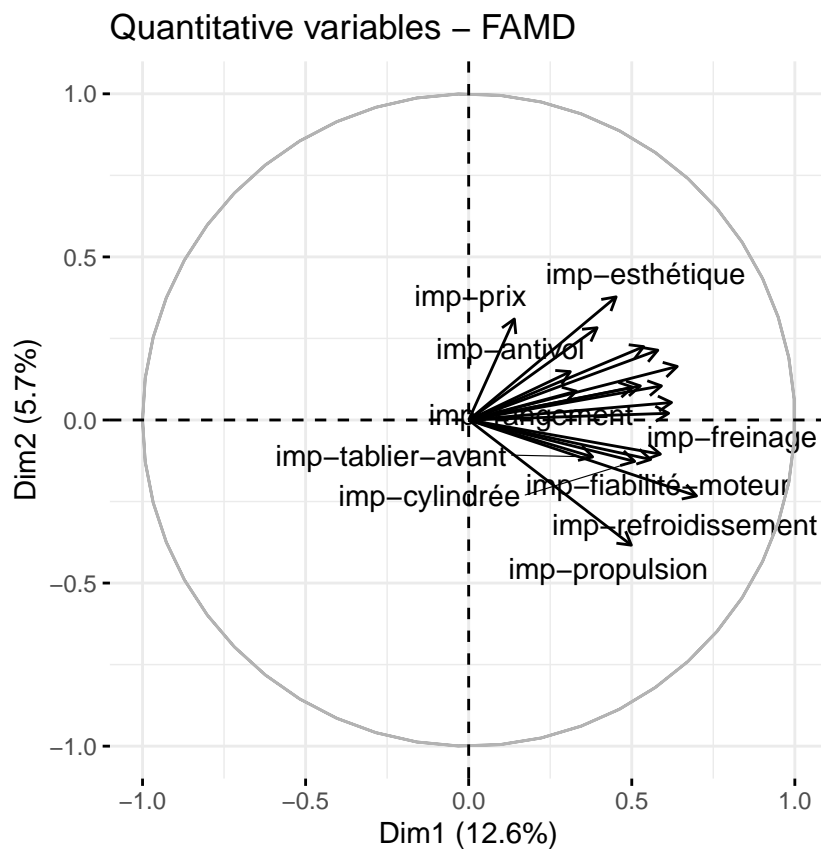
Variables quantitatives

```
quanti.var <- get_famd_var(res.famd, "quanti.var")
quanti.var
```

```
## FAMd results for quantitative variables
## =====
##   Name      Description
## 1 "$coord"   "Coordinates"
## 2 "$cos2"    "Cos2, quality of representation"
## 3 "$contrib" "Contributions"
```

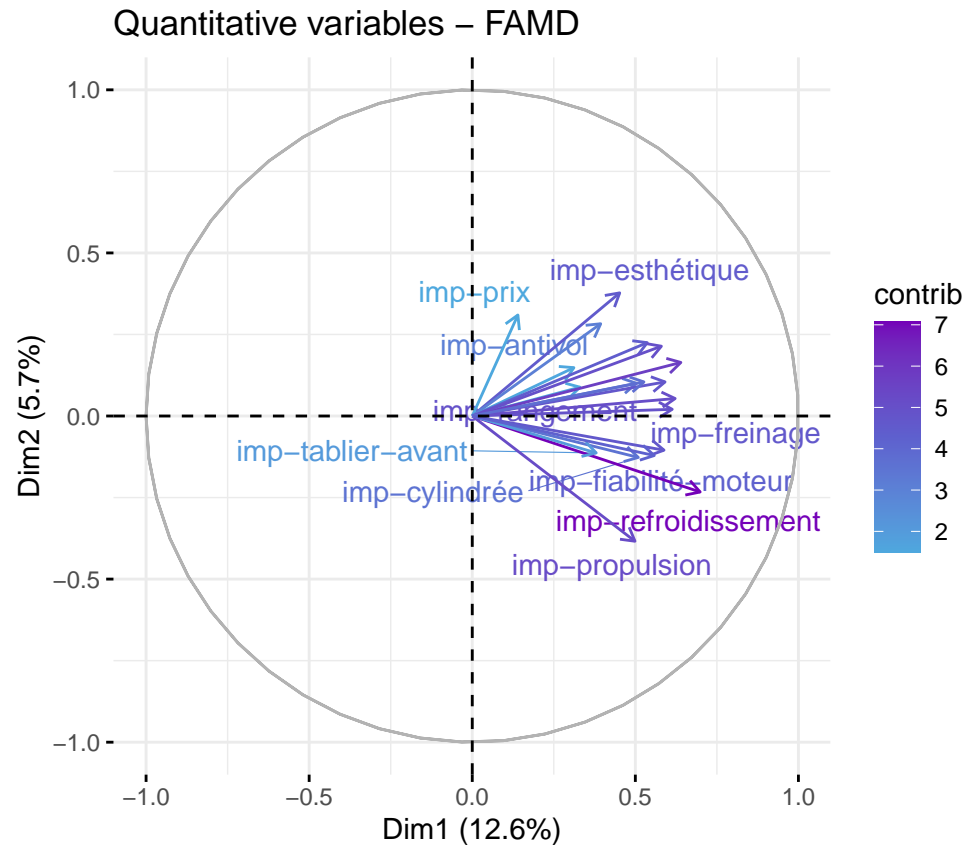
```
fviz_famd_var(res.famd, "quanti.var", repel = TRUE,
              col.var = "black")
```

```
## Warning: ggrepel: 9 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



```
fviz_famd_var(res.famd, "quanti.var", col.var = "contrib",
  gradient.cols = c("#4ea8de", "#5e60ce", "#7400b8"),
  repel = TRUE)
```

```
## Warning: ggrepel: 9 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

<http://www.sthda.com/french/articles/38-methodes-des-composantes-principales-dans-r-guide-pratique/76-afdm-analyse-factorielle-des-donnees-mixtes-avec-r-l-essentiel/>

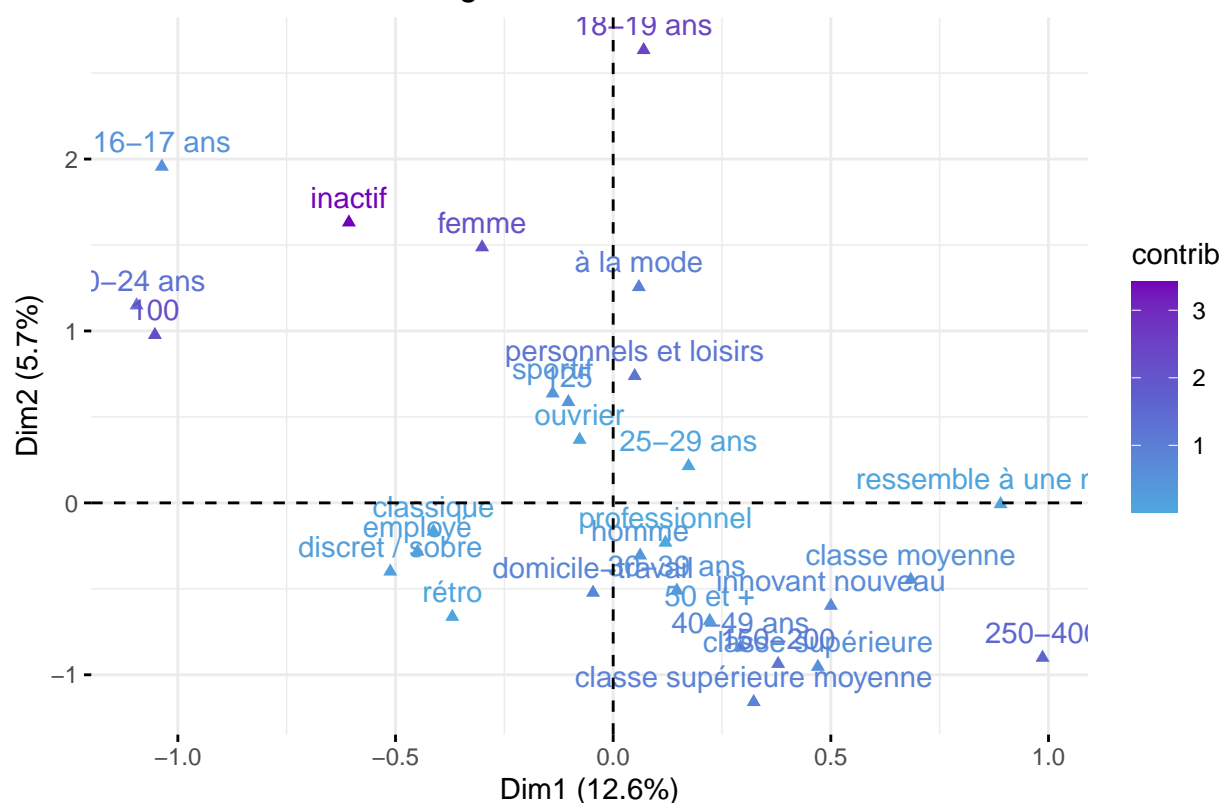
Variables qualitatives

```
quali.var <- get_famd_var(res.famd, "quali.var")
quali.var

## FAMD results for qualitative variable categories
## =====
##   Name      Description
## 1 "$coord"   "Coordinates"
## 2 "$cos2"    "Cos2, quality of representation"
## 3 "$contrib" "Contributions"

fviz_famd_var(res.famd, "quali.var", col.var = "contrib",
              gradient.cols = c("#4ea8de", "#5e60ce", "#7400b8")
              )
```

Qualitative variable categories – FAMD

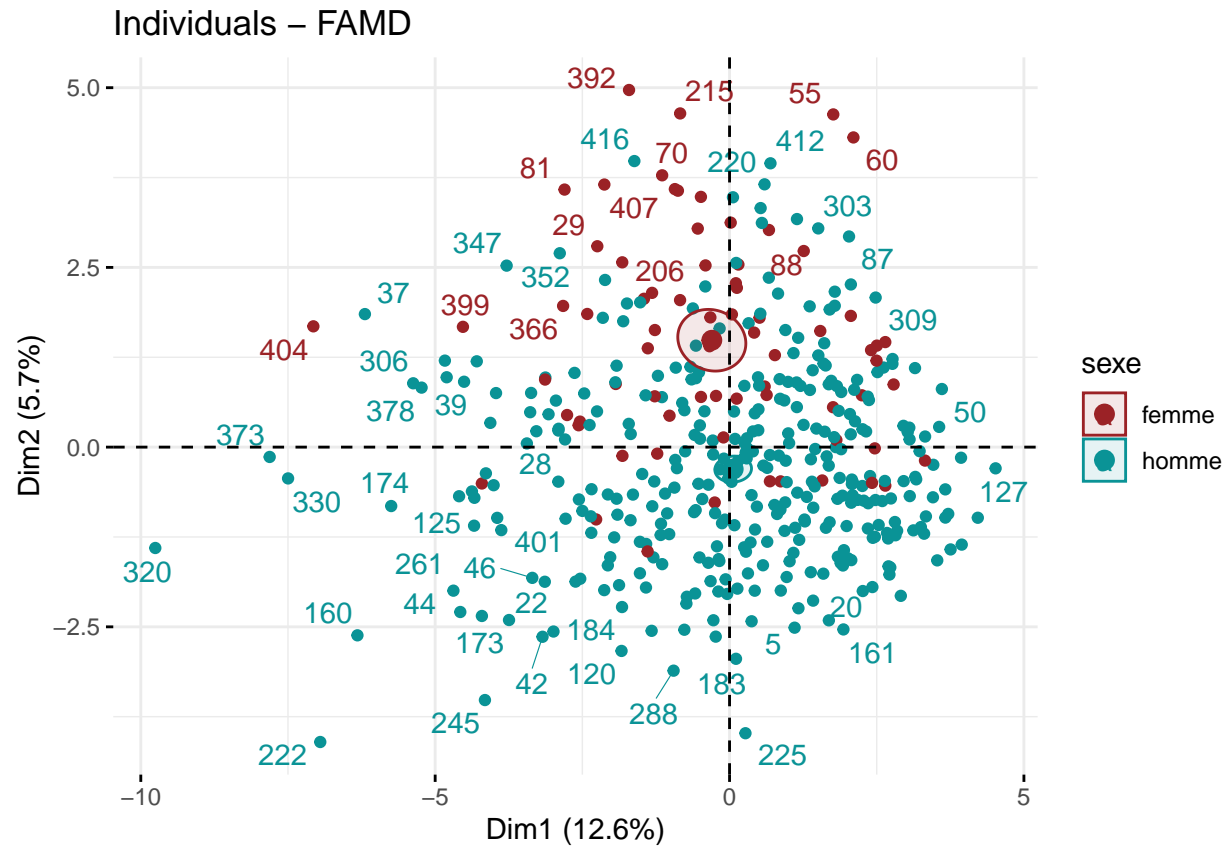


```
fviz_famd_ind(res.famd, col.ind = "cos2",
  gradient.cols = c("#64dfdf", "#48bfe3", "#7400b8"),
  repel = TRUE)
```

```
## Warning: ggrepel: 19 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

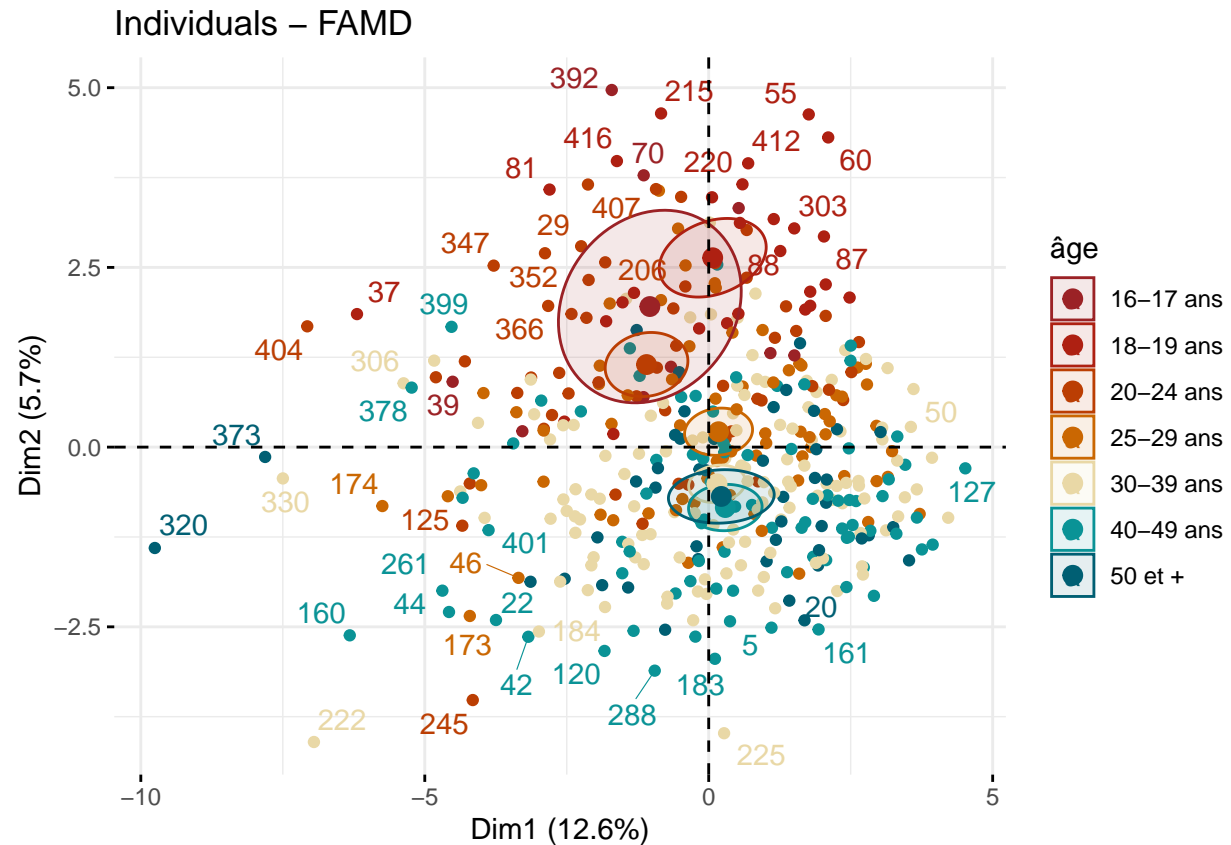
```
## Warning: ggrepel: 363 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

```
## Warning: ggrepel: 365 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



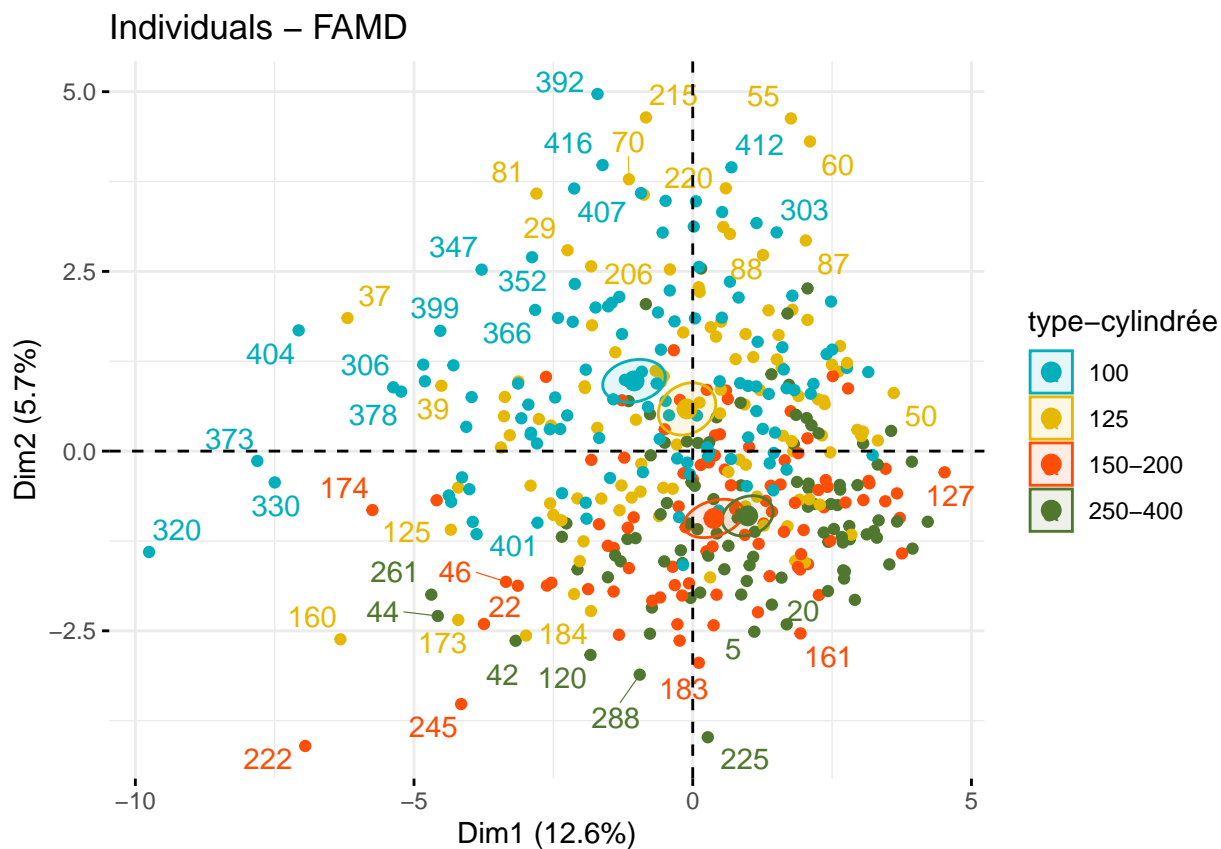
```
fviz_mfa_ind(res.famd,
  habillage = "âge", # color by groups
  palette = c("#9b2226", "#ae2012", "#bb3e03", "#ca6702", "#e9d8a6", "#0a9396", "#005f73"),
  addEllipses = TRUE, ellipse.type = "confidence",
  repel = TRUE # Avoid text overlapping
)
```

```
## Warning: ggrepel: 367 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



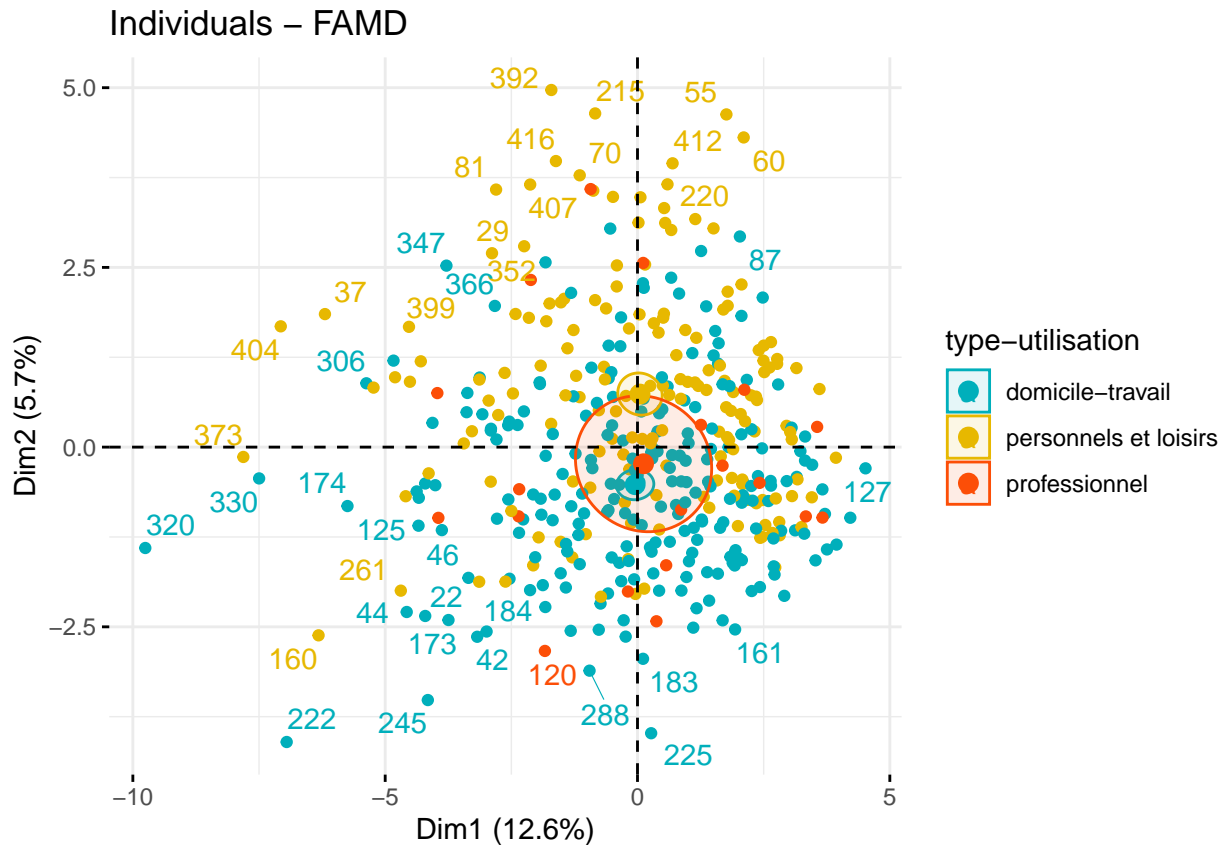
```
fviz_mfa_ind(res.famd,
  habillage = "CSP", # color by groups
  palette = c("#9b2226", "#ae2012", "#bb3e03", "#ca6702", "#e9d8a6", "#0a9396"),
  addEllipses = TRUE, ellipse.type = "confidence",
  repel = TRUE # Avoid text overlapping
)
```

```
## Warning: ggrepel: 381 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

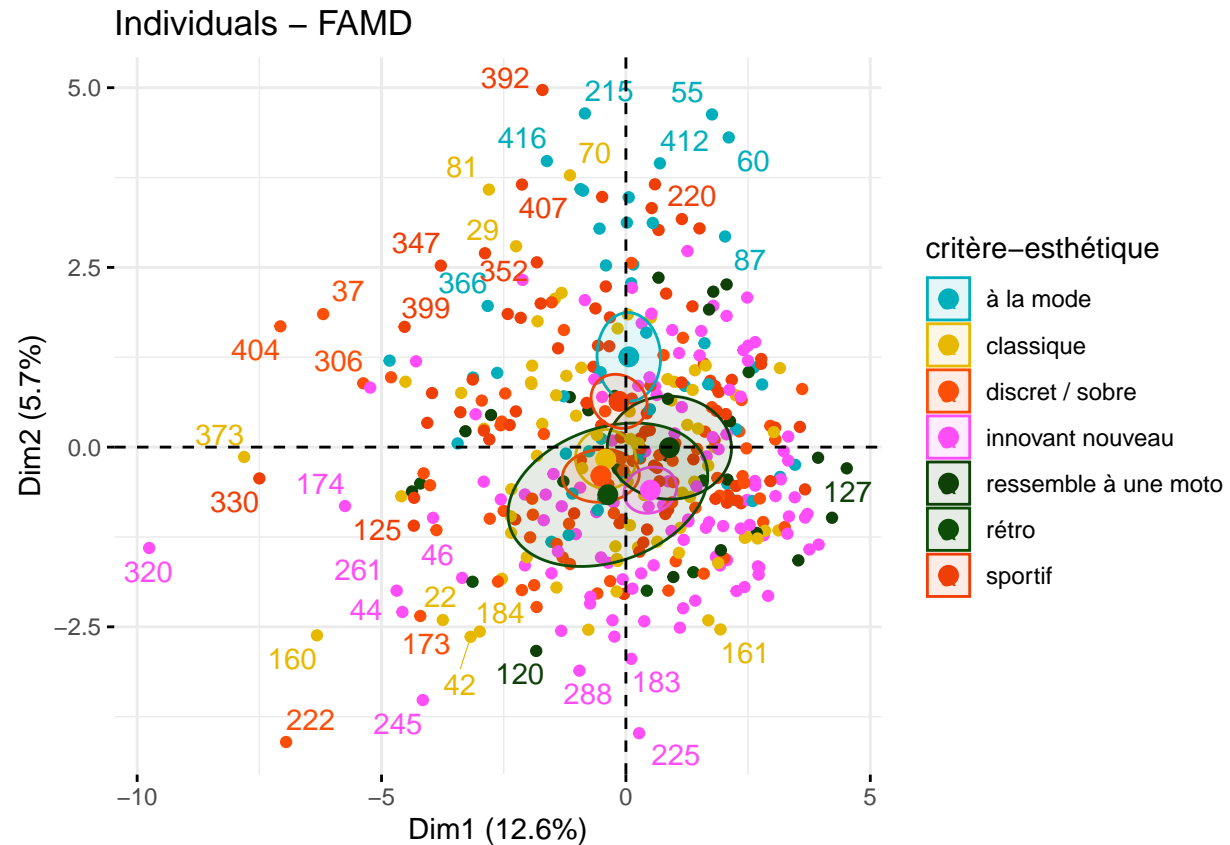
```
fviz_mfa_ind(res.famd,
  habillage = "type-utilisation", # color by groups
  palette = c("#00AFBB", "#E7B800", "#FC4E07"),
  addEllipses = TRUE, ellipse.type = "confidence",
  repel = TRUE # Avoid text overlapping
)
```

```
## Warning: ggrepel: 376 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



```
fviz_mfa_ind(res.famd,
  habillage = "critère-esthétique", # color by groups
  palette = c("#00AFBB", "#E7B800", "#FC4E07", "#FF4EF7", "#0F4007", "#0C4E07", "#F03E07"),
  addEllipses = TRUE, ellipse.type = "confidence",
  repel = TRUE # Avoid text overlapping
)
```

```
## Warning: ggrepel: 376 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

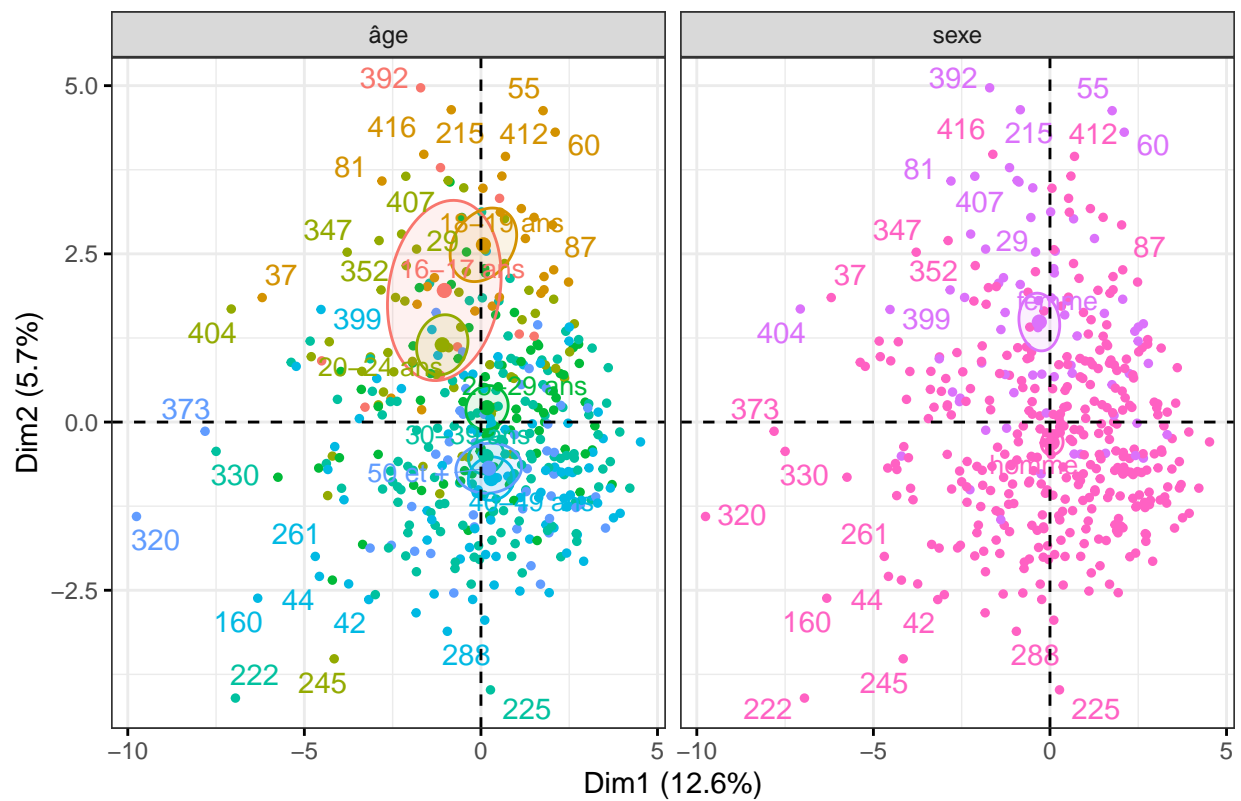



```
fviz_ellipses(res.famd, c("sexe", "âge"), repel = TRUE)
```

```
## Warning: ggrepel: 390 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

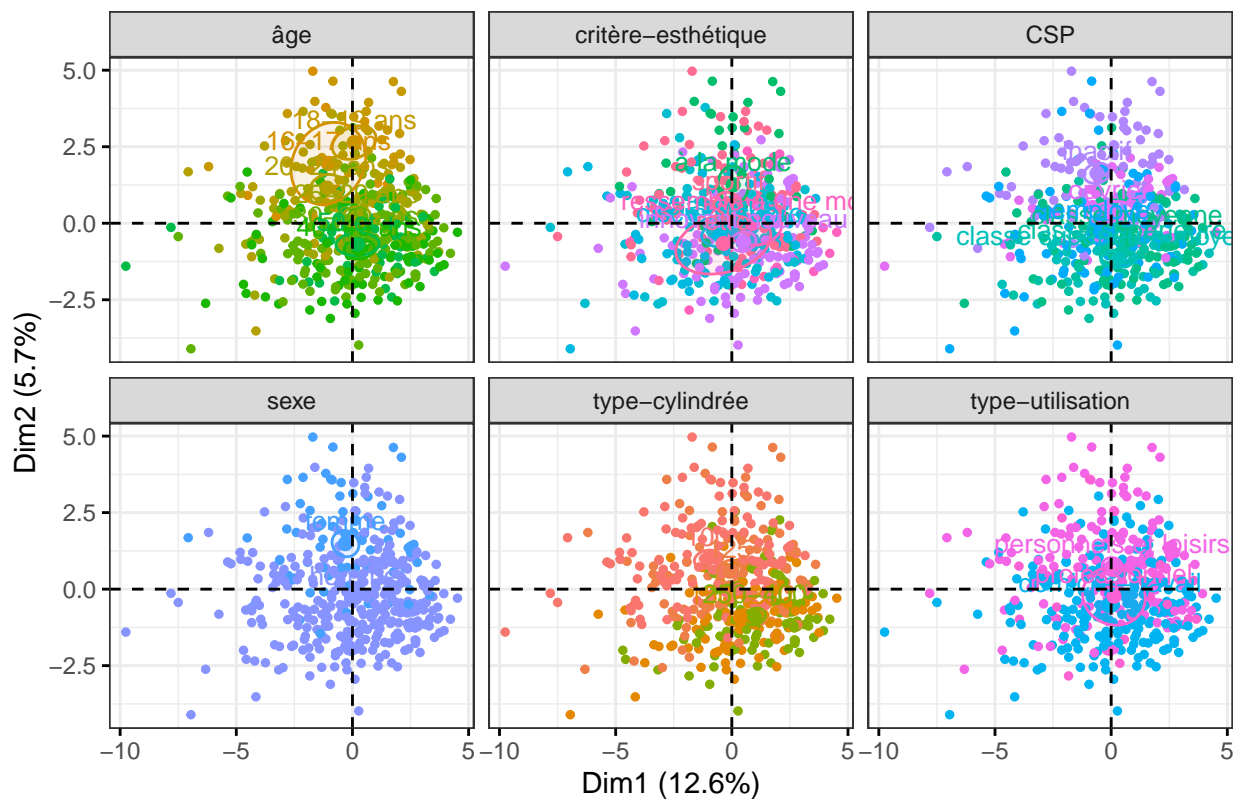
```
## Warning: ggrepel: 390 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```

FAMD factor map



```
fviz_ellipses(res.famd, 1:6, geom = "point")
```

FAMD factor map



Classification hiérarchique ascendante (CAH)

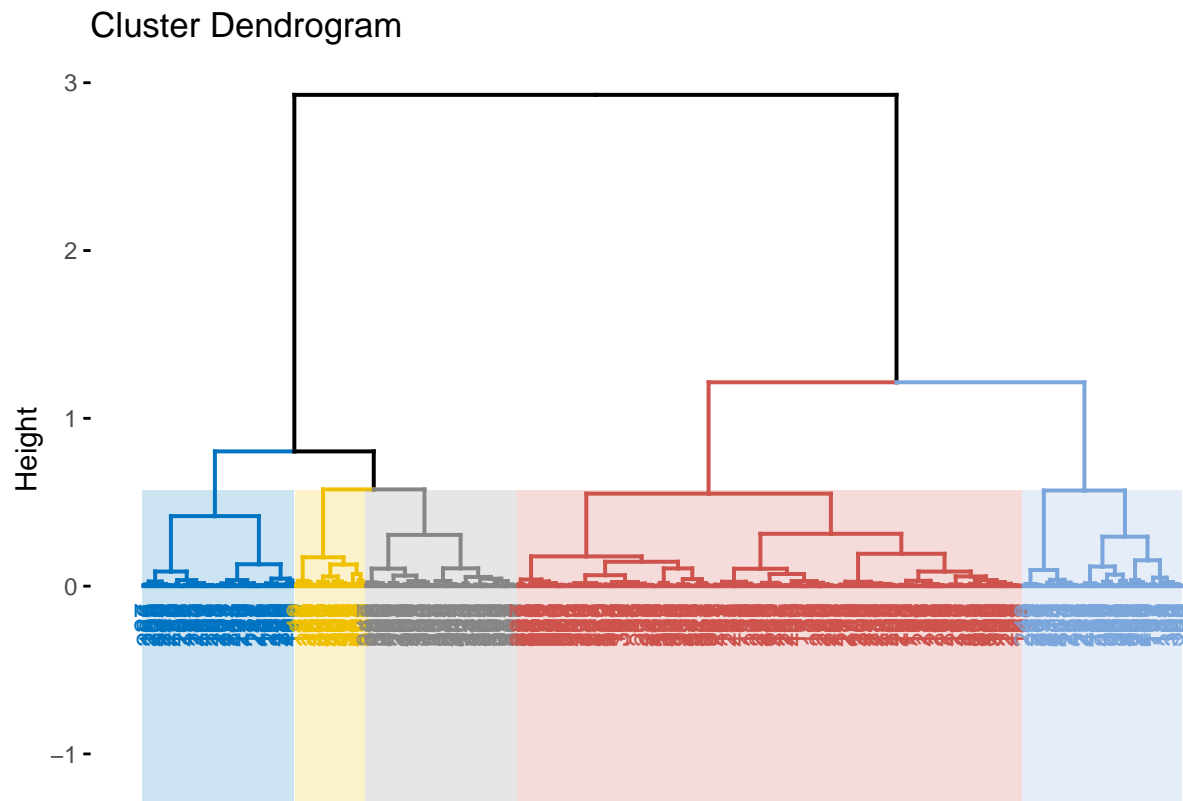
<http://www.sthda.com/french/articles/38-methodes-des-composantes-principales-dans-r-guide-pratique/78-classification-hierarchique-sur-composantes-principales-l-essentiel/>

```
res.hcpc <- HCPC(res.famd, nb.clust=5, proba=1, graph = F)
```

Cas de variables continues

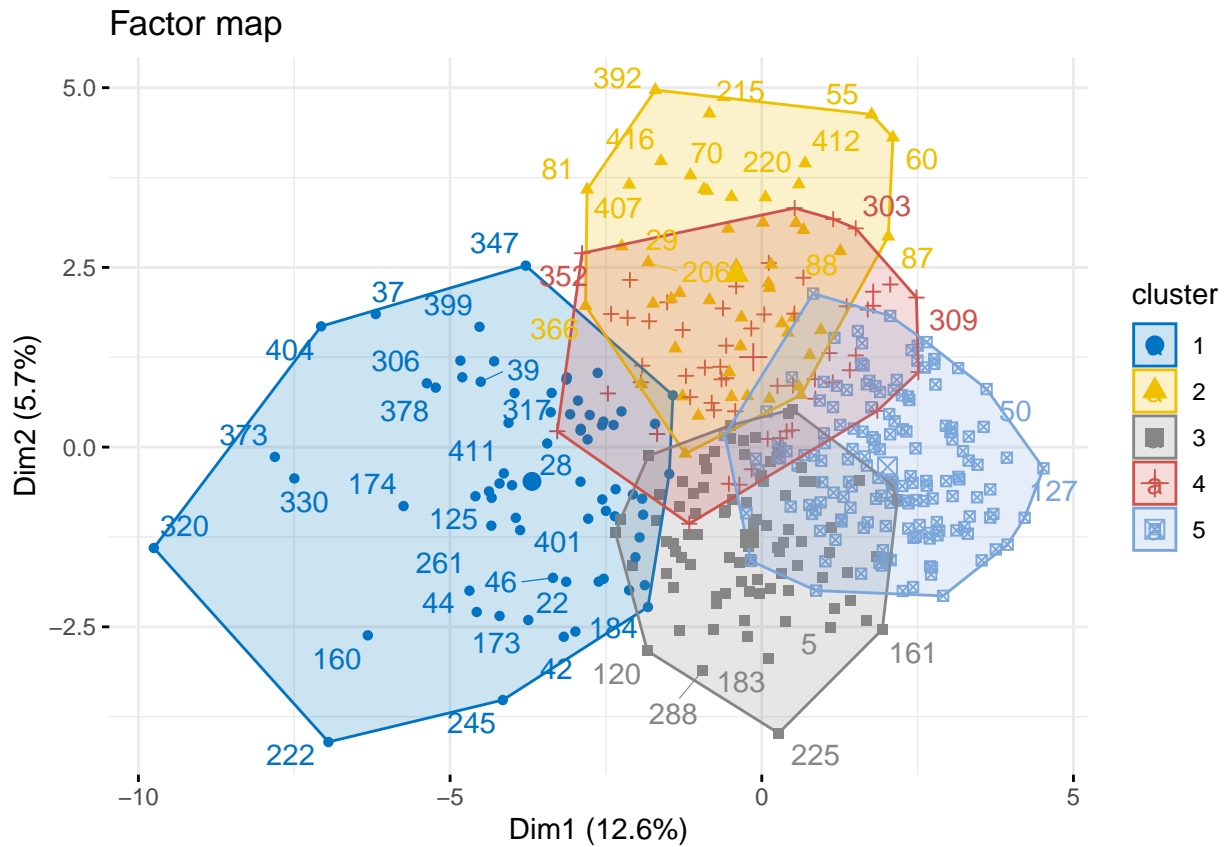
```
fviz_dend(res.hcpc,
  cex = 0.7,                # Taille du text
  palette = "jco",          # Palette de couleur ?ggpubr::ggpar
  rect = TRUE, rect_fill = TRUE, # Rectangle autour des groupes
  rect_border = "jco",      # Couleur du rectangle
  labels_track_height = 0.8  # Augment l'espace pour le texte
)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```



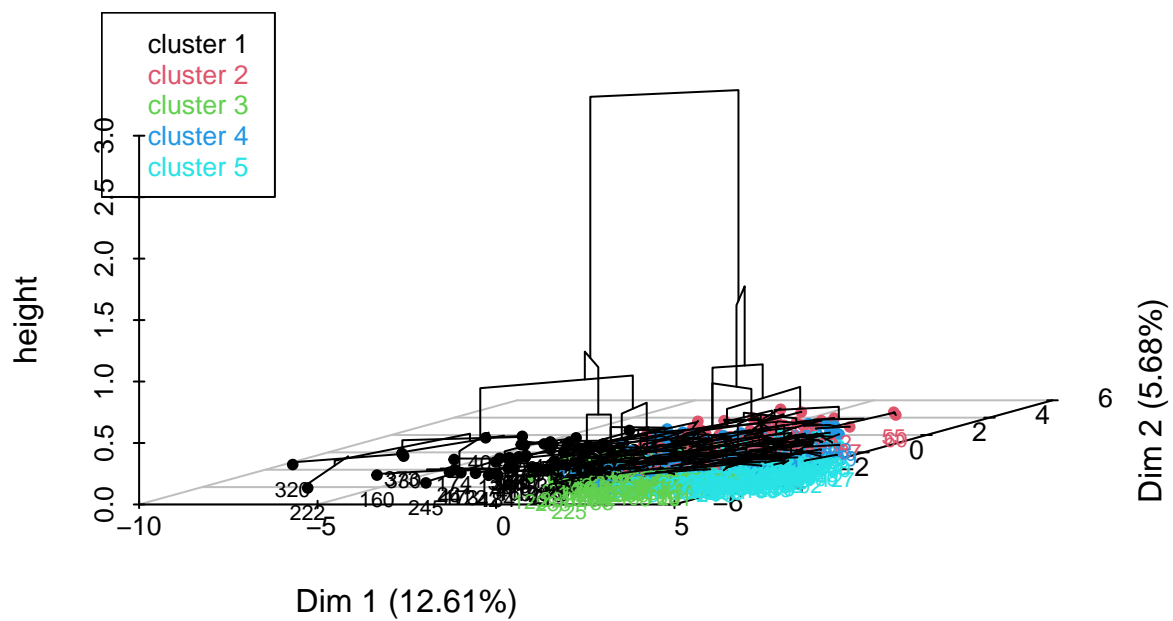
```
fviz_cluster(res.hcpc,
  repel = TRUE,           # Evite le chevauchement des textes
  show.clust.cent = TRUE, # Montre le centre des clusters
  palette = "jco",        # Palette de couleurs, voir ?ggpubr::ggpar
  ggtheme = theme_minimal(),
  main = "Factor map"
)
```

```
## Warning: ggrepel: 364 unlabeled data points (too many overlaps). Consider
## increasing max.overlaps
```



```
# Principal components + tree
plot(res.hcpc, choice = "3D.map")
```

Hierarchical clustering on the factor map



Individus avec classement dans un cluster

```
head(res.hcpc$data.clust, 10)
```

##	sexe	âge	CSP	type-cylindrée	type-utilisation
## 1	femme	25-29 ans	employé	125	domicile-travail
## 2	homme	30-39 ans	classe moyenne	150-200	domicile-travail
## 3	homme	25-29 ans	employé	150-200	domicile-travail
## 4	homme	30-39 ans	ouvrier	125	domicile-travail
## 5	homme	40-49 ans	classe moyenne	250-400	domicile-travail
## 6	homme	30-39 ans	classe supérieure moyenne	250-400	domicile-travail
## 7	homme	25-29 ans	classe moyenne	250-400	domicile-travail
## 8	homme	25-29 ans	employé	150-200	domicile-travail
## 9	femme	30-39 ans	employé	150-200	domicile-travail
## 10	homme	50 et +	classe supérieure moyenne	250-400	domicile-travail
##	critère-esthétique	note-satisfaction	imp-magasin	imp-marque	imp-esthétique
## 1	à la mode	8	5	3	5
## 2	innovant nouveau	10	4	4	5
## 3	sportif	8	2	4	5
## 4	innovant nouveau	8	4	4	4
## 5	innovant nouveau	9	3	3	4
## 6	discret / sobre	9	5	3	4
## 7	sportif	7	3	3	5
## 8	classique	9	1	5	5
## 9	classique	9	2	4	5
## 10	innovant nouveau	9	3	4	4
##	imp-prix	imp-confort-pilote	imp-confort-passager	imp-dimensions	imp-freinage
## 1	4	5	4	4	3
## 2	3	4	4	4	4
## 3	4	4	4	3	4
## 4	4	3	2	4	5
## 5	4	4	2	3	4
## 6	3	4	4	4	5
## 7	5	5	4	3	5
## 8	3	5	3	3	5
## 9	4	4	4	5	1
## 10	5	5	3	5	5
##	imp-cylindrée	imp-antivol	imp-tableau-de-bord	imp-accessoires	imp-rangement
## 1	4	5	4	5	4
## 2	5	2	3	5	5
## 3	4	3	2	2	4
## 4	4	2	2	4	4
## 5	5	3	4	4	4
## 6	4	4	3	3	4
## 7	4	3	3	3	3
## 8	4	5	4	3	3
## 9	4	1	3	3	3
## 10	5	3	4	3	3
##	imp-propulsion	imp-refroidissement	imp-tablier-avant	imp-feux	
## 1	3	3	3	4	
## 2	5	5	4	5	
## 3	5	3	1	4	
## 4	3	2	2	3	
## 5	5	5	5	5	

```
## 6          4          4          5          5
## 7          5          5          5          5
## 8          3          2          4          5
## 9          3          3          3          3
## 10         5          5          3          3
##   imp-fiabilité-moteur clust
## 1          4          2
## 2          5          5
## 3          5          3
## 4          4          1
## 5          5          3
## 6          5          5
## 7          4          5
## 8          5          3
## 9          5          3
## 10         5          3
```

Variables quantitatives décrivant le plus chaque cluster

```
res.hcpc$desc.var$quanti
```

```
## $`1`
##               v.test Mean in category Overall mean sd in category
## imp-prix      -0.1395676      4.140845      4.156250      1.1043547
## imp-magasin   -3.1918367      2.774648      3.235577      1.3447570
## imp-tablier-avant -5.3659312      2.619718      3.411058      1.4473501
## imp-propulsion -5.7513832      3.225352      3.901442      1.2913273
## note-satisfaction -5.9637614      7.380282      8.199519      1.3877350
## imp-antivol   -6.4905793      2.112676      3.045673      1.1202275
## imp-cylindrée -7.2582776      3.535211      4.218750      1.0046510
## imp-rangement -7.6377889      2.873239      3.740385      1.1619505
## imp-esthétique -7.9164090      3.690141      4.391827      1.1937814
## imp-marque    -8.1248570      3.098592      4.004808      1.1525224
## imp-feux      -8.1543372      3.154930      4.052885      1.3177861
## imp-fiabilité-moteur -8.3155885      3.788732      4.468750      0.9629107
## imp-freinage  -8.4541820      3.239437      4.151442      1.1065081
## imp-accessoires -8.7013120      2.309859      3.456731      1.0953365
## imp-dimensions -9.0570549      3.084507      4.045673      1.2189406
## imp-tableau-de-bord -9.5612343      2.309859      3.514423      1.1819243
## imp-confort-passager -9.8508942      2.408451      3.634615      1.0691245
## imp-confort-pilote -10.2853216      3.422535      4.341346      1.0300003
## imp-refroidissement -10.4187223      2.323944      3.600962      1.0315399
##               Overall sd      p.value
## imp-prix      1.0200440 8.890017e-01
## imp-magasin   1.3345568 1.413712e-03
## imp-tablier-avant 1.3628917 8.053265e-08
## imp-propulsion 1.0863656 8.851622e-09
## note-satisfaction 1.2695016 2.464966e-09
## imp-antivol   1.3284355 8.550697e-11
## imp-cylindrée 0.8703085 3.920503e-13
## imp-rangement 1.0492231 2.209838e-14
## imp-esthétique 0.8191403 2.444686e-15
## imp-marque    1.0307652 4.478903e-16
## imp-feux      1.0176762 3.510999e-16
```

```

## imp-fiabilité-moteur 0.7557373 9.129807e-17
## imp-freinage 0.9969414 2.810507e-17
## imp-accessoires 1.2180742 3.280688e-18
## imp-dimensions 0.9807427 1.340202e-19
## imp-tableau-de-bord 1.1642857 1.163605e-21
## imp-confort-passager 1.1503151 6.793686e-23
## imp-confort-pilote 0.8255663 8.206768e-25
## imp-refroidissement 1.1327294 2.036709e-25
##
## $`2`
##
## v.test Mean in category Overall mean sd in category
## note-satisfaction 4.33461786 8.938776 8.199519 0.8429337
## imp-esthétique 3.11570530 4.734694 4.391827 0.4855256
## imp-marque 2.47071040 4.346939 4.004808 0.7967029
## imp-tableau-de-bord 2.45208627 3.897959 3.514423 0.7352606
## imp-magasin 2.10092561 3.612245 3.235577 1.0845168
## imp-confort-pilote 1.70651421 4.530612 4.341346 0.5384043
## imp-prix 1.68939309 4.387755 4.156250 0.7776555
## imp-dimensions 1.51208966 4.244898 4.045673 0.7431486
## imp-accessoires 1.07506864 3.632653 3.456731 0.9624348
## imp-confort-passager 0.38348621 3.693878 3.634615 0.9939425
## imp-feux -0.08827244 4.040816 4.052885 0.6688151
## imp-antivol -0.14156842 3.020408 3.045673 1.2035627
## imp-rangement -0.90908602 3.612245 3.740385 0.9650278
## imp-fiabilité-moteur -0.99877872 4.367347 4.468750 0.5956947
## imp-tablier-avant -1.24190400 3.183673 3.411058 1.1005281
## imp-cylindrée -3.96555684 3.755102 4.218750 0.7701209
## imp-freinage -4.63545282 3.530612 4.151442 1.0517632
## imp-refroidissement -5.02209767 2.836735 3.600962 0.8653639
## imp-propulsion -6.59612751 2.938776 3.901442 1.0768086
##
## Overall sd p.value
## note-satisfaction 1.2695016 1.460135e-05
## imp-esthétique 0.8191403 1.835056e-03
## imp-marque 1.0307652 1.348450e-02
## imp-tableau-de-bord 1.1642857 1.420306e-02
## imp-magasin 1.3345568 3.564750e-02
## imp-confort-pilote 0.8255663 8.791238e-02
## imp-prix 1.0200440 9.114412e-02
## imp-dimensions 0.9807427 1.305111e-01
## imp-accessoires 1.2180742 2.823440e-01
## imp-confort-passager 1.1503151 7.013593e-01
## imp-feux 1.0176762 9.296601e-01
## imp-antivol 1.3284355 8.874209e-01
## imp-rangement 1.0492231 3.633047e-01
## imp-fiabilité-moteur 0.7557373 3.179019e-01
## imp-tablier-avant 1.3628917 2.142720e-01
## imp-cylindrée 0.8703085 7.322480e-05
## imp-freinage 0.9969414 3.561570e-06
## imp-refroidissement 1.1327294 5.111018e-07
## imp-propulsion 1.0863656 4.220360e-11
##
## $`3`
##
## v.test Mean in category Overall mean sd in category
## note-satisfaction 2.2141798 8.465909 8.199519 1.0439094

```


## imp-propulsion	1.9506617	4.102273	3.901442	0.8399103
## imp-fiabilité-moteur	1.5469617	4.579545	4.468750	0.5584392
## imp-refroidissement	0.9649273	3.704545	3.600962	0.8681104
## imp-marque	0.5324265	4.056818	4.004808	0.8306344
## imp-freinage	0.4417801	4.193182	4.151442	0.8237657
## imp-cylindrée	0.2411074	4.238636	4.218750	0.7229095
## imp-confort-passager	-0.2966794	3.602273	3.634615	1.0610862
## imp-confort-pilote	-0.5865564	4.295455	4.341346	0.7254950
## imp-tableau-de-bord	-1.2635824	3.375000	3.514423	1.0369591
## imp-accessoires	-1.3970922	3.295455	3.456731	1.0242413
## imp-tablier-avant	-1.7748292	3.181818	3.411058	1.1922615
## imp-esthétique	-2.5588688	4.193182	4.391827	0.7207628
## imp-dimensions	-2.9366338	3.772727	4.045673	0.9011013
## imp-magasin	-2.9407962	2.863636	3.235577	1.2896601
## imp-antivol	-3.4316947	2.613636	3.045673	1.1523870
## imp-rangement	-3.4460428	3.397727	3.740385	0.9112900
## imp-feux	-3.4939543	3.715909	4.052885	0.9408514
## imp-prix	-7.9640904	3.386364	4.156250	1.1324934

Overall sd p.value

## note-satisfaction	1.2695016	2.681641e-02
## imp-propulsion	1.0863656	5.109731e-02
## imp-fiabilité-moteur	0.7557373	1.218725e-01
## imp-refroidissement	1.1327294	3.345812e-01
## imp-marque	1.0307652	5.944306e-01
## imp-freinage	0.9969414	6.586483e-01
## imp-cylindrée	0.8703085	8.094718e-01
## imp-confort-passager	1.1503151	7.667113e-01
## imp-confort-pilote	0.8255663	5.575017e-01
## imp-tableau-de-bord	1.1642857	2.063800e-01
## imp-accessoires	1.2180742	1.623858e-01
## imp-tablier-avant	1.3628917	7.592609e-02
## imp-esthétique	0.8191403	1.050134e-02
## imp-dimensions	0.9807427	3.317957e-03
## imp-magasin	1.3345568	3.273699e-03
## imp-antivol	1.3284355	5.998224e-04
## imp-rangement	1.0492231	5.688602e-04
## imp-feux	1.0176762	4.759225e-04
## imp-prix	1.0200440	1.664436e-15

##

\$`4`

##	v.test	Mean in category	Overall mean	sd in category
## imp-dimensions	2.69798143	4.375000	4.045673	0.6959705
## imp-esthétique	1.76164671	4.571429	4.391827	0.5297285
## imp-freinage	1.65780190	4.357143	4.151442	0.7423075
## imp-refroidissement	1.56381105	3.821429	3.600962	0.8682318
## imp-feux	1.55624416	4.250000	4.052885	0.7849022
## imp-antivol	1.45181788	3.285714	3.045673	1.3850514
## imp-cylindrée	1.44249265	4.375000	4.218750	0.7455223
## imp-propulsion	0.99306161	4.035714	3.901442	0.8443993
## imp-confort-passager	0.68120363	3.732143	3.634615	1.0605098
## imp-tableau-de-bord	-0.09953256	3.500000	3.514423	1.1019463
## imp-confort-pilote	-0.36763442	4.303571	4.341346	0.7050745
## imp-fiabilité-moteur	-0.42715989	4.428571	4.468750	0.8206518
## imp-rangement	-0.47334752	3.678571	3.740385	0.9084355

```

## imp-prix -0.80877500 4.053571 4.156250 0.9713695
## imp-marque -1.15102340 3.857143 4.004808 1.1406228
## note-satisfaction -1.48878762 7.964286 8.199519 1.0850327
## imp-tablier-avant -2.63385207 2.964286 3.411058 1.4511607
## imp-accessoires -2.77710420 3.035714 3.456731 1.1796532
## imp-magasin -2.92339684 2.750000 3.235577 1.3127126
## Overall sd p.value
## imp-dimensions 0.9807427 0.006976133
## imp-esthétique 0.8191403 0.078129007
## imp-freinage 0.9969414 0.097357458
## imp-refroidissement 1.1327294 0.117861948
## imp-feux 1.0176762 0.119650044
## imp-antivol 1.3284355 0.146552250
## imp-cylindrée 0.8703085 0.149163444
## imp-propulsion 1.0863656 0.320679933
## imp-confort-passager 1.1503151 0.495742649
## imp-tableau-de-bord 1.1642857 0.920715439
## imp-confort-pilote 0.8255663 0.713145846
## imp-fiabilité-moteur 0.7557373 0.669262877
## imp-rangement 1.0492231 0.635965263
## imp-prix 1.0200440 0.418644578
## imp-marque 1.0307652 0.249722611
## note-satisfaction 1.2695016 0.136543302
## imp-tablier-avant 1.3628917 0.008442226
## imp-accessoires 1.2180742 0.005484559
## imp-magasin 1.3345568 0.003462349
##
## $`5`
## v.test Mean in category Overall mean sd in category
## imp-rangement 9.8340836 4.407895 3.740385 0.6524777
## imp-refroidissement 9.5752610 4.302632 3.600962 0.7698212
## imp-accessoires 9.2318992 4.184211 3.456731 0.9206766
## imp-tablier-avant 8.3958697 4.151316 3.411058 1.0745860
## imp-feux 8.2902474 4.598684 4.052885 0.6204823
## imp-freinage 8.1586112 4.677632 4.151442 0.6240991
## imp-confort-pilote 7.6515163 4.750000 4.341346 0.4624022
## imp-confort-passager 7.2085179 4.171053 3.634615 0.8411796
## imp-cylindrée 7.0986105 4.618421 4.218750 0.6682086
## imp-antivol 7.0472536 3.651316 3.045673 1.1824365
## imp-tableau-de-bord 6.9708458 4.039474 3.514423 0.8950270
## imp-dimensions 6.6422694 4.467105 4.045673 0.6378187
## imp-propulsion 6.5509306 4.361842 3.901442 0.8074435
## imp-prix 6.3058250 4.572368 4.156250 0.6747512
## imp-fiabilité-moteur 6.1563110 4.769737 4.468750 0.5189868
## imp-magasin 5.6535611 3.723684 3.235577 1.2258046
## imp-marque 5.0582157 4.342105 4.004808 0.8119605
## imp-esthétique 5.0208576 4.657895 4.391827 0.5631825
## note-satisfaction 0.9350878 8.276316 8.199519 1.2886007
## Overall sd p.value
## imp-rangement 1.0492231 8.029526e-23
## imp-refroidissement 1.1327294 1.016003e-21
## imp-accessoires 1.2180742 2.658751e-20
## imp-tablier-avant 1.3628917 4.624584e-17
## imp-feux 1.0176762 1.130132e-16

```

```
## imp-freinage      0.9969414 3.388986e-16
## imp-confort-pilote 0.8255663 1.986231e-14
## imp-confort-passager 1.1503151 5.656415e-13
## imp-cylindrée     0.8703085 1.260175e-12
## imp-antivol       1.3284355 1.824836e-12
## imp-tableau-de-bord 1.1642857 3.150410e-12
## imp-dimensions    0.9807427 3.088896e-11
## imp-propulsion     1.0863656 5.717964e-11
## imp-prix          1.0200440 2.866629e-10
## imp-fiabilité-moteur 0.7557373 7.445895e-10
## imp-magasin       1.3345568 1.571572e-08
## imp-marque        1.0307652 4.231975e-07
## imp-esthétique    0.8191403 5.144128e-07
## note-satisfaction 1.2695016 3.497431e-01
```

Interprétation

Axes principaux associés aux clusters

```
res.hcpc$desc.axes$quanti
```

```
## $`1`
##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.3    2.3670979      0.35652623  7.244139e-16      1.438010  1.391935
## Dim.4    1.2577887      0.17819867  2.477840e-16      1.328886  1.309304
## Dim.5    0.2707083      0.03763053 -4.658441e-16      1.561888  1.284643
## Dim.2   -2.8547297     -0.47699937  1.086066e-15      1.334162  1.544175
## Dim.1  -14.8016867     -3.68607740 -1.686685e-16      1.609540  2.301425
##          p.value
## Dim.3 1.792819e-02
## Dim.4 2.084682e-01
## Dim.5 7.866154e-01
## Dim.2 4.307348e-03
## Dim.1 1.428548e-49
##
## $`2`
##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.2 11.5692183      2.4000011  1.086066e-15      1.250116  1.544175
## Dim.5  4.9412423      0.8527652 -4.658441e-16      1.053025  1.284643
## Dim.3 -0.9139536     -0.1709047  7.244139e-16      1.298114  1.391935
## Dim.1 -1.3211177     -0.4084598 -1.686685e-16      1.163102  2.301425
## Dim.4 -7.6775264     -1.3504319  2.477840e-16      1.172750  1.309304
##          p.value
## Dim.2 5.901790e-31
## Dim.5 7.762638e-07
## Dim.3 3.607412e-01
## Dim.1 1.864621e-01
## Dim.4 1.621899e-14
##
## $`3`
##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.5 -0.6357194     -0.07739615 -4.658441e-16      1.1296400  1.284643
## Dim.1 -0.9046373     -0.19730720 -1.686685e-16      1.0163375  2.301425
## Dim.3 -4.5117602     -0.59516376  7.244139e-16      1.0599782  1.391935
```

```

## Dim.4 -5.5124987      -0.68400688  2.477840e-16      0.9014821  1.309304
## Dim.2 -8.7095753      -1.27457386  1.086066e-15      0.8927063  1.544175
##           p.value
## Dim.5 5.249594e-01
## Dim.1 3.656576e-01
## Dim.3 6.429186e-06
## Dim.4 3.537748e-08
## Dim.2 3.050153e-18
##
## $`4`
##           v.test Mean in category Overall mean sd in category Overall sd
## Dim.4  8.8546483      1.4429289  2.477840e-16      0.7842389  1.309304
## Dim.2  6.5163770      1.2523793  1.086066e-15      0.9475017  1.544175
## Dim.1 -0.4753854      -0.1361683 -1.686685e-16      1.4037044  2.301425
## Dim.5 -3.4251260      -0.5476362 -4.658441e-16      1.2730228  1.284643
## Dim.3 -5.8530704      -1.0139951  7.244139e-16      1.6231438  1.391935
##           p.value
## Dim.4 8.394809e-19
## Dim.2 7.202580e-11
## Dim.1 6.345123e-01
## Dim.5 6.145145e-04
## Dim.3 4.825798e-09
##
## $`5`
##           v.test Mean in category Overall mean sd in category Overall sd
## Dim.1 13.5530693      2.0178584 -1.686685e-16      1.0120075  2.301425
## Dim.3  6.7375541      0.6067046  7.244139e-16      1.0731110  1.391935
## Dim.4  2.5559753      0.2164977  2.477840e-16      1.0192348  1.309304
## Dim.5 -0.5524554      -0.0459130 -4.658441e-16      1.1544105  1.284643
## Dim.2 -2.7465017      -0.2743674  1.086066e-15      0.9174931  1.544175
##           p.value
## Dim.1 7.598521e-42
## Dim.3 1.610750e-11
## Dim.4 1.058906e-02
## Dim.5 5.806364e-01
## Dim.2 6.023457e-03

```

Individus représentatif de chaque groupe

```
res.hcpc$desc.ind$para
```

```

## Cluster: 1
##      28      30      411      263      368
## 1.016669 1.031467 1.092545 1.273520 1.403789
## -----
## Cluster: 2
##      260      77      51      227      218
## 1.113672 1.263460 1.357640 1.434976 1.648201
## -----
## Cluster: 3
##      79      242      97      26      58
## 0.7836164 0.8192056 1.0134264 1.2064807 1.2395141
## -----
## Cluster: 4

```

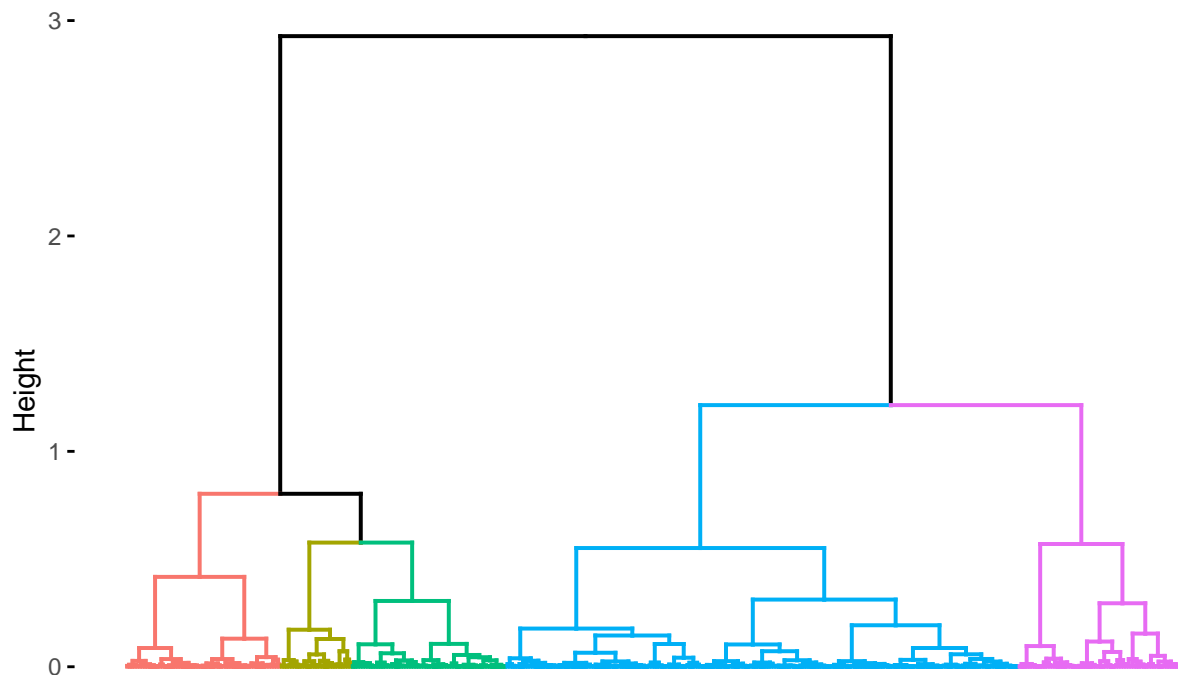
```
##          93          211          353          400          89
## 1.181252 1.233325 1.353339 1.454501 1.595225
## -----
## Cluster: 5
##          168          142          129          143          63
## 0.6408765 0.7857992 0.7947981 0.8687953 0.8866523
```

Cas de variables catégorielles

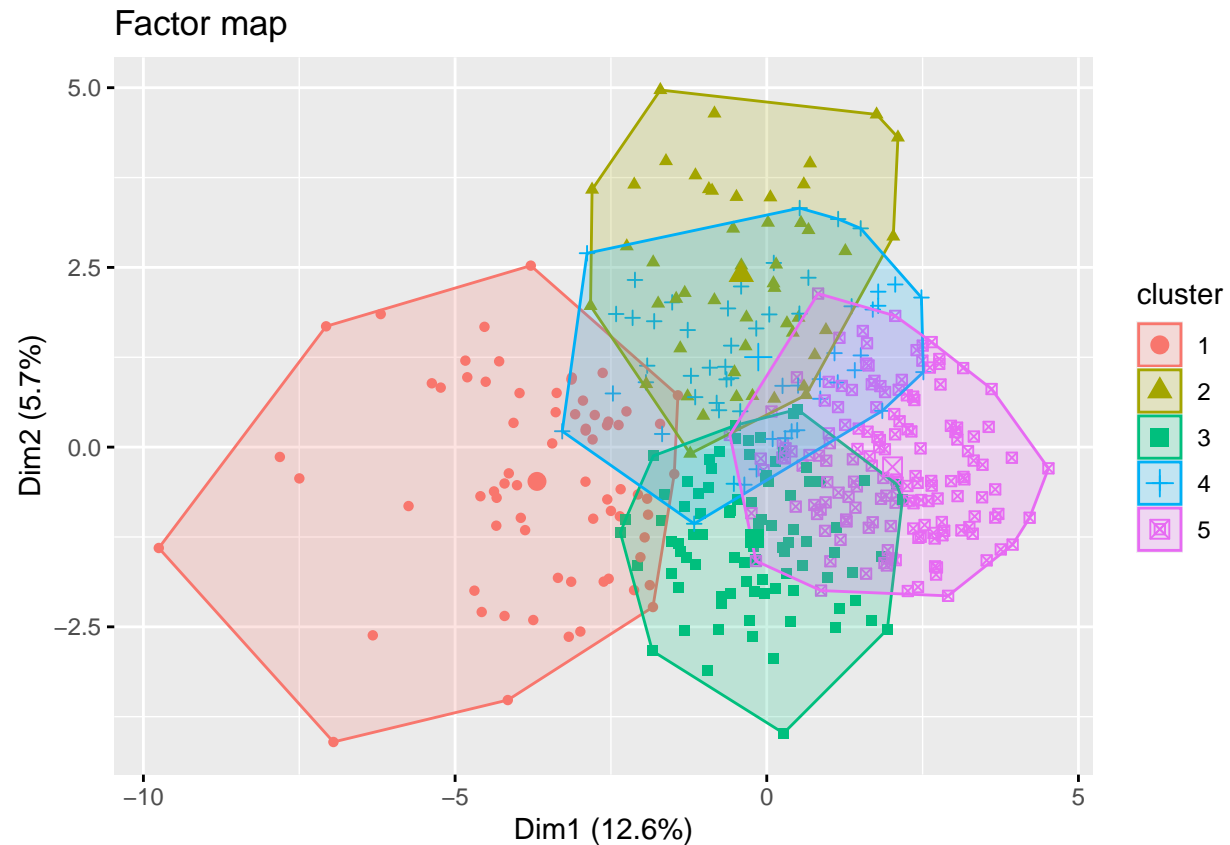
```
# Dendrogramme
fviz_dend(res.hcpc, show_labels = FALSE)
```

```
## Warning: `guides(<scale> = FALSE)` is deprecated. Please use `guides(<scale> =
## "none")` instead.
```

Cluster Dendrogram



```
# Individus
fviz_cluster(res.hcpc, geom = "point", main = "Factor map")
```



```
# Description par les variables
res.hcpc$desc.var$test.chi2
```

```
##                p.value df
## sexe           2.898618e-32 4
## CSP            4.364043e-32 20
## âge            4.662042e-28 24
## type-cylindrée 8.864803e-20 12
## critère-esthétique 3.283795e-13 24
## type-utilisation 1.221514e-06 8
```

```
# Description par les catégories
res.hcpc$desc.var$category
```

```
## $`1`
##          Cla/Mod  Mod/Cla  Global
## type-cylindrée=100 29.565217 47.887324 27.644231
## critère-esthétique=discret / sobre 31.818182 29.577465 15.865385
## sexe=homme 18.550725 90.140845 82.932692
## type-cylindrée=125 21.100917 32.394366 26.201923
## âge=20-24 ans 22.641509 16.901408 12.740385
## CSP=ouvrier 22.727273 14.084507 10.576923
## âge=30-39 ans 20.000000 35.211268 30.048077
## type-utilisation=domicile-travail 18.777293 60.563380 55.048077
## CSP=employé 20.430108 26.760563 22.355769
## critère-esthétique=classique 20.000000 21.126761 18.028846
## critère-esthétique=rétro 25.000000 2.816901 1.923077
## CSP=classe supérieure moyenne 20.000000 14.084507 12.019231
```

## type-utilisation=professionnel	21.052632	5.633803	4.567308
## CSP=classe supérieure	17.073171	9.859155	9.855769
## âge=25-29 ans	16.438356	16.901408	17.548077
## âge=16-17 ans	11.111111	1.408451	2.163462
## critère-esthétique=sportif	15.476190	18.309859	20.192308
## âge=40-49 ans	15.476190	18.309859	20.192308
## âge=50 et +	13.333333	8.450704	10.817308
## critère-esthétique=ressemble à une moto	9.090909	2.816901	5.288462
## CSP=classe moyenne	13.541667	18.309859	23.076923
## CSP=inactif	13.043478	16.901408	22.115385
## type-utilisation=personnels et loisirs	14.285714	33.802817	40.384615
## âge=18-19 ans	7.407407	2.816901	6.490385
## type-cylindrée=150-200	11.702128	15.492958	22.596154
## critère-esthétique=innovant nouveau	12.280702	19.718310	27.403846
## critère-esthétique=à la mode	8.510638	5.633803	11.298077
## sexe=femme	9.859155	9.859155	17.067308
## type-cylindrée=250-400	3.061224	4.225352	23.557692
##	p.value	v.test	
## type-cylindrée=100	6.445177e-05	3.99588957	
## critère-esthétique=discret / sobre	1.247751e-03	3.22773367	
## sexe=homme	7.018042e-02	1.81074445	
## type-cylindrée=125	2.003180e-01	1.28064624	
## âge=20-24 ans	2.595608e-01	1.12742977	
## CSP=ouvrier	3.018705e-01	1.03243049	
## âge=30-39 ans	3.024470e-01	1.03120001	
## type-utilisation=domicile-travail	3.090289e-01	1.01726180	
## CSP=employé	3.329821e-01	0.96812464	
## critère-esthétique=classique	4.559484e-01	0.74553499	
## critère-esthétique=rétro	5.491090e-01	0.59909584	
## CSP=classe supérieure moyenne	5.505412e-01	0.59694939	
## type-utilisation=professionnel	6.209968e-01	0.49443819	
## CSP=classe supérieure	9.699545e-01	0.03766533	
## âge=25-29 ans	8.952680e-01	-0.13164137	
## âge=16-17 ans	7.100910e-01	-0.37173390	
## critère-esthétique=sportif	6.812244e-01	-0.41079289	
## âge=40-49 ans	6.812244e-01	-0.41079289	
## âge=50 et +	5.022455e-01	-0.67096078	
## critère-esthétique=ressemble à une moto	3.261469e-01	-0.98190451	
## CSP=classe moyenne	3.000510e-01	-1.03632394	
## CSP=inactif	2.478607e-01	-1.15556116	
## type-utilisation=personnels et loisirs	2.172964e-01	-1.23374918	
## âge=18-19 ans	1.657018e-01	-1.38614788	
## type-cylindrée=150-200	1.131493e-01	-1.58419534	
## critère-esthétique=innovant nouveau	1.089305e-01	-1.60301859	
## critère-esthétique=à la mode	9.007650e-02	-1.69499431	
## sexe=femme	7.018042e-02	-1.81074445	
## type-cylindrée=250-400	2.618680e-06	-4.69866467	
##			
## \$`2`			
##	Cla/Mod	Mod/Cla	Global
## sexe=femme	54.929577	79.591837	17.067308
## critère-esthétique=à la mode	42.553191	40.816327	11.298077
## CSP=inactif	28.260870	53.061224	22.115385
## âge=18-19 ans	48.148148	26.530612	6.490385

## type-cylindrée=125	23.853211	53.061224	26.201923
## type-utilisation=personnels et loisirs	17.857143	61.224490	40.384615
## âge=25-29 ans	17.808219	26.530612	17.548077
## âge=16-17 ans	22.222222	4.081633	2.163462
## âge=20-24 ans	15.094340	16.326531	12.740385
## type-cylindrée=100	13.043478	30.612245	27.644231
## critère-esthétique=sportif	13.095238	22.448980	20.192308
## CSP=employé	12.903226	24.489796	22.355769
## critère-esthétique=rétro	12.500000	2.040816	1.923077
## critère-esthétique=classique	10.666667	16.326531	18.028846
## CSP=classe moyenne	9.375000	18.367347	23.076923
## type-utilisation=professionnel	5.263158	2.040816	4.567308
## critère-esthétique=innovant nouveau	7.017544	16.326531	27.403846
## type-cylindrée=150-200	6.382979	12.244898	22.596154
## critère-esthétique=ressemble à une moto	0.000000	0.000000	5.288462
## CSP=classe supérieure	2.439024	2.040816	9.855769
## CSP=ouvrier	2.272727	2.040816	10.576923
## âge=50 et +	2.222222	2.040816	10.817308
## âge=30-39 ans	6.400000	16.326531	30.048077
## âge=40-49 ans	4.761905	8.163265	20.192308
## type-utilisation=domicile-travail	7.860262	36.734694	55.048077
## critère-esthétique=discret / sobre	1.515152	2.040816	15.865385
## CSP=classe supérieure moyenne	0.000000	0.000000	12.019231
## type-cylindrée=250-400	2.040816	4.081633	23.557692
## sexe=homme	2.898551	20.408163	82.932692
##	p.value	v.test	
## sexe=femme	5.113536e-26	10.5493764	
## critère-esthétique=à la mode	6.563696e-09	5.8017229	
## CSP=inactif	4.199733e-07	5.0596743	
## âge=18-19 ans	1.143446e-06	4.8651939	
## type-cylindrée=125	2.104757e-05	4.2534779	
## type-utilisation=personnels et loisirs	1.933905e-03	3.1001992	
## âge=25-29 ans	9.336421e-02	1.6779123	
## âge=16-17 ans	3.644964e-01	0.9068306	
## âge=20-24 ans	4.249461e-01	0.7978698	
## type-cylindrée=100	6.161497e-01	0.5013146	
## critère-esthétique=sportif	6.643291e-01	0.4339440	
## CSP=employé	6.919430e-01	0.3962197	
## critère-esthétique=rétro	8.768686e-01	0.1549400	
## critère-esthétique=classique	7.678408e-01	-0.2952004	
## CSP=classe moyenne	4.170328e-01	-0.8115797	
## type-utilisation=professionnel	4.077188e-01	-0.8279147	
## critère-esthétique=innovant nouveau	5.980245e-02	-1.8822473	
## type-cylindrée=150-200	5.885898e-02	-1.8892452	
## critère-esthétique=ressemble à une moto	5.877155e-02	-1.8898984	
## CSP=classe supérieure	3.600987e-02	-2.0968160	
## CSP=ouvrier	2.511108e-02	-2.2396896	
## âge=50 et +	2.223754e-02	-2.2862859	
## âge=30-39 ans	2.219769e-02	-2.2869679	
## âge=40-49 ans	1.895528e-02	-2.3464093	
## type-utilisation=domicile-travail	6.716475e-03	-2.7105844	
## critère-esthétique=discret / sobre	1.494687e-03	-3.1757130	
## CSP=classe supérieure moyenne	1.235676e-03	-3.2305145	
## type-cylindrée=250-400	1.402018e-04	-3.8078119	


```

## sexe=homme 5.113536e-26 -10.5493764
##
## $`3`
##
## Cla/Mod Mod/Cla Global
## type-cylindrée=250-400 42.857143 47.727273 23.557692
## type-utilisation=domicile-travail 27.510917 71.590909 55.048077
## type-cylindrée=150-200 32.978723 35.227273 22.596154
## CSP=classe supérieure moyenne 38.000000 21.590909 12.019231
## CSP=employé 31.182796 32.954545 22.355769
## âge=30-39 ans 28.800000 40.909091 30.048077
## âge=40-49 ans 30.952381 29.545455 20.192308
## sexe=homme 23.188406 90.909091 82.932692
## critère-esthétique=innovant nouveau 27.192982 35.227273 27.403846
## critère-esthétique=rétro 50.000000 4.545455 1.923077
## CSP=classe moyenne 25.000000 27.272727 23.076923
## critère-esthétique=à la mode 25.531915 13.636364 11.298077
## critère-esthétique=classique 24.000000 20.454545 18.028846
## CSP=classe supérieure 24.390244 11.363636 9.855769
## âge=50 et + 22.222222 11.363636 10.817308
## type-utilisation=professionnel 21.052632 4.545455 4.567308
## âge=25-29 ans 19.178082 15.909091 17.548077
## critère-esthétique=sportif 17.857143 17.045455 20.192308
## critère-esthétique=ressemble à une moto 9.090909 2.272727 5.288462
## âge=16-17 ans 0.000000 0.000000 2.163462
## sexe=femme 11.267606 9.090909 17.067308
## critère-esthétique=discret / sobre 9.090909 6.818182 15.865385
## type-cylindrée=125 11.009174 13.636364 26.201923
## CSP=ouvrier 4.545455 2.272727 10.576923
## âge=18-19 ans 0.000000 0.000000 6.490385
## type-utilisation=personnels et loisirs 12.500000 23.863636 40.384615
## âge=20-24 ans 3.773585 2.272727 12.740385
## CSP=inactif 4.347826 4.545455 22.115385
## type-cylindrée=100 2.608696 3.409091 27.644231
##
## p.value v.test
## type-cylindrée=250-400 1.407522e-08 5.67247114
## type-utilisation=domicile-travail 3.991813e-04 3.54062445
## type-cylindrée=150-200 2.211223e-03 3.06029058
## CSP=classe supérieure moyenne 3.655184e-03 2.90648163
## CSP=employé 9.594892e-03 2.59009689
## âge=30-39 ans 1.459911e-02 2.44217396
## âge=40-49 ans 1.777795e-02 2.37021066
## sexe=homme 2.067090e-02 2.31394207
## critère-esthétique=innovant nouveau 6.966495e-02 1.81408300
## critère-esthétique=rétro 7.808003e-02 1.76193645
## CSP=classe moyenne 2.979626e-01 1.04081241
## critère-esthétique=à la mode 4.367212e-01 0.77774193
## critère-esthétique=classique 5.035729e-01 0.66887862
## CSP=classe supérieure 5.859128e-01 0.54476837
## âge=50 et + 8.343912e-01 0.20907312
## type-utilisation=professionnel 9.716848e-01 -0.03549528
## âge=25-29 ans 6.644642e-01 -0.43375794
## critère-esthétique=sportif 4.160604e-01 -0.81327510
## critère-esthétique=ressemble à une moto 1.529245e-01 -1.42927753
## âge=16-17 ans 1.150225e-01 -1.57601435

```

```

## sexe=femme 2.067090e-02 -2.31394207
## critère-esthétique=discret / sobre 5.929249e-03 -2.75166862
## type-cylindrée=125 1.765968e-03 -3.12700519
## CSP=ouvrier 1.747179e-03 -3.13014863
## âge=18-19 ans 1.287517e-03 -3.21874779
## type-utilisation=personnels et loisirs 3.009760e-04 -3.61445854
## âge=20-24 ans 2.198402e-04 -3.69505382
## CSP=inactif 7.609582e-07 -4.94512296
## type-cylindrée=100 1.151493e-10 -6.44559302
##
## $`4`
## Cla/Mod Mod/Cla Global
## CSP=inactif 45.652174 75.000000 22.115385
## âge=20-24 ans 43.396226 41.071429 12.740385
## type-utilisation=personnels et loisirs 23.214286 69.642857 40.384615
## âge=18-19 ans 44.444444 21.428571 6.490385
## type-cylindrée=100 24.347826 50.000000 27.644231
## âge=16-17 ans 66.666667 10.714286 2.163462
## critère-esthétique=ressemble à une moto 40.909091 16.071429 5.288462
## sexe=homme 15.362319 94.642857 82.932692
## critère-esthétique=sportif 22.619048 33.928571 20.192308
## CSP=ouvrier 22.727273 17.857143 10.576923
## critère-esthétique=classique 13.333333 17.857143 18.028846
## critère-esthétique=rétro 12.500000 1.785714 1.923077
## type-utilisation=professionnel 10.526316 3.571429 4.567308
## âge=50 et + 11.111111 8.928571 10.817308
## type-cylindrée=125 11.926606 23.214286 26.201923
## critère-esthétique=discret / sobre 10.606061 12.500000 15.865385
## type-cylindrée=250-400 9.183673 16.071429 23.557692
## critère-esthétique=innovant nouveau 7.894737 16.071429 27.403846
## âge=25-29 ans 5.479452 7.142857 17.548077
## type-cylindrée=150-200 6.382979 10.714286 22.596154
## critère-esthétique=à la mode 2.127660 1.785714 11.298077
## sexe=femme 4.225352 5.357143 17.067308
## CSP=classe supérieure 0.000000 0.000000 9.855769
## CSP=classe supérieure moyenne 0.000000 0.000000 12.019231
## âge=30-39 ans 4.000000 8.928571 30.048077
## CSP=employé 2.150538 3.571429 22.355769
## CSP=classe moyenne 2.083333 3.571429 23.076923
## âge=40-49 ans 1.190476 1.785714 20.192308
## type-utilisation=domicile-travail 6.550218 26.785714 55.048077
## p.value v.test
## CSP=inactif 2.882732e-20 9.22323349
## âge=20-24 ans 4.527729e-09 5.86366046
## type-utilisation=personnels et loisirs 2.385765e-06 4.71765677
## âge=18-19 ans 4.652184e-05 4.07244672
## type-cylindrée=100 1.392628e-04 3.80947386
## âge=16-17 ans 2.985839e-04 3.61652549
## critère-esthétique=ressemble à une moto 1.113501e-03 3.26015823
## sexe=homme 7.193034e-03 2.68777271
## critère-esthétique=sportif 9.499922e-03 2.59351925
## CSP=ouvrier 7.512821e-02 1.77968082
## critère-esthétique=classique 9.942392e-01 -0.00722012
## critère-esthétique=rétro 9.825863e-01 -0.02182660

```

## type-utilisation=professionnel	7.629541e-01	-0.30160384
## âge=50 et +	6.578859e-01	-0.44283392
## type-cylindrée=125	5.991167e-01	-0.52567115
## critère-esthétique=discret / sobre	4.767367e-01	-0.71156092
## type-cylindrée=250-400	1.544177e-01	-1.42409951
## critère-esthétique=innovant nouveau	3.685990e-02	-2.08731243
## âge=25-29 ans	2.069980e-02	-2.31341566
## type-cylindrée=150-200	1.740370e-02	-2.37806628
## critère-esthétique=à la mode	7.482655e-03	-2.67456373
## sexe=femme	7.193034e-03	-2.68777271
## CSP=classe supérieure	1.915551e-03	-3.10302247
## CSP=classe supérieure moyenne	4.392248e-04	-3.51531976
## âge=30-39 ans	6.937970e-05	-3.97840300
## CSP=employé	4.780393e-05	-4.06611219
## CSP=classe moyenne	2.913993e-05	-4.18008570
## âge=40-49 ans	2.188080e-05	-4.24477999
## type-utilisation=domicile-travail	5.189696e-06	-4.55696950
##		
## \$`5`		
##	Cla/Mod	Mod/Cla Global
## sexe=homme	40.000000	90.789474 82.932692
## CSP=classe moyenne	50.000000	31.578947 23.076923
## CSP=classe supérieure	56.097561	15.131579 9.855769
## critère-esthétique=innovant nouveau	45.614035	34.210526 27.403846
## âge=40-49 ans	47.619048	26.315789 20.192308
## âge=50 et +	51.111111	15.131579 10.817308
## critère-esthétique=discret / sobre	46.969697	20.394737 15.865385
## CSP=ouvrier	47.727273	13.815789 10.576923
## type-cylindrée=250-400	42.857143	27.631579 23.557692
## type-cylindrée=150-200	42.553191	26.315789 22.596154
## type-utilisation=domicile-travail	39.301310	59.210526 55.048077
## âge=30-39 ans	40.800000	33.552632 30.048077
## âge=25-29 ans	41.095890	19.736842 17.548077
## CSP=classe supérieure moyenne	42.000000	13.815789 12.019231
## type-utilisation=professionnel	42.105263	5.263158 4.567308
## critère-esthétique=ressemble à une moto	40.909091	5.921053 5.288462
## CSP=employé	33.333333	20.394737 22.355769
## critère-esthétique=classique	32.000000	15.789474 18.028846
## type-cylindrée=125	32.110092	23.026316 26.201923
## critère-esthétique=sportif	30.952381	17.105263 20.192308
## type-utilisation=personnels et loisirs	32.142857	35.526316 40.384615
## type-cylindrée=100	30.434783	23.026316 27.644231
## critère-esthétique=rétro	0.000000	0.000000 1.923077
## critère-esthétique=à la mode	21.276596	6.578947 11.298077
## âge=16-17 ans	0.000000	0.000000 2.163462
## sexe=femme	19.718310	9.210526 17.067308
## âge=20-24 ans	15.094340	5.263158 12.740385
## âge=18-19 ans	0.000000	0.000000 6.490385
## CSP=inactif	8.695652	5.263158 22.115385
##	p.value	v.test
## sexe=homme	9.204622e-04	3.3137730
## CSP=classe moyenne	2.160332e-03	3.0672567
## CSP=classe supérieure	7.910162e-03	2.6558806
## critère-esthétique=innovant nouveau	1.974327e-02	2.3311914

```
## âge=40-49 ans                2.033723e-02  2.3200674
## âge=50 et +                  3.619568e-02  2.0947224
## critère-esthétique=discret / sobre 5.959205e-02  1.8837999
## CSP=ouvrier                  1.107873e-01  1.5946643
## type-cylindrée=250-400       1.416394e-01  1.4697135
## type-cylindrée=150-200       1.731557e-01  1.3621336
## type-utilisation=domicile-travail 1.973667e-01  1.2890902
## âge=30-39 ans                2.401911e-01  1.1745093
## âge=25-29 ans                3.765667e-01  0.8842400
## CSP=classe supérieure moyenne 3.967365e-01  0.8474640
## type-utilisation=professionnel 6.075280e-01  0.5136053
## critère-esthétique=ressemble à une moto 6.603371e-01  0.4394477
## CSP=employé                  4.715379e-01 -0.7199790
## critère-esthétique=classique 3.723657e-01 -0.8920507
## type-cylindrée=125           2.663528e-01 -1.1115010
## critère-esthétique=sportif    2.365329e-01 -1.1836974
## type-utilisation=personnels et loisirs 1.267288e-01 -1.5271298
## type-cylindrée=100           1.105152e-01 -1.5958818
## critère-esthétique=rétro     2.529236e-02 -2.2369079
## critère-esthétique=à la mode 1.910314e-02 -2.3435122
## âge=16-17 ans                1.586972e-02 -2.4118981
## sexe=femme                   9.204622e-04 -3.3137730
## âge=20-24 ans                3.004655e-04 -3.6148984
## âge=18-19 ans                2.782880e-06 -4.6862267
## CSP=inactif                  1.491635e-11 -6.7487119
```

```
res.hcpc$desc.axes
```

```
##
## Link between the cluster variable and the quantitative variables
## =====
##              Eta2          P-value
## Dim.1 0.72445189 1.368685e-113
## Dim.2 0.54502152 5.891248e-69
## Dim.4 0.35968482 1.226013e-38
## Dim.3 0.19250248 3.354334e-18
## Dim.5 0.07774778 1.015034e-06
##
## Description of each cluster by quantitative variables
## =====
## $`1`
##              v.test Mean in category Overall mean sd in category Overall sd
## Dim.3 2.3670979      0.35652623 7.244139e-16      1.438010 1.391935
## Dim.4 1.2577887      0.17819867 2.477840e-16      1.328886 1.309304
## Dim.5 0.2707083      0.03763053 -4.658441e-16      1.561888 1.284643
## Dim.2 -2.8547297     -0.47699937 1.086066e-15      1.334162 1.544175
## Dim.1 -14.8016867    -3.68607740 -1.686685e-16      1.609540 2.301425
##              p.value
## Dim.3 1.792819e-02
## Dim.4 2.084682e-01
## Dim.5 7.866154e-01
## Dim.2 4.307348e-03
## Dim.1 1.428548e-49
##
## $`2`
```

```

##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.2 11.5692183      2.4000011  1.086066e-15      1.250116  1.544175
## Dim.5  4.9412423      0.8527652 -4.658441e-16      1.053025  1.284643
## Dim.3 -0.9139536     -0.1709047  7.244139e-16      1.298114  1.391935
## Dim.1 -1.3211177     -0.4084598 -1.686685e-16      1.163102  2.301425
## Dim.4 -7.6775264     -1.3504319  2.477840e-16      1.172750  1.309304
##          p.value
## Dim.2 5.901790e-31
## Dim.5 7.762638e-07
## Dim.3 3.607412e-01
## Dim.1 1.864621e-01
## Dim.4 1.621899e-14
##
## $`3`
##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.5 -0.6357194     -0.07739615 -4.658441e-16      1.1296400  1.284643
## Dim.1 -0.9046373     -0.19730720 -1.686685e-16      1.0163375  2.301425
## Dim.3 -4.5117602     -0.59516376  7.244139e-16      1.0599782  1.391935
## Dim.4 -5.5124987     -0.68400688  2.477840e-16      0.9014821  1.309304
## Dim.2 -8.7095753     -1.27457386  1.086066e-15      0.8927063  1.544175
##          p.value
## Dim.5 5.249594e-01
## Dim.1 3.656576e-01
## Dim.3 6.429186e-06
## Dim.4 3.537748e-08
## Dim.2 3.050153e-18
##
## $`4`
##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.4  8.8546483      1.4429289  2.477840e-16      0.7842389  1.309304
## Dim.2  6.5163770      1.2523793  1.086066e-15      0.9475017  1.544175
## Dim.1 -0.4753854     -0.1361683 -1.686685e-16      1.4037044  2.301425
## Dim.5 -3.4251260     -0.5476362 -4.658441e-16      1.2730228  1.284643
## Dim.3 -5.8530704     -1.0139951  7.244139e-16      1.6231438  1.391935
##          p.value
## Dim.4 8.394809e-19
## Dim.2 7.202580e-11
## Dim.1 6.345123e-01
## Dim.5 6.145145e-04
## Dim.3 4.825798e-09
##
## $`5`
##          v.test Mean in category Overall mean sd in category Overall sd
## Dim.1 13.5530693      2.0178584 -1.686685e-16      1.0120075  2.301425
## Dim.3  6.7375541      0.6067046  7.244139e-16      1.0731110  1.391935
## Dim.4  2.5559753      0.2164977  2.477840e-16      1.0192348  1.309304
## Dim.5 -0.5524554     -0.0459130 -4.658441e-16      1.1544105  1.284643
## Dim.2 -2.7465017     -0.2743674  1.086066e-15      0.9174931  1.544175
##          p.value
## Dim.1 7.598521e-42
## Dim.3 1.610750e-11
## Dim.4 1.058906e-02
## Dim.5 5.806364e-01
## Dim.2 6.023457e-03

```