Actividad 4: Componentes Principales (2)

Code

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Cargar datos

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```
X = read.csv("paises_mundo.csv")
```

PARTE II

Matrices de varianza-covarianza

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```
Xcov = cov(X)
Xcov
```

```
                CrecPobl       MortInf   PorcMujeres         PNB95      ProdElec
CrecPobl     1.538298e+00  2.195026e+01 -6.078026e+00 -8.933379e+04 -4.973964e+04
MortInf      2.195026e+01  1.032859e+03 -9.249342e+00 -2.269332e+06 -1.043435e+06
PorcMujeres -6.078026e+00 -9.249342e+00  7.698322e+01  2.813114e+05  2.260248e+05
PNB95       -8.933379e+04 -2.269332e+06  2.813114e+05  4.999786e+10  2.247791e+10
ProdElec    -4.973964e+04 -1.043435e+06  2.260248e+05  2.247791e+10  1.821909e+10
LinTelf     -1.369079e+02 -4.381366e+03  4.499750e+02  2.039550e+07  7.583050e+06
ConsAgua    -4.827092e+01 -1.288211e+03 -1.568313e+03  1.097481e+07  1.399817e+07
PropBosq    -3.887018e+00 -1.466316e+01  6.517895e+01  2.474311e+05  7.035979e+04
PropDefor    3.361974e-01  1.276296e+01  2.680592e-01 -5.806203e+04 -3.180340e+04
ConsEner    -8.384169e+02 -4.442568e+04  2.855207e+02  1.415628e+08  6.801296e+07
EmisCO2     -1.137877e+00 -9.485500e+01 -2.150132e+00  2.501673e+05  1.392779e+05
                LinTelf      ConsAgua      PropBosq     PropDefor      ConsEner
CrecPobl    -1.369079e+02 -4.827092e+01     -3.887018  3.361974e-01 -8.384169e+02
MortInf     -4.381366e+03 -1.288211e+03    -14.663158  1.276296e+01 -4.442568e+04
PorcMujeres  4.499750e+02 -1.568313e+03     65.178947  2.680592e-01  2.855207e+02
PNB95        2.039550e+07  1.097481e+07 247431.122807 -5.806203e+04  1.415628e+08
ProdElec     7.583050e+06  1.399817e+07  70359.785965 -3.180340e+04  6.801296e+07
LinTelf      3.841247e+04  1.193110e+04    248.715789 -9.940461e+01  3.426262e+05
ConsAgua     1.193110e+04  3.301981e+05  -2220.757895 -6.743793e+01  2.092242e+05
PropBosq     2.487158e+02 -2.220758e+03    401.003509  2.625263e+00 -5.153439e+03
PropDefor   -9.940461e+01 -6.743793e+01      2.625263  1.817253e+00 -1.051522e+03
ConsEner     3.426262e+05  2.092242e+05  -5153.438596 -1.051522e+03  5.014395e+06
EmisCO2      6.385700e+02  4.869328e+02    -12.897193 -2.632487e+00  1.028616e+04
                EmisCO2
CrecPobl       -1.137877
MortInf       -94.855000
PorcMujeres    -2.150132
PNB95      250167.323509
ProdElec   139277.888640
LinTelf       638.570000
ConsAgua      486.932763
PropBosq      -12.897193
PropDefor      -2.632487
ConsEner    10286.159781
EmisCO2        27.268614
```

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```
Xcor = cor(X)
Xcor
```

```
              CrecPobl     MortInf PorcMujeres       PNB95    ProdElec     LinTelf
CrecPobl     1.00000000  0.55067948 -0.55852711 -0.32212154 -0.29711119 -0.56321228
MortInf      0.55067948  1.00000000 -0.03280139 -0.31579250 -0.24053689 -0.69558922
PorcMujeres -0.55852711 -0.03280139  1.00000000  0.14338826  0.19085114  0.26167018
PNB95       -0.32212154 -0.31579250  0.14338826  1.00000000  0.74476081  0.46539599
ProdElec    -0.29711119 -0.24053689  0.19085114  0.74476081  1.00000000  0.28664508
LinTelf     -0.56321228 -0.69558922  0.26167018  0.46539599  0.28664508  1.00000000
ConsAgua    -0.06772953 -0.06975563 -0.31106243  0.08541500  0.18047653  0.10593934
PropBosq    -0.15650281 -0.02278415  0.37096694  0.05525919  0.02603078  0.06337138
PropDefor    0.20107881  0.29459348  0.02266339 -0.19262327 -0.17478434 -0.37623801
ConsEner    -0.30187731 -0.61731132  0.01453216  0.28272492  0.22501894  0.78068385
EmisCO2     -0.17568860 -0.56520778 -0.04692837  0.21425123  0.19760017  0.62393719
               ConsAgua    PropBosq   PropDefor    ConsEner     EmisCO2
CrecPobl    -0.06772953 -0.15650281  0.20107881 -0.30187731 -0.17568860
MortInf     -0.06975563 -0.02278415  0.29459348 -0.61731132 -0.56520778
PorcMujeres -0.31106243  0.37096694  0.02266339  0.01453216 -0.04692837
PNB95        0.08541500  0.05525919 -0.19262327  0.28272492  0.21425123
ProdElec     0.18047653  0.02603078 -0.17478434  0.22501894  0.19760017
LinTelf      0.10593934  0.06337138 -0.37623801  0.78068385  0.62393719
ConsAgua     1.00000000 -0.19299225 -0.08705811  0.16259804  0.16227447
PropBosq    -0.19299225  1.00000000  0.09725032 -0.11492480 -0.12333592
PropDefor   -0.08705811  0.09725032  1.00000000 -0.34833836 -0.37396154
ConsEner     0.16259804 -0.11492480 -0.34833836  1.00000000  0.87965517
EmisCO2      0.16227447 -0.12333592 -0.37396154  0.87965517  1.00000000
```

Valores y vectores propios de matriz de varianzas

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```
propiosCovVal = eigen(Xcov)$values #valores propios
propiosCovVec = eigen(Xcov)$vectors #vectores propios
propiosCovVal
```

```
 [1] 6.163576e+10 6.581612e+09 4.636256e+06 3.107232e+05 1.216015e+04 5.137767e+02
 [7] 3.627885e+02 4.542082e+01 5.800868e+00 1.438020e+00 4.768083e-01
```

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```
propiosCovVec
```

```
              [,1]          [,2]          [,3]          [,4]          [,5]
 [1,] -1.658168e-06  4.706785e-07  0.0001263736 -1.928408e-05 -0.0055373971
 [2,] -4.048139e-05 -1.774254e-05  0.0082253821 -2.493257e-03 -0.0944030204
 [3,]  5.739096e-06 -1.084543e-05  0.0001318149  5.538307e-03  0.0314036410
 [4,]  8.880376e-01  4.597632e-01  0.0026022071 -3.893588e-04 -0.0003327409
 [5,]  4.597636e-01 -8.880405e-01  0.0005694896  1.096305e-03  0.0002207819
 [6,]  3.504341e-04  4.016179e-04 -0.0619424889  7.641174e-03  0.9921404486
 [7,]  2.625508e-04 -1.122118e-03 -0.0401453227 -9.991411e-01  0.0057795144
 [8,]  4.089564e-06  7.790843e-06  0.0012719918  6.435797e-03  0.0419331615
 [9,] -1.073825e-06  2.350808e-07  0.0001916177  4.043796e-05 -0.0018090751
[10,]  2.547156e-03  7.126782e-04 -0.9972315499  3.973568e-02 -0.0625729475
[11,]  4.643724e-06 -1.315731e-06 -0.0020679047 -5.626049e-05 -0.0042367120
              [,6]          [,7]          [,8]          [,9]         [,10]
 [1,]  1.243456e-02  5.359089e-03 -8.390810e-02 -6.778358e-02 -1.158091e-01
 [2,]  9.917515e-01  2.258019e-02 -7.891128e-02 -1.637836e-02  4.264872e-04
 [3,]  8.552991e-02 -1.136481e-01  9.856498e-01 -1.468464e-02  8.241465e-03
 [4,] -8.621005e-06 -7.566477e-06  1.217248e-05 -3.971469e-07  4.274451e-07
 [5,]  1.955408e-05  1.544658e-05 -2.558998e-05  1.059471e-06 -1.353881e-06
 [6,]  9.109622e-02  4.748682e-02 -3.416812e-02 -5.379549e-03 -3.409423e-03
 [7,] -1.087229e-03 -6.863294e-03  4.698731e-03  7.965261e-05  3.621425e-05
 [8,]  1.721948e-02 -9.920538e-01 -1.169638e-01  1.416566e-03  5.891758e-03
 [9,]  1.758667e-03 -7.455427e-03  1.811443e-02  1.283039e-01 -9.859317e-01
[10,]  2.639673e-03 -3.764707e-03  1.267052e-03  2.262931e-03  2.672618e-04
[11,] -1.877994e-02 -1.709137e-03 -5.204823e-03 -9.891529e-01 -1.200519e-01
             [,11]
 [1,]  9.872887e-01
 [2,] -2.092491e-02
 [3,]  8.344324e-02
 [4,]  2.723996e-07
 [5,] -2.086857e-07
 [6,]  4.944397e-04
 [7,]  4.780416e-04
 [8,] -3.748976e-03
 [9,] -1.052934e-01
[10,]  5.906241e-05
[11,] -8.221371e-02
```

Valores y vectores propios de matriz de covarianzas

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```
propiosCorVal = eigen(Xcor)$values #valores propios
propiosCorVec = eigen(Xcor)$vectors #vectores propios
propiosCorVal
```

```
 [1] 4.02987902 1.92999195 1.37041115 0.86451597 0.79414057 0.72919997 0.57130511
 [8] 0.32680096 0.16806846 0.14632819 0.06935866
```

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```
propiosCorVec
```

```
             [,1]        [,2]        [,3]        [,4]        [,5]        [,6]
 [1,] -0.314119414  0.34835747 -0.07352541 -0.44028717 -0.32972147 -0.18392437
 [2,] -0.392395442 -0.04136238 -0.17759254 -0.13398483  0.08340489 -0.08656390
 [3,]  0.116546319 -0.58283641  0.16686305  0.05865031  0.18654100  0.16835650
 [4,]  0.295393771 -0.17690839 -0.53343025 -0.26248209 -0.14110658  0.04653378
 [5,]  0.258964724 -0.17356372 -0.61438847 -0.17389644 -0.07521971  0.02821905
 [6,]  0.446082934 -0.02719077  0.15177250  0.04959796 -0.05416498  0.02442175
 [7,]  0.092410503  0.32060987 -0.37024258  0.73603097  0.02671021 -0.30940890
 [8,]  0.005692925 -0.45742697  0.16480339  0.04024882 -0.41531702 -0.75356463
 [9,] -0.243652293 -0.15408201 -0.02961449  0.33650345 -0.73261463  0.50894232
[10,]  0.415029554  0.23286257  0.20608749 -0.06730166 -0.23100421  0.05806466
[11,]  0.374531032  0.29168698  0.20631751 -0.14843513 -0.24028756 -0.02809233
              [,7]        [,8]        [,9]       [,10]       [,11]
 [1,]  0.1628974320 -0.09481963 -0.52181220  0.34674573 -0.10062784
 [2,]  0.6398040762 -0.32307802  0.29031618 -0.38959240  0.17487096
 [3,]  0.5310867107  0.05209889 -0.23599758  0.42854658 -0.16786800
 [4,] -0.1490207046 -0.44913216  0.36995675  0.34911534 -0.15247432
 [5,]  0.1082745817  0.50343911 -0.30681318 -0.33770404  0.12366382
 [6,] -0.0008501608 -0.56975094 -0.44733110 -0.20997673  0.44992596
 [7,]  0.2357666690 -0.05962470 -0.08358225  0.20561803 -0.07067780
 [8,] -0.0806036686  0.04275404  0.07438520 -0.08671232 -0.01493710
 [9,]  0.0112333588 -0.01607505  0.01868615 -0.03209758  0.07259619
[10,]  0.2711228006 -0.05023582  0.04339752 -0.36147417 -0.67912543
[11,]  0.3352822144  0.30978009  0.37666244  0.28779437  0.46737561
```

Proporción de varianza

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```
propiosCovVal[1]/sum(diag(Xcov))
```

```
[1] 0.9034543
```

PARTE II

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```
library(stats)
library(factoextra)
```

```
Loading required package: ggplot2
Keep up to date with changes at https://www.tidyverse.org/blog/
Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

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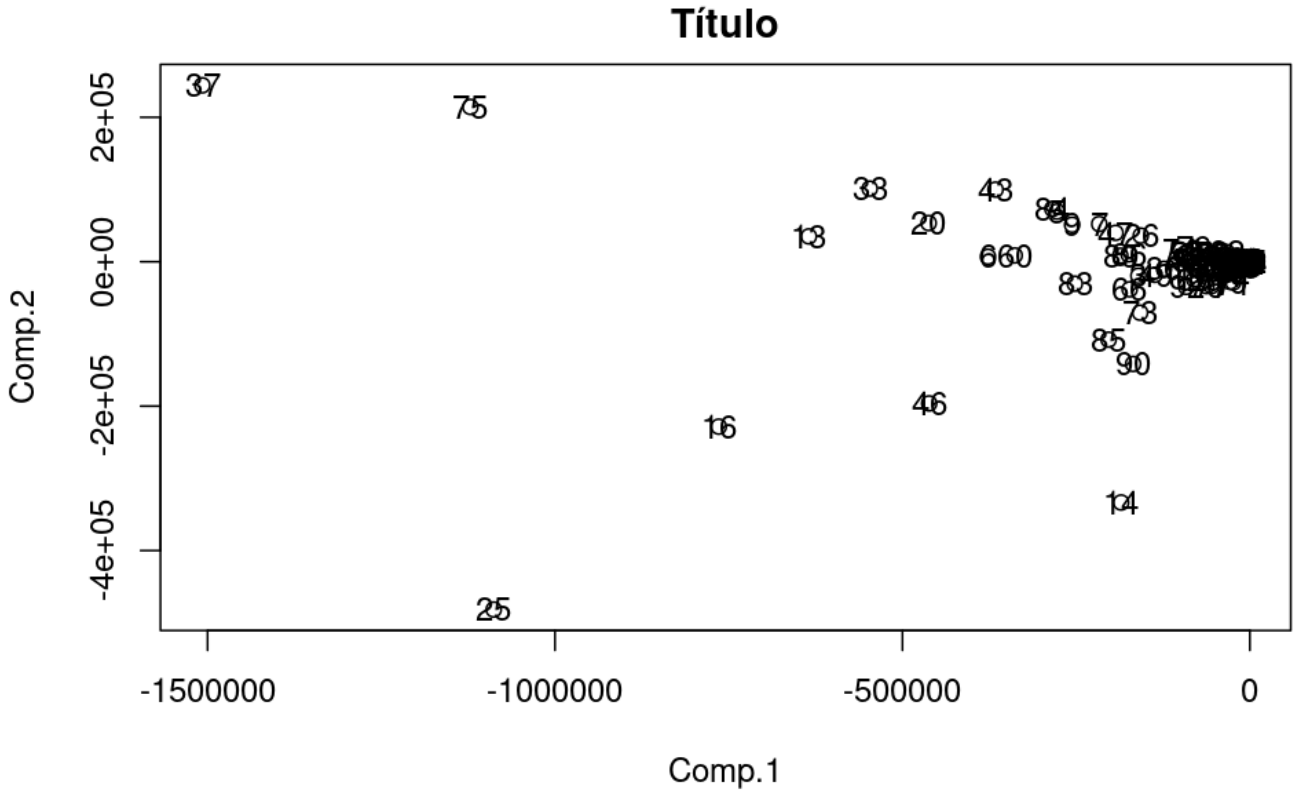
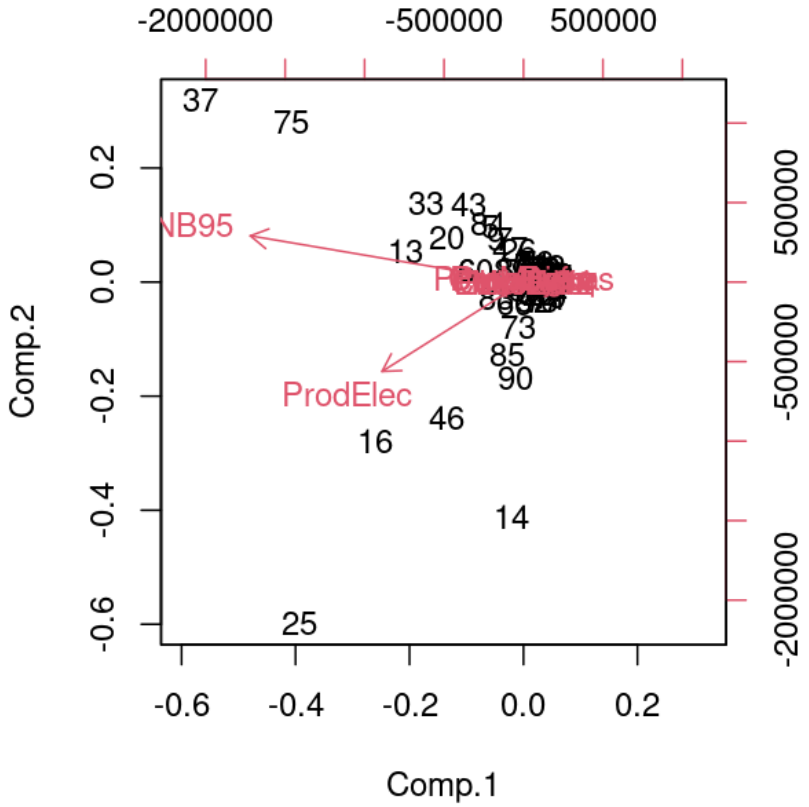
```
library(ggplot2)
datos=X
cpS=princomp(datos,cor=FALSE)
cpaS=as.matrix(datos)%*%cpS$loadings
plot(cpaS[,1:2],type="p", main = "Título")
text(cpaS[,1],cpaS[,2],1:nrow(cpaS))
```



Hide

```
biplot(cpS)
```



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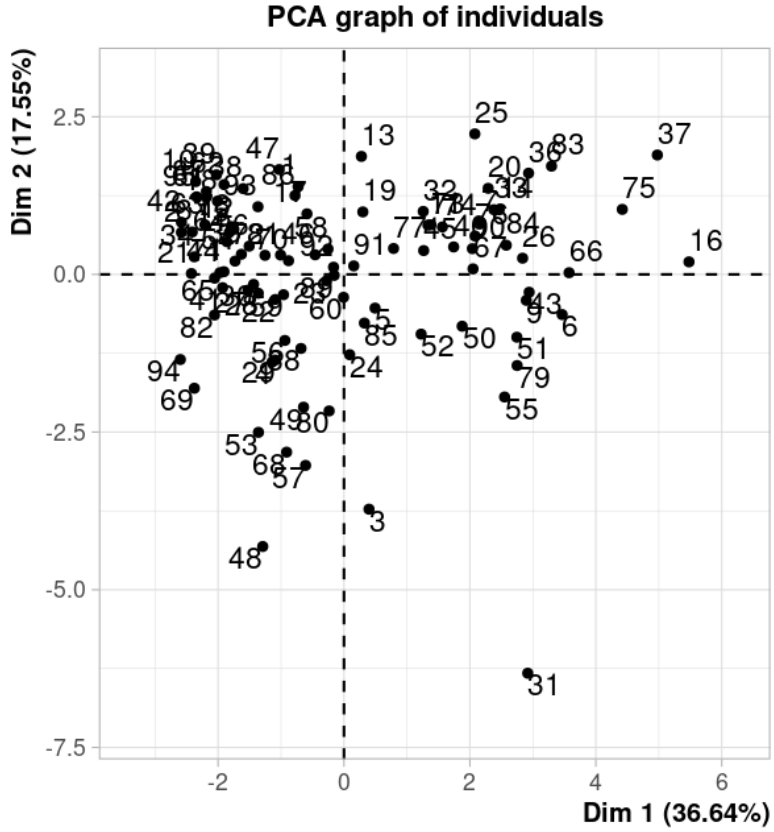
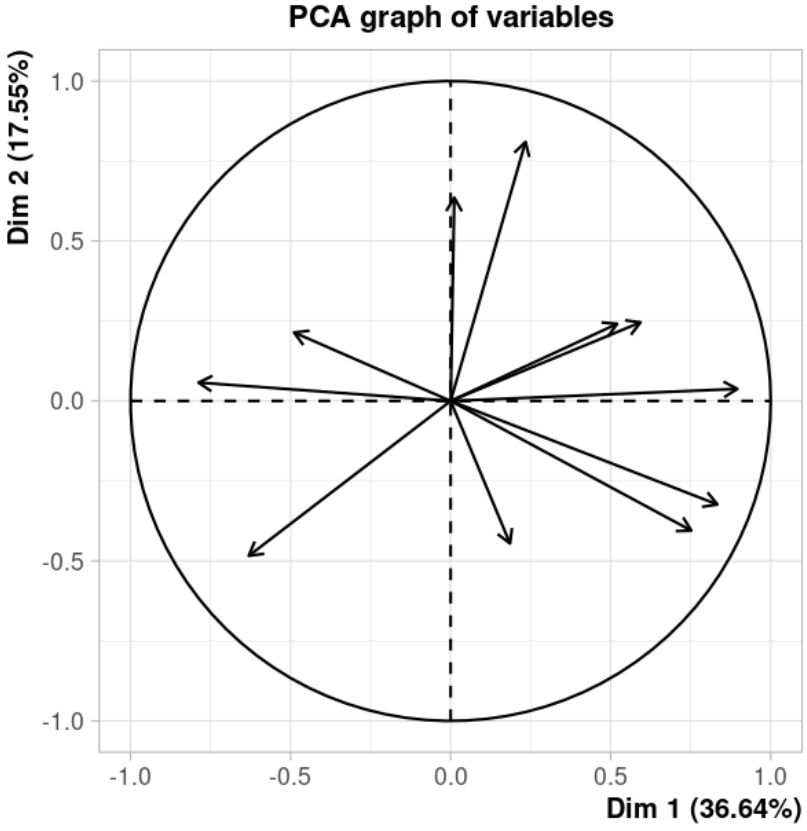
```
library(FactoMineR)
library(factoextra)
library(ggplot2)
datos=X
cp3 = PCA(datos)
```





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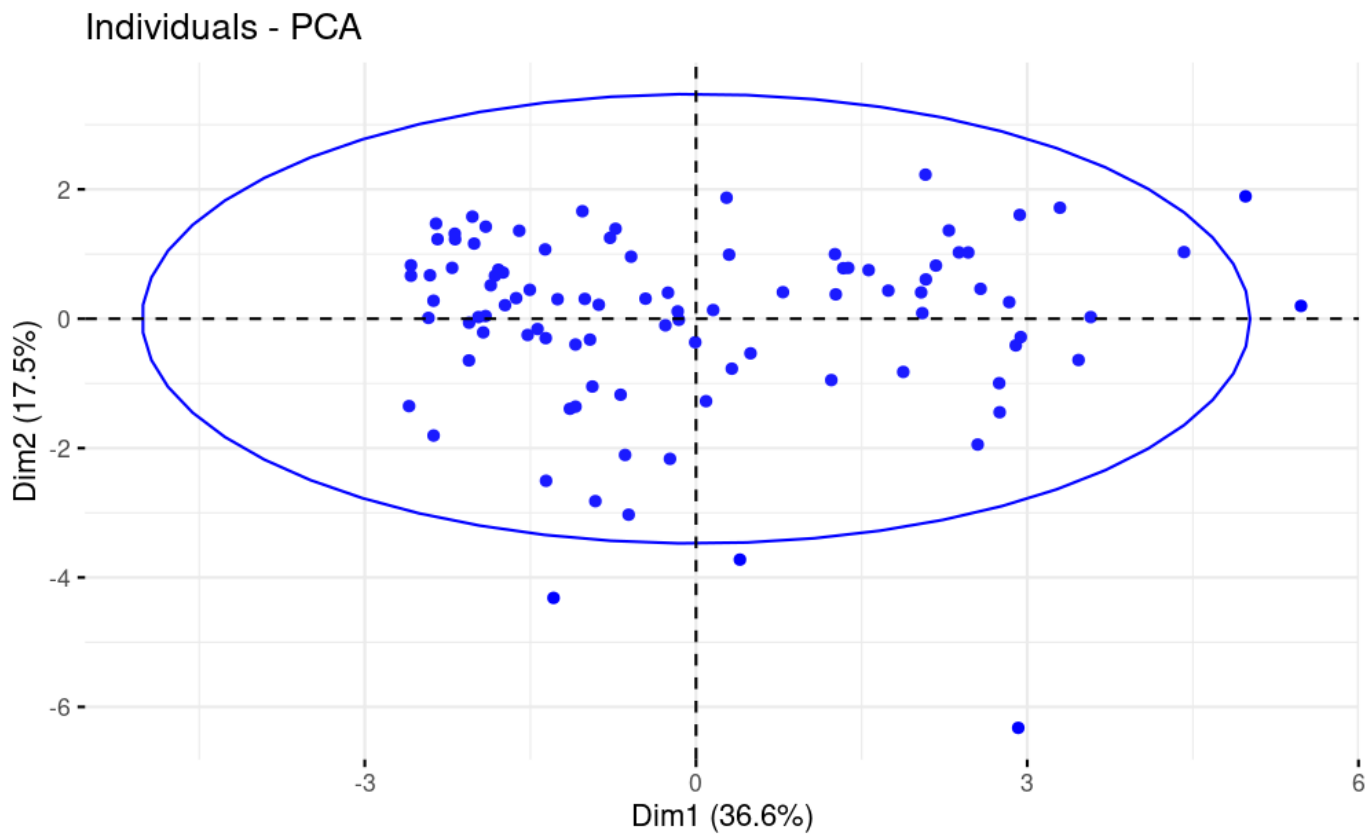
```
fviz_pca_ind(cp3, col.ind = "blue", addEllipses = TRUE, repel = TRUE)
```



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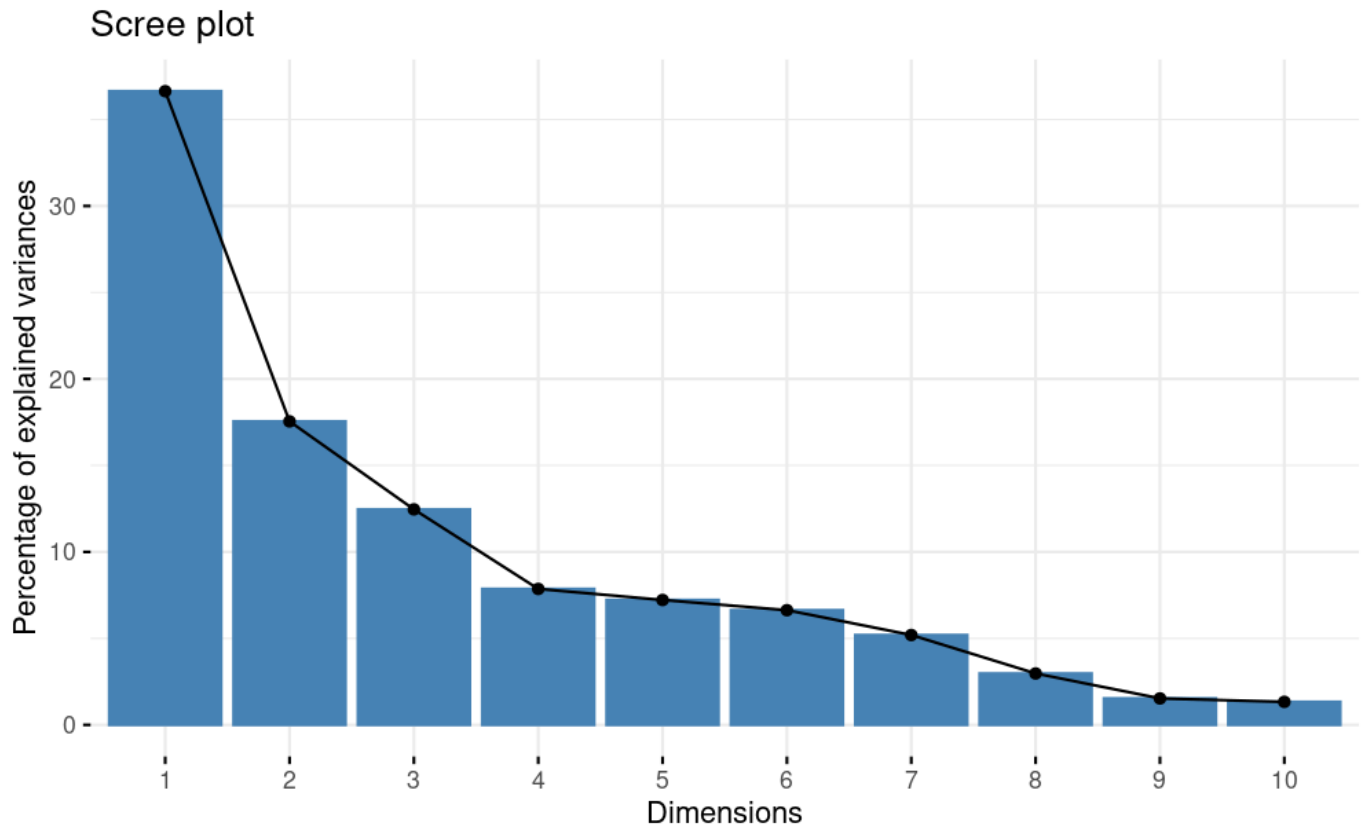
```
fviz_screeplot(cp3)
```



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```
fviz_contrib(cp3, choice = c("var"))
```