A2-Componentes Principales

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

Parte 1

```
cov(datos)
```

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

```
cor(datos)
```

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

```
eigen(cov(datos))[1]
```

```
## $values
##  [1] 6.163576e+10 6.581612e+09 4.636256e+06 3.107232e+05 1.216015e+04
##  [6] 5.137767e+02 3.627885e+02 4.542082e+01 5.800868e+00 1.438020e+00
## [11] 4.768083e-01
```

```
sum(diag(cov(datos)))
```

```
## [1] 68222335253
```

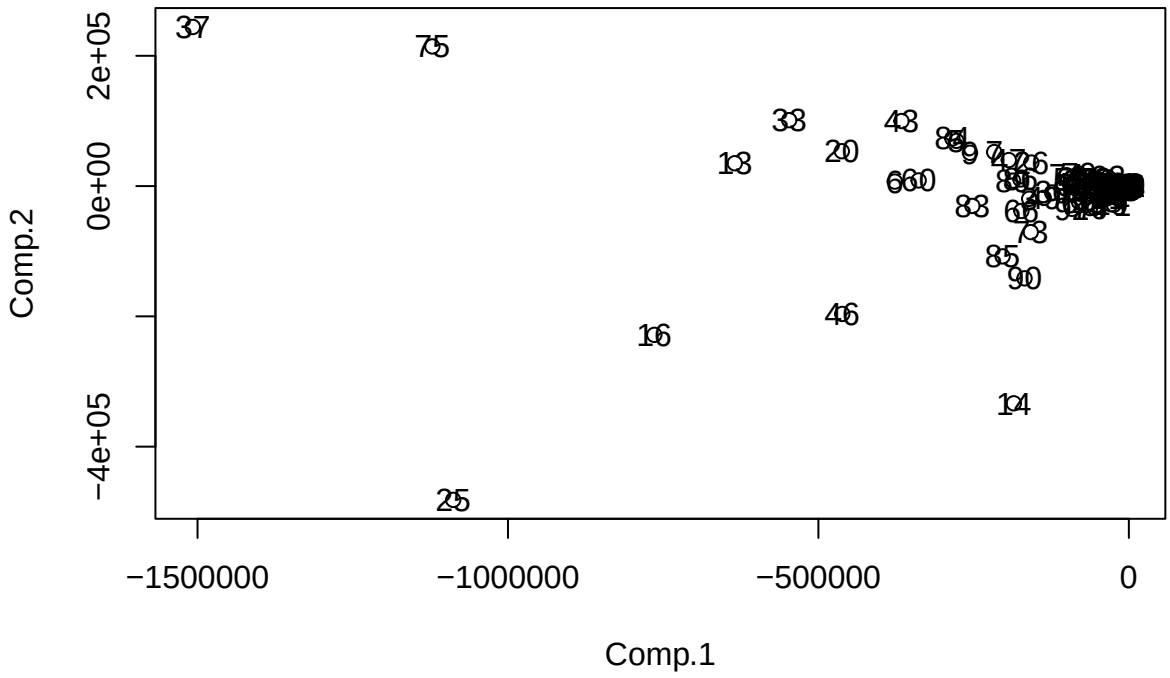
Parte 2

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

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

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

```
library(ggplot2)

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



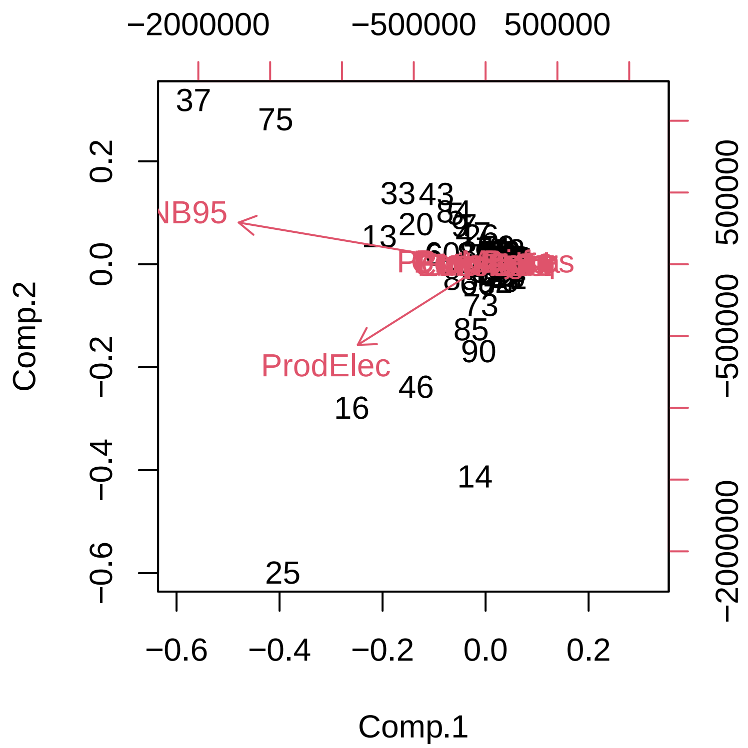

```
biplot(cpS)
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```

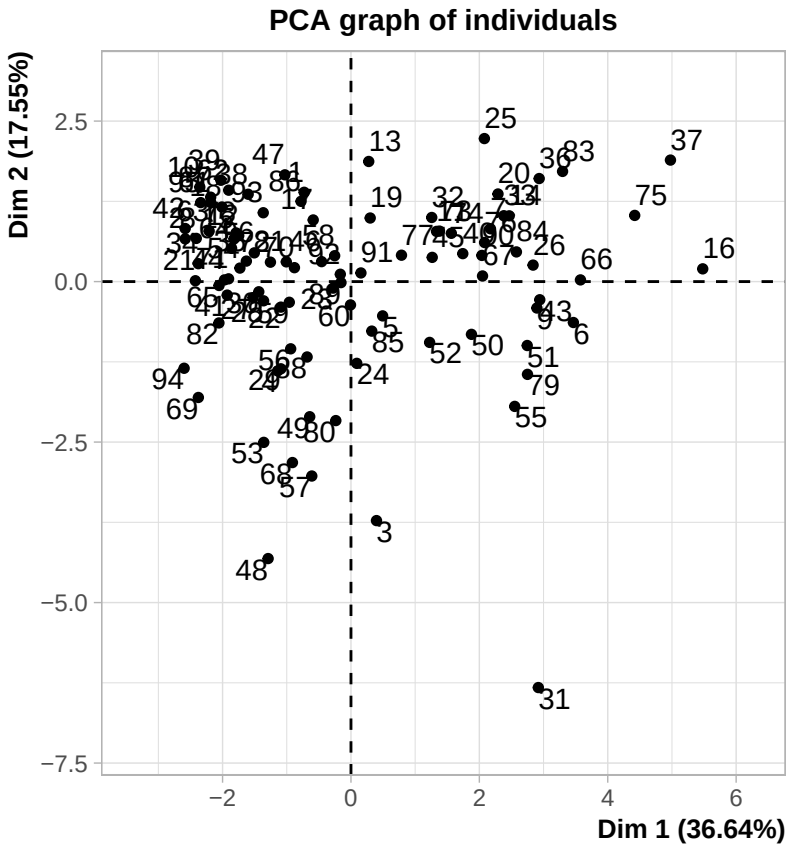
```
## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
```

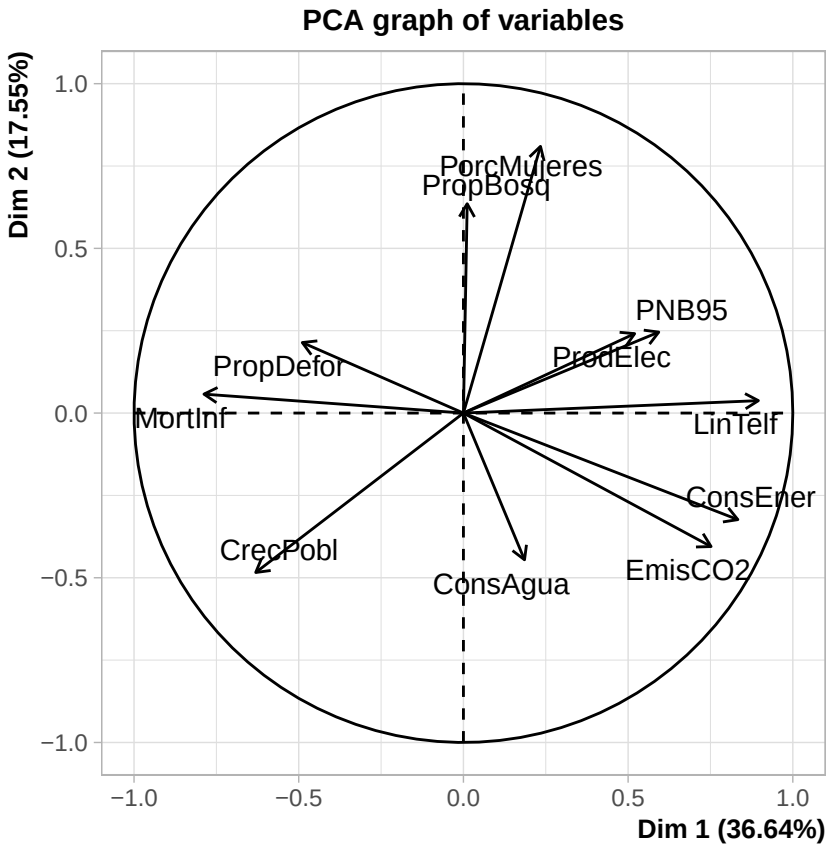
```
## arrow.len): zero-length arrow is of indeterminate angle and so skipped

## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped

## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped

## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped

## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped

## Warning in arrows(0, 0, y[, 1L] * 0.8, y[, 2L] * 0.8, col = col[2L], length =
## arrow.len): zero-length arrow is of indeterminate angle and so skipped
```



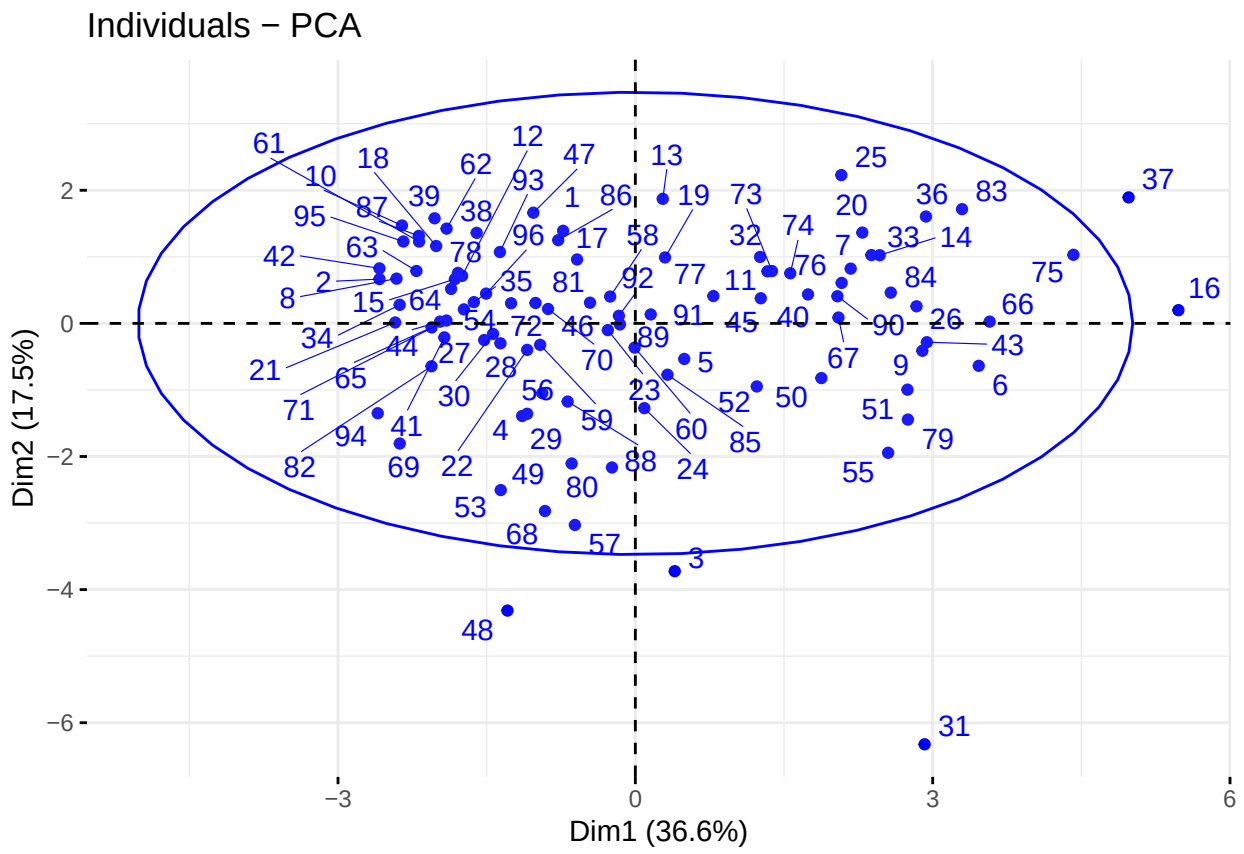
Parte 3

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

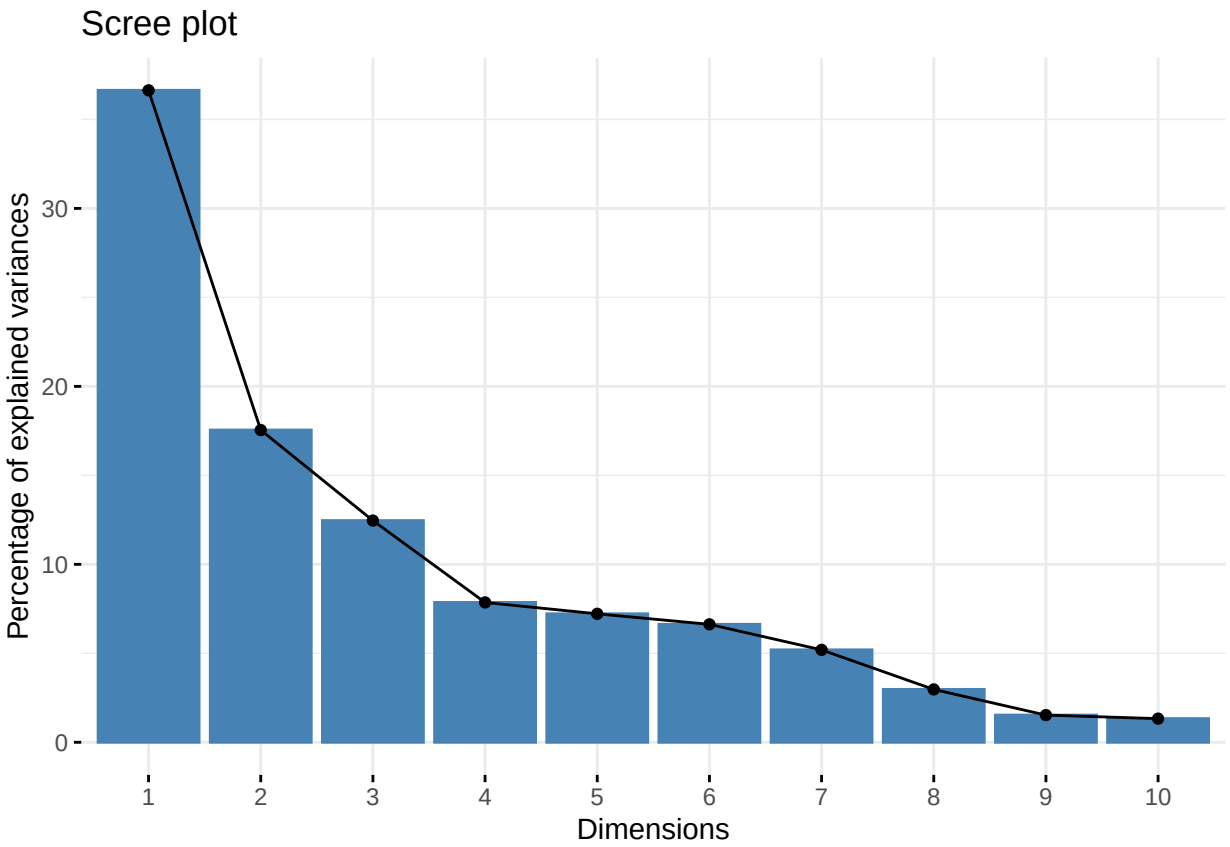

PCA graph of individuals
Dim 2 (17.55%)
Dim 1 (36.64%)
2.5
0.0
−2.5
−5.0
−7.5
−2
0
2
4
6




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




```
fviz_screeplot(cp3)
```


Scree plot
Percentage of explained variances
30
20
10
0
1
2
3
4
5
6
7
8
9
10
Dimensions