Tarea: Analisis de componentes principales

```
x<-datos::mtautos
```

```
str(x)
```

```
## 'data.frame':	32 obs. of  11 variables:
##  $ millas      : num  21 21 22.8 21.4 18.7 18.1 14.3 24.4 22.8 19.2 ...
##  $ cilindros   : num  6 6 4 6 8 6 8 4 4 6 ...
##  $ cilindrada  : num  160 160 108 258 360 ...
##  $ caballos    : num  110 110 93 110 175 105 245 62 95 123 ...
##  $ eje         : num  3.9 3.9 3.85 3.08 3.15 2.76 3.21 3.69 3.92 3.92 ...
##  $ peso        : num  2.62 2.88 2.32 3.21 3.44 ...
##  $ velocidad   : num  16.5 17 18.6 19.4 17 ...
##  $ forma       : num  0 0 1 1 0 1 0 1 1 1 ...
##  $ transmision : num  1 1 1 0 0 0 0 0 0 0 ...
##  $ cambios     : num  4 4 4 3 3 3 3 4 4 4 ...
##  $ carburadores: num  4 4 1 1 2 1 4 2 2 4 ...
```

```
x<-x[,1:7]
```

```
x<-x[,-2]
```

Exploracion Matriz

```
View(x)
```

```
colnames(x)
```

```
## [1] "millas"     "cilindrada" "caballos"   "eje"        "peso"
## [6] "velocidad"
```

2.- Quitar los espacios de los nombres

```
colnames(x)[4]="Life.Exp"
```

```
colnames(x)[6]= "HS.Grad"
```

3.- Se definen n (numero de estados) y p (variables)

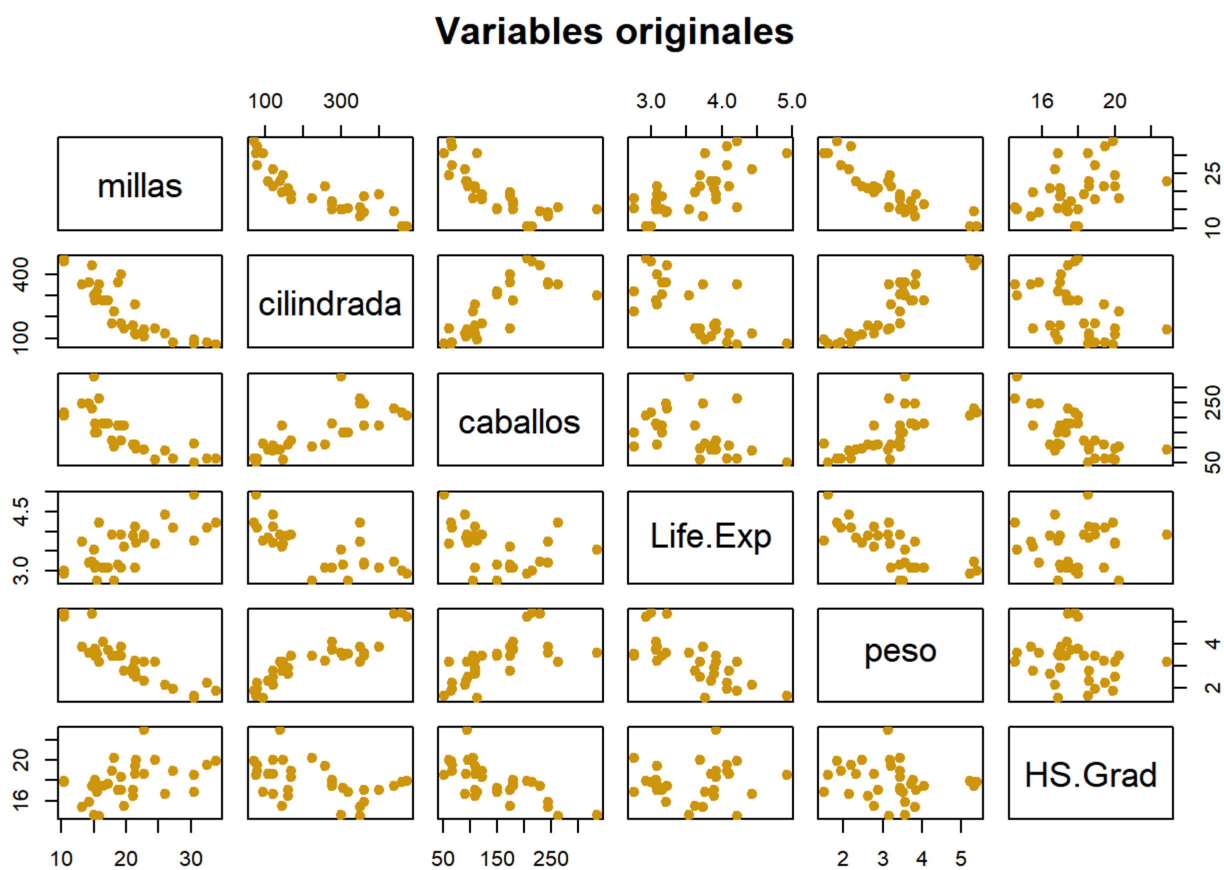
```
dim(x)
```

```
## [1] 32  6
```

```
n<-dim(x)[1]
p<-dim(x)[2]
```

4.- Generaci?n de un scatterplot de las variables originales

```
pairs(x,col="darkgoldenrod3", pch=19,
      main="Variables originales")
```



5.- Obtenci?n de los componentes principales con base en la matriz de covarianza muestral

```
mu<-colMeans(x);mu
```

```
##     millas cilindrada   caballos    Life.Exp       peso    HS.Grad
##  20.090625 230.721875 146.687500   3.596563   3.217250  17.848750
```

```
s<-cov(x);s
```

```
##                 millas  cilindrada   caballos     Life.Exp        peso
## millas       36.324103  -633.09721 -320.73206   2.19506351  -5.1166847
## cilindrada -633.097208 15360.79983 6721.15867 -47.06401915 107.6842040
## caballos   -320.732056  6721.15867 4700.86694 -16.45110887  44.1926613
## Life.Exp      2.195064   -47.06402  -16.45111   0.28588135  -0.3727207
## peso         -5.116685   107.68420   44.19266  -0.37272073   0.9573790
## HS.Grad       4.509149   -96.05168  -86.77008   0.08714073  -0.3054816
##                 HS.Grad
## millas       4.50914919
## cilindrada -96.05168145
## caballos   -86.77008065
## Life.Exp     0.08714073
## peso        -0.30548161
## HS.Grad      3.19316613
```

6.- Obtenci?n de los componentes principales con base a la matriz de covarianza muestral

```
es<-eigen(s);es
```

```
## eigen() decomposition
## $values
## [1] 1.863762e+04 1.453896e+03 9.252216e+00 1.459916e+00 1.157971e-01
## [6] 8.679172e-02
##
## $vectors
##              [,1]         [,2]        [,3]        [,4]          [,5]
## [1,]  0.038121041  0.009182789  0.99197917  0.09118542 -0.0118855167
## [2,] -0.899662536  0.435416473  0.03128880 -0.00358661  0.0011277610
## [3,] -0.434814427 -0.899812970  0.02253072  0.02758290 -0.0020369196
## [4,]  0.002660333 -0.003899948  0.04006140 -0.05508924  0.9503409728
## [5,] -0.006240020  0.004865430 -0.08468926  0.17473521  0.3109736501
## [6,]  0.006671364  0.025018172 -0.07558782  0.97843974 -0.0008589936
##               [,6]
## [1,] -0.0773546682
## [2,]  0.0051664821
## [3,]  0.0006593723
## [4,]  0.3036280760
## [5,] -0.9303376342
## [6,]  0.1904494838
```

7.- Matriz de auto-valores(Lamdas)

```
eigen.val<-es$values;eigen.val
```

```
## [1] 1.863762e+04 1.453896e+03 9.252216e+00 1.459916e+00 1.157971e-01
## [6] 8.679172e-02
```

8.- Matriz de auto-vectores(a1)

```
eigen.vec<-es$vectors;eigen.vec
```

```
##              [,1]         [,2]        [,3]        [,4]          [,5]
## [1,]  0.038121041  0.009182789  0.99197917  0.09118542 -0.0118855167
## [2,] -0.899662536  0.435416473  0.03128880 -0.00358661  0.0011277610
## [3,] -0.434814427 -0.899812970  0.02253072  0.02758290 -0.0020369196
## [4,]  0.002660333 -0.003899948  0.04006140 -0.05508924  0.9503409728
## [5,] -0.006240020  0.004865430 -0.08468926  0.17473521  0.3109736501
## [6,]  0.006671364  0.025018172 -0.07558782  0.97843974 -0.0008589936
##               [,6]
## [1,] -0.0773546682
## [2,]  0.0051664821
## [3,]  0.0006593723
## [4,]  0.3036280760
## [5,] -0.9303376342
## [6,]  0.1904494838
```

Proporci?n de variabilidad para cada vector

```
pro.var<-eigen.val/sum(eigen.val);pro.var
```

```
## [1] 9.271326e-01 7.232441e-02 4.602537e-04 7.262388e-05 5.760355e-06
## [6] 4.317475e-06
```

Proporci?n de variabilidad acumulada

```
pro.var.acum<-cumsum(eigen.val)/sum(eigen.val);pro.var.acum
```

```
## [1] 0.9271326 0.9994570 0.9999173 0.9999899 0.9999957 1.0000000
```

Obtencion de los componentes principales con base en la matriz de correlaciones muestrales

```
R<-cor(x);R
```

```
##                millas cilindrada   caballos    Life.Exp       peso     HS.Grad
## millas      1.0000000 -0.8475514 -0.7761684  0.68117191 -0.8676594  0.41868403
## cilindrada -0.8475514  1.0000000  0.7909486 -0.71021393  0.8879799 -0.43369788
## caballos   -0.7761684  0.7909486  1.0000000 -0.44875912  0.6587479 -0.70822339
## Life.Exp    0.6811719 -0.7102139 -0.4487591  1.00000000 -0.7124406  0.09120476
## peso       -0.8676594  0.8879799  0.6587479 -0.71244065  1.0000000 -0.17471588
## HS.Grad     0.4186840 -0.4336979 -0.7082234  0.09120476 -0.1747159  1.00000000
```

```
eR<-eigen(R);eR
```

```
## eigen() decomposition
## $values
## [1] 4.18739648 1.14811212 0.33335666 0.15436054 0.12479601 0.05197818
##
## $vectors
##            [,1]        [,2]        [,3]       [,4]       [,5]        [,6]
## [1,]  0.4586835 -0.05867609 -0.19479235 0.78205878  0.1111533 -0.35249327
## [2,] -0.4660354  0.06065296  0.09688406 0.60001871 -0.2946297  0.56825752
## [3,] -0.4258534 -0.36147576  0.14613554 0.12301873  0.8057408 -0.04771555
## [4,]  0.3670963 -0.43652537  0.80049152 0.02259258 -0.1437714  0.11277675
## [5,] -0.4386179  0.29953457  0.41776208 0.10438337 -0.2301541 -0.69246040
## [6,]  0.2528320  0.76284877  0.34059066 0.04268124  0.4218755  0.24152663
```

Obtenci?n de auto-valores

```
eigen.val<-eR$values
```

Obtenci?n de auto-vectores

```
eigen.vec<-eR$vectors
```

Proporcion de variablidad

```
pro.var<-eigen.val/sum(eigen.val)
```

Proporcion de variabilidad acumulada

```
pro.var.acum<-cumsum(eigen.val)/sum(eigen.val)
```

Media de los auto-valores

```
mean(eigen.val)
```

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

Obtencion de los coeficientes (nuevas variables)

1.- Centrar los datos con respecto a la media

```
ones<-matrix(rep(1,n),nrow=n, ncol=1)
```

2.- Construccion de la matriz centrada

```
X.cen<-as.matrix(x)-ones%*%mu
X.cen
```

```
##                        millas  cilindrada caballos   Life.Exp     peso  HS.Grad
## Mazda RX4            0.909375  -70.721875 -36.6875  0.3034375 -0.59725 -1.38875
## Mazda RX4 Wag        0.909375  -70.721875 -36.6875  0.3034375 -0.34225 -0.82875
## Datsun 710           2.709375 -122.721875 -53.6875  0.2534375 -0.89725  0.76125
## Hornet 4 Drive       1.309375   27.278125 -36.6875 -0.5165625 -0.00225  1.59125
## Hornet Sportabout   -1.390625  129.278125  28.3125 -0.4465625  0.22275 -0.82875
## Valiant             -1.990625   -5.721875 -41.6875 -0.8365625  0.24275  2.37125
## Duster 360          -5.790625  129.278125  98.3125 -0.3865625  0.35275 -2.00875
## Merc 240D            4.309375  -84.021875 -84.6875  0.0934375 -0.02725  2.15125
## Merc 230             2.709375  -89.921875 -51.6875  0.3234375 -0.06725  5.05125
## Merc 280            -0.890625  -63.121875 -23.6875  0.3234375  0.22275  0.45125
## Merc 280C           -2.290625  -63.121875 -23.6875  0.3234375  0.22275  1.05125
## Merc 450SE          -3.690625   45.078125  33.3125 -0.5265625  0.85275 -0.44875
## Merc 450SL          -2.790625   45.078125  33.3125 -0.5265625  0.51275 -0.24875
## Merc 450SLC         -4.890625   45.078125  33.3125 -0.5265625  0.56275  0.15125
## Cadillac Fleetwood  -9.690625  241.278125  58.3125 -0.6665625  2.03275  0.13125
## Lincoln Continental -9.690625  229.278125  68.3125 -0.5965625  2.20675 -0.02875
## Chrysler Imperial   -5.390625  209.278125  83.3125 -0.3665625  2.12775 -0.42875
## Fiat 128            12.309375 -152.021875 -80.6875  0.4834375 -1.01725  1.62125
## Honda Civic         10.309375 -155.021875 -94.6875  1.3334375 -1.60225  0.67125
## Toyota Corolla      13.809375 -159.621875 -81.6875  0.6234375 -1.38225  2.05125
## Toyota Corona        1.409375 -110.621875 -49.6875  0.1034375 -0.75225  2.16125
## Dodge Challenger    -4.590625   87.278125   3.3125 -0.8365625  0.30275 -0.97875
## AMC Javelin         -4.890625   73.278125   3.3125 -0.4465625  0.21775 -0.54875
## Camaro Z28          -6.790625  119.278125  98.3125  0.1334375  0.62275 -2.43875
## Pontiac Firebird    -0.890625  169.278125  28.3125 -0.5165625  0.62775 -0.79875
## Fiat X1-9            7.209375 -151.721875 -80.6875  0.4834375 -1.28225  1.05125
## Porsche 914-2        5.909375 -110.421875 -55.6875  0.8334375 -1.07725 -1.14875
## Lotus Europa        10.309375 -135.621875 -33.6875  0.1734375 -1.70425 -0.94875
## Ford Pantera L      -4.290625  120.278125 117.3125  0.6234375 -0.04725 -3.34875
## Ferrari Dino        -0.390625  -85.721875  28.3125  0.0234375 -0.44725 -2.34875
## Maserati Bora       -5.090625   70.278125 188.3125 -0.0565625  0.35275 -3.24875
## Volvo 142E           1.309375 -109.721875 -37.6875  0.5134375 -0.43725  0.75125
```

3.- Construccion de la matriz diagonal de las varianzas

```
Dx<-diag(diag(s))
Dx
```

```
##         [,1]    [,2]     [,3]      [,4]     [,5]     [,6]
## [1,] 36.3241     0.0    0.000 0.0000000 0.000000 0.000000
## [2,]  0.0000 15360.8    0.000 0.0000000 0.000000 0.000000
## [3,]  0.0000     0.0 4700.867 0.0000000 0.000000 0.000000
## [4,]  0.0000     0.0    0.000 0.2858814 0.000000 0.000000
## [5,]  0.0000     0.0    0.000 0.0000000 0.957379 0.000000
## [6,]  0.0000     0.0    0.000 0.0000000 0.000000 3.193166
```

4.- Construccion de la matriz centrada multiplicada

```
Dx^1/2
```

```
##          [,1]   [,2]     [,3]      [,4]      [,5]     [,6]
## [1,] 18.16205    0.0    0.000 0.0000000 0.0000000 0.000000
## [2,]  0.00000 7680.4    0.000 0.0000000 0.0000000 0.000000
## [3,]  0.00000    0.0 2350.433 0.0000000 0.0000000 0.000000
## [4,]  0.00000    0.0    0.000 0.1429407 0.0000000 0.000000
## [5,]  0.00000    0.0    0.000 0.0000000 0.4786895 0.000000
## [6,]  0.00000    0.0    0.000 0.0000000 0.0000000 1.596583
```

Datos normalizados

```
Y<-X.cen%*%solve(Dx)^(1/2)
Y
```

```
##                           [,1]        [,2]        [,3]        [,4]
## Mazda RX4            0.15088482 -0.57061982 -0.53509284  0.56751369
## Mazda RX4 Wag        0.15088482 -0.57061982 -0.53509284  0.56751369
## Datsun 710           0.44954345 -0.99018209 -0.78304046  0.47399959
## Hornet 4 Drive       0.21725341  0.22009369 -0.53509284 -0.96611753
## Hornet Sportabout   -0.23073453  1.04308123  0.41294217 -0.83519779
## Valiant             -0.33028740 -0.04616698 -0.60801861 -1.56460776
## Duster 360          -0.96078893  1.04308123  1.43390296 -0.72298087
## Merc 240D            0.71501778 -0.67793094 -1.23518023  0.17475447
## Merc 230             0.44954345 -0.72553512 -0.75387015  0.60491932
## Merc 280            -0.14777380 -0.50929918 -0.34548584  0.60491932
## Merc 280C           -0.38006384 -0.50929918 -0.34548584  0.60491932
## Merc 450SE          -0.61235388  0.36371309  0.48586794 -0.98482035
## Merc 450SL          -0.46302456  0.36371309  0.48586794 -0.98482035
## Merc 450SLC         -0.81145962  0.36371309  0.48586794 -0.98482035
## Cadillac Fleetwood  -1.60788262  1.94675381  0.85049680 -1.24665983
## Lincoln Continental -1.60788262  1.84993175  0.99634834 -1.11574009
## Chrysler Imperial   -0.89442035  1.68856165  1.21512565 -0.68557523
## Fiat 128             2.04238943 -1.22658929 -1.17683962  0.90416444
## Honda Civic          1.71054652 -1.25079481 -1.38103178  2.49390411
## Toyota Corolla       2.29127162 -1.28790993 -1.19142477  1.16600392
## Toyota Corona        0.23384555 -0.89255318 -0.72469984  0.19345729
## Dodge Challenger    -0.76168319  0.70420401  0.04831332 -1.56460776
## AMC Javelin         -0.81145962  0.59124494  0.04831332 -0.83519779
## Camaro Z28          -1.12671039  0.96239618  1.43390296  0.24956575
## Pontiac Firebird    -0.14777380  1.36582144  0.41294217 -0.96611753
## Fiat X1-9            1.19619000 -1.22416874 -1.17683962  0.90416444
## Porsche 914-2        0.98049211 -0.89093948 -0.81221077  1.55876313
## Lotus Europa         1.71054652 -1.09426581 -0.49133738  0.32437703
## Ford Pantera L      -0.71190675  0.97046468  1.71102089  1.16600392
## Ferrari Dino        -0.06481307 -0.69164740  0.41294217  0.04383473
## Maserati Bora       -0.84464392  0.56703942  2.74656682 -0.10578782
## Volvo 142E           0.21725341 -0.88529152 -0.54967799  0.96027290
##                            [,5]        [,6]
## Mazda RX4           -0.610399567 -0.77716515
## Mazda RX4 Wag       -0.349785269 -0.46378082
## Datsun 710          -0.917004624  0.42600682
## Hornet 4 Drive      -0.002299538  0.89048716
## Hornet Sportabout    0.227654255 -0.46378082
## Valiant              0.248094592  1.32698675
## Duster 360           0.360516446 -1.12412636
## Merc 240D           -0.027849959  1.20387148
## Merc 230            -0.068730634  2.82675459
## Merc 280             0.227654255  0.25252621
## Merc 280C            0.227654255  0.58829513
## Merc 450SE           0.871524874 -0.25112717
## Merc 450SL           0.524039143 -0.13920420
## Merc 450SLC          0.575139986  0.08464175
## Cadillac Fleetwood   2.077504765  0.07344945
## Lincoln Continental  2.255335698 -0.01608893
## Chrysler Imperial    2.174596366 -0.23993487
## Fiat 128            -1.039646647  0.90727560
```

```
## Honda Civic         -1.637526508  0.37564148
## Toyota Corolla      -1.412682800  1.14790999
## Toyota Corona       -0.768812180  1.20946763
## Dodge Challenger     0.309415603 -0.54772305
## AMC Javelin          0.222544170 -0.30708866
## Camaro Z28           0.636460997 -1.36476075
## Pontiac Firebird     0.641571082 -0.44699237
## Fiat X1-9           -1.310481114  0.58829513
## Porsche 914-2       -1.100967659 -0.64285758
## Lotus Europa        -1.741772228 -0.53093460
## Ford Pantera L      -0.048290296 -1.87401028
## Ferrari Dino        -0.457097039 -1.31439542
## Maserati Bora        0.360516446 -1.81804880
## Volvo 142E          -0.446876870  0.42041067
```

5.- Construccion de los coeficientes o scores eigen.vec matriz de autovectores

```
scores<-Y%*%eigen.vec
```

Nombramos las columnas PC1…PC8

```
colnames(scores)<-c("PC1","PC2","PC3","PC4","PC5",
                    "PC6")
```

visualizamos

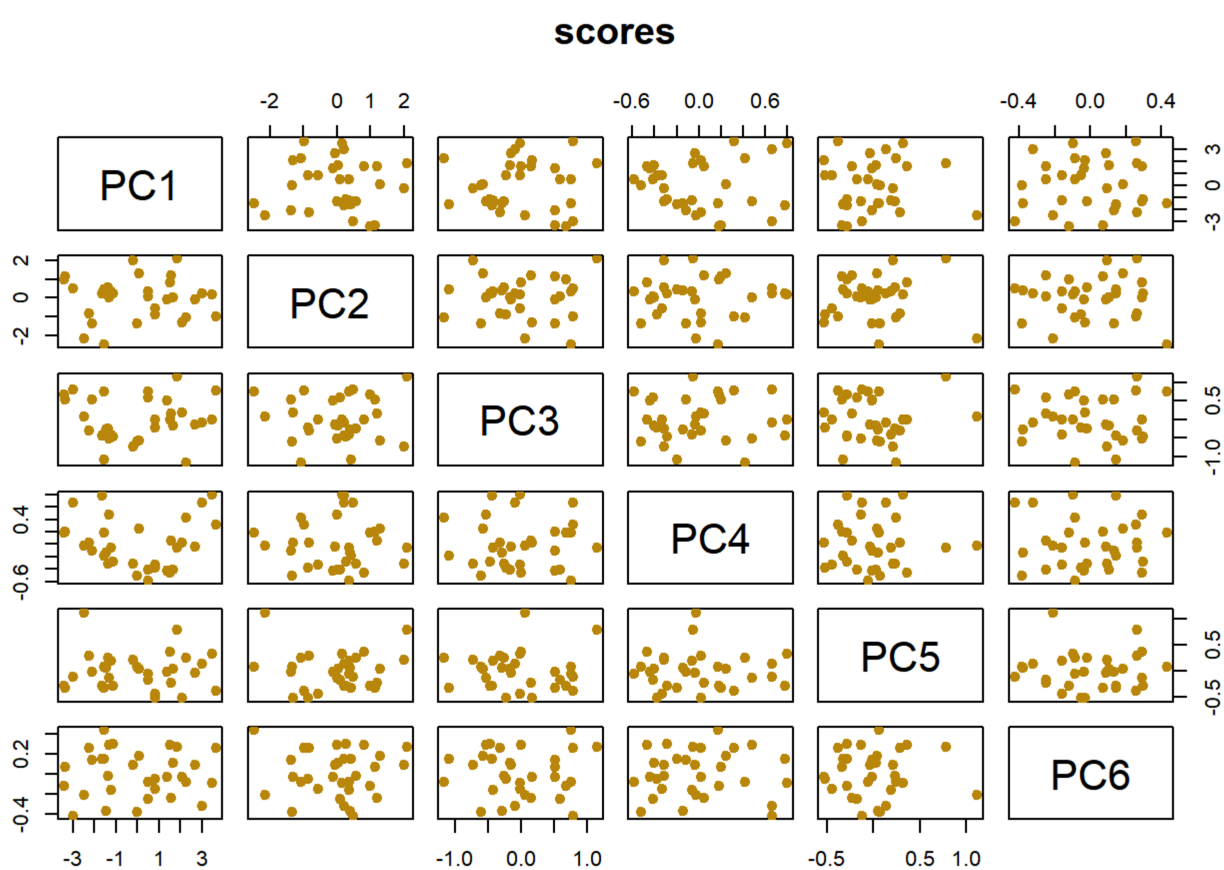
```
scores
```

```
##                            PC1          PC2          PC3         PC4
## Mazda RX4            0.842580639 -0.873469391 -0.228278346 -0.37427255
## Mazda RX4 Wag        0.807504121 -0.556341552 -0.012667800 -0.33369312
## Datsun 710           1.685044761  0.040006569 -0.156493687 -0.40571569
## Hornet 4 Drive       0.096444303  1.294377904 -0.570229748  0.25207881
## Hornet Sportabout   -1.291509555  0.006516693 -0.525074062  0.48131922
## Valiant             -0.218730892  2.005957905 -0.725839941 -0.31361702
## Duster 360          -2.245190880 -0.832631648 -0.313240442  0.02419056
## Merc 240D            1.550656769  1.197159848  0.152817779  0.05288819
## Merc 230             1.832265452  2.073858925  1.150258327 -0.04936365
## Merc 280             0.502753448  0.099432035  0.594300648 -0.41544992
## Merc 280C            0.481098961  0.369202815  0.753908731 -0.58278335
## Merc 450SE          -1.464571595  0.381740160 -0.284259438 -0.14288656
## Merc 450SL          -1.215365529  0.354274415 -0.420394087 -0.05759698
## Merc 450SLC         -1.341005273  0.560786296 -0.254933769 -0.31520557
## Cadillac Fleetwood  -3.357256928  1.127500626  0.521078742  0.20708364
## Lincoln Continental -3.426823644  0.996718766  0.681607545  0.18462986
## Chrysler Imperial   -2.980802933  0.483262622  0.793341147  0.66442458
## Fiat 128             3.026916817  0.217176556 -0.090196261  0.66714798
## Honda Civic          3.684356739 -0.969613645  0.783991314  0.31880089
## Toyota Corolla       3.496444405  0.161656879 -0.011031261  0.80044813
## Toyota Corona        1.545862677  0.802010352  0.007683829 -0.46607822
## Dodge Challenger    -1.546688715  0.427782349 -1.086085997 -0.19363018
## AMC Javelin         -1.150170291  0.262992430 -0.457781132 -0.28265394
## Camaro Z28          -2.108550264 -1.353243809  0.523099358 -0.11347653
## Pontiac Firebird    -1.629232017  0.215163261 -0.436129194  0.78081432
## Fiat X1-9            2.675795416 -0.057483105 -0.146914711 -0.03506244
## Porsche 914-2        2.103412908 -1.318595692  0.172879784  0.02516077
## Lotus Europa         2.252616575 -1.057474693 -1.159836838  0.42357977
## Ford Pantera L      -1.532047829 -2.470900470  0.757669487  0.17734890
## Ferrari Dino         0.001011947 -1.346152342 -0.597578273 -0.51771241
## Maserati Bora       -2.477943625 -2.141594405  0.067555673 -0.02480245
## Volvo 142E           1.401124031 -0.100076652  0.516772623 -0.43591506
##                            PC5         PC6
## Mazda RX4           -0.51522641 -0.05293884
## Mazda RX4 Wag       -0.44299870 -0.15771326
## Datsun 710           0.03340433  0.10756126
## Hornet 4 Drive       0.04326023  0.18173489
## Hornet Sportabout   -0.12822104  0.29051949
## Valiant              0.21465335  0.09145688
## Duster 360           0.28796476  0.26030567
## Merc 240D           -0.22685092 -0.24858075
## Merc 230             0.77769555  0.26377009
## Merc 280            -0.17757395 -0.24926769
## Merc 280C           -0.06174108 -0.08628988
## Merc 450SE           0.05131736 -0.37586534
## Merc 450SL           0.19510864 -0.16085043
## Merc 450SLC          0.23905298 -0.01934996
## Cadillac Fleetwood  -0.33493876  0.07099935
## Lincoln Continental -0.28641866 -0.12098198
## Chrysler Imperial   -0.12099080 -0.42425486
## Fiat 128             0.13222362 -0.31977950
```

```
## Honda Civic         -0.37729414  0.25807107
## Toyota Corolla       0.31593125 -0.09569699
## Toyota Corona        0.36442162  0.29125853
## Dodge Challenger    -0.33055333  0.14335299
## AMC Javelin         -0.28616179  0.29724414
## Camaro Z28          -0.01155770  0.13342234
## Pontiac Firebird    -0.28344806  0.14734508
## Fiat X1-9           -0.03478377  0.09037547
## Porsche 914-2       -0.52486836 -0.03024333
## Lotus Europa         0.24689718 -0.08688085
## Ford Pantera L       0.06645790  0.43308775
## Ferrari Dino         0.07368942 -0.38588778
## Maserati Bora        1.11731392 -0.21177920
## Volvo 142E          -0.01576463 -0.03414438
```

Generacion del grafico de los scores

```
pairs(scores, main="scores", col="darkgoldenrod", pch=19)
```



PCA sintetizado

```
View(x)
head(x)
```

```
##                   millas cilindrada caballos Life.Exp  peso HS.Grad
## Mazda RX4           21.0        160      110     3.90 2.620   16.46
## Mazda RX4 Wag       21.0        160      110     3.90 2.875   17.02
## Datsun 710          22.8        108       93     3.85 2.320   18.61
## Hornet 4 Drive      21.4        258      110     3.08 3.215   19.44
## Hornet Sportabout   18.7        360      175     3.15 3.440   17.02
## Valiant             18.1        225      105     2.76 3.460   20.22
```

Aplicar el c?lculo de la varianza a las columnas 1=filas, 2=columnas

```
apply(x, 2, var)
```

```
##       millas   cilindrada     caballos     Life.Exp         peso      HS.Grad
## 3.632410e+01 1.536080e+04 4.700867e+03 2.858814e-01 9.573790e-01 3.193166e+00
```

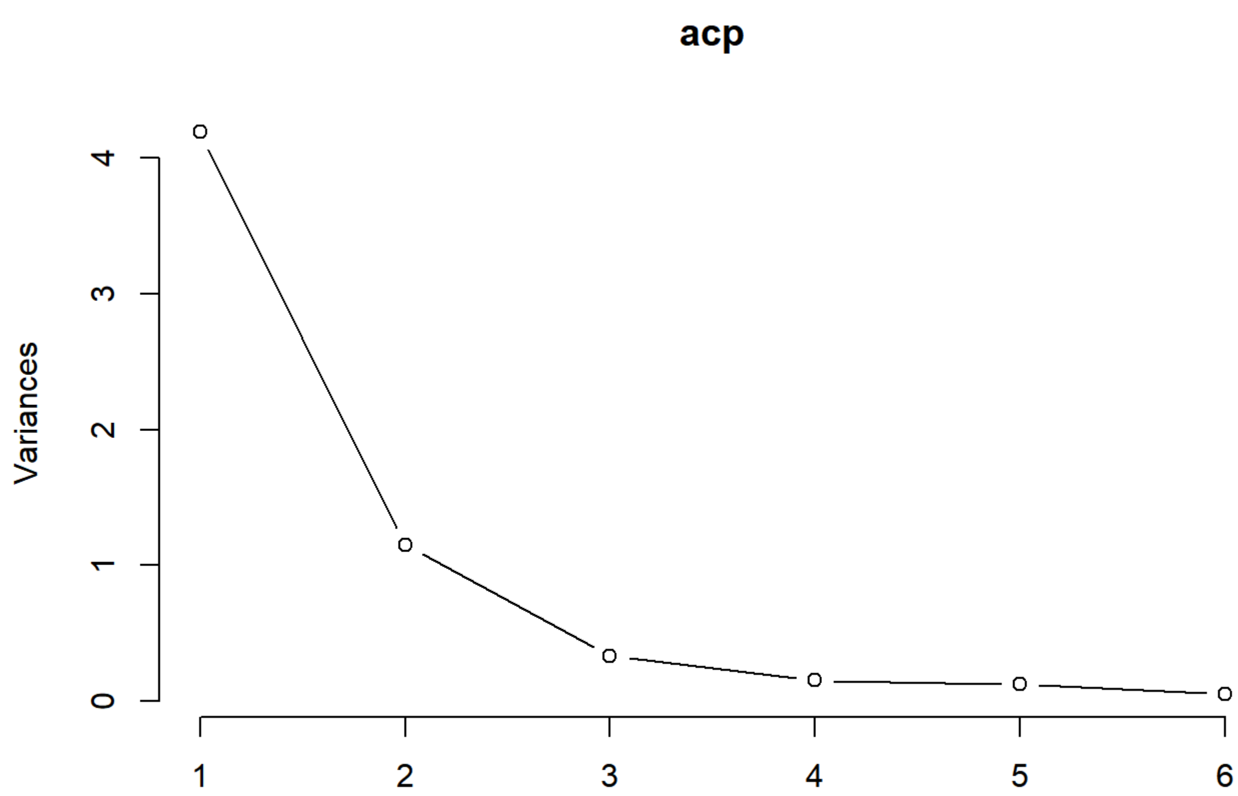
Centrado por la media y escalada por la desviacion standar (dividir entre sd).

```
acp<-prcomp(x, center=TRUE, scale=TRUE)
acp
```

```
## Standard deviations (1, .., p=6):
## [1] 2.0463129 1.0714999 0.5773705 0.3928874 0.3532648 0.2279872
##
## Rotation (n x k) = (6 x 6):
##                   PC1         PC2         PC3        PC4        PC5         PC6
## millas     -0.4586835  0.05867609 -0.19479235 0.78205878 -0.1111533 -0.35249327
## cilindrada  0.4660354 -0.06065296  0.09688406 0.60001871  0.2946297  0.56825752
## caballos    0.4258534  0.36147576  0.14613554 0.12301873 -0.8057408 -0.04771555
## Life.Exp   -0.3670963  0.43652537  0.80049152 0.02259258  0.1437714  0.11277675
## peso        0.4386179 -0.29953457  0.41776208 0.10438337  0.2301541 -0.69246040
## HS.Grad    -0.2528320 -0.76284877  0.34059066 0.04268124 -0.4218755  0.24152663
```

Generaci?n del gr?fico screeplot

```
plot(acp, type="l")
```



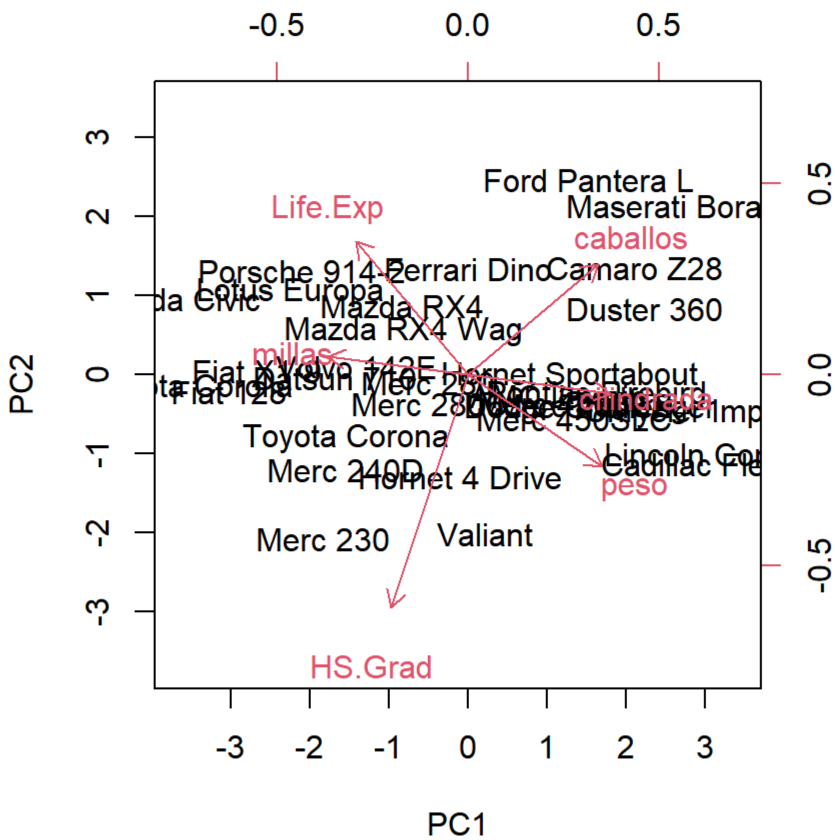
Visualizar el resumen

```
summary(acp)
```

```
## Importance of components:
##                           PC1    PC2     PC3     PC4    PC5     PC6
## Standard deviation     2.0463 1.0715 0.57737 0.39289 0.3533 0.22799
## Proportion of Variance 0.6979 0.1913 0.05556 0.02573 0.0208 0.00866
## Cumulative Proportion  0.6979 0.8892 0.94481 0.97054 0.9913 1.00000
```

Construcción del Biplot

```
biplot(acp, scale=0)
```



Componente principal calculada Suma del producto de la matriz acp de cada uno de los componentes por el dato de la matriz original por filas filas = 1 columnas = 2

```
pc1<-apply(acp$rotation[,1]*x, 1, sum)
```

```
pc2<-apply(acp$rotation[,2]*x, 1, sum)
```

```
pc3<-apply(acp$rotation[,3]*x, 1, sum)
```

```
x$pc1<-pc1;x$pc1
```

```
##  [1]  113.298680  -80.301247    8.543655  -14.706407  -75.347764   55.228566
##  [7]  261.205065  -62.665353   20.439066   14.119147   -8.497850   53.041870
## [13]  196.366315 -144.179048  112.729777  -14.090812  -91.043340   -2.896770
## [19]   47.650902  -30.474336   10.820153  -10.226398  -61.721452   65.000679
## [25]  245.995864  -36.552184   17.262882   23.567456  -35.070637   -6.961840
## [31]  274.538997  -65.811978
```

```
x$pc2<-pc2;x$pc2
```

```
##  [1]   22.365082  -27.308240  -16.862486 -196.432321   84.190984   24.891906
##  [7]   54.318565    1.173447  -26.541458 -128.955451   54.823478   54.342498
## [13]   43.050522  -30.108424 -125.050805 -363.319910  110.196781    4.574276
## [19]    8.897347  -35.239974  -20.737576 -247.421344   73.017519   79.222813
## [25]   89.761869  -31.338970  -19.355890  -66.663856  115.455628   56.405762
## [31]    6.465243  -44.853650
```

```
x$pc3<-pc3;x$pc3
```

```
##  [1]  71.744424 176.054295  28.241250 121.104095 -33.606285 129.476401
##  [7] 158.688744 150.635581  41.075574  90.451708  -3.506859 191.763267
## [13] 119.431133 293.008441 157.890140 191.802201 -43.102472  88.680678
## [19]  33.877037  90.993216  32.092971 140.290728 -27.771578 248.537710
## [25] 134.907340  96.744150  34.618557  72.843520 -19.927264 174.752765
## [31] 186.946673 145.015721
```