Instituto Politécnico Nacional

Escuela Superior de Computo

Programación para la ciencia de datos.

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Practica 8:

Análisis de Componentes Principales

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3AM1

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Unidad temática a la que corresponde la práctica.

III. Técnicas y métodos de modelado.

Objetivo.

Realizar scripts en Lenguaje R que permitan realizar el análisis de componentes principales.

Introducción.

Es una técnica estadística multivariante de simplificación, que permite transformar un conjunto de variables no correlacionados denominados factores o componentes principales.

En esta actividad se incluyen un conjunto de ejercicios que le permiten al discente poner en práctica conceptos sobre la obtención de componentes principales en Lenguaje R.

Material o equipo necesario.

- *Computadora*
- *Internet*
- *Lenguaje R y R Studio*

Ejercicios.

Consideraciones:

Es muy importe saber que este tipo de Análisis de componentes principales solo se puede ejecutar con ciertos tipos de datos.

Es importante tener en cuenta cierto tipos de gráficos que utilizaremos para tener un mejor análisis de nuestro dataset, eso lo haremos consultando los siguientes enlaces.

http://ares.inf.um.es/00Rteam/pub/mamutCola/explorandoDimensiones.html

https://r-charts.com/es/

Se descargó el dataset del link proporcionado por la profesora.

1.-

a) Ejercicio 1

1. Descargar el archivo de ventas clientes del siguiente enlace: https://archive.ics.uci.edu/ml/machine-learning-databases/00292/

2. Aplica el Análisis de Componentes Principales
3. Realiza su interpretación de resultados

Procedimiento:

```
"Practica No. 8
Aplicar el Análisis de componentes principales e interpretar los resultados de el dataset descargado
Hecho por: Maravilla Pérez Vianey 3AM1"

# Primero importamos las librerias que vayamos a ocupar, para esto, se hizo una instalación para posteriormente hacer
library(readr)
library(factoextra)

#Mandamos a leer nuestro dataset, esto primero lo debemos de descargar para poderlo mandar a llamar con la siguiente instrucción
dataset <- read_csv("C:/Users/viane/Desktop/ESCOM/3.-TERCER SEMESTRE/PROGRAMACION PARA LAS CIENCIAS DE DATOS/Wholesale customers data.csv")

#Nomralizacion de los datos
datos_Centrados<- dataset
datos_Centrados$Fresh            <- dataset$Milk              - mean(dataset$Milk)
datos_Centrados$Milk             <- dataset$Fresh             - mean(dataset$Fresh)
datos_Centrados$Grocery          <- dataset$Grocery           - mean(dataset$Grocery)
datos_Centrados$Frozen           <- dataset$Frozen            - mean(dataset$Frozen)
datos_Centrados$Detergents_Paper <- dataset$Detergents_Paper  - mean(dataset$Detergents_Paper)
datos_Centrados$Delicassen       <- dataset$Delicassen        - mean(dataset$Delicassen)

datos_Centrados

#Una vez con los datos ya calculados, calculamos la covarianza de nuestros respectivos datos
matriz_Cov <- cov(datos_Centrados)
matriz_Cov

#PCA
#Calculamos los autovalores y autovectores  (valores propios de la matriz de covarianza)
eigen_a<- eigen(matriz_Cov)
eigen_a$values

#Obtencion de los vectores propios, componentes principales
eigen_a$vectors

#Se calcula la transpuesta de nuestros datos ya tratados
t_eigenvectors <- t(eigen_a$vectors)
t_eigenvectors

#Se calacula la transpuesta de nuestros datos originales con su promedio
t_datos_Centrados <- t(datos_Centrados)
t_datos_Centrados

# Se multiplican los componentes principales por los datos nomalizados (Transpuestos)
pc_scores<- t_eigenvectors %*% t_datos_Centrado
rownames(pc_scores) <- c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5", "PC 6", "PC 7", "PC 8")



#Los transformamos nuevamente para que los datos esten en modo tabla
t(pc_scores)
datos_recuperados <- t(eigen_a$vectors %*% pc_scores)
datos_recuperados[, 1] <- datos_recuperados[, 1] + mean(dataset$X1)
datos_recuperados[, 2] <- datos_recuperados[, 2] + mean(dataset$X2)
datos_recuperados

#Con apply aplicamos la funcion en todos los elementos de nuestra matriz
Media <- apply(X = dataset, MARGIN = 2, FUN = mean)  #Promedio
Varianza <- apply(X = dataset, MARGIN = 2, FUN = var)   #Varianza
Desviacion_e <- apply(X = dataset, MARGIN = 2, FUN = sd) #Desviación Estandar


#Calculamos nuestro Analisis de componentes principales
ACP <- prcomp(dataset, scale= TRUE)
names(ACP)

#Lo aplicamos para las siguientes funciones y se pueda visualizar la informacion de cada "renglon"
ACP$center
ACP$scale
ACP$rotation
```

```r
names(ACP)

#Lo aplicamos para las siguientes funciones y se pueda visualizar la informacion de cada "renglon"
ACP$center
ACP$scale
ACP$rotation
#Definimos nuestras graficas para poder tener una mejor visualizacion de los datos y llegar a una mejor conclusion de nuestros datos

head(ACP$x)  # Visualizamos los primeros 6 datos de nuestra matriz
fviz_eig(ACP) #Hacemos el grafico de nuestro respectivos datos de nuestra PCA

 #Representación bidimensional de las primeras dos componentes (por defecto)
fviz_pca_biplot(ACP, repel = TRUE,
                col.var = "#008B8B", # Definimos el color de las variables
                col.ind = "#8A2BE2"  # Definimos el color de las variables independientes
                )

#Representacion gbidimensional de las primeras dos componentes (por defecto)
fviz_pca_ind(ACP,
             col.ind = "cos2", #Definimos el color de la representación
             gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
             repel = TRUE     #Evitamos la superposición del texto
             )

# Representación en tercera dimensión de nuestras 3 componentes, tanto con variables como individuos
fviz_pca_var(ACP,
             col.var = "contrib", # Definimos el color
             gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
             repel = TRUE     #Evitamos la superposición del texto
             )
```

Resultado:

```
> # Primero importamos las librerias que vayamos a ocupar, para esto, se hizo una instalación para posteriormente hacer
> library(readr)
> library(factoextra)
>
> #Mandamos a leer nuestro dataset, esto primero lo debemos de descargar para poderlo mandar a llamar con la siguiente instrucción
> dataset <- read_csv("C:/Users/viane/Desktop/ESCOM/3.-TERCER SEMESTRE/PROGRAMACION PARA LAS CIENCIAS DE DATOS/Wholesale customers data.csv")
Rows: 440 Columns: 8

-- Column specification --------------------------------------------------------
Delimiter: ","
dbl (8): Channel, Region, Fresh, Milk, Grocery, Frozen, Detergents_Paper, Delicassen

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
```

```
> #Nomralizacion de los datos
> datos_Centrados<- dataset
> datos_Centrados$Fresh            <- dataset$Milk             - mean(dataset$Milk)
> datos_Centrados$Milk             <- dataset$Fresh            - mean(dataset$Fresh)
> datos_Centrados$Grocery          <- dataset$Grocery          - mean(dataset$Grocery)
> datos_Centrados$Frozen           <- dataset$Frozen           - mean(dataset$Frozen)
> datos_Centrados$Detergents_Paper <- dataset$Detergents_Paper - mean(dataset$Detergents_Paper)
> datos_Centrados$Delicassen       <- dataset$Delicassen       - mean(dataset$Delicassen)
>
> datos_Centrados
# A tibble: 440 x 8
   Channel Region  Fresh   Milk Grocery Frozen Detergents_Paper Delicassen
     <dbl>  <dbl>  <dbl>  <dbl>   <dbl>  <dbl>           <dbl>      <dbl>
 1       2      3  3860.   669.   -390. -2858.           -207.      -187.
 2       2      3  4014. -4943.   1617. -1310.            412.       251.
 3       2      3  3012. -5647.   -267.  -667.            635.      6319.
 4       1      3 -4600.  1265.  -3730.  3332.          -2374.       263.
 5       2      3  -386. 10615.   -753.   843.          -1104.      3660.
 6       2      3  2463. -2587.  -2825. -2406.          -1086.       -73.9
 7       2      3 -2597.   126.   -976. -2592.            259.      -980.
 8       2      3  -840. -4421.   1475. -1403.            440.      1041.
 9       1      3 -2148. -6037.  -1759. -2647.          -1165.      -775.
10       2      3  5297. -5994.  10930. -1913.           4544.       573.
# ... with 430 more rows
```

```
> #Una vez con los datos ya calculados, calculamos la covarianza de nuestros respectivos datos
> matriz_Cov <- cov(datos_Centrados)
> matriz_Cov
                  Channel       Region        Fresh          Milk       Grocery        Frozen Detergents_Paper   Delicassen
Channel      2.190723e-01   0.02247877 1.591511e+03     -1001.431  2.707890e+03 -4.590964e+02     1.419358e+03 7.393256e+01
Region       2.247877e-02   0.59949783 1.845044e+02       541.396  5.662581e+01 -7.910183e+01    -5.473509e+00 9.872201e+01
Fresh        1.591511e+03 184.50443674 5.446997e+07   9381788.549  5.108319e+07  4.442612e+06     2.328834e+07 8.457925e+06
Milk        -1.001431e+03 541.39599814 9.381789e+06 159954927.421 -1.424713e+06  2.123665e+07    -6.147826e+06 8.727310e+06
Grocery      2.707890e+03  56.62581280 5.108319e+07  -1424712.796  9.031010e+07 -1.854282e+06     4.189519e+07 5.507291e+06
Frozen      -4.590964e+02 -79.10183268 4.442612e+06  21236654.585 -1.854282e+06  2.356785e+07    -3.044325e+06 5.352342e+06
Detergents_Paper  1.419358e+03  -5.47350901 2.328834e+07  -6147825.712  4.189519e+07 -3.044325e+06     2.273244e+07 9.316807e+05
Delicassen   7.393256e+01  98.72200766 8.457925e+06   8727309.970  5.507291e+06  5.352342e+06     9.316807e+05 7.952997e+06
```

```
> #PCA
> #Calculamos los autovalores y autovectores  (valores propios de la matriz de covarianza)
> eigen_a<- eigen(matriz_Cov)
> eigen_a$values
[1] 1.649959e+08 1.454521e+08 2.513998e+07 1.580390e+07 5.392764e+06 2.203641e+06 5.956297e-01 1.220552e-01
```

```
> #Obtencion de los vectores propios, componentes principales
> eigen_a$vectors
             [,1]          [,2]          [,3]         [,4]          [,5]          [,6]          [,7]          [,8]
[1,]  4.202234e-06 -2.429340e-05  1.406364e-05 3.486248e-06  6.862672e-08  3.100332e-05 -4.547857e-02  9.989653e-01
[2,] -3.328850e-06 -5.754103e-07  1.814881e-06 1.104086e-05  1.335398e-05 -2.417441e-07 -9.989653e-01 -4.547857e-02
[3,] -1.211841e-01 -5.158022e-01 -5.098868e-01 6.456405e-01 -2.032357e-01 -3.349187e-02  4.468091e-06 -5.851887e-06
[4,] -9.765368e-01  1.106139e-01  1.785573e-01 4.187648e-02 -1.598600e-02  1.576316e-02  3.586518e-06  3.813107e-06
[5,] -6.154039e-02 -7.646064e-01  2.757809e-01 -3.754605e-01  1.602915e-01 -4.109389e-01 -3.884769e-07 -8.182480e-06
[6,] -1.523646e-01  1.872345e-02 -7.142004e-01 -6.462923e-01 -2.201861e-01  1.328898e-02 -1.145872e-05  1.248742e-05
[7,]  7.054174e-03 -3.653508e-01  2.044099e-01 -1.493801e-01 -2.079302e-01  8.712843e-01 -2.334761e-06 -3.840358e-05
[8,] -6.810471e-02 -5.707921e-02 -2.832175e-01  2.039579e-02  9.170766e-01  2.654169e-01  1.238986e-05 -4.921851e-06
```

```
> #Se calcula la transpuesta de nuestros datos ya tratados
> t_eigenvectors <- t(eigen_a$vectors)
> t_eigenvectors
             [,1]          [,2]          [,3]         [,4]          [,5]          [,6]          [,7]          [,8]
[1,]  4.202234e-06 -3.328850e-06 -1.211841e-01 -9.765368e-01 -6.154039e-02 -1.523646e-01  7.054174e-03 -6.810471e-02
[2,] -2.429340e-05 -5.754103e-07 -5.158022e-01  1.106139e-01 -7.646064e-01  1.872345e-02 -3.653508e-01 -5.707921e-02
[3,]  1.406364e-05  1.814881e-06 -5.098868e-01  1.785573e-01  2.757809e-01 -7.142004e-01  2.044099e-01 -2.832175e-01
[4,]  3.486248e-06  1.104086e-05  6.456405e-01  4.187648e-02 -3.754605e-01 -6.462923e-01 -1.493801e-01  2.039579e-02
[5,]  6.862672e-08  1.335398e-05 -2.032357e-01 -1.598600e-02  1.602915e-01 -2.201861e-01 -2.079302e-01  9.170766e-01
[6,]  3.100332e-05 -2.417441e-07 -3.349187e-02  1.576316e-02 -4.109389e-01  1.328898e-02  8.712843e-01  2.654169e-01
[7,] -4.547857e-02 -9.989653e-01  4.468091e-06  3.586518e-06 -3.884769e-07 -1.145872e-05 -2.334761e-06  1.238986e-05
[8,]  9.989653e-01 -4.547857e-02 -5.851887e-06  3.813107e-06 -8.182480e-06  1.248742e-05 -3.840358e-05 -4.921851e-06
```

```
> #Se calacula la transpuesta de nuestros datos originales con su promedio
> t_datos_Centrados <- t(datos_Centrados)
> t_datos_Centrados
              [,1]    [,2]    [,3]    [,4]    [,5]    [,6]    [,7]    [,8]    [,9]    [,10]   [,11]   [,12]
Channel     2.0000  2.0000  2.0000  1.0000  2.0000  2.00000  2.0000  2.0000  1.0000  2.0000  2.0000  2.000
Region      3.0000  3.0000  3.0000  3.0000  3.0000  3.00000  3.0000  3.0000  3.0000  3.0000  3.0000  3.000
              [,13]   [,14]   [,15]   [,16]   [,17]   [,18]   [,19]   [,20]   [,21]   [,22]   [,23]   [,24]
Channel     2.0000  2.00000  2.0000  1.000   2.0000  1.0000  2.0000  1.0000  2.0000  1.0000  1.0000  2.000
Region      3.0000  3.00000  3.0000  3.000   3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.000
              [,25]   [,26]    [,27]   [,28]   [,29]   [,30]   [,31]   [,32]   [,33]   [,34]   [,35]    [,36]
Channel     2.0000  2.0000  1.00000  1.000   2.000   1.0000  1.0000  1.0000  1.000   1.0000  1.000   2.0000
Region      3.0000  3.0000  3.00000  3.000   3.000   3.0000  3.0000  3.0000  3.000   3.0000  3.000   3.0000
              [,37]   [,38]   [,39]   [,40]   [,41]   [,42]   [,43]   [,44]   [,45]   [,46]    [,47]   [,48]
Channel     1.000   2.0000  2.000   1.000   1.000   1.0000  2.000   2.000   2.000   2.000   2.00000  2.000
Region      3.000   3.0000  3.000   3.000   3.000   3.0000  3.000   3.000   3.000   3.000   3.00000  3.000
              [,49]   [,50]   [,51]   [,52]   [,53]   [,54]   [,55]   [,56]   [,57]   [,58]   [,59]
Channel     2.00000  2.0000  1.0000  1.0000  2.0000  2.000   1.0000  1.0000  2.0000  2.0000  1.000
Region      3.00000  3.0000  3.0000  3.0000  3.0000  3.000   3.0000  3.0000  3.0000  3.0000  3.000
              [,60]    [,61]   [,62]   [,63]   [,64]   [,65]    [,66]   [,67]   [,68]   [,69]   [,70]
Channel     1.00000  2.00000  2.0000  2.0000  2.0000  1.0000  2.0000  1.0000  2.0000  1.000   1.000
Region      3.00000  3.00000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.000   3.000
              [,71]   [,72]   [,73]   [,74]   [,75]   [,76]   [,77]   [,78]   [,79]   [,80]   [,81]
Channel     1.0000  1.000   1.0000  2.0000  2.0000  1.0000  1.0000  2.0000  1.0000  1.0000  1.0000
Region      3.0000  3.000   3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000
              [,82]   [,83]   [,84]   [,85]   [,86]   [,87]   [,88]   [,89]   [,90]   [,91]   [,92]   [,93]
Channel     2.000   2.0000  1.0000  2.0000  2.000   2.0000  1.0000  1.000   1.0000  1.0000  1.0000  2.0000
Region      3.000   3.0000  3.0000  3.0000  3.000   3.0000  3.0000  3.000   3.0000  3.0000  3.0000  3.0000
              [,94]   [,95]   [,96]    [,97]   [,98]   [,99]   [,100]  [,101]  [,102]  [,103]  [,104]  [,105]
Channel     1.0000  2.000   1.0000  2.0000  1.000   1.000   1.000   2.0000  2.0000  2.0000  1.0000  1.0000
Region      3.0000  3.000   3.0000  3.0000  3.000   3.000   3.000   3.0000  3.0000  3.0000  3.0000  3.0000
              [,106]   [,107]   [,108]   [,109]   [,110]   [,111]    [,112]   [,113]   [,114]   [,115]   [,116]
Channel     1.0000  2.0000  2.00000  2.0000  2.000   1.0000  2.000000  1.000   1.00000  1.0000  1.0000
Region      3.0000  3.0000  3.00000  3.0000  3.000   3.0000  3.000000  3.000   3.00000  3.0000  3.0000
```

```
        [,117]  [,118]  [,119]  [,120]  [,121]  [,122]  [,123]  [,124]  [,125]  [,126]  [,127]  [,128]
Channel 1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  2.0000  1.00000 1.0000  1.000   2.0000
Region  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.00000 3.0000  3.000   3.0000
        [,129]  [,130]  [,131]  [,132]  [,133]  [,134]  [,135]  [,136]  [,137]  [,138]  [,139]  [,140]
Channel  1.000  1.0000  1.0000  1.000   1.000   1.000   1.0000  1.000   1.00000 1.0000  1.000   1.0000
Region   3.000  3.0000  3.0000  3.000   3.000   3.000   3.0000  3.000   3.00000 3.0000  3.000   3.0000
        [,141]  [,142]  [,143]  [,144]  [,145]  [,146]  [,147]  [,148]  [,149]  [,150]  [,151]  [,152]
Channel 1.0000  1.00000 1.00000 1.000   1.000   2.000   1.000   1.0000  1.0000  1.00000 1.0000  1.0000
Region  3.0000  3.00000 3.00000 3.000   3.000   3.000   3.000   3.0000  3.0000  3.00000 3.0000  3.0000
        [,153]  [,154]  [,155]  [,156]  [,157]  [,158]  [,159]  [,160]  [,161]  [,162]  [,163]
Channel 1.00000  1.0000  1.000  2.0000  2.0000  1.0000  2.0000  2.000   2.0000  1.0000  1.0000
Region  3.00000  3.0000  3.000  3.0000  3.0000  3.0000  3.0000  3.000   3.0000  3.0000  3.0000
        [,164]  [,165]  [,166]  [,167]  [,168]  [,169]  [,170]  [,171]  [,172]  [,173]  [,174]
Channel 2.0000  2.0000  2.0000  2.0000  1.0000  1.000   1.0000  2.000   2.000   1.00000 2.0000
Region  3.0000  3.0000  3.0000  3.0000  3.0000  3.000   3.0000  3.000   3.000   3.00000 3.0000
          [,175]  [,176]  [,177]  [,178]  [,179]  [,180]  [,181]  [,182]  [,183]  [,184]  [,185]  [,186]
Channel  1.00000  2.0000  1.000  1.0000  1.0000  1.0000  1.0000  1.000   1.000   1.000   1.000   1.0000
Region   3.00000  3.0000  3.000  3.0000  3.0000  3.0000  3.0000  3.000   3.000   3.000   3.000   3.0000
        [,187]  [,188]  [,189]  [,190]  [,191]  [,192]  [,193]  [,194]  [,195]  [,196]  [,197]  [,198]
Channel 1.0000  1.0000  2.0000  2.0000  1.0000  1.000   1.000   2.0000  1.0000  1.0000  1.000   2.00000
Region  3.0000  3.0000  3.0000  3.0000  3.0000  3.000   3.000   3.0000  3.0000  3.0000  1.000   1.00000
        [,199]  [,200]  [,201]  [,202]  [,203]  [,204]  [,205]  [,206]  [,207]  [,208]  [,209]  [,210]
Channel 1.0000  1.000   2.0000  2.0000  1.000   1.000   1.0000  2.0000  1.000   2.0000  1.0000  2.0000
Region  1.0000  1.000   1.0000  1.0000  1.000   1.000   1.0000  1.0000  1.000   1.0000  1.0000  1.0000
        [,211]  [,212]  [,213]  [,214]  [,215]  [,216]  [,217]  [,218]  [,219]  [,220]  [,221]  [,222]
Channel 1.0000  2.0000  1.0000  1.0000  2.0000  1.0000  2.0000  1.0000  2.000   1.0000  1.0000  1.000
Region  1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  1.000   1.0000  1.0000  1.000
        [,223]  [,224]  [,225]  [,226]  [,227]  [,228]  [,229]  [,230]  [,231]  [,232]  [,233]  [,234]
Channel  1.000  2.0000  1.0000  1.0000  2.00000 1.0000   1.000  1.0000  2.0000  1.000   1.0000  1.0000
Region   1.000  1.0000  1.0000  1.0000  1.00000 1.0000   1.000  1.0000  1.0000  1.000   1.0000  1.0000
        [,235]  [,236]  [,237]  [,238]  [,239]  [,240]  [,241]  [,242]  [,243]  [,244]  [,245]  [,246]
Channel  1.000  1.0000  1.0000  1.0000  1.000   1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  2.0000
Region   1.000  1.0000  1.0000  1.0000  1.000   1.0000  1.0000  1.0000  1.0000  1.0000  1.0000  1.0000
        [,247]  [,248]  [,249]  [,250]  [,251]  [,252]  [,253]  [,254]  [,255]  [,256]  [,257]  [,258]
```

```
Channel  1.0000  1.0000  1.0000  1.000   1.0000  2.000   1.0000  1.0000  1.000   1.0000  1.0000  1.0000
Region   1.0000  1.0000  1.0000  1.000   1.0000  1.000   1.0000  1.0000  1.000   1.0000  1.0000  1.0000
        [,259]  [,260]  [,261]  [,262]  [,263]  [,264]  [,265]  [,266]  [,267]  [,268]  [,269]
Channel  1.000  1.00000  1.0000  1.000   1.0000  1.00000  2.0000  1.000   2.0000  1.0000  2.00000
Region   1.000  1.00000  1.0000  1.000   1.0000  1.00000  1.0000  1.000   1.0000  1.0000  1.00000
        [,270]  [,271]  [,272]  [,273]  [,274]  [,275]  [,276]  [,277]  [,278]  [,279]  [,280]
Channel  1.0000  1.000  1.00000  1.0000  1.0000  1.0000  1.000   1.0000  1.000   1.0000  2.0000
Region   1.0000  1.000  1.00000  1.0000  3.0000  3.0000  3.000   3.0000  3.000   3.0000  3.0000
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Channel  1.0000  2.0000  1.0000  1.0000  1.0000  1.000   1.000   1.0000  1.000   1.000  1.000000  1.0000
Region   3.0000  3.0000  3.0000  3.0000  3.0000  3.000   3.000   3.0000  3.000   3.000  3.000000  3.0000
        [,293]  [,294]  [,295]  [,296]  [,297]  [,298]  [,299]  [,300]  [,301]  [,302]  [,303]  [,304]
Channel  1.0000  2.0000  1.0000  2.0000  1.00000  2.0000  2.0000  1.000   2.0000  2.000   2.0000  2.000
Region   3.0000  2.0000  2.0000  2.0000  2.00000  2.0000  2.0000  2.000   2.0000  2.000   2.0000  2.000
        [,305]  [,306]  [,307]  [,308]  [,309]  [,310]  [,311]  [,312]  [,313]  [,314]  [,315]
Channel  2.0000  2.0000  2.00000  1.0000  1.0000  2.0000  1.0000  1.00000  2.000  1.000   1.0000
Region   2.0000  2.0000  2.00000  2.0000  2.0000  2.0000  2.0000  2.00000  2.000  2.000   2.0000
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Channel  2.000  1.0000  1.0000  1.0000  2.0000  1.0000  1.0000  1.0000  1.0000  1.0000  1.000
Region   2.000  2.0000  2.0000  2.0000  2.0000  2.0000  2.0000  2.0000  2.0000  2.0000  2.000
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Channel  1.0000  1.000  1.000000  1.0000  1.0000  2.0000  1.0000  2.0000  2.000  2.0000  1.0000
Region   2.0000  2.000  2.000000  2.0000  2.0000  2.0000  2.0000  2.0000  2.000  2.0000  2.0000
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Channel  1.0000  1.0000  1.0000  2.0000  2.00000  1.00000  2.000  1.0000  1.0000  2.0000  2.0000
Region   2.0000  2.0000  2.0000  3.0000  3.00000  3.00000  3.000  3.0000  3.0000  3.0000  3.0000
        [,349]  [,350]  [,351]  [,352]  [,353]  [,354]  [,355]  [,356]  [,357]  [,358]  [,359]
Channel  1.0000  2.000  1.0000  2.000  1.000  2.0000  1.0000  1.000  1.00000  2.000  1.000
Region   3.0000  3.000  3.0000  3.000  3.000  3.0000  3.0000  3.000  3.00000  3.000  3.000
        [,360]  [,361]  [,362]  [,363]  [,364]  [,365]  [,366]  [,367]  [,368]  [,369]  [,370]  [,371]
Channel 1.00000  1.0000  1.000  1.0000  1.000  1.000  2.00000  1.000  1.000  1.0000  1.000  2.0000
Region  3.00000  3.0000  3.000  3.0000  3.000  3.000  3.00000  3.000  3.000  3.0000  3.000  3.0000
```

```
Channel  1.0000  1.000  2.0000  1.0000  1.000  2.00000  1.0000  1.0000  2.0000  1.0000  1.0000  1.0000
Region   3.0000  3.000  3.0000  3.0000  3.000  3.00000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000
        [,384]  [,385]  [,386]  [,387]  [,388]  [,389]  [,390]  [,391]  [,392]  [,393]  [,394]
Channel  1.0000  1.0000  1.0000  1.0000  1.0000  1.000  1.00000  1.0000  1.0000  1.0000  1.0000
Region   3.0000  3.0000  3.0000  3.0000  3.0000  3.000  3.00000  3.0000  3.0000  3.0000  3.0000
        [,395]  [,396]  [,397]  [,398]  [,399]  [,400]  [,401]  [,402]  [,403]  [,404]  [,405]  [,406]
Channel  1.0000  1.0000  2.0000  1.0000  1.0000  1.000  1.0000  1.0000  1.000  1.000  1.0000  1.000
Region   3.0000  3.0000  3.0000  3.0000  3.0000  3.000  3.0000  3.0000  3.000  3.000  3.0000  3.000
        [,407]  [,408]  [,409]  [,410]  [,411]  [,412]  [,413]  [,414]  [,415]  [,416]  [,417]  [,418]
Channel  1.0000  2.0000  2.0000  1.0000  1.0000  1.000  1.00000  1.0000  1.000  2.0000  2.0000  1.0000
Region   3.0000  3.0000  3.0000  3.0000  3.0000  3.000  3.00000  3.0000  3.000  3.0000  3.0000  3.0000
        [,419]  [,420]  [,421]  [,422]  [,423]  [,424]  [,425]  [,426]  [,427]  [,428]  [,429]
Channel  2.0000  1.000000  1.0000  2.0000  1.0000  2.0000  2.0000  1.0000  1.00000  1.0000  1.0000
Region   3.0000  3.000000  3.0000  3.0000  3.0000  3.0000  3.0000  3.0000  3.00000  3.0000  3.0000
        [,430]  [,431]  [,432]  [,433]  [,434]  [,435]  [,436]  [,437]  [,438]  [,439]  [,440]
Channel  1.0000  1.0000  1.00000  1.000  1.00000  1.00000  1.0000  1.0000  2.0000  1.0000  1.000
Region   3.0000  3.0000  3.00000  3.000  3.00000  3.00000  3.0000  3.0000  3.0000  3.0000  3.000
 [ reached getOption("max.print") -- omitted 6 rows ]
```

```
> pc_scores<- t_eigenvectors %*% t_datos_Centrados
> pc_scores
           [,1]       [,2]       [,3]       [,4]       [,5]       [,6]       [,7]       [,8]       [,9]       [,10]      [,11]      [,12]
[1,]  -650.022122  4426.804981  4841.998707  -990.346447 -10657.998734 2765.961590  715.550889  4474.583666 6712.0953897   4823.634362  7974.828987  -36.393785
[2,] -1585.519141 -4042.451554 -2578.762221  6279.805968   2159.725755  959.870679 2013.002215 -1429.497018 2205.9091349 -13480.559247 -5711.218967 6037.896357
           [,13]      [,14]      [,15]      [,16]      [,17]      [,18]      [,19]      [,20]      [,21]      [,22]      [,23]
[1,] -19940.202048 -9396.695576 -12660.370431 2997.7258896 10589.523562  6367.0951716 -6623.825337  4861.5315631 -4794.244168  7244.866827 -19299.265694
[2,]  -4591.286546 -5913.157094  -4541.945495 6093.8792739 -6584.215982  3680.7126510 -1254.719581   225.5922437  3988.799302  7347.723232   6936.810632
           [,24]      [,25]      [,26]      [,27]      [,28]      [,29]      [,30]      [,31]      [,32]      [,33]      [,34]
[1,] -19941.088218 -11493.074847 -3309.944671 2968.639051 -872.160242   4895.518984 -29261.093055 -6394.1488844  9813.2767190 -8061.356155 -17605.450989
[2,] -26312.654660  -6171.386567  1161.256698 7158.868510 7603.888167 -24552.373593  10083.337448  -376.4173532  4162.8315174  7976.990582   3963.571741
           [,35]      [,36]      [,37]      [,38]      [,39]      [,40]      [,41]      [,42]      [,43]      [,44]      [,45]
[1,] 11528.0155903 11315.516425 -17225.166763 -3692.391040   6058.938877 -43223.097349 -12657.240546 -6484.4057447  1047.263877   9967.853651  2468.709636
[2,]  6048.9782310 -3970.226966   5190.819199 -6864.586525 -14122.307804  14003.594573   5035.032852  3747.7542375 -7831.460093 -18648.762453 -3417.668272
           [,46]      [,47]      [,48]      [,49]      [,50]      [,51]      [,52]      [,53]      [,54]      [,55]      [,56]
[1,]   3853.458422   7070.678625 -41411.316259   645.598359   3979.648696  6354.520891  9226.0633132 -27289.520971 10914.692807 -13981.644324 7343.5001044
[2,] -21374.176143 -17409.428078 -65788.297951 -3328.870194 -28779.194264  7165.284489  1181.1099255  5807.651211 -7389.762505   9506.073861 2895.7398405
           [,57]      [,58]      [,59]      [,60]      [,61]      [,62]      [,63]      [,64]      [,65]      [,66]      [,67]
[1,]  3.819719e+03  6283.369286 -452.703318 6217.6409237 4220.191774 -30398.840660  3993.2512800   1434.565797  7828.4470372  8.087407e+03 12806.8816858
[2,] -3.319160e+04 -6557.393227 7975.486333 -624.9205032  691.381706 -62369.372958    -0.9210589 -11006.449486  5781.6415714 -4.595084e+04  1097.5700528
           [,68]      [,69]      [,70]      [,71]      [,72]      [,73]      [,74]      [,75]      [,76]      [,77]      [,78]
[1,] -7843.171149  8848.3087656 4760.8326135 -5008.662851 -7622.9660819  7004.446662 -8430.182406  3789.211873 -7333.170561 10720.7451742 -1867.850988
[2,] -4654.938362  1942.3162106 7071.5464164  7252.027301 -8144.4714609  4300.944726  1449.177939 -1802.232158 10517.508104  1955.6087022 -22634.715892
           [,79]      [,80]      [,81]      [,82]      [,83]      [,84]      [,85]      [,86]      [,87]      [,88]      [,89]
[1,] 2350.453356 11004.3108278 6238.532362 11207.132872  1300.063080 -7623.499563  1013.461916 -1.365368e+04 -1.987846e+04 -31824.246848  3982.898499
[2,] 7748.302961  4012.7211280 6625.743247 -9944.870249 -4621.180876  8762.093578  3353.323103 -9.922673e+04 -5.847062e+04   3533.843962  6443.329466
           [,90]      [,91]      [,92]      [,93]      [,94]      [,95]      [,96]      [,97]      [,98]      [,99]      [,100]
[1,] -12388.320816 1617.623801  -879.263422 -1.529142e+03  -3605.220825  5777.897505 12606.7595122 12613.444233 12878.3461048 12764.4405367  2769.088365
[2,]   5242.157788 8542.818934  6745.801552 -3.596151e+04   7380.789497 -7364.932810  2424.3679322  -154.707553  8262.5223365  8215.9701267  7315.990852
           [,101]     [,102]     [,103]     [,104]     [,105]     [,106]     [,107]     [,108]     [,109]     [,110]     [,111]
[1,]  -195.053485   9444.126294  8891.331020 -45183.311111 -1007.852621 -2357.944650 10518.710136   2254.081546 10415.635930   8181.093387 1159.619342
[2,] -6238.743977 -11579.448561 -1754.838044   6064.936027  6099.094878  6877.428435 -5065.318454 -10388.534028 -1656.485410 -22105.013940 7873.011784
           [,112]     [,113]     [,114]     [,115]     [,116]     [,117]     [,118]     [,119]     [,120]     [,121]     [,122]     [,123]
[1,]  -1430.404932 -7154.597498 -1614.754022 -4887.219464 1856.040970 1795.161919  5507.080967 -7365.780560  4346.644140 -4095.123052  8671.8581596 1135.395726
[2,] -11381.082344  7449.091738  7669.874276  8666.303634 7277.280300 6096.971677  3330.576447  8157.141948  6826.518600  7411.377330  6389.2196004 9863.069685
           [,124]     [,125]     [,126]     [,127]     [,128]     [,129]     [,130]     [,131]     [,132]     [,133]     [,134]
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[1,]   376.597996 -22959.547980 -64420.958966 -6910.084288 -9339.077426 12003.6026258 -28445.071396  5121.945238 11246.3088938 -1593.4461716 3955.531374
[2,] -2923.171981   9515.312806  10008.461515  8731.657939 -1719.407334   967.7805905  11650.852582  7750.097147  8475.9166136  7172.2633980 8278.008215
          [,135]     [,136]     [,137]     [,138]     [,139]     [,140]     [,141]     [,142]     [,143]     [,144]     [,145]
[1,] 5739.596075 6795.1462224  6688.4766892  8860.5579473 -827.6340041 7207.865149 -5234.3073693 -1.827673e+04 -24535.964480  1737.812207 -5519.172706
[2,] 6974.080659 6805.6985545 -1360.8286062 -1587.5815226 4002.0066947 4025.512147  2523.0814689  1.286200e+03   2970.181288  8307.728858  7292.302054
          [,146]     [,147]     [,148]     [,149]     [,150]     [,151]     [,152]     [,153]     [,154]     [,155]     [,156]
[1,] -11436.249465 5330.761052 3675.5070686  6927.977519 -18097.964719 -2913.474846 11475.6349249 -5762.270350  8586.2552943 12827.625853   8926.220973
[2,] -24516.856305 6981.405661 5631.3358928  8711.533726  10233.039971  8221.000127  5519.6783252  7721.043879  2436.8812300  8758.273368 -15697.147573
          [,157]     [,158]     [,159]     [,160]     [,161]     [,162]     [,163]     [,164]     [,165]     [,166]     [,167]
[1,]  7948.759038 -4749.161514  9052.097677 11253.941752 10304.768084  918.497445 -2284.553443   4207.298240  6533.699019  -5328.076744  7010.472039
[2,] -7460.833176  7937.008933 -3143.595477 -9297.002478 -4395.969806 9596.549557  6476.172473 -24216.414998 -2391.302668 -13808.414780 -3126.459345
          [,168]     [,169]     [,170]     [,171]     [,172]     [,173]     [,174]     [,175]     [,176]     [,177]     [,178]
[1,] 9919.3535922 7409.957414 7539.457210 11187.840168   8450.238981 11384.4089236  10688.829449 12233.5129204  9398.707915 -33479.997276  -610.8099384
[2,] 4355.3739761 8446.396026 7382.407035 -8450.763131 -23194.569578    34.5741891 -13838.700490  4134.3286620 -5670.935939   4851.308015  2864.0542585
          [,179]     [,180]     [,181]     [,182]     [,183]     [,184]     [,185]     [,186]     [,187]     [,188]     [,189]
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[2,]  2566.0774061  4601.1602534  -374.3596452 -9.910350e+03 -6066.5897679 -2.733145e+04  4664.3003600  5536.684727  7912.087813 -3687.7830004 -5632.685139
          [,190]     [,191]     [,192]     [,193]     [,194]     [,195]     [,196]     [,197]     [,198]     [,199]     [,200]
[1,] 10395.707168 -5076.552941 -104.045812 7656.8527575  11463.324917 6018.0667342 -5425.205188 -20659.774092  9351.225318   788.576111 3512.640294
[2,] -7436.840441  6049.625000 9119.280825 6877.4331166 -10541.450786 6634.6101941  3984.533389   4656.357167 -4151.825627  3598.089032 6946.018654
          [,201]     [,202]     [,203]     [,204]     [,205]     [,206]     [,207]     [,208]     [,209]     [,210]     [,211]
[1,]   6859.289497   5262.980191 -1.436218e+04 12607.389952 10821.231519   9381.225070 6934.440099  9612.363482 10833.3548386   5369.561810 -5400.385806
[2,] -18955.282209 -22229.004478 -1.969278e+03  6500.206472  4533.416175 -18543.180402 8295.392524   112.333394  1350.7666343 -14514.664019  8660.136253
          [,212]     [,213]     [,214]     [,215]     [,216]     [,217]     [,218]     [,219]     [,220]     [,221]     [,222]
[1,] -5.028181e+03 5776.690447 8743.293937  9511.290839  8.130256e+03   6753.263408 -4926.973678 11003.473271 8914.924681 -1460.282667  6627.5073576
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          [,223]     [,224]     [,225]     [,226]     [,227]     [,228]     [,229]     [,230]     [,231]     [,232]     [,233]
[1,]  7062.590317  9165.136672 6022.771301  282.017460 -8472.439822  8758.237068 11406.7993933  3417.680986   171.885060  9401.8910880 -1.249470e+04
[2,]  6648.387293  3543.281433 8094.237600 5065.031409    31.429879  6846.782030  6562.3660441  6271.672800  2351.423789    75.6667044  7.703853e+03
          [,234]     [,235]     [,236]     [,237]     [,238]     [,239]     [,240]     [,241]     [,242]     [,243]     [,244]
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[2,]  3692.356462  6039.888950  3139.143911 6905.464030  8465.918914 8928.536749  9.531131e+03   3982.931937   8591.538614  8095.436147 3564.7622146
          [,245]     [,246]     [,247]     [,248]     [,249]     [,250]     [,251]     [,252]     [,253]     [,254]     [,255]
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[2,] -4009.4739902 -8069.888254 7037.284925 9757.958891  5767.558720  5940.037215 6680.02306  -35068.740737  4945.491148 -5.192358e+03 -3591.9078807
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[2,]  10910.877991  3298.548016  6050.535903  1.071411e+04  6.198806e+03 5361.994798  8377.758062  9231.086614  2376.7802772 -10114.765122 -1.345245e+04
```

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[2,] -14997.154279  8133.399407 -11536.078038  9418.126453  8096.308384  5155.699975  -747.4808218  10093.570870  6307.8556186  7857.9032190   4372.664173
          [,278]     [,279]     [,280]     [,281]     [,282]     [,283]     [,284]     [,285]     [,286]     [,287]     [,288]
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[2,]  8958.612861  6907.009619 -1262.203255 5744.4600508  795.511837   8606.296924   8270.832918   4286.045555  10053.344828 7081.4185453  7233.038392
          [,289]     [,290]     [,291]     [,292]     [,293]     [,294]     [,295]     [,296]     [,297]     [,298]     [,299]
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[2,]  9164.036471  13062.318159  5559.4822891  5197.265349  3946.3194678 -8194.588741  4745.703848 3869.728050  7223.777904 1368.227866 -2099.295679
          [,300]     [,301]     [,302]     [,303]     [,304]     [,305]     [,306]     [,307]     [,308]     [,309]     [,310]
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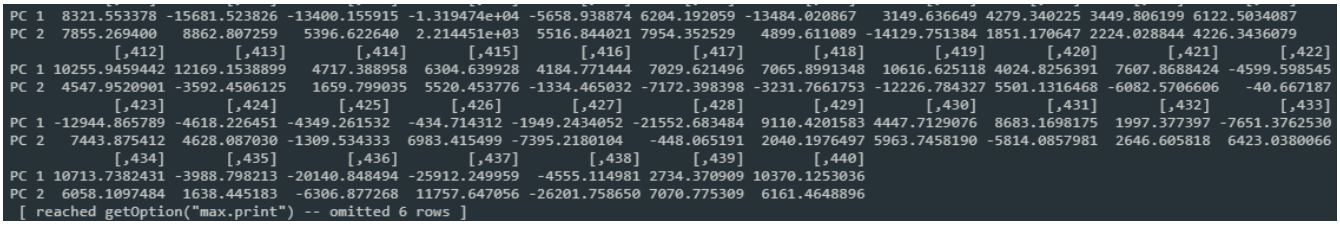
          [,300]       [,301]       [,302]       [,303]       [,304]       [,305]       [,306]       [,307]       [,308]       [,309]       [,310]
PC 1 12739.356702 -3991.296525   5208.353559  9349.805714  9618.109444  10701.233008 11003.461386   3926.987700 -4156.579757 6224.080635   8997.800746
PC 2  6729.042631  1488.949337 -16230.549406 -3376.214363 -7037.205656 -18378.404259 -6016.418935 -16404.677259  7183.759038 6648.220829 -14621.330643
          [,311]       [,312]       [,313]       [,314]       [,315]       [,316]       [,317]       [,318]       [,319]       [,320]       [,321]
PC 1  4275.244624 -16739.591723   9659.458286  2951.012682  2102.1498471  9156.036451 5720.471930 11302.6012844 1069.524407   -387.067649 11008.2911085
PC 2  7056.141998   4481.712518 -13765.059536  7589.903671  2870.0615888 -9466.533800 7179.809036  2312.2665396 5788.468065 -21124.379336  5232.2715505
          [,322]       [,323]       [,324]       [,325]       [,326]       [,327]       [,328]       [,329]       [,330]       [,331]       [,332]
PC 1  3486.280757 -2906.174081  -578.9107221 -12926.104234 -31007.116494  8281.405644 12623.411230 -4848.804819  7178.866567  2757.219358  -1147.951963
PC 2  4811.659854  7197.619301   322.0052690  7894.321480  -6277.800468  7264.357755  7093.948413  6949.245205  4993.158186  5020.329819 -21680.657807
          [,333]       [,334]       [,335]       [,336]       [,337]       [,338]       [,339]       [,340]       [,341]       [,342]       [,343]
PC 1 -9326.379007  5.190418e+02 -5243.746397 -14799.306729 -596.119408  2705.721902  10572.299531  8845.873946 11905.930588  9579.090544 12039.5478365
PC 2  8355.797101 -5.824106e+04  8005.228545  -1544.972128 8487.594989  7109.319788   3539.700654  4283.275595 -3330.958295 -4479.145386  -394.3978023
          [,344]       [,345]       [,346]       [,347]       [,348]       [,349]       [,350]       [,351]       [,352]       [,353]       [,354]
PC 1   9234.015423 9875.262181 11409.122355  8519.074509 -15368.736124 9460.0019778   4334.647731 9427.3963718   9301.526210 12500.8371509  11234.698838
PC 2 -20328.861028 7149.192410  -172.205614 -8755.722553  -2959.809642 5979.7301575 -18208.279346 7033.5152614 -18032.570202  7120.3644745 -13836.911905
          [,355]       [,356]       [,357]       [,358]       [,359]       [,360]       [,361]       [,362]       [,363]       [,364]       [,365]
PC 1 -2423.299168 13019.9079820 -9239.591616  11920.010602  9.149917e+03 11739.6020931 -6719.39219 8502.183151 10913.2897609 8508.6087691 10512.520296
PC 2  4114.500040  6861.9556366 11122.328199 -11327.402086 -2.303398e+03  4145.1213771  7842.20326 8315.508372  6261.8817916 4926.3440343  7304.049998
          [,366]       [,367]       [,368]       [,369]       [,370]       [,371]       [,372]       [,373]       [,374]       [,375]       [,376]       [,377]
PC 1  7217.368375 3546.713177 9681.921583 -8990.930015 7128.114422 -26425.187416 -7811.880396  8648.0246438 -2901.393854 6624.8655728 7418.5009590  7594.033530
PC 2 -1750.076483 7381.282571 8255.069600  8807.777253 8803.687756   7097.188674  8438.377244  5634.2646790   758.344318 6961.4140370 7667.1867491 -7348.730981
          [,378]       [,379]       [,380]       [,381]       [,382]       [,383]       [,384]       [,385]       [,386]       [,387]       [,388]
PC 1 -25207.370505 9678.1334656  8217.505728 -14983.897215 -6093.895851 -22177.702264 10674.0097530 -1.467408e+03 1424.047387 11310.1237453 -7656.592487
PC 2   9377.121152 5944.4475222 -1641.474155  9660.098631  7251.018856   1582.163086  5593.5395428 -1.337067e+04 8318.804224  4758.1703286  8844.468245
          [,389]       [,390]       [,391]       [,392]       [,393]       [,394]       [,395]       [,396]       [,397]       [,398]       [,399]       [,400]
PC 1 3449.993123 3519.359261  9059.634201 10138.2736879 12084.0216646 -12033.919905  830.716561 3389.265330  6495.034944   815.906277  1290.092523 3681.948483
PC 2 8508.194157 7920.414330  7502.732735  5802.3222495  3903.2997007   5003.250208 7243.239861 7972.700557 -5317.573603  8211.186761  9172.321463 8712.119176
          [,401]       [,402]       [,403]       [,404]       [,405]       [,406]       [,407]       [,408]       [,409]       [,410]       [,411]
```



```
PC 1  8321.553378 -15681.523826 -13400.155915 -1.319474e+04 -5658.938874 6204.192059 -13484.020867   3149.636649 4279.340225 3449.806199 6122.5034087
PC 2  7855.269400   8862.807259   5396.622640  2.214451e+03  5516.844021 7954.352529   4899.611089 -14129.751384 1851.170647 2224.028844 4226.3436079
          [,412]       [,413]       [,414]       [,415]       [,416]       [,417]       [,418]       [,419]       [,420]       [,421]       [,422]
PC 1 10255.9459442 12169.1538899   4717.388958  6304.639928  4184.771444  7029.621496  7065.8991348  10616.625118 4024.8256391  7607.8688424 -4599.598545
PC 2  4547.9520901 -3592.4506125   1659.799035  5520.453776 -1334.465032 -7172.398398 -3231.7661753 -12226.784327 5501.1316468 -6082.5706606   -40.667187
          [,423]       [,424]       [,425]       [,426]       [,427]       [,428]       [,429]       [,430]       [,431]       [,432]       [,433]
PC 1 -12944.865789 -4618.226451 -4349.261532  -434.714312 -1949.2434052 -21552.683484  9110.4201583 4447.7129076  8683.1698175  1997.377397 -7651.3762530
PC 2   7443.875412  4628.087030 -1309.534333  6983.415499 -7395.2180104   -448.065191  2040.1976497 5963.7458190 -5814.0857981  2646.605818  6423.0380066
          [,434]       [,435]       [,436]       [,437]       [,438]       [,439]       [,440]
PC 1 10713.7382431 -3988.798213 -20140.848494 -25912.249959  -4555.114981 2734.370909 10370.1253036
PC 2  6058.1097484  1638.445183  -6306.877268  11757.647056 -26201.758650 7070.775309  6161.4648896
 [ reached getOption("max.print") -- omitted 6 rows ]
```

```
> #Los transformamos nuevamente para que los datos esten en modo tabla
> t(pc_scores)
              PC 1          PC 2          PC 3          PC 4          PC 5          PC 6          PC 7          PC 8
  [1,]    -650.02212 -1.585519e+03     95.390677   4540.780521   -356.637079   -226.711788 -3.0371401  1.81785148
  [2,]    4426.80498 -4.042452e+03  -1534.804712   2567.655699    -44.394243   -468.937958 -3.0711158  1.77253184
  [3,]    4841.99871 -2.578762e+03  -3801.384757   2273.494378   5245.385477   2141.123388 -3.0100928  1.76072642
  [4,]    -990.34645  6.279806e+03  -1396.959793  -3310.006036    318.152377    -247.816299 -3.0863212  1.05629811
  [5,] -10657.99873  2.159726e+03     20.043017    172.715426   3188.717161    510.145159 -3.0129498  1.94532361
  [6,]    2765.96159  9.598707e+02   -979.704840   4258.202981   -224.100128     39.527687 -3.0558408  1.87238032
  [7,]     715.55089  2.013002e+03   3259.034414    311.462180    -12.301560    420.873826 -3.0816716  1.84769015
  [8,]    4474.58367 -1.429497e+03    842.633901   -419.073008   1650.151326     -6.947292 -3.0800883  1.79796437
  [9,]    6712.09539  2.205909e+03   1403.852205    889.700073    365.662570   -556.576462 -3.0494915  0.88199495
 [10,]    4823.63436 -1.348056e+04   1375.782665   -365.620249    773.353919   -677.951904 -3.0715186  1.51701452
 [11,]    7974.82899 -5.711219e+03   -333.840474  -3817.574406    287.940491    585.910840 -3.1422588  1.68640153
 [12,]     -36.39379  6.037896e+03   2635.583217   -286.348537    287.824374   -743.675746 -3.0916486  1.99526373
 [13,] -19940.20205 -4.591287e+03   3038.782507   5287.235788    664.133918   -264.571780 -2.9424839  1.78727280
 [14,]   -9396.69558 -5.913157e+03   4401.579400  -2593.149447   -750.912503    330.761991 -3.0763190  1.69461816
 [15,] -12660.37043 -4.541945e+03   3777.003254   2827.577822    464.578428    405.538286 -2.9929717  1.73295856
 [16,]    2997.72589  6.093879e+03   2770.048300    447.050305    284.587453   -175.036628 -3.0466176  0.96277595
 [17,]   10589.52356 -6.584216e+03    206.336706   1571.001708    130.896216   -727.690568 -3.0910059  1.67087475
 [18,]    6367.09517  3.680713e+03  -2416.407431   3739.130609   2942.323548    519.498153 -2.9927390  0.93215987
 [19,]   -6623.82534 -1.254720e+03   1627.004599    423.865048   1864.369420   -468.022226 -3.0319221  1.85140459
 [20,]    4861.53156  2.255922e+02   3278.738203  -1289.717274    646.583054  -1197.987198 -3.0571511  0.84237032
 [21,]   -4794.24417  3.988799e+03   1853.529301   2066.727400    754.632875   1096.538133 -3.0405072  1.91342930
 [22,]    7244.86683  7.347723e+03   -739.672593  -1064.756396   -272.427668     71.611061 -3.0947016  1.02028264
 [23,] -19299.26569  6.936811e+03   -963.665191  -4352.848972   1207.224748   2258.491663 -3.0258520  1.07174040
 [24,] -19941.08822 -2.631265e+04 -14607.432927  13836.713336   8794.077255  -1303.577179 -2.7463585  1.51825096
 [25,] -11493.07485 -6.171387e+03    717.271547    771.449083   3559.402344    155.619848 -2.9833986  1.74665325
 [26,]   -3309.94467  1.161257e+03   4139.395842    954.918468   -752.569412    813.916234 -3.0676841  1.81776044
 [27,]    2968.63905  7.158869e+03    286.197185   -969.606731     97.299951   -261.735800 -3.0728570  1.03021847
 [28,]    -872.16024  7.603888e+03   3163.472157    780.435196    416.581273   -505.802835 -3.0309550  1.02004349
 [29,]    4895.51898 -2.455237e+04  -2437.673667   2849.476035   2634.596590  -2077.971215 -3.0033305  1.33635459
 [30,] -29261.09305  1.008334e+04   7135.306485   2381.772728   -464.601398   1051.932791 -2.9284209  1.09463933
 [31,]   -6394.14888 -3.764174e+02   4015.825037   -926.600396   2739.147357  -1411.308252 -2.9873186  0.87309014
 [32,]    9813.27672  4.162832e+03  -1827.861218   1407.896663   -175.886991    -71.677638 -3.0712864  0.94422334
 [33,]   -8061.35615  7.976991e+03   4526.119252   1497.721994    -56.660201    338.050093 -3.0030101  1.01278729
 [34,] -17605.45099  3.963572e+03    934.128514  -1283.992635   -732.802161  -1702.460455 -3.0176928  1.07831750
 [35,]   11528.01559  6.048978e+03    222.995217   1277.820059     77.046508   -124.524431 -3.0729411  0.95600749
```

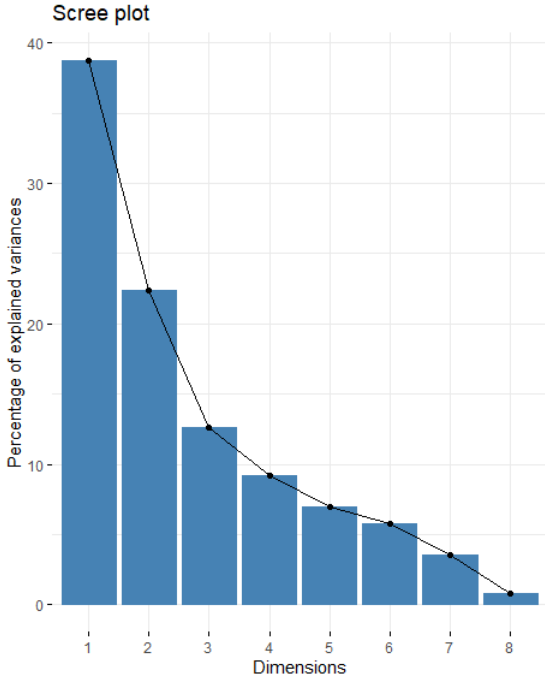
```
[124,]     376.59800 -2.923172e+03  -1612.567111   3526.389102  -1744.769884  -1701.541124 -3.0738946  1.85278225
[125,]  -22959.54798  9.515313e+03   3297.302419   -552.120330   -134.354285    542.281116 -2.9856441  1.13177835
 [ reached getOption("max.print") -- omitted 315 rows ]
> datos_recuperados <- t(eigen_a$vectors %*% pc_scores)
> datos_recuperados[, 1] <- datos_recuperados[, 1] + mean(dataset$X1)
Warning messages:
1: Unknown or uninitialised column: `X1`.
2: In mean.default(dataset$X1) :
  argument is not numeric or logical: returning NA
> datos_recuperados[, 2] <- datos_recuperados[, 2] + mean(dataset$X2)
Warning messages:
1: Unknown or uninitialised column: `X2`.
2: In mean.default(dataset$X2) :
  argument is not numeric or logical: returning NA
> datos_recuperados
      [,1] [,2]       [,3]       [,4]       [,5]       [,6]       [,7]       [,8]
  [1,]   NA   NA  3859.73409   668.70227  -390.27727 -2857.93182  -207.49318  -186.870455
  [2,]   NA   NA  4013.73409 -4943.29773  1616.72273 -1309.93182   411.50682   251.129545
  [3,]   NA   NA  3011.73409 -5647.29773  -267.27727  -666.93182   634.50682  6319.129545
  [4,]   NA   NA -4600.26591  1264.70227 -3730.27727  3332.06818 -2374.49318   263.129545
  [5,]   NA   NA  -386.26591 10614.70227  -753.27727   843.06818 -1104.49318  3660.129545
  [6,]   NA   NA  2462.73409 -2587.29773 -2825.27727 -2405.93182 -1086.49318   -73.870455
  [7,]   NA   NA -2597.26591   125.70227  -976.27727 -2591.93182   258.50682  -979.870455
  [8,]   NA   NA  -840.26591 -4421.29773  1474.72273 -1402.93182   439.50682  1041.129545
  [9,]   NA   NA -2148.26591 -6037.29773 -1759.27727 -2646.93182 -1165.49318  -774.870455
 [10,]   NA   NA  5296.73409 -5994.29773 10929.72273 -1912.93182  4543.50682   573.129545
 [11,]   NA   NA  -393.26591 -8634.29773  5022.72273  1328.06818  3095.50682   219.129545
 [12,]   NA   NA -4672.26591  1145.70227 -3428.27727 -1651.93182 -2332.49318 -1027.870455
 [13,]   NA   NA  6522.73409 19713.70227  3805.72273 -2784.93182   999.50682  1406.129545
 [14,]   NA   NA   411.73409  9216.70227  7030.72273    23.06818  3825.50682  -922.870455
 [15,]   NA   NA  3668.73409 12652.70227  4139.72273 -2777.93182  2176.50682   643.129545
 [16,]   NA   NA -4682.26591 -1747.29773 -4130.27727 -2674.93182 -1917.49318 -1112.870455
 [17,]   NA   NA  3019.73409 -10980.29773  4169.72273 -2937.93182  1626.50682  -444.870455
 [18,]   NA   NA   360.73409 -6124.29773 -5018.27727 -2232.93182 -2511.49318  2953.129545
 [19,]   NA   NA   530.73409  6600.70227  2147.72273  -866.93182  -114.49318  1656.129545
 [20,]   NA   NA -3301.26591 -4220.29773  1512.72273 -2402.93182  -363.49318 -1023.870455
 [21,]   NA   NA -1277.26591  5545.70227 -3349.27727 -2005.93182  -622.49318   599.129545
 [22,]   NA   NA -4925.26591 -6433.29773 -5941.27727   311.06818 -2506.49318  -955.870455
```

```
> #Con apply aplicamos la funcion en todos los elementos de nuestra matriz
> Media <- apply(X = dataset, MARGIN = 2, FUN = mean)  #Promedio
> Varianza <- apply(X = dataset, MARGIN = 2, FUN = var)   #Varianza
> Desviacion_e <- apply(X = dataset, MARGIN = 2, FUN = sd) #Desviación Estandar
> Media
       Channel         Region          Fresh           Milk        Grocery         Frozen Detergents_Paper      Delicassen
      1.322727       2.543182   12000.297727   5796.265909   7951.277273   3071.931818   2881.493182   1524.870455
> Varianza
       Channel         Region          Fresh           Milk        Grocery         Frozen Detergents_Paper      Delicassen
  2.190723e-01   5.994978e-01   1.599549e+08   5.446997e+07   9.031010e+07   2.356785e+07   2.273244e+07   7.952997e+06
> Desviacion_e
       Channel         Region          Fresh           Milk        Grocery         Frozen Detergents_Paper      Delicassen
  4.680516e-01   7.742724e-01   1.264733e+04   7.380377e+03   9.503163e+03   4.854673e+03   4.767854e+03   2.820106e+03
```

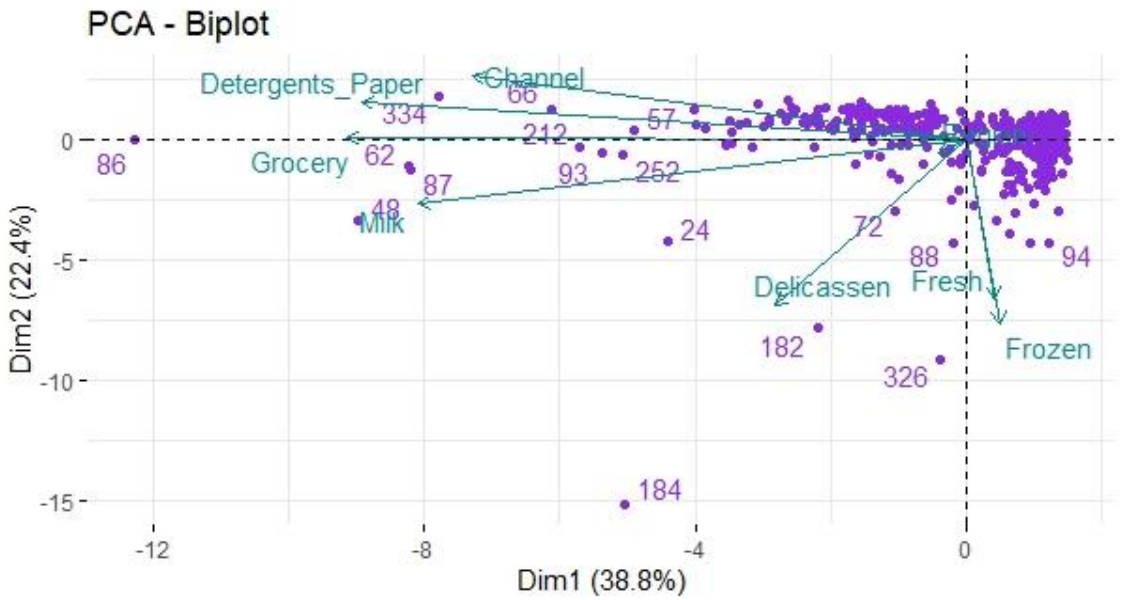
```
> #Calculamos nuestro Analisis de componentes principales
> ACP <- prcomp(dataset, scale= TRUE)
> names(ACP)
[1] "sdev"     "rotation" "center"   "scale"    "x"
```

```
> #Lo aplicamos para las siguientes funciones y se pueda visualizar la informacion de cada "renglon"
> ACP$center
       Channel         Region          Fresh           Milk        Grocery         Frozen Detergents_Paper      Delicassen
      1.322727       2.543182   12000.297727   5796.265909   7951.277273   3071.931818   2881.493182   1524.870455
> ACP$scale
       Channel         Region          Fresh           Milk        Grocery         Frozen Detergents_Paper      Delicassen
  4.680516e-01   7.742724e-01   1.264733e+04   7.380377e+03   9.503163e+03   4.854673e+03   4.767854e+03   2.820106e+03
> ACP$rotation
                      PC1         PC2          PC3         PC4         PC5         PC6          PC7          PC8
Channel          -0.42829156  0.20469886  0.0829798863 -0.02964416  0.03620585 -0.86350670  0.139899044  0.019335373
Region           -0.02472603 -0.04312964  0.9825008891 -0.07784462 -0.13250892  0.08976479 -0.023279938 -0.001545045
Fresh             0.02531946 -0.51344468  0.0889509074  0.79847592  0.25811686 -0.14747474 -0.027173693 -0.033851114
Milk             -0.47440995 -0.20554061 -0.0257510842 -0.05402202  0.07208576  0.31593256  0.789020414 -0.039291347
Grocery          -0.53632914  0.00871762 -0.0453143572  0.12158624 -0.11172990  0.21369889 -0.353064294  0.715984124
Frozen            0.02997456 -0.59274525 -0.1221565222 -0.16131688 -0.75421244 -0.19435993 -0.005336793 -0.012983225
Detergents_Paper -0.52390630  0.12108309 -0.0474814388  0.15101211 -0.17650264  0.19575356 -0.371374310 -0.691672189
Delicassen       -0.16499653 -0.53318082  0.0009301994 -0.53755767  0.54482721 -0.05453289 -0.306582655 -0.075642587
```

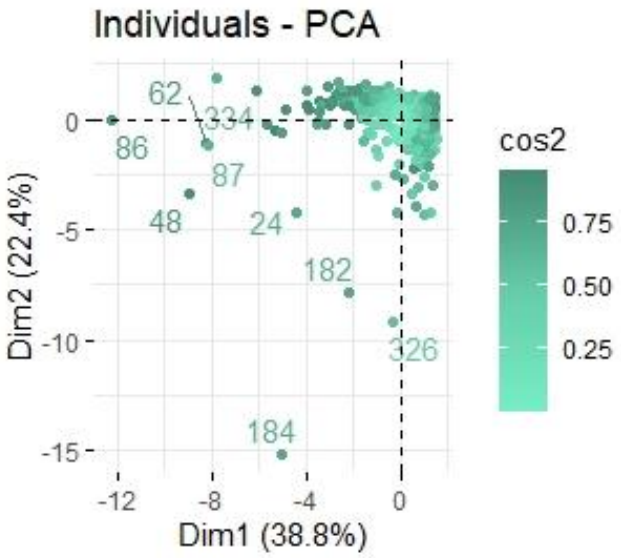
```
> #Definimos nuestras graficas para poder tener una mejor visualizacion de los datos y llegar a una mejor conclusion de nuestros datos
> head(ACP$x)  # Visualizamos los primeros 6 datos de nuestra matriz
          PC1        PC2        PC3         PC4        PC5         PC6        PC7         PC8
[1,] -0.8429794  0.5147648 0.7667594  0.04416453  0.4457267 -0.9383731  0.6540173  0.01808111
[2,] -1.0614682  0.4840503 0.6722101 -0.40091542  0.1303098 -0.8662408  0.5104414  0.07780623
[3,] -1.2676975 -0.6812791 0.6633395 -1.63309380  1.1924556 -1.0772155 -0.2029209 -0.25374856
[4,]  1.0555808 -0.6101270 0.5050795 -0.19578209 -0.4573340  0.1168258 -0.3134471  0.05431530
[5,] -0.6333096 -0.9730912 0.7703319 -0.18616222  0.8129520 -1.5036608 -0.1602166  0.00375915
[6,] -0.5295082  0.5847458 0.7577620 -0.24672790  0.3784085 -1.0713344  0.6578136 -0.02594706
> fviz_eig(ACP) #Hacemos el grafico de nuestro respectivos datos de nuestra PCA
```



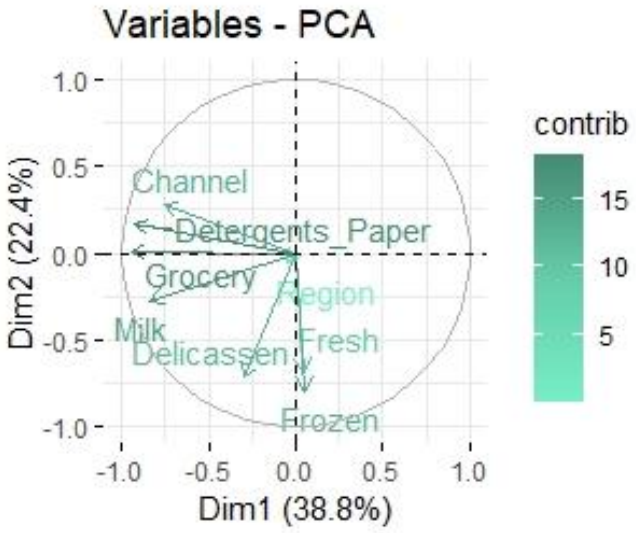

```
>  #Representación bidimensional de las primeras dos componentes (por defecto)
> fviz_pca_biplot(ACP, repel = TRUE,
+                 col.var = "#008B8B", # Definimos el color de las variables
+                 col.ind = "#8A2BE2"  # Definimos el color de las variables independientes
+                 )
```




```
> #Representacion gbidimensional de las primeras dos componentes (por defecto)
There were 31 warnings (use warnings() to see them)
> fviz_pca_ind(ACP,
+              col.ind = "cos2", #Definimos el color de la representación
+              gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
+              repel = TRUE     #Evitamos la superposición del texto
+              )
Warning message:
ggrepel: 431 unlabeled data points (too many overlaps). Consider increasing max.overlaps
```




```
> # Representación en tercera dimensión de nuestras 3 componentes, tanto con variables como individuos
Warning messages:
1: ggrepel: 431 unlabeled data points (too many overlaps). Consider increasing max.overlaps
2: ggrepel: 431 unlabeled data points (too many overlaps). Consider increasing max.overlaps
3: ggrepel: 431 unlabeled data points (too many overlaps). Consider increasing max.overlaps
4: ggrepel: 431 unlabeled data points (too many overlaps). Consider increasing max.overlaps
> fviz_pca_var(ACP,
+              col.var = "contrib", # Definimos el color
+              gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
+              repel = TRUE     #Evitamos la superposición del texto
+              )
```



Interpretación de los datos:

Al termino de nuestro análisis podemos tomar una conclusión respecto a los resultados obtenidos, y es que, al hacer gastos de ciertos tipos de materiales y recursos, se registro que los que más tienen un gasto fijo o frecuente que los demás son la leche, los papeles, el detergente y los alimentos. Por otro lado, en cuestión a lo que se refiere los que están dentro de una medida estándar son los recursos de cadena fría, así mismo, hay existencia de casos en los cuales no se hace ningún gasto alguno dentro de estos registros.

2.-

b) Ejercicio 2

1. Elige algún *dataset* de tu interés y aplica el método de Análisis de Componentes Principales
2. Interpreta resultados

Consideraciones:

Se tomo un data set de hospitalización por covid-19, tanto en la CDMX como en el EDOMEX.

Se tomaron las mismas consideraciones que el ejercicio anterior.

Se tiene un total de camas de cada estado y un total general, tanto de hospitalizaciones como de personas intubadas.

Procedimiento:

```
" Ejercicio 2
Se tiene un dataset de camas de hospitalización por covid19 en CDMX y EDOMEX
Se aplicará el análisis de componentes principales a los siguientes datos, así mismo las mismas intrucciones y pasos"

# Primero importamos las liberias que vayamos a ocupar, para esto, se hizo una instalación para posteriormente hacer
library(readr)
library(factoextra)

#Mandamos a leer nuestro dataset, esto primero lo debemos de descargar para poderlo mandar a llamar con la siguiente instrucción
dataset <- read_csv("C:/Users/viane/Desktop/ESCOM/3.-TERCER SEMESTRE/PROGRAMACION PARA LAS CIENCIAS DE DATOS/Hospitalización.csv")


#Normalizacion de los datos
datos_Centrados<- dataset
datos_Centrados$hospitalizados_totales <- dataset$hospitalizados_totales      - mean(dataset$hospitalizados_totales)
datos_Centrados$intubados_totales      <- dataset$intubados_totales           - mean(dataset$intubados_totales)
datos_Centrados$hospitalizados_edomex  <- dataset$hospitalizados_edomex       - mean(dataset$hospitalizados_edomex)
datos_Centrados$hospitalizados_cdmx    <- dataset$hospitalizados_cdmx         - mean(dataset$hospitalizados_cdmx)
datos_Centrados$intubados_cdmx         <- dataset$intubados_cdmx              - mean(dataset$intubados_cdmx)
datos_Centrados$intubados_edomex       <- dataset$intubados_edomex            - mean(dataset$intubados_edomex)
datos_Centrados

#Una vez con los datos ya calculados, calculamos la covarianza de nuestros respectivos datos
matriz_Cov <- cov(datos_Centrados)
matriz_Cov

#PCA
#Calculamos los autovalores y autovectores  (valores propios de la matriz de covarianza)
eigen_a<- eigen(matriz_Cov)
eigen_a$values

#Obtencion de los vectores propios, componentes principales
eigen_a$vectors

#Se calcula la transpuesta de nuestros datos ya tratados
t_eigenvectors <- t(eigen_a$vectors)
t_eigenvectors
```

```r

#Se calacula la transpuesta de nuestros datos originales con su promedio
t_datos_Centrados <- t(datos_Centrados)
t_datos_Centrados

# Se multiplican los componentes principales por los datos nomalizados (Transpuestos)
pc_scores<- t_eigenvectors %*% t_datos_Centrados
pc_scores
rownames(pc_scores) <- c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5", "PC 6", "PC 7", "PC 8")
pc_scores


#Los transformamos nuevamente para que los datos esten en modo tabla
t(pc_scores)
datos_recuperados <- t(eigen_a$vectors %*% pc_scores)
datos_recuperados[, 1] <- datos_recuperados[, 1] + mean(dataset$X1)
datos_recuperados[, 2] <- datos_recuperados[, 2] + mean(dataset$X2)
datos_recuperados

#Con apply aplicamos la funcion en todos los elementos de nuestra matriz
Media <- apply(X = dataset, MARGIN = 2, FUN = mean)  #Promedio
Varianza <- apply(X = dataset, MARGIN = 2, FUN = var)   #Varianza
Desviacion_e <- apply(X = dataset, MARGIN = 2, FUN = sd) #Desviación Estandar
Media
Varianza
Desviacion_e


#Calculamos nuestro Analisis de componentes principales
ACP <- prcomp(dataset, scale= TRUE)
names(ACP)

#Lo aplicamos para las siguientes funciones y se pueda visualizar la informacion de cada "renglon"
ACP$center
ACP$scale
ACP$rotation

```

```r

#Calculamos nuestro Analisis de componentes principales
ACP <- prcomp(dataset, scale= TRUE)
names(ACP)

#Lo aplicamos para las siguientes funciones y se pueda visualizar la informacion de cada "renglon"
ACP$center
ACP$scale
ACP$rotation

#Definimos nuestras graficas para poder tener una mejor visualizacion de los datos y llegar a una mejor conclusion de nuestros datos
head(ACP$x)  # Visualizamos los primeros 6 datos de nuestra matriz
fviz_eig(ACP) #Hacemos el grafico de nuestro respectivos datos de nuestra PCA

#Representación bidimensional de las primeras dos componentes (por defecto)
fviz_pca_biplot(ACP, repel = TRUE,
                col.var = "#008B8B", # Definimos el color de las variables
                col.ind = "#8A2BE2"  # Definimos el color de las variables independientes
)

#Representacion ghidimensional de las primeras dos componentes (por defecto)
fviz_pca_ind(ACP,
             col.ind = "cos2", #Definimos el color de la representación
             gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
             repel = TRUE     #Evitamos la superposición del texto
)

# Representación en tercera dimensión de nuestras 3 componentes, tanto con variables como individuos
fviz_pca_var(ACP,
             col.var = "contrib", # Definimos el color
             gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
             repel = TRUE     #Evitamos la superposición del texto
)


```

RESULTADOS:

```
> " Ejercicio 2
Warning messages:
1: ggrepel: 6 unlabeled data points (too many overlaps). Consider increasing max.overlaps
2: ggrepel: 6 unlabeled data points (too many overlaps). Consider increasing max.overlaps
+ Se tiene un dataset de camas de hospitalización por covid19 en CDMX y EDOMEX
+ Se aplicará el análisis de componentes principales a los siguientes datos, así mismo las mismas intrucciones y pasos"
[1] " Ejercicio 2\nSe tiene un dataset de camas de hospitalización por covid19 en CDMX y EDOMEX\nSe aplicará el análisis de componentes principales a los siguiente
s datos, así mismo las mismas intrucciones y pasos"
>
> # Primero importamos las librerias que vayamos a ocupar, para esto, se hizo una instalación para posteriormente hacer
> library(readr)
> library(factoextra)
>
> #Mandamos a leer nuestro dataset, esto primero lo debemos de descargar para poderlo mandar a llamar con la siguiente instrucción
> dataset <- read_csv("C:/Users/viane/Desktop/ESCOM/3.-TERCER SEMESTRE/PROGRAMACION PARA LAS CIENCIAS DE DATOS/Hospitalización.csv")
Rows: 101 Columns: 8

-- Column specification --------------------------------------------------------------------------------------------------------------------------------------
Delimiter: ","
dbl (8): Mes, dia, hospitalizados_totales, hospitalizados_cdmx, hospitalizados_edomex, intubados_totales, intubados_cdmx, intubados_edomex

i Use `spec()` to retrieve the full column specification for this data.
i Specify the column types or set `show_col_types = FALSE` to quiet this message.
>
>
> #Nomralizacion de los datos
> datos_Centrados<- dataset
> datos_Centrados$hospitalizados_totales <- dataset$hospitalizados_totales      - mean(dataset$hospitalizados_totales)
> datos_Centrados$intubados_totales      <- dataset$intubados_totales           - mean(dataset$intubados_totales)
> datos_Centrados$hospitalizados_edomex  <- dataset$hospitalizados_edomex       - mean(dataset$hospitalizados_edomex)
> datos_Centrados$hospitalizados_cdmx    <- dataset$hospitalizados_cdmx         - mean(dataset$hospitalizados_cdmx)
> datos_Centrados$intubados_cdmx         <- dataset$intubados_cdmx              - mean(dataset$intubados_cdmx)
> datos_Centrados$intubados_edomex       <- dataset$intubados_edomex            - mean(dataset$intubados_edomex)
> datos_Centrados
```

```
# A tibble: 101 x 8
     Mes   dia hospitalizados_totales hospitalizados_cdmx hospitalizados_edomex intubados_totales intubados_cdmx intubados_edomex
   <dbl> <dbl>                  <dbl>               <dbl>                <dbl>              <dbl>           <dbl>            <dbl>
 1     3    25                -4033.              -2904.               -1129.             -955.           -728.            -227.
 2     3    26                -4010.              -2881.               -1129.             -946.           -719.            -227.
 3     3    27                -3963.              -2834.               -1129.             -928.           -701.            -227.
 4     3    28                -3881.              -2752.               -1129.             -910.           -683.            -227.
 5     4     1                -2754.              -2650.               -1104.             -855.           -633.            -222.
 6     4    10                -2053.              -2175.                -878.             -674.           -505.            -169.
 7     4    14                -1692.              -1899.                -793.             -570.           -418.            -152.
 8     4    15                -1608.              -1888.                -720.             -516.           -406.            -110.
 9     4    16                -2433.              -2754.                -679.             -480.           -371.            -109.
10     4    17                -2251.              -1601.                -650.             -403.           -293.            -110.
# ... with 91 more rows
```

```
> #Una vez con los datos ya calculados, calculamos la covarianza de nuestros respectivos datos
> matriz_Cov <- cov(datos_Centrados)
> matriz_Cov
                              Mes          dia hospitalizados_totales hospitalizados_cdmx hospitalizados_edomex intubados_totales intubados_cdmx
Mes                     8.419604    -5.553861              1336.887           1049.293            287.5938         323.4502       262.8550
dia                    -5.553861    92.474851             -2798.794          -2041.456           -757.3383        -603.2831      -463.7333
hospitalizados_totales 1336.887030 -2798.793960           4212725.768        2936413.400         1276312.3682      953156.6315    708653.7829
hospitalizados_cdmx    1049.293267 -2041.455644           2936413.400        2051717.306          884696.0940      665325.8934    495257.0358
hospitalizados_edomex   287.593762  -757.338317           1276312.368         884696.094          391616.2743      287830.7381    213396.7470
intubados_totales       323.450198  -603.283069            953156.631         665325.893          287830.7381      219366.8499    163212.3825
intubados_cdmx          262.855050  -463.733267            708653.783         495257.036          213396.7470      163212.3825    122007.7481
intubados_edomex         58.424455  -131.824059            244486.028         170009.816           74476.2127       56164.1928     41249.8607
                       intubados_edomex
Mes                           58.42446
dia                         -131.82406
hospitalizados_totales     244486.02842
hospitalizados_cdmx        170009.81574
hospitalizados_edomex       74476.21267
intubados_totales           56164.19277
intubados_cdmx              41249.86069
intubados_edomex            14907.70238
>
> #PCA
> #Calculamos los autovalores y autovectores  (valores propios de la matriz de covarianza)
> eigen_a<- eigen(matriz_Cov)
> eigen_a$values
[1] 6.996209e+06 1.005716e+04 5.242985e+03 8.312431e+02 8.833095e+01 8.790926e+00 4.811455e+00 1.875406e-10
>
```

```
> #Obtencion de los vectores propios, componentes principales
> eigen_a$vectors
             [,1]         [,2]         [,3]         [,4]         [,5]         [,6]         [,7]          [,8]
[1,]  0.0002524908  0.01628274 -0.005487833 -0.01196037  2.798995e-02  0.197718053  0.979635532  0.000000e+00
[2,] -0.0005183906 -0.01068422  0.015202099  0.01642868 -9.980269e-01  0.054827399  0.017913167 -1.581193e-12
[3,]  0.7759256980 -0.22737678 -0.109131904 -0.03145098 -4.429478e-05  0.001134574  0.002356238 -5.773503e-01
[4,]  0.5411082008  0.52048276 -0.312453845  0.07165255 -9.928532e-03 -0.006377769 -0.008095169  5.773503e-01
[5,]  0.2348174973 -0.74785954  0.203321941 -0.10310353  9.884237e-03  0.007512343  0.010451408  5.773503e-01
[6,]  0.1757518732  0.21870341  0.720165837  0.26784655  4.187084e-02  0.562839018 -0.111169071 -9.175880e-13
[7,]  0.1307064913  0.26033275  0.542789423 -0.55289023 -3.206234e-02 -0.550456611  0.103943420  9.137078e-13
[8,]  0.0450414130 -0.04604343  0.188686514  0.77807717 -1.347137e-02 -0.581388758  0.129035770  9.898960e-13
>
> #Se calcula la transpuesta de nuestros datos ya tratados
> t_eigenvectors <- t(eigen_a$vectors)
> t_eigenvectors
             [,1]          [,2]         [,3]         [,4]         [,5]         [,6]         [,7]         [,8]
[1,]  0.0002524908 -5.183906e-04  7.759257e-01  0.541108201  0.234817497  1.757519e-01  1.307065e-01  4.504141e-02
[2,]  0.0162827416 -1.068422e-02 -2.273768e-01  0.520482761 -0.747859542  2.187034e-01  2.603327e-01 -4.604343e-02
[3,] -0.0054878326  1.520210e-02 -1.091319e-01 -0.312453845  0.203321941  7.201658e-01  5.427894e-01  1.886865e-01
[4,] -0.0119603660  1.642868e-02 -3.145098e-02  0.071652552 -0.103103528  2.678465e-01 -5.528902e-01  7.780772e-01
[5,]  0.0279899497 -9.980269e-01 -4.429478e-05 -0.009928532  0.009884237  4.187084e-02 -3.206234e-02 -1.347137e-02
[6,]  0.1977180532  5.482740e-02  1.134574e-03 -0.006377769  0.007512343  5.628390e-01 -5.504566e-01 -5.813888e-01
[7,]  0.9796355323  1.791317e-02  2.356238e-03 -0.008095169  0.010451408 -1.111691e-01  1.039434e-01  1.290358e-01
[8,]  0.0000000000 -1.581193e-12 -5.773503e-01  0.577350269  0.577350269 -9.175880e-13  9.137078e-13  9.898960e-13
>
```

```
> #Se calacula la transpuesta de nuestros datos originales con su promedio
> t_datos_Centrados <- t(datos_Centrados)
> t_datos_Centrados
                              [,1]      [,2]      [,3]      [,4]      [,5]      [,6]      [,7]      [,8]      [,9]      [,10]     [,11]     [,12]
Mes                         3.0000    3.0000    3.0000    3.0000    4.0000    4.0000    4.0000    4.0000    4.0000    4.0000    4.0000    4.00000
dia                        25.0000   26.0000   27.0000   28.0000    1.0000   10.0000   14.0000   15.0000   16.0000   17.0000   18.0000   19.00000
hospitalizados_totales -4033.1485 -4010.1485 -3963.1485 -3881.1485 -3754.1485 -3053.1485 -2692.1485 -2608.1485 -2433.1485 -2251.1485 -2071.1485 -1933.14851
hospitalizados_cdmx    -2904.3366 -2881.3366 -2834.3366 -2752.3366 -2650.3366 -2175.3366 -1899.3366 -1888.3366 -1754.3366 -1601.3366 -1461.3366 -1362.33663
hospitalizados_edomex  -1128.8119 -1128.8119 -1128.8119 -1128.8119 -1103.8119  -877.8119  -792.8119  -719.8119  -678.8119  -649.8119  -609.8119  -570.81188
intubados_totales       -954.9901  -945.9901  -927.9901  -909.9901  -854.9901  -673.9901  -569.9901  -515.9901  -479.9901  -402.9901  -376.9901  -333.99010
intubados_cdmx          -728.2475  -719.2475  -701.2475  -683.2475  -633.2475  -505.2475  -418.2475  -406.2475  -371.2475  -293.2475  -274.2475  -237.24752
intubados_edomex        -227.2772  -227.2772  -227.2772  -227.2772  -222.2772  -169.2772  -152.2772  -110.2772  -109.2772  -110.2772  -103.2772   -97.27723
                             [,13]     [,14]     [,15]     [,16]     [,17]     [,18]     [,19]     [,20]     [,21]     [,22]     [,23]     [,24]
Mes                         4.0000    4.0000    4.00000   4.00000   5.000000  5.00000   5.00000   5.00000   5.00000   5.00000   5.00000   5.0000
dia                        20.0000   21.0000   23.00000  30.00000  5.000000  7.00000   9.00000  11.00000  15.00000  16.00000  20.00000  26.0000
hospitalizados_totales -1837.1485 -1609.1485 -1393.14851  -31.14851 855.851485 767.851485 1077.85149 1284.85149 1732.85149 1831.85149 2286.85149 2201.8515
hospitalizados_cdmx    -1303.3366 -1131.3366  -945.33663 -109.33663 428.663366 414.663366  600.66337  769.66337 1089.66337 1149.66337 1530.66337 1468.6634
hospitalizados_edomex   -533.8119  -477.8119  -447.81188   78.18812 427.188119 353.188119  477.18812  515.18812  643.18812  682.18812  756.18812  733.1881
intubados_totales       -331.9901  -288.9901  -286.99010   18.00990 114.009901 146.009901  198.00990  205.00990  301.00990  307.00990  441.00990  456.0099
intubados_cdmx          -232.2475  -189.2475  -190.24752   83.75248 116.752475 137.752475  156.75248  173.75248  212.75248  220.75248  349.75248  314.7525
intubados_edomex        -100.2772  -100.2772   -97.27723  -12.27723  -3.277228   7.722772   40.72277   30.72277   87.72277   85.72277   90.72277  140.7228
                             [,25]     [,26]     [,27]     [,28]     [,29]     [,30]     [,31]     [,32]     [,33]     [,34]     [,35]     [,36]     [,37]
Mes                         5.0000    5.0000    6.0000    6.0000    6.0000    6.0000    6.0000    6.00000   6.00000   6.00000   6.00000   6.00000   7.00000
dia                        28.0000   30.0000    3.0000    6.0000    8.0000   14.0000   15.0000   19.00000  20.00000  28.00000  29.00000  30.00000   3.00000
hospitalizados_totales 2102.8515 2139.8515 2223.8515 2303.8515 2181.8515 1991.8515 1918.8515 1679.85149 1611.85149 1143.85149 1138.85149 1149.85149 956.85149
hospitalizados_cdmx    1410.6634 1434.6634 1455.6634 1474.6634 1398.6634 1321.6634 1269.6634 1132.66337 1070.66337  770.66337  783.66337  812.66337 656.66337
hospitalizados_edomex   692.1881  705.1881  768.1881  829.1881  783.1881  670.1881  649.1881  547.18812  541.18812  373.18812  355.18812  337.18812 300.18812
intubados_totales       410.0099  459.0099  502.0099  437.0099  420.0099  359.0099  341.0099  277.00990  286.00990  282.00990  273.00990  248.00990 207.00990
intubados_cdmx          291.7525  319.7525  333.7525  283.7525  279.7525  244.7525  236.7525  190.75248  196.75248  196.75248  187.75248  170.75248 135.75248
intubados_edomex        117.7228  138.7228  167.7228  152.7228  139.7228  113.7228  103.7228   85.72277   88.72277   84.72277   84.72277   76.72277  70.72277
                             [,38]     [,39]     [,40]     [,41]     [,42]     [,43]     [,44]     [,45]     [,46]     [,47]     [,48]     [,49]     [,50]
```

```
Mes                    7.00000   7.00000   7.00000   7.00000   7.00000   7.00000   8.00000   8.00000   8.000000   8.000000   8.00000   8.00000
dia                    4.00000  10.00000  15.00000  21.00000  23.00000  30.00000  31.00000   5.00000   7.00000   9.000000  10.000000  11.00000  13.00000
hospitalizados_totales 871.85149 661.85149 614.85149 506.85149 578.85149 458.85149 373.85149 151.85149  72.85149 -33.148515 -78.148515 -136.14851 -160.14851
hospitalizados_cdmx    582.66337 442.66337 401.66337 381.66337 428.66337 373.66337 274.66337 166.66337 105.66337  -5.336634 -36.336634 -107.33663 -187.33663
hospitalizados_edomex  289.18812 219.18812 213.18812 125.18812 150.18812  85.18812  99.18812 -14.81188 -32.81188 -27.811881 -41.811881  -28.81188  27.18812
intubados_totales      215.00990 164.00990 127.00990 111.00990  83.00990 146.00990 138.00990  91.00990  55.00990  65.009901  45.009901  -12.99010 -25.99010
intubados_cdmx         116.75248  82.75248  50.75248  49.75248  14.75248  77.75248  69.75248  51.75248  25.75248  15.752475  -7.247525  -49.24752 -71.24752
intubados_edomex        97.72277  80.72277  75.72277  60.72277  67.72277  67.72277  67.72277  38.72277  28.72277  48.722772  51.722772   35.72277  44.72277
                          [,51]     [,52]     [,53]     [,54]     [,55]     [,56]     [,57]     [,58]     [,59]     [,60]     [,61]     [,62]
Mes                     8.00000   8.000000   8.000000   8.00000   9.00000   9.00000   9.00000   9.00000   9.00000   9.00000   9.00000   9.00000
dia                    18.00000  19.000000  23.000000  25.00000   1.00000   2.00000   3.00000   5.00000  11.00000  20.00000  23.00000  25.00000
hospitalizados_totales -139.14851 -128.148515 -393.148515 -286.14851 -275.14851 -291.14851 -375.14851 -415.14851 -315.14851 -534.14851 -543.14851 -662.14851
hospitalizados_cdmx    -120.33663 -124.336634 -289.336634 -159.33663  -78.33663 -120.33663 -164.33663 -189.33663 -124.33663 -304.33663 -297.33663 -377.33663
hospitalizados_edomex   -18.81188  -3.811881 -103.811881 -126.81188 -196.81188 -170.81188 -210.81188 -225.81188 -190.81188 -229.81188 -245.81188 -284.81188
intubados_totales       -54.99010  -51.990099  -69.990099  -81.99010  -87.99010 -116.99010 -127.99010 -128.99010  -80.99010  -75.99010 -112.99010 -138.99010
intubados_cdmx          -84.24752  -75.247525  -66.247525  -55.24752  -61.24752  -76.24752  -91.24752  -90.24752  -57.24752  -49.24752  -71.24752  -86.24752
intubados_edomex         28.72277   22.722772   -4.277228  -27.27723  -27.27723  -41.27723  -37.27723  -39.27723  -24.27723  -27.27723  -42.27723  -53.27723
                            [,63]      [,64]      [,65]      [,66]      [,67]      [,68]      [,69]      [,70]      [,71]      [,72]      [,73]      [,74]
Mes                      9.00000    9.00000   10.00000   10.00000   10.00000   10.00000   10.00000   10.00000   10.00000   10.00000   10.00000   10.00000
dia                     26.00000   28.00000    1.00000    2.00000    3.00000    7.00000   11.00000   14.00000   20.00000   23.00000   25.00000   29.00000
hospitalizados_totales -756.14851 -718.14851 -688.14851 -694.14851 -740.14851 -646.14851 -666.14851 -539.14851 -387.14851 -396.14851 -378.14851 -263.14851
hospitalizados_cdmx    -453.33663 -412.33663 -407.33663 -401.33663 -443.33663 -423.33663 -412.33663 -318.33663 -257.33663 -231.33663 -207.33663 -128.33663
hospitalizados_edomex  -302.81188 -305.81188 -280.81188 -292.81188 -296.81188 -222.81188 -253.81188 -220.81188 -129.81188 -164.81188 -170.81188 -134.81188
intubados_totales      -158.99010 -138.99010 -156.99010 -152.99010 -163.99010 -143.99010 -125.99010 -115.99010 -100.99010  -57.99010  -65.99010  -52.99010
intubados_cdmx         -102.24752  -82.24752 -103.24752  -92.24752  -97.24752  -92.24752  -74.24752  -61.24752  -60.24752  -17.24752  -25.24752  -38.24752
intubados_edomex        -57.27723  -57.27723  -54.27723  -61.27723  -67.27723  -52.27723  -52.27723  -55.27723  -41.27723  -41.27723  -41.27723  -15.27723
                            [,75]      [,76]      [,77]      [,78]      [,79]      [,80]      [,81]      [,82]      [,83]      [,84]      [,85]      [,86]
Mes                     11.00000   11.00000   11.00000   11.000000  11.00000   11.00000   11.000000  11.000000  11.000000  11.00000   12.00000   12.00000
dia                      1.00000    2.00000    6.00000    9.000000  11.00000   16.00000   17.000000  18.000000  20.000000  30.00000    2.00000    4.00000
hospitalizados_totales -350.14851 -342.14851 -302.14851 -178.148515  90.85149 261.85149 338.851485 442.851485 460.851485 1018.85149 1185.85149 1329.85149
hospitalizados_cdmx    -155.33663 -147.33663 -117.33663  -39.336634 140.66337 323.66337 337.663366 401.663366 431.663366  817.66337  891.66337  965.66337
hospitalizados_edomex  -194.81188 -194.81188 -184.81188 -138.811881 -49.81188 -61.81188   1.188119  41.188119  29.188119  201.18812  294.18812  364.18812
intubados_totales       -49.99010  -69.99010  -70.99010  -27.990099  15.00990  76.00990  50.009901  75.009901 104.009901  180.00990  194.00990  202.00990
intubados_cdmx          -19.24752  -30.24752  -45.24752    9.752475  41.75248  88.75248  66.752475  83.752475 101.752475  146.75248  158.75248  169.75248
intubados_edomex        -31.27723  -40.27723  -26.27723  -38.277228 -27.27723 -13.27723 -17.277228  -9.277228   1.722772   32.72277   34.72277   31.72277
                            [,87]      [,88]      [,89]      [,90]      [,91]      [,92]      [,93]      [,94]      [,95]      [,96]      [,97]      [,98]
```

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Mes                    12.00000   12.00000   12.0000   12.0000   12.0000   12.0000   12.0000   12.0000   12.0000   12.0000   12.0000
dia                     8.00000   15.00000   24.0000   28.0000   31.0000    1.0000    4.0000    5.0000    6.0000   24.0000   29.0000   30.0000
hospitalizados_totales 1725.85149 2610.85149 3535.8515 3708.8515 4148.8515 4193.8515 4392.8515 4406.8515 4515.8515 -4088.1485 -3880.1485 -3814.1485
hospitalizados_cdmx    1215.66337 1824.66337 2493.6634 2553.6634 2857.6634 2935.6634 3061.6634 3076.6634 3176.6634 -2959.3366 -2751.3366 -2708.3366
hospitalizados_edomex   510.18812  786.18812 1042.1881 1155.1881 1291.1881 1258.1881 1331.1881 1330.1881 1339.1881 -1128.8119 -1128.8119 -1105.8119
intubados_totales       233.00990  467.00990  898.0099  984.0099 1061.0099 1134.0099 1126.0099 1109.0099 1093.0099  -948.9901  -903.9901  -878.9901
intubados_cdmx          191.75248  381.75248  712.7525  738.7525  785.7525  855.7525  864.7525  820.7525  819.7525  -722.2475  -677.2475  -657.2475
intubados_edomex         40.72277   84.72277  184.7228  244.7228  274.7228  277.7228  260.7228  287.7228  272.7228  -227.2772  -227.2772  -222.2772
                           [,99]     [,100]     [,101]
Mes                      12.0000    12.0000    12.0000
dia                      31.0000     2.0000     6.0000
hospitalizados_totales -3810.1485 -3745.1485 -3542.1485
hospitalizados_cdmx    -2696.3366 -2648.3366 -2450.3366
hospitalizados_edomex  -1113.8119 -1096.8119 -1091.8119
intubados_totales       -865.9901  -844.9901  -805.9901
intubados_cdmx          -643.2475  -625.2475  -590.2475
intubados_edomex        -223.2772  -220.2772  -216.2772
>
> # Se multiplican los componentes principales por los datos nomalizados (Transpuestos)
> pc_scores<- t_eigenvectors %*% t_datos_Centrados
> pc_scores
             [,1]          [,2]          [,3]          [,4]          [,5]          [,6]          [,7]          [,8]          [,9]          [,10]
[1,] -5.239326e+03 -5.206276e+03 -5.138860e+03 -5.025348e+03 -4.849300e+03 -3.944357e+03 -3.464529e+03 -3.363308e+03 -3.134438e+03 -2.879938e+03
[2,] -1.386200e+02 -1.275779e+02 -1.051900e+02 -7.254331e+01 -4.190754e+01 -5.271416e+01 -1.014337e+01 -6.512199e+01 -4.890223e+01  4.842603e+00
[3,] -7.452757e+00 -5.767430e+00 -2.833563e+00 -1.465520e+01  1.197389e+01  4.297187e+01  6.000876e+01  1.155897e+02  1.080864e+02  1.439322e+02
[4,]  5.513566e+00  3.889238e+00  6.643546e-01 -1.153474e+00 -9.894876e+00 -2.112221e+00 -9.406101e+00  2.173834e+01  1.269444e+01 -8.319704e+00
[5,] -2.058488e+01 -2.172401e+01 -2.301420e+01 -2.465345e+01  2.182460e+00 -6.552388e+00 -1.112447e+01 -1.020340e+01 -1.176265e+01 -1.326450e+01
[6,]  2.930499e+00  2.976175e+00  3.007456e+00  2.855224e+00  1.780341e+00  2.339285e+00  2.608385e+00  2.606262e+00  2.727859e+00  3.215616e+00
[7,]  6.739034e+00  6.559921e+00  6.178043e+00  5.595302e+00  5.554153e+00  5.905958e+00  5.157418e+00  6.710855e+00  6.249833e+00  5.179644e+00
[8,] -3.285714e-11 -3.425630e-11 -3.682726e-11 -3.962558e-11  2.378703e-12 -1.156604e-11 -1.920089e-11 -1.666527e-11 -1.945725e-11 -2.324282e-11
            [,11]         [,12]         [,13]         [,14]         [,15]         [,16]         [,17]         [,18]         [,19]         [,20]
```

```
[1,] -2.647756e+03 -2.465287e+03 -2.349315e+03 -2.053007e+03 -1.777361e+03 -5.142720e+01  1.031490e+03  9.471203e+02  1.330529e+03  1.594516e+03
[2,]  1.716761e+01  2.690050e+01  9.976525e+00  2.636539e+01  5.164359e+01 -8.224689e+01 -2.354578e+02 -1.554562e+02 -2.070897e+02 -1.882181e+02
[3,]  1.190511e+02  1.331852e+02  1.154001e+02  1.024843e+02  2.838902e+01  1.100069e+02  4.426746e+00  3.990872e+01  2.719202e+01 -2.806463e+01
[4,] -6.151599e+00 -1.167391e+01 -1.882710e+01 -3.168793e+01 -2.479140e+01 -6.550572e+01 -7.678888e+01 -6.184257e+01 -4.191732e+01 -5.550845e+01
[5,] -1.487997e+01 -1.594824e+01 -1.720674e+01 -1.894729e+01 -2.242770e+01 -2.973490e+01 -3.847182e+00 -5.913399e+00 -7.420702e+00 -1.084550e+01
[6,]  2.987690e+00  3.207522e+00  3.390498e+00  3.560167e+00  2.885963e+00 -2.514253e+01  4.516414e+00  4.115585e+00  3.945348e+00  3.893484e+00
[7,]  4.894192e+00  4.683301e+00  4.746771e+00  4.184113e+00  3.597554e+00  1.120399e+01  7.037345e+00  6.250546e+00  7.259392e+00  6.510527e+00
[8,] -2.548203e-11 -2.757917e-11 -2.957764e-11 -3.281403e-11 -3.793651e-11  3.352257e-12 -7.461781e-12 -1.109640e-11 -1.236509e-11 -1.804267e-11
            [,21]         [,22]         [,23]         [,24]         [,25]         [,26]         [,27]         [,28]         [,29]         [,30]
[1,]  2.169877e+03  2.290328e+03  2.907548e+03  2.802955e+03  2.672999e+03  2.730964e+03  2.833006e+03  2.901049e+03  2.750363e+03  2.518267e+03
[2,] -1.907731e+02 -2.077447e+02 -1.056226e+02 -1.095621e+02 -1.015879e+02 -9.021397e+01 -1.334802e+02 -2.139744e+02 -1.955717e+02 -1.292587e+02
[3,] -4.979510e+01 -6.311569e+01 -4.924350e+01 -2.394116e+01 -5.327215e+01 -7.686682e+00  3.301614e+01 -4.598334e+01 -3.511206e+01 -8.103582e+01
[4,] -1.130026e+01 -1.849156e+01 -4.460709e+01  1.836645e+01  4.084108e+00  1.731577e+01  3.556871e+01  2.673733e+01  1.744754e+01  1.243776e+01
[5,] -1.476809e+01 -1.595906e+01 -2.161537e+01 -2.613486e+01 -2.883471e+01 -3.007116e+01 -1.725058e+00 -5.224803e+00 -7.323986e+00 -1.473784e+01
[6,]  2.967355e+00  3.180979e+00  3.547085e+00  2.641377e+00  2.842463e+00  2.895854e+00  1.683292e+00  1.934741e+00  2.236737e+00  2.041235e+00
[7,]  7.121701e+00  7.201238e+00  5.191348e+00  6.506298e+00  6.105125e+00  6.342599e+00  7.941918e+00  8.761166e+00  8.440635e+00  7.331112e+00
[8,] -2.265580e-11 -2.459360e-11 -3.513495e-11 -4.053554e-11 -4.517892e-11 -4.706602e-11 -1.253976e-12 -6.180469e-12 -9.890280e-12 -2.215051e-11
            [,31]         [,32]         [,33]         [,34]         [,35]         [,36]         [,37]         [,38]         [,39]         [,40]
[1,]  2.423896e+03  2.122293e+03  2.037073e+03  1.471271e+03  1.467440e+03  1.480464e+03  1.225573e+03  1.117132e+03  8.478193e+02  7.768433e+02
[2,] -1.295898e+02 -9.545747e+01 -1.043971e+02 -2.926532e+01 -1.222269e+01  4.296054e+00 -2.284220e+01 -3.825500e+01 -3.030985e+01 -5.272165e+01
[3,] -8.026831e+01 -1.065129e+02 -7.062026e+01  3.651775e+01  1.799032e+01 -2.465695e+01 -1.244710e+01  1.827223e+01  1.240117e+01 -1.576177e+01
[4,]  5.010467e+00  7.578507e+00  7.337274e+00  1.382969e+01  1.935612e+01  1.943872e+01  2.139125e+01  5.356863e+01  4.936858e+01  5.250156e+01
[5,] -1.578638e+01 -2.037826e+01 -2.067297e+01 -2.743204e+01 -2.882511e+01 -3.068341e+01 -3.030704e+00 -2.818557e+00 -8.915598e+00 -1.401176e+01
[6,]  2.273562e+00  2.093508e+00  2.440177e+00  3.073272e+00  2.792851e+00  2.477879e+00  1.371174e+00  9.827725e-01  1.334844e+00  1.468582e+00
[7,]  7.257627e+00  6.819913e+00  7.127040e+00  6.768873e+00  6.546674e+00  6.147523e+00  7.210591e+00  8.131989e+00  8.088321e+00  8.478225e+00
[8,] -2.414995e-11 -3.152578e-11 -3.207110e-11 -4.370060e-11 -4.579730e-11 -4.872565e-11 -4.742667e-12 -3.427171e-12 -1.326416e-11 -2.090538e-11
            [,41]         [,42]         [,43]         [,44]         [,45]         [,46]         [,47]         [,48]         [,49]         [,50]
[1,]  6.579357e+02  7.359234e+02  6.170914e+02  4.984033e+02  2.290334e+02  1.203241e+02 -1.946274e+01 -8.082787e+01 -1.776021e+02 -2.311192e+02
[2,]  2.410398e+01 -2.079958e+00  7.529406e+01  2.878029e+01  9.496607e+01  8.043795e+01  4.166847e+01  3.572496e+01 -2.065640e+01 -1.077243e+02
[3,] -3.042331e+01 -8.569415e+01  1.104331e+01  4.401052e+01  2.931346e+01  1.143981e+01  6.428468e+01  4.972897e+01  1.331547e+01  3.274203e+01
[4,]  4.823309e+01  6.408955e+01  5.278176e+01  4.921481e+01  3.457215e+01  3.152659e+01  5.019321e+01  6.054093e+01  5.119089e+01  5.615685e+01
[5,] -2.110218e+01 -2.346546e+01 -2.992480e+01 -2.987622e+01 -4.944361e+00 -7.048207e+00 -7.418173e+00 -8.385199e+00 -9.413584e+00 -1.002097e+01
[6,]  1.407345e+00  9.235104e-01  1.813720e+00  2.409621e+00  1.077403e+00  1.214803e+00  1.454868e+00  1.210733e+00  1.526972e+00  2.100949e+00
[7,]  7.312635e+00  7.776887e+00  6.930208e+00  7.753387e+00  7.038941e+00  7.203504e+00  8.369981e+00  8.606284e+00  9.215771e+00  1.074770e+01
[8,] -3.285743e-11 -3.562607e-11 -4.728894e-11 -4.717264e-11 -8.652605e-12 -1.188249e-11 -1.183638e-11 -1.292287e-11 -1.421526e-11 -1.439573e-11
            [,51]         [,52]         [,53]         [,54]         [,55]         [,56]         [,57]         [,58]         [,59]         [,60]
```

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[1,] -1.968913e+02 -1.855655e+02 -5.071557e+02 -3.608967e+02 -3.267950e+02 -3.635196e+02 -4.656130e+02 -5.138362e+02 -3.794311e+02 -6.541315e+02
[2,] -5.226882e+01 -6.480511e+01 -1.603719e+01  4.577387e+01  1.351805e+02  8.790042e+01  1.075076e+02  1.149209e+02  1.181735e+02  1.066668e+02
[3,] -3.072100e+01 -2.169312e+01  2.533791e+01 -3.861530e+01 -8.730512e+01 -9.880263e+01 -9.931418e+01 -9.071173e+01 -5.941663e+01  2.030930e+01
[4,]  5.209279e+01  4.108916e+01  1.717173e+01 -1.666176e+00  1.231298e+01 -3.224752e+00  8.864338e+00  7.533582e+00  1.181826e+01  4.559343e+00
[5,] -1.671382e+01 -1.760648e+01 -2.161557e+01 -2.567970e+01 -3.254516e+00 -4.122566e+00 -5.108915e+00 -7.050238e+00 -1.259256e+01 -2.017018e+01
[6,]  1.761858e+00  2.190102e+00  3.022132e+00  2.814143e+00  5.917257e-01  1.165547e+00  8.452636e-01  1.005776e+00  1.426949e+00  2.681649e+00
[7,]  9.671676e+00  9.732429e+00  8.922809e+00  7.427582e+00  6.659267e+00  7.109465e+00  7.047437e+00  6.991663e+00  7.203933e+00  7.787256e+00
[8,] -2.527217e-11 -2.698262e-11 -3.476255e-11 -4.196792e-11 -6.516979e-12 -7.925835e-12 -9.283703e-12 -1.250174e-11 -2.135066e-11 -3.390523e-11
            [,61]       [,62]       [,63]       [,64]       [,65]       [,66]       [,67]       [,68]       [,69]       [,70]
[1,] -6.711397e+02 -8.229481e+02 -9.470230e+02 -8.899287e+02 -8.638340e+02 -8.662357e+02 -9.284517e+02 -8.224739e+02 -8.338054e+02 -6.733297e+02
[2,]  1.111615e+02  1.166411e+02  1.035534e+02  1.280558e+02  9.590341e+01  1.134150e+02  1.015636e+02  4.020062e+01  8.223703e+01  8.328363e+01
[3,] -2.552104e+01 -2.437889e+01 -1.786129e+01 -1.013936e+01 -3.410399e+01 -3.021804e+01 -2.464089e+01 -6.094170e+00  9.142498e+00 -1.364082e+01
[4,] -2.374983e+00 -7.540131e+00 -7.780037e+00 -1.139613e+01 -5.890826e+00 -1.447548e+01 -2.045962e+01 -1.528327e+01 -1.573494e+01 -2.319034e+01
[5,] -2.403329e+01 -2.607480e+01 -2.676254e+01 -2.900083e+01 -1.950764e+00 -3.217610e+00 -4.055577e+00 -7.043951e+00 -1.127424e+01 -1.483874e+01
[6,]  2.676911e+00  2.887103e+00  3.060849e+00  3.177240e+00  1.768896e+00  1.954556e+00  2.244396e+00  2.782379e+00  2.898843e+00  3.072433e+00
[7,]  7.486864e+00  7.394158e+00  7.661836e+00  7.279430e+00  8.272245e+00  7.897484e+00  8.034130e+00  9.170642e+00  8.652068e+00  8.441466e+00
[8,] -4.007723e-11 -4.348606e-11 -4.453744e-11 -4.842355e-11 -5.066252e-12 -7.519345e-12 -8.928551e-12 -1.314977e-11 -2.023978e-11 -2.597832e-11
            [,71]       [,72]       [,73]       [,74]       [,75]       [,76]       [,77]       [,78]       [,79]       [,80]
[1,] -4.976185e+02 -4.855755e+02 -4.624838e+02 -3.202968e+02 -4.141965e+02 -4.090190e+02 -3.609084e+02 -1.974814e+02  1.417752e+02  3.881556e+02
[2,]  1.524876e+01  7.756929e+01  8.660159e+01  7.286741e+01  1.301223e+02  1.256331e+02  1.198629e+02  1.221073e+02  1.052774e+02  1.954972e+02
[3,] -1.670816e+01  2.338664e+01  2.630206e+00 -2.001168e+01 -5.256897e+00 -3.068656e+01 -4.855182e+01 -1.850085e+01 -3.556102e+01 -4.168265e+01
[4,] -1.852605e+01 -2.497899e+01 -2.089362e+01  8.403644e+00 -7.231101e+00 -1.317089e+01  5.673912e+00 -2.555907e+01 -2.788152e+01 -1.758196e+01
[5,] -2.013241e+01 -2.330842e+01 -2.568132e+01 -2.949617e+01 -2.112589e+00 -3.553887e+00 -7.496315e+00 -1.061697e+01 -1.290611e+01 -1.898076e+01
[6,]  3.621118e+00  3.879079e+00  3.711956e+00  3.185078e+00  2.002442e+00  2.046065e+00  1.749115e+00  2.806016e+00  2.933661e+00  2.466807e+00
[7,]  9.607274e+00  8.752831e+00  8.631882e+00  9.269702e+00  8.711107e+00  8.601791e+00  8.987870e+00  8.571314e+00  8.679326e+00  7.475503e+00
[8,] -3.366693e-11 -3.964602e-11 -4.323875e-11 -4.810109e-11 -5.775467e-12 -8.088860e-12 -1.359797e-11 -1.969551e-11 -2.314899e-11 -3.312995e-11
            [,81]       [,82]       [,83]       [,84]       [,85]       [,86]       [,87]       [,88]       [,89]       [,90]
[1,]  4.626451e+02  5.943406e+02  6.296666e+02  1.332520e+03  1.528113e+03  1.699033e+03  2.184587e+03  3.333564e+03  4.596923e+03  4.811372e+03
[2,]  1.269206e+02  1.161842e+02  1.471807e+02  1.193812e+02  5.678329e+01  1.493664e+01 -4.212137e+01 -3.424593e+01  8.791228e+01  1.806873e+01
[3,] -7.305610e+01 -6.751373e+01 -4.853061e+01 -1.099026e+02 -1.157982e+02 -1.292059e+02 -1.848251e+02 -1.355170e+02  1.156151e+02  1.883922e+02
[4,] -2.339237e+01 -2.266358e+01 -1.343564e+01 -1.300252e+00 -1.263954e+01 -2.532384e+01 -3.171033e+01 -5.238727e+01 -4.954760e+01 -6.930162e+00
[5,] -1.982787e+01 -2.067662e+01 -2.260099e+01 -3.341654e+01 -5.092166e+00 -7.114718e+00 -1.169202e+01 -1.892264e+01 -2.597112e+01 -2.749070e+01
[6,]  2.794771e+00  2.922014e+00  2.789446e+00  2.783283e+00  1.973490e+00  2.492288e+00  2.768714e+00  3.882418e+00  5.325381e+00  5.416159e+00
[7,]  8.307451e+00  8.490476e+00  8.266914e+00  8.662447e+00  9.855969e+00  1.023057e+01  1.073924e+01  1.031779e+01  9.313404e+00  1.137212e+01
[8,] -3.394677e-11 -3.516966e-11 -3.824552e-11 -5.438624e-11 -9.424519e-12 -1.263998e-11 -1.926527e-11 -3.137287e-11 -4.492371e-11 -4.580202e-11
            [,91]       [,92]       [,93]       [,94]       [,95]       [,96]       [,97]       [,98]       [,99]      [,100]
```

```
[1,]  5.370237e+03  5.461742e+03  5.700475e+03  5.711697e+03  5.848878e+03 -5.309921e+03 -5.022190e+03 -4.935078e+03 -4.923290e+03 -4.836696e+03
[2,]  2.203258e+00  9.161936e+01  5.870252e+01  4.764789e+01  6.510174e+01 -1.517094e+02 -6.924013e+01 -6.863367e+01 -5.079134e+01 -4.385080e+01
[3,]  1.597100e+02  2.143954e+02  1.641132e+02  1.266794e+02  7.048801e+01  2.324760e+01 -7.533240e+00  6.323512e+00  1.729869e+01  2.368269e+01
[4,]  5.021649e+00 -4.710477e+00 -2.976437e+01  1.177150e+01 -8.067141e-01  1.468146e+00 -2.914749e+00 -4.735661e+00 -8.196913e+00 -1.102411e+01
[5,] -3.086530e+01 -1.255299e+00 -5.182154e+00 -6.004402e+00 -8.346952e+00 -1.872759e+01 -2.535069e+01 -2.621306e+01 -2.730056e+01  1.592553e+00
[6,]  5.188171e+00  3.660151e+00  4.222003e+00  3.143867e+00  3.018061e+00  5.017805e+00  4.758565e+00  4.941714e+00  5.056351e+00  3.528915e+00
[7,]  1.161946e+01  9.759580e+00  9.656407e+00  1.037576e+01  9.674272e+00  1.581013e+01  1.438084e+01  1.439138e+01  1.411894e+01  1.346525e+01
[8,] -5.052267e-11 -4.306818e-12 -1.102794e-11 -1.061020e-11 -1.510155e-11 -2.992456e-11 -4.146785e-11 -4.232079e-11 -4.472115e-11  6.732876e-13
           [,101]
[1,] -4.559263e+03
[2,]  2.672217e+01
[3,] -1.142068e+01
[4,] -9.464090e+00
[5,] -3.868079e+00
[6,]  3.112492e+00
[7,]  1.228321e+01
[8,] -8.154547e-12
> rownames(pc_scores) <- c("PC 1", "PC 2", "PC 3", "PC 4", "PC 5", "PC 6", "PC 7", "PC 8")
> pc_scores
            [,1]        [,2]        [,3]        [,4]        [,5]        [,6]        [,7]        [,8]        [,9]       [,10]
PC 1 -5.239326e+03 -5.206276e+03 -5.138860e+03 -5.025348e+03 -4.849300e+03 -3.944357e+03 -3.464529e+03 -3.363308e+03 -3.134438e+03 -2.879938e+03
PC 2 -1.386200e+02 -1.275779e+02 -1.051900e+02 -7.254331e+01 -4.190754e+01 -5.271416e+01 -1.014337e+01 -6.512199e+01 -4.890223e+01  4.842603e+00
PC 3 -7.452757e+00 -5.767430e+00 -2.833563e+00 -1.465520e+01  1.197389e+01  4.297187e+01  6.000876e+01  1.155897e+02  1.080864e+02  1.439322e+02
PC 4  5.513566e+00  3.889238e+00  6.643546e-01 -1.153474e+00 -9.894876e+00 -2.112221e+00 -9.406101e+00  2.173834e+01  1.269444e+01 -8.319704e+00
PC 5 -2.058488e+01 -2.172401e+01 -2.301420e+01 -2.465345e+01  2.182460e+00 -6.552388e+00 -1.112447e+01 -1.020340e+01 -1.176265e+01 -1.326450e+01
PC 6  2.930499e+00  2.976175e+00  3.007456e+00  2.855224e+00  1.780341e+00  2.339285e+00  2.608385e+00  2.606262e+00  2.727859e+00  3.215616e+00
PC 7  6.739034e+00  6.559921e+00  6.178043e+00  5.595302e+00  5.554153e+00  5.905958e+00  5.157418e+00  6.710855e+00  6.249833e+00  5.179644e+00
PC 8 -3.285714e-11 -3.425630e-11 -3.682726e-11 -3.962558e-11  2.378703e-12 -1.156604e-11 -1.920089e-11 -1.666527e-11 -1.945725e-11 -2.324282e-11
            [,11]       [,12]       [,13]       [,14]       [,15]       [,16]       [,17]       [,18]       [,19]       [,20]
```

```
PC 1 -2.647756e+03 -2.465287e+03 -2.349315e+03 -2.053007e+03 -1.777361e+03 -5.142720e+01  1.031490e+03  9.471203e+02  1.330529e+03  1.594516e+03
PC 2  1.716761e+01  2.690050e+01  9.976525e+00  2.636539e+01  5.164359e+01 -8.224689e+01 -2.354578e+02 -1.554562e+02 -2.070897e+02 -1.882181e+02
PC 3  1.190511e+02  1.331852e+02  1.154001e+02  1.024843e+02  2.838902e+01  1.100069e+02  4.426746e+00  3.990872e+01  2.719202e+01 -2.806463e+01
PC 4 -6.151599e+00 -1.167391e+01 -1.882710e+01 -3.168793e+01 -2.479140e+01 -6.550572e+01 -7.678888e+01 -6.184257e+01 -4.191732e+01 -5.550845e+01
PC 5 -1.487997e+01 -1.594824e+01 -1.720674e+01 -1.894729e+01 -2.242770e+01 -2.973490e+01 -3.847182e+00 -5.913399e+00 -7.420702e+00 -1.084550e+01
PC 6  2.987690e+00  3.207522e+00  3.390498e+00  3.560167e+00  2.885963e+00 -2.514253e+01  4.516414e+00  4.115585e+00  3.945348e+00  3.893484e+00
PC 7  4.894192e+00  4.683301e+00  4.746771e+00  4.184113e+00  3.597554e+00  1.120399e+01  7.037345e+00  6.250546e+00  7.259392e+00  6.510527e+00
PC 8 -2.548203e-11 -2.757917e-11 -2.957764e-11 -3.281403e-11 -3.793651e-11  3.352257e-12 -7.461781e-12 -1.109640e-11 -1.236509e-11 -1.804267e-11
            [,21]       [,22]       [,23]       [,24]       [,25]       [,26]       [,27]       [,28]       [,29]       [,30]
PC 1  2.169877e+03  2.290328e+03  2.907548e+03  2.802955e+03  2.672999e+03  2.730964e+03  2.833006e+03  2.901049e+03  2.750363e+03  2.518267e+03
PC 2 -1.907731e+02 -2.077447e+02 -1.056226e+02 -1.095621e+02 -1.015879e+02 -9.021397e+01 -1.334802e+02 -2.139744e+02 -1.955717e+02 -1.292587e+02
PC 3 -4.979510e+01 -6.311569e+01 -4.924350e+01 -2.394116e+01 -5.327215e+01 -7.686682e+00  3.301614e+01 -4.598334e+01 -3.511206e+01 -8.103582e+01
PC 4 -1.130026e+01 -1.849156e+01 -4.460709e+01  1.836645e+01  4.084108e+00  1.731577e+01  3.556871e+01  2.673733e+01  1.744754e+01  1.243776e+01
PC 5 -1.476809e+01 -1.595906e+01 -2.161537e+01 -2.613486e+01 -2.883471e+01 -3.007116e+01 -1.725058e+00 -5.224803e+00 -7.323986e+00 -1.473784e+01
PC 6  2.967355e+00  3.180979e+00  3.547085e+00  2.641377e+00  2.842463e+00  2.895854e+00  1.683292e+00  1.934741e+00  2.236737e+00  2.041235e+00
PC 7  7.121701e+00  7.201238e+00  5.191348e+00  6.506298e+00  6.105125e+00  6.342599e+00  7.941918e+00  8.761166e+00  8.440635e+00  7.331112e+00
PC 8 -2.265580e-11 -2.459360e-11 -3.513495e-11 -4.053554e-11 -4.517892e-11 -4.706602e-11 -1.253976e-12 -6.180469e-12 -9.890280e-12 -2.215051e-11
            [,31]       [,32]       [,33]       [,34]       [,35]       [,36]       [,37]       [,38]       [,39]       [,40]
PC 1  2.423896e+03  2.122293e+03  2.037073e+03  1.471271e+03  1.467440e+03  1.480464e+03  1.225573e+03  1.117132e+03  8.478193e+02  7.768433e+02
PC 2 -1.295898e+02 -9.545747e+01 -1.043971e+02 -2.926532e+01 -1.222269e+01  4.296054e+00 -2.284220e+01 -3.825500e+01 -3.030985e+01 -5.272165e+01
PC 3 -8.026831e+01 -1.065129e+02 -7.062026e+01  3.651775e+01  1.799032e+01 -2.465695e+01 -1.244710e+01  1.827223e+01  1.240117e+01 -1.576177e+01
PC 4  5.010467e+00  7.578507e+00  7.337274e+00  1.382969e+01  1.935612e+01  1.943872e+01  2.139125e+01  5.356863e+01  4.936858e+01  5.250156e+01
PC 5 -1.578638e+01 -2.037826e+01 -2.067297e+01 -2.743204e+01 -2.882511e+01 -3.068341e+01 -3.030704e+00 -2.818557e+00 -8.915598e+00 -1.401176e+01
PC 6  2.273562e+00  2.093508e+00  2.440177e+00  3.073272e+00  2.792851e+00  2.477879e+00  1.371174e+00  9.827725e-01  1.334844e+00  1.468582e+00
PC 7  7.257627e+00  6.819913e+00  7.127040e+00  6.768873e+00  6.546674e+00  6.147523e+00  7.210591e+00  8.131989e+00  8.088321e+00  8.478225e+00
PC 8 -2.414995e-11 -3.152578e-11 -3.207110e-11 -4.370060e-11 -4.579730e-11 -4.872565e-11 -4.742667e-12 -3.427171e-12 -1.326416e-11 -2.090538e-11
            [,41]       [,42]       [,43]       [,44]       [,45]       [,46]       [,47]       [,48]       [,49]       [,50]
PC 1  6.579357e+02  7.359234e+02  6.170914e+02  4.984033e+02  2.290334e+02  1.203241e+02 -1.946274e+01 -8.082787e+01 -1.776021e+02 -2.311192e+02
PC 2  2.410398e+01 -2.079958e+00  7.529406e+01  2.878029e+01  9.496607e+01  8.043795e+01  4.166847e+01  3.572496e+01 -2.065640e+01 -1.077243e+02
PC 3 -3.042331e+01 -8.569415e+01  1.104331e+01  4.401052e+01  2.931346e+01  1.143981e+01  6.428468e+01  4.972897e+01  1.331547e+01  3.274203e+01
PC 4  4.823309e+01  6.408955e+01  5.278176e+01  4.921481e+01  3.457215e+01  3.152659e+01  5.019321e+01  6.054093e+01  5.119089e+01  5.615685e+01
PC 5 -2.110218e+01 -2.346546e+01 -2.992480e+01 -2.987622e+01 -4.944361e+00 -7.048207e+00 -7.418173e+00 -8.385199e+00 -9.413584e+00 -1.002097e+01
PC 6  1.407345e+00  9.235104e-01  1.813720e+00  2.409621e+00  1.077403e+00  1.214803e+00  1.454868e+00  1.210733e+00  1.526972e+00  2.100949e+00
PC 7  7.312635e+00  7.776887e+00  6.930208e+00  7.753387e+00  7.038941e+00  7.203504e+00  8.369981e+00  8.606284e+00  9.215771e+00  1.074770e+01
PC 8 -3.285743e-11 -3.562607e-11 -4.728894e-11 -4.717264e-11 -8.652605e-12 -1.188249e-11 -1.183638e-11 -1.292287e-11 -1.421526e-11 -1.439573e-11
            [,51]       [,52]       [,53]       [,54]       [,55]       [,56]       [,57]       [,58]       [,59]       [,60]
```

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PC 1 -1.968913e+02 -1.855655e+02 -5.071557e+02 -3.608967e+02 -3.267950e+02 -3.635196e+02 -4.656130e+02 -5.138362e+02 -3.794311e+02 -6.541315e+02
PC 2 -5.226882e+01 -6.480511e+01 -1.603719e+01  4.577387e+01  1.351805e+02  8.790042e+01  1.075076e+02  1.149209e+02  1.181735e+02  1.066668e+02
PC 3 -3.072100e+01 -2.169312e+01  2.533791e+01 -3.861530e+01 -8.730512e+01 -9.880263e+01 -9.931418e+01 -9.071173e+01 -5.941663e+01  2.030930e+01
PC 4  5.209279e+01  4.108916e+01  1.717173e+01 -1.666176e+00  1.231298e+01 -3.224752e+00  8.864338e+00  7.533582e+00  1.181826e+01  4.559343e+00
PC 5 -1.671382e+01 -1.760648e+01 -2.161557e+01 -2.567970e+01 -3.254516e+00 -4.122566e+00 -5.108915e+00 -7.050238e+00 -1.259256e+01 -2.017018e+01
PC 6  1.761858e+00  2.190102e+00  3.022132e+00  2.814143e+00  5.917257e-01  1.165547e+00  8.452636e-01  1.005776e+00  1.426949e+00  2.681649e+00
PC 7  9.671676e+00  9.732429e+00  8.922809e+00  7.427582e+00  6.659267e+00  7.109465e+00  7.047437e+00  6.991663e+00  7.203933e+00  7.787256e+00
PC 8 -2.527217e-11 -2.698262e-11 -3.476255e-11 -4.196792e-11 -6.516979e-12 -7.925835e-12 -9.283703e-12 -1.250174e-11 -2.135066e-11 -3.390523e-11
            [,61]         [,62]         [,63]         [,64]         [,65]         [,66]         [,67]         [,68]         [,69]         [,70]
PC 1 -6.711397e+02 -8.229481e+02 -9.470230e+02 -8.899287e+02 -8.638340e+02 -8.662357e+02 -9.284517e+02 -8.224739e+02 -8.338054e+02 -6.733297e+02
PC 2  1.111615e+02  1.166411e+02  1.035534e+02  1.280558e+02  9.590341e+01  1.134150e+02  1.015636e+02  4.020062e+01  8.223703e+01  8.328363e+01
PC 3 -2.552104e+01 -2.437889e+01 -1.786129e+01 -1.013936e+01 -3.410399e+01 -3.021804e+01 -2.464089e+01 -6.094170e+00  9.142498e+00 -1.364082e+01
PC 4 -2.374983e+00 -7.540131e+00 -7.780037e+00 -1.139613e+01 -5.890826e+00 -1.447548e+01 -2.045962e+01 -1.528327e+01 -1.573494e+01 -2.319034e+01
PC 5 -2.403329e+01 -2.607480e+01 -2.676254e+01 -2.900083e+01 -1.950764e+00 -3.217610e+00 -4.055577e+00 -7.043951e+00 -1.127424e+01 -1.483874e+01
PC 6  2.676911e+00  2.887103e+00  3.060849e+00  3.177240e+00  1.768896e+00  1.954556e+00  2.244396e+00  2.782379e+00  2.898843e+00  3.072433e+00
PC 7  7.486864e+00  7.394158e+00  7.661836e+00  7.279430e+00  8.272245e+00  7.897484e+00  8.034130e+00  9.170642e+00  8.652068e+00  8.441466e+00
PC 8 -4.007723e-11 -4.348606e-11 -4.453744e-11 -4.842355e-11 -5.066252e-12 -7.519345e-12 -8.928551e-12 -1.314977e-11 -2.023978e-11 -2.597832e-11
            [,71]         [,72]         [,73]         [,74]         [,75]         [,76]         [,77]         [,78]         [,79]         [,80]
PC 1 -4.976185e+02 -4.855755e+02 -4.624838e+02 -3.202968e+02 -4.141965e+02 -4.090190e+02 -3.609084e+02 -1.974814e+02  1.417752e+02  3.881556e+02
PC 2  1.524876e+01  7.756929e+01  8.660159e+01  7.286741e+01  1.301223e+02  1.256331e+02  1.198629e+02  1.221073e+02  1.052774e+02  1.954972e+02
PC 3 -1.670816e+01  2.338664e+01  2.630206e+00 -2.001168e+01 -5.256897e+00 -3.068656e+01 -4.855182e+01 -1.850085e+01 -3.556102e+01 -4.168265e+01
PC 4 -1.852605e+01 -2.497899e+01 -2.089362e+01  8.403644e+00 -7.231101e+00 -1.317089e+01  5.673912e+00 -2.555907e+01 -2.788152e+01 -1.758196e+01
PC 5 -2.013241e+01 -2.330842e+01 -2.568132e+01 -2.949617e+01 -2.112589e+00 -3.553887e+00 -7.496315e+00 -1.061697e+01 -1.290611e+01 -1.898076e+01
PC 6  3.621118e+00  3.879079e+00  3.711956e+00  3.185078e+00  2.002442e+00  2.046065e+00  1.749115e+00  2.806016e+00  2.933661e+00  2.466807e+00
PC 7  9.607274e+00  8.752831e+00  8.631882e+00  9.269702e+00  8.711107e+00  8.601791e+00  8.987870e+00  8.571314e+00  8.679326e+00  7.475503e+00
PC 8 -3.366693e-11 -3.964602e-11 -4.323875e-11 -4.810109e-11 -5.775467e-12 -8.088860e-12 -1.359797e-11 -1.969551e-11 -2.314899e-11 -3.312995e-11
            [,81]         [,82]         [,83]         [,84]         [,85]         [,86]         [,87]         [,88]         [,89]         [,90]
PC 1  4.626451e+02  5.943406e+02  6.296666e+02  1.332520e+03  1.528113e+03  1.699033e+03  2.184587e+03  3.333564e+03  4.596923e+03  4.811372e+03
PC 2  1.269206e+02  1.161842e+02  1.471807e+02  1.193812e+02  5.678329e+01  1.493664e+01 -4.212137e+01 -3.424593e+01  8.791228e+01  1.806873e+01
PC 3 -7.305610e+01 -6.751373e+01 -4.853061e+01 -1.099026e+02 -1.157982e+02 -1.292059e+02 -1.848251e+02 -1.355170e+02  1.156151e+02  1.883922e+02
PC 4 -2.339237e+01 -2.266358e+01 -1.343564e+01 -1.300252e+00 -1.263954e+01 -2.532384e+01 -3.171033e+01 -5.238727e+01 -4.954760e+01 -6.930162e+00
PC 5 -1.982787e+01 -2.067662e+01 -2.260099e+01 -3.341654e+01 -5.092166e+00 -7.114718e+00 -1.169202e+01 -1.892264e+01 -2.597112e+01 -2.749070e+01
PC 6  2.794771e+00  2.922014e+00  2.789446e+00  2.783283e+00  1.973490e+00  2.492288e+00  2.768714e+00  3.882418e+00  5.325381e+00  5.416159e+00
PC 7  8.307451e+00  8.490476e+00  8.266914e+00  8.662447e+00  9.855969e+00  1.023057e+01  1.073924e+01  1.031779e+01  9.313404e+00  1.137212e+01
PC 8 -3.394677e-11 -3.516966e-11 -3.824552e-11 -5.438624e-11 -9.424519e-12 -1.263998e-11 -1.926527e-11 -3.137287e-11 -4.492371e-11 -4.580202e-11
            [,91]         [,92]         [,93]         [,94]         [,95]         [,96]         [,97]         [,98]         [,99]        [,100]
```

```
PC 1  5.370237e+03  5.461742e+03  5.700475e+03  5.711697e+03  5.848878e+03 -5.309921e+03 -5.022190e+03 -4.935078e+03 -4.923290e+03 -4.836696e+03
PC 2  2.203258e+00  9.161936e+01  5.870252e+01  4.764789e+01  6.510174e+01 -1.517094e+02 -6.924013e+01 -6.863367e+01 -5.079134e+01 -4.385080e+01
PC 3  1.597100e+02  2.143954e+02  1.641132e+02  1.266794e+02  7.048801e+01  2.324760e+01 -7.533240e+00  6.323512e+00  1.729869e+01  2.368269e+01
PC 4  5.021649e+00 -4.710477e+00 -2.976437e+01  1.177150e+01 -8.067141e-01  1.468146e+00 -2.914749e+00 -4.735661e+00 -8.196913e+00 -1.102411e+01
PC 5 -3.086530e+01 -1.255299e+00 -5.182154e+00 -6.004402e+00 -8.346952e+00 -1.872759e+01 -2.535069e+01 -2.621306e+01 -2.730056e+01  1.592553e+00
PC 6  5.188171e+00  3.660151e+00  4.222003e+00  3.143867e+00  3.018061e+00  5.017805e+00  4.758565e+00  4.941714e+00  5.056351e+00  3.528915e+00
PC 7  1.161946e+01  9.759580e+00  9.656407e+00  1.037576e+01  9.674272e+00  1.581013e+01  1.438084e+01  1.439138e+01  1.411894e+01  1.346525e+01
PC 8 -5.052267e-11 -4.306818e-12 -1.102794e-11 -1.061020e-11 -1.510155e-11 -2.992456e-11 -4.146785e-11 -4.232079e-11 -4.472115e-11  6.732876e-13
           [,101]
PC 1 -4.559263e+03
PC 2  2.672217e+01
PC 3 -1.142068e+01
PC 4 -9.464090e+00
PC 5 -3.868079e+00
PC 6  3.112492e+00
PC 7  1.228321e+01
PC 8 -8.154547e-12
```

```
> #Los transformamos nuevamente para que los datos esten en modo tabla
> t(pc_scores)
              PC 1        PC 2        PC 3        PC 4        PC 5        PC 6      PC 7          PC 8
  [1,] -5239.32580 -138.619994   -7.452757   5.5135663 -20.584881   2.9304994  6.739034 -3.285714e-11
  [2,] -5206.27641 -127.577915   -5.767430   3.8892381 -21.724006   2.9761750  6.559921 -3.425630e-11
  [3,] -5138.86008 -105.189967   -2.833563   0.6643546 -23.014203   3.0074556  6.178043 -3.682726e-11
  [4,] -5025.34757  -72.543310  -14.655198  -1.1534738 -24.653449   2.8552243  5.595302 -3.962558e-11
  [5,] -4849.30040  -41.907544   11.973887  -9.8948758   2.182460   1.7803413  5.554153  2.378703e-12
  [6,] -3944.35729  -52.714163   42.971872  -2.1122212  -6.552388   2.3392854  5.905958 -1.156604e-11
  [7,] -3464.52947  -10.143371   60.008765  -9.4061015 -11.124471   2.6083850  5.157418 -1.920089e-11
  [8,] -3363.30754  -65.121988  115.589658  21.7383377 -10.203403   2.6062620  6.710855 -1.666527e-11
  [9,] -3134.43821  -48.902234  108.086448  12.6944378 -11.762654   2.7278594  6.249833 -1.945725e-11
 [10,] -2879.93803    4.842603  143.932199  -8.3197039 -13.264502   3.2156161  5.179644 -2.324282e-11
 [11,] -2647.75581   17.167610  119.051115  -6.1515987 -14.879969   2.9876904  4.894192 -2.548203e-11
 [12,] -2465.28727   26.900499  133.185198 -11.6739136 -15.948237   3.2075219  4.683301 -2.757917e-11
 [13,] -2349.31538    9.976525  115.400091 -18.8270981 -17.206738   3.3904980  4.746771 -2.957764e-11
 [14,] -2053.00674   26.365390  102.484263 -31.6879288 -18.947289   3.5601668  4.184113 -3.281403e-11
 [15,] -1777.36125   51.643588   28.389021 -24.7913986 -22.427701   2.8859632  3.597554 -3.793651e-11
 [16,]   -51.42720  -82.246886  110.006946 -65.5057157 -29.734904 -25.1425330 11.203992  3.352257e-12
 [17,]  1031.49049 -235.457840    4.426746 -76.7888812  -3.847182   4.5164141  7.037345 -7.461781e-12
 [18,]   947.12033 -155.456185   39.908724 -61.8425691  -5.913399   4.1155852  6.250546 -1.109640e-11
 [19,]  1330.52864 -207.089678   27.192021 -41.9173244  -7.420702   3.9453477  7.259392 -1.236509e-11
 [20,]  1594.51644 -188.218102  -28.064628 -55.5084516 -10.845496   3.8934838  6.510527 -1.804267e-11
 [21,]  2169.87743 -190.773145  -49.795096 -11.3002607 -14.768095   2.9673551  7.121701 -2.265580e-11
 [22,]  2290.32801 -207.744718  -63.115690 -18.4915600 -15.959064   3.1809793  7.201238 -2.459360e-11
 [23,]  2907.54795 -105.622599  -49.243498 -44.6070944 -21.615369   3.5470853  5.191348 -3.513495e-11
 [24,]  2802.95526 -109.562107  -23.941157  18.3664481 -26.134858   2.6413775  6.506298 -4.053554e-11
 [25,]  2672.99900 -101.587944  -53.272146   4.0841080 -28.834709   2.8424626  6.105125 -4.517892e-11
 [26,]  2730.96393  -90.213969   -7.686682  17.3157695 -30.071164   2.8958535  6.342599 -4.706602e-11
 [27,]  2833.00614 -133.480229   33.016137  35.5687104  -1.725058   1.6832917  7.941918 -1.253976e-12
 [28,]  2901.04874 -213.974392  -45.983342  26.7373300  -5.224803   1.9347409  8.761166 -6.180469e-12
 [29,]  2750.36280 -195.571668  -35.112064  17.4475412  -7.323986   2.2367373  8.440635 -9.890280e-12
 [30,]  2518.26743 -129.258655  -81.035819  12.4377631 -14.737837   2.0412351  7.331112 -2.215051e-11
 [31,]  2423.89594 -129.589776  -80.268314   5.0104667 -15.786378   2.2735615  7.257627 -2.414995e-11
 [32,]  2122.29305  -95.457470 -106.512926   7.5785073 -20.378264   2.0935079  6.819913 -3.152578e-11
 [33,]  2037.07310 -104.397111  -70.620259   7.3372743 -20.672966   2.4401771  7.127040 -3.207110e-11
 [34,]  1471.27076  -29.265316   36.517746  13.8296927 -27.432041   3.0732716  6.768873 -4.370060e-11
 [35,]  1467.44018  -12.222694   17.990316  19.3561160 -28.825110   2.7928513  6.546674 -4.579730e-11
```

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 [35,]  1467.44018  -12.222694   17.990316  19.3561160 -28.825110   2.7928513  6.546674 -4.579730e-11
 [36,]  1480.46413    4.296054  -24.656948  19.4387244 -30.683408   2.4778786  6.147523 -4.872565e-11
 [37,]  1225.57279  -22.842204  -12.447095  21.3912470  -3.030704   1.3711735  7.210591 -4.742667e-12
 [38,]  1117.13229  -38.254998   18.272225  53.5686288  -2.818557   0.9827725  8.131989 -3.427171e-12
 [39,]   847.81934  -30.309847   12.401171  49.3685775  -8.915598   1.3348438  8.088321 -1.326416e-11
 [40,]   776.84327  -52.721653  -15.761773  52.5015626 -14.011756   1.4685819  8.478225 -2.090538e-11
 [41,]   657.93572   24.103983  -30.423309  48.2330874 -21.102176   1.4073452  7.312635 -3.285743e-11
 [42,]   735.92337   -2.079958  -85.694152  64.0895511 -23.465455   0.9235104  7.776887 -3.562607e-11
 [43,]   617.09144   75.294062   11.043308  52.7817559 -29.924799   1.8137199  6.930208 -4.728894e-11
 [44,]   498.40331   28.780288   44.010518  49.2148150 -29.876224   2.4096212  7.753387 -4.717264e-11
 [45,]   229.03340   94.966065   29.313459  34.5721506  -4.944361   1.0774025  7.038941 -8.652605e-12
 [46,]   120.32406   80.437946   11.439813  31.5265915  -7.048207   1.2148025  7.203504 -1.188249e-11
 [47,]   -19.46274   41.668470   64.284680  50.1932125  -7.418173   1.4548676  8.369981 -1.183638e-11
 [48,]   -80.82787   35.724957   49.728965  60.5409312  -8.385199   1.2107326  8.606284 -1.292287e-11
 [49,]  -177.60208  -20.656402   13.315468  51.1908947  -9.413584   1.5269715  9.215771 -1.421526e-11
 [50,]  -231.11916 -107.724339   32.742029  56.1568482 -10.020967   2.1009486 10.747704 -1.439573e-11
 [51,]  -196.89131  -52.268818  -30.721003  52.0927928 -16.713820   1.7618580  9.671676 -2.527217e-11
 [52,]  -185.56546  -64.805105  -21.693124  41.0891621 -17.606476   2.1901020  9.732429 -2.698262e-11
 [53,]  -507.15574  -16.037191   25.337913  17.1717337 -21.615571   3.0221317  8.922809 -3.476255e-11
 [54,]  -360.89666   45.773872  -38.615297  -1.6661764 -25.679705   2.8141426  7.427582 -4.196792e-11
 [55,]  -326.79500  135.180486  -87.305115  12.3129799  -3.254516   0.5917257  6.659267 -6.516979e-12
 [56,]  -363.51960   87.900424  -98.802633  -3.2247515  -4.122566   1.1655474  7.109465 -7.925835e-12
 [57,]  -465.61304  107.507627  -99.314179   8.8643381  -5.108915   0.8452636  7.047437 -9.283703e-12
 [58,]  -513.83620  114.920870  -90.711731   7.5335825  -7.050238   1.0057764  6.991663 -1.250174e-11
 [59,]  -379.43107  118.173475  -59.416632  11.8182636 -12.592563   1.4269486  7.203933 -2.135066e-11
 [60,]  -654.13153  106.666767   20.309295   4.5593430 -20.170184   2.6816489  7.787256 -3.390523e-11
 [61,]  -671.13972  111.161542  -25.521040  -2.3749826 -24.033292   2.6769112  7.486864 -4.007723e-11
 [62,]  -822.94806  116.641109  -24.378892  -7.5401313 -26.074799   2.8871029  7.394158 -4.348606e-11
 [63,]  -947.02304  103.553406  -17.861288  -7.7800373 -26.762544   3.0608490  7.661836 -4.453744e-11
 [64,]  -889.92875  128.055815  -10.139364 -11.3961254 -29.000834   3.1772402  7.279430 -4.842355e-11
 [65,]  -863.83400   95.903414  -34.103990  -5.8908264  -1.950764   1.7688957  8.272245 -5.066252e-12
 [66,]  -866.23574  113.414979  -30.218041 -14.4754807  -3.217610   1.9545556  7.897484 -7.519345e-12
 [67,]  -928.45171  101.563649  -24.640888 -20.4596241  -4.055577   2.2443959  8.034130 -8.928551e-12
 [68,]  -822.47391   40.200624   -6.094170 -15.2832738  -7.043951   2.7823794  9.170642 -1.314977e-11
 [69,]  -833.80540   82.237030    9.142498 -15.7349384 -11.274244   2.8988427  8.652068 -2.023978e-11
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 [70,]  -673.32967   83.283631  -13.640823 -23.1903419 -14.838741   3.0724334  8.441466 -2.597832e-11
 [71,]  -497.61851   15.248761  -16.708160 -18.5260451 -20.132408   3.6211184  9.607274 -3.366693e-11
 [72,]  -485.57549   77.569290   23.386642 -24.9789888 -23.308415   3.8790789  8.752831 -3.964602e-11
 [73,]  -462.48384   86.601593    2.630206 -20.8936171 -25.681324   3.7119563  8.631882 -4.323875e-11
 [74,]  -320.29681   72.867411  -20.011676   8.4036444 -29.496172   3.1850780  9.269702 -4.810109e-11
 [75,]  -414.19654  130.122297   -5.256897  -7.2311007  -2.112589   2.0024417  8.711107 -5.775467e-12
 [76,]  -409.01897  125.633123  -30.686560 -13.1708924  -3.553887   2.0460647  8.601791 -8.088860e-12
 [77,]  -360.90836  119.862900  -48.551820   5.6739119  -7.496315   1.7491152  8.987870 -1.359797e-11
 [78,]  -197.48139  122.107312  -18.500849 -25.5590734 -10.616965   2.8060156  8.571314 -1.969551e-11
 [79,]   141.77521  105.277404  -35.561022 -27.8815201 -12.906107   2.9336608  8.679326 -2.314899e-11
 [80,]   388.15555  195.497152  -41.682654 -17.5819553 -18.980756   2.4668070  7.475503 -3.312995e-11
 [81,]   462.64507  126.920628  -73.056105 -23.3923721 -19.827871   2.7947714  8.307451 -3.394677e-11
 [82,]   594.34059  116.184168  -67.513731 -22.6635756 -20.676621   2.9220140  8.490476 -3.516966e-11
 [83,]   629.66663  147.180726  -48.530609 -13.4356423 -22.600991   2.7894461  8.266914 -3.824552e-11
 [84,]  1332.51958  119.381231 -109.902591  -1.3002522 -33.416535   2.7832830  8.662447 -5.438624e-11
 [85,]  1528.11306   56.783290 -115.798241 -12.6395446  -5.092166   1.9734902  9.855969 -9.424519e-12
 [86,]  1699.03321   14.936639 -129.205929 -25.3238375  -7.114718   2.4922884 10.230568 -1.263998e-11
 [87,]  2184.58735  -42.121370 -184.825125 -31.7103338 -11.692019   2.7687145 10.739240 -1.926527e-11
 [88,]  3333.56448  -34.245933 -135.516978 -52.3872722 -18.922643   3.8824185 10.317794 -3.137287e-11
 [89,]  4596.92280   87.912278  115.615051 -49.5475998 -25.971121   5.3253811  9.313404 -4.492371e-11
 [90,]  4811.37225   18.068734  188.392166  -6.9301622 -27.490695   5.4161588 11.372120 -4.580202e-11
 [91,]  5370.23742    2.203258  159.710018   5.0216489 -30.865300   5.1881714 11.619459 -5.052267e-11
 [92,]  5461.74155   91.619361  214.395421  -4.7104765  -1.255299   3.6601512  9.759580 -4.306818e-12
 [93,]  5700.47516   58.702516  164.113203 -29.7643670  -5.182154   4.2220031  9.656407 -1.102794e-11
 [94,]  5711.69666   47.647887  126.679411  11.7715022  -6.004402   3.1438668 10.375758 -1.061020e-11
 [95,]  5848.87786   65.101738   70.488008  -0.8067141  -8.346952   3.0180606  9.674272 -1.510155e-11
 [96,] -5309.92112 -151.709377   23.247598   1.4681456 -18.727588   5.0178046 15.810128 -2.992456e-11
 [97,] -5022.19003  -69.240127   -7.533240  -2.9147489 -25.350688   4.7585654 14.380842 -4.146785e-11
 [98,] -4935.07787  -68.633666    6.323512  -4.7356611 -26.213060   4.9417140 14.391377 -4.232079e-11
 [99,] -4923.29030  -50.791342   17.298686  -8.1969127 -27.300561   5.0563511 14.118936 -4.472115e-11
[100,] -4836.69637  -43.850799   23.682692 -11.0241105   1.592553   3.5289149 13.465254  6.732876e-13
[101,] -4559.26280   26.722172  -11.420684  -9.4640902  -3.868079   3.1124918 12.283205 -8.154547e-12
```

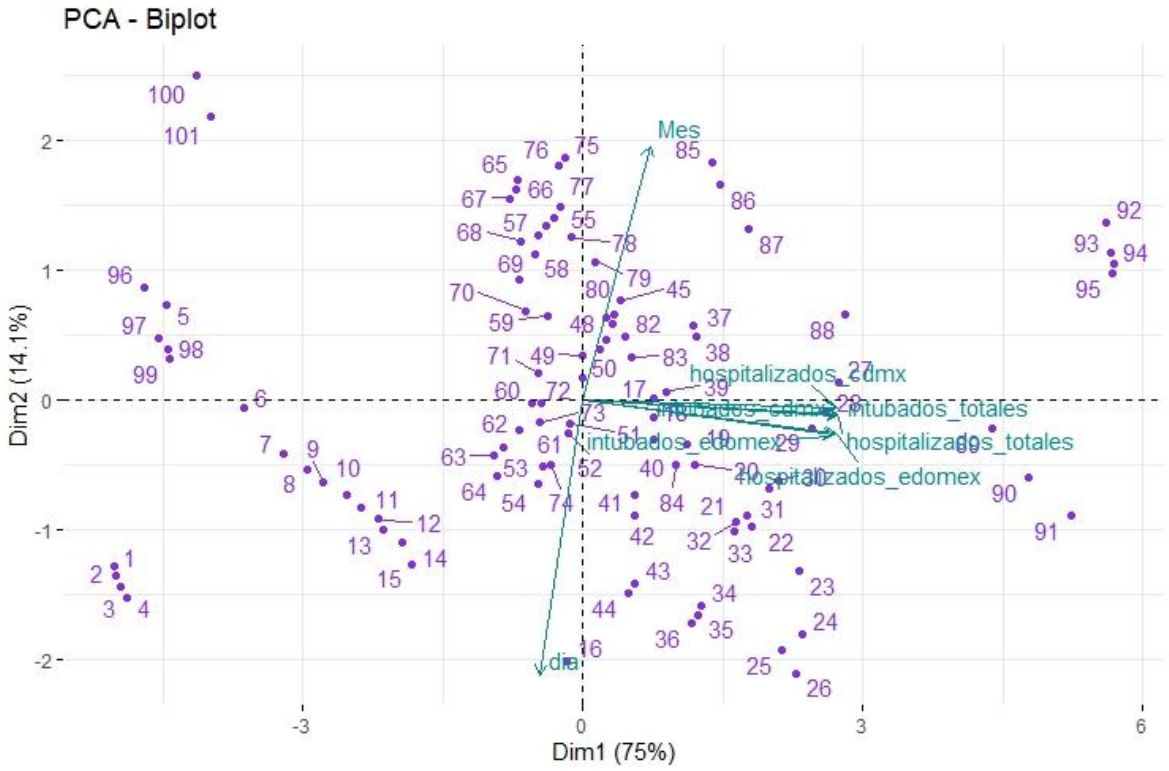
```
> datos_recuperados <- t(eigen_a$vectors %*% pc_scores)
> datos_recuperados[, 1] <- datos_recuperados[, 1] + mean(dataset$X1)
Warning messages:
1: Unknown or uninitialised column: `X1`.
2: In mean.default(dataset$X1) :
  argument is not numeric or logical: returning NA
> datos_recuperados[, 2] <- datos_recuperados[, 2] + mean(dataset$X2)
Warning messages:
1: Unknown or uninitialised column: `X2`.
2: In mean.default(dataset$X2) :
  argument is not numeric or logical: returning NA
> datos_recuperados
      [,1] [,2]       [,3]        [,4]        [,5]      [,6]       [,7]        [,8]
 [1,]   NA   NA -4033.14851 -2904.336634 -1128.811881 -954.9901 -728.247525 -227.277228
 [2,]   NA   NA -4010.14851 -2881.336634 -1128.811881 -945.9901 -719.247525 -227.277228
 [3,]   NA   NA -3963.14851 -2834.336634 -1128.811881 -927.9901 -701.247525 -227.277228
 [4,]   NA   NA -3881.14851 -2752.336634 -1128.811881 -909.9901 -683.247525 -227.277228
 [5,]   NA   NA -3754.14851 -2650.336634 -1103.811881 -854.9901 -633.247525 -222.277228
 [6,]   NA   NA -3053.14851 -2175.336634  -877.811881 -673.9901 -505.247525 -169.277228
 [7,]   NA   NA -2692.14851 -1899.336634  -792.811881 -569.9901 -418.247525 -152.277228
 [8,]   NA   NA -2608.14851 -1888.336634  -719.811881 -515.9901 -406.247525 -110.277228
 [9,]   NA   NA -2433.14851 -1754.336634  -678.811881 -479.9901 -371.247525 -109.277228
[10,]   NA   NA -2251.14851 -1601.336634  -649.811881 -402.9901 -293.247525 -110.277228
[11,]   NA   NA -2071.14851 -1461.336634  -609.811881 -376.9901 -274.247525 -103.277228
[12,]   NA   NA -1933.14851 -1362.336634  -570.811881 -333.9901 -237.247525  -97.277228
[13,]   NA   NA -1837.14851 -1303.336634  -533.811881 -331.9901 -232.247525 -100.277228
[14,]   NA   NA -1609.14851 -1131.336634  -477.811881 -288.9901 -189.247525 -100.277228
[15,]   NA   NA -1393.14851  -945.336634  -447.811881 -286.9901 -190.247525  -97.277228
[16,]   NA   NA   -31.14851  -109.336634    78.188119   18.0099   83.752475  -12.277228
[17,]   NA   NA   855.85149   428.663366   427.188119  114.0099  116.752475   -3.277228
[18,]   NA   NA   767.85149   414.663366   353.188119  146.0099  137.752475    7.722772
[19,]   NA   NA  1077.85149   600.663366   477.188119  198.0099  156.752475   40.722772
[20,]   NA   NA  1284.85149   769.663366   515.188119  205.0099  173.752475   30.722772
[21,]   NA   NA  1732.85149  1089.663366   643.188119  301.0099  212.752475   87.722772
[22,]   NA   NA  1831.85149  1149.663366   682.188119  307.0099  220.752475   85.722772
[23,]   NA   NA  2286.85149  1530.663366   756.188119  441.0099  349.752475   90.722772
[24,]   NA   NA  2201.85149  1468.663366   733.188119  456.0099  314.752475  140.722772
[25,]   NA   NA  2102.85149  1410.663366   692.188119  410.0099  291.752475  117.722772
[26,]   NA   NA  2139.85149  1434.663366   705.188119  459.0099  319.752475  138.722772
[27,]   NA   NA  2223.85149  1455.663366   768.188119  502.0099  333.752475  167.722772
[28,]   NA   NA  2303.85149  1474.663366   829.188119  437.0099  283.752475  152.722772
[29,]   NA   NA  2181.85149  1398.663366   783.188119  420.0099  279.752475  139.722772
[30,]   NA   NA  1991.85149  1321.663366   670.188119  359.0099  244.752475  113.722772
[31,]   NA   NA  1918.85149  1269.663366   649.188119  341.0099  236.752475  103.722772
[32,]   NA   NA  1679.85149  1132.663366   547.188119  277.0099  190.752475   85.722772
[33,]   NA   NA  1611.85149  1070.663366   541.188119  286.0099  196.752475   88.722772
[34,]   NA   NA  1143.85149   770.663366   373.188119  282.0099  196.752475   84.722772
[35,]   NA   NA  1138.85149   783.663366   355.188119  273.0099  187.752475   84.722772
[36,]   NA   NA  1149.85149   812.663366   337.188119  248.0099  170.752475   76.722772
[37,]   NA   NA   956.85149   656.663366   300.188119  207.0099  135.752475   70.722772
[38,]   NA   NA   871.85149   582.663366   289.188119  215.0099  116.752475   97.722772
[39,]   NA   NA   661.85149   442.663366   219.188119  164.0099   82.752475   80.722772
[40,]   NA   NA   614.85149   401.663366   213.188119  127.0099   50.752475   75.722772
[41,]   NA   NA   506.85149   381.663366   125.188119  111.0099   49.752475   60.722772
[42,]   NA   NA   578.85149   428.663366   150.188119   83.0099   14.752475   67.722772
[43,]   NA   NA   458.85149   373.663366    85.188119  146.0099   77.752475   67.722772
[44,]   NA   NA   373.85149   274.663366    99.188119  138.0099   69.752475   67.722772
[45,]   NA   NA   151.85149   166.663366   -14.811881   91.0099   51.752475   38.722772
```

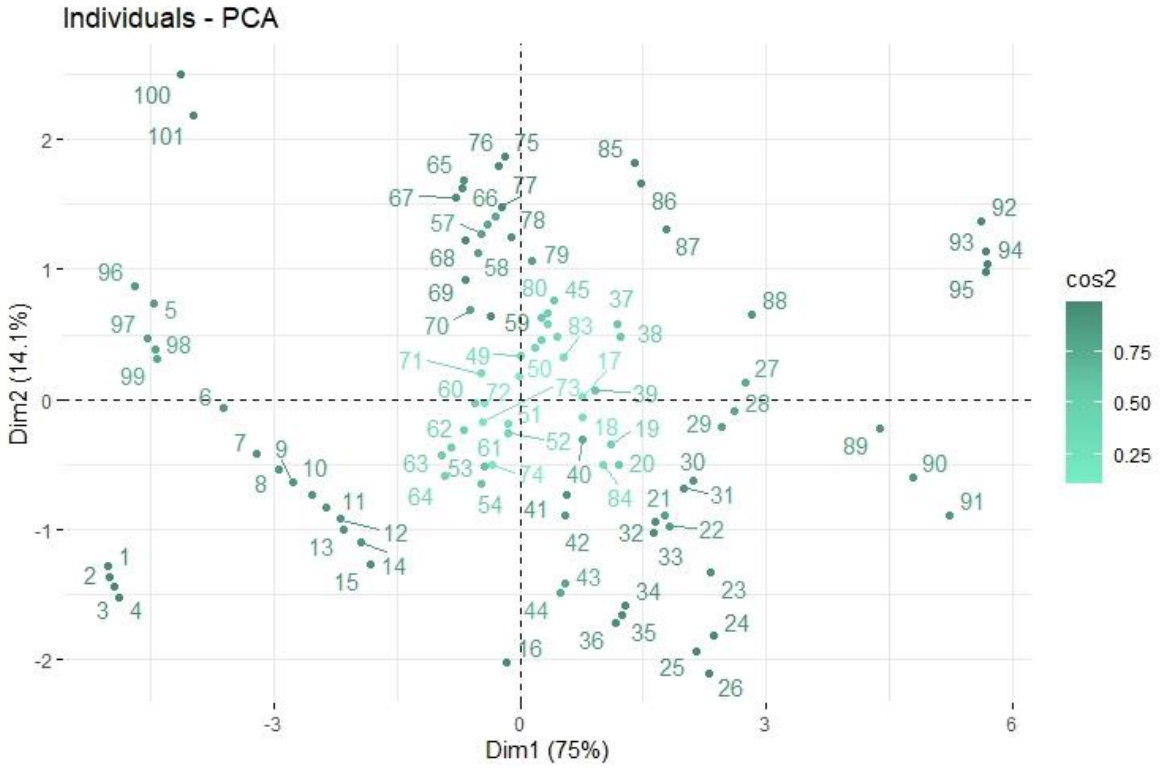
```
 [46,]   NA   NA    72.85149   105.663366   -32.811881   55.0099   25.752475   28.722772
 [47,]   NA   NA   -33.14851    -5.336634   -27.811881   65.0099   15.752475   48.722772
 [48,]   NA   NA   -78.14851   -36.336634   -41.811881   45.0099   -7.247525   51.722772
 [49,]   NA   NA  -136.14851  -107.336634   -28.811881  -12.9901  -49.247525   35.722772
 [50,]   NA   NA  -160.14851  -187.336634    27.188119  -25.9901  -71.247525   44.722772
 [51,]   NA   NA  -139.14851  -120.336634   -18.811881  -54.9901  -84.247525   28.722772
 [52,]   NA   NA  -128.14851  -124.336634    -3.811881  -51.9901  -75.247525   22.722772
 [53,]   NA   NA  -393.14851  -289.336634  -103.811881  -69.9901  -66.247525   -4.277228
 [54,]   NA   NA  -286.14851  -159.336634  -126.811881  -81.9901  -55.247525  -27.277228
 [55,]   NA   NA  -275.14851   -78.336634  -196.811881  -87.9901  -61.247525  -27.277228
 [56,]   NA   NA  -291.14851  -120.336634  -170.811881 -116.9901  -76.247525  -41.277228
 [57,]   NA   NA  -375.14851  -164.336634  -210.811881 -127.9901  -91.247525  -37.277228
 [58,]   NA   NA  -415.14851  -189.336634  -225.811881 -128.9901  -90.247525  -39.277228
 [59,]   NA   NA  -315.14851  -124.336634  -190.811881  -80.9901  -57.247525  -24.277228
 [60,]   NA   NA  -534.14851  -304.336634  -229.811881  -75.9901  -49.247525  -27.277228
 [61,]   NA   NA  -543.14851  -297.336634  -245.811881 -112.9901  -71.247525  -42.277228
 [62,]   NA   NA  -662.14851  -377.336634  -284.811881 -138.9901  -86.247525  -53.277228
 [63,]   NA   NA  -756.14851  -453.336634  -302.811881 -158.9901 -102.247525  -57.277228
 [64,]   NA   NA  -718.14851  -412.336634  -305.811881 -138.9901  -82.247525  -57.277228
 [65,]   NA   NA  -688.14851  -407.336634  -280.811881 -156.9901 -103.247525  -54.277228
 [66,]   NA   NA  -694.14851  -401.336634  -292.811881 -152.9901  -92.247525  -61.277228
 [67,]   NA   NA  -740.14851  -443.336634  -296.811881 -163.9901  -97.247525  -67.277228
 [68,]   NA   NA  -646.14851  -423.336634  -222.811881 -143.9901  -92.247525  -52.277228
 [69,]   NA   NA  -666.14851  -412.336634  -253.811881 -125.9901  -74.247525  -52.277228
 [70,]   NA   NA  -539.14851  -318.336634  -220.811881 -115.9901  -61.247525  -55.277228
 [71,]   NA   NA  -387.14851  -257.336634  -129.811881 -100.9901  -60.247525  -41.277228
 [72,]   NA   NA  -396.14851  -231.336634  -164.811881  -57.9901  -17.247525  -41.277228
 [73,]   NA   NA  -378.14851  -207.336634  -170.811881  -65.9901  -25.247525  -41.277228
 [74,]   NA   NA  -263.14851  -128.336634  -134.811881  -52.9901  -38.247525  -15.277228
 [75,]   NA   NA  -350.14851  -155.336634  -194.811881  -49.9901  -19.247525  -31.277228
 [76,]   NA   NA  -342.14851  -147.336634  -194.811881  -69.9901  -30.247525  -40.277228
 [77,]   NA   NA  -302.14851  -117.336634  -184.811881  -70.9901  -45.247525  -26.277228
 [78,]   NA   NA  -178.14851   -39.336634  -138.811881  -27.9901    9.752475  -38.277228
 [79,]   NA   NA    90.85149   140.663366   -49.811881   15.0099   41.752475  -27.277228
 [80,]   NA   NA   261.85149   323.663366   -61.811881   76.0099   88.752475  -13.277228
 [81,]   NA   NA   338.85149   337.663366     1.188119   50.0099   66.752475  -17.277228
 [82,]   NA   NA   442.85149   401.663366    41.188119   75.0099   83.752475   -9.277228
 [83,]   NA   NA   460.85149   431.663366    29.188119  104.0099  101.752475    1.722772
 [84,]   NA   NA  1018.85149   817.663366   201.188119  180.0099  146.752475   32.722772
 [85,]   NA   NA  1185.85149   891.663366   294.188119  194.0099  158.752475   34.722772
 [86,]   NA   NA  1329.85149   965.663366   364.188119  202.0099  169.752475   31.722772
 [87,]   NA   NA  1725.85149  1215.663366   510.188119  233.0099  191.752475   40.722772
 [88,]   NA   NA  2610.85149  1824.663366   786.188119  467.0099  381.752475   84.722772
 [89,]   NA   NA  3535.85149  2493.663366  1042.188119  898.0099  712.752475  184.722772
 [90,]   NA   NA  3708.85149  2553.663366  1155.188119  984.0099  738.752475  244.722772
 [91,]   NA   NA  4148.85149  2857.663366  1291.188119 1061.0099  785.752475  274.722772
 [92,]   NA   NA  4193.85149  2935.663366  1258.188119 1134.0099  855.752475  277.722772
 [93,]   NA   NA  4392.85149  3061.663366  1331.188119 1126.0099  864.752475  260.722772
 [94,]   NA   NA  4406.85149  3076.663366  1330.188119 1109.0099  820.752475  287.722772
 [95,]   NA   NA  4515.85149  3176.663366  1339.188119 1093.0099  819.752475  272.722772
 [96,]   NA   NA -4088.14851 -2959.336634 -1128.811881 -948.9901 -722.247525 -227.277228
 [97,]   NA   NA -3880.14851 -2751.336634 -1128.811881 -903.9901 -677.247525 -227.277228
 [98,]   NA   NA -3814.14851 -2708.336634 -1105.811881 -878.9901 -657.247525 -222.277228
 [99,]   NA   NA -3810.14851 -2696.336634 -1113.811881 -865.9901 -643.247525 -223.277228
[100,]   NA   NA -3745.14851 -2648.336634 -1096.811881 -844.9901 -625.247525 -220.277228
[101,]   NA   NA -3542.14851 -2450.336634 -1091.811881 -805.9901 -590.247525 -216.277228
```

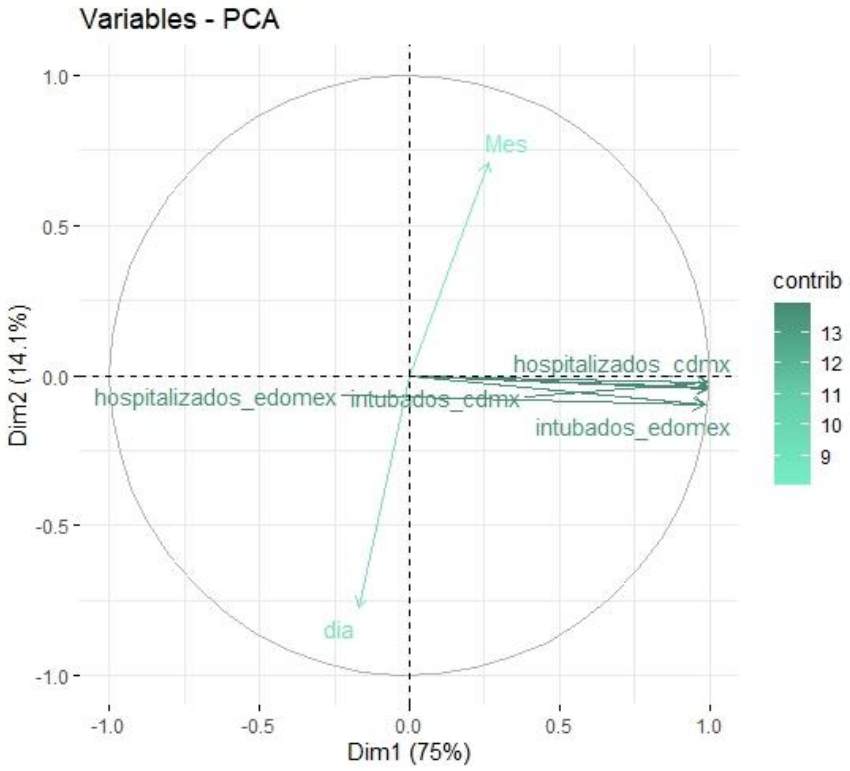
```
> #Con apply aplicamos la funcion en todos los elementos de nuestra matriz
> Media <- apply(X = dataset, MARGIN = 2, FUN = mean)  #Promedio
> Varianza <- apply(X = dataset, MARGIN = 2, FUN = var)   #Varianza
> Desviacion_e <- apply(X = dataset, MARGIN = 2, FUN = sd) #Desviación Estandar
> Media
                  Mes                   dia hospitalizados_totales    hospitalizados_cdmx  hospitalizados_edomex      intubados_totales
             8.019802             15.693069            4138.148515            3009.336634            1128.811881             987.990099
       intubados_cdmx       intubados_edomex
            761.247525             227.277228
> Varianza
                  Mes                   dia hospitalizados_totales    hospitalizados_cdmx  hospitalizados_edomex      intubados_totales
         8.419604e+00          9.247485e+01          4.212726e+06          2.051717e+06          3.916163e+05          2.193668e+05
       intubados_cdmx       intubados_edomex
         1.220077e+05          1.490770e+04
> Desviacion_e
                  Mes                   dia hospitalizados_totales    hospitalizados_cdmx  hospitalizados_edomex      intubados_totales
             2.901655             9.616385            2052.492574            1432.381690             625.792517             468.366149
       intubados_cdmx       intubados_edomex
            349.296075             122.097102
>
>
> #Calculamos nuestro Analisis de componentes principales
> ACP <- prcomp(dataset, scale= TRUE)
> names(ACP)
[1] "sdev"     "rotation" "center"   "scale"    "x"
```

```
> #Lo aplicamos para las siguientes funciones y se pueda visualizar la informacion de cada "renglon"
> ACP$center
                  Mes                   dia hospitalizados_totales    hospitalizados_cdmx  hospitalizados_edomex      intubados_totales
             8.019802             15.693069            4138.148515            3009.336634            1128.811881             987.990099
       intubados_cdmx       intubados_edomex
            761.247525             227.277228
> ACP$scale
                  Mes                   dia hospitalizados_totales    hospitalizados_cdmx  hospitalizados_edomex      intubados_totales
             2.901655             9.616385            2052.492574            1432.381690             625.792517             468.366149
       intubados_cdmx       intubados_edomex
            349.296075             122.097102
> ACP$rotation
                             PC1         PC2          PC3         PC4          PC5          PC6          PC7          PC8
Mes                   0.10784652  0.66893323 -0.728244247 -0.04846269 -0.076633354  0.048321581  0.001226923 -1.998085e-16
dia                  -0.06906956 -0.72913144 -0.680656238  0.01492864 -0.006712901 -0.005885688 -0.001122500  1.117273e-16
hospitalizados_totales  0.40682518 -0.04119333  0.013266450  0.25909700 -0.246083967 -0.268315523  0.004764289  7.955601e-01
hospitalizados_cdmx     0.40682832 -0.01967214 -0.007520892  0.26558770 -0.114724872 -0.664830830  0.010022892 -5.552009e-01
hospitalizados_edomex   0.40312438 -0.09007936  0.060726321  0.24188800 -0.544518671  0.641707720 -0.007315426 -2.425614e-01
intubados_totales       0.40677185 -0.03789049 -0.006676876 -0.08851319  0.429638022  0.128703180 -0.789980046 -2.258805e-15
intubados_cdmx          0.40548840 -0.02071618 -0.023919765  0.19516888  0.644432884  0.224445674  0.575167238  1.466959e-15
intubados_edomex        0.40023628 -0.09398225  0.042783389 -0.86909444 -0.154854758 -0.070056852  0.211978154  6.054596e-16
>
> #Definimos nuestras graficas para poder tener una mejor visualizacion de los datos y llegar a una mejor conclusion de nuestros datos
> head(ACP$x)  # Visualizamos los primeros 6 datos de nuestra matriz
         PC1        PC2       PC3         PC4         PC5         PC6          PC7          PC8
[1,] -5.024709 -1.2841973 0.4645817  0.005670577 -0.10688793  0.02849467 -0.0026951901 -7.455660e-16
[2,] -5.002536 -1.3620585 0.3930841  0.017718889 -0.08732541  0.02245682 -0.0029578176 -5.291282e-16
[3,] -4.950525 -1.4419928 0.3208710  0.040574750 -0.04770229  0.01039830 -0.0033570261 -3.182971e-16
[4,] -4.881636 -1.5231102 0.2487003  0.074338435 -0.01507878 -0.02248067 -0.0034300842 -5.515553e-16
[5,] -4.458093  0.7358011 1.9090641  0.042282196  0.06856754  0.01676153 -0.0008932185 -8.595792e-16
[6,] -3.623771 -0.0627491 1.3032296 -0.019769344  0.07851257  0.03246852 -0.0021359631 -4.325062e-16
> fviz_eig(ACP) #Hacemos el grafico de nuestro respectivos datos de nuestra PCA
```

```
> fviz_eig(ACP) #Hacemos el grafico de nuestro respectivos datos de nuestra PCA
>
> #Representación bidimensional de las primeras dos componentes (por defecto)
> fviz_pca_biplot(ACP, repel = TRUE,
+                 col.var = "#008B8B", # Definimos el color de las variables
+                 col.ind = "#8A2BE2"  # Definimos el color de las variables independientes
+ )
Warning messages:
1: ggrepel: 61 unlabeled data points (too many overlaps). Consider increasing max.overlaps
2: ggrepel: 6 unlabeled data points (too many overlaps). Consider increasing max.overlaps
>
> #Representacion gbidimensional de las primeras dos componentes (por defecto)
> fviz_pca_ind(ACP,
Warning messages:
1: ggrepel: 61 unlabeled data points (too many overlaps). Consider increasing max.overlaps
2: ggrepel: 6 unlabeled data points (too many overlaps). Consider increasing max.overlaps
3: ggrepel: 61 unlabeled data points (too many overlaps). Consider increasing max.overlaps
4: ggrepel: 6 unlabeled data points (too many overlaps). Consider increasing max.overlaps
+              col.ind = "cos2", #Definimos el color de la representación
+              gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
+              repel = TRUE     #Evitamos la superposición del texto
+ )
Warning message:
ggrepel: 68 unlabeled data points (too many overlaps). Consider increasing max.overlaps
>
> # Representación en tercera dimensión de nuestras 3 componentes, tanto con variables como individuos
> fviz_pca_var(ACP,
+              col.var = "contrib", # Definimos el color
+              gradient.cols = c("#76EEC6", "#66CDAA", "#458B74"),
+              repel = TRUE     #Evitamos la superposición del texto
+ )
Warning messages:
1: ggrepel: 68 unlabeled data points (too many overlaps). Consider increasing max.overlaps
2: ggrepel: 68 unlabeled data points (too many overlaps). Consider increasing max.overlaps
3: ggrepel: 6 unlabeled data points (too many overlaps). Consider increasing max.overlaps
>
```


PCA - Biplot
Mes
hospitalizados_cdmx
intubados_totales
intubados_edomex
hospitalizados_totales
hospitalizados_edomex
dia
Dim2 (14.1%)
Dim1 (75%)


Individuals - PCA
cos2
0.75
0.50
0.25
Dim2 (14.1%)
Dim1 (75%)



Interpretación:

Como nos damos cuenta, al hacer el análisis de este dataset, que las hospitalizaciones más recurrentes y con más casos grabes es de la CDMX en todo el año 2020, por otro lado, nos damos cuenta que la tendencia de hospitalización en el EDOMEX es baja, sin embargo, a lo largo del año tuvo una estabilización de casos de hospitalización.

Como vemos en los gráficos, CDMX tuvo días totalmente inestables, pues en a lo largo de el año, tuvo pocos o demasiados casos y la mayor parte son casos grabes, esto quiere decir que tuvo más infecciones registradas y no registradas

Conclusión de la práctica:

A lo largo de la practica nos damos cuenta como es demasiado útil nuestro Análisis de componentes principales, tanto en la estadística de nuestros datos como en su organización de los mismos.

Se entendió la verdadera importancia de ACP, y en como tenemos variabilidad de los datos.