Assignment-4.R

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GitHub Link for .R File:

https://github.com/kunwangRU/Survival-Analysis-of-Patients-with-Heart-Failure/blob/master/PCA%20(Assignment%204).R

```
> #Loading Packages
> library(knitr)
> library(dplyr)

Attaching package: ‘dplyr’

The following objects are masked from ‘package:stats’:

    filter, lag

The following objects are masked from ‘package:base’:

    intersect, setdiff, setequal, union

> library(pander)
Warning message:
package ‘pander’ was built under R version 3.6.3
> #Loading dataset
> rawdata <-read.csv("C:/Users/wangk/Desktop/Rutgers/Rutgers Courseware/Fa
ll 2020/Multivariate Analysis/Assignment 3/heart_failure_clinical_records_
dataset.csv")
> View(rawdata)
> #Identifying different columns names
> names(rawdata)
 [1] "age"                       "anaemia"                   "creatinine_pho
sphokinase"
 [4] "diabetes"                  "ejection_fraction"         "high_blood_pre
ssure"
 [7] "platelets"                 "serum_creatinine"          "serum_sodium"

[10] "sex"                       "smoking"                   "time"

[13] "DEATH_EVENT"
>
> #Data Summary
> str(rawdata)
'data.frame':   299 obs. of  13 variables:
 $ age                     : num  75 55 65 50 65 90 75 60 65 80 ...
 $ anaemia                 : int  0 0 0 1 1 1 1 1 0 1 ...
 $ creatinine_phosphokinase: int  582 7861 146 111 160 47 246 315 157 123
...
 $ diabetes                : int  0 0 0 0 1 0 0 1 0 0 ...
 $ ejection_fraction       : int  20 38 20 20 20 40 15 60 65 35 ...
 $ high_blood_pressure     : int  1 0 0 0 0 1 0 0 0 1 ...
 $ platelets               : num  265000 263358 162000 210000 327000 ...
 $ serum_creatinine        : num  1.9 1.1 1.3 1.9 2.7 2.1 1.2 1.1 1.5 9.4
...
 $ serum_sodium            : int  130 136 129 137 116 132 137 131 138 133
...
 $ sex                     : Factor w/ 2 levels "Female","male": 2 2 2 2 1
 2 2 2 1 2 ...
 $ smoking                 : int  0 0 1 0 0 1 0 1 0 1 ...
 $ time                    : int  4 6 7 7 8 8 10 10 10 10 ...
 $ DEATH_EVENT             : Factor w/ 2 levels "Death","No Death": 2 2 2
2 2 2 2 2 2 2 ...
> summary(rawdata)
```

```
      age            anaemia       creatinine_phosphokinase    diabetes
  ejection_fraction
 Min.   :40.00   Min.   :0.0000   Min.   :  23.0           Min.   :0.0000
  Min.   :14.00
 1st Qu.:51.00   1st Qu.:0.0000   1st Qu.: 116.5           1st Qu.:0.0000
  1st Qu.:30.00
 Median :60.00   Median :0.0000   Median : 250.0           Median :0.0000
  Median :38.00
 Mean   :60.83   Mean   :0.4314   Mean   : 581.8           Mean   :0.4181
  Mean   :38.08
 3rd Qu.:70.00   3rd Qu.:1.0000   3rd Qu.: 582.0           3rd Qu.:1.0000
  3rd Qu.:45.00
 Max.   :95.00   Max.   :1.0000   Max.   :7861.0           Max.   :1.0000
  Max.   :80.00
 high_blood_pressure   platelets      serum_creatinine  serum_sodium
 sex          smoking
 Min.   :0.0000      Min.   : 25100   Min.   :0.500    Min.   :113.0   Fem
ale:105   Min.   :0.0000
 1st Qu.:0.0000      1st Qu.:212500   1st Qu.:0.900    1st Qu.:134.0   mal
e  :194   1st Qu.:0.0000
 Median :0.0000      Median :262000   Median :1.100    Median :137.0
          Median :0.0000
 Mean   :0.3512      Mean   :263358   Mean   :1.394    Mean   :136.6
          Mean   :0.3211
 3rd Qu.:1.0000      3rd Qu.:303500   3rd Qu.:1.400    3rd Qu.:140.0
          3rd Qu.:1.0000
 Max.   :1.0000      Max.   :850000   Max.   :9.400    Max.   :148.0
          Max.   :1.0000
      time         DEATH_EVENT
 Min.   :  4.0   Death   :203
 1st Qu.: 73.0   No Death: 96
 Median :115.0
 Mean   :130.3
 3rd Qu.:203.0
 Max.   :285.0
> head(rawdata)
  age anaemia creatinine_phosphokinase diabetes ejection_fraction high_blo
od_pressure platelets
1  75       0                       582        0                20
          1    265000
2  55       0                      7861        0                38
          0    263358
3  65       0                       146        0                20
          0    162000
4  50       1                       111        0                20
          0    210000
5  65       1                       160        1                20
          0    327000
6  90       1                        47        0                40
          1    204000
  serum_creatinine serum_sodium    sex smoking time DEATH_EVENT
1              1.9          130   male       0    4    No Death
2              1.1          136   male       0    6    No Death
3              1.3          129   male       1    7    No Death
4              1.9          137   male       0    7    No Death
5              2.7          116 Female       0    8    No Death
6              2.1          132   male       1    8    No Death
> dim(rawdata)
[1] 299  13
> #Data Cleaning
>
> #Checking for missing values
> is.null(rawdata)
[1] FALSE
> ##The "FALSE" output shows there is no missing data in the dataset.
>
> #Transforming data (Converting 0,1's to meaningful form)
>
> dataset <- rawdata %>%
```

```
+   mutate(anaemia = ifelse(anaemia ==1, "Yes", "No"),
+          high_blood_pressure = ifelse(high_blood_pressure ==1, "Yes", "N
o"),
+          diabetes = ifelse(diabetes ==1, "Yes", "No"),
+          smoking =ifelse(smoking ==1,"Yes","No"),
+          DEATH_EVENT=ifelse(DEATH_EVENT=="No Death", "Survived", "Death"
)
+   ) %>%
+   mutate_if(is.character, as.factor) %>%
+   dplyr::select(age, anaemia, creatinine_phosphokinase, diabetes, ejecti
on_fraction, high_blood_pressure, platelets,serum_creatinine, serum_sodium
, sex, smoking, time, DEATH_EVENT)
>
> View(dataset)
> summary(dataset)
      age        anaemia   creatinine_phosphokinase diabetes  ejection_fra
ction high_blood_pressure
 Min.   :40.00   No :170   Min.   :  23.0           No :174   Min.   :14.0
0     No :194
 1st Qu.:51.00   Yes:129   1st Qu.: 116.5           Yes:125   1st Qu.:30.0
0     Yes:105
 Median :60.00             Median : 250.0                     Median :38.0
0
 Mean   :60.83             Mean   : 581.8                     Mean   :38.0
8
 3rd Qu.:70.00             3rd Qu.: 582.0                     3rd Qu.:45.0
0
 Max.   :95.00             Max.   :7861.0                     Max.   :80.0
0
   platelets      serum_creatinine  serum_sodium       sex       smoking
     time          DEATH_EVENT
 Min.   : 25100   Min.   :0.500    Min.   :113.0   Female:105   No :203
Min.   :  4.0   Death   :203
 1st Qu.:212500   1st Qu.:0.900    1st Qu.:134.0   male  :194   Yes: 96
1st Qu.: 73.0   Survived: 96
 Median :262000   Median :1.100    Median :137.0
Median :115.0
 Mean   :263358   Mean   :1.394    Mean   :136.6
Mean   :130.3
 3rd Qu.:303500   3rd Qu.:1.400    3rd Qu.:140.0
3rd Qu.:203.0
 Max.   :850000   Max.   :9.400    Max.   :148.0
Max.   :285.0
> #Correlation
>
> correlation<-cor(dataset[c(1,3,5,7,8,9,12)])
> View(correlation)
> #From the table, we can see all the continuous variables are uncorrelate
d
> #Principal components
>
> dataset_pca <- prcomp(dataset[c(1,3,5,7,8,9,12)],scale=TRUE)
> dataset_pca
Standard deviations (1, .., p=7):
[1] 1.2143198 1.0842469 1.0146325 0.9829678 0.9421964 0.8587448 0.8537882

Rotation (n x k) = (7 x 7):
                                 PC1         PC2         PC3         PC4
     PC5         PC6          PC7
age                       0.4649617 -0.45213222  0.00779977  0.19809211  0
.1912135 -0.6341378  0.318421659
creatinine_phosphokinase -0.1379593  0.19389349 -0.81505355  0.33440577 -0
.2948224 -0.1008787  0.264832516
ejection_fraction        -0.1788924 -0.68147830  0.10671326  0.01299509 -0
.4694857  0.3913478  0.344177806
platelets                -0.1992576 -0.24678636 -0.40331735 -0.82095373  0
.1807563 -0.1733047  0.007459381
serum_creatinine          0.5117770 -0.04569638 -0.10167226 -0.18226520 -0
.6335802 -0.1069130 -0.528757042
```

```
serum_sodium              -0.4474108 -0.42971962 -0.11797610  0.36260682  0
.1513990 -0.1865190 -0.641912443
time                      -0.4806034  0.21428597  0.37056533 -0.10046937 -0
.4461860 -0.5985695  0.135357997
> #Recreating the summary table manually
> (eigen_dataset <- dataset_pca$sdev^2)
[1] 1.4745726 1.1755914 1.0294792 0.9662257 0.8877341 0.7374427 0.7289544
> names(eigen_dataset) <- paste("PC",1:7,sep="")
> eigen_dataset
      PC1       PC2       PC3       PC4       PC5       PC6       PC7
1.4745726 1.1755914 1.0294792 0.9662257 0.8877341 0.7374427 0.7289544
> sumlambdas <- sum(eigen_dataset)
> sumlambdas
[1] 7
> propvar <- eigen_dataset/sumlambdas
> propvar
      PC1       PC2       PC3       PC4       PC5       PC6       PC7
0.2106532 0.1679416 0.1470685 0.1380322 0.1268192 0.1053490 0.1041363
> cumvar_dataset <- cumsum(propvar)
> cumvar_dataset
      PC1       PC2       PC3       PC4       PC5       PC6       PC7
0.2106532 0.3785949 0.5256633 0.6636956 0.7905147 0.8958637 1.0000000
> matlambdas <- rbind(eigen_dataset,propvar,cumvar_dataset)
> rownames(matlambdas) <- c("Eigenvalues","Prop. variance","Cum. prop. var
iance")
> round(matlambdas,6)
                     PC1      PC2      PC3      PC4      PC5      PC6
     PC7
Eigenvalues         1.474573 1.175591 1.029479 0.966226 0.887734 0.737443
0.728954
Prop. variance      0.210653 0.167942 0.147068 0.138032 0.126819 0.105349
0.104136
Cum. prop. variance 0.210653 0.378595 0.525663 0.663696 0.790515 0.895864
1.000000
> summary(dataset_pca)
Importance of components:
                          PC1    PC2    PC3    PC4    PC5    PC6    PC7
Standard deviation     1.2143 1.0842 1.0146 0.9830 0.9422 0.8587 0.8538
Proportion of Variance 0.2107 0.1679 0.1471 0.1380 0.1268 0.1053 0.1041
Cumulative Proportion  0.2107 0.3786 0.5257 0.6637 0.7905 0.8959 1.0000
> dataset_pca$rotation
                                PC1         PC2         PC3         PC4
     PC5        PC6          PC7
age                       0.4649617 -0.45213222  0.00779977  0.19809211  0
.1912135 -0.6341378  0.318421659
creatinine_phosphokinase -0.1379593  0.19389349 -0.81505355  0.33440577 -0
.2948224 -0.1008787  0.264832516
ejection_fraction         -0.1788924 -0.68147830  0.10671326  0.01299509 -0
.4694857  0.3913478  0.344177806
platelets                 -0.1992576 -0.24678636 -0.40331735 -0.82095373  0
.1807563 -0.1733047  0.007459381
serum_creatinine           0.5117770 -0.04569638 -0.10167226 -0.18226520 -0
.6335802 -0.1069130 -0.528757042
serum_sodium              -0.4474108 -0.42971962 -0.11797610  0.36260682  0
.1513990 -0.1865190 -0.641912443
time                      -0.4806034  0.21428597  0.37056533 -0.10046937 -0
.4461860 -0.5985695  0.135357997
> print(dataset_pca)
Standard deviations (1, .., p=7):
[1] 1.2143198 1.0842469 1.0146325 0.9829678 0.9421964 0.8587448 0.8537882

Rotation (n x k) = (7 x 7):
                                PC1         PC2         PC3         PC4
     PC5        PC6          PC7
age                       0.4649617 -0.45213222  0.00779977  0.19809211  0
.1912135 -0.6341378  0.318421659
creatinine_phosphokinase -0.1379593  0.19389349 -0.81505355  0.33440577 -0
.2948224 -0.1008787  0.264832516
```

```
ejection_fraction        -0.1788924 -0.68147830  0.10671326  0.01299509 -0
.4694857  0.3913478  0.344177806
platelets                -0.1992576 -0.24678636 -0.40331735 -0.82095373  0
.1807563 -0.1733047  0.007459381
serum_creatinine          0.5117770 -0.04569638 -0.10167226 -0.18226520 -0
.6335802 -0.1069130 -0.528757042
serum_sodium             -0.4474108 -0.42971962 -0.11797610  0.36260682  0
.1513990 -0.1865190 -0.641912443
time                     -0.4806034  0.21428597  0.37056533 -0.10046937 -0
.4461860 -0.5985695  0.135357997
> #Option 1
> #Based on retating components that account for 70% to 90% of the varianc
e, we need to retain PC1 to PC5 or PC1 to PC6
>
> #Option 2
> #Based on the rule of sum to choose all components with eigen values lar
ger than 0.7, we need to retain all the PC's
>
> # Sample scores stored in dataset_pca$x (Calculating Sample scores for e
ach record in the dataset)
> dataset_pca$x
                PC1          PC2           PC3           PC4          PC5
          PC6           PC7
  [1,]  2.527734332  0.773000777 -0.6360993477 -0.2678568163  1.136629478
-0.1546363733  0.3384491539
  [2,] -0.574278487  1.411982903 -6.6668353988  2.5727195549 -1.429368593
 0.5665761470  1.8526683224
  [3,]  2.194672154  1.458053352  0.2483605002  0.2995571159  1.233904702
 0.6874688312  0.4012722981
  [4,]  1.001164626  1.094503385 -0.2028773985  0.1864948063  0.999145445
 1.0055616792 -1.4766510338
  [5,]  3.861077199  2.251467768 -0.2290518522 -2.3968648776  0.225372700
 0.7907638877  1.5950526698
  [6,]  2.883484499 -1.094365765  0.2009953018  0.4554881973  0.557326566
-0.2653173061  0.7847535321
  [7,]  1.839012035  0.707754751  0.0804184093  1.4600086888  1.816428080
-0.3103362594 -0.5592830655
  [8,]  0.455360392 -1.535868079 -0.7598260701 -1.9368388395  0.228909025
 1.6547366577  1.3155929854
  [9,]  0.474195729 -2.263747274 -0.0190576794  0.2024542008 -0.198185343
 1.5705147306  0.3144019368
 [10,]  5.680060396 -1.289760444 -1.4078882179 -2.4413753346 -3.536144927
-1.0435991316 -3.4667285682
 [11,]  3.017371991 -0.797077119 -0.6821722607 -1.5809037304 -0.521153932
 0.0045826272 -0.4753290608
 [12,]  0.472521587  0.026232597 -0.3956525650  0.4910854867  1.734842231
 0.3958806632 -0.8940518058
 [13,]  0.261088280  1.115690004 -0.4439202236  1.1709636021  0.587918838
 1.6952981599 -0.6719961518
 [14,]  0.165981735 -0.050743581 -0.2628976502 -0.1923194154  0.856707861
 1.5297289991 -0.5167176281
 [15,] -0.204362936 -0.040881607 -0.8965835301 -1.4170553561  1.553606635
 1.0204374051 -0.8812645908
 [16,]  1.859952346 -1.244012835  0.6500073359  2.2286816902  0.239446962
 0.6105672381  0.7757631799
 [17,]  1.221808068 -1.700662383 -0.2111746779  0.8127180146  1.639573239
-0.5453170933  0.1385369562
 [18,]  1.345531498  2.876985680 -0.0655601475 -0.0087380686  1.222687614
 1.5851194890  0.3694140778
 [19,]  0.851415204 -0.249276904 -0.2213417205  0.6979929817  1.776094774
-0.0401398517 -0.7524374838
 [20,]  2.150365415  1.139909678  0.6889601436  0.0611926286 -1.386858562
 3.0531636135  1.9484235393
 [21,]  1.033301579  0.109453856 -0.2686235207 -0.0384772797  1.497559688
 0.2530006230 -0.6183983334
 [22,]  1.129172675 -0.121080107 -0.3576276459 -0.3232757784  1.073889043
 0.3536435500 -0.4515272674
 [23,]  0.422199728 -0.843083211 -0.3930187480  0.2830735367  1.446984393
 0.2669142216 -0.4254324193
```

```
 [24,] -0.235531658 -1.446315160 -0.2182632704 -1.0523621825  0.286005860
 1.9758851047  0.6452205447
 [25,]  1.822053892 -0.132680068 -0.5485130799  0.0733544188  0.807787779
-0.1294316785  0.1161487271
 [26,]  1.211927948 -1.558529992  0.0887974159  1.7851775118  0.791571888
-0.3136359653 -1.1350720045
 [27,]  1.834357465 -1.742805555  0.2067412306  1.2944668951  1.390746366
-0.7877977267  0.6530075908
 [28,]  0.939657383 -1.113449659 -0.1023165743 -0.0713961118  0.686257056
 0.5914847731  0.2797181487
 [29,]  3.281061578  0.059917073  0.0301959094 -0.1578883798 -2.276851387
 0.8578127680 -2.2810843534
 [30,]  2.170111207 -0.110314487  0.2771480181  0.4880468350  1.258762836
-0.2106039909  0.7771485018
 [31,]  2.419058992 -1.304502284 -0.4448214374  0.3933803808  0.772866482
-0.9086714705  0.8644048151
 [32,]  2.619440445 -1.575185651 -0.3733025918 -1.1244573987 -0.091972064
-0.3546033280  0.3765337340
 [33,]  0.870040276  0.957528466 -0.2036831143 -1.2726185595  0.685286855
 1.6055772502  0.8114744876
 [34,]  0.071831204  0.290403824 -0.3853141112 -0.3811869090  1.094441902
 1.0286309650 -0.9150418397
 [35,]  0.295619354 -1.342683812  0.2957464761  1.0246674449  0.542350633
 1.0351858406 -0.1470254668
 [36,]  2.366785028 -0.157749706 -0.4922638760 -0.0275778088 -0.615384225
 0.1918576584 -0.7431177511
 [37,]  1.802460653 -1.808549188  0.3491947616  0.6159647328  0.813177200
-0.1155044779  1.3904416242
 [38,]  0.067800124 -2.656568296 -1.0097203741  0.8632672417  0.996013997
-0.4049763226 -0.1997254376
 [39,]  0.740960337  0.453261981 -2.5652354443  0.3434734327 -0.211723999
 0.1514634616 -0.3805878487
 [40,]  0.754675855 -1.069603399 -0.7608815498 -0.3960238819 -0.006258467
 0.3414854682 -1.8920626435
 [41,]  1.728226290  0.655285453 -0.6037648370 -0.0312500249  1.078118717
-0.2552421371 -0.2945658321
 [42,]  0.564583762  0.862434271  0.3263179001  0.6891949454  0.743833840
 1.3576964162 -0.6397735542
 [43,]  0.680504418 -1.042340569 -0.1081952292  1.1694307124  0.490799810
 0.5497642220  0.0216083742
 [44,]  1.087045793 -1.082495698  0.3284239525  0.4025574749  0.471431022
 0.8281876130  0.9314941596
 [45,] -0.311539941 -1.833024663 -0.1012758460  1.2138303482 -0.089353844
 1.4447043123 -0.1898551732
 [46,]  0.487793213  0.171894321 -0.6614329169 -0.6713973281  0.097201342
 1.2432135260 -0.4772121301
 [47,]  0.683082006  1.679718555 -1.0412124804 -0.3052170962  0.738074385
 1.0377289644  0.6300619648
 [48,] -0.386840249 -0.784929404 -1.1648939928 -1.2192920274  1.388912358
 0.4292239417  0.0379834906
 [49,]  3.685428572  0.592121414 -0.2422528179  0.6128223130 -0.646081411
-0.8672146015 -1.1948490544
 [50,] -0.221980025 -0.366379799 -0.7107795261 -0.8728142697  1.504340511
 0.3296433982 -0.8948063850
 [51,]  0.883029796  0.368300794 -0.1223959573  1.2158282938  1.245796833
 0.0139022630 -0.3482373816
 [52,]  0.024450754  0.378338288 -0.8742971411 -1.3105103841  1.605752347
 0.1686335746 -1.3585473359
 [53,]  1.389219421 -2.062290111 -3.8245386355  1.1088814399 -4.477485269
 0.2016647880 -2.6827901398
 [54,]  0.678036913 -1.323288817 -0.1201026706 -0.7813600445  0.639470259
 0.6203387843  0.8914514534
 [55,]  1.427202694  0.172739366 -0.0591159655 -0.4665082140 -0.090008753
 0.8597145621 -0.0010619653
 [56,]  2.350889553 -1.171955731 -1.0074998454 -1.5545263624  1.230723018
-1.6652044075  0.8601785633
 [57,]  1.538184599 -0.572408564  0.0411601920  0.2949007386  0.034734266
-0.0713796971 -0.9862673324
```

```
 [58,] -0.028549263 -0.263477502 -0.1319438750  0.7459514603  0.787180040
 0.8011994711  0.1094632250
 [59,]  0.052014543  1.258212073 -0.8880117602 -0.5147823515  1.158210543
 0.5500072030 -0.6719701732
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 [ reached getOption("max.print") -- omitted 157 rows ]
>
> # Identifying the scores by their survival status
> DEATH_EVENT <- data.frame(DEATH_EVENT=dataset$DEATH_EVENT)
> survival_pca <- cbind(DEATH_EVENT, dataset_pca$x)
> survival_pca
    DEATH_EVENT           PC1          PC2           PC3           PC4
  PC5            PC6           PC7
1      Survived  2.527734332  0.77300078 -0.636099348 -0.267856816  1.1366
29478 -0.1546363733  0.338449154
2      Survived -0.574278487  1.41198290 -6.666835399  2.572719555 -1.4293
68593  0.5665761470  1.852668322
3      Survived  2.194672154  1.45805335  0.248360500  0.299557116  1.2339
04702  0.6874688312  0.401272298
4      Survived  1.001164626  1.09450338 -0.202877398  0.186494806  0.9991
45445  1.0055616792 -1.476651034
5      Survived  3.861077199  2.25146777 -0.229051852 -2.396864878  0.2253
72700  0.7907638877  1.595052670
6      Survived  2.883484499 -1.09436576  0.200995302  0.455488197  0.5573
26566 -0.2653173061  0.784753532
7      Survived  1.839012035  0.70775475  0.080418409  1.460008689  1.8164
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8      Survived  0.455360392 -1.53586808 -0.759826070 -1.936838839  0.2289
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9      Survived  0.474195729 -2.26374727 -0.019057679  0.202454201 -0.1981
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10     Survived  5.680060396 -1.28976044 -1.407888218 -2.441375335 -3.5361
44927 -1.0435991316 -3.466728568
11     Survived  3.017371991 -0.79707712 -0.682172261 -1.580903730 -0.5211
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12     Survived  0.472521587  0.02623260 -0.395652565  0.491085487  1.7348
42231  0.3958806632 -0.894051806
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06635  1.0204374051 -0.881264591
16     Survived  1.859952346 -1.24401283  0.650007336  2.228681690  0.2394
46962  0.6105672381  0.775763180
17     Survived  1.221808068 -1.70066238 -0.211174678  0.812718015  1.6395
73239 -0.5453170933  0.138536956
18     Survived  1.345531498  2.87698568 -0.065560148 -0.008738069  1.2226
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19     Survived  0.851415204 -0.24927690 -0.221341721  0.697992982  1.7760
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20     Survived  2.150365415  1.13990968  0.688960144  0.061192629 -1.3868
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21        Death  1.033301579  0.10945386 -0.268623521 -0.038477280  1.4975
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22     Survived  1.129172675 -0.12108011 -0.357627646 -0.323275778  1.0738
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23     Survived  0.422199728 -0.84308321 -0.393018748  0.283073537  1.4469
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24        Death -0.235531658 -1.44631516 -0.218263270 -1.052362183  0.2860
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25     Survived  1.822053892 -0.13268007 -0.548513080  0.073354419  0.8077
87779 -0.1294316785  0.116148727
26     Survived  1.211927948 -1.55852999  0.088797416  1.785177512  0.7915
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27     Survived  1.834357465 -1.74280555  0.206741231  1.294466895  1.3907
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28     Survived  0.939657383 -1.11344966 -0.102316574 -0.071396112  0.6862
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30     Survived  2.170111207 -0.11031449  0.277148018  0.488046835  1.2587
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31     Survived  2.419058992 -1.30450228 -0.444821437  0.393380381  0.7728
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32     Survived  2.619440445 -1.57518565 -0.373302592 -1.124457399 -0.0919
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33     Survived  0.870040276  0.95752847 -0.203683114 -1.272618560  0.6852
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34        Death  0.071831204  0.29040382 -0.385314111 -0.381186909  1.0944
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35     Survived  0.295619354 -1.34268381  0.295746476  1.024667445  0.5423
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36     Survived  2.366785028 -0.15774971 -0.492263876 -0.027577809 -0.6153
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37     Survived  1.802460653 -1.80854919  0.349194762  0.615964733  0.8131
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38     Survived  0.067800124 -2.65656830 -1.009720374  0.863267242  0.9960
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39        Death  0.740960337  0.45326198 -2.565235444  0.343473433 -0.2117
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40     Survived  0.754675855 -1.06960340 -0.760881550 -0.396023882 -0.0062
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41     Survived  1.728226290  0.65528545 -0.603764837 -0.031250025  1.0781
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42     Survived  0.564583762  0.86243427  0.326317900  0.689194945  0.7438
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43     Survived  0.680504418 -1.04234057 -0.108195229  1.169430712  0.4907
99810  0.5497642220  0.021608374
44        Death  1.087045793 -1.08249570  0.328423953  0.402557475  0.4714
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45     Survived -0.311539941 -1.83302466 -0.101275846  1.213830348 -0.0893
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46     Survived  0.487793213  0.17189432 -0.661432917 -0.671397328  0.0972
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50     Survived -0.221980025 -0.36637980 -0.710779526 -0.872814270  1.5043
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52     Survived  0.024450754  0.37833829 -0.874297141 -1.310510384  1.6057
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53     Survived  1.389219421 -2.06229011 -3.824538635  1.108881440 -4.4774
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56     Survived  2.350889553 -1.17195573 -1.007499845 -1.554526362  1.2307
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57        Death  1.538184599 -0.57240856  0.041160192  0.294900739  0.0347
34266 -0.0713796971 -0.986267332
58        Death -0.028549263 -0.26347750 -0.131943875  0.745951460  0.7871
80040  0.8011994711  0.109463225
59     Survived  0.052014543  1.25821207 -0.888011760 -0.514782352  1.1582
10543  0.5500072030 -0.671970173
60     Survived  1.218097726  0.46525529 -0.248441327  0.226962433  1.3914
67261 -0.5683265136 -0.272470389
61     Survived -1.692110282  2.05068215 -6.991848529  1.468346411 -0.9383
04467 -0.0709837824  0.882025674
62     Survived  1.135269058  0.68206499  0.152990548 -0.402712460 -0.6015
90557  1.4383014638 -0.077215703
63        Death -0.046225751 -0.08381908  0.034087240  0.152911399  0.8202
95715  0.7466479873 -0.693393416
64     Survived -1.435304180 -0.51688460 -1.055822239 -0.440811867  1.0192
92633  0.7474642648 -1.642002703
65        Death -0.979853731 -2.02448640  0.057308387 -0.062079312 -1.3868
90080  2.7551825256  0.732698244
66     Survived  2.739284543  2.02249305  0.656291473  0.030305674 -0.2784
56412  0.5179298565 -0.184574598
67     Survived  0.183577886  1.99073251 -0.019716923  0.018953660  1.0319
27447  0.9039305421 -1.244751617
68     Survived  0.546735936 -0.28361149 -0.121285133  0.350834735  1.5937
46266 -0.5963725703 -0.612970844
69     Survived  0.412380201 -0.32254855 -0.110081116  0.714743476  1.4310
40262 -0.5548150195 -1.046311438
70     Survived  0.723566983 -0.12382872 -0.986324303 -2.196245219  1.2010
58600 -0.5084932603 -0.475889693
71        Death -1.218425240 -0.19662590 -0.416672679 -0.943892674  0.7788
73408  1.3687020917 -0.881154215
72        Death  0.105659414  0.26894416  0.255234921  1.494875433  0.5400
98147  0.7072689100 -0.372642297
73     Survived  0.914040996  0.67649384 -4.495989768  2.161336102 -0.7198
22898 -1.2197462066  2.774933238
74        Death  0.542927160 -0.82066857  0.603398067  1.041780820 -0.1030
92610  0.8549638996  0.243568370
75     Survived  1.112017572  0.83041659 -0.352871545 -0.013451198  1.2113
18067 -0.4654118252  0.074117766
76     Survived  0.208258029  0.75719677  0.261759685  0.671679299  1.5923
94984  0.0202007382 -0.789387286
77        Death -0.300209776 -2.30138793  0.093420385  0.012406458  0.3288
42235  0.5445494007  0.467636699
78        Death -0.732955143  0.10075546  0.176907805  0.128623363  0.2762
59743  1.4753190138 -1.071371958
79        Death  1.094899655 -0.23133678  0.205581474 -0.309197030  0.9990
75137  0.0003178305  1.400904366
80        Death -0.659299249 -0.84081029 -0.295325698 -0.246150826  0.5603
11553  0.8001136645 -0.354116510
81        Death  0.898899651 -0.74122234  0.054642137 -0.304600260  0.3906
75941 -0.0035217891  0.001537837
```

```
82        Death  0.253088019 -1.09736262 -0.136703889  0.254531985  0.0821
28042  0.4900349743  0.471853331
83     Survived  1.720331193  1.10851185  0.344824719 -0.143239214  0.0048
72638  0.2757218559 -0.531373823
84        Death  1.683136644 -1.06059855  0.746148879  0.599058669 -0.2621
40573  0.1565467236  0.910783889
85     Survived -0.224538545  0.11235421 -0.352744893  0.023248739  1.3444
37439 -0.1131322053 -1.035247405
86        Death -1.151513816 -1.21250409 -0.330757839 -1.055724674  0.6213
47378  1.0423315303 -0.269008477
87        Death  0.212753302  0.35540826  0.564377812  0.622494727  0.5115
85111  0.8346338322 -0.392404557
88        Death -0.496720701 -2.06952239  0.187782659  0.023514297  0.2029
88071  0.7980802144  0.334965520
89        Death -0.825058931  0.15946121  0.301336410  0.171957307  0.5533
50478  1.4294935732 -0.613142116
90        Death -0.293654487  0.16690095  0.198251440  1.176350077  1.1747
38107  0.0801941551 -1.628848773
91        Death  0.437193912 -0.86515056  0.396015040  0.221279400  0.6343
76628  0.2945446186  0.611498324
92        Death  0.233484631 -0.15677138 -0.445976213 -0.343530882  0.0844
10402  0.7623580808  0.908482493
93        Death -0.912459299 -0.70634882 -0.034281669 -0.158595989 -0.7509
46878  2.1072402486  0.103889679
94     Survived  0.949803510  0.84575290  0.243857632  0.147137815  0.5711
92972  0.1601092585 -0.527831966
95        Death -0.772497571 -0.75879579 -0.198413135 -0.107287682  1.0894
83139  0.2900698685 -0.702589202
96        Death -0.633642154 -1.67115749  0.451812783  0.684580300 -0.1975
54479  1.2213349435 -0.081889038
97        Death  0.823566681  0.81045264 -0.167199621 -0.061155964  0.7962
68813 -0.0393243056  0.005760410
98        Death  0.316679586 -1.74487173  0.506793980  0.125646486 -0.1599
31728  0.7110875756  0.901655925
99        Death  0.260767162  0.40923352 -0.193194426 -0.510143968  1.1277
83979 -0.0874744944 -0.549211286
100       Death  0.002573181 -0.62774576  0.358219624  0.600606140  0.5889
89465  0.3061672151 -0.449577436
101       Death  0.008333481 -0.08019125 -0.320173929  0.136093490  1.3129
17483 -0.5082601223 -0.903526093
102       Death  0.573268149 -1.08316778 -0.124023448  0.368031900  0.3458
43583 -0.1866325749  0.559786844
103       Death  0.509729488 -0.44804994 -0.274241585  2.087489345  1.2014
26114 -1.2323863509 -0.787918340
104       Death -1.464960296  1.76959780 -4.076117749  1.988490963 -0.8513
81096  0.5535843888  0.155782970
105       Death -0.113877138 -1.59755565 -0.008273626  0.047084655 -0.3711
22208  0.4238922194 -1.284323449
106    Survived  0.139880280 -1.17617914 -1.595764608 -2.798664492  1.3409
07634 -1.2337483663 -0.408313416
107       Death -0.178221939 -0.29141447 -0.282122837  0.072738485 -0.1060
06915  0.8428724043  0.010081733
108       Death -0.802240780  0.90356978 -1.161229526  0.747206055 -0.0018
97865  0.9926740170 -0.184406159
109       Death  0.436689658  0.14007324 -0.540386095 -0.374546166  0.3041
77322  0.2824596547  0.759238359
110       Death -2.056008328 -1.39470030 -2.550111992 -4.778236744  1.5249
11195 -0.1587627395 -1.355509031
111    Survived  1.213262219 -2.03079665  0.368511239 -0.381310833 -0.0730
49892 -0.0660540657  1.865713291
112       Death  0.283002459  0.43995388  0.422817797 -0.030899320  0.4161
78909  0.7251984454 -0.125636227
113       Death  0.242367380  1.09196522 -0.095211776 -0.208401118  0.4722
99316  0.5028224779 -0.814057061
114    Survived  0.075737472 -2.06273695  0.017834998 -0.610744252 -0.1249
54592  0.4307459168  0.692924449
115       Death  1.006842772  0.72759069 -0.278752820 -1.283234105 -0.0424
03922  0.7473508231  1.661704128
```

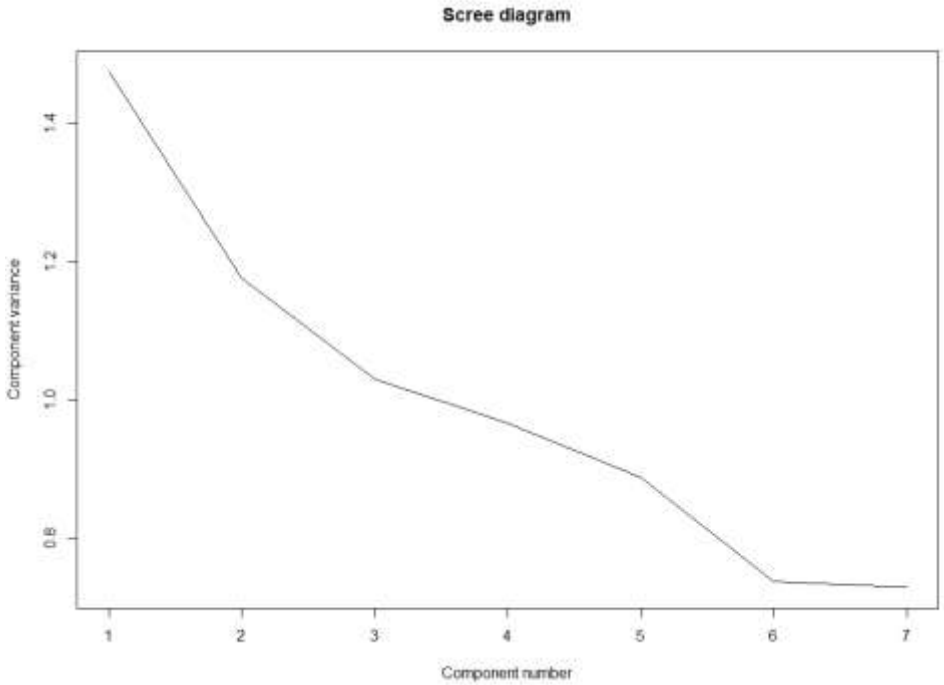
```
116       Death -0.103982578 -0.11051321  0.365666206  1.041590585  0.2984
52179  0.6525291907 -0.289937920
117       Death -0.365684607 -1.35522443  0.485459021 -0.103615987 -0.1091
18654  1.1839405585  0.865420272
118       Death  1.163861867 -3.20499374 -0.775561236 -1.942261693 -0.7353
84188 -0.9105762851 -0.014446815
119       Death -0.340763278 -1.76868340  0.628266621  0.849766258 -0.1448
23669  0.8463527849  0.314592742
120    Survived  1.685273027 -0.81267321 -0.125404518  0.172127042  0.2533
47357 -1.0065979264  0.768837380
121       Death  0.158419709 -1.00840275  0.151445136  0.404906568 -0.9466
39662  1.1772678918  0.774049838
122       Death  0.569665681 -0.05752705  0.739318347  0.823278334  0.4776
47055  0.2939223598  0.218693552
123       Death -0.332577870 -0.36890874  0.357320501  0.551769290  0.7850
21925  0.3506885198 -0.383376194
124       Death -0.507762929 -0.04984448  0.145008681  1.942721663  0.8477
37603 -0.0122678291 -1.295134379
125    Survived  1.652066665  0.09757809 -0.112262417 -0.200310380 -1.4806
48691  0.3268269144 -0.826596853
 [ reached 'max' / getOption("max.print") -- omitted 174 rows ]
> # Means of scores for all the PC's classified by Survival status
>
> #Calculating the mean for all PC's based on Death Event
> tabmeansPC <- aggregate(survival_pca[,2:8],by=list(DEATH_EVENT=dataset$D
EATH_EVENT),mean)
> tabmeansPC
  DEATH_EVENT        PC1         PC2        PC3        PC4        PC5
    PC6          PC7
1       Death -0.4519871 -0.03441739  0.1786064 -0.0251363 -0.1142166 -0.0
3881879  0.06661767
2    Survived  0.9557644  0.07277843 -0.3776781  0.0531528  0.2415204  0.0
8208557 -0.14086862
> #Swapping rows 1 and 2, putting Survived as row 1, Death as row 2
> tabmeansPC <- tabmeansPC[rev(order(tabmeansPC$DEATH_EVENT)),]
> tabmeansPC
  DEATH_EVENT        PC1         PC2        PC3        PC4        PC5
    PC6          PC7
2    Survived  0.9557644  0.07277843 -0.3776781  0.0531528  0.2415204  0.0
8208557 -0.14086862
1       Death -0.4519871 -0.03441739  0.1786064 -0.0251363 -0.1142166 -0.0
3881879  0.06661767
> #Transforming rows to columns and columns to rows
> tabfmeans <- t(tabmeansPC[,-1])
> tabfmeans
            2           1
PC1  0.95576444 -0.45198712
PC2  0.07277843 -0.03441739
PC3 -0.37767805  0.17860637
PC4  0.05315280 -0.02513630
PC5  0.24152044 -0.11421656
PC6  0.08208557 -0.03881879
PC7 -0.14086862  0.06661767
> #Changing column names from 2,1 to Survived and Death
> colnames(tabfmeans) <- t(as.vector(tabmeansPC[1]))
> tabfmeans
       Survived       Death
PC1  0.95576444 -0.45198712
PC2  0.07277843 -0.03441739
PC3 -0.37767805  0.17860637
PC4  0.05315280 -0.02513630
PC5  0.24152044 -0.11421656
PC6  0.08208557 -0.03881879
PC7 -0.14086862  0.06661767
> # Standard deviations of scores for all the PC's classified by Survival
status
>
> #Calculating the Standard deviation for all the PC's based on DEATH_EVEN
T
```

```
> tabsdsPC <- aggregate(survival_pca[,2:8],by=list(DEATH_EVENT=dataset$DEA
TH_EVENT),sd)
> tabfsds <- t(tabsdsPC[,-1])
> colnames(tabfsds) <- t(as.vector(tabsdsPC[1]))
> tabfsds
        Death  Survived
PC1 0.9155587 1.2179821
PC2 0.9879895 1.2665760
PC3 0.8109423 1.2722743
PC4 0.9689635 1.0150444
PC5 0.7177452 1.2658873
PC6 0.8504365 0.8748547
PC7 0.7529194 1.0255226
> #T-Test
> t.test(PC1~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test

data:  PC1 by dataset$DEATH_EVENT
t = -10.06, df = 147.6, p-value < 2.2e-16
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -1.684289 -1.131214
sample estimates:
   mean in group Death mean in group Survived
            -0.4519871              0.9557644

> t.test(PC2~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test

data:  PC2 by dataset$DEATH_EVENT
t = -0.73075, df = 151.63, p-value = 0.4661
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.3970234  0.1826318
sample estimates:
   mean in group Death mean in group Survived
           -0.03441739             0.07277843

> t.test(PC3~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test

data:  PC3 by dataset$DEATH_EVENT
t = 3.9236, df = 132.71, p-value = 0.0001393
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 0.2758487 0.8367202
sample estimates:
   mean in group Death mean in group Survived
             0.1786064             -0.3776781

> t.test(PC4~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test

data:  PC4 by dataset$DEATH_EVENT
t = -0.63174, df = 178.9, p-value = 0.5284
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.3228329  0.1662547
sample estimates:
   mean in group Death mean in group Survived
            -0.0251363              0.0531528

> t.test(PC5~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test
```

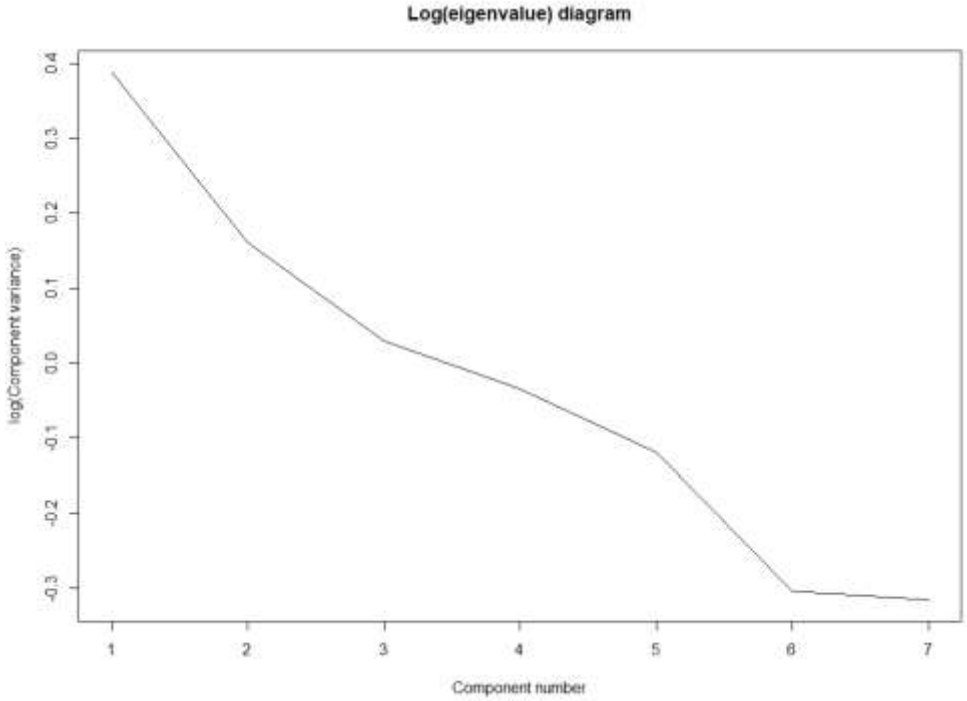
```
data:  PC5 by dataset$DEATH_EVENT
t = -2.5653, df = 124.73, p-value = 0.01149
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.63019346 -0.08128055
sample estimates:
   mean in group Death mean in group Survived
            -0.1142166              0.2415204

> t.test(PC6~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test

data:  PC6 by dataset$DEATH_EVENT
t = -1.1257, df = 181.8, p-value = 0.2618
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.33282083  0.09101212
sample estimates:
   mean in group Death mean in group Survived
            -0.03881879             0.08208557

> t.test(PC7~dataset$DEATH_EVENT,data=survival_pca)

        Welch Two Sample t-test

data:  PC7 by dataset$DEATH_EVENT
t = 1.7696, df = 145.17, p-value = 0.07889
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
 -0.02425267  0.43922525
sample estimates:
   mean in group Death mean in group Survived
             0.06661767            -0.14086862

> #From the results of T-test based on alpha=0.05, we can conclude -
> #PC1, PC3, and PC5 have significant difference in the means between pati
ents who survived and who are dead
> #PC2, PC4, PC6, and PC7 have no significant difference in the means betw
een patients who survived and who are dead
>
> #F-Test
> #F-Test
> var.test(PC1~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC1 by dataset$DEATH_EVENT
F = 0.56505, num df = 202, denom df = 95, p-value = 0.0007985
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.3952366 0.7903553
sample estimates:
ratio of variances
         0.5650548

> var.test(PC2~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC2 by dataset$DEATH_EVENT
F = 0.60847, num df = 202, denom df = 95, p-value = 0.003586
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.425607 0.851087
sample estimates:
ratio of variances
         0.6084742
```

```
> var.test(PC3~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC3 by dataset$DEATH_EVENT
F = 0.40627, num df = 202, denom df = 95, p-value = 9.559e-08
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.2841744 0.5682641
sample estimates:
ratio of variances
         0.4062734

> var.test(PC4~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC4 by dataset$DEATH_EVENT
F = 0.91127, num df = 202, denom df = 95, p-value = 0.5815
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.637399 1.274608
sample estimates:
ratio of variances
         0.9112652

> var.test(PC5~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC5 by dataset$DEATH_EVENT
F = 0.32148, num df = 202, denom df = 95, p-value = 1.502e-11
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.2248625 0.4496580
sample estimates:
ratio of variances
         0.3214774

> var.test(PC6~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC6 by dataset$DEATH_EVENT
F = 0.94496, num df = 202, denom df = 95, p-value = 0.7313
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.6609651 1.3217331
sample estimates:
ratio of variances
         0.9449568

> var.test(PC7~dataset$DEATH_EVENT,data=survival_pca)

        F test to compare two variances

data:  PC7 by dataset$DEATH_EVENT
F = 0.53902, num df = 202, denom df = 95, p-value = 0.0002779
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
 0.3770276 0.7539428
sample estimates:
ratio of variances
         0.5390221

> #From the results of F-test based on alpha=0.05, we can conclude -
> #PC1, PC2, PC3, PC5 and PC7 have significant difference in the variance
between patients who survived and who are dead
```

```
> #PC4 and PC6 have no significant difference in the variance between pati
ents who survived and who are dead
>
> #Plotting the Scree diagram
> plot(eigen_dataset, xlab = "Component number", ylab = "Component varianc
e", type = "l", main = "Scree diagram")
```

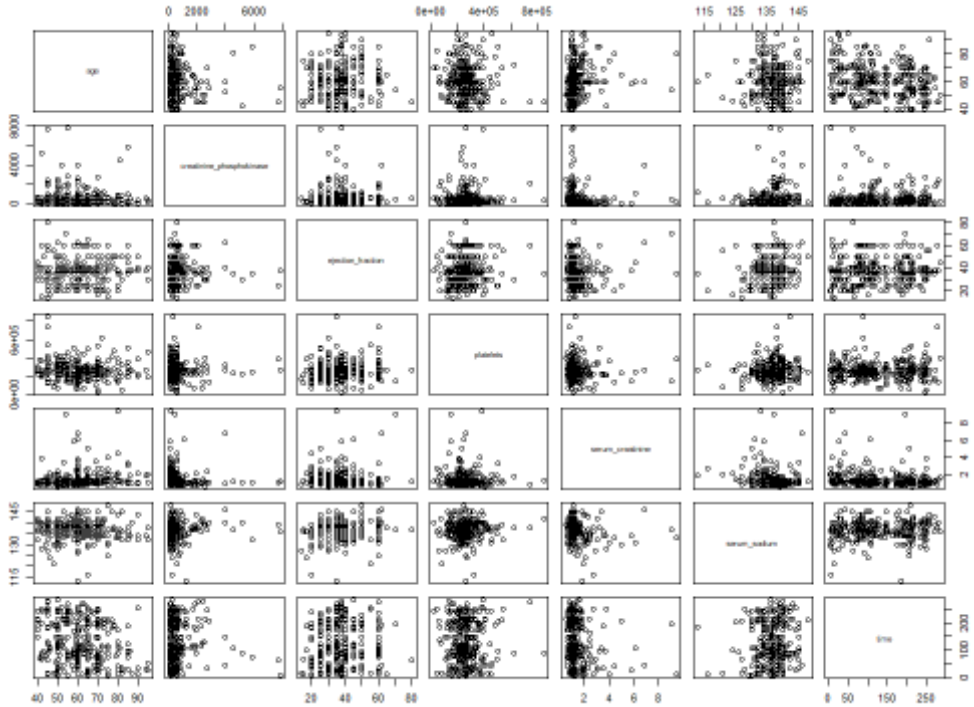



```
> #Based on scree diagram, since the position of elbow is at PC6, we shoul
d keep PC1 to PC6 and discard PC7.
>
> plot(log(eigen_dataset), xlab = "Component number",ylab = "log(Component
 variance)", type="l",main = "Log(eigenvalue) diagram")
```

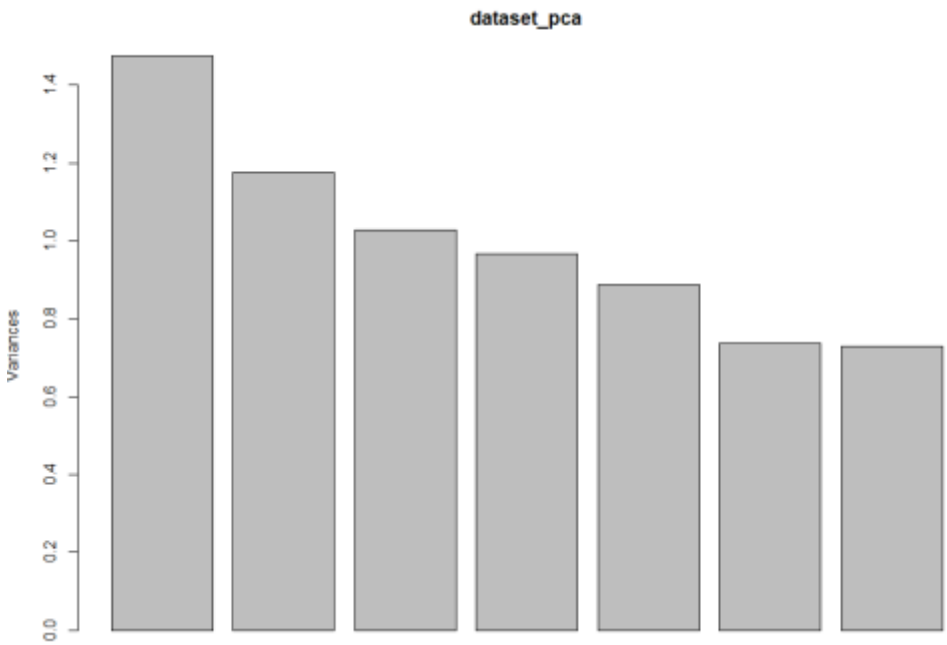



```
> #Based on Log scree diagram, since the position of elbow is at PC6, we s
hould keep PC1 to PC6 and discard PC7.
>
> print(summary(dataset_pca))
Importance of components:
```

```
                          PC1     PC2     PC3     PC4     PC5     PC6     PC7
Standard deviation     1.2143 1.0842 1.0146 0.9830 0.9422 0.8587 0.8538
Proportion of Variance 0.2107 0.1679 0.1471 0.1380 0.1268 0.1053 0.1041
Cumulative Proportion  0.2107 0.3786 0.5257 0.6637 0.7905 0.8959 1.0000
> View(dataset_pca)
> diag(cov(dataset_pca$x))
      PC1       PC2       PC3       PC4       PC5       PC6       PC7
1.4745726 1.1755914 1.0294792 0.9662257 0.8877341 0.7374427 0.7289544
> dataset_pca$rotation[,1]
                     age creatinine_phosphokinase         ejection_fraction
               platelets
               0.4649617                -0.1379593                -0.1788924
               -0.1992576
        serum_creatinine              serum_sodium                      time

               0.5117770                -0.4474108                -0.4806034

> dataset_pca$rotation
                                  PC1         PC2         PC3         PC4
     PC5         PC6          PC7
age                          0.4649617 -0.45213222  0.00779977  0.19809211  0
.1912135 -0.6341378  0.318421659
creatinine_phosphokinase -0.1379593  0.19389349 -0.81505355  0.33440577 -0
.2948224 -0.1008787  0.264832516
ejection_fraction        -0.1788924 -0.68147830  0.10671326  0.01299509 -0
.4694857  0.3913478  0.344177806
platelets                -0.1992576 -0.24678636 -0.40331735 -0.82095373  0
.1807563 -0.1733047  0.007459381
serum_creatinine          0.5117770 -0.04569638 -0.10167226 -0.18226520 -0
.6335802 -0.1069130 -0.528757042
serum_sodium             -0.4474108 -0.42971962 -0.11797610  0.36260682  0
.1513990 -0.1865190 -0.641912443
time                     -0.4806034  0.21428597  0.37056533 -0.10046937 -0
.4461860 -0.5985695  0.135357997

> plot(dataset[c(1,3,5,7,8,9,12)])
```



```
> #Based on the plot, we can see our original continuous variables are not
 correlated
```




```
> #Based on the plot, we can see variance for PC1 through PC7 is decreasin
g
>
> #get the original value of the data based on PCA
> center <- dataset_pca$center
> scale <- dataset_pca$scale
> new_dataset <- as.matrix(dataset[c(1,3,5,7,8,9,12)])
> new_dataset
          age creatinine_phosphokinase ejection_fraction platelets serum_c
reatinine serum_sodium time
  [1,] 75.000                      582                20    265000
     1.90          130    4
  [2,] 55.000                     7861                38    263358
     1.10          136    6
  [3,] 65.000                      146                20    162000
     1.30          129    7
  [4,] 50.000                      111                20    210000
     1.90          137    7
  [5,] 65.000                      160                20    327000
     2.70          116    8
  [6,] 90.000                       47                40    204000
     2.10          132    8
  [7,] 75.000                      246                15    127000
     1.20          137   10
  [8,] 60.000                      315                60    454000
     1.10          131   10
  [9,] 65.000                      157                65    263358
     1.50          138   10
 [10,] 80.000                      123                35    388000
     9.40          133   10
 [11,] 75.000                       81                38    368000
     4.00          131   10
 [12,] 62.000                      231                25    253000
     0.90          140   10
 [13,] 45.000                      981                30    136000
     1.10          137   11
 [14,] 50.000                      168                38    276000
     1.10          137   11
 [15,] 49.000                       80                30    427000
     1.00          138   12
 [16,] 82.000                      379                50     47000
     1.30          136   13
 [17,] 87.000                      149                38    262000
     0.90          140   14
```

```
[18,] 45.000                  582              14    166000
    0.80         127   14
[19,] 70.000                  125              25    237000
    1.00         140   15
[20,] 48.000                  582              55     87000
    1.90         121   15
[21,] 65.000                   52              25    276000
    1.30         137   16
[22,] 65.000                  128              30    297000
    1.60         136   20
[23,] 68.000                  220              35    289000
    0.90         140   20
[24,] 53.000                   63              60    368000
    0.80         135   22
[25,] 75.000                  582              30    263358
    1.83         134   23
[26,] 80.000                  148              38    149000
    1.90         144   23
[27,] 95.000                  112              40    196000
    1.00         138   24
[28,] 70.000                  122              45    284000
    1.30         136   26
[29,] 58.000                   60              38    153000
    5.80         134   26
[30,] 82.000                   70              30    200000
    1.20         132   26
[31,] 94.000                  582              38    263358
    1.83         134   27
[32,] 85.000                   23              45    360000
    3.00         132   28
[33,] 50.000                  249              35    319000
    1.00         128   28
[34,] 50.000                  159              30    302000
    1.20         138   29
[35,] 65.000                   94              50    188000
    1.00         140   29
[36,] 69.000                  582              35    228000
    3.50         134   30
[37,] 90.000                   60              50    226000
    1.00         134   30
[38,] 82.000                  855              50    321000
    1.00         145   30
[39,] 60.000                 2656              30    305000
    2.30         137   30
[40,] 60.000                  235              38    329000
    3.00         142   30
[41,] 70.000                  582              20    263358
    1.83         134   31
[42,] 50.000                  124              30    153000
    1.20         136   32
[43,] 70.000                  571              45    185000
    1.20         139   33
[44,] 72.000                  127              50    218000
    1.00         134   33
[45,] 60.000                  588              60    194000
    1.10         142   33
[46,] 50.000                  582              38    310000
    1.90         135   35
[47,] 51.000                 1380              25    271000
    0.90         130   38
[48,] 60.000                  582              38    451000
    0.60         138   40
[49,] 80.000                  553              20    140000
    4.40         133   41
[50,] 57.000                  129              30    395000
    1.00         140   42
[51,] 68.000                  577              25    166000
    1.00         138   43
```

```
[52,] 53.000                  91              20    418000
    1.40         139   43
[53,] 60.000                3964              62    263358
    6.80         146   43
[54,] 70.000                  69              50    351000
    1.00         134   44
[55,] 60.000                 260              38    255000
    2.20         132   45
[56,] 95.000                 371              30    461000
    2.00         132   50
[57,] 70.000                  75              35    223000
    2.70         138   54
[58,] 60.000                 607              40    216000
    0.60         138   54
[59,] 49.000                 789              20    319000
    1.10         136   55
[60,] 72.000                 364              20    254000
    1.30         136   59
[61,] 45.000                7702              25    390000
    1.00         139   60
[62,] 50.000                 318              40    216000
    2.30         131   60
[63,] 55.000                 109              35    254000
    1.10         139   60
[64,] 45.000                 582              35    385000
    1.00         145   61
[65,] 45.000                 582              80    263358
    1.18         137   63
[66,] 60.000                  68              20    119000
    2.90         127   64
[67,] 42.000                 250              15    213000
    1.30         136   65
[68,] 72.000                 110              25    274000
    1.00         140   65
[69,] 70.000                 161              25    244000
    1.20         142   66
[70,] 65.000                 113              25    497000
    1.83         135   67
[71,] 41.000                 148              40    374000
    0.80         140   68
[72,] 58.000                 582              35    122000
    0.90         139   71
[73,] 85.000                5882              35    243000
    1.00         132   72
[74,] 65.000                 224              50    149000
    1.30         137   72
[75,] 69.000                 582              20    266000
    1.20         134   73
[76,] 60.000                  47              20    204000
    0.70         139   73
[77,] 70.000                  92              60    317000
    0.80         140   74
[78,] 42.000                 102              40    237000
    1.20         140   74
[79,] 75.000                 203              38    283000
    0.60         131   74
[80,] 55.000                 336              45    324000
    0.90         140   74
[81,] 70.000                  69              40    293000
    1.70         136   75
[82,] 67.000                 582              50    263358
    1.18         137   76
[83,] 60.000                  76              25    196000
    2.50         132   77
[84,] 79.000                  55              50    172000
    1.80         133   78
[85,] 59.000                 280              25    302000
    1.00         141   78
```

```
 [86,] 51.000                    78              50    406000
     0.70          140   79
 [87,] 55.000                    47              35    173000
     1.10          137   79
 [88,] 65.000                    68              60    304000
     0.80          140   79
 [89,] 44.000                    84              40    235000
     0.70          139   79
 [90,] 57.000                   115              25    181000
     1.10          144   79
 [91,] 70.000                    66              45    249000
     0.80          136   80
 [92,] 60.000                   897              45    297000
     1.00          133   80
 [93,] 42.000                   582              60    263358
     1.18          137   82
 [94,] 60.000                   154              25    210000
     1.70          135   82
 [95,] 58.000                   144              38    327000
     0.70          142   83
 [96,] 58.000                   133              60    219000
     1.00          141   83
 [97,] 63.000                   514              25    254000
     1.30          134   83
 [98,] 70.000                    59              60    255000
     1.10          136   85
 [99,] 60.000                   156              25    318000
     1.20          137   85
[100,] 63.000                    61              40    221000
     1.10          140   86
[101,] 65.000                   305              25    298000
     1.10          141   87
[102,] 75.000                   582              45    263358
     1.18          137   87
[103,] 80.000                   898              25    149000
     1.10          144   87
[104,] 42.000                  5209              30    226000
     1.00          140   87
[105,] 60.000                    53              50    286000
     2.30          143   87
[106,] 72.000                   328              30    621000
     1.70          138   88
[107,] 55.000                   748              45    263000
     1.30          137   88
[108,] 45.000                  1876              35    226000
     0.90          138   88
[109,] 63.000                   936              38    304000
     1.10          133   88
[110,] 45.000                   292              35    850000
     1.30          142   88
[111,] 85.000                   129              60    306000
     1.20          132   90
[112,] 55.000                    60              35    228000
     1.20          135   90
[113,] 50.000                   369              25    252000
     1.60          136   90
[114,] 70.000                   143              60    351000
     1.30          137   90
[115,] 60.000                   754              40    328000
     1.20          126   91
[116,] 58.000                   400              40    164000
     1.00          139   91
[117,] 60.000                    96              60    271000
     0.70          136   94
[118,] 85.000                   102              60    507000
     3.20          138   94
[119,] 65.000                   113              60    203000
     0.90          140   94
```

```
[120,] 86.000                    582                38    263358
     1.83          134   95
[121,] 60.000                    737                60    210000
     1.50          135   95
[122,] 66.000                     68                38    162000
     1.00          136   95
[123,] 60.000                     96                38    228000
     0.75          140   95
[124,] 60.000                    582                30    127000
     0.90          145   95
[125,] 60.000                    582                40    217000
     3.70          134   96
[126,] 43.000                    358                50    237000
     1.30          135   97
[127,] 46.000                    168                17    271000
     2.10          124  100
[128,] 58.000                    200                60    300000
     0.80          137  104
[129,] 61.000                    248                30    267000
     0.70          136  104
[130,] 53.000                    270                35    227000
     3.40          145  105
[131,] 53.000                   1808                60    249000
     0.70          138  106
[132,] 60.000                   1082                45    250000
     6.10          131  107
[133,] 46.000                    719                40    263358
     1.18          137  107
[134,] 63.000                    193                60    295000
     1.30          145  107
[135,] 81.000                   4540                35    231000
     1.18          137  107
[136,] 75.000                    582                40    263358
     1.18          137  107
[137,] 65.000                     59                60    172000
     0.90          137  107
[138,] 68.000                    646                25    305000
     2.10          130  108
[139,] 62.000                    281                35    221000
     1.00          136  108
[140,] 50.000                   1548                30    211000
     0.80          138  108
[141,] 80.000                    805                38    263358
     1.10          134  109
[142,] 46.000                    291                35    348000
     0.90          140  109
 [ reached getOption("max.print") -- omitted 157 rows ]
> drop(scale(new_dataset,center=center, scale=scale)%*%dataset_pca$rotatio
n[,1])
  [1]  2.527734332 -0.574278487  2.194672154  1.001164626  3.861077199  2.
883484499  1.839012035  0.455360392
  [9]  0.474195729  5.680060396  3.017371991  0.472521587  0.261088280  0.
165981735 -0.204362936  1.859952346
 [17]  1.221808068  1.345531498  0.851415204  2.150365415  1.033301579  1.
129172675  0.422199728 -0.235531658
 [25]  1.822053892  1.211927948  1.834357465  0.939657383  3.281061578  2.
170111207  2.419058992  2.619440445
 [33]  0.870040276  0.071831204  0.295619354  2.366785028  1.802460653  0.
067800124  0.740960337  0.754675855
 [41]  1.728226290  0.564583762  0.680504418  1.087045793 -0.311539941  0.
487793213  0.683082006 -0.386840249
 [49]  3.685428572 -0.221980025  0.883029796  0.024450754  1.389219421  0.
678036913  1.427202694  2.350889553
 [57]  1.538184599 -0.028549263  0.052014543  1.218097726 -1.692110282  1.
135269058 -0.046225751 -1.435304180
 [65] -0.979853731  2.739284543  0.183577886  0.546735936  0.412380201  0.
723566983 -1.218425240  0.105659414
 [73]  0.914040996  0.542927160  1.112017572  0.208258029 -0.300209776 -0.
732955143  1.094899655 -0.659299249
```

```
 [81]  0.898899651  0.253088019  1.720331193  1.683136644 -0.224538545 -1.
151513816  0.212753302 -0.496720701
 [89] -0.825058931 -0.293654487  0.437193912  0.233484631 -0.912459299  0.
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 [97]  0.823566681  0.316679586  0.260767162  0.002573181  0.008333481  0.
573268149  0.509729488 -1.464960296
[105] -0.113877138  0.139880280 -0.178221939 -0.802240780  0.436689658 -2.
056008328  1.213262219  0.283002459
[113]  0.242367380  0.075737472  1.006842772 -0.103982578 -0.365684607  1.
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467388846  1.598996552 -0.631581035
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119171547 -0.064509341 -0.444125160
[145]  0.460757223 -0.924018309 -0.233529052 -0.436148507  1.342902274 -0.
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243674925  1.052741541 -0.641623284
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[169] -0.274210238  0.266619075 -0.313167550 -1.664992985 -0.828592844 -0.
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[177]  0.360140667 -0.942848815 -1.237369104 -1.113963566 -1.048948290  0.
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[185] -0.140491790 -0.208716222 -0.763789931 -0.885651607 -0.237086422 -1.
751953036  0.963952570 -0.280126563
[193] -0.328597199 -0.100554842 -0.106987394 -0.323345347 -1.100442172 -0.
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[201] -0.526961934 -1.619396375 -0.544565076  1.098126067 -0.044705585 -1.
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[209] -1.332937139 -0.454241015 -0.015365369 -1.566238603 -0.420288289  0.
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[217] -1.197782071  2.819082320 -0.043717723 -1.499455374  0.811395730 -1.
236397919 -1.650361577 -0.536939811
[225] -1.200324688  0.924878863  0.272866522 -1.252703260  2.469660414  0.
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[233] -1.456235394 -0.981047821 -1.166563651 -0.442510536 -1.315580297  0.
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[241] -0.866587152 -0.174903513 -1.268929180 -0.751057834 -0.312419629 -0.
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[249] -2.108806972 -0.142319950 -2.065203834 -1.578989548 -0.853796227  0.
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[257] -0.506955333 -1.077683547 -1.032565634 -1.304782548 -1.031113651 -0.
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[265] -0.955640987 -1.803510740 -0.246207148 -0.753606147 -1.987215729 -1.
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[273] -0.045539249 -1.935981379 -0.576598362 -1.983165480 -1.130727977 -0.
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[281] -0.881285203  0.730056510  0.881590202 -1.019374984 -1.888089077 -1.
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[289] -1.303589546 -0.852531462 -2.317256458 -0.711910688 -1.858058677 -0.
674973316 -1.315379022 -1.624532343
[297] -3.483538653 -1.893077377 -1.534165847
> predict(dataset_pca)[,1]
  [1]  2.527734332 -0.574278487  2.194672154  1.001164626  3.861077199  2.
883484499  1.839012035  0.455360392
  [9]  0.474195729  5.680060396  3.017371991  0.472521587  0.261088280  0.
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 [17]  1.221808068  1.345531498  0.851415204  2.150365415  1.033301579  1.
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 [25]  1.822053892  1.211927948  1.834357465  0.939657383  3.281061578  2.
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 [41]  1.728226290  0.564583762  0.680504418  1.087045793 -0.311539941  0.
487793213  0.683082006 -0.386840249
```

```
 [49]  3.685428572 -0.221980025  0.883029796  0.024450754  1.389219421  0.
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 [97]  0.823566681  0.316679586  0.260767162  0.002573181  0.008333481  0.
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[105] -0.113877138  0.139880280 -0.178221939 -0.802240780  0.436689658 -2.
056008328  1.213262219  0.283002459
[113]  0.242367380  0.075737472  1.006842772 -0.103982578 -0.365684607  1.
163861867 -0.340763278  1.685273027
[121]  0.158419709  0.569665681 -0.332577870 -0.507762929  1.652066665 -0.
467388846  1.598996552 -0.631581035
[129]  0.051492264  0.158502028 -1.115008900  2.861531872 -0.628071057 -1.
007350019  0.338277538  0.525002664
[137] -0.046237238  1.542888334  0.227669813 -0.627333413  0.971203868 -1.
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[145]  0.460757223 -0.924018309 -0.233529052 -0.436148507  1.342902274 -0.
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[185] -0.140491790 -0.208716222 -0.763789931 -0.885651607 -0.237086422 -1.
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[193] -0.328597199 -0.100554842 -0.106987394 -0.323345347 -1.100442172 -0.
425418652 -0.455827916  2.175859645
[201] -0.526961934 -1.619396375 -0.544565076  1.098126067 -0.044705585 -1.
152797554 -1.787579734  0.623841874
[209] -1.332937139 -0.454241015 -0.015365369 -1.566238603 -0.420288289  0.
109330844 -0.203554839  0.464010829
[217] -1.197782071  2.819082320 -0.043717723 -1.499455374  0.811395730 -1.
236397919 -1.650361577 -0.536939811
[225] -1.200324688  0.924878863  0.272866522 -1.252703260  2.469660414  0.
360402970  1.211188272  0.273502305
[233] -1.456235394 -0.981047821 -1.166563651 -0.442510536 -1.315580297  0.
593644684 -0.498007769 -0.919197196
[241] -0.866587152 -0.174903513 -1.268929180 -0.751057834 -0.312419629 -0.
506160696 -1.140797421  0.563303858
[249] -2.108806972 -0.142319950 -2.065203834 -1.578989548 -0.853796227  0.
379228852 -1.578542305 -1.582204703
[257] -0.506955333 -1.077683547 -1.032565634 -1.304782548 -1.031113651 -0.
645646306  0.667472409 -1.075952992
[265] -0.955640987 -1.803510740 -0.246207148 -0.753606147 -1.987215729 -1.
113686655 -0.466392968 -1.009507851
[273] -0.045539249 -1.935981379 -0.576598362 -1.983165480 -1.130727977 -0.
359291244 -1.300653413 -1.237988366
[281] -0.881285203  0.730056510  0.881590202 -1.019374984 -1.888089077 -1.
018999515 -0.903279371 -1.911684096
[289] -1.303589546 -0.852531462 -2.317256458 -0.711910688 -1.858058677 -0.
674973316 -1.315379022 -1.624532343
[297] -3.483538653 -1.893077377 -1.534165847
> #The aboved two gives us the same thing
>
> out <- sapply(1:7, function(i){plot(dataset$DEATH_EVENT,dataset_pca$x[,i
],xlab=paste("PC",i,sep=""),ylab="DEATH_EVENT")})
> #From the box plot we can see -
```
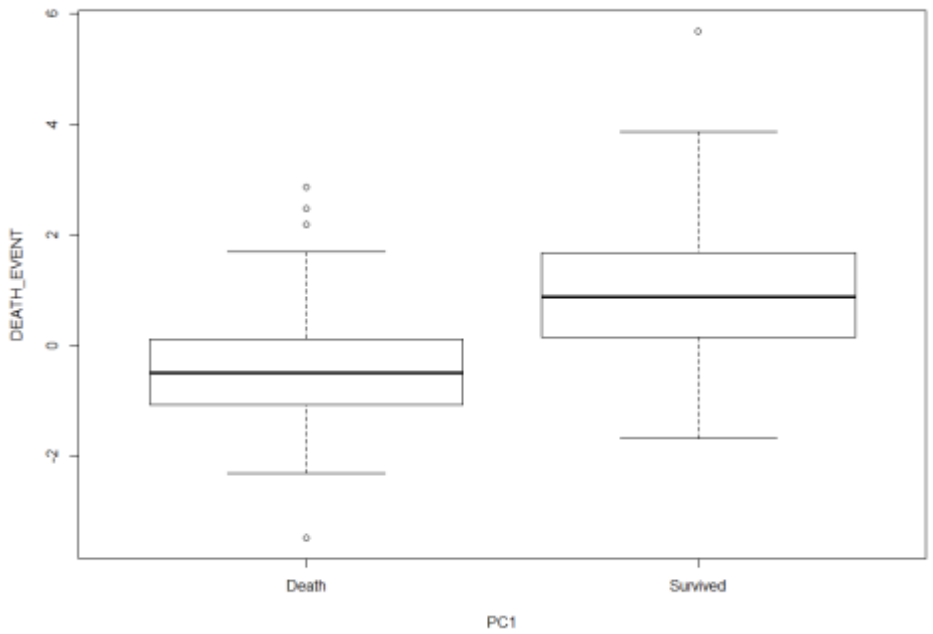
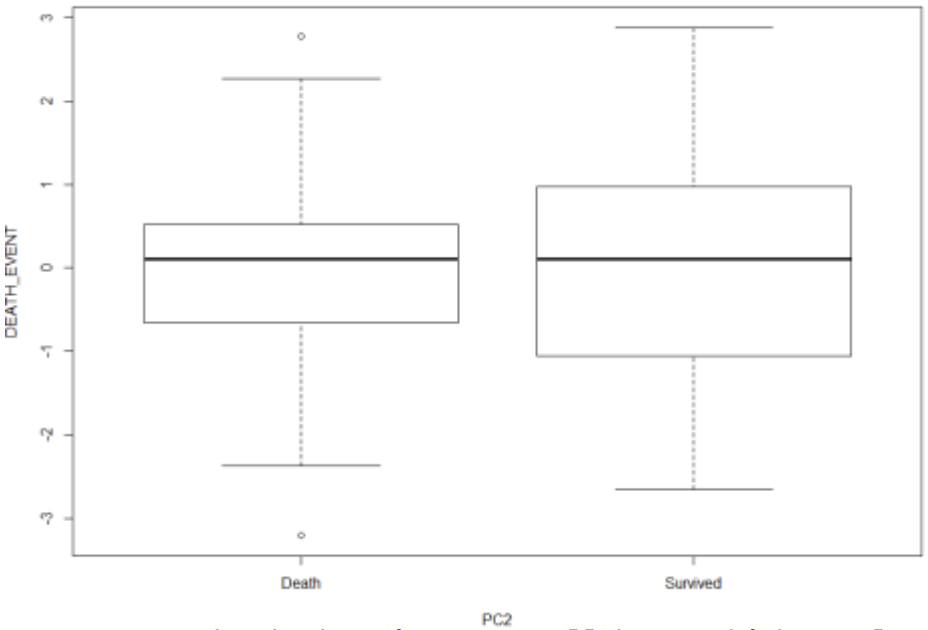
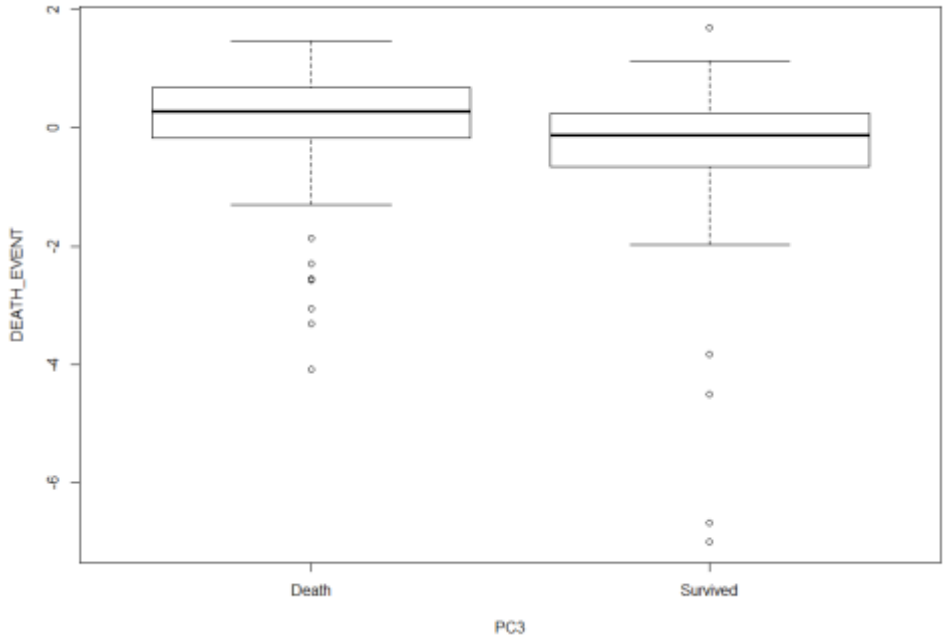

```
> #For PC1, the range for the survived patients is larger than the dead pa
tients; and the survived patients overall have a higher value in PC1 than
dead patients
```



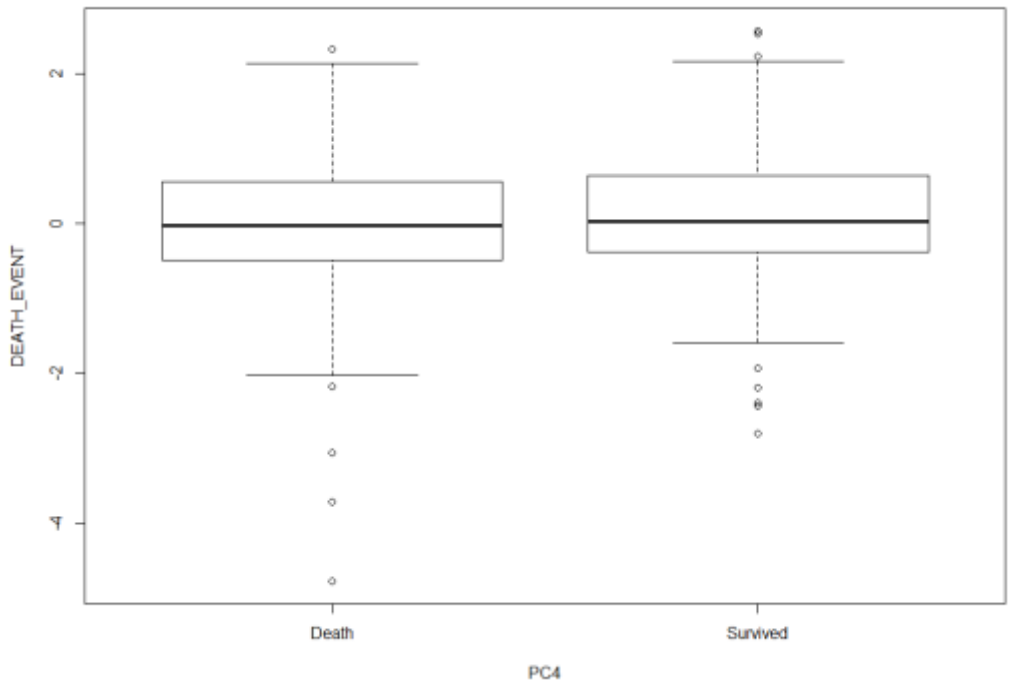

```
> #For PC2, the range for the survived patients is larger than the dead pa
tients
```



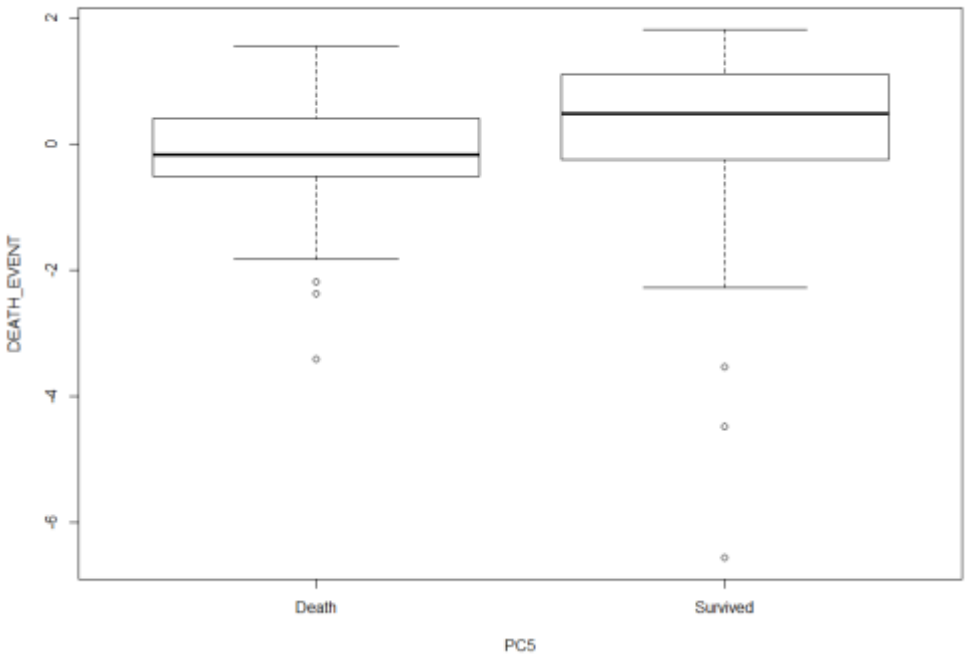

```
> #For PC3, the dead patients overall have a higher value than the survive
d patients
```



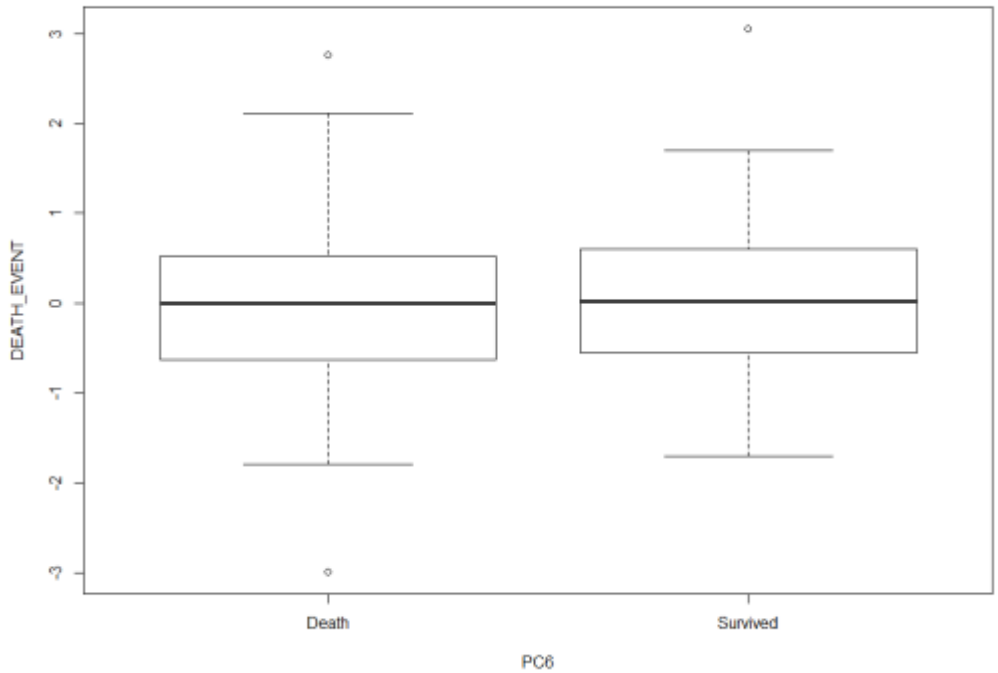

```
> #For PC4, the range for the dead patients is slightly larger than the su
rvived patients (with a smaller lower bound for dead patients)
```



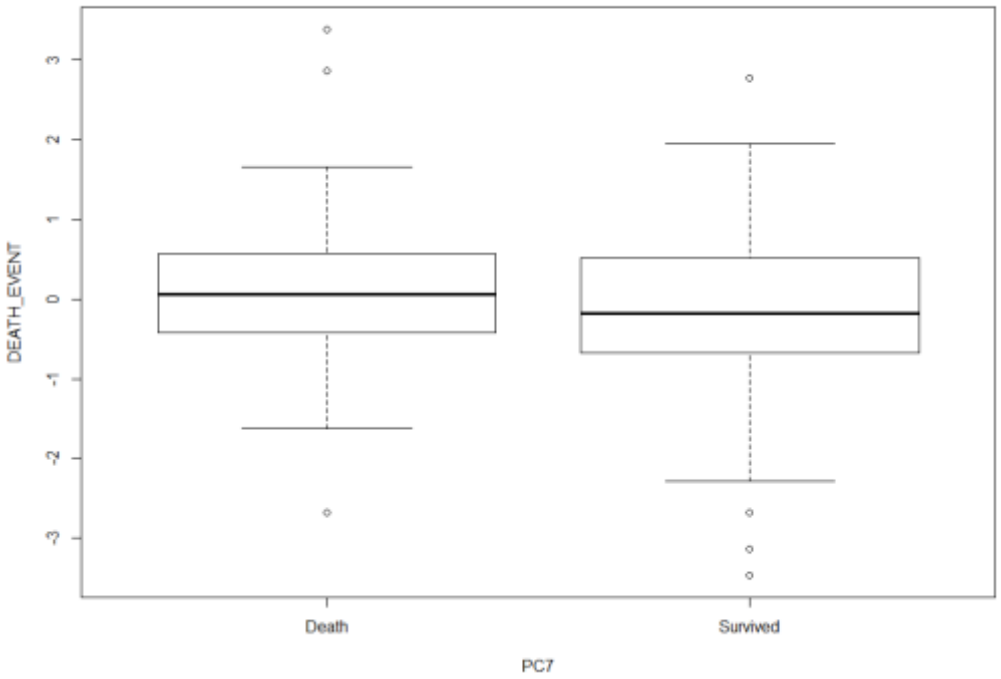

```
> #For PC5, the range for the survived patients is larger than the dead pa
tients
```



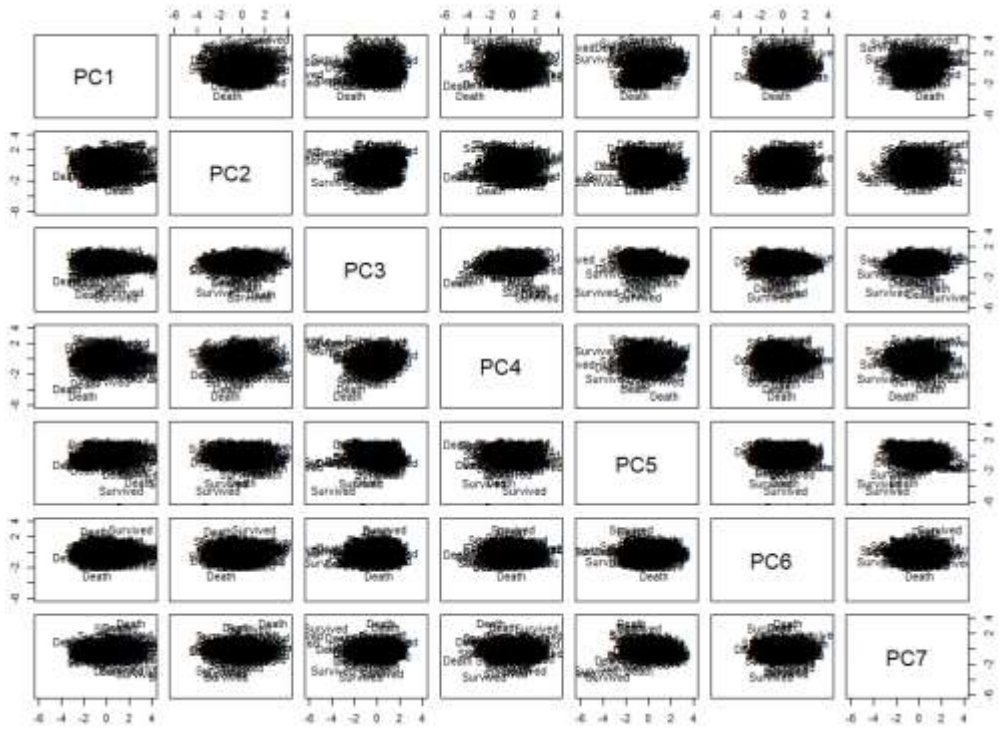

```
> #For PC6, the range for the dead patients is larger than the Survived pa
tients
```




```
> #For PC7, the range for the Survived patients is larger than the dead pa
tients
```




```
> pairs(dataset_pca$x[,1:7], ylim = c(-6,4),xlim = c(-6,4),panel=function(
x,y,...){text(x,y,dataset$DEATH_EVENT)})
```




```
> #From the graph, we can see all the PC's are uncorrelated
```