```
> #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/nidhi/OneDrive/Desktop/MVA/heart_failure_cl
inical_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
 [60,]  1.218097726  0.465255291 -0.2484413266  0.2269624328  1.391467261
-0.5683265136 -0.2724703887
 [61,] -1.692110282  2.050682155 -6.9918485287  1.4683464106 -0.938304467
-0.0709837824  0.8820256741
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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
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11     Survived  3.017371991 -0.79707712 -0.682172261 -1.580903730 -0.5211
53932  0.0045826272 -0.475329061
12     Survived  0.472521587  0.02623260 -0.395652565  0.491085487  1.7348
42231  0.3958806632 -0.894051806
13     Survived  0.261088280  1.11569000 -0.443920224  1.170963602  0.5879
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14     Survived  0.165981735 -0.05074358 -0.262897650 -0.192319415  0.8567
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15        Death -0.204362936 -0.04088161 -0.896583530 -1.417055356  1.5536
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16     Survived  1.859952346 -1.24401283  0.650007336  2.228681690  0.2394
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17     Survived  1.221808068 -1.70066238 -0.211174678  0.812718015  1.6395
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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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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
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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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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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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
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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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47      Survived  0.683082006  1.67971855 -1.041212480 -0.305217096  0.7380
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48      Survived -0.386840249 -0.78492940 -1.164893993 -1.219292027  1.3889
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49      Survived  3.685428572  0.59212141 -0.242252818  0.612822313 -0.6460
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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
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58        Death -0.028549263 -0.26347750 -0.131943875  0.745951460  0.7871
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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
```
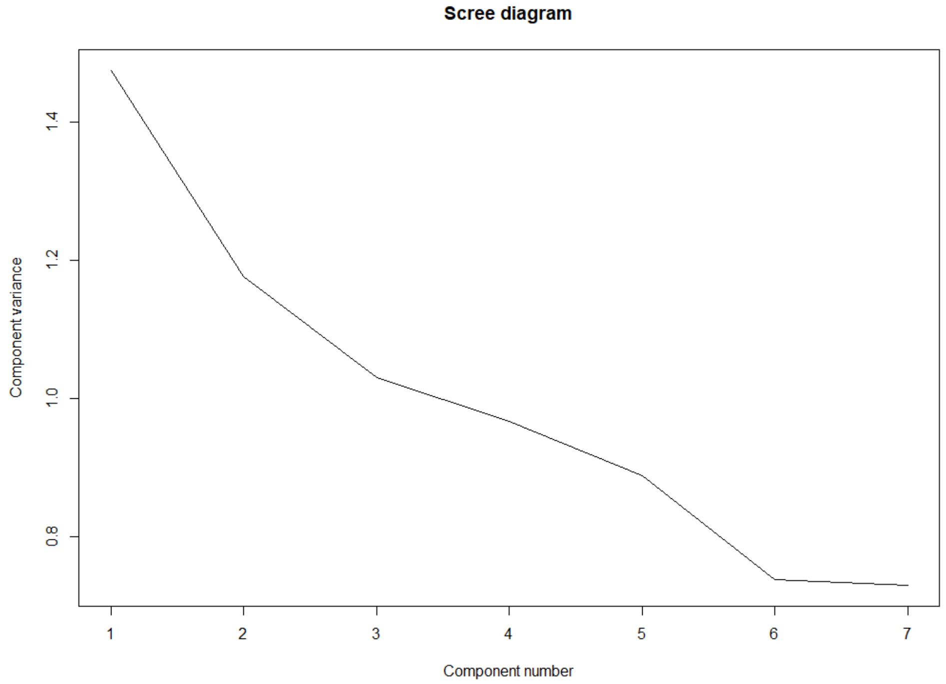

```
89         Death -0.825058931  0.15946121  0.301336410  0.171957307  0.5533
50478  1.4294935732 -0.613142116
90         Death -0.293654487  0.16690095  0.198251440  1.176350077  1.1747
38107  0.0801941551 -1.628848773
91         Death  0.437193912 -0.86515056  0.396015040  0.221279400  0.6343
76628  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
```

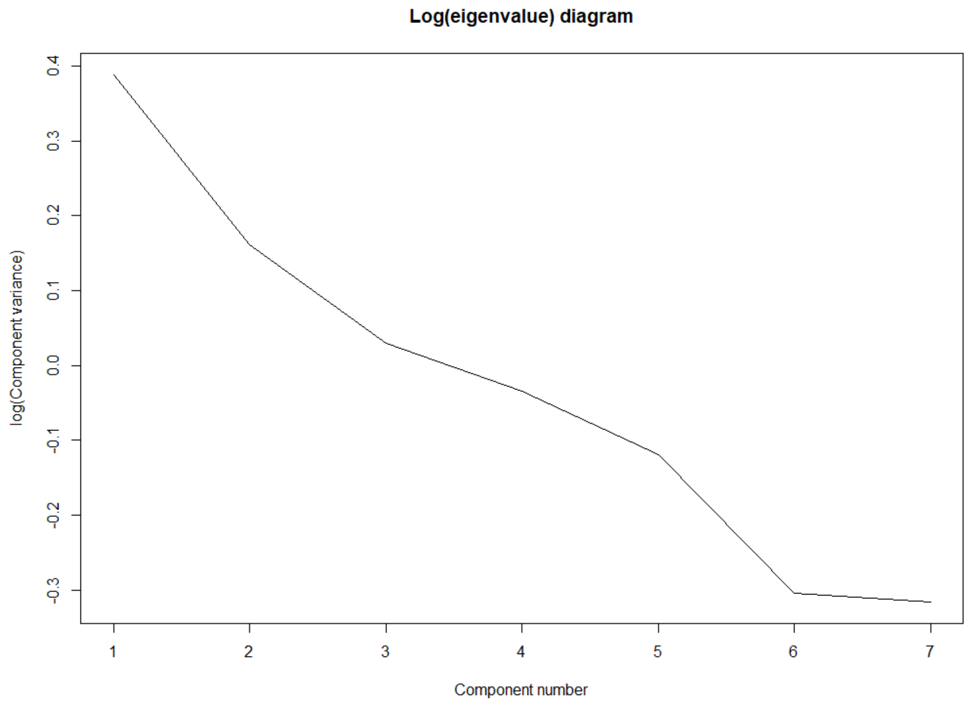
```
> t.test(PC1~dataset$DEATH_EVENT,data=survival_pca)

	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")
```

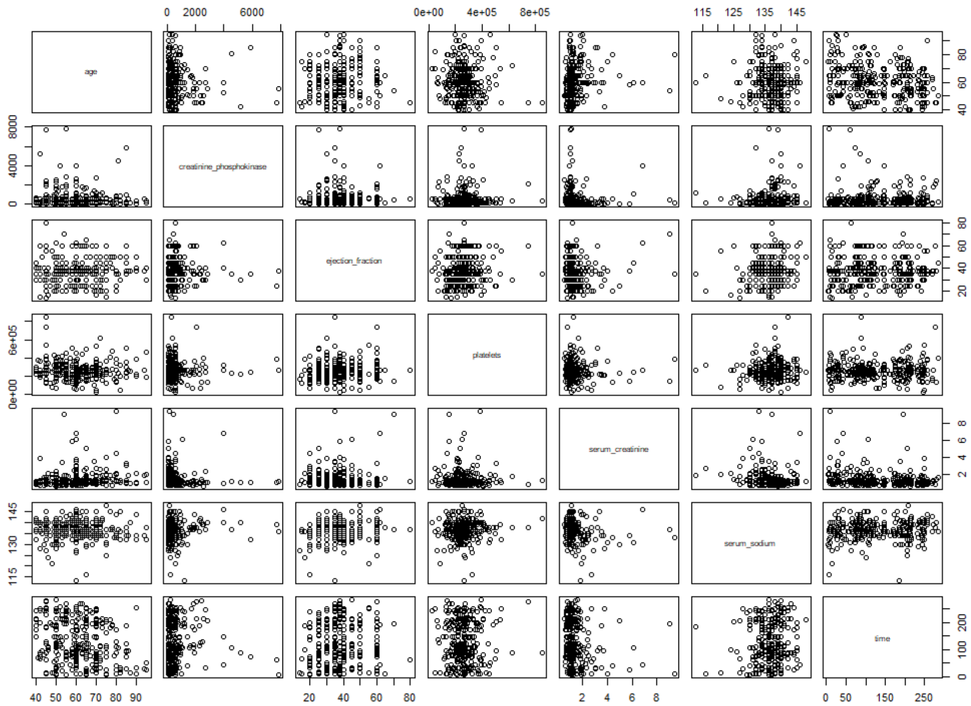



```
> #Based on scree diagram, since the position of elbow is at PC6, we shoul
d keep PC1 to PC6 and discard PC7.
>
> plot(log(eigen_dataset), xlab = "Component number",ylab = "log(Component
variance)", type="l",main = "Log(eigenvalue) diagram")
```

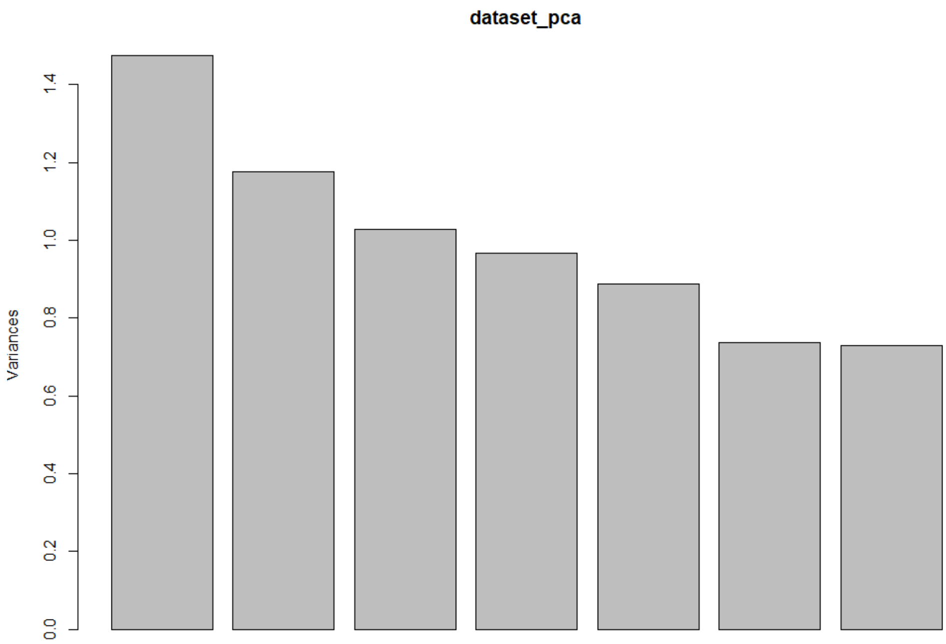



```
> #Based on Log scree diagram, since the position of elbow is at PC6, we s
hould keep PC1 to PC6 and discard PC7.
>
> print(summary(dataset_pca))
Importance of components:
                          PC1    PC2    PC3    PC4    PC5    PC6    PC7
Standard deviation     1.2143 1.0842 1.0146 0.9830 0.9422 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
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1.30          136    59
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1.00          139    60
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2.30          131    60
 [63,] 55.000                  109                 35     254000
1.10          139    60
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1.00          145    61
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1.18          137    63
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2.90          127    64
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1.30          136    65
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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
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[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
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1.50          135   95
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1.00          136   95
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0.75          140   95
[124,] 60.000                       582                 30     127000
0.90          145   95
[125,] 60.000                       582                 40     217000
3.70          134   96
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 [ reached getOption("max.print") -- omitted 157 rows ]
> drop(scale(new_dataset,center=center, scale=scale)%*%dataset_pca$rotatio
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  [9]  0.474195729  5.680060396  3.017371991  0.472521587  0.261088280  0.
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> predict(dataset_pca)[,1]
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[241] -0.866587152 -0.174903513 -1.268929180 -0.751057834 -0.312419629 -0.
506160696 -1.140797421  0.563303858
[249] -2.108806972 -0.142319950 -2.065203834 -1.578989548 -0.853796227  0.
379228852 -1.578542305 -1.582204703
[257] -0.506955333 -1.077683547 -1.032565634 -1.304782548 -1.031113651 -0.
645646306  0.667472409 -1.075952992
[265] -0.955640987 -1.803510740 -0.246207148 -0.753606147 -1.987215729 -1.
113686655 -0.466392968 -1.009507851
[273] -0.045539249 -1.935981379 -0.576598362 -1.983165480 -1.130727977 -0.
359291244 -1.300653413 -1.237988366
[281] -0.881285203  0.730056510  0.881590202 -1.019374984 -1.888089077 -1.
018999515 -0.903279371 -1.911684096
[289] -1.303589546 -0.852531462 -2.317256458 -0.711910688 -1.858058677 -0.
674973316 -1.315379022 -1.624532343
[297] -3.483538653 -1.893077377 -1.534165847
> #The aboved two gives us the same thing
>
> out <- sapply(1:7, function(i){plot(dataset$DEATH_EVENT,dataset_pca$x[,i
],xlab=paste("PC",i,sep=""),ylab="DEATH_EVENT")})
> #From the box plot we can see -
```
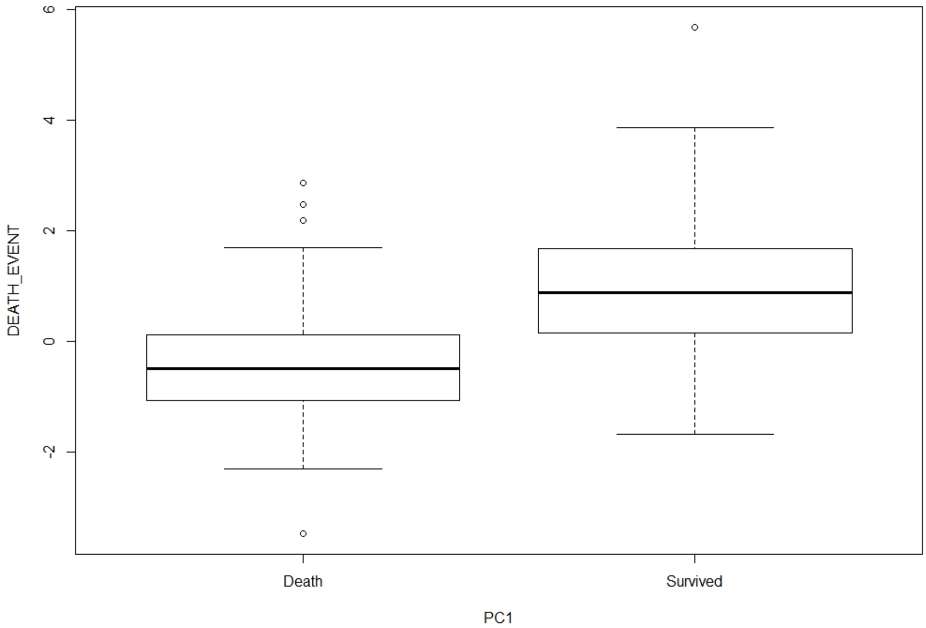
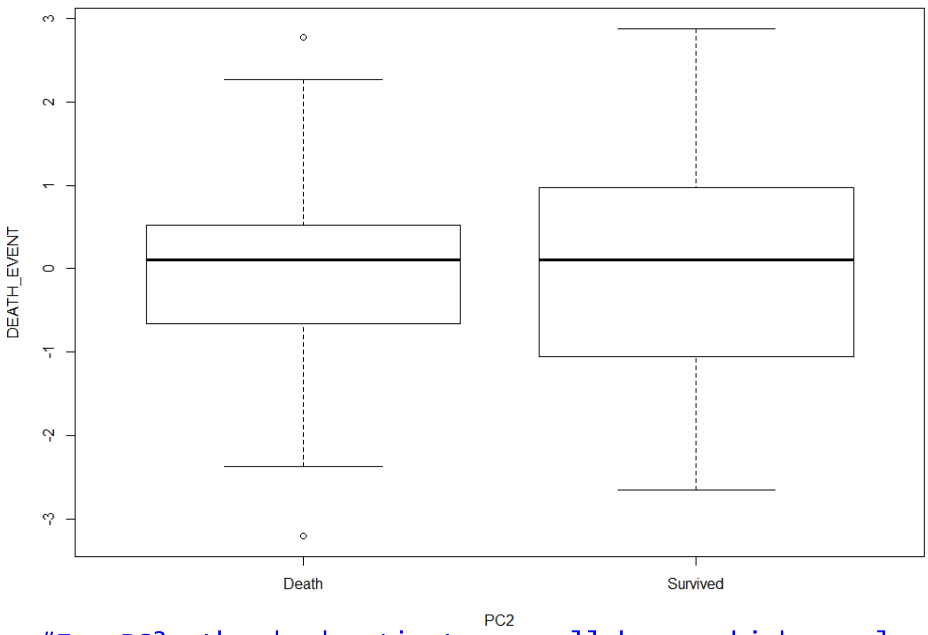
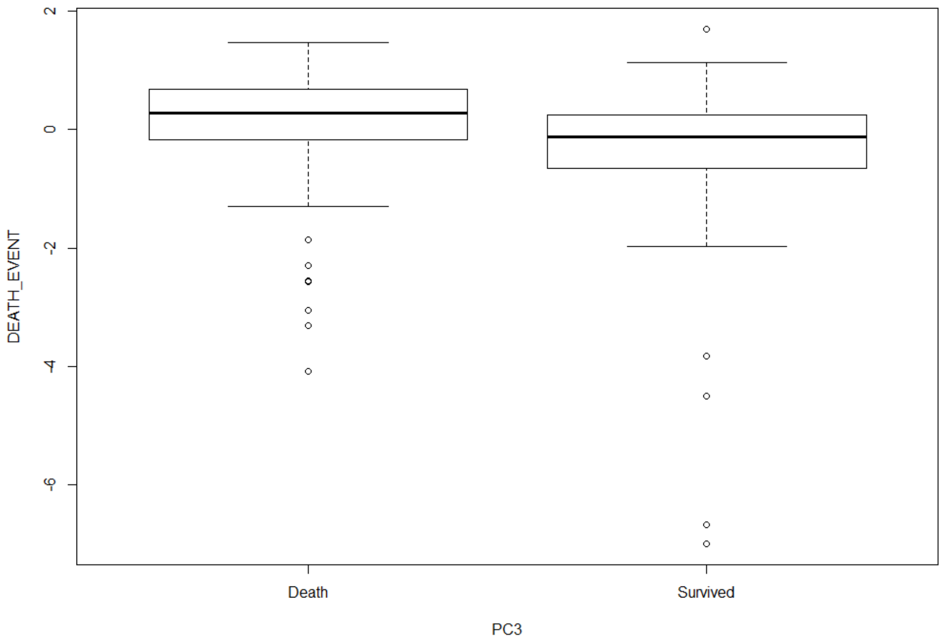

```
> #For PC1, the range for the survived patients is larger than the dead pa
tients; and the survived patients overall have a higher value in PC1 than
dead patients
```



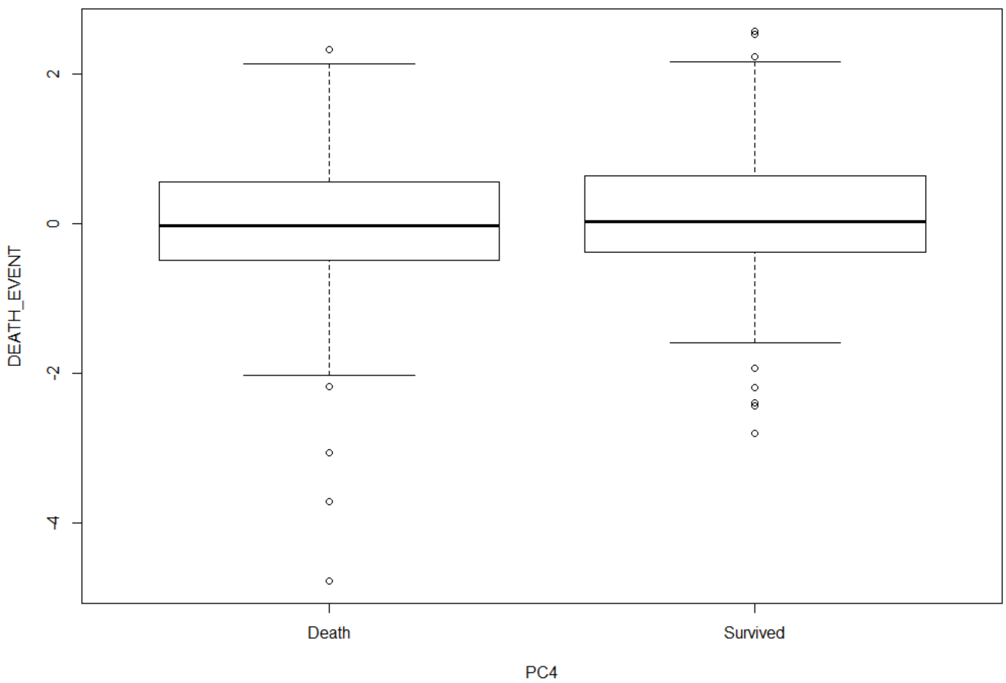

```
> #For PC2, the range for the survived patients is larger than the dead pa
tients
```



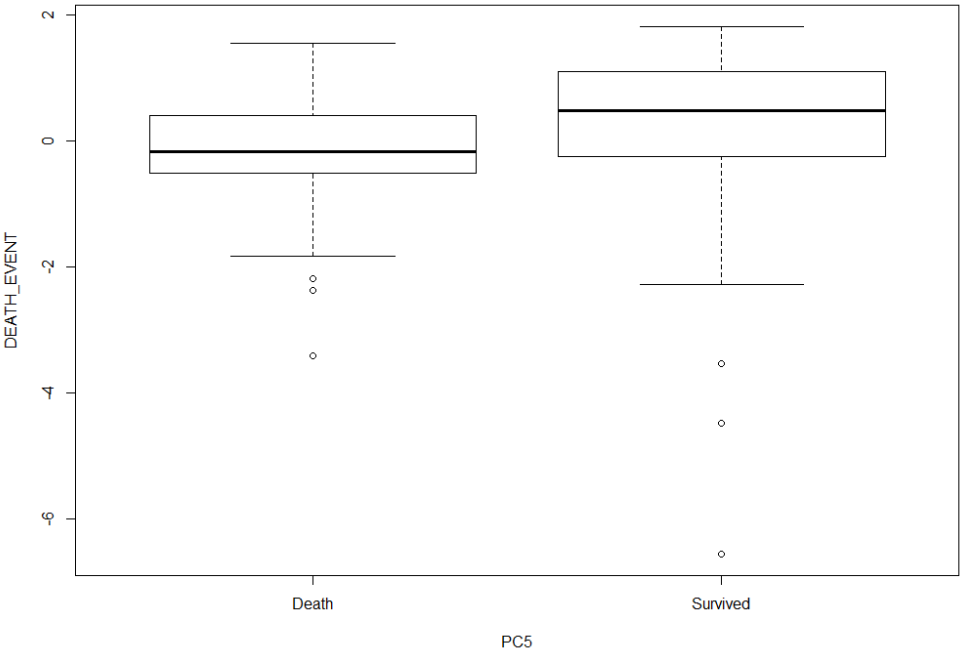

```
> #For PC3, the dead patients overall have a higher value than the survive
d patients
```



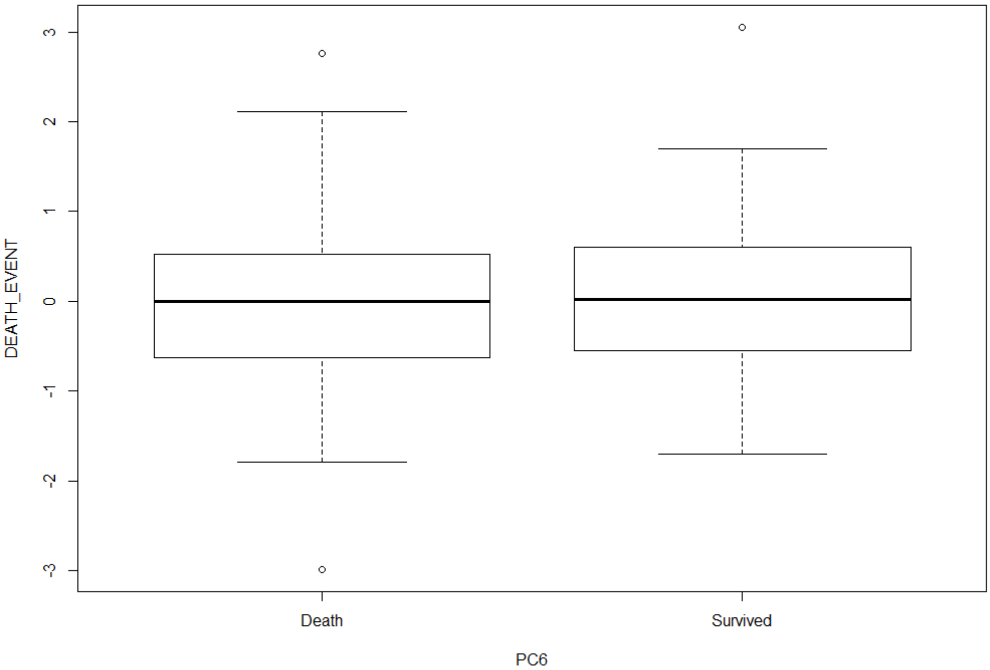
> #For PC4, the range for the dead patients is slightly larger than the survived patients (with a smaller lower bound for dead patients)



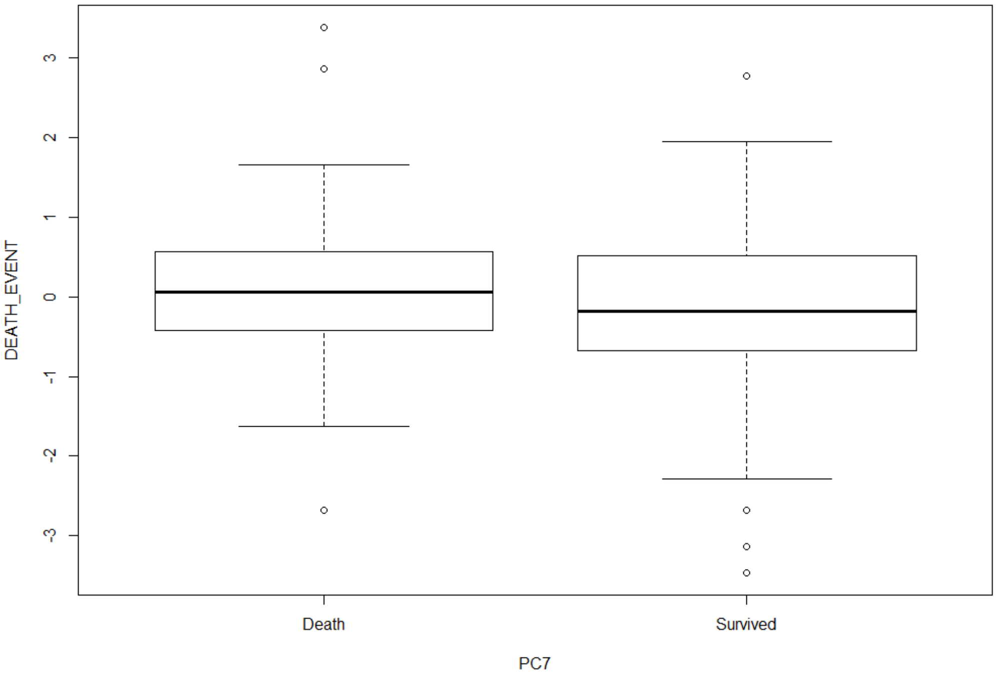
> #For PC5, the range for the survived patients is larger than the dead patients



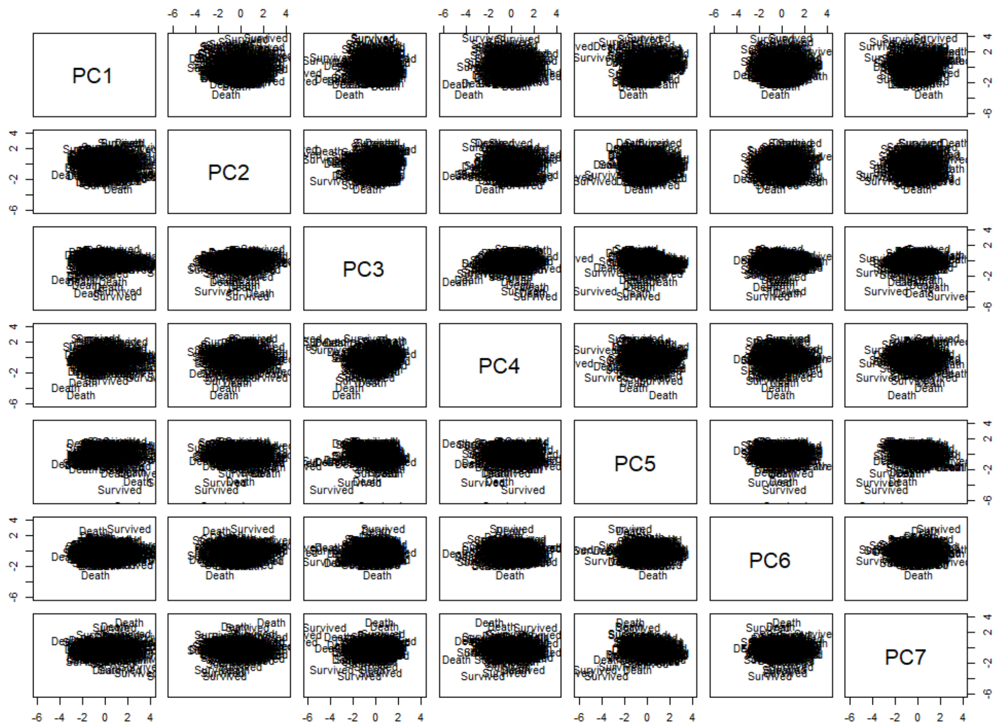
> #For PC6, the range for the dead patients is larger than the Survived pa
tients



> #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
```