Assignment-7.R

nidhi

2020-10-29

```
#Loading Packages
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(GGally)
```

```
## Warning: package 'GGally' was built under R version 3.6.3
```

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

```
## Warning: package 'ggplot2' was built under R version 3.6.3
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```
##
## Attaching package: 'GGally'
```

```
## The following object is masked from 'package:dplyr':
##
##     nasa
```

```
library(car)
```

```
## Warning: package 'car' was built under R version 3.6.3
```

```
## Loading required package: carData
```

```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:dplyr':
##
##     recode
```

```
library(MASS)

##
## Attaching package: 'MASS'

## The following object is masked from 'package:dplyr':
##
##     select

library(gvlma)
library(leaps)

## Warning: package 'leaps' was built under R version 3.6.3

library(relaimpo)

## Warning: package 'relaimpo' was built under R version 3.6.3

## Loading required package: boot

##
## Attaching package: 'boot'

## The following object is masked from 'package:car':
##
##     logit

## Loading required package: survey

## Loading required package: grid

## Loading required package: Matrix

## Loading required package: survival

##
## Attaching package: 'survival'

## The following object is masked from 'package:boot':
##
##     aml

##
## Attaching package: 'survey'

## The following object is masked from 'package:graphics':
##
##     dotchart

## Loading required package: mitools

## This is the global version of package relaimpo.
```

```
## If you are a non-US user, a version with the interesting additional metric
pmvd is available

## from Ulrike Groempings web site at prof.beuth-hochschule.de/groemping.

#Loading dataset
rawdata <-read.csv("C:/Users/nidhi/OneDrive/Desktop/MVA/heart_failure_clinica
l_records_dataset.csv")
View(rawdata)

#Identifying different columns names
names(rawdata)

##  [1] "age"                       "anaemia"
##  [3] "creatinine_phosphokinase" "diabetes"
##  [5] "ejection_fraction"         "high_blood_pressure"
##  [7] "platelets"                 "serum_creatinine"
##  [9] "serum_sodium"              "sex"
## [11] "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
##  Min.   :40.00   Min.   :0.0000   Min.   :  23.0
##  1st Qu.:51.00   1st Qu.:0.0000   1st Qu.: 116.5
##  Median :60.00   Median :0.0000   Median : 250.0
##  Mean   :60.83   Mean   :0.4314   Mean   : 581.8
```

```
##  3rd Qu.:70.00   3rd Qu.:1.0000   3rd Qu.: 582.0
##  Max.   :95.00   Max.   :1.0000   Max.   :7861.0
##     diabetes      ejection_fraction high_blood_pressure   platelets
##  Min.   :0.0000   Min.   :14.00     Min.   :0.0000      Min.   : 25100
##  1st Qu.:0.0000   1st Qu.:30.00     1st Qu.:0.0000      1st Qu.:212500
##  Median :0.0000   Median :38.00     Median :0.0000      Median :262000
##  Mean   :0.4181   Mean   :38.08     Mean   :0.3512      Mean   :263358
##  3rd Qu.:1.0000   3rd Qu.:45.00     3rd Qu.:1.0000      3rd Qu.:303500
##  Max.   :1.0000   Max.   :80.00     Max.   :1.0000      Max.   :850000
##  serum_creatinine  serum_sodium       sex         smoking
##  Min.   :0.500    Min.   :113.0   Female:105   Min.   :0.0000
##  1st Qu.:0.900    1st Qu.:134.0   male  :194   1st Qu.:0.0000
##  Median :1.100    Median :137.0                Median :0.0000
##  Mean   :1.394    Mean   :136.6                Mean   :0.3211
##  3rd Qu.:1.400    3rd Qu.:140.0                3rd Qu.:1.0000
##  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
## 1  75       0                     582        0                20
## 2  55       0                    7861        0                38
## 3  65       0                     146        0                20
## 4  50       1                     111        0                20
## 5  65       1                     160        1                20
## 6  90       1                      47        0                40
##   high_blood_pressure platelets serum_creatinine serum_sodium    sex
## 1                   1    265000             1.9          130   male
## 2                   0    263358             1.1          136   male
## 3                   0    162000             1.3          129   male
## 4                   0    210000             1.9          137   male
## 5                   0    327000             2.7          116 Female
## 6                   1    204000             2.1          132   male
##   smoking time DEATH_EVENT
## 1       0    4    No Death
## 2       0    6    No Death
## 3       1    7    No Death
## 4       0    7    No Death
## 5       0    8    No Death
## 6       1    8    No Death
```

```
dim(rawdata)
```

```
## [1] 299  13
```

```r
#Data Cleaning

#Checking for missing values
is.null(rawdata)
```

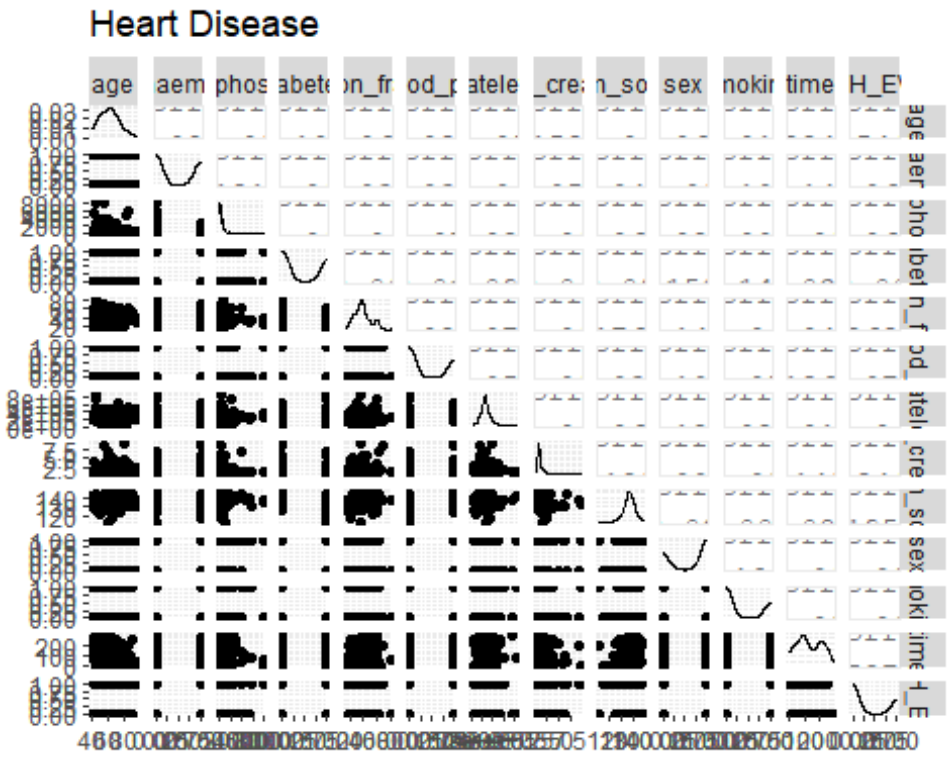
```
## [1] FALSE
```

```r
##The "FALSE" output shows there is no missing data in the dataset.

#Transforming data (Converting 0,1's to meaningful form)

data <- rawdata %>%
  mutate(DEATH_EVENT=ifelse(DEATH_EVENT=="Death",0,1),
         sex=ifelse(sex=="male",1,0)
  ) %>%
  mutate_if(is.character, as.factor) %>%
  dplyr::select(age, anaemia, creatinine_phosphokinase, diabetes, ejection_fr
action, high_blood_pressure, platelets,serum_creatinine, serum_sodium, sex, s
moking, time, DEATH_EVENT)

View(data)
summary(data)
```

```
##       age           anaemia       creatinine_phosphokinase
##  Min.   :40.00   Min.   :0.0000   Min.   :  23.0
##  1st Qu.:51.00   1st Qu.:0.0000   1st Qu.: 116.5
##  Median :60.00   Median :0.0000   Median : 250.0
##  Mean   :60.83   Mean   :0.4314   Mean   : 581.8
##  3rd Qu.:70.00   3rd Qu.:1.0000   3rd Qu.: 582.0
##  Max.   :95.00   Max.   :1.0000   Max.   :7861.0
##     diabetes      ejection_fraction high_blood_pressure   platelets
##  Min.   :0.0000   Min.   :14.00     Min.   :0.0000      Min.   : 25100
##  1st Qu.:0.0000   1st Qu.:30.00     1st Qu.:0.0000      1st Qu.:212500
##  Median :0.0000   Median :38.00     Median :0.0000      Median :262000
##  Mean   :0.4181   Mean   :38.08     Mean   :0.3512      Mean   :263358
##  3rd Qu.:1.0000   3rd Qu.:45.00     3rd Qu.:1.0000      3rd Qu.:303500
##  Max.   :1.0000   Max.   :80.00     Max.   :1.0000      Max.   :850000
##  serum_creatinine  serum_sodium        sex            smoking
##  Min.   :0.500    Min.   :113.0   Min.   :0.0000   Min.   :0.0000
##  1st Qu.:0.900    1st Qu.:134.0   1st Qu.:0.0000   1st Qu.:0.0000
##  Median :1.100    Median :137.0   Median :1.0000   Median :0.0000
##  Mean   :1.394    Mean   :136.6   Mean   :0.6488   Mean   :0.3211
##  3rd Qu.:1.400    3rd Qu.:140.0   3rd Qu.:1.0000   3rd Qu.:1.0000
##  Max.   :9.400    Max.   :148.0   Max.   :1.0000   Max.   :1.0000
##       time        DEATH_EVENT
##  Min.   :  4.0   Min.   :0.0000
##  1st Qu.: 73.0   1st Qu.:0.0000
##  Median :115.0   Median :0.0000
##  Mean   :130.3   Mean   :0.3211
```

```
##  3rd Qu.:203.0   3rd Qu.:1.0000
##  Max.   :285.0   Max.   :1.0000

dataset<-data
attach(dataset)

#Performing Multiple Regression on our dataset
fit <- lm(DEATH_EVENT~age+anaemia+creatinine_phosphokinase+diabetes+ejection_
fraction+high_blood_pressure+platelets+serum_creatinine+serum_sodium+sex+smok
ing+time, data=dataset)
#show the results
summary(fit)

##
## Call:
## lm(formula = DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase +
##     diabetes + ejection_fraction + high_blood_pressure + platelets +
##     serum_creatinine + serum_sodium + sex + smoking + time, data = dataset
)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.80866 -0.28041 -0.04205  0.24742  0.96983
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                1.664e+00  6.954e-01   2.392  0.01738 *
## age                        5.767e-03  1.867e-03   3.088  0.00221 **
## anaemia                   -2.766e-03  4.438e-02  -0.062  0.95035
## creatinine_phosphokinase   3.427e-05  2.247e-05   1.525  0.12840
## diabetes                   1.928e-02  4.410e-02   0.437  0.66236
## ejection_fraction         -9.834e-03  1.844e-03  -5.333 1.96e-07 ***
## high_blood_pressure       -1.430e-02  4.565e-02  -0.313  0.75438
## platelets                 -8.370e-08  2.208e-07  -0.379  0.70492
## serum_creatinine           8.527e-02  2.123e-02   4.017 7.54e-05 ***
## serum_sodium              -7.599e-03  5.024e-03  -1.513  0.13149
## sex                       -6.369e-02  5.108e-02  -1.247  0.21353
## smoking                   -5.733e-03  5.119e-02  -0.112  0.91091
## time                      -2.733e-03  2.903e-04  -9.415  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3646 on 286 degrees of freedom
## Multiple R-squared:  0.4168, Adjusted R-squared:  0.3924
## F-statistic: 17.04 on 12 and 286 DF,  p-value: < 2.2e-16

#Summary has three sections
#Section1: How well does the model fit the data
#Based on Adjusted R-squared value (0.3924), our model can explain 39.24% of
variation in Death_Event(Survived or not survived)
```

```r
#Section2: Is the hypothesis supported?
#Based on the p-value of each independent variable we found age, ejection_fraction, serum_creatinine and time have significant impact for predicting Death_Event at significance level of 0.05
#Age has significantly positive impact on Death_Event which means elder patients have higher chance of survival holding other independent variables constant, which is against our hypothesis
#Ejection_fraction has significantly negative impact on Death_Event which means patients with lower ejection fraction have higher chance of survival holding other independent variables constant, which supports our hypothesis
#Serum_creatinine has significantly positive impact on Death_Event which means patients with higher level of Serum_creatinine have a higher chance of survival holding other independent variables constant, which is against our hypothesis
#Time has significantly negative impact on Death_Event which means patients who have closer follow-up period have higher chance of survival holding other independent variables constant
#For other independent variables, no significant impact is found for Death_Event

#Section3: How well does data fit the model
#Based on F-statistic and its p-value, since p-value is smaller than 0.05, we can say our model has significant predictive power

#Plotting
ggpairs(data=dataset, title="Heart Disease")
```




```
confint(fit,level=0.95)
```

```
##                                 2.5 %        97.5 %
## (Intercept)                2.948959e-01  3.032216e+00
## age                        2.091427e-03  9.441730e-03
## anaemia                   -9.012611e-02  8.459435e-02
## creatinine_phosphokinase -9.964467e-06  7.849673e-05
## diabetes                  -6.751944e-02  1.060698e-01
## ejection_fraction         -1.346289e-02 -6.204407e-03
## high_blood_pressure       -1.041538e-01  7.556037e-02
## platelets                 -5.183239e-07  3.509178e-07
## serum_creatinine           4.348865e-02  1.270487e-01
## serum_sodium              -1.748777e-02  2.289480e-03
## sex                       -1.642331e-01  3.686234e-02
## smoking                   -1.064866e-01  9.502127e-02
## time                      -3.304154e-03 -2.161529e-03
```

```
# Predicted Values and residuals
fitted(fit)
```

```
##           1           2           3           4           5
##  0.982345979  0.834590601  0.875165092  0.776784161  1.163193304
##           6           7           8           9          10
##  0.841370721  0.913803559  0.410394682  0.434424722  1.429472461
##          11          12          13          14          15
##  0.926121014  0.663799435  0.606474040  0.502764204  0.604838745
##          16          17          18          19          20
```

```
##  0.629173000  0.682895433  0.792607354  0.769153879  0.630192236
##           21           22           23           24           25
##  0.780200331  0.773402126  0.566577875  0.288319276  0.878818105
##           26           27           28           29           30
##  0.698538512  0.759402673  0.546983047  0.952355824  0.805102397
##           31           32           33           34           35
##  0.835097173  0.794369743  0.627809164  0.627942594  0.417614891
##           36           37           38           39           40
##  0.871890118  0.611826468  0.550781656  0.808662158  0.730403477
##           41           42           43           44           45
##  0.837765771  0.628951296  0.520200951  0.491264131  0.364484181
##           46           47           48           49           50
##  0.562534674  0.643436728  0.446790685  1.107141235  0.572442107
##           51           52           53           54           55
##  0.654045296  0.669162036  0.885766132  0.497469251  0.695739523
##           56           57           58           59           60
##  0.854853814  0.668728846  0.401646128  0.576070700  0.724977161
##           61           62           63           64           65
##  0.714794341  0.573718264  0.423140250  0.319595316  0.021624082
##           66           67           68           69           70
##  0.843114846  0.665225354  0.585312682  0.649344672  0.657460408
##           71           72           73           74           75
##  0.229489442  0.439856881  0.806749766  0.364763841  0.677576180
##           76           77           78           79           80
##  0.529138249  0.235890962  0.287865358  0.491876123  0.318931556
##           81           82           83           84           85
##  0.558219619  0.338553347  0.766072787  0.463808473  0.545099101
##           86           87           88           89           90
##  0.150886122  0.382505900  0.152216225  0.235952998  0.438076133
##           91           92           93           94           95
##  0.372082705  0.384458142  0.149073345  0.579936570  0.360664236
##           96           97           98           99          100
##  0.100440253  0.581626482  0.283129189  0.573597849  0.428496351
##          101          102          103          104          105
##  0.496157505  0.395228869  0.589683553  0.484531208  0.353131352
##          106          107          108          109          110
##  0.575989106  0.307411584  0.364634222  0.433000167  0.258870084
##          111          112          113          114          115
##  0.326364752  0.380575682  0.510174815  0.273762431  0.449255407
##          116          117          118          119          120
##  0.382183619  0.171667430  0.489278466  0.193431807  0.661838202
##          121          122          123          124          125
##  0.183125936  0.453619127  0.379803580  0.422036882  0.589154377
##          126          127          128          129          130
##  0.229379076  0.713184116  0.149166604  0.364731016  0.469171071
##          131          132          133          134          135
##  0.055120875  0.768247285  0.290889329  0.051596736  0.620405915
##          136          137          138          139          140
##  0.404037020  0.195743460  0.636025647  0.443949643  0.338661854
##          141          142          143          144          145
```

```
##  0.470688815  0.277699395  0.440903385  0.293268672  0.535779129
##          146          147          148          149          150
##  0.253661872  0.305392393  0.149199576  0.564643334  0.374763454
##          151          152          153          154          155
##  0.483262620  0.053680466  0.150176108  0.333101661  0.375742253
##          156          157          158          159          160
##  0.461345806  0.353227423  0.347105819  0.368983263  0.155749500
##          161          162          163          164          165
##  0.305630225  0.177840477  0.243283767  0.351240957  0.324331129
##          166          167          168          169          170
##  0.496396718 -0.019149971  0.576528928  0.315644564  0.373091269
##          171          172          173          174          175
##  0.256621200  0.223216564 -0.025230846  0.289820175  0.249694372
##          176          177          178          179          180
## -0.040013163  0.296176972  0.062646047 -0.029794303  0.117292801
##          181          182          183          184          185
##  0.184614055  0.334425228  0.381734292  0.381197201  0.263286356
##          186          187          188          189          190
##  0.269317891  0.030165627  0.432140051  0.192349525 -0.039902324
##          191          192          193          194          195
##  0.412205374  0.042596251  0.087298094  0.260747841  0.276426893
##          196          197          198          199          200
##  0.153970464  0.106209140  0.238641693  0.312688795  0.421154097
##          201          202          203          204          205
##  0.082619417 -0.203199663 -0.096124339  0.418186449  0.134390205
##          206          207          208          209          210
##  0.042045365 -0.031654779  0.240263319  0.189934820  0.187077883
##          211          212          213          214          215
##  0.348319411 -0.254248656  0.065651459  0.252722608  0.113568005
##          216          217          218          219          220
##  0.224967128  0.042084718  0.462223622  0.213771907  0.087845418
##          221          222          223          224          225
##  0.418710323 -0.089560837 -0.050000988  0.134748266  0.161876676
##          226          227          228          229          230
##  0.135504256  0.213655158  0.098152391  0.647379732  0.335542521
##          231          232          233          234          235
##  0.329206748  0.148401328 -0.068838898  0.027055455 -0.069551381
##          236          237          238          239          240
## -0.013547732 -0.092337855  0.227329121  0.142594920 -0.066951840
##          241          242          243          244          245
##  0.161384581  0.190335108 -0.056687689  0.119465257  0.107810427
##          246          247          248          249          250
##  0.069797443  0.174308511  0.301331485 -0.101827332  0.113146471
##          251          252          253          254          255
##  0.096706771  0.050056203 -0.096129560  0.222952872 -0.266917056
##          256          257          258          259          260
## -0.004312678  0.138717239 -0.050587985  0.026570140 -0.213260537
##          261          262          263          264          265
## -0.091209278  0.035977880  0.234502267 -0.156152023 -0.011973678
##          266          267          268          269          270
```

```
## -0.127586535  0.212809281 -0.026613984 -0.090638893 -0.077639926
##          271          272          273          274          275
##  0.037462947 -0.023331908  0.087630358 -0.238644474  0.032522926
##          276          277          278          279          280
## -0.122717475  0.062014916  0.024605632  0.043904507 -0.003471040
##          281          282          283          284          285
##  0.070808910  0.133657649  0.193641479 -0.007012765 -0.215890150
##          286          287          288          289          290
## -0.088875925 -0.015130338 -0.225060398  0.037111917  0.067864297
##          291          292          293          294          295
## -0.301636861 -0.040458049 -0.169552332 -0.076298724 -0.158667692
##          296          297          298          299
## -0.047755325 -0.379408376 -0.158778882 -0.262307731
```

```
residuals(fit)
```

```
##           1           2           3           4           5
##  0.017654021  0.165409399  0.124834908  0.223215839 -0.163193304
##           6           7           8           9          10
##  0.158629279  0.086196441  0.589605318  0.565575278 -0.429472461
##          11          12          13          14          15
##  0.073878986  0.336200565  0.393525960  0.497235796 -0.604838745
##          16          17          18          19          20
##  0.370827000  0.317104567  0.207392646  0.230846121  0.369807764
##          21          22          23          24          25
## -0.780200331  0.226597874  0.433422125 -0.288319276  0.121181895
##          26          27          28          29          30
##  0.301461488  0.240597327  0.453016953  0.047644176  0.194897603
##          31          32          33          34          35
##  0.164902827  0.205630257  0.372190836 -0.627942594  0.582385109
##          36          37          38          39          40
##  0.128109882  0.388173532  0.449218344 -0.808662158  0.269596523
##          41          42          43          44          45
##  0.162234229  0.371048704  0.479799049 -0.491264131  0.635515819
##          46          47          48          49          50
##  0.437465326  0.356563272  0.553209315 -0.107141235  0.427557893
##          51          52          53          54          55
##  0.345954704  0.330837964  0.114233868  0.502530749  0.304260477
##          56          57          58          59          60
##  0.145146186 -0.668728846 -0.401646128  0.423929300  0.275022839
##          61          62          63          64          65
##  0.285205659  0.426281736 -0.423140250  0.680404684 -0.021624082
##          66          67          68          69          70
##  0.156885154  0.334774646  0.414687318  0.350655328  0.342539592
##          71          72          73          74          75
## -0.229489442 -0.439856881  0.193250234 -0.364763841  0.322423820
##          76          77          78          79          80
##  0.470861751 -0.235890962 -0.287865358 -0.491876123 -0.318931556
##          81          82          83          84          85
## -0.558219619 -0.338553347  0.233927213 -0.463808473  0.454900899
```

```
##           86           87           88           89           90
## -0.150886122 -0.382505900 -0.152216225 -0.235952998 -0.438076133
##           91           92           93           94           95
## -0.372082705 -0.384458142 -0.149073345  0.420063430 -0.360664236
##           96           97           98           99          100
## -0.100440253 -0.581626482 -0.283129189 -0.573597849 -0.428496351
##          101          102          103          104          105
## -0.496157505 -0.395228869 -0.589683553 -0.484531208 -0.353131352
##          106          107          108          109          110
##  0.424010894 -0.307411584 -0.364634222 -0.433000167 -0.258870084
##          111          112          113          114          115
##  0.673635248 -0.380575682 -0.510174815  0.726237569 -0.449255407
##          116          117          118          119          120
## -0.382183619 -0.171667430 -0.489278466 -0.193431807  0.338161798
##          121          122          123          124          125
## -0.183125936 -0.453619127 -0.379803580 -0.422036882  0.410845623
##          126          127          128          129          130
## -0.229379076  0.286815884 -0.149166604 -0.364731016 -0.469171071
##          131          132          133          134          135
## -0.055120875 -0.768247285 -0.290889329 -0.051596736 -0.620405915
##          136          137          138          139          140
## -0.404037020 -0.195743460 -0.636025647 -0.443949643 -0.338661854
##          141          142          143          144          145
##  0.529311185 -0.277699395 -0.440903385 -0.293268672  0.464220871
##          146          147          148          149          150
## -0.253661872 -0.305392393 -0.149199576  0.435356666 -0.374763454
##          151          152          153          154          155
##  0.516737380 -0.053680466 -0.150176108 -0.333101661 -0.375742253
##          156          157          158          159          160
## -0.461345806 -0.353227423 -0.347105819 -0.368983263 -0.155749500
##          161          162          163          164          165
## -0.305630225 -0.177840477 -0.243283767  0.648759043  0.675668871
##          166          167          168          169          170
##  0.503603282  0.019149971  0.423471072 -0.315644564 -0.373091269
##          171          172          173          174          175
## -0.256621200 -0.223216564  0.025230846 -0.289820175 -0.249694372
##          176          177          178          179          180
##  0.040013163 -0.296176972 -0.062646047  0.029794303 -0.117292801
##          181          182          183          184          185
## -0.184614055  0.665574772  0.618265708  0.618802799  0.736713644
##          186          187          188          189          190
##  0.730682109  0.969834373  0.567859949 -0.192349525  0.039902324
##          191          192          193          194          195
## -0.412205374 -0.042596251 -0.087298094 -0.260747841  0.723573107
##          196          197          198          199          200
##  0.846029536 -0.106209140 -0.238641693 -0.312688795 -0.421154097
##          201          202          203          204          205
## -0.082619417  0.203199663  0.096124339 -0.418186449 -0.134390205
##          206          207          208          209          210
## -0.042045365  0.031654779 -0.240263319 -0.189934820 -0.187077883
```

```
##          211          212          213          214          215
## -0.348319411  0.254248656 -0.065651459  0.747277392 -0.113568005
##          216          217          218          219          220
## -0.224967128 -0.042084718  0.537776378 -0.213771907 -0.087845418
##          221          222          223          224          225
##  0.581289677  0.089560837  0.050000988 -0.134748266 -0.161876676
##          226          227          228          229          230
## -0.135504256 -0.213655158 -0.098152391 -0.647379732 -0.335542521
##          231          232          233          234          235
##  0.670793252 -0.148401328  0.068838898 -0.027055455  0.069551381
##          236          237          238          239          240
##  0.013547732  0.092337855 -0.227329121 -0.142594920  0.066951840
##          241          242          243          244          245
## -0.161384581 -0.190335108  0.056687689 -0.119465257 -0.107810427
##          246          247          248          249          250
## -0.069797443  0.825691489 -0.301331485  0.101827332 -0.113146471
##          251          252          253          254          255
## -0.096706771 -0.050056203  0.096129560 -0.222952872  0.266917056
##          256          257          258          259          260
##  0.004312678 -0.138717239  0.050587985 -0.026570140  0.213260537
##          261          262          263          264          265
##  0.091209278 -0.035977880  0.765497733  0.156152023  0.011973678
##          266          267          268          269          270
##  0.127586535  0.787190719  0.026613984  0.090638893  0.077639926
##          271          272          273          274          275
## -0.037462947  0.023331908 -0.087630358  0.238644474 -0.032522926
##          276          277          278          279          280
##  0.122717475 -0.062014916 -0.024605632 -0.043904507  0.003471040
##          281          282          283          284          285
## -0.070808910 -0.133657649 -0.193641479  0.007012765  0.215890150
##          286          287          288          289          290
##  0.088875925  0.015130338  0.225060398 -0.037111917 -0.067864297
##          291          292          293          294          295
##  0.301636861  0.040458049  0.169552332  0.076298724  0.158667692
##          296          297          298          299
##  0.047755325  0.379408376  0.158778882  0.262307731
```

```r
#Anova Table
anova(fit)
```

```
## Analysis of Variance Table
##
## Response: DEATH_EVENT
##                           Df Sum Sq Mean Sq F value    Pr(>F)
## age                        1  4.196  4.1960 31.5729 4.557e-08 ***
## anaemia                    1  0.127  0.1268  0.9543   0.32946
## creatinine_phosphokinase   1  0.569  0.5695  4.2851   0.03934 *
## diabetes                   1  0.043  0.0433  0.3256   0.56869
## ejection_fraction          1  5.203  5.2030 39.1504 1.429e-09 ***
## high_blood_pressure        1  0.275  0.2746  2.0664   0.15167
```

```
## platelets                   1  0.025  0.0254  0.1908   0.66255
## serum_creatinine            1  4.107  4.1070 30.9035 6.218e-08 ***
## serum_sodium                1  0.631  0.6310  4.7479   0.03015 *
## sex                         1  0.201  0.2015  1.5160   0.21923
## smoking                     1  0.009  0.0091  0.0687   0.79346
## time                        1 11.781 11.7810 88.6465 < 2.2e-16 ***
## Residuals                 286 38.009  0.1329
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

#Based on p-values, age,creatinine_phosphokinase, ejection_fraction, serum_creatinine, serum_sodium and time variables have significant mean difference between Survived and Not survived patients at significance level of 0.05

#Covariance

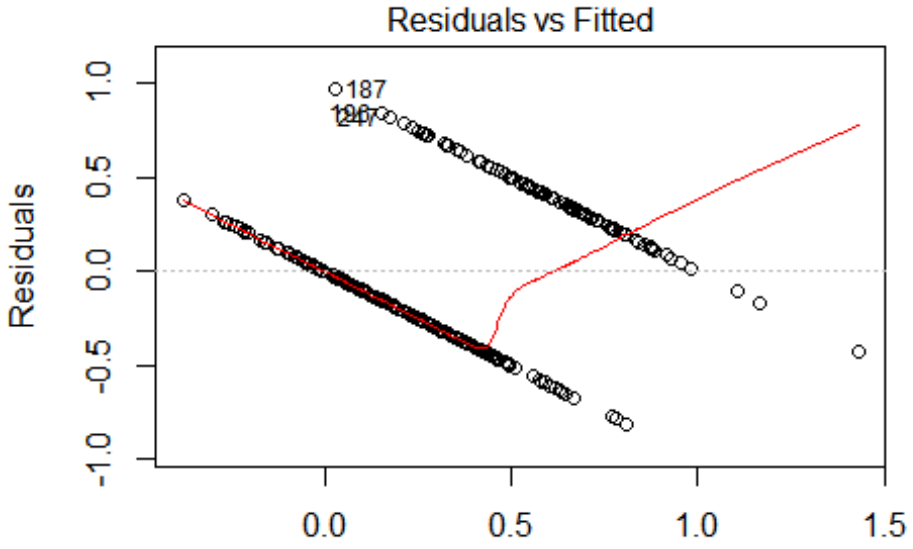
```
vcov(fit)
```

```
##                             (Intercept)           age       anaemia
## (Intercept)               4.835167e-01 -2.387576e-04  1.031142e-03
## age                      -2.387576e-04  3.486349e-06 -3.481328e-06
## anaemia                   1.031142e-03 -3.481328e-06  1.969917e-03
## creatinine_phosphokinase  6.020118e-07  3.020610e-09  1.897233e-07
## diabetes                 -4.506457e-03  6.465941e-06  3.018936e-05
## ejection_fraction         1.040950e-04 -2.810547e-07 -2.990373e-07
## high_blood_pressure       5.946787e-04 -4.984347e-06  3.682716e-05
## platelets                -5.777669e-09  1.346060e-11  4.069839e-10
## serum_creatinine         -3.056697e-03 -4.760214e-06 -2.892930e-05
## serum_sodium             -3.394660e-03  2.213797e-07 -1.625557e-05
## sex                      -2.164976e-03 -6.846002e-06  1.064317e-04
## smoking                   5.404737e-05  1.297890e-06  1.859829e-04
## time                     -5.109123e-06  1.000600e-07  1.777094e-06
##                          creatinine_phosphokinase      diabetes
## (Intercept)                          6.020118e-07 -4.506457e-03
## age                                  3.020610e-09  6.465941e-06
## anaemia                              1.897233e-07  3.018936e-05
## creatinine_phosphokinase             5.049706e-10  9.079477e-09
## diabetes                             9.079477e-09  1.944492e-03
## ejection_fraction                    1.524811e-09  7.861101e-07
## high_blood_pressure                  7.027453e-08  4.179662e-05
## platelets                           -1.391402e-13 -8.264813e-10
## serum_creatinine                    -3.590277e-09  4.818313e-05
## serum_sodium                        -8.999146e-09  2.339215e-05
## sex                                 -8.814132e-08  2.029489e-04
## smoking                              6.852607e-08  2.202832e-04
## time                                 4.481005e-10 -8.136546e-08
##                          ejection_fraction high_blood_pressure
## (Intercept)                   1.040950e-04        5.946787e-04
## age                          -2.810547e-07       -4.984347e-06
## anaemia                      -2.990373e-07        3.682716e-05
## creatinine_phosphokinase      1.524811e-09        7.027453e-08
```

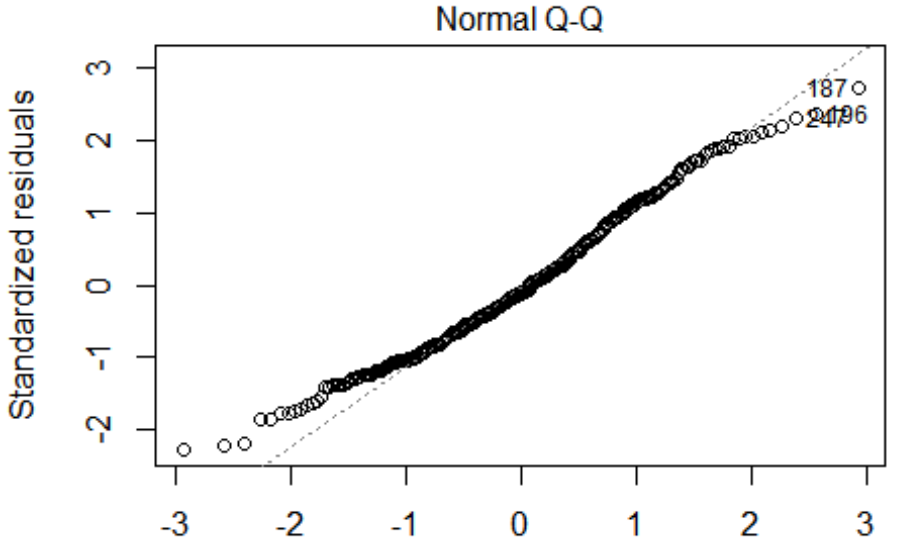
```
## diabetes                       7.861101e-07        4.179662e-05
## ejection_fraction              3.399792e-06        8.439954e-08
## high_blood_pressure            8.439954e-08        2.084132e-03
## platelets                     -2.108483e-11       -4.364144e-10
## serum_creatinine              -6.409676e-07        3.291456e-05
## serum_sodium                  -1.579505e-06       -1.101839e-05
## sex                            1.143668e-05        1.918222e-04
## smoking                        8.653958e-07        5.879382e-05
## time                          -2.335071e-08        2.535664e-06
##                                  platelets serum_creatinine  serum_sodium
## (Intercept)                -5.777669e-09    -3.056697e-03 -3.394660e-03
## age                         1.346060e-11    -4.760214e-06  2.213797e-07
## anaemia                     4.069839e-10    -2.892930e-05 -1.625557e-05
## creatinine_phosphokinase -1.391402e-13    -3.590277e-09 -8.999146e-09
## diabetes                   -8.264813e-10     4.818313e-05  2.339215e-05
## ejection_fraction          -2.108483e-11    -6.409676e-07 -1.579505e-06
## high_blood_pressure        -4.364144e-10     3.291456e-05 -1.101839e-05
## platelets                   4.875751e-14     7.213667e-11 -5.444894e-11
## serum_creatinine            7.213667e-11     4.505652e-04  1.910521e-05
## serum_sodium               -5.444894e-11     1.910521e-05  2.524017e-05
## sex                         1.502167e-09     4.894986e-07  1.938850e-06
## smoking                    -1.113137e-09     3.552634e-05 -2.533983e-06
## time                        3.574473e-13     6.490395e-07 -1.036241e-07
##                                      sex       smoking          time
## (Intercept)                -2.164976e-03  5.404737e-05 -5.109123e-06
## age                        -6.846002e-06  1.297890e-06  1.000600e-07
## anaemia                     1.064317e-04  1.859829e-04  1.777094e-06
## creatinine_phosphokinase -8.814132e-08  6.852607e-08  4.481005e-10
## diabetes                    2.029489e-04  2.202832e-04 -8.136546e-08
## ejection_fraction           1.143668e-05  8.653958e-07 -2.335071e-08
## high_blood_pressure         1.918222e-04  5.879382e-05  2.535664e-06
## platelets                   1.502167e-09 -1.113137e-09  3.574473e-13
## serum_creatinine            4.894986e-07  3.552634e-05  6.490395e-07
## serum_sodium                1.938850e-06 -2.533983e-06 -1.036241e-07
## sex                         2.609544e-03 -1.120641e-03  3.471694e-08
## smoking                    -1.120641e-03  2.620259e-03  5.899581e-07
## time                        3.471694e-08  5.899581e-07  8.424954e-08

#Correlation
cov2cor(vcov(fit))

##                             (Intercept)          age       anaemia
## (Intercept)                1.000000000 -0.18389332  0.033410956
## age                       -0.183893320  1.00000000 -0.042008336
## anaemia                    0.033410956 -0.04200834  1.000000000
## creatinine_phosphokinase   0.038527090  0.07199066  0.190223297
## diabetes                  -0.146969208  0.07853137  0.015425059
## ejection_fraction          0.081189133 -0.08163555 -0.003654056
## high_blood_pressure        0.018733288 -0.05847365  0.018175300
## platelets                 -0.037629302  0.03264813  0.041527186
```

```
## serum_creatinine         -0.207094136 -0.12010532 -0.030706839
## serum_sodium             -0.971727417  0.02359969 -0.072900788
## sex                      -0.060948785 -0.07177434  0.046942349
## smoking                   0.001518437  0.01357939  0.081860954
## time                     -0.025313772  0.18462528  0.137943944
##                         creatinine_phosphokinase     diabetes
## (Intercept)                           0.038527090 -0.146969208
## age                                   0.071990659  0.078531373
## anaemia                               0.190223297  0.015425059
## creatinine_phosphokinase              1.000000000  0.009162726
## diabetes                              0.009162726  1.000000000
## ejection_fraction                     0.036800753  0.009668388
## high_blood_pressure                   0.068501851  0.020762298
## platelets                            -0.028041352 -0.084880742
## serum_creatinine                     -0.007526900  0.051476985
## serum_sodium                         -0.079711721  0.105589547
## sex                                  -0.076782846  0.090095131
## smoking                               0.059573165  0.097590194
## time                                  0.068700295 -0.006357015
##                         ejection_fraction high_blood_pressure
## (Intercept)                    0.081189133         0.018733288
## age                           -0.081635546        -0.058473652
## anaemia                       -0.003654056         0.018175300
## creatinine_phosphokinase       0.036800753         0.068501851
## diabetes                       0.009668388         0.020762298
## ejection_fraction              1.000000000         0.001002654
## high_blood_pressure            0.001002654         1.000000000
## platelets                     -0.051787285        -0.043292797
## serum_creatinine              -0.016376878         0.033966171
## serum_sodium                  -0.170509524        -0.048040721
## sex                            0.121420391         0.082253393
## smoking                        0.009168883         0.025159205
## time                          -0.043630504         0.191357417
##                            platelets serum_creatinine serum_sodium
## (Intercept)              -0.037629302    -0.2070941364 -0.971727417
## age                       0.032648129    -0.1201053245  0.023599688
## anaemia                   0.041527186    -0.0307068386 -0.072900788
## creatinine_phosphokinase -0.028041352    -0.0075269004 -0.079711721
## diabetes                 -0.084880742     0.0514769849  0.105589547
## ejection_fraction        -0.051787285    -0.0163768778 -0.170509524
## high_blood_pressure      -0.043292797     0.0339661707 -0.048040721
## platelets                 1.000000000     0.0153906352 -0.049082040
## serum_creatinine          0.015390635     1.0000000000  0.179154186
## serum_sodium             -0.049082040     0.1791541856  1.000000000
## sex                       0.133172688     0.0004514299  0.007554673
## smoking                  -0.098481760     0.0326963688 -0.009853386
## time                      0.005577087     0.1053436951 -0.071060900
##                                    sex       smoking         time
## (Intercept)              -0.0609487846  0.001518437 -0.025313772
## age                      -0.0717743414  0.013579394  0.184625277
```

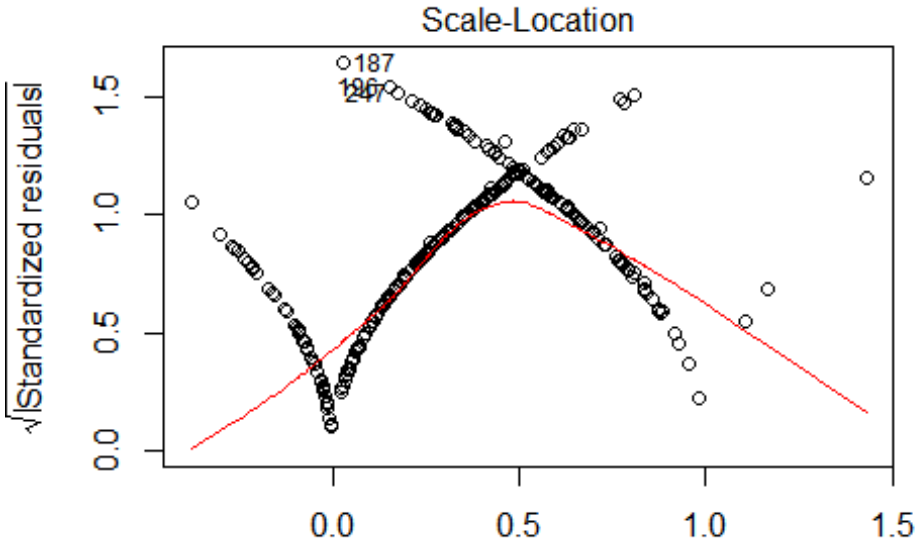
```
## anaemia                    0.0469423486  0.081860954  0.137943944
## creatinine_phosphokinase -0.0767828455  0.059573165  0.068700295
## diabetes                   0.0900951311  0.097590194 -0.006357015
## ejection_fraction          0.1214203912  0.009168883 -0.043630504
## high_blood_pressure        0.0822533929  0.025159205  0.191357417
## platelets                  0.1331726879 -0.098481760  0.005577087
## serum_creatinine           0.0004514299  0.032696369  0.105343695
## serum_sodium               0.0075546735 -0.009853386 -0.071060900
## sex                        1.0000000000 -0.428560522  0.002341399
## smoking                   -0.4285605220  1.000000000  0.039706834
## time                       0.0023413988  0.039706834  1.000000000

#diagnostic plots
plot(fit)
```



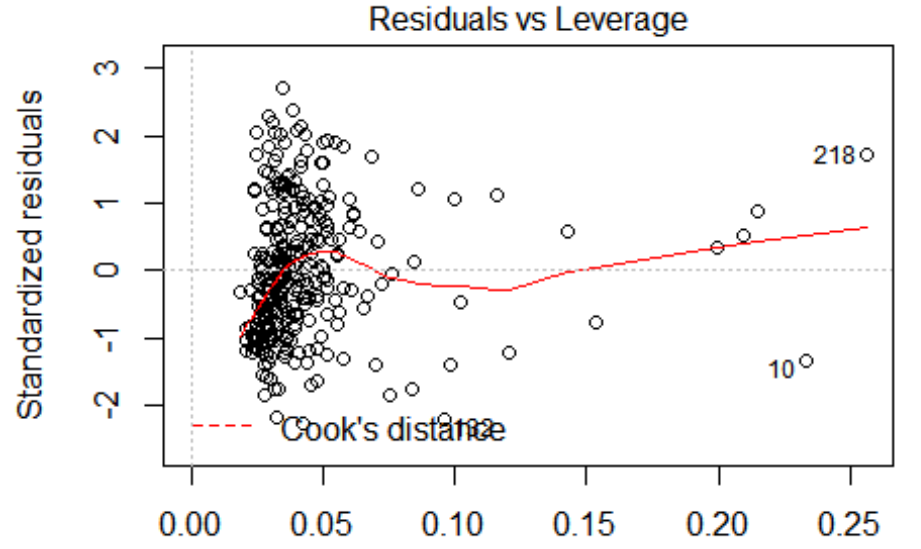
:ATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabet



:ATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabet



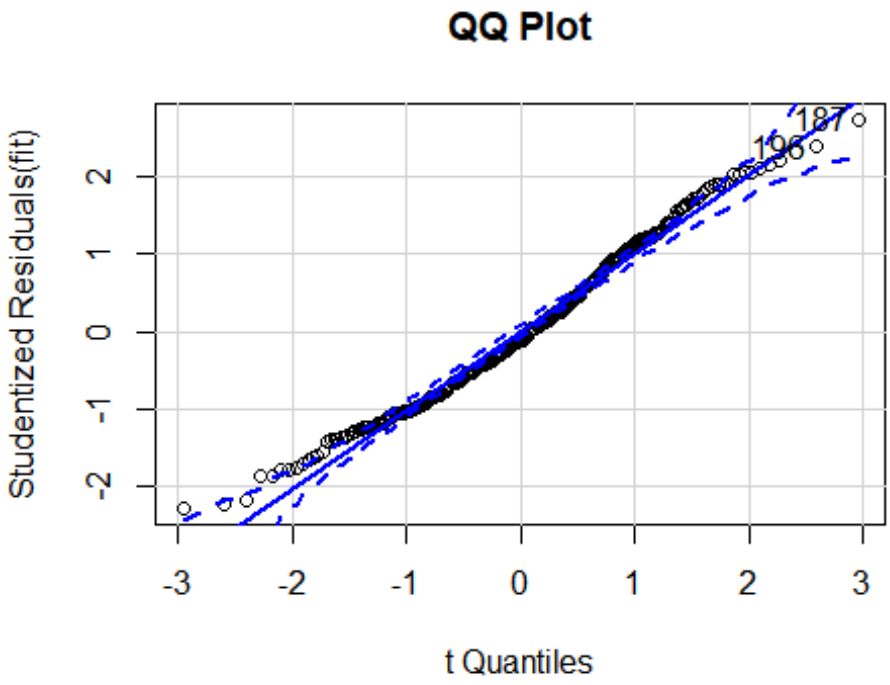
ATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabet



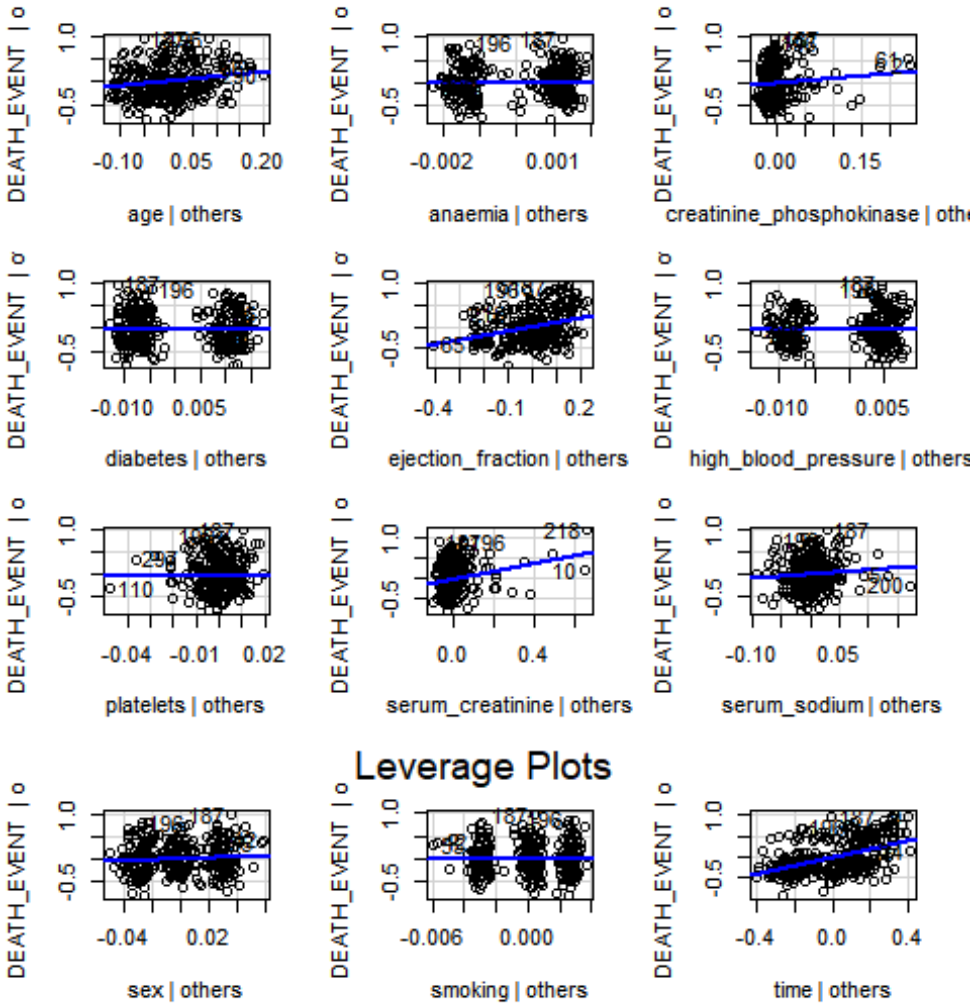
ATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabet

```r
# Checking the existence of Outliers
outlierTest(fit)
```

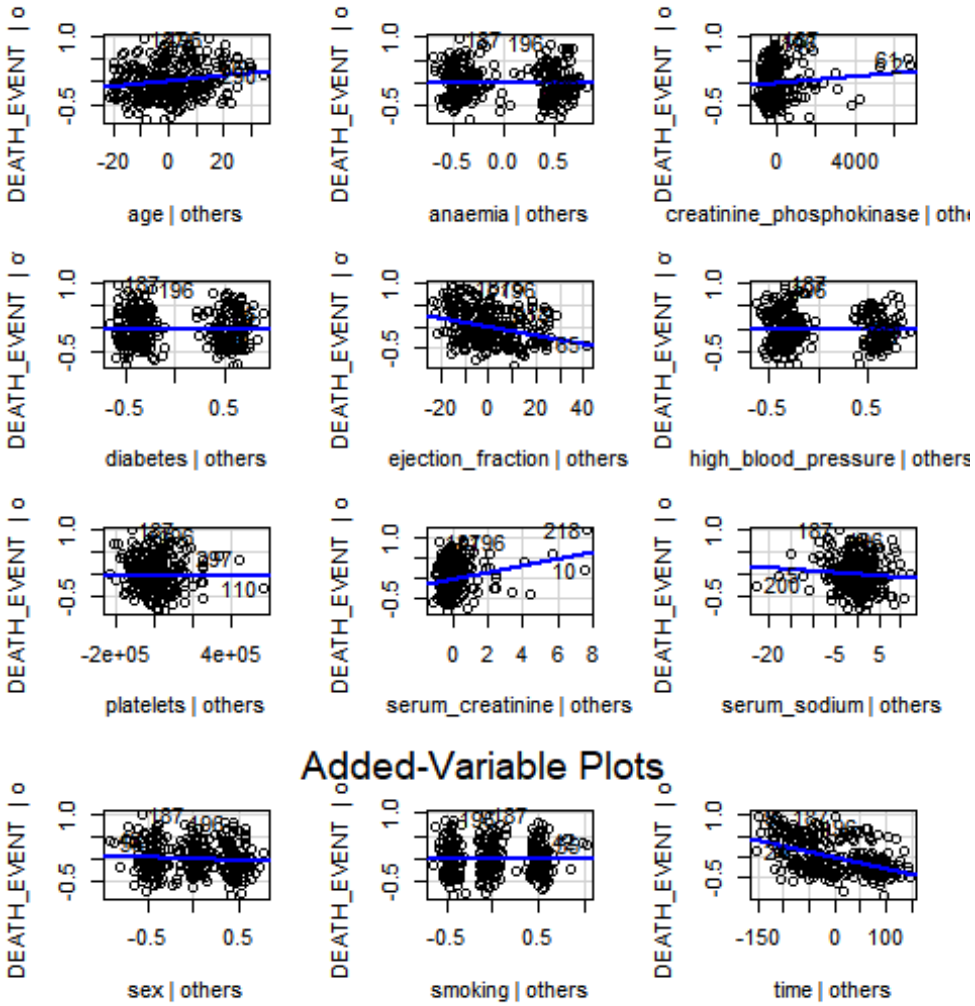
```
## No Studentized residuals with Bonferroni p < 0.05
## Largest |rstudent|:
##     rstudent unadjusted p-value Bonferroni p
## 187  2.73831          0.0065644           NA

#Since p-value is smaller than 0.05, we can say there are some outliers

#Plotting the data, to identify outliers
qqPlot(fit, main="QQ Plot")
```



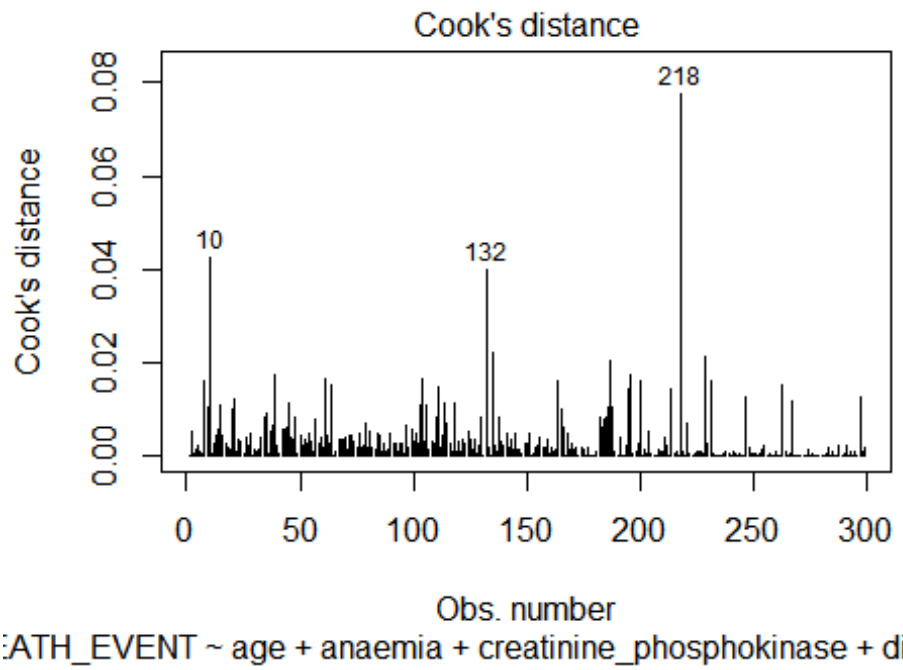

```
## [1] 187 196

#Based on the plot, we can say record 187 and 196 are identified as outliers

#Leverage plots
leveragePlots(fit)
```




```r
# added variable plots
avPlots(fit)
```

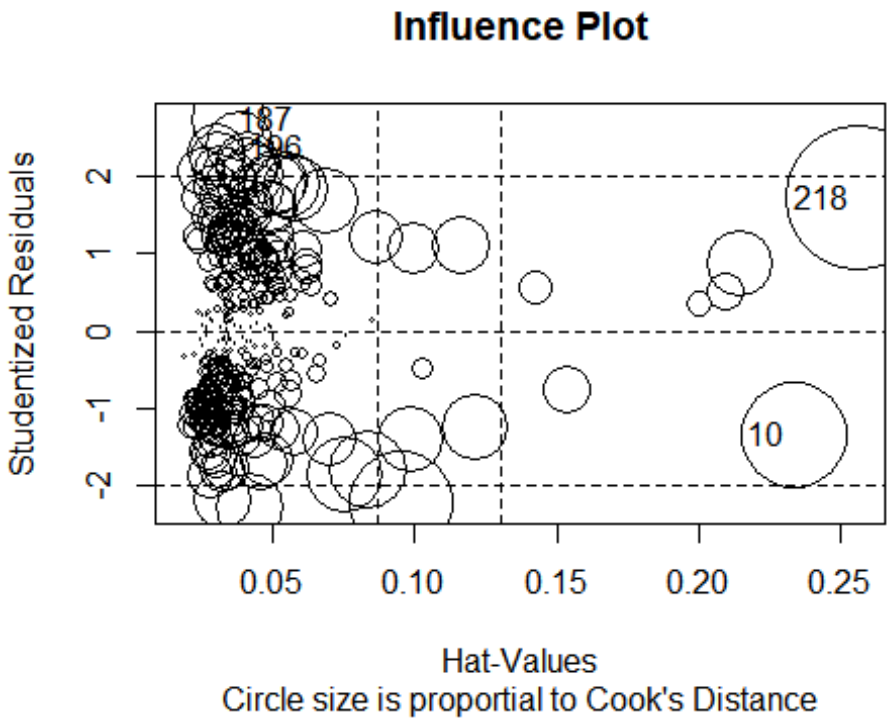



```
# Cook's Distance plot
cutoff <- 4/((nrow(dataset)-length(fit$coefficients)-2))
plot(fit, which=4, cook.levels=cutoff)
```

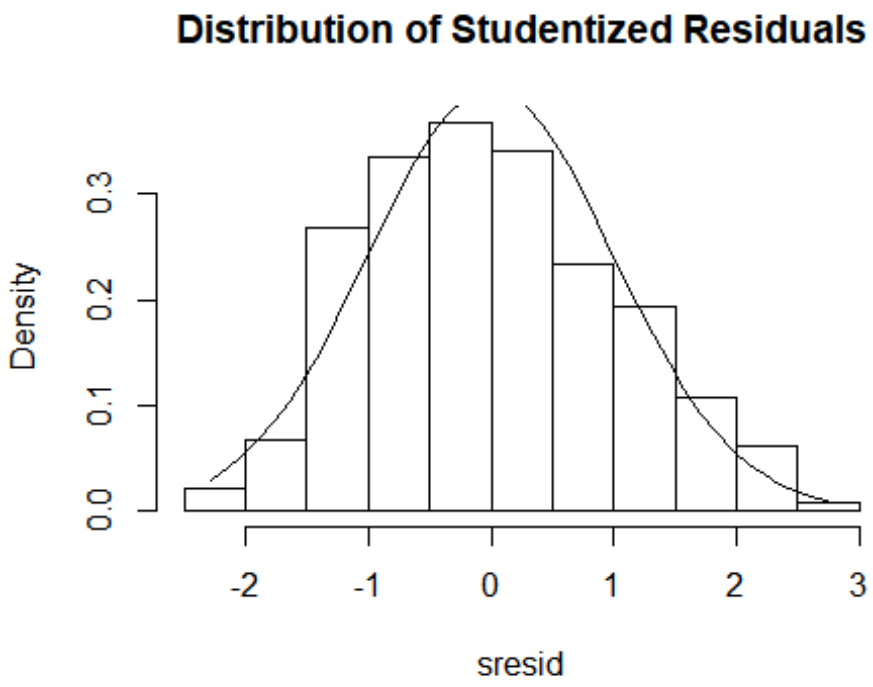



```
#Based on Cook's Distance plot, records 10, 132 and 218 have negative effect
on our regression model

# Influence Plot
influencePlot(fit, id.method="identify", main="Influence Plot", sub="Circle s
ize is proportial to Cook's Distance" )
```

```
## Warning in plot.window(...): "id.method" is not a graphical parameter

## Warning in plot.xy(xy, type, ...): "id.method" is not a graphical paramete
r

## Warning in axis(side = side, at = at, labels = labels, ...): "id.method" i
s
## not a graphical parameter

## Warning in axis(side = side, at = at, labels = labels, ...): "id.method" i
s
## not a graphical parameter

## Warning in box(...): "id.method" is not a graphical parameter

## Warning in title(...): "id.method" is not a graphical parameter

## Warning in plot.xy(xy.coords(x, y), type = type, ...): "id.method" is not
a
## graphical parameter
```




```
##       StudRes        Hat      CookD
## 10  -1.347257 0.23319463 0.04234040
## 187  2.738310 0.03469004 0.02026761
## 196  2.385849 0.03831717 0.01716472
## 218  1.716078 0.25603549 0.07743463

#Based on the plot, we can identify records 10,187,196,218 as outliers

# distribution of studentized residuals
sresid <- studres(fit)
hist(sresid, freq=FALSE,
     main="Distribution of Studentized Residuals")
xfit<-seq(min(sresid),max(sresid),length=40)
yfit<-dnorm(xfit)
lines(xfit, yfit)
```

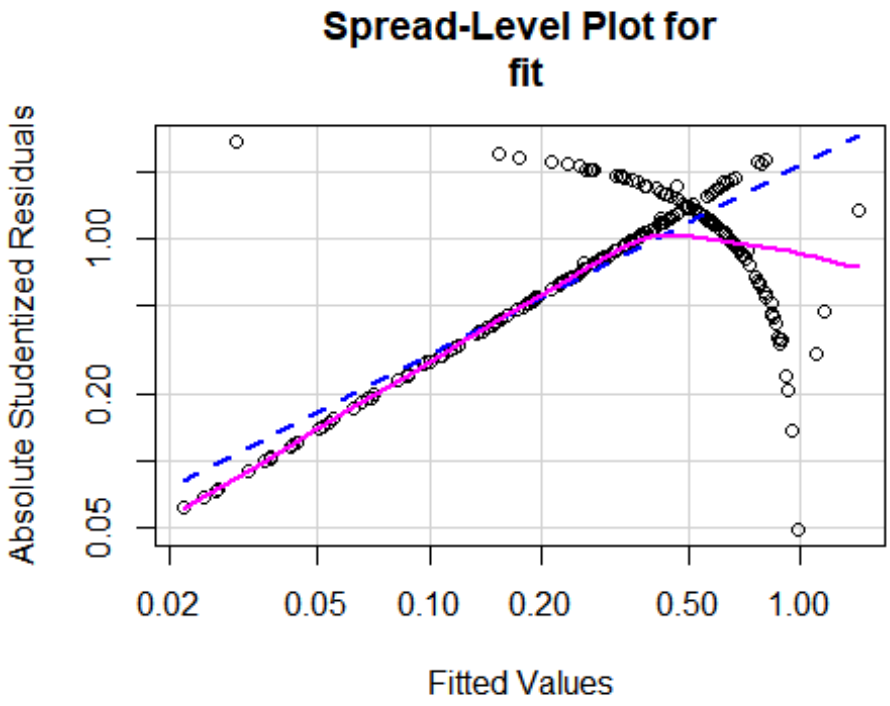



```
#Based on the plot, we can see the Studentized residuals are almost normally
distributed

#Non-constant Error Variance
# Evaluate homoscedasticity
# non-constant error variance test
ncvTest(fit)
```

```
## Non-constant Variance Score Test
## Variance formula: ~ fitted.values
## Chisquare = 17.61125, Df = 1, p = 2.7098e-05
```

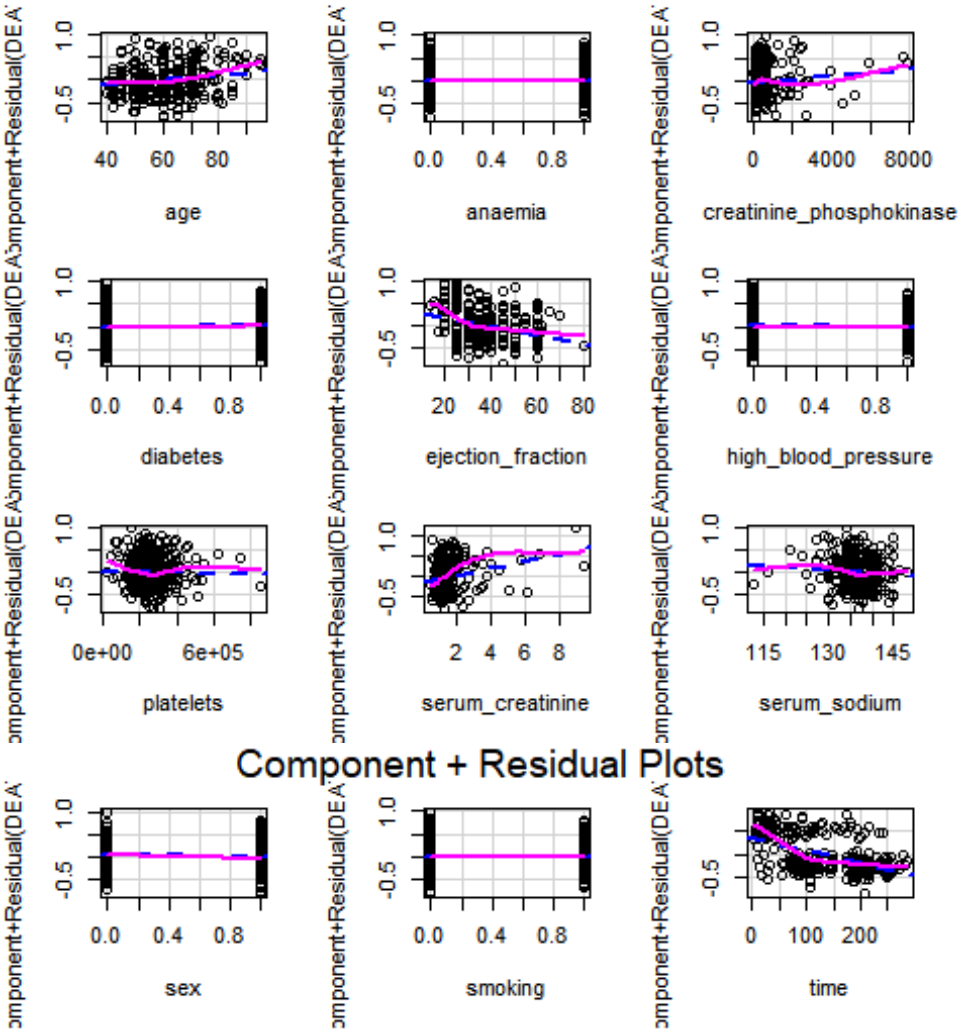
```
#Based on the p-value, since it is smaller than 0.05, we have the problem of
heteroscedasticity

# plot studentized residuals vs. fitted values
spreadLevelPlot(fit)
```

```
## Warning in spreadLevelPlot.lm(fit):
## 48 negative fitted values removed
```




```
##
## Suggested power transformation:  0.1502631

#Multi-collinearity
# Evaluate Collinearity

# variance inflation factors(VIF)
vif(fit)

##                      age                  anaemia creatinine_phosphokinase
##                 1.106067                 1.087163                 1.066014
##                 diabetes        ejection_fraction      high_blood_pressure
##                 1.064324                 1.067758                 1.068377
##                platelets         serum_creatinine             serum_sodium
##                 1.045809                 1.081241                 1.101927
##                      sex                  smoking                     time
##                 1.337716                 1.285049                 1.138009

#Based on VIF values, we don't have a problem of multi-collinearity as they h
ave measure less than 5

#Using the cutoff value as 2 for checking multi-collinearity
sqrt(vif(fit)) > 2

##                      age                  anaemia creatinine_phosphokinase
##                    FALSE                    FALSE                    FALSE
##                 diabetes        ejection_fraction      high_blood_pressure
```

```
##                    FALSE                    FALSE                    FALSE
##                platelets         serum_creatinine             serum_sodium
##                    FALSE                    FALSE                    FALSE
##                      sex                  smoking                     time
##                    FALSE                    FALSE                    FALSE

#Again, we have no problem of multi-collinearity

#Nonlinearity
# component + residual plot
crPlots(fit)
```




```
#Non-independence of Errors
# Test for Autocorrelated Errors
durbinWatsonTest(fit)
```

```
##  lag Autocorrelation D-W Statistic p-value
##    1       0.2102177      1.577746   0.002
##  Alternative hypothesis: rho != 0

#Since p-value is smaller than 0.05, we may have the problem of Autocorrelate
d errors

#Global test of model assumptions
gvmodel <- gvlma(fit)
summary(gvmodel)

##
## Call:
## lm(formula = DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase +
##     diabetes + ejection_fraction + high_blood_pressure + platelets +
##     serum_creatinine + serum_sodium + sex + smoking + time, data = dataset
)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.80866 -0.28041 -0.04205  0.24742  0.96983
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                1.664e+00  6.954e-01   2.392  0.01738 *
## age                        5.767e-03  1.867e-03   3.088  0.00221 **
## anaemia                   -2.766e-03  4.438e-02  -0.062  0.95035
## creatinine_phosphokinase   3.427e-05  2.247e-05   1.525  0.12840
## diabetes                   1.928e-02  4.410e-02   0.437  0.66236
## ejection_fraction         -9.834e-03  1.844e-03  -5.333 1.96e-07 ***
## high_blood_pressure       -1.430e-02  4.565e-02  -0.313  0.75438
## platelets                 -8.370e-08  2.208e-07  -0.379  0.70492
## serum_creatinine           8.527e-02  2.123e-02   4.017 7.54e-05 ***
## serum_sodium              -7.599e-03  5.024e-03  -1.513  0.13149
## sex                       -6.369e-02  5.108e-02  -1.247  0.21353
## smoking                   -5.733e-03  5.119e-02  -0.112  0.91091
## time                      -2.733e-03  2.903e-04  -9.415  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3646 on 286 degrees of freedom
## Multiple R-squared:  0.4168, Adjusted R-squared:  0.3924
## F-statistic: 17.04 on 12 and 286 DF,  p-value: < 2.2e-16
##
##
## ASSESSMENT OF THE LINEAR MODEL ASSUMPTIONS
## USING THE GLOBAL TEST ON 4 DEGREES-OF-FREEDOM:
## Level of Significance =  0.05
##
## Call:
```

```
##  gvlma(x = fit)
##
##                     Value   p-value                   Decision
## Global Stat        23.441 0.0001034 Assumptions NOT satisfied!
## Skewness            4.679 0.0305261 Assumptions NOT satisfied!
## Kurtosis            3.335 0.0678280    Assumptions acceptable.
## Link Function       5.410 0.0200201 Assumptions NOT satisfied!
## Heteroscedasticity 10.017 0.0015513 Assumptions NOT satisfied!
```

```
fit
```

```
##
## Call:
## lm(formula = DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase +
##     diabetes + ejection_fraction + high_blood_pressure + platelets +
##     serum_creatinine + serum_sodium + sex + smoking + time, data = dataset
## )
##
## Coefficients:
##              (Intercept)                       age
##                1.664e+00                 5.767e-03
##                  anaemia  creatinine_phosphokinase
##               -2.766e-03                 3.427e-05
##                 diabetes         ejection_fraction
##                1.928e-02                -9.834e-03
##      high_blood_pressure                 platelets
##               -1.430e-02                -8.370e-08
##         serum_creatinine              serum_sodium
##                8.527e-02                -7.599e-03
##                      sex                   smoking
##               -6.369e-02                -5.733e-03
##                     time
##               -2.733e-03
```

```
summary(fit)
```

```
##
## Call:
## lm(formula = DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase +
##     diabetes + ejection_fraction + high_blood_pressure + platelets +
##     serum_creatinine + serum_sodium + sex + smoking + time, data = dataset
## )
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.80866 -0.28041 -0.04205  0.24742  0.96983
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)               1.664e+00  6.954e-01   2.392  0.01738 *
## age                       5.767e-03  1.867e-03   3.088  0.00221 **
```

```
## anaemia                  -2.766e-03  4.438e-02  -0.062  0.95035
## creatinine_phosphokinase  3.427e-05  2.247e-05   1.525  0.12840
## diabetes                  1.928e-02  4.410e-02   0.437  0.66236
## ejection_fraction        -9.834e-03  1.844e-03  -5.333 1.96e-07 ***
## high_blood_pressure      -1.430e-02  4.565e-02  -0.313  0.75438
## platelets                -8.370e-08  2.208e-07  -0.379  0.70492
## serum_creatinine          8.527e-02  2.123e-02   4.017 7.54e-05 ***
## serum_sodium             -7.599e-03  5.024e-03  -1.513  0.13149
## sex                      -6.369e-02  5.108e-02  -1.247  0.21353
## smoking                  -5.733e-03  5.119e-02  -0.112  0.91091
## time                     -2.733e-03  2.903e-04  -9.415  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3646 on 286 degrees of freedom
## Multiple R-squared:  0.4168, Adjusted R-squared:  0.3924
## F-statistic: 17.04 on 12 and 286 DF,  p-value: < 2.2e-16

fit1 <- fit
fit2 <- lm(DEATH_EVENT~age+creatinine_phosphokinase+diabetes+ejection_fractio
n+high_blood_pressure+platelets+serum_creatinine+serum_sodium+sex+smoking+tim
e, data=dataset)

# compare models
anova(fit1, fit2)

## Analysis of Variance Table
##
## Model 1: DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabetes
+
##     ejection_fraction + high_blood_pressure + platelets + serum_creatinine
+
##     serum_sodium + sex + smoking + time
## Model 2: DEATH_EVENT ~ age + creatinine_phosphokinase + diabetes + ejectio
n_fraction +
##     high_blood_pressure + platelets + serum_creatinine + serum_sodium +
##     sex + smoking + time
##   Res.Df    RSS Df   Sum of Sq      F Pr(>F)
## 1    286 38.009
## 2    287 38.010 -1 -0.00051611 0.0039 0.9504

step <- stepAIC(fit, direction="both")

## Start:  AIC=-590.72
## DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabetes +
##     ejection_fraction + high_blood_pressure + platelets + serum_creatinine
+
##     serum_sodium + sex + smoking + time
##
##                            Df Sum of Sq    RSS     AIC
## - anaemia                   1    0.0005 38.010 -592.72
```

```
## - smoking                    1    0.0017 38.011 -592.71
## - high_blood_pressure        1    0.0130 38.022 -592.62
## - platelets                  1    0.0191 38.028 -592.57
## - diabetes                   1    0.0254 38.034 -592.52
## - sex                        1    0.2066 38.216 -591.10
## <none>                                   38.009 -590.72
## - serum_sodium               1    0.3041 38.313 -590.34
## - creatinine_phosphokinase   1    0.3090 38.318 -590.30
## - age                        1    1.2676 39.277 -582.91
## - serum_creatinine           1    2.1446 40.154 -576.31
## - ejection_fraction          1    3.7801 41.789 -564.37
## - time                       1   11.7810 49.790 -512.00
##
## Step:  AIC=-592.72
## DEATH_EVENT ~ age + creatinine_phosphokinase + diabetes + ejection_fractio
n +
##     high_blood_pressure + platelets + serum_creatinine + serum_sodium +
##     sex + smoking + time
##
##                             Df Sum of Sq    RSS     AIC
## - smoking                    1    0.0015 38.011 -594.71
## - high_blood_pressure        1    0.0129 38.022 -594.62
## - platelets                  1    0.0189 38.028 -594.57
## - diabetes                   1    0.0255 38.035 -594.52
## - sex                        1    0.2060 38.216 -593.10
## <none>                                   38.010 -592.72
## - serum_sodium               1    0.3075 38.317 -592.31
## - creatinine_phosphokinase   1    0.3256 38.335 -592.17
## + anaemia                    1    0.0005 38.009 -590.72
## - age                        1    1.2677 39.277 -584.91
## - serum_creatinine           1    2.1446 40.154 -578.31
## - ejection_fraction          1    3.7804 41.790 -566.37
## - time                       1   11.9876 49.997 -512.75
##
## Step:  AIC=-594.71
## DEATH_EVENT ~ age + creatinine_phosphokinase + diabetes + ejection_fractio
n +
##     high_blood_pressure + platelets + serum_creatinine + serum_sodium +
##     sex + time
##
##                             Df Sum of Sq    RSS     AIC
## - high_blood_pressure        1    0.0127 38.024 -596.61
## - platelets                  1    0.0202 38.031 -596.55
## - diabetes                   1    0.0270 38.038 -596.50
## <none>                                   38.011 -594.71
## - sex                        1    0.2733 38.284 -594.57
## - serum_sodium               1    0.3077 38.319 -594.30
## - creatinine_phosphokinase   1    0.3283 38.339 -594.14
## + smoking                    1    0.0015 38.010 -592.72
## + anaemia                    1    0.0004 38.011 -592.71
```

```
## - age                         1    1.2696 39.281 -586.88
## - serum_creatinine            1    2.1513 40.162 -580.25
## - ejection_fraction           1    3.7793 41.790 -568.37
## - time                        1   11.9897 50.001 -514.73
##
## Step:  AIC=-596.61
## DEATH_EVENT ~ age + creatinine_phosphokinase + diabetes + ejection_fractio
n +
##     platelets + serum_creatinine + serum_sodium + sex + time
##
##                              Df Sum of Sq    RSS     AIC
## - platelets                   1    0.0216 38.045 -598.44
## - diabetes                    1    0.0277 38.051 -598.39
## <none>                                    38.024 -596.61
## - sex                         1    0.2641 38.288 -596.54
## - serum_sodium                1    0.3143 38.338 -596.15
## - creatinine_phosphokinase    1    0.3382 38.362 -595.96
## + high_blood_pressure         1    0.0127 38.011 -594.71
## + smoking                     1    0.0013 38.022 -594.62
## + anaemia                     1    0.0003 38.023 -594.61
## - age                         1    1.2591 39.283 -588.87
## - serum_creatinine            1    2.1649 40.189 -582.05
## - ejection_fraction           1    3.7790 41.803 -570.28
## - time                        1   12.2858 50.310 -514.89
##
## Step:  AIC=-598.44
## DEATH_EVENT ~ age + creatinine_phosphokinase + diabetes + ejection_fractio
n +
##     serum_creatinine + serum_sodium + sex + time
##
##                              Df Sum of Sq    RSS     AIC
## - diabetes                    1    0.0242 38.070 -600.25
## - sex                         1    0.2516 38.297 -598.47
## <none>                                    38.045 -598.44
## - serum_sodium                1    0.3232 38.369 -597.91
## - creatinine_phosphokinase    1    0.3335 38.379 -597.83
## + platelets                   1    0.0216 38.024 -596.61
## + high_blood_pressure         1    0.0141 38.031 -596.55
## + smoking                     1    0.0026 38.043 -596.46
## + anaemia                     1    0.0001 38.045 -596.44
## - age                         1    1.2718 39.317 -590.61
## - serum_creatinine            1    2.1755 40.221 -583.81
## - ejection_fraction           1    3.8181 41.863 -571.84
## - time                        1   12.2760 50.321 -516.82
##
## Step:  AIC=-600.25
## DEATH_EVENT ~ age + creatinine_phosphokinase + ejection_fraction +
##     serum_creatinine + serum_sodium + sex + time
##
##                              Df Sum of Sq    RSS     AIC
```

```
## <none>                                  38.070 -600.25
## - sex                          1    0.2830 38.353 -600.03
## - creatinine_phosphokinase     1    0.3337 38.403 -599.64
## - serum_sodium                 1    0.3460 38.416 -599.54
## + diabetes                     1    0.0242 38.045 -598.44
## + platelets                    1    0.0182 38.051 -598.39
## + high_blood_pressure          1    0.0147 38.055 -598.36
## + smoking                      1    0.0042 38.065 -598.28
## + anaemia                      1    0.0001 38.069 -598.25
## - age                          1    1.2516 39.321 -592.58
## - serum_creatinine             1    2.1579 40.228 -585.76
## - ejection_fraction            1    3.8212 41.891 -573.65
## - time                         1   12.2628 50.332 -518.76

step$anova

## Stepwise Model Path
## Analysis of Deviance Table
##
## Initial Model:
## DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase + diabetes +
##     ejection_fraction + high_blood_pressure + platelets + serum_creatinine
+
##     serum_sodium + sex + smoking + time
##
## Final Model:
## DEATH_EVENT ~ age + creatinine_phosphokinase + ejection_fraction +
##     serum_creatinine + serum_sodium + sex + time
##
##
##                     Step Df     Deviance Resid. Df Resid. Dev       AIC
## 1                                            286   38.00902 -590.7234
## 2             - anaemia  1 0.0005161064       287   38.00953 -592.7194
## 3             - smoking  1 0.0015286615       288   38.01106 -594.7073
## 4 - high_blood_pressure  1 0.0127406287       289   38.02380 -596.6071
## 5           - platelets  1 0.0216002449       290   38.04540 -598.4373
## 6            - diabetes  1 0.0242332485       291   38.06964 -600.2469

#Based on the output, we can say the final model has variables age, creatinin
e_phosphokinase, ejection_fraction, serum_creatinine, serum_sodium, sex, and
time included

leaps<-regsubsets(DEATH_EVENT~age+anaemia+creatinine_phosphokinase+diabetes+e
jection_fraction+high_blood_pressure+platelets+serum_creatinine+serum_sodium+
sex+smoking+time, data=dataset,nbest=10)
summary(leaps)

## Subset selection object
## Call: regsubsets.formula(DEATH_EVENT ~ age + anaemia + creatinine_phosphok
inase +
##     diabetes + ejection_fraction + high_blood_pressure + platelets +
```

```
##     serum_creatinine + serum_sodium + sex + smoking + time, data = dataset
,
##     nbest = 10)
## 12 Variables  (and intercept)
##                           Forced in Forced out
## age                           FALSE      FALSE
## anaemia                       FALSE      FALSE
## creatinine_phosphokinase      FALSE      FALSE
## diabetes                      FALSE      FALSE
## ejection_fraction             FALSE      FALSE
## high_blood_pressure           FALSE      FALSE
## platelets                     FALSE      FALSE
## serum_creatinine              FALSE      FALSE
## serum_sodium                  FALSE      FALSE
## sex                           FALSE      FALSE
## smoking                       FALSE      FALSE
## time                          FALSE      FALSE
## 10 subsets of each size up to 8
## Selection Algorithm: exhaustive
##           age anaemia creatinine_phosphokinase diabetes ejection_fraction
## 1  ( 1 )  " " " "     " "                      " "      " "
## 1  ( 2 )  " " " "     " "                      " "      " "
## 1  ( 3 )  " " " "     " "                      " "      "*"
## 1  ( 4 )  "*" " "     " "                      " "      " "
## 1  ( 5 )  " " " "     " "                      " "      " "
## 1  ( 6 )  " " " "     " "                      " "      " "
## 1  ( 7 )  " " "*"     " "                      " "      " "
## 1  ( 8 )  " " " "     "*"                      " "      " "
## 1  ( 9 )  " " " "     " "                      " "      " "
## 1  ( 10 ) " " " "     " "                      " "      " "
## 2  ( 1 )  " " " "     " "                      " "      "*"
## 2  ( 2 )  " " " "     " "                      " "      " "
## 2  ( 3 )  " " " "     " "                      " "      " "
## 2  ( 4 )  "*" " "     " "                      " "      " "
## 2  ( 5 )  " " " "     "*"                      " "      " "
## 2  ( 6 )  " " " "     " "                      " "      " "
## 2  ( 7 )  " " " "     " "                      " "      " "
## 2  ( 8 )  " " " "     " "                      " "      " "
## 2  ( 9 )  " " " "     " "                      "*"      " "
## 2  ( 10 ) " " " "     " "                      " "      " "
## 3  ( 1 )  " " " "     " "                      " "      "*"
## 3  ( 2 )  "*" " "     " "                      " "      "*"
## 3  ( 3 )  " " " "     " "                      " "      "*"
## 3  ( 4 )  " " " "     " "                      " "      "*"
## 3  ( 5 )  " " " "     "*"                      " "      "*"
## 3  ( 6 )  " " " "     " "                      " "      "*"
## 3  ( 7 )  " " " "     " "                      " "      "*"
## 3  ( 8 )  " " " "     " "                      " "      "*"
## 3  ( 9 )  " " " "     " "                      "*"      "*"
## 3  ( 10 ) " " "*"     " "                      " "      "*"
```

```
## 4  ( 1 )  "*" " "     " "                    " "      "*"
## 4  ( 2 )  " " " "     " "                    " "      "*"
## 4  ( 3 )  " " " "     "*"                    " "      "*"
## 4  ( 4 )  " " " "     " "                    " "      "*"
## 4  ( 5 )  " " " "     " "                    " "      "*"
## 4  ( 6 )  " " " "     " "                    "*"      "*"
## 4  ( 7 )  " " " "     " "                    " "      "*"
## 4  ( 8 )  " " " "     " "                    " "      "*"
## 4  ( 9 )  " " "*"     " "                    " "      "*"
## 4  ( 10 ) "*" " "     " "                    " "      "*"
## 5  ( 1 )  "*" " "     " "                    " "      "*"
## 5  ( 2 )  "*" " "     "*"                    " "      "*"
## 5  ( 3 )  "*" " "     " "                    " "      "*"
## 5  ( 4 )  "*" " "     " "                    " "      "*"
## 5  ( 5 )  "*" " "     " "                    "*"      "*"
## 5  ( 6 )  "*" " "     " "                    " "      "*"
## 5  ( 7 )  "*" "*"     " "                    " "      "*"
## 5  ( 8 )  "*" " "     " "                    " "      "*"
## 5  ( 9 )  " " " "     "*"                    " "      "*"
## 5  ( 10 ) " " " "     " "                    " "      "*"
## 6  ( 1 )  "*" " "     "*"                    " "      "*"
## 6  ( 2 )  "*" " "     " "                    " "      "*"
## 6  ( 3 )  "*" " "     "*"                    " "      "*"
## 6  ( 4 )  "*" " "     " "                    " "      "*"
## 6  ( 5 )  "*" " "     " "                    "*"      "*"
## 6  ( 6 )  "*" " "     "*"                    " "      "*"
## 6  ( 7 )  "*" " "     "*"                    "*"      "*"
## 6  ( 8 )  "*" " "     " "                    " "      "*"
## 6  ( 9 )  "*" "*"     " "                    " "      "*"
## 6  ( 10 ) "*" " "     " "                    " "      "*"
## 7  ( 1 )  "*" " "     "*"                    " "      "*"
## 7  ( 2 )  "*" " "     "*"                    " "      "*"
## 7  ( 3 )  "*" " "     "*"                    "*"      "*"
## 7  ( 4 )  "*" " "     "*"                    " "      "*"
## 7  ( 5 )  "*" " "     "*"                    " "      "*"
## 7  ( 6 )  "*" "*"     "*"                    " "      "*"
## 7  ( 7 )  "*" " "     "*"                    "*"      "*"
## 7  ( 8 )  "*" " "     " "                    " "      "*"
## 7  ( 9 )  "*" " "     " "                    "*"      "*"
## 7  ( 10 ) "*" "*"     " "                    " "      "*"
## 8  ( 1 )  "*" " "     "*"                    "*"      "*"
## 8  ( 2 )  "*" " "     "*"                    " "      "*"
## 8  ( 3 )  "*" " "     "*"                    " "      "*"
## 8  ( 4 )  "*" " "     "*"                    " "      "*"
## 8  ( 5 )  "*" "*"     "*"                    " "      "*"
## 8  ( 6 )  "*" " "     "*"                    "*"      "*"
## 8  ( 7 )  "*" " "     "*"                    " "      "*"
## 8  ( 8 )  "*" " "     "*"                    " "      "*"
## 8  ( 9 )  "*" "*"     "*"                    " "      "*"
## 8  ( 10 ) "*" " "     "*"                    "*"      "*"
```

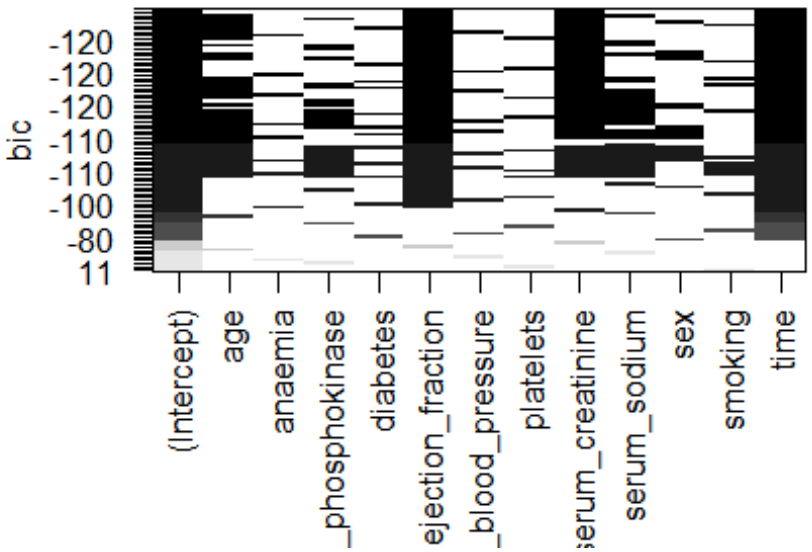
```
##          high_blood_pressure platelets serum_creatinine serum_sodium sex
## 1  ( 1 )  " "                " "       " "               " "          " "
## 1  ( 2 )  " "                " "       "*"               " "          " "
## 1  ( 3 )  " "                " "       " "               " "          " "
## 1  ( 4 )  " "                " "       " "               " "          " "
## 1  ( 5 )  " "                " "       " "               "*"          " "
## 1  ( 6 )  "*"                " "       " "               " "          " "
## 1  ( 7 )  " "                " "       " "               " "          " "
## 1  ( 8 )  " "                " "       " "               " "          " "
## 1  ( 9 )  " "                "*"       " "               " "          " "
## 1  ( 10 ) " "                " "       " "               " "          " "
## 2  ( 1 )  " "                " "       " "               " "          " "
## 2  ( 2 )  " "                " "       "*"               " "          " "
## 2  ( 3 )  " "                " "       " "               "*"          " "
## 2  ( 4 )  " "                " "       " "               " "          " "
## 2  ( 5 )  " "                " "       " "               " "          " "
## 2  ( 6 )  " "                "*"       " "               " "          " "
## 2  ( 7 )  " "                " "       " "               " "          " "
## 2  ( 8 )  "*"                " "       " "               " "          " "
## 2  ( 9 )  " "                " "       " "               " "          " "
## 2  ( 10 ) " "                " "       " "               " "          "*"
## 3  ( 1 )  " "                " "       "*"               " "          " "
## 3  ( 2 )  " "                " "       " "               " "          " "
## 3  ( 3 )  " "                " "       " "               "*"          " "
## 3  ( 4 )  " "                " "       " "               " "          "*"
## 3  ( 5 )  " "                " "       " "               " "          " "
## 3  ( 6 )  " "                " "       " "               " "          " "
## 3  ( 7 )  " "                "*"       " "               " "          " "
## 3  ( 8 )  "*"                " "       " "               " "          " "
## 3  ( 9 )  " "                " "       " "               " "          " "
## 3  ( 10 ) " "                " "       " "               " "          " "
## 4  ( 1 )  " "                " "       "*"               " "          " "
## 4  ( 2 )  " "                " "       "*"               "*"          " "
## 4  ( 3 )  " "                " "       "*"               " "          " "
## 4  ( 4 )  " "                " "       "*"               " "          "*"
## 4  ( 5 )  " "                " "       "*"               " "          " "
## 4  ( 6 )  " "                " "       "*"               " "          " "
## 4  ( 7 )  " "                "*"       "*"               " "          " "
## 4  ( 8 )  "*"                " "       "*"               " "          " "
## 4  ( 9 )  " "                " "       "*"               " "          " "
## 4  ( 10 ) " "                " "       " "               "*"          " "
## 5  ( 1 )  " "                " "       "*"               "*"          " "
## 5  ( 2 )  " "                " "       "*"               " "          " "
## 5  ( 3 )  " "                " "       "*"               " "          "*"
## 5  ( 4 )  " "                " "       "*"               " "          " "
## 5  ( 5 )  " "                " "       "*"               " "          " "
## 5  ( 6 )  "*"                " "       "*"               " "          " "
## 5  ( 7 )  " "                " "       "*"               " "          " "
## 5  ( 8 )  " "                "*"       "*"               " "          " "
## 5  ( 9 )  " "                " "       "*"               "*"          " "
```

```
## 5  ( 10 ) " "                 " "       "*"               "*"          "*"
## 6  ( 1 )  " "                 " "       "*"               "*"          " "
## 6  ( 2 )  " "                 " "       "*"               "*"          "*"
## 6  ( 3 )  " "                 " "       "*"               " "          "*"
## 6  ( 4 )  " "                 " "       "*"               "*"          " "
## 6  ( 5 )  " "                 " "       "*"               "*"          " "
## 6  ( 6 )  " "                 " "       "*"               " "          " "
## 6  ( 7 )  " "                 " "       "*"               " "          " "
## 6  ( 8 )  "*"                 " "       "*"               "*"          " "
## 6  ( 9 )  " "                 " "       "*"               "*"          " "
## 6  ( 10 ) " "                 "*"       "*"               "*"          " "
## 7  ( 1 )  " "                 " "       "*"               "*"          "*"
## 7  ( 2 )  " "                 " "       "*"               "*"          " "
## 7  ( 3 )  " "                 " "       "*"               "*"          " "
## 7  ( 4 )  " "                 "*"       "*"               "*"          " "
## 7  ( 5 )  "*"                 " "       "*"               "*"          " "
## 7  ( 6 )  " "                 " "       "*"               "*"          " "
## 7  ( 7 )  " "                 " "       "*"               " "          "*"
## 7  ( 8 )  "*"                 " "       "*"               "*"          "*"
## 7  ( 9 )  " "                 " "       "*"               "*"          "*"
## 7  ( 10 ) " "                 " "       "*"               "*"          "*"
## 8  ( 1 )  " "                 " "       "*"               "*"          "*"
## 8  ( 2 )  " "                 "*"       "*"               "*"          "*"
## 8  ( 3 )  "*"                 " "       "*"               "*"          "*"
## 8  ( 4 )  " "                 " "       "*"               "*"          "*"
## 8  ( 5 )  " "                 " "       "*"               "*"          "*"
## 8  ( 6 )  " "                 " "       "*"               "*"          " "
## 8  ( 7 )  "*"                 " "       "*"               "*"          " "
## 8  ( 8 )  " "                 "*"       "*"               "*"          " "
## 8  ( 9 )  " "                 " "       "*"               "*"          " "
## 8  ( 10 ) " "                 "*"       "*"               "*"          " "
##           smoking time
## 1  ( 1 )  " "     "*"
## 1  ( 2 )  " "     " "
## 1  ( 3 )  " "     " "
## 1  ( 4 )  " "     " "
## 1  ( 5 )  " "     " "
## 1  ( 6 )  " "     " "
## 1  ( 7 )  " "     " "
## 1  ( 8 )  " "     " "
## 1  ( 9 )  " "     " "
## 1  ( 10 ) "*"     " "
## 2  ( 1 )  " "     "*"
## 2  ( 2 )  " "     "*"
## 2  ( 3 )  " "     "*"
## 2  ( 4 )  " "     "*"
## 2  ( 5 )  " "     "*"
## 2  ( 6 )  " "     "*"
## 2  ( 7 )  "*"     "*"
## 2  ( 8 )  " "     "*"
```

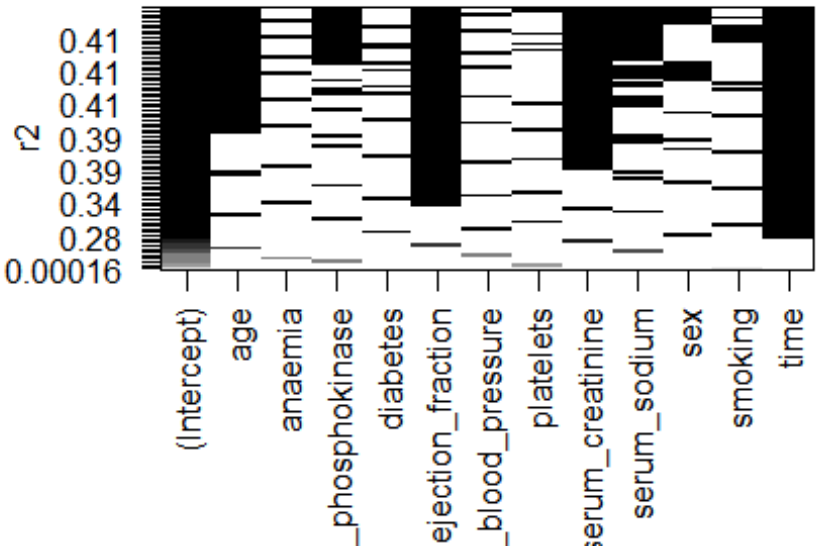
```
## 2  ( 9 )  " "     "*"
## 2  ( 10 ) " "     "*"
## 3  ( 1 )  " "     "*"
## 3  ( 2 )  " "     "*"
## 3  ( 3 )  " "     "*"
## 3  ( 4 )  " "     "*"
## 3  ( 5 )  " "     "*"
## 3  ( 6 )  "*"     "*"
## 3  ( 7 )  " "     "*"
## 3  ( 8 )  " "     "*"
## 3  ( 9 )  " "     "*"
## 3  ( 10 ) " "     "*"
## 4  ( 1 )  " "     "*"
## 4  ( 2 )  " "     "*"
## 4  ( 3 )  " "     "*"
## 4  ( 4 )  " "     "*"
## 4  ( 5 )  "*"     "*"
## 4  ( 6 )  " "     "*"
## 4  ( 7 )  " "     "*"
## 4  ( 8 )  " "     "*"
## 4  ( 9 )  " "     "*"
## 4  ( 10 ) " "     "*"
## 5  ( 1 )  " "     "*"
## 5  ( 2 )  " "     "*"
## 5  ( 3 )  " "     "*"
## 5  ( 4 )  "*"     "*"
## 5  ( 5 )  " "     "*"
## 5  ( 6 )  " "     "*"
## 5  ( 7 )  " "     "*"
## 5  ( 8 )  " "     "*"
## 5  ( 9 )  " "     "*"
## 5  ( 10 ) " "     "*"
## 6  ( 1 )  " "     "*"
## 6  ( 2 )  " "     "*"
## 6  ( 3 )  " "     "*"
## 6  ( 4 )  "*"     "*"
## 6  ( 5 )  " "     "*"
## 6  ( 6 )  "*"     "*"
## 6  ( 7 )  " "     "*"
## 6  ( 8 )  " "     "*"
## 6  ( 9 )  " "     "*"
## 6  ( 10 ) " "     "*"
## 7  ( 1 )  " "     "*"
## 7  ( 2 )  "*"     "*"
## 7  ( 3 )  " "     "*"
## 7  ( 4 )  " "     "*"
## 7  ( 5 )  " "     "*"
## 7  ( 6 )  " "     "*"
## 7  ( 7 )  " "     "*"
## 7  ( 8 )  " "     "*"
```

```
## 7  ( 9 )  " "     "*"
## 7  ( 10 ) " "     "*"
## 8  ( 1 )  " "     "*"
## 8  ( 2 )  " "     "*"
## 8  ( 3 )  " "     "*"
## 8  ( 4 )  "*"     "*"
## 8  ( 5 )  " "     "*"
## 8  ( 6 )  "*"     "*"
## 8  ( 7 )  "*"     "*"
## 8  ( 8 )  "*"     "*"
## 8  ( 9 )  "*"     "*"
## 8  ( 10 ) " "     "*"
```

```
plot(leaps)
```




```
plot(leaps,scale="r2")
```




```
coef(leaps,1:5)
```

```
## [[1]]
##  (Intercept)         time
##  0.734682508 -0.003175261
##
## [[2]]
##      (Intercept) serum_creatinine
##        0.1356370        0.1330339
##
## [[3]]
##       (Intercept) ejection_fraction
##        0.72529879       -0.01061424
##
## [[4]]
##  (Intercept)          age
## -0.285802141  0.009975892
##
## [[5]]
##  (Intercept) serum_sodium
##   3.14775088  -0.02068927
```

```
# Calculate Relative Importance for Each Predictor
calc.relimp(fit,type=c("lmg","last","first","pratt"),rela=TRUE)
```

```
## Warning in rev(variances[[p]]) - variances[[p + 1]]: Recycling array of le
ngth 1 in vector-array arithmetic is deprecated.
##   Use c() or as.vector() instead.

## Response variable: DEATH_EVENT
## Total response variance: 0.2187156
## Analysis based on 299 observations
##
## 12 Regressors:
## age anaemia creatinine_phosphokinase diabetes ejection_fraction high_blood
_pressure platelets serum_creatinine serum_sodium sex smoking time
## Proportion of variance explained by model: 41.68%
## Metrics are normalized to sum to 100% (rela=TRUE).
##
## Relative importance metrics:
##
##                                lmg         last        first
## age                      0.0937640906 6.385122e-02 1.157589e-01
## anaemia                  0.0049359382 2.599695e-05 7.896800e-03
## creatinine_phosphokinase 0.0125437999 1.556567e-02 7.075237e-03
## diabetes                 0.0007300819 1.279073e-03 6.787492e-06
## ejection_fraction        0.1546141562 1.904061e-01 1.297295e-01
## high_blood_pressure      0.0075585019 6.565266e-04 1.132195e-02
## platelets                0.0024364830 9.619330e-04 4.341764e-03
## serum_creatinine         0.1332438538 1.080252e-01 1.557149e-01
## serum_sodium             0.0450742068 1.531584e-02 6.851592e-02
## sex                      0.0037103743 1.040443e-02 3.350075e-05
## smoking                  0.0006537701 8.395941e-05 2.865178e-04
## time                     0.5407347433 5.934241e-01 4.993182e-01
##                                pratt
## age                       8.927702e-02
## anaemia                  -4.664673e-04
## creatinine_phosphokinase  1.069850e-02
## diabetes                 -9.491313e-05
## ejection_fraction         1.603553e-01
## high_blood_pressure      -2.782506e-03
## platelets                 2.063568e-03
## serum_creatinine          1.331607e-01
## serum_sodium              3.357606e-02
## sex                       6.742258e-04
## smoking                   1.736031e-04
## time                      5.733650e-01
##
## Average coefficients for different model sizes:
##
##                                    1X           2Xs           3Xs
## age                       9.975892e-03  9.462064e-03  8.977711e-03
## anaemia                   6.247150e-02  5.514393e-02  4.817298e-02
## creatinine_phosphokinase  3.023443e-05  3.219618e-05  3.377364e-05
## diabetes                 -1.839080e-03  1.852069e-03  5.053665e-03
```

```
## ejection_fraction        -1.061424e-02 -1.051875e-02 -1.042816e-02
## high_blood_pressure       7.761414e-02  6.808268e-02  5.881738e-02
## platelets                -2.349673e-07 -2.098009e-07 -1.874021e-07
## serum_creatinine          1.330339e-01  1.272750e-01  1.218126e-01
## serum_sodium             -2.068927e-02 -1.935134e-02 -1.804686e-02
## sex                      -4.221895e-03 -9.949780e-03 -1.572026e-02
## smoking                  -1.262315e-02 -1.395430e-02 -1.479149e-02
## time                     -3.175261e-03 -3.130357e-03 -3.086429e-03
##                                    4Xs           5Xs           6Xs
## age                       8.521826e-03  8.093342e-03  7.691150e-03
## anaemia                   4.153323e-02  3.519809e-02  2.914068e-02
## creatinine_phosphokinase  3.499096e-05  3.587129e-05  3.643648e-05
## diabetes                  7.805559e-03  1.015224e-02  1.214099e-02
## ejection_fraction        -1.034251e-02 -1.026181e-02 -1.018604e-02
## high_blood_pressure       4.980484e-02  4.103297e-02  3.249124e-02
## platelets                -1.676213e-07 -1.502952e-07 -1.352535e-07
## serum_creatinine          1.166433e-01  1.117631e-01  1.071670e-01
## serum_sodium             -1.677454e-02 -1.553311e-02 -1.432131e-02
## sex                      -2.148608e-02 -2.720690e-02 -3.284851e-02
## smoking                  -1.517259e-02 -1.513369e-02 -1.470899e-02
## time                     -3.043468e-03 -3.001463e-03 -2.960402e-03
##                                    7Xs           8Xs           9Xs
## age                       7.314121e-03  6.961114e-03  6.630990e-03
## anaemia                   2.333448e-02  1.775395e-02  1.237494e-02
## creatinine_phosphokinase  3.670700e-05  3.670195e-05  3.643914e-05
## diabetes                  1.382052e-02  1.523994e-02  1.644800e-02
## ejection_fraction        -1.011517e-02 -1.004918e-02 -9.988049e-03
## high_blood_pressure       2.417079e-02  1.606453e-02  8.167160e-03
## platelets                -1.223244e-07 -1.113386e-07 -1.021331e-07
## serum_creatinine          1.028500e-01  9.880674e-02  9.503197e-02
## serum_sodium             -1.313789e-02 -1.198155e-02 -1.085094e-02
## sex                      -3.838194e-02 -4.378275e-02 -4.903016e-02
## smoking                  -1.393084e-02 -1.282964e-02 -1.143382e-02
## time                     -2.920273e-03 -2.881058e-03 -2.842736e-03
##                                   10Xs          11Xs          12Xs
## age                       6.322613e-03  6.034851e-03  5.766578e-03
## anaemia                   7.175118e-03  2.134180e-03 -2.765880e-03
## creatinine_phosphokinase  3.593524e-05  3.520594e-05  3.426613e-05
## diabetes                  1.749252e-02  1.842000e-02  1.927520e-02
## ejection_fraction        -9.931758e-03 -9.880295e-03 -9.833650e-03
## high_blood_pressure       4.752014e-04 -7.012907e-03 -1.429674e-02
## platelets                -9.455323e-08 -8.845434e-08 -8.370305e-08
## serum_creatinine          9.152060e-02  8.826772e-02  8.526866e-02
## serum_sodium             -9.744662e-03 -8.661238e-03 -7.599145e-03
## sex                      -5.410641e-02 -5.899606e-02 -6.368536e-02
## smoking                  -9.769796e-03 -7.861942e-03 -5.732644e-03
## time                     -2.805281e-03 -2.768663e-03 -2.732842e-03
```

```r
# Bootstrap Measures of Relative Importance (100 samples)
boot <- boot.relimp(fit, b = 100, type = c("lmg","last", "first", "pratt"), r
ank = TRUE, diff = TRUE, rela = TRUE)

## Warning in rev(variances[[p]]) - variances[[p + 1]]: Recycling array of le
ngth 1 in vector-array arithmetic is deprecated.
##   Use c() or as.vector() instead.

booteval.relimp(boot)

## Warning in rev(variances[[p]]) - variances[[p + 1]]: Recycling array of le
ngth 1 in vector-array arithmetic is deprecated.
##   Use c() or as.vector() instead.

## Response variable: DEATH_EVENT
## Total response variance: 0.2187156
## Analysis based on 299 observations
##
## 12 Regressors:
## age anaemia creatinine_phosphokinase diabetes ejection_fraction high_blood
_pressure platelets serum_creatinine serum_sodium sex smoking time
## Proportion of variance explained by model: 41.68%
## Metrics are normalized to sum to 100% (rela=TRUE).
##
## Relative importance metrics:
##
##                                 lmg         last        first
## age                      0.0937640906 6.385122e-02 1.157589e-01
## anaemia                  0.0049359382 2.599695e-05 7.896800e-03
## creatinine_phosphokinase 0.0125437999 1.556567e-02 7.075237e-03
## diabetes                 0.0007300819 1.279073e-03 6.787492e-06
## ejection_fraction        0.1546141562 1.904061e-01 1.297295e-01
## high_blood_pressure      0.0075585019 6.565266e-04 1.132195e-02
## platelets                0.0024364830 9.619330e-04 4.341764e-03
## serum_creatinine         0.1332438538 1.080252e-01 1.557149e-01
## serum_sodium             0.0450742068 1.531584e-02 6.851592e-02
## sex                      0.0037103743 1.040443e-02 3.350075e-05
## smoking                  0.0006537701 8.395941e-05 2.865178e-04
## time                     0.5407347433 5.934241e-01 4.993182e-01
##                                 pratt
## age                      8.927702e-02
## anaemia                 -4.664673e-04
## creatinine_phosphokinase 1.069850e-02
## diabetes                -9.491313e-05
## ejection_fraction        1.603553e-01
## high_blood_pressure     -2.782506e-03
## platelets                2.063568e-03
## serum_creatinine         1.331607e-01
## serum_sodium             3.357606e-02
## sex                      6.742258e-04
## smoking                  1.736031e-04
```

```
## time                       5.733650e-01
##
## Average coefficients for different model sizes:
##
##                                    1X           2Xs           3Xs
## age                         9.975892e-03  9.462064e-03  8.977711e-03
## anaemia                     6.247150e-02  5.514393e-02  4.817298e-02
## creatinine_phosphokinase    3.023443e-05  3.219618e-05  3.377364e-05
## diabetes                   -1.839080e-03  1.852069e-03  5.053665e-03
## ejection_fraction          -1.061424e-02 -1.051875e-02 -1.042816e-02
## high_blood_pressure         7.761414e-02  6.808268e-02  5.881738e-02
## platelets                  -2.349673e-07 -2.098009e-07 -1.874021e-07
## serum_creatinine            1.330339e-01  1.272750e-01  1.218126e-01
## serum_sodium               -2.068927e-02 -1.935134e-02 -1.804686e-02
## sex                        -4.221895e-03 -9.949780e-03 -1.572026e-02
## smoking                    -1.262315e-02 -1.395430e-02 -1.479149e-02
## time                       -3.175261e-03 -3.130357e-03 -3.086429e-03
##                                    4Xs           5Xs           6Xs
## age                         8.521826e-03  8.093342e-03  7.691150e-03
## anaemia                     4.153323e-02  3.519809e-02  2.914068e-02
## creatinine_phosphokinase    3.499096e-05  3.587129e-05  3.643648e-05
## diabetes                    7.805559e-03  1.015224e-02  1.214099e-02
## ejection_fraction          -1.034251e-02 -1.026181e-02 -1.018604e-02
## high_blood_pressure         4.980484e-02  4.103297e-02  3.249124e-02
## platelets                  -1.676213e-07 -1.502952e-07 -1.352535e-07
## serum_creatinine            1.166433e-01  1.117631e-01  1.071670e-01
## serum_sodium               -1.677454e-02 -1.553311e-02 -1.432131e-02
## sex                        -2.148608e-02 -2.720690e-02 -3.284851e-02
## smoking                    -1.517259e-02 -1.513369e-02 -1.470899e-02
## time                       -3.043468e-03 -3.001463e-03 -2.960402e-03
##                                    7Xs           8Xs           9Xs
## age                         7.314121e-03  6.961114e-03  6.630990e-03
## anaemia                     2.333448e-02  1.775395e-02  1.237494e-02
## creatinine_phosphokinase    3.670700e-05  3.670195e-05  3.643914e-05
## diabetes                    1.382052e-02  1.523994e-02  1.644800e-02
## ejection_fraction          -1.011517e-02 -1.004918e-02 -9.988049e-03
## high_blood_pressure         2.417079e-02  1.606453e-02  8.167160e-03
## platelets                  -1.223244e-07 -1.113386e-07 -1.021331e-07
## serum_creatinine            1.028500e-01  9.880674e-02  9.503197e-02
## serum_sodium               -1.313789e-02 -1.198155e-02 -1.085094e-02
## sex                        -3.838194e-02 -4.378275e-02 -4.903016e-02
## smoking                    -1.393084e-02 -1.282964e-02 -1.143382e-02
## time                       -2.920273e-03 -2.881058e-03 -2.842736e-03
##                                   10Xs          11Xs          12Xs
## age                         6.322613e-03  6.034851e-03  5.766578e-03
## anaemia                     7.175118e-03  2.134180e-03 -2.765880e-03
## creatinine_phosphokinase    3.593524e-05  3.520594e-05  3.426613e-05
## diabetes                    1.749252e-02  1.842000e-02  1.927520e-02
## ejection_fraction          -9.931758e-03 -9.880295e-03 -9.833650e-03
## high_blood_pressure         4.752014e-04 -7.012907e-03 -1.429674e-02
```

```
## platelets                -9.455323e-08 -8.845434e-08 -8.370305e-08
## serum_creatinine          9.152060e-02  8.826772e-02  8.526866e-02
## serum_sodium             -9.744662e-03 -8.661238e-03 -7.599145e-03
## sex                      -5.410641e-02 -5.899606e-02 -6.368536e-02
## smoking                  -9.769796e-03 -7.861942e-03 -5.732644e-03
## time                     -2.805281e-03 -2.768663e-03 -2.732842e-03
##
##
##  Confidence interval information ( 100 bootstrap replicates, bty= perc ):
## Relative Contributions with confidence intervals:
##
##                                                    Lower  Upper
##                                 percentage 0.95    0.95    0.95
## age.lmg                          0.0938    _BCDEF______  0.0233  0.1672
## anaemia.lmg                      0.0049    ____EFGHIJKL  0.0010  0.0347
## creatinine_phosphokinase.lmg     0.0125    ____EFGHIJKL  0.0006  0.0551
## diabetes.lmg                     0.0007    _____FGHIJKL  0.0005  0.0360
## ejection_fraction.lmg            0.1546    _BCDE_______  0.0458  0.2785
## high_blood_pressure.lmg          0.0076    ____EFGHIJKL  0.0016  0.0509
## platelets.lmg                    0.0024    _____FGHIJKL  0.0006  0.0371
## serum_creatinine.lmg             0.1332    _BCDE_______  0.0312  0.2646
## serum_sodium.lmg                 0.0451    __CDEFGH____  0.0062  0.1361
## sex.lmg                          0.0037    ____EFGHIJKL  0.0008  0.0494
## smoking.lmg                      0.0007    _____FGHIJKL  0.0008  0.0210
## time.lmg                         0.5407    A___________  0.3617  0.6406
##
## age.last                         0.0639    _BCDEFG_____  0.0144  0.1544
## anaemia.last                     0.0000    ____EFGHIJKL  0.0000  0.0323
## creatinine_phosphokinase.last    0.0156    ___DEFGHIJKL  0.0000  0.0696
## diabetes.last                    0.0013    ____EFGHIJKL  0.0000  0.0433
## ejection_fraction.last           0.1904    _BCD________  0.0673  0.3438
## high_blood_pressure.last         0.0007    ___DEFGHIJKL  0.0000  0.0377
## platelets.last                   0.0010    ____EFGHIJKL  0.0000  0.0343
## serum_creatinine.last            0.1080    _BCDEFG_____  0.0043  0.2668
## serum_sodium.last                0.0153    __CDEFGHIJKL  0.0000  0.0834
## sex.last                         0.0104    ___DEFGHIJKL  0.0000  0.0858
## smoking.last                     0.0001    _____FGHIJKL  0.0000  0.0206
## time.last                        0.5934    A___________  0.3789  0.7347
##
## age.first                        0.1158    _BCDEF______  0.0275  0.1995
## anaemia.first                    0.0079    _____FGHIJKL  0.0000  0.0425
## creatinine_phosphokinase.first   0.0071    ____EFGHIJKL  0.0000  0.0467
## diabetes.first                   0.0000    _____FGHIJKL  0.0000  0.0419
## ejection_fraction.first          0.1297    _BCDE_______  0.0256  0.2456
## high_blood_pressure.first        0.0113    ____EFGHIJKL  0.0000  0.0747
## platelets.first                  0.0043    _____FGHIJKL  0.0000  0.0419
## serum_creatinine.first           0.1557    _BCDE_______  0.0573  0.2821
## serum_sodium.first               0.0685    _BCDEFGH____  0.0116  0.1710
## sex.first                        0.0000    ____EFGHIJKL  0.0000  0.0379
## smoking.first                    0.0003    ______GHIJKL  0.0000  0.0336
```

```
## time.first                         0.4993    A___________  0.3362  0.5863
##
## age.pratt                          0.0893    _BCDEFG_____  0.0214  0.1729
## anaemia.pratt                     -0.0005    ____EFGHIJKL -0.0087  0.0328
## creatinine_phosphokinase.pratt     0.0107    ____EFGHIJKL -0.0030  0.0528
## diabetes.pratt                    -0.0001    ____EFGHIJKL -0.0027  0.0375
## ejection_fraction.pratt            0.1604    _BCDE_______  0.0430  0.2953
## high_blood_pressure.pratt         -0.0028    ____EFGHIJKL -0.0131  0.0305
## platelets.pratt                    0.0021    ____EFGHIJKL -0.0047  0.0340
## serum_creatinine.pratt             0.1332    _BCDE_______  0.0200  0.2721
## serum_sodium.pratt                 0.0336    __CDEFGHIJK_ -0.0060  0.1234
## sex.pratt                          0.0007    ___DEFGHIJKL -0.0079  0.0567
## smoking.pratt                      0.0002    _____FGHIJKL -0.0073  0.0199
## time.pratt                         0.5734    A___________  0.3824  0.6838
##
## Letters indicate the ranks covered by bootstrap CIs.
## (Rank bootstrap confidence intervals always obtained by percentile method)
## CAUTION: Bootstrap confidence intervals can be somewhat liberal.
##
##
##  Differences between Relative Contributions:
##
##                                                                    Lower
Upper
##                                                  difference 0.95 0.95
## age-anaemia.lmg                                   0.0888     *    0.0027
## age-creatinine_phosphokinase.lmg                  0.0812          -0.0129
## age-diabetes.lmg                                  0.0930     *    0.0160
## age-ejection_fraction.lmg                        -0.0609          -0.2175
## age-high_blood_pressure.lmg                       0.0862     *    0.0061
## age-platelets.lmg                                 0.0913     *    0.0134
## age-serum_creatinine.lmg                         -0.0395          -0.1977
## age-serum_sodium.lmg                              0.0487          -0.0765
## age-sex.lmg                                       0.0901     *    0.0159
## age-smoking.lmg                                   0.0931     *    0.0142
## age-time.lmg                                     -0.4470     *   -0.5961
## anaemia-creatinine_phosphokinase.lmg             -0.0076          -0.0494
## anaemia-diabetes.lmg                              0.0042          -0.0306
## anaemia-ejection_fraction.lmg                    -0.1497     *   -0.2618
## anaemia-high_blood_pressure.lmg                  -0.0026          -0.0387
## anaemia-platelets.lmg                             0.0025          -0.0354
## anaemia-serum_creatinine.lmg                     -0.1283     *   -0.2572
## anaemia-serum_sodium.lmg                         -0.0401          -0.1332
## anaemia-sex.lmg                                   0.0012          -0.0473
## anaemia-smoking.lmg                               0.0043          -0.0145
## anaemia-time.lmg                                 -0.5358     *   -0.6258
## creatinine_phosphokinase-diabetes.lmg             0.0118          -0.0256
## creatinine_phosphokinase-ejection_fraction.lmg   -0.1421     *   -0.2612
## creatinine_phosphokinase-high_blood_pressure.lmg  0.0050          -0.0411
## creatinine_phosphokinase-platelets.lmg            0.0101          -0.0253
```

```
## creatinine_phosphokinase-serum_creatinine.lmg      -0.1207     *   -0.2361
## creatinine_phosphokinase-serum_sodium.lmg          -0.0325         -0.1229
## creatinine_phosphokinase-sex.lmg                    0.0088         -0.0450
## creatinine_phosphokinase-smoking.lmg                0.0119         -0.0143
## creatinine_phosphokinase-time.lmg                  -0.5282     *   -0.6279
## diabetes-ejection_fraction.lmg                     -0.1539     *   -0.2744
## diabetes-high_blood_pressure.lmg                   -0.0068         -0.0422
## diabetes-platelets.lmg                             -0.0017         -0.0303
## diabetes-serum_creatinine.lmg                      -0.1325     *   -0.2605
## diabetes-serum_sodium.lmg                          -0.0443     *   -0.1339
## diabetes-sex.lmg                                   -0.0030         -0.0459
## diabetes-smoking.lmg                                0.0001         -0.0194
## diabetes-time.lmg                                  -0.5400     *   -0.6348
## ejection_fraction-high_blood_pressure.lmg           0.1471     *    0.0303
## ejection_fraction-platelets.lmg                     0.1522     *    0.0384
## ejection_fraction-serum_creatinine.lmg              0.0214         -0.1459
## ejection_fraction-serum_sodium.lmg                  0.1095         -0.0382
## ejection_fraction-sex.lmg                           0.1509     *    0.0110
## ejection_fraction-smoking.lmg                       0.1540     *    0.0394
## ejection_fraction-time.lmg                         -0.3861     *   -0.5593
## high_blood_pressure-platelets.lmg                   0.0051         -0.0322
## high_blood_pressure-serum_creatinine.lmg           -0.1257     *   -0.2599
## high_blood_pressure-serum_sodium.lmg               -0.0375         -0.1253
## high_blood_pressure-sex.lmg                         0.0038         -0.0414
## high_blood_pressure-smoking.lmg                     0.0069         -0.0151
## high_blood_pressure-time.lmg                       -0.5332     *   -0.6334
## platelets-serum_creatinine.lmg                     -0.1308     *   -0.2607
## platelets-serum_sodium.lmg                         -0.0426         -0.1334
## platelets-sex.lmg                                  -0.0013         -0.0455
## platelets-smoking.lmg                               0.0018         -0.0177
## platelets-time.lmg                                 -0.5383     *   -0.6316
## serum_creatinine-serum_sodium.lmg                   0.0882         -0.0458
## serum_creatinine-sex.lmg                            0.1295     *    0.0277
## serum_creatinine-smoking.lmg                        0.1326     *    0.0270
## serum_creatinine-time.lmg                          -0.4075     *   -0.5944
## serum_sodium-sex.lmg                                0.0414         -0.0067
## serum_sodium-smoking.lmg                            0.0444     *    0.0005
## serum_sodium-time.lmg                              -0.4957     *   -0.5997
## sex-smoking.lmg                                     0.0031         -0.0170
## sex-time.lmg                                       -0.5370     *   -0.6331
## smoking-time.lmg                                   -0.5401     *   -0.6319
##
## age-anaemia.last                                    0.0638         -0.0084
## age-creatinine_phosphokinase.last                   0.0483         -0.0380
## age-diabetes.last                                   0.0626     *    0.0004
## age-ejection_fraction.last                         -0.1266         -0.2977
## age-high_blood_pressure.last                        0.0632         -0.0113
## age-platelets.last                                  0.0629     *    0.0003
## age-serum_creatinine.last                          -0.0442         -0.2104
## age-serum_sodium.last                               0.0485         -0.0486
```

```
## age-sex.last                                          0.0534          -0.0036
## age-smoking.last                                      0.0638     *     0.0038
## age-time.last                                        -0.5296     *    -0.7074
## anaemia-creatinine_phosphokinase.last                -0.0155          -0.0576
## anaemia-diabetes.last                                -0.0013          -0.0398
## anaemia-ejection_fraction.last                       -0.1904     *    -0.3384
## anaemia-high_blood_pressure.last                     -0.0006          -0.0356
## anaemia-platelets.last                               -0.0009          -0.0326
## anaemia-serum_creatinine.last                        -0.1080     *    -0.2649
## anaemia-serum_sodium.last                            -0.0153          -0.0807
## anaemia-sex.last                                     -0.0104          -0.0810
## anaemia-smoking.last                                 -0.0001          -0.0177
## anaemia-time.last                                    -0.5934     *    -0.7309
## creatinine_phosphokinase-diabetes.last                0.0143          -0.0285
## creatinine_phosphokinase-ejection_fraction.last      -0.1748     *    -0.3316
## creatinine_phosphokinase-high_blood_pressure.last     0.0149          -0.0208
## creatinine_phosphokinase-platelets.last               0.0146          -0.0256
## creatinine_phosphokinase-serum_creatinine.last       -0.0925          -0.2428
## creatinine_phosphokinase-serum_sodium.last            0.0002          -0.0648
## creatinine_phosphokinase-sex.last                     0.0052          -0.0842
## creatinine_phosphokinase-smoking.last                 0.0155          -0.0192
## creatinine_phosphokinase-time.last                   -0.5779     *    -0.7175
## diabetes-ejection_fraction.last                      -0.1891     *    -0.3416
## diabetes-high_blood_pressure.last                     0.0006          -0.0294
## diabetes-platelets.last                               0.0003          -0.0295
## diabetes-serum_creatinine.last                       -0.1067          -0.2595
## diabetes-serum_sodium.last                           -0.0140          -0.0797
## diabetes-sex.last                                    -0.0091          -0.0817
## diabetes-smoking.last                                 0.0012          -0.0195
## diabetes-time.last                                   -0.5921     *    -0.7257
## ejection_fraction-high_blood_pressure.last            0.1897     *     0.0542
## ejection_fraction-platelets.last                      0.1894     *     0.0656
## ejection_fraction-serum_creatinine.last               0.0824          -0.1140
## ejection_fraction-serum_sodium.last                   0.1751     *     0.0309
## ejection_fraction-sex.last                            0.1800     *     0.0209
## ejection_fraction-smoking.last                        0.1903     *     0.0611
## ejection_fraction-time.last                          -0.4030     *    -0.6069
## high_blood_pressure-platelets.last                   -0.0003          -0.0303
## high_blood_pressure-serum_creatinine.last            -0.1074          -0.2591
## high_blood_pressure-serum_sodium.last                -0.0147          -0.0812
## high_blood_pressure-sex.last                         -0.0097          -0.0692
## high_blood_pressure-smoking.last                      0.0006          -0.0166
## high_blood_pressure-time.last                        -0.5928     *    -0.7335
## platelets-serum_creatinine.last                      -0.1071          -0.2636
## platelets-serum_sodium.last                          -0.0144          -0.0797
## platelets-sex.last                                   -0.0094          -0.0763
## platelets-smoking.last                                0.0009          -0.0177
## platelets-time.last                                  -0.5925     *    -0.7306
## serum_creatinine-serum_sodium.last                    0.0927          -0.0587
## serum_creatinine-sex.last                             0.0976          -0.0039
```

```
## serum_creatinine-smoking.last                          0.1079         -0.0010
## serum_creatinine-time.last                            -0.4854     *   -0.6986
## serum_sodium-sex.last                                  0.0049         -0.0443
## serum_sodium-smoking.last                              0.0152         -0.0174
## serum_sodium-time.last                                -0.5781     *   -0.7172
## sex-smoking.last                                       0.0103         -0.0170
## sex-time.last                                         -0.5830     *   -0.7273
## smoking-time.last                                     -0.5933     *   -0.7274
##
## age-anaemia.first                                      0.1079     *    0.0143
## age-creatinine_phosphokinase.first                     0.1087     *    0.0076
## age-diabetes.first                                     0.1158     *    0.0257
## age-ejection_fraction.first                           -0.0140         -0.1926
## age-high_blood_pressure.first                          0.1044     *    0.0031
## age-platelets.first                                    0.1114     *    0.0125
## age-serum_creatinine.first                            -0.0400         -0.1972
## age-serum_sodium.first                                 0.0472         -0.1055
## age-sex.first                                          0.1157     *    0.0217
## age-smoking.first                                      0.1155     *    0.0215
## age-time.first                                        -0.3836     *   -0.5235
## anaemia-creatinine_phosphokinase.first                 0.0008         -0.0421
## anaemia-diabetes.first                                 0.0079         -0.0291
## anaemia-ejection_fraction.first                       -0.1218     *   -0.2349
## anaemia-high_blood_pressure.first                     -0.0034         -0.0647
## anaemia-platelets.first                                0.0036         -0.0411
## anaemia-serum_creatinine.first                        -0.1478     *   -0.2678
## anaemia-serum_sodium.first                            -0.0606         -0.1655
## anaemia-sex.first                                      0.0079         -0.0289
## anaemia-smoking.first                                  0.0076         -0.0209
## anaemia-time.first                                    -0.4914     *   -0.5705
## creatinine_phosphokinase-diabetes.first                0.0071         -0.0360
## creatinine_phosphokinase-ejection_fraction.first      -0.1227     *   -0.2346
## creatinine_phosphokinase-high_blood_pressure.first    -0.0042         -0.0727
## creatinine_phosphokinase-platelets.first               0.0027         -0.0320
## creatinine_phosphokinase-serum_creatinine.first       -0.1486     *   -0.2660
## creatinine_phosphokinase-serum_sodium.first           -0.0614         -0.1600
## creatinine_phosphokinase-sex.first                     0.0070         -0.0296
## creatinine_phosphokinase-smoking.first                 0.0068         -0.0286
## creatinine_phosphokinase-time.first                   -0.4922     *   -0.5755
## diabetes-ejection_fraction.first                      -0.1297     *   -0.2413
## diabetes-high_blood_pressure.first                    -0.0113         -0.0729
## diabetes-platelets.first                              -0.0043         -0.0392
## diabetes-serum_creatinine.first                       -0.1557     *   -0.2778
## diabetes-serum_sodium.first                           -0.0685     *   -0.1689
## diabetes-sex.first                                     0.0000         -0.0296
## diabetes-smoking.first                                -0.0003         -0.0247
## diabetes-time.first                                   -0.4993     *   -0.5858
## ejection_fraction-high_blood_pressure.first            0.1184     *    0.0041
## ejection_fraction-platelets.first                      0.1254     *    0.0147
## ejection_fraction-serum_creatinine.first              -0.0260         -0.1891
```

```
## ejection_fraction-serum_sodium.first                 0.0612         -0.0756
## ejection_fraction-sex.first                          0.1297     *    0.0059
## ejection_fraction-smoking.first                      0.1294     *    0.0237
## ejection_fraction-time.first                        -0.3696     *   -0.5277
## high_blood_pressure-platelets.first                  0.0070         -0.0417
## high_blood_pressure-serum_creatinine.first          -0.1444     *   -0.2724
## high_blood_pressure-serum_sodium.first              -0.0572         -0.1576
## high_blood_pressure-sex.first                        0.0113         -0.0348
## high_blood_pressure-smoking.first                    0.0110         -0.0199
## high_blood_pressure-time.first                      -0.4880     *   -0.5778
## platelets-serum_creatinine.first                    -0.1514     *   -0.2772
## platelets-serum_sodium.first                        -0.0642     *   -0.1669
## platelets-sex.first                                  0.0043         -0.0375
## platelets-smoking.first                              0.0041         -0.0309
## platelets-time.first                                -0.4950     *   -0.5823
## serum_creatinine-serum_sodium.first                  0.0872         -0.0295
## serum_creatinine-sex.first                           0.1557     *    0.0527
## serum_creatinine-smoking.first                       0.1554     *    0.0493
## serum_creatinine-time.first                         -0.3436     *   -0.5058
## serum_sodium-sex.first                               0.0685     *    0.0050
## serum_sodium-smoking.first                           0.0682     *    0.0072
## serum_sodium-time.first                             -0.4308     *   -0.5336
## sex-smoking.first                                   -0.0003         -0.0204
## sex-time.first                                      -0.4993     *   -0.5800
## smoking-time.first                                  -0.4990     *   -0.5849
##
## age-anaemia.pratt                                    0.0897         -0.0002
## age-creatinine_phosphokinase.pratt                   0.0786         -0.0134
## age-diabetes.pratt                                   0.0894     *    0.0147
## age-ejection_fraction.pratt                         -0.0711         -0.2348
## age-high_blood_pressure.pratt                        0.0921     *    0.0156
## age-platelets.pratt                                  0.0872     *    0.0120
## age-serum_creatinine.pratt                          -0.0439         -0.2078
## age-serum_sodium.pratt                               0.0557         -0.0694
## age-sex.pratt                                        0.0886     *    0.0138
## age-smoking.pratt                                    0.0891     *    0.0131
## age-time.pratt                                      -0.4841     *   -0.6438
## anaemia-creatinine_phosphokinase.pratt              -0.0112         -0.0517
## anaemia-diabetes.pratt                              -0.0004         -0.0423
## anaemia-ejection_fraction.pratt                     -0.1608     *   -0.2850
## anaemia-high_blood_pressure.pratt                    0.0023         -0.0283
## anaemia-platelets.pratt                             -0.0025         -0.0365
## anaemia-serum_creatinine.pratt                      -0.1336     *   -0.2699
## anaemia-serum_sodium.pratt                          -0.0340         -0.1239
## anaemia-sex.pratt                                   -0.0011         -0.0590
## anaemia-smoking.pratt                               -0.0006         -0.0171
## anaemia-time.pratt                                  -0.5738     *   -0.6791
## creatinine_phosphokinase-diabetes.pratt              0.0108         -0.0278
## creatinine_phosphokinase-ejection_fraction.pratt    -0.1497     *   -0.2846
## creatinine_phosphokinase-high_blood_pressure.pratt   0.0135         -0.0250
```

```
## creatinine_phosphokinase-platelets.pratt             0.0086         -0.0244
## creatinine_phosphokinase-serum_creatinine.pratt     -0.1225     *   -0.2475
## creatinine_phosphokinase-serum_sodium.pratt         -0.0229         -0.1104
## creatinine_phosphokinase-sex.pratt                   0.0100         -0.0545
## creatinine_phosphokinase-smoking.pratt               0.0105         -0.0152
## creatinine_phosphokinase-time.pratt                 -0.5627     *   -0.6756
## diabetes-ejection_fraction.pratt                    -0.1605     *   -0.2934
## diabetes-high_blood_pressure.pratt                   0.0027         -0.0247
## diabetes-platelets.pratt                            -0.0022         -0.0302
## diabetes-serum_creatinine.pratt                     -0.1333     *   -0.2694
## diabetes-serum_sodium.pratt                         -0.0337         -0.1227
## diabetes-sex.pratt                                  -0.0008         -0.0522
## diabetes-smoking.pratt                              -0.0003         -0.0211
## diabetes-time.pratt                                 -0.5735     *   -0.6809
## ejection_fraction-high_blood_pressure.pratt          0.1631     *    0.0451
## ejection_fraction-platelets.pratt                    0.1583     *    0.0439
## ejection_fraction-serum_creatinine.pratt             0.0272         -0.1515
## ejection_fraction-serum_sodium.pratt                 0.1268         -0.0279
## ejection_fraction-sex.pratt                          0.1597     *    0.0075
## ejection_fraction-smoking.pratt                      0.1602     *    0.0443
## ejection_fraction-time.pratt                        -0.4130     *   -0.6061
## high_blood_pressure-platelets.pratt                 -0.0048         -0.0334
## high_blood_pressure-serum_creatinine.pratt          -0.1359     *   -0.2764
## high_blood_pressure-serum_sodium.pratt              -0.0364         -0.1173
## high_blood_pressure-sex.pratt                       -0.0035         -0.0581
## high_blood_pressure-smoking.pratt                   -0.0030         -0.0284
## high_blood_pressure-time.pratt                      -0.5761     *   -0.6826
## platelets-serum_creatinine.pratt                    -0.1311     *   -0.2690
## platelets-serum_sodium.pratt                        -0.0315         -0.1232
## platelets-sex.pratt                                  0.0014         -0.0544
## platelets-smoking.pratt                              0.0019         -0.0182
## platelets-time.pratt                                -0.5713     *   -0.6777
## serum_creatinine-serum_sodium.pratt                  0.0996         -0.0570
## serum_creatinine-sex.pratt                           0.1325     *    0.0152
## serum_creatinine-smoking.pratt                       0.1330     *    0.0129
## serum_creatinine-time.pratt                         -0.4402     *   -0.6507
## serum_sodium-sex.pratt                               0.0329         -0.0264
## serum_sodium-smoking.pratt                           0.0334         -0.0133
## serum_sodium-time.pratt                             -0.5398     *   -0.6636
## sex-smoking.pratt                                    0.0005         -0.0235
## sex-time.pratt                                      -0.5727     *   -0.6797
## smoking-time.pratt                                  -0.5732     *   -0.6751
##                                                    0.95
## age-anaemia.lmg                                     0.1615
## age-creatinine_phosphokinase.lmg                    0.1595
## age-diabetes.lmg                                    0.1605
## age-ejection_fraction.lmg                           0.0885
## age-high_blood_pressure.lmg                         0.1592
## age-platelets.lmg                                   0.1562
## age-serum_creatinine.lmg                            0.0845
```

```
## age-serum_sodium.lmg                                    0.1342
## age-sex.lmg                                             0.1585
## age-smoking.lmg                                         0.1633
## age-time.lmg                                           -0.2148
## anaemia-creatinine_phosphokinase.lmg                    0.0241
## anaemia-diabetes.lmg                                    0.0298
## anaemia-ejection_fraction.lmg                          -0.0370
## anaemia-high_blood_pressure.lmg                         0.0283
## anaemia-platelets.lmg                                   0.0319
## anaemia-serum_creatinine.lmg                           -0.0221
## anaemia-serum_sodium.lmg                                0.0046
## anaemia-sex.lmg                                         0.0287
## anaemia-smoking.lmg                                     0.0298
## anaemia-time.lmg                                       -0.3422
## creatinine_phosphokinase-diabetes.lmg                   0.0487
## creatinine_phosphokinase-ejection_fraction.lmg         -0.0339
## creatinine_phosphokinase-high_blood_pressure.lmg        0.0453
## creatinine_phosphokinase-platelets.lmg                  0.0532
## creatinine_phosphokinase-serum_creatinine.lmg          -0.0225
## creatinine_phosphokinase-serum_sodium.lmg               0.0206
## creatinine_phosphokinase-sex.lmg                        0.0489
## creatinine_phosphokinase-smoking.lmg                    0.0526
## creatinine_phosphokinase-time.lmg                      -0.3389
## diabetes-ejection_fraction.lmg                         -0.0436
## diabetes-high_blood_pressure.lmg                        0.0219
## diabetes-platelets.lmg                                  0.0218
## diabetes-serum_creatinine.lmg                          -0.0226
## diabetes-serum_sodium.lmg                              -0.0004
## diabetes-sex.lmg                                        0.0233
## diabetes-smoking.lmg                                    0.0270
## diabetes-time.lmg                                      -0.3465
## ejection_fraction-high_blood_pressure.lmg               0.2577
## ejection_fraction-platelets.lmg                         0.2744
## ejection_fraction-serum_creatinine.lmg                  0.2096
## ejection_fraction-serum_sodium.lmg                      0.2543
## ejection_fraction-sex.lmg                               0.2709
## ejection_fraction-smoking.lmg                           0.2759
## ejection_fraction-time.lmg                             -0.1238
## high_blood_pressure-platelets.lmg                       0.0490
## high_blood_pressure-serum_creatinine.lmg               -0.0091
## high_blood_pressure-serum_sodium.lmg                    0.0152
## high_blood_pressure-sex.lmg                             0.0480
## high_blood_pressure-smoking.lmg                         0.0484
## high_blood_pressure-time.lmg                           -0.3528
## platelets-serum_creatinine.lmg                         -0.0258
## platelets-serum_sodium.lmg                              0.0035
## platelets-sex.lmg                                       0.0273
## platelets-smoking.lmg                                   0.0279
## platelets-time.lmg                                     -0.3416
## serum_creatinine-serum_sodium.lmg                       0.2320
```

```
## serum_creatinine-sex.lmg                                  0.2606
## serum_creatinine-smoking.lmg                              0.2587
## serum_creatinine-time.lmg                                -0.1437
## serum_sodium-sex.lmg                                      0.1215
## serum_sodium-smoking.lmg                                  0.1280
## serum_sodium-time.lmg                                    -0.2168
## sex-smoking.lmg                                           0.0452
## sex-time.lmg                                             -0.3452
## smoking-time.lmg                                         -0.3592
##
## age-anaemia.last                                          0.1485
## age-creatinine_phosphokinase.last                         0.1374
## age-diabetes.last                                         0.1386
## age-ejection_fraction.last                                0.0308
## age-high_blood_pressure.last                              0.1502
## age-platelets.last                                        0.1531
## age-serum_creatinine.last                                 0.1201
## age-serum_sodium.last                                     0.1347
## age-sex.last                                              0.1489
## age-smoking.last                                          0.1543
## age-time.last                                            -0.2437
## anaemia-creatinine_phosphokinase.last                     0.0177
## anaemia-diabetes.last                                     0.0207
## anaemia-ejection_fraction.last                           -0.0600
## anaemia-high_blood_pressure.last                          0.0262
## anaemia-platelets.last                                    0.0314
## anaemia-serum_creatinine.last                            -0.0038
## anaemia-serum_sodium.last                                 0.0165
## anaemia-sex.last                                          0.0271
## anaemia-smoking.last                                      0.0298
## anaemia-time.last                                        -0.3708
## creatinine_phosphokinase-diabetes.last                    0.0536
## creatinine_phosphokinase-ejection_fraction.last          -0.0466
## creatinine_phosphokinase-high_blood_pressure.last         0.0644
## creatinine_phosphokinase-platelets.last                   0.0570
## creatinine_phosphokinase-serum_creatinine.last            0.0071
## creatinine_phosphokinase-serum_sodium.last                0.0500
## creatinine_phosphokinase-sex.last                         0.0526
## creatinine_phosphokinase-smoking.last                     0.0643
## creatinine_phosphokinase-time.last                       -0.3583
## diabetes-ejection_fraction.last                          -0.0493
## diabetes-high_blood_pressure.last                         0.0342
## diabetes-platelets.last                                   0.0405
## diabetes-serum_creatinine.last                            0.0017
## diabetes-serum_sodium.last                                0.0237
## diabetes-sex.last                                         0.0286
## diabetes-smoking.last                                     0.0413
## diabetes-time.last                                       -0.3665
## ejection_fraction-high_blood_pressure.last                0.3378
## ejection_fraction-platelets.last                          0.3392
```

```
## ejection_fraction-serum_creatinine.last             0.3118
## ejection_fraction-serum_sodium.last                 0.3367
## ejection_fraction-sex.last                          0.3404
## ejection_fraction-smoking.last                      0.3427
## ejection_fraction-time.last                        -0.0676
## high_blood_pressure-platelets.last                  0.0377
## high_blood_pressure-serum_creatinine.last           0.0018
## high_blood_pressure-serum_sodium.last               0.0258
## high_blood_pressure-sex.last                        0.0209
## high_blood_pressure-smoking.last                    0.0309
## high_blood_pressure-time.last                      -0.3684
## platelets-serum_creatinine.last                     0.0018
## platelets-serum_sodium.last                         0.0267
## platelets-sex.last                                  0.0267
## platelets-smoking.last                              0.0260
## platelets-time.last                                -0.3625
## serum_creatinine-serum_sodium.last                  0.2573
## serum_creatinine-sex.last                           0.2495
## serum_creatinine-smoking.last                       0.2587
## serum_creatinine-time.last                         -0.1569
## serum_sodium-sex.last                               0.0699
## serum_sodium-smoking.last                           0.0752
## serum_sodium-time.last                             -0.2971
## sex-smoking.last                                    0.0761
## sex-time.last                                      -0.3512
## smoking-time.last                                  -0.3708
##
## age-anaemia.first                                   0.1944
## age-creatinine_phosphokinase.first                  0.1944
## age-diabetes.first                                  0.1971
## age-ejection_fraction.first                         0.1371
## age-high_blood_pressure.first                       0.1926
## age-platelets.first                                 0.1938
## age-serum_creatinine.first                          0.0736
## age-serum_sodium.first                              0.1539
## age-sex.first                                       0.1974
## age-smoking.first                                   0.1969
## age-time.first                                     -0.1711
## anaemia-creatinine_phosphokinase.first              0.0381
## anaemia-diabetes.first                              0.0407
## anaemia-ejection_fraction.first                    -0.0166
## anaemia-high_blood_pressure.first                   0.0396
## anaemia-platelets.first                             0.0404
## anaemia-serum_creatinine.first                     -0.0429
## anaemia-serum_sodium.first                          0.0038
## anaemia-sex.first                                   0.0413
## anaemia-smoking.first                               0.0402
## anaemia-time.first                                 -0.3206
## creatinine_phosphokinase-diabetes.first             0.0444
## creatinine_phosphokinase-ejection_fraction.first   -0.0178
```

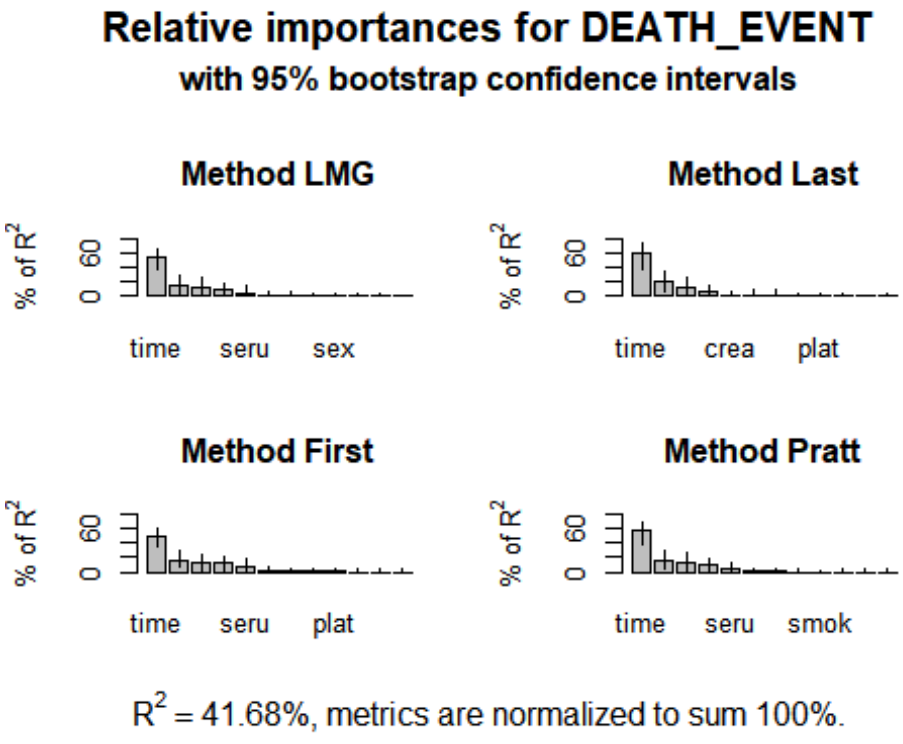
```
## creatinine_phosphokinase-high_blood_pressure.first  0.0409
## creatinine_phosphokinase-platelets.first             0.0419
## creatinine_phosphokinase-serum_creatinine.first     -0.0554
## creatinine_phosphokinase-serum_sodium.first          0.0198
## creatinine_phosphokinase-sex.first                   0.0433
## creatinine_phosphokinase-smoking.first               0.0411
## creatinine_phosphokinase-time.first                 -0.3296
## diabetes-ejection_fraction.first                    -0.0238
## diabetes-high_blood_pressure.first                   0.0274
## diabetes-platelets.first                             0.0320
## diabetes-serum_creatinine.first                     -0.0439
## diabetes-serum_sodium.first                         -0.0015
## diabetes-sex.first                                   0.0274
## diabetes-smoking.first                               0.0343
## diabetes-time.first                                 -0.3223
## ejection_fraction-high_blood_pressure.first          0.2428
## ejection_fraction-platelets.first                    0.2373
## ejection_fraction-serum_creatinine.first             0.1327
## ejection_fraction-serum_sodium.first                 0.1927
## ejection_fraction-sex.first                          0.2338
## ejection_fraction-smoking.first                      0.2440
## ejection_fraction-time.first                        -0.1551
## high_blood_pressure-platelets.first                  0.0739
## high_blood_pressure-serum_creatinine.first          -0.0225
## high_blood_pressure-serum_sodium.first               0.0213
## high_blood_pressure-sex.first                        0.0725
## high_blood_pressure-smoking.first                    0.0725
## high_blood_pressure-time.first                      -0.3218
## platelets-serum_creatinine.first                    -0.0526
## platelets-serum_sodium.first                        -0.0005
## platelets-sex.first                                  0.0382
## platelets-smoking.first                              0.0379
## platelets-time.first                                -0.3144
## serum_creatinine-serum_sodium.first                  0.2530
## serum_creatinine-sex.first                           0.2790
## serum_creatinine-smoking.first                       0.2772
## serum_creatinine-time.first                         -0.1129
## serum_sodium-sex.first                               0.1516
## serum_sodium-smoking.first                           0.1598
## serum_sodium-time.first                             -0.1775
## sex-smoking.first                                    0.0359
## sex-time.first                                      -0.3228
## smoking-time.first                                  -0.3335
##
## age-anaemia.pratt                                    0.1659
## age-creatinine_phosphokinase.pratt                   0.1620
## age-diabetes.pratt                                   0.1699
## age-ejection_fraction.pratt                          0.0839
## age-high_blood_pressure.pratt                        0.1673
## age-platelets.pratt                                  0.1664
```

```
## age-serum_creatinine.pratt                                  0.0993
## age-serum_sodium.pratt                                      0.1505
## age-sex.pratt                                               0.1719
## age-smoking.pratt                                           0.1757
## age-time.pratt                                             -0.2246
## anaemia-creatinine_phosphokinase.pratt                      0.0294
## anaemia-diabetes.pratt                                      0.0291
## anaemia-ejection_fraction.pratt                            -0.0470
## anaemia-high_blood_pressure.pratt                           0.0320
## anaemia-platelets.pratt                                     0.0342
## anaemia-serum_creatinine.pratt                             -0.0178
## anaemia-serum_sodium.pratt                                  0.0202
## anaemia-sex.pratt                                           0.0291
## anaemia-smoking.pratt                                       0.0278
## anaemia-time.pratt                                         -0.3654
## creatinine_phosphokinase-diabetes.pratt                     0.0488
## creatinine_phosphokinase-ejection_fraction.pratt           -0.0364
## creatinine_phosphokinase-high_blood_pressure.pratt          0.0541
## creatinine_phosphokinase-platelets.pratt                    0.0514
## creatinine_phosphokinase-serum_creatinine.pratt            -0.0096
## creatinine_phosphokinase-serum_sodium.pratt                 0.0283
## creatinine_phosphokinase-sex.pratt                          0.0549
## creatinine_phosphokinase-smoking.pratt                      0.0538
## creatinine_phosphokinase-time.pratt                        -0.3637
## diabetes-ejection_fraction.pratt                           -0.0416
## diabetes-high_blood_pressure.pratt                          0.0339
## diabetes-platelets.pratt                                    0.0229
## diabetes-serum_creatinine.pratt                            -0.0155
## diabetes-serum_sodium.pratt                                 0.0104
## diabetes-sex.pratt                                          0.0277
## diabetes-smoking.pratt                                      0.0382
## diabetes-time.pratt                                        -0.3733
## ejection_fraction-high_blood_pressure.pratt                 0.2845
## ejection_fraction-platelets.pratt                           0.2966
## ejection_fraction-serum_creatinine.pratt                    0.2347
## ejection_fraction-serum_sodium.pratt                        0.2901
## ejection_fraction-sex.pratt                                 0.2959
## ejection_fraction-smoking.pratt                             0.2983
## ejection_fraction-time.pratt                               -0.1261
## high_blood_pressure-platelets.pratt                         0.0283
## high_blood_pressure-serum_creatinine.pratt                 -0.0124
## high_blood_pressure-serum_sodium.pratt                      0.0156
## high_blood_pressure-sex.pratt                               0.0300
## high_blood_pressure-smoking.pratt                           0.0305
## high_blood_pressure-time.pratt                             -0.3739
## platelets-serum_creatinine.pratt                           -0.0177
## platelets-serum_sodium.pratt                                0.0140
## platelets-sex.pratt                                         0.0367
## platelets-smoking.pratt                                     0.0284
## platelets-time.pratt                                       -0.3666
```

```
## serum_creatinine-serum_sodium.pratt                  0.2547
## serum_creatinine-sex.pratt                           0.2708
## serum_creatinine-smoking.pratt                       0.2672
## serum_creatinine-time.pratt                         -0.1569
## serum_sodium-sex.pratt                               0.1233
## serum_sodium-smoking.pratt                           0.1241
## serum_sodium-time.pratt                             -0.2495
## sex-smoking.pratt                                    0.0611
## sex-time.pratt                                      -0.3705
## smoking-time.pratt                                  -0.3763
##
## * indicates that CI for difference does not include 0.
## CAUTION: Bootstrap confidence intervals can be somewhat liberal.
```

```
plot(booteval.relimp(boot,sort=TRUE))
```

```
## Warning in rev(variances[[p]]) - variances[[p + 1]]: Recycling array of le
ngth 1 in vector-array arithmetic is deprecated.
##   Use c() or as.vector() instead.
```




```
summary(fit)
```

```
##
## Call:
## lm(formula = DEATH_EVENT ~ age + anaemia + creatinine_phosphokinase +
##     diabetes + ejection_fraction + high_blood_pressure + platelets +
##     serum_creatinine + serum_sodium + sex + smoking + time, data = dataset
```

```
)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.80866 -0.28041 -0.04205  0.24742  0.96983
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)               1.664e+00  6.954e-01   2.392  0.01738 *
## age                       5.767e-03  1.867e-03   3.088  0.00221 **
## anaemia                  -2.766e-03  4.438e-02  -0.062  0.95035
## creatinine_phosphokinase  3.427e-05  2.247e-05   1.525  0.12840
## diabetes                  1.928e-02  4.410e-02   0.437  0.66236
## ejection_fraction        -9.834e-03  1.844e-03  -5.333 1.96e-07 ***
## high_blood_pressure      -1.430e-02  4.565e-02  -0.313  0.75438
## platelets                -8.370e-08  2.208e-07  -0.379  0.70492
## serum_creatinine          8.527e-02  2.123e-02   4.017 7.54e-05 ***
## serum_sodium             -7.599e-03  5.024e-03  -1.513  0.13149
## sex                      -6.369e-02  5.108e-02  -1.247  0.21353
## smoking                  -5.733e-03  5.119e-02  -0.112  0.91091
## time                     -2.733e-03  2.903e-04  -9.415  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.3646 on 286 degrees of freedom
## Multiple R-squared:  0.4168, Adjusted R-squared:  0.3924
## F-statistic: 17.04 on 12 and 286 DF,  p-value: < 2.2e-16
```