Week13-Homework5-MuthukumarSrinivasanAndRajagopalSrinivasan

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May 21, 2017

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When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
##01-Data Exploration

library("pastecs")
```

```
## Loading required package: boot
```

```
library(pander)
library(e1071)
library(funModeling)
```

```
## Loading required package: Hmisc

## Loading required package: lattice

##
## Attaching package: 'lattice'

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

## Loading required package: survival

##
## Attaching package: 'survival'

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

## Loading required package: Formula

## Loading required package: ggplot2

##
## Attaching package: 'Hmisc'
```

```
## The following object is masked from 'package:e1071':
##
##     impute

## The following objects are masked from 'package:base':
##
##     format.pval, round.POSIXt, trunc.POSIXt, units

## funModeling v.1.6.2 :)
## Documentation at livebook.datascienceheroes.com
```

```
library("dplyr")
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:Hmisc':
##
##     combine, src, summarize

## The following objects are masked from 'package:pastecs':
##
##     first, last

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(Amelia)
```

```
## Loading required package: Rcpp

## ##
## ## Amelia II: Multiple Imputation
## ## (Version 1.7.4, built: 2015-12-05)
## ## Copyright (C) 2005-2017 James Honaker, Gary King and Matthew Blackwell
## ## Refer to http://gking.harvard.edu/amelia/ for more information
## ##
```

```
library(corrplot)
```

```
trgData<-read.csv("https://raw.githubusercontent.com/muthukumars/DATA-621/master/Week13-Homework5/wine-
trgDataRemovedIndex<-trgData[-1] #remove index column

str(trgDataRemovedIndex)
```

```
## 'data.frame':    12795 obs. of  15 variables:
##  $ TARGET            : int  3 3 5 3 4 0 0 4 3 6 ...
##  $ FixedAcidity      : num  3.2 4.5 7.1 5.7 8 11.3 7.7 6.5 14.8 5.5 ...
##  $ VolatileAcidity   : num  1.16 0.16 2.64 0.385 0.33 0.32 0.29 -1.22 0.27 -0.22 ...
##  $ CitricAcid        : num  -0.98 -0.81 -0.88 0.04 -1.26 0.59 -0.4 0.34 1.05 0.39 ...
##  $ ResidualSugar     : num  54.2 26.1 14.8 18.8 9.4 ...
##  $ Chlorides         : num  -0.567 -0.425 0.037 -0.425 NA 0.556 0.06 0.04 -0.007 -0.277 ...
##  $ FreeSulfurDioxide : num  NA 15 214 22 -167 -37 287 523 -213 62 ...
##  $ TotalSulfurDioxide: num  268 -327 142 115 108 15 156 551 NA 180 ...
##  $ Density           : num  0.993 1.028 0.995 0.996 0.995 ...
##  $ pH                : num  3.33 3.38 3.12 2.24 3.12 3.2 3.49 3.2 4.93 3.09 ...
##  $ Sulphates         : num  -0.59 0.7 0.48 1.83 1.77 1.29 1.21 NA 0.26 0.75 ...
##  $ Alcohol           : num  9.9 NA 22 6.2 13.7 15.4 10.3 11.6 15 12.6 ...
##  $ LabelAppeal       : int  0 -1 -1 -1 0 0 0 1 0 0 ...
##  $ AcidIndex         : int  8 7 8 6 9 11 8 7 6 8 ...
##  $ STARS             : int  2 3 3 1 2 NA NA 3 NA 4 ...
```

```
names(trgDataRemovedIndex)
```

```
##  [1] "TARGET"             "FixedAcidity"       "VolatileAcidity"
##  [4] "CitricAcid"         "ResidualSugar"      "Chlorides"
##  [7] "FreeSulfurDioxide"  "TotalSulfurDioxide" "Density"
## [10] "pH"                 "Sulphates"          "Alcohol"
## [13] "LabelAppeal"        "AcidIndex"          "STARS"
```

```
head(trgDataRemovedIndex)
```

```
##   TARGET FixedAcidity VolatileAcidity CitricAcid ResidualSugar Chlorides
## 1      3          3.2           1.160      -0.98          54.2    -0.567
## 2      3          4.5           0.160      -0.81          26.1    -0.425
## 3      5          7.1           2.640      -0.88          14.8     0.037
## 4      3          5.7           0.385       0.04          18.8    -0.425
## 5      4          8.0           0.330      -1.26           9.4        NA
## 6      0         11.3           0.320       0.59           2.2     0.556
##   FreeSulfurDioxide TotalSulfurDioxide Density   pH Sulphates Alcohol
## 1                NA                268 0.99280 3.33     -0.59     9.9
## 2                15               -327 1.02792 3.38      0.70      NA
## 3               214                142 0.99518 3.12      0.48    22.0
## 4                22                115 0.99640 2.24      1.83     6.2
## 5              -167                108 0.99457 3.12      1.77    13.7
## 6               -37                 15 0.99940 3.20      1.29    15.4
##   LabelAppeal AcidIndex STARS
## 1           0         8     2
## 2          -1         7     3
## 3          -1         8     3
## 4          -1         6     1
## 5           0         9     2
## 6           0        11    NA
```

```
summary(trgDataRemovedIndex)
```

```
##      TARGET       FixedAcidity     VolatileAcidity     CitricAcid
```

```
##  Min.   :0.000   Min.   :-18.100   Min.   :-2.7900   Min.   :-3.2400
##  1st Qu.:2.000   1st Qu.:  5.200   1st Qu.: 0.1300   1st Qu.: 0.0300
##  Median :3.000   Median :  6.900   Median : 0.2800   Median : 0.3100
##  Mean   :3.029   Mean   :  7.076   Mean   : 0.3241   Mean   : 0.3084
##  3rd Qu.:4.000   3rd Qu.:  9.500   3rd Qu.: 0.6400   3rd Qu.: 0.5800
##  Max.   :8.000   Max.   : 34.400   Max.   : 3.6800   Max.   : 3.8600
##
##  ResidualSugar        Chlorides       FreeSulfurDioxide TotalSulfurDioxide
##  Min.   :-127.800   Min.   :-1.1710   Min.   :-555.00   Min.   :-823.0
##  1st Qu.:  -2.000   1st Qu.:-0.0310   1st Qu.:   0.00   1st Qu.:  27.0
##  Median :   3.900   Median : 0.0460   Median :  30.00   Median : 123.0
##  Mean   :   5.419   Mean   : 0.0548   Mean   :  30.85   Mean   : 120.7
##  3rd Qu.:  15.900   3rd Qu.: 0.1530   3rd Qu.:  70.00   3rd Qu.: 208.0
##  Max.   : 141.150   Max.   : 1.3510   Max.   : 623.00   Max.   :1057.0
##  NA's   :616        NA's   :638       NA's   :647       NA's   :682
##     Density             pH          Sulphates          Alcohol
##  Min.   :0.8881   Min.   :0.480   Min.   :-3.1300   Min.   :-4.70
##  1st Qu.:0.9877   1st Qu.:2.960   1st Qu.: 0.2800   1st Qu.: 9.00
##  Median :0.9945   Median :3.200   Median : 0.5000   Median :10.40
##  Mean   :0.9942   Mean   :3.208   Mean   : 0.5271   Mean   :10.49
##  3rd Qu.:1.0005   3rd Qu.:3.470   3rd Qu.: 0.8600   3rd Qu.:12.40
##  Max.   :1.0992   Max.   :6.130   Max.   : 4.2400   Max.   :26.50
##                   NA's   :395     NA's   :1210      NA's   :653
##   LabelAppeal          AcidIndex          STARS
##  Min.   :-2.000000   Min.   : 4.000   Min.   :1.000
##  1st Qu.:-1.000000   1st Qu.: 7.000   1st Qu.:1.000
##  Median : 0.000000   Median : 8.000   Median :2.000
##  Mean   :-0.009066   Mean   : 7.773   Mean   :2.042
##  3rd Qu.: 1.000000   3rd Qu.: 8.000   3rd Qu.:3.000
##  Max.   : 2.000000   Max.   :17.000   Max.   :4.000
##                                       NA's   :3359
```

```
means <- sapply(trgDataRemovedIndex, function(y) mean(y, na.rm = TRUE))
mins <- sapply(trgDataRemovedIndex, function(y) min(y, na.rm=TRUE))
medians <- sapply(trgDataRemovedIndex, function(y) median(y, na.rm = TRUE))
maxs <- sapply(trgDataRemovedIndex, function(y) max(y, na.rm=TRUE))
IQRs <- sapply(trgDataRemovedIndex, function(y) IQR(y, na.rm = TRUE))
SDs <- sapply(trgDataRemovedIndex, function(y) sd(y, na.rm = T))

skews <- sapply(trgDataRemovedIndex, function(y) skewness(y, na.rm = TRUE))
cors <- as.vector(cor(trgDataRemovedIndex$TARGET, trgDataRemovedIndex[ , 1:ncol(trgDataRemovedIndex)], u
NAs <- sapply(trgDataRemovedIndex, function(y) sum(length(which(is.na(y)))))

datasummary <- data.frame(means, mins, medians, maxs, IQRs, SDs, skews, cors, NAs)
colnames(datasummary) <- c("MEAN", "MIN","MEDIAN", "MAX", "IQR", "STD. DEV","SKEW", "$r_{TARGET}$", "NAs
datasummary <- round(datasummary, 2)
pander(datasummary)
```

Table 1: Table continues below

	MEAN	MIN	MEDIAN	MAX	IQR	STD. DEV	SKEW
TARGET	3.03	0	3	8	2	1.93	-0.33

	MEAN	MIN	MEDIAN	MAX	IQR	STD. DEV	SKEW
FixedAcidity	7.08	-18.1	6.9	34.4	4.3	6.32	-0.02
VolatileAcidity	0.32	-2.79	0.28	3.68	0.51	0.78	0.02
CitricAcid	0.31	-3.24	0.31	3.86	0.55	0.86	-0.05
ResidualSugar	5.42	-127.8	3.9	141.2	17.9	33.75	-0.05
Chlorides	0.05	-1.17	0.05	1.35	0.18	0.32	0.03
FreeSulfurDioxide	30.85	-555	30	623	70	148.7	0.01
TotalSulfurDioxide	120.7	-823	123	1057	181	231.9	-0.01
Density	0.99	0.89	0.99	1.1	0.01	0.03	-0.02
pH	3.21	0.48	3.2	6.13	0.51	0.68	0.04
Sulphates	0.53	-3.13	0.5	4.24	0.58	0.93	0.01
Alcohol	10.49	-4.7	10.4	26.5	3.4	3.73	-0.03
LabelAppeal	-0.01	-2	0	2	2	0.89	0.01
AcidIndex	7.77	4	8	17	1	1.32	1.65
STARS	2.04	1	2	4	2	0.9	0.45

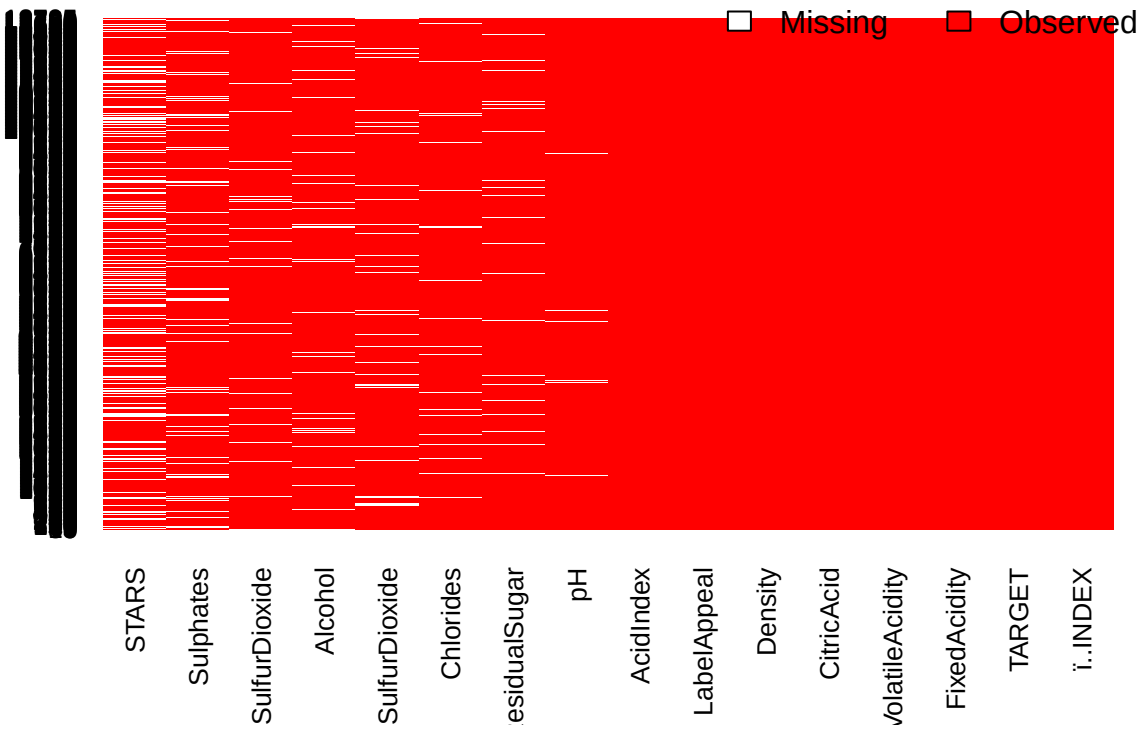
	r_{TARGET}	NAs
TARGET	1	0
FixedAcidity	-0.01	0
VolatileAcidity	-0.08	0
CitricAcid	0	0
ResidualSugar	0	616
Chlorides	-0.03	638
FreeSulfurDioxide	0.02	647
TotalSulfurDioxide	0.02	682
Density	-0.05	0
pH	0	395
Sulphates	-0.02	1210
Alcohol	0.07	653
LabelAppeal	0.5	0
AcidIndex	-0.17	0
STARS	0.55	3359

```
#Correlation Matrix for the data with Index column removed
correlationCoeff<-cor(trgDataRemovedIndex)
correlationCoeff
```

```
##                         TARGET FixedAcidity VolatileAcidity   CitricAcid
## TARGET              1.000000000 -0.049010939     -0.08879321  0.008684633
## FixedAcidity       -0.049010939  1.000000000      0.01237500  0.014240478
## VolatileAcidity    -0.088793212  0.012375004      1.00000000 -0.016953371
## CitricAcid          0.008684633  0.014240478     -0.01695337  1.000000000
## ResidualSugar                NA           NA              NA           NA
## Chlorides                    NA           NA              NA           NA
## FreeSulfurDioxide            NA           NA              NA           NA
## TotalSulfurDioxide           NA           NA              NA           NA
## Density            -0.035517502  0.006476528      0.01473492 -0.013952174
## pH                           NA           NA              NA           NA
## Sulphates                    NA           NA              NA           NA
## Alcohol                      NA           NA              NA           NA
```

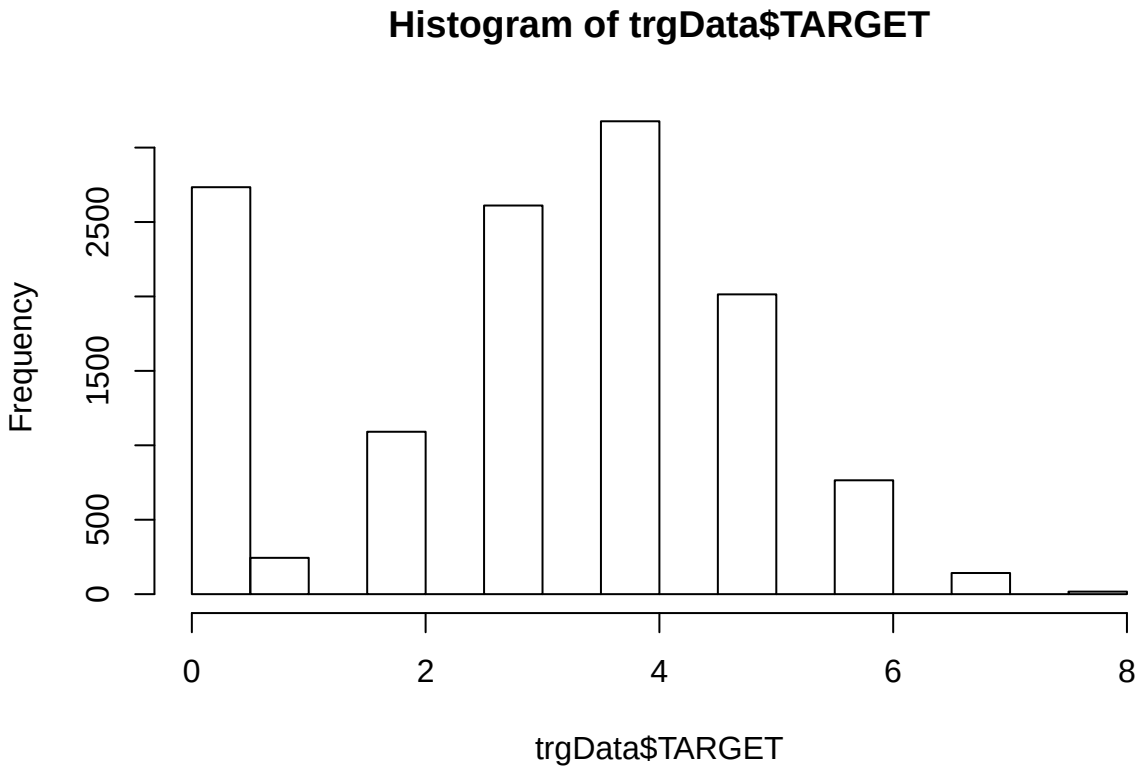
```
## LabelAppeal         0.356500469 -0.003366431     -0.01698703  0.008650177
## AcidIndex          -0.246049449  0.178437010      0.04464154  0.065697323
## STARS                        NA           NA              NA           NA
##                    ResidualSugar Chlorides FreeSulfurDioxide
## TARGET                        NA        NA                NA
## FixedAcidity                  NA        NA                NA
## VolatileAcidity               NA        NA                NA
## CitricAcid                    NA        NA                NA
## ResidualSugar                  1        NA                NA
## Chlorides                     NA         1                NA
## FreeSulfurDioxide             NA        NA                 1
## TotalSulfurDioxide            NA        NA                NA
## Density                       NA        NA                NA
## pH                            NA        NA                NA
## Sulphates                     NA        NA                NA
## Alcohol                       NA        NA                NA
## LabelAppeal                   NA        NA                NA
## AcidIndex                     NA        NA                NA
## STARS                         NA        NA                NA
##                    TotalSulfurDioxide      Density pH Sulphates Alcohol
## TARGET                             NA -0.035517502 NA        NA      NA
## FixedAcidity                       NA  0.006476528 NA        NA      NA
## VolatileAcidity                    NA  0.014734923 NA        NA      NA
## CitricAcid                         NA -0.013952174 NA        NA      NA
## ResidualSugar                      NA           NA NA        NA      NA
## Chlorides                          NA           NA NA        NA      NA
## FreeSulfurDioxide                  NA           NA NA        NA      NA
## TotalSulfurDioxide                  1           NA NA        NA      NA
## Density                            NA  1.000000000 NA        NA      NA
## pH                                 NA           NA  1        NA      NA
## Sulphates                          NA           NA NA         1      NA
## Alcohol                            NA           NA NA        NA       1
## LabelAppeal                        NA -0.009370077 NA        NA      NA
## AcidIndex                          NA  0.040412947 NA        NA      NA
## STARS                              NA           NA NA        NA      NA
##                     LabelAppeal   AcidIndex STARS
## TARGET               0.356500469 -0.24604945    NA
## FixedAcidity        -0.003366431  0.17843701    NA
## VolatileAcidity     -0.016987027  0.04464154    NA
## CitricAcid           0.008650177  0.06569732    NA
## ResidualSugar                 NA          NA    NA
## Chlorides                     NA          NA    NA
## FreeSulfurDioxide             NA          NA    NA
## TotalSulfurDioxide            NA          NA    NA
## Density             -0.009370077  0.04041295    NA
## pH                            NA          NA    NA
## Sulphates                     NA          NA    NA
## Alcohol                       NA          NA    NA
## LabelAppeal          1.000000000  0.02475468    NA
## AcidIndex            0.024754678  1.00000000    NA
## STARS                         NA          NA     1

##              variable q_zeros p_zeros q_na  p_na q_inf p_inf    type
## 1            ï..INDEX       0    0.00    0  0.00     0     0 integer
```

```
## 2              TARGET    2734   21.37    0  0.00     0     0 integer
## 3         FixedAcidity      39    0.30    0  0.00     0     0 numeric
## 4      VolatileAcidity      18    0.14    0  0.00     0     0 numeric
## 5           CitricAcid     115    0.90    0  0.00     0     0 numeric
## 6        ResidualSugar       6    0.05  616  4.81     0     0 numeric
## 7            Chlorides       5    0.04  638  4.99     0     0 numeric
## 8    FreeSulfurDioxide      11    0.09  647  5.06     0     0 numeric
## 9   TotalSulfurDioxide       7    0.05  682  5.33     0     0 numeric
## 10             Density       0    0.00    0  0.00     0     0 numeric
## 11                  pH       0    0.00  395  3.09     0     0 numeric
## 12           Sulphates      22    0.17 1210  9.46     0     0 numeric
## 13             Alcohol       2    0.02  653  5.10     0     0 numeric
## 14         LabelAppeal    5617   43.90    0  0.00     0     0 integer
## 15           AcidIndex       0    0.00    0  0.00     0     0 integer
## 16               STARS       0    0.00 3359 26.25     0     0 integer
##    unique
## 1   12795
## 2       9
## 3     470
## 4     815
## 5     602
## 6    2077
## 7    1663
## 8     999
## 9    1370
## 10   5933
## 11    497
## 12    630
## 13    401
## 14      5
## 15     14
## 16      4
```

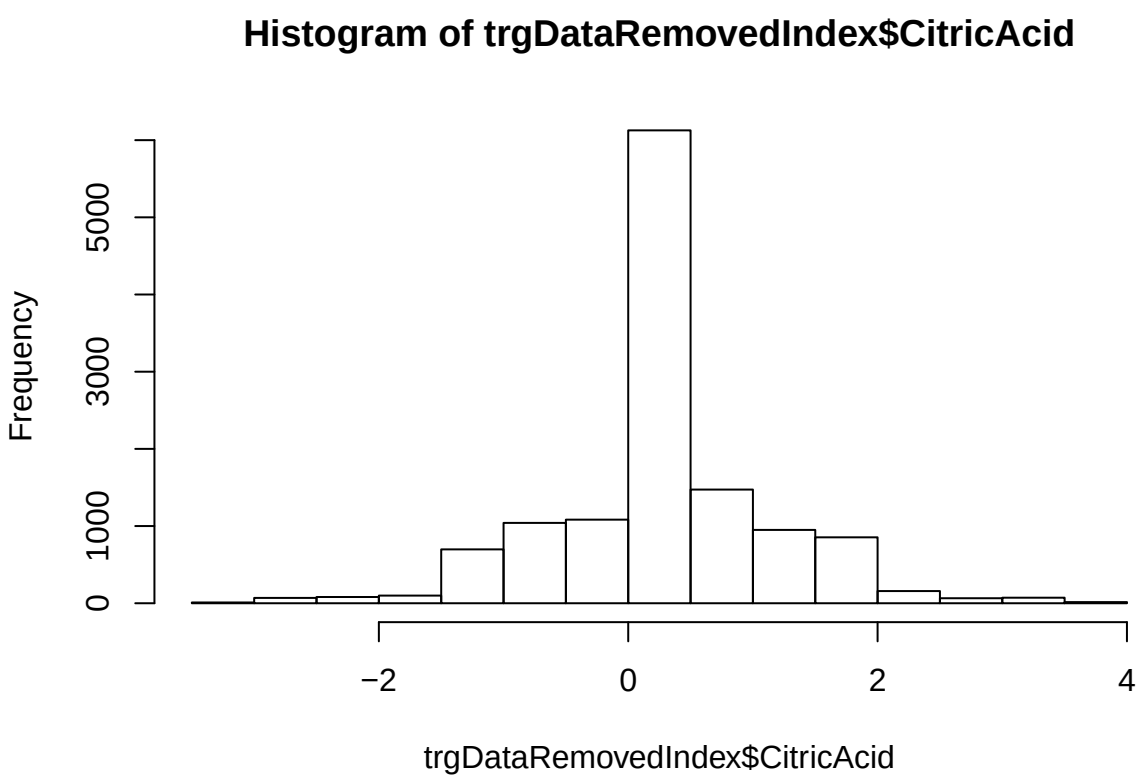



```
## Loading required package: xts

## Loading required package: zoo

##
## Attaching package: 'zoo'

## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric

##
## Attaching package: 'xts'

## The following objects are masked from 'package:dplyr':
##
##     first, last

## The following objects are masked from 'package:pastecs':
##
##     first, last

##
## Attaching package: 'PerformanceAnalytics'
```

```
## The following objects are masked from 'package:e1071':
##
##     kurtosis, skewness

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

##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##   0.000   2.000   3.000   3.029   4.000   8.000
```




```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
## -3.2400  0.0300  0.3100  0.3084  0.5800  3.8600
```




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

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

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

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## Warning in axis(side = side, at = at, labels = labels, ...): "method" is
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## Warning in plot.xy(xy.coords(x, y), type = type, ...): "method" is not a
## graphical parameter

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

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```

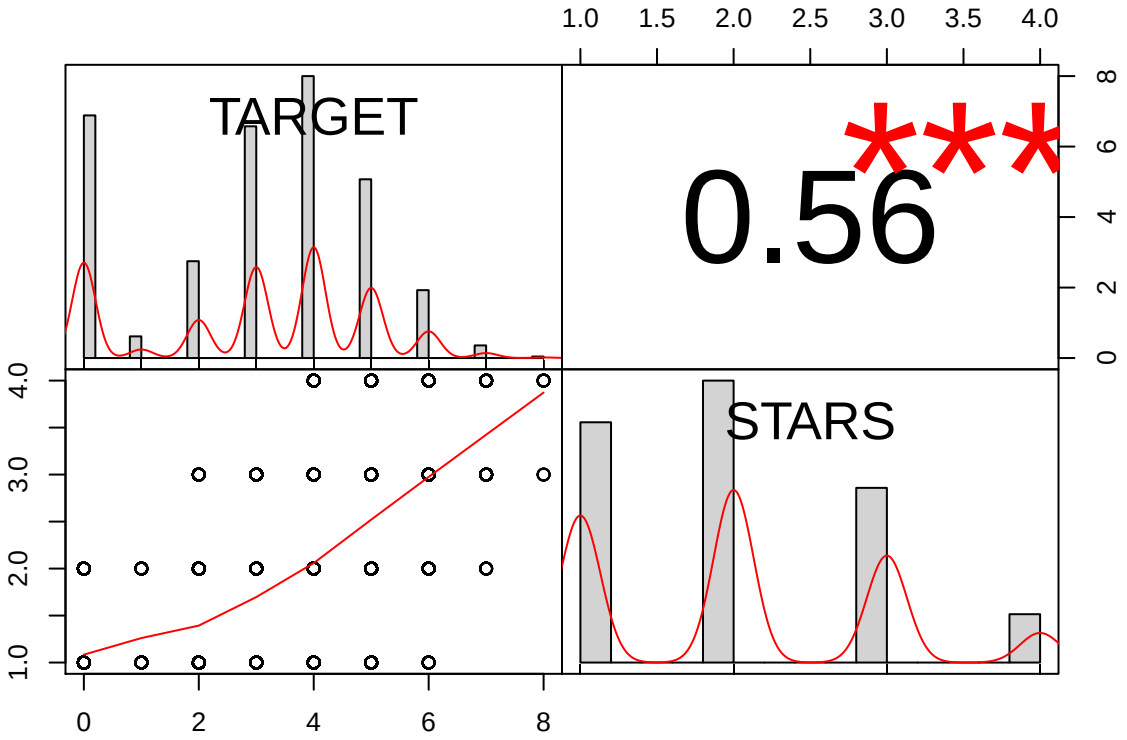


```
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```

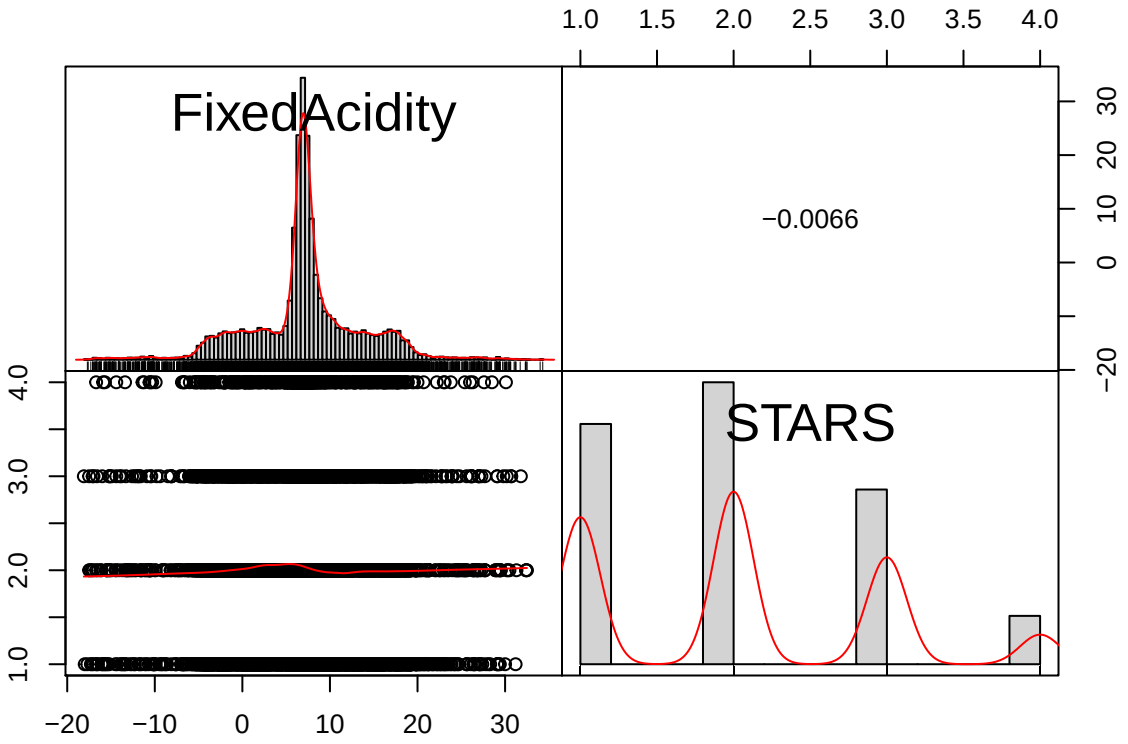


```
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```

```
## Warning in axis(side = side, at = at, labels = labels, ...): "method" is
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```

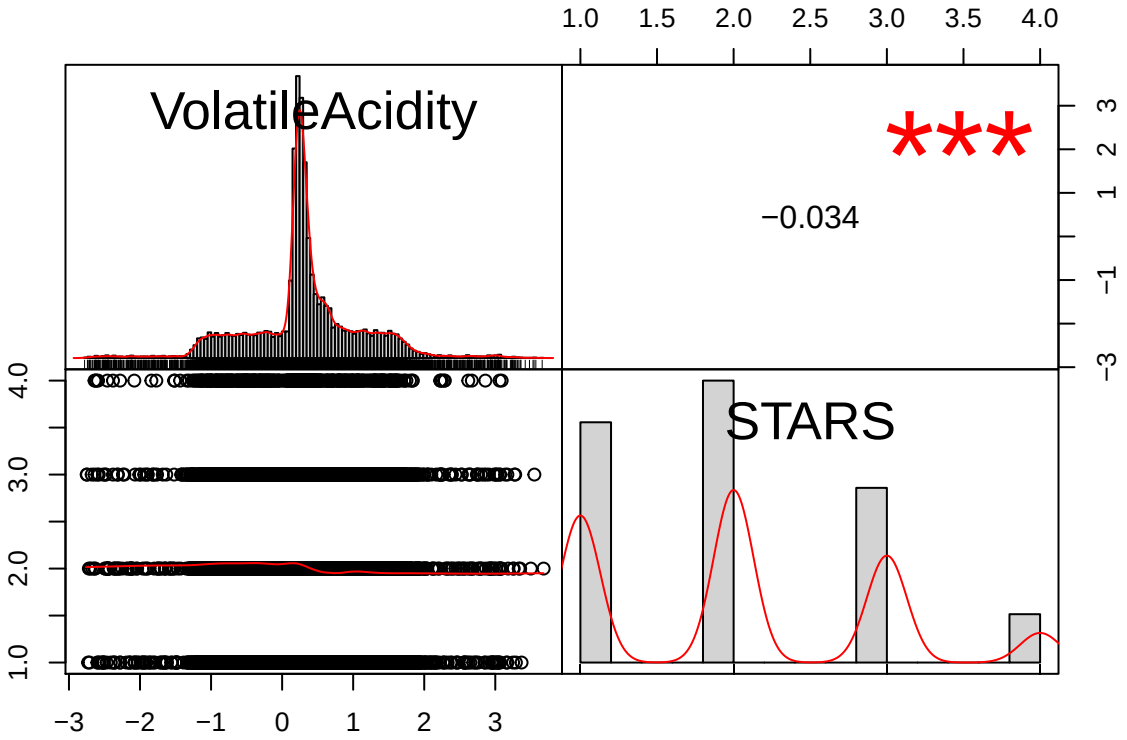


```
## Warning in plot.window(...): "method" is not a graphical parameter

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

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

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

## Warning in plot.xy(xy, type, ...): "method" is not a graphical parameter
```

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

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

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

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

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

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

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

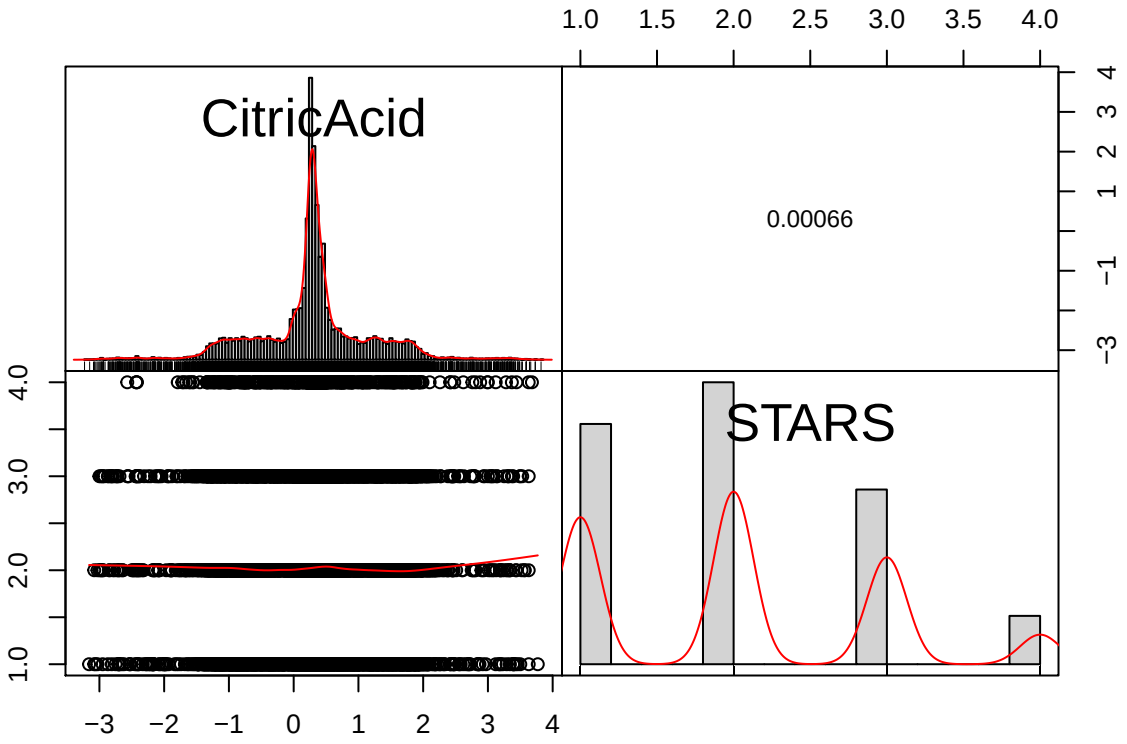


```
## Warning in plot.window(...): "method" is not a graphical parameter

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

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

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```
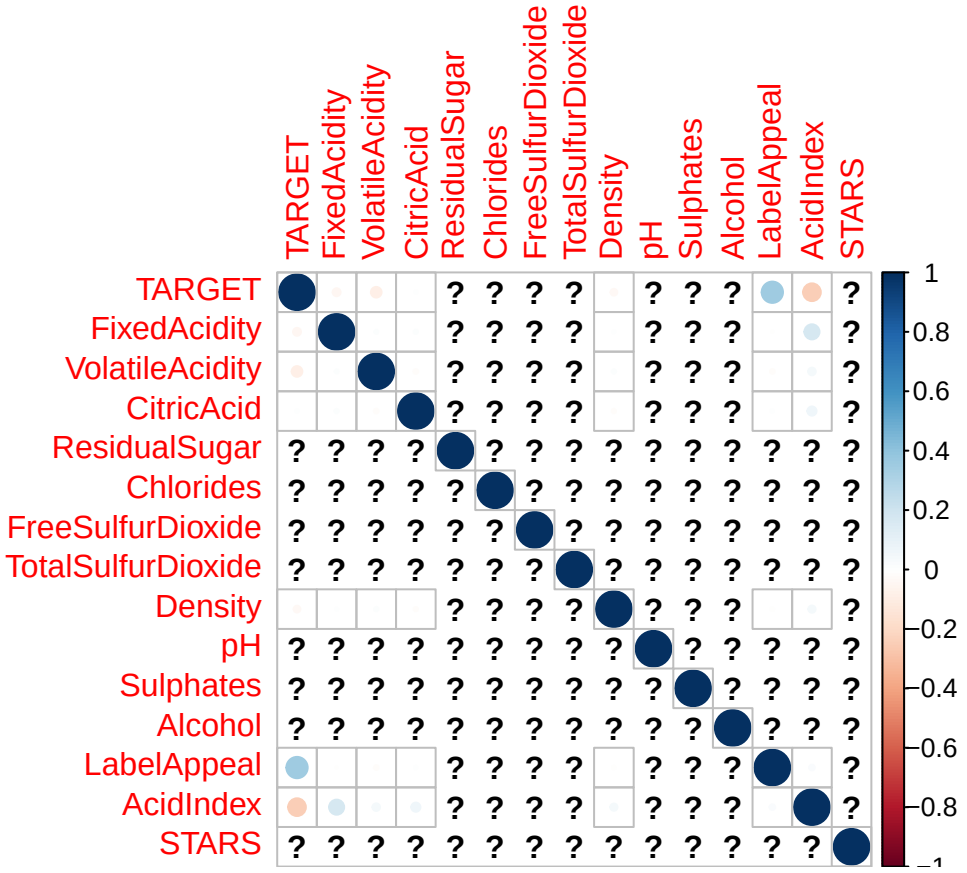
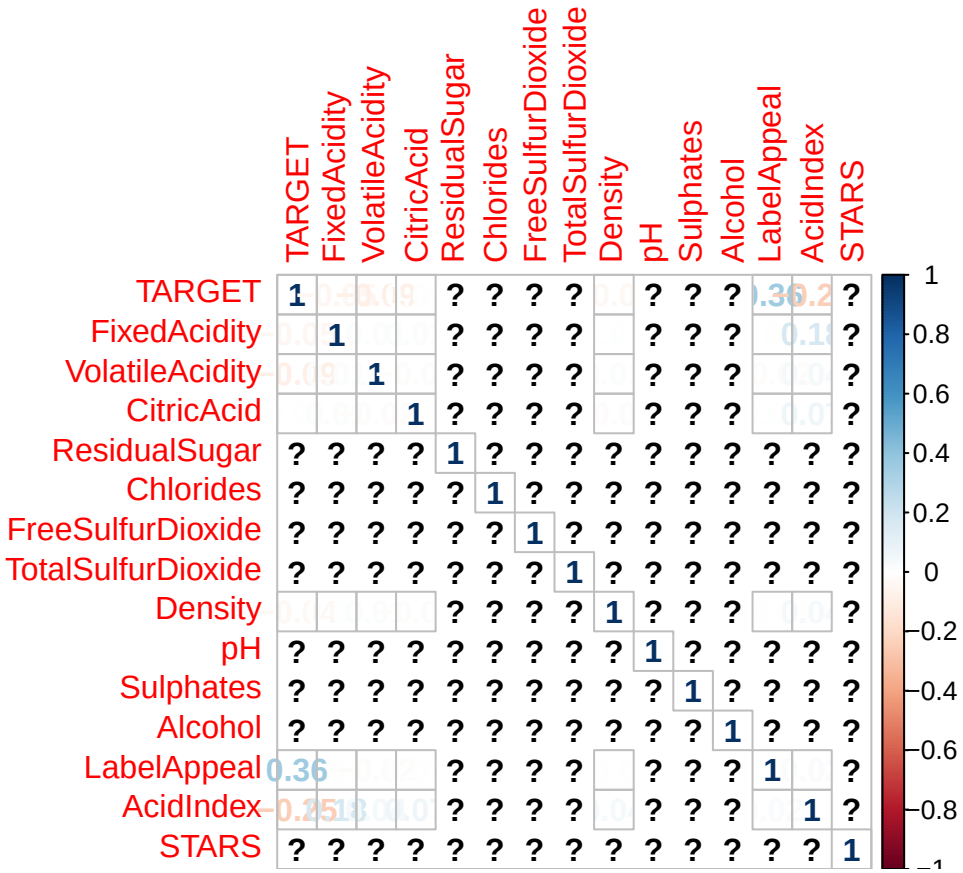
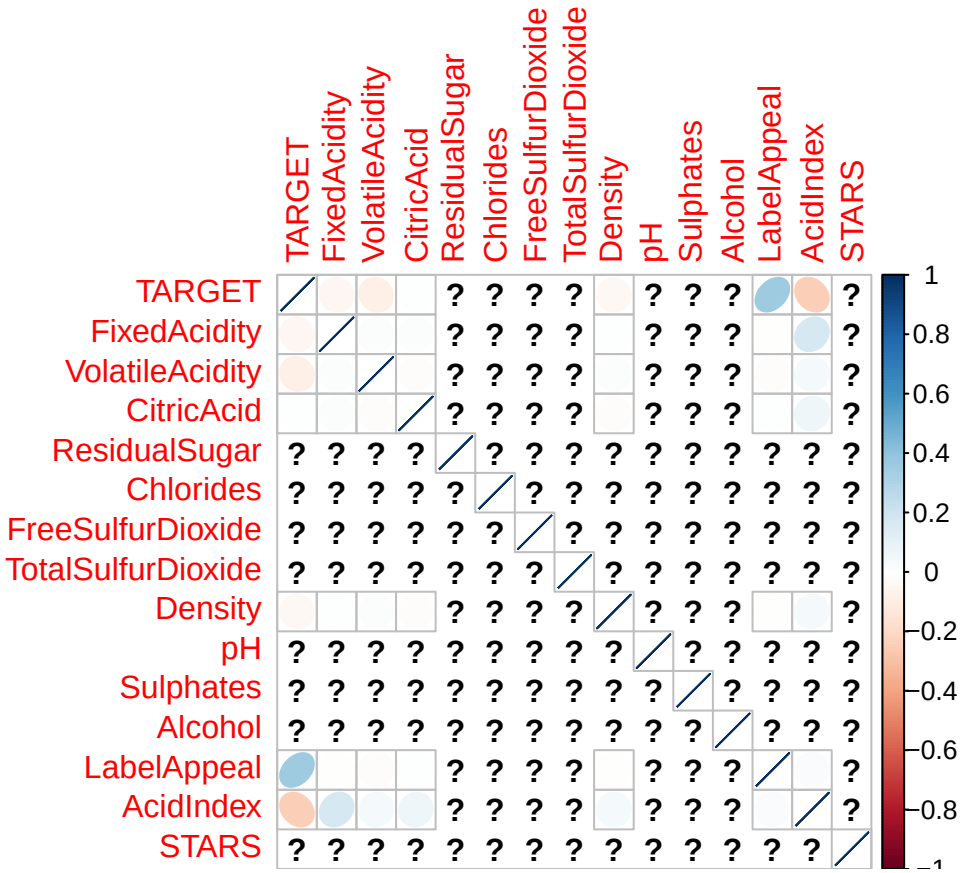
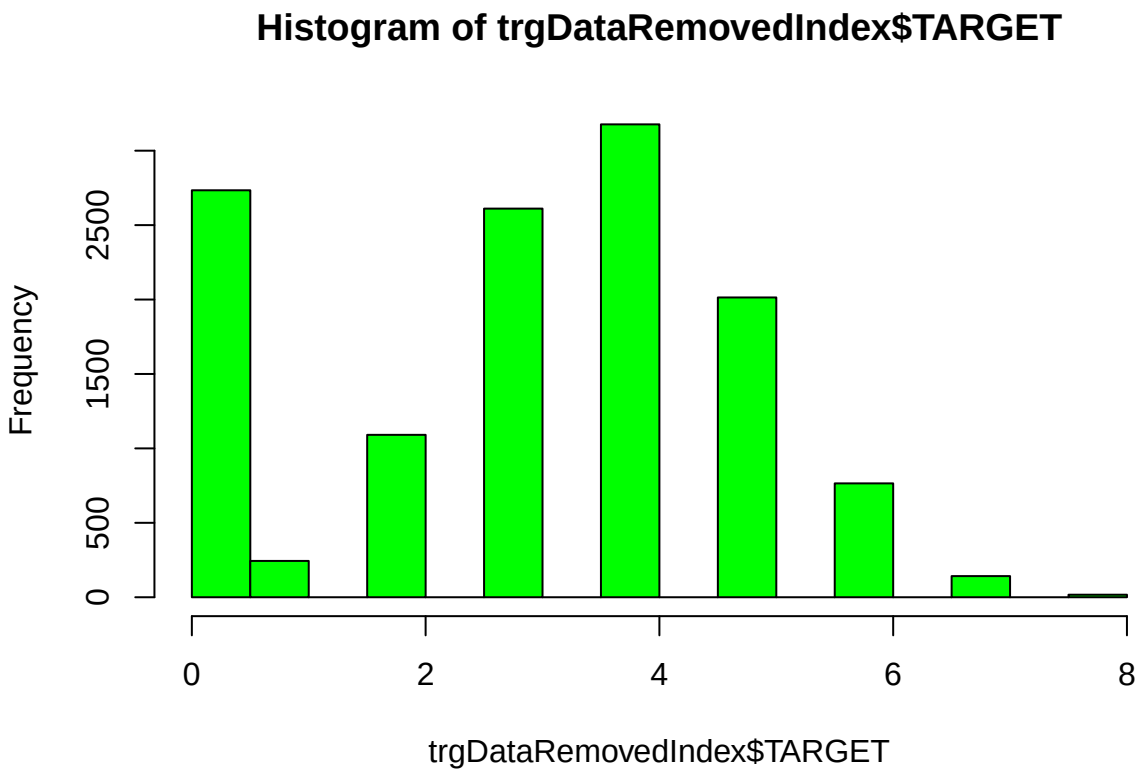
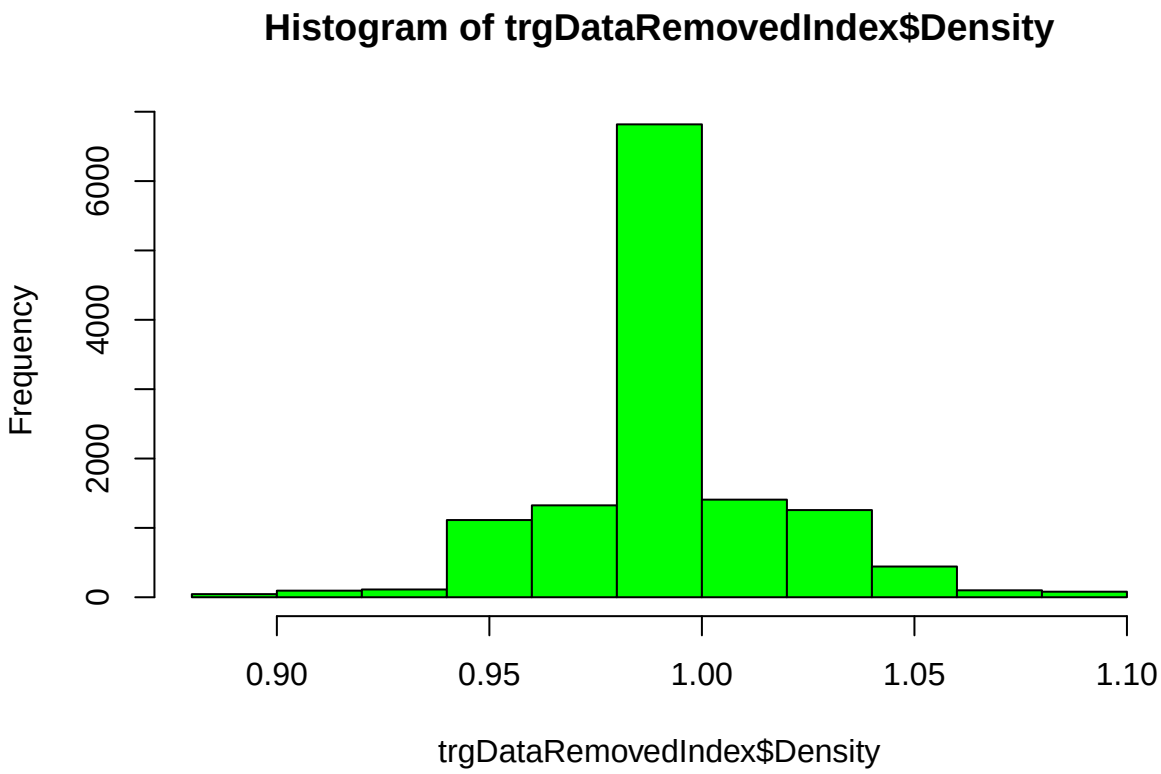
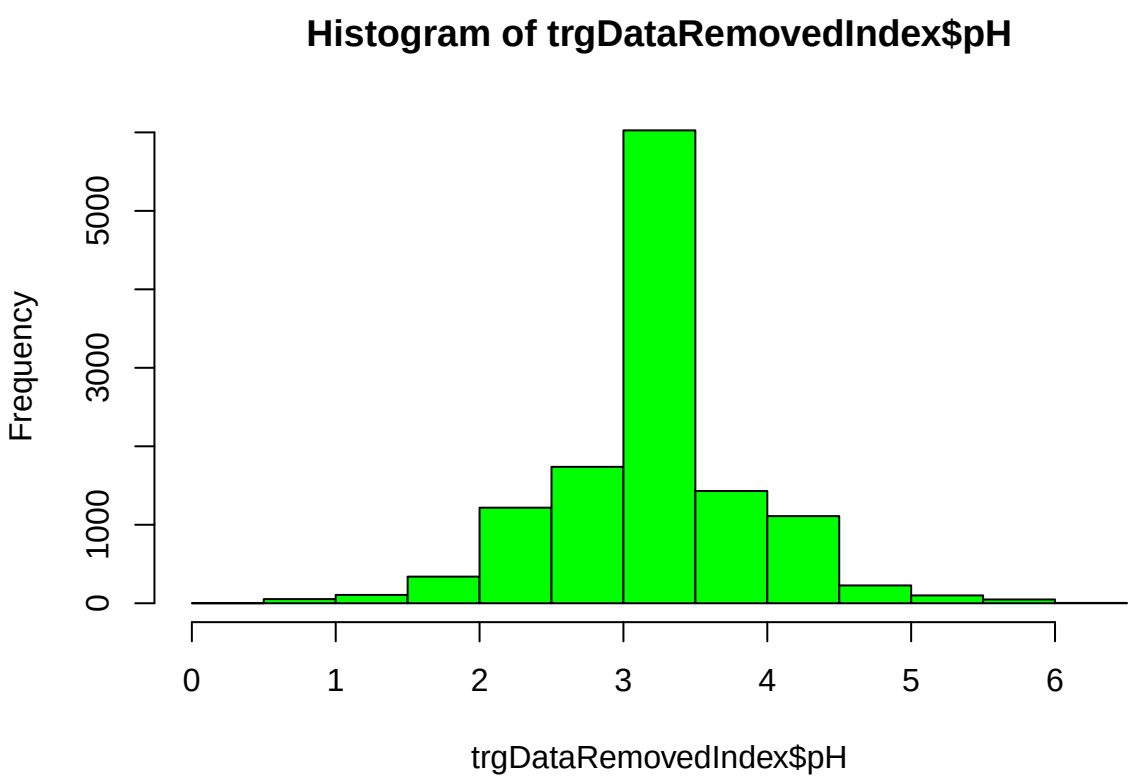




TARGET
FixedAcidity
VolatileAcidity
CitricAcid
ResidualSugar
Chlorides
FreeSulfurDioxide
TotalSulfurDioxide
Density
pH
Sulphates
Alcohol
LabelAppeal
AcidIndex
STARS
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1


TARGET
FixedAcidity
VolatileAcidity
CitricAcid
ResidualSugar
Chlorides
FreeSulfurDioxide
TotalSulfurDioxide
Density
pH
Sulphates
Alcohol
LabelAppeal
AcidIndex
STARS
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8


Histogram of trgDataRemovedIndex$TARGET
Frequency
0
500
1500
2500
0
2
4
6
8
trgDataRemovedIndex$TARGET


Histogram of trgDataRemovedIndex$Density
Frequency
0
2000
4000
6000
0.90
0.95
1.00
1.05
1.10
trgDataRemovedIndex$Density



	Estimate	Std. Error	z value	Pr(>|z|)
FixedAcidity	0.0003293	0.001053	0.3128	0.7545
VolatileAcidity	-0.0256	0.008353	-3.065	0.002177
CitricAcid	-0.0007259	0.007575	-0.09583	0.9237
ResidualSugar	-6.141e-05	0.0001941	-0.3165	0.7517
Chlorides	-0.03007	0.02056	-1.463	0.1435
FreeSulfurDioxide	6.734e-05	4.404e-05	1.529	0.1262
TotalSulfurDioxide	2.081e-05	2.855e-05	0.7287	0.4662
Density	-0.3725	0.2462	-1.513	0.1303
pH	-0.004661	0.009598	-0.4856	0.6272
Sulphates	-0.005164	0.007051	-0.7323	0.464
Alcohol	0.003948	0.001771	2.229	0.02579
LabelAppeal	0.1771	0.007954	22.27	7.07e-110
AcidIndex	-0.0487	0.005903	-8.251	1.573e-16
STARS	0.1871	0.007487	24.99	7.344e-138
(Intercept)	1.593	0.2506	6.359	2.032e-10

(Dispersion parameter for poisson family taken to be 1)

Null deviance:	5844 on 6435 degrees of freedom
Residual deviance:	4009 on 6421 degrees of freedom

	Estimate	Std. Error	z value	Pr(>|z|)
VolatileAcidity	-0.02396	0.00813	-2.948	0.003201
Chlorides	-0.0262	0.02002	-1.308	0.1907
FreeSulfurDioxide	7.89e-05	4.287e-05	1.84	0.0657
TotalSulfurDioxide	2.286e-05	2.786e-05	0.8204	0.412
LabelAppeal	0.1756	0.007741	22.68	6.501e-114
AcidIndex	-0.04904	0.005701	-8.602	7.828e-18
STARS	0.1886	0.007283	25.89	8.899e-148
Alcohol	0.003668	0.001728	2.122	0.0338
Density	-0.3408	0.2401	-1.419	0.1559
Sulphates	-0.005539	0.00687	-0.8063	0.4201
pH	-0.006185	0.009398	-0.6581	0.5105
(Intercept)	1.571	0.2445	6.424	1.323e-10

(Dispersion parameter for poisson family taken to be 1)

Null deviance:	6146 on 6746 degrees of freedom
Residual deviance:	4212 on 6735 degrees of freedom

	Estimate	Std. Error	z value	Pr(>|z|)
LabelAppeal	0.1819	0.006538	27.82	2.687e-170
AcidIndex	-0.0498	0.004822	-10.33	5.183e-25
STARS	0.1857	0.006112	30.38	9.705e-203
(Intercept)	1.259	0.04029	31.24	3.148e-214

(Dispersion parameter for poisson family taken to be 1)

Null deviance:	8597 on 9435 degrees of freedom
Residual deviance:	5868 on 9432 degrees of freedom

Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.