ACADGILD

SESSION 11: Linear Models

Assignment 1

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Data Analytics

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1. Problem Statement

1. Use the link given below and locate the bank marketing dataset.
https://archive.ics.uci.edu/ml/machine-learning-databases/00222/

Perform the below operations:

a) Create a visual for representing missing values in the dataset.
b) Show a distribution of clients based on a job.
c) Check whether is there any relation between Job and Marital Status?
d) Check whether is there any association between Job and Education?

2. Solution

a. Create a visual for representing missing values in the dataset.

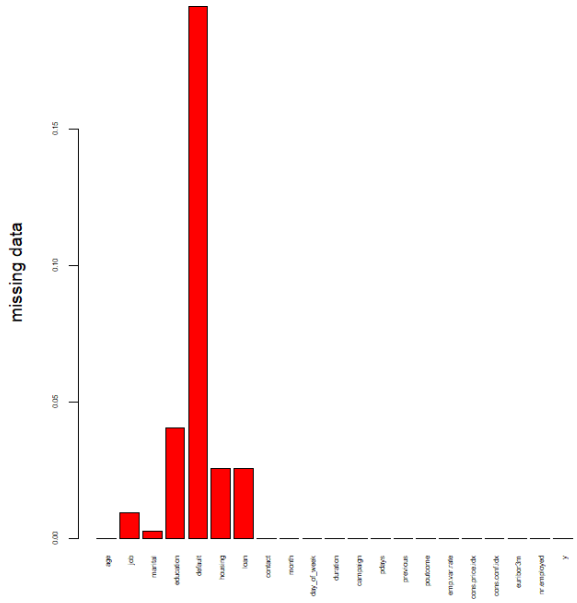
The R-script for the given problem is as follows:

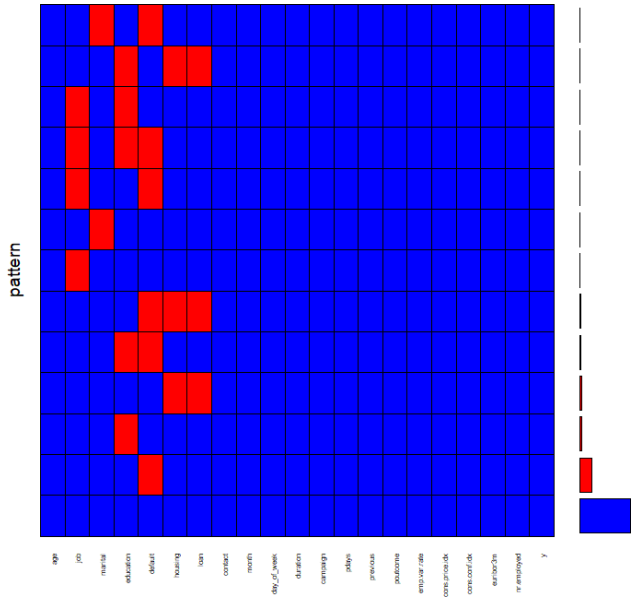
```
# Import BankMArketing Data
library(readr)
bank <- read.csv("E:/uday/acadgild data analytics/supporting files/bank-additional/bank-additional/bank-additional.csv", sep=";")
View(bank)
dim(bank)
str(bank)

# a. Create a visual for representing missing values in the dataset.
library(psych)
psych::describe(bank)
library(VIM)
missing <- bank
missing[missing == "unknown"] <- NA

aggr(missing, col=c('blue', 'red'),
    numbers=TRUE, sortvars= TRUE,
    labels=names(missing), cex.axis=0.5,
    gap=3, ylab=c("missing data","pattern"))

sapply(missing, function(x) sum(is.na(x)))
```

The output of the R-Script (from Console window) is given as follows:

```
> library(readr)
> bank <- read.csv("E:/uday/acadgild data analytics/supporting
files/bank-additional/bank-additional/bank-additional.csv", sep=";")
> View(bank)
> dim(bank)
[1] 4119   21
> str(bank)
'data.frame':  4119 obs. of  21 variables:
 $ age           : int  30 39 25 38 47 32 32 41 31 35 ...
 $ job           : Factor w/ 12 levels "admin.","blue-collar",..: 2 8 8 8 1 8
1 3 8 2 ...
 $ marital       : Factor w/ 4 levels "divorced","married",..: 2 3 2 2 2 3 3
2 1 2 ...
 $ education     : Factor w/ 8 levels "basic.4y","basic.6y",..: 3 4 4 3 7 7 7
7 6 3 ...
 $ default       : Factor w/ 3 levels "no","unknown",..: 1 1 1 1 1 1 1 2 1 2
...
 $ housing       : Factor w/ 3 levels "no","unknown",..: 3 1 3 2 3 1 3 3 1 1
...
 $ loan          : Factor w/ 3 levels "no","unknown",..: 1 1 1 2 1 1 1 1 1 1
...
 $ contact       : Factor w/ 2 levels "cellular","telephone": 1 2 2 2 1 1 1 1
1 2 ...
 $ month         : Factor w/ 10 levels "apr","aug","dec",..: 7 7 5 5 8 10 10
8 8 7 ...
 $ day_of_week   : Factor w/ 5 levels "fri","mon","thu",..: 1 1 5 1 2 3 2 2 4
3 ...
 $ duration      : int  487 346 227 17 58 128 290 44 68 170 ...
 $ campaign      : int  2 4 1 3 1 3 4 2 1 1 ...
 $ pdays         : int  999 999 999 999 999 999 999 999 999 999 ...
 $ previous      : int  0 0 0 0 0 2 0 0 1 0 ...
 $ poutcome      : Factor w/ 3 levels "failure","nonexistent",..: 2 2 2 2 2 1
2 2 1 2 ...
 $ emp.var.rate  : num  -1.8 1.1 1.4 1.4 -0.1 -1.1 -1.1 -0.1 -0.1 1.1 ...
 $ cons.price.idx: num  92.9 94 94.5 94.5 93.2 ...
 $ cons.conf.idx : num  -46.2 -36.4 -41.8 -41.8 -42 -37.5 -37.5 -42 -42 -36.4
...
 $ euribor3m     : num  1.31 4.86 4.96 4.96 4.19 ...
 $ nr.employed   : num  5099 5191 5228 5228 5196 ...
 $ y             : Factor w/ 2 levels "no","yes": 1 1 1 1 1 1 1 1 1 1 ...

> library(psych)
> psych::describe(bank)
              vars    n     mean      sd  median  trimmed     mad      min
age              1 4119    40.11   10.31   38.00    39.44   10.38    18.00
job*             2 4119     4.82    3.61    4.00     4.60    4.45     1.00
marital*         3 4119     2.18    0.61    2.00     2.22    0.00     1.00
education*       4 4119     4.78    2.15    4.00     4.92    2.97     1.00
default*         5 4119     1.20    0.40    1.00     1.12    0.00     1.00
housing*         6 4119     2.08    0.98    3.00     2.10    0.00     1.00
loan*            7 4119     1.35    0.74    1.00     1.19    0.00     1.00
contact*         8 4119     1.36    0.48    1.00     1.32    0.00     1.00
month*           9 4119     5.29    2.31    5.00     5.37    2.97     1.00
day_of_week*    10 4119     3.01    1.39    3.00     3.01    1.48     1.00
duration        11 4119   256.79  254.70  181.00   210.52  136.40     0.00
campaign        12 4119     2.54    2.57    2.00     1.99    1.48     1.00
pdays           13 4119   960.42  191.92  999.00   999.00    0.00     0.00
previous        14 4119     0.19    0.54    0.00     0.06    0.00     0.00
poutcome*       15 4119     1.92    0.37    2.00     1.99    0.00     1.00
emp.var.rate    16 4119     0.08    1.56    1.10     0.27    0.44    -3.40
cons.price.idx  17 4119    93.58    0.58   93.75    93.58    0.56    92.20
cons.conf.idx   18 4119   -40.50    4.59  -41.80   -40.59    6.52   -50.80
euribor3m       19 4119     3.62    1.73    4.86     3.81    0.16     0.64
nr.employed     20 4119  5166.48   73.67 5191.00  5178.54   55.00  4963.60
```

```
y*                21 4119    1.11   0.31    1.00    1.01   0.00    1.00
                    max    range  skew  kurtosis   se
age               88.00    70.00  0.72      0.43 0.16
job*              12.00    11.00  0.41     -1.42 0.06
marital*           4.00     3.00 -0.03     -0.29 0.01
education*         8.00     7.00 -0.28     -1.21 0.03
default*           3.00     2.00  1.55      0.43 0.01
housing*           3.00     2.00 -0.16     -1.95 0.02
loan*              3.00     2.00  1.72      1.03 0.01
contact*           2.00     1.00  0.60     -1.64 0.01
month*            10.00     9.00 -0.31     -1.02 0.04
day_of_week*       5.00     4.00  0.00     -1.26 0.02
duration        3643.00  3643.00  3.29     20.72 3.97
campaign          35.00    34.00  4.00     25.24 0.04
pdays            999.00   999.00 -4.77     20.77 2.99
previous           6.00     6.00  4.02     22.08 0.01
poutcome*          3.00     2.00 -0.84      3.55 0.01
emp.var.rate       1.40     4.80 -0.73     -1.04 0.02
cons.price.idx    94.77     2.57 -0.22     -0.82 0.01
cons.conf.idx    -26.90    23.90  0.29     -0.32 0.07
euribor3m          5.04     4.41 -0.71     -1.40 0.03
nr.employed     5228.10   264.50 -1.08      0.06 1.15
y*                 2.00     1.00  2.50      4.25 0.00
> library(VIM)
Loading required package: colorspace
Loading required package: grid
Loading required package: data.table
data.table 1.11.8  Latest news: r-datatable.com
VIM is ready to use.
 Since version 4.0.0 the GUI is in its own package VIMGUI.

          Please use the package to use the new (and old) GUI.

Suggestions and bug-reports can be submitted at:
https://github.com/alexkowa/VIM/issues

Attaching package: 'VIM'

The following object is masked from 'package:datasets':

    sleep

Warning message:
package 'VIM' was built under R version 3.5.2
>
> missing <- bank
> missing[missing == "unknown"] <- NA
>
> aggr(missing, col=c('blue', 'red'),
+      numbers=TRUE, sortvars= TRUE,
+      labels=names(missing), cex.axis=0.5,
+      gap=3, ylab=c("missing data","pattern"))
Warning message:
In plot.aggr(res, ...) : not enough horizontal space to display frequencies
>
> sapply(missing, function(x) sum(is.na(x)))
           age            job        marital      education        default
             0             39             11            167            803
       housing           loan        contact          month    day_of_week
           105            105              0              0              0
      duration       campaign          pdays       previous       poutcome
             0              0              0              0              0
  emp.var.rate cons.price.idx  cons.conf.idx      euribor3m    nr.employed
             0              0              0              0              0
             y
             0
```





Conclusion/Interpretation:
Visual for representing missing values in the dataset is created

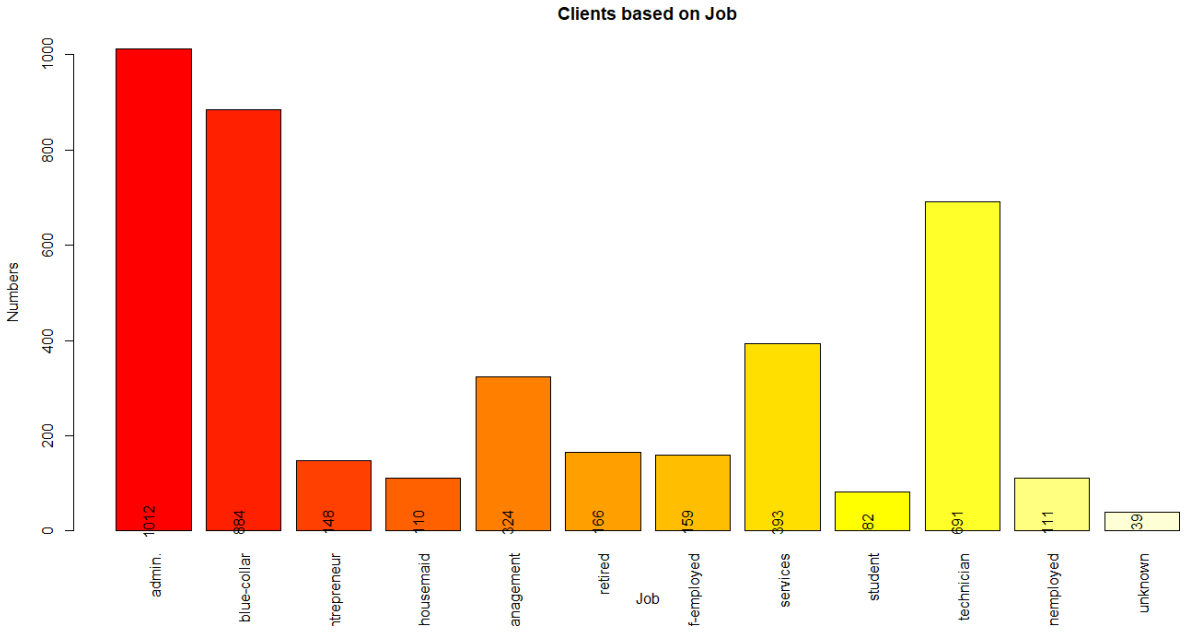
b. Show a distribution of clients based on a job.

The R-script for the given problem is as follows:

```
t <- table(bank$job)
# distribution in tabular form
t
# distribution in graphical form
title <- barplot(t, xlab = "Job", ylab = "Numbers", main = "Clients based on Job",
                 col = heat.colors(12), las=3)
text(title, 0, t, pos = 3, srt = 90)
```

The output of the R-Script (from Console window) is given as follows:

```
> t <- table(bank$job)
> # distribution in tabular form
> t

       admin.    blue-collar   entrepreneur      housemaid     management
         1012            884            148            110            324
      retired  self-employed       services        student     technician
          166            159            393             82            691
   unemployed        unknown
          111             39
> title <- barplot(t, xlab = "Job", ylab = "Numbers", main = "Clients based
on Job",
+                  col = heat.colors(12), las=3)
> text(title, 0, t, pos = 3, srt = 90)
```



Conclusion/Interpretation:

Distribution of clients based on a job is obtained in tabular and graphical form.

c. Check whether is there any relation between Job and Marital Status?

The R-script for the given problem is as follows:

chisq.test(missing$job, missing$marital)

The output of the R-Script (from Console window) is given as follows:

```
> chisq.test(missing$job, missing$marital)

  Pearson's Chi-squared test

data:  missing$job and missing$marital
X-squared = 395.28, df = 20, p-value < 2.2e-16
```

Conclusion/Interpretation:

Ho : There is NO association between Job and Marital Status

Since P Value is less than 0.05, there is association between Job and Marital status at 95% confidence level. Since NA values are very less, they are omitted.

d. Check whether is there any association between Job and Education?

The R-script for the given problem is as follows:

```
chisq.test(missing$job, missing$education)
```

The output of the R-Script (from Console window) is given as follows:

```
> chisq.test(missing$job, missing$education)

  Pearson's Chi-squared test

data:  missing$job and missing$education
X-squared = 3429, df = 60, p-value < 2.2e-16
```

Conclusion/Interpretation:

Ho : There is NO association between Job and Education.

Since the P value is less than 0.05, there is association between Job and Education at 95% confidence level.Since NA values are very less, they are omitted