Import BankMArketing Data

```
bank<-read.csv(file.choose())

dim(bank)

str(bank))
```

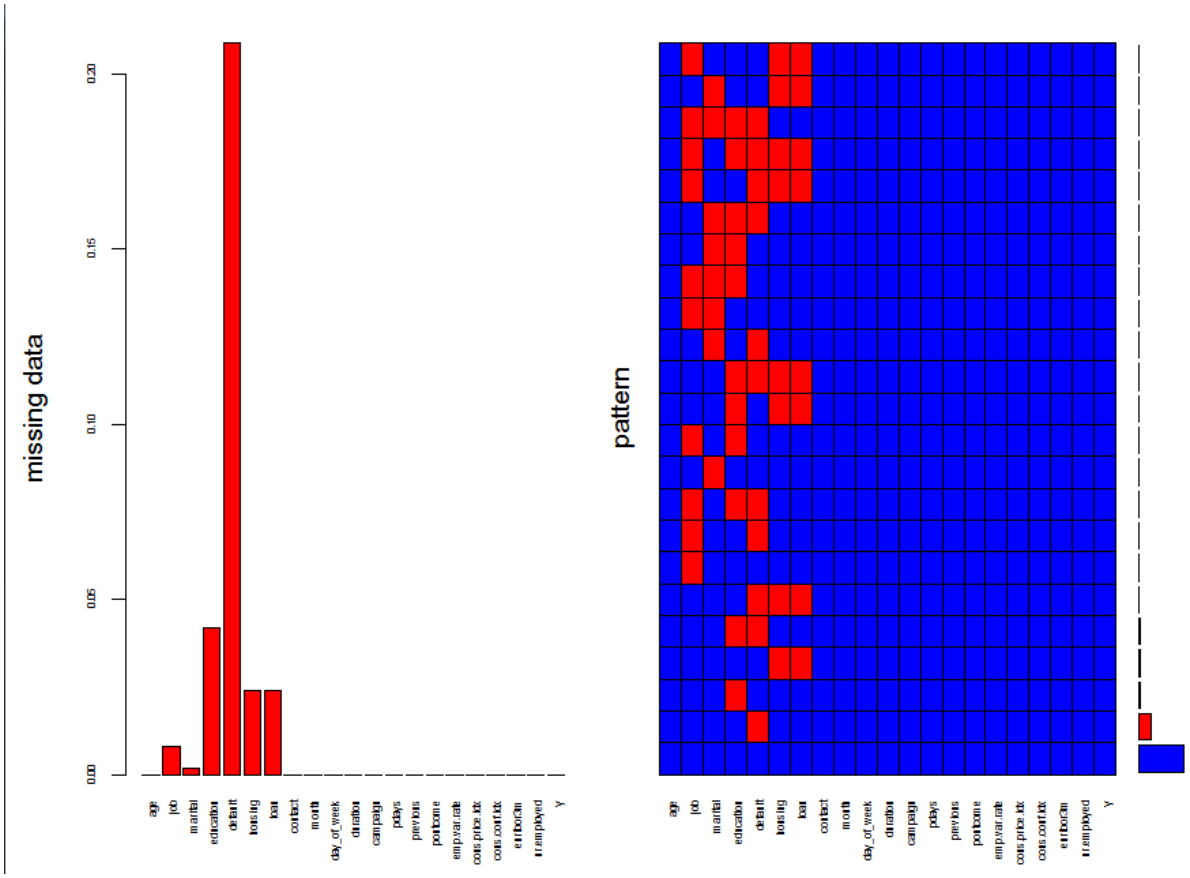
```
> bank<-read.csv(file.choose())
> dim(bank)
[1] 41188    21
> str(bank)
'data.frame':   41188 obs. of  21 variables:
 $ age           : int  56 57 37 40 56 45 59 41 24 25 ...
 $ job           : Factor w/ 12 levels "admin.","blue-collar",..: 4 8 8 1 8 8 1 2 10 8 ..
.
 $ marital       : Factor w/ 4 levels "divorced","married",..: 2 2 2 2 2 2 2 2 3 3 ...
 $ education     : Factor w/ 8 levels "basic.4y","basic.6y",..: 1 4 4 2 4 3 6 8 6 4 ...
 $ default       : Factor w/ 3 levels "no","unknown",..: 1 2 1 1 1 2 1 2 1 1 ...
 $ housing       : Factor w/ 3 levels "no","unknown",..: 1 1 3 1 1 1 1 1 3 3 ...
 $ loan          : Factor w/ 3 levels "no","unknown",..: 1 1 1 1 3 1 1 1 1 1 ...
 $ contact       : Factor w/ 2 levels "cellular","telephone": 2 2 2 2 2 2 2 2 2 2 ...
 $ month         : Factor w/ 10 levels "apr","aug","dec",..: 7 7 7 7 7 7 7 7 7 7 ...
 $ day_of_week   : Factor w/ 5 levels "fri","mon","thu",..: 2 2 2 2 2 2 2 2 2 2 ...
 $ duration      : int  261 149 226 151 307 198 139 217 380 50 ...
 $ campaign      : int  1 1 1 1 1 1 1 1 1 1 ...
 $ pdays         : int  999 999 999 999 999 999 999 999 999 999 ...
 $ previous      : int  0 0 0 0 0 0 0 0 0 0 ...
 $ poutcome      : Factor w/ 3 levels "failure","nonexistent",..: 2 2 2 2 2 2 2 2 2 2 ...
 $ emp.var.rate  : num  1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 1.1 ...
 $ cons.price.idx: num  94 94 94 94 94 ...
 $ cons.conf.idx : num  -36.4 -36.4 -36.4 -36.4 -36.4 -36.4 -36.4 -36.4 -36.4 -36.4 ...
 $ euribor3m     : num  4.86 4.86 4.86 4.86 4.86 ...
 $ nr.employed   : num  5191 5191 5191 5191 5191 ...
 $ y             : Factor w/ 2 levels "no","yes": 1 1 1 1 1 1 1 1 1 1 ...
>
```

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

```
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)))

```
> psych::describe(bank)
              vars     n    mean     sd  median trimmed    mad     min     max   range
skew kurtosis   se
age              1 41188   40.02  10.42   38.00   39.30  10.38   17.00   98.00   81.00
0.78     0.79 0.05
job*             2 41188    4.72   3.59    3.00    4.48   2.97    1.00   12.00   11.00
0.45    -1.39 0.02
marital*         3 41188    2.17   0.61    2.00    2.21   0.00    1.00    4.00    3.00 -
0.06    -0.34 0.00
education*       4 41188    4.75   2.14    4.00    4.88   2.97    1.00    8.00    7.00 -
0.24    -1.21 0.01
default*         5 41188    1.21   0.41    1.00    1.14   0.00    1.00    3.00    2.00
1.44     0.07 0.00
housing*         6 41188    2.07   0.99    3.00    2.09   0.00    1.00    3.00    2.00 -
0.14    -1.95 0.00
loan*            7 41188    1.33   0.72    1.00    1.16   0.00    1.00    3.00    2.00
1.82     1.38 0.00
contact*         8 41188    1.37   0.48    1.00    1.33   0.00    1.00    2.00    1.00
0.56    -1.69 0.00
month*           9 41188    5.23   2.32    5.00    5.31   2.97    1.00   10.00    9.00 -
0.31    -1.03 0.01
day_of_week*    10 41188    3.00   1.40    3.00    3.01   1.48    1.00    5.00    4.00
0.01    -1.27 0.01
duration        11 41188  258.29 259.28  180.00  210.61 139.36    0.00 4918.00 4918.00
3.26    20.24 1.28
campaign        12 41188    2.57   2.77    2.00    1.99   1.48    1.00   56.00   55.00
4.76    36.97 0.01
pdays           13 41188  962.48 186.91  999.00  999.00   0.00    0.00  999.00  999.00 -
4.92    22.23 0.92
previous        14 41188    0.17   0.49    0.00    0.05   0.00    0.00    7.00    7.00
3.83    20.11 0.00
poutcome*       15 41188    1.93   0.36    2.00    2.00   0.00    1.00    3.00    2.00 -
0.88     3.98 0.00
emp.var.rate    16 41188    0.08   1.57    1.10    0.27   0.44   -3.40    1.40    4.80 -
0.72    -1.06 0.01
cons.price.idx  17 41188   93.58   0.58   93.75   93.58   0.56   92.20   94.77    2.57 -
0.23    -0.83 0.00
cons.conf.idx   18 41188  -40.50   4.63  -41.80  -40.60   6.52  -50.80  -26.90   23.90
0.30    -0.36 0.02
euribor3m       19 41188    3.62   1.73    4.86    3.81   0.16    0.63    5.04    4.41 -
0.71    -1.41 0.01
nr.employed     20 41188 5167.04  72.25 5191.00 5178.43  55.00 4963.60 5228.10  264.50 -
1.04     0.00 0.36
y*              21 41188    1.11   0.32    1.00    1.02   0.00    1.00    2.00    1.00
2.45     4.00 0.00
> 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"))
Warning message:
In plot.aggr(res, ...) :
  not enough vertical space to display frequencies (too many combinations)
> sapply(missing, function(x) sum(is.na(x)))
          age           job       marital     education       default       housing
         loan
            0           330            80          1731          8597           990
          990
     contact         month   day_of_week      duration      campaign         pdays
     previous
            0             0             0             0             0             0
           0
    poutcome  emp.var.rate cons.price.idx  cons.conf.idx     euribor3m   nr.employed
           y
            0             0             0             0             0             0
           0
>
```



#----------

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

t <- table(bank$job)

distribution in tabular form

t

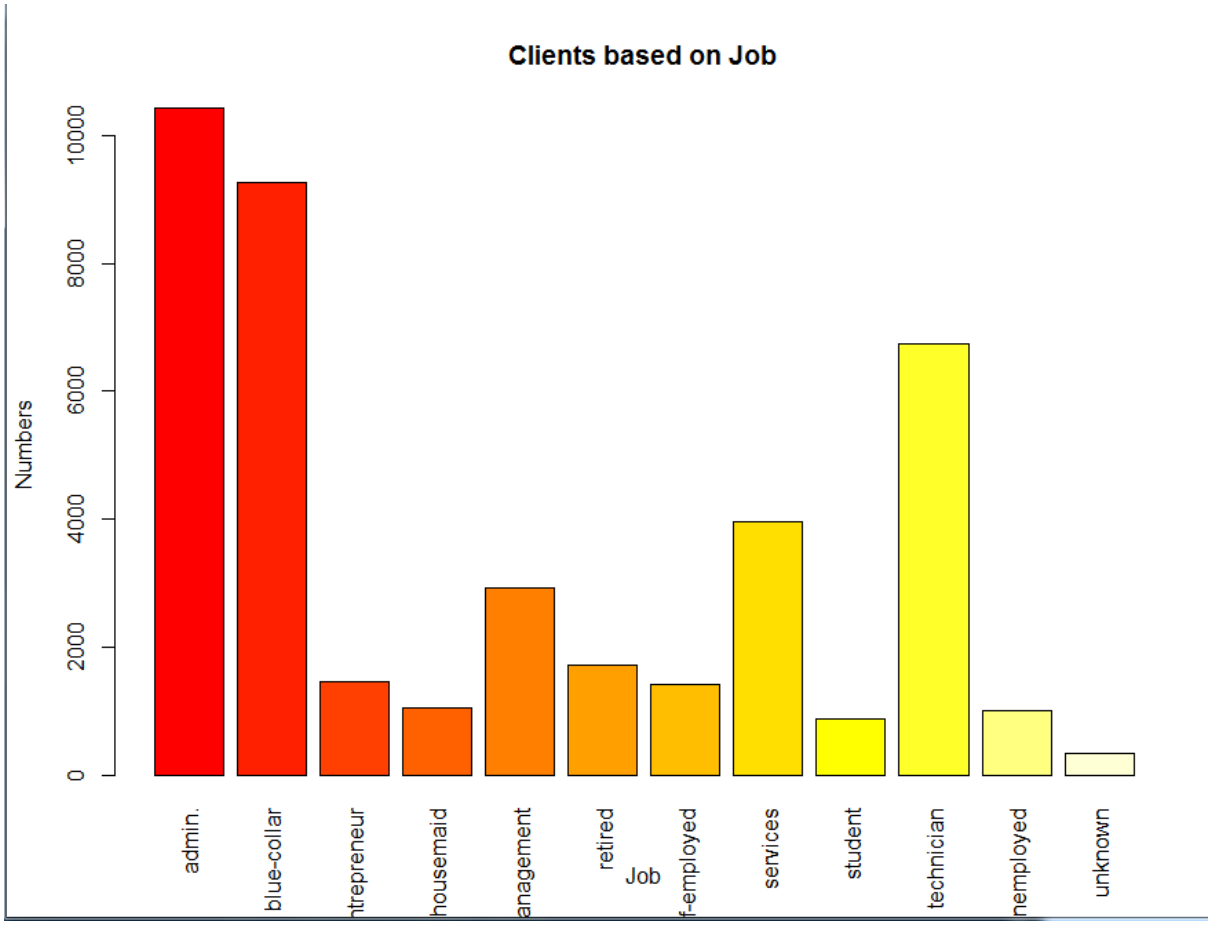
```
> t <- table(bank$job)
> t

       admin.    blue-collar   entrepreneur      housemaid     management        retired self-em
ployed      services
        10422           9254           1456           1060           2924           1720
  1421           3969
     student     technician     unemployed        unknown
         875           6743           1014            330
```

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)



#----------

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

Ho : There is NO association between Job and Marital Status

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

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

        Pearson's Chi-squared test

data:  missing$job and missing$marital
X-squared = 4045.1, df = 20, p-value < 2.2e-16
```

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, are omitted

----

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

Ho : There is NO association between Job and Education.

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

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

        Pearson's Chi-squared test

data:  missing$job and missing$education
X-squared = 37338, df = 77, p-value < 2.2e-16
```

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, are omitted

#----------