ACADGILD ASSIGNMENT 11.1

SESSION 11: Linear Models

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

Answer:

```
library(readr)
bank_full <- read_csv("C:/Users/Rajesh
Chowdary/Downloads/bank/bank-full.csv")
View(bank_full)
bank_full <- read_delim("C:/Users/Rajesh
Chowdary/Downloads/bank/bank-full.csv",
                                  ";", escape_double = FALSE, trim_ws =
TRUE)
```

```
Parsed with column specification:
cols(
  `"age;""job""` = col_character(),
  `""marital""` = col_character(),
  `""education""` = col_character(),
  `""default""` = col_character(),
  `""balance""` = col_double(),
  `""housing""` = col_character(),
  `""loan""` = col_character(),
  `""contact""` = col_character(),
  `""day""` = col_double(),
  `""month""` = col_character(),
  `""duration""` = col_double(),
  `""campaign""` = col_double(),
  `""pdays""` = col_double(),
  `""previous""` = col_double(),
  `""poutcome""` = col_character(),
  `""y"""` = col_character()
)
```

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

Answer:

head(bank_full) ## Displays first 6 rows for each variable
summary(bank_full) ## Provides basic statistical information of each variable
is.na(bank_full) ## Displays True for a missing value

Output from R console:

```
> summary(bank_full)
 "age;""job""       ""marital""        ""education""      ""default""
 Length:45211       Length:45211       Length:45211       Length:45211
 Class :character   Class :character   Class :character   Class :character
 Mode  :character   Mode  :character   Mode  :character   Mode  :character



  ""balance""      ""housing""          ""loan""          ""contact""
 Min.   : -8019   Length:45211       Length:45211       Length:45211
 1st Qu.:    72   Class :character   Class :character   Class :character
 Median :   448   Mode  :character   Mode  :character   Mode  :character
 Mean   :  1362
 3rd Qu.:  1428
 Max.   :102127
    ""day""        ""month""          ""duration""      ""campaign""
 Min.   : 1.00   Length:45211       Min.   :   0.0   Min.   : 1.000
 1st Qu.: 8.00   Class :character   1st Qu.: 103.0   1st Qu.: 1.000
 Median :16.00   Mode  :character   Median : 180.0   Median : 2.000
 Mean   :15.81                      Mean   : 258.2   Mean   : 2.764
 3rd Qu.:21.00                      3rd Qu.: 319.0   3rd Qu.: 3.000
 Max.   :31.00                      Max.   :4918.0   Max.   :63.000
   ""pdays""       ""previous""       ""poutcome""            ""y""""
 Min.   : -1.0   Min.   :  0.0000   Length:45211        Length:45211
 1st Qu.: -1.0   1st Qu.:  0.0000   Class :character    Class :character
 Median : -1.0   Median :  0.0000   Mode  :character    Mode  :character
 Mean   : 40.2   Mean   :  0.5803
 3rd Qu.: -1.0   3rd Qu.:  0.0000
 Max.   :871.0   Max.   :275.0000
> is.na(bank_full)
        "age;""job"" ""marital"" ""education"" ""default"" ""balance"" ""housing""
   [1,]        FALSE       FALSE         FALSE       FALSE       FALSE       FALSE
   [2,]        FALSE       FALSE         FALSE       FALSE       FALSE       FALSE
   [3,]        FALSE       FALSE         FALSE       FALSE       FALSE       FALSE
   [4,]        FALSE       FALSE         FALSE       FALSE       FALSE       FALSE
```

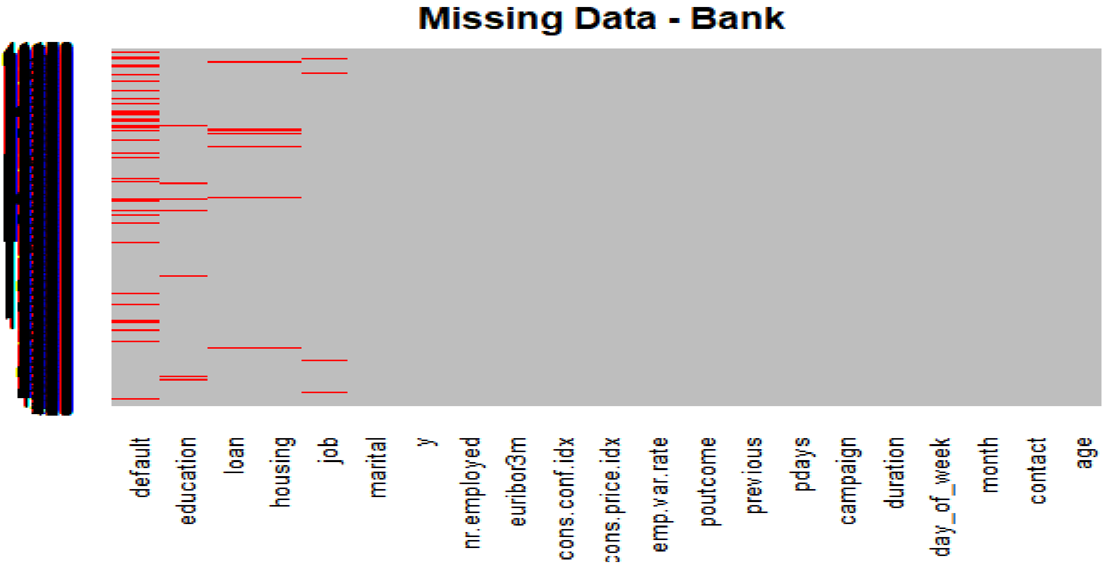
```
 [5,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
 [6,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
 [7,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
 [8,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
 [9,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[10,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[11,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[12,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[13,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[14,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[15,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[16,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[17,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[18,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[19,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[20,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[21,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[22,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[23,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[24,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[25,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[26,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[27,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[28,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[29,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[30,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[31,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[32,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[33,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[34,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[35,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[36,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[37,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[38,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[39,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[40,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[41,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[42,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[43,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[44,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[45,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[46,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[47,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[48,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[49,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[50,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[51,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[52,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[53,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[54,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[55,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[56,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[57,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[58,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[59,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[60,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
[61,]   FALSE   FALSE    FALSE   FALSE   FALSE   FALSE
```

```
[62,]        FALSE       FALSE         FALSE       FALSE       FALSE       FALSE
      ""loan"" ""contact"" ""day"" ""month"" ""duration"" ""campaign"" ""pdays""
 [1,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [2,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [3,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [4,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [5,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [6,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [7,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [8,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
 [9,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[10,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[11,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[12,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[13,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[14,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[15,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[16,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[17,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[18,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[19,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[20,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[21,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[22,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[23,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[24,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[25,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[26,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[27,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[28,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[29,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[30,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[31,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[32,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[33,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[34,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[35,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[36,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[37,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[38,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[39,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[40,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[41,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[42,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[43,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[44,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[45,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[46,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[47,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[48,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[49,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[50,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[51,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[52,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[53,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[54,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[55,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
```

```
[56,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[57,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[58,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[59,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[60,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[61,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
[62,]    FALSE       FALSE   FALSE     FALSE        FALSE        FALSE     FALSE
      ""previous"" ""poutcome"" ""y"""
 [1,]        FALSE        FALSE  FALSE
 [2,]        FALSE        FALSE  FALSE
 [3,]        FALSE        FALSE  FALSE
 [4,]        FALSE        FALSE  FALSE
 [5,]        FALSE        FALSE  FALSE
 [6,]        FALSE        FALSE  FALSE
 [7,]        FALSE        FALSE  FALSE
 [8,]        FALSE        FALSE  FALSE
 [9,]        FALSE        FALSE  FALSE
[10,]        FALSE        FALSE  FALSE
[11,]        FALSE        FALSE  FALSE
[12,]        FALSE        FALSE  FALSE
[13,]        FALSE        FALSE  FALSE
[14,]        FALSE        FALSE  FALSE
[15,]        FALSE        FALSE  FALSE
[16,]        FALSE        FALSE  FALSE
[17,]        FALSE        FALSE  FALSE
[18,]        FALSE        FALSE  FALSE
[19,]        FALSE        FALSE  FALSE
[20,]        FALSE        FALSE  FALSE
[21,]        FALSE        FALSE  FALSE
[22,]        FALSE        FALSE  FALSE
[23,]        FALSE        FALSE  FALSE
[24,]        FALSE        FALSE  FALSE
[25,]        FALSE        FALSE  FALSE
[26,]        FALSE        FALSE  FALSE
[27,]        FALSE        FALSE  FALSE
[28,]        FALSE        FALSE  FALSE
[29,]        FALSE        FALSE  FALSE
[30,]        FALSE        FALSE  FALSE
[31,]        FALSE        FALSE  FALSE
[32,]        FALSE        FALSE  FALSE
 [33,]        FALSE        FALSE  FALSE
[34,]        FALSE        FALSE  FALSE
[35,]        FALSE        FALSE  FALSE
[36,]        FALSE        FALSE  FALSE
[37,]        FALSE        FALSE  FALSE
[38,]        FALSE        FALSE  FALSE
[39,]        FALSE        FALSE  FALSE
[40,]        FALSE        FALSE  FALSE
[41,]        FALSE        FALSE  FALSE
[42,]        FALSE        FALSE  FALSE
[43,]        FALSE        FALSE  FALSE
[44,]        FALSE        FALSE  FALSE
[45,]        FALSE        FALSE  FALSE
[46,]        FALSE        FALSE  FALSE
[47,]        FALSE        FALSE  FALSE
[48,]        FALSE        FALSE  FALSE
[49,]        FALSE        FALSE  FALSE
```

```
 [50,]          FALSE            FALSE   FALSE
[51,]          FALSE            FALSE   FALSE
[52,]          FALSE            FALSE   FALSE
[53,]          FALSE            FALSE   FALSE
[54,]          FALSE            FALSE   FALSE
[55,]          FALSE            FALSE   FALSE
[56,]          FALSE            FALSE   FALSE
[57,]          FALSE            FALSE   FALSE
[58,]          FALSE            FALSE   FALSE
[59,]          FALSE            FALSE   FALSE
[60,]          FALSE            FALSE   FALSE
[61,]          FALSE            FALSE   FALSE
[62,]          FALSE            FALSE   FALSE
 [ reached getOption("max.print") -- omitted 45149 rows ]
```

hence no missing values.ALL the columns shows FALSE



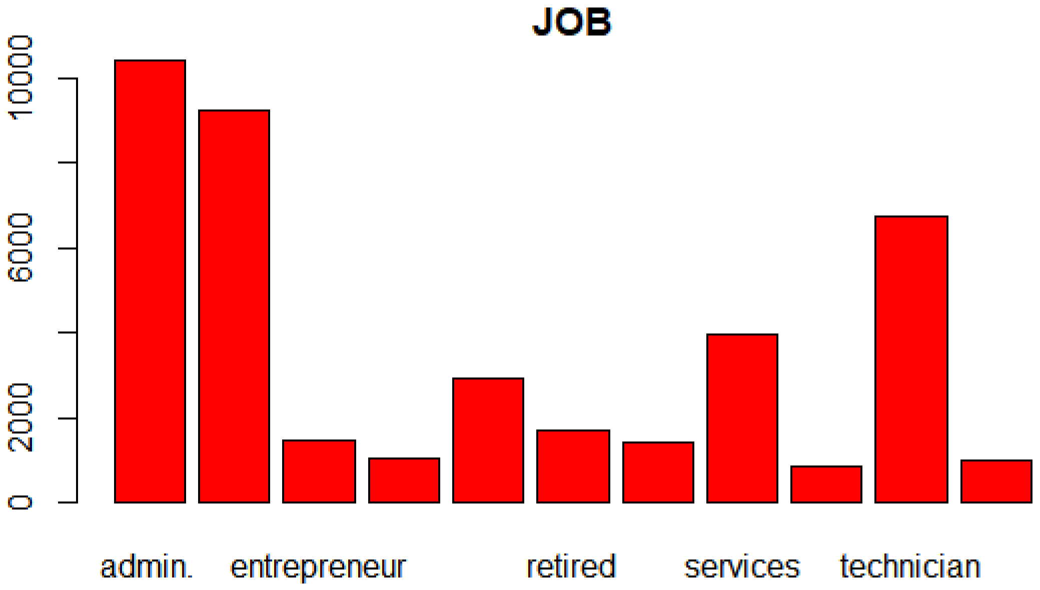
b. Show a distribution of clients based on a job.

Answer:

barplot(table(bankdata$job),col="red",main="JOB")

BARPLOT

Clients based on a job



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

Answer:

```
with(bankdata,chisq.test(job,marital))
with(bankdata,table(job,marital))
```

Output from R-console

```
>with(bankdata,chisq.test(job,marital))

      Pearson's Chi-squared test

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

> with(bankdata,table(job,marital))
               marital
job             divorced married single
  admin.            1280    5253   3875
  blue-collar        728    6687   1825
  entrepreneur       179    1071    203
  housemaid          161     777    119
  management         331    2089    501
```

```
  retired            348    1274     93
  self-employed      133     904    379
  services           532    2294   1137
  student              9      41    824
  technician         774    3670   2287
  unemployed         124     634    251

>
```

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

Answer:

with(bankdata,chisq.test(job,education))
with(bankdata,table(job,education))
(OR)
with(bankdata, prop.table(table(job,education)))

Output from R-console:

```
> with(bankdata,chisq.test(job,education))

      Pearson's Chi-squared test

data:  job and education
X-squared = 35560, df = 60, p-value < 2.2e-16

Warning message:
In chisq.test(job, education) : Chi-squared approximation may be
incorrect
> with(bankdata,table(job,education))
               education
job              basic.4y basic.6y basic.9y high.school illiterate
  admin.               77      151      499        3329          1
  blue-collar        2318     1426     3623         878          8
  entrepreneur        137       71      210         234          2
  housemaid           474       77       94         174          1
  management          100       85      166         298          0
  retired             597       75      145         276          3
  self-employed        93       25      220         118          3
  services            132      226      388        2682          0
  student              26       13       99         357          0
  technician           58       87      384         873          0
  unemployed          112       34      186         259          0
               education
```

```
job             professional.course university.degree
  admin.                        363              5753
  blue-collar                   453                94
  entrepreneur                  135               610
  housemaid                      59               139
  management                     89              2063
  retired                       241               285
  self-employed                 168               765
  services                      218               173
  student                        43               170
  technician                   3320              1809
  unemployed                    142               262
> with(bankdata, prop.table(table( job,education)))
               education
job                 basic.4y     basic.6y     basic.9y  high.school
illiterate
  admin.        1.961384e-03 3.846350e-03 1.271079e-02 8.479800e-02
2.547252e-05
  blue-collar   5.904529e-02 3.632381e-02 9.228692e-02 2.236487e-02
2.037801e-04
  entrepreneur  3.489735e-03 1.808549e-03 5.349228e-03 5.960569e-03
5.094503e-05
  housemaid     1.207397e-02 1.961384e-03 2.394416e-03 4.432218e-03
2.547252e-05
  management    2.547252e-03 2.165164e-03 4.228438e-03 7.590810e-03
0.000000e+00
  retired       1.520709e-02 1.910439e-03 3.693515e-03 7.030414e-03
7.641755e-05
  self-employed 2.368944e-03 6.368129e-04 5.603953e-03 3.005757e-03
7.641755e-05
  services      3.362372e-03 5.756788e-03 9.883336e-03 6.831729e-02
0.000000e+00
  student       6.622854e-04 3.311427e-04 2.521779e-03 9.093688e-03
0.000000e+00
  technician    1.477406e-03 2.216109e-03 9.781446e-03 2.223751e-02
0.000000e+00
  unemployed    2.852922e-03 8.660655e-04 4.737888e-03 6.597381e-03
0.000000e+00
               education
job             professional.course university.degree
  admin.               9.246523e-03      1.465434e-01
  blue-collar          1.153905e-02      2.394416e-03
  entrepreneur         3.438790e-03      1.553823e-02
  housemaid            1.502878e-03      3.540680e-03
  management           2.267054e-03      5.254980e-02
  retired              6.138876e-03      7.259667e-03
  self-employed        4.279383e-03      1.948647e-02
  services             5.553008e-03      4.406745e-03
  student              1.095318e-03      4.330328e-03
  technician           8.456875e-02      4.607978e-02
  unemployed           3.617097e-03      6.673799e-03

>
```