Assignment 11.1

1. Use the given link and locate the bank marketing dataset. Data Set Link
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?

```
## The data set can be obtained from
http://archive.ics.uci.edu/ml/datasets/Bank+Marketing
## DATASET UNDERSTANDING
library(readr)
bank_full <- read_delim("C:/Sourav/R/bank-full.csv", ";",
escape_double = FALSE, trim_ws = TRUE)

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

```r
#Lets look at dataset and generate initial understanding about the column
types
str(bank_full)
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    45211 obs. of  17 variables:
##  $ age      : int  58 44 33 47 33 35 28 42 58 43 ...
##  $ job      : chr  "management" "technician" "entrepreneur" "blue-collar"
...
##  $ marital  : chr  "married" "single" "married" "married" ...
##  $ education: chr  "tertiary" "secondary" "secondary" "unknown" ...
##  $ default  : chr  "no" "no" "no" "no" ...
##  $ balance  : int  2143 29 2 1506 1 231 447 2 121 593 ...
##  $ housing  : chr  "yes" "yes" "yes" "yes" ...
##  $ loan     : chr  "no" "no" "yes" "no" ...
##  $ contact  : chr  "unknown" "unknown" "unknown" "unknown" ...
##  $ day      : int  5 5 5 5 5 5 5 5 5 5 ...
##  $ month    : chr  "may" "may" "may" "may" ...
##  $ duration : int  261 151 76 92 198 139 217 380 50 55 ...
##  $ campaign : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ pdays    : int  -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 ...
##  $ previous : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ poutcome : chr  "unknown" "unknown" "unknown" "unknown" ...
##  $ y        : chr  "no" "no" "no" "no" ...
##  - attr(*, "spec")=List of 2
##   ..$ cols   :List of 17
##   .. ..$ age      : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ job      : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ marital  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ education: list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ default  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ balance  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ housing  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ loan     : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ contact  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ day      : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ month    : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ duration : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ campaign : list()
```

```
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ pdays    : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ previous : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ poutcome : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ y        : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   ..$ default: list()
##   .. ..- attr(*, "class")= chr  "collector_guess" "collector"
##   ..- attr(*, "class")= chr "col_spec"
```

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

```
#A deep check for NA in a particular column let say age
if(length(which(is.na(bank_full$age)==TRUE)>0)){
print("Missing Value found in the specified column")
} else
print("All okay: No Missing Value found in the specified column")

## [1] "All okay: No Missing Value found in the specified column"

# Check another example say
if(length(which(is.na(bank_full$campaign)==TRUE)>0)){print("Missing Value
found in the specified column")} else
print("All okay: No Missing Value found in the specified column")

## [1] "All okay: No Missing Value found in the specified column"

head(bank_full) ## Displays first 6 rows for each variable

## # A tibble: 6 x 17
##     age job        marital education default balance housing loan   contact
##   <int> <chr>      <chr>   <chr>     <chr>     <int> <chr>   <chr> <chr>
## 1    58 management married tertiary  no         2143 yes     no    unknown
## 2    44 technician single  secondary no           29 yes     no    unknown
## 3    33 entrepren~ married secondary no            2 yes     yes   unknown
## 4    47 blue-coll~ married unknown   no         1506 yes     no    unknown
## 5    33 unknown    single  unknown   no            1 no      no    unknown
## 6    35 management married tertiary  no          231 yes     no    unknown
## # ... with 8 more variables: day <int>, month <chr>, duration <int>,
## #   campaign <int>, pdays <int>, previous <int>, poutcome <chr>, y <chr>

str(bank_full) ## Describes each variables
```

```
## Classes 'tbl_df', 'tbl' and 'data.frame':    45211 obs. of  17 variables:
##  $ age      : int  58 44 33 47 33 35 28 42 58 43 ...
##  $ job      : chr  "management" "technician" "entrepreneur" "blue-collar"
...
##  $ marital  : chr  "married" "single" "married" "married" ...
##  $ education: chr  "tertiary" "secondary" "secondary" "unknown" ...
##  $ default  : chr  "no" "no" "no" "no" ...
##  $ balance  : int  2143 29 2 1506 1 231 447 2 121 593 ...
##  $ housing  : chr  "yes" "yes" "yes" "yes" ...
##  $ loan     : chr  "no" "no" "yes" "no" ...
##  $ contact  : chr  "unknown" "unknown" "unknown" "unknown" ...
##  $ day      : int  5 5 5 5 5 5 5 5 5 5 ...
##  $ month    : chr  "may" "may" "may" "may" ...
##  $ duration : int  261 151 76 92 198 139 217 380 50 55 ...
##  $ campaign : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ pdays    : int  -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 ...
##  $ previous : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ poutcome : chr  "unknown" "unknown" "unknown" "unknown" ...
##  $ y        : chr  "no" "no" "no" "no" ...
##  - attr(*, "spec")=List of 2
##   ..$ cols   :List of 17
##   .. ..$ age      : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ job      : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ marital  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ education: list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ default  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ balance  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ housing  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ loan     : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ contact  : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ day      : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ month    : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ duration : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ campaign : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ pdays    : list()
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ previous : list()
```

```
##   .. .. ..- attr(*, "class")= chr  "collector_integer" "collector"
##   .. ..$ poutcome : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   .. ..$ y        : list()
##   .. .. ..- attr(*, "class")= chr  "collector_character" "collector"
##   ..$ default: list()
##   .. ..- attr(*, "class")= chr  "collector_guess" "collector"
##   ..- attr(*, "class")= chr "col_spec"
```

```
summary(bank_full) ## Provides basic statistical information of each variable
```

```
##       age            job              marital           education
##  Min.   :18.00   Length:45211        Length:45211       Length:45211
##  1st Qu.:33.00   Class :character   Class :character   Class :character
##  Median :39.00   Mode  :character   Mode  :character   Mode  :character
##  Mean   :40.94
##  3rd Qu.:48.00
##  Max.   :95.00
##    default            balance          housing              loan
##  Length:45211       Min.    : -8019   Length:45211       Length:45211
##  Class :character   1st Qu.:    72   Class :character   Class :character
##  Mode  :character   Median :   448   Mode  :character   Mode  :character
##                     Mean    :  1362
##                     3rd Qu.:  1428
##                     Max.    :102127
##    contact              day            month              duration
##  Length:45211       Min.    : 1.00   Length:45211       Min.    :   0.0
##  Class :character   1st Qu.: 8.00   Class :character   1st Qu.: 103.0
##  Mode  :character   Median :16.00   Mode  :character   Median : 180.0
##                     Mean    :15.81                      Mean    : 258.2
##                     3rd Qu.:21.00                      3rd Qu.: 319.0
##                     Max.    :31.00                      Max.    :4918.0
##     campaign          pdays          previous          poutcome
##  Min.   : 1.000   Min.    : -1.0   Min.    :  0.0000   Length:45211
##  1st Qu.: 1.000   1st Qu.: -1.0   1st Qu.:  0.0000   Class :character
##  Median : 2.000   Median : -1.0   Median :  0.0000   Mode  :character
##  Mean   : 2.764   Mean    : 40.2   Mean    :  0.5803
##  3rd Qu.: 3.000   3rd Qu.: -1.0   3rd Qu.:  0.0000
##  Max.   :63.000   Max.    :871.0   Max.    :275.0000
##       y
##  Length:45211
##  Class :character
##  Mode  :character
##
##
##
```

```
## DATA EXPLORATION - Check for Missing Data
## Option 1
is.na(bank_full) ## Displays True for a missing value
```

```
##              age   job marital education default balance housing  loan
##     [1,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [2,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [3,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [4,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [5,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [6,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [7,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [8,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##     [9,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [10,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [11,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [12,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [13,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [14,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [15,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [16,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [17,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [18,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [19,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [20,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [21,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [22,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [23,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [24,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [25,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [26,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [27,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [28,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [29,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [30,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [31,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [32,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [33,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [34,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [35,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [36,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [37,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [38,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [39,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [40,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [41,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [42,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [43,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [44,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [45,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [46,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [47,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [48,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
##    [49,] FALSE FALSE   FALSE     FALSE   FALSE   FALSE   FALSE FALSE
```

Deleted remaining false as it is very lengthy

```
FALSE    FALSE FALSE    FALSE    FALSE
##  [4653,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4654,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4655,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4656,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4657,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4658,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4659,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4660,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4661,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4662,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4663,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4664,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4665,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4666,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4667,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4668,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4669,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4670,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4671,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4672,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4673,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4674,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4675,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4676,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4677,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4678,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4679,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4680,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4681,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4682,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4683,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4684,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4685,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4686,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4687,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4688,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4689,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4690,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4691,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4692,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4693,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4694,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4695,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4696,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4697,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4698,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
##  [4699,]   FALSE FALSE FALSE    FALSE    FALSE FALSE    FALSE    FALSE
```

```
##  [5867,] FALSE
##  [5868,] FALSE
##  [5869,] FALSE
##  [5870,] FALSE
##  [5871,] FALSE
##  [5872,] FALSE
##  [5873,] FALSE
##  [5874,] FALSE
##  [5875,] FALSE
##  [5876,] FALSE
##  [5877,] FALSE
##  [5878,] FALSE
##  [5879,] FALSE
##  [5880,] FALSE
##  [5881,] FALSE
##  [5882,] FALSE
##  [ reached getOption("max.print") -- omitted 39329 rows ]
```

```
## Since it is a large dataset, graphical display of missing values will
prove to be easier
##Option 2
require(Amelia)
```

```
## Loading required package: Amelia
```

```
## Loading required package: Rcpp
```

```
## ##
## ## Amelia II: Multiple Imputation
## ## (Version 1.7.5, built: 2018-05-07)
## ## Copyright (C) 2005-2018 James Honaker, Gary King and Matthew Blackwell
## ## Refer to http://gking.harvard.edu/amelia/ for more information
## ##
```

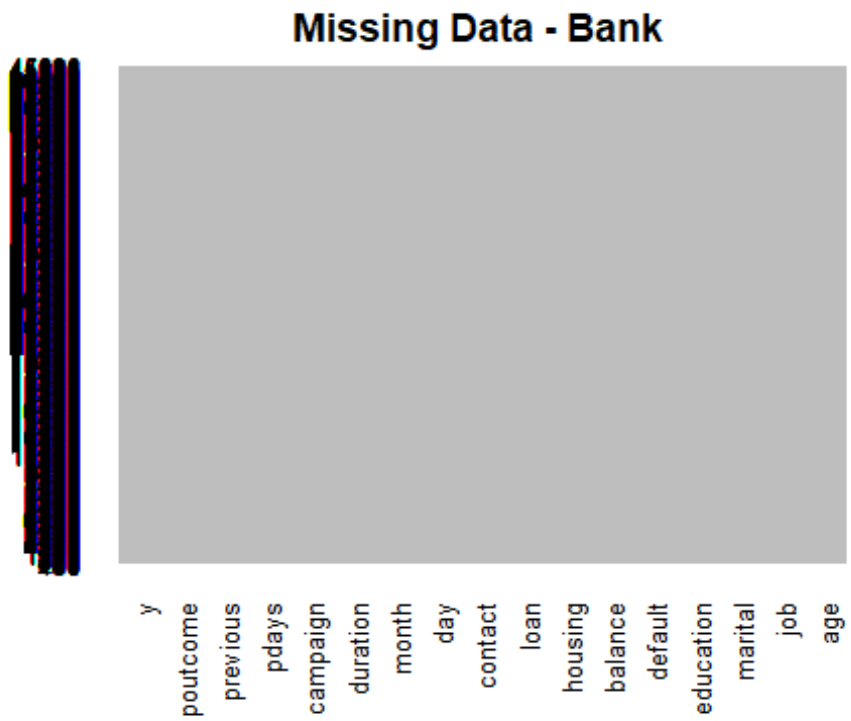
```
missmap(bank_full,main="Missing Data - Bank ",
col=c("red","grey"),legend=FALSE)
```

```
## Warning in if (class(obj) == "amelia") {: the condition has length > 1 and
## only the first element will be used
```

```
## Warning: Unknown or uninitialised column: 'arguments'.
```

```
## Warning: Unknown or uninitialised column: 'arguments'.
```

```
## Warning: Unknown or uninitialised column: 'imputations'.
```




```
## No red colour stripes are visible. hence no missing values.
summary(bank_full) ## displays missing values if any under every variable
```

```
##       age            job              marital           education
##  Min.   :18.00   Length:45211       Length:45211       Length:45211
##  1st Qu.:33.00   Class :character   Class :character   Class :character
##  Median :39.00   Mode  :character   Mode  :character   Mode  :character
##  Mean   :40.94
##  3rd Qu.:48.00
##  Max.   :95.00
##    default            balance          housing              loan
##  Length:45211       Min.    : -8019   Length:45211       Length:45211
##  Class :character   1st Qu.:    72   Class :character   Class :character
##  Mode  :character   Median :   448   Mode  :character   Mode  :character
##                     Mean    :  1362
##                     3rd Qu.:  1428
##                     Max.    :102127
##    contact                day            month              duration
##  Length:45211       Min.    : 1.00   Length:45211       Min.    :   0.0
##  Class :character   1st Qu.: 8.00   Class :character   1st Qu.: 103.0
##  Mode  :character   Median :16.00   Mode  :character   Median : 180.0
##                     Mean    :15.81                      Mean    : 258.2
##                     3rd Qu.:21.00                      3rd Qu.: 319.0
##                     Max.    :31.00                      Max.    :4918.0
##     campaign          pdays          previous          poutcome
##  Min.   : 1.000   Min.    : -1.0   Min.    :  0.0000   Length:45211
##  1st Qu.: 1.000   1st Qu.: -1.0   1st Qu.:  0.0000   Class :character
```

```
##  Median : 2.000   Median : -1.0   Median :  0.0000   Mode  :character
##  Mean   : 2.764   Mean   : 40.2   Mean   :  0.5803
##  3rd Qu.: 3.000   3rd Qu.: -1.0   3rd Qu.:  0.0000
##  Max.   :63.000   Max.   :871.0   Max.   :275.0000
##       y
##  Length:45211
##  Class :character
##  Mode  :character
##
##
##
```

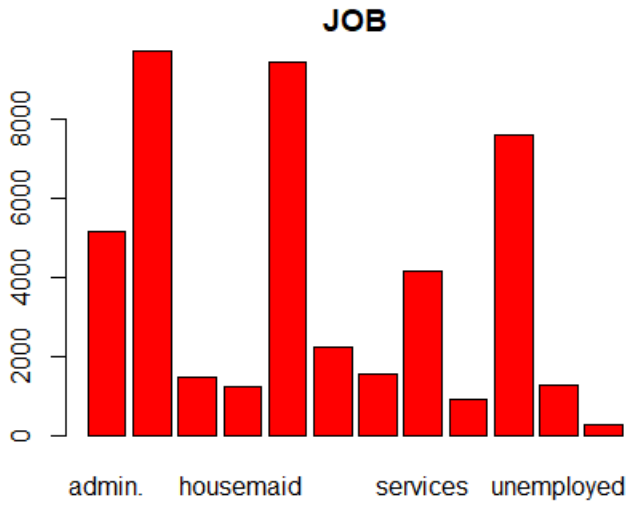
b. Show a distribution of clients based on a Job.

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

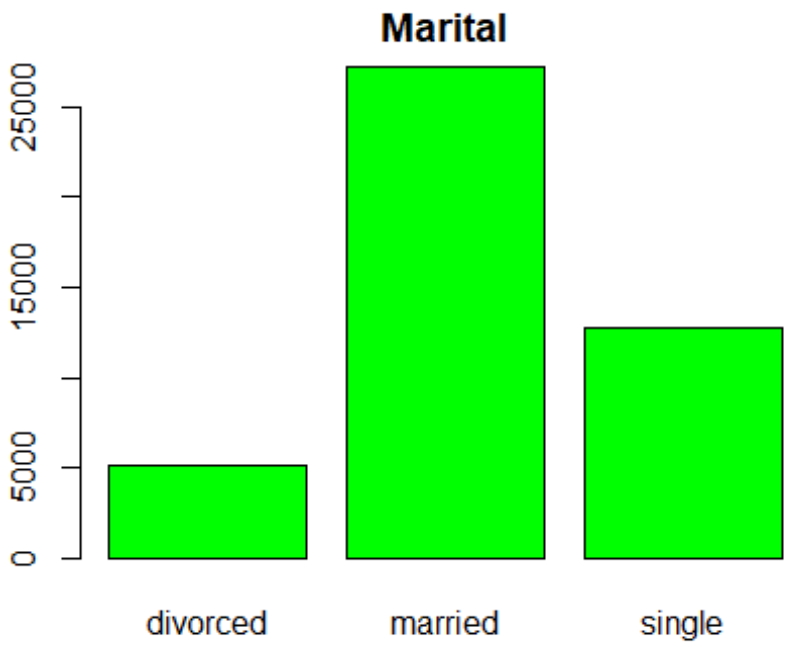
d. Check whether is there any association between Job and Education?

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

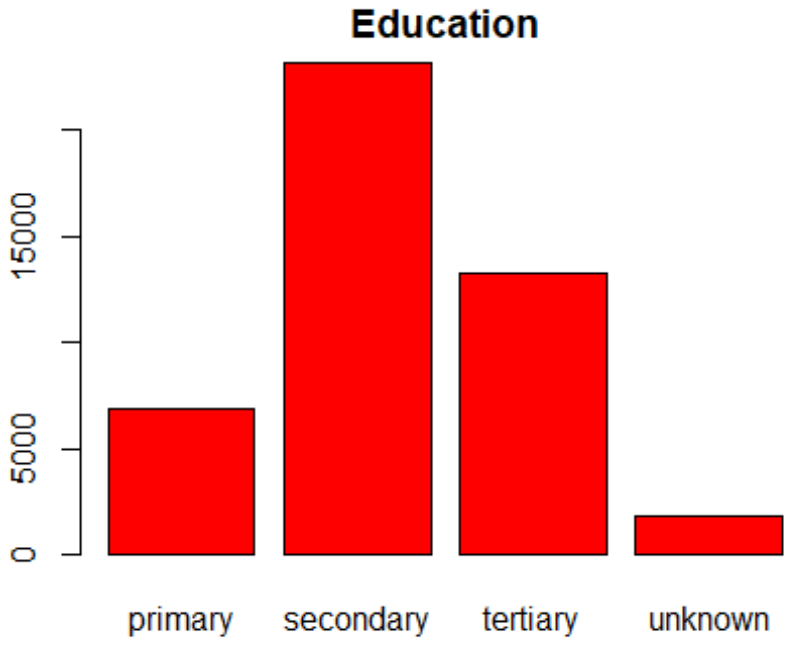
```
## Barplotsfor Categorical Variables
barplot(table(bank_full$job),col="red",main="JOB")
```



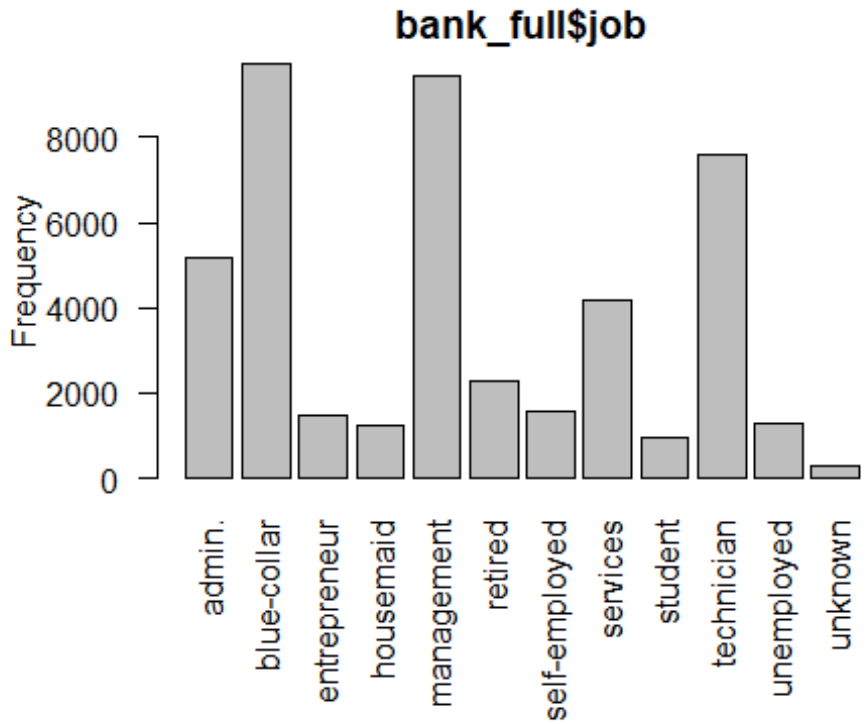

```
barplot(table(bank_full$marital),col="green",main="Marital")
```



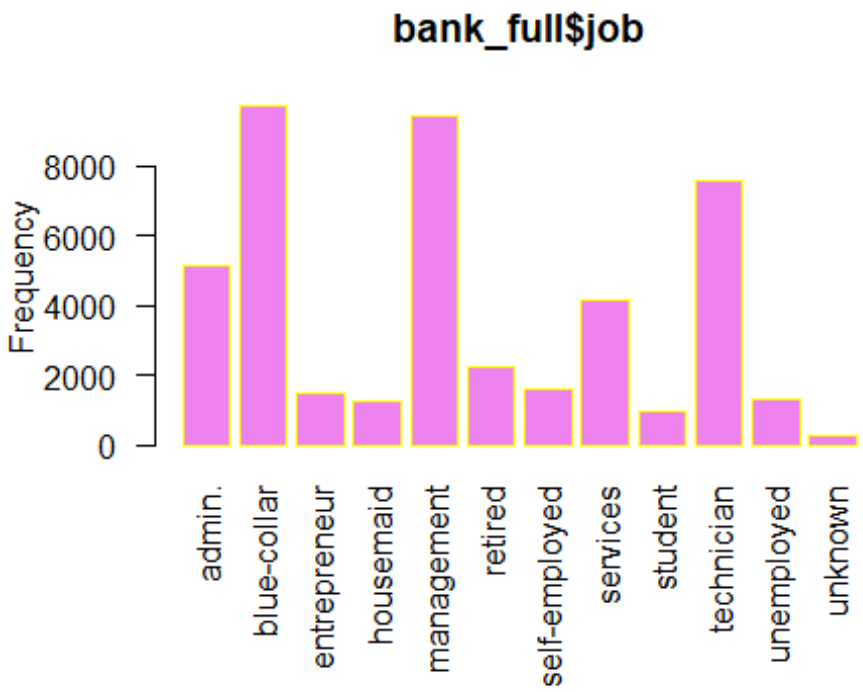

```r
barplot(table(bank_full$education),col="red",main="Education")
```



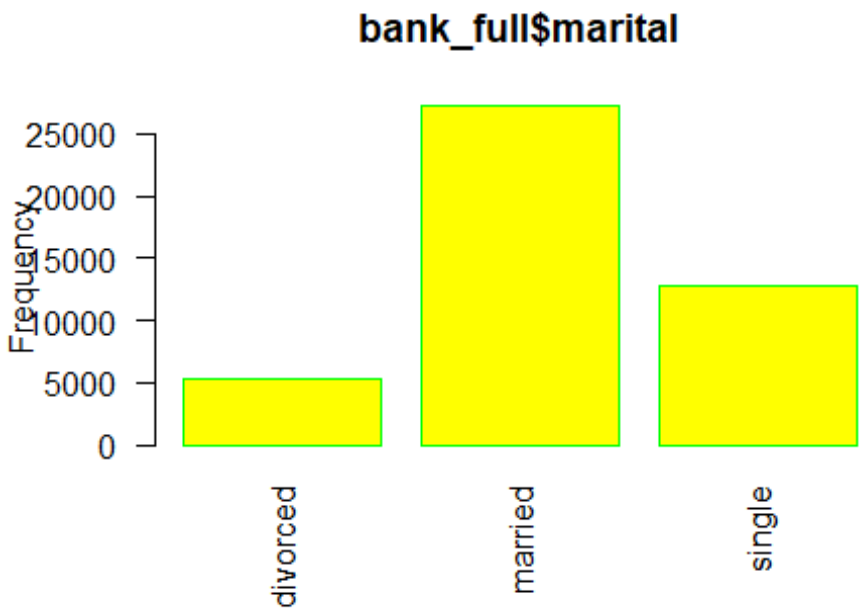
```r
par(oma=c(2,0,0,0))  #so labels are not cut off
barplot(table(bank_full$job),ylab = "Frequency", main = "bank_full$job",
          border="black", col="grey",las=2)
```



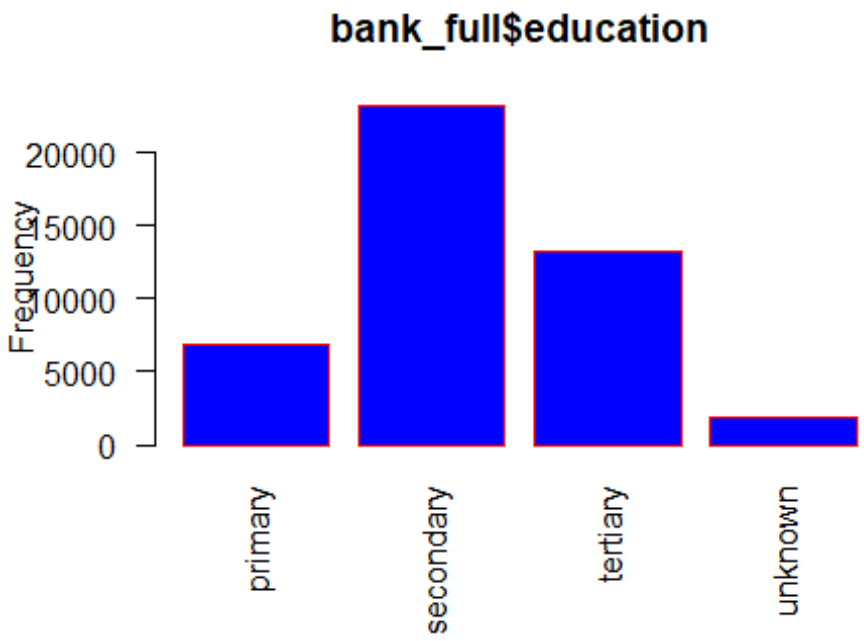

```r
#Histogram for job,marital and education - three categorical variables

par(oma=c(2,0,0,0))  #so labels are not cut off
barplot(table(bank_full$job),ylab = "Frequency", main = "bank_full$job",
          border="yellow", col="violet",las=2)
```




```r
par(oma=c(2,0,0,0))  #so labels are not cut off
barplot(table(bank_full$marital),ylab = "Frequency", main =
"bank_full$marital",
          border="green", col="yellow",las=2)
```




```r
par(oma=c(2,0,0,0))  #so labels are not cut off
barplot(table(bank_full$education),ylab = "Frequency", main =
"bank_full$education",
          border="red", col="blue",las=2)
```



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

As both are a categorical variable this can be checked with chisq.test

```
with(bank_full, chisq.test( job, marital))

##
##  Pearson's Chi-squared test
##
## data:  job and marital
## X-squared = 3837.6, df = 22, p-value < 2.2e-16

with(bank_full, table( job, marital) )

##                marital
## job             divorced married single
##   admin.              750    2693   1728
##   blue-collar         750    6968   2014
##   entrepreneur        179    1070    238
##   housemaid           184     912    144
##   management         1111    5400   2947
##   retired             425    1731    108
##   self-employed       140     993    446
##   services            549    2407   1198
##   student               6      54    878
```

```
##   technician          925     4052    2620
##   unemployed          171      731     401
##   unknown              17      203      68
```

```
# OR
with(bank_full, prop.table(table( job,education)))
```

```
##                education
## job                  primary    secondary     tertiary      unknown
##   admin.        0.0046227688 0.0933179978 0.0126517883 0.0037822654
##   blue-collar   0.0831213643 0.1187985225 0.0032956581 0.0100418040
##   entrepreneur  0.0040476875 0.0119882330 0.0151732985 0.0016810068
##   housemaid     0.0138683064 0.0087368118 0.0038265024 0.0009953330
##   management    0.0065028422 0.0247948508 0.1725465042 0.0053526797
##   retired       0.0175842162 0.0217646148 0.0080953750 0.0026321028
##   self-employed 0.0028754064 0.0127623808 0.0184247196 0.0008626219
##   services      0.0076308863 0.0764636925 0.0044679392 0.0033177766
##   student       0.0009732145 0.0112362036 0.0049324279 0.0036053173
##   technician    0.0034947247 0.1156576939 0.0435292296 0.0053526797
##   unemployed    0.0056844573 0.0161022760 0.0063922497 0.0006414368
##   unknown       0.0011280441 0.0015704143 0.0008626219 0.0028090509
```

```
#<2.2e-16 means 0.00000000000000022. It is (very much) less than 0.05
```

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

As both are a categorical variable this can be checked with chisq.test

```
with(bank_full, chisq.test( job,education))
```

```
##
##  Pearson's Chi-squared test
##
## data:  job and education
## X-squared = 28483, df = 33, p-value < 2.2e-16
```

```
with(bank_full, table( job, education) )
```

```
##                education
## job             primary secondary tertiary unknown
##   admin.            209      4219      572     171
##   blue-collar      3758      5371      149     454
##   entrepreneur      183       542      686      76
##   housemaid         627       395      173      45
##   management        294      1121     7801     242
##   retired           795       984      366     119
```

```
##   self-employed     130       577       833       39
##   services          345      3457       202      150
##   student            44       508       223      163
##   technician        158      5229      1968      242
##   unemployed        257       728       289       29
##   unknown            51        71        39      127
```

```
# OR
with(bank_full, prop.table(table( job,education)))
```

```
##                education
## job                  primary    secondary     tertiary      unknown
##   admin.        0.0046227688 0.0933179978 0.0126517883 0.0037822654
##   blue-collar   0.0831213643 0.1187985225 0.0032956581 0.0100418040
##   entrepreneur  0.0040476875 0.0119882330 0.0151732985 0.0016810068
##   housemaid     0.0138683064 0.0087368118 0.0038265024 0.0009953330
##   management    0.0065028422 0.0247948508 0.1725465042 0.0053526797
##   retired       0.0175842162 0.0217646148 0.0080953750 0.0026321028
##   self-employed 0.0028754064 0.0127623808 0.0184247196 0.0008626219
##   services      0.0076308863 0.0764636925 0.0044679392 0.0033177766
##   student       0.0009732145 0.0112362036 0.0049324279 0.0036053173
##   technician    0.0034947247 0.1156576939 0.0435292296 0.0053526797
##   unemployed    0.0056844573 0.0161022760 0.0063922497 0.0006414368
##   unknown       0.0011280441 0.0015704143 0.0008626219 0.0028090509
```

```
#<2.2e-16 means 0.00000000000000022. It is (very much) less than 0.05
```

R Markdown

This is an R Markdown document. Markdown is a simple formatting syntax for authoring HTML, PDF, and MS Word documents. For more details on using R Markdown see http://rmarkdown.rstudio.com.

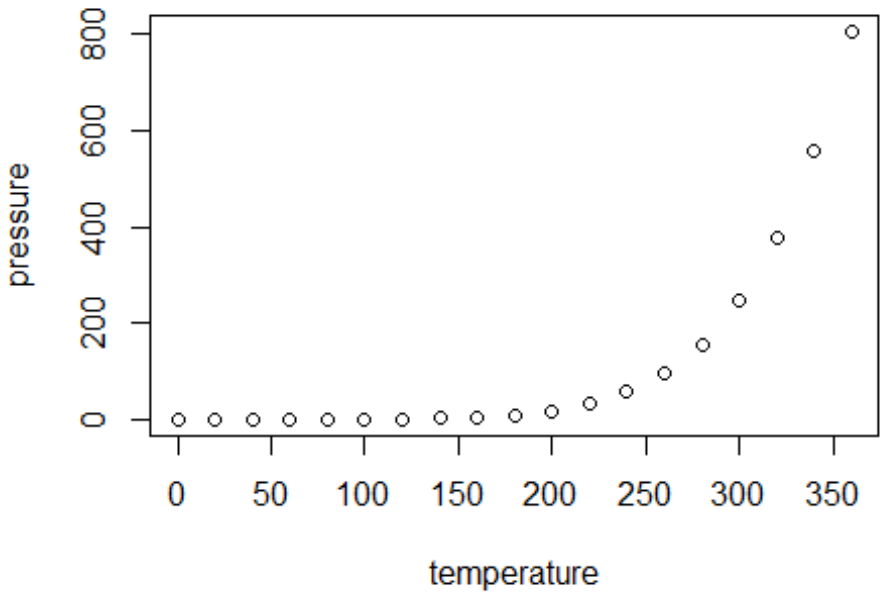
When you click the **Knit** button a document will be generated that includes both content as well as the output of any embedded R code chunks within the document. You can embed an R code chunk like this:

```
summary(cars)
```

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

Including Plots

You can also embed plots, for example:



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