Advertising Analysis

Tabitha Kariuki

2022-07-15

R Programming Exploratory Data Analysis

1. Defining the Question

a) Specifying the Data Analytic Question

A Kenyan entrepreneur has created an online cryptography course and would want to advertise it on her blog. She currently targets audiences originating from various countries. In the past, she ran ads to advertise a related course on the same blog and collected data in the process. She would now like to employ your services as a Data Science Consultant to help her identify which individuals are most likely to click on her ads.

b) Defining the Metric for Success

1.Exhaustively apply the exploratory data analysis approaches while defining the question, the metric for success, the context, experimental design taken and the appropriateness of the available data to answer the given question.

2.Perform univariate analysis by calculating and interpreting measures of central tendency for the set of data.

3.Exhaustively perform bivariate analysis by creating relevant visualizations

c) Understanding the context

Perform Exploratory Data Analysis for the give data set http://bit.ly/IPAdvertisingData

d) Experimental design taken

1.Reading and checking our data

2.Clean data by finding and dealing with outliers, anomalies, and missing data within the dataset.

3.Perform univariate and bivariate analysis.

4.From your insights provide a conclusion and recommendation.

e) Appropriateness of the available data

The dataset has appropriate columns and rows to answer the questions. The data is relevant for our analysis.

2. Importing Libraries

```
# install.package("data.table") # install package data.table to work with
data tables
library(data.table) # load package
# install.package("tidyverse") # install packages to work with data frame -
extends into visualization
library(tidyverse)
```

```
## ── Attaching packages ─────────────────────────────────────── tidyverse
1.3.1 ──

## ✓ ggplot2 3.3.6     ✓ purrr   0.3.4
## ✓ tibble  3.1.7     ✓ dplyr   1.0.9
## ✓ tidyr   1.2.0     ✓ stringr 1.4.0
## ✓ readr   2.1.2     ✓ forcats 0.5.1

## ── Conflicts ────────────────────────────────────────── tidyverse_conflicts() ──
## ✕ dplyr::between()   masks data.table::between()
## ✕ dplyr::filter()    masks stats::filter()
## ✕ dplyr::first()     masks data.table::first()
## ✕ dplyr::lag()       masks stats::lag()
## ✕ dplyr::last()      masks data.table::last()
## ✕ purrr::transpose() masks data.table::transpose()
```

3. Loading our dataset

```
# Loading our dataset into our environment

ad <- fread('http://bit.ly/IPAdvertisingData')
```

4. Reading our dataset

```
# Checking our top rows

head(ad)
```

```
##    Daily Time Spent on Site Age Area Income Daily Internet Usage
## 1:                    68.95  35    61833.90               256.09
## 2:                    80.23  31    68441.85               193.77
## 3:                    69.47  26    59785.94               236.50
## 4:                    74.15  29    54806.18               245.89
## 5:                    68.37  35    73889.99               225.58
## 6:                    59.99  23    59761.56               226.74
##                            Ad Topic Line           City Male    Country
## 1:    Cloned 5thgeneration orchestration    Wrightburgh    0    Tunisia
## 2:    Monitored national standardization      West Jodi    1      Nauru
## 3:      Organic bottom-line service-desk       Davidton    0 San Marino
## 4: Triple-buffered reciprocal time-frame West Terrifurt    1      Italy
## 5:         Robust logistical utilization   South Manuel    0    Iceland
## 6:       Sharable client-driven software      Jamieberg    1     Norway
##              Timestamp Clicked on Ad
```

```
## 1: 2016-03-27 00:53:11             0
## 2: 2016-04-04 01:39:02             0
## 3: 2016-03-13 20:35:42             0
## 4: 2016-01-10 02:31:19             0
## 5: 2016-06-03 03:36:18             0
## 6: 2016-05-19 14:30:17             0
```

```
# Checking our bottom rows

tail(ad)
```

```
##    Daily Time Spent on Site Age Area Income Daily Internet Usage
## 1:                    43.70  28    63126.96               173.01
## 2:                    72.97  30    71384.57               208.58
## 3:                    51.30  45    67782.17               134.42
## 4:                    51.63  51    42415.72               120.37
## 5:                    55.55  19    41920.79               187.95
## 6:                    45.01  26    29875.80               178.35
##                          Ad Topic Line          City Male
## 1:        Front-line bifurcated ability  Nicholasland    0
## 2:        Fundamental modular algorithm     Duffystad    1
## 3:      Grass-roots cohesive monitoring   New Darlene    1
## 4:         Expanded intangible solution South Jessica    1
## 5: Proactive bandwidth-monitored policy   West Steven    0
## 6:      Virtual 5thgeneration emulation   Ronniemouth    0
##                   Country           Timestamp Clicked on Ad
## 1:                Mayotte 2016-04-04 03:57:48             1
## 2:                Lebanon 2016-02-11 21:49:00             1
## 3: Bosnia and Herzegovina 2016-04-22 02:07:01             1
## 4:               Mongolia 2016-02-01 17:24:57             1
## 5:              Guatemala 2016-03-24 02:35:54             0
## 6:                 Brazil 2016-06-03 21:43:21             1
```

```
# Checking the shape of our data

dim(ad)
```

```
## [1] 1000   10
```

We have 1000 rows and 10 columns

```
# Checking the class/datatypes

str(ad)
```

```
## Classes 'data.table' and 'data.frame':   1000 obs. of  10 variables:
##  $ Daily Time Spent on Site: num  69 80.2 69.5 74.2 68.4 ...
##  $ Age                     : int  35 31 26 29 35 23 33 48 30 20 ...
##  $ Area Income             : num  61834 68442 59786 54806 73890 ...
##  $ Daily Internet Usage    : num  256 194 236 246 226 ...
##  $ Ad Topic Line           : chr  "Cloned 5thgeneration orchestration"
```

```
"Monitored national standardization" "Organic bottom-line service-desk"
"Triple-buffered reciprocal time-frame" ...
##  $ City                    : chr  "Wrightburgh" "West Jodi" "Davidton"
"West Terrifurt" ...
##  $ Male                    : int  0 1 0 1 0 1 0 1 1 1 ...
##  $ Country                 : chr  "Tunisia" "Nauru" "San Marino" "Italy"
...
##  $ Timestamp               : POSIXct, format: "2016-03-27 00:53:11" "2016-
04-04 01:39:02" ...
##  $ Clicked on Ad           : int  0 0 0 0 0 0 0 1 0 0 ...
##  - attr(*, ".internal.selfref")=<externalptr>

# checking the attributes of our dataset

class(ad)

## [1] "data.table" "data.frame"
```

5. Data Cleaning

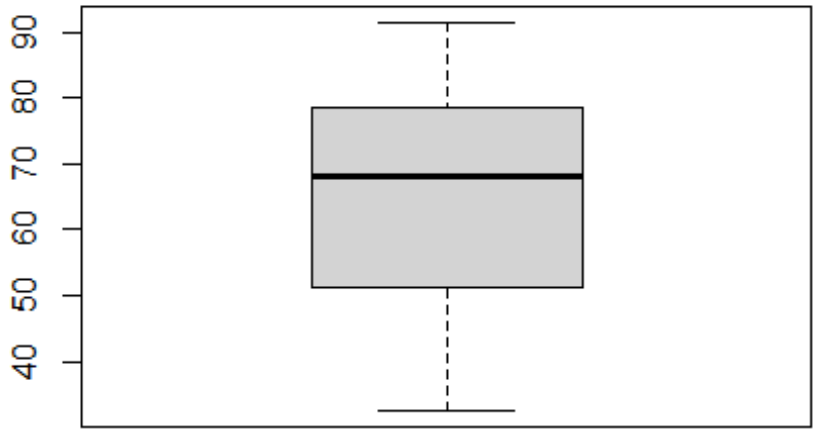
```
# Sum of null values in each column using the function colSums()

colSums(is.na(ad))

## Daily Time Spent on Site                      Age              Area Income
##                        0                        0                        0
##     Daily Internet Usage            Ad Topic Line                     City
##                        0                        0                        0
##                     Male                  Country                Timestamp
##                        0                        0                        0
##            Clicked on Ad
##                        0
```

There are no missing values in our dataset

```
# Now lets find the duplicated rows in the dataset
# and assign to a variable duplicated_rows below

duplicated_rows <- ad[duplicated(ad),]

# Lets print out the variable duplicated_rows and see these duplicated rows

duplicated_rows

## Empty data.table (0 rows and 10 cols): Daily Time Spent on Site,Age,Area
Income,Daily Internet Usage,Ad Topic Line,City...
```

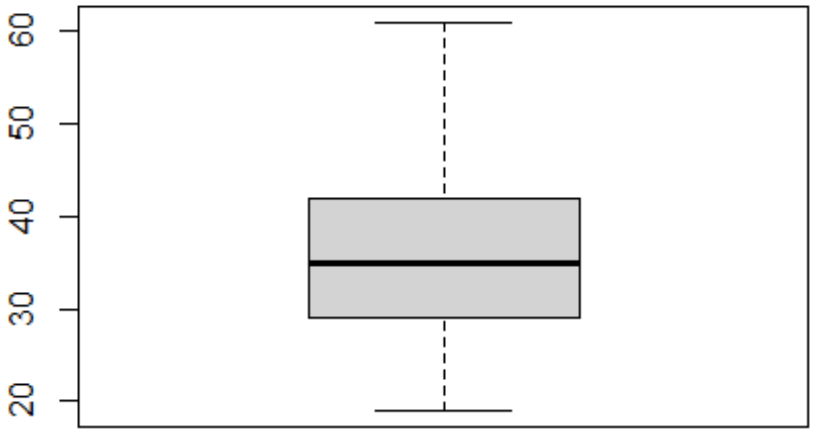
There are no duplicated rows

```
# Checking for outliers in the Daily Time Spent on Site column

boxplot(ad$'Daily Time Spent on Site')
```



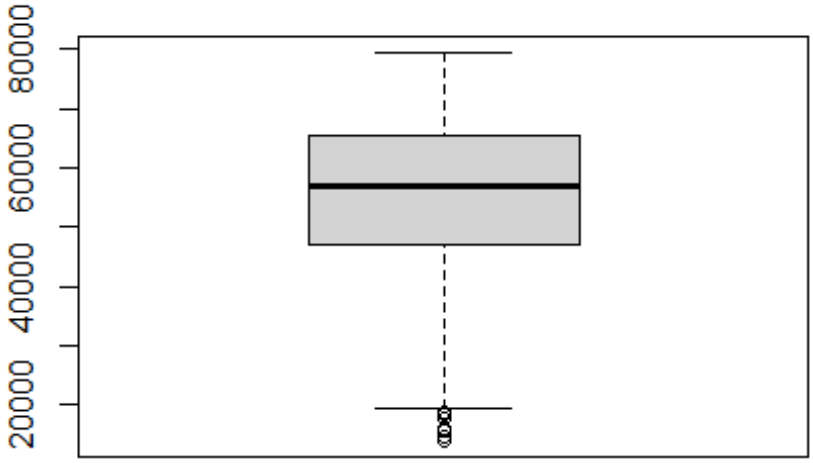
There are no outliers in the 'Daily Time Spent on Site' column

```
# Checking for outliers in the age column

boxplot(ad$'Age')
```



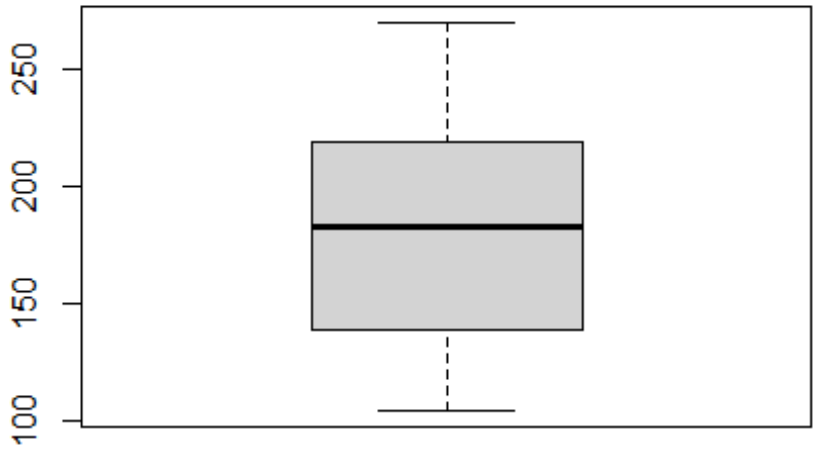
There are no outliers in the age column

```
# Checking for outliers in the Area Income column

boxplot(ad$'Area Income')
```



There are outliers in the 'area income' column. However we will not be dropping them since it is true representation of individual's income

```
# Checking for outliers in the Daily Internet Usage column

boxplot(ad$'Daily Internet Usage')
```



There are no outliers in the 'Daily Internet usage' column

Exploratory Data Analysis

6. Univariate Analysis

```
# Summary statistics of our data

summary(ad)
```

```
##  Daily Time Spent on Site      Age         Area Income    Daily Internet
Usage
##  Min.   :32.60            Min.   :19.00   Min.   :13996   Min.   :104.8
##  1st Qu.:51.36            1st Qu.:29.00   1st Qu.:47032   1st Qu.:138.8
##  Median :68.22            Median :35.00   Median :57012   Median :183.1
##  Mean   :65.00            Mean   :36.01   Mean   :55000   Mean   :180.0
##  3rd Qu.:78.55            3rd Qu.:42.00   3rd Qu.:65471   3rd Qu.:218.8
##  Max.   :91.43            Max.   :61.00   Max.   :79485   Max.   :270.0
##  Ad Topic Line          City                Male         Country
##  Length:1000        Length:1000        Min.   :0.000   Length:1000
##  Class :character   Class :character   1st Qu.:0.000   Class :character
##  Mode  :character   Mode  :character   Median :0.000   Mode  :character
##                                        Mean   :0.481
##                                        3rd Qu.:1.000
##                                        Max.   :1.000
##    Timestamp                       Clicked on Ad
```

```
##  Min.   :2016-01-01 02:52:10.00   Min.   :0.0
##  1st Qu.:2016-02-18 02:55:42.00   1st Qu.:0.0
##  Median :2016-04-07 17:27:29.50   Median :0.5
##  Mean   :2016-04-10 10:34:06.64   Mean   :0.5
##  3rd Qu.:2016-05-31 03:18:14.00   3rd Qu.:1.0
##  Max.   :2016-07-24 00:22:16.00   Max.   :1.0
```

Mean

```
mean(ad$"Daily Time Spent on Site")

## [1] 65.0002
```

The average time spent on the site is 65 minutes.

```
mean(ad$"Age")

## [1] 36.009
```

The average age of repondents is 36 years.

```
mean(ad$"Area Income")

## [1] 55000
```

The average income of repondents is 55000

```
mean(ad$"Daily Internet Usage")

## [1] 180.0001
```

The average internet usage is 180.0 units

Mode

```
# Unfotunately, R does not have a standard in-built function to calculate
mode so we have to build one
# We create the mode function that will perform our mode operation for us

getmode <- function(v) {
   uniqv <- unique(v)
   uniqv[which.max(tabulate(match(v, uniqv)))]}

getmode(ad$Age)

## [1] 31
```

Most frequent age is 31 years

```
getmode(ad$`Daily Time Spent on Site`)

## [1] 62.26
```

Most frequent daily time spent is 62.26 minutes

```
getmode(ad$`Area Income`)
```

```
## [1] 61833.9
```

Most common area income is 61833.9

```
getmode(ad$`Daily Internet Usage`)
```

```
## [1] 167.22
```

Most frequent units used for daily internet usage is 167.22.

Median The median is the middle number in a sorted, ascending or descending list of numbers

```
median(ad$`Daily Time Spent on Site`)
```

```
## [1] 68.215
```

```
median(ad$Age)
```

```
## [1] 35
```

```
median(ad$`Area Income`)
```

```
## [1] 57012.3
```

```
median(ad$`Daily Internet Usage`)
```

```
## [1] 183.13
```

Min and Max Values/Otherwise known as Range

Showing the highest and the least values in our numerical data

```
range(ad$Age)
```

```
## [1] 19 61
```

```
range(ad$`Daily Time Spent on Site`)
```

```
## [1] 32.60 91.43
```

```
range(ad$`Area Income`)
```

```
## [1] 13996.5 79484.8
```

```
range(ad$`Daily Internet Usage`)
```

```
## [1] 104.78 269.96
```

Quantiles

Getting the first and the third quantile together with the range and the median using the quantile() function

```
quantile(ad$Age)
```

```
##   0%  25%  50%  75% 100% 
##   19   29   35   42   61
```

```
quantile(ad$`Daily Time Spent on Site`)
```

```
##      0%     25%     50%     75%    100% 
## 32.6000 51.3600 68.2150 78.5475 91.4300
```

```
quantile(ad$`Area Income`)
```

```
##       0%      25%      50%      75%     100% 
## 13996.50 47031.80 57012.30 65470.64 79484.80
```

```
quantile(ad$`Daily Internet Usage`)
```

```
##       0%      25%      50%      75%     100% 
## 104.7800 138.8300 183.1300 218.7925 269.9600
```

Standard Deviation

A standard deviation (or σ) is a measure of how dispersed the data is in relation to the mean. Low standard deviation means data are clustered around the mean, and high standard deviation indicates data are more spread out.

```
sd(ad$`Daily Time Spent on Site`)
```

```
## [1] 15.85361
```

```
sd(ad$Age)
```

```
## [1] 8.785562
```

```
sd(ad$`Area Income`)
```

```
## [1] 13414.63
```

```
sd(ad$`Daily Internet Usage`)
```

```
## [1] 43.90234
```

Variance

The variance is a numerical measure of how the data values is dispersed around the mean.

```
var(ad$`Daily Time Spent on Site`)
```

```
## [1] 251.3371
```

```
var(ad$Age)
```

```
## [1] 77.18611
```

```
var(ad$`Area Income`)
```

```
## [1] 179952406

var(ad$`Daily Internet Usage`)

## [1] 1927.415
```

Frequencies

```
# Gender Frequency Table
# 0 for not male while 1 is male

gender = table(ad$Male)
gender

##
##   0   1
## 519 481
```

519 respondents are not Male while 481 are male

```
# city Frequency Table

city = table(ad$City)

# Arranging cities from the most frequent and displaying the first 6 rows

highestcity <- sort(city, decreasing = TRUE)
head(highestcity)

##
##       Lisamouth    Williamsport Benjaminchester       East John    East
Timothy
##               3               3               2               2
2
##        Johnstad
##               2

# country Frequency Table

country = table(ad$Country)

# Arranging countries from the least frequent and displaying the first 6 rows

countries <- sort(country, increasing = TRUE)
head(countries)

##
##                                                Aruba
##                                                    1
##                                              Bermuda
##                                                    1
```

```
## British Indian Ocean Territory (Chagos Archipelago)
##                                                    1
##                                               Cape Verde
##                                                    1
##                                                  Germany
##                                                    1
##                                                   Jordan
##                                                    1
```

```
# clicked on ad Frequency Table

clickad = table(ad$`Clicked on Ad`)
clickad
```

```
##
##   0   1
## 500 500
```

```
# clicked on ad Frequency Table

clickad = table(ad$`Clicked on Ad`)
clickad
```

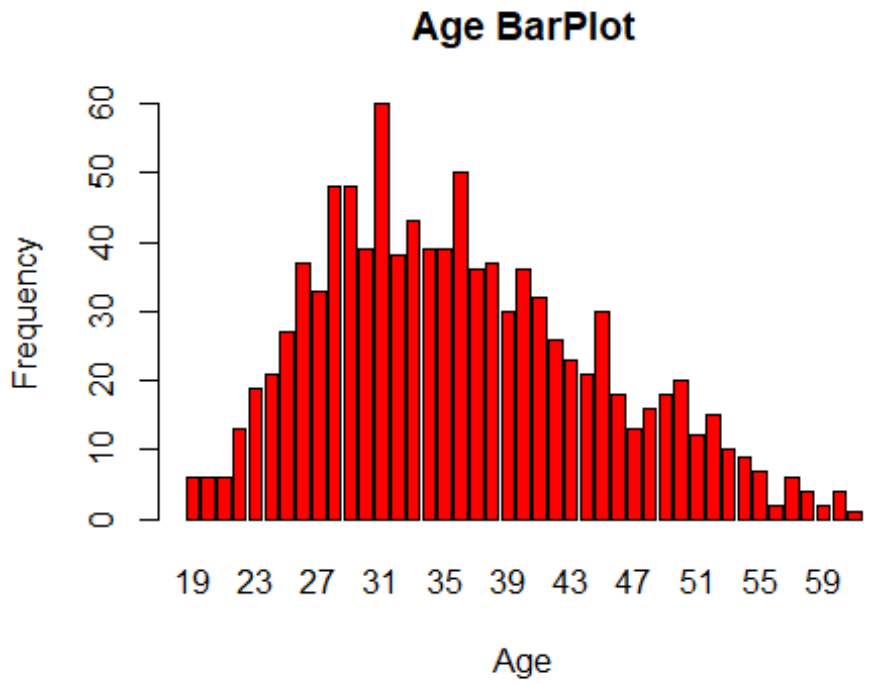
```
##
##   0   1
## 500 500
```

Half of the respondents clicked on ad

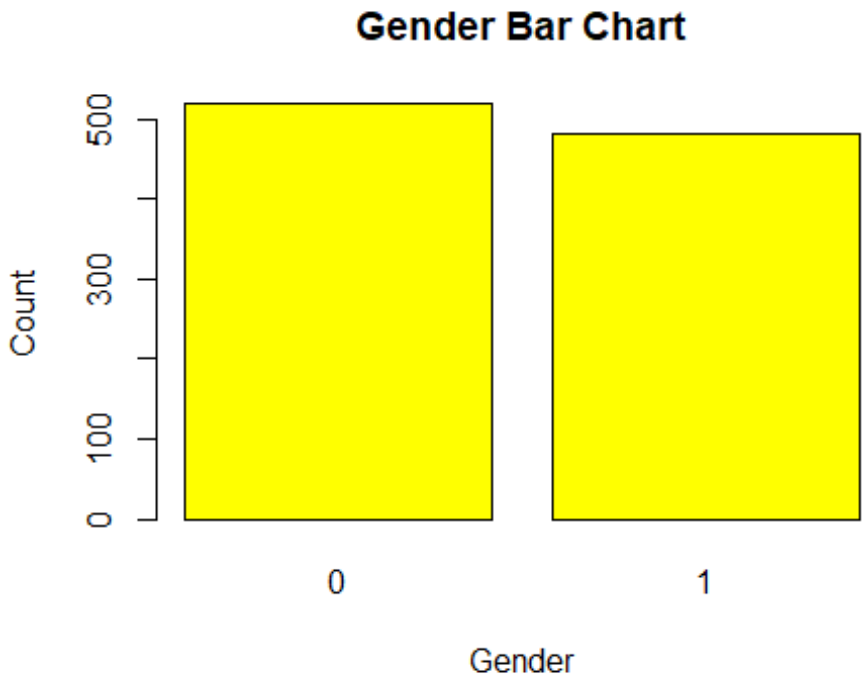
Barplots

The box plot of an observation variable is a graphical representation based on its quantiles, as well as its smallest and largest values. It attempts to provide a visual shape of the data distribution.

```
# Fits we get the frequency distribution table

age <- table(ad$Age)

# Then we plot a bar chart

barplot(age, xlab ='Age', ylab ='Frequency', main ='Age BarPlot', col =
'red')
```

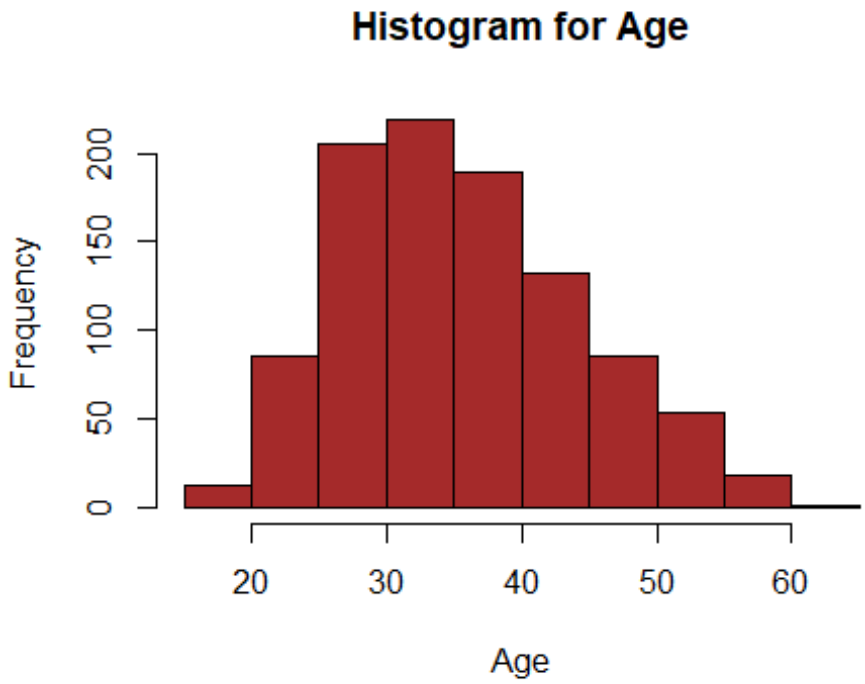



```
# Gender barplot

barplot(gender, xlab = 'Gender', ylab = 'Count', main = 'Gender Bar Chart',
col = "yellow")
```



Histograms

```
# Plot a histogram for the age column

hist(ad$Age, xlab = 'Age', main = 'Histogram for Age', col = 'brown')
```



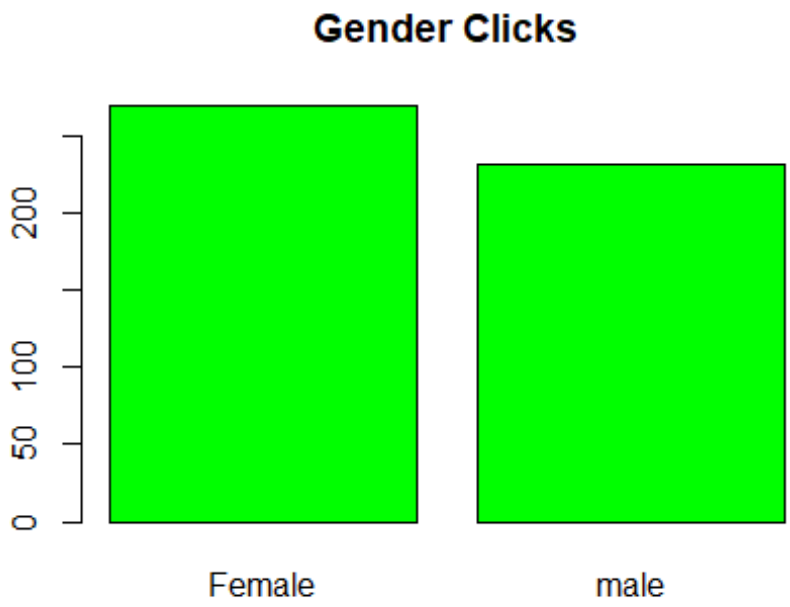
7. BiVariate Analysis**

Which Gender clicked the most ads

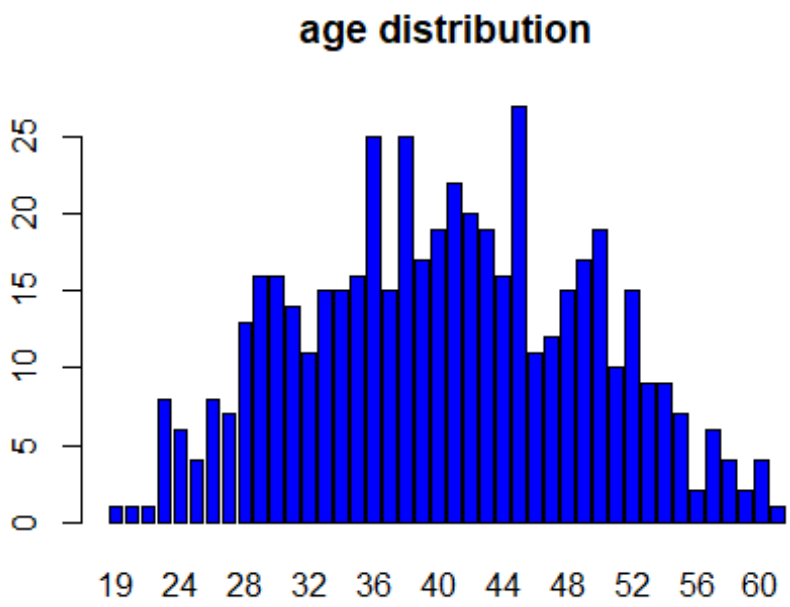
```
# Creating a dataframe for those who clicked the ad

clicked <- ad[ad$'Clicked on Ad'==1,]
head(clicked)
```

```
##    Daily Time Spent on Site Age Area Income Daily Internet Usage
## 1:                    66.00  48    24593.33                131.76
## 2:                    47.64  49    45632.51                122.02
## 3:                    69.57  48    51636.92                113.12
## 4:                    42.95  33    30976.00                143.56
## 5:                    63.45  23    52182.23                140.64
## 6:                    55.39  37    23936.86                129.41
##                            Ad Topic Line             City Male
## 1:              Reactive local challenge Port Jefferybury    1
## 2:        Centralized neutral neural-net  West Brandonton    0
## 3: Centralized content-based focus group   West Katiefurt    1
## 4:         Grass-roots coherent extranet     West William    0
## 5:    Persistent demand-driven interface   New Travistown    1
## 6:    Customizable multi-tasking website   West Dylanberg    0
##                  Country           Timestamp Clicked on Ad
## 1:             Australia 2016-03-07 01:40:15             1
## 2:                 Qatar 2016-03-16 20:19:01             1
## 3:                 Egypt 2016-06-03 01:14:41             1
```

```
## 4:              Barbados 2016-03-24 09:31:49             1
## 5:                 Spain 2016-03-09 03:41:30             1
## 6: Palestinian Territory 2016-01-30 19:20:41             1

genderclicks<- table(clicked$Male)
label<- c("Female","male")
barplot(genderclicks,names.arg=label,main="Gender Clicks", col = 'green')
```




```
ageDist<- table(clicked$Age)
barplot(ageDist,main="age distribution", col = 'blue')
```



Covariance

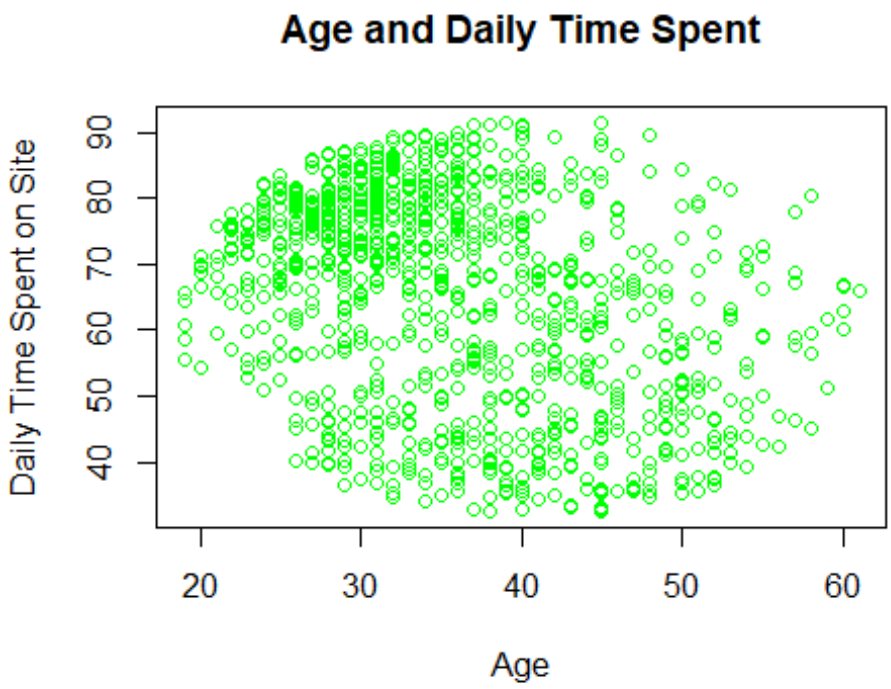
```
# We can find the covariance between age and the daily time spent on the site

age <- ad$Age
time <- ad$"Daily Time Spent on Site"

cov(age, time)

## [1] -46.17415
```

There is a negative covariance between age and the daily time spent on the site which means that the older a person is, the less time they spend on the site daily.

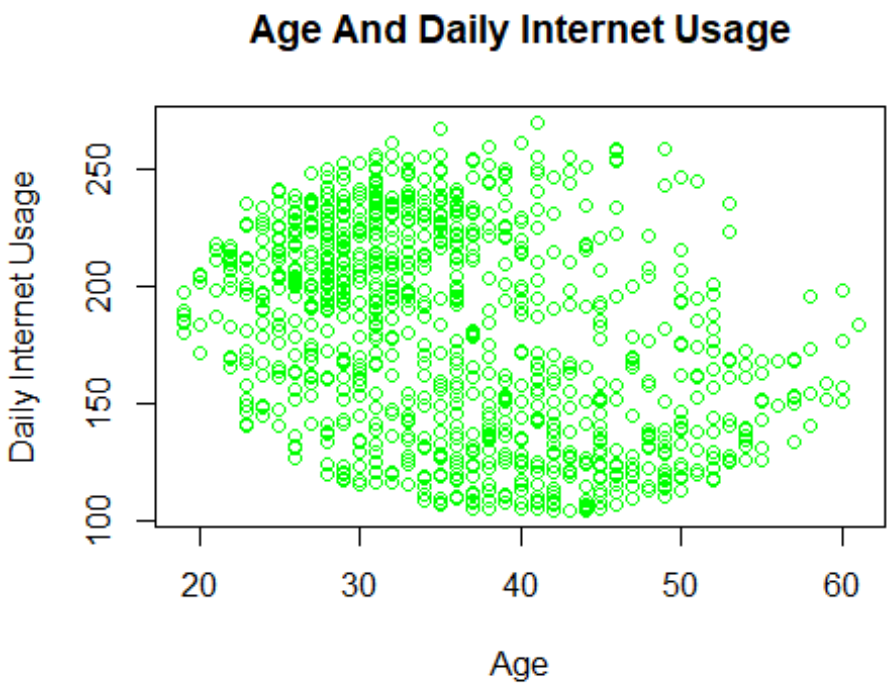
```
# We can find the covariance between age and the internet units

age <- ad$Age
units <- ad$`Daily Internet Usage`

cov(age, units)

## [1] -141.6348
```

There is a negative covariance between age and the daily internet usage on the site which means that the older a person gets, the less time they spend on daily internet usage.

```r
# Scatter plot showing distribution of age and time spent on site

plot(age, time, xlab = 'Age', ylab = 'Daily Time Spent on Site', main = 'Age and Daily Time Spent', col = 'green')
```




```r
# Scatter plot showing distribution of age and Internet usage

plot(age, units, xlab = 'Age', ylab = 'Daily Internet Usage', main = 'Age And Daily Internet Usage', col = "green")
```



8. Conclusion

1. There were more females than males in our data.
2. The data had 500 individuals who clicked on the ads while 500 individuals did not click on the ads.
3. Czech Republic and France both had the highest number of respondents.
4. The average area income is 55000.
5. The average age of most audience is 36 years with most of the audience being around the age of 31.
6. Lisamouth and Williamsport cities both had the highest number of individuals (3) in the dataset.
7. There are more females visiting the site compared to males as well as clicking the ads.

9. Recommendations

1. Individuals who are of the female gender and are between 28 and 36 years old were the most in our data set, therefore she should creates an ad that targets these individuals
2. Most of the those who click on the ad have an area income of 55000, so maybe reevaluate the prices to accommodate other income levels.