Jackson Ip Week 12

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Define the 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.

The metric for success

This project will be successful if we are able to determine which individuals are most likely to click on the ads.

The Outline context

The number of clicks an ad has helps understand how well the ad is being received by its audience. Ads that are targeted to the right audience receive the highest number of clicks. In our case determining the best audience for the ads will help company grow as well as increase the number of clicks and reach.

Experimental design

1. Define the Questions.
2. Import, load and preview the data.
3. Data Cleaning.
4. Data Analysis.
5. Conclusion and Recommendation.

Importing the libraries

```
#Import the data library
library(data.table)

## Warning: package 'data.table' was built under R version 4.0.5
```

Load the dataset

```
#Load our data
dt=read.csv('C:/Users/Rino/Desktop/Remote/advertising.csv')
```

Preview the data

```
# preview the head
head(dt)
```

```
##   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
```

```
#Change the male column name to be gender
names(dt)[names(dt)== 'Male']<-'Gender'
```

Preview tail

```
tail(dt)
```

```
##      Daily.Time.Spent.on.Site Age Area.Income Daily.Internet.Usage
## 995                     43.70  28    63126.96               173.01
## 996                     72.97  30    71384.57               208.58
## 997                     51.30  45    67782.17               134.42
## 998                     51.63  51    42415.72               120.37
## 999                     55.55  19    41920.79               187.95
## 1000                    45.01  26    29875.80               178.35
##                            Ad.Topic.Line          City Gender
## 995         Front-line bifurcated ability  Nicholasland      0
## 996         Fundamental modular algorithm     Duffystad      1
## 997       Grass-roots cohesive monitoring   New Darlene      1
## 998          Expanded intangible solution South Jessica      1
## 999  Proactive bandwidth-monitored policy   West Steven      0
## 1000      Virtual 5thgeneration emulation   Ronniemouth      0
##                      Country           Timestamp Clicked.on.Ad
```

```
## 995                 Mayotte 2016-04-04 03:57:48             1
## 996                 Lebanon 2016-02-11 21:49:00             1
## 997  Bosnia and Herzegovina 2016-04-22 02:07:01             1
## 998                Mongolia 2016-02-01 17:24:57             1
## 999               Guatemala 2016-03-24 02:35:54             0
## 1000                 Brazil 2016-06-03 21:43:21             1
```

Check the info

```
str(dt)
```

```
## '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" ...
##  $ Gender                  : int  0 1 0 1 0 1 0 1 1 1 ...
##  $ Country                 : chr  "Tunisia" "Nauru" "San Marino" "Italy"
...
##  $ Timestamp               : chr  "2016-03-27 00:53:11" "2016-04-04
01:39:02" "2016-03-13 20:35:42" "2016-01-10 02:31:19" ...
##  $ Clicked.on.Ad           : int  0 0 0 0 0 0 0 1 0 0 ...
```

```
#dt$Date <- as.Date(df$Timestamp)
#df$Time <- format(df$Timestamp,"%H:%M:%S")
```

Check the shape

```
dim(dt)
```

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

```
#Our code has 1000 rows and 10 columns
```

Data Cleaning

Check for missing data(Null vaalues)

```
sum(is.na(dt))
```

```
## [1] 0
```

Our data has no missing data

Check for duplicates

```
#checking for duplicates
duplicated <- dt[duplicated(dt),]
duplicated
```

```
##  [1] Daily.Time.Spent.on.Site Age                      Area.Income
##  [4] Daily.Internet.Usage     Ad.Topic.Line            City
##  [7] Gender                   Country                  Timestamp
## [10] Clicked.on.Ad
## <0 rows> (or 0-length row.names)
```

There are no duplicated rows/values in our data

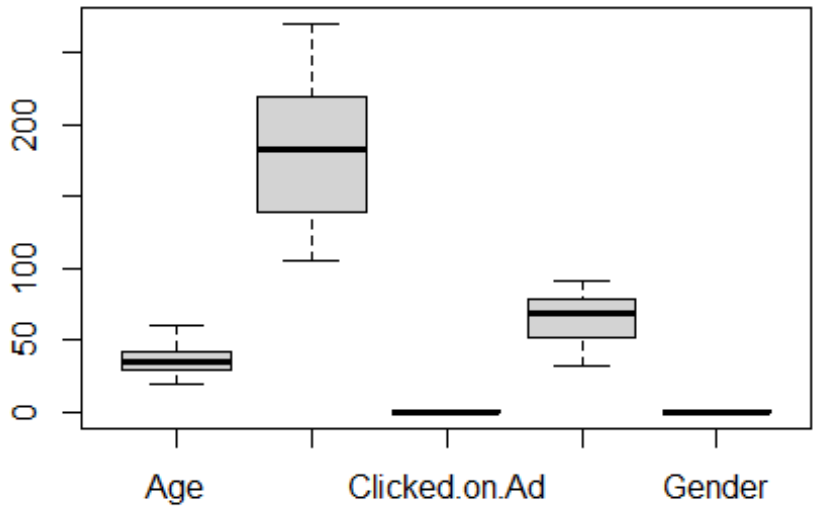
Check for outliers

```
### Identify numeric cols
nums <- unlist(lapply(dt, is.numeric))
y<- colnames(dt[nums])
y
```

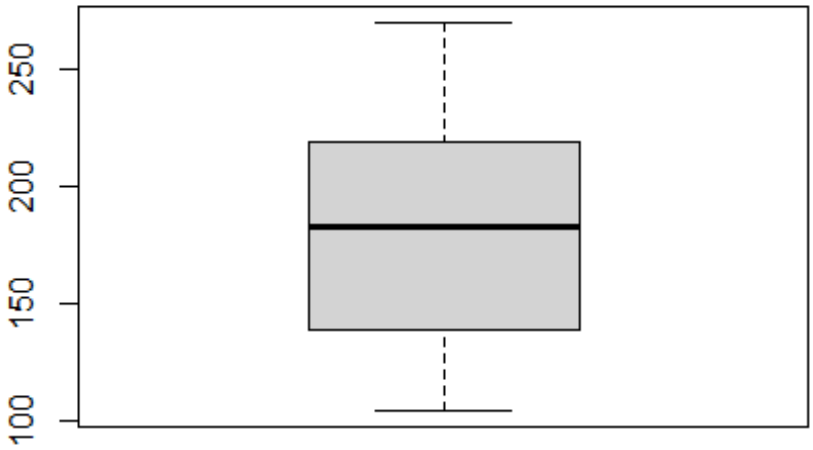
```
## [1] "Daily.Time.Spent.on.Site" "Age"
## [3] "Area.Income"               "Daily.Internet.Usage"
## [5] "Gender"                    "Clicked.on.Ad"
```

Check fo outliers

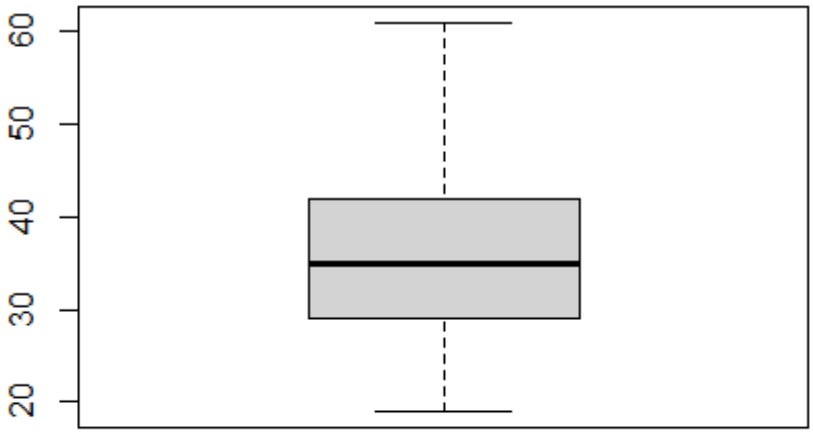
```
boxplot(dt[c('Age','Daily.Internet.Usage','Clicked.on.Ad','Daily.Time.Spent.on.Site','Gender')])
```



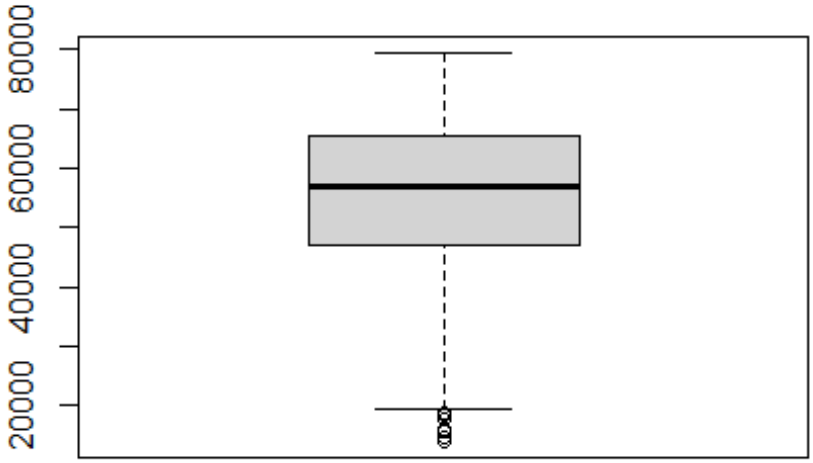

```
# checking for outliers on Daily Internet Usage
boxplot(dt$Daily.Internet.Usage)
```




```
# checking for outliers on Age
boxplot(dt$Age)
```



```
# checking for outliers on Area.Income
boxplot(dt$Area.Income)
```

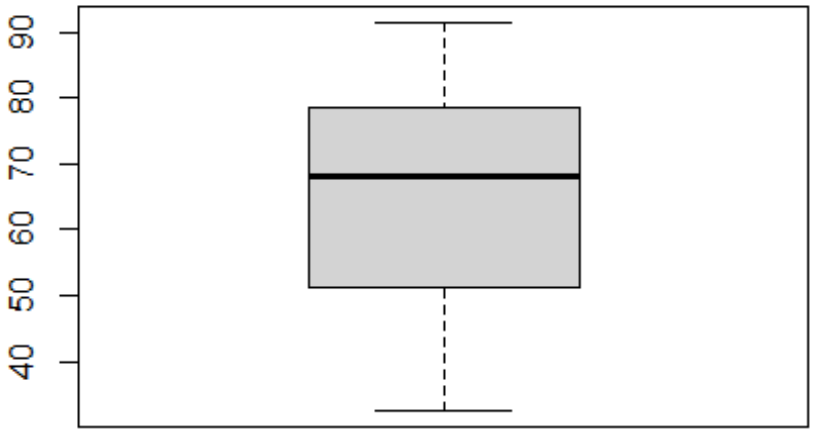


There are outliers in area income column

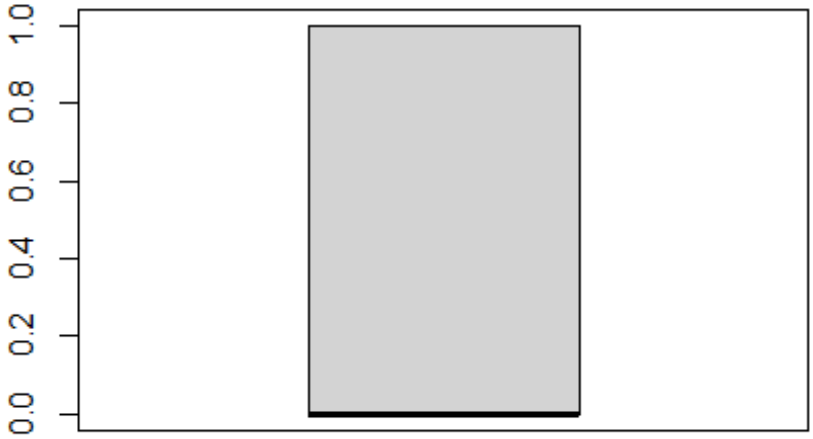
```
boxplot.stats(dt$Area.Income)$out
```

```
## [1] 17709.98 18819.34 15598.29 15879.10 14548.06 13996.50 14775.50
18368.57
```

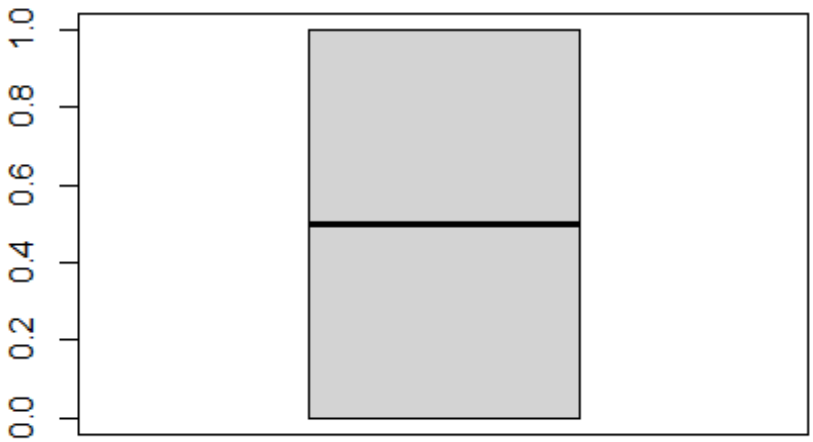
```
#checking the values in area income that are outliers

# checking for outliers on Daily.Time.Spent.on.Site
boxplot(dt$Daily.Time.Spent.on.Site)
```




```r
# checking for outliers on Male
boxplot(dt$Gender)
```



```
# checking for outliers on Clicked.on.Ad
boxplot(dt$Clicked.on.Ad)
```



There are no outliers in our data except Area.Income.

Data Analysis

Univarient Analysis

Measure of central tendacy

```
#Getting the statistical summaries of the data
summary(dt)
```

```
##  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               Gender        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
##  Length:1000        Min.   :0.0
##  Class :character   1st Qu.:0.0
##  Mode  :character   Median :0.5
##                     Mean   :0.5
##                     3rd Qu.:1.0
##                     Max.   :1.0
```

From the above we can see that maximum daily time spent on site is 91 mins while the minimum time spent is 32 mins. In average time spent on the blog is 65 minutes. The maximum age of the customers visiting the 61 years while the minimum age is 19 years. However the average age of viewers is 35 years. The average income earned by their viewers is 55,000 with the maximum amount earned being 79,000 and minimum amount is 13996.

Measure of dispersion

```
#create a function
summary.list = function(x)list(
 Variance=var(x, na.rm=TRUE),
 Std.Dev=sd(x, na.rm=TRUE),
 Coeff.Variation.Prcnt=sd(x, na.rm=TRUE)/mean(x, na.rm=TRUE)*100,
 Std.Error=sd(x, na.rm=TRUE)/sqrt(length(x[!is.na(x)]))
)
```

Calling the function for each column

```
#For Daily.Time.Spent.on.Site
summary.list(dt$Daily.Time.Spent.on.Site)

## $Variance
## [1] 251.3371
##
## $Std.Dev
## [1] 15.85361
##
## $Coeff.Variation.Prcnt
## [1] 24.3901
##
## $Std.Error
## [1] 0.5013353

#For Age
summary.list(dt$Age)

## $Variance
## [1] 77.18611
##
## $Std.Dev
## [1] 8.785562
```

```
##
## $Coeff.Variation.Prcnt
## [1] 24.39824
##
## $Std.Error
## [1] 0.2778239
```

```
#For Daily.Time.Spent.on.Site
summary.list(dt$Area.Income)
```

```
## $Variance
## [1] 179952406
##
## $Std.Dev
## [1] 13414.63
##
## $Coeff.Variation.Prcnt
## [1] 24.39024
##
## $Std.Error
## [1] 424.208
```

```
#For Daily.Internet.Usage
summary.list(dt$Daily.Internet.Usage)
```

```
## $Variance
## [1] 1927.415
##
## $Std.Dev
## [1] 43.90234
##
## $Coeff.Variation.Prcnt
## [1] 24.39017
##
## $Std.Error
## [1] 1.388314
```

Summaries when ad is cliecked

```
#Get the summaries when there is a click
dt.sub <- subset(dt, Clicked.on.Ad == 1)
```

Summaries

```
summary(dt.sub)
```

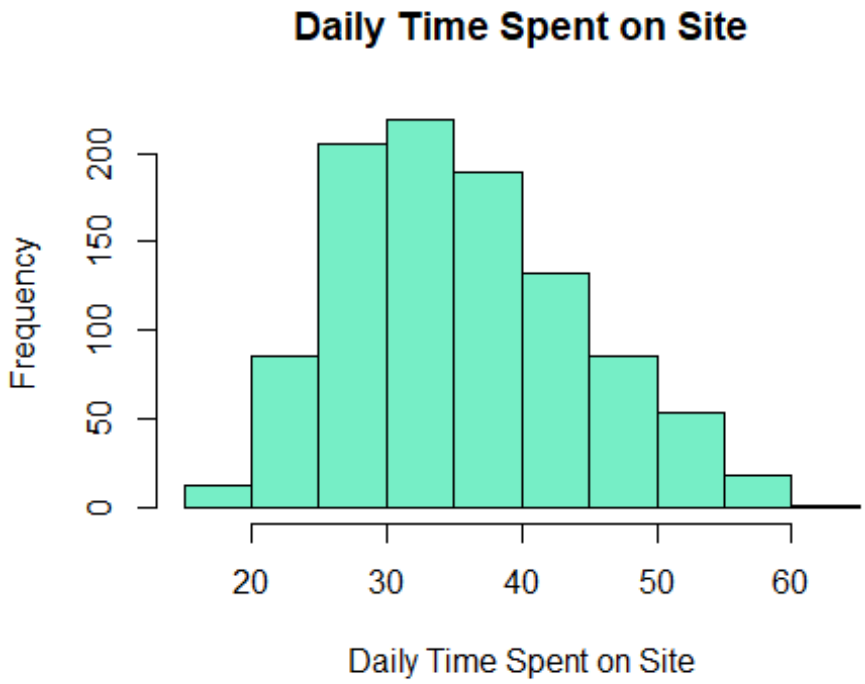
```
##  Daily.Time.Spent.on.Site      Age         Area.Income
Daily.Internet.Usage
##  Min.   :32.60            Min.   :19.00   Min.   :13996   Min.   :104.8
##  1st Qu.:42.84            1st Qu.:34.00   1st Qu.:39107   1st Qu.:123.6
##  Median :51.53            Median :40.00   Median :49417   Median :138.8
##  Mean   :53.15            Mean   :40.33   Mean   :48614   Mean   :145.5
```

```
##  3rd Qu.:62.08            3rd Qu.:47.00   3rd Qu.:59241   3rd Qu.:161.2
##  Max.   :91.37            Max.   :61.00   Max.   :78521   Max.   :270.0
##  Ad.Topic.Line          City               Gender        Country
##  Length:500         Length:500         Min.   :0.000   Length:500
##  Class :character   Class :character   1st Qu.:0.000   Class :character
##  Mode  :character   Mode  :character   Median :0.000   Mode  :character
##                                        Mean   :0.462
##                                        3rd Qu.:1.000
##                                        Max.   :1.000
##   Timestamp         Clicked.on.Ad
##  Length:500         Min.   :1
##  Class :character   1st Qu.:1
##  Mode  :character   Median :1
##                     Mean   :1
##                     3rd Qu.:1
##                     Max.   :1
```

When there was a click on the ad, the average time spent was 53 mins, with the average age of the viewers being 40 years. The average income of the viewers who viewed the ads was 48,000 and they spent in an average 145 minutes on the internet.

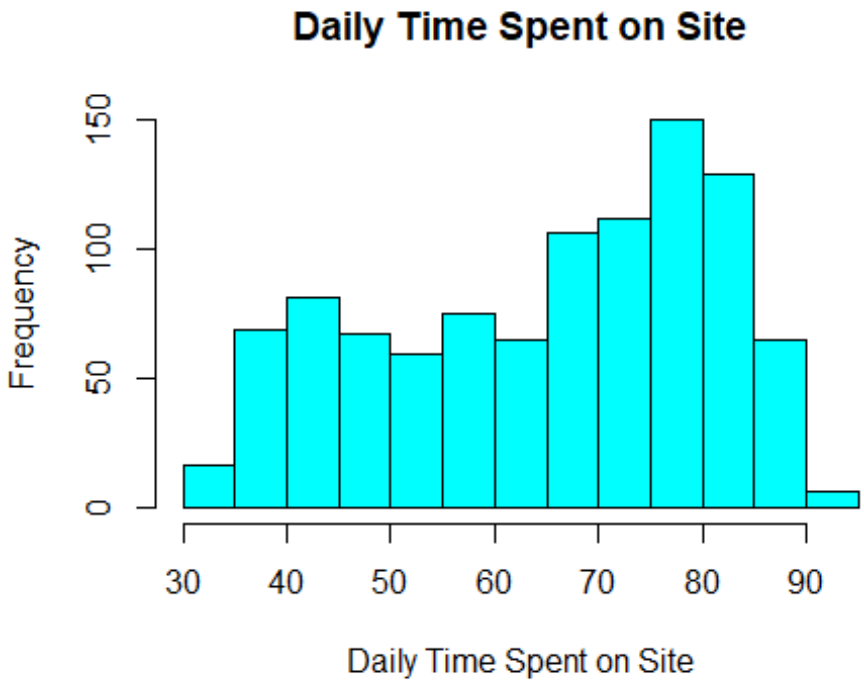
Distribution of Numeric columns

```
#For Age
hist(dt$Age,
     main = "Daily Time Spent on Site",
     xlab = "Daily Time Spent on Site",
     col = "aquamarine2")
```



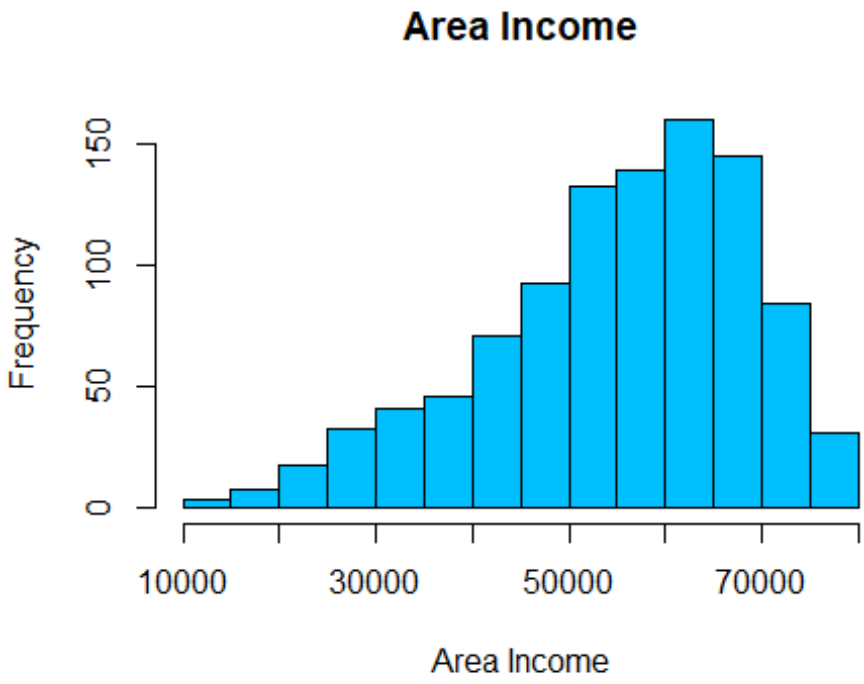
Most respondents fall in the age bracket 25-40 years.

```
# Histograms for Daily.Time.Spent.on.Site
hist(dt$Daily.Time.Spent.on.Site,
  main = "Daily Time Spent on Site",
  xlab = "Daily Time Spent on Site",
  col = "cyan1")
```



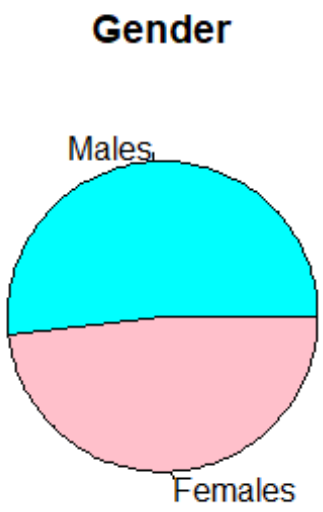
Daily time speant on site is skewed to the left.Most time spent is between 75 mins to 85 mins.

```
# Histograms for Area Income
hist(dt$Area.Income,
  main = "Area Income",
  xlab = "Area Income",
  col = "deepskyblue")
```

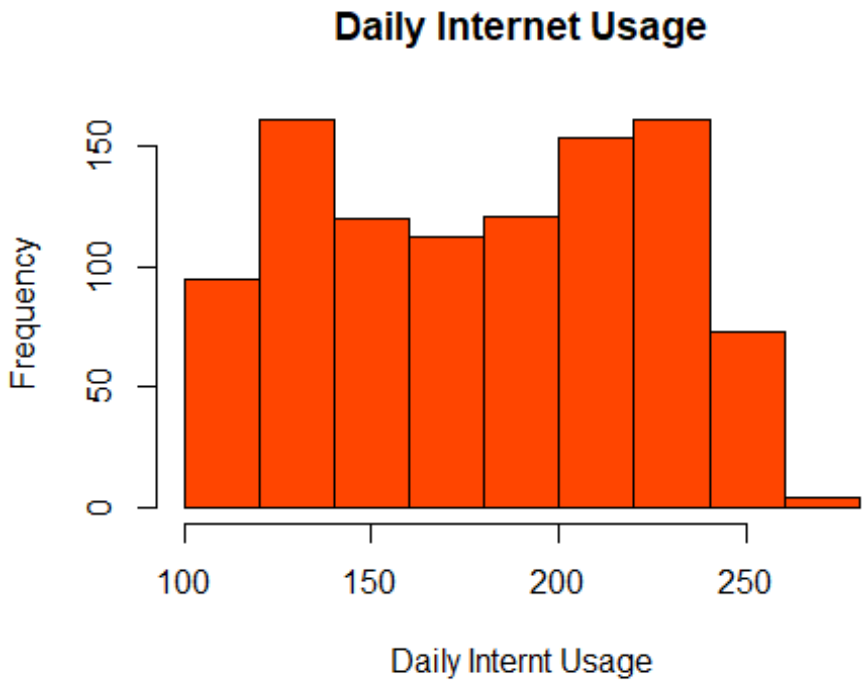


The area income columns is skewed to the left.Most respondent spend between 55,000 to 7,0000.

```
# Histograms for Area Income
df<-table(dt$Gender)

# Create a vector of labels

pie(df,
    labels <- c("Males", "Females"),
    col = c("cyan", "pink"),
    main="Gender")
```




```r
# Histograms for Daily.Time.Spent.on.Site
hist(dt$Daily.Internet.Usage,
  main = "Daily Internet Usage",
  xlab = "Daily Internt Usage",
  col = "orangered")
```



Bivarient Analysis

Correlation matrix

```
cor(dt[,unlist(lapply(dt, is.numeric))])
```

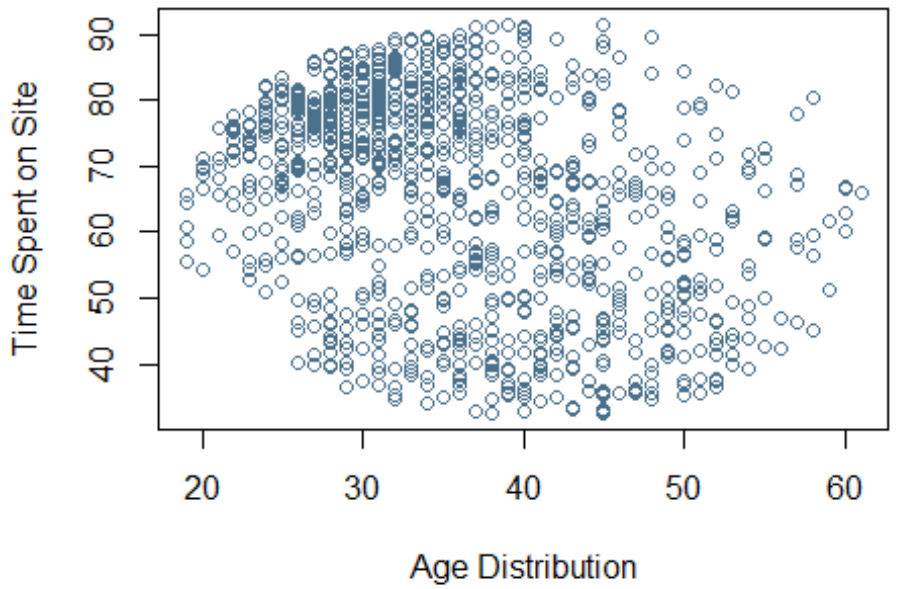
```
##                           Daily.Time.Spent.on.Site         Age  Area.Income
## Daily.Time.Spent.on.Site               1.00000000 -0.33151334  0.310954413
## Age                                   -0.33151334  1.00000000 -0.182604955
## Area.Income                            0.31095441 -0.18260496  1.000000000
## Daily.Internet.Usage                   0.51865848 -0.36720856  0.337495533
## Gender                                -0.01895085 -0.02104406  0.001322359
## Clicked.on.Ad                         -0.74811656  0.49253127 -0.476254628
##                           Daily.Internet.Usage       Gender Clicked.on.Ad
## Daily.Time.Spent.on.Site           0.51865848 -0.018950855   -0.74811656
## Age                               -0.36720856 -0.021044064    0.49253127
## Area.Income                        0.33749553  0.001322359   -0.47625463
## Daily.Internet.Usage               1.00000000  0.028012326   -0.78653918
## Gender                             0.02801233  1.000000000   -0.03802747
## Clicked.on.Ad                     -0.78653918 -0.038027466    1.00000000
```

The Table shows the correlations between each columns. The most correlated features are daily internet usage and daily time spent on the site while the least correlated items are clicks on ad and daily internet usage. There is positive correlation between age an clicks on ads.

Scatter plots

Let's plot a scatter plot for age and daily time spent on site.

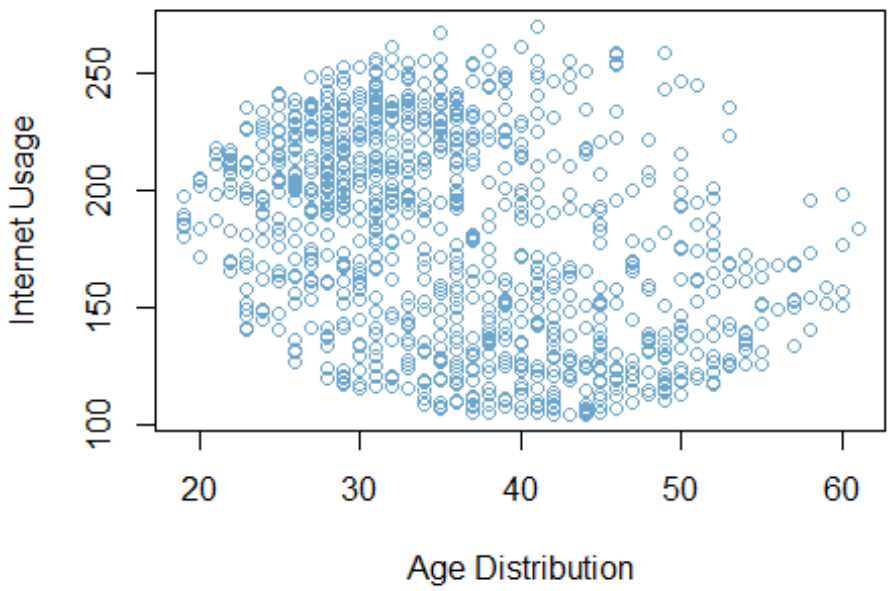
```
plot(dt$Age,dt$Daily.Time.Spent.on.Site,
     xlab = "Age Distribution",
     ylab = "Time Spent on Site",
     col="skyblue4")
```



Most customers spending the largest amount of time in the sites are between 37yrs and 45 years

Let's plot a scatter plot for age and daily internet usage.

```
plot(dt$Age,dt$Daily.Internet.Usage,
     xlab = "Age Distribution",
     ylab = "Internet Usage",
     col="skyblue3")
```



Let's plot a scatter plot for age and Area Income.

```
plot(dt$Age,dt$Area.Income,
     xlab = "Age Distribution",
     ylab = "Area income",
     col="skyblue3")
```

Most of the customers with the highest area income are between 40 and 45 years.

Covariance

```
#Covariance between age and daily time spent
cov(dt$Age, dt$Daily.Time.Spent.on.Site)

## [1] -46.17415
```

The covariance of Age and Daily.Time.Usage variable is about -46.17415, It indicates a negative linear relationship between the two variables

```
# Covariance between age and daily internet usage
cov(dt$Age, dt$Daily.Internet.Usage)

## [1] -141.6348
```

The covariance of Age and Daily.Internet.Usage variable is about -141.6348, It indicates a negative linear relationship between the two variables

```
#Covariance between age and area income
cov(dt$Age, dt$Area.Income)

## [1] -21520.93
```

The covariance of Age and area income variable is about -21520.93, It indicates a negative linear relationship between the two features.

```
#Covariance between age and clicks
cov(dt$Age, dt$Clicked.on.Ad)
```

```
## [1] 2.164665
```

The covariance of Age and clicks on ad variable is about 2.164665, It indicates a positive linear relationship between the two features.

```
#Covariance between age and gender
cov(dt$Age, dt$Gender)

## [1] -0.09242142
```

The covariance of Age and gender variable is about -0.09242142, It indicates a negative linear relationship between the two features.

Conclusion

1. From the above we can see that maximum daily time spent on site is 91 mins while the minimum time spent is 32 mins. In average time spent on the blog is 65 minutes.
2. The maximum age of the customers visiting the 61 years while the minimum age is 19 years. However the average age of viewers is 35 years.
3. The average income earned by their viewers is 55,000 with the maximum amount earned being 79,000 and minimum amount is 13996.
4. When there was a click on the ad, the average time spent was 53 mins, with the average age of the viewers being 40 years. The average income of the viewers who viewed the ads was 48,000 and they spent in an average 145 minutes on the internet.
5. Most respondents fall in the age bracket 25-40 years.
6. Daily time speant on site is skewed to the left.Most time spent is between 75 mins to 85 mins.
7. The area income columns is skewed to the left.Most respondent spend between 55,000 to 7,0000.
8. The Table shows the correlations between each columns. The most correlated features are daily internet usage and daily time spent on the site while the least correlated items are clicks on ad and daily internet usage. There is positive correlation between age an clicks on ads.
9. Most customers spending the largest amount of time in the sites are between 37yrs and 45 years

Recommendation

1. The ads should target people with an income between 50,000 and 70,000 since they are the people most interested with the ad.
2. We recommend that ads to be tailor to suit viewers of the age group between 25 years and 40 years.
3. Our client should tailor the course to be less than 85 mins or between 75 mins and 85 mins.