Moringa_Data_Science_Prep_W12_Independent_Project_2020_02_Gideon_Cheruiyot_DataReport

Gideon Cheruiyot

28/02/2020

#Problem statement: I dentify individuals who are more likely to click on the Ads posted on his/her blog

#Metrics of success: our success will be measured by our ability to identify attributes of the the users who click the adverts.#

#Data relevance

The appropriateness of the data will be addressed by checking:

- whether the data is accurate?
- whether the dataset is enough to sufficiently address the problem at hand?
- whether the dtaset was biased or imbalanced? # Experimental design:
- loading and previewing the dataset
- Cleaning , checking for outliers
- Conducting exploratory data analysis to find out patterns and relationships
- Comunicating the obsertavtions and findings
- Drawing conclusion

#Challenging the solution. More analysis need to be done to clearly predict the person likely to click on the Ad, this may include modeling for instance incorporating a logistic regression model.

##Loading the dataset

```
data <- read.csv('advertising.csv')
head(data)
```

```
##   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
```

Understanding the datatypes for our features

```
str(data)
```

```
## '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           : Factor w/ 1000 levels "Adaptive 24hour
Graphic Interface",..: 92 465 567 904 767 806 223 724 108 455 ...
##  $ City                    : Factor w/ 969 levels
"Adamsbury","Adamside",..: 962 904 112 940 806 283 47 672 885 713 ...
##  $ Male                    : int  0 1 0 1 0 1 0 1 1 1 ...
##  $ Country                 : Factor w/ 237 levels "Afghanistan",..: 216
148 185 104 97 159 146 13 83 79 ...
##  $ Timestamp               : Factor w/ 1000 levels "2016-01-01
02:52:10",..: 440 475 368 57 768 690 131 334 549 942 ...
##  $ Clicked.on.Ad           : int  0 0 0 0 0 0 0 1 0 0 ...
```

Finding any missing values

```
colSums(is.na(data))
```

```
## 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
```

Exploratory Data Analysis

Univariate analysis

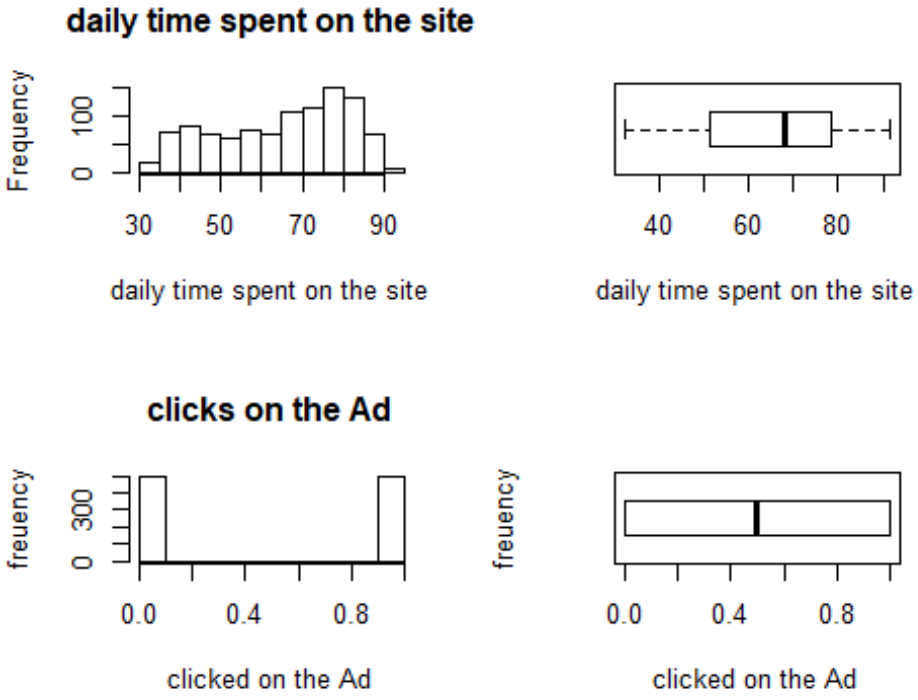
```
summary(data)
```

```
##  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
##  Adaptive 24hour Graphic Interface      :  1   Lisamouth      :  3
##  Adaptive asynchronous attitude         :  1   Williamsport   :  3
##  Adaptive context-sensitive application :  1   Benjaminchester:  2
##  Adaptive contextually-based methodology:  1   East John      :  2
##  Adaptive demand-driven knowledgebase   :  1   East Timothy   :  2
##  Adaptive uniform capability            :  1   Johnstad       :  2
##  (Other)                                :994   (Other)        :986
##       Male                 Country                   Timestamp
Clicked.on.Ad
##  Min.   :0.000   Czech Republic:  9   2016-01-01 02:52:10:  1   Min.
:0.0
##  1st Qu.:0.000   France        :  9   2016-01-01 03:35:35:  1   1st
Qu.:0.0
##  Median :0.000   Afghanistan   :  8   2016-01-01 05:31:22:  1   Median
:0.5
##  Mean   :0.481   Australia     :  8   2016-01-01 08:27:06:  1   Mean
:0.5
##  3rd Qu.:1.000   Cyprus        :  8   2016-01-01 15:14:24:  1   3rd
Qu.:1.0
##  Max.   :1.000   Greece        :  8   2016-01-01 20:17:49:  1   Max.
:1.0
##                  (Other)       :950   (Other)            :994
```

Finding outliers

could not find any outliers

```
Dt_spent <- data$Daily.Time.Spent.on.Site
dt_clicked <- data$Clicked.on.Ad
par(mfrow=c(2,2))
hist(Dt_spent,xlab = 'daily time spent on the site', main = 'daily time spent
on the site' )
boxplot(Dt_spent,xlab = 'daily time spent on the site', horizontal=TRUE)
hist(dt_clicked, xlab = 'clicked on the Ad', ylab = 'freuency',main = 'clicks
on the Ad')
boxplot(dt_clicked, xlab = 'clicked on the Ad', ylab = 'freuency',
horizontal=TRUE)
```



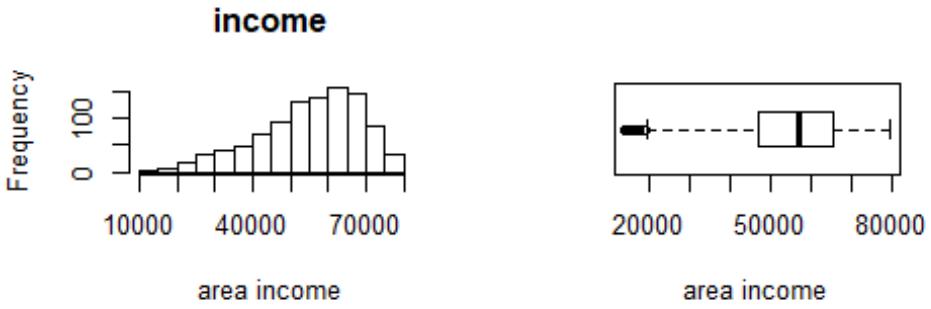
on Average people spent an 65 minutes on the site on a daily basis and a maximum of 88 minutes. clicks on the the Ad are balanced, the number of people who clicked and those who did not click on the AD are equal.

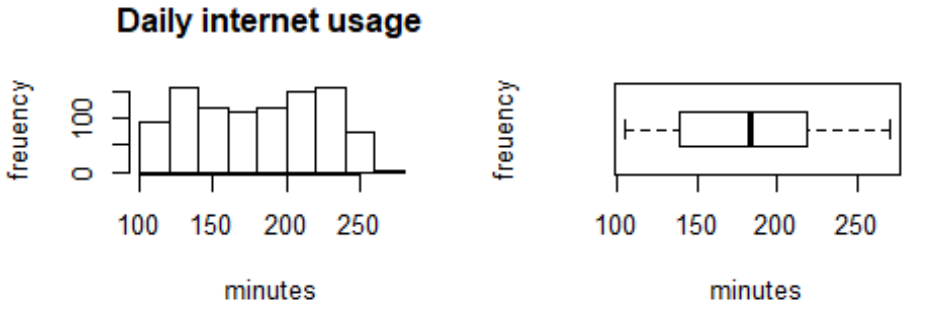
```
library(e1071)
skewness(data$Clicked.on.Ad)

## [1] 0

skewness(data$Daily.Time.Spent.on.Site)

## [1] -0.370646
```

conclusion: clicked.on. the Ad and Daily.time.Spent.on.Site features have no skewness.

values that are deemed to be outliers in the area income feature

```
a_income <- data$Area.Income
d_internet_usage <- data$Daily.Internet.Usage
par(mfrow=c(2,2))
hist(a_income,xlab = 'area income', main = 'income' )
boxplot(a_income,xlab = 'area income', horizontal=TRUE)
hist(d_internet_usage, xlab = 'minutes', ylab = 'freuency',main = 'Daily
internet usage')
boxplot(d_internet_usage, xlab = 'minutes', ylab = 'freuency',
horizontal=TRUE)
```






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

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

```
skewness(data$Daily.Internet.Usage)
```

```
## [1] -0.03343681
```

```
skewness(data$Area.Income)
```

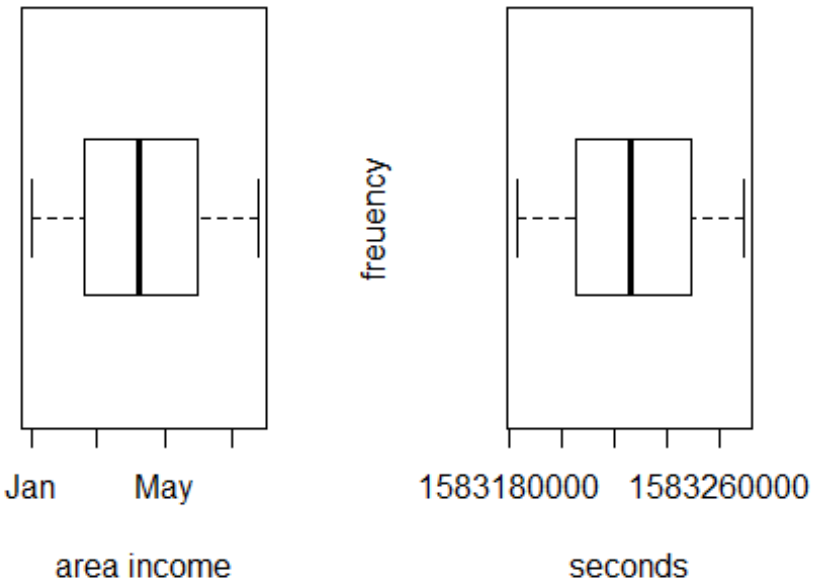
```
## [1] -0.6484229
```

Daily.Internet.Usage and Area.Income features appear to have no skweness. *The maximum area income was approximately 8,000 and an average of between 5,000 and 6,000.Additional area income appears to be skewed to the left

found no outliers in the daily internet usage *The outliers were retained due to the fact that, different countries have different range of income and they appear to be normal, there are low and high income earning countries.

Feature enginering to allow analysis based on time and date. first step was to split the Timestap into 'Date' and 'Time' then conerted them into Date and Time formats respectively*

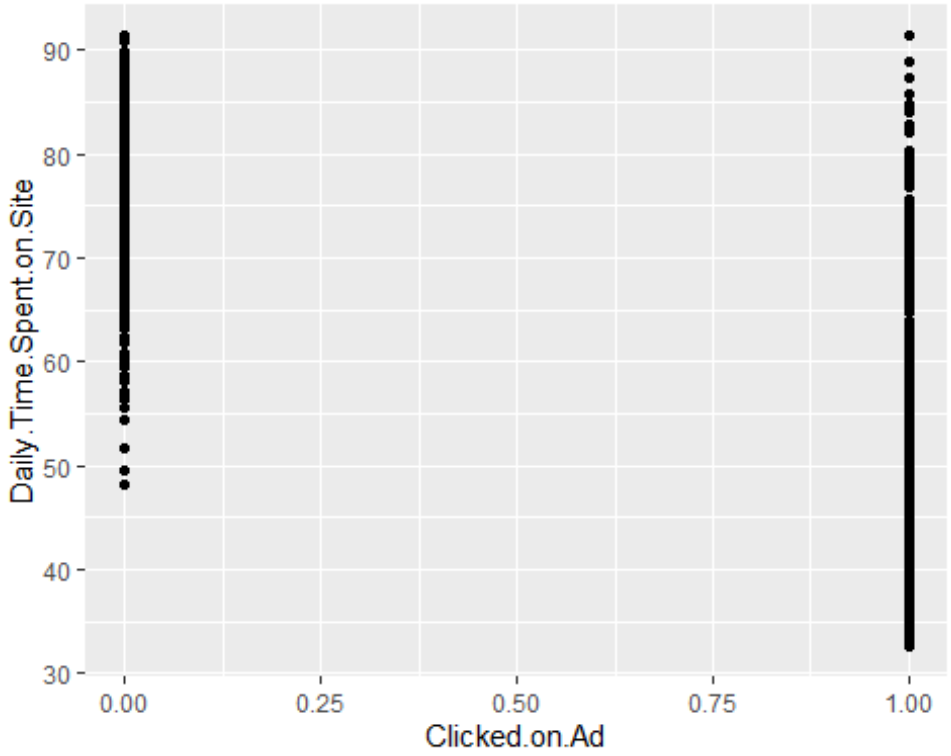
```
data$Date <- sapply(strsplit(as.character(data$Timestamp), " "), "[", 1)
data$Time <- sapply(strsplit(as.character(data$Timestamp), " "), "[", 2)

date <- as.Date(data$Date)
Time <- as.POSIXct(data$Time,format="%H:%M:%S")

par(mfrow=c(1,2))
#plot.ts(date,xlab = 'area income', main = 'income' )
boxplot(date,xlab = 'area income', horizontal=TRUE)
#plot.ts(Time, xlab = 'minutes', ylab = 'freuency',main = 'Daily internet
usage')
boxplot(Time, xlab = 'seconds', ylab = 'freuency', horizontal=TRUE)
```



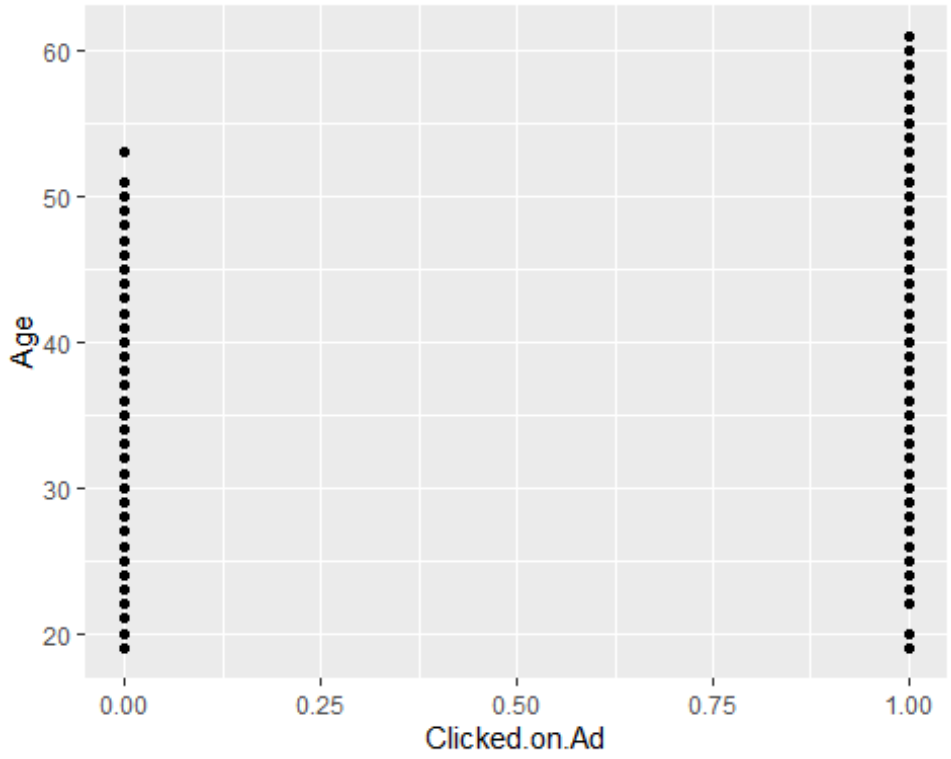
*There were no outliers, for Date and Time. # Bivariate analysis

```
colnames(data)

##  [1] "Daily.Time.Spent.on.Site" "Age"
##  [3] "Area.Income"              "Daily.Internet.Usage"
##  [5] "Ad.Topic.Line"            "City"
##  [7] "Male"                     "Country"
##  [9] "Timestamp"                "Clicked.on.Ad"
## [11] "Date"                     "Time"
```

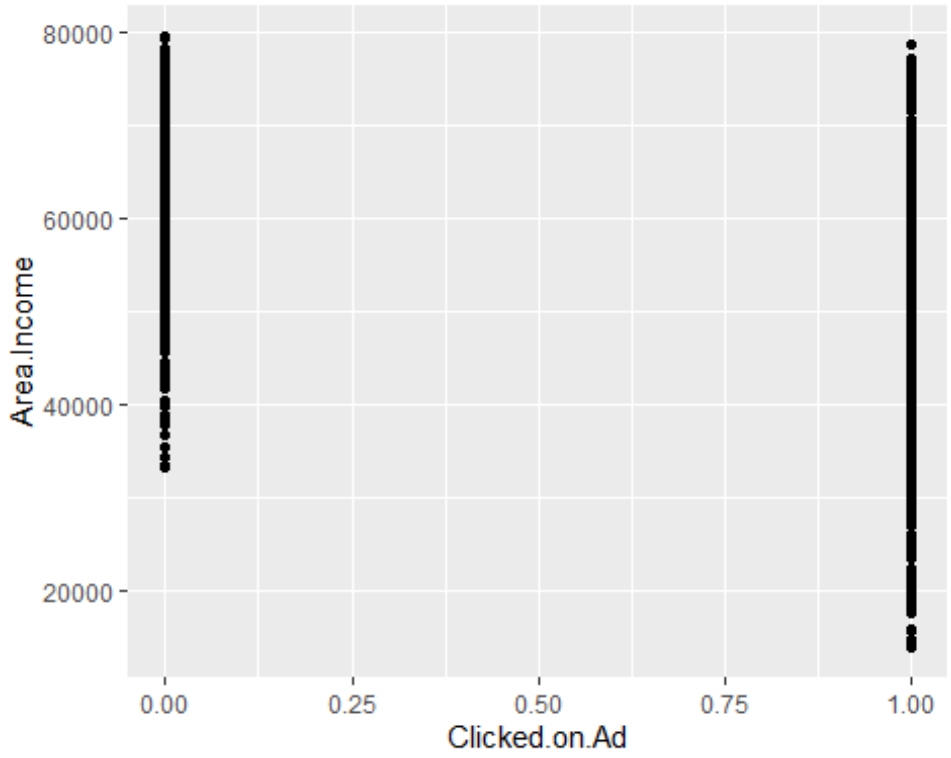
```r
#scat.raw.melt <- data$melt(measure.vars = 1:4)
library(ggplot2)
library(dplyr)

##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union

par(mfrow=c(2,2))

ggplot(data = data) +
  geom_point(mapping = aes(x = Clicked.on.Ad ,  y= Daily.Time.Spent.on.Site))
```



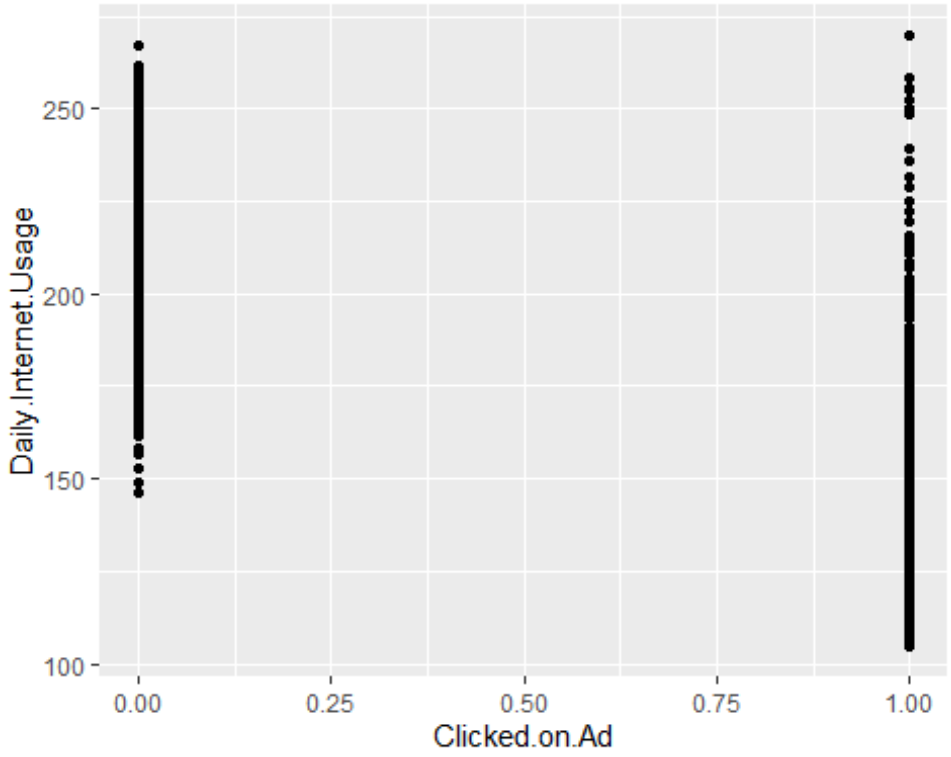

```r
ggplot(data = data) +
  geom_point(mapping = aes(x = Clicked.on.Ad ,  y= Age))
```




```
ggplot(data = data) +
  geom_point(mapping = aes(x = Clicked.on.Ad ,  y= Area.Income))
```



```
ggplot(data = data) +
  geom_point(mapping = aes(x = Clicked.on.Ad ,  y= Daily.Internet.Usage))
```



users who spend less than 50 minutes in the site on a daily basis are more likely to click on the Ads. While people with less than 150 minutes on the internet are more likely to click on the Ads. Age does not have much influence on the likelihood of one clicking the Ads, however, older people above 50 years are more likely to click on the Ads. * people from low area income of below 3,000 are more likely to click on the Ads

```
factor <- factor(data$Country)
as.numeric(factor)
```

```
##    [1] 216 148 185 104  97 159 146  13  83  79 172  35  61  27  19 198 162
1
##   [19]  30 175  37  37  35 112 213 140 220  81  31  28 166  12 129 188  58
123
##   [37] 142 222 178 119 175 216 218 178 155 218 172 199 215 104  31 224  89
138
##   [55] 217  52 103 202  15 100  35 183  35  33  45  38 176 219 216 157  28
219
##   [73]  49 217  86  51  68 172 101 222 139 154 143 211  28 171  41 231  13
233
##   [91] 107 171 184  81   8   2  95 122  61  18 234 189 129  55  87 209  25
45
##  [109]  88 138 126 117  64  90 215 107 223 133 195  25  81  23 164 229 196
61
##  [127]  96  67  58 107 122 181  53 225  22  22   8 183 113 210  80  93 112
```

```
178
##  [145] 219  55 150  20  58 196 153 212 110 161 211  36  22  53  50 121 112
222
##  [163]   6 148  63 141 202 211  29  42 170 127 172 192  88 109 113 176  44
28
##  [181] 232  86 166 136 184 192 105  16  38   3  69 110  10  28 167 188 201
119
##  [199]  85 223   9  10  77 108 187 196  52  69  13 186  69  54 114 160 190
184
##  [217]  33 134  55  43 169  65 218 116  69 217 109  17  46  32 207 189 182
13
##  [235]  42 159 219  70 196 133   1 138  74 167   3 185  87 191 208 121  60
205
##  [253] 139  70  71 231  53 166 217   2  74 164 121 210 128 135   3  45 106
82
##  [271] 186 188  84  21 103  94  65 165 114 134  72 158 117 182   4  14 214
214
##  [289]  74 189 152 207 226 144 201 125 233  43  75  75  93 190 136 221  36
9
##  [307]  37 195 117 182  58  96 207 180 156  71  54  74  50  14 236  48 226
168
##  [325]  22   7 196 192  70 133  37 204 152  27 192  67  27 135  99  55  64
137
##  [343]  80  91  67  64  95  76  19 148 166  62 120  36 177 173   9 184   1
15
##  [361] 167   6   2  96  68  55 202   1 176 163 184 225  81  51 160   7  54
166
##  [379] 110  42 114   2  75  59 237  52  36 141  94 126 172  44  18 203 209
64
##  [397]  38 179  34 220  62 126  18   4 116 139   7  18  68 207  92 103  26
16
##  [415]  50 146 151  55  97 161 120 109  72 220  48 224 123  73 164 129 236
49
##  [433]  48 188 146  59  17 171  43  26 189 128  65  82 215 210 167 156   1
6
##  [451]  61  69 170  14  78 163 226  45  63 138 131  60 200 115 183 205 198
219
##  [469]  99  49  13  70 160 101  64  71  14  92 234 119  59 214 115 226  21
99
##  [487]  52  32   4 151 210  81  73  87 102  93  62  44 146 124  13 227 137
57
##  [505]  51 130 105 174  40  76   3 171 157 217  88 139  81   4  94 141  66
66
##  [523] 199 144 223 234 234  36 153  13  33 120  19  73 228 228  29 231 146
131
##  [541] 105  17   3 220  77  36  85 209  99 195  22 189  13  85  45 164  16
47
##  [559] 234 154  85 230  26 127 231 149 224   2 126  90 235  98 171 227   9
72
##  [577]   9 218  94 190  54 182 169 207  51 138 119 187 149  79 100 153 120
```

```
199
##  [595] 223  99 183 141  94 164 114  66 176 114  83 212 160  67 107  40 196
138
##  [613] 208  26  37  60 236  89 138  16  39  73 187  71  35 116 144 231 161
102
##  [631] 166  21  52  71 194 166  20  26  23 233  15 141  56 175  29  66  90
66
##  [649] 135  57 206 181 151  81 126 188  34  55 115 151 172   5 121  44 232
208
##  [667]  64 140 103  96 192  53 173 236  75  58  16 213 218  21  72 133  73
60
##  [685] 171 223  34 123 105   8  44 234 117  95 230 230  86  82 206 178 117
131
##  [703]  45 222 131 104 106 135 217 147  44 150  80  48 188  96 168 193 227
140
##  [721] 170 217 221 157 156 222 230 225  11 204 211  74  70 183 188  35  16
204
##  [739] 202 214 112 114  50 121 237  50  96  69 150 204  19 165 104  20 197
7
##  [757] 191 181 221 187  82 231 119 130  27  32 197  55  62 213  71  75  33
34
##  [775] 136 195   2  26 107  31 178  27  98  77 225 111  79 184 100  50 158
121
##  [793]  83 169 110 100  21 147  54 106 237   5 123  54 217  95 150 227 132
234
##  [811] 183 226   6  40 203 233 237  42 181 176 139  75  56 202 169  69 167
232
##  [829] 107  99 162 116 131   1  14 138 137  43  53  20 127   1 123 196 149
198
##  [847]  95 193  40 221 230   7 205 237 228 119  61  81  17 199 109  82 139
169
##  [865]   7  41 137 212  11 154  64  38  52 205 235 213  11  63  19   4 180
3
##  [883] 218 136 196 124  71  63 130 136 160  84  56 153 151  20 207  62 207
166
##  [901] 119  35 124 231 123 104 185 126 157 230 216 165 125  92  66  62 155
211
##  [919] 228 195 128 112 115  16  90  66  27  54 192  59  24 105 177   2 145
237
##  [937]  77  29 206 162  83  79  32 122 129 118  55  97 167  40  91  46 123
223
##  [955] 101  38 202 131 200  60 188  36  20  90 130 100  33   1 119 151  95
161
##  [973] 127 228  54 137 155  71 106 157  33 229 137  32  71 235 158 169  17
182
##  [991] 214  47 142 102 136 117  27 141  86  29
```

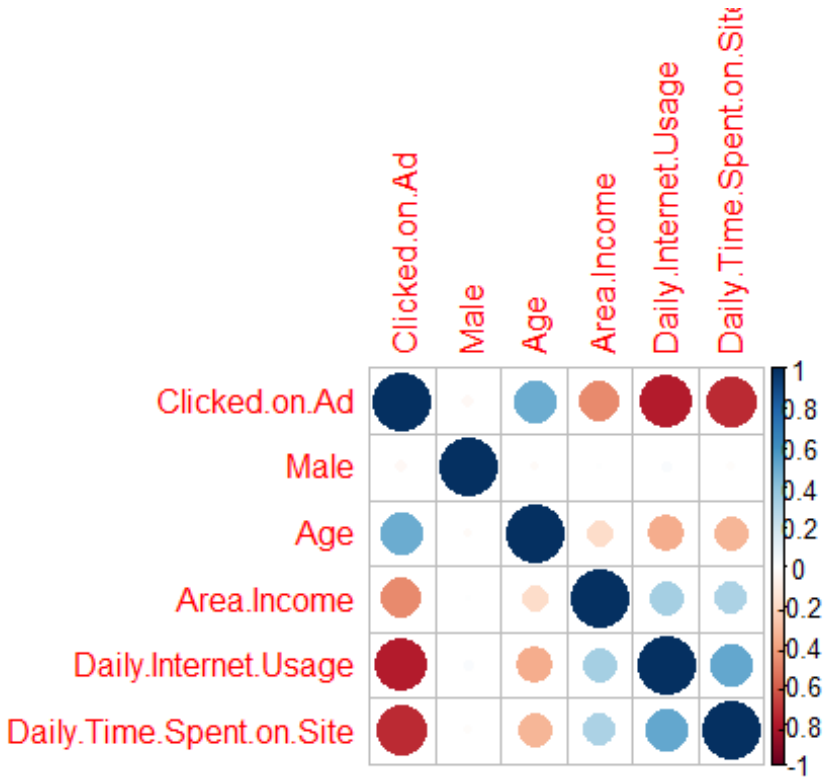
```
summary(data)
```

```
##  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
##  Adaptive 24hour Graphic Interface      :  1   Lisamouth      :  3
##  Adaptive asynchronous attitude         :  1   Williamsport   :  3
##  Adaptive context-sensitive application :  1   Benjaminchester:  2
##  Adaptive contextually-based methodology:  1   East John      :  2
##  Adaptive demand-driven knowledgebase   :  1   East Timothy   :  2
##  Adaptive uniform capability            :  1   Johnstad       :  2
##  (Other)                                :994   (Other)        :986
##       Male                 Country                   Timestamp
Clicked.on.Ad
##  Min.   :0.000   Czech Republic:  9   2016-01-01 02:52:10:  1   Min.
:0.0
##  1st Qu.:0.000   France        :  9   2016-01-01 03:35:35:  1   1st
Qu.:0.0
##  Median :0.000   Afghanistan   :  8   2016-01-01 05:31:22:  1   Median
:0.5
##  Mean   :0.481   Australia     :  8   2016-01-01 08:27:06:  1   Mean
:0.5
##  3rd Qu.:1.000   Cyprus        :  8   2016-01-01 15:14:24:  1   3rd
Qu.:1.0
##  Max.   :1.000   Greece        :  8   2016-01-01 20:17:49:  1   Max.
:1.0
##                  (Other)       :950   (Other)            :994
##      Date               Time
##  Length:1000        Length:1000
##  Class :character   Class :character
##  Mode  :character   Mode  :character
##
##
##
##
```

#multivariate Analysis

```
sub_data <- c('Clicked.on.Ad', 'Male', 'Age', 'Area.Income',
'Daily.Internet.Usage', 'Daily.Time.Spent.on.Site')
num <- data[,sub_data]
num_cor <- cor(num)
library(corrplot)

## corrplot 0.84 loaded
```

```
corrplot(num_cor)
```



- There is a strong positive correlation between Age and the those who clicked the AD,hence the older the user the more likely he/she will click the ad.*
- Daily inter usage and Daily time spent o the site has a strong negative correlation to Clicking the Ad.Thus, the less time one spents on both the site and the internet he/she will be more likely to click on the Ads.*
- Gender(Rep' by - 'Male') has no correlation to the likelihood of one clicking the Ad.*
- Area income as weak positive corelation with the the likelihood of one clicking the Ad, suggesting that , the higher the area income the more likely that the person will clkick on the Ad.*