In [21]:

```
#Analysis is carried out on a marketing campaign dataset based on a case of a
#retailer company in computer accessories. The dataset consists of 19 variable
s and 1500 cases.
#The data will first be prepared by identifying missing values and errors in d
ata entry. The
#variables which are not related to the analysis will be eliminated and some v
ariable will be
#transformed according to the needs of the analysis. After preparing the data,
Python
#programmes will be developed to analyse the summary statistics, correlation a
nd Euclidean
#distance. Finally, a logistic regression model will be built using Python and
the model will be
#checked for adequacy.

#Loading the library
import pandas as pd
import numpy as np

#Loading the data
data= pd.read_csv('Marketing Campaign data.csv')
```

In [2]:

```
# obtain a summary statistics, from which the min value can be
#observed to check for missing values for certain variables.
data.describe()
```

Out[2]:

```
             CUST_ID          AGE  YRS_RESIDENCE  AFFINITY_CARD  BULK_PACK_DISKETTES
count    1500.000000  1500.000000    1500.000000    1500.000000            1500.0000
mean   102250.500000    38.892000       4.088667       0.253333               0.6280
std       433.157015    13.636384       1.920919       0.435065               0.4835
min    101501.000000    17.000000       0.000000       0.000000               0.0000
25%    101875.750000    28.000000       3.000000       0.000000               0.0000
50%    102250.500000    37.000000       4.000000       0.000000               1.0000
75%    102625.250000    47.000000       5.000000       1.000000               1.0000
max    103000.000000    90.000000      14.000000       1.000000               1.0000
```

In [3]:

```
# checking for empty entry in the dataset
data.isnull().sum()
```

Out[3]:

```
CUST_ID                     0
CUST_GENDER                 0
AGE                         0
CUST_MARITAL_STATUS         0
COUNTRY_NAME                0
CUST_INCOME_LEVEL           0
EDUCATION                   0
OCCUPATION                  0
HOUSEHOLD_SIZE              0
YRS_RESIDENCE               0
AFFINITY_CARD               0
BULK_PACK_DISKETTES         0
FLAT_PANEL_MONITOR          0
HOME_THEATER_PACKAGE        0
BOOKKEEPING_APPLICATION     0
PRINTER_SUPPLIES            0
Y_BOX_GAMES                 0
OS_DOC_SET_KANJI            0
COMMENTS                   73
dtype: int64
```

In [4]:

```
#It was observed that the variable ‘OCCUPATION' has missing values which were recorded as ‘?'.
#This cannot be used in the analysis and hence these cases have to be deleted.
#The variable ‘COMMENTS’ have missing values, these cases will not be removed as it was decided
#that variable would be eliminated.
# Deleting '?' in variable OCCUPATION and NAN values
data=data.replace({'?':np.nan}).dropna()
# altenative method to droping NAN values
#data1 = data[~pd.isnull(data)]
```

In [5]:

```
# Dropping variables
data=data.drop(['PRINTER_SUPPLIES','COMMENTS','OS_DOC_SET_KANJI'],axis=1)
data
# alternative method
#list_drop = ['PRINTER_SUPPLIES','COMMENTS','OS_DOC_SET_KANJI']
#data.drop(list_drop, axis=1, inplace=True)
```

Out[5]:

	CUST_ID	CUST_GENDER	AGE	CUST_MARITAL_STATUS	COUNTRY_NAME	CUST_INCOMI
0	101501	F	41	NeverM	United States of America	J: 190,000
1	101502	M	27	NeverM	United States of America	I: 170,000
2	101503	F	20	NeverM	United States of America	H: 150,000
3	101504	M	45	Married	United States of America	B: 30,00(
4	101505	M	34	NeverM	United States of America	K: 250,000
...	...	...	...	...	...	
1495	102996	M	17	NeverM	United States of America	C: 50,00(
1496	102997	M	41	Married	Spain	L: 300,000 a
1497	102998	M	53	Married	United States of America	J: 190,000
1498	102999	M	55	Married	United States of America	C: 50,00(
1499	103000	F	40	Divorc.	United States of America	E: 90,000

1351 rows × 16 columns

In [6]:
```
## Variable transformation
# changing customer gender into 1 and 0 for M and F respectively
gender = {'M': 1,'F': 0}
data.CUST_GENDER = [gender[item] for item in data.CUST_GENDER]
##############################################################################
##
# Checking frequency of each country in the data
pd.value_counts(data['COUNTRY_NAME'])
# Country name into ordinal numbers
country_code = {
                'United States of America':1,
                'Argentina':2,
                'Italy':3,
                'Brazil':4,
                'Germany':5,
                'Poland':6,
                'Canada':7,
                'United Kingdom':8,
                'Saudi Arabia':9,
                'Denmark':10,
                'China':11,
                'Singapore':11,
                'New Zealand':11,
                'Japan':11,
                'Spain':11,
                'Turkey':11,
                'Australia':11,
                'France':11,
                'South Africa':1}
data.COUNTRY_NAME = [country_code[item] for item in data.COUNTRY_NAME]
##############################################################################
##
# Checking number of categories that is already classified
pd.value_counts(data['CUST_INCOME_LEVEL'])
# Customer income level into ordinal
income_level= {
'J: 190,000 - 249,999':4,
'L: 300,000 and above':5,
'I: 170,000 - 189,999':4,
'K: 250,000 - 299,999':4,
'F: 110,000 - 129,999':3,
'G: 130,000 - 149,999':3,
'E: 90,000 - 109,999':2,
'H: 150,000 - 169,999':4,
'B: 30,000 - 49,999':1,
'C: 50,000 - 69,999':2,
'D: 70,000 - 89,999':2,
'A: Below 30,000':1}
data.CUST_INCOME_LEVEL= [income_level[item] for item in data.CUST_INCOME_LEVEL
]
##############################################################################
##
# Checking current classification of education
pd.value_counts(data['EDUCATION'])
# Education into ordinal level
education= {
```

```
'HS-grad':4,
'< Bach.':4,
'Bach.':5,
'Masters':5,
'Assoc-V':4,
'Assoc-A':4,
'10th':2,
'11th':3,
'Profsc':5,
'7th-8th':2,
'9th':2,
'PhD':5,
'12th':3,
'5th-6th':1,
'Presch.':1,
'1st-4th':1,}
data.EDUCATION = [education[item] for item in data.EDUCATION]
##############################################################################
##
# Identify how the data entry error was identified by python
pd.value_counts(data['HOUSEHOLD_SIZE'])
# household into ordinal level
household= {'1':1,'2':2,'3':3,'4-5':4, '6-8':5, '9+':6}
data.HOUSEHOLD_SIZE = [household[item] for item in data.HOUSEHOLD_SIZE]
##############################################################################
##
pd.value_counts(data['OCCUPATION'])
occupation= {
'Exec.':1,
'Crafts':2,
'Sales':3,
'Cleric.':4,
'Prof.':5,
'Other':6,
'Machine':7,
'Transp.':8,
'Handler':9,
'TechSup':10,
'Farming':11,
'Protec.':12,
'House-s':13,
'Armed-F':14,}
data.OCCUPATION=[occupation[item] for item in data.OCCUPATION]
##############################################################################
###
pd.value_counts(data['CUST_MARITAL_STATUS'])
marital={
'Married':1,
'NeverM':2,
'Divorc.':3,
'Separ.':4,
'Widowed':5,
'Mabsent':6,
'Mar-AF':7,}
data.CUST_MARITAL_STATUS=[marital[item] for item in data.CUST_MARITAL_STATUS]
```

In [7]:

```
#Python code designed to calculate the summary statistics of any variables

#Summary statistics
# create a dictonary for all variables
dic={ 1:'CUST_GENDER',
    2:'AGE',
    3:'CUST_MARITAL_STATUS',
    4:'COUNTRY_NAME',
    5:'CUST_INCOME_LEVEL',
    6:'EDUCATION',
    7:'OCCUPATION',
    8:'HOUSEHOLD_SIZE',
    9:'YRS_RESIDENCE',
    10:'AFFINITY_CARD',
    11:'BULK_PACK_DISKETTES',
    12:'FLAT_PANEL_MONITOR',
    13:'HOME_THEATER_PACKAGE',
    14:'BOOKKEEPING_APPLICATION',
    15:'Y_BOX_GAMES',}
# provide a list of variable number to choose from
print('Choose the variables number from list shown',
    'customer gender          - 1',
    'Age                      - 2',
    'Marital status           - 3',
    'Country name             - 4',
    'Income level             - 5',
    'Education                - 6',
    'Occupation               - 7',
    'Household size           - 8',
    'Yrs residence            - 9',
    'Affinity card            - 10',
    'Bulk Pack Diskettes      - 11',
    'Flat panel monitor       - 12',
    'Home theater package     - 13',
    'Bookkeeping application  - 14',
    'Y box games              - 15',
    sep="\n")
# store the user choice
x=int(input(
'Enter the respective number of variable to obtain summary statistics:'))
# Calculation
SUM=data[dic[x]].sum()
MEAN=data[dic[x]].mean()
Standard_deviation=data[dic[x]].std()
Skewness=data[dic[x]].skew()
Kurtosis=data[dic[x]].kurt()
print('The sum is %d.' % SUM,
       'The Mean is %f' %MEAN,
       'The Standard Deviation is %f' %Standard_deviation,
       'The Skewness is %f' % Skewness,
       'The Kurtosis is %f' %Kurtosis,
        sep="\n")
```

```
Choose the variables number from list shown
customer gender          - 1
Age                      - 2
Marital status           - 3
Country name             - 4
Income level             - 5
Education                - 6
Occupation               - 7
Household size           - 8
Yrs residence            - 9
Affinity card            - 10
Bulk Pack Diskettes      - 11
Flat panel monitor       - 12
Home theater package     - 13
Bookkeeping application  - 14
Y box games              - 15
Enter the respective number of variable to obtain summary statistics:4
The sum is 1843.
The Mean is 1.364175
The Standard Deviation is 1.448582
The Skewness is 5.002511
The Kurtosis is 26.313792
```

In [8]:

```
# Correlation of target variable with other variables
Correlation= data.corr()['AFFINITY_CARD']
print(Correlation.sort_values(ascending=False))
##############################################################################
##
# Euclidean Distance
from scipy.spatial import distance
# prompt to enter Customer ID
Customer_ID_1= int(input(
'Enter ID number of customer:'))
Customer_ID_2= int(input(
'Ebter ID number of next customer:'))
# Euclidean distance calculation
euc_dst= distance.euclidean(data.loc[Customer_ID_1],data.loc[Customer_ID_2])
print('The Euclidean distance is %f.' % euc_dst)
###################################################
```

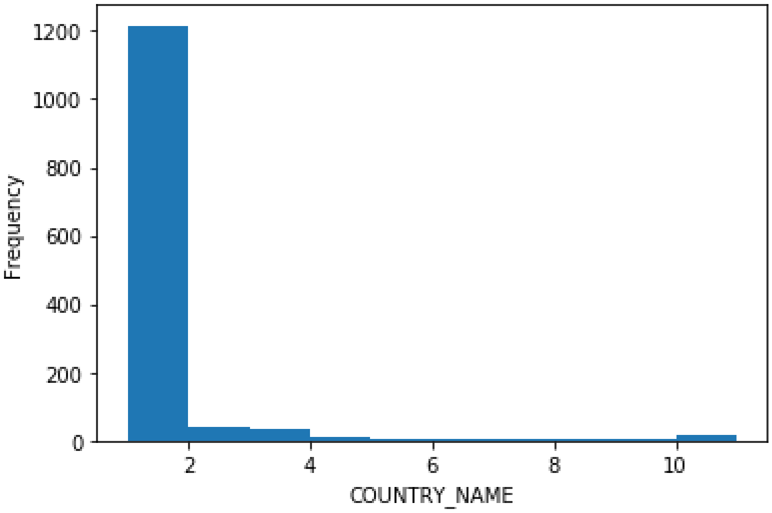
```
AFFINITY_CARD              1.000000
YRS_RESIDENCE              0.355878
EDUCATION                  0.299675
HOME_THEATER_PACKAGE       0.282150
AGE                        0.250049
CUST_GENDER                0.232752
BOOKKEEPING_APPLICATION    0.169069
HOUSEHOLD_SIZE             0.050500
COUNTRY_NAME               0.038701
CUST_INCOME_LEVEL         -0.011094
BULK_PACK_DISKETTES       -0.013852
FLAT_PANEL_MONITOR        -0.025359
CUST_ID                   -0.034516
OCCUPATION                -0.162829
Y_BOX_GAMES               -0.281529
CUST_MARITAL_STATUS       -0.348459
Name: AFFINITY_CARD, dtype: float64
Enter ID number of customer:4
Ebter ID number of next customer:3
The Euclidean distance is 12.165525.
```

In [9]:

```
# Histogram for chosen variable
import matplotlib.pyplot as plt

# create a dictonary for all variables
dic={
1:'CUST_GENDER',
2:'AGE',
3:'CUST_MARITAL_STATUS',
4:'COUNTRY_NAME',
5:'CUST_INCOME_LEVEL',
6:'EDUCATION',
7:'OCCUPATION',
8:'HOUSEHOLD_SIZE',
9:'YRS_RESIDENCE',
10:'AFFINITY_CARD',
11:'BULK_PACK_DISKETTES',
12:'FLAT_PANEL_MONITOR',
13:'HOME_THEATER_PACKAGE',
14:'BOOKKEEPING_APPLICATION',
15:'Y_BOX_GAMES',}
# provide a list of variable number to choose from

print('Choose the variables number from list shown',
    'customer gender          - 1',
    'Age                      - 2',
    'Marital status           - 3',
    'Country name             - 4',
    'Income level             - 5',
    'Education                - 6',
    'Occupation               - 7',
    'Household size           - 8',
    'Yrs residence            - 9',
    'Affinity card            - 10',
    'Bulk Pack Diskettes      - 11',
    'Flat panel monitor       - 12',
    'Home theater package     - 13',
    'Bookkeeping application  - 14',
    'Y box games              - 15',
    sep="\n")

# store the user choice
num=int(input('Enter the respective number of the variable:'))

#plot the histogram
data[dic[num]].plot(kind='hist',stacked=True,bins=10)
# label x axis according the user choice
plt.xlabel(dic[num])
```

```
Choose the variables number from list shown
customer gender          - 1
Age                      - 2
Marital status           - 3
Country name             - 4
Income level             - 5
Education                - 6
Occupation               - 7
Household size           - 8
Yrs residence            - 9
Affinity card            - 10
Bulk Pack Diskettes      - 11
Flat panel monitor       - 12
Home theater package     - 13
Bookkeeping application  - 14
Y box games              - 15
Enter the respective number of the variable:4
```

```
Out[9]: Text(0.5, 0, 'COUNTRY_NAME')
```

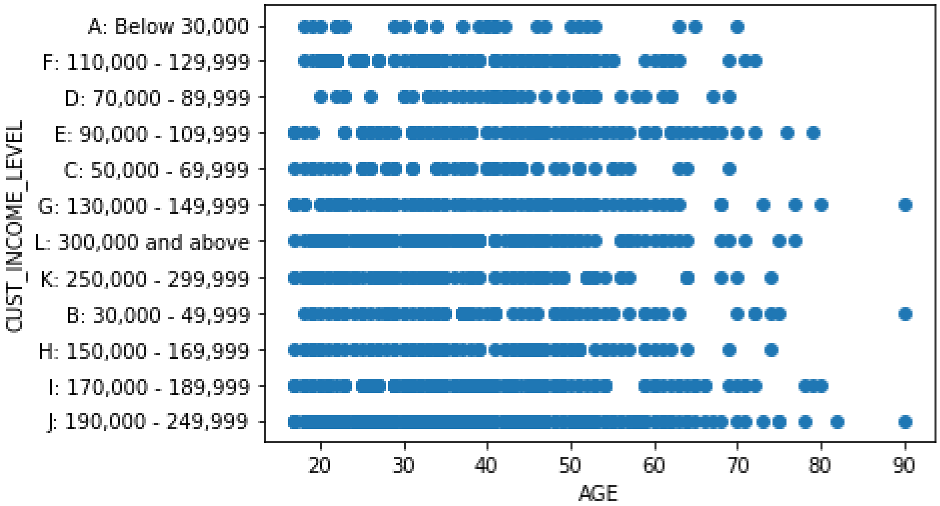


In [25]:

```
# scatter plot of any 2 chosen variables
# create a dictonary for all variables
dic={
1:'CUST_GENDER',
2:'AGE',
3:'CUST_MARITAL_STATUS',
4:'COUNTRY_NAME',
5:'CUST_INCOME_LEVEL',
6:'EDUCATION',
7:'OCCUPATION',
8:'HOUSEHOLD_SIZE',
9:'YRS_RESIDENCE',
10:'AFFINITY_CARD',
11:'BULK_PACK_DISKETTES',
12:'FLAT_PANEL_MONITOR',
13:'HOME_THEATER_PACKAGE',
14:'BOOKKEEPING_APPLICATION',
15:'Y_BOX_GAMES',}
# provide a list of variable number to choose from

print('Choose the variables number from list shown',
    'customer gender          - 1',
    'Age                      - 2',
    'Marital status           - 3',
    'Country name             - 4',
    'Income level             - 5',
    'Education                - 6',
    'Occupation               - 7',
    'Household size           - 8',
    'Yrs residence            - 9',
    'Affinity card            - 10',
    'Bulk Pack Diskettes      - 11',
    'Flat panel monitor       - 12',
    'Home theater package     - 13',
    'Bookkeeping application  - 14',
    'Y box games              - 15',
    sep="\n")

# store the user choice
x=int(input('Enter the respective number of the variable for x axis:'))
y=int(input('Enter the respective number of the variable for y axis:'))

#plot the scatter plot
plt.scatter(data[dic[x]],data[dic[y]])
# label x and y axis
plt.xlabel(dic[x])
plt.ylabel(dic[y])
```

```
Choose the variables number from list shown
customer gender          - 1
Age                      - 2
Marital status           - 3
Country name             - 4
Income level             - 5
Education                - 6
Occupation               - 7
Household size           - 8
Yrs residence            - 9
Affinity card            - 10
Bulk Pack Diskettes      - 11
Flat panel monitor       - 12
Home theater package     - 13
Bookkeeping application  - 14
Y box games              - 15
Enter the respective number of the variable for x axis:2
Enter the respective number of the variable for y axis:5
```

```
Out[25]: Text(0, 0.5, 'CUST_INCOME_LEVEL')
```



In [18]:

```
# Data modelling LOGISTIC REGRESSION
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
# classifying explanatory variables into x and target variable into y
y = data.iloc[:,[10]]
X = data.iloc[:,[1,2,3,4,5,6,7,8,9,11,12,13,14,15]]
# spliting data into training and testing
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=0)
#checking training and test data partition
X_train.shape
X_test.shape
# implementing the model
import statsmodels.api as sm
logit_model=sm.Logit(y_train,X_train)
#checking summary statistics to check for significance of variable
result=logit_model.fit()
print(result.summary())
# Fit logistic regression to the training set
logic = LogisticRegression(random_state=0,max_iter=1000)
logic.fit(X_train, np.ravel(y_train,order='C'))
```

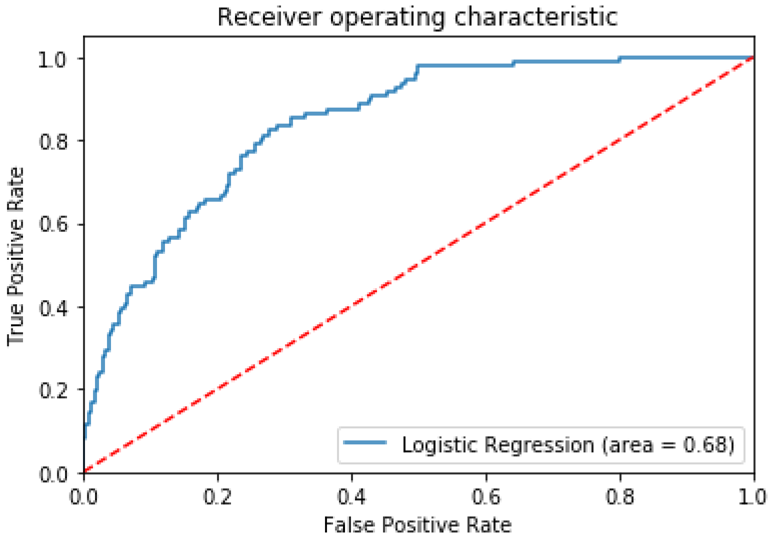
```
Optimization terminated successfully.
         Current function value: 0.388416
         Iterations 8
                           Logit Regression Results
=============================================================================
=
Dep. Variable:          AFFINITY_CARD   No. Observations:                 101
3
Model:                          Logit   Df Residuals:                      99
9
Method:                           MLE   Df Model:                           1
3
Date:                Tue, 05 May 2020   Pseudo R-squ.:                  0.318
0
Time:                        11:43:17   Log-Likelihood:                -393.4
6
converged:                       True   LL-Null:                       -576.9
4
Covariance Type:            nonrobust   LLR p-value:                 2.092e-7
0
=============================================================================
==============
                              coef    std err          z      P>|z|      [0.0
25      0.975]
-----------------------------------------------------------------------------
--------------
CUST_GENDER                -0.1660      0.243     -0.684      0.494      -0.6
42       0.310
AGE                        -0.0402      0.012     -3.396      0.001      -0.0
63      -0.017
CUST_MARITAL_STATUS        -1.5059      0.170     -8.884      0.000      -1.8
38      -1.174
COUNTRY_NAME                0.0207      0.062      0.334      0.739      -0.1
01       0.142
CUST_INCOME_LEVEL          -0.1646      0.149     -1.105      0.269      -0.4
57       0.127
EDUCATION                   0.7926      0.164      4.839      0.000       0.4
72       1.114
OCCUPATION                 -0.1030      0.030     -3.463      0.001      -0.1
61      -0.045
HOUSEHOLD_SIZE             -0.1778      0.105     -1.690      0.091      -0.3
84       0.028
YRS_RESIDENCE               0.2818      0.070      4.046      0.000       0.1
45       0.418
BULK_PACK_DISKETTES         0.9557      0.541      1.766      0.077      -0.1
05       2.016
FLAT_PANEL_MONITOR         -0.5355      0.459     -1.167      0.243      -1.4
35       0.364
HOME_THEATER_PACKAGE        0.7960      0.301      2.648      0.008       0.2
07       1.385
BOOKKEEPING_APPLICATION    -0.6934      0.491     -1.414      0.157      -1.6
55       0.268
Y_BOX_GAMES                -1.4552      0.367     -3.961      0.000      -2.1
75      -0.735
=============================================================================
==============
```

Out[18]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=1000,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=0, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

In [19]:
```
# Predict test set results and confusion matrix
y_pred = logic.predict(X_test)
from sklearn.metrics import confusion_matrix
confusion_matrix = confusion_matrix(y_test, y_pred)
print(confusion_matrix)
# Accuracy of model
print
('Accuracy on test data:{:.2f}'.format(logic.score(X_test, y_test)))

# Creating ROC curve
from sklearn.metrics import roc_auc_score
from sklearn.metrics import roc_curve
logit_roc_auc = roc_auc_score(y_test, logic.predict(X_test))
fpr, tpr, thresholds = roc_curve(y_test, logic.predict_proba(X_test)[:,1])
plt.figure()
plt.plot(fpr, tpr, label='Logistic Regression (area = %0.2f)' % logit_roc_auc)
# plot base line
plt.plot([0, 1], [0, 1],'r--')
# Set axis limit for x-axis and y-axis
plt.xlim([0.0, 1.0])
plt.ylim([0.0, 1.05])
# label axis
plt.xlabel('False Positive Rate')
plt.ylabel('True Positive Rate')
plt.title('Receiver operating characteristic')
# Dispay AUC at lower right
plt.legend(loc="lower right")
```

```
[[221  21]
 [ 53  43]]
```

Out[19]:
```
<matplotlib.legend.Legend at 0x1bbbb3e2288>
```



In [ ]:

```
# Detailed Explanation can be found in Python.pdf
```