Logistic Regression

Logistic regression is a statistical model that in its basic form uses a logistic function to model a binary dependent variable, although many more complex extensions exist. In regression analysis, logistic regression (or logit regression) is estimating the parameters of a logistic model (a form of binary regression).

1. Reading the Data

In [1]:
```
import numpy as np
import pandas as pd
```

In [2]:
```
df=pd.read_csv("C:\\Users\\Gaurav\\Desktop\\MachineLearning\\FloatInt\\L06Logist
df.head()
```

Out[2]:

	accepted	creditscore	amount	age	marital	health_ins	creditgrade
0	0	387	42580093	87	0	0	A
1	0	400	80816186	49	0	1	A
2	0	360	37264552	46	1	0	A
3	0	378	7209235	38	1	0	A
4	0	387	71637479	51	1	0	A

In [3]:
```
df.shape
```

Out[3]:
```
(2500, 7)
```

In [4]:
```
df.describe()
```

Out[4]:

	accepted	creditscore	amount	age	marital	health_ins
count	2500.000000	2500.000000	2.500000e+03	2500.000000	2500.000000	2500.000000
mean	0.518800	286.824400	3.364925e+07	58.156400	0.494800	0.440000
std	0.499746	74.884278	2.897636e+07	21.082678	0.500073	0.496486
min	0.000000	100.000000	5.113590e+05	18.000000	0.000000	0.000000
25%	0.000000	246.000000	8.954224e+06	40.000000	0.000000	0.000000
50%	1.000000	298.000000	2.360884e+07	61.000000	0.000000	0.000000
75%	1.000000	343.250000	5.592593e+07	76.000000	1.000000	1.000000
max	1.000000	400.000000	9.995992e+07	90.000000	1.000000	1.000000

2. Loading the library

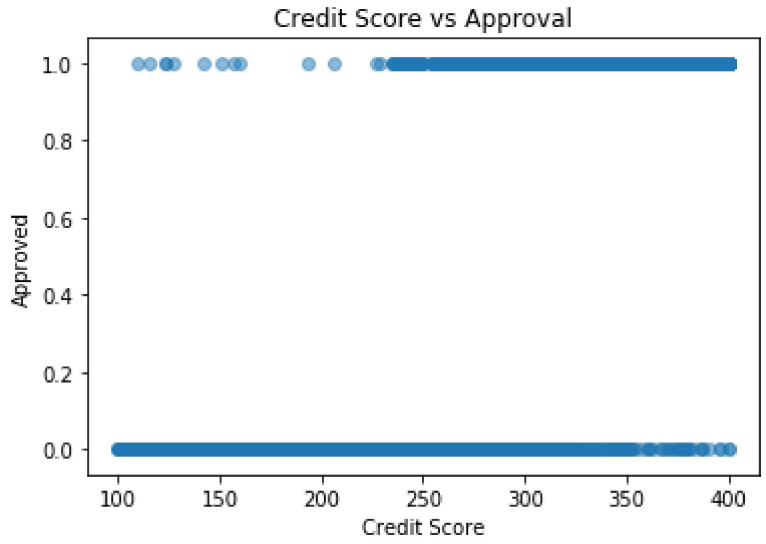
In [5]:
```
from sklearn.preprocessing import MinMaxScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression

from sklearn.metrics import accuracy_score,roc_auc_score,confusion_matrix

import matplotlib.pyplot as plt
```

In [6]:
```
x=df['creditscore']
y=df['accepted']
```

In [7]:
```
print(y.value_counts())
```

```
1    1297
0    1203
Name: accepted, dtype: int64
```

In [8]:
```
plt.scatter(x,y,alpha=0.5)
plt.title("Credit Score vs Approval")
plt.xlabel("Credit Score")
plt.ylabel("Approved")
plt.show()
```



It shows that credit score is not only the reason behind accepting and rejecting the loan. There may be many other reason behind this.

3. Model Building [Using only 1 Column]

In [9]:
```
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.7,random_state=0)
xtrain=pd.DataFrame(xtrain)
xtest=pd.DataFrame(xtest)
ytrain=pd.DataFrame(ytrain)
ytest=pd.DataFrame(ytest)
```

In [10]:
```
#Transformation
scale=MinMaxScaler()
xtrain=scale.fit_transform(xtrain)
xtest=scale.transform(xtest)
```

```
C:\Users\Gaurav\Anaconda3\lib\site-packages\sklearn\preprocessing\data.py:334:
DataConversionWarning: Data with input dtype int64 were all converted to float6
4 by MinMaxScaler.
  return self.partial_fit(X, y)
```

In [11]:
```
#Initializing the instance of the class
model=LogisticRegression(random_state=0,solver='lbfgs')

#Fitting the model
model.fit(xtrain,ytrain)
```

```
C:\Users\Gaurav\Anaconda3\lib\site-packages\sklearn\utils\validation.py:761: Da
taConversionWarning: A column-vector y was passed when a 1d array was expected.
Please change the shape of y to (n_samples, ), for example using ravel().
  y = column_or_1d(y, warn=True)
```

Out[11]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='warn',
          n_jobs=None, penalty='l2', random_state=0, solver='lbfgs',
          tol=0.0001, verbose=0, warm_start=False)
```

4. Predicting the Value

In [12]:
```
pred_prob=model.predict_proba(xtest)   #give the actual probability values  [[p,
```

In [13]:
```
pred=model.predict(xtest)      #give the value as 0 and 1    [0,1,0....]
```

In [14]:
```
print("       Accuracy Score")
print("---------------------------------")
accuracy_score(ytest,pred)
```

```
       Accuracy Score
---------------------------------
```

Out[14]:
```
0.8022857142857143
```

```
        Our model gives correct output for 80 input for every input in pro
   bability.
```

Now we will take all the columns as input and try to check whether our accuracy improves or not.

a. Model Building [Using all Columns]

In [15]:
```
x=df[["creditscore","amount","age","marital","health_ins"]]
y=df["accepted"]
```

In [16]:
```
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.7,random_state=0)
xtrain=pd.DataFrame(xtrain)
xtest=pd.DataFrame(xtest)
ytrain=pd.DataFrame(ytrain)
ytest=pd.DataFrame(ytest)
```

In [17]:
```
#Transformation
scale=MinMaxScaler()
xtrain=scale.fit_transform(xtrain)
xtest=scale.transform(xtest)
```

```
C:\Users\Gaurav\Anaconda3\lib\site-packages\sklearn\preprocessing\data.py:334:
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In [18]:
```
#Initializing the instance of the class
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#Fitting the model
model.fit(xtrain,ytrain)
```

```
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Out[18]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
          intercept_scaling=1, max_iter=100, multi_class='warn',
          n_jobs=None, penalty='l2', random_state=0, solver='lbfgs',
          tol=0.0001, verbose=0, warm_start=False)
```

b. Predicting from Modal

In [19]:
```
pred=model.predict(xtest)      #give the value as 0 and 1    [0,1,0....]
```

In [20]:
```
print("       Accuracy Score")
print("---------------------------------")
accuracy_score(ytest,pred)
```

```
       Accuracy Score
---------------------------------
```

Out[20]:
```
0.9514285714285714
```

We see that our accuracy have incresed from 80 to 95%.

In [21]:
```
model.coef_
```

Out[21]:
```
array([[ 5.35715507, -3.23045671, -0.12705459,  1.41530128,  3.79372072]])
```

We see that age have very small value for beta3 i.e it is not contributing for the data value.This gives us a variable importance.Now remove variable age and see the accuracy level.You will find that there is no significant in accuracy level.