Logistic Regression

Logistic regression is a classification algorithm used to assign observations to a discrete set of classes. Unlike linear regression which outputs continuous number values, logistic regression transforms its output using the logistic sigmoid function to return a probability value which can then be mapped to two or more discrete classes.

Logistic regression can be used for:

1: Binary Classification

2: Multi-class Classification

3: One-vs-Rest Classification

Assumptions of Logistic regression

1:- The dependent variable must be categorical in nature.

2:- The independent variables(features) must be independent.

3:- There should be no outliers in the data. Check for outliers.

4:- There should be no high correlations among the independent variables. This can be checked using a correlation matrix.

In [1]:
```
# Import libraries
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score, recall_score, precision_score, f1_score, confusion_matrix, classificatior
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler, LabelEncoder, MinMaxScaler
```

In [2]:
```
# data import
df = sns.load_dataset('titanic')
df.head()
```

Out[2]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adult_male	deck	embark_town	alive	alone
0	0	3	male	22.0	1	0	7.2500	S	Third	man	True	NaN	Southampton	no	False
1	1	1	female	38.0	1	0	71.2833	C	First	woman	False	C	Cherbourg	yes	False
2	1	3	female	26.0	0	0	7.9250	S	Third	woman	False	NaN	Southampton	yes	True
3	1	1	female	35.0	1	0	53.1000	S	First	woman	False	C	Southampton	yes	False
4	0	3	male	35.0	0	0	8.0500	S	Third	man	True	NaN	Southampton	no	True

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 15 columns):
 #   Column       Non-Null Count  Dtype   
---  ------       --------------  -----   
 0   survived     891 non-null    int64   
 1   pclass       891 non-null    int64   
 2   sex          891 non-null    object  
 3   age          714 non-null    float64 
 4   sibsp        891 non-null    int64   
 5   parch        891 non-null    int64   
 6   fare         891 non-null    float64 
 7   embarked     889 non-null    object  
 8   class        891 non-null    category
 9   who          891 non-null    object  
 10  adult_male   891 non-null    bool    
 11  deck         203 non-null    category
 12  embark_town  889 non-null    object  
 13  alive        891 non-null    object  
 14  alone        891 non-null    bool    
dtypes: bool(2), category(2), float64(2), int64(4), object(5)
memory usage: 80.7+ KB
```

In [4]:
```
# pre prcoess the data
# remove the deck column
df.drop('deck', axis=1, inplace=True)
# impute missing values in age and fare
df['age'].fillna(df['age'].median(), inplace=True)
df['fare'].fillna(df['fare'].median(), inplace=True)
# impute missing values in embark and embarked town
df['embark_town'].fillna(df['embark_town'].mode()[0], inplace=True)
df['embarked'].fillna(df['embarked'].mode()[0], inplace=True)

# encode the categorical variables using for loop where object and categoy datatypes are given
for col in df.columns:
    if df[col].dtype == 'object' or df[col].dtype.name == 'category':
        df[col] = LabelEncoder().fit_transform(df[col])
df.head()
```

```
C:\Users\ustb\AppData\Local\Temp\ipykernel_11360\2703612986.py:5: FutureWarning: A value is trying to be set on a cop
y of a DataFrame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which
we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or d
f[col] = df[col].method(value) instead, to perform the operation inplace on the original object.


  df['age'].fillna(df['age'].median(), inplace=True)
C:\Users\ustb\AppData\Local\Temp\ipykernel_11360\2703612986.py:6: FutureWarning: A value is trying to be set on a cop
y of a DataFrame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which
we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or d
f[col] = df[col].method(value) instead, to perform the operation inplace on the original object.


  df['fare'].fillna(df['fare'].median(), inplace=True)
C:\Users\ustb\AppData\Local\Temp\ipykernel_11360\2703612986.py:8: FutureWarning: A value is trying to be set on a cop
y of a DataFrame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which
we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or d
f[col] = df[col].method(value) instead, to perform the operation inplace on the original object.


  df['embark_town'].fillna(df['embark_town'].mode()[0], inplace=True)
C:\Users\ustb\AppData\Local\Temp\ipykernel_11360\2703612986.py:9: FutureWarning: A value is trying to be set on a cop
y of a DataFrame or Series through chained assignment using an inplace method.
The behavior will change in pandas 3.0. This inplace method will never work because the intermediate object on which
we are setting values always behaves as a copy.

For example, when doing 'df[col].method(value, inplace=True)', try using 'df.method({col: value}, inplace=True)' or d
f[col] = df[col].method(value) instead, to perform the operation inplace on the original object.


  df['embarked'].fillna(df['embarked'].mode()[0], inplace=True)
```

Out[4]:

	survived	pclass	sex	age	sibsp	parch	fare	embarked	class	who	adult_male	embark_town	alive	alone
0	0	3	1	22.0	1	0	7.2500	2	2	1	True	2	0	False
1	1	1	0	38.0	1	0	71.2833	0	0	2	False	0	1	False
2	1	3	0	26.0	0	0	7.9250	2	2	2	False	2	1	True
3	1	1	0	35.0	1	0	53.1000	2	0	2	False	2	1	False
4	0	3	1	35.0	0	0	8.0500	2	2	1	True	2	0	True

In [5]:
```
# X and y column
X = df.drop('survived', axis=1)
y = df['survived']
```

In [6]:
```
# train test split the data
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2)
```

In [7]:
```
# model call
model = LogisticRegression()
```

In [8]:
```
# train the model
model.fit(X_train, y_train)
```

```
C:\Users\ustb\.anaconda\anwaar\Lib\site-packages\sklearn\linear_model\_logistic.py:444: ConvergenceWarning: lbfgs fai
led to converge (status=1):
STOP: TOTAL NO. of ITERATIONS REACHED LIMIT.

Increase the number of iterations (max_iter) or scale the data as shown in:
    https://scikit-learn.org/stable/modules/preprocessing.html
Please also refer to the documentation for alternative solver options:
    https://scikit-learn.org/stable/modules/linear_model.html#logistic-regression
  n_iter_i = _check_optimize_result(
```

Out[8]:

▾ LogisticRegression

LogisticRegression()

In [9]:
```
# predict the values
y_pred = model.predict(X_test)
```

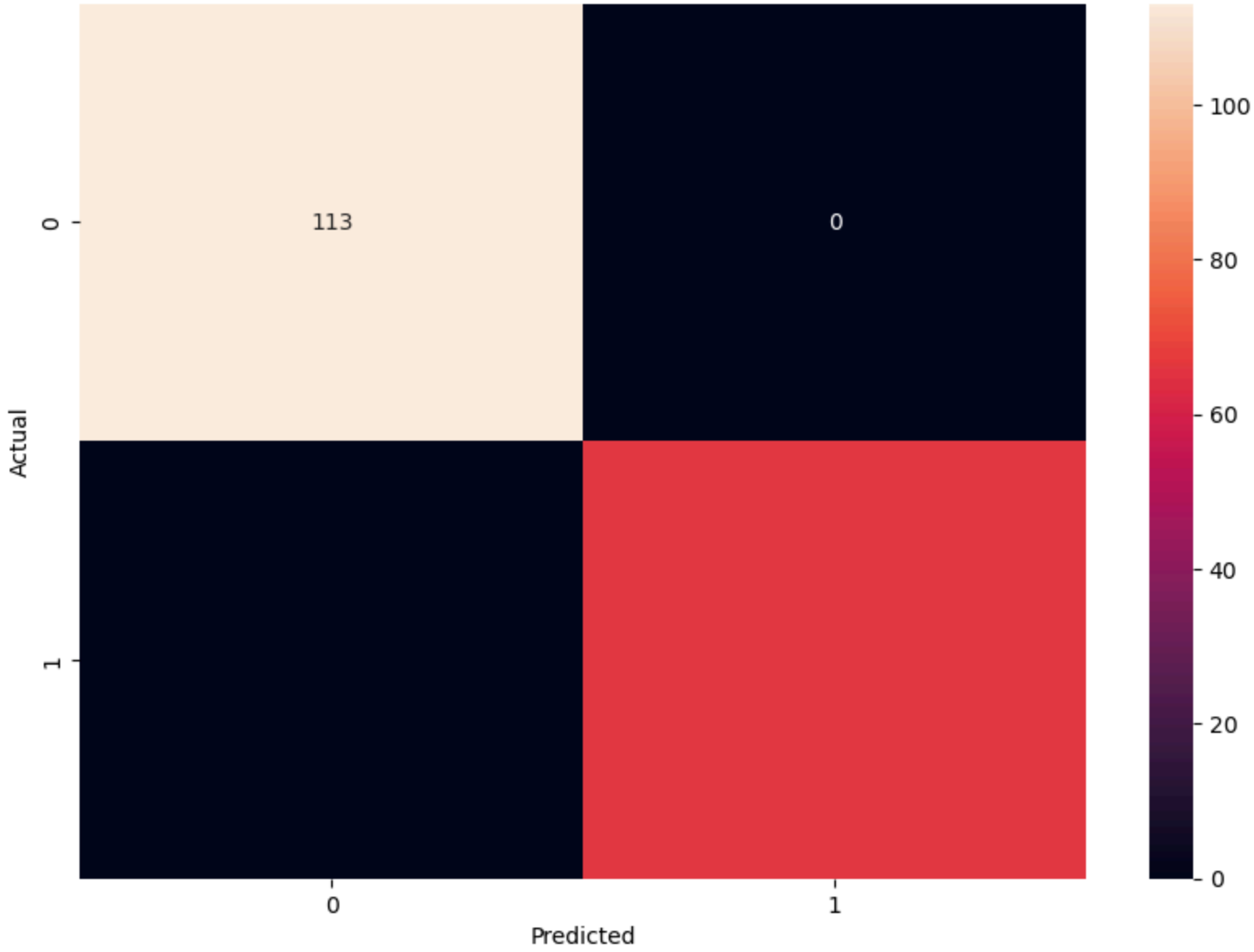
In [10]:
```
# evaluate the model
print('Accuracy Score: ', accuracy_score(y_test, y_pred))
print(".....................................")
print('Recall Score: ', recall_score(y_test, y_pred))
print(".....................................")
print('Precision Score: ', precision_score(y_test, y_pred))
print(".....................................")
print('F1 Score: ', f1_score(y_test, y_pred))
print(".....................................")
print('Confusion Matrix: \n', confusion_matrix(y_test, y_pred))
print(".....................................")
print('Classification Report: \n', classification_report(y_test, y_pred))
```

```
Accuracy Score:  1.0
.....................................
Recall Score:  1.0
.....................................
Precision Score:  1.0
.....................................
F1 Score:  1.0
.....................................
Confusion Matrix:
 [[113   0]
 [  0  66]]
.....................................
Classification Report:
              precision    recall  f1-score   support

           0       1.00      1.00      1.00       113
           1       1.00      1.00      1.00        66

    accuracy                           1.00       179
   macro avg       1.00      1.00      1.00       179
weighted avg       1.00      1.00      1.00       179
```

In [11]:
```
# plot the confusion matrix
plt.figure(figsize=(10, 7))
```

```
sns.heatmap(confusion_matrix(y_test, y_pred), annot=True, fmt='d')
plt.xlabel('Predicted')
plt.ylabel('Actual')
```

Out[11]: Text(95.72222222222221, 0.5, 'Actual')



In [12]:
```
# save the model
#import pickle
#pickle.dump(model, open('./saved_models/02_model_logistic_regression.pkl', 'wb'))
```

In [ ]:
```

```