```
Practical No-5
Aim:
Data Analytics II
1. Implement logistic regression using Python/R to perform
classification on
Social_Network_Ads.csv dataset.
2. Compute Confusion matrix to find TP, FP, TN, FN, Accuracy, Error
rate, Precision, Recall
on the given dataset.
```

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

```
dataset = pd.read_csv(r"C:\Users\System21\Desktop\diabetes.csv")
```

```
dataset
```

```
     Pregnancies  Glucose  BloodPressure  SkinThickness  Insulin   BMI
\
0              6      148             72             35        0  33.6

1              1       85             66             29        0  26.6

2              8      183             64              0        0  23.3

3              1       89             66             23       94  28.1

4              0      137             40             35      168  43.1

..           ...      ...            ...            ...      ...   ...

763           10      101             76             48      180  32.9

764            2      122             70             27        0  36.8

765            5      121             72             23      112  26.2

766            1      126             60              0        0  30.1

767            1       93             70             31        0  30.4


     DiabetesPedigreeFunction  Age  Outcome
0                       0.627   50        1
1                       0.351   31        0
2                       0.672   32        1
3                       0.167   21        0
4                       2.288   33        1
..                        ...  ...      ...
763                     0.171   63        0
```

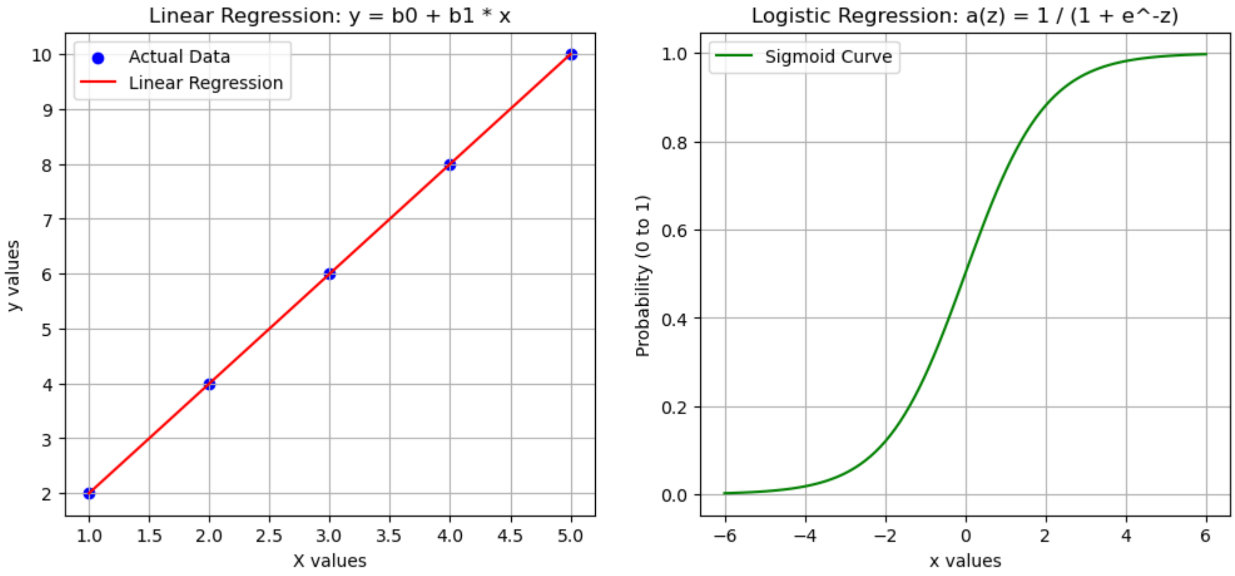
```
764                     0.340   27         0
765                     0.245   30         0
766                     0.349   47         1
767                     0.315   23         0

[768 rows x 9 columns]
```

```
dataset.describe()
```

```
       Pregnancies     Glucose  BloodPressure  SkinThickness
Insulin  \
count   768.000000  768.000000     768.000000     768.000000
768.000000
mean      3.845052  120.894531      69.105469      20.536458
79.799479
std       3.369578   31.972618      19.355807      15.952218
115.244002
min       0.000000    0.000000       0.000000       0.000000
0.000000
25%       1.000000   99.000000      62.000000       0.000000
0.000000
50%       3.000000  117.000000      72.000000      23.000000
30.500000
75%       6.000000  140.250000      80.000000      32.000000
127.250000
max      17.000000  199.000000     122.000000      99.000000
846.000000

              BMI  DiabetesPedigreeFunction         Age     Outcome
count  768.000000                768.000000  768.000000  768.000000
mean    31.992578                  0.471876   33.240885    0.348958
std      7.884160                  0.331329   11.760232    0.476951
min      0.000000                  0.078000   21.000000    0.000000
25%     27.300000                  0.243750   24.000000    0.000000
50%     32.000000                  0.372500   29.000000    0.000000
75%     36.600000                  0.626250   41.000000    1.000000
max     67.100000                  2.420000   81.000000    1.000000
```

```python
import numpy as np
import matplotlib.pyplot as plt
from sklearn.linear_model import LinearRegression
def sigmoid(z):
    return 1/(1 + np.exp(-z))
X_linear = np.array([1, 2, 3, 4, 5]).reshape(-1, 1)
y_linear = np.array([2, 4, 6, 8, 10])
linear_model = LinearRegression()
linear_model.fit(X_linear, y_linear)
y_pred_linear = linear_model.predict(X_linear)
X_logistic = np.linspace(-6, 6, 100)
y_logistic = sigmoid(X_logistic)
```

```
plt.figure(figsize=(12, 5))
plt.subplot(1, 2, 1)
plt.scatter(X_linear, y_linear, color='blue', label="Actual Data")
plt.plot(X_linear, y_pred_linear, color='red', label="Linear
Regression")
plt.title("Linear Regression: y = b0 + b1 * x")
plt.xlabel("X values")
plt.ylabel("y values")
plt.legend()
plt.grid()
plt.subplot(1, 2, 2)
plt.plot(X_logistic, y_logistic, color='green', label="Sigmoid Curve")
plt.title("Logistic Regression: a(z) = 1 / (1 + e^-z)")
plt.xlabel("x values")
plt.ylabel("Probability (0 to 1)")
plt.legend()
plt.grid()
plt.show()
```

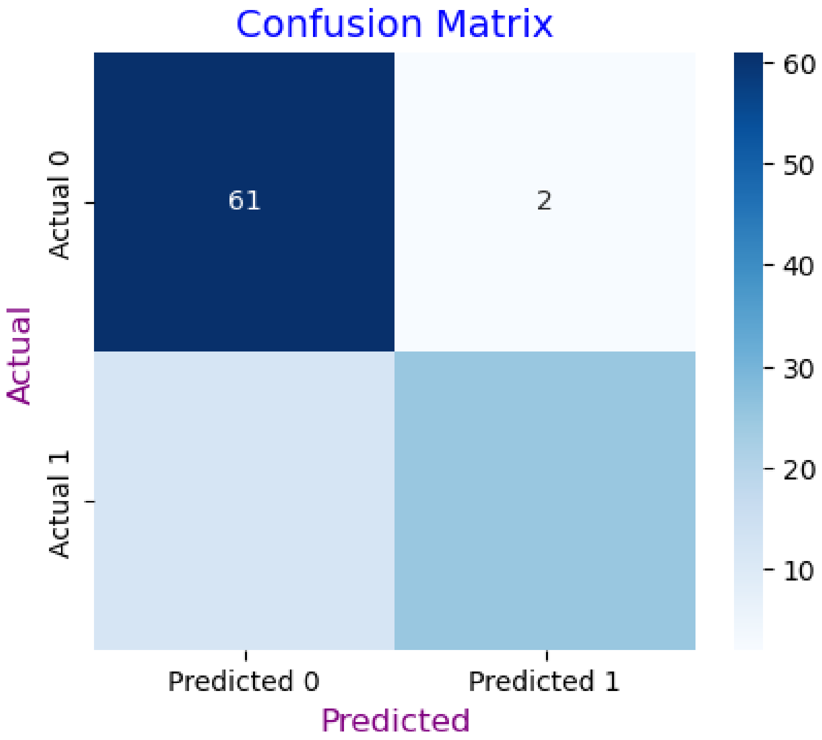


```
import pandas as pd
import numpy as np
import warnings
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix, classification_report
from tabulate import tabulate

# Ignore future warnings
warnings.simplefilter(action='ignore', category=FutureWarning)
```

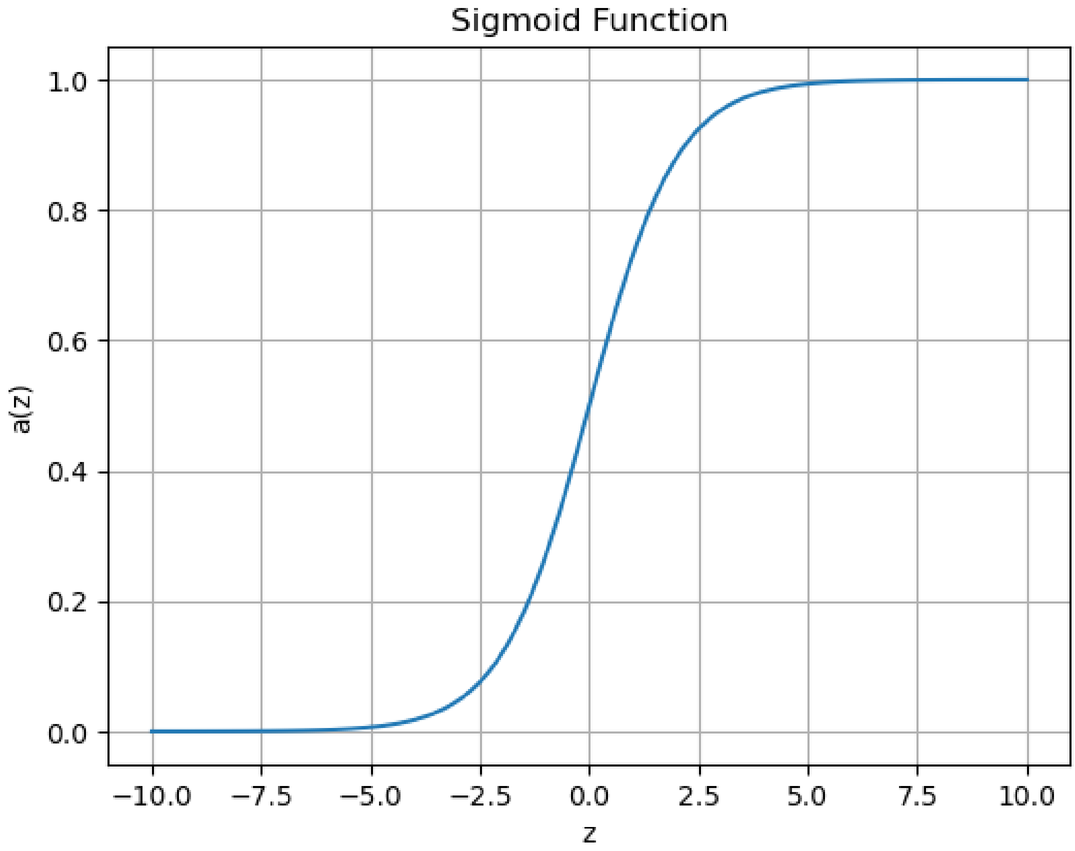
```python
# Load the dataset
dataset = pd.read_csv("Social_Network_Ads.csv")

# Preview the dataset
print("\nDataset Preview: \n")
print(tabulate(dataset.head(), headers='keys', tablefmt='grid'))

# Prepare features and target
X = dataset[['Age', 'EstimatedSalary']].values
y = dataset['Purchased'].values

# Split the dataset into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.25, random_state=42)

# Scale the features
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)

# Initialize and train the logistic regression model
multi_logistic = LogisticRegression(solver='lbfgs')
multi_logistic.fit(X_train, y_train)

# Make predictions on the test set
y_pred_multi = multi_logistic.predict(X_test)
print("\nLogistic Regression Predictions: \n", y_pred_multi)

# Create and display the confusion matrix
cm = confusion_matrix(y_test, y_pred_multi)
cm_df = pd.DataFrame(cm, index=["Actual 0", "Actual 1"],
columns=["Predicted 0", "Predicted 1"])
print("\nConfusion Matrix:\n")
print(tabulate(cm_df, headers='keys', tablefmt='grid'))

# Generate and display the classification report
report_df = pd.DataFrame(classification_report(y_test, y_pred_multi,
output_dict=True)).transpose()
print("\nClassification Report:\n")
print(tabulate(report_df, headers='keys', tablefmt='grid'))
```

```
Dataset Preview:

+----+-----------+----------+-------+-------------------+-------------
+
|    |   User ID | Gender   |   Age |   EstimatedSalary |   Purchased
|
+====+===========+==========+=======+===================+=============
+
|  0 |  15624510 | Male     |    19 |                19000 |           0
|
+----+-----------+----------+-------+--------------------+-------------
+
|  1 |  15810944 | Male     |    35 |                20000 |           0
|
+----+-----------+----------+-------+--------------------+-------------
+
|  2 |  15668575 | Female   |    26 |                43000 |           0
|
+----+-----------+----------+-------+--------------------+-------------
+
|  3 |  15603246 | Female   |    27 |                57000 |           0
|
+----+-----------+----------+-------+--------------------+-------------
+
|  4 |  15804002 | Male     |    19 |                76000 |           0
|
+----+-----------+----------+-------+--------------------+-------------
+

Logistic Regression Predictions:
 [0 1 0 1 0 0 1 0 0 0 0 1 0 0 0 0 1 1 0 1 0 0 0 1 0 0 1 0 1 0 0 0 1 0
1 0 0
 0 0 0 0 0 0 0 0 1 0 0 0 0 0 1 0 0 0 0 1 0 0 0 0 0 1 0 0 0 1 1 0 0 1 0
0 0
 0 0 1 1 0 0 0 0 1 0 1 0 0 1 0 0 1 0 0 0 0 0 1 0 1 0]

Confusion Matrix:

+----------+---------------+---------------+
|          |   Predicted 0 |   Predicted 1 |
+==========+===============+===============+
| Actual 0 |            61 |             2 |
+----------+---------------+---------------+
| Actual 1 |            12 |            25 |
+----------+---------------+---------------+

Classification Report:

+--------------+-------------+-----------+------------+-----------+
|              |   precision |   recall  |   f1-score |   support |
+==============+=============+===========+============+===========+
| 0            |    0.835616 | 0.968254  |   0.897059 |     63    |
+--------------+-------------+-----------+------------+-----------+
| 1            |    0.925926 | 0.675676  |   0.78125  |     37    |
+--------------+-------------+-----------+------------+-----------+
| accuracy     |    0.86     | 0.86      |   0.86     |      0.86 |
+--------------+-------------+-----------+------------+-----------+
| macro avg    |    0.880771 | 0.821965  |   0.839154 |    100    |
+--------------+------------+----------+------------+-----------+
| weighted avg |    0.869031 | 0.86     |   0.85421  |    100    |
+--------------+------------+----------+------------+-----------+
```

```python
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix
warnings.simplefilter(action='ignore', category=FutureWarning)
dataset = pd.read_csv("Social_Network_Ads.csv")
X = dataset[['Age', 'EstimatedSalary']].values
y = dataset['Purchased'].values
X_train, X_test, y_train, y_test = train_test_split(X, y,
test_size=0.25, random_state=42)
scaler = StandardScaler()
X_train = scaler.fit_transform(X_train)
X_test = scaler.transform(X_test)
logistic_model = LogisticRegression(solver='lbfgs')
logistic_model.fit(X_train, y_train)
y_pred = logistic_model.predict(X_test)
cm = confusion_matrix(y_test, y_pred)
plt.figure(figsize=(5, 4))
sns.heatmap(cm, annot=True, fmt='d', cmap='Blues',
xticklabels=["Predicted 0", "Predicted 1"], yticklabels=["Actual 0",
"Actual 1"])
plt.xlabel("Predicted", fontsize=12, color="purple")
plt.ylabel("Actual", fontsize=12, color="purple")
plt.title("Confusion Matrix", fontsize=14, color="blue")
plt.show()
```



```
import numpy as np
import matplotlib.pyplot as plt

def sigmoid(z):
    return 1/(1 + np.exp(-z))

z = np.linspace(-10, 10, 100)
plt.plot(z, sigmoid(z))
plt.title("Sigmoid Function")
plt.xlabel("z")
plt.ylabel("a(z)")
plt.grid()
plt.show()
```



```
13229 Shruti Manwar
```