Name: Nikita Thadani Class : D15C Roll No: 55

Experiment No: 5

Aim: Perform Regression Analysis using Scipy and Sci-kit learn.

Theory

1. Linear Regression:

Linear Regression is a supervised learning algorithm used to predict continuous numerical values.

- It assumes a linear relationship between the independent (input) and dependent (target) variables.
- The model minimizes the sum of squared errors to determine the best-fitting line.
- It is evaluated using performance metrics like Mean Squared Error (MSE) and R-squared (R^2).
- It works best when data follows a linear trend but is sensitive to outliers.

2. Logistic Regression:

Logistic Regression is a classification algorithm used for predicting binary outcomes (0 or 1).

- It applies the sigmoid function to convert linear outputs into probabilities.
- A threshold (typically 0.5) is used to classify data points.
- The model is trained using gradient descent to minimize the log loss function.
- Performance is assessed using accuracy, precision, recall, F1-score, and confusion matrices.

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1.Import necessary libraries and load the dataset

+ Code + Text

```
import pandas as pd

# Load the dataset
file_path = "/content/Loan_default.csv"
df = pd.read_csv(file_path)

# Display basic info
print(df.head())  # Show first few rows
print(df.info())  # Show dataset summary
```

2.Check for missing values and anomalies in the dataset.

```
      LoanID  Age  Income  LoanAmount  CreditScore  MonthsEmployed
0  I38PQUQS96   56   85994       50587          520              80
1  HPSK72WA7R   69   50432      124440          458              15
2  C1OZ6DPJ8Y   46   84208      129188          451              26
3  V2KKSFM3UN   32   31713       44799          743               0
4  EY08JDHTZP   60   20437        9139          633               8

   NumCreditLines  InterestRate  LoanTerm  DTIRatio     Education  \
0               4         15.23        36      0.44   Bachelor's
1               1          4.81        60      0.68     Master's
2               3         21.17        24      0.31     Master's
3               3          7.07        24      0.23  High School
4               4          6.51        48      0.73   Bachelor's

  EmploymentType MaritalStatus HasMortgage HasDependents LoanPurpose
0      Full-time      Divorced         Yes            Yes       Other
1      Full-time       Married          No             No       Other
2     Unemployed      Divorced         Yes            Yes        Auto
3      Full-time       Married          No             No    Business
4     Unemployed      Divorced          No            Yes        Auto

  HasCoSigner  Default
0         Yes        0
1         Yes        0
2          No        1
3          No        0
4          No        0
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 255347 entries, 0 to 255346
Data columns (total 18 columns):
```

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a) Perform Logistic regression to find out relation between variables

3.Train the dataset using Linear Regression

+ Code + Text

```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeRegressor
from sklearn.metrics import accuracy_score, classification_report, confusion_matrix, mean_squared_error

# Load dataset
file_path = "/content/Loan_default.csv"
df = pd.read_csv(file_path)

# Drop LoanID as it's just an identifier
df.drop(columns=["LoanID"], inplace=True)

# Encode categorical variables
categorical_cols = ["Education", "EmploymentType", "MaritalStatus", "HasMortgage",
                    "HasDependents", "LoanPurpose", "HasCoSigner"]

label_encoders = {}
for col in categorical_cols:
    le = LabelEncoder()
    df[col] = le.fit_transform(df[col])
    label_encoders[col] = le

# Split data into features and target
X = df.drop(columns=["Default"])
y = df["Default"]

# Split into training and test sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42, stratify=y)

# (a) Perform Logistic Regression
log_reg = LogisticRegression(max_iter=1000, random_state=42)
log_reg.fit(X_train, y_train)

y_pred = log_reg.predict(X_test)

# Logistic Regression Evaluation
print("Logistic Regression Accuracy:", accuracy_score(y_test, y_pred))
print("Confusion Matrix:\n", confusion_matrix(y_test, y_pred))
print("Classification Report:\n", classification_report(y_test, y_pred))
```

4.Train the dataset using Logistic Regression and compute:

- **Accuracy Score**
- **Precision, Recall, and F1-score**

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```
Logistic Regression Accuracy: 0.8854709222635598
Confusion Matrix:
 [[45028   111]
 [ 5738   193]]
Classification Report:
              precision    recall  f1-score   support

           0       0.89      1.00      0.94     45139
           1       0.63      0.03      0.06      5931

    accuracy                           0.89     51070
   macro avg       0.76      0.52      0.50     51070
weighted avg       0.86      0.89      0.84     51070
```

b) Apply regression model technique to predict the data on the above dataset.

- **Find Mean Squared Error (MSE) and R-squared score.**

```
reg_model = DecisionTreeRegressor(random_state=42)
reg_model.fit(X_train, y_train)

y_pred_reg = reg_model.predict(X_test)

# Regression Model Evaluation
mse = mean_squared_error(y_test, y_pred_reg)
print("Decision Tree Regression MSE:", mse)
```

```
Decision Tree Regression MSE: 0.19674955942823574
```

```
from sklearn.metrics import r2_score

y_prob = log_reg.predict_proba(X_test)[:, 1]
r_squared = r2_score(y_test, y_prob)

print("R-squared value:", r_squared)
```

```
R-squared value : 0.3017
```

Conclusion:

The logistic regression model achieves 88.54% accuracy, but its recall for loan defaulters (Class 1) is very low (0.03), indicating poor detection of actual defaults. The decision tree regression model has an MSE of 0.1967 and an R^2 score of 0.3017, showing moderate predictive power. Improving class balance and feature selection could enhance model performance.

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