Logistic-Regression

January 14, 2025

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'''
   Logistic Regression -->

   Logistic Regression is a supervised machine learning algorithm used for␣
↪binary
   and multi-class classification problems. It predicts probabilities and␣
↪classifies data
   based on a threshold (usually 0.5). Despite its name, Logistic Regression␣
↪is a
   classification algorithm, not a regression algorithm.
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'''
   Problems -->

   Linear Decision Boundary :

   Assumes a linear relationship between the independent variables and the␣
↪log-odds of the target.
   Fails to perform well with non-linear relationships unless transformed␣
↪features or kernels are used.

   Sensitive to Multicollinearity :

   Poor performance when independent variables are highly correlated unless␣
↪addressed (e.g., using PCA).

   Performance with Imbalanced Data :

   Struggles with datasets where classes are highly imbalanced unless handled␣
↪with techniques
   like oversampling or class weighting.

   Feature Engineering Dependence :

   Requires careful feature engineering, scaling, and selection for optimal␣
↪performance.
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   Assumes Independence of Features :

   Assumes that features are not highly dependent on one another, which may␣
↪not hold in real-world data.

   Limited to Linearly Separable Data :

   Struggles to classify datasets where classes are not linearly separable.

   Not Suitable for Large Number of Features :

   While efficient, it might not scale well for datasets with a very large␣
↪number of irrelevant or
   redundant features without proper preprocessing.
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'''
   When to Use Logistic Regression -->

   Logistic regression is ideal for :

   Problems requiring simple, interpretable models.
   Binary or multi-class classification with linearly separable data.
   Datasets with fewer features and no strong multicollinearity.
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'''
   Applications of Logistic Regression -->

   Binary Classification :

   Spam detection (spam vs. not spam)
   Disease prediction (has disease vs. doesn't have disease)

   Multi-Class Classification (with extensions like one-vs-rest or multinomial␣
↪logistic regression) :

   Handwritten digit recognition
   Customer segmentation

   Real-world Applications :

   Credit scoring
   Marketing campaigns
   Fraud detection
'''
```

[1]:
```
#   Importing Libraries -->

import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import confusion_matrix, accuracy_score
```

[2]:
```
#   Importing Dataset -->

data = pd.read_csv('Data/Social_Network_Ads.csv')
data.head(10)
```

[2]:

	Age	EstimatedSalary	Purchased
0	19	19000	0
1	35	20000	0
2	26	43000	0
3	27	57000	0
4	19	76000	0
5	27	58000	0
6	27	84000	0
7	32	150000	1
8	25	33000	0
9	35	65000	0

[3]:
```
x_data = data.iloc[:, :-1].values
y_data = data.iloc[:, -1].values
```

[4]:
```
#   Splitting Data -->

x_train, x_test, y_train, y_test = train_test_split(x_data, y_data, test_size=0.
 ↪25, random_state=42)
```

[5]:
```
x_train
```

[5]:
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```

[6]:
```
y_train
```

[6]:
```
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```

[7]:
```
#   Scaling Features -->

sc = StandardScaler()
x_train = sc.fit_transform(x_train)
x_test = sc.transform(x_test)
```

[8]:
```
x_train
```

[8]:
```
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```

```
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[-0.2677513 ,  2.25216949],
[-0.2677513 ,  0.20739823],
[ 0.3214325 ,  0.26582026],
```

```
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[ 1.1070109 , -0.14313399],
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```

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```

```
       [-1.34792161, -1.25315268],
       [-1.15152701, -1.01946453],
       [ 0.5178271 ,  1.84321524],
       [ 0.1250379 ,  0.20739823],
       [-0.56234321,  0.47029739]])
```

[9]:
```
x_test
```

[9]:
```
array([[ 0.812419  , -1.39920777],
       [ 2.0889839 ,  0.52871943],
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       [ 1.0088136 ,  0.76240757],
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       [-0.75873781, -0.23076704],
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       [-0.85693511,  0.38266434],
       [ 0.2232352 ,  0.14897619],
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       [-0.2677513 , -0.14313399],
       [ 1.4998001 , -1.04867555],
       [-1.44611891, -0.6397213 ],
       [-1.74071081, -1.36999675],
       [-0.75873781,  0.49950841],
       [-0.2677513 ,  1.11293979],
       [ 1.4016028 , -0.93183148],
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       [ 0.1250379 , -0.8149874 ],
       [ 1.794392  , -0.28918908],
       [-1.54431621, -1.25315268],
       [-0.85693511,  0.29503128],
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       [-1.83890811, -1.48684082],
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       [-0.0713567 , -0.49366621],
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       [-1.83890811, -1.42841878],
       [ 0.812419  , -0.84419842],
       [-1.83890811,  0.0029211 ],
       [-0.169554  ,  2.16453644],
       [-0.95513241,  0.26582026],
       [ 0.2232352 ,  1.08372877],
       [-0.2677513 ,  0.14897619],
       [-0.0713567 , -0.43524417],
       [ 0.0268406 , -0.14313399],
       [-1.15152701, -1.16551962],
```

```
[-1.93710541, -0.05550093],
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[ 0.6160244 ,  2.01848135],
[-0.85693511, -0.25997806],
[-0.66054051,  0.03213212],
[ 1.0088136 , -0.84419842],
[-0.36594861, -0.78577639],
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[ 1.4998001 ,  0.35345332],
[ 0.0268406 , -0.43524417],
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[ 0.9106163 ,  2.16453644],
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```
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       [ 0.4196298 , -0.17234501],
       [ 1.4998001 ,  2.13532542],
       [-0.36594861,  1.22978386]])
```

[10]:
```
#   Building The Model -->

model = LogisticRegression(random_state=42)
model.fit(x_train, y_train)
```

[10]:
```
LogisticRegression(random_state=42)
```

[11]:
```
#   Predicting Result -->

y_pred = model.predict(sc.transform([[30,87000]]))

if y_pred == 0 :
    print("No")
else :
    print("Yes")
```

```
No
```

[12]:
```
#   Predicting Test Set Results -->

y_pred = model.predict(x_test)
print(np.concatenate((y_pred.reshape(len(y_pred),1), y_test.
  ↪reshape(len(y_test),1)),1))
```

```
[[0 0]
 [1 1]
 [0 0]
 [1 1]
 [0 0]
 [0 0]
 [1 1]
 [0 0]
 [0 0]
```

```
[0 0]
[0 0]
[1 1]
[0 0]
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[0 0]
[0 0]
[1 1]
[0 0]
[1 1]
[0 1]]
```

[13]:
```
#   Confusion Matrix -->

confusion_matrix(y_test, y_pred)
```

[13]:
```
array([[61,  2],
       [12, 25]], dtype=int64)
```

[14]:
```
#   Accuracy Score -->

print(accuracy_score(y_test, y_pred))
```

```
0.86
```