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.

Setup

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error, confusion_matrix
from sklearn.preprocessing import LabelEncoder
```

In [2]:
```
sns.set()
np.random.seed(0)
```

Loading the dataset

In [3]:
```
df=pd.read_csv('Social_Network_Ads.csv')
```

In [4]:
```
df.shape
```

Out[4]:
```
(400, 5)
```

In [5]:
```
df.head()
```

Out[5]:

	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

In [6]:
```
gender = df['Gender']
```

In [7]:
```
le = LabelEncoder()
le.fit(['Male', 'Female'])
```

Out[7]:
```
LabelEncoder()
```

In [8]:
```
gender = le.transform(gender)
```

In [9]:

```
df['Gender'] = gender
```

In [10]:
```
df
```

Out[10]:

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	1	19	19000	0
1	15810944	1	35	20000	0
2	15668575	0	26	43000	0
3	15603246	0	27	57000	0
4	15804002	1	19	76000	0
...	...	...	...	...	...
395	15691863	0	46	41000	1
396	15706071	1	51	23000	1
397	15654296	0	50	20000	1
398	15755018	1	36	33000	0
399	15594041	0	49	36000	1

400 rows × 5 columns

Splitting into Train and Test data

In [11]:
```
X, Y = df.drop('Purchased', axis='columns'), df['Purchased']
```

In [12]:
```
X
```

Out[12]:

	User ID	Gender	Age	EstimatedSalary
0	15624510	1	19	19000
1	15810944	1	35	20000
2	15668575	0	26	43000
3	15603246	0	27	57000
4	15804002	1	19	76000
...	...	...	...	...
395	15691863	0	46	41000
396	15706071	1	51	23000
397	15654296	0	50	20000
398	15755018	1	36	33000
399	15594041	0	49	36000

400 rows × 4 columns

In [13]:
```
Y
```

Out[13]:
```
0      0
1      0
2      0
3      0
```

```
4      0
       ..
395    1
396    1
397    1
398    0
399    1
Name: Purchased, Length: 400, dtype: int64
```

In [14]:
```
X_train, X_val, Y_train, Y_val = train_test_split(X, Y, random_state=0)
```

In [15]:
```
X_train.shape, X_val.shape, Y_train.shape, Y_val.shape
```

Out[15]:
```
((300, 4), (100, 4), (300,), (100,))
```

Training the Logistic Regression Model

In [16]:
```
model = LogisticRegression(random_state=0)
```

In [17]:
```
model.fit(X_train, Y_train)
```

Out[17]:
```
LogisticRegression(random_state=0)
```

Evaluation

In [18]:
```
Y_pred = model.predict(X_val)
```

In [19]:
```
error = mean_squared_error(Y_val, Y_pred)
```

In [20]:
```
print("Validation error (MSE) : ", error)
```

```
Validation error (MSE) :  0.19
```

Confusion Matrix

In [21]:
```
cm = confusion_matrix(Y_val, Y_pred)
```

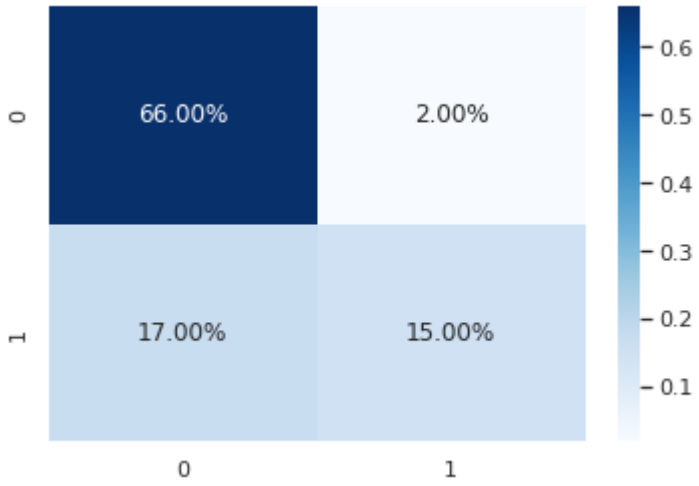
In [22]:
```
cm
```

Out[22]:
```
array([[66,  2],
       [17, 15]])
```

In [23]:
```
np.sum(cm, axis=1)
```

Out[23]:
```
array([68, 32])
```

In [24]:
```
sns.heatmap(cm/np.sum(cm), annot=True, fmt='.2%', cmap='Blues')
plt.show()
```



In [25]:

```
def evaluate_metrics_for_class(cm):
    row_sums, col_sums = np.sum(cm, axis=1), np.sum(cm, axis=0)
    TP, FP, FN = cm[0][0], row_sums[0] - cm[0][0], col_sums[0] - cm[0][0]
    TN = np.sum(cm) - TP - FP - FN
    precision = TP / (TP + FP)
    recall = TP / (TP + FN)
    return TP, FP, FN, TN, precision, recall
```

In [26]:

```
TP, FP, FN, TN, precision, recall = evaluate_metrics_for_class(cm)
```

In [27]:

```
print("TP : ", TP)
print("FP : ", FP)
print("FN : ", FN)
print("TN : ", TN)
print("Precision : ", precision)
print("Recall : ", recall)
```

```
TP :  66
FP :  2
FN :  17
TN :  15
Precision :  0.9705882352941176
Recall :  0.7951807228915663
```