In [ ]:
```
"""
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.
"""
```

In [10]:
```
# Importing the dependencies

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

In [2]:
```
# Importing dataset from local file

df = pd.read_csv("Social_Network_Ads.csv")
```

In [3]:
```
df
```

Out[3]:

	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
...	...	...	...	...	...
395	15691863	Female	46	41000	1
396	15706071	Male	51	23000	1
397	15654296	Female	50	20000	1
398	15755018	Male	36	33000	0
399	15594041	Female	49	36000	1

400 rows × 5 columns

In [4]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype 
---  ------           --------------  ----- 
 0   User ID          400 non-null    int64 
 1   Gender           400 non-null    object
 2   Age              400 non-null    int64 
 3   EstimatedSalary  400 non-null    int64 
 4   Purchased        400 non-null    int64 
dtypes: int64(4), object(1)
memory usage: 15.8+ KB
```

In [5]:
```
df.isnull().sum()

# no null values;
```

Out[5]:
```
User ID            0
Gender             0
Age                0
EstimatedSalary    0
Purchased          0
dtype: int64
```

In [6]:
```
df.shape
```

Out[6]:
```
(400, 5)
```

In [9]:
```
df.describe()
```

Out[9]:

	User ID	Age	EstimatedSalary	Purchased
count	4.000000e+02	400.000000	400.000000	400.000000
mean	1.569154e+07	37.655000	69742.500000	0.357500
std	7.165832e+04	10.482877	34096.960282	0.479864
min	1.556669e+07	18.000000	15000.000000	0.000000
25%	1.562676e+07	29.750000	43000.000000	0.000000
50%	1.569434e+07	37.000000	70000.000000	0.000000
75%	1.575036e+07	46.000000	88000.000000	1.000000
max	1.581524e+07	60.000000	150000.000000	1.000000

In [12]:
```
X = df.iloc[:, [2, 3]].values
# X = df[['EstimatedSalary','Age']]
y = df.iloc[:, 4].values
# y = df['Purchased']
```

Test-size = 0.2

In [63]:
```
# Splitting the dataset into the Training set and Test set

from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.2, random_state = 42)
```

In [64]:
```
# Feature Scaling
from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

In [65]:
```
from sklearn.linear_model import LogisticRegression
lr = LogisticRegression(random_state = 42)
lr.fit(X_train, y_train)
```

Out[65]:
```
▾ LogisticRegression
LogisticRegression(random_state=42)
```

In [66]:
```
y_pred = lr.predict(X_test)
```

In [67]:
```
y_pred
```

Out[67]:
```
array([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])
```

In [68]:
```
y_test
```

Out[68]:
```
array([0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 1, 0, 0,
       1, 1, 0, 1, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       1, 1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 0, 1])
```

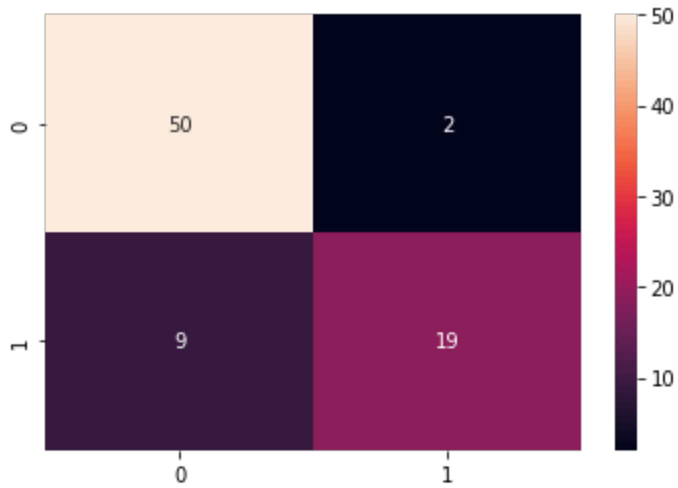
In [69]:
```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
print(cm)

# TP FP
# FN TN
```

```
[[50  2]
 [ 9 19]]
```

In [70]:
```
sns.heatmap(cm ,annot=True)
```

Out[70]: <AxesSubplot: >



In [71]:
```
from sklearn.metrics import classification_report
print(classification_report(y_test,y_pred))
```

```
              precision    recall  f1-score   support

           0       0.85      0.96      0.90        52
           1       0.90      0.68      0.78        28

    accuracy                           0.86        80
   macro avg       0.88      0.82      0.84        80
weighted avg       0.87      0.86      0.86        80
```

In [72]:
```
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_test, y_pred)
accuracy
```

Out[72]: 0.8625

In [73]:
```
error_rate = 1-accuracy
error_rate
```

Out[73]: 0.13749999999999996

Test-size = 0.25

In [39]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.25, random_state=25)
```

In [40]:
```
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

In [41]:
```
lr = LogisticRegression(random_state=25)
lr.fit(X_train, y_train)
```

Out[41]:
```
▾ LogisticRegression
LogisticRegression(random_state=25)
```

In [42]:
```
y_pred = lr.predict(X_test)
```

In [43]:
```
cm = confusion_matrix(y_test, y_pred)
```

In [44]:
```
print(cm)

# TP FP
# FN TN
```

```
[[58  8]
 [13 21]]
```

In [45]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.82      0.88      0.85        66
           1       0.72      0.62      0.67        34

    accuracy                           0.79       100
   macro avg       0.77      0.75      0.76       100
weighted avg       0.79      0.79      0.79       100
```

In [ ]:
```
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_test, y_pred)
accuracy
```

Test-size = 0.3

In [52]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3,random_state=25)
```

In [53]:
```
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

In [54]:
```
lr = LogisticRegression(random_state=30)
lr.fit(X_train, y_train)
```

Out[54]:
```
▾ LogisticRegression
LogisticRegression(random_state=30)
```

In [55]:
```
y_pred = lr.predict(X_test)
```

In [56]:
```
cm = confusion_matrix(y_test, y_pred)
```

In [57]:
```
print(cm)

# TP FP
# FN TN
```

```
[[70  7]
 [16 27]]
```

In [58]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

           0       0.81      0.91      0.86        77
           1       0.79      0.63      0.70        43

    accuracy                           0.81       120
   macro avg       0.80      0.77      0.78       120
weighted avg       0.81      0.81      0.80       120
```

In [59]:
```
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_test, y_pred)
accuracy
```

Out[59]: 0.8083333333333333

In [61]:
```
error_rate = 1-accuracy
error_rate
```

Out[61]: 0.19166666666666665

In [ ]: