heart-data

February 10, 2023

[256]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings('ignore')
```

[257]:
```
heart_data=pd.read_csv('heart.csv')
heart_data.head()
```

[257]:

	Age	Sex	ChestPainType	RestingBP	Cholesterol	FastingBS	RestingECG	MaxHR	\
0	40	M	ATA	140	289	0	Normal	172	
1	49	F	NAP	160	180	0	Normal	156	
2	37	M	ATA	130	283	0	ST	98	
3	48	F	ASY	138	214	0	Normal	108	
4	54	M	NAP	150	195	0	Normal	122	

	ExerciseAngina	Oldpeak	ST_Slope	HeartDisease
0	N	0.0	Up	0
1	N	1.0	Flat	1
2	N	0.0	Up	0
3	Y	1.5	Flat	1
4	N	0.0	Up	0

1 Data Information

- No Null Values

[258]:
```
heart_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 918 entries, 0 to 917
Data columns (total 12 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Age             918 non-null    int64
 1   Sex             918 non-null    object
 2   ChestPainType   918 non-null    object
 3   RestingBP       918 non-null    int64
```

```
 4   Cholesterol     918 non-null    int64
 5   FastingBS       918 non-null    int64
 6   RestingECG      918 non-null    object
 7   MaxHR           918 non-null    int64
 8   ExerciseAngina  918 non-null    object
 9   Oldpeak         918 non-null    float64
 10  ST_Slope        918 non-null    object
 11  HeartDisease    918 non-null    int64
dtypes: float64(1), int64(6), object(5)
memory usage: 86.2+ KB
```

2 Data Description

[259]:
```
heart_data.describe()
```

[259]:
```
              Age   RestingBP  Cholesterol   FastingBS       MaxHR  \
count  918.000000  918.000000   918.000000  918.000000  918.000000
mean    53.510893  132.396514   198.799564    0.233115  136.809368
std      9.432617   18.514154   109.384145    0.423046   25.460334
min     28.000000    0.000000     0.000000    0.000000   60.000000
25%     47.000000  120.000000   173.250000    0.000000  120.000000
50%     54.000000  130.000000   223.000000    0.000000  138.000000
75%     60.000000  140.000000   267.000000    0.000000  156.000000
max     77.000000  200.000000   603.000000    1.000000  202.000000

          Oldpeak  HeartDisease
count  918.000000    918.000000
mean     0.887364      0.553377
std      1.066570      0.497414
min     -2.600000      0.000000
25%      0.000000      0.000000
50%      0.600000      1.000000
75%      1.500000      1.000000
max      6.200000      1.000000
```

3 Checking For Outliers

- Age

[260]:
```
heart_data[heart_data.Age>3*heart_data.Age.std()*heart_data.Age.mean()]
```

[260]:
```
Empty DataFrame
Columns: [Age, Sex, ChestPainType, RestingBP, Cholesterol, FastingBS,
RestingECG, MaxHR, ExerciseAngina, Oldpeak, ST_Slope, HeartDisease]
Index: []
```

- Cholesterol

[261]:
```
heart_data[heart_data.Cholesterol>3*heart_data.Cholesterol.std()*heart_data.
↪Cholesterol.mean()]
```

[261]:
```
Empty DataFrame
Columns: [Age, Sex, ChestPainType, RestingBP, Cholesterol, FastingBS,
RestingECG, MaxHR, ExerciseAngina, Oldpeak, ST_Slope, HeartDisease]
Index: []
```

- Resting BP(Blood Pressure)

[262]:
```
heart_data[heart_data.RestingBP>3*heart_data.RestingBP.std()*heart_data.
↪RestingBP.mean()]
```

[262]:
```
Empty DataFrame
Columns: [Age, Sex, ChestPainType, RestingBP, Cholesterol, FastingBS,
RestingECG, MaxHR, ExerciseAngina, Oldpeak, ST_Slope, HeartDisease]
Index: []
```

- Max HR(Heart Rate)

[263]:
```
heart_data[heart_data.MaxHR>3*heart_data.MaxHR.std()*heart_data.MaxHR.mean()]
```

[263]:
```
Empty DataFrame
Columns: [Age, Sex, ChestPainType, RestingBP, Cholesterol, FastingBS,
RestingECG, MaxHR, ExerciseAngina, Oldpeak, ST_Slope, HeartDisease]
Index: []
```

- We Infer that data do not have outliers

[264]:
```
X=heart_data.drop(columns="HeartDisease")
Y=heart_data[["HeartDisease"]]
```

4 Labelling Categorical Data

- Categorical Data is:

[265]:
```
cat_column=X.select_dtypes("object").columns
cat_column
```

[265]:
```
Index(['Sex', 'ChestPainType', 'RestingECG', 'ExerciseAngina', 'ST_Slope'],
dtype='object')
```

[266]:
```
from sklearn.preprocessing import LabelEncoder
lbl=LabelEncoder()
X.Sex=lbl.fit_transform(X.Sex)
X.ChestPainType=lbl.fit_transform(X.ChestPainType)
X.RestingECG=lbl.fit_transform(X.RestingECG)
X.ExerciseAngina=lbl.fit_transform(X.ExerciseAngina)
```

```
X.ST_Slope=lbl.fit_transform(X.ST_Slope)
X.head()
```

[266]:

	Age	Sex	ChestPainType	RestingBP	Cholesterol	FastingBS	RestingECG	\
0	40	1	1	140	289	0	1	
1	49	0	2	160	180	0	1	
2	37	1	1	130	283	0	2	
3	48	0	0	138	214	0	1	
4	54	1	2	150	195	0	1	

	MaxHR	ExerciseAngina	Oldpeak	ST_Slope
0	172	0	0.0	2
1	156	0	1.0	1
2	98	0	0.0	2
3	108	1	1.5	1
4	122	0	0.0	2

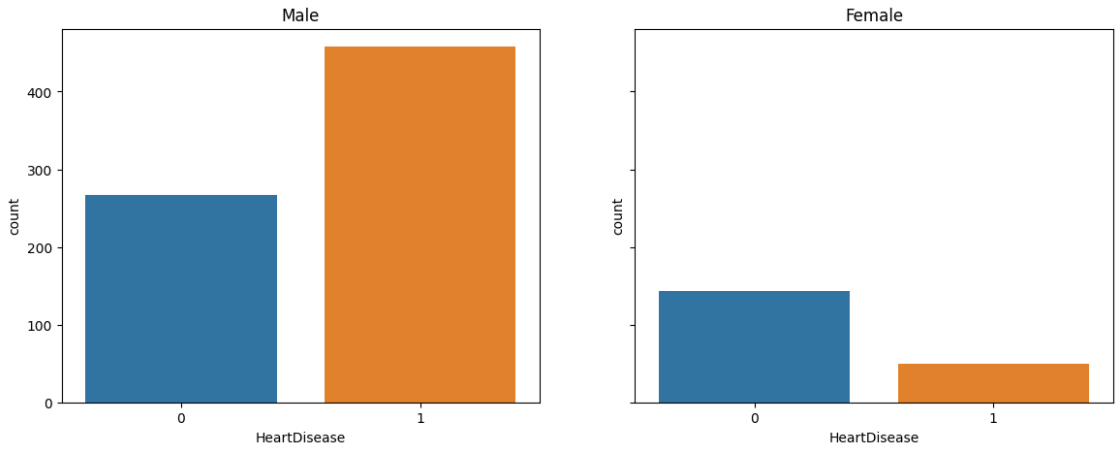
5 Visualizing Data

6 Sex Vs HeartDisease

- 0 is No HeartDisease
- 1 is HeartDisease

[267]:
```
import seaborn as sns
fig,(ax1,ax2)=plt.subplots(1,2,figsize=(14,5),sharey=True)
ax1.set_title('Male')
sns.countplot(heart_data[heart_data['Sex']=="M"]['HeartDisease'],ax=ax1)
ax2.set_title('Female')
sns.countplot(heart_data[heart_data['Sex']=="F"]['HeartDisease'],ax=ax2)
```

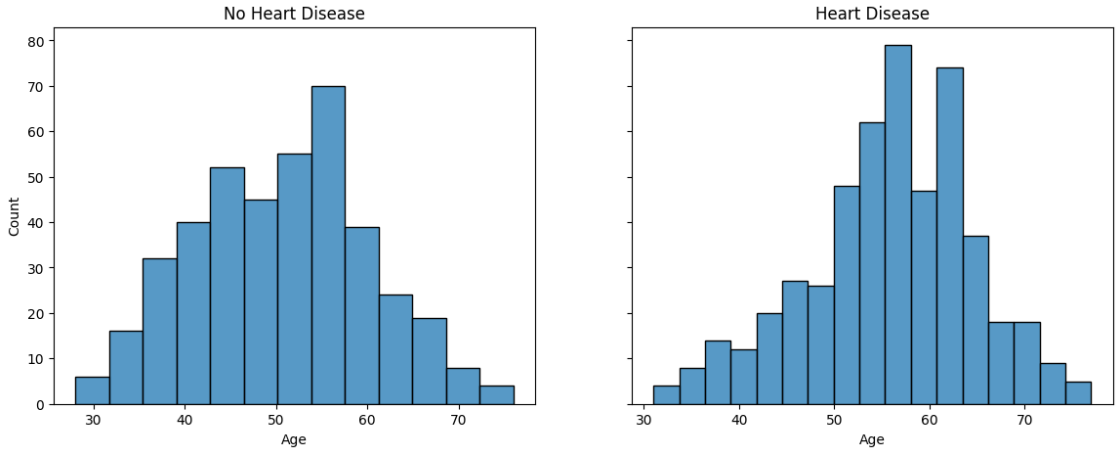
[267]: <AxesSubplot:title={'center':'Female'}, xlabel='HeartDisease', ylabel='count'>



7 Age Vs HeartDisease

[268]:
```
fig,(ax1,ax2)=plt.subplots(1,2,figsize=(14,5),sharey=True)
ax1.set_title('No Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==0]['Age'],ax=ax1)
ax2.set_title('Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==1]['Age'],ax=ax2)
```

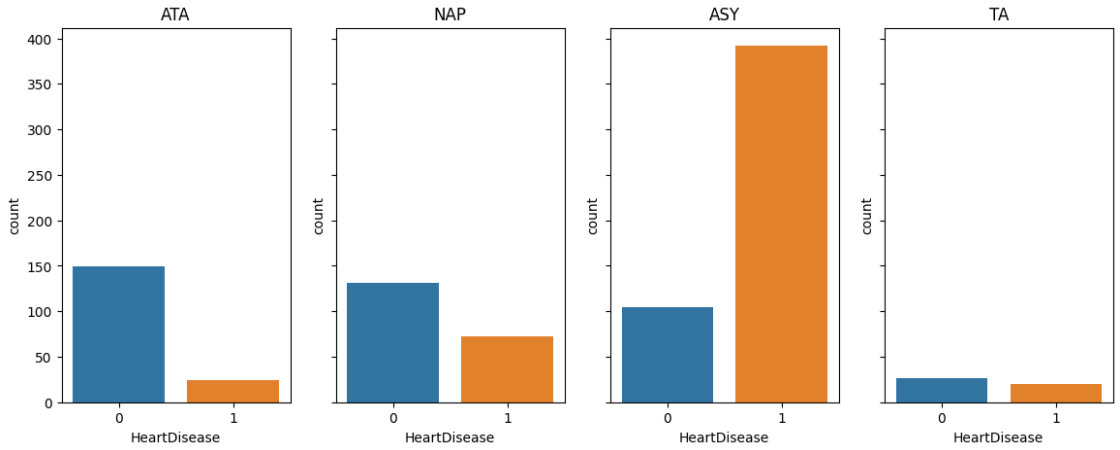
[268]:
```
<AxesSubplot:title={'center':'Heart Disease'}, xlabel='Age', ylabel='Count'>
```



8 Chest Pain Type Vs HeartDisease

[269]:
```
fig,(ax1,ax2,ax3,ax4)=plt.subplots(1,4,figsize=(14,5),sharey=True)
ax1.set_title('ATA')
sns.countplot(heart_data[heart_data.
  ↪ChestPainType=="ATA"]['HeartDisease'],ax=ax1)
ax2.set_title('NAP')
sns.countplot(heart_data[heart_data.
  ↪ChestPainType=="NAP"]['HeartDisease'],ax=ax2)
ax3.set_title('ASY')
sns.countplot(heart_data[heart_data.
  ↪ChestPainType=="ASY"]['HeartDisease'],ax=ax3)
ax4.set_title('TA')
sns.countplot(heart_data[heart_data.ChestPainType=="TA"]['HeartDisease'],ax=ax4)
```

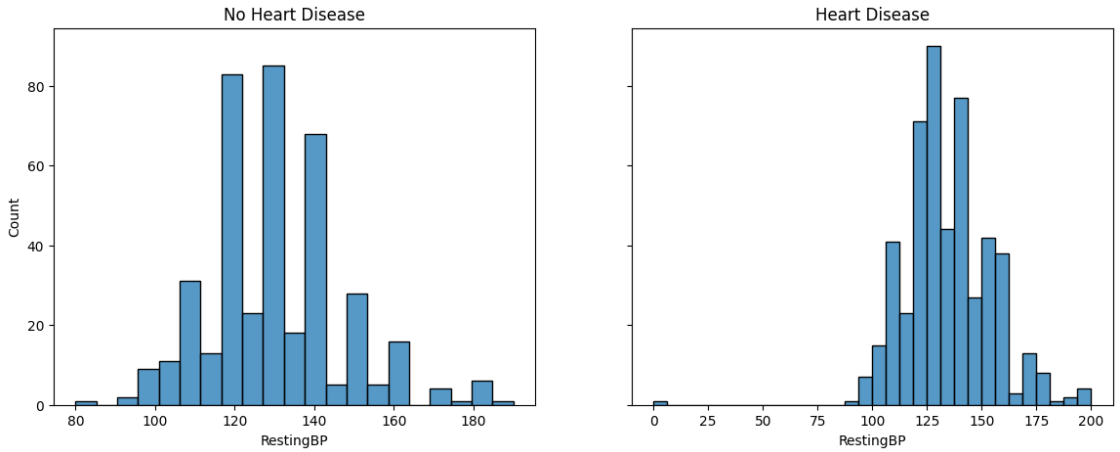
[269]:
```
<AxesSubplot:title={'center':'TA'}, xlabel='HeartDisease', ylabel='count'>
```



9 RestingBP vs HeartDisease

[270]:
```
fig,(ax1,ax2)=plt.subplots(1,2,figsize=(14,5),sharey=True)
ax1.set_title('No Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==0]['RestingBP'],ax=ax1)
ax2.set_title('Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==1]['RestingBP'],ax=ax2)
```

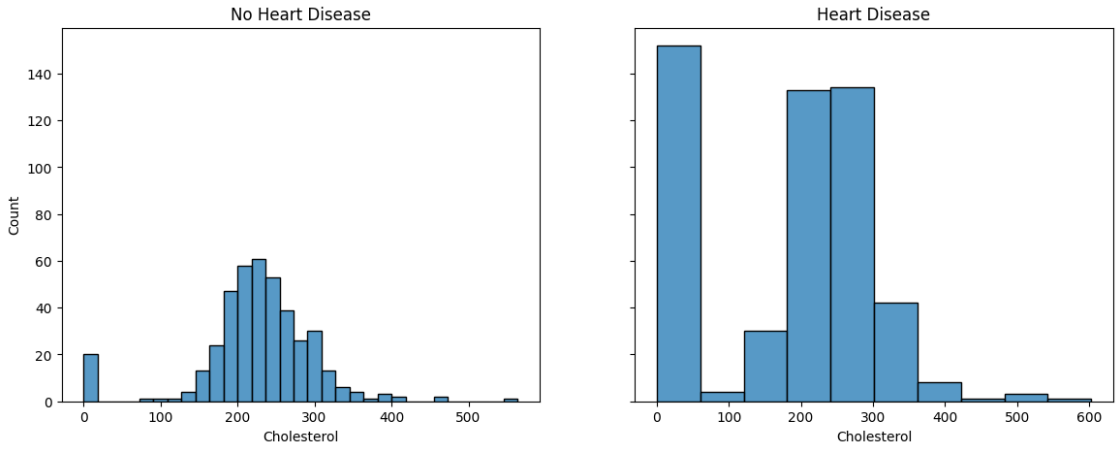
[270]:
```
<AxesSubplot:title={'center':'Heart Disease'}, xlabel='RestingBP',
ylabel='Count'>
```



10 Cholesterol vs HeartDisease

[271]:
```
fig,(ax1,ax2)=plt.subplots(1,2,figsize=(14,5),sharey=True)
ax1.set_title('No Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==0]['Cholesterol'],ax=ax1)
ax2.set_title('Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==1]['Cholesterol'],ax=ax2)
```

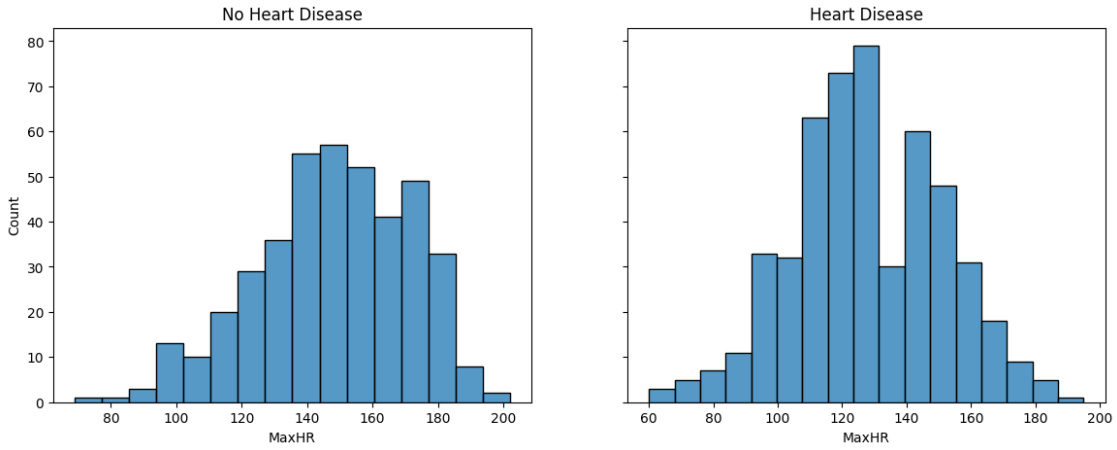
[271]:
```
<AxesSubplot:title={'center':'Heart Disease'}, xlabel='Cholesterol',
ylabel='Count'>
```



11 MaxHR vs HeartDisease

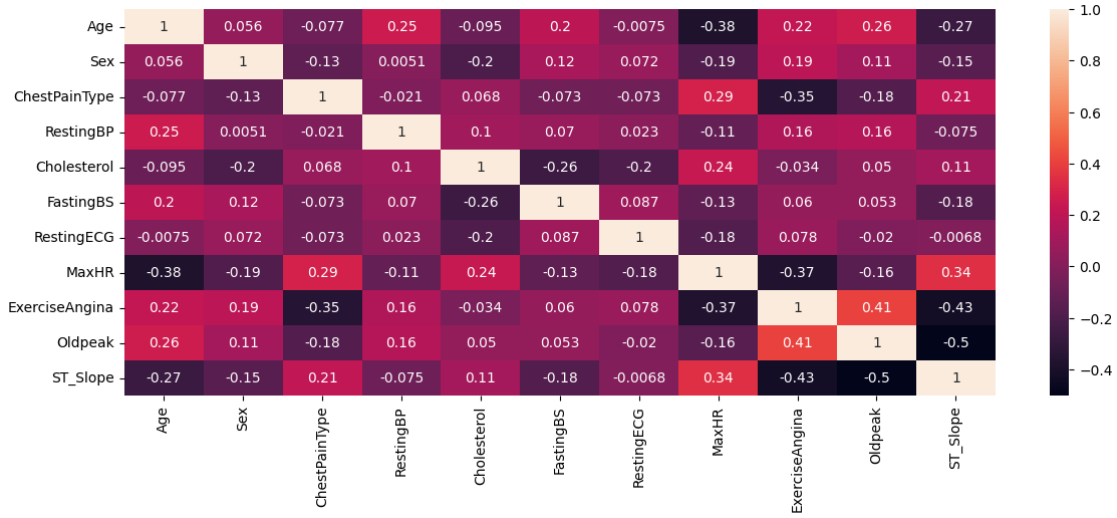
[272]:
```
fig,(ax1,ax2)=plt.subplots(1,2,figsize=(14,5),sharey=True)
ax1.set_title('No Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==0]['MaxHR'],ax=ax1)
ax2.set_title('Heart Disease')
sns.histplot(heart_data[heart_data['HeartDisease']==1]['MaxHR'],ax=ax2)
```

[272]:
```
<AxesSubplot:title={'center':'Heart Disease'}, xlabel='MaxHR', ylabel='Count'>
```



[273]:
```
plt.figure(figsize=(14,5))
sns.heatmap(X.corr(),annot=True)
```

[273]: <AxesSubplot:>



12 Using Random Forest Classifier

13 Scalling Data

[274]:
```
from sklearn.preprocessing import StandardScaler
num_col=X.columns.drop(['Sex', 'ChestPainType', 'RestingECG', 'ExerciseAngina',␣
 ↪'ST_Slope'])
```

```
num_col=num_col.drop('Oldpeak')
sc=StandardScaler()
X[num_col]=sc.fit_transform(X[num_col])
X.head()
```

[274]:

	Age	Sex	ChestPainType	RestingBP	Cholesterol	FastingBS	\
0	-1.433140	1	1	0.410909	0.825070	-0.551341	
1	-0.478484	0	2	1.491752	-0.171961	-0.551341	
2	-1.751359	1	1	-0.129513	0.770188	-0.551341	
3	-0.584556	0	0	0.302825	0.139040	-0.551341	
4	0.051881	1	2	0.951331	-0.034755	-0.551341	

	RestingECG	MaxHR	ExerciseAngina	Oldpeak	ST_Slope
0	1	1.382928	0	0.0	2
1	1	0.754157	0	1.0	1
2	2	-1.525138	0	0.0	2
3	1	-1.132156	1	1.5	1
4	1	-0.581981	0	0.0	2

14 Selecting Paramters For Random Forest

[275]:
```
from sklearn.model_selection import GridSearchCV,train_test_split
from sklearn.ensemble import RandomForestClassifier
clf=GridSearchCV(RandomForestClassifier(),{
    'n_estimators':list(range(1,100,5))
},cv=5,return_train_score=False)
clf.fit(X,Y)
pd.DataFrame(clf.cv_results_)[['param_n_estimators','mean_test_score']]
```

[275]:

	param_n_estimators	mean_test_score
0	1	0.754811
1	6	0.802762
2	11	0.817997
3	16	0.821323
4	21	0.819078
5	26	0.819114
6	31	0.814730
7	36	0.826734
8	41	0.827821
9	46	0.825647
10	51	0.822387
11	56	0.824584
12	61	0.822363
13	66	0.825659
14	71	0.816904
15	76	0.828908

```
16                  81          0.817991
17                  86          0.831094
18                  91          0.825630
19                  96          0.825665
```

[276]:
```
clf.best_params_
```

[276]:
```
{'n_estimators': 86}
```

[277]:
```
X_train,X_test,y_train,y_test=train_test_split(X,Y,test_size=0.
↪2,random_state=11)
```

[278]:
```
model=RandomForestClassifier(n_estimators=clf.best_params_['n_estimators'])
model.fit(X_train,y_train)
```

[278]:
```
RandomForestClassifier(n_estimators=86)
```

15 Checking For Overfitting

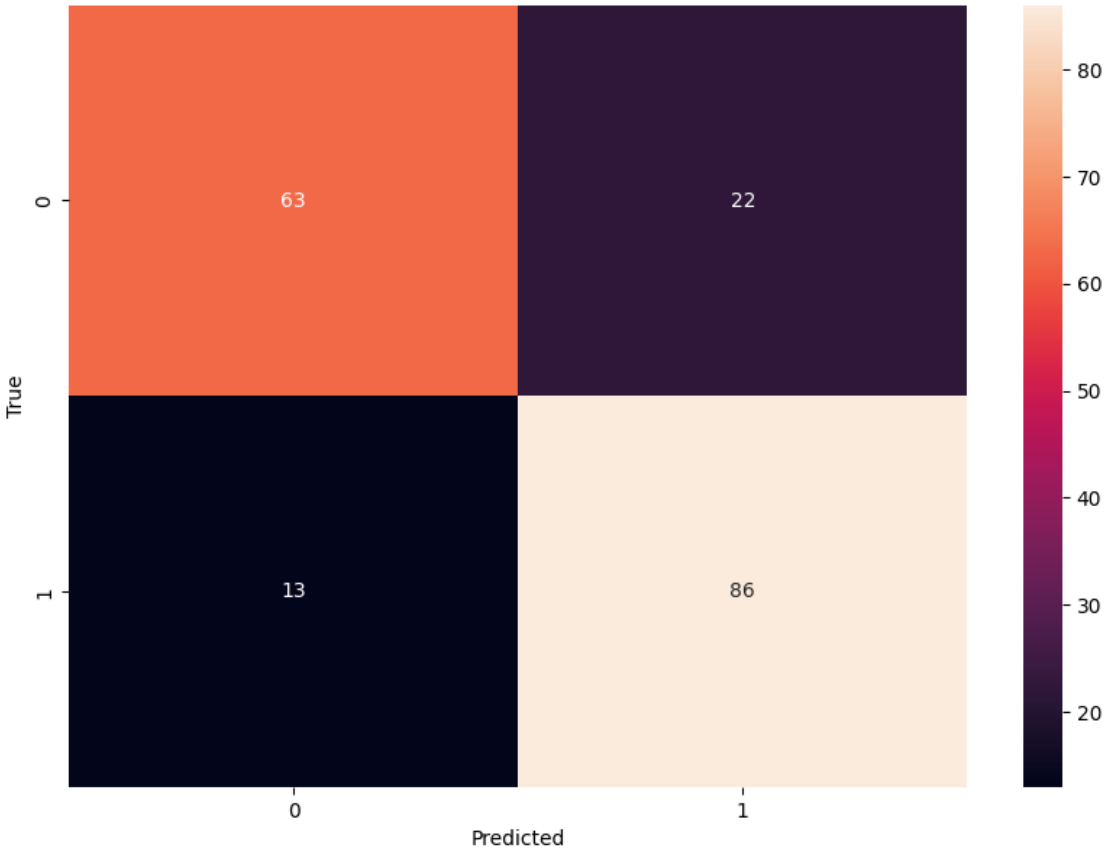
[279]:
```
from sklearn.metrics import confusion_matrix,accuracy_score
print("Training Accuracy: ",accuracy_score(y_train,model.predict(X_train)))
print("Testing Accuracy: ",accuracy_score(y_test,model.predict(X_test)))
```

```
Training Accuracy:  1.0
Testing Accuracy:  0.8097826086956522
```

16 Confusion Matrix

[280]:
```
plt.figure(figsize=(10,7))
sns.heatmap(confusion_matrix(y_test,model.predict(X_test)),annot=True)
plt.xlabel("Predicted",fontdict={"size":10})
plt.ylabel("True",fontdict={"size":10})
```

[280]:
```
Text(95.72222222222221, 0.5, 'True')
```


63
22
13
86
0
1
True
0
1
Predicted
80
70
60
50
40
30
20