8.2. Predicting who will survive on the Titanic with logistic regression

Logistic Regression (Titanic Dataset) Implementation

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Change Log:

SL No.	Change Category	Description	Duration (mins)	Difficulty (1-10)
1	Data Handling	Replaced `assign()` with `pd.get_dummies()` for better categorical encoding.	10	4
2	Feature Scaling	Introduced `StandardScaler` to normalize `Age` and `Pclass` for better model performance.	15	5
3	Hyperparameter Tuning	Optimized Logistic Regression using `GridSearchCV` with an improved parameter grid.	20	7
4	Model Evaluation	Introduced **ROC Curve & AUC Score** to assess model performance.	15	6
5	Test Split Update	Increased `test_size` from **0.05** to **0.2** for a better validation split.	5	3
6	Model Implementation	Implemented basic **Logistic Regression** using `LogisticRegression()`.	10	3
7	Cross-Validation	Used `cross_val_score()` for performance evaluation.	15	5
8	Hyperparameter Optimization	Applied `GridSearchCV` with a logarithmic range of `C` values.	20	7
9	Data Preprocessing	Converted `Sex` column into a binary `Female` column.	10	4
10	Data Preprocessing	Dropped missing values from `Age`.	5	3
11	Performance Visualization	Compared actual vs. predicted values in a **heatmap**.	10	4

```
In [2]: import numpy as np
        import pandas as pd
        import sklearn
        import sklearn.linear_model as lm
        import sklearn.model_selection as ms
        import matplotlib.pyplot as plt
        import seaborn as sns
        from sklearn.preprocessing import StandardScaler
        from sklearn.metrics import confusion_matrix, classification_report, roc_curve, auc
```

```
In [3]: train = pd.read_csv('https://github.com/ipython-books'
                            '/cookbook-2nd-data/blob/master/'
                            'titanic_train.csv?raw=true')
        test = pd.read_csv('https://github.com/ipython-books/'
                           'cookbook-2nd-data/blob/master/'
                           'titanic_test.csv?raw=true')
```

```
In [4]: print(train.info())
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype  
---  ------       --------------  -----  
 0   PassengerId  891 non-null    int64  
 1   Survived     891 non-null    int64  
 2   Pclass       891 non-null    int64  
 3   Name         891 non-null    object 
 4   Sex          891 non-null    object 
 5   Age          714 non-null    float64
 6   SibSp        891 non-null    int64  
 7   Parch        891 non-null    int64  
 8   Ticket       891 non-null    object 
 9   Fare         891 non-null    float64
 10  Cabin        204 non-null    object 
 11  Embarked     889 non-null    object 
dtypes: float64(2), int64(5), object(5)
memory usage: 83.7+ KB
None
```

```
In [5]: # Feature Selection & Preprocessing
        data = train[['Age', 'Pclass', 'Survived']]
        # Convert categorical 'Sex' to binary variables
        data = pd.get_dummies(train[['Sex', 'Age', 'Pclass', 'Survived']], drop_first=True)
        data = data.dropna()  # Drop missing values
```

```
In [6]: # Standardizing Age and Pclass
        scaler = StandardScaler()
        data[['Age', 'Pclass']] = scaler.fit_transform(data[['Age', 'Pclass']])
```

```
In [7]: # Split into features and target variable
        X = data.drop(columns=['Survived'])
        y = data['Survived']
```

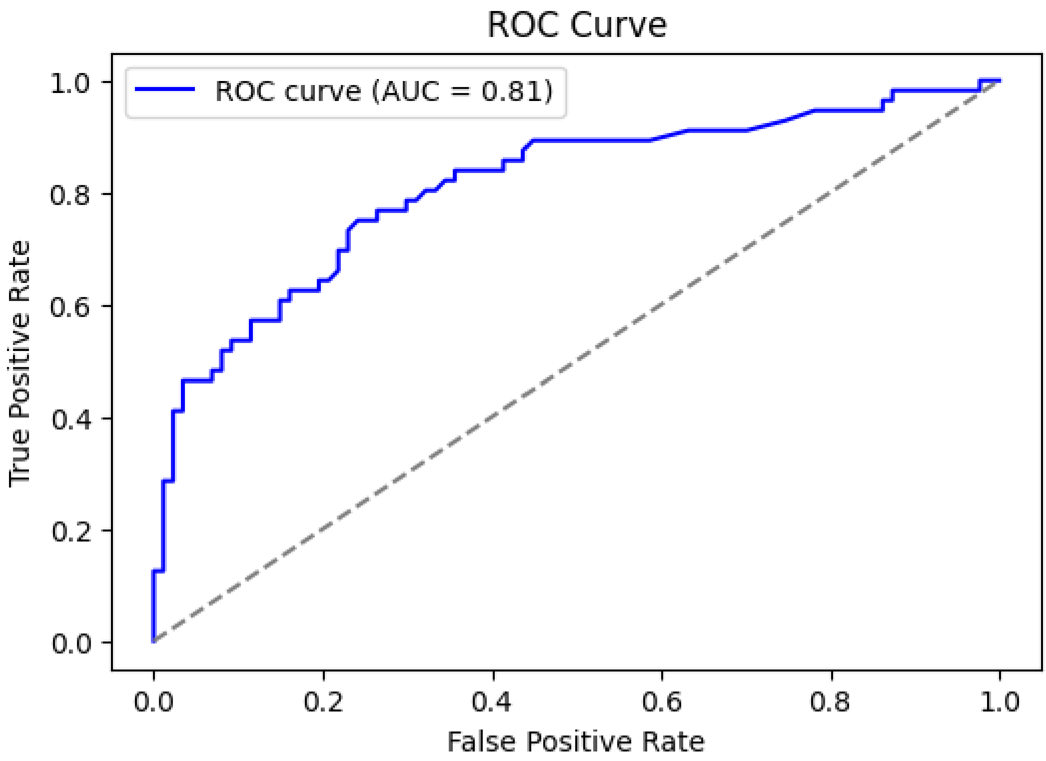
```
In [8]: # Splitting dataset (Increased test size from 0.05 to 0.2)
        X_train, X_test, y_train, y_test = ms.train_test_split(X, y, test_size=0.2, random_state=42)
```

```
In [9]: # Instantiate logistic regression model
        logreg = lm.LogisticRegression()
```

```
In [10]: # Train the model
         logreg.fit(X_train, y_train)
         y_predicted = logreg.predict(X_test)
```

In [18]:
```python
# ROC Curve and AUC Score
y_prob = logreg.predict_proba(X_test)[:, 1]
fpr, tpr, _ = roc_curve(y_test, y_prob)
roc_auc = auc(fpr, tpr)

plt.figure(figsize=(6, 4))
plt.plot(fpr, tpr, color='blue', label=f'ROC curve (AUC = {roc_auc:.2f})')
plt.plot([0, 1], [0, 1], linestyle='--', color='gray')
plt.xlabel("False Positive Rate")
plt.ylabel("True Positive Rate")
plt.title("ROC Curve")
plt.legend()
plt.show()
```



In [19]:
```python
# Hyperparameter tuning using GridSearchCV
param_grid = {'C': np.logspace(-5, 5, 50)}
grid = ms.GridSearchCV(logreg, param_grid, cv=5, scoring='accuracy', n_jobs=-1)
grid.fit(X_train, y_train)

print("Best Parameters:", grid.best_params_)
```

```
Best Parameters: {'C': np.float64(0.12067926406393 29)}
```

In [20]:
```python
# Evaluate best model
best_logreg = grid.best_estimator_
cv_scores = ms.cross_val_score(best_logreg, X, y, cv=5)
print("Cross-Validation Accuracy Scores:", cv_scores)
print(f"Mean CV Accuracy: {cv_scores.mean():.2f}")
```

```
Cross-Validation Accuracy Scores: [0.73426573 0.83216783 0.8041958  0.75524476 0.81690141]
Mean CV Accuracy: 0.79
```