xgm-and-lgbm

November 25, 2024

[1]:
```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt
import warnings
warnings.filterwarnings("ignore")
```

[2]:
```
data=pd.read_csv(r"/content/Titanic_train.csv")
data
```

[2]:
```
     PassengerId  Survived  Pclass  \
0              1         0       3
1              2         1       1
2              3         1       3
3              4         1       1
4              5         0       3
..           …       …     …
886          887         0       2
887          888         1       1
888          889         0       3
889          890         1       1
890          891         0       3

                                                 Name     Sex   Age  SibSp  \
0                             Braund, Mr. Owen Harris    male  22.0      1
1    Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
2                                Heikkinen, Miss. Laina  female  26.0      0
3          Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                              Allen, Mr. William Henry    male  35.0      0
..                                                   …     …   …    …
886                              Montvila, Rev. Juozas    male  27.0      0
887                       Graham, Miss. Margaret Edith  female  19.0      0
888           Johnston, Miss. Catherine Helen "Carrie"  female   NaN      1
889                              Behr, Mr. Karl Howell    male  26.0      0
890                                Dooley, Mr. Patrick    male  32.0      0

     Parch            Ticket     Fare Cabin Embarked
```

```
0        0         A/5 21171   7.2500   NaN        S
1        0          PC 17599  71.2833   C85        C
2        0  STON/O2. 3101282   7.9250   NaN        S
3        0            113803  53.1000  C123        S
4        0            373450   8.0500   NaN        S
..     …              …       …   …      …
886      0            211536  13.0000   NaN        S
887      0            112053  30.0000   B42        S
888      2        W./C. 6607  23.4500   NaN        S
889      0            111369  30.0000  C148        C
890      0            370376   7.7500   NaN        Q

[891 rows x 12 columns]
```

[3]:
```
data.isnull().sum()
```

[3]:
```
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
```

[4]:
```
train_df = pd.read_csv(r"/content/Titanic_train.csv")
test_df = pd.read_csv(r"/content/Titanic_test.csv")
combine = [train_df, test_df]
```

[5]:
```
combine
```

[5]:
```
[     PassengerId  Survived  Pclass  \
 0              1         0       3
 1              2         1       1
 2              3         1       3
 3              4         1       1
 4              5         0       3
 ..           …       …     …
 886          887         0       2
 887          888         1       1
 888          889         0       3
 889          890         1       1
```

```
890          891         0       3

                                                    Name     Sex   Age  SibSp  \
0                                Braund, Mr. Owen Harris    male  22.0      1
1    Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
2                                Heikkinen, Miss. Laina  female  26.0      0
3          Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                              Allen, Mr. William Henry    male  35.0      0
..                                                  …     …   …    …
886                              Montvila, Rev. Juozas    male  27.0      0
887                       Graham, Miss. Margaret Edith  female  19.0      0
888            Johnston, Miss. Catherine Helen "Carrie"  female   NaN      1
889                              Behr, Mr. Karl Howell    male  26.0      0
890                                Dooley, Mr. Patrick    male  32.0      0

     Parch            Ticket     Fare Cabin Embarked
0        0         A/5 21171   7.2500   NaN        S
1        0          PC 17599  71.2833   C85        C
2        0  STON/O2. 3101282   7.9250   NaN        S
3        0            113803  53.1000  C123        S
4        0            373450   8.0500   NaN        S
..     …               …      …   …      …
886      0            211536  13.0000   NaN        S
887      0            112053  30.0000   B42        S
888      2        W./C. 6607  23.4500   NaN        S
889      0            111369  30.0000  C148        C
890      0            370376   7.7500   NaN        Q

[891 rows x 12 columns],
     PassengerId  Pclass                                               Name  \
0            892       3                                   Kelly, Mr. James
1            893       3                   Wilkes, Mrs. James (Ellen Needs)
2            894       2                          Myles, Mr. Thomas Francis
3            895       3                                   Wirz, Mr. Albert
4            896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)
..           …     …                                                    …
413         1305       3                                Spector, Mr. Woolf
414         1306       1                      Oliva y Ocana, Dona. Fermina
415         1307       3                      Saether, Mr. Simon Sivertsen
416         1308       3                               Ware, Mr. Frederick
417         1309       3                          Peter, Master. Michael J

        Sex   Age  SibSp  Parch              Ticket      Fare Cabin Embarked
0      male  34.5      0      0              330911    7.8292   NaN        Q
1    female  47.0      1      0              363272    7.0000   NaN        S
2      male  62.0      0      0              240276    9.6875   NaN        Q
3      male  27.0      0      0              315154    8.6625   NaN        S
```

```
 4    female  22.0      1      1             3101298   12.2875   NaN        S
 ..      …   …    …    …                 …        …   …       …
 413    male   NaN      0      0           A.5. 3236    8.0500   NaN        S
 414  female  39.0      0      0            PC 17758  108.9000  C105        C
 415    male  38.5      0      0  SOTON/O.Q. 3101262    7.2500   NaN        S
 416    male   NaN      0      0              359309    8.0500   NaN        S
 417    male   NaN      1      1                2668   22.3583   NaN        C

 [418 rows x 11 columns]]
```

[6]:
```
train_df.head()
```

[6]:
```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                Name     Sex   Age  SibSp  \
0                            Braund, Mr. Owen Harris    male  22.0      1
1  Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
2                             Heikkinen, Miss. Laina  female  26.0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                           Allen, Mr. William Henry    male  35.0      0

   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
```

[7]:
```
train_df.columns
```

[7]:
```
Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked'],
      dtype='object')
```

[8]:
```
train_df.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
```

[9]:
```
test_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 418 entries, 0 to 417
Data columns (total 11 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  418 non-null    int64
 1   Pclass       418 non-null    int64
 2   Name         418 non-null    object
 3   Sex          418 non-null    object
 4   Age          332 non-null    float64
 5   SibSp        418 non-null    int64
 6   Parch        418 non-null    int64
 7   Ticket       418 non-null    object
 8   Fare         417 non-null    float64
 9   Cabin        91 non-null     object
 10  Embarked     418 non-null    object
dtypes: float64(2), int64(4), object(5)
memory usage: 36.0+ KB
```

[10]:
```
train_df.describe()
```

[10]:

	PassengerId	Survived	Pclass	Age	SibSp	\
count	891.000000	891.000000	891.000000	714.000000	891.000000	
mean	446.000000	0.383838	2.308642	29.699118	0.523008	
std	257.353842	0.486592	0.836071	14.526497	1.102743	
min	1.000000	0.000000	1.000000	0.420000	0.000000	
25%	223.500000	0.000000	2.000000	20.125000	0.000000	
50%	446.000000	0.000000	3.000000	28.000000	0.000000	
75%	668.500000	1.000000	3.000000	38.000000	1.000000	
max	891.000000	1.000000	3.000000	80.000000	8.000000	

```
              Parch        Fare
count   891.000000  891.000000
mean      0.381594   32.204208
std       0.806057   49.693429
min       0.000000    0.000000
25%       0.000000    7.910400
50%       0.000000   14.454200
75%       0.000000   31.000000
max       6.000000  512.329200
```

[11]:
```
train_df.describe(include=['O'])
```

[11]:
```
                           Name   Sex  Ticket    Cabin Embarked
count                       891   891     891      204      889
unique                      891     2     681      147        3
top     Braund, Mr. Owen Harris  male  347082  B96 B98        S
freq                          1   577       7        4      644
```

[12]:
```
test_df
```

[12]:
```
     PassengerId  Pclass                                          Name  \
0            892       3                              Kelly, Mr. James
1            893       3              Wilkes, Mrs. James (Ellen Needs)
2            894       2                     Myles, Mr. Thomas Francis
3            895       3                              Wirz, Mr. Albert
4            896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)
..           …     …                                               …
413         1305       3                           Spector, Mr. Woolf
414         1306       1                 Oliva y Ocana, Dona. Fermina
415         1307       3                 Saether, Mr. Simon Sivertsen
416         1308       3                          Ware, Mr. Frederick
417         1309       3                     Peter, Master. Michael J

        Sex   Age  SibSp  Parch              Ticket      Fare Cabin Embarked
0      male  34.5      0      0              330911    7.8292   NaN        Q
1    female  47.0      1      0              363272    7.0000   NaN        S
2      male  62.0      0      0              240276    9.6875   NaN        Q
3      male  27.0      0      0              315154    8.6625   NaN        S
4    female  22.0      1      1             3101298   12.2875   NaN        S
..      …   …    …    …                 …        …   …      …
413    male   NaN      0      0           A.5. 3236    8.0500   NaN        S
414  female  39.0      0      0            PC 17758  108.9000  C105        C
415    male  38.5      0      0  SOTON/O.Q. 3101262    7.2500   NaN        S
416    male   NaN      0      0              359309    8.0500   NaN        S
417    male   NaN      1      1                2668   22.3583   NaN        C

[418 rows x 11 columns]
```

[13]:
```
survived = train_df[train_df['Survived'] == 1]
not_survived = train_df[train_df['Survived'] == 0]

print ("Survived: %i (%.1f%%)"%(len(survived), float(len(survived))/
  ↪len(train_df)*100.0))
print ("Not Survived: %i (%.1f%%)"%(len(not_survived), float(len(not_survived))/
  ↪len(train_df)*100.0))
print ("Total: %i"%len(train_df))
```

```
Survived: 342 (38.4%)
Not Survived: 549 (61.6%)
Total: 891
```

[14]:
```
train_df.Pclass.value_counts()
```

[14]:
```
Pclass
3    491
1    216
2    184
Name: count, dtype: int64
```

[15]:
```
train_df.groupby('Pclass').Survived.value_counts()
```

[15]:
```
Pclass  Survived
1       1           136
        0            80
2       0            97
        1            87
3       0           372
        1           119
Name: count, dtype: int64
```

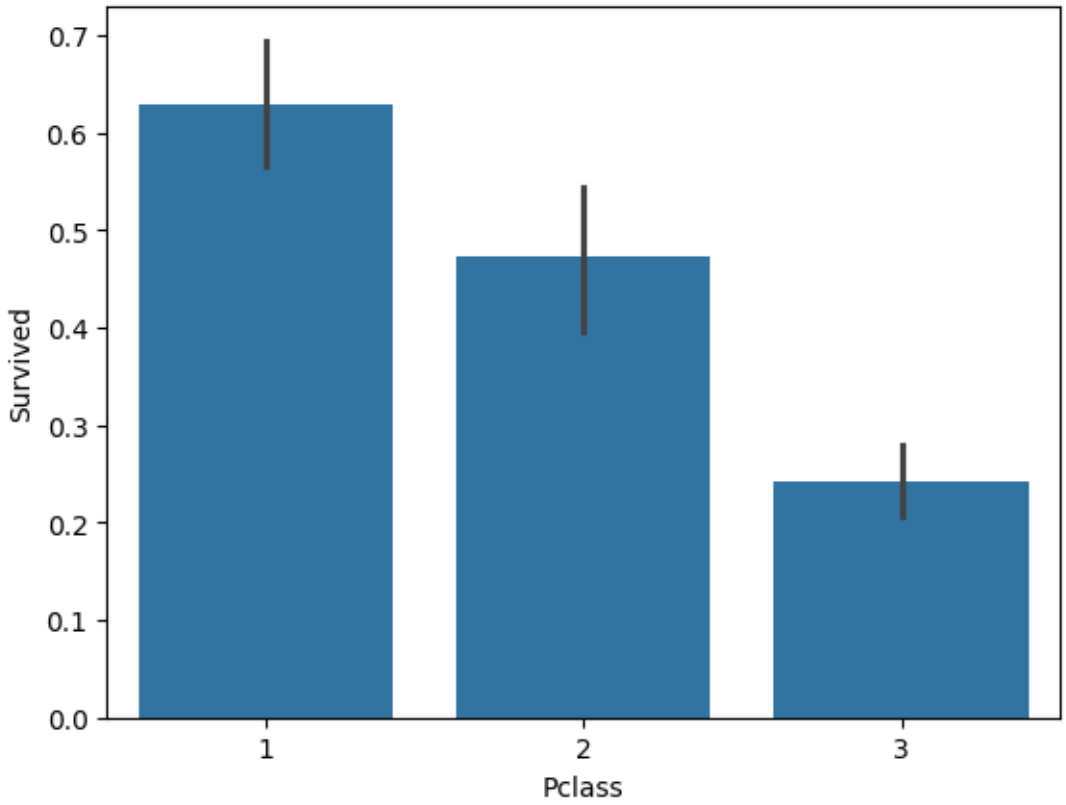
[16]:
```
train_df[['Pclass', 'Survived']].groupby(['Pclass'], as_index=False).mean()
```

[16]:

	Pclass	Survived
0	1	0.629630
1	2	0.472826
2	3	0.242363

[17]:
```
sns.barplot(x='Pclass', y='Survived', data=train_df)
```

[17]:
```
<Axes: xlabel='Pclass', ylabel='Survived'>
```



[18]:
```
train_df.Sex.value_counts()
```

[18]:
```
Sex
male      577
female    314
Name: count, dtype: int64
```

[19]:
```
train_df.groupby('Sex').Survived.value_counts()
```

[19]:
```
Sex     Survived
female  1           233
        0            81
male    0           468
        1           109
Name: count, dtype: int64
```

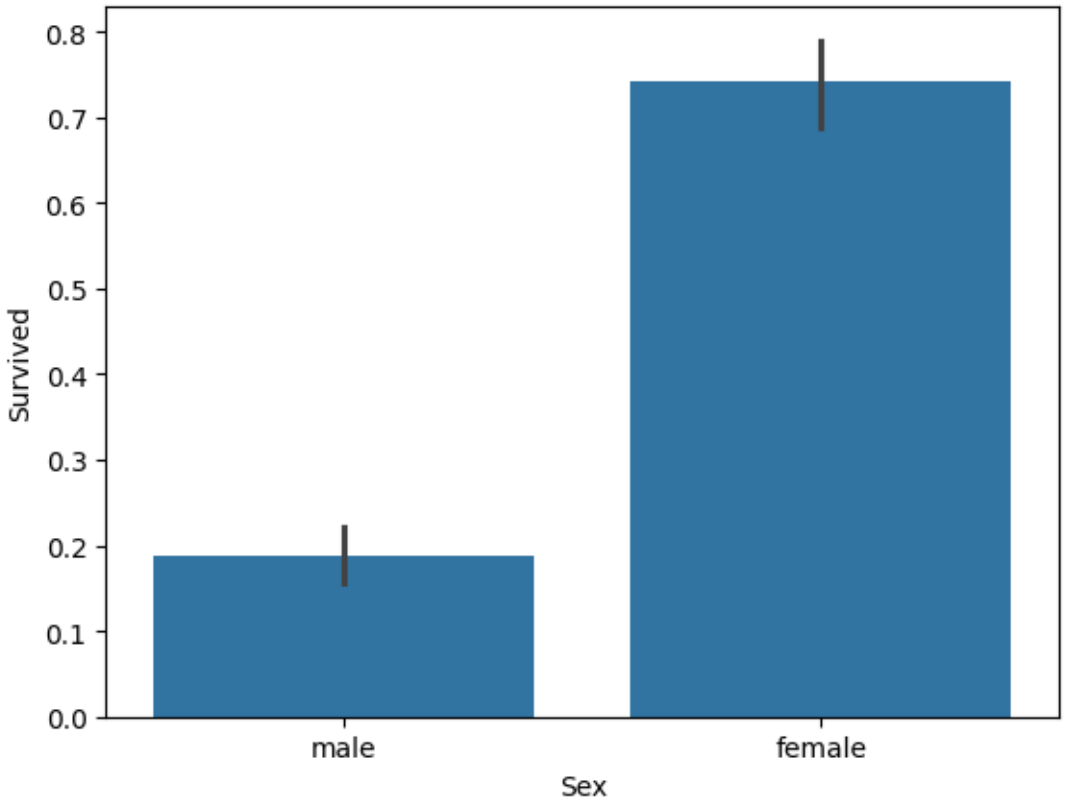
[20]:
```
train_df[['Sex', 'Survived']].groupby(['Sex'], as_index=False).mean()
```

[20]:

	Sex	Survived
0	female	0.742038
1	male	0.188908

[21]:
```
sns.barplot(x='Sex', y='Survived', data=train_df)
```

[21]: <Axes: xlabel='Sex', ylabel='Survived'>

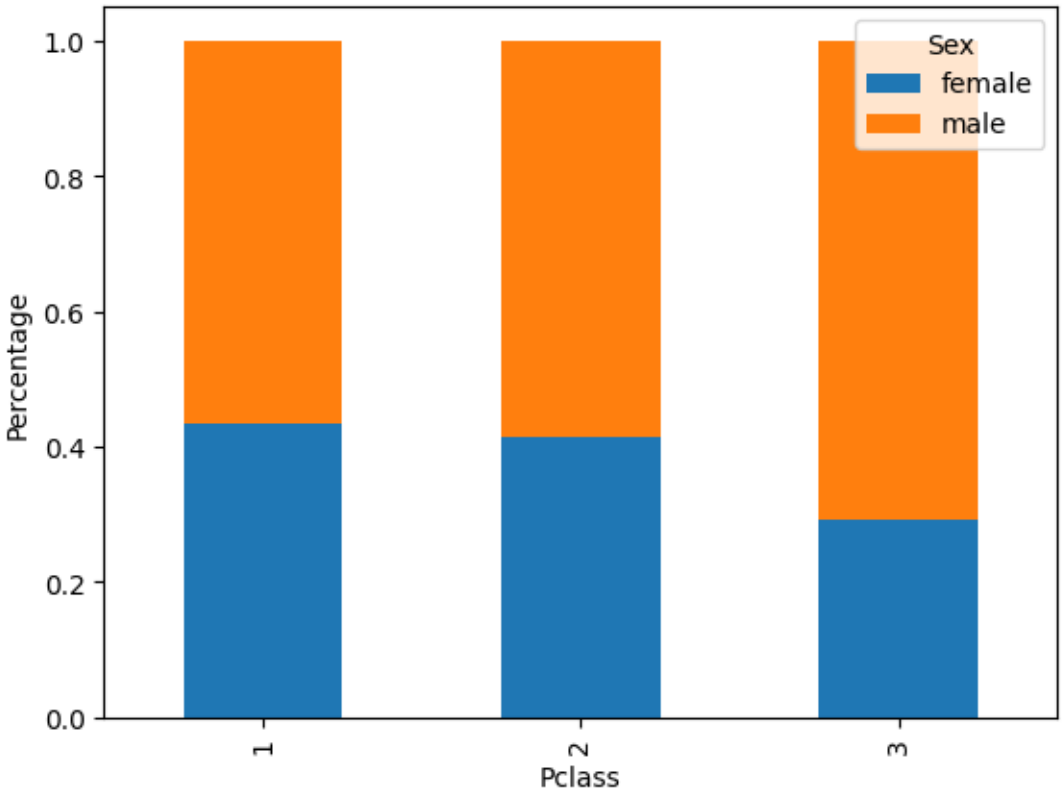


[24]:
```
tab = pd.crosstab(train_df['Pclass'], train_df['Sex'])
print (tab)

tab.div(tab.sum(1).astype(float), axis=0).plot(kind="bar", stacked=True)
plt.xlabel('Pclass')
plt.ylabel('Percentage')
```

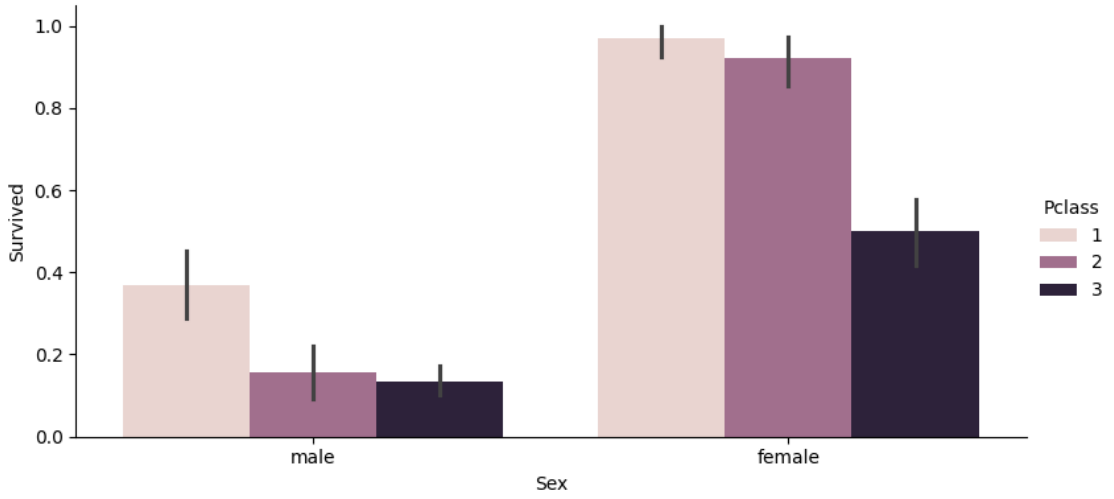
```
Sex     female  male
Pclass
1           94   122
2           76   108
3          144   347
```

[24]: Text(0, 0.5, 'Percentage')



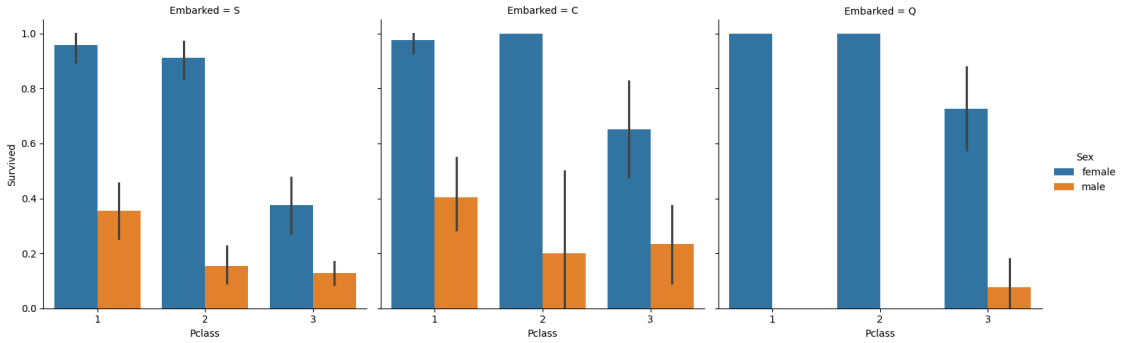
[31]:
```
import seaborn as sns
import matplotlib.pyplot as plt

# Use catplot instead of factorplot
sns.catplot(x='Sex', y='Survived', hue='Pclass', kind='bar', data=train_df,␣
 ↪height=4, aspect=2)
plt.show()
```



[32]:
```
import seaborn as sns
import matplotlib.pyplot as plt

# Use catplot instead of factorplot
sns.catplot(x='Pclass', y='Survived', hue='Sex', col='Embarked', kind='bar',␣
 ↪data=train_df)
# kind='bar' specifies a bar plot, which is the default for factorplot
plt.show()
```



[33]:
```
train_df.Embarked.value_counts()
```

[33]:
```
Embarked
S    644
C    168
Q     77
Name: count, dtype: int64
```

[34]:
```
train_df.groupby('Embarked').Survived.value_counts()
```

[34]:
```
Embarked  Survived
C         1            93
          0            75
Q         0            47
          1            30
S         0           427
          1           217
Name: count, dtype: int64
```

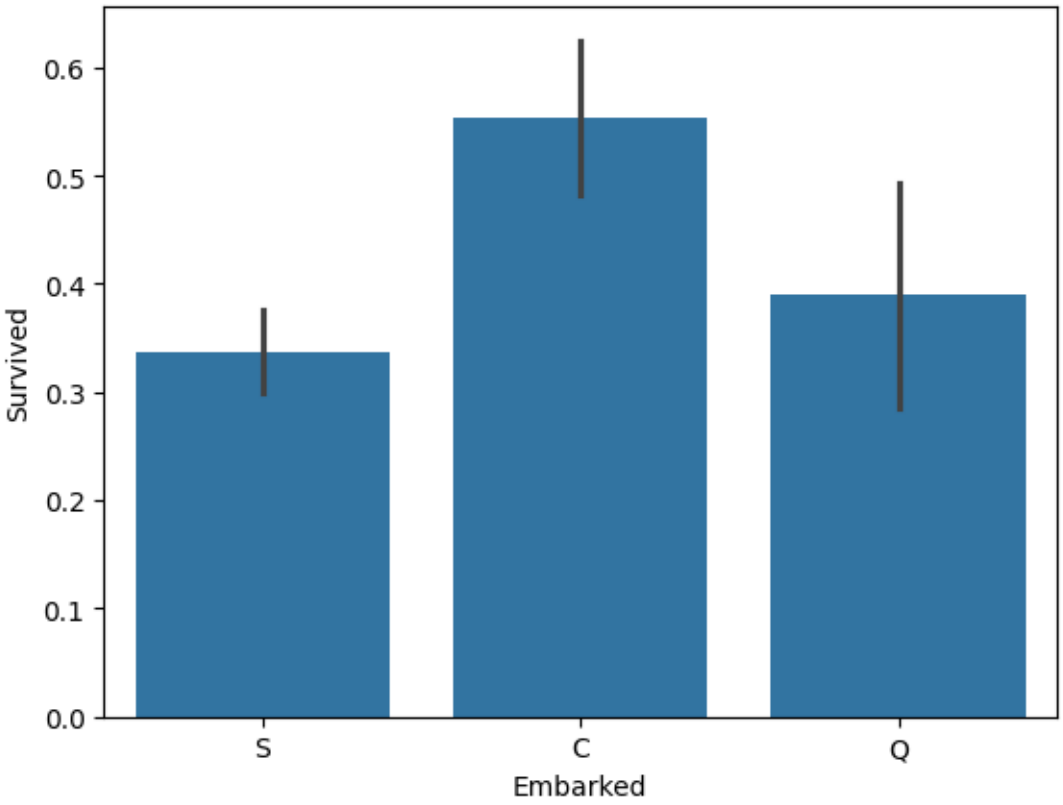
[35]:
```
train_df[['Embarked', 'Survived']].groupby(['Embarked'], as_index=False).mean()
```

[35]:

	Embarked	Survived
0	C	0.553571
1	Q	0.389610
2	S	0.336957

[36]:
```
sns.barplot(x='Embarked', y='Survived', data=train_df)
```

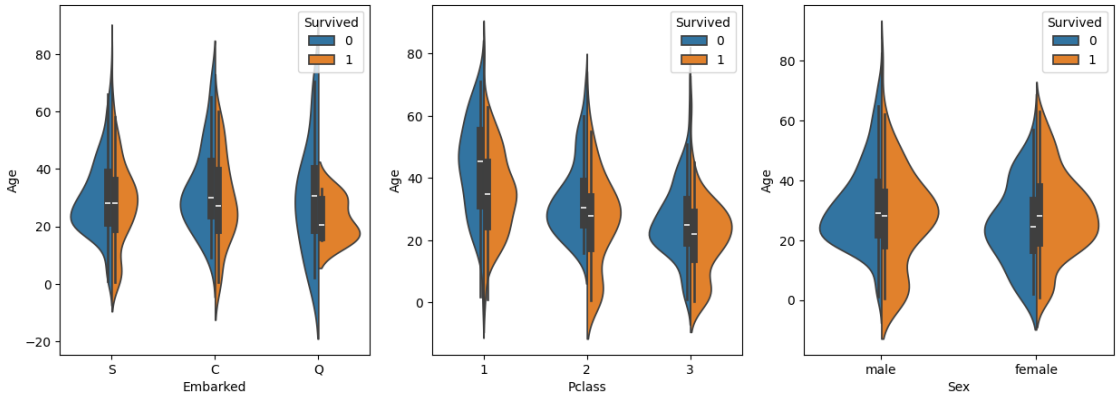
[36]:
```
<Axes: xlabel='Embarked', ylabel='Survived'>
```



[39]:
```
fig = plt.figure(figsize=(15,5))
ax1 = fig.add_subplot(131)
ax2 = fig.add_subplot(132)
ax3 = fig.add_subplot(133)

sns.violinplot(x="Embarked", y="Age", hue="Survived", data=train_df,␣
 ↪split=True, ax=ax1)
sns.violinplot(x="Pclass", y="Age", hue="Survived", data=train_df, split=True,␣
 ↪ax=ax2)
sns.violinplot(x="Sex", y="Age", hue="Survived", data=train_df, split=True,␣
 ↪ax=ax3)
```

[39]:
```
<Axes: xlabel='Sex', ylabel='Age'>
```



[40]:
```
!pip install seaborn
import seaborn as sns
import matplotlib.pyplot as plt
import pandas as pd
import numpy as np

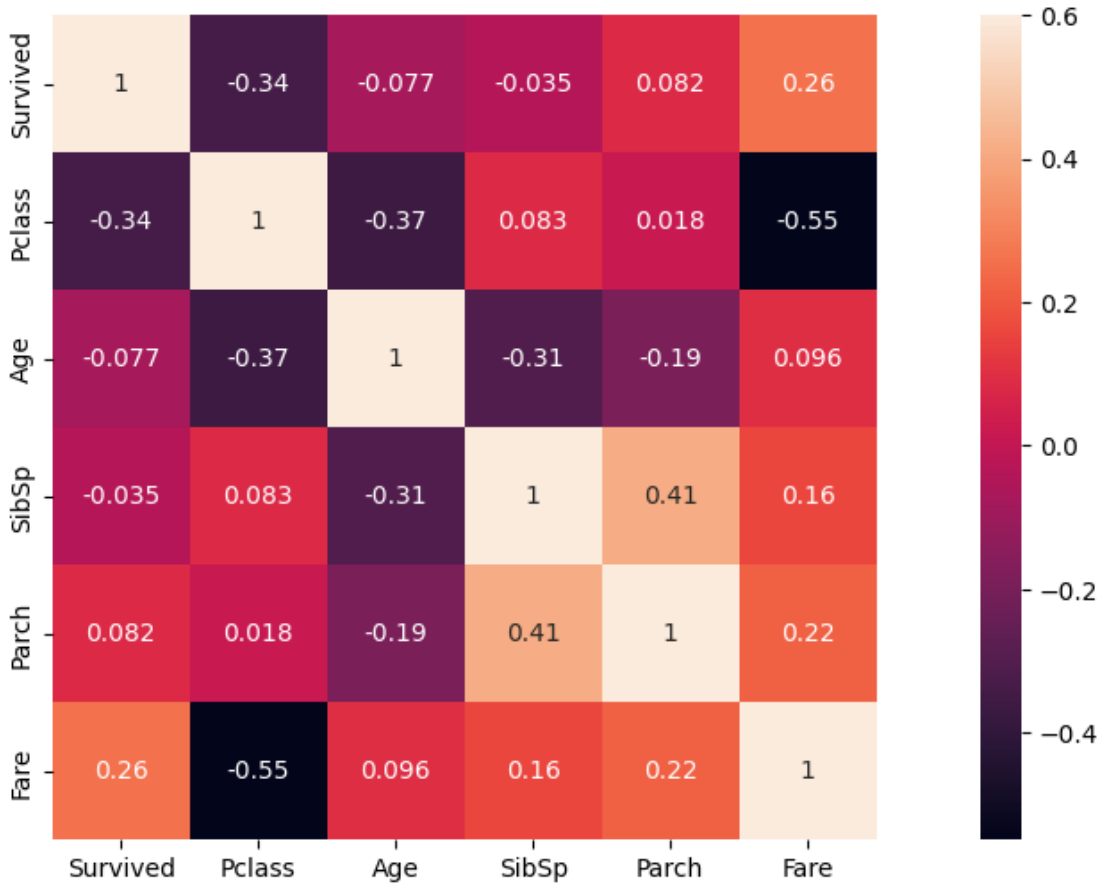
# Assuming train_df is your DataFrame
plt.figure(figsize=(15,6))

# Select only numeric columns for correlation calculation
numeric_df = train_df.select_dtypes(include=np.number)

# Calculate and plot the correlation matrix
sns.heatmap(numeric_df.drop('PassengerId',axis=1).corr(), vmax=0.6,␣
 ↪square=True, annot=True)
plt.show()
```

```
Requirement already satisfied: seaborn in /usr/local/lib/python3.10/dist-
packages (0.13.2)
```

```
Requirement already satisfied: numpy!=1.24.0,>=1.20 in
/usr/local/lib/python3.10/dist-packages (from seaborn) (1.26.4)
Requirement already satisfied: pandas>=1.2 in /usr/local/lib/python3.10/dist-
packages (from seaborn) (2.2.2)
Requirement already satisfied: matplotlib!=3.6.1,>=3.4 in
/usr/local/lib/python3.10/dist-packages (from seaborn) (3.8.0)
Requirement already satisfied: contourpy>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn)
(1.3.1)
Requirement already satisfied: cycler>=0.10 in /usr/local/lib/python3.10/dist-
packages (from matplotlib!=3.6.1,>=3.4->seaborn) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn)
(4.55.0)
Requirement already satisfied: kiwisolver>=1.0.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn)
(1.4.7)
Requirement already satisfied: packaging>=20.0 in
/usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn)
(24.2)
Requirement already satisfied: pillow>=6.2.0 in /usr/local/lib/python3.10/dist-
packages (from matplotlib!=3.6.1,>=3.4->seaborn) (11.0.0)
Requirement already satisfied: pyparsing>=2.3.1 in
/usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn)
(3.2.0)
Requirement already satisfied: python-dateutil>=2.7 in
/usr/local/lib/python3.10/dist-packages (from matplotlib!=3.6.1,>=3.4->seaborn)
(2.8.2)
Requirement already satisfied: pytz>=2020.1 in /usr/local/lib/python3.10/dist-
packages (from pandas>=1.2->seaborn) (2024.2)
Requirement already satisfied: tzdata>=2022.7 in /usr/local/lib/python3.10/dist-
packages (from pandas>=1.2->seaborn) (2024.2)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.10/dist-
packages (from python-dateutil>=2.7->matplotlib!=3.6.1,>=3.4->seaborn) (1.16.0)
```



[41]:
```
train_test_data = [train_df, test_df] # combining train and test dataset

for dataset in train_test_data:
    dataset['Title'] = dataset.Name.str.extract(' ([A-Za-z]+)\.')
```

[42]:
```
train_df.tail()
```

[42]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	Title
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.00	NaN	S	Rev
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.00	B42	S	Miss
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	NaN	1	2	W./C. 6607	23.45	NaN	S	Miss
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.00	C148	C	Mr
890	891	0	3	Dooley, Mr. Patrick									

```
890    male  32.0      0      0      370376   7.75   NaN        Q     Mr
```

[43]:
```
pd.crosstab(train_df['Title'], train_df['Sex'])
```

[43]:
```
Sex       female  male
Title
Capt           0     1
Col            0     2
Countess       1     0
Don            0     1
Dr             1     6
Jonkheer       0     1
Lady           1     0
Major          0     2
Master         0    40
Miss         182     0
Mlle           2     0
Mme            1     0
Mr             0   517
Mrs          125     0
Ms             1     0
Rev            0     6
Sir            0     1
```

[44]:
```
for dataset in train_test_data:
    dataset['Title'] = dataset['Title'].replace(['Lady', 'Countess','Capt',␣
 ↪'Col', \
            'Don', 'Dr', 'Major', 'Rev', 'Sir', 'Jonkheer', 'Dona'], 'Other')

    dataset['Title'] = dataset['Title'].replace('Mlle', 'Miss')
    dataset['Title'] = dataset['Title'].replace('Ms', 'Miss')
    dataset['Title'] = dataset['Title'].replace('Mme', 'Mrs')

train_df[['Title', 'Survived']].groupby(['Title'], as_index=False).mean()
```

[44]:
```
    Title  Survived
0  Master  0.575000
1    Miss  0.702703
2      Mr  0.156673
3     Mrs  0.793651
4   Other  0.347826
```

[45]:
```
title_mapping = {"Mr": 1, "Miss": 2, "Mrs": 3, "Master": 4, "Other": 5}
for dataset in train_test_data:
    dataset['Title'] = dataset['Title'].map(title_mapping)
    dataset['Title'] = dataset['Title'].fillna(0)
```

[46]:
```
train_df
```

[46]:
```
     PassengerId  Survived  Pclass  \
0              1         0       3
1              2         1       1
2              3         1       3
3              4         1       1
4              5         0       3
..           …       …     …
886          887         0       2
887          888         1       1
888          889         0       3
889          890         1       1
890          891         0       3

                                                 Name     Sex   Age  SibSp  \
0                             Braund, Mr. Owen Harris    male  22.0      1
1    Cumings, Mrs. John Bradley (Florence Briggs Th…  female  38.0      1
2                              Heikkinen, Miss. Laina  female  26.0      0
3         Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                            Allen, Mr. William Henry    male  35.0      0
..                                                 …     …   …    …
886                            Montvila, Rev. Juozas    male  27.0      0
887                     Graham, Miss. Margaret Edith  female  19.0      0
888         Johnston, Miss. Catherine Helen "Carrie"  female   NaN      1
889                            Behr, Mr. Karl Howell    male  26.0      0
890                              Dooley, Mr. Patrick    male  32.0      0

     Parch            Ticket     Fare Cabin Embarked  Title
0        0         A/5 21171   7.2500   NaN        S      1
1        0          PC 17599  71.2833   C85        C      3
2        0  STON/O2. 3101282   7.9250   NaN        S      2
3        0            113803  53.1000  C123        S      3
4        0            373450   8.0500   NaN        S      1
..     …              …      …   …      …    …
886      0            211536  13.0000   NaN        S      5
887      0            112053  30.0000   B42        S      2
888      2        W./C. 6607  23.4500   NaN        S      2
889      0            111369  30.0000  C148        C      1
890      0            370376   7.7500   NaN        Q      1

[891 rows x 13 columns]
```

[47]:
```
for dataset in train_test_data:
    dataset['Sex'] = dataset['Sex'].map( {'female': 1, 'male': 0} ).astype(int)
```

[48]:
```
train_df
```

[48]:
```
     PassengerId  Survived  Pclass  \
0              1         0       3
1              2         1       1
2              3         1       3
3              4         1       1
4              5         0       3
..           …       …     …
886          887         0       2
887          888         1       1
888          889         0       3
889          890         1       1
890          891         0       3

                                                 Name  Sex   Age  SibSp  \
0                             Braund, Mr. Owen Harris    0  22.0      1
1    Cumings, Mrs. John Bradley (Florence Briggs Th…    1  38.0      1
2                              Heikkinen, Miss. Laina    1  26.0      0
3         Futrelle, Mrs. Jacques Heath (Lily May Peel)    1  35.0      1
4                           Allen, Mr. William Henry    0  35.0      0
..                                                …  …   …    …
886                            Montvila, Rev. Juozas    0  27.0      0
887                     Graham, Miss. Margaret Edith    1  19.0      0
888         Johnston, Miss. Catherine Helen "Carrie"    1   NaN      1
889                            Behr, Mr. Karl Howell    0  26.0      0
890                              Dooley, Mr. Patrick    0  32.0      0

     Parch            Ticket     Fare Cabin Embarked  Title
0        0         A/5 21171   7.2500   NaN        S      1
1        0          PC 17599  71.2833   C85        C      3
2        0  STON/O2. 3101282   7.9250   NaN        S      2
3        0            113803  53.1000  C123        S      3
4        0            373450   8.0500   NaN        S      1
..     …              …      …   …      …    …
886      0            211536  13.0000   NaN        S      5
887      0            112053  30.0000   B42        S      2
888      2        W./C. 6607  23.4500   NaN        S      2
889      0            111369  30.0000  C148        C      1
890      0            370376   7.7500   NaN        Q      1

[891 rows x 13 columns]
```

[49]:
```
train_df.Embarked.unique()
```

[49]:
```
array(['S', 'C', 'Q', nan], dtype=object)
```

[50]:
```
train_df['Embarked'].value_counts()
```

[50]:
```
Embarked
S    644
C    168
Q     77
Name: count, dtype: int64
```

[51]:
```
for dataset in train_test_data:
    dataset['Embarked'] = dataset['Embarked'].fillna('S')
```

[52]:
```
train_df['Embarked'].unique()
```

[52]:
```
array(['S', 'C', 'Q'], dtype=object)
```

[53]:
```
for dataset in train_test_data:

    dataset['Embarked'] = dataset['Embarked'].map( {'S': 0, 'C': 1, 'Q': 2} ).
 ↪astype(int)
```

[54]:
```
train_df
```

[54]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked	Title
0	1	0	3	Braund, Mr. Owen Harris	0	22.0	1						
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th…	1	38.0	1						
2	3	1	3	Heikkinen, Miss. Laina	1	26.0	0						
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	1	35.0	1						
4	5	0	3	Allen, Mr. William Henry	0	35.0	0						
..	…	…	…	…	…	…	…						
886	887	0	2	Montvila, Rev. Juozas	0	27.0	0						
887	888	1	1	Graham, Miss. Margaret Edith	1	19.0	0						
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	1	NaN	1						
889	890	1	1	Behr, Mr. Karl Howell	0	26.0	0						
890	891	0	3	Dooley, Mr. Patrick	0	32.0	0						

```
0        0         A/5 21171   7.2500   NaN         0      1
1        0          PC 17599  71.2833   C85         1      3
2        0  STON/O2. 3101282   7.9250   NaN         0      2
3        0            113803  53.1000  C123         0      3
4        0            373450   8.0500   NaN         0      1
..     …                …       …   …       …    …
886      0            211536  13.0000   NaN         0      5
887      0            112053  30.0000   B42         0      2
888      2        W./C. 6607  23.4500   NaN         0      2
889      0            111369  30.0000  C148         1      1
890      0            370376   7.7500   NaN         2      1

[891 rows x 13 columns]
```

[55]:
```
for dataset in train_test_data:
    age_avg = dataset['Age'].mean()
    age_std = dataset['Age'].std()
    age_null_count = dataset['Age'].isnull().sum()

    age_null_random_list = np.random.randint(age_avg - age_std, age_avg +␣
 ↪age_std, size=age_null_count)
    dataset['Age'][np.isnan(dataset['Age'])] = age_null_random_list
    dataset['Age'] = dataset['Age'].astype(int)

train_df['AgeBand'] = pd.cut(train_df['Age'], 5)

print (train_df[['AgeBand', 'Survived']].groupby(['AgeBand'], as_index=False).
 ↪mean())
```

```
          AgeBand  Survived
0  (-0.08, 16.0]  0.537037
1   (16.0, 32.0]  0.349558
2   (32.0, 48.0]  0.378486
3   (48.0, 64.0]  0.434783
4   (64.0, 80.0]  0.090909
```

[56]:
```
train_df.head()
```

[56]:
```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                Name  Sex  Age  SibSp  Parch  \
0                            Braund, Mr. Owen Harris    0   22      1      0
```

```
1  Cumings, Mrs. John Bradley (Florence Briggs Th…    1   38      1      0
2                             Heikkinen, Miss. Laina    1   26      0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    1   35      1      0
4                           Allen, Mr. William Henry    0   35      0      0

             Ticket     Fare Cabin  Embarked  Title       AgeBand
0         A/5 21171   7.2500   NaN         0      1  (16.0, 32.0]
1          PC 17599  71.2833   C85         1      3  (32.0, 48.0]
2  STON/O2. 3101282   7.9250   NaN         0      2  (16.0, 32.0]
3            113803  53.1000  C123         0      3  (32.0, 48.0]
4            373450   8.0500   NaN         0      1  (32.0, 48.0]
```

[57]:
```
for dataset in train_test_data:
    dataset.loc[ dataset['Age'] <= 16, 'Age'] = 0
    dataset.loc[(dataset['Age'] > 16) & (dataset['Age'] <= 32), 'Age'] = 1
    dataset.loc[(dataset['Age'] > 32) & (dataset['Age'] <= 48), 'Age'] = 2
    dataset.loc[(dataset['Age'] > 48) & (dataset['Age'] <= 64), 'Age'] = 3
    dataset.loc[ dataset['Age'] > 64, 'Age'] = 4
```

[58]:
```
train_df.head()
```

[58]:
```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                Name  Sex  Age  SibSp  Parch  \
0                            Braund, Mr. Owen Harris    0    1      1      0
1  Cumings, Mrs. John Bradley (Florence Briggs Th…    1    2      1      0
2                             Heikkinen, Miss. Laina    1    1      0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    1    2      1      0
4                           Allen, Mr. William Henry    0    2      0      0

             Ticket     Fare Cabin  Embarked  Title       AgeBand
0         A/5 21171   7.2500   NaN         0      1  (16.0, 32.0]
1          PC 17599  71.2833   C85         1      3  (32.0, 48.0]
2  STON/O2. 3101282   7.9250   NaN         0      2  (16.0, 32.0]
3            113803  53.1000  C123         0      3  (32.0, 48.0]
4            373450   8.0500   NaN         0      1  (32.0, 48.0]
```

[59]:
```
for dataset in train_test_data:
    dataset['Fare'] = dataset['Fare'].fillna(train_df['Fare'].median())
```

[60]:
```
train_df['FareBand'] = pd.qcut(train_df['Fare'], 4)
```

```
print (train_df[['FareBand', 'Survived']].groupby(['FareBand'], as_index=False).
↪mean())
```

```
          FareBand  Survived
0   (-0.001, 7.91]  0.197309
1   (7.91, 14.454]  0.303571
2   (14.454, 31.0]  0.454955
3  (31.0, 512.329]  0.581081
```

[61]:
```
for dataset in train_test_data:
    dataset.loc[ dataset['Fare'] <= 7.91, 'Fare'] = 0
    dataset.loc[(dataset['Fare'] > 7.91) & (dataset['Fare'] <= 14.454), 'Fare']␣
↪= 1
    dataset.loc[(dataset['Fare'] > 14.454) & (dataset['Fare'] <= 31), 'Fare']  ␣
↪= 2
    dataset.loc[ dataset['Fare'] > 31, 'Fare'] = 3
    dataset['Fare'] = dataset['Fare'].astype(int)
```

[62]:
```
train_df
```

[62]:
```
     PassengerId  Survived  Pclass  \
0              1         0       3
1              2         1       1
2              3         1       3
3              4         1       1
4              5         0       3
..           …       …     …
886          887         0       2
887          888         1       1
888          889         0       3
889          890         1       1
890          891         0       3

                                                 Name  Sex  Age  SibSp  \
0                             Braund, Mr. Owen Harris    0    1      1
1    Cumings, Mrs. John Bradley (Florence Briggs Th…    1    2      1
2                             Heikkinen, Miss. Laina    1    1      0
3         Futrelle, Mrs. Jacques Heath (Lily May Peel)    1    2      1
4                           Allen, Mr. William Henry    0    2      0
..                                                …  …  …    …
886                           Montvila, Rev. Juozas    0    1      0
887                    Graham, Miss. Margaret Edith    1    1      0
888        Johnston, Miss. Catherine Helen "Carrie"    1    1      1
889                           Behr, Mr. Karl Howell    0    1      0
890                             Dooley, Mr. Patrick    0    1      0

     Parch            Ticket  Fare Cabin  Embarked  Title       AgeBand  \
```

```
0        0         A/5 21171     0   NaN         0      1  (16.0, 32.0]
1        0          PC 17599     3   C85         1      3  (32.0, 48.0]
2        0  STON/O2. 3101282     1   NaN         0      2  (16.0, 32.0]
3        0            113803     3  C123         0      3  (32.0, 48.0]
4        0            373450     1   NaN         0      1  (32.0, 48.0]
..     …               …   …   …       …    …          …
886      0            211536     1   NaN         0      5  (16.0, 32.0]
887      0            112053     2   B42         0      2  (16.0, 32.0]
888      2        W./C. 6607     2   NaN         0      2  (16.0, 32.0]
889      0            111369     2  C148         1      1  (16.0, 32.0]
890      0            370376     0   NaN         2      1  (16.0, 32.0]

            FareBand
0     (-0.001, 7.91]
1    (31.0, 512.329]
2     (7.91, 14.454]
3    (31.0, 512.329]
4     (7.91, 14.454]
..               …
886   (7.91, 14.454]
887   (14.454, 31.0]
888   (14.454, 31.0]
889   (14.454, 31.0]
890   (-0.001, 7.91]

[891 rows x 15 columns]
```

[63]:
```
for dataset in train_test_data:
    dataset['FamilySize'] = dataset['SibSp'] +  dataset['Parch'] + 1

print (train_df[['FamilySize', 'Survived']].groupby(['FamilySize'],␣
 ↪as_index=False).mean())
```

```
   FamilySize  Survived
0           1  0.303538
1           2  0.552795
2           3  0.578431
3           4  0.724138
4           5  0.200000
5           6  0.136364
6           7  0.333333
7           8  0.000000
8          11  0.000000
```

[64]:
```
for dataset in train_test_data:
    dataset['IsAlone'] = 0
    dataset.loc[dataset['FamilySize'] == 1, 'IsAlone'] = 1
```

```
print (train_df[['IsAlone', 'Survived']].groupby(['IsAlone'], as_index=False).
  ↪mean())
```

```
   IsAlone  Survived
0        0  0.505650
1        1  0.303538
```

[65]:
```
train_df.head()
```

[65]:
```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                Name  Sex  Age  SibSp  Parch  \
0                            Braund, Mr. Owen Harris    0    1      1      0
1  Cumings, Mrs. John Bradley (Florence Briggs Th…    1    2      1      0
2                             Heikkinen, Miss. Laina    1    1      0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    1    2      1      0
4                           Allen, Mr. William Henry    0    2      0      0

             Ticket  Fare Cabin  Embarked  Title       AgeBand  \
0         A/5 21171     0   NaN         0      1  (16.0, 32.0]
1          PC 17599     3   C85         1      3  (32.0, 48.0]
2  STON/O2. 3101282     1   NaN         0      2  (16.0, 32.0]
3            113803     3  C123         0      3  (32.0, 48.0]
4            373450     1   NaN         0      1  (32.0, 48.0]

          FareBand  FamilySize  IsAlone
0   (-0.001, 7.91]           2        0
1  (31.0, 512.329]           2        0
2   (7.91, 14.454]           1        1
3  (31.0, 512.329]           2        0
4   (7.91, 14.454]           1        1
```

[66]:
```
features_drop = ['Name', 'SibSp', 'Parch', 'Ticket', 'Cabin', 'FamilySize']
train_df = train_df.drop(features_drop, axis=1)
test_df = test_df.drop(features_drop, axis=1)
train_df = train_df.drop(['PassengerId', 'AgeBand', 'FareBand'], axis=1)
```

[67]:
```
train_df.head()
```

[67]:
```
   Survived  Pclass  Sex  Age  Fare  Embarked  Title  IsAlone
0         0       3    0    1     0         0      1        0
```

1	1	1	1	2	3	1	3	0
2	1	3	1	1	1	0	2	1
3	1	1	1	2	3	0	3	0
4	0	3	0	2	1	0	1	1

[68]:
```
test_df.head()
```

[68]:

	PassengerId	Pclass	Sex	Age	Fare	Embarked	Title	IsAlone
0	892	3	0	2	0	2	1	1
1	893	3	1	2	0	0	3	0
2	894	2	0	3	1	2	1	1
3	895	3	0	1	1	0	1	1
4	896	3	1	1	1	0	3	0

[69]:
```
X_train = train_df.drop('Survived', axis=1)
y_train = train_df['Survived']
X_test = test_df.drop("PassengerId", axis=1).copy()

X_train.shape, y_train.shape, X_test.shape
```

[69]:
```
((891, 7), (891,), (418, 7))
```

[70]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.svm import SVC, LinearSVC
from sklearn.neighbors import KNeighborsClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.linear_model import Perceptron
from sklearn.linear_model import SGDClassifier
```

[71]:
```
clf = DecisionTreeClassifier()
clf.fit(X_train, y_train)
y_pred_decision_tree = clf.predict(X_test)
acc_decision_tree = round(clf.score(X_train, y_train) * 100, 2)
print (acc_decision_tree)
```

```
87.65
```

[72]:
```
clf = RandomForestClassifier(n_estimators=100)
clf.fit(X_train, y_train)
y_pred_random_forest = clf.predict(X_test)
acc_random_forest = round(clf.score(X_train, y_train) * 100, 2)
print (acc_random_forest)
```

```
87.65
```

[73]:
```
clf = KNeighborsClassifier(n_neighbors = 3)
clf.fit(X_train, y_train)
y_pred_knn = clf.predict(X_test)
acc_knn = round(clf.score(X_train, y_train) * 100, 2)
print (acc_knn)
```

```
85.07
```

[74]:
```
pip install xgboost
```

```
Requirement already satisfied: xgboost in /usr/local/lib/python3.10/dist-
packages (2.1.2)
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-packages
(from xgboost) (1.26.4)
Requirement already satisfied: nvidia-nccl-cu12 in
/usr/local/lib/python3.10/dist-packages (from xgboost) (2.23.4)
Requirement already satisfied: scipy in /usr/local/lib/python3.10/dist-packages
(from xgboost) (1.13.1)
```

[75]:
```
import xgboost as xgb
```

[76]:
```
model = xgb.XGBClassifier()
```

[77]:
```
clf_xgb=model.fit(X_train, y_train)
```

[78]:
```
y_pred_xgb = clf_xgb.predict(X_test)
acc_xgb = round(clf_xgb.score(X_train, y_train) * 100, 2)
print (acc_xgb)
```

```
87.43
```

[79]:
```
y_pred_xgb = clf_xgb.predict(X_test)
acc_xgb = round(clf_xgb.score(X_train, y_train) * 100, 2)
print (acc_xgb)
```

```
87.43
```

[80]:
```
from sklearn.model_selection import GridSearchCV


# Define hyperparameters grid
param_grid = {
    'max_depth': [3, 6, 9],
    'learning_rate': [0.1, 0.01, 0.05],
    'n_estimators': [100, 200, 300],
    'subsample': [0.8, 0.9, 1.0],
    'colsample_bytree': [0.8, 0.9, 1.0]
}
```

```
# Initialize XGBoost classifier
xgb_model = xgb.XGBClassifier()

# Initialize Grid Search with cross-validation
grid_search = GridSearchCV(estimator=xgb_model, param_grid=param_grid, cv=3,␣
 ↪scoring='accuracy')

# Perform grid search
grid_search.fit(X_train, y_train)

# Get best parameters and best score
best_params = grid_search.best_params_
best_score = grid_search.best_score_

# Train final model with best parameters
final_model = xgb.XGBClassifier(**best_params)
final_model.fit(X_train, y_train)
```

[80]:
```
XGBClassifier(base_score=None, booster=None, callbacks=None,
              colsample_bylevel=None, colsample_bynode=None,
              colsample_bytree=0.9, device=None, early_stopping_rounds=None,
              enable_categorical=False, eval_metric=None, feature_types=None,
              gamma=None, grow_policy=None, importance_type=None,
              interaction_constraints=None, learning_rate=0.05, max_bin=None,
              max_cat_threshold=None, max_cat_to_onehot=None,
              max_delta_step=None, max_depth=3, max_leaves=None,
              min_child_weight=None, missing=nan, monotone_constraints=None,
              multi_strategy=None, n_estimators=300, n_jobs=None,
              num_parallel_tree=None, random_state=None, …)
```

[81]:
```
print(best_params)
print(best_score)
```

```
{'colsample_bytree': 0.9, 'learning_rate': 0.05, 'max_depth': 3, 'n_estimators':
300, 'subsample': 0.8}
0.8204264870931538
```

[82]:
```
params = {
    'max_depth': 3,
    'learning_rate': 0.05,
    'n_estimators': 300,
    'subsample': 0.8,
    'colsample_bytree': 0.8
}
```

```
model = xgb.XGBClassifier(**params)
clf_xgb=model.fit(X_train, y_train)
y_pred_train_xgb=clf_xgb.predict(X_train)
y_pred_xgb = clf_xgb.predict(X_test)
acc_xgb = round(clf_xgb.score(X_train, y_train) * 100, 2)
print (acc_xgb)
```

```
85.63
```

[83]:
```
y_train.value_counts()
```

[83]:
```
Survived
0    549
1    342
Name: count, dtype: int64
```

[84]:
```
from sklearn.metrics import precision_score, recall_score, f1_score


precision=precision_score(y_train,y_pred_train_xgb)
precision
```

[84]:
```
0.8664383561643836
```

[85]:
```
recall = recall_score(y_train, y_pred_train_xgb)

# Calculate F1-score
f1 = f1_score(y_train, y_pred_train_xgb)

print("Precision:", precision)
print("Recall:", recall)
print("F1-score:", f1)
```

```
Precision: 0.8664383561643836
Recall: 0.7397660818713451
F1-score: 0.7981072555205048
```

[87]:
```
pip install lightgbm
```

```
Requirement already satisfied: lightgbm in /usr/local/lib/python3.10/dist-
packages (4.5.0)
Requirement already satisfied: numpy>=1.17.0 in /usr/local/lib/python3.10/dist-
packages (from lightgbm) (1.26.4)
Requirement already satisfied: scipy in /usr/local/lib/python3.10/dist-packages
(from lightgbm) (1.13.1)
```

[88]:
```
import lightgbm as lgb
```

[89]:
```
model = lgb.LGBMClassifier()
```

[90]:
```
clf_lgb=model.fit(X_train, y_train)
```

```
[LightGBM] [Info] Number of positive: 342, number of negative: 549
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000558 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
[LightGBM] [Info] Number of data points in the train set: 891, number of used
features: 7
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```

[91]:

```
y_pred_test = clf_lgb.predict(X_test)
y_pred_train=clf_lgb.predict(X_train)
acc_lgb = round(clf_lgb.score(X_train, y_train) * 100, 2)
print (acc_lgb)
```

```
86.53
```

[92]:

```
print(clf_lgb.feature_importances_)
```

```
[365 171 563 541 417 306 195]
```

[93]:

```
X_train.columns
```

[93]:

```
Index(['Pclass', 'Sex', 'Age', 'Fare', 'Embarked', 'Title', 'IsAlone'],
dtype='object')
```

[94]:

```
from sklearn.model_selection import RandomizedSearchCV

# Define parameter space
param_grid = {
    'num_leaves': [20, 30, 40, 50],
    'learning_rate': [0.01, 0.05, 0.1],
    'max_depth': [-1, 5, 10, 15],
    'min_child_samples': [20, 30, 40, 50]
}

# Define the objective function
def objective(params):
    model = lgb.LGBMClassifier(**params)
```

```
    model.fit(X_train, y_train)
    y_pred_train = model.predict(X_train)
    accuracy = accuracy_score(y_train, y_pred_train)
    return -accuracy  # Minimize negative accuracy

# # Split data into training and validation sets
# X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.2,␣
↪random_state=42)

# Initialize RandomizedSearchCV
rs = RandomizedSearchCV(estimator=lgb.LGBMClassifier(),
                        param_distributions=param_grid,
                        n_iter=50,
                        scoring='accuracy',
                        cv=3,
                        random_state=42)

# Perform hyperparameter tuning
rs.fit(X_train, y_train)

# Get the best parameters
best_params = rs.best_params_
print("Best parameters:", best_params)

# # Evaluate the best model
# best_model = rs.best_estimator_
# y_pred_test = best_model.predict(X_test)
# test_accuracy = accuracy_score(y_test, y_pred_test)
# print("Test accuracy:", test_accuracy)
```

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Streaming output truncated to the last 5000 lines.
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000102 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
[LightGBM] [Info] Number of data points in the train set: 594, number of used
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features: 7
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.383838 -> initscore=-0.473288
[LightGBM] [Info] Start training from score -0.473288
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000098 seconds.
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And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000093 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
[LightGBM] [Info] Number of data points in the train set: 594, number of used
features: 7
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.383838 -> initscore=-0.473288
[LightGBM] [Info] Start training from score -0.473288
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
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And if memory is not enough, you can set `force_col_wise=true`.
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000104 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
[LightGBM] [Info] Number of data points in the train set: 594, number of used
features: 7
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.383838 -> initscore=-0.473288
[LightGBM] [Info] Start training from score -0.473288
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000097 seconds.
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And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
[LightGBM] [Info] Number of data points in the train set: 594, number of used
features: 7
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[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.383838 -> initscore=-0.473288
[LightGBM] [Info] Start training from score -0.473288
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000093 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
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[LightGBM] [Info] Number of data points in the train set: 594, number of used
features: 7
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.383838 -> initscore=-0.473288
[LightGBM] [Info] Start training from score -0.473288
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
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[LightGBM] [Info] Number of positive: 228, number of negative: 366
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000104 seconds.
You can set `force_row_wise=true` to remove the overhead.
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And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
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[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
[LightGBM] [Info] Number of positive: 342, number of negative: 549
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
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You can set `force_row_wise=true` to remove the overhead.
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Best parameters: {'num_leaves': 30, 'min_child_samples': 20, 'max_depth': 15,
'learning_rate': 0.05}
```

[95]:

```python
params= {'num_leaves': 40, 'min_child_samples': 20, 'max_depth': 5,␣
 ↪'learning_rate': 0.05}
model = lgb.LGBMClassifier(**params)
clf_lgb=model.fit(X_train, y_train)
y_pred_test = clf_lgb.predict(X_test)
y_pred_train=clf_lgb.predict(X_train)
acc_lgb = round(clf_lgb.score(X_train, y_train) * 100, 2)
print (acc_lgb)
```

```
[LightGBM] [Info] Number of positive: 342, number of negative: 549
```

```
[LightGBM] [Info] Auto-choosing row-wise multi-threading, the overhead of
testing was 0.000151 seconds.
You can set `force_row_wise=true` to remove the overhead.
And if memory is not enough, you can set `force_col_wise=true`.
[LightGBM] [Info] Total Bins 26
[LightGBM] [Info] Number of data points in the train set: 891, number of used
features: 7
[LightGBM] [Info] [binary:BoostFromScore]: pavg=0.383838 -> initscore=-0.473288
[LightGBM] [Info] Start training from score -0.473288
[LightGBM] [Warning] No further splits with positive gain, best gain: -inf
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85.75
```
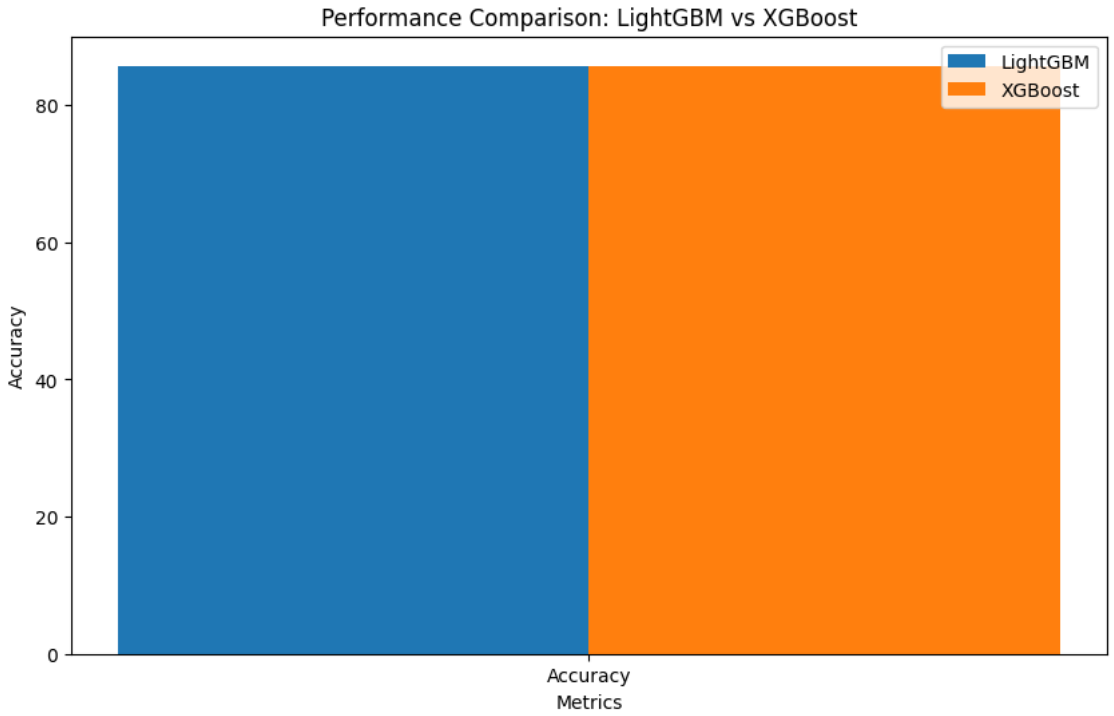

[96]:

```
labels = ['Accuracy']
lgb_scores = [acc_xgb]
xgb_scores = [acc_lgb]

x = range(len(labels))

plt.figure(figsize=(10, 6))

plt.bar(x, lgb_scores, width=0.4, label='LightGBM', align='center')
plt.bar([i + 0.4 for i in x], xgb_scores, width=0.4, label='XGBoost',␣
 ↪align='center')

plt.xlabel('Metrics')
plt.ylabel('Accuracy')
plt.xticks([i + 0.2 for i in x], labels)
plt.title('Performance Comparison: LightGBM vs XGBoost')
plt.legend()
plt.show()

# Interpretation
print("LightGBM Accuracy:", acc_lgb)
print("XGBoost Accuracy:", acc_xgb)
```




```
LightGBM Accuracy: 85.75
XGBoost Accuracy: 85.63
```

[ ]: