Titanic - Exploratory Data Analysis

In this project, I explored the Titanic: Machine Learning from Disaster dataset from Kaggle. The key steps I performed included:

Data Cleaning: Handled missing values (e.g., age and embarked), corrected data types, and cleaned categorical fields.

Summary Statistics: Generated group-wise survival insights — e.g., survival rates by gender, passenger class, and family size.

Visualizations: Created multiple plots using Matplotlib and Seaborn, including:

Bar plots for survival by gender, class, and embarkation point

Box plots of age and fare distributions

A correlation heatmap for numerical features

Insights: Found clear survival trends based on gender and class, where females and first-class passengers had higher chances of survival.

This EDA provided a solid foundation for future steps like model building or dashboarding.

In [42]:
```
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import matplotlib.ticker as mtick
from ydata_profiling import ProfileReport
import seaborn as sns
```

In [18]:
```
df=pd.read_csv("train.csv")
df.head()
```

Out[18]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500

In [19]:
```
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
```

In [20]:
```
df.isna().sum()
```

Out[20]:
```
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
```

In [21]:
```
df.duplicated().sum()
```

Out[21]:
```
0
```

In [22]:
```
df['Age'] = df['Age'].fillna(df['Age'].median())
df['Embarked'] = df['Embarked'].fillna(df['Embarked'].mode()[0])
df.drop('Cabin', axis=1, inplace=True)
```

In [23]:
```
df['Survived'] = df['Survived'].astype('category')
df['Pclass'] = df['Pclass'].astype('category')
df['Sex'] = df['Sex'].astype('category')
df['Embarked'] = df['Embarked'].astype('category')
```

In [24]:
```
df['Age']=df['Age'].astype(int)
```

In [26]:
```
df.dtypes
```

Out[26]:
```
PassengerId       int64
Survived       category
Pclass         category
Name             object
Sex            category
Age               int32
SibSp             int64
Parch             int64
Ticket           object
Fare            float64
Embarked       category
dtype: object
```

In [27]:
```
df.isnull().sum()
```

Out[27]:
```
PassengerId    0
Survived       0
Pclass         0
Name           0
Sex            0
Age            0
SibSp          0
Parch          0
Ticket         0
Fare           0
Embarked       0
dtype: int64
```

In [29]:
```
profile = ProfileReport(df, title="Titanic Dataset Profiling Report", explorative=T
profile.to_file("titanic_profile_report.html")
```

```
Summarize dataset:   0%|                                                    | 0/16 [00:00
<?, ?it/s, Describe variable: Name]
Summarize dataset:  56%|████████████████▉               | 9/16 [00:00<00:00, 30.
09it/s, Describe variable: Embarked]
100%|████████████████████████████████████████████████████████████████████
███| 11/11 [00:00<00:00, 39.31it/s]
Summarize dataset:  72%|█████████████████████▋          | 13/18 [00:00<00:00, 3
0.09it/s, Calculate auto correlation]C:\Users\Hp\AppData\Roaming\Python\Python39\sit
e-packages\ydata_profiling\model\pandas\discretize_pandas.py:52: FutureWarning: Sett
ing an item of incompatible dtype is deprecated and will raise in a future error of
pandas. Value '[2 4 3 4 4 3 6 0 3 1 0 7 2 4 1 6 0 3 3 3 4 4 1 3 0 4 3 2 3 3 4 3 3 8
3 5 3
 2 2 1 4 3 3 0 2 3 3 3 3 2 0 2 6 3 8 3 2 3 0 1 2 4 5 0 3 3 3 2 2 3 3 1 2 3
 3 3 3 3 0 3 2 3 3 3 2 4 1 3 2 2 3 2 5 3 7 3 8 2 4 4 3 3 2 4 4 3 2 3 4 3 5
 1 2 2 2 2 8 3 2 0 2 3 3 3 6 1 3 2 3 5 4 2 5 3 3 2 2 4 1 2 3 2 2 2 2 2 3 1
 4 5 6 2 6 4 3 6 1 3 3 3 5 4 3 2 0 1 3 5 3 3 7 0 0 2 6 2 3 6 3 4 3 3 1 0 0
 3 3 5 4 4 3 2 2 0 5 7 3 5 3 2 3 3 4 5 2 0 3 3 1 4 2 4 2 3 3 3 3 5 3 3 1 3
 6 3 4 2 2 2 2 3 4 3 7 0 2 3 5 0 2 4 3 3 3 2 3 5 3 2 4 6 3 3 7 3 5 3 3 3 4
 6 3 0 6 4 3 4 1 3 7 4 3 3 5 4 3 7 5 3 0 4 8 3 1 2 3 4 3 2 5 2 3 2 4 2 2 3
 2 0 3 6 3 3 2 3 3 0 3 2 3 3 2 2 3 3 5 3 2 6 3 4 2 3 3 2 3 4 7 4 3 1 3 5 4
 1 3 3 3 5 5 5 0 2 3 3 4 2 4 3 0 5 2 3 1 3 3 3 2 4 3 3 4 3 5 4 3 3 7 3 3 2
 3 2 2 2 0 3 2 3 2 2 5 0 3 4 3 2 0 4 3 2 4 2 3 2 2 2 3 5 2 3 4 3 2 3 2 4 6
 0 2 3 3 3 4 3 5 3 4 2 3 1 3 2 3 3 2 3 3 2 3 3 3 3 5 2 6 1 2 2 7 3 5 2 3 3
 3 0 1 4 0 6 4 3 3 6 3 3 8 3 6 3 5 4 5 5 3 4 3 6 3 0 3 4 4 2 2 3 4 3 2 0 1
 3 6 7 3 3 4 7 3 1 3 2 6 8 2 3 6 3 3 2 2 2 3 4 1 2 4 3 3 3 3 3 4 6 2 5 4 3
 4 3 3 2 3 5 3 4 6 3 4 2 0 3 2 3 3 0 5 3 3 2 4 1 1 3 6 7 2 3 4 0 2 3 3 2 2
 7 5 3 4 4 3 4 3 3 3 2 2 3 3 3 7 6 4 3 1 2 4 4 3 3 3 4 6 4 3 2 5 7 2 3 4 6
 5 3 4 4 3 6 3 6 2 3 3 5 4 4 3 3 2 4 4 3 3 3 4 2 4 3 0 3 3 5 2 2 2 7 7 2 3
 3 9 6 3 3 1 3 3 3 5 3 2 2 0 3 0 5 2 6 3 2 3 2 2 3 2 2 3 3 2 7 6 4 5 4 2 3
 3 3 5 3 4 3 8 3 3 2 2 2 5 4 3 3 2 1 7 3 1 2 2 1 3 0 3 3 7 6 5 3 6 5 2 4 2
 3 3 4 5 5 2 3 2 3 5 3 6 2 4 3 3 4 0 2 4 6 3 2 3 3 3 3 3 1 3 2 2 3 5 4 3 3
 3 4 2 2 3 8 1 3 2 3 0 0 4 2 5 0 3 2 4 4 3 5 2 4 1 6 3 3 3 3 2 5 7 3 6 2 3
 0 3 5 1 2 3 3 3 3 2 0 0 5 3 1 3 3 3 4 6 3 3 3 4 3 1 0 3 3 4 2 4 4 3 4 4 0
 3 3 2 3 5 1 6 3 4 3 0 3 3 0 3 7 1 0 3 2 2 4 2 3 3 3 2 1 3 4 2 5 3 4 3 3 0
 9 1 1 5 2 5 6 2 3 5 2 5 3 2 5 3 3 3 0 3 5 4 5 3 1 2 2 3 6 3 4 2 3 3 4 3 2
 3 3 3]' has dtype incompatible with int32, please explicitly cast to a compatible d
type first.
  discretized_df.loc[:, column] = self._discretize_column(
Summarize dataset: 100%|████████████████████████████████████████████████████| 45/45
[00:12<00:00,  3.65it/s, Completed]
Generate report structure: 100%|████████████████████████████████████████████
████| 1/1 [00:13<00:00, 13.84s/it]
Render HTML: 100%|██████████████████████████████████████████████████████████
████| 1/1 [00:04<00:00,  4.88s/it]
Export report to file: 100%|████████████████████████████████████████████████
████| 1/1 [00:00<00:00, 33.67it/s]
```

In [30]:
```python
# Title
df['Title'] = df['Name'].str.extract(' ([A-Za-z]+)\.', expand=False)
df['Title'] = df['Title'].replace(['Lady', 'Countess','Capt', 'Col', 'Don',
                                   'Dr', 'Major', 'Rev', 'Sir', 'Jonkheer', 'Dona']
df['Title'] = df['Title'].replace({'Mlle': 'Miss', 'Ms': 'Miss', 'Mme': 'Mrs'})

# Family size and solo traveler
df['FamilySize'] = df['SibSp'] + df['Parch'] + 1
df['IsAlone'] = (df['FamilySize'] == 1).astype(int)
```

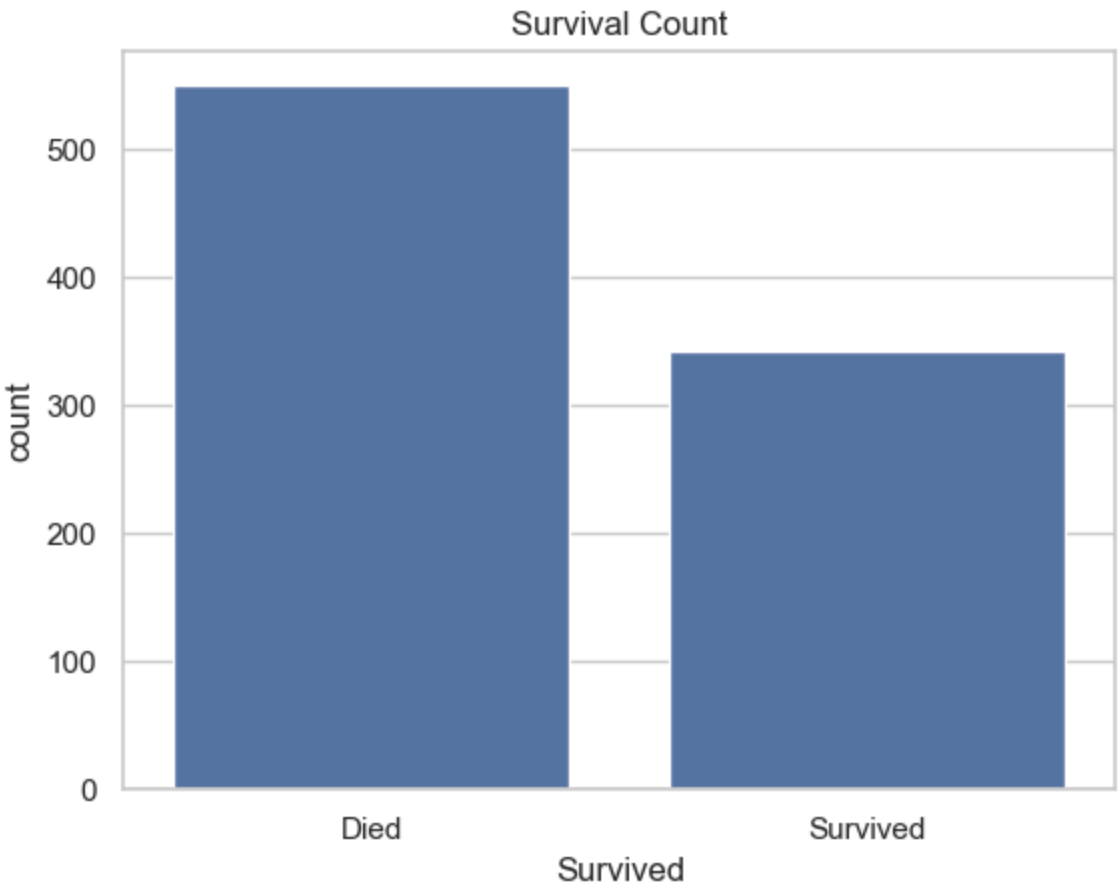
```
# Age and Fare bins
df['AgeGroup'] = pd.cut(df['Age'], bins=[0, 12, 18, 60, 100], labels=['Child', 'Tee
df['FareBand'] = pd.qcut(df['Fare'], 4, labels=['Low', 'Medium', 'High', 'Very High
```

In [31]:
```
df.describe()
```

Out[31]:

	PassengerId	Age	SibSp	Parch	Fare	FamilySize	IsAlone
count	891.000000	891.000000	891.000000	891.000000	891.000000	891.000000	891.000000
mean	446.000000	29.345679	0.523008	0.381594	32.204208	1.904602	0.602694
std	257.353842	13.028212	1.102743	0.806057	49.693429	1.613459	0.489615
min	1.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
25%	223.500000	22.000000	0.000000	0.000000	7.910400	1.000000	0.000000
50%	446.000000	28.000000	0.000000	0.000000	14.454200	1.000000	1.000000
75%	668.500000	35.000000	1.000000	0.000000	31.000000	2.000000	1.000000
max	891.000000	80.000000	8.000000	6.000000	512.329200	11.000000	1.000000

In [51]:
```
sns.countplot(x='Survived', data=df)
plt.title("Survival Count")
plt.xticks([0, 1], ['Died', 'Survived'])
plt.show()
```



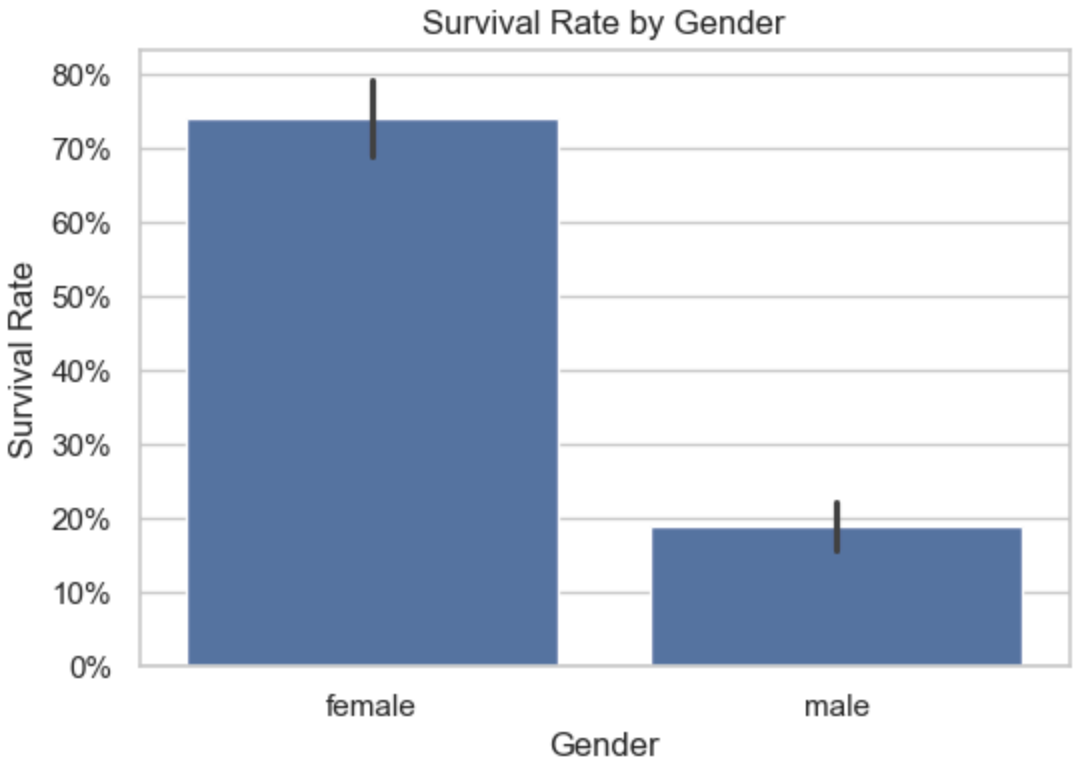
In [36]:
```
df['Survived'] = df['Survived'].astype(int)

# Survival Rate by Gender
print("\n Survival Rate by Gender:")
print(df.groupby('Sex', observed=False)['Survived'].mean())

# Survival Rate by Passenger Class
print("\n Survival Rate by Passenger Class:")
print(df.groupby('Pclass', observed=False)['Survived'].mean())

# Survival Rate by Age Group
print("\n Survival Rate by Age Group:")
print(df.groupby('AgeGroup', observed=False)['Survived'].mean())

# Survival Rate by Title
print("\n Survival Rate by Title:")
print(df.groupby('Title', observed=False)['Survived'].mean().sort_values(ascending=

# Survival Rate by Family Size
print("\n Survival Rate by Family Size:")
print(df.groupby('FamilySize', observed=False)['Survived'].mean())

# Survival Rate by IsAlone
print("\n Survival Rate by IsAlone:")
print(df.groupby('IsAlone', observed=False)['Survived'].mean())

# Survival Rate by Fare Band
```

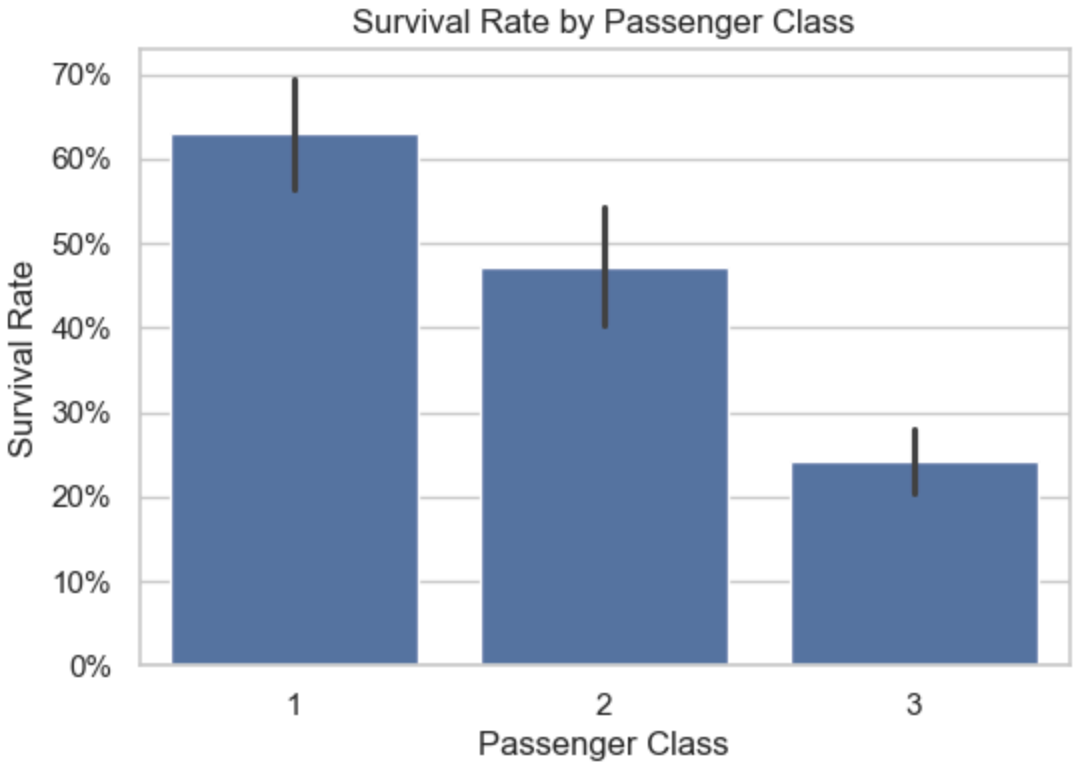
```
print("\n Survival Rate by Fare Band:")
print(df.groupby('FareBand', observed=False)['Survived'].mean())
```

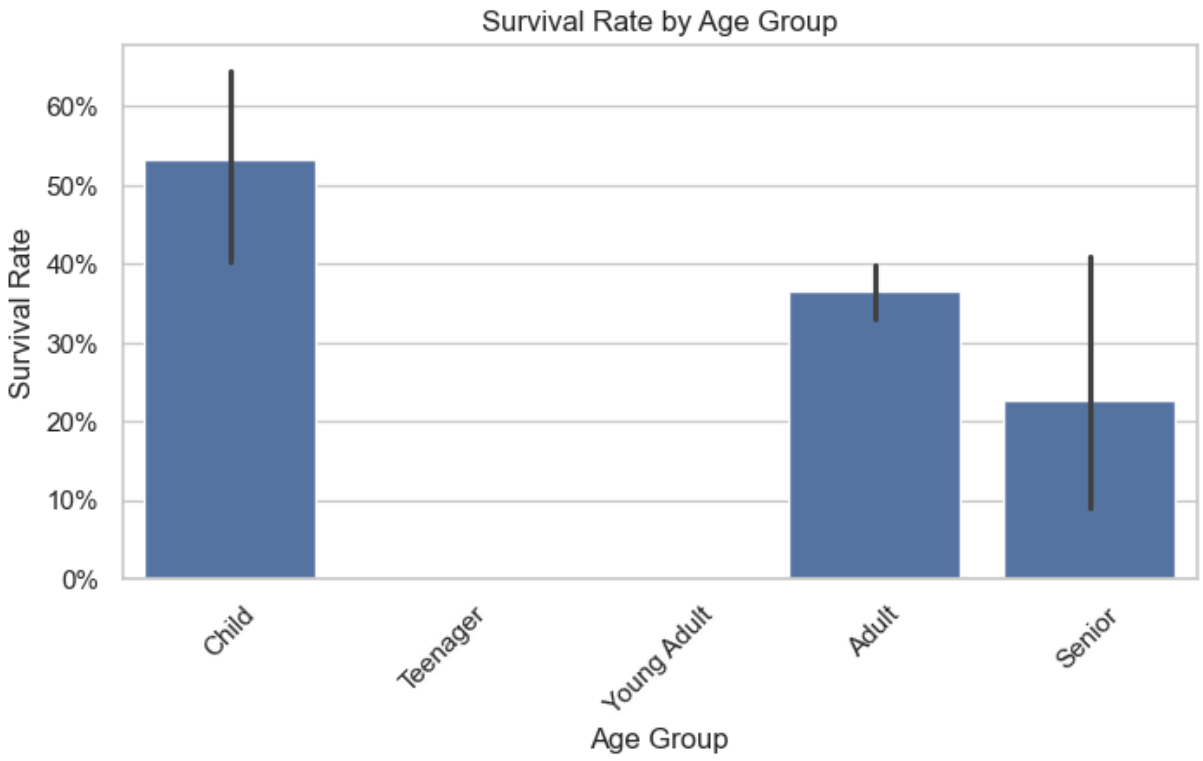
```
 Survival Rate by Gender:
Sex
female    0.742038
male      0.188908
Name: Survived, dtype: float64

 Survival Rate by Passenger Class:
Pclass
1    0.629630
2    0.472826
3    0.242363
Name: Survived, dtype: float64

 Survival Rate by Age Group:
AgeGroup
Child     0.532258
Teen      0.428571
Adult     0.365753
Senior    0.227273
Name: Survived, dtype: float64

 Survival Rate by Title:
Title
Mrs       0.793651
Miss      0.702703
Master    0.575000
Rare      0.347826
Mr        0.156673
Name: Survived, dtype: float64

 Survival Rate by Family Size:
FamilySize
1     0.303538
2     0.552795
3     0.578431
4     0.724138
5     0.200000
6     0.136364
7     0.333333
8     0.000000
11    0.000000
Name: Survived, dtype: float64

 Survival Rate by IsAlone:
IsAlone
0    0.505650
1    0.303538
Name: Survived, dtype: float64

 Survival Rate by Fare Band:
FareBand
Low          0.197309
Medium       0.303571
High         0.454955
Very High    0.581081
Name: Survived, dtype: float64
```

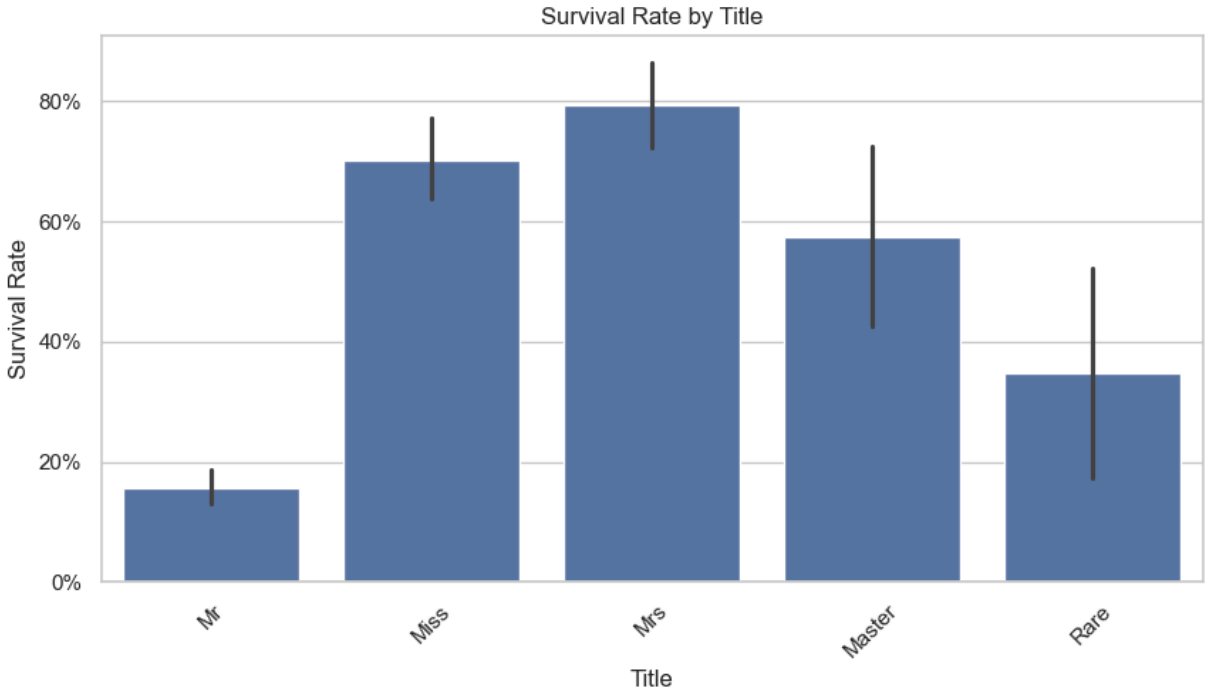
In [44]:
```
# 1. Survival by Gender
plt.figure(figsize=(6,4))
sns.barplot(data=df, x='Sex', y='Survived')
plt.title('Survival Rate by Gender')
plt.ylabel('Survival Rate')
plt.xlabel('Gender')
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()

# 2. Survival by Passenger Class
plt.figure(figsize=(6,4))
sns.barplot(data=df, x='Pclass', y='Survived')
plt.title('Survival Rate by Passenger Class')
plt.ylabel('Survival Rate')
plt.xlabel('Passenger Class')
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()

# 3. Survival by Age Group
plt.figure(figsize=(8,4))
sns.barplot(data=df, x='AgeGroup', y='Survived', order=['Child','Teenager','Young A
plt.title('Survival Rate by Age Group')
plt.ylabel('Survival Rate')
plt.xlabel('Age Group')
plt.xticks(rotation=45)
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()

# 4. Survival by Title
plt.figure(figsize=(10,5))
sns.barplot(data=df, x='Title', y='Survived', order=df['Title'].value_counts().inde
plt.title('Survival Rate by Title')
plt.ylabel('Survival Rate')
plt.xlabel('Title')
plt.xticks(rotation=45)
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()

# 5. Survival by Family Size
plt.figure(figsize=(8,4))
sns.barplot(data=df, x='FamilySize', y='Survived')
plt.title('Survival Rate by Family Size')
plt.ylabel('Survival Rate')
plt.xlabel('Family Size')
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()

# 6. Survival by IsAlone
plt.figure(figsize=(6,4))
sns.barplot(data=df, x='IsAlone', y='Survived')
plt.title('Survival Rate by IsAlone')
plt.ylabel('Survival Rate')
plt.xlabel('Is Alone (1 = Yes, 0 = No)')
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()
```

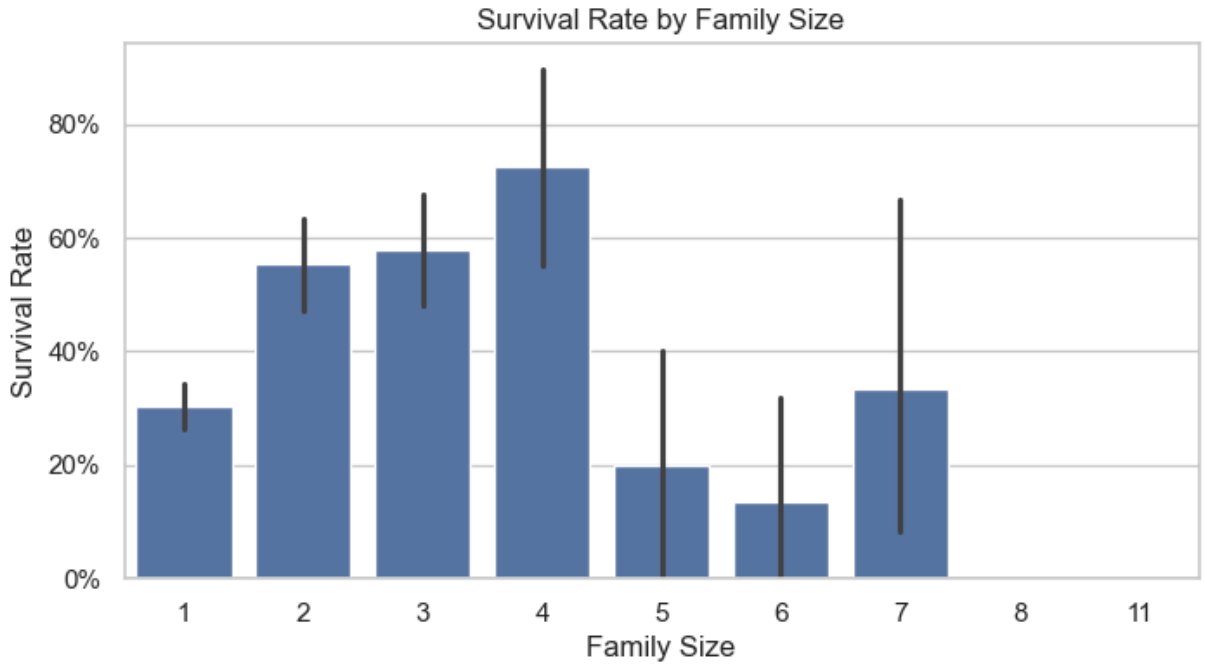
```
# 7. Survival by Fare Band
plt.figure(figsize=(8,4))
sns.barplot(data=df, x='FareBand', y='Survived', order=df['FareBand'].cat.categorie
plt.title('Survival Rate by Fare Band')
plt.ylabel('Survival Rate')
plt.xlabel('Fare Band')
plt.xticks(rotation=45)
plt.gca().yaxis.set_major_formatter(mtick.PercentFormatter(1.0))
plt.show()
```

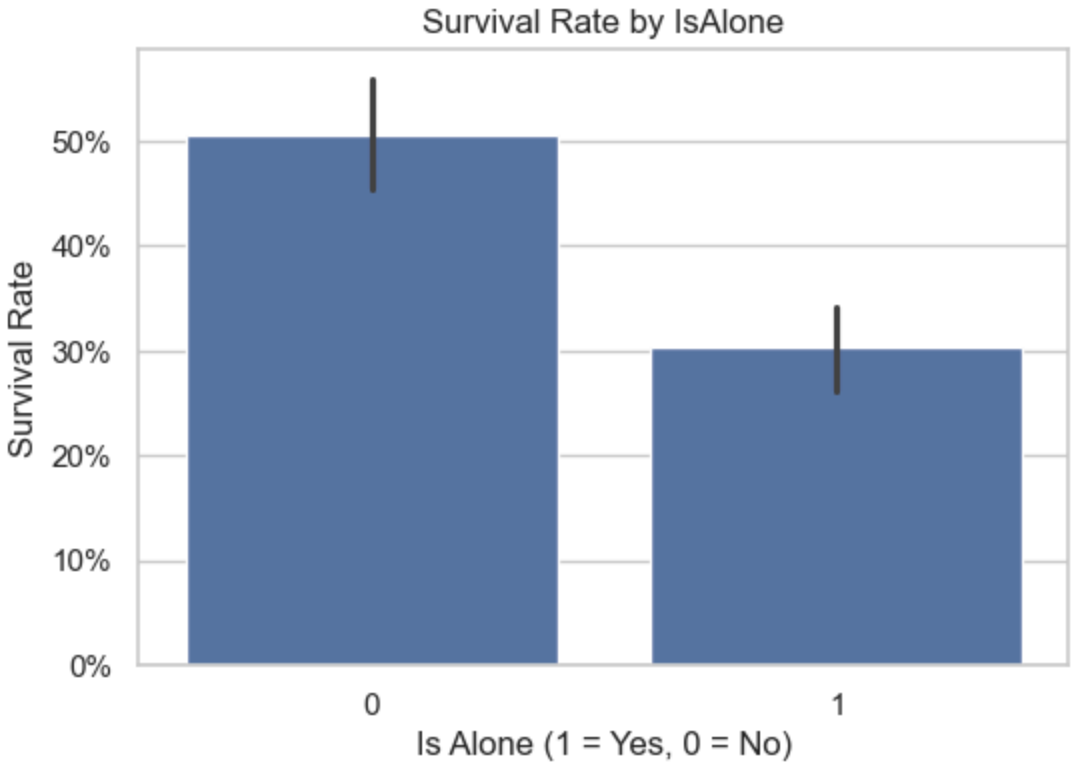


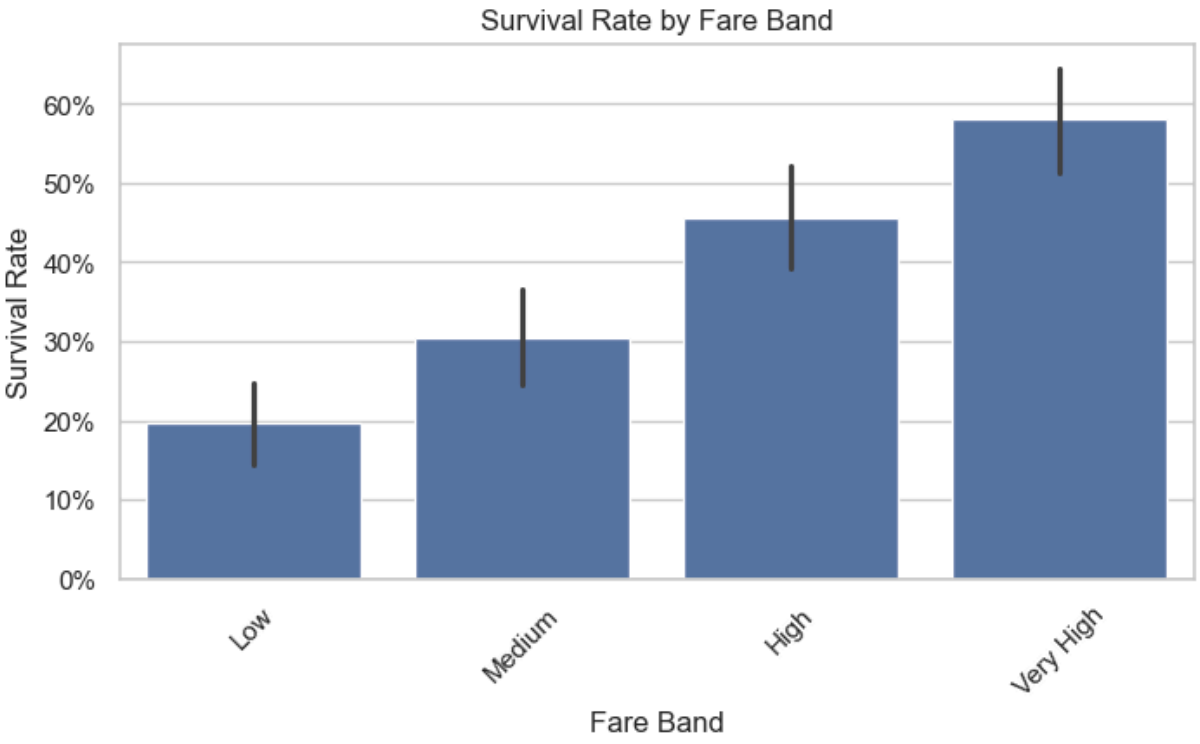

Survival Rate by Passenger Class
70%
60%
50%
40%
30%
20%
10%
0%
Survival Rate
1
2
3
Passenger Class


Survival Rate by Age Group
60%
50%
40%
30%
20%
10%
0%
Survival Rate
Child
Teenager
Young Adult
Adult
Senior
Age Group

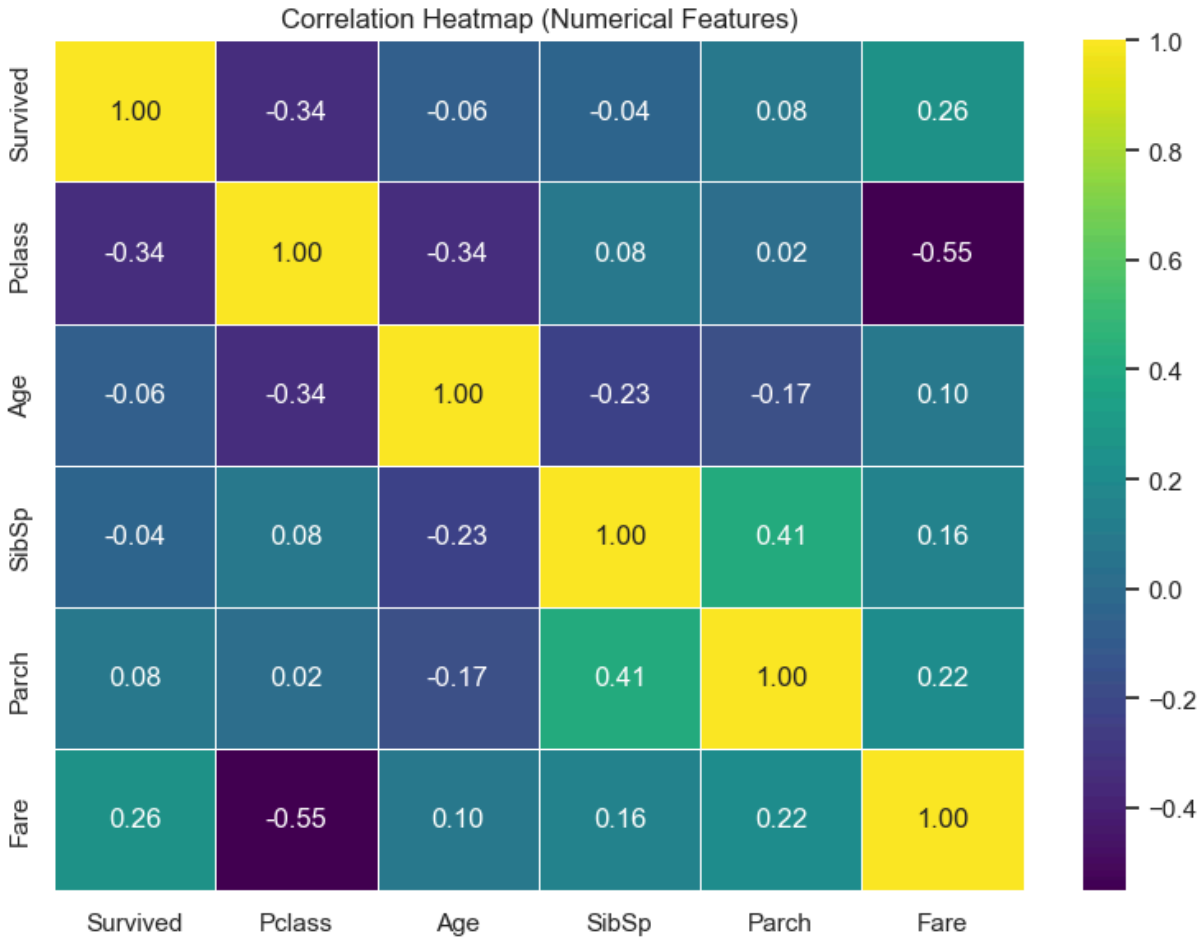

Survival Rate by Title
Survival Rate
80%
60%
40%
20%
0%
Mr
Miss
Mrs
Master
Rare
Title


Survival Rate by Family Size
Survival Rate
80%
60%
40%
20%
0%
1
2
3
4
5
6
7
8
11
Family Size

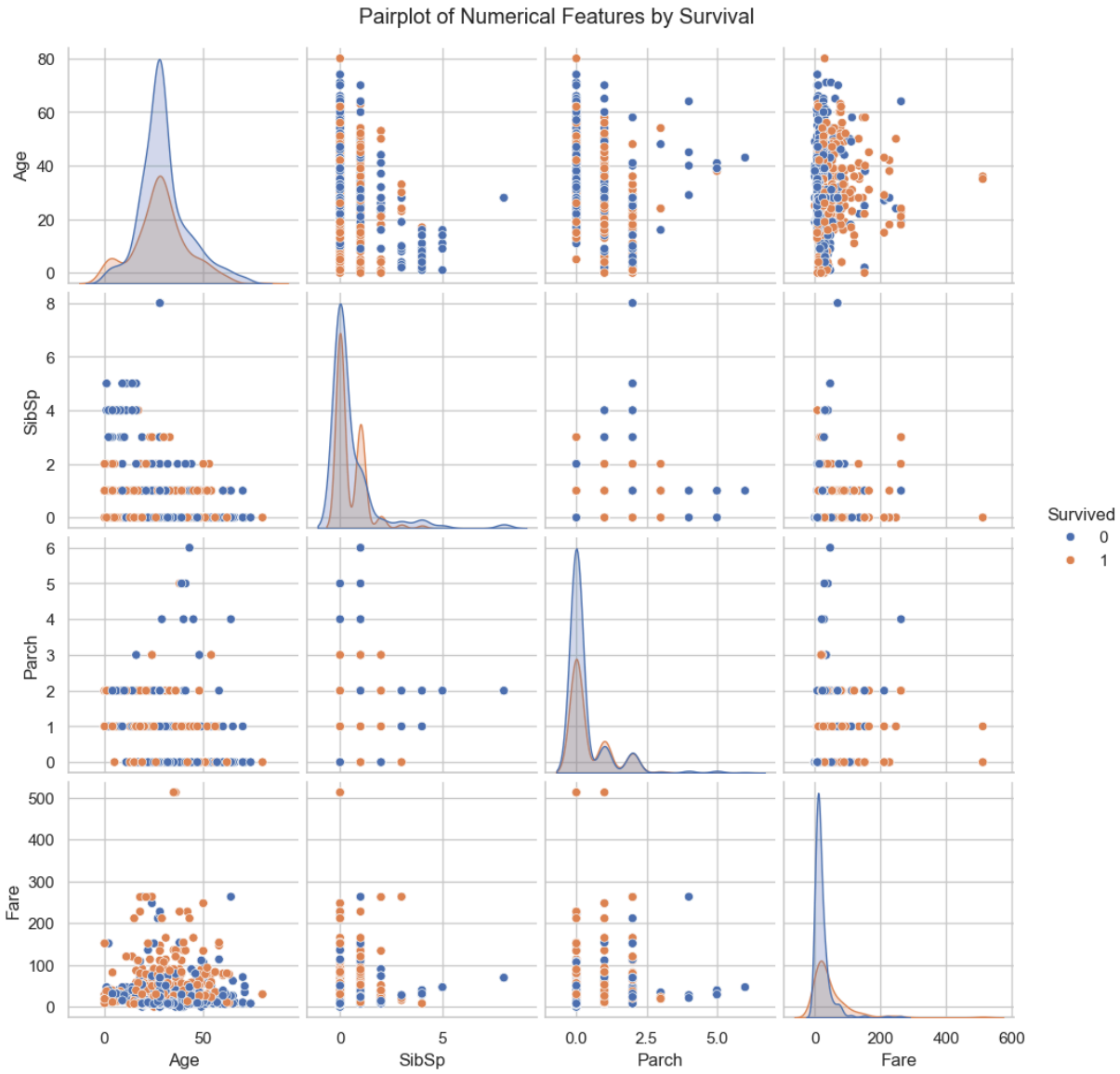




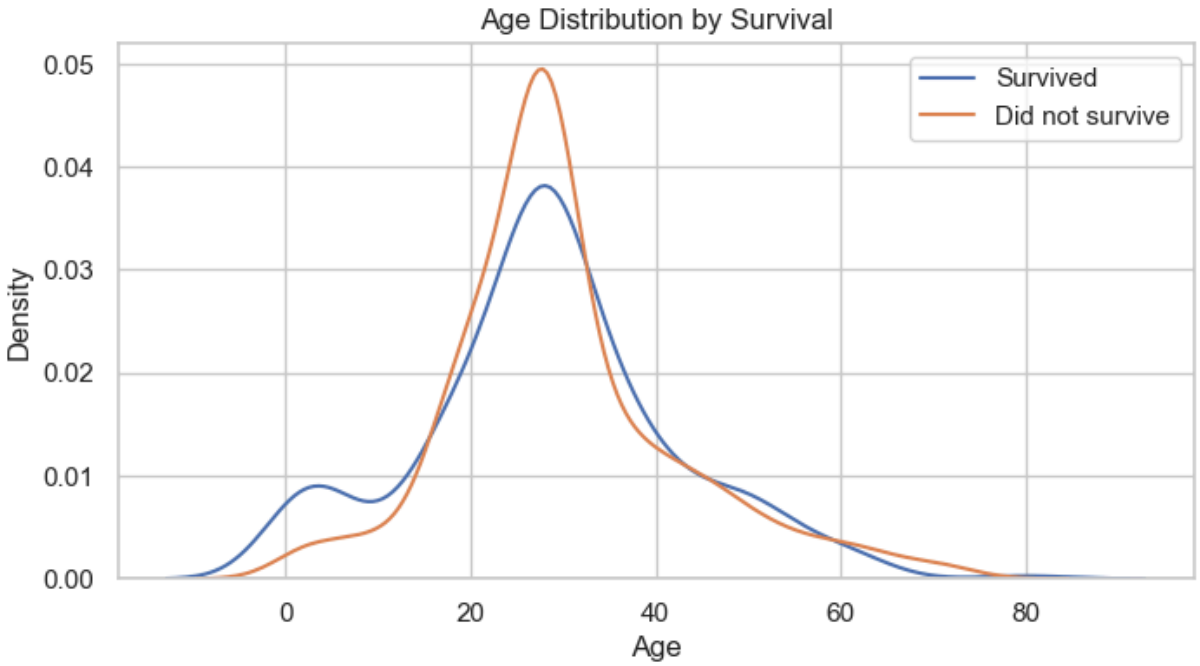
In [49]:
```
numerical_df = df[['Survived', 'Pclass', 'Age', 'SibSp', 'Parch', 'Fare']]
corr = numerical_df.corr()
plt.figure(figsize=(8, 6))
sns.heatmap(corr, annot=True, cmap='viridis', fmt=".2f", linewidths=0.5)
plt.title("Correlation Heatmap (Numerical Features)")
plt.tight_layout()
plt.show()
```



In [50]:
```
sns.pairplot(numerical_df, hue='Survived', diag_kind='kde')
plt.suptitle("Pairplot of Numerical Features by Survival", y=1.02)
plt.show()
```



In [53]:
```
plt.figure(figsize=(8, 4))
sns.kdeplot(data=df[df['Survived']==1], x='Age', label='Survived')
sns.kdeplot(data=df[df['Survived']==0], x='Age', label='Did not survive')
plt.title('Age Distribution by Survival')
plt.xlabel('Age')
plt.legend()
plt.show()
```


Age Distribution by Survival
Survived
Did not survive
Density
0.05
0.04
0.03
0.02
0.01
0.00
0
20
40
60
80
Age

In [ ]:

In [ ]: