Titanic EDA

Name: Harsh Sharma
Task: Task 5 – Exploratory Data Analysis
Dataset: train.csv

In [6]:
```
# Cell: imports and settings
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

sns.set_style('whitegrid')
pd.set_option('display.max_columns', None)

# Load
df = pd.read_csv('train.csv')
```

In [7]:
```
# Basic inspection
print("Shape:", df.shape)
display(df.head())
display(df.info())
display(df.describe(include='all').T)
print("\nMissing values:")
display(df.isnull().sum().sort_values(ascending=False))
```

```
Shape: (891, 12)
```

	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

```
<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
```

	count	unique	top	freq	mean	std	min	25%	50%	7
PassengerId	891.0	NaN	NaN	NaN	446.0	257.353842	1.0	223.5	446.0	66
Survived	891.0	NaN	NaN	NaN	0.383838	0.486592	0.0	0.0	0.0	
Pclass	891.0	NaN	NaN	NaN	2.308642	0.836071	1.0	2.0	3.0	
Name	891	891	Braund, Mr. Owen Harris	1	NaN	NaN	NaN	NaN	NaN	N
Sex	891	2	male	577	NaN	NaN	NaN	NaN	NaN	N
Age	714.0	NaN	NaN	NaN	29.699118	14.526497	0.42	20.125	28.0	3
SibSp	891.0	NaN	NaN	NaN	0.523008	1.102743	0.0	0.0	0.0	
Parch	891.0	NaN	NaN	NaN	0.381594	0.806057	0.0	0.0	0.0	
Ticket	891	681	347082	7	NaN	NaN	NaN	NaN	NaN	N
Fare	891.0	NaN	NaN	NaN	32.204208	49.693429	0.0	7.9104	14.4542	3
Cabin	204	147	B96 B98	4	NaN	NaN	NaN	NaN	NaN	N
Embarked	889	3	S	644	NaN	NaN	NaN	NaN	NaN	N

```
Missing values:

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

In [8]:
```
# Fill Embarked with mode
df['Embarked'] = df['Embarked'].fillna(df['Embarked'].mode()[0])

# HasCabin
df['HasCabin'] = df['Cabin'].notnull().astype(int)

# Extract Title from Name
df['Title'] = df['Name'].str.extract(r',\s*([^\.]+)\.', expand=False)
# Map rare titles to "Other"
rare_titles = ['Lady','Countess','Capt','Col','Don','Dr','Rev','Sir','Jonkh
df['Title'] = df['Title'].replace(rare_titles, 'Other')
df['Title'] = df['Title'].replace({'Mlle':'Miss','Ms':'Miss','Mme':'Mrs'})

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

# Quick check
display(df[['HasCabin','Title','FamilySize','IsAlone']].head())
```

	HasCabin	Title	FamilySize	IsAlone
0	0	Mr	2	0
1	1	Mrs	2	0
2	0	Miss	1	1
3	1	Mrs	2	0
4	0	Mr	1	1

In [9]:
```
# Impute Age by median age per Title
title_age_median = df.groupby('Title')['Age'].median()
def fill_age(row):
    if pd.isnull(row['Age']):
        return title_age_median.get(row['Title'], df['Age'].median())
    else:
        return row['Age']

df['Age'] = df.apply(fill_age, axis=1)
```

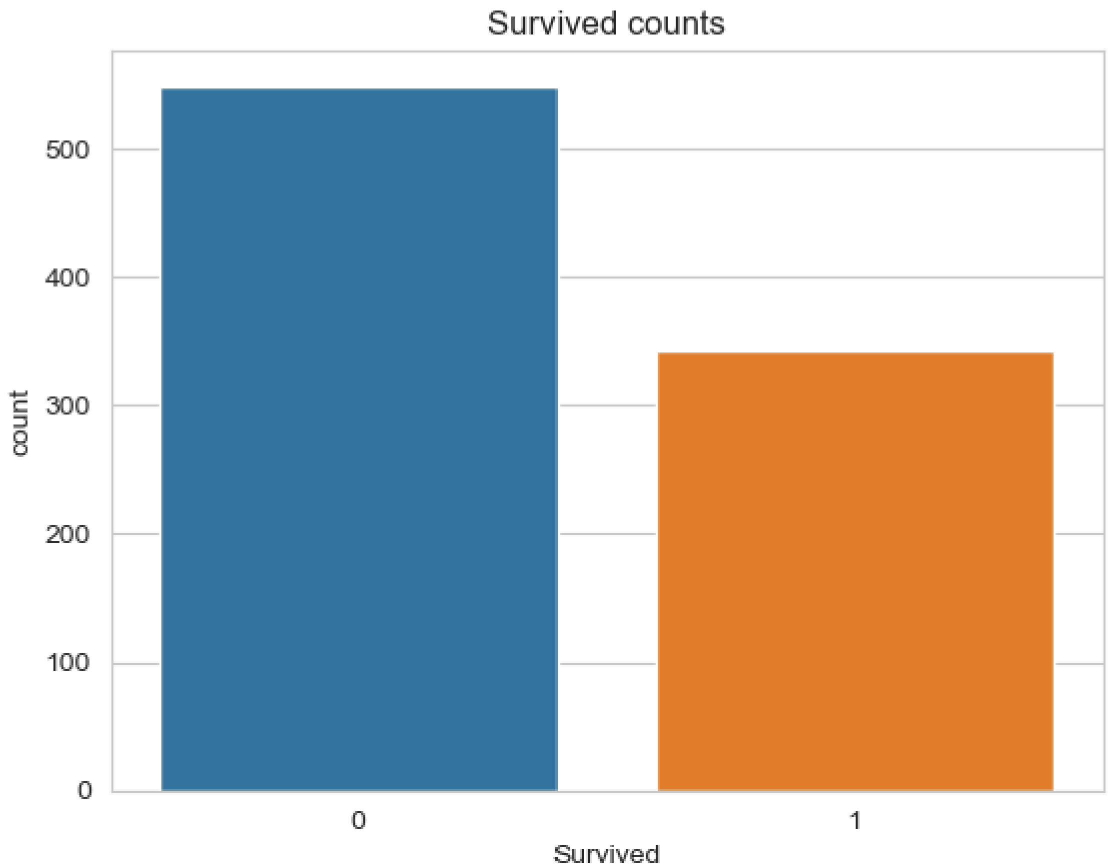
In [10]:

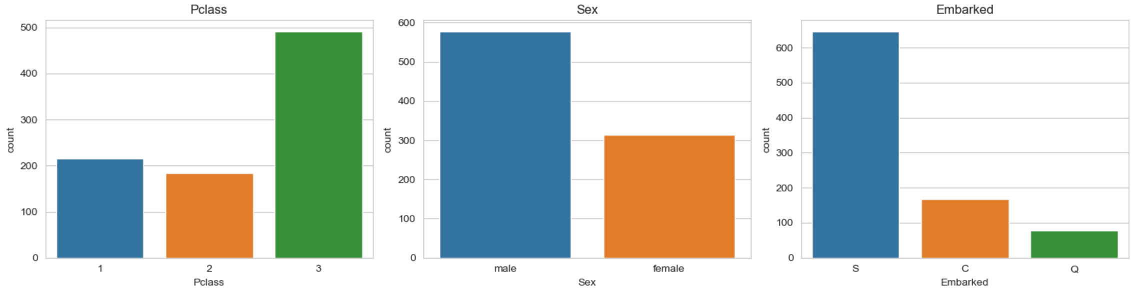
```
print("Missing after imputation:")
display(df.isnull().sum())

# Drop columns not needed for EDA/report (keep them if you want to engineer
# e.g. drop Ticket, Cabin (already used HasCabin)
df_clean = df.drop(columns=['Ticket','Cabin','Name','PassengerId'])
display(df_clean.head())
```

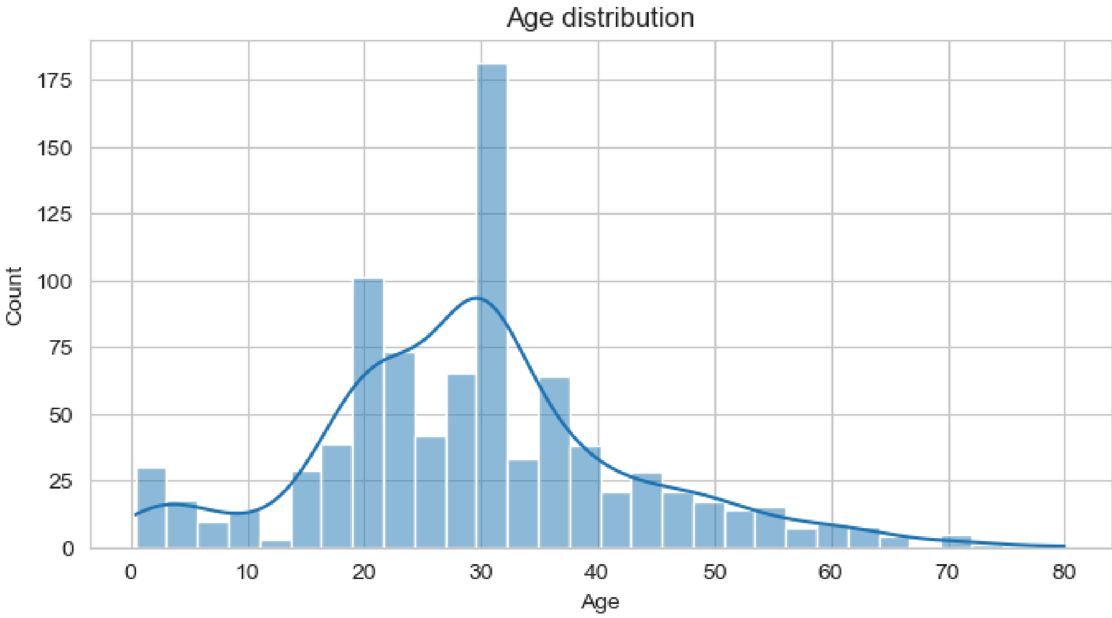
```
Missing after imputation:

PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age              0
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         0
HasCabin         0
Title            0
FamilySize       0
IsAlone          0
dtype: int64
```

	Survived	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked	HasCabin	Title	Famil
0	0	3	male	22.0	1	0	7.2500	S	0	Mr	
1	1	1	female	38.0	1	0	71.2833	C	1	Mrs	
2	1	3	female	26.0	0	0	7.9250	S	0	Miss	
3	1	1	female	35.0	1	0	53.1000	S	1	Mrs	
4	0	3	male	35.0	0	0	8.0500	S	0	Mr	

In [11]:
```python
# Survived counts
sns.countplot(x='Survived', data=df)
plt.title('Survived counts')
plt.show()

# Pclass, Sex, Embarked counts
fig, axes = plt.subplots(1,3, figsize=(15,4))
sns.countplot(x='Pclass', data=df, ax=axes[0]); axes[0].set_title('Pclass')
sns.countplot(x='Sex', data=df, ax=axes[1]); axes[1].set_title('Sex')
sns.countplot(x='Embarked', data=df, ax=axes[2]); axes[2].set_title('Embark
plt.tight_layout()
plt.show()

# Age histogram
plt.figure(figsize=(8,4))
sns.histplot(df['Age'], bins=30, kde=True)
plt.title('Age distribution')
plt.show()
```

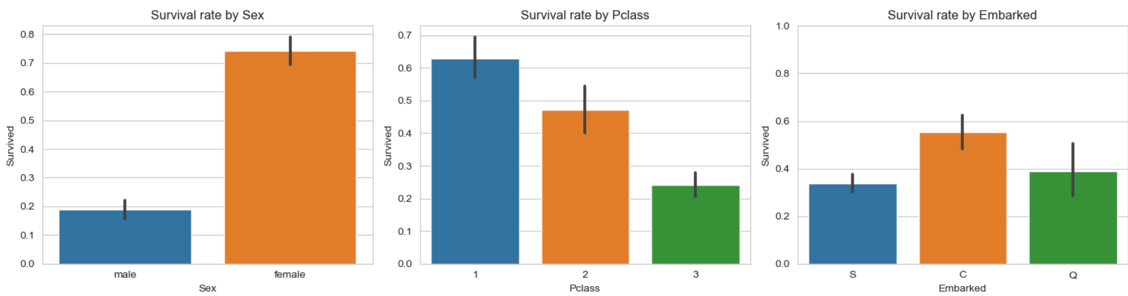




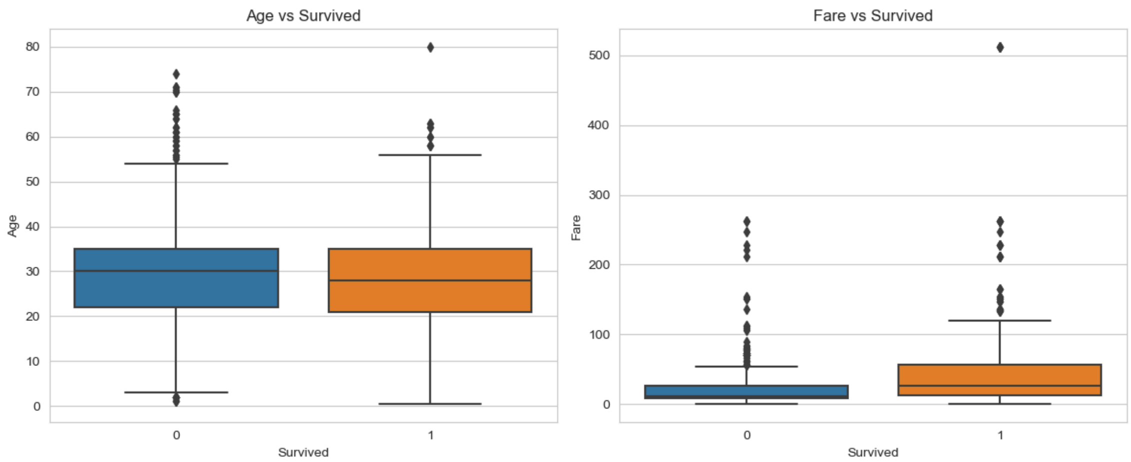


In [12]:
```
# Survival rate by Sex
display(pd.crosstab(df['Sex'], df['Survived'], normalize='index')*100)

# Plot survival rate by Sex, Pclass, Embarked
fig, axes = plt.subplots(1,3, figsize=(15,4))
sns.barplot(x='Sex', y='Survived', data=df, ax=axes[0])
sns.barplot(x='Pclass', y='Survived', data=df, ax=axes[1])
sns.barplot(x='Embarked', y='Survived', data=df, ax=axes[2])
axes[0].set_title('Survival rate by Sex')
axes[1].set_title('Survival rate by Pclass')
axes[2].set_title('Survival rate by Embarked')
plt.ylim(0,1)
plt.tight_layout()
plt.show()
```

Survived	0	1
Sex		
female	25.796178	74.203822
male	81.109185	18.890815

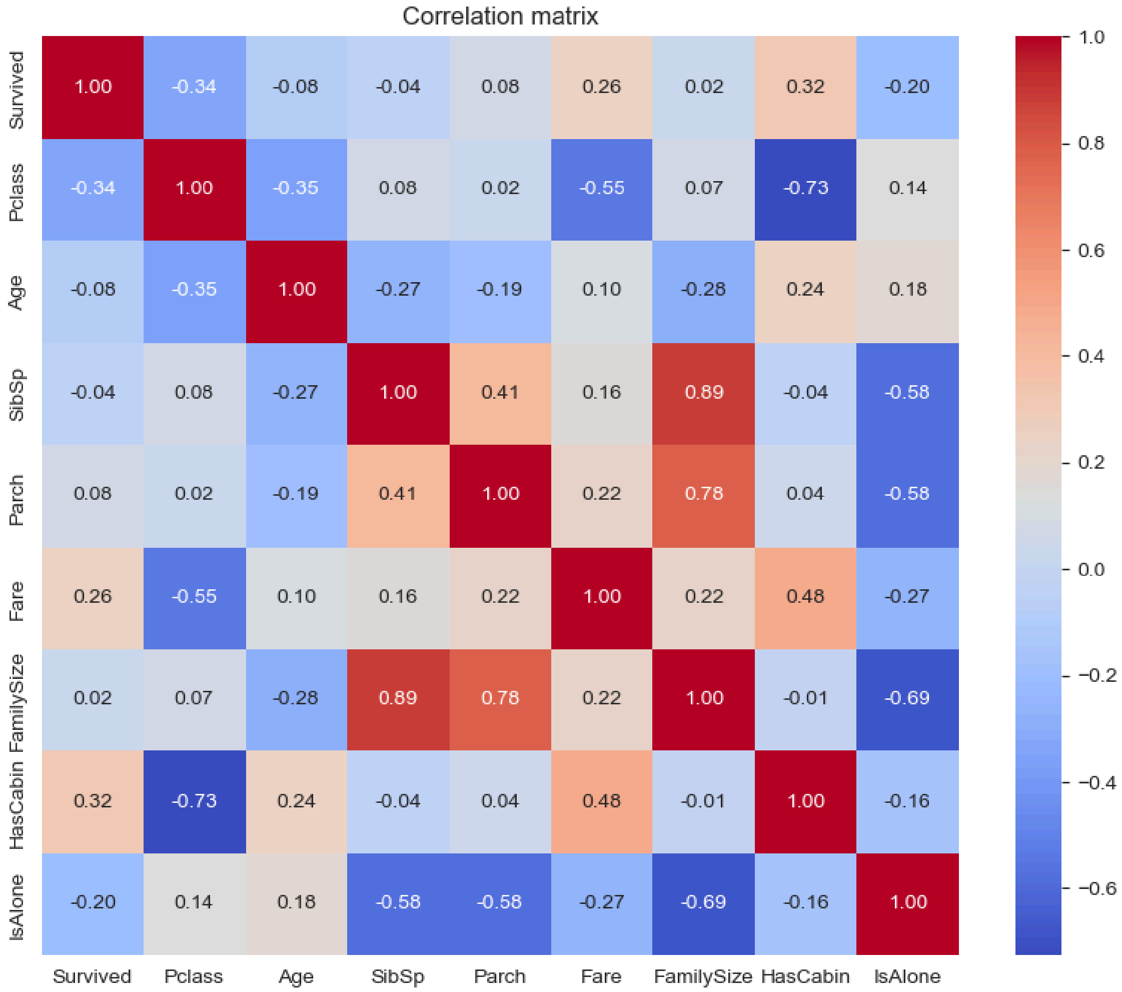


In [13]:
```
# Boxplots
fig, axes = plt.subplots(1,2, figsize=(12,5))
sns.boxplot(x='Survived', y='Age', data=df, ax=axes[0])
sns.boxplot(x='Survived', y='Fare', data=df, ax=axes[1])
axes[0].set_title('Age vs Survived')
axes[1].set_title('Fare vs Survived')
plt.tight_layout()
plt.show()
```



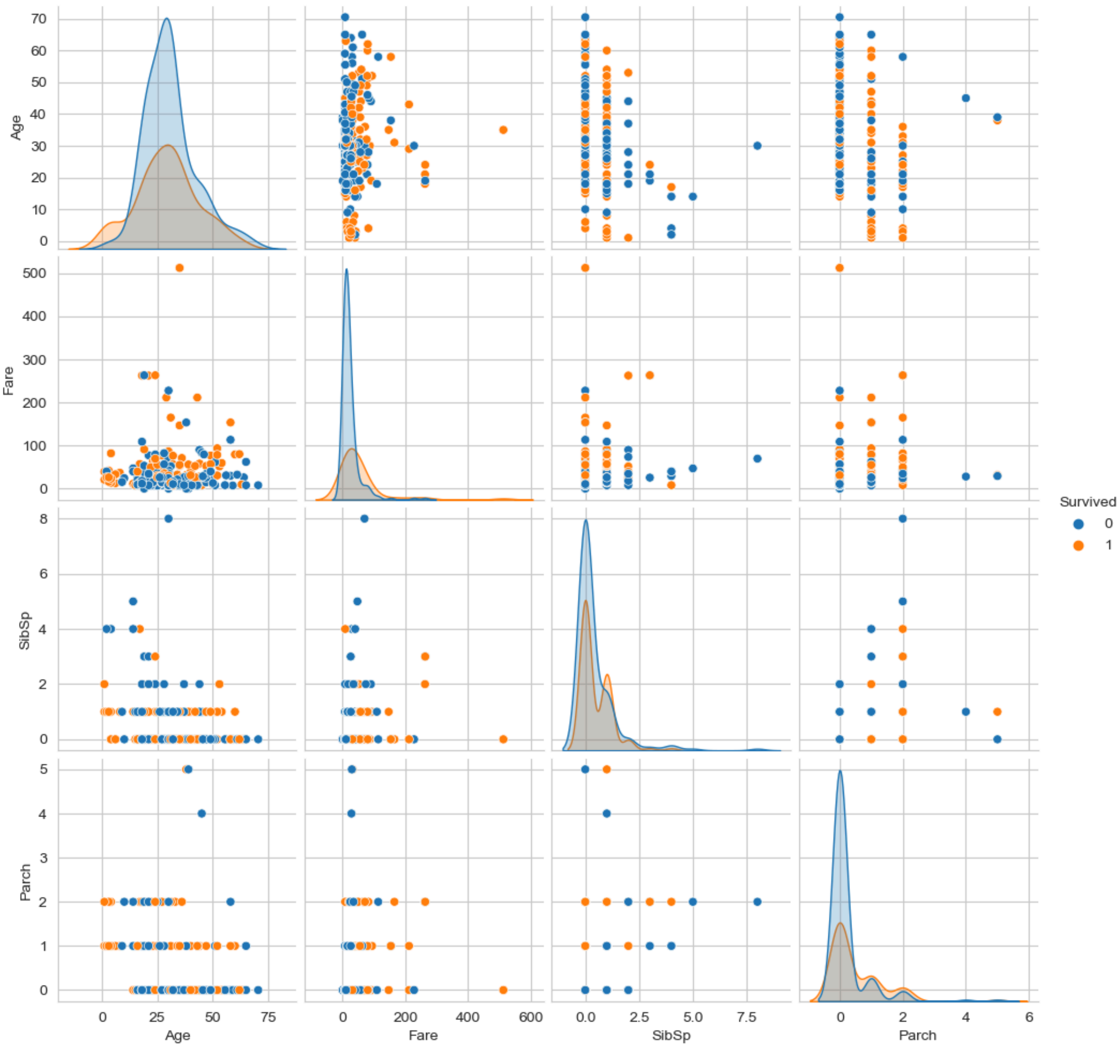
In [14]:

```python
# Correlation heatmap
num_cols = ['Survived','Pclass','Age','SibSp','Parch','Fare','FamilySize','
plt.figure(figsize=(10,8))
sns.heatmap(df[num_cols].corr(), annot=True, fmt=".2f", cmap='coolwarm', sc
plt.title('Correlation matrix')
plt.show()

# Pairplot (small sample to speed up)
sns.pairplot(df.sample(300), vars=['Age','Fare','SibSp','Parch'], hue='Surv
plt.show()
```



	Survived	Pclass	Age	SibSp	Parch	Fare	FamilySize	HasCabin	IsAlone
Survived	1.00	-0.34	-0.08	-0.04	0.08	0.26	0.02	0.32	-0.20
Pclass	-0.34	1.00	-0.35	0.08	0.02	-0.55	0.07	-0.73	0.14
Age	-0.08	-0.35	1.00	-0.27	-0.19	0.10	-0.28	0.24	0.18
SibSp	-0.04	0.08	-0.27	1.00	0.41	0.16	0.89	-0.04	-0.58
Parch	0.08	0.02	-0.19	0.41	1.00	0.22	0.78	0.04	-0.58
Fare	0.26	-0.55	0.10	0.16	0.22	1.00	0.22	0.48	-0.27
FamilySize	0.02	0.07	-0.28	0.89	0.78	0.22	1.00	-0.01	-0.69
HasCabin	0.32	-0.73	0.24	-0.04	0.04	0.48	-0.01	1.00	-0.16
IsAlone	-0.20	0.14	0.18	-0.58	-0.58	-0.27	-0.69	-0.16	1.00

```
C:\ProgramData\anaconda3\Lib\site-packages\seaborn\axisgrid.py:118: UserW
arning: The figure layout has changed to tight
  self._figure.tight_layout(*args, **kwargs)
```



In [15]:
```
# Chi-square test for Sex vs Survived
import scipy.stats as stats
cont_table = pd.crosstab(df['Sex'], df['Survived'])
chi2, p, dof, ex = stats.chi2_contingency(cont_table)
print("Chi2 test for Sex vs Survived -> p-value:", p)

# t-test for Age by survival groups
survived_age = df[df['Survived']==1]['Age']
nonsurvived_age = df[df['Survived']==0]['Age']
tstat, p_age = stats.ttest_ind(survived_age, nonsurvived_age, equal_var=Fal
print("t-test Age by Survived -> p-value:", p_age)
```

```
Chi2 test for Sex vs Survived -> p-value: 1.1973570627755645e-58
t-test Age by Survived -> p-value: 0.021490175388249624
```

In [16]:
```python
# VIF (on numeric columns)
from statsmodels.stats.outliers_influence import variance_inflation_factor
X = df[num_cols].drop(columns=['Survived'])  # exclude target
X = X.fillna(0)
vif_data = pd.DataFrame()
vif_data['feature'] = X.columns
vif_data['VIF'] = [variance_inflation_factor(X.values, i) for i in range(X.
display(vif_data)
```

	feature	VIF
0	Pclass	2.669450
1	Age	1.247118
2	SibSp	71.060873
3	Parch	38.606138
4	Fare	1.615440
5	FamilySize	272.321098
6	HasCabin	2.168795
7	IsAlone	2.081842

Summary of findings

- Key finding 1: Females had much higher survival rate.
- Key finding 2: Higher class (Pclass=1) had much better survival.
- Key finding 3: Having a cabin (HasCabin) correlates with higher fare/likely Pclass and survival.
- Key finding 4: Family size effects...
- Limitations: missing Cabin, possible imputation bias for Age, etc.

In [17]:
```python
# Save cleaned data
df.to_csv('train_cleaned.csv', index=False)

# Save key figures programmatically (example)
# plt.savefig('fig_survived_counts.png', dpi=150)   # call after each plot
```

In [ ]:
```python

```