In [6]:
```python
#Title & Objective - Exploratory Data Analysis (EDA)  Extract insights using visual and statistical exploration.
#Dataset (source, rows x cols) - titanic.csv 893*12
#Imports & settings
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import missingno as msno
from scipy import stats
from scipy.stats import chi2_contingency, ttest_ind
import statsmodels.api as sm
from statsmodels.stats.outliers_influence import variance_inflation_factor
import os
```

In [7]:
```python
#Load data & quick peek
# Change file path as needed
data_path = "C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5\\titanic task5.csv"
df = pd.read_csv(data_path)

# Quick checks
print("Shape:", df.shape)
display(df.head())
display(df.info())
display(df.describe(include='all').T)
```

Shape: (891, 12)

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

```
<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%	75%	max
PassengerId	891.0	NaN	NaN	NaN	446.0	257.353842	1.0	223.5	446.0	668.5	891.0
Survived	891.0	NaN	NaN	NaN	0.383838	0.486592	0.0	0.0	0.0	1.0	1.0
Pclass	891.0	NaN	NaN	NaN	2.308642	0.836071	1.0	2.0	3.0	3.0	3.0
Name	891	891	Braund, Mr. Owen Harris	1	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Sex	891	2	male	577	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Age	714.0	NaN	NaN	NaN	29.699118	14.526497	0.42	20.125	28.0	38.0	80.0
SibSp	891.0	NaN	NaN	NaN	0.523008	1.102743	0.0	0.0	0.0	1.0	8.0
Parch	891.0	NaN	NaN	NaN	0.381594	0.806057	0.0	0.0	0.0	0.0	6.0
Ticket	891	681	347082	7	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Fare	891.0	NaN	NaN	NaN	32.204208	49.693429	0.0	7.9104	14.4542	31.0	512.3292
Cabin	204	147	B96 B98	4	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Embarked	889	3	S	644	NaN	NaN	NaN	NaN	NaN	NaN	NaN

In [12]:
```python
#Clean column names & duplicates
# Normalize column names
df.columns = df.columns.str.strip().str.lower().str.replace(' ', '_')

# Drop exact duplicates (if any)
dup_count = df.duplicated().sum()
print(f"Duplicate rows: {dup_count}")
df = df.drop_duplicates()
```

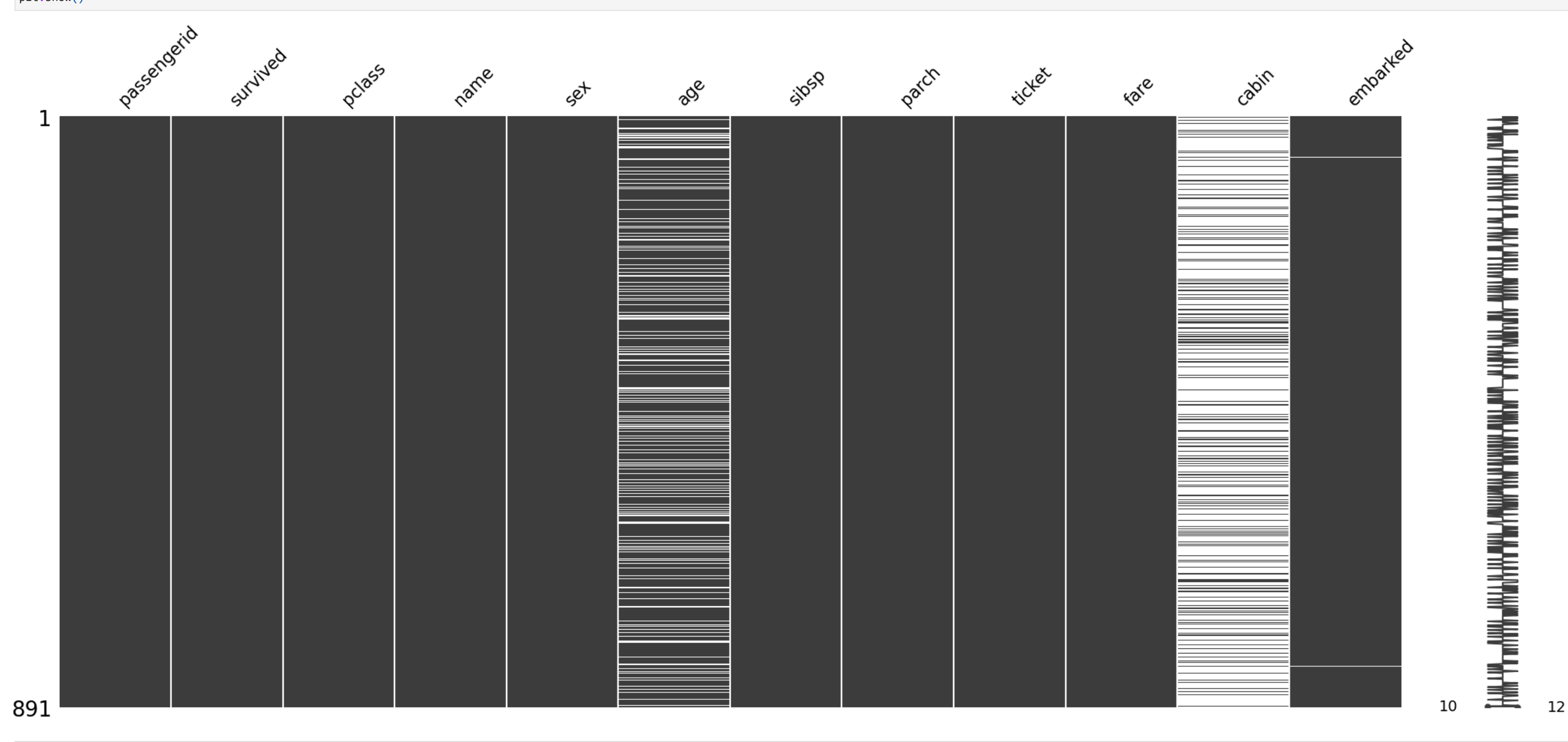
Duplicate rows: 0

In [14]:
```python
#Missing values overview
missing = df.isnull().sum().sort_values(ascending=False)
missing_percent = (df.isnull().mean()*100).sort_values(ascending=False)
pd.concat([missing, missing_percent], axis=1, keys=['missing_count','missing_percent'])
```

Out[14]:

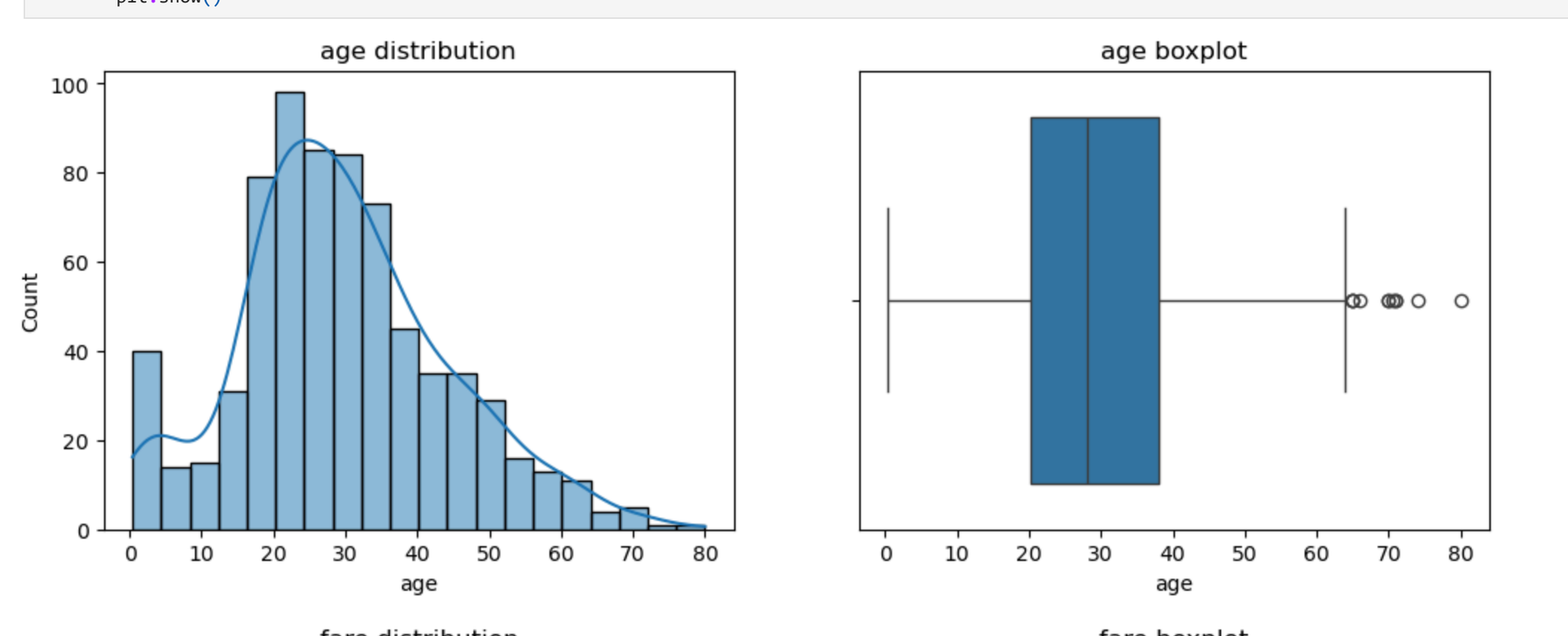
	missing_count	missing_percent
cabin	687	77.104377
age	177	19.865320
embarked	2	0.224467
passengerid	0	0.000000
survived	0	0.000000
pclass	0	0.000000
name	0	0.000000
sex	0	0.000000
sibsp	0	0.000000
parch	0	0.000000
ticket	0	0.000000
fare	0	0.000000

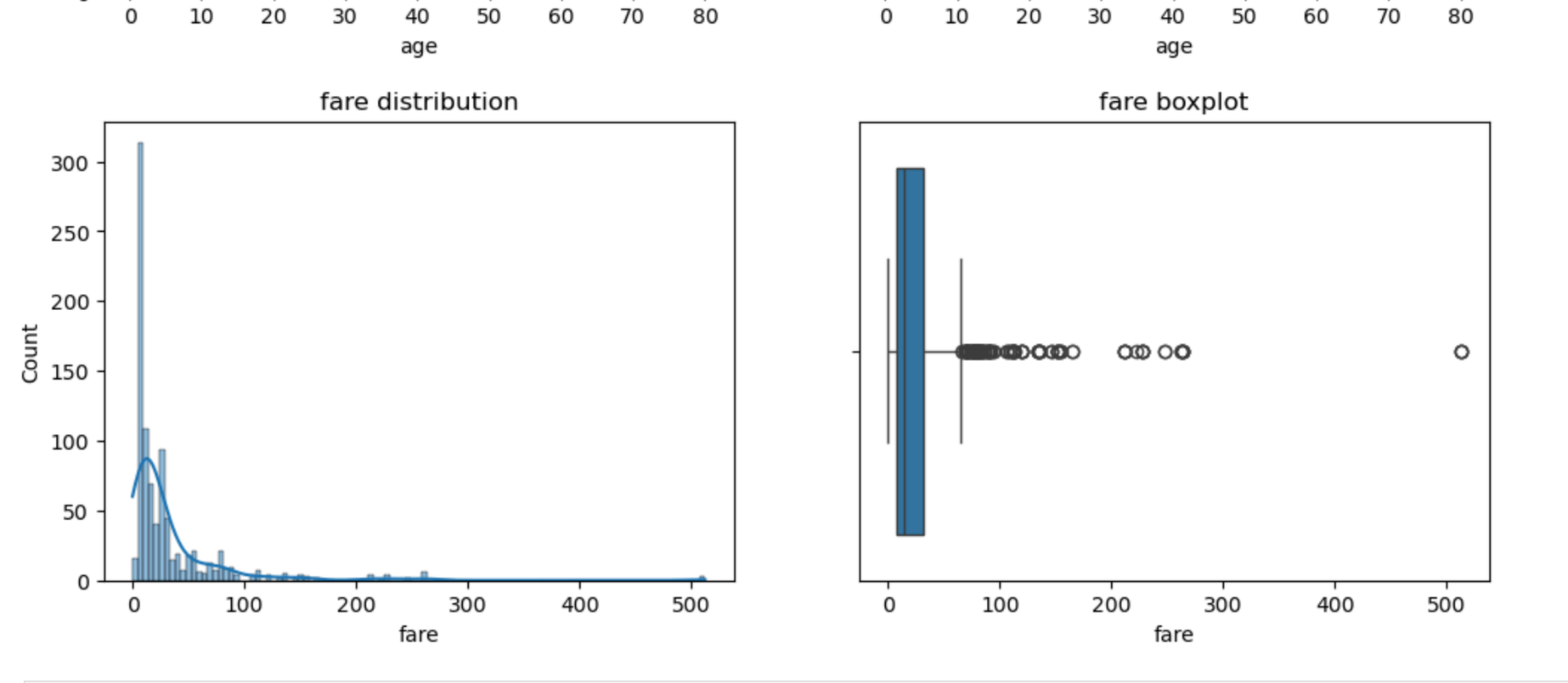
In [22]:
```python
msno.matrix(df)
plt.savefig('C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
msno.heatmap(df)
plt.savefig('C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
plt.show()
```



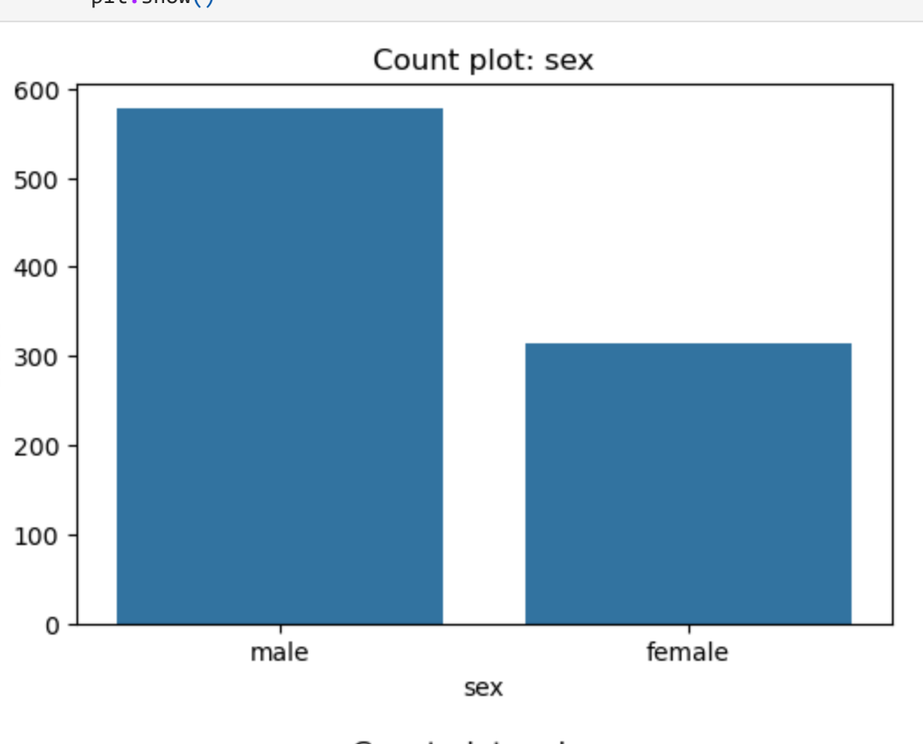
In [26]:
```python
#Convert dtypes (dates, categories)
# Convert categorical-looking columns to category dtype
for col in df.select_dtypes(include='object').columns:
    if df[col].nunique() < 30:   # heuristic
        df[col] = df[col].astype('category')
```

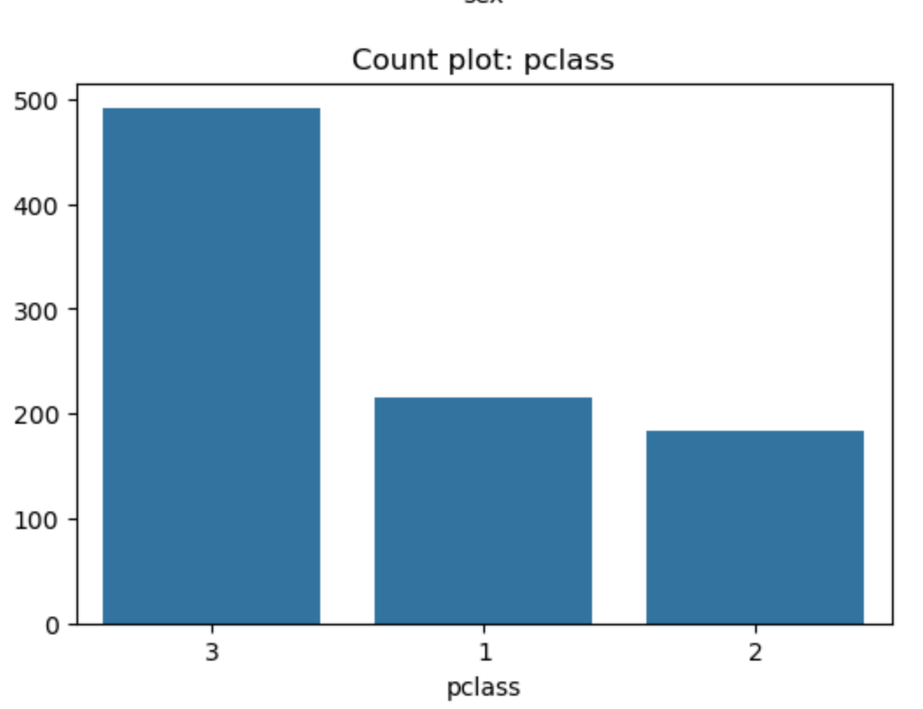
In [30]:
```python
#Numeric histograms + boxplots
num_cols = df.select_dtypes(include=[np.number]).columns.tolist()
for col in ['age','fare']:   # adapt to columns present
    if col in df.columns:
        plt.figure(figsize=(12,4))
        plt.subplot(1,2,1)
        sns.histplot(df[col].dropna(), kde=True)
        plt.title(f'{col} distribution')
        plt.subplot(1,2,2)
        sns.boxplot(x=df[col])
        plt.title(f'{col} boxplot')
        plt.savefig(f'C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
        plt.show()
```

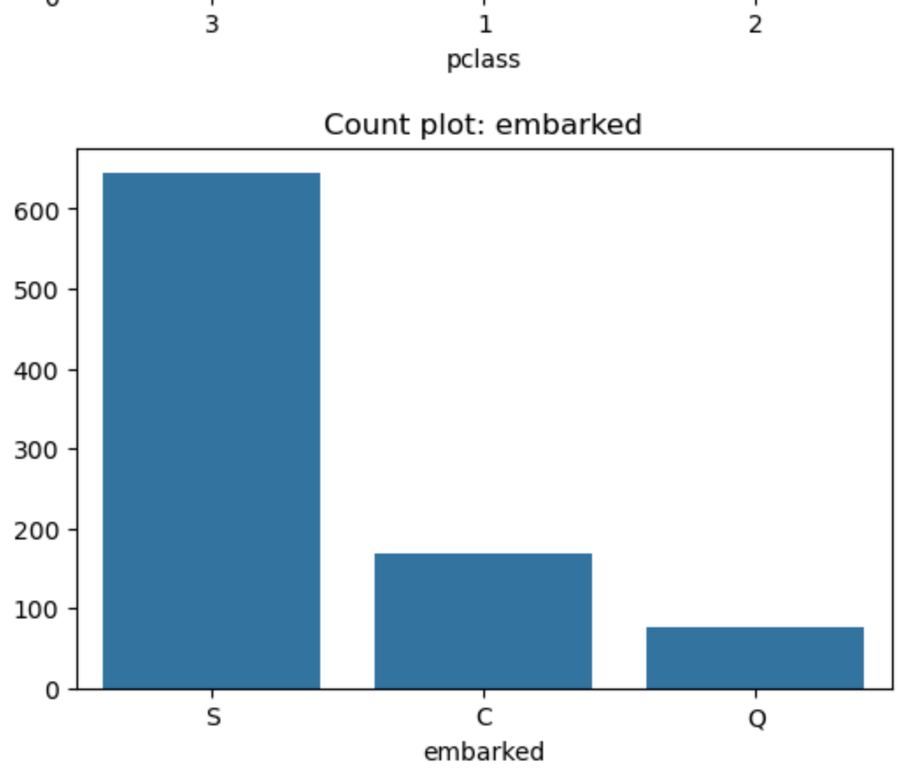


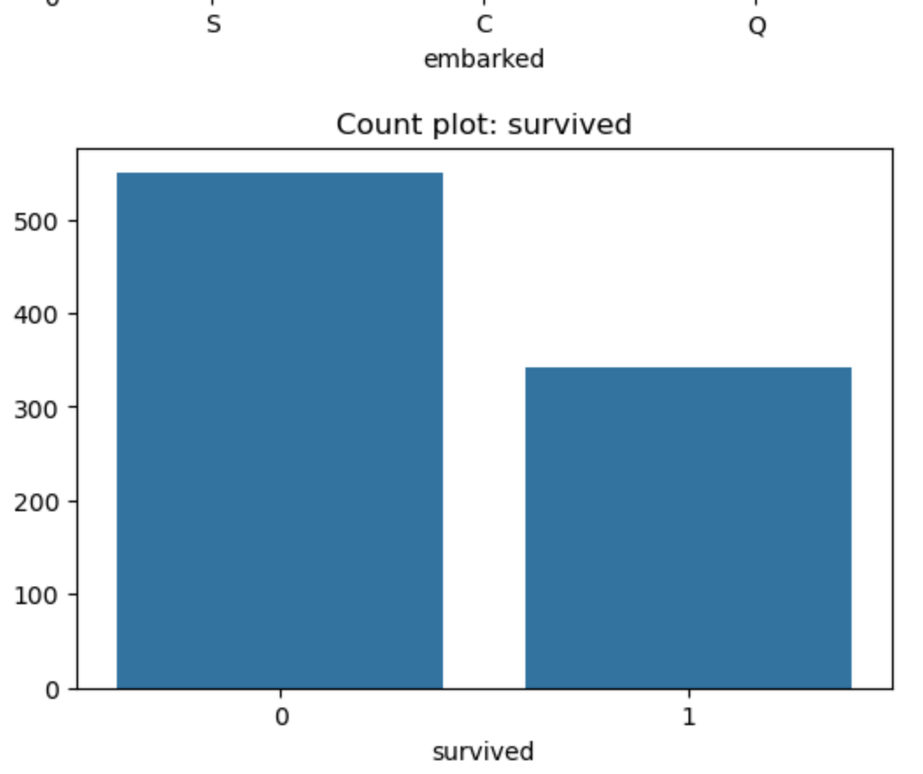


In [32]:
```python
#Categorical counts
cat_cols = df.select_dtypes(include=['category','object']).columns.tolist()
for col in ['sex','pclass','embarked','survived']:  # adapt to dataset
    if col in df.columns:
        plt.figure(figsize=(6,4))
        order = df[col].value_counts().index
        sns.countplot(data=df, x=col, order=order)
        plt.title(f'Count plot: {col}')
        plt.savefig(f'C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
        plt.show()
```





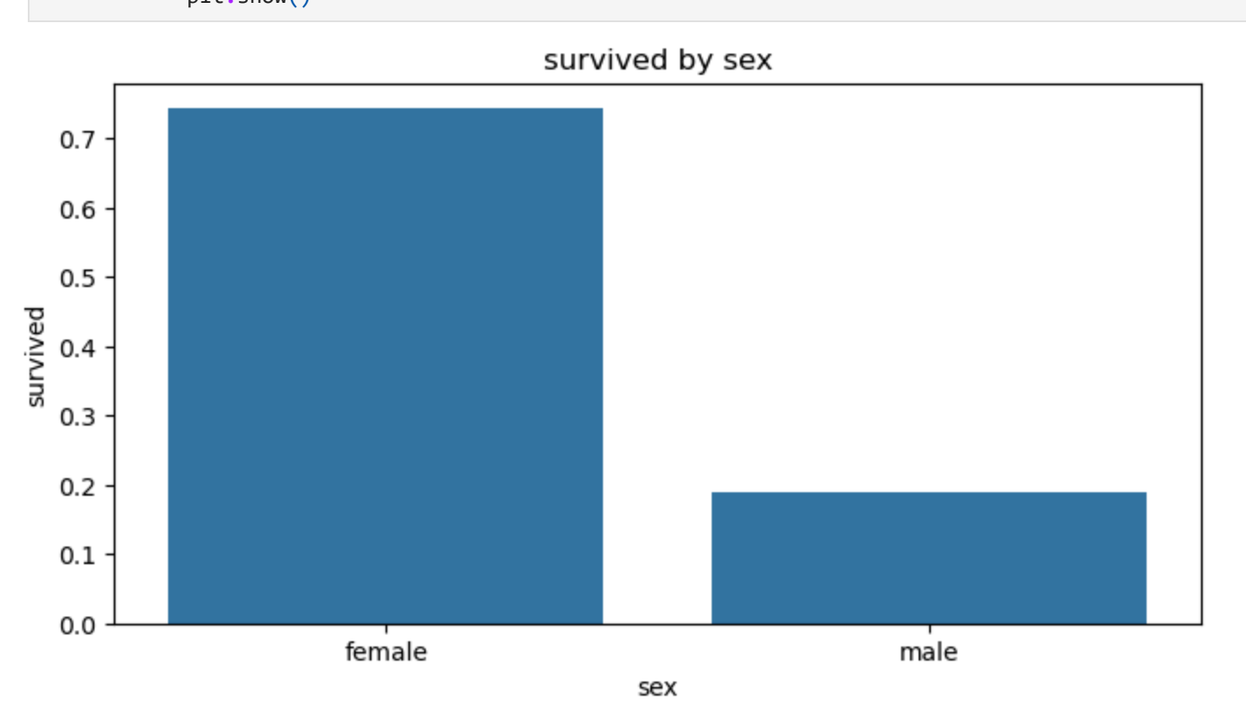


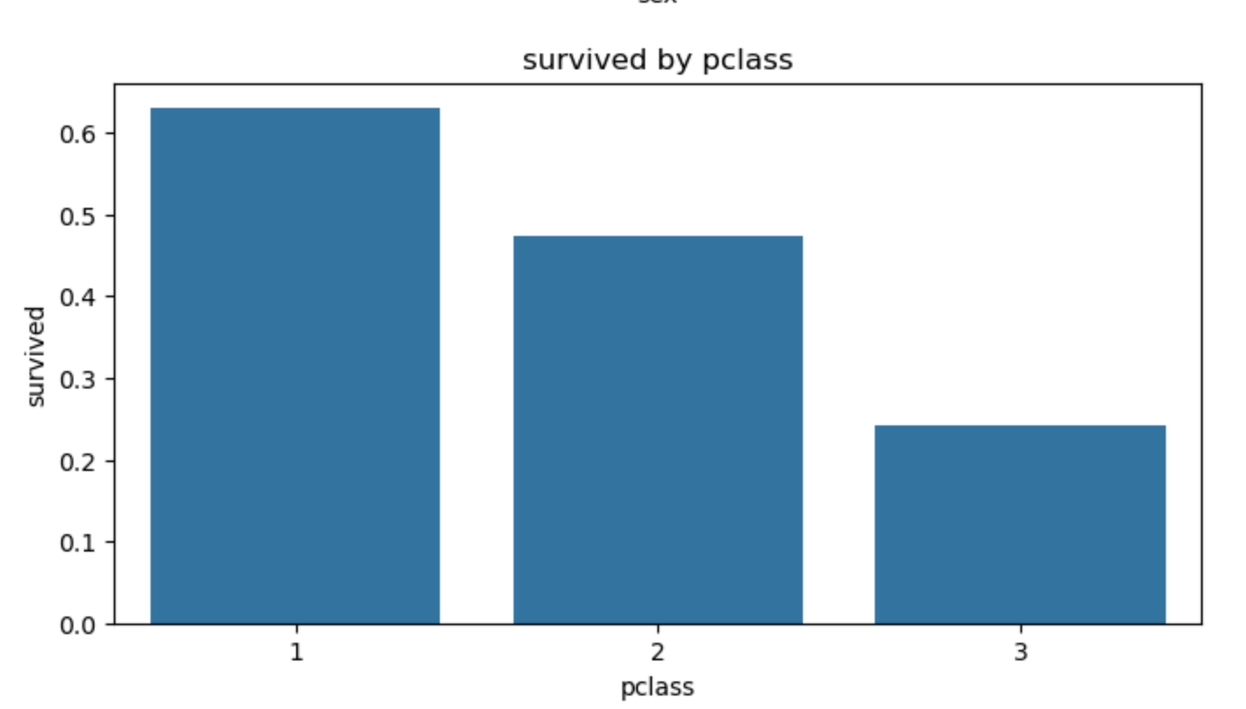


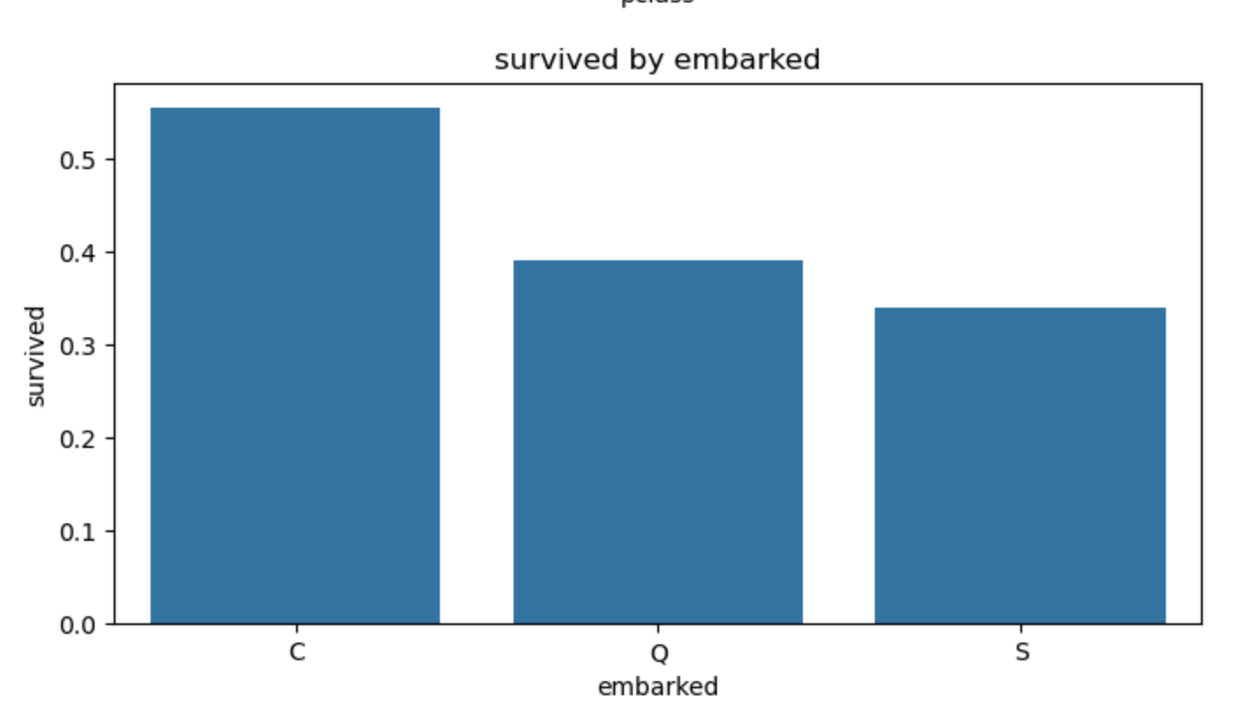
In [38]:
```python
#Common Titanic strategy
# Example imputations (Titanic-like)
if 'age' in df.columns:
    if 'age' in df.columns:
     df['age'] = df.groupby(['pclass','sex'],observed=False)['age'].transform(lambda x: x.fillna(x.median()))
if 'embarked' in df.columns:
    df['embarked'] = df['embarked'].fillna(df['embarked'].mode()[0])
if 'fare' in df.columns:
    df['fare'] = df['fare'].fillna(df['fare'].median())

# Create binary feature for heavily missing columns like cabin
if 'cabin' in df.columns:
    df['has_cabin'] = df['cabin'].notnull().astype(int)
```

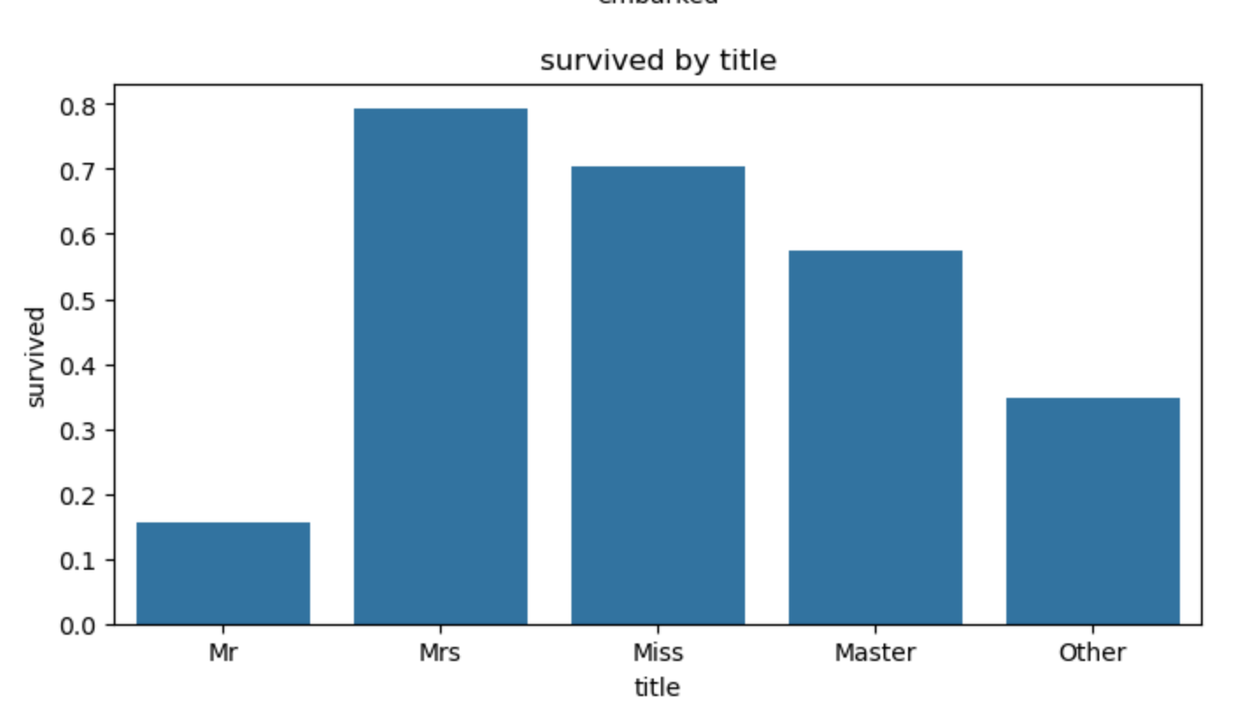
In [42]:
```python
#Feature engineering (useful transforms)
# Family size
if {'sibsp','parch'}.issubset(df.columns):
    df['family_size'] = df['sibsp'] + df['parch'] + 1
    df['is_alone'] = (df['family_size'] == 1).astype(int)

# Extract title from name (Titanic)
if 'name' in df.columns:
    df['title'] = df['name'].str.extract(r'([A-Za-z]+)\.', expand=False)
    df['title'] = df['title'].replace(['Mlle','Ms','Mme'],'Miss')
    df['title'] = df['title'].apply(lambda x: x if x in ['Mr','Mrs','Miss','Master'] else 'Other')
```

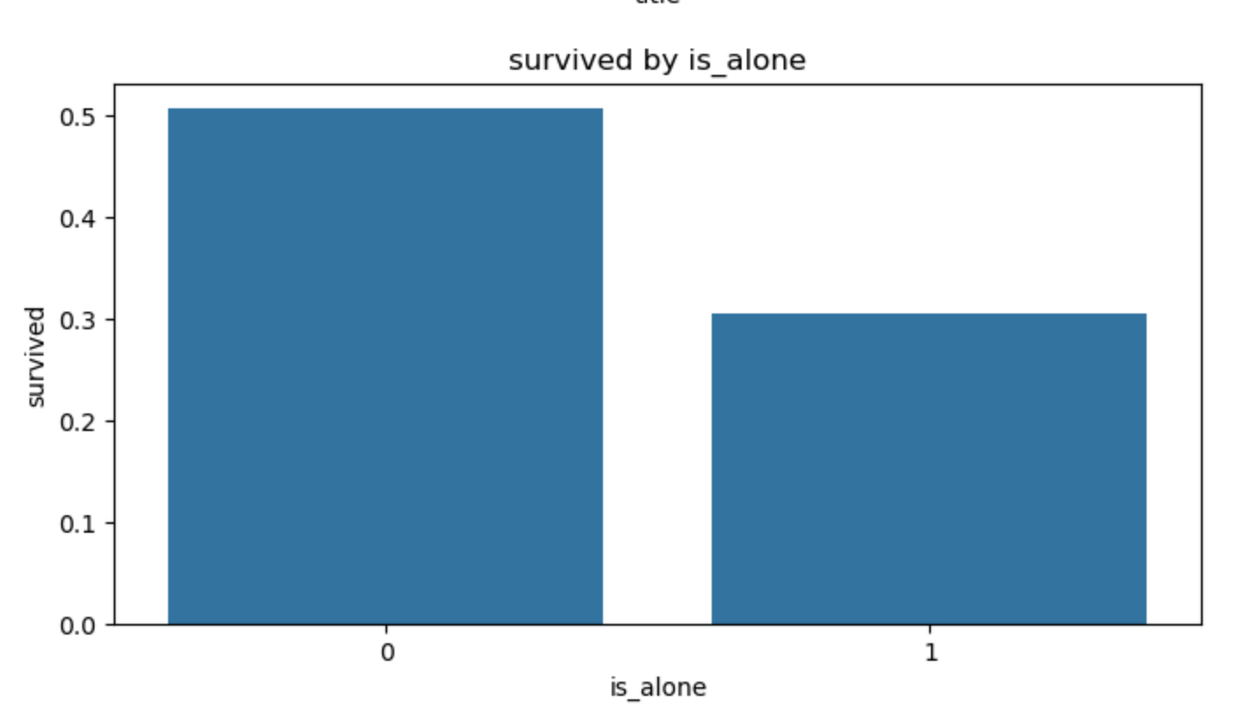
In [46]:
```python
#Bivariate analysis (target vs features)
target = 'survived'   # change to your target column
if target in df.columns:
    # Categorical vs target
    for col in ['sex','pclass','embarked','title','is_alone']:
        if col in df.columns:
            plt.figure(figsize=(8,4))
            sns.barplot(x=col, y=target, data=df, errorbar=None, estimator=np.mean)
            plt.title(f'{target} by {col}')
            plt.savefig(f'C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
            plt.show()
    # Numeric vs target
    for col in ['age','fare','family_size']:
        if col in df.columns:
            plt.figure(figsize=(6,4))
            sns.boxplot(x=target, y=col, data=df)
            plt.title(f'{col} distribution by {target}')
            plt.savefig(f'C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
            plt.show()
```

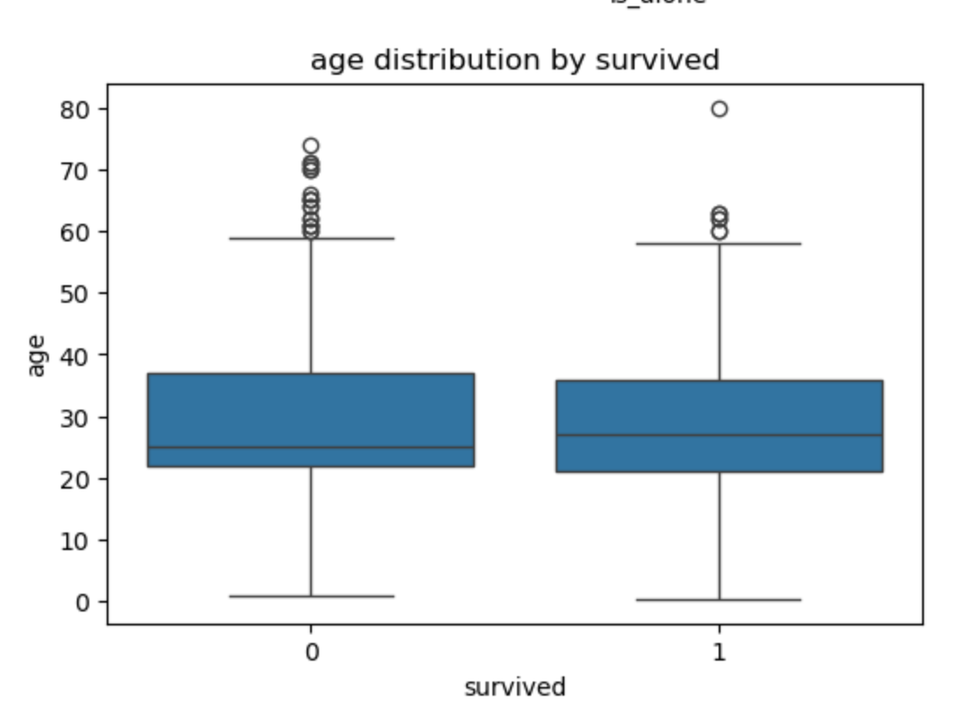


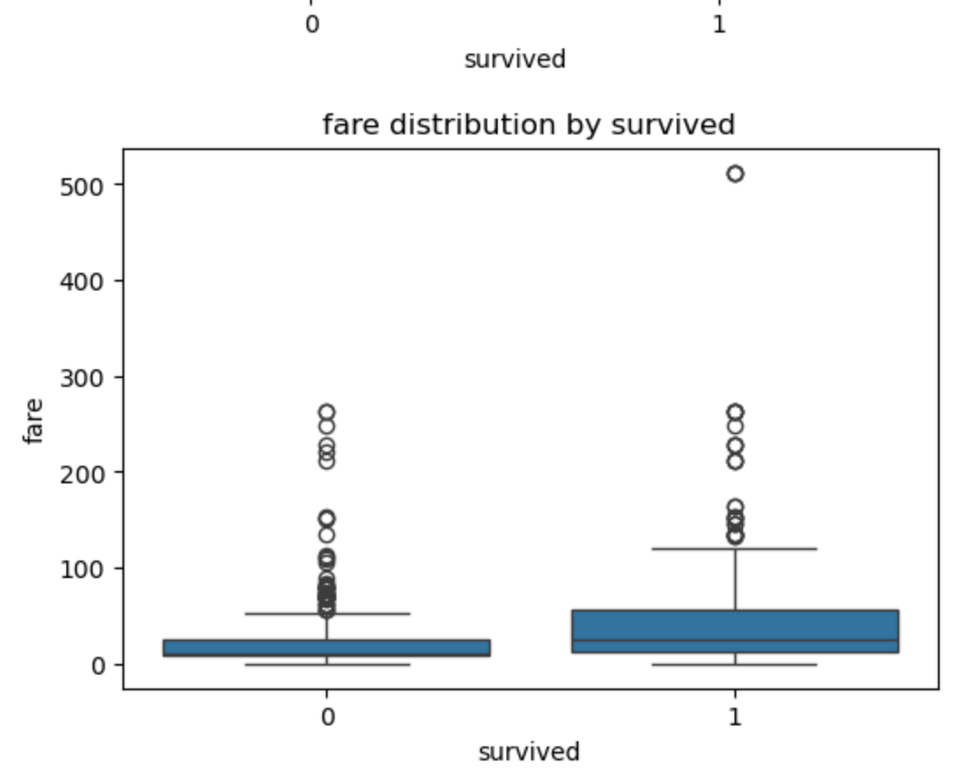


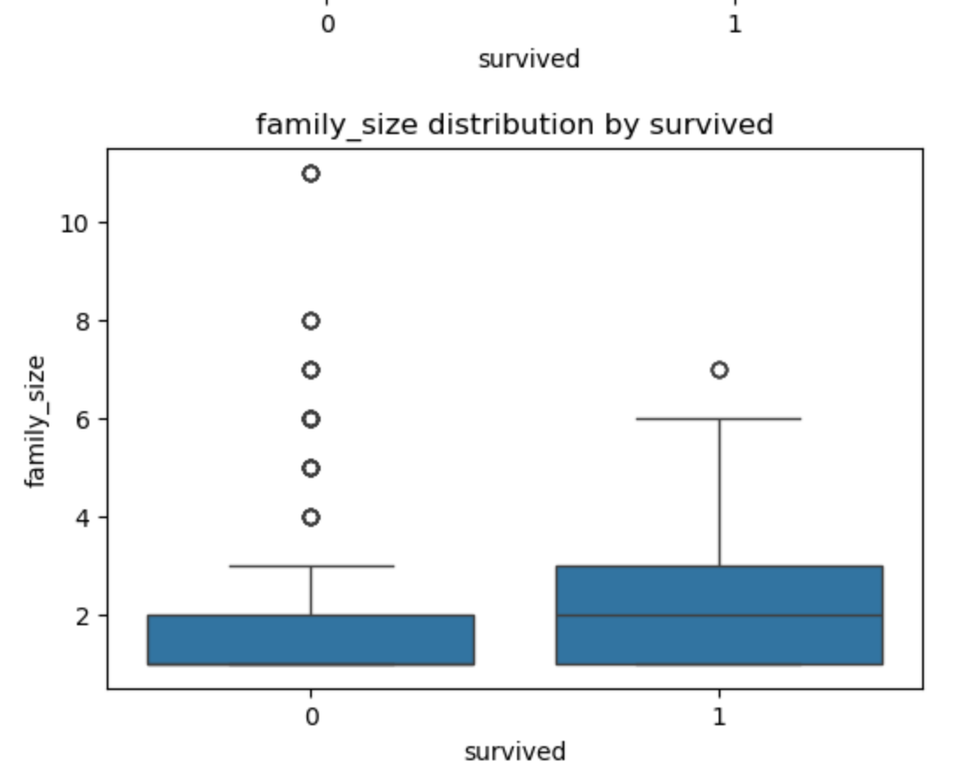




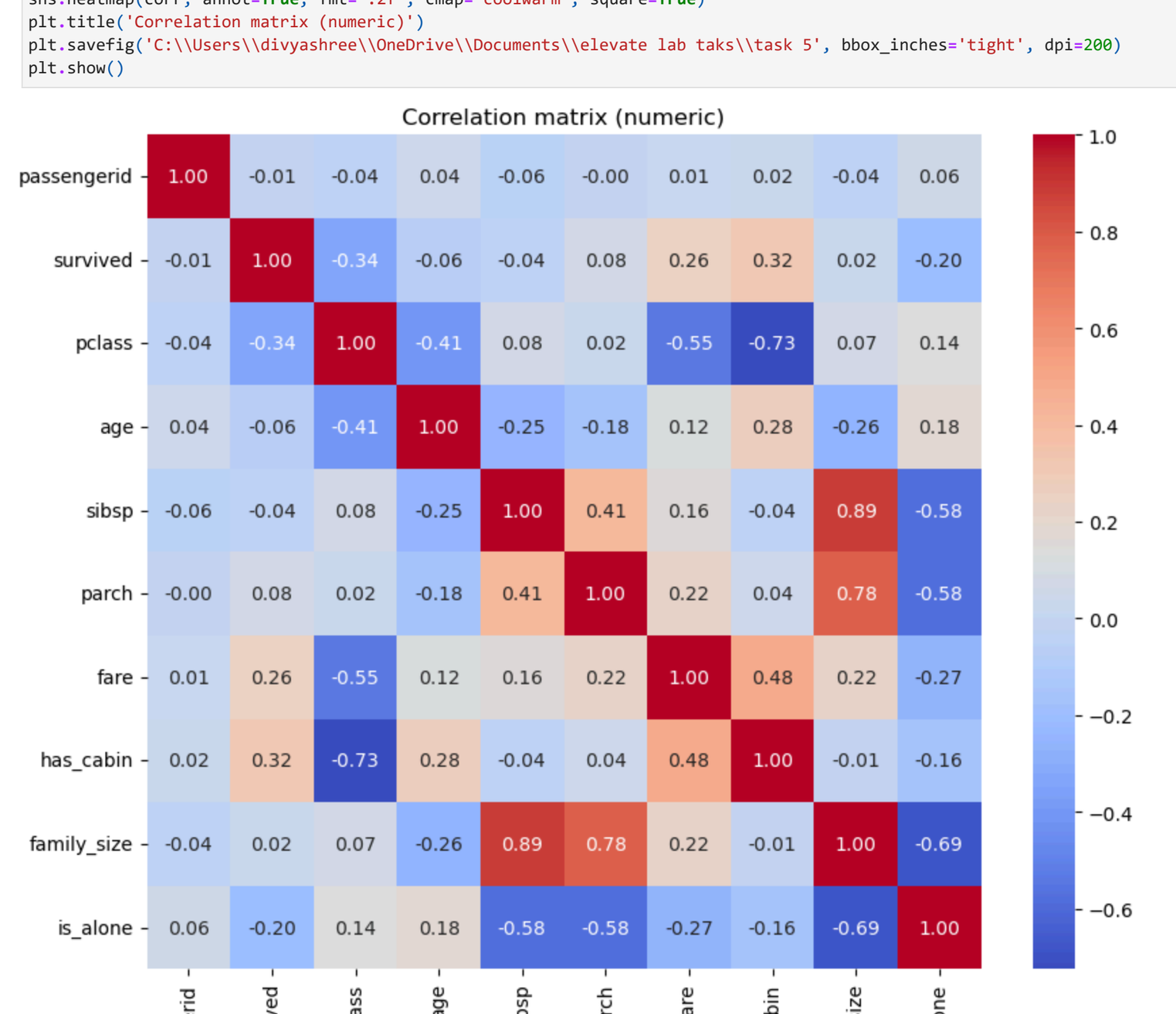




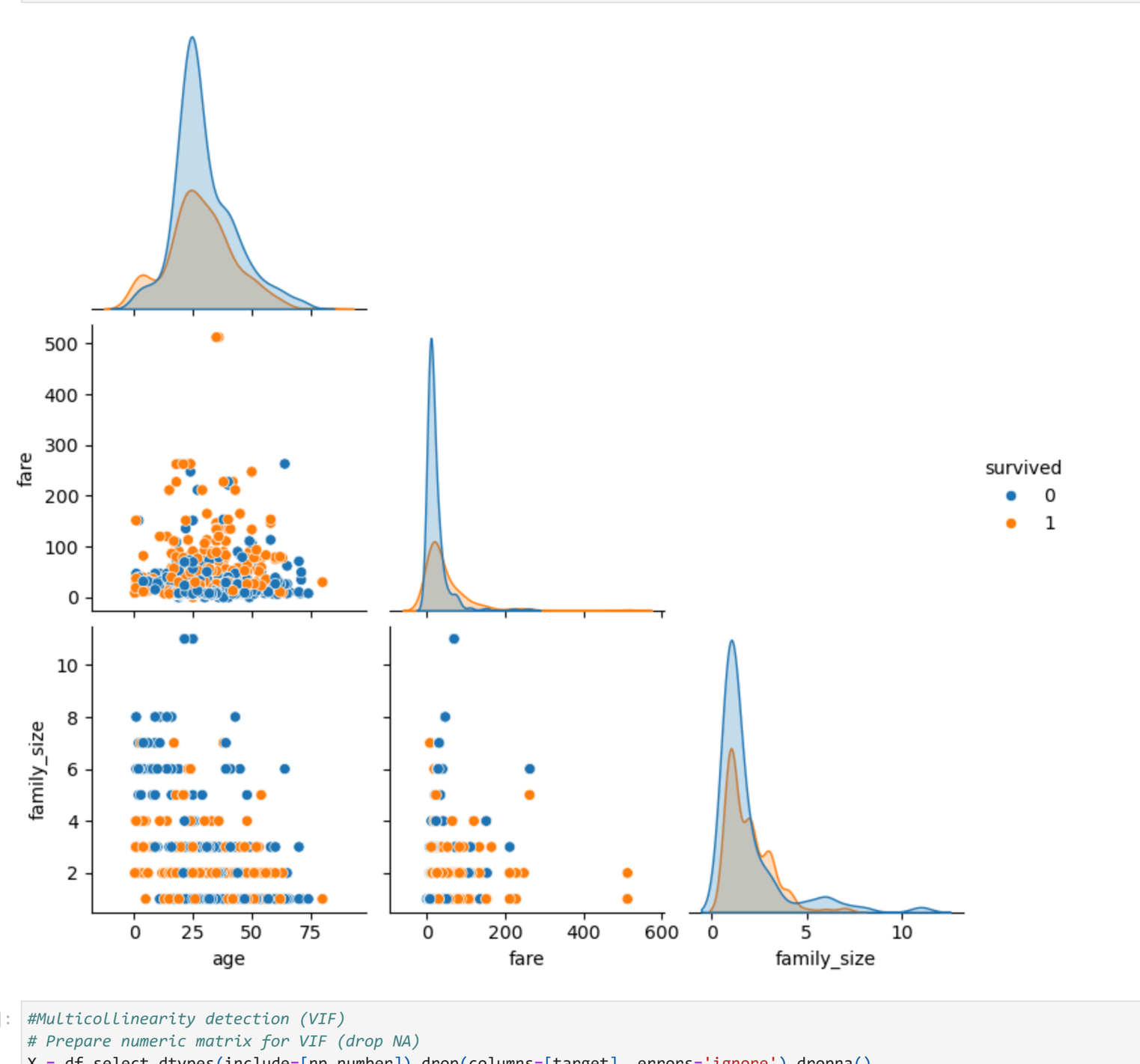




In [48]:
```python
#Correlation & multivariate analysis
# Correlation matrix (numeric)
num_df = df.select_dtypes(include=[np.number])
corr = num_df.corr()
plt.figure(figsize=(10,8))
sns.heatmap(corr, annot=True, fmt=".2f", cmap='coolwarm', square=True)
plt.title('Correlation matrix (numeric)')
plt.savefig('C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
plt.show()
```



In [50]:
```python
cols = ['age','fare','family_size', target]
cols = [c for c in cols if c in df.columns]
sns.pairplot(df[cols].dropna(), hue=target, diag_kind='kde', corner=True)
plt.savefig('C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
plt.show()
```



In [52]:
```python
#Multicollinearity detection (VIF)
# Prepare numeric matrix for VIF (drop NA)
X = df.select_dtypes(include=[np.number]).drop(columns=[target], errors='ignore').dropna()
X_const = sm.add_constant(X)
vif_data = pd.DataFrame()
vif_data['feature'] = X_const.columns
vif_data['VIF'] = [variance_inflation_factor(X_const.values, i) for i in range(X_const.shape[1])]
vif_data.sort_values('VIF', ascending=False)
```

```
C:\Users\divyashree\anaconda3\Lib\site-packages\statsmodels\regression\linear_model.py:1783: RuntimeWarning: divide by zero encountered in scalar divide
  return 1 - self.ssr/self.centered_tss
C:\Users\divyashree\anaconda3\Lib\site-packages\statsmodels\stats\outliers_influence.py:197: RuntimeWarning: divide by zero encountered in scalar divide
  vif = 1. / (1. - r_squared_i)
```

Out[52]:

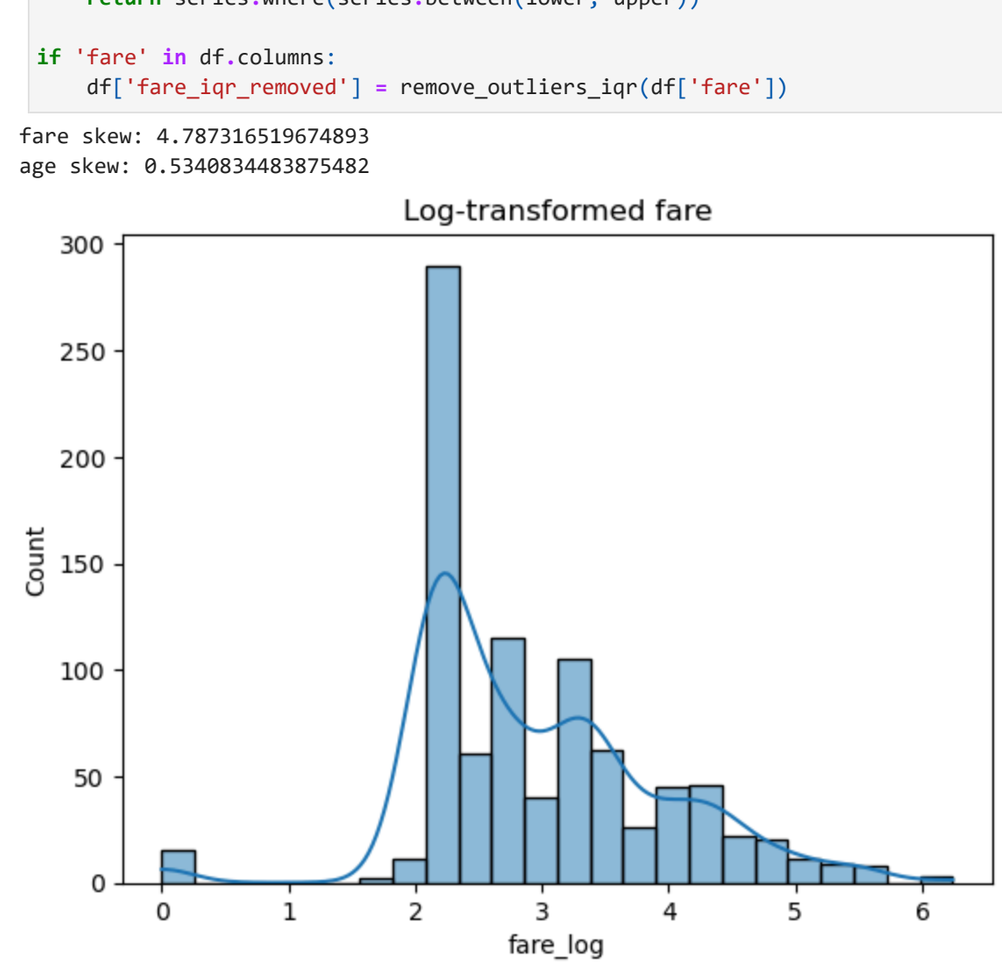
	feature	VIF
4	sibsp	inf
5	parch	inf
8	family_size	inf
2	pclass	2.779621
7	has_cabin	2.168982
9	is_alone	2.097761
6	fare	1.618458
3	age	1.313374
1	passengerid	1.008039
0	const	0.000000

In [54]:
```python
#Statistical tests
if {'sex', target}.issubset(df.columns):
    ct = pd.crosstab(df['sex'], df[target])
    chi2, p, dof, expected = chi2_contingency(ct)
    print('Chi-square p-value (sex vs target):', p)

if 'age' in df.columns and target in df.columns:
    grp0 = df[df[target]==0]['age'].dropna()
    grp1 = df[df[target]==1]['age'].dropna()
    tstat, pval = ttest_ind(grp0, grp1, nan_policy='omit')
    print('t-test p-value (age by target):', pval)
```

```
Chi-square p-value (sex vs target): 1.1973570627755645e-58
t-test p-value (age by target): 0.07548530586360941
```

In [58]:
```python
#Handling skew & outliers
# Check skew
for col in ['fare','age']:
    if col in df.columns:
        print(col, 'skew:', df[col].dropna().skew())

# Log transform fare if skewed
if 'fare' in df.columns:
    df['fare_log'] = np.log1p(df['fare'])
    sns.histplot(df['fare_log'].dropna(), kde=True)
    plt.title('Log-transformed fare')
    plt.savefig('C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5', bbox_inches='tight', dpi=200)
    plt.show()

def remove_outliers_iqr(series, k=1.5):
    q1 = series.quantile(0.25)
    q3 = series.quantile(0.75)
    iqr = q3 - q1
    lower = q1 - k * iqr
    upper = q3 + k * iqr
    return series.where(series.between(lower, upper))

if 'fare' in df.columns:
    df['fare_iqr_removed'] = remove_outliers_iqr(df['fare'])
```

```
fare skew: 4.787316519674893
age skew: 0.5340834483875482
```



In [64]:
```python
df.to_csv("C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5\\cleaned dataset.csv", index=False)
# Save a few key figures (already saved above with plt.savefig). Confirm files:
import glob
print(sorted(glob.glob('C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5\\figures'))[:10])
```

```
['C:\\Users\\divyashree\\OneDrive\\Documents\\elevate lab taks\\task 5\\figures']
```